Case Study Report Multidisciplinary Project Hanoi, Vietnam

What research can be performed?

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Masterproject Hue

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The work of this project group consists of the following reports:

I. Main report
II. Case study report
III. Fieldwork report

All reports are available by sending an email to
mail@masterprojecthue.com or internationaloffice-citg@tudelft.nl

Content

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Introduction

In this report the cases as described in the main report of the 'Masterproject Hue' are presented in full detail. Each case study has a similar structure, to make them as uniform as possible. It is tried to match the 'difficulty level' of the case with the expected final level of the master students, but some fine-tuning will always be needed before commencing the actual assignment. Case studies that are very broad (with different angles of approach) are described from the point of view of a certain stakeholder. However, this is not bounding, but more a possible direction towards specifying the subject.

Case 1-6 are related to Disaster Management, case 7-12 to Coastal Engineering and 13-21 to Water (resources) Management. Case 22, climate change, is a case that can be applied on all sectors and is therefore not classified into one of the three disciplines. The Coastal Engineering cases require somewhat more theory and challenge the students to make use of (process based) models, while the Water Management cases are more pointed at finding practical solutions for problems. The Disaster Management cases require quite some theoretical background, but with a lot of space for creative solutions. It should be noticed that there is much overlap between the categories; reservoirs influence almost every aspect as does climate change. The details about these relations can be found in the main report of this project group.

The main components of the case descriptions are:

Introduction
A short introduction towards the field of research, with a description of general aspects concerning the topic and sometimes with some examples.

Problem description
A description of the actual problem(s) concerning the topic, often multiple problems are present, which are described briefly.

Objective
To give a clear goal for each case, an objective is formulated: what should be handed in to solve the problem? Depending on the time available for the case study the objective could be elaborated or reduced, also depending on the requirements of the student's mentor.

Approach
An indication of the steps that could be taken to find a good solution for the case. These steps are not obligatory but give a first idea for a work plan, and how to reach the objectives as described above. Often the word 'implementation' is used, which has the context 'how to make the solution feasible', or in other words: how can the solution be constructed, and how can the right permits be gathered e.g. which institutions ministries etc. need to be contacted.

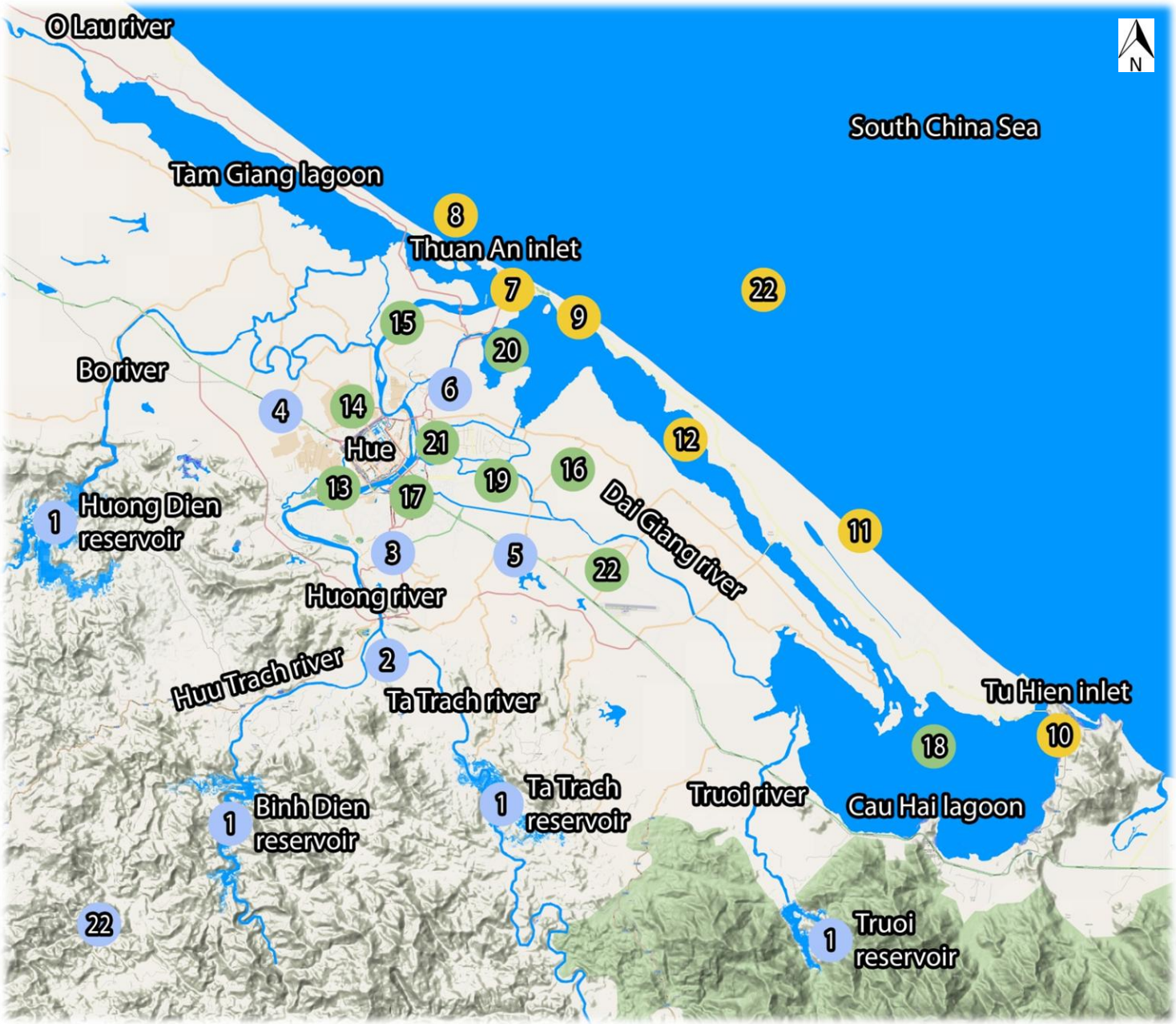
Literature and other references that can be used
For each case study three references or literature sources are provided. Not all of the references are stated in the text itself, but can be used when attending the case study.

Photos[1]
In addition to the general structure each case has two relevant photos of the actual area, to accompany the text and to give some context.

[1] Photos at the end of the case are taken by the project group itself, all images in top of the cases are free of copyright.

Overview of case relations.

In the map below an overview of the cases is given: each case is represented by its number and placed on a representative location. The relations between the cases are described in the general report of the project group 'Masterproject Hue', which is available by sending an email to InternationalOffice-CITG@tudelft.nl.



Case 1: Dams and reservoirs

Master plan for using existing infrastructure to regulate river discharges

Keywords: water management, infrastructure, soil erosion, hydropower, irrigation water, flood retention, salt intrusion



Introduction
Reservoir regulation is often a complicated problem due to the large number of stakeholders involved, each with their own interests. Especially in the Hue area, where multiple reservoirs are acting in the same basin, strict regulation should be applied. Due to the wet and dry season the use of reservoirs is extensive and complicated: a lot of possible functions of reservoirs can be applied in this region.

Problem description
At this moment reservoirs are not controlled by a central organization. In addition, the occurrence of a distinct wet and dry season makes the operations even harder, since capacity limits of the reservoirs are sometimes met (Van Thang, 2009).

The main conflicting interests in the region are, amongst others: irrigation, waterpower, flood retention, preventing salt intrusion, water supply for domestic use and safety of the dam itself. Where waterpower preferably needs a constant supply of water with a high head, flood prevention asks for an empty reservoir for most of the time. To prevent salt intrusion discharges should be higher during the dry season, which means that the reservoir should be filled at the end of the raining season. This implies additional risk to the reservoir itself, since there are limits to the retention volume.
The already occurring soil erosion is intensifying due to the construction of dams and reservoirs, intensification of agriculture and other human related activities such as deforestation and an increasing urbanization. The soil erosion enlarges the risks of damage to nature, infrastructure, etc.

Objective
The approach depends on the stakeholder represented. Nevertheless, optimization should be in the context of the whole area: simple optimization for one stakeholder is not sufficient. In addition, the regulation and impact of multiple reservoirs needs to be taken into account.

Advised general structure of the research

- Determine the main priority for the reservoirs and the corresponding preferred regulation per stakeholder (literature study);
- Asses the current situation for the reservoirs concerning erosion-sedimentation and social economic impact (fieldwork);
- Propose improvements to the existing regulation by combining stakeholder preferences;
- Develop a master plan for the regulation of the reservoirs influencing the Huong River;
- Determine if additional reservoirs can help to prevent future flooding;
- Map the soil erosion problems due to the construction of dams and reservoirs should be made;
- Propose mitigation measurements to prevent (or minimize) future damage to inhabitants and nature in the Hue area.

Literature and other references that can be used

International Rivers Network. (2001, July 1st). Planned Dams in Vietnam. Retrieved September 20, 2013, from International Rivers: http://www.internationalrivers.org/resources/planned-dams-in-vietnam-4079

Nguyen, D., & Hawkins, K. B. (2011, September 1st). Vietnam: Vietnam Power Development Plan for the 2011-2020 Period. Retrieved September 24, 2013, from http://www.mondaq.com/x/144632/Renewables/Vietnam+Power+Development+Plan+for+the+20112020+Period

Masterproject Hue Main Report; TU Delft and WRU, 2013. Available via internationaloffice-citg@tudelft.nl

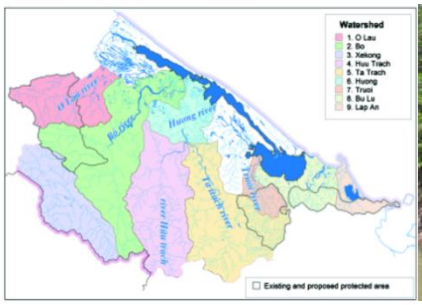
The Ta Trach reservoir in construction.

