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RIKZ, Rijkswaterstaat

A long-term morphological model for the whole Dutch Coast

Part II: Application of the model

Report

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Contents

1 Introduction

1.1 Background

National decisions regarding coastal management require understanding of the long-term (50-100 years) effects and large-scale (1-100 km) implications of both natural processes and major coastal engineering projects. Examples are the effects of climate change and sea-level rise on a sandy coast that is partly protected by groynes or sea-walls and, in relation to this, the long-term effects of coastline maintenance by on-going nourishment. Problems related to major coastal engineering projects are the far-field effects of large-scale land reclamation and the effects of the large-scale sand-mining necessary for such projects.

The national research program COAST*2005 focuses, amongst others, on understanding these long-term, large-scale morphological effects and on developing the tools to quantify them. Within this framework, a model is being developed, which should be capable of simulating the morphological evolution of the Dutch coast at the required spatial and temporal scales.

Morphological characteristics of complicated coastal systems can be described using different modelling approaches [De Vriend et al., 1993]. One such an approach is process-based modelling where the physical processes involved are described mathematically, combining a detailed fluid-flow model with a sediment-transport model. By successive iteration the dynamical evolution of an area can be simulated.

For the analysis of the dominant processes and circulation patterns, wave, current and sediment transport, process-based models appear to be useful. However, they are less suitable for simulating long time periods, as they require large computational effort and the numerous iterations and accumulation of rounding-off errors may lead to unrealistic results. Moreover, it is questionable whether such an up-scaling approach yields realistic and useful result for long-term applications, because processes that may be ignored at the small scale (hence are not included in the process models), may have large net effects on the large scale.

PONTOS and ASMITA use a different modelling approach, which is behaviour-oriented [Steetzel et al., 1998; Stive et al., 1998]. In PONTOS the physical processes (i.e. cross- and long-shore transport) are parameterised in simple relationships which respond to input conditions of wave and tidal climate and sea-level. The combined effects of the processes result in the morphological evolution of the coastal system. The resolution of simulations is coarser than would be available with a process-based model, but the results in terms of the distribution of erosion and sedimentation after, e.g. a 50 year-period, seem more realistic. In addition, because of its straightforward approach, these models are easier accessible and more user-friendly than most process-based models. Calculations with the previous version of the PONTOS model (version 1.0) indicated that it is a promising tool to simulate and quantify the morphological implications of the problems just described

The basic concept in ASMITA is that a tidal inlet system can be schematised into a number of morphological elements and that for each element a morphological equilibrium exists depending on the hydrodynamic conditions and large-scale morphometric conditions (e.g. tidal basin area). When one or more elements are out of equilibrium morphological changes will take place tending to restore the system to (a possibly new) equilibrium. Erosion/sedimentation rates are assumed to be proportional to the difference between the local equilibrium concentration and the actual concentration.

1.2 Study objective

Within the framework of the Dutch national research program "COAST*2005", a model has to be developed that is capable of quantifying the long-term (50 to 100 years) and large-scale (1-100 km) morphological evolution of the Dutch coast. This model will be used to determine the effects of sea level rise for a partly protected coastline, the far field effects of a large-scale land reclamation and the required extraction of large amounts of sand (sand mining), the long-term effects of ongoing nourishments and the long-term effects of a changing climate.

Within the framework of a preceding phase of the study (contract RKZ-370), the set-up of the PONTOS-model, the so-called pilot-version and the conceptual validation of its components were dealt with. Also a preliminary application for the Holland coast was addressed [Steetzel et al., 1998]. In the next phase of the study (contract RKZ-594), the existing pilot version has been updated and validated yielding a more complete and better applicable version of the model and the PONTOS-1.0 model has been applied to the Holland coast.

In the present phase of the study (contract RKZ-1257) the application is extended. In order to apply the model concept to the entire Dutch coast the impact of ebb-deltas and related tidal inlet systems has to be taken into account. Therefore an 'inlet-extension' of the PONTOS-concept, based on formulations used in the MOBIC-model (a multi-layer model for the interrupted coast which acted as the basis of the current PONTOS-model) has to be implemented. The ASMITA model will be used to provide input for this inlet extension.

1.3 Approach

The model developed is originally based on the multi-layer concept, in which the cross-shore profile is schematised as a number of mutually coupled layers, defined between fixed profile depths. These layers interact through cross-shore transport. In longshore direction the layers respond to gradients in the longshore transport generated at the profile regions they represent.

This type of models has been developed to describe the movement of selected depth contours in a similar way as one-line models. The cross-shore exchange of sand between the various cross-shore subsections and associated changes in the bed profile can to some extent be taken into account. This was first accomplished by Bakker, later by Perlin and Dean, by De Vriend and Bakker and Steetzel (see [Bakker, 1999]).

In spite of the additional detail given by the multi-line models, they have not been very successful so far, mainly because it has been difficult to specify realistic relations for cross-shore sediment transport and the distribution of the longshore transport. The initial result was a model that is more detailed than the one-line model, but also requires much more calibration and in the end does not provide significantly more new information than it requires for calibration.

Some recent developments have substantially increased the applicability of these models. Starting with the Bakker's two-line model (1968), Steetzel (1995) extended the concept by incorporating the morphological behaviour of mixed tidal inlets based on work by De Vriend and Bakker (1993) and more recently by adding more layers and improving the way in which both the cross-shore and longshore interaction are taken into account [Steetzel et al., 1997].

Earlier versions of this kind of models, see e.g. [Bakker et al., 1988], had the drawback that the interaction between the layers and their response in the longshore direction was determined by a series of constants, which had to be pre-defined by the user based on mathematical process-based models or on empirical data. This put considerable restraints on the practical use of the concept. In the present set-up of the model these pre-defined constants have been replaced by formulations to compute cross-shore and longshore sediment transports directly within the model in terms of external conditions such as wave climate, tidal conditions, bathymetry and sediment characteristics.

1.4 Project team

The work has been carried out by a joint venture WL | Delft Hydraulics and Alkyon Hydraulic Consultancy & Research mainly by Dr. Ir. H.J. Steetzel (Alkyon) and Dr.Ir. Z.B. Wang (WL | Delft Hydraulics).

Dr. J.P.M. Mulder and Ir. J.G. de Ronde participated on behalf of the National Institute for Marine and Coastal Management of Rijkswaterstaat.

1.5 Set-up of the report

The final report of the study is divided into two parts, namely the model formulatios and the application of this model to the Dutch coast.

This is part II of the report, application of the model to the Dutch coast. Attention has been paid to the general set-up of the application, the calibration and verification of the model as well as the results of the computations. The following items will be discussed:

- The general set-up of the application (Chapter 2);
- The description of the model input (Chapter 3);
- The calibration of the model (Chapter 4);
- The verification of the model (Chapter 5);
- The results of the model application (Chapter 6).

In Chapter 7 the main conclusions and recommendations with respect to application are summarized.

2 General set-up of the model

2.1 Introduction

Some general aspects of this application of the PonTos-model for the Dutch coast are discussed hereafter. A more detailed description of the applied input is provided in the next chapter.

For the definition of the model, the Dutch coast is schematised along a so-called reference line. This reference line more or less follows the curved coastline of Belgium and The Netherlands. The definition of the reference line has been adjusted compared to the original reference line [Steetzel et al., 1999]. These adjustments are:

- An additional curved section at the south side of the model in order to take into account the overall shape of the Belgium coastline;
- An additional curved section at the northeast side of the model in order to take into account the overall shape of the eastern Dutch Wadden Islands.

In the actual PONTOS-model the reference line is schematised as a straight line. All data (layer positions and environmental conditions) are defined with reference to this straight line.

Figure 2.1 shows the general set-up of the reference line. A detail of the Dutch coast is shown in Figure 2.2.

Details with respect to the definition of the reference line are presented in Section 3.2.1.

2.2 Hydraulic conditions

For the hydraulic conditions time-averaged climates have been used. The wave conditions have been determined using measured time series at a number of wave stations along the Dutch coast.
In order to provide enough information for the southern part of the model, an additional wave climate station at the WestHinderBank (WHB) has been applied.

In order to use the basic wave direction formulation (using the direction the waves come from), a special numerical procedure has been developed to translate the offshore wave conditions to an arbitrary position along the reference line.

For the definition of the mean tidal climate, use has been made of a computation with the so-called KUSTSTROOK-model. Information from a number of stations along the coast has been used as input for the model.

2.3 Back barrier system

2.3.1 Introduction

As described in part I of this report, the ASMITA model is used to define the net exchange with the back barrier systeml. A distinction has been made between the Wadden and the Delta region.

2.3.2 The Wadden region

The ASMITA model is used for the assessment of the net sediment transport through the inlets in the Wadden Sea. For each of these inlets an ASMITA model already exists. These models have been set up by Van Goor (2001) and Kragtwijk (2001) during the preparation of their Msc-thesis. The models for Eijerlandse Gat, Amelander Zeegat and Friesche Zeegat are due to Van Goor (2001) and the models for Marsdiep and Vlie are due to Kragtwijk. As all these models are calibrated the original parameter setting of the models are applied (see Chapter 3 and Annex A).

For the Wadden Sea basins the ASMITA model is used in on-line option, i.e. ASMITA is run at each time step of the PONTONS simulation.

In the model the two tidal inlets Pinkgat and Zoutkamplaag have been considered as a single tidal inlets, because they are located closely to each other and because their ebb-tidal deltas cannot be distiguished from each other. The combination is realised by adding the sediment exchange at the inlets together after that for each of the two inlet the ASMITA model is run.

2.3.3 The Delta region

For the Delta coast in SW NL Western Scheldt is the only natural tidal basin left in this region. All the other inlets are closed or semi-closed, so that there is no exchange of sand between the basins and the coast. Thus only the exchange of sand between the Western Scheldt and the coast need to be simulated by ASMITA.The most recent model for this area (Western Scheldt plus Eastern Scheldt) was set up by Meangbua (2003).

Due to the complex bathymetry, the schematisation of the area was made in terms of 'wet volume' of each element in the schematization: 6 elements for the estuary, 27 elements for the river mouth (outer delta) of the Western Scheldt (Figure 2.4). (NB: 'Wet volume' = volume of water between the water level and the bed level). As a consequence, the empirical equilibrium relations as used for the Wadden Sea inlets cannot be used to determine the morphological equilibrium state. Instead equilibrium volumes of each section are determined by calibration. It turned out that the equilibrium volumes for the Western Scheldt were all larger than determined in an earlier ASMITA study by Wang (1997), which included only the Western Scheldt. Nevertheless, since the morphological behaviour of the study area could be reproduced well, it was concluded by Meangbua (2003) that results using these equilibrium volumes are qualitatively realistic.

A difficulty here is that the definition of the ebb-tidal delta is not clear. It is not clear where the transition between the basin and the coast is located. For practical reasons it is decided to use the cross-section defined by the seawards boundary of the segments 8-12 in the model of Meangbua (2003, see also Steetzel and Wang, 2003) for this purpose (see Figure 2.4). The sediment transport over this cross-section from the ASMITA model will be transferred to PONTOS. No feed back from PONTOS to ASMITA will be taken into account here.

The ASMITA model for the Western Scheldt inlet is completely different than the ASMITA models for the Wadden Sea inlets. As no feed back from PONTOS to ASMITA will take place it is decided to keep the coupling for this inlet off-line.

The model is set up such that the simulations start in 1988, so model results for the required transport is only available from 1988. To complete the required time series starting from 1970 the transport is derived from the field data for the period 1970-1988. The field data as reported by Wang (1997) are used. More recent data analysis has been carried out by Nederbragt and Liek (2004), but their results cannot be directly used because not the same schematisation of the ebb-tidal delta area is used. However their data have been used for checking the final results.

The following steps are followed for driving the transport rate through the mentioned croos-section from the field data:

Step 1. Transport through the cross-section Vlissingen-Breskens as already reported in Wang (1997) is used. The transport is drives from the sand balance of the Western Scheldt estuary assuming that there is no transport through the border between the Netherlands and Belgium. The data agree with those reported by Nederbragt and Liak (2004).

Period	Export through (Million m^3/year)
1970 – 1975	-3.4
1975 – 1980	-3.2
1980 – 1985	-0.88
1985 – 1990	-0.32

Step 2: Determine the natural sedimentation of the area between the cross-section Vlissingen-Breskens and the cross-section through which the transport is required. This can be done using the available data of wet volumes, dredging and dumping amounts. These data are only available for the whole period 1970-1994. So only an averaged sedimentation rate can be determined. This is about 0.1 million m^3 per year.

segment	wet volume (m3)		Dumping	total sedimentation	Natural sedimentation
	1969/1970	1993/1994	(10^6 m^3)	(10^6 m^3)	(10^6 m^3)
7	93971341	95634866	-1.4	-1.663525	-0.263525
8	1.89E+08	1.89E+08	0	0	0
9	8.65E+08	8.65E+08	1.8	0	-1.8
10	1.41E+08	1.48E+08	-2.4	-7	-4.6
11	59517389	59478277	0	0.039112	0.039112
12	1.90E+08	1.81E+08	0	9	9
Total change in 24 year				0.375587	2.375587

Step3: Determine the transport through the cross-section based on the sand-balance.

Step 4: Transform the step-function time series into a trend-line function and combine the results with the out put of the model. The final results are shown in Figure 2.5.

2.4 Coastal management

2.4.1 Nourishments (model input)

In order to take into account the effects of coastal management, the possibilities to define and apply pre-defined nourishment schemes have been extended. Basically, two types of pre-defined nourishment schemes can be used, namely:

- A scheme simulating the performed nourishments (until present);
- An anticipated nourishment scheme simulating future efforts.

For the latter anticipated schemes two scenarios have been defined.

As mentioned before, in order to test the concept of 'system nourishments', a special auto cell-nourishment option has been defined.

2.4.2 Coastal State Indicators (model output)

Using the output of the model, the evolution of specific layer positions or volumes in specific sections can be assessed.

For the assessment of the location of the so-called BCL, the position of the upper layer (representing the Y_1- and Y_2-layer; from NAP-7m till NAP+3 m) can be used as a first estimate.
In order to take into account the local vertical boundaries (which vary along the coast) more accurately and (possibly) also the level of the mean sea level, some additional processing of the basic layer information may be required.

The model can directly be used to assess the evolution of the volume in a specific coastal section. A distinction may be made between the volumes in the lower zone (the Y_3- and Y_4-layer; representing the area between the NAP-20m and the NAP-7m depth contour) and the upper zone (the area between the NAP-7m depth contour and the local dune top). The results can be presented in terms of absolute changes (in Mm^3) or time-averaged rates (in Mm^3/yr).
Figure 2.3 provides a general overview of the coastal sections applied in this study.

It should be noted the location of the so-called "afslaglijn", cannot be computed using the PONTOS-model, since yearly-averaged climates are applied by definition. The computation of the position of "afslaglijnen" requires more extreme surge conditions and a more detailed computational model (DUROSTA/DUINTOETS). However, the location of the dune foot (represented by the location of the Y_0-layer) is available.

3 Description of the applied model input

3.1 Introduction

In the following the input of the model for the Dutch coast application is described. Referring to the modified model set-up, nine different groups of input parameters are being distinguished. These groups are given in Table 3.1.

