Integrated Flood Risk Analysis
and Management Methodologies

FLOODsite

Final Management Report

ANNEX 1: PARTNER REPORTS

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WHOLE PROJECT MANAGEMENT REPORT

1. Overview

This report (Annex 1 to FLOODsite Management Report: Whole Project) contains individual Management Reports prepared by each partner within the project consortium.

2. Individual Partner Management Reports

2.1 Partner 1 - HRW

Task 2 – Estimation of Extremes

HR Wallingford was a member of the research team, concentrating in particular on joint probability analysis. The work in Year 1 involved writing up best practice guidance for the use of joint probability methods in the UK for the assessment of the probability of extreme conditions causing a flood risk. This followed a long programme of development of analysis methods and mapping of dependence between several flood risk variable-pairs around England, Scotland and Wales. In Year 2 there was a review of alternative approaches to joint probability analysis, preparation of best practice guidance for use of joint probability methods, and discussion of methods for handling multiple flood risks. The main item of work was a review of methods for inclusion of temporal sequencing into the Monte Carlo simulation approach to joint probability analysis, and initial implementation and testing of the preferred approach. Work in Year 3 concentrated on engagement with a statistician able to provide the necessary consultancy services to incorporate short-term sequencing into the Monte-Carlo simulation approach to joint probability analysis. Other work involved production of a report on 'Activity 3' (Hydraulic loading of flood defence structures), plus submission of journal and conference papers. The work in Year 4, to complete the task, involved report and journal paper writing, and development and testing of a statistical method for the incorporation of short-term sequencing into the Monte Carlo simulation approach to joint probability analysis. It was necessary to engage a statistician under a subcontract to provide the necessary specialist input, at a cost of €12,740. Three journal papers were finalised and accepted for publication, and one conference paper was presented.

(A total of 8.72 months was devoted to Task 2)

Task 4 – Understanding and predicting failure modes

HR Wallingford led this task, which involved planning, participating and steering a significant number of different research actions. In Year 1 of the project the effort was directed at preparing an internal project status report on performance and reliability summarising failure modes for the main flood defence types. Conditions in the Thames Estuary flood defence system were also examined, to enable the further (tailored) development of failure modes in the context of the pilot studies (Task 24). In Year 2 effort concentrated on contributions to the 'matrix' of defence type and loadings, leading to structuring, collating and editing content for the Defence Asset Failure Modes Report (the main task deliverable). Work also involved reviewing and developing defence failure fault trees. Year 3 involved a technical review on validation of geophysical investigation research, plus analysis of breach formation processes in relation to soil parameters. There was also a review of blockwork and shingle beach failure mechanisms, with structuring of physical model tests to investigate beach response under varying wave conditions. The above activities continued during Year 4, when the main research programme was completed. This included a review and analysis of surface erosion knowledge, leading to a position report. During Year 5 an additional piece of research was undertaken in association with the large scale wave induced breach testing under Task 6, as detailed below. Additional effort during the final year was directed at:

- Final reporting on the Task group work and dissemination (inc FLOODrisk 2008 conference) [Task leader]
- Analysis (in relation to reliability analysis) of the effects of holes and discontinuities in an embankment surface under wave loading.

(A total of 21.49 months was devoted to Task 4)

Task 5 – Predicting morphological changes in rivers, estuaries and the coast

The HR Wallingford contribution to this task was principally on morphological change in rivers. Work was brought forward in Year 1 to enable information to be captured and analysed on the transient morphological effects of the exceptional flash flood which occurred in North Cornwall (around Boscastle) on 16th August 2004. Year 2 effort covered both fluvial and coastal activities, with data collected relating to Case Studies on the river morphology work. A rapid broad-scale shoreline evolution model was formulated and applied to a section of the UK coastline. This demonstrated that this type of modelling can be successfully carried out. In Year 3 the HRW contribution to fluvial and coastal components was completed. The fluvial input has involved the reporting of case studies, the development of the approach for taking morphology into account when assessing flood risk and production of the final report including a scientific review. The coastal work continued the development of the rapid shoreline evolution model. The final reporting and delivery of the generic model was completed, and journal and conference papers were produced. A small input was provided in Year 4 to finalise the major task deliverable for submission in April 2008.
(17.14 months)

Task 6 – Modelling breach initiation and growth

HRW led this task. The main research activity started in Year 2, through undertaking initial actions including a review of the current breach modelling state of the art. This review continued in Year 3 in addition to the leading of various task meetings. Links were established with an external research project led by the Dam Safety Interest Group allowing collaborative analysis of breach model performance, which involved liaison with USBR, USACE and USDA-ARS amongst a wider group of international participants. Development of the HR BREACH model was also planned and implemented using feedback from this collaborative work. These activities continued during Year 4, with extensive analysis and development of breach model performance, and comparison with other models available internationally. Delays arising from partner resourcing and other technical issues meant that the task research programme ran over in to Year 5. Final effort in Year 5 was directed at:

- Lead editor for content and completion of the breach modelling review (M6.1) and the Task deliverable report (D6.1) - Modelling Breach Initiation and Growth
- Completion of analysis of the HR Breach model performance and further development of the HR Breach model
- Continued collaboration with the international DSIG breach modelling team
- Detailed analysis of breach flow behaviour using both IMPACT project data and new data provided by USDA-ARS
- Integration of the HR Breach model with the InfoWorksRS 2D flow model.

(22.99 months)

Task 7 – Reliability analysis of flood defence structures and systems

The main activity, started in Year 2, primarily involved the development of information relating to the Thames case study site. Site visits were conducted and data collated on defence types, crest levels and geometry, historical flood events and past failures. The identification of potential failure modes commenced in tandem with the parallel tasks looking at fault tree analysis. In Year 3 analysis of defences from Dartford Creek to Gravesend was undertaken, involving consideration of multiple failure modes for a range of different structure types and generating fragility curves and annual probability of failures. Initial work on constructing a database of uncertainty information (probability distributions and parameters) associated with the Task 4 failure modes was commenced. A format for presenting fault trees for different structure types was also constructed.

HRW input during Year 4 was primarily concerned with the development of information relating to the development of a flood defence reliability software tool. HR Wallingford coded the main software interface. TUD provided software subroutines of the Limit State Equations (equations that describe the structural reliability of a defence) that have been developed within Task 4. HR Wallingford integrated these LSEs into the software tool. The software has been applied to some pilot sites, and a comprehensive user manual has been developed.
HRW's input during Year 5 was primarily involved with finalising the reliability software tool. This involved the creation of new user friendly interface, the preparation of an accompanying user manual and the preparation of a downloadable package of software materials than be placed on the FLOODsite website . The software has been applied on the TE2100 study and has received wide interest, in particular from the USACE. Work has now completed and the software tool and accompanying user manual has been uploaded to the FLOODsite. Additional work regarding reliability analysis, in collaboration with TUD has been supported by FLOODsite. This involved the linking of the Task 7 reliability tool, with a finite element geotechnical model of flood defences around New Orleans.
(5.16 months)

Task 14 – Design and ex-ante evaluation of innovative strategies for flood risk mitigation

A small input was provided for Year 2, based around use of the Thames as a pilot study site for flood risk management scenarios. HRW also participated in the development / review of the scoping document produced by WL|Delft. The HRW input during Year 3 included the development of generic methodologies for building long-term strategic alternatives and evaluating them in the context of different future socio-economic scenarios. Work on the Thames Pilot also got underway, with particular emphasis on developing socio-economic scenarios (in close collaboration with the FHRC Thames Estuary 2100 - TE2100 - team) and portfolios of resilient and resistant long-term management strategies (in close collaboration with the TE2100 HLO team). The methodology for the assessment of risk was developed for the Thames.

During Year 4, the Thames Pilot was rapidly progressed. Future climatic and socio-economic scenarios and portfolios of resilient and resistant long-term management strategies (in close collaboration with the Environment Agency of England and Wales TE2100 team) were implemented. The methodology for the assessment of risk had been developed for the Thames and an approach for evaluating and representing long-term robustness, flexibility and sustainability was developed (building on collaborative work with WUR and WL¦Delft). The small input for Year 5 involved finalising the HRW contribution to the final report, namely the chapter on the Thames.
(11.51 months)

Task 17 – Emergency flood management – evacuation planning

HRW was a member of the research team. During Year 2, a workshop was held at HR Wallingford in November 2005 for some 50 people from various organisations involved with flood event management in England and Wales, to ascertain their requirements with regards to emergency flood management. A report was also produced on the review of the existing methods of emergency response for floods in the UK. This focused on the following: the legislative background to flood emergency management in the UK; the role of organisations in response to a flood event; flood preparedness; flood incident management; emergency response; as well as a range of case studies.

In Year 3, the review report of evacuation models was completed in January 2007. This review covers not only evacuation models used for flood emergencies but also those employed to model evacuation for technological hazards (e.g. nuclear power stations, chemical plants). Data collection for two embayments in the Thames Estuary was completed, and the BC Hydro Loss of Life Model (LSM) was applied, looking at different breach and evacuation scenarios. This work was discussed at a meeting in early 2007 with the Environment Agency. A workshop was attended with BC Hydro and other researchers, to discuss the future development of loss of life modelling.

During Year 4 the following inputs were delivered:
- Two dimensional hydraulic modelling was carried out using TuFlow to reconstruct the 1953 Great North Sea flood that occurred on Canvey Island as a result of breaches of the flood defences. The results of the hydraulic modelling were verified against flood volumes estimated in 1953 after the event;
- The number of receptors (e.g. people, vehicle and properties) on Canvey Island in 1953 were compiled from historical data and 1951 census data;
- The BC Hydro Life Safety Model (LSM) was applied to Canvey Island for the re-constructed 1953 event.
- A workshop was attended in Vancouver, Canada in November 2007 on our experiences in using the Loss of life and evacuation models in order to disseminate the results of the work to other researchers in North America;
- Alternative and simpler approaches were tested in order to obtain first order estimates of evacuation times for Thamesmead and Canvey Island;
- An end user workshop was held in January 2008 to disseminate results and to obtain end user feedback on the work carried out;

HR Wallingford carried out the following during the final year:
- The Task 17 Executive Summary and final report were completed in March 2008 and uploaded to the FLOODsite website, along with two technical notes on a review of evacuation models and a review of end user requirements in the UK;
- There have been on-going liaison between BC Hydro, USBR and TU Delft over the use and development of the Life Safety Model, and its use for evacuation planning and flood event management;
- The outputs from T17 were disseminated at several conferences, including UK Defra conference, FRIAR, 4th Flood Defence Symposium (Toronto) and FLOOD*risk* 2008;
- Dutch mortality functions were applied to the case of Canvey Island to determine their wider applicability;
- The final demonstration CD was delivered in December 2008, providing an additional output summary of the Task.

(25.1 months)

Task 18 – Framework for long-term planning

HR Wallingford led this Task and within it also the scientific integration of Theme 3. Theme 3 provided the overall framework for integration of the project science to ensure its eventual dissemination and exploitation. Effort in the first project year was devoted to the detailed negotiation of risk analysis and management concepts with Themes 1, 2 and 4 in the preparation of the “Dresden” paper. The second year was devoted to a review of decision support systems used in long-term flood risk management in the UK. The review considered many different criteria, such as data requirements, software architecture, and the measures, instruments and scenarios that can be incorporated in the DSS. Effort in Year 3 focused on the development of the conceptual and methodological frameworks of flood risk management integration. One of the main activities in this period was the finalisation of the review of DSS tools (D18.1). Separate reports were produced for UK and Netherlands, with IOER producing an overall summary report, with inclusion of tools from other countries. Following initial development of the conceptual framework (the so-called ‘Dresden Paper’), much work was undertaken on developing the methodological framework, including a draft report for comment. This considered:
- How the different modules interact and are alerted to reflect change (e.g. source, pathway, receptor, consequence, external driver, management response)
- Multi-stage decisions and how the future state can be explored through multiple snap-shots

- Development of a rapid flood risk model for the Thames pilot to enable multiple snap-shots through time to be modelled
- Developing initial measures for robustness, sustainability and adaptability for long-term planning in close collaboration with Task 14.
- Preparation of a conference paper on the Task 18 Thames work for the European symposium on Flood Risk Management held in Dresden, February 2007.

Our effort in Year 4 focused on (i) finalising the development of the conceptual, methodological and technological frameworks of flood risk management integration; (ii) developing a semi-quantitative approach for dealing with options appraisal and (iii) development of the prototype DSS tool and underlying model runs for the Thames pilot. Particular innovative aspects included:

- Consideration of multi-stage decisions and how the future state can be explored through multiple snap-shots.
- Move to a more continuous representation of the future socio-economic and climatic space in support of the robustness measure. This enables the evaluation of a given strategic alternative in the context of this entire space and through time (e.g. 100 years).
- Developing a flexibility measure which takes the multi-stage decision process into account via a decision pipeline approach. This provides an indication of the number of 'acceptable' pathways through the system.
- Developing an overall sustainability measure which considers social issues, long-term affordability and ecological aspects as well as robustness and flexibility.

The HR Wallingford contribution to Task 18 in year 5 included:

- Finalising the prototype DSS tool for the Thames - where key elements include case management, ranking techniques and presentation of outputs to decision makers
- Enacting the scenarios and strategic alternatives developed in Task 14 (de Bruijn et al, 2008) within the prototype DSS tool.
- Preparation of the final report
- Provision of extensive inputs on the Thames to Task 30 web-based knowledge transfer.
- Preparation of a conference paper on the Task 14 and Task 18 work on the Thames Pilot for FLOODrisk 2008 held in Oxford, September-October 2008.

The work undertaken under Tasks 14 and 18 has been closely allied to the Environment Agency's Modelling Decision Support Framework (MDSF), as they both seek to provide decision support tools for flood risk management in the medium to long-term. There have been additional benefits, therefore, in being able to develop consistent and effective case management systems, with consideration of wider risk metrics (people, habitat) and means of portraying decision support information.
(26.45 months)

Task 19 – Framework for flood management planning

In Year 2 a report was produced on the requirements of flood event managers, to ensure that the framework for flood event management planning produced under this task would meet this need. The report was based on a review of the Environment Agency's flood warning management system; feedback from a workshop held at HR Wallingford in November 2005 (see Task 17) and a review of emergency planning exercises carried out in the UK by flood incident managers. Work also started on a review of different types of decision support systems and their use in flood event management; this was completed in Year 3 (January 2007). A meeting was held with the Environment Agency TE2100 project team to discuss the functionality of the flood incident management decision support framework. Work in Year 3 also included programming of the decision framework, involving methods to include results of evacuation models and the 'flood risk to people' approach.

HRW inputs during Year 4 comprised:

- Methodology for the decision support framework finalised with Delft Hydraulics and other partners;
- Specification for the FLINTOF framework completed;
- The FLINTOF framework set up within ArcGIS including the following modules:
    - Risk to people;
    - Assessment of inundation of evacuation routes;
    - Probability of building collapse;
    - Evaluation module for different scenarios;
- An animated demonstration of the FLINTOF system Task 19 was completed for dissemination via the internet.

During the final year, the following activities were completed:
- A paper related to Task 19 was presented at the FLOODrisk 2008 conference;
- Task 19 Final Report and Executive summary completed after a number of internal and external reviews and uploaded to the FLOODsite website during the early part of Year 5;
- HRW also contributed to the additional CD, prepared by Sogreah, which provided a further summary of the outputs from Tasks 17 and 19.

(10.07 months)

Task 24 – Pilot study of Thames Estuary

HR Wallingford led this Task. Effort in Year 1 concentrated on discussion with the Environment Agency how the research pilot studies contribute to and complement broader investigations of flood risk management in the Thames estuary as part of the Thames2100 long term planning initiative.

The second project year involved collation of data and uploading the metadata to NOKIS, and establishing a baseline system model for the Thames estuary including sources (extreme loading and joint probability), pathways (defences and floodplains) and receptors (people and property). In Year 3 a state of the art flood risk model of the Thames estuary was constructed, based on the Source-Pathway-Receptor-Consequence conceptual model. The model includes a joint probability method for establishing loads, a reliability method coupled to a Monte-Carlo procedure for including defence failures, these two modules are linked to a newly developed flood spreading method, which facilitates attributing to risk to specific defences for maintenance prioritisation purposes. The model was successfully utilised for preliminary economic appraisal on the Environment Agency's TE2100 project. During Year 4, the development of the flood risk model was continued, reflecting how the Thames Pilot provided a valuable focus for showcasing many of the scientific outputs. The Environment Agency's TE2100 project team commissioned HR Wallingford to undertake further runs of different intervention options, as well as requesting a series of further refinements. The method was trialled on eight catchment sites around the country. Work during the final period primarily involved the preparation of a paper and presentation on uncertainty at the FLOOD*risk* 2008 conference and the completion of the contribution to the Theme 4 book. The Task 24 chapter describes the development of the modelling method and its application to the Thames Estuary.

(36.48 months)

Task 28 – Integrated information management

This Task was led by HR Wallingford, but in close partnership with TU Delft who also acted at Leader of Theme 5, within which Task 28 sits. Year 1 involved initial preparation, with Partner 12, of the internal report describing target audiences (Deliverable D28.1). Year 2 concentrated on the development and launch of the project Communication and Dissemination Plan. This has provided an essential framework through which all communication and dissemination activities from FLOODsite can be monitored. The C&D plan was developed in consultation with (industry) members of the AIB and other key end user organisations. A majority of work during Year 3 was undertaken by HR Wallingford. This work included:

- Updating and improving the Communication and Dissemination Plan, based on feedback from the AIB and Management Team
- Liaising with Task 30 with respect to developing the E-Flood specification
- Liaising with Task 32 in developing the public access area of the FLOODsite website, including the production of summary pages for the pilot studies.

Activities undertaken by HR Wallingford during Year 4 were:

- Revision of the Communication and Dissemination Plan (Version 6, Edition 3)
- Production of 4 FLOODsite leaflets for the FP5 CatchMod project
- Redesign of the "Project Links" area on the website, to give better public access. This was implemented by our website subcontractor, along with updates to the databases for the project links
- Review of the FLOODsite policy on Exploitable Knowledge and development of the Plan for Using and Disseminating Knowledge.

HRW input to Task 28 during Year 5 has focused on the production of 2-page Fact Sheets for all science tasks. Thirty-five fact sheets have been produced in total to aid dissemination of key facts and products to a range of audiences. Considerable effort has also been spent supporting implementation of Task 30 research work where IHE have produced interactive online content promoting / disseminating key task outputs. Additional effort has been put into structuring and developing the interface between Theme 5 online dissemination and the wider project website. Research Links and Useful Websites have also been kept up to date.
(7.39 months)

Task 29 – Text-based knowledge transfer

HR Wallingford was a member of the research team, responsible for Chapter 4 of the text-based guidance document ('Design and assessment of preventative flood risk management strategies'.) Effort in Year 2 was mainly devoted to assisting in preparing the concept for and outline of the text-based guidance document. This involved discussions with the task leader and project partners, including meetings in the UK, Netherlands and at the Braunschweig workshop in February 2006. Planning of the output continued during Year 3, with attendance at the Dresden conference and team meeting. This allowed for interaction with other Task Leaders and other researchers, in order to help understand the topics that will be included in the book. Work during Year 4 consisted of several planning and co-ordination meetings, attending the FLOODsite conferences (including the Grenoble team workshop in February 2008) to interact with the Task leaders and other researchers, and drafting, reviewing and revising the text and other chapters. Actual work in the final year of the project consisted of working with the overall editor in:

- assisting in updating the draft of Chapter 4 following comments by other participating organisations:
- attending a further team planning meeting for the Task 29 report in Brussels on 28th May
- attending the FLOODsite end of project conference "FLOODrisk08" in Oxford September/October 2008 to interact with the Task leaders and other researchers
- reviewing other chapters of the task 29 report as agreed
- providing final English Language edits of the text of chapters 1, 2 and 5.

(4.27 months)

Task 30 – Web based knowledge transfer

Resources during Year 2 were devoted to the planning, structuring and development of the Theme 5 aspects of the project website (in close collaboration with Task 32). A decision was taken at the start of the project to maximise use of the web to aid team communication, research dissemination and project management. The web has grown considerably during the first two years of the project and is proving to be a very effective project tool. Effort during Year 3 was directed at:

- Delivery of M30.1 – a report detailing a review of the science being undertaken across the project and likely suitability of specific items for use within task 30 for online interactive dissemination
- Structuring and implementation of the public interface to the website.
- Technical review, discussion and development of overall concepts for Task 30 – i.e. scope of work to be implemented by IHE
- Planning and participating in various task team and technical meetings / workshops (June 06, Feb 07).

Work during Year 4 continued the above tasks, including the expansion of the public interface to the web site to enable access to animations and models via task outputs, as well as via the Modelling facility. HRW input during Year 5 included the development of a Visual Material Library and Toolkit on the FLOODsite website. In collaboration with Tasks 28 and 32, Task web pages have also been produced for all Tasks focussed at a range of different audiences, which link to the Interactive Pages produced by IHE where appropriate.
(6.33 months)

Task 32 – Networking and harmonisation

HR Wallingford led Task 32 which formed a critical part of the integration of the project as a team. The sub-contractor (SAMUI) was selected to prepare the project web site, brochure, poster and image. Year 1 saw delivery of the project web site and a document on the Language of Risk. Both of these were crucial to the success of the project. HR Wallingford also organised the project launch workshop in Brussels in July 2004. Year 2 included a number of further phased developments of the project website, along with production of a Year 1 Project CD ROM. Work by HR Wallingford and Samui also including development and support of web pages for the 3rd project workshop. Two important areas of work during the year were establishing data protocols, and procedures for identifying and ensuring links with external projects. Developments during Year 3 included improvements to web site (online EC reporting tool and restructuring of document management system), update and printing of project brochure, production of Year 2 CD, and support to the Dresden team meeting and symposium.

During Year 4 a new version of the public web pages went live (May 2007), which improved access to all publicly-available information. Other activities included production of Year 3 CD, increased efforts to enhance team awareness of the need to act on external project links, update of guidance and procedures for publication, and support and implementation of the Year 4 project workshop in Grenoble. Effort during Year 5 was directed at a wide range of activities, including:

- Continued updating of the web site, including functionality for on-line Year 5 reporting.
- Design and production of the end of Year 4 CD ROM and end of project CD ROM
- Support and implementation of the final FLOOD*risk* 2008 conference (and associated team meetings) in Oxford, which was a very successful event.
- Ensuring that all project outputs are available online via the document management system of the web site
- Planning and implementing the long-term availability of the web site.
- Contributing to meetings with external stakeholders.

(26.34 months)

Task 33 – Assessment and review

HR Wallingford led this task, which was introduced into the project in response to the guidance for contract negotiation. Assessment and review activities during Year 1 included establishing and setting out terms of reference for:

- the Project Board (PB)
- the Scientific and Technical Advisory Board (STAB)
- the Applications and Implementation Board (AIB).

Professor Stephen Huntington of HR Wallingford chaired the STAB and is a member of the PB. Effort during rest of project included participating in and supporting the three Boards.

Activity during the following four years involved assessment and review undertaken whilst attending and supporting the above Board meetings. The Boards undertook valuable reviews of the project science during the Dresden and Grenoble workshops, to assist with project integration and improved dissemination of the outputs.
(7.33 months)

Task 34 – Partner Audits

Subsequent to the commencement of the project, DG Research prepared a general contract amendment removing the need for annual audit of small expenditures. Although the Commission contract with Consortium now has Clause 39 included, removing the need to audit expenditure below €150,000, HR Wallingford will need to submit an audit certificate each year of the project.

HR Wallingford incurred the following approximate audit costs during the project duration:
€2,000 for the auditing of Year 1 project costs
€2600 for Year 2
€2894 for Year 3
€2560 for Year 4
€2633 for Year 5.

Task 35 – Project Coordination and management

HR Wallingford led this task with assistance from Partner 46 Deltares (formally Partner 2, WL|Delft Hydraulics). HR Wallingford directly employed a project administrator to service the needs of the Consortium. This work has involved establishing office, communication and information management systems, dealing with partner queries by post, e-mail, phone and fax, negotiation on amendments to the Consortium agreement, liaison with the Scientific Officer in DG research and preparing papers and minutes for the project management team. We have also provided guidance to our partners on the FP6 annual reporting requirements as these differ substantially from those of earlier Framework Programmes.

The Coordinator, Paul Samuels, his deputies Mark Morris and Andy Tagg (from year 3), and the Administrator (Jackie Bushell from 1 June 2004 to completion) jointly gave 16 months effort to the project coordination during Year 1. This represented approximately one third of the project allocation of resource available to management activities, once the financial burden of Auditing was extracted from the Consortium Management costs. This volume of effort was higher than that initially budgeted (10 months) but was considered necessary to establish appropriate systems and structures to ensure smooth running of the project throughout its duration.

The Coordinator team jointly gave ~9.6 months effort to the project coordination during Year 2. This represents a slight reduction in total months from that in Year 1, which was higher due to the additional work of initiating the project, but was consistent with anticipated inputs.

Due to the conflicting pressures of providing project management support and undertaking project science, HRW decided to enlist the services of a further experienced Project Manager from December 2006, in order to allow Mark Morris to concentrate on research under tasks 4 and 6. The Coordinator, Paul Samuels, his deputy Mark Morris, the new Project Manager Andy Tagg and the Administrator, Jackie Bushell, jointly gave 9.7 months effort to the project coordination during Year 3. This is consistent with the level of effort in Year 2.

By Year 4, when the project was well advanced, with smooth-running procedures, the majority of the coordination activities were handled by the dedicated Administrator, Mrs Jackie Bushell in addition to ensuring continued maintenance of the project web site, and other assessment and review activities. The amount of effort given by the HRW project team to coordination activities amounted to 2.2 months during Year 4. The same coordination procedures were followed during the final year of the project, although greater effort was expended on the final reporting. Overall the HRW project team spent 13.65 months during Year 5 on coordination, which included allowable time to the end of March 2009.

2.2 Partner 2 & 46 – WL|Delft

On December 31, 2007, WL|Delft Hydraulics merged with several other research institutes into a new organization called Deltares. In the meantime, the EU approved that all WL|Delft Hydraulics' tasks and responsibilities in the FLOODsite project will be passed on to Deltares, and Deltares accepted these tasks and responsibilities. Deltares was added as partner #46 for administrative reasons, but in this management report we report our activities as partner #2, with partner id. WL|Delft.

This section provides a brief description of the work carried out by WL|Delft in the reporting period, i.e. the period from 1 March 2004 – 28 February 2009. This description is provided at the task level. Explanatory notes on major cost items are included.

Task 2: Estimation of extremes

In the framework of Activity 3 of Task 2, WL|Delft carried out Action 1, which deals with wave transformation over shallow foreshores. The main objective of this action is the modelling of wave transformation over shallow foreland at different water levels based on advanced available numerical models. From this modelling, the run-up and pressure on the flood-defence structures was estimated. WL|Delft delivered guidelines on wave impacts on flood-defence structures with shallow foreshores. In this context, a model has been set-up and calculations have been carried out for the Petten Sea Defence. The results were analysed and presented at the Waves 2005 conference.

The results of this activity were reported in the Task 2 report Hydraulic Loading of Flood Defence Structures. WL|Delft has contributed to two of the papers of the special issue of the Journal of Hydraulic Research, in which most of the work carried out within task 2 is described.

Task 4: Understanding and predicting failure modes

For Task 4, Activity 1, Action 2, WL|Delft has performed a review of literature on failure modes of revetments. The review is based on work already undertaken in The Netherlands, especially the guidelines developed by the Technical Advisory Committee on Flood Defence (TAW) and work done within the European Union frameworks CLASH and OPTICREST. In addition, the failure modes of dunes were subject of a literature review.

For Task 4, Activity 4, Action 1, WL|Delft studied the failure modes of placed block revetments in more detail, especially block removal by wave impact.

Together with the other partners involved in Task 4 a matrix was composed containing all possible combinations of hydraulic structure types and hydraulic loadings. An inventory was made of the relevant failure mechanisms for all structure type - load combinations in the matrix. The results of the literature review are used to fill the matrix and to give concise descriptions of the failure mechanisms. In addition, the literature review is presented in the form of a cross-reviewed report on failure modes of block revetments.

Task 8: Flood inundation modelling / methodologies

In year 1, the Task leader (WL|Delft) co-ordinated the development of the Research Implementation Plan, organized a kick-off meeting in Brussels and contributed to Theme meetings in Brussels and the FLOODsite workshop in Delft. A start was made with the model development for the Scheldt pilot site.

During the second project year, much effort was put in data collection as required for the development of inundation models. WL|Delft also organized a task meeting and participated in the FLOODsite workshop in Braunschweig. The actual research focussed on the impact of objects, such as buildings, on inundation patterns and flow characteristics (R&D research of Deltares|Delft). Also, a review was performed on existing software packages for inundation modelling. The review has become a chapter in the final report of Task 8.

In year 3, effort was still being put in the collection of accurate data of the pilot sites. Problems consisted of permission (Thames pilot site) and accuracy (most of the flash flood pilot sites). WL|Delft organized a task meeting and contributed to the FLOODsite workshop in Dresden. The research focussed on the analysis oft the results of the Scheldt models. Also, a study was carried out that resulted in a "cookbook" for the preparation of flood maps. The latter project was financed by the EVD, International Public Co-operation, Ministry of Economic affairs, The Netherlands. The cookbook was based on a benchmark of SOBEK-1D2D, the Delft-FEWS Flood Mapping Utility (FMU), interpolation of observed flood levels and interpolation of flood levels computed with a 1D model.