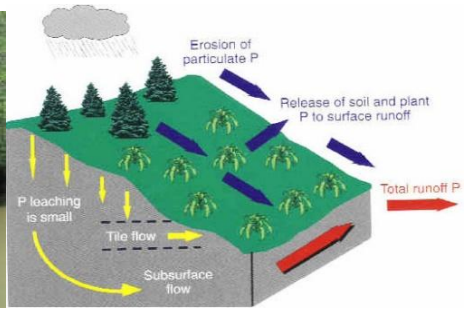
The downstream side of the Truoi reservoir, due to the bare land around the water stream it can be concluded that larger flows occur quite regularly.

Case 2: Rainwater runoff

Effects of the watershed characteristics on the runoff relationships in the Thua Thien-Hue province

Keywords: water management, watershed, runoff, remote sensing





Introduction

The runoff of rainwater towards a river system is mainly governed by the characteristics (size, slope, shape and vegetation) of the surrounding (mountainous) area. An urban area for example has different runoff characteristic than a rural area, resulting in different behaviour of the high water waves in the river: fast runoff causes a steep and 'high' high water wave, while forests spread the runoff in the river over time. Especially human interventions in nature will change runoff characteristics, mostly by deforestation but also by the construction of dams and reservoirs and urbanization (sewage channels, proofing the surface).

Problem description

The runoff characteristics of Thua Thien-Hue province are such that it takes only a few hours for precipitation to reach the river system, resulting in short warning times, steep and especially high flood waves and thus potential flooding. The short warning times give people little time to prepare for floods (get to safe ground and limit damage to property), which in turn can cause substantial damage in both social as economic aspects. An additional aspect is reservoir regulation: for reservoirs it is desired to know how fast the water reaches the reservoirs.

Objective

In order to be capable to provide better flood predictions, it is necessary that the characteristics of the watersheds in relation to the runoff are better understood. It is therefore desirable to precisely map the runoff characteristics. Better flood predictions can then be used for adaptation measures in the city of Hue and for reservoir regulation. It is advised to choose a certain stakeholder (city of Hue, reservoir management, ecological institute) to give a clear goal for the research.

Advised general structure of the research

- Confine the area of interest: upstream or downstream of the reservoirs;
- Index the available research and data towards the hydrological behaviour of the confined area (literature study);
- Indentify the characteristics of the surface: land use, type of soil, slope etc. (fieldwork);
- Calculate the runoff indices of the watersheds, including their lag time en variation, and analyse their influence on the occurrence of a high water wave;
- Model the high water wave based on a representative precipitation event and its deformation in time;
- Conclude which measures can be taken to improve city safety e.g. improve riverbanks, heighten dikes, warning system etc.

Literature and other references that can be used

Bao, T. Q. (2012).The effects of watershed characteristics on storm runoff relationships in VietnamGhosh, A. (2010). Water management in developing country: A case study of a watershed development program in the state of Bihar, India

Vishnudas, S. (2006). Sustainable Watershed Management, Kerala State India

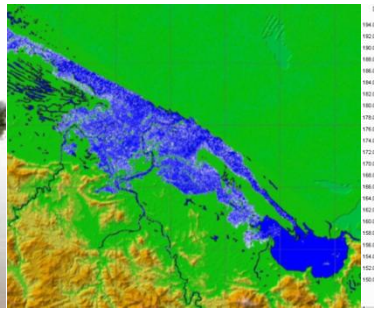
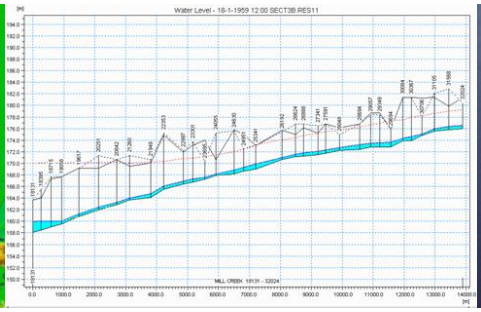
Different runoff characteristics on this mountain hill due to deforestation and different types of trees.

Urbanization changes the runoff time of large areas.

Case 3: Flood hazard

The assessment of potential flood events, flood frequencies, duration, extent, inundation depths and flow velocities in the Thua Thien-Hue area

Keywords: river engineering, flooding, remote sensing, numerical modelling


Introduction

With the current (state of the art) modelling in science, we are able to provide much more information concerning flooding than for example 50 years ago. Knowledge from hydrology and hydraulics enable us to assess the probability of floods including the extent, depth and duration better. Geotechnical knowledge provides information about the strength of the flood protection system and the probability of failure. Geographic information systems combined with economic and casualty prediction models can estimate the potential risk. Hence, risk can be determined (risk = probability x damage) and the most effective measures can be taken accordingly.

Flood hazard modelling is an attempt to understand and manage the mechanisms that are present in the waterway and the floodplains during severe rain. Since it is advantageous to anticipate on floods before they occur, this is a field of research that is getting more and more important.

Problem description

In the recent past several large floods have caused disasters in Southeast Asia. Historical floods have always been present, but both the frequency of floods as the human activity in the flood plains has increased. The flooding of the Thua Thien-Hue province is a serious problem for the region, which gets even more complex due to the combination of an extended flat territory and the frequent occurrence of tropical storms. Flooding in the area can occur very fast due to the relatively short rivers, but a clear overview of the 'weak' areas is missing.

Objective

This case is meant to produce flood maps, indicating which areas flood at what time during a certain extend. These flood maps can then be used to implement evacuation plans, or to prioritize measurements in the area; which depends on the stakeholder chosen or appointed for this case.

Advised general structure of the research

- Analyse historical floods in both frequency, cause and development in time to determine a representative flood wave for a certain return time (literature study);
- Indicate which current protection is present in the city of Hue, and which parts of the city should be protected with corresponding priority, e.g. imperial city, industrial area etc. (fieldwork);
- Model the representative flood wave in for example a computer program like SOBEK (Deltares) by first developing a digital elevation model (DEM) based on GIS-data;
- Assess the modelled flooding of the area;
- Propose solutions to improve the safety of the city of Hue (keep flooding out);
- Take the effects of climate change into account.

Literature and other references that can be used

Thuc, T. (2010). Impacts of climate change on water resources in the Huong River basin and adaptation measures

Villegas, P. (2004). Flood modelling in Perfume river basin, Hue Province, Vietnam

Vriend, H.J.; Havinga, H.; Prooijen, B.C.; Visser, P.J.; Wang, Z.B. (2011). River Engineering, lecture notes CT4345

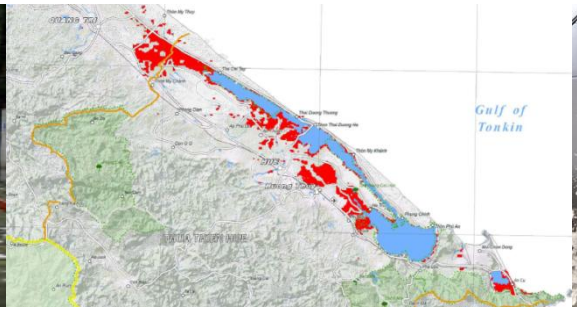
How safe are these river embankments? And how often do they flood?

The present embankments sometimes just stop, thus making the risk of flooding higher.

Case 4: Managing flood risks

Analyse and reduce the effects of flooding in the Thua Thien-Hue area

Keywords: river engineering, flooding, remote sensing, risk analysis, economic optimization

Introduction

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Flood risk management is based on a three-step approach. The first step is the analysis of the flood hazard (Case 3). The second part is the calculation of the risk by taking the product of the probability of the flood events and the corresponding consequence (risk = probability x consequence). The third step is providing information to evaluate the flood risk.

Problem description

This case study is focused on the second and third step of flood risk management. Assuming that certain regions (in the city) will be flooded, which parts of those regions are the most vulnerable and where does the flood cause most damage? This applies to both social (casualties) as economic (industrial) aspects.

Objective

An analysis and evaluation of the flood risk should be made based on the flood maps produced by flood hazard modelling. This is a combination between the flood characteristics, such as water depth and flow velocity, with evacuation efficiency and vulnerability including economic activity of inhabitants. It is advised to use the HIS-SSM model (Deltares), because it combines economic damage and different types of land use. The result should be applicable to evacuation planning, which is the main stakeholder (including the government) for this case.

Advised general structure of the research

- Divide Hue city in certain areas (literature study);
- Analyse the city of Hue: determine the value of the areas and the potential damage (literature study, fieldwork);
- Assess the risk of flooding of the areas;
- Propose measurements for flood prevention in the city itself (when the city is actually flooded, prevent damage to certain areas).