Group no.	*Parameter group*	*Remarks*
1	Geometry	Orientation Levels, positions
2	Bed material	Sediment characteristics
3	Structures	Dikes, dams
4	Tidal inlets	Inlet characteristics
5	Conditions	Waves, tides, changes and trends
6	Boundaries	Longshore, cross-shore, inlets
7	Management	Nourishments and scenario's
8	Run specifications	Time stepping, output
9	Calibration factors	Longshore, cross-shore, inlets

Table 3.1: Overview of main parameter groups in the PONTOS-model

In the following sections the group specific input is described.

For a more detailed description of the applied input, reference is made to Annex A in which detailed tables are provided. Also an extended version of Table 3.1 is provided in which the applied computational arrays are defined.

3.2 Geometry

3.2.1 Reference line

The reference line, which describes the overall contour of the (Dutch) North Sea coast, consist out of five subsequent sections namely a circle segment, a straight line and next three other circle segments. Some basic characteristics of the reference line are summarized in the following table (see also Figure 2.1 and 2.2).

Section	*X_1 [km]*	*X_2 [km]*	*R [km]*	*Shape*	*Remarks*
1	-50.00	28.284	250	Circle	South of updrift boundary
2	28.284	93.431	-	Straight line	
3	93.431	211.241	150	Circle	
4	211.241	296.919	150	Circle	
5	296.919	400.000	150	Circle	East of downdrift boundary

Table 3.2: Characteristics of the applied reference line

Along this reference line, the coastline angle gradually changes. This relative orientation is used as input for the PonTos-model.

This coastline angle is used to transfer the (interpolated) offshore wave directions (given relative to the North) towards the morphological wave direction (relative to the local coastline and with a positive angle yielding positive transport).

3.2.2 Layer levels

The upper level of the dune layer (the Z_0-level) depends on the location along the coast. The actual dune level used in the computations is based on the JARKUS-dataset.

For the other layer levels the default values have been used.

Level	*Z [m]*	*Remarks*
Z_0	>NAP + 3 m	Level depends on X-ordinate along coast
Z_1	NAP + 3 m	Transition beach/dune
Z_2	NAP – 2 m	Transition surfzone layer /beach
Z_3	NAP – 7 m	Transition middle shoreface / surfzone
Z_4	NAP - 13 m	Transition lower / middle shoreface
Z_5	NAP - 20 m	Lower shoreface level

Table 3.3: Overview of the applied layer levels

Figure 3.1 provides an overview of the applied levels along the coast.

3.2.3 Layer positions

The actual position of an individual layer is assessed from either the JARKUS-data set or the bottom topography applied in the so-called KUSTSTROOK-model. For each individual profile the results are transferred to the reference grid.
Figures 3.2 to 3.6 show the applied initial positions in 1970, 1990 and 2003 for the individual layers. It should be noted that, since only limited information is available for the deeper region, the position for these layers remains the same.
The initial layer positions for 1970, 1990 and 2003 are provided in Figures 3.7 to 3.9.

3.2.4 Outer boundary

For this application, the location of the seaward boundary is located at a fixed position, namely 20,000 m seaward from the reference line.

3.3 Material

For the western part a constant sediment size has been applied whereas a gradual decrease of the diameter has been applied for the northerly Wadden Coast. Figure 3.10 shows the applied longshore distribution.

No specific cross-shore distribution of the sediment size is taken into account. The DSZ-value equals 1.0 for all levels.

3.4 Structures

The location of revetments and dikes is based on the extensive overview provided in the 'Afslagkaart'-study [Alkyon, 2002].

Details on the location and dimension of the applied structures are presented in Annex A. It should be noted that the (relatively small) groynes, which are present along the Holland coast, are not taken into account in the model.

Figure 3.11 provides an overview of the applied structures. In addition to the existing dams also a number new dams are shown. These three dams are related to scenario C.

3.5 Tidal inlets

3.5.1 Introduction

Along the northerly Wadden coast, six major tidal inlet systems are present. In addition both the Western Scheldt and Eastern Scheldt estuary are schematised as a tidal inlet for the Delta region. In the initial phase the mutually coupled inlet system of the Pinkegat (#5) and Zoutkamperlaag (#6) has been treated as two neighbouring systems. In the final runs however, the inlet systems have been merged yielding one 13 km wide combined tidal inlet (#9) between Ameland and Schiermonikoog.

As a consequence, in the final Dutch coast model the seven inlets are defined. Using this schematisation the total coastline of 341 km consists of 103 km tidal inlets / outer deltas (30 %) and 238 km of dunes (70 %).

3.5.2 Geometry

The overall geometry of the individual inlets (positions of boundaries and centre) has been based on analysis of the inlet systems. These boundaries are presented in Annex A.

3.5.3 Equilibrium shape

For the PonTos-model the equilibrium shape (protrusion and offset) are required.
Figure 3.12 shows the applied schematisation for the Wadden inlets, which has been based on the 1990-contours. The related protrusion and offset values are given in the annex.

	Inlet	X_l [m]	X_c [m]	X_r [m]	B [m]	Delta [-]	lambda_r [-]	phi_r [-]	Q_ebb [Mm^3/yr]
#1	Marsdiep	212000	219000	227000	15000	0.467	0.345	0.089	0.604
#2	Eierlandse Gat	243000	248000	253000	10000	0.500	0.226	0.039	0.475
#3	Vlie	263000	270000	278000	15000	0.467	0.233	0.163	0.599
#4	Amelander Zeegat	298000	304000	310000	12000	0.500	0.311	0.176	0.147
#5	Pinkegat	329000	332000	334000	5000	0.600	0.143	0.302	0.404
#6	Zoutkamperlaag	335000	338000	342000	7000	0.429	0.198	-0.106	0.135

Table 3.4: Main characteristics of the Wadden inlets

The main characteristics of the Wadden inlets are presented in Table 3.4. In the right-hand column, the magnitude of the mean transport in the ebb channel is given which is required to obtain the equilibrium state. As elaborated in Part I of this report (Chapter 7), this rate is computed by the model and based on the characteristics of the shape-forcing (vertical) tide and wave climate.
The order of magnitude (which is in the range of 0.1 to 0.5 Mm^3/yr) seems reasonable.

Figure 3.13 shows the applied schematisation for the Delta inlets, which has also been based on the 1990-contours.

3.5.4 ASMITA-coeffients

The coefficients that have been applied in the basin module of the PONTOS-model are summarized in Annex A.
These coefficients have been used to run the model in the online mode yielding the net transport through the tidal channel as a result.

3.5.5 Net transport and basin evolution

Figure 3.14 shows the evolution of the net transport for the Wadden inlets. For the period 2003 – 2053 a distinction is made between the results for two sea level rise scenario's. More sea lever rise yields relatively less import from the basin (visually more import towards the basin).

From the AsMiTa-results, the evolution of the characteristic flat level can be computed. The results of this computation are presented in Figure 3.15 showing that the flat are able to follow the mean sea level to a large extent.
Figure 3.16 shows the evolution of the depth above the flats. For increased sea level rise an increase in the order of 0.05 to 0.10 m can be expected.

The (volume of the) outer delta plays an important role in the tidal inlet model. Figure 3.17 shows the computed evolution of this volume (using the ASMITA-module). The related changes are relatively limited.

In addition, Figure 3.18 shows the applied import from the Western Scheldt basin for two sea level rise scenario's. This has been based on existing ASMITA-results.

3.6 Hydraulic conditions

3.6.1 Wave climate

Time averaged wave information is defined using five wave climate stations.
The position and description of these stations is provided in Table 3.5.

No.	*X_l [km]*	*Station identification*
1	-10.0	WHB
2	55.0	EUR
3	155.0	YM6
4	240.0	ELD
5	340.0	SON

Table 3.5: Overview of applied wave climate stations

It should be noted that the nearshore information from 'Meetpost Noordwijk' (MPN) is not taken into account.

In each of the stations, a wave climate table is assessed from the available time series.
In total 9 different wave directions with 10 wave height classes each have been defined as well as one residual class (with non-relevant wave conditions). As a consequence the average wave climate is defined using 91 (= 9 x 10 +1) conditions, each with a specific frequency of occurrence.

Parameter	*Magnitudes*	*Number*
Wave directions	0, 30, 60, 90, 210, 240, 270, 300, 330	9
Wave heights	0.50, 1.00, 1.50, 2.00, 2.50, 3.00, 3.75, 4.75, 5.75, 6.75	10
Wave period	Related to wave direction/height	90

Table 3.6: Overview of applied wave climate classes

More details on the tidal climate climates are provided in Annex A.
Figure 3.19 shows the longshore distribution of wave climate characteristics.

3.6.2 Tidal climate

Comparable to the wave climate stations a limited number of points have been used.
The required time series are obtained from a computation with the so-called KUSTSTROOK-model. In total, 9 different tidal wave climate stations have been defined.

No.	*Output*	*X_l [km]*	*Remarks*
1	#03	-19.0	Near WHB (southerly boundary)
2	#06	30.2	
3	#07	61.0	
4	#11	120.3	
5	#16	183.4	
6	#23	236.6	
7	#29	279.7	
8	#40	338.3	
9	#45	373.3	Near Borkum (easterly boundary)

Table 3.7: Overview of applied tidal climate stations

In each of the stations, a tidal climate table is assessed from the computed time series.
In total 12 different tidal conditions have been defined, each with a different water level, longshore velocity and percentage of occurrence.
More details on the tidal climate climates are provided in Annex A.
Figure 3.20 shows the longshore distribution of the tidal range. In this figure also the tidal range used in the individual basins is shown.

As a consequence the average hydraulic climate along the coast is defined as a longshore varying climate using 1,092 (= 91 x 12) individual combinations of wave and tidal conditions.

3.6.3 Changes and trends

For the mean sea level two specific time series have been used, namely:
- A low scenario using 0.20 m/century;
- A moderate scenario using 0.60 m/century.

These scenarios will also be applied for the computation of the net transport rate through individual inlets. For each inlet, time series for both sea level rise scenario [1] and [2] will be present.

The default setting with no relative wave height change has been used. A CWH-value of 1.0 has been used for the complete period.
The default setting with no absolute wave direction change has been used. A CWD-value of 0.0 has been used for the complete period.
The default setting with no relative tidal range change has been used. A CTR-value of 1.0 has been used for the complete period.
The default setting with no relative tidal velocity change has been used. A CTV-value of 1.0 has been used for the complete period.

3.7 Boundary conditions

3.7.1 Left-hand updrift boundary

For the left-hand, southerly boundary of the model (located at X = 5.000 km at the easterly dam of Zeebrugge harbour), a free open boundary has been used. Consequently, the transport rates are directly related to the local coastal orientation and the local wave and tdal climates.

3.7.2 Right-hand downdrift boundary

For the right-hand, easterly boundary of the model (located at X = 346.000 km), a free open boundary has been used. Consequently, the transport rates are directly related to the local coastal orientation and the local wave and tidal climates.

3.7.3 Dune boundary

In order to take into account the net sediment transport across the first dune row, a net boundary transport at the landward boundary has been applied.
Comparable to the original application for the Wadden Coast [Steetzel, 1995], a constant rate of q_0 = - 2 $m^3/m^1/yr$ (sediment loss in landward direction) can be used.
This value is assumed to be independent of both time (years 1970 – 2053) and location along the coast (X = 5 – 346 km) [Steetzel, 1995].
For the complete stretch of 238 km consisting of dunes, this transport contribution would yield a net sediment loss of 0.476 Mm^3/yr.

In the present runs this sediment loss is not taken into account.

3.7.4 Seaward boundary

In order to take into account the net sediment transport across the lower shoreface boundary, a net boundary transport at the seaward boundary has been applied.
Comparable to the original application for the Wadden Coast [Steetzel, 1995], a constant rate of q_5 = -5 m^3/m^1/yr (sediment gain in landward direction) could be used. For the complete stretch of 341 km (= 346 – 5) this transport contribution would yield a net sediment gain of 1.705 Mm^3/yr.
In the present runs this sediment gain is not taken into account.

3.7.5 Tidal inlet boundaries

For each of the tidal inlets the net sediment transport across the landward model boundary is computed using the ASMITA-model.

3.8 Management

3.8.1 Pre-defined performed schemes

Until 2003, a large number of nourishments have been performed.
For each individual nourishment, the location along the coast, the cross-shore position (level interval), the nourishment period as well as the nourished volume have been determined.
In the computations, a total number of 228 individual nourishments have been taken into account. The total nourishment volume amounts to 160.210 Mm^3, representing an average nourishment effort of approximately 4.86 Mm^3/yr (in the period 1970 – 2003).

Figure 3.21 and 3.22 show the longshore distribution of the nourishments in the period 1970-1990 and 1990-2003 respectively (note the different vertical scale). Both the detailed and the section-averaged (solid line) magnitudes are presented.
The time-evolution of the nourishment intensity is presented in Figure 3.23. As can be observed, the nourishment intensity shows a gradual increase.

More details on the performed nourishment schemes are provided in Annex A.

3.8.2 Pre-defined anticipated schemes

For the anticipated nourishment schemes (period 2003 – 2053), two different scenarios are defined, namely:

- a nourishment scheme based on the predictions of [Mulder, 2000] with a total constant rate of 11.9 Mm^3/yr (denoted as scheme A), and
- a nourishment scheme based on the mean efforts in the period 2001 - 2003 with a total constant rate of 13.0 Mm^3/yr (scheme B).

Apart form the different rate, the location of the nourishments is also different.

In vertical / cross-shore direction it is assumed that 30 % of the nourishment volume is positioned on the beach (in the Y_1- layer between NAP-2 m and NAP+3 m) and 70 % in the interval between NAP-8 m and NAP-5 m.
As a consequence 2/3 of this 70 % (46.7 % of the total) is placed in the Y_2- layer between NAP-7 m and NAP-2 m and 1/3 (23.3 % of the total) is placed in the Y_3- layer between NAP-13 m and NAP-7 m.

The detailed longshore distribution per individual coastal section is based on the present distribution of the nourishment efforts. The longshore distribution for the A- and the B-scheme is presented in Figure 3.24 and 3.25 respectively.
More details for both schemes are provided in Annex A.

It should be noted that, due to the presence of the various inlets (where dune and beach nourishments can not be taken into account) the actual input in the model is somewhat less then the anticipated numbers (thus less than 11.9 Mm^3/yr for the A-scenario and less that 13.0 Mm^3/yr for the B-scenario).

Since especially the mutual difference between the various schemes is very important, Figure 3.26 provides an overview of the applied nourishment input. The upper plot refers to the recent scheme (1990 – 2003 period), the others to the A- and B-scenario respectively.
Figure 3.27 provides an overview for the Holland coast only. As can be observed, the nourishment intensity for the A-scenario is less than the intensity of the present scheme.

3.8.3 Auto layer-nourishments

The application of a critical Y_1-position for specific stretches according to the location of the basal coastline (the so-called BCL-position) is used in management scenario C. In this case the initial position of the Y_1--layer for the Holland coast is used as a critical position.
Additional nourishments are applied to achieve this goal.

3.9 Additional run information

3.9.1 Computational grid

The basic grid size equals 1 km. Near the dams at example Hoek van Holland and IJmuiden a grid size of 500 m has been applied. Using this schematization in total 389 grid cells are present on a 341 km long stretch.
More details are provided in Annex A.

3.9.2 Time range

The total computational time period amounts to 83 years. Details are provided in Annex A.
The first period (1970 – 2003) will be used for calibration and verification purposes.
The model predictions will be performed for the second period (2003 – 2053).