In year 4, the attempts to obtain accurate data of a flash flood river had to be continued. Together with UNESCO-IHE, WL|Delft organized a meeting with project team members involved in the FLOODsite project Task 8 and those involved in the Flood Risk Management Research Consortium of the UK. The meeting provided an opportunity to present scientific achievements and discuss task related issues. The actual research work focussed on the development of flooding models for the Thames pilot. In that context, the impact on the model results of grid cell size was studied, as well as how to schematise built up areas, and how to deal with wind during a flood. Drafting of the final report for this task was started as well. A paper and two abstracts were submitted for the River Flow Conference and the Flood Risk Management Conference respectively. Both conferences took place in 2008, the fifth year of the FLOODsite project.

In year 5, WL|Delft participated in the FLOODsite workshop in Grenoble. For this workshop WL|Delft wrote an executive summary of the Task 8 results. Task 8 results also were published in the proceedings and presented at the conferences of River Flow Conference (1 paper and presentation) and the Flood Risk Management Conference (2 papers and presentations). The research work focussed on the development of a flooding model for the Brembo river in Italy. Last but not least, the final report of Task 8 was completed.

Task 10: Socio-economic evaluation and modelling methodologies

Deltares contributes to Task 10 task by predicting the effects of floods and flood-induced pollution on ecosystem health. The Deltares contribution in the past 5 years focused on two mayor aspects: (1) the development of an ecotoxicological risk model, applied for the Western Scheldt, and (2) the development of a 1D/2D hydrodynamic and water quality model for flooding, applied for a dike breach near Middelburg, The Netherlands.

Related to the development of an ecotoxicological risk model, applied for the Western Scheldt, a detailed case study for the area "Land van Saeftinghe" was carried out. This area of the Western Scheldt estuary is flooded seasonally, which means that changes in the water quality impact the soil quality and therefore the toxic stress in a normally 'dry' habitat. The OMEGA model yielded a Potential Affected Fraction (ms-PAF) on a chronic exposure level of around 9% for the study area. The main pollutant causing the ms-PAF is copper (80-90%). Translating this outcome to risks, 9% of the species present in the study area might have an effect caused by toxicants. This risk level is higher then Dutch law allows for single toxicants (a PAF of 5% is allowed). Combining toxic risks leads to a Water Framework Directive classification as a water body chemical at risk.

The second element in WL|Delft activities for Task 10 relate to the development of a 1D/2D hydrodynamic and water quality model for flooding, applied for a dike breach near Middelburg. During flood events, large amounts of sediment are transported to the inundated area. The irregular supply of thousands of tons of sediment may shape the inundated area. Due to the occasional sedimentation of massive amounts of sediments this situation is undesired not only from the morphology point of view, but also from the water quality point of view. The excess of sedimentation during flood events carries with it significantly high levels of pollutant fractions absorbed in the sediment. Moreover, the transport and distribution of pollutants from storage facilities or industries is another risk during flood events. High concentrations of pollutants offer high ecotoxicological risks not only for plants and animals, but also for humans. A case study was carried out for Middelburg and the surroundings, in the province of Zeeland, based on the collapse of dikes and the inundation of the land. A dam or dike break scenario was simulated for the research.

The results of these contributions are reported as part of the overall reporting for this task.

Theme leadership Theme 2

For Theme 2 (Tasks 12 through 17) WL|Delft provided the theme leadership. The theme leader, dr. Frans Klijn, co-ordinated the Research Implementation Plans and participated in the discussions regarding the Language of Risk and the Framework for an Integrated Approach. In year 2, the theme leadership was temporarily taken over by Mr. Jos Dijkman because of illness of Dr. Klijn.

The theme leader yearly updated the DOW for the theme and co-ordinated the work in the tasks. He saw to it that all task deliverables were produced and were up to standard, and that Executive Summaries were produced. Also, the theme leader of Theme 2 participated in the Executive Management Team and contributed to the yearly FLOODsite meetings and the FLOODsite final report.

Task 12: Identification and ex-post evaluation of existing flood mitigation measures

In Task 12, WL|Delft had a relatively modest role. For this task, a classification of flood mitigation measures was prepared, including a clear description of the context in which they were used and a description of their functioning. Next, a database system was developed, based on the classification of measures and instruments for pre-flood, flood-event and post-flood interventions, as well as for the application context in the different European countries with regard to flash floods, lowland floods, floods in estuaries, and coastal floods. Around the database system a web-based application has been developed which allows soliciting data on measures applied as well as their functioning. The web-application was delivered to the task leader (IOER) which concluded the main effort of WL|Delft to this task. Finally, the task leader was given assistance in his production of the task deliverables at request.

For this task WL|Delft also developed a damage module which facilitates developing a tailor-made flood damage assessment method. The user of the module can perform damage calculations by identifying relevant maps, tables and by prescribing the relationships between those maps and tables. The damage module is not only useful for the determination of actual potential flood damages, but also serves to assess flood impacts which are expected to occur after the implementation of flood measures. This tool, therefore, contributes to the process of selection and evaluation of flood risk management measures. The module includes a sample flood assessment method, a simplified general method to calculate flood damages and a user manual.
WL|Delft also contributed to a study at pre-feasibility level on future flood risk management in the Netherlands, including the question how to formulate safety levels, and the identification of measures to both reduce the probability of flooding and to reduce the susceptibility to flood damage.

Task 14: Design and ex-ante evaluation of innovative strategies for flood risk management

For Task 14 WL|Delft was Task Leader. The key research activities started in March 2005 with a scoping document, in order to achieve a common understanding and view on the work to be done by all the partners in this task. This scoping document was based on a review of mainstream existing methods of scenario development and of designing strategies for flood risk management. The findings of the review were reported, sent out for comments among the partners involved, and discussed during the Braunschweig workshop on 16 February 2006. Next, a number of meetings were organised in Delft, Wallingford and Dresden where WL|Delft in cooperation with the partners in the task drafted the methodology/procedure which was to be tested in the three pilot areas.
After that, WL|Delft put lots of effort in the trial on the Westerschelde Estuarine polder area, for which future scenarios were specified and quantified, present and future risks were quantified and assessed,

and strategic policy alternatives were defined. The consequences of various strategic alternatives were assessed as to their influence on flood risk and on overall sustainability in various futures (by confronting them to different scenarios). The results of the work have been shared with local stakeholders in co-operation with Task 25, and have been reported in the final task 14 report (task deliverable).
As responsible task leader WL|Delft edited the final task report, including chapters on the Westerschelde and Thames, and produced an Executive Summary. Also, a paper was produced for the FLOODrisk 2008 conference in Oxford (September 2008).

During the 5 years of FLOODsite, there have been substantial exchanges of knowledge between the Task 14 work proper and other research, e.g. for the national government. This included work on an interactive tool to be used in the upcoming societal discussion in the Netherlands on the future protection strategy against river and coastal floods, as well as a study on the present and future flood risk as a function of climate change and demographic and economic developments in the whole of the Netherlands for the Netherlands' 2nd Sustainability Outlook, in co-operation with the National Environmental Assessment Agency (MNP). Some results of the latter work were presented during the European Symposium on Flood Risk Management Research in Dresden (February 2007).
WL|Delft also investigated flood risk mapping approaches in Europe and performed a preliminary mapping of 'risky places' in the Netherlands, along with research on how to better quantify casualty risk. Also an Outlook Document was produced for the Netherlands' water management policy, applying ideas on scenarios and strategic planning based on perspectives as identified in Task 14.

Task 17: Emergency flood management – evacuation planning

WL|Delft is Leader of Task 17. For Task 17 activities included a review of operational flood management methods, application of several evacuation models in the Schelde pilot area, analyzing the probability of building collapse during floods and investigating the effectiveness of compartmentalization to increase the time available for evacuation. This knowledge is required for the development of evacuation plans. As Task Leader WL|Delft coordinated between the partners and organised and chaired numerous meetings and phone conferences (mostly combined with Task 19).

WL|Delft contributed to the review report of operational flood management methods and models (Milestone 17.1, finalised in January 2007). Specific research was carried out to investigate the relation between flood characteristics and casualties based on data from the flooding of New Orleans. Further activities focused on the application of several evacuation and traffic management models on the Schelde pilot area, to test the suitability of these models to support the preparation of evacuation plans. The following models were applied in the framework of this task: Evacuation Calculator, and the road traffic models ESCAPE and INDY. The application of the BC Hydro Life Safety Model by TU Delft has been supported. Results were discussed with local end-users of province of Zeeland and the regional water board. Other research looked into the effectiveness of compartmentalisation as a measure to limit the number of flood casualties and to increase the time available for evacuation.

Products:

- FLOODsite report T17-07-02 'Evacuation and traffic management' by Darren Lumbroso et al.
- CD containing all results from task 17 and task 19
- Paper and presentation at FLOODrisk2008 conference in Oxford

Task 18: Framework for long-term planning

For Task 18 WL|Delft activities included a review of existing system tools in the Netherlands that support long term flood risk management. The technical aspects, advantages and disadvantages of the various national approaches and DSS tools were described, with a focus on experiences with actual application in decision making. Next, a methodology for a DSS to support long-term flood risk management planning was developed and a prototype DSS for the Schelde pilot area was designed. The first steps were made in the implementation of a planning kit for flood risk management (matching project Q4345.95). The uncertainties in the calculation of flood risk have been analysed and reported.

The work for the lead project has been matched with comparable activities for the long-term planning of the flood protection level in the Netherlands, and the development of a DSS for that purpose. The Planning Kit, an internet-based interactive tool for flood management planning was prepared to enable the users to participate in the societal discussion on flood management issues for the Rhine River in the Netherlands.

Products:

- FLOODsite report T18-06-01 Development of DSS for long-term planning: Review of existing tools by Jochen Schanze et al.
- FLOODsite report T18-08-01 Methodology for a DSS to support long-term flood risk management planning by Caroline McGahey et al.
- Poster presentation for the NCR-days, November 2008.

Task 19: Framework for flood management planning

WL|Delft is Leader of Task 19. For Task 19, activities focused on reviewing the flood event management Decision Support Systems in the Netherlands, analyzing the risk of fatalities, depending on flood characteristics and the probability of building collapse during floods. This information was used in the development of the prototype Decision Support System (DSS) on flood event management for the Schelde pilot area. DSS end-user requirements were collected as well. Specific research activities have been carried out into the development of a methodological framework and implementation of this in a Evacuation Support System (matching project Q4005.20) and the development of DSS software components to be used (matching project Z4260). WL|Delft contributed to and edited the review report, the technical note on the methodological framework and the final report. As Task Leader WL|Delft coordinated between the partners and organised and chaired numerous meetings and phone conferences (mostly combined with Task 17).

Products:

- FLOODsite report T19-07-01 ‘Review of flood event management Decision Support Systems’ by Rob Maaten et al.
- FLOODsite report T19-07-03 ‘Frameworks for flood event management’ by Marjolein Mens et al.
- Paper at FLOODrisk2008 conference in Oxford

Task 25: Pilot Study Site “River Scheldt” (Estuary)

WL|Delft was task leader of this task. The rationale for the Schelde pilot study was to apply and test the approach to flood risk management developed in the FLOODsite project. The Task 25 pilot study focused on two elements of this approach, i.e. a Flood Risk Analysis and a Flood Risk Assessment. After a kick-off meeting in 2004 an inventory of existing data was made and a baseline report on the flood risk situation along the Schelde Estuary was prepared and delivered.

In order to seek maximum involvement of stakeholders, including citizens, scientists and policy makers in the flood risk assessment, in total three workshops have been organised by the task leader in close cooperation with partner TUD. These workshops were held in December 2005, January 2007 and January 2008.

For the flood risk analysis of both the present situation and possible future conditions of the Schelde area, modelling activities were carried out together with Task 14. This involved the set up and calibration of a 1D/2D hydrodynamic model (SOBEK) combined with a damage model which produces inundation and flood risk maps. In order to calculate future flood risks, scenarios for climate change, estuary conditions, economy and demography were developed and quantified for the Schelde area. The results of this flood risk analysis were used in the stakeholder workshops.

The task leader (or his substitute) participated in the FLOODsite workshops in Brussels, Delft, Braunschweig, Dresden and Grenoble. Furthermore, he presented two papers on the Pilot Study in the FLOODRisk2008 Conference in Oxford.

In 2005 an update was made of the RIP which made the pilot activities more in line with the other FLOODsite tasks and overall project objectives. As coordinator of the pilot, the task leader also organised two meetings for which all other task leaders that are involved in the Pilot Site were invited.

The task leader assisted in preparing a questionnaire to 3000 inhabitants living along the embankments of the Schelde Estuary, with the objective of obtaining insight in the level of risk perception.

The task leader drafted the Chapter on the Schelde pilot, incorporating all results from the pilot activities, including the risk modelling, the workshops and the questionnaire.

Task 26: Pilot Study Site “Ebro Delta”

WL|Delft was responsible for the ecological aspects in this pilot site. To estimate the ecological impact of inundation in the Ebro delta, the effects of an increased water level of the sea during the next 50 – 100 years and the effects of increased flooding frequency during storms was estimated for the most important natural habitats and wildlife in Ebro Delta (La Banya and Buda Island). This was done by using information extracted from existing maps of vegetation types in both areas to derive a vegetation – elevation model. This model was used to predict spatial distribution of the vegetation under new conditions. The ecologist from WL|Delft conducted a field visit to the Delta during the reporting period. He has sent his final report to the Task leader of Task 26 (Jose Jimenez) at the end of the year 2007.

Task 29: Text based knowledge transfer

For Task 29, WL|Delft was Task Leader. As this task aimed at communicating on the experiences and findings of FLOODsite as a whole to a wider audience, the major activities were carried out during years 4 and 5 of the FLOODsite project.

First, however, a scoping of the deliverables, focusing especially on a guidance document, was performed. This involved considerations and discussions with the partners and potential end-users on target group, format, style, size, etc. The scoping resulted in a discussion paper, a draft table of contents and a list of potential text boxes (indicating the FLOODsite task which might provide the knowledge). The document has been discussed with all the partners involved the task. It has also been presented to all FLOODsite task leaders during the Braunschweig meeting, whereas during next years meeting in Dresden the task leaders have been interviewed to find out what their most outstanding results so-far were.

In year 4 (2007), first the international writing team was formed and several meetings were held with this team in Wallingford and Delft, in order to tune approach and style. The writing tasks were distributed and substantial progress was made on the drafting of texts, with WL|Delft being responsible for the first draft of the chapter on flood event management. The content matter was mainly derived from the executive summaries which became available on tasks in Theme 1, 2 and 3.

During year 5 the editing, illustrating and laying-out/ realisation of the final task report demanded a huge effort of WL|Delft, resulting in the production of the final report (*Flood risk assessment and flood risk management; and introduction and guidance based on experiences and findings of FLOODsite*). In this context, a workshop was held in order to fully involve the remainder of the FLOODsite community in the production of this high-profile output of FLOODsite (a side-event during the FLOODrisk 2008 conference in Oxford). This resulted in the advice to the Management Team to have the guidance document published as E-publication via FLOODsite’s website in order to ensure free access.

Task 32: Networking and harmonization

During Year 1, WL|Delft acted as host of the second FLOODsite workshop, 14-16 February 2005 in Delft. The activities within Task 32 consisted of the organisation of this workshop, including the provision of meeting venues, hotel accommodation logistics, preparation of hand-outs for participants, coach rental, lunches and workshop dinner expenses, etc. Also expenses of WL|Delft for the FLOODsite launching workshop in Brussels, July 2004 were accounted for in task 32.

During Year 2, WL|Delft participated in the third FLOODsite workshop, February 2006 in Braunschweig.

During Year 3, WL|Delft participated in the fourth FLOODsite workshop, February 2007 in Dresden and gave two presentations and presented two posters during the embedded European Symposium on Flood Risk Management Research. These activities are matched by WL|Delft's activities regarding the performance of the New Orleans Flood Protection System during hurricane Katrina. These activities relate to the evaluation of detailed technical studies carried out under the leadership of the US Army Corps of Engineers (A0101).

During year 4, WL|Delft participated in several meetings of the Management Team.

In February 2008, WL|Delft participated in fifth FLOODsite workshop in Grenoble. Finally, Deltares actively participated in the Oxford Conference in the fall of 2008.

Task 33: Assessment and review

For Task 33, during the 5 years of the project work was carried out related to the various project boards that assessed project progress (Project Board, Executive Management Team, Partner General Assembly, Scientific and Technical Advisory Board and Application and Implementation Board).

Work was carried out related to overall project assessment and review, and the review of science and applicability of the task research during the various FLOODsite workshops. Professor Van Beek commented on scientific achievements in his capacity as WL|Delft member of the Scientific and Technical Advisory Board. Similarly, Mr. Van Os, chairman of the Application and Implementation Board, provided feedback to Task Leaders.

Task 35: Project Co-ordination

WL|Delft acts as advisor to the FLOODsite co-ordinator. In that capacity Mr. Ad van Os is member of the FLOODsite Executive Management Team. He also is chairman of the FLOODsite Application and Implementation Board (AIB) and member of the FLOODsite Project Board.
As member of the Management Team he attended and, if asked, chaired the Meetings and took part in numerous telephone conferences with members of the FLOODsite coordination team.
As chairman of the AIB her prepared and chaired the meetings of this Board and produced the four yearly AIB reports.
As member of the Project Board he attended all four meetings of this Board and helped the chairman with drafting his yearly reports.

2.3 Partner 3 - LWI

The key costs for travel and subsistence arose from participation of staff members to workshops and conferences within FLOOD*site*. Furthermore, Dr. Andreas Kortenhaus is a member of the Management Team of FLOOD*site* and therefore attended the Management Team Meetings as listed below. Details of all travels for LWI staff, which were paid from FLOOD*site* resources, are listed in the following table for all five years of FLOOD*site*.

Date	Destination	Purpose	LWI staff member
Year 1			
11/03/04 - 12/03/04	Brussels	Management Team Meeting	Dr.-Ing. Andreas Kortenhaus
06/04/04	Dresden	Theme 1 – Theme 4 Meeting	Dr.-Ing. Andreas Kortenhaus
02/06/04	Brussels	Management Team Meeting	Dr.-Ing. Andreas Kortenhaus
04/07/04 - 07/07/04	Brussels	Management Team Meeting FLOODsite Launch Workshop	Dr.-Ing. Andreas Kortenhaus
16/11/05 - 17/11/04	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus
29/11/04	Hamburg	Task 27 Meeting	Dr.-Ing. Andreas Kortenhaus
13/12/04 - 14/12/04	TU Delft	SubTheme 1.2 RIP development	Dr.-Ing. Andreas Kortenhaus
13/01/05	Barcelona	SubTheme 1.1 Meeting	Dr.-Ing. Andreas Kortenhaus
17/01/05 - 18/01/05	Brussels	Management Team SubTheme 1.2 Meeting	Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. P. Geisenhainer
24/01/05	St. Peter-Ording	Task 27 Board Meeting	Dr.-Ing. Andreas Kortenhaus
13/02/05 - 17/02/05	Delft	Workshop Delft	Prof. Dr.-Ing. H. Oumeraci Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. P. Geisenhainer Dipl.-Ing. Ruth Bittner M.Sc. Claudia D'Eliso
Year 2			
31/03/05-01/04*05	Wallingford	Task 6 Meeting	Dr.-Ing. Andreas Kortenhaus
06/04/05-07/04/05	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus
30/05/05-01/06/05	Leipzig	Subtheme 1.3 Meeting	Dr.-Ing. Andreas Kortenhaus
03/06/05	Hamburg	NOKIS Meeting	Dr.-Ing. Andreas Kortenhaus
06/06/05-10/06/05	Hanover	Interschutz fair	Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. Peter Geisenhainer
15/06/05-17/06/05	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus
04/09/05-07/09/05	Prague	Management Team Task 4,6,7 meeting	Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. Peter Geisenhainer M.Sc. Claudia D'Eliso
13/10/05-14/10/05	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus
05/12/05-08/12/05	Delft	Management Team Task 4,6,7 Meeting	Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. Peter Geisenhainer
01/02/06-02/02/06	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus
09/02/06-10/02/06	Siegen	Symposium	Dipl.-Ing. Peter Geisenhainer
17/02/06-17/02/06	Braunschweig	Management Team	Dr.-Ing. Andreas Kortenhaus

Date	Destination	Purpose	LWI staff member
		Year 3	
01/03/06-02/03/06	Hannover	NOKIS Meeting	Dr.-Ing. Andreas Kortenhaus
26/03/06-28/03/06	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus
20/04/06-21/04/06	Kiel	Task 27 Meeting	Dr.-Ing. Andreas Kortenhaus
07/05/06-11/05/06	Porto	Conference	Dipl.-Ing. Peter Geisenhainer
31/05/06-31/05/06	Kiel	Task 27 Meeting	Dr.-Ing. Andreas Kortenhaus
06/06/06-07/06/06	Wallingford	Task 4/6/7 Meeting	Dr.-Ing. Andreas Kortenhaus
13/06/06-15/06/06	Brussels	Management Team, Task 2	Dr.-Ing. Andreas Kortenhaus
20/07/06-21/07/06	Delft	Subtheme 1.2 Meeting	Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. Peter Geisenhainer
13/09/06-15/09/06	Hamburg	Conference	Dr.-Ing. Andreas Kortenhaus
19/09/06-21/09/06	Brussels	Management Team, Conference	Dr.-Ing. Andreas Kortenhaus
02/10/06-02/10/06	Delft	Task 4/6 Meeting IHE	Dr.-Ing. Andreas Kortenhaus
13/10/06-13/10/06	St. Peter-Ording	Field visit pilot site	Dr.-Ing. Andreas Kortenhaus
01/11/06-01/11/06	Bremerhaven	Conference	Dipl.-Ing. Peter Geisenhainer
07/11/06-09/11/06	Budapest	Symposium with USACE	Dr.-Ing. Andreas Kortenhaus
15/11/06-16/11/06	Brussels	Task 3, Task 5 Meeting	Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. Christoph Plogmeier
14/12/06-16/12/06	Brussels	Theme 3, MT, Task 6 Meeting	Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. Peter Geisenhainer Dipl.-Ing. Grzegorz Stanczak
03/01/07-05/01/07	Aachen	Conference	Dipl.-Ing. Peter Geisenhainer
11/01/07-13/01/07	Kiel	Task 27 Meeting, Master Course	Dr.-Ing. Andreas Kortenhaus
05/02/07-09/02/07	Dresden	FLOODsite Workshop, Management Team	Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. Peter Geisenhainer Dipl.-Ing. Grzegorz Stanczak Dipl.-Ing. Christoph Plogmeier Prof. Hocine Oumeraci
		Year 4	
25/03/07	Delft	Management Team	Dr.-Ing. Andreas Kortenhaus
24/05/07-25/05/07	Delft	Meeting FLOODsite Project/ComCoast	Dr.-Ing. Andreas Kortenhaus
15/05/07-17/05/07	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus
26/06/07-29/06/07	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus
03/07/07-04/07/07	Ribe	Field visit pilot site	Dipl.-Ing. Peter Geisenhainer Klaus-Peter Schleicher
10/07/07-11/07/07	Hamburg	Meeting Task 6	Dr.-Ing. Andreas Kortenhaus
11/07/07-12/07/07	Brussels	Management Team, Task 6	Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. Peter Geisenhainer
24/07/07-25/07/07	Lemvig	Meeting Task 6	Dipl.-Ing. Peter Geisenhainer
13/08/07-14/08/07	Lemvig	Meeting Task 6	Dipl.-Ing. Peter Geisenhainer
26/09/07	Delft	Meeting Task 7	Dr.-Ing. Andreas Kortenhaus
08/10/07	Kiel	Meeting Task 27	Dr.-Ing. Andreas Kortenhaus

Date	Destination	Purpose	LWI staff member
21/11/07-23/11/07	Delft/Brussels	Meeting Task 6	Dr.-Ing. Andreas Kortenhaus
11/12/07-13/12/07	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus
16/12/07-18/12/07	Kiel	Meeting Task 27	Dr.-Ing. Andreas Kortenhaus
07/01/08-08/01/08	Delft	Meeting Task 7	Dr.-Ing. Andreas Kortenhaus
30/01/08	Neumünster	Meeting Task 6	Dipl.-Ing. Peter Geisenhainer
Year 5			
09/02/08 – 23/02/08	Grenoble	FLOODsite Workshop	Dr.-Ing. Andreas Kortenhaus
26/03/08	Delft	Management Team	Dr.-Ing. Andreas Kortenhaus
13/05/08	Hannover	Model tests	Dipl.-Ing. Peter Geisenhainer
20/05/08	Hannover	Model tests	Dipl.-Ing. Peter Geisenhainer
21/05/08	Hannover	Model tests	Dipl.-Ing. Peter Geisenhainer
26/05/08	Hannover	Model tests	Dipl.-Ing. Peter Geisenhainer
27/05/08	Hannover	Model tests	Dipl.-Ing. Peter Geisenhainer
28/05/08	Hannover	Model tests	Dipl.-Ing. Peter Geisenhainer
29/05/08	Hannover	Model tests	Dipl.-Ing. Peter Geisenhainer
25/06/08-26/06/08	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus
30/08/08 – 06/09/08	Hamburg	ICCE	Dr.-Ing. Andreas Kortenhaus Dipl.-Ing. Peter Geisenhainer
23/09/08	St. Peter Ording	Final Meeting Task	Dr.-Ing. Andreas Kortenhaus
28/09/08 – 04/10/08	Oxford	Final Workshop FLOODsite	Dr.-Ing. Andreas Kortenhaus
20/10/08 – 23/10/08	Brussels	Management Team	Dr.-Ing. Andreas Kortenhaus

Staff at LWI comprises the following members:

- Prof. Dr.-Ing. Hocine Oumeraci
- Dr.-Ing. Andreas Kortenhaus
- Dipl.-Ing. Peter Geisenhainer *)
- Dipl.-Ing. Matthias Kudella *)
- Dipl.-Ing. Christoph Plogmeier
- Dipl.-Ing. Markus Anhalt
- Dipl.-Ing. Susanne Brinck *)
- Dipl.-Ing. Ruth Bittner *)
- M.Sc. Claudia D'Eliso
- M.Sc. Grzegorz Stanczak
- Dipl.-Ing. Kai Utschinski *)
- Dipl.-Ing. Florian Brinkmann *)
- Dipl.-Ing. Hans-Jörg Lambrecht *)
- Dipl.-Ing. Thomas Pachnio *)
- Dipl.-Ing. Dirk Banemann *)
- Dipl.-Ing. Nina Berger*)
- Dipl.-Ing. Peter Schley*)
- cand.-ing Thierry Fengang *)

*) Staff members paid from FLOOD*site*

Task 2 – Task Estimation of Extremes

Year 1
LWI spent 0.5 PM (all not paid by FLOOD*site*) in Year 1.

Year 2
LWI is partner of the research team and spent 3.5 person months (2.5 paid by) in Year 2. LWI developed an advanced model (based on a neural network) which will help to fit two-dimensional frequency distributions into a design concept for joint probabilities of extreme events. A report "2-dimensional frequency distributions - Extreme water levels at different stages within estuaries" was written and distributed as a first draft within the team.

Year 3
LWI has finalised the work on extreme events, mostly by reviewing papers submitted for the Special Issue of the "Journal of Hydraulic Research" which is now under external review. Furthermore, work on Activity 3 of Task 2 on hydraulic loading of flood defences has been mostly completed and a draft report has been submitted. LWI has spent 3.6 person months (3.5 paid by FLOOD*site*) in Year 3.

Year 4
Work on Task 2 has been completed. Remaining efforts are focussing on assisting to draft the Executive Summary of Task 2 and further dissemination means (Newsletter contributions, etc.); 0.1 PM has been spent (all not paid by FLOOD*site*).

LWI has spent 7.7 PM on Task 2 (6.0 PM paid by FLOOD*site*) for the whole project.

Task 3 - Contribution to European Flood Hazard Atlas

Year 3
LWI has completed work under Activity 1 of Task 3 and has delivered the respective part of the review report comprising the German experience on flood hazard mapping, mainly for river flooding. LWI contributions are now complete by 60%; 2.3 PM (1.0 PM not paid by FLOOD*site*) have been spent on Task 3.

Year 4
LWI has assisted in writing the review report of Task 3 by drafting a chapter on uncertainties of flood hazard mapping resulting from experience originating from river flooding. LWI contributions are complete by 90%; 8.2 PM (4.0 PM not paid by FLOOD*site*) have been spent on Task 3.

Year 5
LWI has assisted in writing the final report of Task 3 by drafting a chapter on uncertainties of flood hazard mapping resulting from experience originating from river flooding. LWI contributions are complete; 1.6 PM (all not paid by FLOOD*site*) have been spent on Task 3 in Year 5.

LWI has spent 12.1 PM on Task 3 (5.0 PM paid by FLOOD*site*) for the whole project.

Task 4 – Understanding and predicting failure modes

Year 1
LWI is partner of this task and has spent 7.3 person months (2.0 of which are paid by FLOOD*site*) in Year 1 of the project.

Year 2
LWI is partner of this task and has spent 18.4 person months (5.0 of which are paid by FLOOD*site*) in Year 2 of the project. Two external PhD students are working in Task 4 in addition to staff members from LWI. The overall effort has been directed at:

- Collecting information and drafting a report on available flood defence structures in the Pilot Sites of FLOOD*site* (together with Task 7)
- Assisting in preparations for a report on failure modes for the main flood defence types, including templates for detailed descriptions of failure modes
- A review report on erosion / instability of the inner slope of coastal embankments due to wave overtopping (together with Task 6)
- starting hydraulic model tests on wave impact on coastal embankments to better understand the initiation of breaching from the seaward side

A first draft of the failure mode report was circulated amongst partners in mid April 2005 by HR Wallingford. LWI has drafted a detailed report on the state-of-the-art of breaching of coastal dikes (together with Task 6) giving some guidance on structures as well. Furthermore, LWI has extensively contributed to the preparation of a matrix of failure modes for the complete set of flood defence structures.