Literature and other references that can be used

CUR-publication 190, "Probabilities in civil engineering, Part 1: Probabilistic design in theory", March 1997, CUR Foundation, Gouda

IMOLA (2007). Assessment of the impact of the yearly flood and develop strategies and tools in Tam Giang and Cau Hai Lagoon

Ministry of Agriculture and Rural Development. (2007). National strategy for natural disaster prevention, response and mitigation to 2020. Hanoi.

The water level in 1999 even reached up to 0.5 meters.

The 'dikes' along this part of the river do not look very reassuring at this moment, but on the other hand: does this region have a high priority?

Case 5: Inland damage control

Living in a flood prone area: inland damage control in the Thua Thien-Hue province

Keywords: river engineering, flooding, damage control, planning

versus

Introduction
Damage control is an important topic in regions like Hue, which suffers from frequent flooding. Although prevention is often the most applied way to minimize damage, possibilities to take preventive actions can be difficult or expensive. Therefore, other possibilities should be found to reduce or even avoid damage. Inland damage control does not have to do with preventing the disaster event, but with minimisation of the damage caused by such an event. Proper damage control could save a lot of economic damage and casualties in Thua Thien-Hue province.

Problem definition
In past floods (1981-2005) a lot of casualties and damage were reported in the Thua Thien-Hue province. Although the average number of casualties during flooding becomes smaller, the risks of casualties during extreme floods are increasing. The (economic) damage at infrastructure is increasing, since lack of infrastructure has a growing impact on the daily lives of the people in the area. Another problem appeared during the flood of November 1999: the water rose to such a height that the whole coastal barrier area was cut off. There was no electricity and it was impossible to enter the area by road, so what kind of structures can be designed to prevent such events from happening again?

Objective
This research focuses at improvements towards buildings and infrastructure in such a way that damage is minimized during disasters, especially floods. Due to climate change effects future floods might be more severe, therefore the solutions should also be suitable for larger floods than seen in the past. It is for example interesting to investigate what to do to avoid damage on sewerage and electricity networks, how to keep hospitals in operation and how to keep the areas accessible by road transport.

Advised general structure of the research:
- Determine vulnerable areas with the help of flood inundation maps, fieldwork and historical events (literature study, fieldwork);
- Indicate which infrastructure or buildings should be improved to minimize damage during a design flood;
- Propose improvements for the indicated infrastructure and buildings.

Literature and other references that can be used

Asia Disaster Reduction Center (ADRC). Report about the flooding in Hue in November 1999. Retrieved on September 12th, 2013 via link: http://www.adrc.asia/counterpart_report/vietnam_HUE_Flood991103.html

Ministry of Agriculture and Rural Development. (2007). National strategy for natural disaster prevention, response and mitigation to 2020. Hanoi.

Vietnam Rivers Network (VRN): Climate Change Adaptation. www.vrn.org.vn

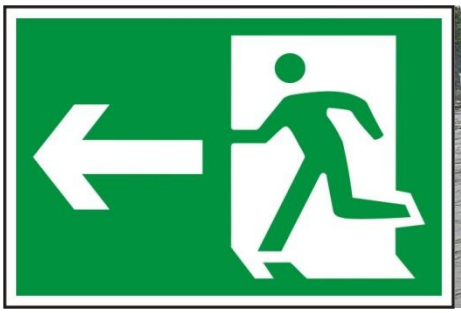
Houses on poles might be one of the solutions, although the design on this photo can be improved.

Brick and/or concrete walls do not necessarily mean safe housing...

Case 6: Evacuation planning

Master plan for increasing the evacuation progress during a flood event in the city of Hue

Keywords: river engineering, flooding, evacuation, planning



Introduction
An evacuation plan is a regulative procedure to get people out of a certain area during the occurrence of a disastrous event. In particular, in dense populated areas an evacuation plan is important to keep the number of deadly casualties during distress situations as low as possible. The city of Hue is a city which has to deal with floods but has no clear evacuation plan for such events.

Problem definition
It is very hard to predict large floods in advance: the most accurate measurements are precipitation amounts from the weather stations in the mountainous area and by remote sensing. In the Hue area only a short time is available between (severe) rainfall and flooding, which implies that measurements to keep the flood out usually cannot be taken in time. At the moment the area is not protected in a decent way, so the only option (besides damage control) is then to evacuate people out of dangerous areas. A clear evacuation plan is not available at the moment, which induces dangerous situations, especially in urban areas surrounding the lagoon.

Objective
The main objective of this case study is the development of an evacuation plan: what is the fastest way to evacuate people (and maybe also animals) to safer grounds? The time available should be indicated, and the needed logistical improvements to achieve evacuation in that time should be mapped. Finally, the implementation of the evacuation plan should be discussed.

Advised general structure of the research:
- Determine or assume the time available to evacuate people;
- Indicate the amount of people, animals and goods that need to be evacuated in case of a disaster event (literature study, fieldwork);
- Assess flood inundation maps, wherein specifically the land elevations should be taken into account;
- Research the available logistics to evacuate people (trucks, roads, police force);
- Determine logistical improvements needed to facilitate an evacuation in the provided time;
- Think of a strategy to implement the evacuation plan.

Literature and other references that can be used

Asia Disaster Reduction Centre (ADRC). Report about the flooding in Hue in November 1999. Retrieved on September 12th, 2013 via link: http://www.adrc.asia/counterpart_report/vietnam_HUE_Flood991103.html

Office of Critical Infrastructure Protection and Emergency Preparedness (2002): Strategic Planning Guide for the Evacuation of a Highly Urbanized Environment ISBN: 0-662-33946-0

Phuoc, N.K.T. (2007). Flood Hazard Modelling in Thua Thien-Hue Province, Vietnam

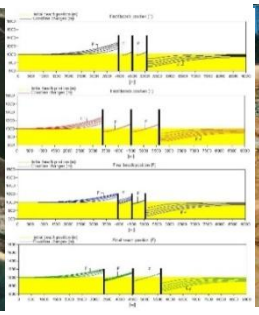
Small gates as here in the old Imperial City might proof a problem for fast evacuation.

These types of low bridges might get flooded, and may not provide enough capacity for a fast evacuation.

Case 7: Breakwaters built in the Thuan An inlet

The effect of the breakwaters around the Thuan An inlet on coastal and inlet stability

Keywords: coastal engineering, breakwaters, tidal inlet



Introduction

Lagoon systems can be found all over the world, often with just a few inlets connecting the lagoon to the sea. Many inlets are naturally unstable; the position, width, depth, etc. changes in time. This is governed by many factors, which makes it difficult to predict inlet changes in the future. For economic reasons (shipping, urbanization) it is often desired to fixate a tidal inlet. This is also the case at the Thuan An inlet, where several structures (a breakwater and jetties) have been built, aiming for inlet stabilization. These constructions aim to stabilize the inlet and ensure sufficient width and depth for shipping throughout the year. Already significant changes in the coastline can be seen around the inlet due to these hard structures. South of the southernmost jetty the coastline has almost migrated to the tip of the jetty and at the north side of the breakwaters sand has eroded.

Problem definition

The position of the structures is not optimal with respect to the dominant wave direction. In addition, the jetties show degradation due to displacement of armour units, failing of surrounding revetments and severe erosion under the armour units. For future planning the jetties and breakwater should be adjusted, extended or improved; which one should be investigated in this case.

Objective

Research for this case should focus on the effect of all the recently build structures on the adjacent coastline and inlet. Comparing the outcome of this research with the predicted effects enhances the knowledge on the Thuan An inlet stability, and makes it possible to make better predictions in the future. In addition, safety for the surrounding villages should be ensured. Therefore, measures should be investigated to further stabilize the inlet, which is needed since the east jetty is not adequate to stop erosion completely (Google Earth, 2013). Possibilities are the adjustment, movement or extension of the current breakwater and/or jetties, or by building new structures. Special attention should be paid towards the populated area south of the inlet and the former military airport to the southeast, which are delicate areas. To provide a clear goal for this research a stakeholder e.g. navigation, housing, sand mining etc. should be chosen.

Advised general structure of the research

- Make a detailed analysis of the current situation of the breakwaters and accretion/erosion processes by means of a site visit, interviews and historical data;
- Research effects of the structures in a historic perspective, and extrapolate these findings to the future concerning the chosen stakeholder;
- Research different possibilities to improve the structures, or propose locations for new ones;
- Combine implementation options with the best options for improved or new breakwaters to give an advise concerning your stakeholder.

Literature and other references that can be used

d'Angremond, K.; Van Roode, F.C. (2001): Breakwaters and closure dams ISBN: 90-407-2127-0
Lam, N.T. (2007). Morphodynamics of Hue tidal inlets, Vietnam
Masterproject Hue Fieldwork report; TU Delft and WRU, 2013. Available via internationaloffice-citg@tudelft.nl

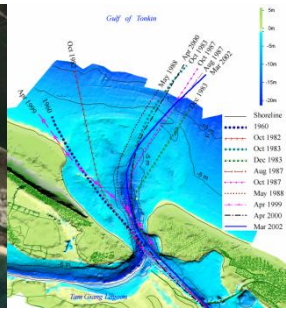
The west jetty, build with a modified Haros, looking towards the shore.

The north breakwater, build with Tetrapods, looking towards the lagoon.

Case 8: Stability of the Thuan An inlet

Research towards a solution for the instability of the Thuan An inlet

Keywords: coastal engineering, tidal inlet, numerical modelling



Introduction

Tidal inlets can be found along barrier coasts throughout the world. Tidal inlets play an important role in exchanging water and providing a navigational pathway for ships and small boats to travel between the oceans and sheltered waters. The importance of inlets is demonstrated by the increasing interests and the large number of inlet improvement activities for navigation across the world.