3.9.3 Time-stepping constraints

The basic time-stepping constraints are summarized in the following table.

Parameter	*Value*
Dt_min	0.01 year
Dt_max	1.0 year
DY/dt_max	25 m

Table 3.8: Overview of time stepping constraints

The actual time step is to a large extent related to the mobility of the individual layers and thus to the last parameter.

3.9.4 Balance sections

According to [Mulder, 2000] nine different coastal sections have been defined.
In addition two small sections for the 'Euromaas-geul' and the 'IJ-geul' are present.
Since the updrift boundary is located at 'Zeebrugge', another updrift section is defined.
The outer boundaries of the first and last coastal section correspond with the first and last point of the computational grid.
It should be noted that the Eem-section has not been taken into account in the present computations.

3.10 Calibration factors

3.10.1 Longshore transport

Initially, no corrections for the wave-induced longshore sediment transport, the wave direction and the tide-induced longshore sediment transport have been applied.
The default CWX-value of 1.0, CWD-value of 0.0 and CTX-value of 1.0 hav been used for the complete stretch.
The final calibration is discussed in the next chapter.

3.10.2 Cross-shore transport

Initially, no corrections for the wave-induced cross-shore sediment transport, the cross-shore steepness and the profile shape calibration have been applied. The default CCX-value of 1.0, CSX-value of 1.0 and CPX-value of 1.0 have been used for the complete stretch.

The CWXj-value refers to the new cross-shore process calibration.
The assessment of the required factors is elaborated in the next chapter.

3.10.3 Tidal inlet transports

The default settings have been applied for the tidal inlet transports.
More information on this is provided in the next chapter.

4 Calibration of the model

4.1 Calibration and verification procedure

The period 1970 – 2003 has been used for calibration and verification purposes.
Basically, the first part (1970 – 1990) is used for calibration; the second part (1990 – 2003) for verification. However, the amount of useful calibration and verification data is very limited, especially with respect to the large-scale development. For the calibration and validation of the evolution of large-scale cells only one data set is available, which makes the distinction between the calibration and verification phase somewhat unclear.

In the calibration phase (1970 –1990) the conclusions on the performance of the model will primarily be based on the comparison between the computed transports and the most likely transport patterns. Also some attention will be paid on the general trends in the various zones.

The development of the coastal cells will be compared with 'observed' data (for the period 1990-2003) in the verification phase.

In the verification phase (1990 – 2003) the conclusions on the performance of the model will be based on the comparison between the computed movement of the various layers and the observed displacement of these layers (see Chapter 5 for more details).

If the model is able to produce a reasonable resemblance, the applied calibrations factors will be used for the prediction phase (see Chapter 6).

It should be noted that the original phases (1970 → 1985 → 2000) have been changed [Steetzel and Wang, 2003]. For the transition from the calibration to the verification phase 1990 is used (instead of 1985), because of the distinct change in coastal management in this year.

4.2 Cross-shore transport calibration

4.2.1 Layer distances

For the calibration of the model special attention has been given to the cross-shore transport. For this purpose, the initial layer positions for the relevant years have been studied in more detail.

The equilibrium layer distance (or profile steepness) plays an important role in the assessment of the cross-shore transport rate. The general idea is that the actual layer configuration reflects this equilibrium state to a large extent. Consequently, the first step is to elaborate the mutual layer distances.

Figure 4.1 and 4.2 show the longshore distribution of the mutual layer distance for 1970 and 1990 respectively. As can be observed, the layer distance increases with increasing depth. The combined results for the individual cross-shore zones are presented in Figure 4.3 to 4.6.

4.2.2 Calibration factor

Using the new computational routine to assess the non-calibrated climate-based equilibrium layer distances, the longshore distribution of the correction factor has been assessed. The results of these computations (denoted by the solid and open dots for 1970 and 1990 respectively) are presented in Figure 4.7 to 4.10.

Figure 4.7 shows the results of these computations for the distance between the Y0 and Y1-layer (related to the beach width).
For the Holland coast the actual 'beach width' is in the order of 100 m (see Figure 4.3). Since the computation model yields a smaller distance (in the order of 50 m) as a result, the required correction factor is in the order of 2.

The dots in the figure refer to the most favourable correction factor for each individual profile (grid cell) and year.
For the applied calibration factor (in this case the CW1-coefficient), the mean trend has been used, given by the solid black line in the figure.
The same procedure is applied for the others zones; see Figure 4.8 to 4.10.

More details on the magnitude of the applied calibration factors are presented in Annex A.
It should be noted that each actual calibration factor (or in fact the longshore distribution of the CWj-value) has a direct impact on the magnitude of the cross-shore transport rates.

4.2.3 Cross-shore transport rates

In order to calibrate and check the overall pattern of the cross-shore transport rate, the initial cross-shore transport across the 7m-depth contour has been computed using former described calibration factors. The result is provided in Figure 4.11 showing the cross-shore transport rate (denoted as the q_3-value) for the initial situation in 1970 and 1990 respectively.

The longshore distribution of this transport rate is directly related to the magnitude of the CW3-value as shown in Figure 4.9. As can be observed the magnitude of the applied calibration factor is somewhat less than the most favourable correction factor for the Holland coast. This 'calibrated mismatch' yields a residual (landward directed) cross-shore transport as a result.

For the Waddencoast a landward transport is found for the western part whereas the eastern part is more or less in an equilibrium state. At the scale of the outer deltas, a seaward directed peak in the cross-shore transport can be observed at the location of the ebb-channel.
For the Delta coast the cross-shore transport pattern is comparable (net cross-shore gain).
It should be noted that no information is available on the actual cross-shore transport patterns for these regions.

However, for the Holland coast some information is present for comparison.
Figure 4.12 shows the computed cross-shore transport rates for this part of the coast.
The (calibrated) general pattern for the Holland coast seems consistent with available insights.
According to [Van Rijn, 1995]:

- Order of magnitude 0 to 5 m^3/m/yr landward;
- Minimum between Hoek van Holland and IJmuiden;
- Maximum north of Hoek van Holland 10 to 15 m^3/m/yr landward;
- A seaward peak just south of IJmuiden;
- Maximum north of IJmuiden 15 to 20 m^3/m/yr landward.

In Figure 4.12, the solid black line denotes this actual transport pattern (referring to the cross-shore transport across the NAP-8m depth contour).
Comparing this pattern with the computed (and calibrated) patterns, it was concluded that the overall resemblance is acceptable.
The only major differences are present on the right-hand side. Since the actual cross-shore transport pattern in this region is not known (due to the complexity of the outer delta region), it is difficult to improve this.
Based on the previous, it was concluded that the cross-shore transport pattern produced by the model is acceptable and can be used for further elaboration.

4.3 Longshore transport calibration

In order to check the computed longshore patterns, the initial longshore transport patterns have been computed for the 1970 and 1990 situation.
The results with respect to the upper zone (landward of the NAP-7m depth contour) are presented in Figure 4.13 to 4.15, showing the wave-induced, tide-induced and total longshore transport rates respectively.

Comparable to the cross-shore case, no information is available for the whole stretch.
However, for the Holland coast some information is present. Data from two different sources is presented in Figure 4.16, namely data from Van Rijn (1995) and more recent info from Roelvink (2001) referring to a 'Flyland-study' with the DELFT3D-model.

According to [Van Rijn, 1995]:

- Order of magnitude 0.10 to 0.15 Mm^3/yr for the upper zone;
- A gradual increase in the transport rate towards the Wadden inlets starting with negative values for the region just north of IJmuiden.

The present results show the same pattern, except for the negative part (see Figure 4.16).

In Figure 4.16 also the results from Roelvink (2001) are added schematically. It should be noted that the presented line refers to the non-calibrated pattern (for calibration purposes the magnitudes have been reduced by a factor two) and only gives a schematic line.

The overall pattern of Roelvink (2001) deviates from the Van Rijn (1995) pattern for especially the right-hand part. No negative transports are present here.

In summary it was concluded that the computed patterns agree with the available insights and there is no need for additional calibration. Consequently, the default setting for the longshore transports can be used for further elaboration.

Comparable to the upper zone, in Figure 4.13 to 4.15 the longshore transport patterns for the lower zone (in between the NAP-7m and NAP-20m depth contour) are presented in Figure 4.17 to 4.19 for the wave-induced, tide-induced and total transport rates respectively.

As can be observed, the contribution of the waves is only minor in this region. The overall pattern is dominated by the tide-induced transports.
Figure 4.20 shows the time-averaged tide-induced transport capacity (including the effects of wave stirring) for the various layers. The q_1- to q_4-numbers refer to the average transport in the NAP-2/+3, NAP-7/-2, NAP-13/-7 and NAP-20/-13 zone respectively.
In Figure 4.21 the results for deeper water for the Holland coast are compared with the results according to Van Rijn (1995). As can be observed, the present model yields slightly higher values in the left-hand part.
Because of the fact that the actual values are subject to large uncertainties, no additional calibration of the transport patterns for the deeper region was carried out.

In summary it was concluded that the computed longshore transport patterns are acceptable. Consequently, no additional calibration was required and the default settings can be applied for further elaborations.

4.4 Coastal evolution

4.4.1 Large-scale evolution

Using former derived setting the model has been applied to compute the coastal evolution for the 1970 – 1990 period, taking into account the performed nourishments.

Figure 4.22 provides an overview of the initial (1970) and final (1990) layer positions.
Since the related changes on this large scale are relatively minor, it is very difficult to draw conclusions on the model performance using this kind of plots.

4.4.2 Detailed evolution near IJmuiden

Since major changes occur in the IJmuiden region, a comparison between the observed and computed developments in this area seems interesting.
Figure 4.23 shows the related results. The upper plot shows the observed evolution (based on the initial 1970 and 1990 layer positions), whereas the lower plot shows the computed evolution. In both cases, the thick lines refer to the 1990-situation. It should be noted that the observed layer position for the Y_3-layer is probably incorrect.
The changes in the upper layers are comparable to a large extent. The model reproduces the distinct accretion on the south boundary. In the lower layer the agreement seems less, which is also due to the lack of adequate observed data. The computed trends with an accretion on the updrift side and erosion on the downdrift side (representing the scour hole) are consistent with general observations.

It is concluded that the model provides adequate results in this region. However, a more detailed comparison requires a more detailed model (including detailed calibration etc.).

4.4.3 Evolution of the outer deltas

The anticipated behaviour of the outer deltas in the model is already described in part I of this report. The actual calibration of the model is taken into account in the definition of the outer delta model itself (see Chapter 7).

4.5 Layer evolution

In order to check the behaviour of the model, a comparison is made between the observed and the computed time-averaged trends for specific layers.
The ‘observed trend’ is based on the difference between the initial (1970) and final (1990) layer positions. The results for the dune layer, the upper layer and the lower layer are presented in Figure 4.24 to 4.29 respectively.

Figure 4.24 shows a comparison between the observed trend (the boxes) and the section-averaged computed trend for the dune layer. As can be observed a lot of scatter is present.
Figure 4.25 shows the results for the Holland coast (the stretch with the most accurate data) in more detail. The red boxes and red line (showing a section-averaged magnitude) denote the observed trend.
The results of the model are presented on both the scale of the grid cells as well as a section-averaged value (see also Figure 4.24).
As can be observed the results show a lot of scatter yielding form –1 to +1 m/year. The observed and computed section-averaged values are comparable.

Figure 4.26 and 4.27 show the results for the (relatively important) upper layer. The section-averaged observed trend amounts to +1.0 m/yr and -0.1.1 m/yr for the southern and northern part respectively. The values for the southern part are comparable with the computed rates. For the northern part a larger deviation is present.
On the more detailed scale (comparing the red boxes and the thin line), the resemblance is less, although some of the patterns are reproduced rather well.

Figure 4.28 and 4.29 show the results for the lower layer. It should be noted that the information on the observed trend is very limited. The model yields negative trends for the lower layer for most of the sections. For the Holland coast the maximum deviation is in the order of 0.5 m/year.

Based on these elaborations it is concluded that the model produces useful results, especially on a more integrated scale.

4.6 Large-scale cell evolution

The PONTOS-model can also be used to compute the average behaviour of coastal cells.
The integrated results for the calibration period are provided in Figure 4.30.

In this figure/table, the average trend (expressed in Mm^3/yr) is presented for a number of levels, namely:

- The whole Dutch coast (1 cell);
- The upper and lower layer along the Dutch coast (2 cells);
- The individual coastal systems Delta, Holland and Wadden coast (3 cells);
- The individual coastal cells (11 cells);
- The upper and lower sections for the individual coastal cells (22 cells).

The interaction across the boundaries of the individual cells is provided in the box located at the centre of each boundary.
In addition, the net exchange with the back-barrier system (box below the most landward cell) and the applied nourishment intensity (box in upper right corner of each cell) is provided.

As can be observed, the overall sediment budgets are dominated by the losses towards the tidal basins. The average loss towards the Wadden Sea amounts to 3.9 Mm^3/yr (for the 1970 – 1990 period; see centre of the cell on the most aggregate level). For the Delta coast (the Western Scheldt inlet) the average loss towards the basin equals 2.0 Mm^3/yr (see also Figure 3.18).

The net loss of the whole coastal system is about 5.4 Mm^3/yr,which includes a net nourishment contribution of 1.5 Mm3/yr. Without latter coastal management efforts, the total net loss would have been in the order of 6.9 Mm^3/yr.

A comparison with the observed sediment loss (only available on the 1965-1995 period) is presented in the next chapter.

4.7 Sensitivity and reliability of the model

In order to test and calibrate the computational model, a number of individual computations have been performed.
However, in order to gain insight in the actual sensitivity of the model, a large number of mutually related computations should be performed in which the actual input is varied between distinct boundaries. Since the present version of the model requires long run-times, it was not possible to perform such a systematic sensitivity check.

Nevertheless, it is obvious from the present experiences that the overall results of the model are dominated by the net transport across the models boundaries. This holds for both the net transport in the tidal inlets as well as for the net transport across the NAP-20m depth contour.
On a more detailed scale the behaviour of the individual layers is controlled by the applied calibration of the cross-shore transport pattern to a large extent. In the present version oif the model the so-called CW-parameters play an important role in this calibration.

It is recommended to perform such a systematic sensitivity check in a next phase of the model application.

4.8 Conclusions

The model has been calibrated by running the model for the period 1970-1990 and comparing the model results to the available data. The amount of useful calibration (and verification) data on especially the larger scales is very limited. Therefore also insight into the coastal sediment transport, both cross-shore and longshore, as presented in the literature has been used for the calibration of the governing processes.

The following conclusions are drawn concerning the calibration of the model:

- The most important calibration coefficients appear to be those controlling the equilibrium layer distances. For these coefficients for all layers spatial variable values far from the theoretical value (1.0) are necessary in order to have correct model behaviour. These coefficients mainly control the cross-shore sediment transport in the model.
- The general calibrated pattern of the cross-shore sediment transport at 7 m depth along the Holland Coast produced by the model is consistent with the insight available in the literature.
- Default setting of the parameters controlling the longshore sediment transport appears to be sufficient for reproducing the patterns along the Holland Coast described in the literature for the upper zone (landwards of NAP-7 m). For the lower zone the model yields slightly higher values in the Southern part. Given the uncertainties of the data presented in the literature the agreement is considered to be acceptable.
- Comparison between the model results and observations concerning coastal evolution in the IJmuiden region, the most active part of the Holland Coast, shows reasonable agreement.
- The observed trend of layer positions along the Holland Coast shows a lot of scatter. The model cannot reproduce this scattered trend accurately. Concerning the section averaged trend the agreement between the model and the observation is fair.
- The sediment budgets of the large-scale cells are dominated by the losses towards the tidal basins.
- Taking into account the ‘intra-coupling’ for the tidal inlets has only a minor effect and is not taken into account in the final runs with the model.
- In order to assess the sensitivity of the model in more detail, a large number of computations should be performed. Since the present version of the model requires long run-times, it was not possible to perform a systematic sensitivity check.