A literature review on erosion due to wave overtopping has also been undertaken. The review is focused on coastal dikes, but several aspects are common to other kinds of defence structures as river dams and embankments. The report includes morphological boundary conditions, hydraulic boundary conditions, causes of breach initiation, breach parameters and flow, erosion processes, sediment transport processes, and available breach models.

Also a review of available literature has commenced to bring together the state-of-the-art knowledge for wave-induced impacts and subsequent erosion problems. Hydraulic model tests have started where wave impacts on embankments are tested under controlled model conditions. In the first phase of these tests, impact pressures have been measured on the surface, the second phase investigated sand deformations under a fixed crack in the embankment. Within the third phase, tests are now being performed where different clay materials are tested.

Year 3
LWI has spent 20.3 person months (7.1 of which are paid by FLOOD*site*) in Year 3 of the project. Two external PhD students are still working on subjects of Task 4 and Task 6 in addition to staff members from LWI. The overall efforts have been directed to:

- Finalising the report on failure modes for main flood defence types, including templates for detailed descriptions of failure modes
- Performance and analysis of hydraulic model tests on wave impact on coastal embankments to better understand the initiation of breaching from the seaward side

The final draft of the failure mode report was circulated amongst partners end of 2006 by HR Wallingford. LWI has contributed to the preparation of the final version of this report, including a detailed revision of the limit state equations and the relevant templates, and the associated uncertainties.

The review of available literature on the state-of-the-art knowledge for wave-induced impacts and subsequent erosion problems is now complete and will be submitted as a research output. Hydraulic model tests have been performed and analysed where wave impacts on embankments are tested under controlled model conditions. Two different test programmes were conducted. The first programme consisted of impact experiments concerning pure natural clay and clay including a grass layer. The second test series contained impact tests on pure clay to investigate and analyse the influence of water content and grade of compaction on the erosion resistance of the soil.

Furthermore, two tests with a small-scale dike model in a glass flume were conducted. In these experiments, the breach initiation and the breach development of a sea dike caused by wave impact was investigated.

In addition to the staff members of LWI, two Master Thesis students from IHE, Delft, were hosted from November 2006 to January 2007 who performed parts of their master thesis with LWI. Both of them were involved in Task 4 related work and have assisted in both wave overtopping studies and wave impacts on clay surface as breach initiation, respectively.

Year 4
LWI has spent 10.9 person months (7 of which are paid by FLOOD***site***) in Year 4 of the project. The overall efforts have been directed at:

- Finalising the report on failure modes for main flood defence types, including templates for detailed descriptions of failure modes
- Finalising the reports on block removal by wave impacts and erosion of the seaward and shoreward side of the dikes.

The final draft of the failure mode report was circulated amongst partners in 2007 by HR Wallingford again for final comments. LWI has contributed to this revision with final comments on some of the limit state equations and failure mode templates.

Year 5
LWI has spent 0.2 person months (all of which are not paid by FLOOD***site***) in Year 5 of the project. Efforts have been directed at finalising the report on failure modes for main flood defence types, including templates for detailed descriptions of failure modes. Further work has been devoted to the finalisation of the Task Executive Summary, the Fact Sheet for Task 4, and the finalisation of outstanding research reports.

LWI has spent 57.1 PM on Task 4 (21.1 PM paid by FLOOD***site***) for the whole project.

Task 6 – Modelling breach initiation and growth

Year 1
LWI is partner of this task and has spent 4.0 person months (all of which are not paid by FLOOD***site***) in Year 1 of the project.

Year 2
The main LWI contribution to this task is the performance of large-scale experiments in the Large Wave Flume (GWK) in Hanover, planned for Year 3. To prepare theses experiments small-scale tests have been performed for simple sand dikes under overflow conditions and waves in the laboratories of LWI in summer and autumn 2005. These tests were conducted to gain experiences with breaching models under small-scale conditions and to test measurement devices. The experiments have been performed with a scale of 1:10 in an existing basin and in the LWI wave flume. The behaviour and the development of dike breaches under waves and overflow conditions have been investigated. Final testing however was conducted with a thin clay layer on top of the dike as well. Two different model setups were used. The model setups as well as the performance and the analysis of experiments used 20.4 person months (where 7.5 months were paid by FLOOD***site***) in Year 2.

Two PhD students at LWI are working on the improvement of breach models initiated from the seaward and the landward side where the former is induced by wave impacts and the latter by wave overtopping, respectively. Both students have first developed a simple model based on available literature and some preliminary assumptions.

Year 3
Within Year 3, small-scale tests have been performed and analysed for simple sand dikes under overflow conditions and waves in the LWI lab. Preparatory ideas for the conduction of the large-scale tests have been drafted in Year 3 and circulated amongst project partners within FLOOD***site*** and to

colleagues outside the project as well. This note includes the model setup, the test programme and a description of different measurement devices which should be used.

Two PhD students at LWI (funded by external resources) are working on the improvement of breach models initiated from the seaward and the landward side where the former is induced by wave impacts and the latter by wave overtopping, respectively. Both students have completed a simple model based on available literature and some preliminary assumptions. The development of the detailed models is in progress, one PhD will be delivered in May 2007.

Results of the wave impact and erosion studies performed under Task 4 are directly used for improvements of the breach models. Details of model developments and progress have been discussed at various Task meetings throughout the year. Overall, LWI has spent 24.2 PM on this Task (11.4 were funded by FLOOD***site***).

Year 4
The large-scale experiments in the Large Wave Flume (GWK) in Hanover partly slipped into Year 5. Preparations of these tests have been described in a note including the model setup, the test programme, and a description of different measurement devices which should be used. This has been constantly updated and was discussed in various meetings. Preparations of the testing has now started at the large wave flume in Hannover, tests are anticipated for April/May 2008.

A PhD student at LWI (funded by external resources) is still working on the improvement of a breach model initiated from the seaward side induced by wave impacts. The development of the detailed model describing this breaching process is completed, the PhD will be delivered end of March 2008 and defended end of May 2008.

Results of the wave impact and erosion studies performed under Task 4 are directly used for improvements of the breach model predicting breaching from the seaward side. Details of model developments and progress have been discussed at various Task meetings throughout the year. Overall, LWI has spent 28.6 PM in Year 4 (16 of which were funded by FLOOD***site***).

Year 5
The large-scale model tests on breaching of sea dikes were performed between February and June 2008, analysis of the test results was summarised in a report which was delivered in autumn 2008.

A PhD was delivered end of March 2008 and defended end of May 2008.

Overall, LWI has spent 15.4 PM on this Task (14.0 PM were funded by FLOOD***site***) in Year 5.

LWI has spent 92.6 PM on Task 6 (48.9 PM were funded by FLOOD***site***) for the whole project.

Task 7 – Reliability analysis of flood defence structures and systems

Year 2
The work in Year 2 (3.0 person months where 1.5 person months were funded by FLOOD***site***) involved writing a first draft of the report on using reliability methods for the pilot site ‘German Bight Coast’. The study is based on the LWI ProDeich model and available data for cross sections, water levels and wave climate information from the pilot site. The ProDeich model has been expanded, improved and was made more user-friendly. The study has shown difficulties in assessing some of the required data but gives good insight in relative importance of the various sections along the coastal defence line. Probabilistic results are reasonable and can be compared to earlier results of similar applications.

Year 3

The work in Year 3 (7.75 person months where 6.5 months were funded by FLOOD***site***) included further work on the improvement of the available reliability models. For this purpose, LWI has started to code some of the new limit state equations developed under Task 4 for further use in Task 7. Main additional work was performed to supervise a student from TUD to compare different reliability models using a standard dike and the data available from Task 27.

Year 4
The work in Year 4 (4.8 person months where 4.0 months were funded by FLOOD***site***) included some further work on the improvement of the available reliability models by work done under Task 4 and 7 of FLOOD***site***. This comprised work on the coding of the limit state equations, fault tree set ups for various flood defence structures, and development of the software tool available from Task 7.

Year 5
The work in Year 5 (0.2 person months none of which were funded by FLOOD***site***) included work on further editions of the final Task 7 report on reliability analysis of flood defences. Additionally, assistance was provided for the Executive Summary for Task 7 and the Task 7 Fact sheet.

LWI has spent 15.75 PM on Task 7 (12.0 PM were funded by FLOOD***site***) for the whole project.

Task 27 – Pilot study of German Bight

Year 1
LWI has spent 1.3 PM on Task 27 (1.0 PM was funded by FLOOD***site***).

Year 2
Based on Activity 1, Action 5 a first preliminary model was drafted for the coastal defence line in the German Bight Coast area. The ProDeich model was improved in terms of data handling, user-friendliness and fault tree calculations but no new limit state equations from FLOOD***site*** have yet been included. Calculations have been performed for the whole area. A report has been drafted but is not ready by now. Overall, 0.5 person months have been spent in Year 2.

Year 3
Work has been conducted on flood inundation modelling of the pilot site. This work has been performed outside the original scope of the work planned for Task 27 and has been performed to better link activities regarding reliability studies and damage evaluation in the pilot site. The work is still in progress, strong links are established with Task 7 and Task 8 of FLOOD***site***. Overall, 4.85 person months (4.5 from FLOOD***site***) have been spent in Year 3. Furthermore, outside the funded work within FLOOD***site***, a student has performed her student project work in performing sensitivity analyses of the inundation model.

Year 4
Further work has been conducted on flood inundation modelling of the pilot site. This work has been performed outside the original scope of the work planned for Task 27 and has been performed to better link activities regarding reliability studies and damage evaluation in the pilot site. The work is still in progress, strong links are established with Task 7 and Task 8 of FLOOD***site***. Overall, 8.9 person months (8 PM from FLOOD***site***) have been spent in Year 4.

Year 5
Further work has been conducted on flood inundation modelling of the pilot site. This work has been performed outside the original scope of the work planned for Task 27 and has been performed to better link activities regarding reliability studies and damage evaluation in the pilot site. The work is complete now. Overall, 3.7 person months (0.5 PM from FLOOD***site***) have been spent in Year 5.

LWI has spent 19.3 PM on Task 27 (14.0 PM were funded by FLOOD***site***) for the whole project.

Task 32 – Networking and harmonisation

Year 2
LWI has prepared and organized the 3rd Overall FLOOD***site*** Workshop from 13.02.2006 to 16.02.2006 in Braunschweig. Within Year 2, the workshop costs amounted to 17,323.73 €. Personnel costs for Task 32 within Year 2 amounted to 2.9 person months (0.4 PM paid by **FLOOD*site***).

Task 33 – Assessment and Review

Year 1
LWI has spent 0.2 PM on Task 33 (none of which was funded by FLOOD***site***).

Year 2
Andreas Kortenhaus from LWI has participated in seven MT Meetings throughout 2005 (see table under section 1). Within Year 2 of FLOOD***site*** the personnel costs for Task 33 therefore were 0.4 person months (none of which were paid by FLOOD***site***).

Year 3
Andreas Kortenhaus from LWI has participated in five MT Meetings throughout 2006 and 2007 (see table under section 1). Within Year 3 of FLOOD***site*** the personnel costs for Task 33 therefore were 0.3 person months (none of which were paid by FLOOD***site***).

Year 4
Andreas Kortenhaus from LWI has participated in 5 MT Meetings throughout 2007 and 2008 (see table under section 1). Within Year 4 of FLOOD***site*** the personnel costs for Task 33 therefore were 0.3 person months (none of which were paid by FLOOD***site***).

Year 5
Andreas Kortenhaus from LWI has participated in 3 MT Meetings throughout 2008 (see table under section 1). Within Year 5 of FLOOD***site*** the personnel costs for Task 33 therefore were 0.2 person months (none of which were paid by FLOOD***site***).

LWI has spent 1.4 PM on Task 33 (0.6 PM funded by FLOOD***site***) for the whole project.

Altogether, LWI has spent 208.9 PM on the whole project including all tasks (108.0 PM were funded by FLOOD***site***).

2.4 Partner 4 - IOER

Task 12 – Identification and ex-post evaluation of existing flood mitigation and defence measures
IOER was leading the Task. Work has been successfully finished. It encompasses the development and testing of a methodology for the ex-post evaluation of measures and instruments. The methodology rests upon a framework for systematic evaluation of interventions for flood risk reduction at project level and considers conditions under which these are implemented and operated. Evaluation criteria are effectiveness, cost-effectiveness, robustness and flexibility. To ensure applicability of the methodology five case studies were conducted and finalised. The cases were:

1) Risk reduction in residential and commercial buildings in the April 2006 Elbe River flood in Dresden and Pirna (IOER),
2) Contingency Planning in the Tisza River Basin (HEURAqua),
3) Hungarian-Ukrainian co-operation for flood and excess water defence along the Upper Tisza River (VITUKI),
4) Levees and warning systems on the Odra River in the 1997 Odra River flood (UniPo),
5) Emergency storage in the August 2002 Elbe River flood (UniPo).

Based on experiences with testing the methodology an EU guideline on ex-post evaluation of measures and instruments in flood risk management was derived. This tool supporting evaluation practice is available on the FLOODsite website together with the web-based information tool for the selection of measures and instruments and the final report on the methodology. As task leader, IOER organised a number of task meetings. Beside EC funds work has been co-funded through involvement of IOER staff.

Task 13 – Investigation of integrated strategies considering planning and communicative instruments
IOER was leading the Task. Work has been successfully finished. The task analysed current Flood Risk Management (FRM) with regard to a) different types of floods and b) a broad spectrum of structural and non-structural measures as well as c) the process of making strategies under different context conditions. Its focus is on long-term FRM. It had two main aims:

- *Comprehensive framework* for strategies of pre-flood risk management that enables decision makers to identify strategic issues and to deploy issue-specific combinations of structural and non-structural measures,
- *Recommendations to practitioners* that show in detail how to define and manage strategic issues. For instance, Task 13 showed how to conduct a series of scenario-based workshops under time pressure for using strategic planning for long-term FRM.

Task 13 achieved its aims through (1) conceptual development based on extensive literature reviews and (2) case studies providing dense interaction with practitioners (especially at local and regional level). Against the background of social science research on management and strategy, Task 13 adopted a comparative case study approach for achieving its aims. Thereby, Task 13 referred to internationally acknowledged standards of conducting case studies (see Yin R (2003) Case Study Research. Design and Methods, Sage, Thousand Oaks). This methodology has proven successful for dealing with differences and similarities between cases like Dresden/Weisseritz River and London/Thames estuary. Results were published in a number of papers. As task leader, IOER organised a number of task meetings.

Task 14 – Design and Ex-ante evaluation of innovative strategies for flood risk management
IOER contributed to the overall outcome of Task 14. Work has been successfully finished. It particularly covered the developing and testing of the scenario planning approach applied for the Elbe River pilot. The final report covers the (i) introduction of the applied scenario-planning approach, (ii) the definition of the flood risk system, (iii) the description of the coupled models for system analysis, (iv) the scenario design, (v) the analysis and assessment of the current flood risk management strategy,

(vi) the formulation of strategic alternatives, (vii) the composition of Elbe futures, (viii) the analysis of flood risks in selected Elbe futures, (ix) the evaluation of strategic alternatives and Elbe futures, and (x) discussion and conclusions. Work was carried out in close cooperation with Task 18 and Task 21. Due to some issues with the availability of key data from the matching research project VERIS-Elbe, results are presented in a separate report as research output. Results moreover are visualised in the FLOODsite Elbe tool. Beside EC funds work has been co-funded through involvement of IOER staff.

Task 17 – Emergency flood management – evacuation planning

IOER contributed to the overall outcome of Task 17. Work has been successfully finished. It carried out a survey on existing German operational flood management which has been included in the overall review of such tools in Task 17. The survey covered (i) the legal and institutional background of emergency flood management, (ii) the emergency flood management itself and (iii) methods and models to support emergency flood management. Beside EC funds work has been co-funded through involvement of IOER staff.

Task 18 – Framework for long-term Planning

IOER contributed to the overall outcome of Task 18. Work has been successfully finished. Firstly, this covered an initiative on the developed of an overall framework on integrated flood risk management and led to the so called “Dresden Paper”. Results integrate water and social science issues and specify the relations between scientific methods and theories on the one hand and real-world flood risk management on the other hand. Secondly, IOER carried out an international survey on existing decision support tools for flood risk management together with partners HR Wallingford and WL Delft. Results provided a baseline for the development of the FLOODsite DSS for long-term planning, but can also used more generally for the DSS development. The report is accessible on the FLOODsite website. Thirdly, IOER designed, programmed and documented a web-based spatial decision support system (SDSS).

Tool development focused on the inclusion of the extensive data from pre-processed model runs analysing Elbe futures (see Task 14). Moreover, the interactive and user-oriented functionalities of the tool and its GUI were further extended. This particularly referred to the programming and implementation of parallel visualisation of assumptions from the Elbe futures (left hand map) and resulting flood risks (right hand maps). In addition functionalities for the comparison of futures using maps, diagrams and tables were realised. The tool is online. Access to high resolution damage information is currently restricted; aggregated data are available for the public. The report shows the consistent development of the tool from a generic conceptual framework over the methodological framework of Task 18 to the technological approach of a web-based SDSS for long-term flood risk management applying guiding questions. Beside EC funds work has been co-funded through involvement of IOER staff.

Task 21 – Pilot study "Elbe River Basin"

IOER was leading the Task. Work has been successfully finished. The task dealt with developing and testing the FLOODsite methodology in the Elbe River basin. Therefore comprehensive and in-depth investigations were carried out in 5 pilot areas considering sources, pathways, receptors and consequences in headwaters and the lowland part of the Elbe River with its tributaries. IOER was strongly involved in the 2 pilot areas of the Mulde River. The overall approach for these 2 pilot areas was conceptualised by IOER and is based on the formulation and parameterisation of scenarios covering climate (regional+temporal downscaling of ECHAM5 projections) and land-use change as well as strategic alternative of risk reduction options. The resulting futures (see task 14) were simulated applying coupled models ranging from a plot-scale rainfall-runoff model (BROOK90-LWF), a meso-scale rainfall-runoff model (PREVAH), a hydrodynamic model (HEC-RAS), various damage models and a multi-criteria risk evaluation approach by Task 21 partners. Furthermore, a series of workshop were carried out to ensure stakeholder involvement. As task leader, IOER organised a number of task and sub-group meetings and further established the links to relevant institutions of flood risk management in the Elbe River basin, like the International Commission for the Protection of the Elbe River (ICPE) and the national Elbe Board.

IOER contribution covered the final reporting and the edition of the final manuscript of the FLOODsite pilot book including chapters from all pilot studies. Reporting particularly addressed the final integration of scientific work carried out in the Elbe pilot under several FLOODsite tasks. As far as the pilot book is concerned a generic chapter on the basic understanding of and integrated methodologies for flood risk management were formulated. Furthermore contributions from all seven pilots were reviewed and adjusted to the overall concept of the book in close-collaboration with the respective partners. Assistance during the process of publication will be ensured from the IOER also after the official end of FLOODsite. Beside EC funds work has been co-funded through involvement of IOER staff.

Task 29 – Text-based knowledge transfer

IOER contributed to the overall outcome of Task 29. Work has been successfully finished. The overall objective of this task was to communicate and promote uptake of the findings of the whole IP in the form of clear and concise dissemination material and best practice guidance with special attention to the target audiences identified under **FLOOD*site***, the general public, the professional community and teaching/academic communities as well as the decision-makers at a more political level. IOER was involved in the elaboration of the structure of the best practice guide. It formulated chapter 3 on measures and instruments and contributed to chapter 4 regarding strategy development. Moreover participated in the task meetings and contributed to the discussion of the entire guideline. Beside EC funds work has been co-funded through involvement of IOER staff.

Task 32 – Networking and Harmonisation

IOER contributed to the overall outcome of Task 32. Work has been successfully finished. The task aimed at the development and communication through the project website and otherwise the common vision for **FLOOD*site*** and its position within the broadest remit of holistic flood risk management. Specific objectives were (i) to link with external research and policy development activities, (ii) to provide internal coherence within the FLOODsite consortium and (iii) to develop a common language of risk for flood management. IOER organised the European Symposium on Flood Risk Management Research (EFRM 2007) on 6th-7th February 2007 as integrated but public part of the 4th Annual Workshop of FLOODsite in Dresden. The symposium was attended by nearly 250 participants from 38 countries. Moreover, the IOER used its network to link with the German RIMAX research programme, EU-MEDIN and ERA-NET CRUE. In addition IOER contributed to all annual project workshops by chairing and contributing to various sessions. Furthermore, it provided links to the German RIMAX research. Further networking activities addressed a meeting with members of Working Group Floods of the European Member States in Brussels and a number of regional workshops such as meetings of the International Commission for the Elbe Protection and the German Elbe Board with members from all Bundeslaender within the Elbe River basin. Beside EC funds work has been co-funded through involvement of IOER staff.

Task 33 – Assessment and Review

IOER contributed to the overall outcome of Task 33. Work has been successfully finished. IOER was active in the Management Team (MT), the Project Board (PB) and the Advisory and Implementation Board (AIB) of FLOODsite. In terms of the responsibility for theme 4 IOER coordinated the 7 pilots. This covered numerous reviews of the project documents (executive summaries, final reporting documents etc.) of all pilots. Beside EC funds work has been co-funded through involvement of IOER staff.

2.5 Partner 5 - ENPC

Task 16 – Real time guidance for flashflood risk management

ENPC mainly contributed to activity 1 and action 2 of task 16 through a PhD thesis[1]. This action aimed at evaluating the performances of existing rainfall-runoff models for the simulation and forecast of flash-floods (floods affecting watersheds of limited area). Two pilot areas were selected for this test: the upper Loire river watershed located in the northern part of the Cevennes-Vivarais observatory region and the Adige watershed.

A detailed performance evaluation of a series of rainfall-runoff models has been conducted on the Loire area dataset (11 watersheds with areas ranging from 20 to 3200 km^2) during the second year of the FLOODSITE project. These tests were focussed on lumped models only, with an hourly computation time step, including a lumped version of Topmodel and artificial neural networks. A split-sample test approach has been used to evaluate the performances of the models. This evaluation has shown that:

1. The performances of the tested models, measured with Nash and Persistence criteria are close to one-another. No model appears to out-perform the other models.
2. The obtained values for the Nash criteria are not particularly high (between 0.5 and 0.8) but lay in the average range of previously published rainfall-runoff model validation results. Note that most of the previous works were conducted on daily models while hourly models were tested here.
3. No evolution of the model performances with the area of the watershed is noticeable.
4. The performances of the models appear to be poor if criteria adapted to the short term forecasting issue are used: negative persistence criteria for forecasting lead-times lower than the time-to-peak of the watershed, less than 50% of the major floods for which the errors on the peak time, discharges and flood volumes are lower than 20%.
5. Topmodel has also been evaluated on one of the Adige watershed with similar results (cf. report of Pauline Chaillou, August 2006, université di Padova – LTHE).

These relatively disappointing results[2] have led to a re-orientation of the objectives of the task. It has been decided to seek for the major sources of uncertainties in rainfall-runoff modelling and more precisely, to evaluate the impact of the uncertainties in the spatial rainfall amount estimations on the rainfall-runoff simulations. The development of a spatial rainfall estimation error model and the propagation of randomly generated rainfall scenarios into the rainfall-runoff models is the ENPC contribution for this third year. The main parts of this work and results are the following ones:

1. Calibration and validation of a spatial rainfall interpolation method based on geo-statistics (kriging) for the upper Loire river basin, able to fill the gaps between the rain gauges. A meteorological radar covers the area, but due to its specificity and location, a quantitative use of its measurements appears impossible. The coherency between the model theoretical and observed interpolation error distributions of the one hour rainfall rates has been tested for some rain gauges of the existing rain gauge network.
2. Definition and calibration of a temporal dependence model for the one hour rainfall rates interpolation errors.
3. Generation of mean spatial hourly rainfall rates scenarios based on the observed point rainfall rates and the proposed interpolation error model.

The results indicate that the spatial rainfall interpolation is a major source of uncertainty and therefore a major factor limiting the accuracy of the rainfall-runoff simulations. The range of the possible simulated discharges generally covers the observed discharges for the small watersheds (area < 500 km^2). Uncertainties in the spatial rainfall estimates alone explain the differences between simulated and measured hydrographs. It is not completely the case for larger watersheds where the spatial and

[1] A complementary action has also been conducted during year 3 aiming at evaluating the possibility to produce short term rainfall field forecasts based on multifractals models to extend the rainfall-runoff forecasting lead time.

[2] Note that this result is in accordance with the experience of many operational forecasting services in France. Rainfall-runoff models are seldom used and considered as relatively inaccurate.

temporal pattern of the rainfall may play an important role and therefore the use of distributed hydrological models may lead to an improvement of the simulation results. No additional work has been done on this task during the last year of the project, except dissemination activities: attendance to the FLOODrisk 2008 and other conferences and submission of papers in international peer reviewed journals (see list).

3.5 month of permanent staff and 15.4 months of temporary staff (PhD Thesis) were affected to task 16. Numerous communications and publications were produced. The corresponding PhD defence took place in December 2007.

Papers :

Delrieu G., Braud I., Berne A., Borga M., Nakakita E., Seed A., Boudevillain B., Fabry F., Freer J., Gaume E., Tabary P., Uijlenhoet R., 2009. Weather radar and Hydrology, Advances in Water resources, accepted.

Gaume E., Mouhous N., Andrieu H., 2007. Rainfall stochastic disaggregation models: calibration and validation of a multiplicative cascade model, Advances in Water Ressources, doi:10.1016/j.advwatres.2006.11.007.

Gaume E., Sivakumar B., Kolasinski M., Hazoumé L., 2006. Identification of chaos in rainfall disaggregation : application to a 5-minute point rainfall series, Journal of hydrology, 328, 56-64.

Manus C., Anquetin S., Braud I., Vandervaere J.-P., Creutin J.-D. , Viallet P. and Gaume E., 2009. A modelling approach to assess the hydrological response of small Mediterranean catchments to the variability of soil characteristics in a context of extreme events. Hydrol. Earth Syst Sci, 13, 79–97.

Moulin, L ., Gaume E., Obled Ch., 2009. Uncertainties on mean areal precipitation: assessment and impact on streamflow simulations. Hydrol. Earth Syst Sci, 13, 99–114.

Norbiato D., Borga M.; Degli Esposti S.; Gaume E.; Anquetin S., 2008. Flash flood warning based on rainfall depth-duration thresholds and soil moisture conditions: An assessment under European conditions. Journal of Hydrology. 362, 274– 290. doi:10.1016/j.jhydrol.2008.08.023

Thesis:

Moulin L., 2007, Prévision des crues rapides avec des modèles hydrologiques globaux. Application aux bassins opérationnels de la Loire supérieure : évaluation des modélisations, prise en compte des incertitudes sur les précipitations moyennes spatiales et utilisation de prévisions météorologiques, PhD, Ecole Nationale du Génie Rural des Eaux et des Forêts, Agro ParisTech (Paris).

Task 17 – Emergency flood management - evacuation planning

ENPC contribution to task 17 aimed at developing a prototype tool for the road network diagnosis during flash floods. A prototype tool has been developed for the detection of potentially flooded roads in flash-flood prone areas that can help to steer the traffic management and rescue decisions during storm events. It has been tested on some areas of the Gard region pilot site that is frequently exposed to heavy flood events and where an exhaustive inventory of the roads flooded during the last 40 years is available for its calibration and validation.

The prototype tool has been tested on five recent floods for which detailed inventories of submerged roads exist. The very promising results obtained were presented during a workshop in December 2007 to the end users of the Gard region: road network management services, flood forecasting service and fire brigades. The prototype is able to detect in advance 100% of the points which will be flooded with a significant but acceptable false alarm ratio (about 70% of the detected points at risk are actually not flooded on average over the 4 test events).

The contribution to the task 17 final deliverable has been prepared on time in July 2007 with an additional text on the end users' feedback in December 2007. The corresponding PhD defence took place in December 2007.

The flash-flood road network warning prototype were also used as input to the On-line web services for road routing that has initially been developed in the context of the Orchestra IP by JRC (FLOODsite partner 9).
A French national research project aiming at preparing the operational implementation of the proposed tool has been selected for a funding by the "Agence Nationale de la Recherche": project PrediFlood (2009-2011).

4.5 months of permanent staff and 21,5 months of temporary staff (PhD Thesis) were affected to task 17. Numerous communications have been done and a first publication will be soon submitted.

Papers :

Versini P.-A., Andrieu, H., Gaume, E., 2009. Assessment of the vulnerability of roads to flooding based on geographical information – test in Flash –flood prone area (the Gard region, France). To be submitted to NHESS.

Thesis:

Versini P-A., 2007. Surveillance du risque hydrologique diffus le long des itinéraires routiers. Eléments pour la construction d'un outil d'annonce de coupure. Ecole Nationale des Ponts et Chaussées, ParisTech (Paris).

Task 23 – Pilot Study Site "Flash Flood Basins: monitoring and validation"

ENPC led the action 2 of activity 1. The major part of the work has been conducted during the year 2005 and ended with the production of one of the deliverables of the FLOODsite project (report T23-06-02): a methodological note on post flash-flood investigations published in February 2006.
This report has circulated within the FLOODsite community but has also already been diffused to other research teams interested by the subject. This report contains:

1. A description of the various types of measured data that may be available after a major flash-flood event and discusses the limits of these data.
2. Proposals for the organization of a post-flood investigation: checklist and schedule of tasks, field equipments, suggestion of cross section survey and witness account summary sheet formats.
3. A large chapter devoted to peak discharge estimation, one key data for the description of flash floods, based on a large literature review and of a critical analysis of proposed methods and past studies, especially studies conducted by the USGS services.
4. A description of a method for collecting witnesses accounts based on past experiences: when and how to conduct an interview, what type of questions, what type of information can be gathered through interviews? The main conclusion is that these interviews should be based on open-ended questions and that as many accounts as possible should be collected to enable cross-validations.
5. Some illustrations of data interpretations and conclusions that can be drawn on the rainfall-runoff dynamics after post-flood investigations. This part refers to previous works but is mainly based on the example of the September 2002 floods in the South of France which mobilized a significant part of the French hydrological community.