The Thuan An inlet is the northernmost inlet out of two connecting the Cau Hai lagoon with the South Chinese sea. The inlet is very dynamic and variable under the influences from the sea, flows and upstream rivers. During the cyclone Eve in November 1999 for example a new breach at Hoa Duan (4 km south of the Thuan An inlet) arose, which caused the Thuan An inlet to become very unstable. To reduce the instability (beside the closure of the Hoa Duan inlet), some structures like breakwaters and jetties have been placed in the recent past in order to stabilise the inlet.

Problem description

In previous decades the Thuan An inlet was acting as an unstable tidal inlet, which is a potential treat for the inlet-related activities. Seasonal closure and shoaling of tidal inlets cause a number of social and environmental concerns, such as risk of flooding in the low-lying coastal plain and negative impacts on navigation and fisheries; thereby harming the social-economic development of the region. The most important stakeholder is the shipping industry, which needs a certain guaranteed depth.

Objective

In this case study the stability of the Thuan An inlet should investigated, where after solutions for the instability should be proposed. To make clear which requirements the measures should have a certain stakeholder should be chosen, presumably the navigation industry. It should be made sure that the inlet stays navigable, a requirement which can be reached by several solutions, of which the best should be chosen. To assess the solutions it is advised to use process-based software like Delft3D, to take all the hydrodynamics and morphodynamics into account.

Advised general structure of the research:

- Analyse the historical behaviour of the tidal inlet, especially during dry and wet seasons (literature study)
- Indicate the dominant morphological processes in the (de)formation of the Thuan An inlet (fieldwork);
- Indicate the actual harm caused by the morphological processes, by looking at the economical and ecological values of the surroundings;
- Think of possible interventions to secure the objective for the stakeholder. Both 'hard' as 'soft' solutions should be proposed;
- Model the 'zero' scenario, a 'do nothing' scenario and the proposed solutions;
- Assess the modelled solutions by comparing them to the do nothing solution;
- Give an advise concerning the measures to be taken, or not to be taken;
- Think of implementation possibilities of the proposed solution.

Literature and other references that can be used

Lam, N.T. (2007). Morphodynamics of Hue tidal inlets, Vietnam
Lam, N.T. (2007). Hydrodynamic modelling of tidal inlets in Hue, Vietnam
Masterproject Main Fieldwork Report; TU Delft and WRU, 2013. Available via internationaloffice-citg@tudelft.nl

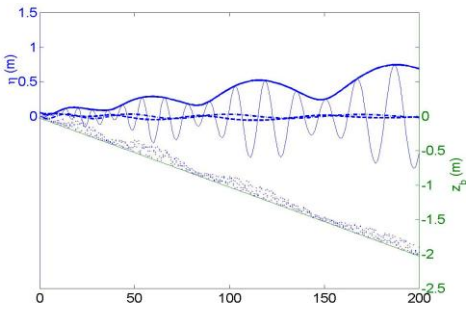
Broken revetments near the west jetty of the Thuan An inlet.

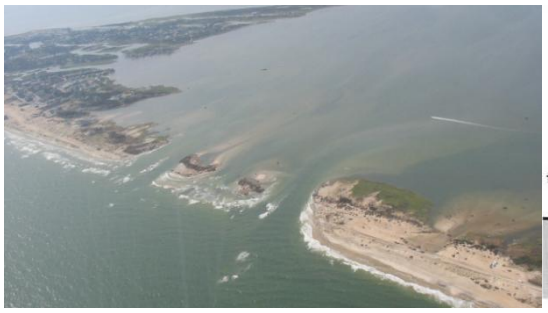
Large scale accretion at the north breakwater of the Thuan An inlet.

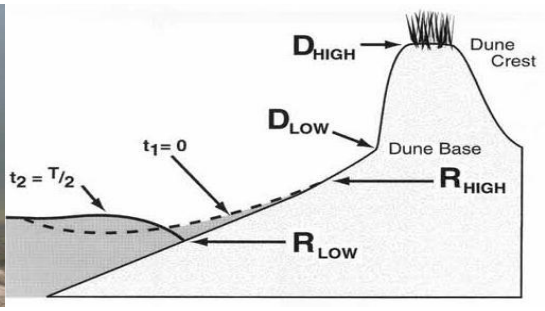
Case 9: Breaching of the coastal barrier

Investigate and limit potential breaching of the coastal barrier system around Hue

Keywords: coastal engineering, episodic erosion, breaching, numerical modelling







Introduction

Breaching is a phenomenon which occurs every year at several coasts around the world. It is a complex morphodynamic process which occurs most of the time in tropical storm areas. A breach in a coastal barrier is initiated due to a combination of storm surge, high river discharges and often some degree of erosion at forehand. At the bayside, a high water level may result from a large runoff in combination with a high tide and small inlets. From the seaward side the water level can be elevated by storm surges or high waves.

Historical data have shown that cyclone-induced coastal breaching can cause major losses of houses, boats, crops and human life; also thousands of people need to be evacuated. Breaches are therefore a major treat for cities with a natural coastal system, as is the case in the Hue area.

Problem description

Since the coastal barrier in the Thua Thien-Hue province in central Vietnam consists of a natural system, breaches can occur. Most breaches occur during the cyclone season, when both water setup due to strong winds and dune erosion due to waves occur simultaneously. In combination with heavy rainfall, breaching occurs near places where the river enters a lagoon because the inlets cannot flush all the water from the lagoon (Tuan, 2007).

Objective

In this case study first of all an analysis of the problem of breaching of the coast near Hue must be made starting with mapping of the weak spots in the coastal barrier. After this initial analysis solutions to increase the safety level of the system should be proposed, which can be done with both hard measures like seawalls as with soft measurements like nourishments. The coastal barrier system must be able to cope with a cyclone with a return period of 10 years and the implementation of improvements should be described.

Advised general structure of the research

- Perform a literature study toward the historical breaching processes in the coastal barrier (literature study);
- Determine current weak spots or possible threats in or to the coastal barrier, by indexing the occurring erosion and possible water levels (fieldwork). It is advised to use the software Xbeach (Deltares);
- Propose measurements for improvement of the safety level; possibly consisting out of new guidelines or regulations;
- Think of the implementation procedure for the newly proposed solutions.

Literature and other references that can be used

Lam, N.T. (2007). Morphodynamics of Hue tidal inlets, Vietnam
Tuan, T.Q. (2007). Seasonal breaching of coastal barriers
Tung, T.T. (2011). Morphodynamics of seasonally closed coastal inlets at the central coast of Vietnam

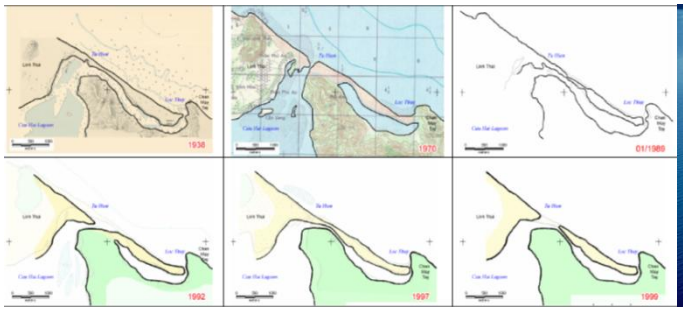
The sand dunes, with cultivated land in front of them.

The pile row which was used as a start to close the Hoa Diem breach in 2000.

Case 10: Stability of the Tu Hien inlet

Research towards a solution for the instability of the Tu Hien inlet

Keywords: coastal engineering, tidal inlet, numerical modelling


Introduction

Tidal inlets can be found along barrier coasts throughout the world. Tidal inlets play an important role in exchanging water and providing a navigational pathway for ships and small boats to travel between the oceans and sheltered waters. The importance of inlets is demonstrated by the increasing interests and the large number of inlet improvement activities for navigation across the world.

The Tu Hien inlet is the southernmost out of two inlets of the Cau Hai lagoon. The inlet is very dynamic and variable under the influences of the sea, flows and upstream rivers. In the time period from the early 19th century to the end of the 20th century, the Tu Hien inlet has experienced openings and closures many times due to extreme weather conditions caused by floods and storms. Although not a specific stakeholder can be appointed, the whole area benefits from the presence of the inlet: excessive water from the rivers can find its way to the ocean and thus prevents more severe flooding.

Problem description

As stated above, the Thu Hien inlet was and is acting as an unstable tidal inlet, which is a potential threat for the inlet-related activities. Seasonal closure and shoaling of tidal inlets cause a number of social and environmental concerns, such as risk of flooding in the low-lying coastal plain and negative impacts on navigation and fisheries; thereby harming the social-economic development of the region. A part of the dynamical behaviour can be seen by a quickly growing spit in the north, which even causes erosion on the south bank. This in turn is enforced by human interventions like deforestation and slash and burn.

Objective

In this case study the stability of the Tu Hien inlet should investigated, where after solutions for the instability should be proposed. To make clear which requirements the measures should have a certain stakeholder should be chosen, which in this case would mean the government (who wants to keep the inlet open). The stabilization of the inlet can be reached by several solutions, of which the best should be chosen. To assess the solutions it is advised to use process-based software like Delft3D, to take all the hydrodynamics and morphodynamics into account.