In summary it is concluded that the model provides acceptable results especially on the large-scale and therefore the derived model settings can be used for verification purposes.

5 Verification of the model

5.1 Introduction

Using former derived settings the model has been applied to compute the coastal evolution for the 1990 – 2003 period, taking into account the performed nourishments.
Special attention will be given to the comparison with the available large-scale data.

5.2 Coastal evolution

Figure 5.1 provides an overview of the initial (1990) and final (2003) layer positions.
Related changes on this large scale are relatively minor.

Figure 5.2 provides a comparison between the observed and computed developments in IJmuiden area. The upper plot shows the observed evolution (based on the initial 1990 and 2003 layer positions), whereas the lower plot shows the computed evolution. In both cases, the thick lines refer to the 2003-situation. The changes in the upper layers are comparable.
The actual evolution of the lower region (which is not represented by the 'observed data' presented in Figure 5.2) is reproduced by the model: accretion on the updrift side and erosion on the downdrift side (representing the formation of a large-scale scour hole).

5.3 Layer evolution

5.3.1 Upper layer

In order to check the behaviour of the model, a comparison is made between the observed and the computed time-averaged trends for especially the upper layer for the Holland coast.
The "observed trend" is based on the difference between the initial (1990) and final (2003) layer positions. The results for this layer are presented in Figure 5.3.
The overall pattern is comparable. The section–averaged accretion for the observed data amounts to +1.9 and +1.5 m/yr for the south and north part respectively. The model yields +2.9 and +2.8 m/yr as a result.

5.3.2 BCL-layer

Figure 5.4 shows a comparison between the observed and computed trend of the so-called BCL-layer.
The observed trend is based on the computed MCL-position for the initial 1990 and the (initial) 2003 bottom topography. In the figure, the red boxes denote the individual 'observed' trends; the section-averaged values by the red line.

The computed values are based on MCL-position for the initial 1990 and the computed 2003 bottom topography. In the figure, the open boxes denote the individual computed trends; the section-averaged values by the blue line.

As can be observed, the resemblance between observed and computed values is rather good. The individual MCL-trends show the comparable patterns and the deviation between the section averaged trends is only limited.
For the southern part the model yields +2.3 m/yr compared to +1.9 m/yr for the data.
In the southern part the computed trend amounts to +2.1 m/yr whereas the data suggest a +1.3 m/yr trend.

Based on this comparison, it is concluded that the model is able to produce a rather good representation of the MCL-trends for the Holland coast, although no specific calibration effort has been performed to achieve this.

5.4 Large-scale cell evolution

Figure 5.5 provides the computed time-averaged evolution of the coastal system for the 1990 – 2003 period (comparable to Figure 4.30 for the 1970-1990 period).

The overall sediment budgets are dominated by the losses towards the tidal basins as well as the nourishment input.
The average gain amounts to +3.8 Mm^3/yr (compared to –5.4 Mm^3/yr for the 1970 – 1990 period).
This large difference is due to the larger nourishment quantity (+6.5 instead of +1.5 Mm^3/yr) and the significant change in the net transport at Western Scheldt inlet (+1.4 instead of –2.0 Mm^3/yr).

Figure 5.6 shows the computed differences in the computed trends between the verification and calibration period.
The relative total difference amounts to +9.2 Mm^3/yr, due to an increase in the nourishment rate (+5.0 Mm^3/yr) and a significant decrease in the loss towards the basins (4.2 Mm^3/yr less).

In order to verify the overall behaviour of the coastal system, a comparison is made with the results of an extensive sediment balance study [Mulder, 2000].
In this report the time-averaged sand balance is provided for the 1965 – 1995 period. The average loss amounts to 6.4 Mm^3/yr.

Table 5.1 provides the original data (based on Table 2 in [Mulder, 2000]).
It should be noted that the original data have been corrected for the performed nourishments.

The total nourishment volume in this period (1965 – 1995) amounts to 74 Mm^3 (see Annex A) yielding an average gain of 2.5 Mm^3/yr on average. Latter nourishment effort per individual cell is added in the table.

section	Delta	Holland		Wadden					total
cell	1, 2 & 3	4	6	7	8	9	10	11	
part	Delta	HvH - IJmuiden	IJmuiden - Den Helder	Marsdiep	Eierlandse Gat	Vliestroom	Amelander Zeegat	Friesche Zeegat	
Upper	0.30	0.25	-0.08	-1.04	-1.12	-0.75	0.61	0.29	-1.54
Lower		-0.43	-0.01	-0.74	-0.40	0.07	0.08	0.05	-1.38
Outer deltas	-2.50			-1.13	0.92	-0.82	1.42	-1.37	-3.48
Total	-2.20	-0.18	-0.09	-2.91	-0.60	-1.50	2.11	-1.03	-6.40
Nourished	1.05	0.31	0.12	0.24	0.51	0.01	0.15	0.09	2.47
Net total	-1.15	0.13	0.03	-2.67	-0.09	-1.49	2.26	-0.94	-3.93

Table 5.1: Overview of available large-scale data (expressed in Mm^3/yr) for the 1965 – 1995 period.

The net total is presented in the lower row of the table and can be compared with the cell-data provided in Figure 4.30 (for the 1970 – 1990 period) and Figure 5.5 (for the 1990 – 2003 period).

Table 5.2 summarizes the computed results for the 1970 – 1990 period.
In this case, the net total (including the performed nourishments) is derived directly from the computed results (see Figure 4.30). In order to compute the autonomous total trend, the performed nourishments have to be subtracted from the net total values.

section	Delta	Holland		Wadden					total
cell	1, 2 & 3	4	6	7	8	9	10	11	
part	Delta	HvH - IJmuiden	IJmuiden - Den Helder	Marsdiep	Eierlandse Gat	Vliestroom	Amelander Zeegat	Friesche Zeegat	
Upper	-0.65	0.31	0.09	-0.05	-0.07	-1.40	-0.65	-1.78	-4.20
Lower	-0.78	-0.38	-0.03	-0.43	-0.16	0.19	0.16	0.45	-0.98
Net Total	-1.43	-0.07	0.06	-0.48	-0.23	-1.21	-0.50	-1.33	-5.18
Nourished	0.65	0.25	0.04	0.16	0.33	0.00	0.06	0.05	1.53
Total	-2.08	-0.32	0.03	-0.64	-0.56	-1.21	-0.56	-1.37	-6.71

Table 5.2: Large-scale results (expressed in Mm^3/yr) for the 1970 – 1990 period.

Comparable data are presented for the 1990 – 2003 period (see also Figure 5.4) in Table 5.3.

section	Delta	Holland		Wadden					total
Cell	1, 2 & 3	4	6	7	8	9	10	11	
part	Delta	HvH - IJmuiden	IJmuiden - Den Helder	Marsdiep	Eierlandse Gat	Vliestroom	Amelander Zeegat	Friesche Zeegat	
Upper	3.33	1.75	1.01	0.41	0.72	-1.30	-0.43	-0.39	5.10
Lower	-0.63	-0.35	-0.04	-0.42	-0.15	0.23	0.17	0.10	-1.08
Net Total	2.70	1.41	0.97	-0.01	0.57	-1.08	-0.26	-0.29	4.02
Nourished	1.37	1.73	0.94	0.55	1.13	0.16	0.34	0.31	6.52
Total	1.33	-0.32	0.03	-0.56	-0.56	-1.23	-0.59	-0.60	-2.51

Table 5.3: Large-scale results (expressed in Mm^3/yr) for the 1990 – 2003 period.

Table 5.4 presents an overview of the net total trends (including performed nourishments) for the three sources.

section	Delta	Holland		Wadden					Total
Cell	1, 2 & 3	4	6	7	8	9	10	11	
part	Delta	HvH - IJmuiden	IJmuiden - Den Helder	Marsdiep	Eierlandse Gat	Vliestroom	Amelander Zeegat	Friesche Zeegat	
Data (65-95)	-1.15	0.13	0.03	-2.67	-0.09	-1.49	2.26	-0.94	-3.93
Model (70-90)	-1.43	-0.07	0.06	-0.48	-0.23	-1.21	-0.50	-1.33	-5.18
Model (90-03)	2.70	1.41	0.97	-0.01	0.57	-1.08	-0.26	-0.29	4.02

Table 5.4: Comparison of net total trends (expressed in Mm^3/yr; including nourishments).

As can be observed, the impact of increased nourishment efforts is significant (compare the lower two rows).
The computed values for the 1970 – 1990 period agree well with the observed values (1965 – 1995 period). Only the data for cell 7 (Marsdiep) and 10 (Amelander Zeegat) show a large difference. The overall trend for the observed data is relatively less due to the increased nourishment effort (until 1995 for the ‘data’ instead of until 1990 for the ‘model’).

The results with respect to the autonomous trends (without nourishments) are presented in Table 5.5.

Section	Delta	Holland		Wadden					Total
Cell	1, 2 & 3	4	6	7	8	9	10	11	
Part	Delta	HvH - IJmuiden	IJmuiden - Den Helder	Marsdiep	Eierlandse Gat	Vliestroom	Amelander Zeegat	Friesche Zeegat	
Data (65-95)	-2.20	-0.18	-0.09	-2.91	-0.60	-1.50	2.11	-1.03	-6.40
Model (70-90)	-2.08	-0.32	0.03	-0.64	-0.56	-1.21	-0.56	-1.37	-6.71
Model (90-03)	1.33	-0.32	0.03	-0.56	-0.56	-1.23	-0.59	-0.60	-2.51

Table 5.5: Comparison of autonomous trends (expressed in Mm^3/yr; without nourishments).

Taking into account a correction for the nourishment efforts provides even a better agreement between observed (1965 – 1995) and computed data (1970 – 1990).
However, the large discrepancies for cell 7 and 10 remain. It is noted that these discrepancies are directly caused by the differences between the computed and the observed exchanges between the ebb-tidal delta and the tidal basins. This means that the discrepancy is in the ASMITA part of the model. For cell 7 this is probably due to the insufficient calibrattion of the existing ASMITA model. For cell 10 the reliability of the observation data can be questioned. More recent analysis of the field data suggests a different picture, which agrees much better with the model results.

5.5 Conclusions

The period 1990-2003 has been used for the verification of the model. The model run has been continued for this period with the same parameters settings for the model as in the final calibration run. It is noted that the coastal management in this period is considerably different than that in the calibration period. This makes the verification run not simply an extrapolation of the calibration run. The following conclusions are drawn:

- Concerning the coastal evolution and the evolution of the layer position, the agreement between the model results and the observation data is similar as in the calibration period.

- The overall sediment budgets of the coast are dominated by exchanges with the tidal basins and by the nourishment input. The increased nourishment rate and the decreased sediment loss to the tidal basins have together resulted in a gain for the coast in the verification period in contrast to a loss in the calibration period.
- Concerning the sediment budgets the agreement between the model and the data is reasonable for most of the large-scale cells. Only for the cells Marsdiep and the Amelanderzeegat the discrepancy between the model and the data is considerable. To resolve these discrepancies it is recommended to revisit the calibration of the ASMITA mnodel for Marsdiep and to revisit the data analysis for the Amlanderzeegat.

In summary, it is concluded that the model provides fairly good results concerning the sediment balance of the large-scale cells. The general patterns of both the behaviour of both layer and coastal cells agree with observed data to a large extent. This holds also for the trend in the BCL-layer, which is reprocuded by the model rather well.
The agreement concerning the detailled variation of the individual layers is less.

Since the basic idea of the model is to provide results on a relatively large scale (coastal cells) this goal seems to be achieved. Moreover, the model results for the BCL-layer are fairly good also. As a consequence the originally derived model settings (see Chapter 4) can now be used for prediction purposes.

6 Prediction simulations

6.1 Definition of the scenario's

The predictions are performed for the period 2003 – 2053 (+50 year period).

For the sea-level rise rate two specific scenarios have been used, namely:
1. A low scenario using 0.20 m/century;
2. A high scenario using 0.60 m/century.

For the anticipated nourishment schemes (period 2003 – 2053), three different management scenarios are defined, namely:
A. A nourishment scheme based on the predictions of [Mulder, 2000] with a total invariable rate of 11.9 Mm3/yr;
B. A nourishment scheme based on the mean efforts in the period 2001 - 2003 with a total invariable rate of 13.0 Mm3/yr;
C. A nourishment scheme according to [A] including the construction of three dams along the Holland coast combined with active auto-nourishments in this region.

The latter three management schemes ([A], [B] and [C]) are combined with the two sea level rise schemes ([1] and [2]), yielding six combinations.
As shown in the table, only 4 combinations are used for the computations.

Scenario	Management [A]	Management [B]	Management [C]
Sea level rise [1]	[1A]	-	-
Sea level rise [2]	[2A]	[2B]	[2C]

Table 6.1: Applied scenario's for predictions

With respect to the results of the various computations, special attention is given to the so-called MCL-trends as well as the volumes in specific sections. In order to gain insight in the effect of the various scenarios, also the relative impacts are assessed.

In the following the results of the performed predictions for the period 2003 – 2053 are presented. Four different model runs are defined, namely (see also Table 6.1):
- P1A: 0,2 m/yr sea level rise combined with nourishment scenario A;
- P2A: 0,6 m/yr sea level rise combined with nourishment scenario A;
- P2B: 0,6 m/yr sea level rise combined with nourishment scenario B;
- P2C: 0,6 m/yr sea level rise combined with nourishment scenario A, the construction of three dams and auto-nourishments along the Holland coast.

6.2 MCL-trends

6.2.1 Individual results per scenario

Comparable to the procedure followed for the verification of the MCL-trend (see Figure 5.4), the computed trends are based on the initial MCL-position in 2003 and the computed MCL-position in 2013. As a result the computed trend is based on a 10-year time frame.

Figure 6.1 shows the computed individual trends for scenario 1A.
In the upper figure both the applied (scenario A) and the recent (1990-2003) nourishment scheme is provided. As can be observed, the intensity of the anticipated scheme is less than the actual scheme. As a result, in some regions negative trends occur.

This same pattern is present for scenario 2A; see Figure 6.2. Due to the increase in sea level rise, the trends are slightly more negative.

In case of scenario 2B a more intense nourishment scheme is applied (see upper plot of Figure 6.3) the amount of negative trends is reduced considerably.

The results for scenario 2C are provided in Figure 6.4.
In addition to the basic nourishment scheme (scheme A), also additional nourishments are present as shown in the upper plot. Latter are the result of using the so-called auto-nourishment option of the PONTOS-model.
Regions with negative trends are restricted to the downdrift side of the additional dams.

6.2.2 Effect of increased sea level rise

The relative impact of increased sea level rise (0.6 m/century instead of 0.2 m/century) can be determined by subtraction the results of run 2A and run 1A.
The result is shown in Figure 6.5, showing an increased sea level rise will yield a negative correction on the actual MCL-trend. This (more or less uniform) correction is in the order of 0.2 to 0.4 m/yr.