The approach proposed in the methodological note has been applied and tested within the European research project HYDRATE, specifically focussed on flash floods. The proposed methodology should be considered as a first step to define common practices for post flood investigations which are now considered as an absolutely necessary task to increase our knowledge about the hydrology of these extreme flood events.

7 months of permanent staff and 10 months of temporary staff were affected to task 23. Numerous communications and publications have been produced, some of them at the fringe of the topic of the WP, based the collected data (see list).

Papers :

Bain V., Gaume E., Bernardara P., Newinger O., Barbuc M., Bateman A., Blaškovičová L., Blöschl G., Borga M., Dumitrescu A., Daliakopoulos I., Garcia J., Irimescu A., Kohnova S., Koutroulis A., Marchi L., Matreata S., Medina V., Preciso E., Sempere-Torres D., Stancalie G., Szolgay J., Tsanis J., Velasco D., Viglione A., 2009. A collation of data on European flash floods. Journal of Hydrology. 367, 70-78, doi:10.1016/j.jhydrol.2008.12.028.

Beaugendre H., Ern, A., Esclaffer Th., Gaume E., Ginzburg I., Kao C., 2006. A seepage face model for the interaction of shallow water tables with the ground surface: Application of the obstacle-type method. Journal of Hydrology, 329(1-2), 258-273.

Bonnifait L., Delrieu G., Le Lay M., Masson A., Belleudy Ph., Gaume E., Saulnier G-M., 2009. Hydrologic and hydraulic distributed modelling with radar rainfall input-reconstruction of the 8-9 September 2002 catastrophic flood event in the Grad region, France. Advances in Water Ressources, accepted.

Borga M., E. Gaume, D. Creutin, L. Marchi, 2008, Surveying flash flood response: gauging the ungauged extremes, Hydrological processes, doi: 10.1002/hyp.7111.

Gaume E., Borga M., 2008. Post flood field investigations after major flash floods: proposal of a methodology and illustrations. Journal of flood risk management, 1, 175–189. doi:10.1111/j.1753-318X.2008.00023.x

Gaume E., 2006. On the asymptotic behavior of flood peak distributions. Hydrology and Earth System Sciences, 10(2),233-243.

Neppel L., Renard B., Lang M., Coeur D., Gaume E., Jacob N., Payrastre O., Pobanz K., Vinet F., 2009. Flood frequency analysis using historical data: accounting for random and systematic errors. Hydrological Sciences Journal. Submitted.

Payrastre O., Gaume E., Andrieu H., 2006. Apport du recueil de données historiques pour l'étude des crues extrêmes de petits cours d'eau, étude du cas de quatre bassins versants affluents de l'Aude. La Houille Blanche, 6, 79-86.

Payrastre O., E. Gaume and H. Andrieu, 2005. Use of historical data to assess the occurrence of floods in small watersheds in the French Mediterranean area. Advances in Geosciences, 2, 313-320.

Thesis:

Gaume E., 2007, Un parcours dans l'étude des phénomènes extrêmes en hydrologie, thèse d'habilitation à diriger des recherches, Université Pierre et Marie Curie (Paris).

Payrastre O., 2005. Faisabilité et utilité du recueil de données historiques pour l'étude des crues extrêmes de petits cours d'eau Etude du cas de quatre bassins versants affluents de l'Aude. Ecole Nationale des Ponts et Chaussées, ParisTech (Paris).

2.6 Partner 6 - Geo

Task 12 - Identification and ex-post evaluation of existing measures

In Task 12 the following progress have been done during the first year of the project:

New technology and interrelated objectives were found. The work with the equipment was planned and potential interest of the end users was evaluated. Propagation material for Czech end users was prepared. The main work in Task 12 will start in the Year 2 of the FLOODsite project. The work will concern the GEM apparatus, which is used for geophysical technology testing. Geophysical methodology is used for the test of flood control embankments conditions and damage prevention – GMS system.
„Geophysical Monitoring System“ (GMS) consists of the three basic parts:
(quick testing measurement) – quick and inexpensive measurement for the dike/embankment structure and homogeneity assessment. This methodology also serves as a basis for repeated monitoring measurements.
(diagnostic measurement) – detailed measurement performed in disturbed (inhomogeneous) parts for the detection of hidden dike/embankment defects
measurement of geotechnical condition - geophysical measurement performed for the monitoring of geomechanical properties of disturbed dike segments

Task 21 - River Elbe Basin

In Task 21 the following progress have been done during the first year of the project:

A system based on large GIS database has been established. GIS database comprise data from Czech and Austrian region and concerned e.g. territory, socio-economical, hydrological or geological map data. Based on this data the studied area was allocated. Some meteorological, hydrological and hydrogeological data in time series (if available) were provided. In first step the local authorities and administrator of the ponds were challenged to cooperation. The satellite picture analysis have been started to identify land cover of the area.

Major costs are represented by equipment purchase. The GEM-2 apparatus will be used to geophysical technology testing to predict the dam failure sites/mechanisms. This will be carried out under Task 12, on the Odra catchment.

Deviations from the cost budget and from person-month budget were caused by the equipment purchase and also by later start of the project. The person-month under Task 12 have been reduced in the first year (reporting period), according to the table 1.2, from 4,75 to 3,39 PM. Under Task 12 the main work is connected with GEM-2 usage. The apparatus was purchased in February 2005, which means at the end of reporting period that is why the certain amount of PMs was adjusted to the second year of the project (next reporting period). The cost budget was also changed because of GEM-2 purchase, this caused a reduction of costs in categories personnel costs and travel costs.

The following progress has been done during the second year of the project:

The GEO contribution to this task was devoted to the research in the Pilot area Třenoňsko in the Czech Republic. GEO has spent 0.88 months effort in Year 3 of the project. This effort has been directed at:

- Finishing the work concerning identification of weaknesses and dangerous points in relation to the area management and flood management, evaluation of ecological vulnerability
- Close cooperation with the local actors in order to find out the local needs, requirements and expectations and reflects them in the project.

- Finalizing the outputs - the Final Report, including and creation risk maps and other graphical outputs such as the leaflet.
- Cooperation with the Task Leader, Research Implementation Plan and activity report contribution.

During the third year of the project the following progress have been done:

The GEO contribution to this task was devoted to the research in the Pilot area Třenoňsko in the Czech Republic. GEO has spent 0.88 months effort in Year 3 of the project. This effort has been directed at:

- Finishing the work concerning identification of weaknesses and dangerous points in relation to the area management and flood management, evaluation of ecological vulnerability
- Close cooperation with the local actors in order to find out the local needs, requirements and expectations and reflects them in the project.
- Finalizing the outputs - the Final Report, including and creation risk maps and other graphical outputs such as the leaflet.

Cooperation with the Task Leader, Research Implementation Plan and activity report contribution.

Task 33 – Assessment and review

A total of 0.02 months effort has been given to this Task by GEO in the second and third year of the project. It covered the Research Implementation Plans and Description of Work contributions and preparation for PGA meeting.

2.7 Partner 7 – HEURAqua

Task 12 – Identification and ex-post evaluation of existing flood mitigation and defence measures - Action 6 Case study "Tisza river-A"

General objective of the task undertaken is to test the role of contingency planning, the development and deployment of flood emergency organisations in the preparedness for emergency situation. HEURAqua collected the majority of the data needed for the main objective of the work at five locations involving three District Environmental and Water Directorates, the Archive of Water Affairs and the National Technical Emergency Controlling Headquarters. The work in Year 2 covered identification of the elements of the contingency plans and organisational frameworks used in Hungary, data collection on the extreme flood along the Middle-Tisza River in 2000. Report describing the contingency planning and organisational framework of emergency operation in Hungary and its role, effects and effectiveness during the extreme flood of 2000 is under preparation. The work in Year 3 covered the preparation of the final report describing the contingency planning and organisational framework of emergency operation in Hungary and its role, effects and effectiveness during the extreme flood of 2000 is under preparation. The task has been finished in Year 3 with due regard to the orientations of the 4th workshop.

Task 22 – Pilot Study "River Tisza Basin"

Our task covers analysis of the factors of river capacity problems along part of the Middle-Tisza section (Tószeg-Tiszajenő 325 – 297 fkm) as well as making scenario analysis of intervention options to raise the flood conveyance capacity of the flood bed.

The work in Year 2 covered adjustment of the RIP, data collection, verification, model calibration, analysis of different flood situations, investigation of river capacity in case of different river morphology and geometry. We utilised the services of Middle-Tisza District Environment and Water Directorate, Szolnok for these tasks. Data needed for the reporting period objectives of the work has been collected; calibration of the 1D hydrodynamic model was successful, factors of river capacity problems were analysed, scenario analysis of river capacity improvement options have also been started. D22.1.e reporting is overdue (Mn 24), first drafts of the research output are expected to be released by the end of Mn 26.

The work in Year 3 covered scenario analysis of river capacity improvement options as well as that of the impacts of partial floodplain reactivation with controlled inundation or in other words, impact analysis of flood detention basins established in the protected floodplain, compilation of the research output report (by merging the formerly planned *D22.1.e* and *f* reports). The draft report has been submitted under the number T22-2007-02. Planned activities regarding vulnerability analysis could not start in Year 3 because of the delay in research output from Sub-Task 1.3 concerning methodology development (D9.1), which was finished in the end of this reporting period.

The work in Year 4 focussed on a pilot study application of general vulnerability analysis methodologies in a selected flood area along the pilot study area in the Middle-Tisza region. During selection of the flood area to be investigated, experiences of the extreme flood of 2006 were also taken into consideration. The selected flood area is situated at the confluence of Tisza and Hármas-Körös rivers. It covers 139 km^2 rural territories, there are 3 villages and several ranches endangered. Population of the flood area is in the range of 8,000 while the endangered assets in the settlements are in the range of 10 million Euros, in the agriculture 1.4 million Euros.

All activities of the task have been finished until the end of Year 4 except finalisation of the vulnerability analysis and the report on pilot study application of general vulnerability analysis. The reason for that is the returning serious illness of the sub-task leader during Year 4.

After a temporary recovery of the sub-task leader the report was finalised by the end of Year 4 and uploaded to the FLOODsite homepage in March 2008.

Task 33 – Assessment and Review

Concerning activities related to Task 33 H-EURAqua could not be represented on some of the FLOOD*site* Project Workshops and PGAs due to serious illness of the sub-task leader.

2.8 Partner 8 - INPG

Task 1 - Identification of Flash-Flood Hazards

INPG led this task and devoted more than 23 month effort dedicated to:

1. The identification of the meteorological factors associated to the flash-flood storms event.
2. Writing the milestone "Report on the analysis of the meteorological test cases" by O. Nuissier, V. Ducrocq, S. Anquetin and putting together the five requested Milestones from the different partners.
3. Writing the Deliverable D1.1 "Hydrometeorological modelling for Fash-Flood" by S. Anquetin et al.
4. Writing the paper published in 2008 "A numerical study of the three catastrophic precipitating events over southern France. Part I; numerical framework and synoptic ingredients" by O. Nuissier, V. Ducrocq, D. Ricard, C. Lebeaupin, S. Anquetin, Quarterly Journal of the Royal Meteorological Society, 134 (630):111-130.
5. The organization of the FLOODsite workshop "Flash-Flood meeting Task 1, Task 16, Task 23" held in Grenoble September, 21st – 22d, 2005

Task 10 – Socio-Economic Evaluation and Modelling Methodologies

INPG is a member of the Task team, concentrating on the evaluation of the vulnerability of people exposed to flash-floods. INPG initiated its investigations on the hydrometeorological circumstances of casualties in Mediterranean storms under Activity 2 of Task 12. Then it appeared during the Braunchweig FLOODsite meeting that these investigations could be better developed under the umbrella of Task 10.

The work in Year 2 (1.85 months) involved the analysis of the survey on tourist population performed in the Autumn 2004.

The work in Year 3 (1.5 months) involved the analysis of the survey on resident population performed in autumn 2004. In addition a second survey, based on a cognitive map, has been carried out during the same year to improve the knowledge about risk perception.

The work in Year 4 concentrated on the finalization of the paper titled "*Human exposure to flash-floods – relation between flood parameters and human vulnerability during a storm of September 2002 in Southern France*" by I. Ruin, J.-D. Creutin, S. Anquetin and C. Lutoff published in 2008 in the Journal of Hydrology, 361: 199-213.

Task 15 – Radar and satellite observation of storm rainfall for flash-flood forecasting in small and medium-size basins.

INPG led this task which global aim was to develop a Structured Algorithm System (SAS) for quantitative precipitation estimation (QPE) at the space and timescales of interest for flash-flood analysis and prediction. The work consisted in developing the radar and satellite SAS, establishing the SAS library, and in the implementation/evaluation/dissemination of the SAS.

Most of the work has been done during the three first years of the project (more than 25 mm). The various steps of radar processing for QPE were investigated in regions prone to flash-floods like the Cévennes Vivarais region in France with special attention to the following aspects:

1. Development of a ground clutter processing technique based on the pulse to pulse variability of the reflectivity
2. Development of a coupled identification of rain types (convective, widespread) and vertical profile of reflectivity. This effort has been part of the PhD. Theses of B. Chapon « *Etude des pluies intenses dans la région Cévennes Vivarais à l'aide du radar météorologique. Régionalisation des traitements radar et analyse de la granulométrie des pluies au sol* ». (Université J. Fourier, 2006, 187 p.) and P.-E. Kirstetter *« Estimation quantitative des précipitations par radar météorologique : inférence de la structure verticale des pluies et modélisation des erreurs radar-pluviomètres »* (Université Joseph Fourier, 2008, 276 p).
3. Preliminary investigation of the Z-R relationship analysis conditional on the rain types has been addressed by Chapon (2006) using drop size distribution measurements collected in the Cévennes region. It gave rise to a refereed paper by Chapon et al., 2008: Variability of rain drop size distribution and its effect on the Z-R relationship - A case study for intense Mediterranean rainfall. *Atmospheric Research*, **87,** 52-65.

4. The overhaul of the radar SAS FORTRAN codes which was achieved at the end of Year 2. This software development was made in close cooperation with Météo-France. The description of the radar SAS is done in Delrieu, G. et al. 2009: Bollène 2002 experiment: radar rainfall estimation in the Cévennes-Vivarais region, France. *Journal of Applied Meteorology and Climatology*, in press.
5. Implementation and evaluation of the radar SAS within the Italian and French hydrometeorological observatories. For INPG, this activity led to two papers in refereed journals: Delrieu, G. 2009: Bollène 2002 experiment: radar rainfall estimation in the Cévennes-Vivarais region, France. *Journal of Applied Meteorology and Climatology*, in press, and Kirstetter, P.-E. et al. 2009: Toward an error model for radar quantitative precipitation estimation in the Cévennes-Vivarais region, France. *Advances in Water Resources*, submitted.
6. Implementation of the radar data with several temporal resolutions (5 minutes, 1 hour) into the satellite SAS in cooperation with Task partners who compared several satellite algorithms with reference to radar data provided.

Year 4 has been devoted to the final reporting outlining the SAS for radar and satellite detection of storm rainfall, its theoretical and operational assessment.

Task 16 – Real time guidance for flash-flood risk management

INPG is a member of the Task team and has devoted effort during years 2 and 3 of the project (more than 23 mm) to achieve the following points:

1. In collaboration with JRC-IES, the assessment of LISFLOOD for flash-flood forecasting for the pilot site Cévennes – Vivarais. The main results published in 2008 concern : The benefit of high-resolution operational weather forecasts for flash flood warning. Hydrology and Earth System Sciences, 12(4): 1039-1051 by J. Younis, S. Anquetin and J. Thielen del Pozzo.
2. In collaboration with UniPad, the flash-flood guidance concept was applied for the first time to French catchments. In the framework of the training period of P. Chailloux who shared her time between Grenoble and Padua (April 2006 – September 2006), the Cévennes – Vivarais data base has been put in proper format to be used in the software developed at UniPad and first simulations proved to be encouraging for the method. This work has contributed to the paper published in 2008 : Flash flood warning based on rainfall thresholds and soil moisture conditions: An assessment for gauged and ungauged basins. Journal of Hydrology **362**(3-4): 274-290. By Norbiato D.? M. Borga,S.D. Esposti, E. Gaume and S. Anquetin.
3. The organization of i) the kick-off meeting held in Grenoble September, 21st – 22d, 2005 and ii) the task meeting held in Padua October, 6th, 2006 that allowed the finalization of the report by P. Chailloux.

Year 4 saw the finalization of the report comparing the FFG and rainfall-runoff models approaches and proposing a limited number of models adapted to flood forecasting on small watersheds.

Task 23 – Pilot study site “Flash-Flood basins”

INPG, a member of the Task team, has spent almost 13 months effort during Years 2 and 3 of the project. This task is essentially linked to Tasks 1, 15 and 16 in term of implementation. Work related to Task 1 and Task 15 has contributed to improve the data collected within the pilot site “Cévennes – Vivarais”. Work related to Task 16 provided a first test of the flash flood guidance method to the site.
INPG contributed to deliver the “Report outlining the observational methodology for flash flood monitoring”, research output M23.2 and followed during Year 4 the preparation of the book on Pilot Sites in which the Chapter 4 is on the Flash Flood Basin Pilot.

Task 31 – Face to face knowledge transfer

INPG was a member of the Task team. The resource devoted to this task (almost 4 months) has been used in the definition of the post-graduate training courses in collaboration with UniPad. The objective was to take advantage of the main results obtained in the different FLOODsite Tasks. INPG kept connection with UNIPAD and TU-Dresden in view of finalizing the CPD Course package.

Task 32 - Networking and harmonisation

INPG organized in Grenoble during the period 11-13 February 2008 the 5th Annual Workshop of the FLOODsite Project. More than one hundred persons attended the Workshop, representing Project Partners or being members of the Project Boards. This workshop was organized by Mr. L. Bonnifait under the responsibility of Dr. J-D. Creutin. It required in total a 3 months effort during Year 4.

Task 33 – Assessment and review

The resource devoted to this task allowed different participations in the core management structures as a specialist on real-time flood forecasting technology.

2.9 Partner 9 – JRC/IES

Task 16 – Task Description

The aim of the study was to propose a regional approach for early flashflood warning applicable to ungauged river basins. The concept is based on hydrological modelling and the principle of discharge threshold exceedance. The thresholds are derived from long-term simulation with the hydrological model itself. Flow simulations based on weather forecasting data are then compared against these thresholds. The method has been verified on long-time historic series, several case studies of extreme flashfloods, and a 6 months flashflood forecasting period for the pilot catchment in the Cevennes (FR).

The FLOODS group of the JRC was only given a 7 months contribution for this work (7.6 man months). Preparation work was performed by the permanent staff (J. Thielen) during the first years of the FLOODsite project (total 2.49 man months) by setting up the model and running first test runs, but the bulk of the work was performed during year 4 when J. Younis could be recruited on the project (total 3.94 man months). He performed the necessary data collection, model runs, exploration of results and base research.

Publications on the work were submitted to HESSD in 2008 and after very positive feedback from the reviewers published early 2008 in HESS. A final report summarising all results from the project was published in December 2008.

Results were presented and discussed during several conferences including the final FLOODsite conference in September 2008 (Total Mission costs in all years 3177,42 €).

1. Younis, J., Anquetin, S., Thielen, J. (2008), The benefit of high-resolution operational weather forecasts for flash flood warning, Hydro. Earth.Syst. Sci, 12, 1039-1051
2. Younis, J. and Thielen J. (2008) Early Flash Flood Warning: A feasibility study with a distributed hydrological model and threshold exceedance, European Commission, EUR 23637 EN

1. Younis, J., Anquetin, S., Thielen, J. (2008), The benefit of high-resolution operational weather forecasts for flash flood warning Hydrol. Earth Syst. Sci. Discuss., 5, 345–377, 2008

2.10 Partner 10 – MU/FHRC

In total 72.5 person months were completed for this project. Aside from general management of Partner 10 contributions and attendance at the annual FLOOD*site* workshops, the contribution by MU/FHRC to the FLOOD*site* project is outlined below. Note that two cost adjustments have been made in this final year of the project: a deduction of 4,181.30 Euros for time overcharged in year 2, and additional expenses of 6,069 Euros not claimed in Year 4.

Task 9 – Guidelines for socio-economic Flood Damage Evaluation

All work for this Task was completed in Years 1 to 3. A total of 12.69 person months were spent on this Task (1.18 in Year 1, 9.86 in Year 2 and 1.65 in Year 3). Research began in Year 1 where time was spent in contributing to the Task RIP and in beginning work for Activity 2 on *Guideline proposals for evaluating flood damage*. This included work for Action 2 (Guidelines for application of willingness-to-pay surveys to estimate benefits of alleviating flooding); Action 3 (Guidelines for application of Expressed Preference methods to evaluate (environmental) intangibles); and Action 5 (Guidelines for damage reducing effects of flood warning). A two day workshop was hosted and held in London with partners from Tasks 10 and 11 to plan research activities for the coming years. In this year there was a deviation from the original cost budget and person-month budget due to the late starting of the research activities (as confirmed at the FLOOD*site* partner workshop in Delft in February 2005). This mainly affected FHRC contributions to Tasks 9 and 11 (see below), whereby less costs and person-months were utilised in Year 1 than originally planned.

In year 2 FHRC made three major contributions to this Task and to the draft Deliverable, these were: providing guidelines on developing flood damage databases; providing guidelines on social issues, providing guidelines on the damage reducing effects of flood warnings. We also made contributions by the way of comments on guidelines for estimating indirect flood damages, and on the guidelines for socio-economic flood damage evaluation as a whole. Less person months were spent in Year 2 than originally estimated. However, in the original programme no allowance had been made for revising the Guidelines at a later stage once feedback had been received, therefore, some of this time was used later in Year 3 of the project for this purpose.

In Year 3 the draft Deliverable report document was sent to various end users for comments. Time was also spent in revising Chapter 8 on assessing the benefits of flood warnings, based on recent research completed for another project which further progressed this area of work. We also spent some time on minor revisions to other chapters based on feedback received from the end users. Some of the remaining resources were spent in producing a short two page summary of the Guidelines which can be used to publicise the Deliverable report and in contributing to the Task Executive Summary. As work for this Task was completed well within budget, remaining resources were transferred to Task 10 in Year 4 to help finance a series of expert interviews in two European countries for Activity 2 (Modelling the damage reducing effects of flood warnings), which were not originally planned but were important for the research, as well as financing three additional European case studies, and for data purchase costs associated with these. Some budget was also transferred to Task 11 to cover some overspending in that Task during Year 3 (see below).

Task 10 – Methodologies for intangible damages and multi-criteria evaluation

A total of 31.66 person months were spent on this Task. Research began in Month 19 of the project. Therefore the only work on this Task during the first year was in drafting the RIP and in hosting and attending the two day London planning workshop for Tasks 9, 10 and 11 mentioned above, a total of 0.35 person months. FHRC is the lead partner for this Task. In addition to general co-ordination of the Task activities with collaborating partners UFZ and WL-Delft (now Deltares), FHRC made a major contribution to Activity 1 *Building up a model to estimate loss of life for flood events* in the second year (5.56 months). A literature review was completed on identifying factors leading to risks to people from flood events. Corresponding scenarios were also identified for varying types of event. An analysis was made of factors leading to risk to life in European flood events (where they may differ from UK events) and a start was made on gathering data from European flood events in order to contribute to calibrating the risk to life model due to start in month 25. Less time was used than planned in Year 2 due to the delay in waiting for data from European partners. These person months were carried into Year 3 to continue the work.

In Year 3 key contributions were made to Activities 1 and 2, resulting in 8.85 person months in total. For Activity 1, developing a risk to life model, work was completed on identifying the characteristics of flood hazards, the areas affected and the people at risk i.e. the possible predictors of loss of life in floods. The work was used to identify information on relationships between hazard and risk. Much of the year was spent in trying to obtain data on different flood events in order to test and calibrate the current risk to life model and to further refine or revise the model where necessary. The poor response from European partners thus delayed progress on this Activity. However, progress was finally made in testing the model with data received from 17 flood locations, although some final data was not received until Year 4. Limited progress was made in mapping potential risk to life, as this Action could not be completed until work on the risk to life model had been finalised. Work also began on a separate health impacts model.

For Activity 2 *Modelling the damage reducing effects of flood warnings*, we revised the existing flood warnings model. We also produced a new, much more realistic and holistic flood warning response and benefits model. This is a new conceptual model which will be more applicable to Europe, and was the focus of part of our expert interviews which were conducted in Year 4 in France and the Czech Republic. A Floodsite partner survey of flood warnings systems was also completed in a number of countries and we developed a qualitative interviewing tool which was later used for our expert interviews. A journal paper was also submitted in Year 3 on the latest major survey results from a UK Defra-funded project, from which the Activity 2 work draws. Overall, less time was used than originally estimated for this Task in Year 3 as many months were spent chasing up and awaiting data from other partners, thus delaying progress. Data was also sought, and acquired, from people external to Floodsite. Due to the delays in data acquisition, the original time-schedule for the Task had to be extended to Month 45 and remaining person months were carried over into Year 4.

In Year 4 a total of 12.60 person months were spent on Task 10. Work for Activity 1 on 'Building a model to estimate risk to life for European flood events' progressed well after the long delays in the previous year. The data were finally received and additional data were gathered on causes of death in European flood events and on additional case studies in Boscastle, the Czech Republic and Poland. Work proceeded on calibrating the UK model with European data and subsequently in identifying problems with the UK model. A workshop was held in May 2007 with end users at the Environment Agency and HR Wallingford in the UK to help refine the model. Finally a new risk to life model was developed which is more applicable to European flood events, and which also incorporates additional risk mitigating factors. Further work was completed on mapping the new risk to life model. A draft Milestone report (M10.1 *Building a model to estimate risk to life for European flood events*) was completed in November 2007 and finalised in February 2008.

Work for Activity 2 on 'Modelling the damage reducing effects of flood warnings' also progressed well in Year 4. A partner survey of flood warning systems was completed for a number of European countries. Expert interviews on the benefits from flood warning systems were conducted with key professionals in France and the Czech Republic to inform the development of the new conceptual model on flood warning benefits. In-depth case studies were conducted in Germany and France to test the new model with real-life data. A draft report (M10.2 *Modelling the damage reducing effects of flood warnings*) was produced at the end of November 2007 and was finalised in the early part of Year 5, having been delayed by waiting for final case study data from France.

Additionally in Year 4 work was undertaken on reviewing and approving a Research Output report (RO10.1) from INPG on a *Risk to life case study of the River Gard;* on reviewing, editing and approving Milestone report M10.3 from WL/Delft on *Toxic stress: the development and use of the*

OMEGA modelling framework in a case study; and reviewing and approving Milestone report M10.4 on *GIS based Multicriteria Analysis as Decision Support in Flood Risk Management.* Time was also spent on producing the Task Deliverable Report (D10.1 *Socio-economic and ecological modelling and evaluation methodologies)* which incorporated results from all four of the Milestone reports and in producing the Task Executive Summary report.

For the final Year 5 of FLOOD*site* most of the FHRC work related to this Task, resulting in 4.3 person months in total. In addition to general co-ordination of the Task activities and reporting, work was undertaken for Activity 1 on finalising the health impacts model for floods. This involved completion of a literature review and development of a conceptual model on the health impacts of floods, resulting in a Research Output Report (T10-09-02)**.** A book chapter was also completed on "The socio-psychological aspects of flood risk management" for a Flood Management Handbook edited by C. Thorne and G. Pender et al. due to be published in 2009 (Wiley-Blackwell). Part of this chapter is based on research conducted in developing the Health Impacts Model. Several days were also spent in March/April 2008 on completing the final Milestone report for Activity 2 on *Modelling the damage reducing effects of flood warnings'* (T10-07-12) which had been delayed in Year 4 due to waiting for data from Europe. One journal paper has also been published in *Meteorological Applications* in relation to Activity 2 entitled *'Understanding and enhancing the public's behavioural response to flood warning information'.*

Following the Task Reviews in Grenoble in February 2008, it was decided by the Management Team that the Executive Summary report which had been submitted for Task 10 was too long (each of the four separate Activities comprising a significant research project in their own right,) and indeed should be split into four separate Executive Summaries. This was completed in Year 5, along with minor alterations to make each summary a stand alone report. Comments and suggestions for revisions were also made for the four Task Fact Sheets, one for each Activity. Two papers were submitted to, and presented at, the FLOODrisk 2008 conference in relation to Activities 1 and 2. Some final minor corrections were made to Milestone reports and to the Final Deliverable report. Note that the 4.3 person months claimed for Year 5 also includes three days for work completed under Task 11 (see below) and all final year and project reporting time.

Task 11 – Risk perception, community behaviour and social resilience

As highlighted above, work for Task 11 began later than originally planned and as a consequence there was a deviation from the original cost budget and person-month budget (as confirmed at the FLOOD*site* partner workshop in Delft in February 2005). Therefore less costs and person-months were utilised in Year 1 of this Task than originally planned, 1.85 in total. Research in Year 1 focused on contributing to the task RIP and on Activity 1, Action 1 *Indicators for social resilience* and on Action 4, preparation for *Empirical investigation* of a case study in Spain. However, on further investigation it was decided not to go ahead with this particular case study. Time was also spent in hosting and attending the two day London workshop for Tasks 9, 10 and 11 mentioned above.