Advised general structure of the research:

- Analyse the historical behaviour of the tidal inlet, especially during dry and wet seasons;
- Indicate the dominant morphological processes in the (de)formation of the Thu Hien inlet;
- Indicate the actual harm caused by the morphological processes, by looking at the economical and ecological values of the surroundings and the erosion caused by the northern spit;
- Think of possible interventions to secure the objective for the stakeholder. Both 'hard' as 'soft' solutions should be proposed;
- Model the 'do nothing' scenario and the proposed solutions;
- Assess the modelled solutions by comparing them to the do nothing solution;
- Give an advise concerning the measures to be taken, or not to be taken;
- Think of implementation possibilities of the proposed solution.

Literature and other references that can be used

Lam, N.T. (2007). Morphodynamics of Hue tidal inlets, Vietnam
Lam, N.T. (2007). Hydrodynamic modelling of tidal inlets in Hue, Vietnam
Tung, T.T. (2011). Morphodynamics of seasonally closed coastal inlets at the central coast of Vietnam

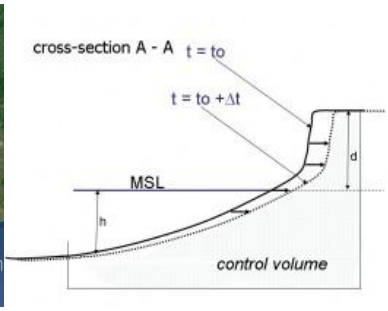
Structural coastal erosion on one side of the Tu Hien inlet, seen by the roots that lay bare....

...while a sand spit is growing on the other side.

Case 11: Structural dune erosion

Research towards finding solutions for the structural erosion of the coastal barrier system near Hue

Keywords: coastal engineering, structural dune erosion, numerical modelling



Introduction

Coastal dunes are valued for their aesthetic beauty and their ability to protect human-made structures by absorbing wave energy and blocking storm surges. In addition, coastal dunes are important as wildlife habitat. Erosion of dunes is a natural geological process, which may occur slowly over thousands of years or more or less instantaneous during storms. The erosion process is influenced greatly by sea level rise, accelerating the erosion process.

Problem description

In previous decades the coast of Hue has suffered from structural erosion which will potentially undermine the positive effects, and then specifically the safety function, of the coastal dunes as described in the introduction. This erosion especially threatens housing near the lagoons and basins in the Hue area, due to an increased risk of flooding.

Objective

The main objective of this case study is mapping the causes of structural erosion by analysing the current and past processes. By using this knowledge future estimates can be made including the proposing of solutions to reduce or even stop the occurring erosion. An additional research can be performed towards consequences of the structural dune erosion: what kind of problems will arise when no changes to the beach profile are made, as structural erosion continues and the sea level will rise significantly? To do so use should be made of a process-based model like Delft3D, which includes the coupling between hydrodynamics and morphodynamics.

To understand the current erosion, an analysis must be made of erosion in the past. Short term fluctuations and long term trends in dune-beach evolution need to be identified to understand the current and future erosion processes. This can be done with a data analysis of historical coastline profiles or with a 1D coastline model like Unibest CL+, which is able to model fluctuations in longshore transport.

Advised general structure of the research:

- Research structural erosion and consequences in the past (literature study);
- Make a detailed analysis of locations at the coastal system surrounding Hue where structural erosion is occurring (fieldwork);
- Analyse the occurring processes and make a division in short and long term processes;
- Indicate human impact on the current erosion;
- Model future scenarios;
- Model solutions to stop or reduce future erosion.

Literature and other references that can be used

Masterproject Hue Fieldwork report; TU Delft and WRU, 2013. Available via internationaloffice-citg@tudelft.nl

Tung, T.T. (2001). Coastal erosion along the sand barrier, case study in Hue Vietnam

Wind en wave data of the region: BMT ARGOSS

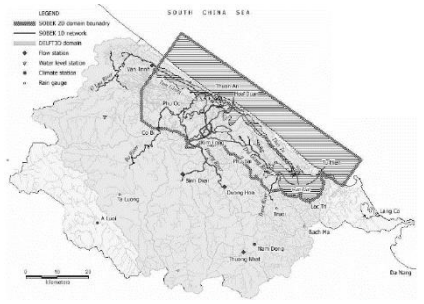
The cultivation in front of the dunes enhances erosion, since no sand is supplied.

Where the roots start, a large part of the erosion stops.

Case 12: Sediment balance lagoon

Researching the sediment balance in the Tam Giang-Cau Hai lagoon

Keywords: coastal engineering, lagoon, sediment balance, coastal zone management



Introduction
Lagoon systems are often very complex systems and are therefore difficult to model. Variable discharges and sediment supply from rivers, import and export of water, sediment transport through inlets and the hydrodynamics of the lagoon itself all greatly influence the morphodynamic system of the lagoon.

Three rivers discharge water and sediment in the Tam Giang-Cau Hai lagoon, which consists of two large and several smaller lagoons. The lagoon is connected to the ocean by two inlets. Considering the highly variable discharge of the rivers due to the wet and dry season, and the dynamic behaviour of the inlets, it is clear that it is a highly variable system.

Problem description
Already a lot of scientific research has been carried out on both the longshore transport along the coast as well as on the stability of the inlets. The basis for all these computations is the sediment balance. In most of the current computations use is made of average values, or values based on unreliable data; the division of the individual sediment sources is not well known.

Objective
By using information from past research in combination with new measurements, individual sources and sinks of sediment should be indicated. After this, it is possible to make an estimate of the sediment balance of the lagoon. With this sediment balance it is possible to assess erosion/sedimentation processes in the lagoon as a whole, and more reliable models can be developed. To get into more detail about the morphodynamics of the lagoon system, use can be made of a model like Delft3D (Deltares).

Advised general structure of the research
- Confine the research area: determine which parts will be taken into consideration (fieldwork);
- Indicate all sources and sinks in the lagoon area;
- Try to find information about the sediment transport of the indicated sources and sinks (literature study);
- Assess and compare the found data to historical observations;
- Describe and/or model the processes that occur in the lagoon.

Literature and other references that can be used

Lam, N.T. (2007). Morphodynamics of Hue tidal inlets, Vietnam

Lam, N.T. (2007). Hydrodynamic modeling of tidal inlets in Hue, Vietnam

Vriend, H.J.; Havinga, H.; Prooijen, B.C.; Visser, P.J.; Wang, Z.B. (2011). River Engineering, lecture notes CT4345

A high sediment concentration in the (Huong) River, as seen by the rainwater flowing into the river.

Human influence on the sediment balance, although small scale, on long term it does have an effect.

Case 13: Logistics of (sewage) water distribution in urban areas

Improving the sewage system and drinking water system to improve living standards

Keywords: water management, sewer system, waste water


Introduction

A good sewer system is one of the most important things to get the living standard to a higher level. Not only the hygiene of the area improves, but also the absence of smell and more recreational possibilities ameliorate the experience of the living area. The existing sewer system in the Hue City has mainly a drainage function (Lieu, 2010), which is a combination of sewers, channels, rivers and lakes. Sewers are connected to channels and rivers, which means that it is a half open combined sewer system.

The same can be said about the distribution of domestic water: a good distribution system has no leaks and provides water under such a pressure that no external pollution can get into the system.

Especially for economically fast developing countries as Vietnam, a good (sewer) water system has a high priority; which can be noticed by the governmental report called "Guidelines for Urban Drainage and Sewerage System Development Effective to Year 2020" where the Vietnamese government formulated the goal to increase the coverage of the sewer/drainage system in urban areas to at least 80% in 2020.

Problem definition

The sewer system of the city of Hue is quite old; it is build by the French in the colonial period in the mid 20th century. This old French sewer system is still in operation these days, but with more and more problems concerning the capacity, quality and maintenance. In addition, most of the sewer system drains to open water, without any purification of the sewage water. The coverage of the sewer system for the city of Hue is low and the capacity is by far inadequate. This leads to inundation during heavy rainfall and water pollution, since all waste and pollution in the streets is flushed into surface water. In addition, the connection rate of the city of Hue to the public sewer system is around 30%, and in the citadel around 56%. Houses which are not connected to the sewer system store waste water into septic tanks, which in turn are drained into the drainage system. However, lots of septic tanks have an inappropriate design which results in leaking of polluted water in the groundwater, which causes polluted intake for domestic use.

Besides concerns about quality of the domestic water itself (which is a different case), there are problems with the distribution. A lot of houses do not have access to tap water, and a lot of water (order 40%) is lost by leakage.

Objective

This case needs intensive fieldwork to develop an overview of the current distribution and sewage system, and to propose solutions to improve this system. Especially the capacity of the sewer system should be mentioned: during rainfall the sewer system should be able to discharge most of the rainwater. In addition, the distribution of sewage water should no longer take place via channels and lakes, but in a confined system.

By combining solutions or improvements to both the sewage as domestic water distribution, more cost effective construction works can be planned.