6.2.3 Effect of other nourishment scheme

The impact of the nourishment scheme can be assessed from the difference between run P2B and P2A. The result with respect to the MCL-trend is shown in Figure 6.6. As can be observed, the positive correction is directly related to the magnitude of the increased nourishment intensity (see upper plot).

6.2.4 Effect of additional structures and additional nourishments

The impact of the scenario 2C can be assessed from the difference between run P2C and P2A. The result with respect to the MCL-trend is shown in Figure 6.7. As can be observed, the positive correction is directly related to the magnitude of the additional nourishment intensity (see upper plot). The negative impacts are related to the new structures.

6.3 Volumetric changes

6.3.1 Individual results per scenario

The integrated results for the prediction runs are provided in Figure 6.8 to 6.11, showing both the average behaviour over the initial 10-year period (2003-2013) as the whole 50-year period (2003-2053).

For scenario 1A (see Figure 6.8a and 6.8b) the effect of the averaging period is only limited. More effects are present for the scenarios with increased sea level rise (see Figure 6.9 to 6.11).

It should be noted that the actual accretion/erosion number per individual cells are based on the results for a fixed vertical reference level. The consequences for a relative defence level (linked to the mean sea water level) will be discussed hereafter.

6.3.2 Effect of increased sea level rise

The impact of increased sea level rise can be computed from the difference between run P2A and P1A. The result with respect to the large-scale cell evolution is provided Figure 6.12 (for both a 10- and 50-year averaged period).
As can be observed, the effects are mainly restricted to the tidal inlet area, showing some additional erosion of especially the upper zone. Increased sea level rise is especially important on the longer time scale (compare Figure 6.12a and 6.12b).

6.3.3 Effect of other nourishment scheme

The impact of the nourishment scheme can be computed from the difference between run P2B and P2A. The result with respect to the large-scale cell evolution is provided in Figure 6.13 (for both a 10- and 50-year averaged period).
The effects are consistent with the original objectives of the two individual schemes.

6.3.4 Effect of additional structures along the Holland coast

The impact of the construction of three dams and the additional nourishments can be derived from the difference between run P2C and P2A.
The result with respect to the large-scale cell evolution is provided Figure 6.14 (for both a 10- and 50-year averaged period).
From these results is can be found that this requires additional nourishments up to 1.7 Mm^3/yr (averaged over a 10-year period) and 0.8 Mm^3/yr (averaged over a 50-year period).
Also a small effect is present on the updrift cell (Marsdiep).

Figure 6.15 shows the longshore distribution of the nourishment intensity (both detailed and cell-averaged) for both the pre-defined nourishments (according to scenario A) and the auto-generated additional nourishments (indicated in red).
It should be noted that the latter nourishment intensity for the Holland coast is based on the initial 10-year average.

Since, the momentary magnitude of this additional nourishment will decrease in time by definition, the 50-year average value is much lower (see Figure 6.14b).

Figure 6.16 provides the time evolution of the nourishment intensity, starting in 1970.
The required additional nourishments are initially in the order of 3 to 5 Mm^3/yr. After 10 years in the order of 1 Mm^3/yr.

6.4 Volumetric results for modified reference level

6.4.1 Introduction

For a situation with sea level rise amount of sediment loss in a specific section can be expressed relative to a fixed reference level as well as relative to a reference level, which is coupled on the mean sea water level.
The PONTOS-model uses a fixed vertical reference level.

6.4.2 Assessments of basic corrections

In order to transform the original PONTOS-results towards results for a relative level magnitude of the correction has to be determined.
This correction depends on the area of each individual cell as well as on the amount of sea level rise.

In order to compute the areas of the individual cells, the position of the upper and lower boundary of both the upper and lower layer have to be determined.
These boundaries have been based on the elaboration shown in Figure 6.17. In this figure a number of contours and layer positions are shown. The actual boundaries are based on the NAP+3m (Pontos), NAP-7m and NAP-20m respectively.
Based on this the areas of the individual cells has been computed; see Figure 6.18.

The correction (or in fact the sediment loss) per individual cell is shown in Figure 6.19 and 6.20 respectively.
In case of 0.2 m/century sea level rise, the coastal system experiences a net loss of about 7.4 Mm^3/yr.

6.4.3 Results per individual scenario

For each of the four scenarios, the net sediment gain or loss for each individual cell is provided in Figure 6.21, 6.23, 6.25 and 6.27. These results are comparable to the 10-year averaged results as discussed in Section 6.3. In these cases, the volume change is relative to a fixed vertical reference level.
The results for a relative level (fixed to a increasing water level) are provided in Figure 6.22, 6.24, 6.26 and 6.27 respectively.
The latter results show a more negative trend for the area of interest.

In case of scenario 1A (with 0.2 m/century sea level rise), the net trend (including nourishments and on the large-scale) is still positive. For the other scenarios (with 0.6 m/century sea level rise), this trend is negative (up to –14 Mm^3/yr).

6.5 Detailed results for scenario C

Figure 6.29 to 6.31 show the detailed evolution of the Holland coast in case of scenario 2C for the intervals 2003 - 2013, 2003 – 2028 and 2003 – 2053 respectively.
The impact of especially the new dams can be observed in these plots, showing accretion on the updrift side of these structures.

6.6 Conclusions

With the calibrated model simulations of 50 years have been carried out for four scenarios in order to evaluate the impact of the accelerated sea level rise rate and various management options. In summary the following conclusions have been drawn:

- According to the model, the effect of accelerated sea-level rise will be mainly restricted to the tidal inlet areas. The extra sediment demand in the basins will cause additional erosion of especially the upper zone of the adjacent coasts.
- For the large-scale cells the nourishment appears to be an effective management measure. Extra nourishment causes additional gain for the coast of almost the equal amount.
- After the construction of the three considered dams along the Holland Coast additional nourishment will be required, initially in the order of 3 to 5 Mm^3/year and later (after about 10 years) in the order of 1 Mm^3/year.

7 Conclusions and recommendations

7.1 Conclusions

7.1.1 Model concept

The model concept has been described in part I of this report. This part of the report describes the set-up, calibration, verification and the application of the model to the entire Dutch coast. With respect to the model it is concluded that:

- The model has been improved on various points.
- Both the tidal inlet and the coupling with the back-barrier system have been incorporated successfully.
- The model provides valuable results on especially the large-scale.
- Results on smaller scales show promising results, although a lot is scatter can be found on these scales.
- The time required to run the model is a problem, because it requires in the order of days to perform a single long-term run.

7.1.2 Model calibration and verification

The model has been calibrated by running the model for the period 1970-1990 and comparing the model results to the available data. The amount of useful calibration (and verification) data on especially the larger scales is very limited. Therefore also insight into the coastal sediment transport, both cross-shore and longshore, as presented in the literature has been used for the calibration of the governing processes. The following conclusions are drawn concerning the calibration of the model:

- The most important calibration coefficients appear to be those controlling the equilibrium layer distances. For these coefficients for all layers spatial variable values far from the theoretical value (1.0) are necessary in order to have correct model behaviour. These coefficients mainly control the cross-shore sediment transport in the model.
- The general calibrated pattern of the cross-shore sediment transport at 7 m depth along the Holland Coast produced by the model is consistent with the insight available in the literature.
- Default setting of the parameters controlling the longshore sediment transport appears to be sufficient for reproducing the patterns along the Holland Coast described in the literature for the upper zone (landwards of NAP-7 m). For the lower zone the model yields slightly higher values in the Southern part. Given the uncertainties of the data presented in the literature the agreement is considered to be acceptable.
- Comparison between the model results and observations concerning coastal evolution in the IJmuiden region, the most active part of the Holland Coast, shows reasonable agreement.

- The observed trend of layer positions along the Holland Coast shows a lot of scatter. This scattered trend cannot be reproduced by the model accurately. Concerning the section averaged trend the agreement between the model and the observation is fair.
- The sediment budgets of the large-scale cells are dominated by the losses towards the tidal basins.
- The performance of the lower layer is still not satisfactory although it should be stated that the available information is limited also

The period 1990-2003 has been used for the calibration of the model. The model has been continued for this period with the same parameters settings for the model as in the final calibration run. It is noted that the coastal management in this period is considerably different than that in the calibration period. This makes the verification run not simply an extrapolation of the calibration run. Concerning the verification of the model the following conclusions are drawn:

- Concerning the coastal evolution and the evolution of the layer position, the agreement between the model results and the observation data is similar as in the calibration period.
- It is concluded that the model is able to produce a rather good representation of the MCL-trends for the Holland coast, although no specific calibration effort has been performed to achieve this.
- The overall sediment budgets of the coast are dominated by exchanges with the tidal basins and by the nourishment input. The increased nourishment and the decreased sediment loss to the tidal basins have together resulted in a gain for the coast in the verification period in contrast to a loss in the calibration period.
- Concerning the sediment budgets the agreement between the model and the data is reasonable for most of the large-scale cells. Only for the cells Marsdiep and the Amelanderzeegat the discrepancy between the model and the data is considerable.

In summary, it is concluded that the model provides fairly good results. The general patterns of both the behaviour of both layer and coastal cells agree with observed data to a large extent.

Since the basic idea of the model is to provide results on a relatively large scale (coastal cells) this goal seems to be achieved.

7.1.3 Model application

With the calibrated model simulations of 50 years have been carried out for four scenarios in order to evaluate the impact of the accelerated sea-level rise rate and various management options. In summary the following conclusions have been drawn:

- According to the model, the effect of accelerated sea-level rise will be mainly restricted to the tidal inlet areas. The extra sediment demand in the basins will cause additional erosion of especially the upper zone of the adjacent coasts.
- For the large-scale cells the nourishment appears to be an effective management measure. Extra nourishment causes additional gain for the coast of almost the equal amount.

- After the construction of the three considered dams along the Holland Coast additional nourishment will be required, initially in the order of 3 to 5 Mm^3/year and later (after about 10 years) in the order of 1 Mm^3/year.
- The strength of the model is in the evaluation of the effect of various changes in the natural forcing and in the human interferences, by comparing the model results for the different scenarios.
- Prediction in absolute sense with the model still accompanies with considerable uncertainties although individual results are promising.

7.2 Recommendations

7.2.1 Model

With respect to the model it is recommended to:

- Investigate the possibilities to reduce the required computational time;
- To perform a large number of computations in order to assess the sensitivity of the model in more detail (since the present version of the model requires long run-times, it was not possible to perform a systematic sensitivity check).
- To improve the auto-nourishment mode by using the relative BCL-layer rather than an absolute Y_1-layer.
- Give more attention to the sediment demand of the tidal basins because of the dominant role of the sediment exchange between the tidal basins and the coast for the sediment budgets of the large scale coast cells. Especially the modelling of the tidal inlets Marsdiep, Amalanderzeegat and the Western Scheldt estuary should be paid more attention to.
- Improve the calibration concerning the development of the individual layers and especially the lower layer.

7.2.2 Application

With respect to the application it is recommended to:

- Provide more large-scale data (especially more details as a function of time) for calibration and validation purposes;
- To use this data for a better calibration of the model;
- Use the present version of the model application only for large-scale development of the coast.
- The present large-scale model is not suitable for simulating development on detailled scales. Such a scale askes for a more detailed model set-up.
- Carry out longer-term simulations, e.g. for 500 years.

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A Model Input

ANNEX A

Overview of input data

no.	Group	Sub	Item	Specification	array	length
1	Geometry	1.1	Overall		COD	10
		1.2	Levels	Level Z0	Z0X	100
				Level Z1	Z1X	5
				Level Z2	Z2X	5
				Level Z3	Z3X	5
				Level Z4	Z4X	5
				Level Z5	Z5X	5
		1.3	Layers	Layer Y0	Y0X	500
				Layer Y1	Y1X	500
				Layer Y2	Y2X	500
				Layer Y3	Y3X	500
				Layer Y4	Y4X	500
		1.4	Seaward		YBX	50
2	Material	2.1	Longshore		DSX	50
		2.2	Cross-shore		DSZ	5
3	Structures	3.1	Revetments		RVM	25
		3.2	Groynes		GRN	50
		3.3	Breakwaters		OBW	10
4	Inlets	4.1	Inlet characteristics		TID	15
		4.2	Basin characteristics		TBD	15
		4.3	Inlet coefficients		TIC	15
		4.4	Basis coefficients		TBC	15
5	Conditions	5.1	Waves	Stations	WCR	10
				Climate conditions	WCi	99
		5.2	Tides	Stations	TCR	10
				Climate conditions	WTi	20
		5.3	Changes	Sealevel	CSL	5
				Wave heights	CWH	5
				Wave direction	CWD	5
				Tidal range	CTR	100
				Tidal velocity	CTV	5
6	Boundaries	6.1	Left	Layer Y0	QL1	5
				Layer Y1	QL2	5
				Layer Y2	QL3	5
				Layer Y3	QL4	5
				Layer Y4	QL5	5
		6.2	Right	Layer Y0	QR1	5
				Layer Y1	QR2	5
				Layer Y2	QR3	5
				Layer Y3	QR4	5
				Layer Y4	QR5	5
		6.3	Dune		QDX	25
		6.4	Sea		QSX	5
		6.5	Inlets (pre-defined)	no.nn	QInn	10
7	Management	7.1	Schemes		PSS	250
		7.2	Layers	Layer Y0	Y0C	25
				Layer Y1	Y1C	200
				Layer Y2	Y2C	25
				Layer Y3	Y3C	10
				Layer Y4	Y4C	5
		7.3	Cells		VCC	10
8	Runinfo	8.1	Grid		CGD	50
		8.2	Time-range		TRD	15
		8.3	Constraints		TSC	(3)
		8.4	Output	Balance sections	CSD	20
				BCL-levels	CLD	30
				Profile location	CPD	10
				Depth contours	CCD	5
				Box boundaries	CBD	20
		8.5	Stochasts		SVC	30
9	Calibration	9.1	Longshore	Wave	CWX	10
				direction	CDX	10
				Tide	CTX	10
		9.2	Cross-shore	Capacity	CCX	10
				Steepness	CSX	10
				Type	CPX	10
				Equilibrium width correction	CW1X	500
					CW2X	500
					CW3X	500
					CW4X	500
		9.3	Tidal inlets	Capacity	CQI	15

Overview of parameter groups

X [m]	CO [deg]
-50000	27.06
28284	45.00
93431	45.00
211241	90.00
305278	0.00
400000	36.18

Longshore distribution of coastal orientation

X [m]	**Z0 [m]**
0	11.00
21000	11.00
33000	5.00
54000	5.00
58000	13.00
82000	13.00
86000	7.00
96800	6.90
98100	10.10
100700	12.60
109600	11.00
110700	16.67
112000	10.30
112900	16.90
115700	13.00
117400	6.80
119600	21.50
120000	16.67
128700	21.00
130400	7.40
131700	16.20
134800	18.60
135400	7.60
137200	17.00
142800	21.30
147600	19.40
150000	22.00
151500	11.80
153800	20.40
159500	20.00
161600	4.00

X [m]	Z0 [m]
162600	4.00
165500	21.00
183300	20.10
187300	10.10
190400	19.00
192700	12.00
199500	12.00
206500	19.40
208600	11.50
216500	17.20
219700	11.20
223000	11.00
243000	11.00
257000	8.00
263000	15.00
277000	15.00
300000	8.00
307000	4.00
313000	12.00
326000	8.00
343000	10.00
353000	4.00
358000	10.00
400000	10.00