In Year 2 FHRC contributions to this Task resulted in 5.56 person months. A report on social resilience indicators was produced which served as a basis for the national case studies and was later used to characterise the social resilience of different communities at risk from flooding. Secondly, we contributed to discussions on common hypotheses on the relationships between risk perception, community behaviour and social resilience, and to the common methodological approach and questionnaires to be used in the German and Italian partners (UFZ/ISIG) case study surveys. We began re-analysis of old FHRC data sets which had comparable questions to those used in the German and Italian case studies. We also included some comparable questions in a survey conducted for another FHRC project in the Thames region, which resulted in 200 interviews with 'at-risk' residents. Data from this survey was used in Year 3 in contributing to the country case study report. Less time was used than originally planned in Year 2 as more time was needed in Year 3 for data analysis and in contributing to the cross country comparison report.

In Year 3 FHRC made two major contributions to this Task (10.46 person months). Firstly, a lengthy re-analysis of old FHRC data from past surveys was completed. The data analyses covered those aspects of the data that were relevant to the aims of Task 11 in looking at risk perception or construction, community behaviour and social resilience. Secondly, we produced a Milestone report based on the re-analysis work. We also attended a Task workshop in Italy in September. Following the workshop further work was carried out in revising the country case study report. Year 3 was the most resource intensive for FHRC and all of the remaining person months were utilised. We contributed just over three more person months in total than were originally allocated to this Task due to unsatisfactory data analysis by a new research assistant which had to be re-analysed by a more senior researcher. However, we had transferred remaining resources from Tasks 9 and 13 to cover this and to allow us to contribute to the cross-country comparison report and Task 'guidelines' in Year 4 and remaining minor inputs in Year 5.

In Year 4 only 1.25 person months were used for the Task. These mainly focused on contributing to two Milestone reports and to the Task Deliverable. The first Milestone report is one of the three reports which comprise M11.3. This was the FHRC report *Vulnerability and flooding: a reanalysis of FHRC data. Country report for England and Wales.* A first draft of this report was produced in Year 3 and only minor revisions were made in June of Year 4 to finalise the report. The second Milestone report is M11.4 *Vulnerability, resilience and social construction of flood risks.* This report comprised a cross-country comparison of the three M11.3 country reports from Germany, Italy and England and Wales. Finally, FHRC contributed to D11.1 *Recommendations for flood risk management with the communities at risk* by drafting certain sections and commenting on the overall report. A one day workshop was also attended in London in January 2008 at which we reported the key findings from the Task to Defra and Environment Agency staff in the UK.

In the final Year 5 FHRC input mainly focused on commenting on the final versions of the Task Deliverable report and to the final Executive Summary, Task Fact Sheet and publicity material. For the latter a two page summary of the UK contribution to the research was provided to the Task leader. Work also began on a paper on the use of social vulnerability indicators; this paper will not be completed by the end of the project but should be available shortly thereafter. A total of 0.17 person months, or three days, were used in the final year but these were allocated to Task 10 as all remaining Task 11 budget had been used in Year 4. Therefore 19.12 person months were used for the Task in total.

Task 13 – Strategies for pre-flood risk management

A total of 4.12 person months were spent on this Task in total. In Year 1 the FHRC input to Task 13 was in contributing to the Task RIP and research for Activity 1, Action 2 on developing a typology of context conditions (0.06 person months). In the following Year 2 the FHRC contribution focused on producing a case study from the Thames in London. The work was due to commence in Month 19 but was delayed by a couple of months due to circumstances relating to the Task leading partner (IOER). A detailed framework was produced for the Thames study along with a draft report on the context of the case study in line with other cases studies within the Task. Work then proceeded on the case study itself. Due to the delay in starting the work, only 1.44 person months were used in Year 2, with the bulk of the work being completed in Year 3.

In the third year FHRC produced the final case study report on strategic planning for the Thames Estuary. Discussions also took place with the Task leader on further developing the conceptual framework for the case studies, and further work was undertaken on reviewing relevant documentation. An interviewing tool was developed for interviews with key stakeholders with an involvement in strategic planning and flood risk management in the Thames estuary and one-to-one in–depth interviews were carried out with key stakeholders. The interviews were transcribed and analysed and a preliminary draft report was produced. The work was slightly delayed due to slow response/feedback from the Task leader (IOER). A total of 2.62 person months were spent on this

Task in Year 3. Although it was planned that resources would be spent in making any revisions to the Thames Case Study in Year 4, this was not deemed necessary by the Task leader but time was spent in drafting a journal paper and contributing with Task partners to papers to be published in peer reviewed journals. As stated above, remaining budget for this Task was used to complete work in Task 11.

Task 29 – Text-based knowledge transfer

A total of 3.18 person months have been spent on Task 29. In the first year minimal contributions were made to the Task RIP and no person months were claimed. In Year 2 0.42 person months were spent in reading and commenting on material (draft report format and contents) sent by the Task Leader and in attending a Task meeting at the Braunschweig workshop. In Year 3 time was spent in attending a meeting at HR Wallingford to discuss text based material to be produced for the Task. Work was also done in providing possible chapter headings and draft text and in responding to comments on these by other Task members. Additional time was spent in discussions during the annual workshop, in reviewing material produced by other partners, and in correspondence with the Task Leader regarding Schools-based material, 0.47 person months in total.

The FHRC contribution to the Task in Year 4 (1.00 pm) was in contributing to the FLOOD*site* guidance document/book for text-based knowledge transfer. This included commenting on the overall structure and various drafts of the book to date and also drafting sections of the book on the science of flood risk management. It also included retrieving text from other FLOOD*site* reports for inclusion in the book as well as attendance at Task meetings. In the final Year 5, time was spent contributing to the FLOOD*site* guidance document/book for text-based knowledge transfer. This included contributing to the second stage of drafts, checking drafts from other partners, attending a meeting in Oxford, scrutiny for ‘best English’, producing the content for 10 ‘boxes’ within the book outlining key results from FLOOD*site* research, and finally contributions to finalisation of the book (1.29 pm).

Task 32 – Networking and harmonising

The FHRC contribution to this Task has almost totally been related to the activities of the STAB (1.05 person months in total). This included 0.79 person months in Year 1, 0.14 person months in Year 2 (some of which were also spent in contributing to the Language of Risk document by submitting revised socio-economic definitions), and 0.12 person months in Year 3. No work was claimed under this Task in Years 4 and 5.

Task 33 – Assessment and review

A total of 0.64 person months were spent on this Task in total. All of this work related to activities undertaken for the STAB. This included 0.15 person months spent in Year 1, 0.14 person months in Year 2, 0.12 person months in Year 3 (which also included acting as a Reviewer of other Tasks during the annual workshop in Dresden), 0.23 in Year 4 (which again included contributing to the Tasks Review Panel at the annual partner workshop. Although FHRC contributed to work for the STAB during Year 5 no claims have been made for this work.

2.11 Partner 11 – UniPo

Task 12 – IDENTIFICATION AND EX-POST EVALUATION OF EXISTING FLOOD MITIGATION AND DEFENCE MEASURES

The University of Potsdam was involved in the site-specific ex-post evaluations of measures and instruments, namely the case study "Lowland part of the Elbe River". An overall of 6.51 person months were spent on collecting data, studying reports, listing all appropriate criteria to be included in the investigation and associated methods to be applied. Furthermore, we contributed to the "Methodology for ex-post Evaluation of Pre-Flood and Flood Event Measures and Instruments (ex-post EFM)" that was developed in this task and prepared our case-study report according to the developed methodology.

Task 21 – PILOT STUDY "RIVER ELBE BASIN"

The University of Potsdam spent an overall of 7.24 person months on investigations in one of the five pilot areas of the task. This activity was dedicated to the issue of flood detention in the lowland part of the Elbe in Germany. Following the overall FLOODsite methodology, we estimated flood risk by studying the flood hazard and the vulnerability of the area. In the flood hazard assessment hydrodynamic models of different complexities were applied in order to investigate of a range of flood conditions and management options. Obtained results included the Elbe peak attenuation effect as well as flooding parameters such as inundation extent, duration, water depth and flow velocity for the area under investigation. The vulnerability assessment comprised economic as well as ecological aspects. An agricultural damage model was applied to estimate flood damage to crops associated to the investigated scenarios. For the ecological assessment a water quality model was set-up on the basis of the hydrodynamic model in order to study ecological effects of flood water detention, namely the dissolved oxygen balance. Finally, in an overall evaluation conclusions were drawn on the operation (weir control, land use, etc.) of flood detention areas.
Results were published in three ISI-listed journals (another publication is accepted/under review) and presented on several international conferences. Furthermore, we participated in the Floodmaster course.

Task 33 – Assessment and Review

Regular financial assessment reports (including the audit report) were provided. We attended all yearly team workshops.

2.12 Partner 12 – TUD

This chapter provides a brief description of the work carried out by TU Delft during the whole project period, i.e. the period from 1 March 2004 – 28 February 2009. This description is provided at the task level. Explanatory notes on any major cost items are included.

Task 2- Estimation of Extremes

Van Gelder, Gupta, Rajabalinejad, Burgmeijer have worked on the completion of 2 papers on Dutch data management for assessment of extremes for the Journal of Hydraulic Engineering.

Task 4 – Understanding and predicting failure modes

Van Gelder, Buijs and Visser have contributed to an overview of failure modes.

Task 6 – Modelling breach initiation and growth

The TUD breach model consists of a version for sand-dikes developed by Visser (1998), and a version for clay-dikes developed for Task 6 by Zhu (2006). TUD has merged both models into one model for dikes and is developing a simplified version of the merged model that has relatively small computational times. Dr. Visser has contributed to:

1. Conference paper: Morris, M.W., Hassan, M.A.A.M., Kortenhaus, A., Geisenhainer, P., Visser, P.J., Zhu, Y., 2009. Modelling Breach Initiation and Growth. In: P.Samuels, S. Huntington, W. Allsop and J. Harrop (Eds.), Flood Risk Management: Research and Practice, Proc. European Conf. Flood Risk Management (FLOODrisk 2008), Oxford, UK, 30 September - 2 October 2008, Abstracts p. 105, Paper on CD-Rom pp. 581-591, Taylor & Francis Group, London, UK.
2. Report: Morris, M.W., Kortenhaus, A. and Visser, P.J., 2009. Modelling Breach Initiation and Growth. FLOODsite Report T06-08-02.
3. FLOODsite website: description of Task 6 outcomes.

Task 7 – Reliability analysis of flood defence structures and systems

All planned activities of Task 7 have been carried out successfully, amongst other the PRA of the Thames site and Scheldt site, a report how to specify uncertainties for models and parameters to be used in **FLOOD*site***, and the completion of a software tool. Special care is considered to make the report compatible with the LOR document. Research on sampling methods with Finite Element Models has been carried out in close collaboration with HR Wallingford. The following TU Delft people were actively involved in task 7: Van Gelder, Buijs, Gupta, Rajabalinejad, Burgmeijer, Shams, Van Erp, Kanning, Ter Horst, Mai Van.

Task 14 – Design and ex-ante evaluation of innovative strategies for flood risk mitigation

Within task 14 Erik Mostert has commented on and contributed to Activity 1: Definition of strategies and future scenarios, Action 3: Definition of future scenarios with respect to changes in economy, demography and land use. This has been done in the form of a literature review. Specific scenario's for the Scheldt basin has been developed by Marjolein Mens, who started to work in the project on 1 March 2006.

Task 19 – Framework for flood management planning

TUD managed for Task 19, Activity 4, Action 4a the study 'Traffic modelling for large-scale evacuations during floods'. This study replaces the planned study (according to the RIP of Task 19) 'Identification of possible breach locations (initiation) and likely breach growth'. The project

'Traffic modelling for large-scale evacuations during floods' was done by Joost Mak, as his MSc Thesis study for Erasmus University Rotterdam.

Task 25: Pilot Study Site "River Scheldt" (Estuary)

Interview sessions on the pilot Schelde have been held and reported by Jill Slinger et al.

Task 28 – Integrated information management

Erik Mosselman and Kees Sloff have guided and monitored the progress in Tasks 28-31, with particular attention to Task 30. Furthermore, Theme 5 has encouraged and monitored the communication activities in the pilot application studies of Tasks 21-27.
Theme 5 has guided and monitored the progress in Tasks 28-31, with close involvement in the web-based dissemination under Task 30 in particular.

Task 29 – Text-based knowledge transfer

Work on developing educational material for secondary school has started in December 2007. A workplan was made, and children where given questionnaires and in several classrooms discussions where held to establish a starting point. Many websites were explored to gather ideas on possible approaches, technical possiblities and good practises for educational websites. Furthermore contacts were established with experts in different fields and the first bits of texts were written.
Sandra Junier has worked extensively on task 29 and developed and tested a website for secondary school children on flood risk management (www.floodsite.net/juniorfloodsite). Hereby task 29 has been completed. In addition, a special session on "taking dissemination seriously" was organized at the end of the Floodrisk conference in Oxford where, among others, the website was presented and discussed.

Task 30 – Web based knowledge transfer

Erik Mosselman and Kees Sloff have guided and monitored the progress in Tasks 28-31, with particular attention to Task 30. Furthermore, Theme 5 has encouraged and monitored the communication activities in the pilot application studies of Tasks 21-27.

2.13 Partner 13 - UPC/LIM

Task 2- Estimation of Extremes

The total amount of man months expended in task 2 during the whole project is of 17.36, split in the following way:

During year 1, the reporting period has just one month, only initial work was performed. The main work was done in i) Joint occurrences, ii) Definition of what is an extreme, and iii) Conventional versus sophisticated tools for assessment of extreme distributions. All the partners compiled the existing information from the Catalan coast, with special emphasis on the pilot site Ebro Delta. The total amount of man months expended during the first year was 0.4.

During the second year, the research developed by LIM/UPC was concentrated in three actions within this task and the total amount of man months expended was 8.82 :

- Under theoretical analysis methods LIM/UPC is analysing the reduction of uncertainty due to a priori information on wave characteristics. Using meteorological features of wave climate off the Catalan coast, a priori information is introduced into generalized Pareto distributions to reduce the confidence intervals for torrential climates such as that found in the North-Western Mediterranean.

- Under the analysis of extreme events, and how they are controlled by morphodynamic features, LIM/UPC is considering the plan and profile control of morphological items such as a river mouth apex or a nearshore bar, both for the Ebro delta field case.

- Under the hydraulic loading of flood defence structures, LIM/UPC is considering the combination of a wave-soil-structure model with extreme analyses. Two options are been evaluated, one based on the VOF technique and the other based on a Lagrangian particle tracking finite element method. Recommendations of how to combine wave-soil-structure models with extremal analysis will be obtained based on previous developments within this task for both models and extreme distributions.

The work developed by LIM-UPC during year 3 of the project in this task has made reference to the already produced deliverable which deals with how to assess extreme values in coastal, riverine and estuarine environments making use of the best available tools (with a total amount of man-months expended during this reporting period of 8.14). The emphasis has been placed on using the most advanced and off the shelf concepts and models to predict extremes. Next, the obtained results have been made available through the project and with the aim of making them also available to a wider community of potential users. Because of that, and apart from the already mentioned deliverable, we are about to produce a special issue in the Journal of Hydraulic Research. The papers, which have been conceived as chapters following the sequential line of the work in Task 2, are now under review. It will be a very natural way to transmit the achievements obtained in Task 2 to any potential user worldwide.

Task 3 - Contributing to European flood hazards atlas

The total amount of man months expended in task 3 during the whole project is of 9.26, split in the following way:

During the first and second years no objectives originally planned since the activities in this task start at month 25.

During the third year LIM/UPC has devoted 2 months effort (that was the first active year of the Task) to works related to *Activity 1 (Review of existing approaches in Flood Hazard Mapping).* Within this, UPC has mainly worked on:

➢
- Review of existing approaches in Coastal Flood Hazard Mapping.
- Review of official Coastal Flood Hazard Mapping approaches (Spain, USA).
- Integration of morphological data, incl. time variation (UPC).

During the fourth year of the project LIM/UPC has devoted 4 months effort, focusing the activity on:
➢ *Activity 1.* Within this activity, UPC has worked on how to incorporate the influence / interaction of coastal morphodynamics in flood hazard mapping. This includes the review of coastal morphodynamic processes and models to incorporate the impulsive coastal response during the impact of coastal storms. Also, a methodology to incorporate this aspect in FHM has been developed.
Activity 2. Within this activity, UPC has worked on Compilation and analysis of existing recommendations in Flood Hazard Mapping with emphasis in Coastal Flood Mapping.
➢ *Activity 3.* Within this activity, UPC has worked in collaboration to Task 26 in the testing of the methodology developed to incorporate morphodynamic response in coastal FHM in the Ebro delta.

During the fifth year, the Task 3 activities was finalised and the report Guidelines on Flood Hazard Mapping (T03-08-02) were produced as deliverable, expending a total amount of 3.26 man months. Also during this period, the developed methodology for accounting coastal morphodynamics on inundation of the coastal plain was applied to the Ebro Delta.

Task 5 - Predicting morphological changes in rivers, estuaries and coast

The total amount of man months expended in task 3 during the whole project is of 8.62, split in the following way:

During the first year no objectives originally planned since the activities in this task start at month 13.

During the second year LIM/UPC is a member of the research team, concentrating in Activity 1 (Morphological change – Coasts), Action 2 (Regional evolution models for regional changes). The work in year 2 (5 man months) involved (i) the development of a methodology to assess the coastal vulnerability to storm impacts at regional level and testing it with data from the Catalan coast; (ii) the development of a parametric formula to describe overwash processes to be included in a coastal evolution model. Part of this last action was undertaken during a short research stage (June-July 2005) at the Center for Coastal Geology (US Geological Survey) at St. Petersburg, Florida (USA) with the group of Extreme Storms (directed by Dr. Asbury H. Sallenger, Jr.).

During the third year, LIM/UPC concentrate the work in Activity 1 (Morphological change – Coasts), Action 2 (Regional evolution models for regional changes). The work in year 3 (3.62 months) has

been devoted to finalise (i) the development of a methodology to assess the coastal vulnerability to storm impacts at regional level and testing it with data from the Catalan coast; (ii) the development of a parametric formula to describe overwash processes to be included in a coastal evolution model. In addition to this, final deliverable has been produced and, also, part of the results has been presented outside the project in Conferences and Journals.

Task 26 - Pilot Study "River Ebro Delta Coast"

The total amount of man months expended in task 26 during the whole project is of 17.27, split in the following way:

In the framework of Task 26, the main activities done during the first years was data and information compilation of the pilot area, liaison with local end-users, information compilation on management strategies and conflicts, and coastal morphodynamics relevant processes, dedications on effort of 1.85 man months.

During the second year LIM/UPC has devoted 4.34 months effort during the second project year to:

- Prepare the Task Research Implementation Plan.
- Compile existing wave and water level data, morphological data (shorelines, beach profiles, aerial photographs) and socio-economic data.
- Analyse wave data to characterise coastal storms in the area and to classify them in terms of their potential for erosion and flooding.
- Identify and characterise the most important storm events in the area (as a function of their impacts) during the last 15 years.
- Write a Report presenting the results.

During the third year LIM/UPC has devoted 5.27 months effort during the third project year to: (i) Compile socio-economic data to characterise this component in the Ebro delta to make an Integrated Assessment (this also includes to interview stakeholders to get their perception of existing risks) and, (ii) characterize the coastal response to storms and to start to assess interactions and feedbacks between coastal erosion and inundation during storms. In addition to this, part of the results has been presented outside the project in Conferences and Journals.

During the fourth year LIM/UPC has devoted 5.81 months effort during the fourth project year to works related to the characterisation of the physical response of the Ebro delta coast to the impact of storms and the identification and delineation of areas prone to be flooded. In addition to this, UPC also helps to WL|Delft Hydraulics to compile data required to assess the ecological impact of inundation ion the Ebro delta. In addition to this, parts of the results have been presented outside the project in Conferences and Journals.

Task 32 - Networking and Harmonisation

The total amount of man months expended in task 32 during the whole project is of 0.92. The work in this task has been mainly in coordinating the outputs of extreme assessment in drivers with morphodynamics responses and structures responses.

Task 33 – Assessment and review

The total amount of man months expended in task 33 during the whole project is of 0.69, dedicated to:

- Participation of Prof Agustín Sánchez-Arcilla in the Scientific and Technical Advisory Board (STAB). Organization of a FLOODsite workshop for the Spanish and Catalan administrations.
- Participation of Prof Agustín Sánchez-Arcilla in the Scientific and Technical Advisory Board (STAB) in Dresden (Germany),etc.
- Participation of Prof Agustín Sánchez-Arcilla in the Congress Oceans’07 presenting results of the project (Aberdeen). The core of the presentation was focused on the extreme wave, surge and river discharge distributions based on the Task.2 results.
- Presentation of the results project in the “European Conference on Flood Risk Management”. The core of the presentation was focused with the result of the Task 2. “Estimation of Extremes”.

As a general comment, during the project development no deviation exist in the number of man-month devoted but a deviation exits in the cost of the man-months.
In the preparation of the proposal was used the standards rates for the different personnel categories in the UPC. When the cost statement is done, it is used the current UPC cost for the EU projects for the personnel involved in the project. The deviation in the indirect costs has been occurred due to the same reason.

2.14 Partner 15 - UniBris

Task 8 - Flood inundation modelling/methodologies

For Task 8 the major expenditure was undertaken in Year 2 of the project when Dr. Simon Woodhead was employed for 7 months as a project scientist. Dr. Woodhead's tasks were to review the data available at the pilot study sites to determine if they capable of supporting inundation modelling, negotiate copyright agreements with data providers for selected sites (e.g. with the UK Environment Agency for the Thames site), write a report on inundation modelling methodologies which was a major Task 8 deliverable, and begin preliminary inundation modelling of the Thames.

Other expenditure by UniBris on Task 8 related solely to minor travel costs in support of the above work and there were no deviations from the project plan.

In Years 3, 4 and 5 UniBris has continued to be involved in FLOODsite and has contributed significant unfunded research time to Task 8. The cost of this contribution was of the order several times the value of the FLOODsite funding and relates to continuation of modelling work by Professor Paul Bates and Tim Fewtrell a UK funded Ph.D. student and contributions to reports and papers.

The main outcomes of the UniBris work on FLOODsite are summarised in the following peer-reviewed publications:

1. Fewtrell, T., Bates, P.D., Horritt, M. and Hunter, N. (2008). Evaluating the effect of scale in flood inundation modelling in urban environments. *Hydrological Processes*, **22**, 5107–5118. (http://dx.doi.org/10.1002/hyp.7148).
2. Fewtrell, T.J., Bates, P.D., de Wit, A., Asselman, N. and Sayers, P. (2009). Comparison of varying complexity numerical models for the prediction of flood inundation in Greenwich, UK. In Samuels, P., Huntington, S., Allsop, W. and Harrop, J. (eds), *Flood Risk Management: Research and Practice*, CRC Press, London, 95-104.
3. Bates, P.D., Pappenberger, F. and Romanowicz, R. (in review). Uncertainty in flood inundation modelling. In Beven, K.J. and Hall, J. (eds), *Applied uncertainty analysis for flood risk management*, John Wiley and Sons, Chichester.

2.15 Partner 16 - UniPad

Task 1 – Identification of Flash Flood Hazards

UniPad is a member of the research team, concentrating in particular on flash flood modelling and analysis of hydrometeorological processes.
Work in Task1 was mainly focused on the field work required to identify the critical controlling processes (related to soil properties, topography and precipitation variability) for extreme flood response in humid, mountainous basins in the central-eastern Italian Alps. Among other things, this involved i) post-event surveys and data retrieval for the flash flood occurred on Fella river on 29 august 2003 and for several flash flood events occurred on 2004 and 2005 in the upper Adige river basin; ii) data elaboration, hydrological model set-up and analysis of Fella flash flood event; iii) field work on precipitation, soil moisture patterns and piezometric response on small alpine basins. Part of this data were analysed during a stay of a collaborator at the Oregon University.
Whole Task 1 work involved 12.04 mm and 2mm from own staff.

Task 13 –Strategies for Pre-flood Risk management

UniPad is a member of the research team, concentrating in particular on the case study 'Adige river', which aims at investigating the characteristics of the current flood risk management framework in an Alpine-Mediterranean region suffering from both flash flooding and plain flooding. The work in this Task involved i) acquisition of documentation concerning normative regulation for flood risk mitigation in the concerned area (Adige Basin), ii) involved analysis of the practical implementation of the four main groups of pre-flood measures (physical, regulatory, financial, communicative) in the study area.
Whole Task 13 work involved 3.7 mm and 2 mm from own staff.

Task 15 – Radar and satellite observation of storm rainfall for flash-flood forecasting in small and medium-size basins

UniPad is a member of the research team, concentrating in particular on the development of a Bayesian approach for evaluating the uncertainty of radar rainfall estimates. The work in this Task involved analysis of the practical implementation of the method in the Adige hydrometeorological observatory. A number of algorithms have been integrated to develop a radar data processing system specifically suited for alpine conditions and for use with C-band data. The resulting processing system has been implemented on the radar center of the Adige Pilot basin. The uncertainty associated to the processing system has been derived following the Generalised Likelihood Uncertainty Estimation (GLUE) approach, to provide a measure of the uncertainty associated to the parameterization of the system.
Whole Task 15 work involved 6.5 mm and 2 mm from own staff.

Task 16 – Realtime guidance for flash flood risk management

UniPad is leading this task and has spent 8.33 mm and 6 mm from own staff on this task. This effort has been directed at:

- developing the Task Research Implementation Plan with other **FLOODsite** partners and preparing an internal project status report on flash flood guidance;
- developing an internal project report on the feasibility of implementation of flash flood guidance in the 'Flash Flood basin' Pilot.
- Developing and implementing the Flash Flood Guidance (FFG) algorithm;
- Testing the Flash Flood Guidance (FFG) algorithm;
- Preparing the final Task report.

Task 23 – Pilot study " flash flood basins"

UniPad is leading this Task and has spent 15.7 mm effort and 7 mm from own staff on this Task. This effort has been directed at:

- Developing the Task Research Implementation Plan with other **FLOODsite** partners;
- Developing the report on post event flash flood survey;
- Developing the report on the observation and monitoring of flash flood events.
- Implementing the FFG algorithm on the 'Flash Flood basin' Pilot.
- Validating the Flash flood risk management methodology on the 'Flash Flood basin' Pilot;
- Preparing the final Task report.

Task 31 – Face-to-face Knowledge Transfer

UniPad is leading this Task and has spent 7.0 mm effort and 7 mm from own staff on this Task. This effort has been directed at:

- Developing the Task Research Implementation Plan with other **FLOODsite** partners;
- Integrating the FLOODsite risk management vision into the existing Master course on "*Hydrogeological risk mitigation*", taught at University of Padova under the patronage of UNESCO (http://www.tesaf.unipd.it/dmt/**);**
- Developing the first Educational Package for professionals involved in flood risks management;
- Preparing the final Task report.

Task 33 – Assessment and review

A total of 0.5 mm effort has been given to the Task.

2.16 Partner 17 – UT

Task 9 – Task Description

- A literature review of existing methods of contingent valuation to evaluate intangibles on how to estimate indirect economic effects of flooding was conducted. UT staff participated a meeting with partners and discussing tasks and labour share (0.5mm)
- A concept of how to incorporate existing scientific methods with stakeholder knowledge in the view of the case studies that are conducted in task 25 and 26 was discussed and designed.
- UT is a member of the research team contributing to the 'Guidelines for socio-economic flood damage evaluation', which is the core task for Task 09. The 2nd FLOODsite year was the period of the main contributions for UT to this document (4.86 mm). UT is author for the chapters 5 “Guidelines for estimating (indirect) economic damage” and 7 “ Making choices on the quality of the environment: Contingent Valuation and Cost-Benefit Analysis”. These two chapters focus on the estimation of costs that occur both for pre-flood mitigation measures and after flood recovering measures.
- Essential questions such as how to handle direct and indirect costs, what are available methods for the determination of intangible values and the problem of double counting are analysed. Recommendations for the use of methods in relationship to flood damage evaluation are given.
- Furthermore, UT contributed to and reviewed the chapters one and two. These chapters are a general introduction to the problem of socio-economic flood damage evaluation, and are essential for the general understanding of the topic (0.7 mm).

Task 25 – Task Description

- The 0.5 man month has been used to review methods of damage functions and perceptions on risk. Furthermore, differences of flood perception and damage functions between Belgium and The Netherlands have been discussed and analysed (0.5mm).
- UT focussed on flood risk perceptions, land use change as damage mitigation option, the vulnerability of economic actors (both in coastal regions and river basins) and participatory process management. A summary of the literature research has been delivered as contribution to the “Book on FLOODsite Research at European Pilot Sites”. Conference papers about participatory project management have been presented at the iEMSs conference in Barcelona, July 7-10, 2008, at the European Water Management conference in Prague, 16th - 17th June 2008 and the IAP2 conference, Glasgow, 27th -29th of August 2008 . UT devoted 2.0 person months to this effort (2.0mm).
- Between November 2007 and February 2008 a survey was designed, reviewed and sent out to a random sample of 3000 residents of the Dutch province of Zeeland along the Schelde shore. The survey covered the following topics: (1) risk perception, (2) asset values and willingness to pay (3) preferences for flood protection and mitigation measures, (4) evacuation and early-warning systems and (5) the role of the authorities. Both letters were sent out as well as an online questionnaire (www.schelde-enquete.nl) was designed (2.56mm)
- The survey that was designed between November 2007 and February 2008 was implemented and finalised in April 2008. Some of the results have been presented at the European Conference on Flood Risk Management, Research in to Practice in Oxford, UK, 30 September - 2 October 2008.
- Furthermore, selected data of this survey have been used in a doctoral thesis.
- The analysis of the results and another publication is processing. Moreover, the basic statistics will be published on the website (www.schelde-enquete.nl) (2mm)

Task 26 – Task Description

- The 0.5 man month has been devoted to collect and view relevant data for this task. Furthermore, a decision has been made for the method that will be used for the integrated assessment of the flood risk problem in the Ebro delta. The chosen core method 'Multi-criteria analysis' is now being described and fit to the requirements of the regional socio-economic data.