Advised general structure of the research

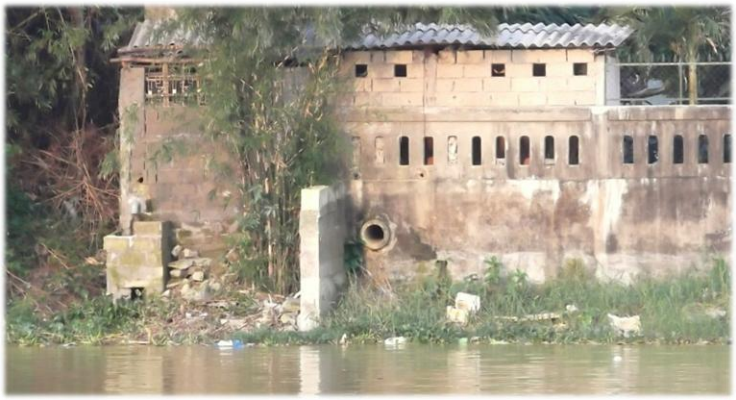
- Investigate the current system of the sewage and domestic water system of Hue; by determining for example capacity, coverage, estimated leakage and if the sewer system is combined or separated (fieldwork, literature study);
- Asses in which areas of the city problems will arise due to problems with the sewer system;
- Determine the needed improvements to reach the governmental standards;
- Propose solutions and improvements, including regulations for implementation.

Literature and other references that can be used

Lieu, P.K. (2010), Introduction to urban sanitation status in Hue City, Vietnam [lecture]

U.S. environmental protection agency (1991), Sewer system infrastructure analysis and rehabilitation. Handbook.

Van, N.K. & Huong, L.V. (2011), The impacts of social-economic activities on the environment of Huong River basin.



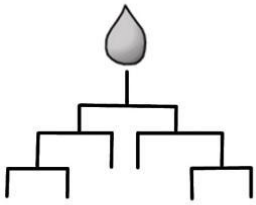
Sewage pipes draining in the river.

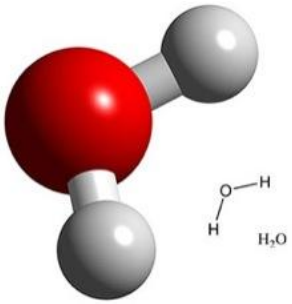
'Hidden' sewage pipes in the river.

Case 14: Requirements for water usage

Optimization of water usage by assessing the required quality

Keywords: water management, water allocation, conflicting interests





Introduction
In the Thua Thien-Hue province water is required for many different purposes, such as agriculture, hydropower, against salt intrusion or domestic use. For which purpose the water can be used depends on the quality of the water and its distribution possibilities. With the growing population in the Hue area, in combination with climate change effects, more and more conflicts will occur concerning the water distribution. Clear guidelines towards the requirements of the water could help to solve these conflicts faster.

Problem description
At this moment not all water is used in the most efficient way; water with a relatively high quality is sometimes used for purposes that do not require high quality water. On the other hand, there is often a shortage of high quality water in the city of Hue itself. In addition, it is expected that the wet periods will cause more floods and the dry periods more droughts due to climate change (Institute of Meteorological, Hydrological and Environment, 2008). This means that in dry seasons even less water will be available for the purposes stated earlier.

The quality of the water (especially the salinity) can be controlled to a certain degree by regulation of dams and reservoirs build upstream of the Huong river. This is an improvement towards a better water supply, but a shortage of water can still exist in some years (Masterproject Hue, 2013). To make most efficient use of the water clear requirements for different purposes should be stated in a type of regulation guideline, which is not present at the moment. Besides more efficient use of water, a distinction between essential activities and less essential activities can then be made with this guideline.

Objective
The main purpose of this research is to make a clear overview of the requirements towards water quality for different stakeholders and to give an advice concerning the most effective water distribution. Especially solutions for a more efficient use of water during dry periods are useful: water which is applicable for domestic use should not be used for irrigation, and vice versa. By stating which quality may be used for which purpose, a more durable approach towards water distribution can be achieved.

When it appears that a certain amount of water of a certain quality is available, solutions need to be proposed to improve the available amount. An example could be to reduce the salt water intrusion and thereby improving water quality downstream.

Advised general structure of the research

- Investigate and map all the stakeholders that use water in the dry season, determine their interests and prioritize their activities (fieldwork);
- Determine the needed water quality for the activities found (literature study);
- Assess the amount of water needed of each quality;
- Develop a plan for a more efficient way of using the available water;
- Come up with solutions if the required amount of water is bigger than available;
- Develop a guideline for the water distribution in years with a long dry season. This guideline should at least include how water should be distributed over the different stakeholders and how they are allowed to use the water.

Literature and other references that can be used

Huang, R., George, D.L., Birch, C.J. (2006), The agricultural water supply challenge – The need for improved water use efficiency.

Masterproject Hue Fieldwork report; TU Delft and WRU, 2013. Available via internationaloffice-citg@tudelft.nl

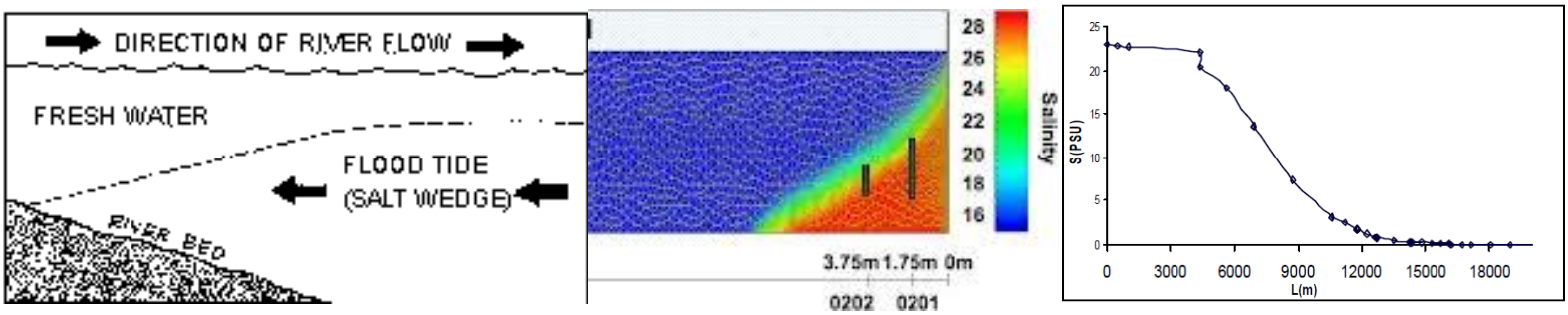
The World Health Organisation (WHO) has all types of regulations towards different qualities for different purposes. www.who.int/en/

Domestic use of water needs other requirements than for example agricultural use (below).

Case 15: Saltwater intrusion

The effects of salt intrusion in the Huong river

Keywords: water management, salt intrusion



Introduction

Intrusion of salt water into a particular freshwater area is a phenomenon that often occurs in coastal areas due to groundwater flows or an opening in the sea defence. Because saline water has higher density then fresh water, a salt wedge can be manifested: the saline water flows inland 'beneath' the fresher water, causing salinisation of the groundwater. The Huong river has large discharges for some months of the year but during the dry season the discharge is insufficient to prevent serious salt water intrusion.

Problem definition

The Huong river is the main source for both agricultural irrigation (rice paddies) and domestic water intake. With the large amounts of agriculture in the area, the demand for water of the Huong river is high. Low discharges during large periods of the year, the intake of water and sea level rise due to climate change cause saline water to intrude into the river. Beside the fact that the water is not useful for the earlier described intake, salinisation also causes problems for fisheries: a specific type of fish is caught in this area, which depends on a certain salinity ratio.

In the past some measures have been taken such as flushing the river by use of reservoirs or prevention of salt wedges with the Thao Long dam (with discharge sluices) but a good working solution has not been found yet. The current re-allocation of water by using the reservoirs to increase the water level downstream could significantly contribute to mitigating the hazard of saline water intrusion into the river.

Objective

Interesting is the effect of the existing and new constructed reservoirs on the salt intrusion in the river and how they impact the already executed measures. A possible tool to research this part is the software program MIKE 11. In addition, new measures which could be taken to mitigate the salt intrusion in the Huong river should be thought of. Possible additional measurement could be the construction of additional dams or setting up a so called 'bubble' line. New solutions should be assessed on social-economic values.

Advised general structure of the research

- Analyse the measurements taken in the past and their impact in the area;
- Analyse the current situation: where is the salt intruding and what effect do the new reservoirs have on this intrusion?
- Determine the problems involving the salt intrusion: what kind of difficulties do people experience?
- Propose new (regulation) measurements towards managing the salt intrusion;
- Assess the proposed measurements in a social economic perspective.

Literature and other references that can be used

Cat, V.M. (2012) Assessment of saline water intrusion into Huong River in Dry season

Ministry of Natural Resources and Environment (2009). Climate change sea level scenarios for Vietnam

NCAP Vietnam Studies (2012). Thua Thien-Hue Province, Huong River Basin and Phu Vang districts. Retrieved September 9th, 2013 via link: http://weadapt.org/knowledge-base/national-adaptation-planning/ncap-vietnam-study-sites

The Thao Long dam with its 15 gates.

Saltwater intrusion may cause groundwater to be useless, and therefore making agriculture very difficult.

Case 16: Agricultural use of water in the Thua Thien-Hue province

Requirements and optimization of the agricultural use of water

Keywords: water management, irrigation, rice production, water shortage



Introduction

Agriculture is a dominant economic activity in the Thua Thien-Hue province. The most important branches of agriculture are the rice production and the cultivation of shrimps. Rice production takes 64% of the gross output of the agricultural sector and provides 91% of the food production in the region (International Centre for Environmental Management 2001-2002). Agriculture is therefore a very important activity in the area, and since rice paddies need a lot of water, a big user of the available water resources.