X [m]	**Z1 [m]**
0	3.00
400000	3.00

X [m]	**Z2 [m]**
0	-2.00
400000	-2.00

X [m]	**Z3 [m]**
0	-7.00
400000	-7.00

X [m]	**Z4 [m]**
0	-13.00
400000	-13.00

X [m]	**Z5 [m]**
0	-20.00
400000	-20.00

Longshore distribution of various layer levels
(Z0X refers to the dune level)

X [m]	YB [m]
0	20000.00
400000	20000.00

Longshore distribution of offshore boundary

X [m]	Ds [mm]
0	0.250
250000	0.250
400000	0.150

Longshore distribution of sediment size

Z [m]	FD [-]
-20.00	1.000
0.00	1.000
20.00	1.000

Cross-shore distribution

Xl [m]	Yl [m]	Xr [m]	Yr [m]	Z [m]	Tc [yr]	Td [yr]	L_x [m]
91000	5000	93000	7000	5.00	0	0	2000
93000	7000	94000	7000	5.00	0	0	1000
94000	7000	96500	5000	5.00	0	0	2500
192628	4339	194093	4213	12.00	0	0	1465
194093	4213	195108	4109	12.00	0	0	1016
195108	4109	195761	4031	12.00	0	0	653
195761	4031	196458	3939	12.00	0	0	697
196458	3939	196731	3881	12.00	0	0	274
196731	3881	196894	3843	12.00	0	0	163
196894	3843	197380	3674	12.00	0	0	486
197380	3674	197926	3459	12.00	0	0	546

Location and dimensions of revetments and dams

X [m]	Yl [m]	Ys [m]	Z [m]	E [-]	Tc [yr]	Td [yr]	L_y [m]	Remarks
5000	-3000	0	4.00	1.00	0	0	3000	
96500	3000	7000	4.00	1.00	0	0	4000	
98000	3000	7000	4.00	1.00	0	0	4000	
115000	3400	3800	4.00	1.00	0	0	400	
115500	3400	3650	4.00	1.00	0	0	250	
161500	2500	5100	4.00	1.00	0	0	2600	
162500	2500	4600	4.00	1.00	0	0	2100	
245000	500	3000	4.00	1.00	1995	2100	2500	Texel

Location and dimensions of groyns

X [m]	Yl [m]	Ys [m]	Z [m]	E [-]	Tc [yr]	Td [yr]	L_y [m]	Remarks
5000	-3000	0	4.00	1.00	0	0	3000	
96500	3000	7000	4.00	1.00	0	0	4000	
98000	3000	7000	4.00	1.00	0	0	4000	
115000	3400	3800	4.00	1.00	0	0	400	
115500	3400	3650	4.00	1.00	0	0	250	
137500	1900	2700	4.00	1.00	2003	2100	800	Noordwijk
161500	2500	5100	4.00	1.00	0	0	2600	
162500	2500	4600	4.00	1.00	0	0	2100	
180000	3700	4400	4.00	1.00	2003	2100	700	Egmond
198500	3500	4200	4.00	1.00	2003	2100	700	Petten
245000	500	3000	4.00	1.00	1995	2100		Texel

Location and dimensions of groyns (incl. additional dams)

	1970				
	X_l [m]	X_c [m]	X_r [m]	B [m]	delta
#1	212000	219000	227000	15000	0.467
#2	243000	248000	253000	10000	0.500
#3	263000	270000	278000	15000	0.467
#4	298000	304000	310000	12000	0.500
#5	329000	332000	334000	5000	0.600
#6	335000	338000	342000	7000	0.429
#7	10000	20000	30000	20000	0.500
#8	39000	49000	57000	18000	0.556

#1	Marsdiep
#2	Eierlandse Gat
#3	Vlie
#4	Amelander Zeegat
#5	Pinkegat
#6	Zoutkamperlaag
#7	Westerschelde
#8	Oosterschelde

	1990				
	X_l [m]	X_c [m]	X_r [m]	B [m]	delta
#1	212000	219000	227000	15000	0.467
#2	243000	248000	253000	10000	0.500
#3	263000	270000	278000	15000	0.467
#4	298000	304000	310000	12000	0.500
#5	329000	332000	334000	5000	0.600
#6	335000	338000	342000	7000	0.429
#7	10000	20000	30000	20000	0.500
#8	39000	49000	57000	18000	0.556

	2003				
	X_l [m]	X_c [m]	X_r [m]	B [m]	delta
#1	212000	219000	227000	15000	0.467
#2	243000	248000	253000	10000	0.500
#3	263000	270000	278000	15000	0.467
#4	298000	304000	310000	12000	0.500
#5	329000	332000	334000	5000	0.600
#6	335000	338000	342000	7000	0.429
#7	10000	20000	30000	20000	0.500
#8	39000	49000	57000	18000	0.556

Location and dimensions of tidal inlets

	1970									-0.066
	A_f [Mm2]	A_c [Mm2]	A_d [Mm2]	H [m]	V_f [Mm3]	V_c [Mm3]	V_d [Mm3]	Ab [Mm3	P [Mm3]	MFL
#1	133.000	522.000	93.000	1.65	52.000	2160.000	509.000	655.000	1028.750	-0.500
#2	105.000	52.700	37.800	1.65	55.000	106.000	132.000	157.700	205.205	-0.367
#3	328.000	387.000	106.000	1.90	162.000	1230.000	370.000	715.000	1196.500	-0.522
#4	178.000	98.000	75.000	2.15	120.000	302.000	131.000	276.000	473.400	-0.467
#5	38.100	11.500	34.000	2.15	29.600	18.500	35.000	49.600	77.040	-0.364
#6	65.000	40.000	78.000	2.25	69.000	177.000	151.000	105.000	167.250	-0.129
#7	0.000	0.000	0.000	3.80	0.000	0.000	0.000	0.000	0.000	
#8	0.000	0.000	0.000	3.20	0.000	0.000	0.000	0.000	0.000	

	1990									-0.026
	A_f [Mm2]	A_c [Mm2]	A_d [Mm2]	H [m]	V_f [Mm3]	V_c [Mm3]	V_d [Mm3]	Ab [Mm3	P [Mm3]	MFL
#1	133.000	522.000	93.000	1.65	46.600	2165.600	496.500	655.000	1034.150	-0.501
#2	105.000	52.700	37.800	1.65	54.600	105.100	130.800	157.700	205.605	-0.331
#3	328.000	387.000	106.000	1.90	163.800	1239.500	366.500	715.000	1194.700	-0.477
#4	178.000	98.000	75.000	2.15	119.900	304.600	130.700	276.000	473.500	-0.427
#5	38.100	11.500	34.000	2.15	29.610	17.280	34.020	49.600	77.030	-0.324
#6	65.000	40.000	78.000	2.25	66.900	160.300	125.400	105.000	169.350	-0.122
#7	0.000	0.000	0.000	3.80	0.000	0.000	0.000	0.000	0.000	
#8	0.000	0.000	0.000	3.20	0.000	0.000	0.000	0.000	0.000	

	2003									0.000
	A_f [Mm2]	A_c [Mm2]	A_d [Mm2]	H [m]	V_f [Mm3]	V_c [Mm3]	V_d [Mm3]	Ab [Mm3	P [Mm3]	MFL
#1	133.000	522.000	93.000	1.65	46.400	2173.200	490.600	655.000	1034.350	-0.476
#2	105.000	52.700	37.800	1.65	54.600	105.100	130.300	157.700	205.605	-0.305
#3	328.000	387.000	106.000	1.90	163.700	1243.700	364.700	715.000	1194.800	-0.451
#4	178.000	98.000	75.000	2.15	119.600	305.700	130.600	276.000	473.800	-0.403
#5	38.100	11.500	34.000	2.15	29.630	17.260	33.910	49.600	77.010	-0.297
#6	65.000	40.000	78.000	2.25	67.300	158.800	120.500	105.000	168.950	-0.090
#7	0.000	0.000	0.000	3.80	0.000	0.000	0.000	0.000	0.000	
#8	0.000	0.000	0.000	3.20	0.000	0.000	0.000	0.000	0.000	

Location and dimensions of tidal inlets

	1970	
	lambda_r	phi_r
#1	0.345	0.089
#2	0.226	0.039
#3	0.233	0.163
#4	0.311	0.176
#5	0.143	0.302
#6	0.198	-0.106
#7	0.283	0.230
#8	0.356	0.222

	1990	
	lambda_r	phi_r
#1	0.345	0.089
#2	0.226	0.039
#3	0.233	0.163
#4	0.311	0.176
#5	0.143	0.302
#6	0.198	-0.106
#7	0.283	0.230
#8	0.356	0.222

	2003	
	lambda_r	phi_r
#1	0.345	0.089
#2	0.226	0.039
#3	0.233	0.163
#4	0.311	0.176
#5	0.143	0.302
#6	0.198	-0.106
#7	0.283	0.230
#8	0.356	0.222

Coefficients for tidal inlets

	1970										
	alfa_f [-]	alfa_c*E6 [*]	alfa_d*E3 [*]	C_E [ppt]	r [-]	ws_f [m/day]	ws_c [m/day]	ws_d [m/day]	delta_fc[m3/s]	delta_cd[m3/s]	delta_do[m3/s]
#1	0.046264	22.000	4.025	0.200	2.0	8.640	8.640	0.864	980	2450	1550
#2	0.222248	13.130	8.000	0.200	2.0	8.640	4.320	0.864	1000	1500	1500
#3	0.139860	9.600	2.662	0.200	2.0	8.640	8.640	0.864	1300	2560	1770
#4	0.220859	10.240	2.921	0.200	2.0	8.640	4.320	0.864	1000	1500	1500
#5	0.284134	10.140	6.927	0.200	2.0	8.640	8.640	0.864	1000	1500	1500
#6	0.296296	27.266	9.137	0.200	2.0	8.640	8.640	0.864	1000	1500	1500

	1990										
	alfa_f [-]	alfa_c*E6 [*]	alfa_d*E3 [*]	C_E [ppt]	r [-]	ws_f [m/day]	ws_c [m/day]	ws_d [m/day]	delta_fc[m3/s]	delta_cd[m3/s]	delta_do[m3/s]
#1	0.046264	22.000	4.025	0.200	2.0	8.640	8.640	0.864	980	2450	1550
#2	0.222248	13.130	8.000	0.200	2.0	8.640	4.320	0.864	1000	1500	1500
#3	0.139860	9.600	2.662	0.200	2.0	8.640	8.640	0.864	1300	2560	1770
#4	0.220859	10.240	2.921	0.200	2.0	8.640	4.320	0.864	1000	1500	1500
#5	0.284134	10.140	6.927	0.200	2.0	8.640	8.640	0.864	1000	1500	1500
#6	0.296296	27.266	9.137	0.200	2.0	8.640	8.640	0.864	1000	1500	1500

	2003										
	alfa_f [-]	alfa_c*E6 [*]	alfa_d*E3 [*]	C_E [ppt]	r [-]	ws_f [m/day]	ws_c [m/day]	ws_d [m/day]	delta_fc[m3/s]	delta_cd[m3/s]	delta_do[m3/s]
#1	0.046264	22.000	4.025	0.200	2.0	8.640	8.640	0.864	980	2450	1550
#2	0.222248	13.130	8.000	0.200	2.0	8.640	4.320	0.864	1000	1500	1500
#3	0.139860	9.600	2.662	0.200	2.0	8.640	8.640	0.864	1300	2560	1770
#4	0.220859	10.240	2.921	0.200	2.0	8.640	4.320	0.864	1000	1500	1500
#5	0.284134	10.140	6.927	0.200	2.0	8.640	8.640	0.864	1000	1500	1500
#6	0.296296	27.266	9.137	0.200	2.0	8.640	8.640	0.864	1000	1500	1500

Basin coefficients

X [m]	Table [-]	Hs_mean*) [m]	Hs_dom [m]	Tp_mean [s]	Phi_mean*) [d]	Phi_dom [d]	hs_mean [m]	d_mean [m]
-6539	1	1.039	1.429	5.125	153.498	-62.589	0.00	31.00
59889	2	1.218	1.763	5.326	160.992	-80.325	0.00	32.00
159907	3	1.259	1.870	5.357	182.205	-79.859	0.00	21.00
234486	4	1.341	1.922	5.600	182.415	-71.438	0.00	26.00
346096	5	1.153	1.672	5.287	198.084	-46.894	0.00	19.00

Longshore distribution of characteristic wave conditions (91 conditions)

X [m]	Table [-]	Hs_mean*) [m]	Hs_dom [m]	Tp_mean [s]	Phi_mean*) [d]	Phi_dom [d]	hs_mean [m]	d_mean [m]
-6539	1	1.338	1.426	5.124	153.498	-62.465	0.00	31.00
59889	2	1.594	1.763	5.326	160.992	-80.147	0.00	32.00
159907	3	1.662	1.870	5.356	182.205	-79.760	0.00	21.00
234486	4	1.755	1.921	5.601	182.415	-71.393	0.00	26.00
346096	5	1.522	1.673	5.287	198.084	-46.926	0.00	19.00

Longshore distribution of characteristic wave conditions (10 conditions)
(using dominant wave per individual direction only)