- The main effort in this reporting period was to develop and implement a flood risk management tool to approach and enhance the FLOODsite methodology. More specific, UT in collaboration with UPC and UniLund are required to develop:
    1. a framework for integrated assessment of flood effects in the Ebro Delta;
    2. conduct an evaluation and quantification of the integrated deltaic coastal response with emphasis on socio-economic response, and adaptation to local specifics;
    3. Identifications of management strategies to cope with, avoid and mitigate the impact of floods.
- Based upon the FLOODsite risk approach UT applied the *psychomatric paradigm* (Slovic, 1987) in a risk-benefit approach to integrate a variety of stakeholder-based risk perceptions with a set of plausible storm surge scenarios. This integration enables the researchers to analyse the implications of climate-change induced floods on the land use of the coastal zone of the delta. Furthermore, a variety of possible measures including their implications UT in collaboration with UPC developed a questionnaire among stakeholders in the delta and a spatial multi-criteria analysis (SMCA). The main achievement of this approach is a methodologically consistent integration of social-science based empirical methods with analytical and modelling methods. In this specific case stakeholders' risk perception was translated into weights of the SMCA.
- The methodology has been completely worked out, and can easily be applied to follow-up studies with improved data and a more comprehensive questionnaire. The effort so far has already revealed some contradictions between local stakeholders such as farmers' representatives of the salt industry, the tourism sector and the responsible authorities. One possible policy measure was identified: land use changes. This is based upon the risk-benefit approach, and can lower damage on land use functions without major investments in safety measures. Whereas, local authorities appreciated this type of policy measures, it was completely refused by local farmers. As mentioned above, a more comprehensive questionnaire can reveal a more significant reflection of public opinion within the delta. The methodology, however, provides policy makers with a tool that can show consequences of chosen policy measures on the overall land use and productivity in the area including storm surge scenarios based upon both climate change and subsidence induced sea level rise. This way the methodology supports the search for a political process towards a sustainable development of the Ebro Delta.
- Besides reporting the method, UT representatives travelled to the Ebro delta in order to conduct the interviews. As a side product a master thesis based upon this study has been successfully accomplished.
- The Task 26 partners have now a consistent methodology that enables policy makers to decide for appropriate measures in order to push forward a sustainable development of the Ebro Delta. Yet, local stakeholders and authorities have to decide how to proceed with the policy process including a social learning process. The risk-benefit based SMCA will support this policy process (6.23mm).
- The methods as well as the results of the research that has been conducted in the Ebro delta in 2006 is published in the journal 'Natural Hazards' in March 2008.
- Furthermore, the research was presented at the 32th Congress of the International Association of Hydraulic Engineering & Research, IAHR, CORILA in Venice, Italy, July 1-6 2007. Another presentation was given at the CAIWA conference in Basel 12 – 17 of November 2007. The journal paper as well as both articles in the conference proceedings are listed on the FLOODsite publications list (0.4mm).

Task 33 – Task Description

- UT takes part at the assessment and review process as a partner with regular duties. All required review tasks have been accomplished as required (0.51mm)

2.17 Partner 18 - WUR

Task 1 – Identification of Flash Flood Hazards

During Years 1-3 (6.88 months in total) WUR has been involved in: (1) a theoretical analysis of hydrological similarity of subsurface flow response of hillslopes with complex geometry; (2) the application of the hillslope-storage Boussinesq model to rainfall-runoff modelling of small mountainous catchments. Regarding the former, the results have been published in a peer-reviewed journal article in Year 2. Regarding the latter, a peer-reviewed journal article is in preparation. Although WUR did not have any formal contribution to this task during Year 4 (0.00 months), the results obtained during previous years were summarized in a FLOODsite report and have been presented at two international scientific meetings. In addition, preparation of a journal article on the second aspect mentioned above continued. Similarly, although WUR did not have any formal contribution to this task during Year 5 (0.00 months), results have been presented at two international scientific meetings.

Task 14 – Long-term Strategies for Flood Risk Management

Wageningen University and Research Centre (WUR) was a member of the team working on scenario definition and strategic alternative design. The WUR effort was directed at (1) a literature review of existing methods for scenario definition, (2) development of the methodology of confronting strategies with scenarios, including assessing the alternative's contribution to sustainable development, methods for obtaining and integrating indicator scores as well as the presentation of results. Furthermore (3) our findings were elaborated in the proposed framework for a full assessment of strategic alternatives, and (4) we participated in testing this proposal in the Schelde Estuary case study. We participated in meetings in Delft, Wallingford and Dresden.

Task 15 – Radar and Satellite Observation of Storm Rainfall for Flash Flood Forecasting in Small to Medium Basins

During Years 1-3 (4.73 months in total) WUR has developed a stochastic model of the microstructure of rainfall, which has been used to: (1) objectively compare different algorithms to correct for rainfall-induced attenuation of the weather radar signal; (2) quantify the sampling error of disdrometers (instruments used for ground validation of rainfall retrievals from weather radar observations). Regarding both aspects, peer-reviewed journal articles have been published in Years 2-4. Although WUR did not have any formal contribution to this task during Year 4 (0.00 months), the results obtained during previous years have been presented at three international scientific meetings and contributed to four journal articles published in Year 3 and one journal article published in Year 4. Similarly, although WUR did not have any formal contribution to this task during Year 5 (0.00 months), the results obtained during previous years have been presented at international scientific meetings.

Task 23 – Pilot Study Site "Flash Flood Basins: Monitoring and Validation"

During Years 1-2 (4.73 months in total) WUR has concentrated on weather radar rainfall estimation over the Ardennes pilot application site and its hydrological application, specifically for the Ourthe catchment, a tributary to the Meuse river. Preliminary results were published in a peer-reviewed journal article in Year 2. During Year 3 (2.78 months), in collaboration with the Royal Meteorological Institute of Belgium (RMI), a subcontractor to WUR in this task, a detailed comparison of rainfall data from the Wideumont weather radar and from a rain gauge network for the period from October 2002 to March 2003 was carried out. The results were summarized in a FLOODsite report and presented at an international scientific conference. During Year 4 work on the hydrological application of the Wideumont weather radar continued. Research results have been presented at an international scientific meeting and have been reported in the form of a conference paper. Similarly, during Year 5 work on the hydrometeorology of the Ourthe catchment continued. Research results have been presented at international scientific meetings and have been reported in the form of a conference paper.

2.18 Partner 19 - UniLund

Task 2 – Estimation of extremes

A long-term time series of suitable sea level data from the Falsterbo peninsula at the south-west corner of Sweden have undergone analysis regarding long-term trends and extreme value distribution. Based on this, long-term forecasts were estimated. Similarly, the combined effect of sea level variation and calculated wave run-up levels were used to estimate future extreme total run-up elevations for two locations at the Falsterbo peninsula, both experiencing the same water levels but very different wave climates depending on shoreline orientation.

Actual research work was finished in Yr3 as planned. The work in Yr4 is related to the submission of a journal article for a Special Issue where the work of Task 2 is going to be published.

Task 5 – Predicting morphological changes in rivers, estuaries and coasts

A first formulation of an analytical model to describe the response of a dune to wave impact and overwash has been made. Three sediment volume conservation equations are combined to model the response of a geometrically schematized dune. In addition, two transport equations describing (1) the erosion of the dune face due to wave impact and (2) the lowering of the dune crest due to overwash is needed to close the problem. The transport equation originally proposed by Fisher and Overton, later modified by Larson, Eriksson, and Hanson, was employed to estimate the transport from the dune face, whereas the formula developed by Larson, Wise, and Kraus was utilized to calculate the transport over the dune crest. Solutions have been derived for simplified forcing conditions with respect to water level and waves, and for geometric configurations corresponding to dune and barrier island profiles.

A methodology to simulate the probability of eroded volume, dune foot retreat, and overwash volume was proposed based on the aforementioned analytical model. Data from Ocean City on waves, water level, and wind every hour from 1930 to 2000 were available for developing and testing the methodology. Simulations yielded time series of various quantities that were statistically analyzed and empirical distribution functions were derived. Such functions provide the probability of, for example, a certain dune erosion, dune foot retreat, and overwash volume, as well as dune collapse (breaching). The sensitivity in the simulation results to different physical parameters was also investigated.

Actual research work was finished in Yr3 as planned. The work in Yr4 is related to the submission of a journal article for a Special Issue where the work of Task 5 is going to be published.

Task 26 – Pilot Study Site "Ebro Delta" (Coastal/Estuary)

A first formulation was made of an analytical model to describe profile response along different coastal stretches in the Ebro Delta for various storm scenarios. Data available from the Ebro Delta to be employed in modelling the response of the barrier island to storms were reviewed. The storm erosion model SBEACH was set up to be applied to the Ebro Delta situation.

Adaptation of morphodynamic models to estimate the coastal response has been completed. Assessment of coastal storm induced erosion and overwash is ongoing and will be completed on schedule. Results were published in a joint Task 26 report coordinated by UPC. The work was finished in Yr4.

2.19 Partner 20 - CAU

Task 27– Task Description

The University of Kiel (CAU) leads Task 27 which combines methods for calculating the failure probability of coastal defences with the methods for socio-economic damage evaluation.

The official beginning of the work in Task 27 was 10/04. The personnel costs funded by FLOODsite ended with the official end of Task 27 in 02/08. For editing the pilot book chapter and further dissemination activities in year 5 additional costs (outside FLOODsite) were used.

Year 1:
Resources devoted to Task 27 comprise **5** months effort.
These person months have been used to perform the following work during the reporting period::

- Compose status report of previous analyses (methods, data, techniques) of flood related vulnerabilities for the pilot site
- Updating the data set of pilot site
- Documentation of existing methods for vulnerability assessment (CAU with Task9)
- Contact and inform national, regional and local authorities/stakeholder by the establishment of an advisory board (first meeting 24.01.05)
- Develop and prepare reports such as RIP

Travel costs were exclusively used for the 1. FLOODsite Workshop in Delft.

Year 2:
Resources devoted to Task 27 comprise **6** months effort. These person months have been used to perform the following work during the reporting period:

- Collection and documentation of specific data and methods for the pilot site
- Update the socio economic data set with surveys
- Collecting data for assessment of failure probabilities
- Participation and organisation of the III. Workshop of the FLOODmaster-Course, University of Dresden (1/06)
- Updating year 2 reports

The appeared travel costs were exclusively used for the 2. FLOODsite Workshop in Braunschweig and participation in the III. Workshop of the FLOODmaster-Course (1/06) in Büsum.

Year 3:
Resources devoted to Task 27 comprise **7.5** months effort . These person months have been used to perform the following work during the reporting period:

- Updating socio-economic data and methods for the pilot site
- Design a high resolution DEM for inundation modelling in the pilot site
- Collecting data for assessment of failure probabilities
- Design of a new methodology for a micro scale socio-economic damage potential analysis
- Conducting an advisory board meeting
- Participation and Organisation of the III. Workshop: Coastal Floods of the FLOODmaster-Course, University of Dresden (1/07)
- Updating year 3 reports

The travel costs were used for the Advisory Board meeting, the 3. FLOODsite Workshop and the EFRM Symposium in Dresden.

Year 4:
Resources devoted to Task 27 comprise **8** person months effort, whereof 6 were funded by FLOODsite.

These person months have been used to perform the following work during the reporting period:

- Completing the update of socio-economic data and methods for the pilot site
- Designing a new methodology for a micro scale socio-economic damage potential analysis
- Combining vulnerability analysis with inundation simulation for risk analysis
- Defining risk zones in the pilot site
- Developing a risk analysis tool
- Conducting an advisory board meeting and a meeting with the local disaster management group
- Participation and Organisation of the III. Workshop: Coastal Floods of the FLOODmaster-Course, University of Dresden (1/08)
- Updating year 4 reports
- Presentation of the results at conferences

The travel costs were used for the Advisory Board meeting, the meeting with the disaster management group and the 4. FLOODsite Workshop in Grenoble.

Year 5:
Resources devoted to Task 27 comprise **2** months effort in Year 5 which has not been funded by FLOODsite. These person months have been used to perform the following work during the reporting period:

- Drafting the Task 27 chapter for the *pilot book*
- Attending the FLOODsite final conference in Oxford, incl. presentation
- Presenting the results at the EGU in Vienna
- Updating the year 5 reports
- Final advisory and end-user workshop
- Participation and Organisation of the III. Workshop: Coastal Floods of the FLOODMASTER-Course (1/09)

The travel costs were used for the Advisory Board meeting, the FLOODsite final conference in Oxford and dissemination activities.

Overall Task 27 person months: 28.5 (whereof 24.5 funded by FLOODsite)

2.20 Partner 21 - VITUKI

Task 12 – Identification and ex-post evaluation of existing flood mitigation and defence measures

Task 12 aims at developing and testing a methodology for ex-post evaluation of measures and instruments. The methodology supports the case-specific evaluation of implemented measures and instruments with respect to their (side-) effects, effectiveness, efficiency, robustness and flexibility. The development of the methodology is based on the identification and classification of measures and instruments, for which the methodology is developed. These are mainly pre-flood and flood-event interventions. The methodology is tested in five case studies. The case studies evaluate different interventions in different conditions. The case study "Tisza B", carried out by VITUKI, focused on non-structural instruments. In this pilot we describe how an international cooperation can help improve monitoring, data exchange and flood forecasting. By the end of year 3 we have used all 1.9 months available for the pilot.

When testing the ex-post evaluation tool developed by the task we have realised that it does not cover the evaluation non-structural methods. In Dresden we agreed with the Task leader to review the tool from the point of view of non-structural methods and we will make proposals on how to include them into it. This has taken about 2 weeks of our time what we have covered from our own resources.

Task 17 – Emergency flood management – evacuation planning

The objective of task 17 of the FLOODsite programme is to develop a method and tools for identifying appropriate evacuation and rescue plans. For the pilot sites Thames, Schelde and Gard models were prepared. The aim was to compare different methods and tools in a benchmark study. Recommendations for improvement of methods and tools were drawn from the pilot applications. As far as possible these recommendations were implemented within this task.

The role of VITUKI was to review existing methodology especially focusing on the Hungarian lowland rivers. We have reported on floodplain localisation (confinement) planning and the methodology used for evacuation planning in Hungary. It turned out that no sophisticated computer models are used in Hungary but the standard content of an evacuation plan was presented.

By the end of year 4 we have used 4.8 man months. Our contribution to Task 17 has been finalised by the Grenoble Workshop.

Task 22 – Pilot Study of the River Tisza

The objective of Task 22 of the FLOODsite programme is to develop river basin based, precautionary and sustainable flood management strategies, to investigate and analyse previous floods, to foster international co-operation and **to apply the outcome of other tasks** by preparing vulnerability analysis.

In year 3 most of the Sub-Tasks under Task 22 have been finalised (draft research outputs prepared). The research on "Development a basin wide integrated system of monitoring, flood forecasting and warning" has been delayed by 6 months. It was finalised by the modified deadline.

In year 4 only one Sub-Task was running "full-time": "The pilot study application of general vulnerability analysis developed in sub-theme 1.3". This is executed by H-EURAqua. Input is obtained from FLOODsite Sub-Task 1.3 on "Risk analysis: Scientific knowledge and understanding the vulnerability and sensitivity of the receptors of risk". The report on this Sub-Task was finalised and uploaded to the FLOODsite homepage in March 2008. On top of this finalisation of research outputs, writing a Chapter on the Tisza Pilot for the "Pilot Book" and preparation of materials for Task 30 (Communication and Dissemination) was going on.

Task 22 is composed of three, essentially independent, activities:

– Development of river basin based, precautionary and sustainable flood management strategies

- Fostering international co-operation
- Vulnerability analysis

The first two are subdivided into 5 and 2 actions respectively. The third activity started after having received the output of Sub-Task 1.3.

VITUKI's contribution to Task 22 included two research outputs on "the analysis of the impact of extreme precipitation patterns on the flood peaks along the Tisza River" and on "the development the basin wide integrated system of monitoring, flood forecasting and warning".

The major outcomes of the first research for the Tisza Basin can be summarised as:
- The importance of the antecedent precipitation and the water content of the snow cover is higher than we have thought it previously,
- The run-off is very sensitive to the path of the frontal zones; minor deviation in geographical location of the precipitation field can produce extreme floods,
- The most dangerous situations for the lower Hungarian Tisza reach are the precipitation events on the Upper-Tisza followed by 8-10 days with a precipitation on the Körös-Maros catchment.

The second part of research focuses on three main topics:
- the inventory of existing monitoring systems,
- the inventory of existing (in the Tisza Basin) flood forecasting systems and
- a proposal to create WEB based "virtual" forecasting centre.

To meet the data requirements of the different models a central, "virtual" database is proposed. The INTERNET based information centre can easily be accessed by each country. The row data and the product (the forecasts) will be publicly available, while the private part serves for the communication of the national forecasting centres and for storage and exchange of internal data and information.
A draft version of this "virtual" database has also been prepared.

We have used 4.26 man months in years 1-5.

2.21 Partner 22 – IHE

Task 4 – Understanding and predicting failure modes

Action 3, under Activity 3, reviews small scale tests on erosion and failure analysis, and is undertaken by IHE (partner 22). This action has focussed on erosion associated with the crest and rear face of dikes – thereby excluding erosion of armour layers and revetments which is adequately covered in other actions/ activities. A further limit state equation has been drafted from this detailed analysis which will be included in the overall failure mode analysis and the templates under Activity 1.

Task 20 – Development of framework for influence and impact of Uncertainty

IHE is a member of the research team for the development of framework for influence and impact of uncertainty. IHE is primarily focussed on propagation of integral uncertainty through composite (hybrid) models using efficient computational methods, in order to provide robust uncertainty estimates on model outputs. The IHE has spent 25.9 man-months effort in the whole project duration. The research at IHE was conducted by Durga Lal Shrestha, PhD student. The work was supervised by Prof Dimitri P. Solomatine and Prof Roland Price. The followings are summary of the research activities which were carried out during the project period:

1. A review and evaluation of uncertainty propagation methods in flood models. The focus was on methods which compute total uncertainties without attempting to separate contributions from different sources.
2. Development of the integral uncertainty method based on machine learning techniques to model uncertainty through hydrological models. This method is referred as UNcertainty Estimation based on local Errors and Clustering (UNEEC).
3. Implementation and testing of UNEEC methodology in several case studies including FLOODsite pilot sites in collaboration with FLOODsite partners.
4. Development, implementation and testing of data-driven techniques to surrogate complex models. Novel methodology has been developed to estimate the uncertainty of the hydrological model predictions by replicating sampling based (e.g., Monte Carlo simulations) uncertainty analysis method. The methodology has been applied to Posina catchment, in Italy, (subcatchment of Adige River Basin, Italy).
5. Application of the efficient resampling method to analyze the complex (slow) flood models' parametric uncertainty in Posina catchment, Italy. The effort has been given to integrate the resampling techniques with the global optimization techniques.
6. Dissemination of the methodology and results. Much effort has been given to disseminate the methodological developments and application results through publication in conferences and journals. Three papers have published in peer reviewed international journals and methodology and application results have been presented in several international conferences, seminar, workshops and meetings.
7. Contribution of web-based dissemination material for use in Task 30
8. Preparation of the final task report.

Task 30 – Web-based Knowledge Transfer

IHE is a member of the research teams focusing on the web-based knowledge transfer of outcomes from the project. The specific objective of Task 30 is to enhance uptake through the adoption of a web-enabled knowledge based, modelling and dissemination platform, which is referred to as E-Flood. The IHE has spent about 16 man-months effort in the whole project duration. There are three stages of intensive activities over the 5-year period though which Task 30 endeavours to reach the goal as described in the DOW.

1. Stage one: Communicating with project partners and building the specifications of E-FLOOD. The activities of the first two years were mainly intended to obtain a clear image of how the web platform should be shaped given the material from other tasks. As most of the tasks were

not yet at the level where substantial deliverables were available. The concept of the proposed E-FLOOD had to be formulated with active communication, the project document of individual tasks and partial results delivered by tasks as well as the experience from similar systems.

2. Stage two: prototyping and functional design of tasks to be fitted to the platform. Year 3 and Year 5 see the development of the E-FLOOD platform with more project outcomes became available. By the end of year 4, a preliminary form of E-FLOOD with three components (Knowledge Map, Modelling Facility and eLearning facility) were developed, which also included some initial results from other tasks. Decisions on hardware and software development technologies were made during this period with dedicated Web/Database server made available to the project.

3. Stage three: Intensive activity all through later Year 4 and entire 4 focused on finalizing functional design of all available task inputs, the implementation and integration of the product. The concept of E-FLOOD also progressed into a multi-components platform based on the common template. Internal/external test, iteration and regression together with intense communication with individual tasks, end user and MT. The outcome of Task 30 was also partly integrated into the main FLOODsite website by the end of Year 5 while a standalone, dedicated server was also ready with the full implementation of Task 30 on site.

2.22 Partner 23 - UR3

Task 2 – Task Description

The activity of the UR3 research team was focused on the Singular Spectrum analysis of time series of interest in the project. Both Sea Level data and wind waves records were considered.
All the activities within the project were coordinated by Prof. Leopoldo Franco.

In year one of the project the data have been gathered by the UR3 team (Dr Gian Mario Beltrami and Dr Giovanni Cuomo) . This analysis supports the work in Task 2 by providing a methodology for long term analysis to assess the importance of trends in time series.

Together with data collection the research team established research collaborations with other partners of the project. In particular Mr Aldric Aurelien Andreoli, graduating student at UR3, worked at UPC (Barcelona) during Year 2 in order to gather and analyze data coming from Spanish and Italian coastal stations and supported UPC and UR3 work on extreme wave analysis.

Dr Riccardo Briganti and Dr Gian Mario Beltrami applied existing codes and developed new ones to analyse the collected data analysis owned by the partner UR3 to wave and sea level data in the Mediterranean Sea.

Two test cases have been selected for the wave data, namely Alghero and Tortosa. The data from Tortosa came from UPC, while the Alghero records were provided by the Italian Wave and Sea Levels Measurement Network. Prof. Leopoldo Franco wrote and translated into English the Italian Wave Atlas, making it available to the other partners of the project.

As for the Sea level records the data coming from land based stations owned by the Italian Wave and Sea Levels Measurement Network have been analysed.

Much of the analysis has been carried out in Year 2 of the project. Dr. Riccardo Briganti carried out much of the analysis using Singular Spectrum Analysis, supported by Gian Mario Beltrami for the Sea Levels part.

The work led to a series of publications in International Conferences and a Journal Publication, in the Special Issue of Journal of Hydraulic Research devoted to the results of Task 2 of the project.
The preparation of the paper was carried out from the end Year 2 through Year 3, extending beyond the paid time for this partner.

R.Briganti attended the Task 2 meeting in Bruxelles in October 2005 and the second year project meeting in Braunschweig, Germany (Feb. 2006), while L.Franco attended the meeting in Delft. Leopoldo Franco and Riccardo Briganti attended the task 2 meeting in Lisbon during the ICCE conference (sept 2004). In 2005 L.Franco attended an ICE conference in UK followed by a conference in Island on coastal structures related to flooding hazard in the European Union

2.23 Partner 24 - SOG

Introduction

SOGREAH is a member of the research team concentrating on emergency flood management and evacuation planning in particular.
In the framework of this involvement, SOGREAH has contributed to activities carried on in Tasks 17 and Task 19.

The two first years of the project have been dedicated to preparatory actions. During this period, Sogreah together with CEREVE, the other French partner of the project involved in tasks 17 and 19, has reviewed evacuation and rescue methods and models in France. This has contributed to the SoA report on the Activity 0.

Still during this preparatory period, after the French law on modernisation of civil protection in force since August 2004, Sogreah has worked on the definition of a methodology for the preparation of Crisis management plans at the city level (in French: 'Plan Communal de Sauvegarde' – PCS, Ministère de l'Intérieur). This methodology then has been applied in consulting engineering projects to provide services (out of Floodsite) to various municipalities.

During this initial period, Sogreah has also prepared its research plans for the forthcoming period, focusing on the 2D modelling of urban floods and its relations with the appropriate flood management planning.

Task 17 – Emergency flood management: evacuation planning

SOGREAH reviewed and contributed to the Report "User requirements in flood evacuation management » (Final version, Dec.2006) bringing in particular the results of field surveys in Loire river basin conducted under FP5 OSIRIS Project (IST-1999-11598)

French case studies (Arles, 2003, Somme, 2001) have been analysed and Sogreah contributed to the Review Report "Review report of operational flood management methods and models ".

SOGREAH reviewed Task 17 Report "Evacuation and rescue management » (T17_07_02, Feb.2008).

Task 19 - Development of framework for flood event management planning

Sogreah contributed to the Activity Report "The use of GIS for natural hazard assessment and management: the French experience" and "Review of flood event management - Decision Support Systems" (Draft version (December 2006).

Activity "2D approach to urban flood modelling" :

It is now widely recognised that flood risk has to be managed in an integrated manner, including flooding from rivers and groundwater, the sea, sewer systems and pluvial flooding. Considerable progress has been made on the principles of integrated flood risk management. However, the methodologies to enable fully integrated risk assessment of flooding from all sources and appraisal of strategic portfolios of options are not yet fully developed.

This development has to be carried out first for urban areas because they represent the most challenging locations for broad scale flood risk analysis from multiple sources.
Besides, the Crisis management plan at the city level (PCS), as a part of a regulatory law on modernization of the rescue services, is used to prepare a community , among other risks, to possible flood crisis management. To what extent the 2D modelling can contribute to the PCS preparation at the local level for flood risk management has been investigated.

The aim of the research has been to derive and validate a pragmatic approach to attribution of flood risk in urban areas including issues relative to crisis management, using 2D hydrodynamics modelling results on the basis of available applications of TELEMAC 2D System (www.telemacsystem.fr). This has enabled identification of the critical points related to the representation of the complex topography, geometry of buildings, roads, sewers, etc. to be taken into account for appropriate urban flooding case studies so that they can be targeted for improvement in view of in crisis management (determination of evacuation paths, vulnerable zones, etc.).

The research has been performed on existing 2D models set-up for urban areas situated in the Southern France submitted to frequent flash floods due to intense concentrated precipitation.
Two application sites have been selected in the Mediterranean region of France. One of the sites is a borough of the city of Nice, an area with high level of flood risk exposure due to Var river high level flows concomitant with storm surge and the second one is a urban area of an unidentified city in the same Mediterranean region of southern France. The study used a hydrodynamic model elaborated in the frame of Flood Risk Prevention Plan for the Lower Var river valley (PPRI) with a direct liaise with Alpes Maritimes County Directorate for Infrastructure (DDE06), which was the site end-user.

The first task in the research led by SOGREAH was identifying the stakes in the study area through inventory and detailed analysis of the available information of the cities under consideration. The identified stakes such as residential areas, public centres, open areas and infrastructures are categorised in such useful way for the study and management of flooding. In the two consecutive tasks the core application of the 2D modelling for flood risk assessment through in-depth study of the vulnerability of the stakes and the respective flood hazards was performed. For this, the use of two already existing TELEMAC 2D models was made with the set up for the two project sites taking into account the topography, geometry of various structures and different hydraulic properties in the area.

For the flood events tested in different scenarios the results obtained from the 2D model such as the flood water depth, velocity (speed and direction of flood propagation), the discharge and duration of submersion have been used in the analysis. This analysis is incorporated into the different steps in flood management planning such as flood hazard assessment, risk analysis and disaster management.

Finally, the study brought an insight into the effectiveness of the 2D modelling as a source of information for a decision support tool for flood management by assessing the extent to which the model contributes to the requirements of the PCS. The report provides also some suggestions related to the model for better improvements of 2D approach to urban flood modelling coherent with the PCS regulations.

The study has also assessed the existing regulations in some EUmember states (France, UK,Germany) with respect to urban flood risk prevention. In particular, the link between 2D modelling approach and Flood Crisis Management plans for urban areas has been assessed and appropriate lessons related to methodological guidelines and specification of additional tools in order to cope with existing regulations in France has been drawn.

The participation to the research of Euro Aquae Hydroinformatics Master student Yidnekachew Moreda, led in the frame of his professional internship under the supervision of Dr. Marc Erlich of Maëva Dupont, resulted in the Technical note Report: “Benefits of 2D Modelling Approach for Urban flood management”.

Based on this experience SOGREAH reviewed and contributed (Chapter 7) to the Task 19 Report “Frameworks for flood event management » (T19-07-03, Feb.2008)

In addition, during the FLOODsite Meeting in Grenoble, Dr.Jean-Luc Rahuel from SOGREAH participated in the review panel of Tasks 4, 6 and 7.

During the last year of the project, an interactive presentation of the results obtained by all project partners involved in tasks 17 and 19 has been designed, realised and disseminated by Sogreah.

The interactive presentation on CD-ROM aims at containing and showing all main activities and results of tasks 17 & 19, including reports, articles, and all relevant documentation package.
The user interface is based on html web browser possibilities and the design is the same as the Floodsite web site.

SOGREAH's Effort (person * month) in the reported period:

	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Task 17	0,01	0,10	0,67			0,78
Task 19	0,80	1,20	1,00	5,00	8,65	16,65
Task 33	0,14	0,10				0,24
All tasks	**0,95**	**1,40**	**1,67**	**5,00**	**8,65**	**17,67**

Note: effort for year 5 includes adjustments on previous years.