Problem description

The challenge for the agricultural sector is twofold: first there is the availability of water and secondly the processing of waste water.

The total output of rice from agriculture between 1994 and 2000 increased approximately 70%, a process that had several reasons like higher economic returns and government policies. Expansion and intensification of the rice production cause pressure on the river basin and ecosystem of the lagoon due to the large amount of water which is needed (Wood & Halsema, 2008). The growing and more intensive rice production requires more water for irrigation. However, the amount of water, in particular in dry periods is limited. Even with the construction of dams upstream of the Huong river, limited water availability during the dry season exists.

Pesticides and other chemicals are used on the rice plants to protect the harvest. However, these pesticides will be distributed through the irrigation system into the Huong river after the water irrigation water is flushed away (Nguyen & de Vries). The Huong river transports the pesticides downstream to the lagoon, where they can cause severe damage to both shrimp farms and society, which directly uses the water for domestic purposes.

Objective

This research aims at the optimization of current irrigation processes to serve the growing and intensifying rice production with limited amount of water in dry periods. To do so it must be made clear where water intakes should be located, and at which time enough water is available. Therefore it should be known what kind of water amount is used at this moment; this immediately gives an estimate about the amount of polluted water that runs into the Huong river. Solutions towards optimization of irrigation and to minimize the water pollution need to be presented.

Advised general structure of the research

- Determine the current amount of water needed for agriculture and in what way the water is used (literature study, fieldwork);
- Analyse how the current irrigation systems function, and think of possibilities to optimise this process;
- Determine the needed quality for irrigation purposes, and present the best locations for water intake in combination with other stakeholders in the area;
- Propose improvements towards the (re)use of waste water, and how to prevent the intrusion of pesticides in the natural system;
- Think of ways to implement the proposed improvements.

Literature and other references that can be used

International Centre for Environmental Management. (2001-2002). Field Study: Vietnam, Thua Thien Hue Province.

Nguyen, N.T.T., de Vries, M.B., Redicting trends in water quality in the coastal zone of TT-Hue, Vietnam – An assessment of impacts of rice culture and Aquaculture

Wood, A., van Halsema G.E. (2008), Scoping agriculture-wetland interactions towards a sustainable multiple-response strategy.

Rice paddies need a lot of water

Shrimp farms need a certain water quality; otherwise shrimps will not survive like in this deserted shrimp farm.

Case 17: Domestic use of water in the Thua Thien-Hue province

Requirements and optimization of the domestic use of water

Keywords: water management, water allocation, rural areas, water quality



Introduction

Domestic use of water means water that is used in and around homes for things like food preparation, showering, (dish) washing, gardening and of course drinking. These tasks require a sufficient water quality (for both health and convenience) and enough availability throughout the year.
Along the Huong river the Thua Thien-Hue Water Supply and Drainage Company operates three water treatment plants for water supply of the city of Hue (International Centre for Environmental Management, 2001-2002)). The water supply in the city of Hue is really good; the tap water coverage is nearly 100%. However, somewhat outside the city the situation is different, where people are assigned to use other sources for water like wells or rain water.

Problem description

In rural areas in the Thua Thien-Hue province the coverage of drinking water is less than in the city: in the Dien Loc commune, for example, the coverage is 63.2% and in the Quang Ngan commune around 70.9%. The people that are not connected with the water service system use rainwater, water from wells or water from rivers and channels. From a hygienic point of view this is not desirable, especially since a lot of water is polluted to a certain degree (see for example the problem description of cases 16, 18 and 19). In the Loc Binh commune, well qualified domestic water is even very limited in the dry season, due to heavy metals in the water, complicated geology and shortage of fresh water in drilled wells (Lieu, Tuan & Giang, 2011). This last reason indicates difficulties with salinisation of groundwater, but also salinisation at water intake points is something that requires some attention.

Objective

It is useful for the local governance to know the state of the current problem and to know which steps should be taken in the future to improve the coverage of the water distribution outside of the city. In the developed overview, current aspects that influence both water quality and possible intake locations (like salt water intrusion and the presence of pesticides) should be presented.

Advised general structure of the research

- Analyse the current water supply system: where are the treatment plants and water intakes located, how is the water treated and how much water is distributed?
- Try to get insight in the tap water coverage for every district in the Thua Thien-Hue province.
- Analyse the quality of the water which is used by people that are not connected to the water service system to determine the 'profit' that could be reached by improvements.
- Propose solutions/improvements/guidelines to get the water distribution, especially in rural areas, to a higher level: give an advice towards the locations of water intake, the required level of treatment and an estimate for future capacity demands.

Literature and other references that can be used

Lieu, P.K., Tuan, T.A., Giang, N.B.(2011) Current status of public water access and use in rural area of Thua Thien-Hue province: the case studies of Dien Loc, Quang Ngan and Quang Tho communes.

International Centre for Environmental Management. (2001-2002). Field Study: Vietnam, Thua Thien Hue Province.

Tam, H.L., Long T.D. (2009) Water supply and rural environment project: Evaluation report on the water safety model in Thua Thien-Hue.

Dishwashing (above) needs other requirements than food preparation (below).

Case 18: Fishery in the Tam Giang-Cau Hai lagoon

A study towards regulation of fishery and other activities at the lagoon waters to preserve nature values and maintain livelihoods of local inhabitants

Keywords: water management, lagoon, fishery, aquaculture


Introduction

The Tam Giang-Cau Hai lagoon in Thua Thien-Hue province is a major source of livelihood for many local residents. Historically, fishing has always been the main economic activity on the lagoon waters and since the eighties of the previous century the aquaculture industry (especially shrimp ponds) has expanded rapidly. In recent years the IMOLA project has done a lot of work to investigate and regulate fishery in the lagoon, with a lot of reports and data that can be used.

Problem description

The uncontrolled expansion of fisheries, aquaculture and other activities on the lagoon waters has inevitably led to problems regarding the lagoons ecosystem. Densely stacked fishing gears prevent water circulation (and thus natural mechanism for water purification), trap pollutants and capture juvenile fish, threatening the quantity and diversity of the fish population.

The relatively new shrimp ponds in the lagoon produce waste containing fish feces, uneaten nutrients and chemicals for water and (fish) disease treatment. In absence of waste water treatment, these contaminants flow uncontrollably into the lagoon waters, deteriorating the lagoon ecosystem. Limited experience and knowledge in shrimp farming also contribute to this problem. It is also possible that the uncontrolled build-up of shrimp ponds negatively influences the lagoons water drainage and storage capabilities during floods and storms.

Objective

The challenge in this case is to propose and research solutions to improve the water quality, with minimal impact for society. Therefore, all solutions and improvements should be discusses with local people to determine the feasibility. In addition, implementation via the governmental structure should be described.

Advised general structure of the research

- Analyse the current situation, in a historical perspective but with future prospects (fieldwork);
- Research the impact and effectiveness of the rearrangement of stake traps and demarcation & protection of spawning grounds under the IMOLA project (literature study);
- Map the impact of aquaculture and other human related activities at the lagoon system, ecosystem and water quality (fieldwork);
- Propose solutions or improvements for the current problems, without doing too much damage to the economic activity;
- Discuss the feasibility of the proposed solutions and improvement with local fisherman (fieldwork);
- Argue an implementation strategy for the solutions and improvement that are found feasible.

Literature and other references that can be used

IMOLA (2007). Reports and literature concerning fishery can be found at the website of IMOLA Hue project. Retrieved September 5th, 2013 via link: http://www.imolahue.org

Ministry of Agriculture and Rural Development. (2009). Objectives and directions for agricultural and rural development. Hanoi.

Vietnam Rivers Network (VRN): Cimate Change Adaptation. www.vrn.org.vn

A small fishing boat.

Shrimp farming is also a type of fishery.

Case 19: Indexation of water quality and its polluters

Master plan for the water quality problems in the Huong river

Keywords: water management, water quality



Introduction

Whenever people live near a river the water will get, to a certain degree, polluted. Therefore water pollution is a problem that occurs in almost every river in the world. In some rivers the pollution is actually decreasing (Rhine), but especially in non-western countries the pollution is a growing problem. This is not different for the Huong river in the Hue area, especially since the river has quite a low discharge in the dry season.

Problem description

The water quality of the Huong river is doubtful: although the water quality was found to be rather good in 2006 (Van Hop et al., 2006, Masterproject Hue, 2013) many (both tourists as native) people talk about large scale pollution by noticing waste, smell or colour changes in the water. In addition, most of the (urban) wastewater is not treated, which implies that wastewater pollution is present (Working paper South East Asia, 2010).

Objective

The main objective is the indexation of polluters in the water system in the Hue city: where does pollution occur, what is the source of the pollution, what is the impact and how are the future prospects? An additional task will be to investigate the awareness under the local people, and their willingness to improve the water quality.

Advised general structure of the research

- Carry out an analysis of the occurring pollution (fieldwork)
  - What are the sources of the pollutions (locations)
  - How do these sources contribute to pollution of the water
  - How do existing structures influence the water quality
  - What kind of measurements are present at this moment to improve water quality
- Determine the impact of water quality on the society
- Investigate the awareness among people to improve water quality (will society corporate with new measures?)
- Find out what water quality requirements should be met (literature study)

Literature and other references that can be used

Masterproject Hue Fieldwork report; TU Delft and WRU, 2013. Available via internationaloffice-citg@tudelft.nl

South East Asia Department of Waste and Sanitation Sector Assessment. (2011). Strategy and Roadmap

Van Hop et al. (2006).Surface water quality in Thua Thien-Hue Province

Waste and litter at the riverbanks of the Huong river.