Station	1					
Cond [-]	Hs [m]	Tp [s]	phi [deg]	hs [m]	d [m]	p [-]
1	0.010	0.010	0.000	0.000	31.00	0.0509
2	0.500	4.000	0.000	0.000	31.00	0.0594
3	1.000	5.660	0.000	0.000	31.00	0.0360
4	1.500	6.200	0.000	0.000	31.00	0.0262
5	2.000	7.160	0.000	0.000	31.00	0.0151
6	2.500	7.700	0.000	0.000	31.00	0.0083
7	3.000	8.440	0.000	0.000	31.00	0.0047
8	3.750	8.950	0.000	0.000	31.00	0.0022
9	4.750	10.070	0.000	0.000	31.00	0.0002
10	5.750	10.730	0.000	0.000	31.00	0.0000
11	6.750	11.620	0.000	0.000	31.00	0.0000
12	0.500	4.000	30.000	0.000	31.00	0.0718
13	1.000	5.660	30.000	0.000	31.00	0.0553
14	1.500	6.200	30.000	0.000	31.00	0.0243
15	2.000	7.160	30.000	0.000	31.00	0.0104
16	2.500	7.700	30.000	0.000	31.00	0.0051
17	3.000	8.440	30.000	0.000	31.00	0.0011
18	3.750	8.950	30.000	0.000	31.00	0.0002
19	4.750	10.070	30.000	0.000	31.00	0.0000
20	5.750	10.730	30.000	0.000	31.00	0.0000
21	6.750	11.620	30.000	0.000	31.00	0.0000
22	0.500	4.000	60.000	0.000	31.00	0.0304
23	1.000	5.660	60.000	0.000	31.00	0.0189
24	1.500	6.200	60.000	0.000	31.00	0.0069
25	2.000	7.160	60.000	0.000	31.00	0.0036
26	2.500	7.700	60.000	0.000	31.00	0.0018
27	3.000	8.440	60.000	0.000	31.00	0.0002
28	3.750	8.950	60.000	0.000	31.00	0.0000
29	4.750	10.070	60.000	0.000	31.00	0.0000
30	5.750	10.730	60.000	0.000	31.00	0.0000
31	6.750	11.620	60.000	0.000	31.00	0.0000
32	0.500	4.000	90.000	0.000	31.00	0.0109
33	1.000	5.660	90.000	0.000	31.00	0.0039
34	1.500	6.200	90.000	0.000	31.00	0.0006
35	2.000	7.160	90.000	0.000	31.00	0.0001
36	2.500	7.700	90.000	0.000	31.00	0.0000
37	3.000	8.440	90.000	0.000	31.00	0.0000
38	3.750	8.950	90.000	0.000	31.00	0.0000
39	4.750	10.070	90.000	0.000	31.00	0.0000
40	5.750	10.730	90.000	0.000	31.00	0.0000
41	6.750	11.620	90.000	0.000	31.00	0.0000
42	0.500	4.000	210.000	0.000	31.00	0.0203
43	1.000	5.660	210.000	0.000	31.00	0.0190
44	1.500	6.200	210.000	0.000	31.00	0.0136
45	2.000	7.160	210.000	0.000	31.00	0.0056
46	2.500	7.700	210.000	0.000	31.00	0.0019
47	3.000	8.440	210.000	0.000	31.00	0.0007
48	3.750	8.950	210.000	0.000	31.00	0.0002
49	4.750	10.070	210.000	0.000	31.00	0.0000
50	5.750	10.730	210.000	0.000	31.00	0.0000
51	6.750	11.620	210.000	0.000	31.00	0.0000
52	0.500	4.000	240.000	0.000	31.00	0.0616
53	1.000	5.660	240.000	0.000	31.00	0.0892
54	1.500	6.200	240.000	0.000	31.00	0.0582
55	2.000	7.160	240.000	0.000	31.00	0.0316
56	2.500	7.700	240.000	0.000	31.00	0.0168
57	3.000	8.440	240.000	0.000	31.00	0.0050
58	3.750	8.950	240.000	0.000	31.00	0.0015
59	4.750	10.070	240.000	0.000	31.00	0.0001
60	5.750	10.730	240.000	0.000	31.00	0.0000
61	6.750	11.620	240.000	0.000	31.00	0.0000
62	0.500	4.000	270.000	0.000	31.00	0.0440
63	1.000	5.660	270.000	0.000	31.00	0.0253
64	1.500	6.200	270.000	0.000	31.00	0.0131
65	2.000	7.160	270.000	0.000	31.00	0.0065
66	2.500	7.700	270.000	0.000	31.00	0.0026
67	3.000	8.440	270.000	0.000	31.00	0.0010
68	3.750	8.950	270.000	0.000	31.00	0.0002
69	4.750	10.070	270.000	0.000	31.00	0.0000
70	5.750	10.730	270.000	0.000	31.00	0.0000
71	6.750	11.620	270.000	0.000	31.00	0.0000
72	0.500	4.000	300.000	0.000	31.00	0.0317
73	1.000	5.660	300.000	0.000	31.00	0.0176
74	1.500	6.200	300.000	0.000	31.00	0.0089
75	2.000	7.160	300.000	0.000	31.00	0.0039
76	2.500	7.700	300.000	0.000	31.00	0.0026
77	3.000	8.440	300.000	0.000	31.00	0.0008
78	3.750	8.950	300.000	0.000	31.00	0.0001
79	4.750	10.070	300.000	0.000	31.00	0.0000
80	5.750	10.730	300.000	0.000	31.00	0.0000
81	6.750	11.620	300.000	0.000	31.00	0.0000
82	0.500	4.000	330.000	0.000	31.00	0.0337
83	1.000	5.660	330.000	0.000	31.00	0.0147
84	1.500	6.200	330.000	0.000	31.00	0.0090
85	2.000	7.160	330.000	0.000	31.00	0.0043
86	2.500	7.700	330.000	0.000	31.00	0.0034
87	3.000	8.440	330.000	0.000	31.00	0.0020
88	3.750	8.950	330.000	0.000	31.00	0.0008
89	4.750	10.070	330.000	0.000	31.00	0.0000
90	5.750	10.730	330.000	0.000	31.00	0.0000
91	6.750	11.620	330.000	0.000	31.00	0.0000
	1.4285	5.1252	-62.5888	0.000	31.00	1.0000

Individual wave conditions wave climate station no. 1
(for all individual conditions, viz. 10 wave height classes per direction)

Station	2					
Cond [-]	Hs [m]	Tp [s]	phi [deg]	hs [m]	d [m]	p [-]
1	0.010	0.010	0.000	0.000	32.00	0.0828
2	0.500	4.000	0.000	0.000	32.00	0.0503
3	1.000	5.660	0.000	0.000	32.00	0.0521
4	1.500	6.200	0.000	0.000	32.00	0.0284
5	2.000	7.160	0.000	0.000	32.00	0.0127
6	2.500	7.700	0.000	0.000	32.00	0.0057
7	3.000	8.440	0.000	0.000	32.00	0.0025
8	3.750	8.950	0.000	0.000	32.00	0.0021
9	4.750	10.070	0.000	0.000	32.00	0.0003
10	5.750	10.730	0.000	0.000	32.00	0.0000
11	6.750	11.620	0.000	0.000	32.00	0.0000
12	0.500	4.000	30.000	0.000	32.00	0.0333
13	1.000	5.660	30.000	0.000	32.00	0.0329
14	1.500	6.200	30.000	0.000	32.00	0.0170
15	2.000	7.160	30.000	0.000	32.00	0.0082
16	2.500	7.700	30.000	0.000	32.00	0.0039
17	3.000	8.440	30.000	0.000	32.00	0.0016
18	3.750	8.950	30.000	0.000	32.00	0.0009
19	4.750	10.070	30.000	0.000	32.00	0.0001
20	5.750	10.730	30.000	0.000	32.00	0.0000
21	6.750	11.620	30.000	0.000	32.00	0.0000
22	0.500	4.000	60.000	0.000	32.00	0.0209
23	1.000	5.660	60.000	0.000	32.00	0.0168
24	1.500	6.200	60.000	0.000	32.00	0.0099
25	2.000	7.160	60.000	0.000	32.00	0.0045
26	2.500	7.700	60.000	0.000	32.00	0.0016
27	3.000	8.440	60.000	0.000	32.00	0.0007
28	3.750	8.950	60.000	0.000	32.00	0.0005
29	4.750	10.070	60.000	0.000	32.00	0.0000
30	5.750	10.730	60.000	0.000	32.00	0.0000
31	6.750	11.620	60.000	0.000	32.00	0.0000
32	0.500	4.000	90.000	0.000	32.00	0.0118
33	1.000	5.660	90.000	0.000	32.00	0.0093
34	1.500	6.200	90.000	0.000	32.00	0.0050
35	2.000	7.160	90.000	0.000	32.00	0.0011
36	2.500	7.700	90.000	0.000	32.00	0.0003
37	3.000	8.440	90.000	0.000	32.00	0.0001
38	3.750	8.950	90.000	0.000	32.00	0.0000
39	4.750	10.070	90.000	0.000	32.00	0.0000
40	5.750	10.730	90.000	0.000	32.00	0.0000
41	6.750	11.620	90.000	0.000	32.00	0.0000
42	0.500	4.000	210.000	0.000	32.00	0.0261
43	1.000	5.660	210.000	0.000	32.00	0.0352
44	1.500	6.200	210.000	0.000	32.00	0.0295
45	2.000	7.160	210.000	0.000	32.00	0.0189
46	2.500	7.700	210.000	0.000	32.00	0.0104
47	3.000	8.440	210.000	0.000	32.00	0.0051
48	3.750	8.950	210.000	0.000	32.00	0.0020
49	4.750	10.070	210.000	0.000	32.00	0.0001
50	5.750	10.730	210.000	0.000	32.00	0.0001
51	6.750	11.620	210.000	0.000	32.00	0.0000
52	0.500	4.000	240.000	0.000	32.00	0.0398
53	1.000	5.660	240.000	0.000	32.00	0.0479
54	1.500	6.200	240.000	0.000	32.00	0.0387
55	2.000	7.160	240.000	0.000	32.00	0.0288
56	2.500	7.700	240.000	0.000	32.00	0.0193
57	3.000	8.440	240.000	0.000	32.00	0.0113
58	3.750	8.950	240.000	0.000	32.00	0.0073
59	4.750	10.070	240.000	0.000	32.00	0.0010
60	5.750	10.730	240.000	0.000	32.00	0.0001
61	6.750	11.620	240.000	0.000	32.00	0.0000
62	0.500	4.000	270.000	0.000	32.00	0.0240
63	1.000	5.660	270.000	0.000	32.00	0.0202
64	1.500	6.200	270.000	0.000	32.00	0.0150
65	2.000	7.160	270.000	0.000	32.00	0.0107
66	2.500	7.700	270.000	0.000	32.00	0.0061
67	3.000	8.440	270.000	0.000	32.00	0.0042
68	3.750	8.950	270.000	0.000	32.00	0.0044
69	4.750	10.070	270.000	0.000	32.00	0.0008
70	5.750	10.730	270.000	0.000	32.00	0.0001
71	6.750	11.620	270.000	0.000	32.00	0.0000
72	0.500	4.000	300.000	0.000	32.00	0.0208
73	1.000	5.660	300.000	0.000	32.00	0.0172
74	1.500	6.200	300.000	0.000	32.00	0.0123
75	2.000	7.160	300.000	0.000	32.00	0.0082
76	2.500	7.700	300.000	0.000	32.00	0.0056
77	3.000	8.440	300.000	0.000	32.00	0.0031
78	3.750	8.950	300.000	0.000	32.00	0.0028
79	4.750	10.070	300.000	0.000	32.00	0.0006
80	5.750	10.730	300.000	0.000	32.00	0.0000
81	6.750	11.620	300.000	0.000	32.00	0.0000
82	0.500	4.000	330.000	0.000	32.00	0.0311
83	1.000	5.660	330.000	0.000	32.00	0.0272
84	1.500	6.200	330.000	0.000	32.00	0.0187
85	2.000	7.160	330.000	0.000	32.00	0.0119
86	2.500	7.700	330.000	0.000	32.00	0.0075
87	3.000	8.440	330.000	0.000	32.00	0.0038
88	3.750	8.950	330.000	0.000	32.00	0.0038
89	4.750	10.070	330.000	0.000	32.00	0.0008
90	5.750	10.730	330.000	0.000	32.00	0.0002
91	6.750	11.620	330.000	0.000	32.00	0.0000
	1.7626	5.3259	-80.3250	0.000	32.00	1.0000

Individual wave conditions wave climate station no. 2
(for all individual conditions, viz. 10 wave height classes per direction)

Station	3					
Cond [-]	Hs [m]	Tp [s]	phi [deg]	hs [m]	d [m]	p [-]
1	0.010	0.010	0.000	0.000	21.00	0.0907
2	0.500	4.000	0.000	0.000	21.00	0.0421
3	1.000	5.660	0.000	0.000	21.00	0.0449
4	1.500	6.200	0.000	0.000	21.00	0.0226
5	2.000	7.160	0.000	0.000	21.00	0.0096
6	2.500	7.700	0.000	0.000	21.00	0.0034
7	3.000	8.440	0.000	0.000	21.00	0.0016
8	3.750	8.950	0.000	0.000	21.00	0.0013
9	4.750	10.070	0.000	0.000	21.00	0.0004
10	5.750	10.730	0.000	0.000	21.00	0.0001
11	6.750	11.620	0.000	0.000	21.00	0.0000
12	0.500	4.000	30.000	0.000	21.00	0.0266
13	1.000	5.660	30.000	0.000	21.00	0.0236
14	1.500	6.200	30.000	0.000	21.00	0.0108
15	2.000	7.160	30.000	0.000	21.00	0.0039
16	2.500	7.700	30.000	0.000	21.00	0.0014
17	3.000	8.440	30.000	0.000	21.00	0.0004
18	3.750	8.950	30.000	0.000	21.00	0.0001
19	4.750	10.070	30.000	0.000	21.00	0.0000
20	5.750	10.730	30.000	0.000	21.00	0.0000
21	6.750	11.620	30.000	0.000	21.00	0.0000
22	0.500	4.000	60.000	0.000	21.00	0.0147
23	1.000	5.660	60.000	0.000	21.00	0.0140
24	1.500	6.200	60.000	0.000	21.00	0.0082
25	2.000	7.160	60.000	0.000	21.00	0.0030
26	2.500	7.700	60.000	0.000	21.00	0.0012
27	3.000	8.440	60.000	0.000	21.00	0.0003
28	3.750	8.950	60.000	0.000	21.00	0.0002
29	4.750	10.070	60.000	0.000	21.00	0.0001
30	5.750	10.730	60.000	0.000	21.00	0.0000
31	6.750	11.620	60.000	0.000	21.00	0.0000
32	0.500	4.000	90.000	0.000	21.00	0.0096
33	1.000	5.660	90.000	0.000	21.00	0.0093
34	1.500	6.200	90.000	0.000	21.00	0.0039
35	2.000	7.160	90.000	0.000	21.00	0.0011
36	2.500	7.700	90.000	0.000	21.00	0.0003
37	3.000	8.440	90.000	0.000	21.00	0.0001
38	3.750	8.950	90.000	0.000	21.00	0.0000
39	4.750	10.070	90.000	0.000	21.00	0.0000
40	5.750	10.730	90.000	0.000	21.00	0.0000
41	6.750	11.620	90.000	0.000	21.00	0.0000
42	0.500	4.000	210.000	0.000	21.00	0.0222
43	1.000	5.660	210.000	0.000	21.00	0.0333
44	1.500	6.200	210.000	0.000	21.00	0.0285
45	2.000	7.160	210.000	0.000	21.00	0.0197
46	2.500	7.700	210.000	0.000	21.00	0.0110
47	3.000	8.440	210.000	0.000	21.00	0.0055
48	3.750	8.950	210.000	0.000	21.00	0.0028
49	4.750	10.070	210.000	0.000	21.00	0.0004
50	5.750	10.730	210.000	0.000	21.00	0.0000
51	6.750	11.620	210.000	0.000	21.00	0.0000
52	0.500	4.000	240.000	0.000	21.00	0.0352
53	1.000	5.660	240.000	0.000	21.00	0.0396
54	1.500	6.200	240.000	0.000	21.00	0.0324
55	2.000	7.160	240.000	0.000	21.00	0.0243
56	2.500	7.700	240.000	0.000	21.00	0.0176
57	3.000	8.440	240.000	0.000	21.00	0.0111
58	3.750	8.950	240.000	0.000	21.00	0.0078
59	4.750	10.070	240.000	0.000	21.00	0.0015
60	5.750	10.730	240.000	0.000	21.00	0.0002
61	6.750	11.620	240.000	0.000	21.00	0.0000
62	0.500	4.000	270.000	0.000	21.00	0.0245
63	1.000	5.660	270.000	0.000	21.00	0.0223
64	1.500	6.200	270.000	0.000	21.00	0.0175
65	2.000	7.160	270.000	0.000	21.00	0.0132
66	2.500	7.700	270.000	0.000	21.00	0.0087
67	3.000	8.440	270.000	0.000	21.00	0.0053
68	3.750	8.950	270.000	0.000	21.00	0.0055
69	4.750	10.070	270.000	0.000	21.00	0.0018
70	5.750	10.730	270.000	0.000	21.00	0.0006
71	6.750	11.620	270.000	0.000	21.00	0.0000
72	0.500	4.000	300.000	0.000	21.00	0.0263
73	1.000	5.660	300.000	0.000	21.00	0.0247
74	1.500	6.200	300.000	0.000	21.00	0.0191
75	2.000	7.160	300.000	0.000	21.00	0.0131
76	2.500	7.700	300.000	0.000	21.00	0.0082
77	3.000	8.440	300.000	0.000	21.00	0.0050
78	3.750	8.950	300.000	0.000	21.00	0.0053
79	4.750	10.070	300.000	0.000	21.00	0.0016
80	5.750	10.730	300.000	0.000	21.00	0.0003
81	6.750	11.620	300.000	0.000	21.00	0.0000
82	0.500	4.000	330.000	0.000	21.00	0.0406
83	1.000	5.660	330.000	0.000	21.00	0.0433
84	1.500	6.200	330.000	0.000	21.00	0.0297
85	2.000	7.160	330.000	0.000	21.00	0.0177
86	2.500	7.700	330.000	0.000	21.00	0.0097
87	3.000	8.440	330.000	0.000	21.00	0.0053
88	3.750	8.950	330.000	0.000	21.00	0.0056
89	4.750	10.070	330.000	0.000	21.00	0.0017
90	5.750	10.730	330.000	0.000	21.00	0.0007
91	6.750	11.620	330.000	0.000	21.00	0.0001
	1.8702	5.3569	-79.8586	0.000	21.00	1.0000