Participation in Meetings:

Year 1
- Floodsite Workshop, Brussels (BE), July 6-7, 2004
- Floodsite meeting, Delft (NL), Feb. 15-17, 2005

Year 2
- Floodsite Workshop , Braunschweig (GE), Feb. 13-15, 2006

Year 3
- Task 17 and 19 Technical Meeting, ENPC , Paris (FR), May 11, 2006
- Task 17 and 19 Technical Meeting, ENPC , Paris (FR), July 31, 2006
- Task 17 and 19 Technical Meeting, ENPC , Paris (FR), Oct.10, 2006

Year 4
- Task 19 Technical Meeting, Nice (FR), Feb, 26, 2007
- Task 17 and 19 Technical Meeting, ENPC , Paris (FR), May 9, 2007
- Task 17 and 19 Technical Meeting, ENPC , Paris (FR), Oct.9 , 2007
- FLOODsite workshop and task 17 and 19 Technical Meeting, Grenoble (FR), Feb.11-14, 2008
-

Year 5
- FLOODrisk 2008 Conference, Oxford (UK) Sept. 29th to Oct. 2nd, 2008.

Dissemination activities:

- Production of a CD Rom presenting the results obtained in tasks 17 and 19 of the project.
- Contribution to the book: "Flood risk management, research and practice", CRC Press

Conference papers

- Erlich, M. (2007): Benefits of 2D Modelling Approach for Urban flood management, 60-years of IMGW Wroclaw Conference , Nov.22-23, Wroclaw, Poland, 21 pp.
- C.Coulet, L.Evaux, A.Rebaï (2008) “Study of floods occurring in urban areas through coupled numerical modelling of 2D surface and sewage network flows” FLOODrisk 2008 Conference, Oxford, UK.
- E.David, M.Erlich, A.Masson (2008) “Benefits of 2D modelling approach for urban flood management”, FLOODrisk 2008 Conference, Oxford, UK.

2.24 Partner 26 - JRC - IPSC

Task 9 – Guidelines for damage assessment

With respect to resources, one person-month has been devoted to the JRC-IPSC activities for this task. Major costs included the three missions that were made on our FLOODsite budget. These were missions to meetings in Delft (13-16 February, 2005), and Braunschweig (13-16 February, 2006). These meetings were planned in combination with the meetings for task 17. The mission to Leipzig (31st May- June 2nd, 2005) was purely devoted to task 9. Besides that we have spent time on several tasks within the project. Among these tasks were: co-writing, together with Twente University, the chapter on indirect economic in the overall document on guidelines on damage assessment, and contributing to editing these guidelines as a whole.

Task 17 – Emergency flood management – evacuation planning

With respect to resources, all person-months after year one have been devoted to the JRC-IPSC activities for this task with more specifically the following activities:

- The report on user requirements consists of an analysis and synthesis of the transcriptions of the numerous interviews and meetings made with stakeholders, as found in the deliverables of other partners in Task 17. This wide variety of information has been transformed into a set of explicit requirements with rationale, and will be used as input to subsequent work of Task 17.

- The web tool development consists of the exploitation of on-line web services for road routing that were initially developed in the context of the Orchestra IP. These services have been adapted to match the requirements on evacuation management mentioned above. This work has resulted in an on-line application for routing in emergency situations.

Other major costs included the five missions that were made on our FLOODsite budget. These were missions for meetings in Delft (February 2005) and Braunschweig (February 2006). These meetings were planned in combination with the meetings for task 9. Other mission were for the meetings in Paris (May, July and October 2006) which were all dedicated to task 17 only.

2.25 Partner 27 - IBW

Task 2 – Task Description

Year 1
IBW team compiled, revised digitised and formatted 44 years (1958-2001) of atmospheric and wave data from the Baltic Sea, including flood events in the area. This data were collected for the use in Task 2 Action 2.3.1.9 Neural Network. Also, the data on daily seawater levels in Gdańsk (1961-1990) and in the Vistula River at Tczew benchmark station (1961-1989) were collated, revised, digitised and formatted for the application in Task 2 Action 2.2.3.2 Canonical Correlation Analysis. All these activities consumed 9.49 EU funded man-months plus additional 9.4 man-months own IBW resources upon the AC cost model.

Year 2
IBW effort for Year 2 amounted to 21.69 man months, of which 10.69 was provided by the FLOODsite project and the remaining 11 by IBW own funding (AC cost model). These resources were spent on:

- The analysis of multi-decadal data sets of atmospheric, wave and sea level data in extreme conditions,
- Implementation of the results of analysis to the neural network models. The neural network models were tested and verified for the prediction of extreme waves and storm surges in selected locations of the South Baltic Sea coastal area. The invented methodology can be applied to the other coastal and river estuaries locations.
- Initial canonical correlation analysis computations for raw time series of water levels in the Vistula River and seawater level in the Gulf of Gdańsk were performed, these calculations proved inconclusive by including all phenomena imprinted in the data into the analysis,
- Pre-processing of both series with Singular Spectrum Analysis was done, which revealed that random deviations from annual seasonality can be the only possible driver of joint coastal extremes,
- Repeated CCA computations for those deviations indicated low likelihood of joint coastal extremes, the results were put together and submitted to Estuarine, Coastal and Shelf Science journal as a scientific paper; which was then reviewed and published (Różyński, G., Ostrowski, R., Pruszak, Z., Szmytkiewicz, M., Skaja, M., (2006) Data-driven analysis of joint coastal extremes near a large non-tidal estuary in North Europe, *Estuarine, Coastal and Shelf Science, Volume: 68, Issue: 1-2, June, 2006, pp. 317-327).*

Year 3
IBW effort amounted to 9.59 man months using the FLOODsite project resources and 9 man months of IBW own staff, according to the AC cost model. These resources were spent on the development of a statistically based model to forecast sea state parameters including extreme sea states. The model is based on the application of a neural network and is an alternative to standard numerical prediction models, which often provide unsatisfactory results, especially for complicated seabed topography or when a short-term forecasting is required. The constructed neural network was applied to predict extreme sea state parameters at selected locations in the Baltic Sea. The paper summarizing these actions was tentatively accepted for the publication in the Task 2 related special issue of Journal of Hydraulic Research (Paplińska-Swerpel, B., Paszke, Ł., Sulisz, W. and Bolaños, R. 2006. Application of Statistical Methods for the Prediction of Extreme Wave Events). The paper covers both the description and application of the developed methodology.

Year 4
Task completed, no actions taken in Year 4.

Year 5
Task completed, no actions taken in Year 5.

Dissemination: a paper in special issue of the Journal of Hydraulic research related to the application of canonical correlation analysis and bootstrap re-sampling method: Reeve, D.E., Różyński, G., Ying Li, 2008. Extreme water levels of the Vistula River and Gdansk Harbour. *Journal of Hydraulic Research, Vol. 46, Extra Issue 2 (2008), pp. 235–245.*

Task 3 – Task Description

Year 1
No activity

Year 2
No activity

Year 3
IBW effort in Task 3 amounted to 2 man months, using the FLOODsite project resources and 2 man months of IBW own staff, according to the AC cost model. These resources were spent on the inventory of existing approaches in River Flood Hazard Mapping in East European countries and on the preparation of review of existing methods of flood hazard mapping at the relevant National Agency in Poland grouping Regionalne Zarządy Gospodarki Wodnej in Poland (Regional Boards of Water Management). The review contains the description of the following steps in flood hazard mapping process:

- data collection,
- hydraulic models, and layouts of river valley cross-sections,
- raster maps,
- Digital Terrain Model.

Year 4
No actions taken in Year 4.

Year 5
IBW effort for amounted to 1.3 man months. Additional equivalent support was provided from IBW own funding (AC cost model).
Work on hazard mapping was focused on a review of existing flood hazard mapping techniques and also on the analysis of using different mapping techniques. The inventory of existing approaches in river flood hazard mapping in Eastern European countries was conducted and the review of existing methods in flood hazard mapping in Polish national agencies were reanalyzed. The review focused on the description of the main steps in flood hazard mapping process including data collection, hydraulic models, layout of river valley cross-sections, raster maps, etc. The work comprises a critical review of different flood hazard mapping approaches by taking into account technical and scientific aspects.

Task 4 – Task Description

Year 1
No activity

Year 2
IBW PAN spent 8 months effort in Year 2 of the project within Task 4 activities; 4 funded by the Project and 4 by own IBW funding upon AC cost model. The main effort was put into:

- Preparation of the experimental equipment for model tests on flood defense embankment: assembling of a de-airing device for pressure gauges and pressure gauges calibration unit, modernization of an automatic system for the measurements of water content, soil density and water pore pressure, tests of image processing software to trace soil displacements, installation of pressure gauges in the experimental stand.
- Execution of preliminary tests, checks and calibrations of the equipment and the automatic measurement system.

- Contribution to Task 4 Failure Modes Report.

Year 3
IBW PAN spent 7.44 man-months using the FLOODsite project resources and 7 man months of IBW own staff, according to the AC cost model. Task 4 activities included the following items:

- Elaboration of the test program on model flood embankment,
- Analysis of the test results,
- Completion of the action report: "Air trapping phenomenon and cracking. Model tests on flood embankment" (Authors: D. Leśniewska, P. Bogacz, J. Kaczmarek, H. Zaradny),
- Contribution to Task 4 Failure Modes Report.

Year 4
Task completed: no actions taken in Year 4.
Dissemination: key IBW researcher presented the FLOODsite project at the SAFE Conference "Participate in FP7Research for the Environment", Panel: Environmental Research – Lessons Learned, Opportunities Offered, Istanbul, Turkey, 9-10 January 2008, presentation title: 'FP6 Project "FLOODsite": Integrated Flood Risk Analysis and Management Methodologies', speaker: D. Leśniewska.

Year 5
Task completed, no actions taken in Year 5.

2.26 *Partner 29* - AUTh

Task 2 – Estimation of Extremes

AUTh is a member of the research team, concentrating in particular on spatial analysis of extreme values. During Years 1-3 of the FLOODsite project, AUTh proceeded in the analysis and application of the methodologies developed for estimating joint probabilities of extreme spatial surge events, of extreme wave heights and surges, as well as extreme wave heights and wave periods. AUTh's research team also examined the existence of trends and seasonal components in metocean signals. AUTh had respectively 4.0, 8.0 and 3.0 actual Person months in Task 2. In Year 3, AUTh's research team contributed to the Technical Report for Task 2.

A member of the AUTh team participated at the 2nd Workshop of FLOODsite (Annual Meeting) in Delft, the Netherlands (14-16 February 2005) and at the Task 2 FLOODsite Project Workshop in Brussels (13-14 October 2005). The research team of AUTh participated, represented by one person at the Task 2 Meeting (13 February 2006) and at the 3rd Workshop of FLOODsite (Annual Meeting) in Braunschweig (13-16 February 2006). Also, one person from the team took part in the Task 2 Meeting in Brussels (15 June 2006), in the 4th Workshop of FLOODsite (Annual Meeting) in Dresden, Germany (5-9 February 2007) and in the FLOODsite Partner General Assembly Meeting and Flood Risk Management and Research into Practice Conference in Oxford, UK (29 September - 2 October 2008).

During the five years of the FLOODsite project, the AUTh research team, participated and presented papers in the following conferences: 1) XXXI IAHR Congress, Korea 2005 (11-16 September 2005), 2) Nat. Conference on Coastal Engineering and Management, Athens 2005 (21-24 November 2005), 3) 1st International Conference on Coastal Zone Management and Engineering in the Middle East, Dubai 2005 (27-29 November 2005), 4) XXXIII IAHR Congress, Venice 2007 (1-6 July 2007), 5) ICCE 2008, Hamburg, Germany (31 August- 5 September 2008), 6) The European Conference on Flood Risk Management and Research into Practice : FLOODrisk 2008 (30 September- 2 October 2008).

Task 3 – Contribution to the European Flood Hazard Atlas

AUTh is a member of the research team, concentrating in particular on reviewing methods and techniques for coastal flood risk prediction. During Years 3-5, currently available methods for forecasting variables relating to coastal flooding and currently used models for flood inundation where reviewed and presented. AUTh had 2.0, 1.0 and 0.5 planned and 2.0, 1.0 and 0.5 actual Person-months in Task 3 during Years 3, 4 and 5, respectively. AUTh contributed to the report: "Review on Flood Hazard Mapping", Technical FLOODsite Report T03-07-01. During Year 4 AUTh prepared the expanded version of the report: "Review on Flood Hazard Mapping":
FLOODsite/ Integrated Flood Risk Analysis and Management Methodologies, 2007 - Review on Flood Hazard Mapping, Technical report T03-07-01

AUTh presented at the Task 3 Meeting in Brussels (15 November 2006) the following presentation:
Prinos, P. and Galiatsatou, P., 2006, Models and Techniques for Flood Hazard Mapping, Brussels 2006.

A member of the AUTh team participated in the 4th Workshop of FLOODsite (Annual Meeting) in Dresden, Germany (5-9 February 2007), where a Task 3 Meeting took place. Also, a member of the AUTh team participated in the 3rd meeting of EXCIMAP (14-15 December 2006, Hague, the Netherlands), where he presented the Task 3 activities with regard to flood hazard mapping and an overall view of the FLOODsite project.

During the five years period of the project the following journal papers were published:

1. Galiatsatou, P., Prinos, P., (2008), "Statistical models for bivariate extremal analysis of a spatial process", Journal of Hydraulic Research, Vol. 46, Extra Issue 2, pp 257-270

2. Galiatsatou, P., Prinos, P., Sanchez-Arcilla, A., (2008), "Estimation of extremes. Conventional versus Bayesian techniques", Journal of Hydraulic Research, Vol. 46, Extra Issue 2, pp 211-223

3. Sanchez-Arcilla, A., Gomez-Aguar, J., Egozcue, J.J., Ortego, M.I., Galiatsatou, P., Prinos, P., (2008), "Extremes from scarce data. The role of Bayesian and scaling techniques in reducing uncertainty", Journal of Hydraulic Research, Vol. 46, Extra Issue 2, pp 224-234

Another journal paper is under review :

4. Galiatsatou, P., Prinos, P., (2008), "Modeling non-Stationary extreme waves using a point process approach and wavelets", Journal of Waterway, Port, Coastal, and Ocean Engineering, ASCE

Other papers written and presented in conferences during the five years of the project are:

1. Galiatsatou, P., Prinos, P., Krestenitis, Y., (2005), "Bivariate extreme analysis of atmospheric pressure in the Aegean sea", Proc. XXXI IAHR Congress, Korea 2005, pp. 3677-3686

2. Galiatsatou, P., Prinos, P., (2005), " Flood risk analysis and management in coastal areas-The European Program FLOODsite", Proc. Nat. Conference on Coastal Engineering and Management, Athens 2005, pp 225-236

3. Galiatsatou, P., Prinos, P., (2005), "Analysis of extreme coastal events using POT methodologies", Proc. Nat. Conference on Coastal Engineering and Management, Athens 2005, pp 545-556

4. Galiatsatou, P., Prinos, P., (2005), "Analysis of dependence in a bivariate process of extreme waves and surges", Proc. 1st International Conference on Coastal Zone Management and Engineering in the Middle East, Dubai 2005, pp 221-225

5. Galiatsatou, P., Prinos, P., (2006), "Probability of occurrence of extreme rainfall events in northern Greece", Proc. International Conference on Protection and Restoration of the Environment, Chania 2006, pp 329-330

6. Galiatsatou, P., Prinos, P., Krestenitis, Y., (2006), "Bivariate analysis of extreme waves", Nat. Symposium on Oceanography and Fishery, Thessaloniki 2006 (full paper in the cd of the Conference)

7. Galiatsatou, P., Prinos, P., (2006), "Analysis of extreme rainfall events using a Poisson process", Proc. 10th Nat. Conference E.Y.E, Xanthi 2006, Greece, pp 47-54

8. Galiatsatou, P., Prinos, P., (2007), "Estimation of extreme storm surges using a spatial linkage assumption", XXXIII Congress of IAHR, pp 754 (abstract), full paper in the Conference CD-Theme D2.b Risk Analysis

9. Galiatsatou, P., Prinos, P., (2007), "Outliers and trend detection tests in rainfall extremes", XXXIII Congress of IAHR, pp 125 (abstract), full paper in the Conference CD-Theme B2.c Extreme Events

10. Galiatsatou, P., Prinos, P., (2007), "Joint exceedance probabilities of extreme waves and storm surges", XXXIII Congress of IAHR, pp 780 (abstract), full paper in the Conference CD- JFK Competition

11. Galiatsatou, P., Prinos, P., (2008), "Bivariate analysis and joint exceedance probabilities of extreme wave heights and periods", ICCE 2008, Hamburg, Germany (abstract in the CD of the Proceedings - full paper accepted for publication)

12. Galiatsatou, P., Prinos, P., (2008), "Analysis of extreme waves using wavelets", Proc. Nat. Conference on Coastal Engineering and Management, Lesvos 2008, pp 23-32

13. Galiatsatou, P., Samaras, A., Prinos, P., (2008), "Extreme events and risk of coastal flooding", Proc. Nat. Conference on Coastal Engineering and Management, Lesvos 2008, pp 105-114

14. Galiatsatou, P., Prinos, P., (2008), "Non-stationary point process models for extreme storm surges", Flood Risk Management Research into Practice 2008, Oxford, UK

One book chapter was also prepared during the five years of the project:

1. Prinos, P., Galiatsatou, P., (2008), "Coastal Flooding: Analysis and Assessment of Risk", Handbook of Coastal and Ocean Engineering, Chapter 38 (in press)

2.27 Partner 31 - UoP

Task 2 – Estimation of Extremes

University of Plymouth is a member of the research team, concentrating in particular on the development and application of resampling methods for quantifying uncertainty in extreme value estimates. UoP focussed on using resampling techniques in order to determine the best fit to specific families of distribution functions. Defining a robust error norm is one promising method which was pursued.

The work in Year 1 involved the development of the methodologies, meeting with other Task researchers and assisting in planning the work programme with regard to data exchanges. In Year 2, further methodological development took place, including investigation of appropriate error norms to measure 'goodness-of-fit'. Suitable datasets for analysis were also identified at this time. In Year 3 the methodology was applied to several datasets including wave data from Duck (USA), Alghero (Italy) and Ebro (Spain). The methodology, information on the application sites and results were prepared for Deliverable D2.1 to which we contributed, and which prepared for the transfer of this research knowledge and guidance into the project team as a whole, and beyond. We have also contributed the preparation of the Task Research Implementation Plan document and regular reporting documents. The bulk of the technical work was completed by the end of Year 3, and work beyond this has comprised dissemination activities such as reporting, meetings and conferences.

Major cost items were the employment of a researcher, travel and subsistence for attending meetings.

Task 5 – Predicting morphological changes in rivers, estuaries and the coast

The UoP contribution to this task was Task management and a contribution to the work on morphological change at the coast. In particular, UoP's contribution was the development of a new ensemble forecasting beach model which was validated against wave and beach level measurements from Christchurch Bay, UK.

The Task management activities, including organisation of meeting, disseminating and gathering information from Task partners and reporting, continued throughout the duration of the project. On the technical side, the work in Year 1 was mainly the development of the methodologies, meeting with other Task researchers. In Year 2, further methodological development took place, including investigation of a range of different approaches to ensemble beach forecasting. In Year 3 a suitable dataset was identified for testing and the methodology was applied to this. The methodology, information on the application sites and results were prepared for Deliverable D5.1, which UoP coordinated. We have also coordinated the preparation of the Task Research Implementation Plan document. The bulk of the technical work was completed by the end of Year 3, and work beyond this has comprised dissemination activities such as reporting, meetings and conferences.

Major cost items were the employment of a researcher, travel and subsistence for attending meetings.

2.28 Partner 33 – ISIG

YEAR 1

Task 11 – Risk perception community behaviour and social resilience

Development of a common survey approach, joint specification of tasks for each partner; definition of criteria for site selection, interviews with local qualified informers, preliminary drafts of protocols for fieldwork.

Task 32 – Networking and Harmonisation

Contribution to "Language of Risk" document

There was a deviation from the planned cost budget with regard to person/month: 0.67 p/m were used instead of the planned 3 p/m. This is due to the delay of a month in task 11 activities. ISIG staff (Bruna De Marchi) contributed with 1 p/m, working on tasks, attending project meetings and networking with partners.

YEAR 2

Task 11 – Risk perception community behaviour and social resilience

ISIG spent 10.7 p/m effort in Year 2 of the project, working in close collaboration with the other participants, UFZ and MU/FHRC, and moreover with partner 16 UniPad. ISIG's effort was directed to the preparation and implementation of fieldwork in the Italian Adige river basin. The preparation of fieldwork included: establishment of criteria and procedures for site selection; visits to candidate sites; collection of information from local sources such as statistical services, public servants, and elected officers; definition of preliminary research hypotheses; establishment of sampling principles and survey technical procedures; completion of interview, focus group and survey protocols and questionnaires; training of 8 interviewers. The implementation of fieldwork in the four sites in the province of Trento (Bocenago, Vermiglio, Romagnano, Roverè della Luna) included: 4 focus group discussions with local stakeholders and analysis of results; 20 pre-structured interviews with qualified informers and analysis of results; 20 face to face pre-testing of the survey questionnaire; consequent refinement of the questionnaire; face to face submission of 400 questionnaires in four sites; revision and control of filled-in questionnaires; coding of responses to pre-structured questions and transcription of responses to open questions; preparation of SPSS Syntax and Data Document; first run of frequency distributions for closed questions. ISIG staff (Bruna De Marchi and Maura Del Zotto) contributed to all phases of the work with a total of 5 p/m.
There was an increase in the p/m spent (10.7) with respect to those originally planned (8.67), mostly spent for fieldwork, i.e. face-to-face submission of questionnaires in the Trento area.

Task 35 – Project coordination

The audit for Y1 was completed, and the relative cost of 249 euros was included in the Y2 cost statement. This was due to late communication that no yearly audit was necessary, but just a single one might be presented at the end of the project.

YEAR 3

Task 11 – Risk perception community behaviour and social resilience

ISIG spent 9.3 person/months in Year 3 of the project, working in close collaboration with the partners involved in Task 11, UFZ and MU/FHRC, and moreover with partner 16, UniPad.
The activities performed were the following:
preparation and implementation of fieldwork in the municipality of Vipiteno/Sterzing, in the Adige/Sarca river basin, Trentino Alto-Adige Region;

preparation and implementation of fieldwork in the municipality of Malborghetto-Valbruna, in the upper Tagliamento river basin, Friuli Venezia Giulia Region;
data treatment;
preparation of country Reports.

The preparation and implementation of fieldwork in Vipiteno/Sterzing included the revision and adaptation of the questionnaire used in the Trento area and its translation into German for submission to the German speaking population in the bilingual area of study. The implementation of fieldwork included: training of six interviewers and face to face submission of 186 questionnaires; revision and control of filled-in questionnaires; coding of responses to pre-structured questions and transcription of responses to open questions; preparation of SPSS Syntax and Data Document; data treatment.

The work was extended to include an extra case study in the Tagliamento river basin, which was not originally planned and was not included in the description of Task 11. The proposal was presented at the project meeting held in Braunschweig in February 2006, and met with no objections, provided that non more project resources were requested.

The preparation of fieldwork in the Tagliamento river basin included: visits to candidate sites; collection of information from local sources such as statistical services, public servants, and elected officers; final selection of site (Malborghetto-Valbruna municipality); establishment of survey technical procedures; completion of interview protocols; refinement of the questionnaire; training of four interviewers.

The implementation of fieldwork in Malborghetto-Valbruna included: 13 pre-structured interviews with qualified informers and analysis of results; face to face submission of 100 questionnaires; revision and control of filled-in questionnaires; coding of responses to pre-structured questions and transcription of responses to open questions; preparation of SPSS Syntax and Data Document; data treatment. Reports were prepared (in final form for the Trento area, in draft for the other sites). Also many dissemination activities were conducted in the areas of investigation.

The volume of effort was of 2.77 p/m, lower than the initially budgeted (12.07 p/m).

ISIG staff contributed significantly to all phases of the work, with a total of 4 p/m. In particular Bruna De Marchi was involved in preparation and implementation of fieldwork in Vipiteno Sterzing and Maura Del Zotto in data treatment.

YEAR 4

Task 11 – Risk perception community behaviour and social resilience

The year 4 resources have been devoted to: i) complete the data analysis; ii) complete the country report (M 11.3); iii) contribute to the cross-country report (M 11.4); iv) contribute to the preparation of the task 11 deliverable, “Recommendations for flood risk management with communities” (D.11.1). D11.1 has been conceived as a “living document” that will be discussed with various stakeholders at different occasions in the final months of the FLOODsite project in order to receive feedback from different stakeholders about its applicability and usefulness for effective and participated flood risk management.

Moreover several dissemination activities have been organised in Italy and abroad. Two rounds of feedback meetings took place in the Trento and Bolzano/Bozen area (two of the areas of fieldwork), involving officers from provincial services and agencies for civil protection, water resources, risk prevention and hydrology, members of voluntary fire brigade corps, local authorities and residents. Several articles abut such initiatives were published in local newspapers. Dissemination activities included also lectures in training courses, Master and Ph.D programmes, and conference participation.

A PhD thesis, “Le dinamiche sociali del rischio e della vulnerabilità. L’esperienza di Malborghetto-Valbruna”. (“The social dynamics of risk and vulnerability. The experience of Malborghetto-Valbruna”) based on fieldwork in the Tagliamento river, was prepared by Anna Scolobig, to be defended in the first half of 2008 at the University of Udine.

ISIG spent 4.57 person/months in Year 4 of the project. The volume of effort is considerably higher that initially budgeted (0.09 person months) mostly due to the postponement of tasks originally foreseen for Year 3, such as completion of the country report, contribution to the cross-country report and preparation of deliverable D 11.1 (see also Task 11 Activity Report).

YEAR 5

Task 11 – Risk perception community behaviour and social resilience

The main activities in Y5 consisted in refinement of data analysis, polishing of research reports, improvement of deliverable D11.1 (“Recommendations for flood risk management with communities at risk”), and dissemination of research results. The last activity was also aimed at collecting comments and suggestions to be fed into D11.1, which had been conceived as “a living document” to be finalised also on the basis of a constant dialogue between the research team and other social actors. Feedback from colleagues and stakeholders was sought and obtained, which allowed us to frame our policy recommendations as well as to identify areas and themes needing further research.
The major travel cost was incurred for attending the FLOODsite final conference in Oxford, 29th September - 3rd October 2008 (Anna Scolobig).
The volume of effort spent was 2 p/m, higher than the 0.09 p/m originally budgeted. This was due to the necessity of finalising and polishing reports and deliverables and to engage in dissemination activities. Moreover, ISIG staff (Maura Del Zotto) contributed with 0.3 p/m fore refinement of data analysis and reports.

Task 35 – Project coordination

Audit is in preparation for the Years 2, 3, 4, and 5. As specified above the audit for Y2 had already been submitted and included in the cost statement of Y2.

2.29 Partner 35 - UCL

Task 5 – Task Description

UCL was involved in Task 5 / Activity 2 together with HRW. UCL has worked on the example of the river Rhine (Action 2), as it appeared impossible to obtain suitable data from the pilot sites.

The results of this work are exploitable as demonstration of the morphological consequences of the presence of structures during a flood. A large part of the working time was spent in managing the data, prior to start the modelling work. This explains that more than the estimated 5.7 men month were needed (a total of 9 funded men-months instead of 5.7, but with lower unit cost in order to match the available budget). During year 2, the work was carried out by Nicolas le Grelle (6 man months as a researcher) then by Benoit Spinewine (3 month as doctoral grant, with a much lower cost). During year 3, additional unfounded work was carried by Benoit Spinewine (estimation: 3 men-months) and by Corrado Carena (MSc student, 4 man months). Years 4 (1 unfunded man-month) and 5 (0.5 unfunded man-month) were devoted to a paper and a communication (see below). Scientific guidance was offered by Yves Zech, UCL team leader, not funded by the project, for a total estimated of 2 month.

A poster (Spinewine et al., 2007), covering the achievements, was presented during the 32nd IAHR Congress held in Venice. Also, a paper presenting the work in more details was published in the *Journal of Flood Risk Management* (Spinewine and Zech, 2009). This additional work took 1.5 men-months, covered by UCL own staff.

References:

- Spinewine B., Carena C., Zech Y. (2007), “Learning from the past to improve the future. An ex-post analysis of the German Upper Rhine”, *Proceedings 32nd Congress International Association of Hydraulic Engineering and Research, Venice, July 1-6, 2007*, 10 pages (CD-ROM proceedings)
- Spinewine B., Zech Y. "An ex-post analysis of the German Upper Rhine: data gathering and numerical modelling of morphological changes in the19th century", *Journal of Flood Risk Management* Vol. 1 (1), pp. 57-68

Task 8 – Task Description

UCL spent a significant time in contacts with FLOOD*site* partners to identify pilot sites suitable for simulation under Task 8: data transmission and availability appeared difficult (contacts to obtain the data were carried out by Yves Zech, UCL team leader for 2 × 0.25 months, and Sandra Soares Frazão for 2 × 0.75 months, during Years 2 and 3).

Finally, a first model was established for the Scheldt case, using data provided by Delft Hydraulics. The data had the SOBEK format; it was thus first translated to be used with the UCL model. First computational runs were performed, with a good qualitative agreement with the SOBEK results. Then, simulation of the Scheldt pilot site was achieved during Year 3 and Year 4. The work consisted of:

- Detailed simulations of the 1953 flooding in the Scheldt area in the Netherlands using the UCL numerical model SV2D;
- Comparison with results obtained by WL|Delft hydraulics (now Deltares) by means of their SOBEK software;
- Submission and presentation of a paper to the River Flow 2008 conference held in Cesme, Turkey (Soares-Frazão et al., 2008).