Sand mining, and all of the suspended sediments that come with it, causes very turbid water.

Case 20: Improvements in open water treatment

The analysis and removal of debris in open water

Keywords: water management, water quality, waste water treatment



Introduction

The water system in the city of Hue, with the channels, rivers and bridges, is a magnificent view, but a view that is disturbed by litter which is floating in the water. Luckily, there are several ways to 'catch' the debris, and thus to make sure that pollution and health dangers are reduced. Around the world solutions like debris booms, grids and buffer zones are used; measures that are only present in a very limited way in the Hue area.

Problem definition

A lot of waste is floating in and around the Huong river and the surrounding channels located in Hue City. Some reasons of the floating litter in the open water are the rapid increase of hotels due to tourism, lack of access to good garbage dump sites and a lack of awareness of the effect of waste on the water system (Van & Huong, 2011). Public places like the Dong Ba market produce a lot of waste, which (about 1-1.2 million litres of untreated wastewater and kilos of other waste) is put into the river each day. In addition, the channels connected to the Huong river transport waste to the main flow. (Lieu, 2010). Improving the open water in and around the city becomes a more and more important topic, mainly due to an increasing public awareness of the problems and negative publicity. In the past some advises were given towards improvements, but until now no big interventions have been noticed.

Objective

This research is focused on finding measures and ideas for improving the open water quality of the Huong river. An important aspect of the solutions should be the implementation and maintenance: how is it guaranteed that the measure keeps working for a longer time?
Possibilities are, as mentioned in the introduction, debris booms, buffer zones and grids, but also creating a closed system with a water treatment plant could be possible. The best solutions should be found by assessing the efficiency, implementation possibilities, cost and public support.

Advised general structure of the research

- Try to get an overview of the historical development of the city, to be able to act towards future trends.
- Analyse the kind and source of waste that is present in the water system of Hueand determine the locations where the waste accumulates (fieldwork).
- Propose different solutions and mention the advantages and disadvantages of the solutions.
- Propose a strategy for implementation of the best solution, including improvement of public awareness towards the importance of clean open water under local society.

Literature and other references that can be used

Lieu, P.K. (2010), Introduction to urban sanitation status in Hue City, Vietnam [lecture]
Van Hop et al. (2006), Surface water quality in Thua Thien-Hue Province
Van, N.K. & Huong, L.V. (2011), The impacts of socio-economic activities on the environment of Huong River basin

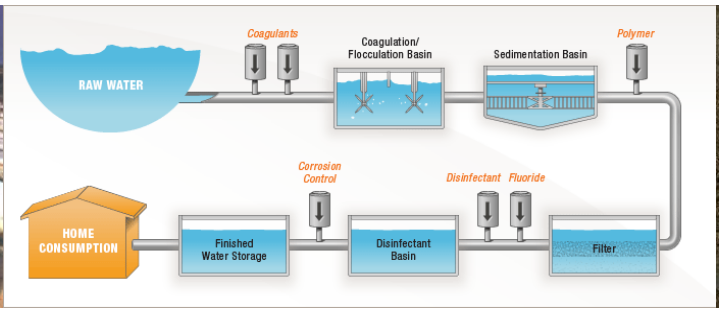
Waste floating in the Huong river.

Grids on revetments capture a lot of litter... Maybe a solution?

Case 21: Improvements in sewage water treatment

A research to improve the waste water treatment in the future

Keywords: water management, sewer system, wastewater treatment, hygiene



Introduction

Waste water treatment is something that is not available in all countries, but is very important for public health. In the city of Hue, most of the waste water flows directly in channels, which in turn drain in the Huong river. You could say that the sewer system functions more as a drainage system than for regulation of sewage water. Most of the water in the sewage system is therefore not treated (Lieu, 2010). It is needless to say that this causes a bad hygienic situation, and in addition facilitates living space for rats and other vermin.

Problem description

Besides the negative effects stated in the introduction, untreated waste water causes a mess when floods occur and diminishes the perception that tourists have on, for example, the old citadel, an important touristic attraction. Still, waste water treatment is a something that is not very usual in the city of Hue. A large amount of waste water from the sewers is directly flushed into the Huong river or the channels of Hue and even polluted water from domestic sewage and from public facilities such as hospitals and hotels are being discharged nearly untreated (Lieu, 2010; JICA Vietnam Office, 2011).

A thing that makes the situation more complex is the occurrence of heavy rainfall: it is almost impossible to design treatment plants that can handle the amount of rainwater in the wet season. Unfortunately, most of the sewage system is a combined system, so separation of actual waste water and rainwater is not possible at this moment.

Objective

In this case improvements for the waste water treatment in the city of Hue should be proposed: what capacity for waste water treatment is needed, which kind of treatment is necessary (composition of the waste water) and what requirements towards water quality should be met?

The second part of the objective is to come up with ideas about how to handle the waste water during heavy rainfall. Treatment plants are not capable of handling all rainwater, so maybe, for example, some valves or overflow constructions can be placed to switch between full treatment and emergency overflow.

Advised general structure of the research

- Analyse the current treatment system of sewage water;
- Try to analyse the composition of the waste water;
- Determine the requirements for the treatment plants: capacity, kind of treatment and requirements towards the treated water;
- Give an advice towards improving the sewage water treatment system: should current plants be upgraded, or should new ones be built?
- Think of options to handle waste water during the wet season, when not all sewage water can be treated.

Literature and other references that can be used

JICA Vietnam Office (2011), JICA's Cooperation for the Development of Central Vietnam
Lieu, P.K. (2010), Introduction to urban sanitation status in Hue City, Vietnam [lecture]
South East Asia Department of Waste and Sanitation Sector Assessment. (2011). Strategy and Roadmap

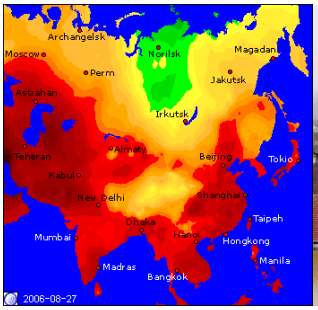
In the Netherlands dunes are used to treat water for domestic use, maybe this is also possible in Vietnam?

Sewage water from boats may also be an aspect that needs improvement.

Case 22: Climate change

Prospects of the future

Keywords: water management, coastal engineering, river engineering, sea level rise, hydrology





Introduction

Everyone is affected in a certain way by climate change, this subject is therefore a hot topic all over the world. Climate change as such, is not a 'thing', but a name for a lot of processes like increase in temperature, sea level rise, increased precipitation, more distinct wet – dry seasons and an intensifying storm climate. For the Thua Thien-Hue province three processes are assumed to be the most important at this moment: sea level rise, increased precipitation and an increase in the number of (heavy) storms.

Problem definition

It is safe to assume that the sea level near Vietnam will rise in the coming future (Slangen et al., 2012), (MRE, 2009), also due to its geographic location: since the mass of ice sheets attracts water, water levels may lower at the poles, while rising near the equator (Solomon, 2007). Sea level rise may cause increasing erosion on the coast due to adjustments of the beach profile. In addition, the water level of the Huong river rises since the water level at the mouth is higher. If the coast does not adapt fast enough, additional breaches may occur in the dune system.

In addition, the rainfall during the rainy season is assumed to intensify, which indicates a higher flood risk. Meanwhile, rainfall in the dry periods shows a decreasing trend, which indicates higher risk of droughts. Both floods and droughts have a large impact on agriculture, aquaculture, water supply for industry, energy generation and municipal/civil use.

Finally, the number of typhoons might increase due to warmer sea water, with the storms itself becoming more severe. These storms already cause a lot of damage every year; more storms will make it harder for the region to develop economically and might scare people away.

Objective

Research on this topic should focus on one of the problems described above, or on another relevant process induced by climate change in the Thua Thien-Hue province. For each subject an assessment towards the estimated frequency, damage and the corresponding impact on society should be made. In past report some scenarios are assumed for the subjects described above, but it is unclear how reliable these scenarios actually are and if and how they can be applied to the local region, a study

towards these researches is recommended. To specify the research it is advised to assess the influence of climate change on a specific case as dune erosion, salt intrusion or economic impact.

Advised general structure of the research

- Indicate the region that will be researched;
- Describe the current situation and which parameters are influenced by the climate change processes;
- Find (historical) data to endorse different scenario's (literature study);
- Argue the impact of each scenario (fieldwork);
- Describe the estimated impact of the scenarios on society;
- Propose a strategy to cope with the processes: facilitate, mitigate or adapt?

Literature and other references that can be used

Ministry of Natural Resources and Environment (MRE) (2009). Climate change sea level scenarios for Vietnam.

Slangen, B. A. et al (20012). Towards regional projections of twenty-first century sea-level change based on IPCC SRES scenarios.

Solomon, S., D. Qin, M. Manning, (eds.), 2007: Technical Summary. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change . Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Storms cause severe damage to, among others, forests: what will be the impact of additional storms?

Sea level rise causes additional erosion on the beaches, due to an adjusting beach profile.

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Notes