The second pilot site that was first selected was the Adige River. Unfortunately, it appeared that the available data was not sufficient to do a complete flood simulation. Therefore, UCL proposed to use another test case, for which data are available and usable. It consists of the Brembo River, located also in Northern Italy, for which data were provided by the University of Pavia. These simulations took place mainly during Year 5 (5.0 men-months funded by FLOOD*site* instead of the 5.7 planned), and additional work by own staff). The work achieved during Year 5 consisted of:

- Preparation of a usable data set to perform the simulations;
- One-dimensional simulation of the flood in the Brembo river using the UCL numerical model SV1D;
- Comparison with results obtained by WL|Delft hydraulics (now Deltares) by means of their SOBEK software and results obtained by the University of Pavia by means of their two softwares ORSA1D and SANA;
- Submission of an abstract for the XXXIII IAHR Congress to be held in Vancouver, August 2009. The abstract is accepted, the paper is in preparation.

Additionally to the funded 5.0 men-month (Christine Dal Cin), works were carried out by unfunded UCL staff members (Yves Zech: 1.5 month of supervision and contacts with University of Pavia; Sandra Soares-Frazão: 3 months of supervision, contacts with University of Pavia and comparison works; Laurent Goutière: 2 months of computational works, Mirjana Velickovic: 3.5 months of computational works).

References:

- Soares-Frazao S., Asselman N., Velickovic M., Goutiere L., Zech Y., (2008), "Modelling of the 1953 inundation of the "Zuid Beveland" polders in the Netherlands", Proceedings River Flow 2008 International Conference on Fluvial hydraulics, Cesme, 3-5 September 2008, pp. 1745-1754.

Task 30 – Task Description

Although UCL was not explicitly involved in Task 30, a significant work was done to prepare the results from the simulations in the format required by the Task 30 persons. Several contacts were needed to allow for the presentation of our work in Task 8 on the project website.

Task 33 – Task Description

This task consists of all the required contacts and meeting required by the project management. Beside many informal contacts inside tasks 5 and 8, UCL participated to the following meetings:

- Participation of Yves Zech, Sandra Soares Frazão and Nicolas le Grelle to Theme 1.2 meeting in Brussels (19 January 2005)
- Participation of Yves Zech and Sandra Soares Frazão to the General workshop in Delft (14-16 February 2005)
- Participation of Yves Zech and Sandra Soares Frazão to the General workshop in Braunschweig (13-15 March 2006)
- Participation of Yves Zech and Sandra Soares Frazão to Task 5 meeting in Brussels (16 November 2006)
- Participation of Yves Zech and Sandra Soares Frazão to the General workshop in Dresden (5-8 February 2007)
- Participation of Yves Zech, Sandra Soares Frazão and Mirjana Velickovic to the General workshop in Grenoble (12-14 February 2008)

The following tables summarise the participation of funded and unfunded UCL staff members to the tasks 5 and 8, in which UCL was involved.

	Le Grelle	Spinewine	Dal Cin
<u>Task 5</u> Year 2	6.0	3.0	
<u>Task 8</u> Year 5			5.0

Funded men-months

	Zech	Soares-Frazão	Spinewine	Goutière	Velickovic	Carena	Total
Task 5							
Year 1	0.25	0.25					0.50
Year 2	1.00						1.00
Year 3	1.00		3.00			4.00	8.00
Year 4	0.50		0.50				1.00
Year 5			0.50				0.50
	2.75	0.00	4.00	0.00	0.00	4.00	11.00
Task 8							
Year 1	0.25	0.25					0.50
Year 2	0.25	0.75					1.00
Year 3	0.25	0.75		2.00			3.00
Year 4	0.50	1.00			1.50		3.00
Year 5	1.00	2.00			2.00		5.00
	2.25	5.00	0.00	2.00	3.50	0.00	12.50
Task 30							
Year 5		0.50					0.50
	0.00	0.50	0.00	0.00	0.00	0.00	0.50

Unfunded men-months

2.30 Partner 36 - INFRAM

Task 4 – Understanding and predicting failure modes

INFRAM was only involved in Task 4, with a limited budget. For this reason INFRAM's work was devoted to the first three years of FLOOD*site* only. No activities took place in the last two years. Workshops were only attended in the first three years.

INFRAM worked on the overtopping failure mechanism and gave an overall view of overflow tests performed in the Netherlands on real dikes and the results achieved. This gave insight in initiation of failure mechanisms due to overtopping and this was used to verify or update the limit state equations. INFRAM had an active role in establishing all the failure mechanism descriptions, which are now in the main results of Task 4, the report "Failure Mechanisms for Flood Defence Structure (Report Number T04-06-01).

During the project it became clear that the idea of the Wave Overtopping Simulator could be developed and real tests on dikes could be performed. The work was not financed by FLOODsite, but were matching funds. Results have been presented and discussed during workshops and various presentations and papers were given at conferences. Wave overtopping tests were performed on a dike with normal protection (grass on clay), on a reinforced section with a geotextile in the grass cover, and finally on a section with bare clay. Results were incorporated in the relevant failure mechanisms.

2.31 Partner 37 - UniBo

Task 16 – Real-time guidance for flash-flood risk management

This task is related to task 15 and aims to identify the best method for allowing the evaluation of flash flood risk at a regional level. The two existing approaches for this are: (1) using 'classical' detailed hydrologic models, and (2) using the so-called Flash Flood Guidance FFG concept that directly links rain or discharge thresholds to levels of risk.

UniBo contributed to this task with a total of 14.01 person/months as scheduled.

Part of the work of UNIBO in (4.5 person/month) was mainly devoted to develop the Bayesian Rainfall Threshold method to be implemented in all the pilot sites of the task.
The aim of this procedure is to determine the FFG rainfall depth and compute FFG-values based on the minimisation of a Bayesian Loss Function of the discharge conditional upon the state of saturation of the catchment. One of the limits of the method is represented by the excessive data requirement. As a matter of fact, the minimization of the expected cost of flood warning upon which the rainfall threshold is computed needs an estimation of the joint probability density function between the rainfall volume at a fixed duration, V(T), and the peak of the discharge following a time interval equal to the concentration time of the catchment, Qp The estimation of the empirical (i.e. based on the data) joint probability density function requires a large amount of data and therefore long rainfall and discharge time series (e.g. thousands of years). Since it is not possible to find such observed long time series, they are synthetically reproduced by a rainfall-runoff model calibrated on the observed discharge data and fed by a stochastic rainfall model calibrated on the observed rainfall data. This chain of models can then replicate rainfall and discharge time series as long as required. The joint probability density function is then estimated following a classical Monte Carlo approach. This methodology will be hereafter referred to as BRTMC (Bayesian Rainfall Threshold using a Monte Carlo approach).

To overcome the limit of the BRTMC methodology, a second methodology has been recently developed by UniBo hereafter referred to as BRTNQT (Bayesian Rainfall Threshold using the Normal Quantile Transform). The difference with BRTMC consists in the inference of the joint probability density. Instead of the classical Monte Carlo approach the inference of the joint PDF is performed by transforming the two variables, V(T) and Qp, into two standard normally distributed variables by means of the Normal Quantile Transform (NQT). This procedure ensures, by construction, that the marginal distribution of the variables are standard normal, but does not guarantee that the joint PDF is multivariate standard normal distribution. Therefore generally the normality of the joint distribution must be tested by comparing the empirical (based on the data) distribution with the theoretical form or existing goodness of fitting test. The NQT leads to the inference of the meta-Gaussian joint PDF which can be performed using a much smaller amount of data then the BRTMC (e.g. tens of years).

During the third year, the BRTNQT has been developed and implemented such that the only data requirement is the rainfall and discharge time series (for the joint PDF inference) and the average soil moisture time series which conditions the rainfall thresholds. The average soil moisture conditions, which often necessitates to be simulated by a rainfall-runoff model, can be substituted with a reliable antecedent conditions index (such as API, AMC, etc..) computed based on the precipitation. A computer program which performs the BRTNQT methodology has been developed and implemented on the pilot basins.

Moreover, UniBo also developed a procedure for the evaluation of the different FFG methods. This procedure has three options: the evaluation is performed on the basis of (i) the expected cost of the flood warning system defined by a utility cost function or (ii) the score of the contingency table or (iii) some forecast skill scores such as the hit rate and the false-alarm rate.

UniBo has also contributed the preparation of the Activity Report for this task.

The work of UNIBO in year 4 (6.5 person/month) was devoted to develop the Bayesian Rainfall Threshold method using the Normal Quantile Transform and to implement it on the catchment studied. One of the limits of the original Bayesian Rainfall Threshold (BRTMC) is represented by the excessive data requirement. To overcome the limit of the original methodology, a new methodology has been developed by UniBo hereafter referred to as BRTNQT (Bayesian Rainfall Threshold using the Normal Quantile Transform). During the year 4, the BRTNQT has been developed and implemented such that the only data requirement is the rainfall and discharge time series (for the joint PDF inference) and the average soil moisture time series which conditions the rainfall thresholds. The average soil moisture conditions, which often necessitates to be simulated by a rainfall-runoff model, can be substituted with a reliable antecedent conditions index (such as API, AMC, etc…) computed based on the precipitation. A computer program which performs the BRTNQT methodology has been developed and implemented on the pilot basins.

Moreover, UniBo also developed a procedure for the evaluation of the different FFG methods. This procedure has three options: the evaluation is performed on the basis of (i) the expected cost of the flood warning system defined by a utility cost function or (ii) the score of the contingency table or (iii) some forecast skill scores such as the hit rate and the false-alarm rate.

No work has been done in year 5.

Task 33 – Assessment and review

This task was introduced into the project in response to the guidance for contract negotiation; a total of 0.34 person/months effort has been given to the Task. Assessment and review activities undertaken have included establishing and setting out terms of reference for:

- the Project Board (PB)
- the Scientific and Technical Advisory Board (STAB)

Prof. Ezio Todini participated at the FLOODsite workshops, participated to the STAB and he is a member of the PB.

2.32 Partner 39 – CTU

Task 21– Task Description

Pilot Area Stropnice – Moldawa River Basin:

The assessment was based on available data measured before and after flood and mathematical models application. The only flood defence structure in the Upper Stropnice River watershed is the Humenice Reservoir. As the monitoring and mathematical model show, the Humenice Reservoir does not provide protection for such catastrophic floods like that in 2002 (return period 50-100 years). The reservoir was designed for protection against 5-year floods and is able to protect downstream areas to corresponding flood risk.

The detention capacity of the watershed was evaluated based on comparison of data from the past century. No significant changes of land-use during study period were detected. Subsequently, the risk evaluation of the flood origin in the pilot area was based on the generally accepted factors, such deforestation, wetlands changes, changes of the natural shape of the river channels, etc. The flood impact on river ecology was assessed. The flood cause changes in the morphology of the river channel. The study section of the river is minimally impacted by anthropogenic activity, it means that the flood occurrence follow natural pattern and the changes in river habitats also follow natural pattern which aquatic organisms are able to predict. The predictability of the changes in aquatic habitats allow organism to maximally avoid stress (hiding, life cycle follows the natural flow pattern, etc.), caused by changes in morphology and extreme water flow (hydraulic stress). The natural pattern of flood occurrence in natural rivers is the main reason why the devastation of the aquatic community is not as dramatic as it is observed in urban rivers, where the flood occurrence do not follow natural pattern and they are anthropogenically induce, therefore they are not predictable for the aquatic organisms. Organisms are not able to minimize their contact with stress. The behaviour of organism was observed during an artificial flood, when an impact of hydraulic stress on different species of benthic organisms was observed. Different level of tolerance of single species was observed. The evaluation of critical points and potential frictions areas show that they are having local character and the risk may be minimized by following the operational manual and its requirements on maintaining the river channel and the banks in good conditions.

During the project more than 15 organizations were contacted and close cooperation with local governmental and municipal organization was established.

Overall Task 21 person months 11 funded by FLOODsite.

2.33 Partner 40 - GRAHI-UPC

Task 1 – Identification of flash flood hazards

The GRAHI-UPC contribution to this task is focused in the parameterisation of hydrological models (Activity 4 of Task 1). GRAHI-UPC has analyzed the way to parameterize the DiCHiTop distributed hydrological model in poorly gauged or ungauged basins. Data from the Hydrometeorological Observatory of Catalunya has been used to test the proposed methodology. In particular, data from the Besos flash-flood pilot basin (1020 km^2) and the Anoia basin (904 km^2, tributary of the Llobregat river) and respective subcatchments have been used to cross-validate the methodology from one catchment to another. The study has implied the hydrological characterization of the different catchments, and the application of the hydrological model into them. Also, it has implied the identification of important measurable hydrogeomorphological features that can characterize the response of the catchment.

GRAHI-UPC has concluded the work within this activity, summarized in the Project Document T01-06-22. The total cost of the task has been 25.01 man/months, without deviations from the planned expenditures.

Task 23 – Pilot study of flash flood basins – monitoring and validation

Work done within Task 23 has been focused on the hydrological characterization of the Besos flash-flood pilot basin (1020 km^2) and on the implementation of an operational flood forecasting system for this catchment based on weather radar information.

The flood forecasting system (called EHIMI) has been developed and implemented in the ACA's (Agència Catalana de l'Aigua) control centre. A new generation of software tools have been designed in order to fit the new and future requirements. Experience during the FLOODsite project and interaction with ACA's staff has guided this platform in three main aspects: 1) Visualization tools, evolving to a easy-to-use and easy-to-interpret platform; 2) Modularisation of the system, related to the optimisation of the computations in the server, improvements in real-time data acquisition and storage, and operational radar data management and processing; 3) New capabilities and processed information offered to the decision makers, synthesizing spatially distributed warnings over the land.

Compilation and processing of hydrometeorological data from the Besos area (in the Hydrometeorological Observatory of Catalunya) has been done during the years of the project. These data have been used to adjust the flood forecasting system, mainly the radar processing and the distributed hydrological model. Data from selected events have been used in the work made in Task 1, and also have been shared to Task 20 for the analysis of hydrological uncertainty. In addition, the DiCHiTop hydrological model has been adapted to fit into the web-based knowledge platform developed in Task 30, allowing an interactive execution of the model.

An implementation of a radar-based rainfall nowcasting technique was made (now operational), and the analysis of its implications in runoff forecasts using the multiple step ahead methodology (in different subcatchments of the Besos basin), led to some interesting conclusions from a spatial scale perspective (first results published in 2005).

An interesting point of confluence with Task 23 was EWASE, a R&D project within the ERA-NET CRUE integrated project supported by the European Commission under FP6. In accordance to FLOODsite objectives, the final purpose of this project was to relate economic efforts needed to implement efficient flood warning systems with the expected reduction of damages, in zones prone to be affected by flash-floods. This project has involved the application of three distributed rainfall-runoff models in two different basins (the Besos basin in Catalunya, Spain, and the Traisen basin, in Austria).

GRAHI-UPC has concluded the work within this activity. The total cost of the task has been 27.94 man/months, without deviations from the planned expenditures.

Task 33 – Assessment and review

Resources devoted to this task (0.09 months) has been used in the management of the project and the preparation of reports.

2.34 Partner 43 – TU Dres

Task 1 (Identification of Flash Flood Hazards):
The chair of hydrology (TU Dres) was one of five task partners. Its activities started in November 2004 and finished in January 2006 whereas all in Task 1 originally planned person months (5.75) have been spent. Milestones as well as deliverables are achieved – the expected results can shortly be summarized as follows: The available rainfall-runoff models do not allow for an acceptable prediction accuracy, especially for extreme events in small catchments. The aim was to develop a simple updating procedure that allows (for the updating of sensitive state variables) to control the runoff generation approach of an appropriate rainfall runoff model. Two models were investigated: first the model WASIM-ETH which was too complex for the envisaged purpose. As an alternative the more conceptual rainfall-runoff model PREVAH was tested and finally implemented describing the catchment characteristics by using hydrologic response units (HRU). Runoff generation processes are represented by linear reservoirs. This allows for the adjustment of the pre-event state of the system, i.e. the soil moisture content using a simple procedure based on the comparison between the predicted and the measured development of the flood wave. Several tests of the updating procedure using data from mountainous catchments in Switzerland and Germany showed a significant increase in prediction accuracy with respect to peak discharge at a very early state of the flood.

Task 15 (Radar and Satellite Observation of Storm Rainfall for Flash-flood Forecasting in Small and Medium-size Basins):

The aim of this Task was the development of a radar and satellite Structured Algorithm System (SAS) for quantitative precipitation estimation (QPE) at the space and timescales of interest for flash-flood analysis and prediction. Thereby, the part of the TU Dresden was to develop a satellite based SAS for detecting extreme storm rainfall by using highly resolved geostationary satellite data (Meteosat-6, Meteosat-8). This has been done by building up a twofolded SAS, one part based on Meteosat-6 Rapid Scan data (M6/RS-SAS) and the second part based on Meteosat-8 data (MSG-SAS). Both parts include several rainfall estimation techniques. Three heavy precipitation events in orographic distinct and consequently flash flood prone regions (Alto Adige, Cévennes-Vivarais, Saxony) have been examined by applying these techniques with regard to the possibilities of detecting storm rainfalls by using satellite data.
For validation and as a reference radar data of the co-operation partners INPG (Institut National Polytechnique de Grenoble) and UniPad (University of Padua) have been used. The Saxon event has been compared to radar data of the DWD (Deutscher Wetterdienst).
To correct the estimated rain rates concerning the orographic situation, the wind and moisture conditions and the cloud growth rate additional data like MPEF products and radiosondes were included in the M6/RS-SAS. The rain rates resulting from the MSG-SAS were corrected in respect of the moisture conditions of the environment and the growing or decaying of the raining clouds.

The work of the meteorology team of TU Dres has been finished in month 42 and was reported by a deliverable. A total of 7.04 person months was available for this task that has been spent completely.

Task 21 (Pilot Study River Elbe Basin):
Within task 21 all three working groups of TU Dres (meteorology, hydrology, and soil science group) were involved in the case study of the Mulde catchment.

Group of Hydrology
Based on a comprehensive data analysis rainfall- runoff models for the upper Mulde catchment which covers an area of altogether 5340 km² were set up and verified. Within this process a reservoir module was developed and implemented in the model system. Following the classification of future climate trends as defined by the International Panel on Climate Change (IPCC, 2001a) rainfall series derived from future climate scenarios (A2 and B1) were used to investigate flood characteristics under possible future climatic conditions. The results of these investigations show no significant change of

the hydrologic characteristics compared to the average hydrologic characteristics of the last 90 years. However, the rainfall series derived from the future climate scenarios covered only the period from 2091 to 2100 which is too short to allow for a comprehensive comparison. In order to deliver flood hydrographs with high recurrence intervals to the project partners who intend to do the hydraulic modelling and flood risk analysis we applied the method of the mean standardised hydrograph (DYCK 1979). The generated flood hydrographs were submitted to the project partners concerned.

Group of Meteorology
There were three objectives for the working group of meteorology. The first objective was the use and analysis of regionalised climate and climate forecasts along IPCC scenarios for the investigation of flood events. The daily data of the climate scenarios A2 and B1 calculated by a statistical-dynamic model after ENKE have been analysed for the mean realisation of the climatologic period 2071-2100 (most important: changes in frequency and amount of precipitation; temperature changes). To use these scenario data in the hydrological models they had to be downscaled to hourly data. This was realised by developing a weather generator for temporal downscaling what was the second objective.
The third objective was the statistical investigation of the future design precipitation. Therefore, the climate scenarios A2 and B1 have been analysed concerning the changes of the return period of a precipitation event [hN(D,t)] with a actual (summer 1951-2000) return period of 100 yrs and a duration of 24 hrs, 48 hrs and 72 hrs. It could be shown that a historical ‘100a return period’ rain will probably be a 65a (24hrs), 85a (48hrs), 97a (72hrs) rain by the end of the 21st century.
During the fifth project year TU Dres contributed the development of the DSS tool and the writing of the book on FLOOD*site* Research at European Pilot Sites. Further, the fifth year was used to write a final report.

Group of Soil Science
To assess the effectiveness of potential land-use changes the plot model LWF-BROOK90 was used. A rainfall-runoff model was applied for the Schwarze Pockau River (subcatchment of the Vereinigte Mulde) to scale up the results from the plot model and to consider the spatial distribution of runoff concentration components. The impact of the land-use is highly variable considering the rainfall event characteristics and the pre-event soil moisture due to the pre-event weather situation. For the Schwarze Pockau River two land-use scenarios (present land-use and potential natural vegetation) were compared in to investigate potential land-use effects.
Investigations confirm that adopted land use could be an efficient means of flood detention providing additional storage and transferring runoff into slower pathways. But there is a considerable lack of data for model parameterisation particularly with respect to short-term vegetation changes and their long-term effects on soil properties. Our investigation in the catchment of the upper *Mulde* explored the impact of afforestation measures on the soil hydraulic properties. ‘False chronosequences’ were used to quantify the time-dependent dynamical character of such changes. Four plots were identified at a test area with comparable pedological start conditions and a set of tree stands of different age. An increased conductivity and a higher portion of coarse/middle pores were observed corresponding to the age of the tree stands. Compared to the vegetation parameters these soil effects are generally not simulated in rainfall-runoff models concerning land-use scenarios.

Within Task 21 two subcontracts were planned. One was closed with the IfT (*Institut für Troposphärenforschung*) Leipzig and had an amount equivalent of 2.0 person months. Subject of the research done by the IfT was an estimation of the maximum physically possible precipitation in Saxony by means of an atmospheric model, executed for different climate scenarios. The work was finished during the fifth project year and delivered by a technical report.
The second subcontract was not concluded. The planned work of this subcontract (climate change data and analysis of future precipitation and future design precipitation) has been done by TU Dres. The subcontractor originally planned provided the data at no costs. Hence, in agreement with the coordinator, the foreseen budget equivalent of 2.0 person months was used at the TU Dres.

For Task 21, TU Dres had a total of originally 15.74 person months and an equivalent of about 4.0 person months for subcontracting. All have been spent until the end of the fifth project year.

Task 31 (Face to Face Knowledge Transfer):

TU Dres is one of three task partners and in cooperation with UniPad delivering a European Master platform on "Integrated Flood Risk Management". The flood related teaching modules have been established at the Dresden University of Technology (supported by national funding) under the title "Flood Risk Management of Extreme of Floods - FLOODmaster" as part of the master course "Hydro Science and Engineering" and as a basis for a common European Master Course. The FLOODmaster modules are open to students from abroad and professionals. To successful students a FLOODmaster certificate is awarded. Experiences, documentation materials and expertise developed and achieved during the ongoing FLOOD*master* project mainly web based for download and interactive use are available and are included in the FEM (Task 31) of FLOODsite.

Up to now, four courses have been finished. Many of the students in hydrology and geography meet the challenge to study FRM additionally to the "standard duties". Furthermore, there is an increasing number of external professionals taking the course besides of the students from Hydro Science and Engineering – the group the modules was designed for – finishing the one-year programme.
The units have been supported by more than 60 experts representing 16 national and 7 international institutions. The development of the study programme is advised by a scientific committee and closely linked to national (BMBF-research activity RIMAX) and international partners and activities (EU Integrated Project FLOODsite).

The web site of the study programme was updated to a learning management system. Thus, the teaching material is now web-based for download and interactive use as study material for university lectures as well as e-learning conditions (on a password basis). This facilitates options for inter-linking master courses all-over Europe as a requirement of an open European educational platform offered to graduates and professionals of national and international universities, research institutions, administration, and consultancies.

This task had a total of 6.05 person months that were spent until the end of the fourth project year.

Task 33 – Assessment and Review

In this task, the total of 0.46 person months was spent for preparing all regular research and financial reports and for attending all yearly team workshops. Further, Prof. Christian Bernhofer is a member of the STAB and he participated in the STAB meetings.

2.35 Partner 44 - UFZ

Task 9 – Guidelines for socio-economic Flood Damage Evaluation

This task is meant to achieve two major objectives: first, to perform a country study on flood damage evaluation methods in EU countries, and second, to write a guideline document on flood damage evaluation. UFZ is co-ordinating this task.
The work on the country studies, which was done by UFZ scientists alone, was completed in November 2005 (month 21). This work included literature review and expert interviews in the UK, the Netherlands, Czech Republic and Germany. The final research output was a country study report available on the FLOODsite-website.
With regard to the guideline document, UFZ collected and edited all individual guideline chapters from the task partners and contributed with two major guideline chapters. UFZ prepared a first draft for the final deliverable document in March 2006 and sent this around among experts for a revision process. Based on the comments received the guideline document was revised in January 2007. The final deliverable of this task was then delivered at the beginning of February 2007.

Altogether 11.87 person month were used for Task 9.

Task 10 – Socio-economic and ecological evaluation methodologies

The overall objective of this task is to focus research efforts on innovative methods to understand, model and evaluate flood damages and other flood losses. Among the four sub-tasks dealt with in task 10, UFZ research focuses on the methodological foundation of multicriteria evaluation to evaluate flood damage and flood risk under uncertainty, referring in particular to GIS-based damage models.
The work done in Task 10 included:

- Literature review of the existing GIS-based MCA approaches
- Identification, enhancement and testing of different MCA approaches appropriate for the assessment of flood risks and flood damages able to process GIS-based information and to consider uncertainty of data
- Building up exemplary GIS data with information on economic, social and ecological flood risks for an area in the Mulde basin pilot region (task 21)
- Application of two different GIS-based multicriteria risk assessment approaches to the Mulde test site and production of multicriteria risk maps for this area
- Development of an alpha-version of a software tool which supports both, the risk calculation and mapping of single criteria as well as the multi-criteria analysis.

One scientist was financed for altogether 12.63 person months.

Task 11 – Risk perception, community behaviour and social resilience

The objective of Task 11 is to better understand the impact of floods on communities and the latter's capability to respond and recover from such events. Based on questionnaire surveys and further data collection in different EU countries, the task provides a better understanding of subjective perceptions, the collective preparedness and capabilities of communities at risk and recently affected, respectively, from a bottom-up perspective which in many respects differs from decision-makers' evaluations. Understanding how communities cope in flood events, how they respond, how they behave, etc. is valuable information to share with those yet to be impacted and with time to prepare, as well as with those agencies responding to flood events. The work done in Task 11 involved:

- coming to a better and more critical understanding of buzzwords of natural hazards research, such as vulnerability and resilience, in a social-science context,
- the application of these concepts to disastrous flood events in European welfare societies,
- the review of a number of vulnerability indices used in social-science flood research,
- in-depth analyses of flood risk perception, community behaviour and factors significant for social resilience in three European regions,
- a cross-cultural comparison of these findings and

- the formulation of recommendations to flood risk professionals for flood risk management with the people at risk.

One doctoral student was financed in this task, summing up to 27.04 person months.

Task 21 - Pilot Study River Elbe Basin

The pilot study for the Elbe River aims at a comprehensive development and testing of the FLOODsite methodology under the conditions of a large European river basin. With regard to hydrodynamic modelling a quasi 2D-approach (HEC-RAS) was applied to the Lower Mulde river. Applying this model, water stages of different recurrence intervals (1:10, 1:25, 1:50, 1:100, 1:200, 1:500) were calculated for two water way construction scenarios (with and without the planned measures of the official flood protection concept). Furthermore, GIS-data on assets at risk in the Lower Mulde catchment were gathered. Combining this data with the inundation scenarios mentioned above, social, economic and environmental flood damages and risks were calculated and then aggregated to a multicriteria risk map. This was done by means of the multicriteria risk assessment and mapping approach developed in Task 10. Several UFZ scientists, who are also involved in the tasks 9, 10 and 11, are also involved in task 21. Their contributions amount to 20.07 person months in the whole project.

Task 22 – Pilot Study of the River Tisza

The pilot study for the Tisza River aims at testing some of the FLOODsite-methodology under the specific setting of Eastern European countries. UFZ scientists delivered an inventory of pollution sources and fate of pollutants for the River basin. Furthermore, UFZ was involved in a scenario analysis which aimed at raising the flood conveyance capacity of the flood bed. EU funds were used to finance a UFZ scientist for 9.91 person months.

Task 33 – Assessment and review

Frank Messner as the leader of sub-theme 1.3 had a function as consultant to the boards (PB, STAB and AIB) with regard to vulnerability and assessment issues. In this function he also took part in one meeting of the Project Board (PB). A total of 0.19 person month has been given to the task.

2.36 Partner 45 - UNEW

Task 20 – Task Description

Newcastle University led Task 20. Research at Newcastle University was conducted by Dr Hamish Harvey (12 months), Dr Roger Peppe (18 months) and Dr Mark Tarver (5 months) who undertook the following activities:

- Conceptual development of the framework for the influence and impact of uncertainty.
- Conceptual development of an approach supporting the modular definition and execution of complex flood risk analysis studies including rigorous uncertainty analysis.
- A simple illustrative case study (completed and written up).
- Implementation and testing of the Reframe software framework for supporting the modular definition and execution of complex flood risk analysis studies including rigorous uncertainty analysis.
- Implementation of a web-based interface.
- Writing up into a final report and two papers in a special issue of the Journal of River Basin Management (Volume 6, Issue 2)
- Contribution of web-based dissemination material for use in Task 30

The main use of resources was in staff time for Drs Harvey and Peppe. Travel and subsistence funds were used for travel to meetings, conferences and other dissemination activities. Modest consumables were required, commensurate with an office-based theoretical, software development and application activity.

The work was supervised by Prof Jim Hall who also contributed to methodological development, writing up and dissemination of the work through numerous presentations at international conference and meetings. As overall Task leader, Prof Hall also oversaw the successful research activities in Task 20 taking place at UNESCO-IHE.

Task 24 – Task Description

Newcastle University have participated in Task 24 through application of techniques for robust decision making under uncertainty to the Thames case study site. Specifically the work involved application to the Thames Estuary of info-gap decision analysis under uncertainty. The work was carried out by Dr Hamish Harvey, who spent 5 months on the study. The work was supervised by Prof Jim Hall who also contributed to methodological development, writing up and dissemination of the work.