Individual wave conditions wave climate station no. 3
(for all individual conditions, viz. 10 wave height classes per direction)

Station	4					
Cond [-]	Hs [m]	Tp [s]	phi [deg]	hs [m]	d [m]	p [-]
1	0.010	0.010	0.000	0.000	26.00	0.0626
2	0.500	4.000	0.000	0.000	26.00	0.0370
3	1.000	5.660	0.000	0.000	26.00	0.0428
4	1.500	6.200	0.000	0.000	26.00	0.0267
5	2.000	7.160	0.000	0.000	26.00	0.0117
6	2.500	7.700	0.000	0.000	26.00	0.0055
7	3.000	8.440	0.000	0.000	26.00	0.0023
8	3.750	8.950	0.000	0.000	26.00	0.0012
9	4.750	10.070	0.000	0.000	26.00	0.0004
10	5.750	10.730	0.000	0.000	26.00	0.0001
11	6.750	11.620	0.000	0.000	26.00	0.0000
12	0.500	4.000	30.000	0.000	26.00	0.0363
13	1.000	5.660	30.000	0.000	26.00	0.0300
14	1.500	6.200	30.000	0.000	26.00	0.0139
15	2.000	7.160	30.000	0.000	26.00	0.0047
16	2.500	7.700	30.000	0.000	26.00	0.0026
17	3.000	8.440	30.000	0.000	26.00	0.0008
18	3.750	8.950	30.000	0.000	26.00	0.0005
19	4.750	10.070	30.000	0.000	26.00	0.0000
20	5.750	10.730	30.000	0.000	26.00	0.0000
21	6.750	11.620	30.000	0.000	26.00	0.0000
22	0.500	4.000	60.000	0.000	26.00	0.0191
23	1.000	5.660	60.000	0.000	26.00	0.0226
24	1.500	6.200	60.000	0.000	26.00	0.0112
25	2.000	7.160	60.000	0.000	26.00	0.0062
26	2.500	7.700	60.000	0.000	26.00	0.0023
27	3.000	8.440	60.000	0.000	26.00	0.0007
28	3.750	8.950	60.000	0.000	26.00	0.0002
29	4.750	10.070	60.000	0.000	26.00	0.0000
30	5.750	10.730	60.000	0.000	26.00	0.0000
31	6.750	11.620	60.000	0.000	26.00	0.0000
32	0.500	4.000	90.000	0.000	26.00	0.0086
33	1.000	5.660	90.000	0.000	26.00	0.0082
34	1.500	6.200	90.000	0.000	26.00	0.0033
35	2.000	7.160	90.000	0.000	26.00	0.0007
36	2.500	7.700	90.000	0.000	26.00	0.0003
37	3.000	8.440	90.000	0.000	26.00	0.0001
38	3.750	8.950	90.000	0.000	26.00	0.0000
39	4.750	10.070	90.000	0.000	26.00	0.0000
40	5.750	10.730	90.000	0.000	26.00	0.0000
41	6.750	11.620	90.000	0.000	26.00	0.0000
42	0.500	4.000	210.000	0.000	26.00	0.0154
43	1.000	5.660	210.000	0.000	26.00	0.0276
44	1.500	6.200	210.000	0.000	26.00	0.0208
45	2.000	7.160	210.000	0.000	26.00	0.0160
46	2.500	7.700	210.000	0.000	26.00	0.0097
47	3.000	8.440	210.000	0.000	26.00	0.0050
48	3.750	8.950	210.000	0.000	26.00	0.0024
49	4.750	10.070	210.000	0.000	26.00	0.0002
50	5.750	10.730	210.000	0.000	26.00	0.0000
51	6.750	11.620	210.000	0.000	26.00	0.0000
52	0.500	4.000	240.000	0.000	26.00	0.0299
53	1.000	5.660	240.000	0.000	26.00	0.0407
54	1.500	6.200	240.000	0.000	26.00	0.0310
55	2.000	7.160	240.000	0.000	26.00	0.0220
56	2.500	7.700	240.000	0.000	26.00	0.0137
57	3.000	8.440	240.000	0.000	26.00	0.0095
58	3.750	8.950	240.000	0.000	26.00	0.0067
59	4.750	10.070	240.000	0.000	26.00	0.0012
60	5.750	10.730	240.000	0.000	26.00	0.0003
61	6.750	11.620	240.000	0.000	26.00	0.0000
62	0.500	4.000	270.000	0.000	26.00	0.0255
63	1.000	5.660	270.000	0.000	26.00	0.0262
64	1.500	6.200	270.000	0.000	26.00	0.0213
65	2.000	7.160	270.000	0.000	26.00	0.0170
66	2.500	7.700	270.000	0.000	26.00	0.0117
67	3.000	8.440	270.000	0.000	26.00	0.0076
68	3.750	8.950	270.000	0.000	26.00	0.0065
69	4.750	10.070	270.000	0.000	26.00	0.0024
70	5.750	10.730	270.000	0.000	26.00	0.0012
71	6.750	11.620	270.000	0.000	26.00	0.0000
72	0.500	4.000	300.000	0.000	26.00	0.0246
73	1.000	5.660	300.000	0.000	26.00	0.0271
74	1.500	6.200	300.000	0.000	26.00	0.0227
75	2.000	7.160	300.000	0.000	26.00	0.0151
76	2.500	7.700	300.000	0.000	26.00	0.0097
77	3.000	8.440	300.000	0.000	26.00	0.0070
78	3.750	8.950	300.000	0.000	26.00	0.0068
79	4.750	10.070	300.000	0.000	26.00	0.0021
80	5.750	10.730	300.000	0.000	26.00	0.0005
81	6.750	11.620	300.000	0.000	26.00	0.0001
82	0.500	4.000	330.000	0.000	26.00	0.0321
83	1.000	5.660	330.000	0.000	26.00	0.0367
84	1.500	6.200	330.000	0.000	26.00	0.0316
85	2.000	7.160	330.000	0.000	26.00	0.0211
86	2.500	7.700	330.000	0.000	26.00	0.0124
87	3.000	8.440	330.000	0.000	26.00	0.0074
88	3.750	8.950	330.000	0.000	26.00	0.0062
89	4.750	10.070	330.000	0.000	26.00	0.0019
90	5.750	10.730	330.000	0.000	26.00	0.0006
91	6.750	11.620	330.000	0.000	26.00	0.0002
	1.9222	5.6001	-71.4379	0.000	26.00	1.0000

Individual wave conditions wave climate station no. 4

(for all individual conditions, viz. 10 wave height classes per direction)

Station	5					
Cond [-]	Hs [m]	Tp [s]	phi [deg]	hs [m]	d [m]	p [-]
1	0.010	0.010	0.000	0.000	19.00	0.0598
2	0.500	4.000	0.000	0.000	19.00	0.0410
3	1.000	5.660	0.000	0.000	19.00	0.0376
4	1.500	6.200	0.000	0.000	19.00	0.0195
5	2.000	7.160	0.000	0.000	19.00	0.0081
6	2.500	7.700	0.000	0.000	19.00	0.0030
7	3.000	8.440	0.000	0.000	19.00	0.0012
8	3.750	8.950	0.000	0.000	19.00	0.0005
9	4.750	10.070	0.000	0.000	19.00	0.0001
10	5.750	10.730	0.000	0.000	19.00	0.0000
11	6.750	11.620	0.000	0.000	19.00	0.0000
12	0.500	4.000	30.000	0.000	19.00	0.0359
13	1.000	5.660	30.000	0.000	19.00	0.0203
14	1.500	6.200	30.000	0.000	19.00	0.0067
15	2.000	7.160	30.000	0.000	19.00	0.0024
16	2.500	7.700	30.000	0.000	19.00	0.0010
17	3.000	8.440	30.000	0.000	19.00	0.0004
18	3.750	8.950	30.000	0.000	19.00	0.0002
19	4.750	10.070	30.000	0.000	19.00	0.0000
20	5.750	10.730	30.000	0.000	19.00	0.0000
21	6.750	11.620	30.000	0.000	19.00	0.0000
22	0.500	4.000	60.000	0.000	19.00	0.0403
23	1.000	5.660	60.000	0.000	19.00	0.0256
24	1.500	6.200	60.000	0.000	19.00	0.0125
25	2.000	7.160	60.000	0.000	19.00	0.0065
26	2.500	7.700	60.000	0.000	19.00	0.0018
27	3.000	8.440	60.000	0.000	19.00	0.0002
28	3.750	8.950	60.000	0.000	19.00	0.0000
29	4.750	10.070	60.000	0.000	19.00	0.0000
30	5.750	10.730	60.000	0.000	19.00	0.0000
31	6.750	11.620	60.000	0.000	19.00	0.0000
32	0.500	4.000	90.000	0.000	19.00	0.0215
33	1.000	5.660	90.000	0.000	19.00	0.0125
34	1.500	6.200	90.000	0.000	19.00	0.0054
35	2.000	7.160	90.000	0.000	19.00	0.0015
36	2.500	7.700	90.000	0.000	19.00	0.0003
37	3.000	8.440	90.000	0.000	19.00	0.0001
38	3.750	8.950	90.000	0.000	19.00	0.0000
39	4.750	10.070	90.000	0.000	19.00	0.0000
40	5.750	10.730	90.000	0.000	19.00	0.0000
41	6.750	11.620	90.000	0.000	19.00	0.0000
42	0.500	4.000	210.000	0.000	19.00	0.0059
43	1.000	5.660	210.000	0.000	19.00	0.0071
44	1.500	6.200	210.000	0.000	19.00	0.0031
45	2.000	7.160	210.000	0.000	19.00	0.0013
46	2.500	7.700	210.000	0.000	19.00	0.0003
47	3.000	8.440	210.000	0.000	19.00	0.0001
48	3.750	8.950	210.000	0.000	19.00	0.0000
49	4.750	10.070	210.000	0.000	19.00	0.0000
50	5.750	10.730	210.000	0.000	19.00	0.0000
51	6.750	11.620	210.000	0.000	19.00	0.0000
52	0.500	4.000	240.000	0.000	19.00	0.0129
53	1.000	5.660	240.000	0.000	19.00	0.0148
54	1.500	6.200	240.000	0.000	19.00	0.0084
55	2.000	7.160	240.000	0.000	19.00	0.0027
56	2.500	7.700	240.000	0.000	19.00	0.0005
57	3.000	8.440	240.000	0.000	19.00	0.0003
58	3.750	8.950	240.000	0.000	19.00	0.0001
59	4.750	10.070	240.000	0.000	19.00	0.0000
60	5.750	10.730	240.000	0.000	19.00	0.0000
61	6.750	11.620	240.000	0.000	19.00	0.0000
62	0.500	4.000	270.000	0.000	19.00	0.0438
63	1.000	5.660	270.000	0.000	19.00	0.0557
64	1.500	6.200	270.000	0.000	19.00	0.0370
65	2.000	7.160	270.000	0.000	19.00	0.0197
66	2.500	7.700	270.000	0.000	19.00	0.0077
67	3.000	8.440	270.000	0.000	19.00	0.0029
68	3.750	8.950	270.000	0.000	19.00	0.0024
69	4.750	10.070	270.000	0.000	19.00	0.0007
70	5.750	10.730	270.000	0.000	19.00	0.0001
71	6.750	11.620	270.000	0.000	19.00	0.0001
72	0.500	4.000	300.000	0.000	19.00	0.0537
73	1.000	5.660	300.000	0.000	19.00	0.0542
74	1.500	6.200	300.000	0.000	19.00	0.0393
75	2.000	7.160	300.000	0.000	19.00	0.0268
76	2.500	7.700	300.000	0.000	19.00	0.0138
77	3.000	8.440	300.000	0.000	19.00	0.0077
78	3.750	8.950	300.000	0.000	19.00	0.0078
79	4.750	10.070	300.000	0.000	19.00	0.0024
80	5.750	10.730	300.000	0.000	19.00	0.0006
81	6.750	11.620	300.000	0.000	19.00	0.0001
82	0.500	4.000	330.000	0.000	19.00	0.0514
83	1.000	5.660	330.000	0.000	19.00	0.0503
84	1.500	6.200	330.000	0.000	19.00	0.0396
85	2.000	7.160	330.000	0.000	19.00	0.0252
86	2.500	7.700	330.000	0.000	19.00	0.0151
87	3.000	8.440	330.000	0.000	19.00	0.0084
88	3.750	8.950	330.000	0.000	19.00	0.0074
89	4.750	10.070	330.000	0.000	19.00	0.0021
90	5.750	10.730	330.000	0.000	19.00	0.0005
91	6.750	11.620	330.000	0.000	19.00	0.0001
	1.6723	5.2872	-46.8942	0.000	19.00	1.0000

Individual wave conditions wave climate station no. 5
(for all individual conditions, viz. 10 wave height classes per direction)

X [m]	Table [-]	ha_mean [m]	ha_min [m]	ha_max [m]	d_ha [m]	v_mean [m/s]	d_mean [m
-18990	1	0.0386	-1.9480	2.1580	4.1060	0.0014	10.00
30246	2	0.0377	-1.4760	1.7950	3.2710	0.0022	8.92
60986	3	0.0755	-1.0500	1.4750	2.5250	-0.0552	10.85
120313	4	0.0735	-0.6660	1.1580	1.8240	0.0285	8.48
183431	5	0.0333	-0.6000	0.7560	1.3560	0.0084	7.73
236590	6	0.0477	-0.7420	0.7200	1.4620	0.0054	7.32
279712	7	0.0480	-0.8610	0.8710	1.7320	0.0155	8.42
338345	8	0.0261	-1.0680	0.9200	1.9880	0.0281	9.02
373338	9	0.0027	-1.1010	0.9280	2.0290	0.0991	8.08

Longshore distribution of characteristic tidal conditions (12 conditions)

Station	1			
Cond [-]	ha [m]	va [m/s]	d [m]	p [-]
1	0.7910	0.2280	10.00	0.080
2	-0.0860	-0.0270	10.00	0.080
3	-0.9910	-0.3440	10.00	0.080
4	-1.6910	-0.4190	10.00	0.080
5	-1.9480	-0.4100	10.00	0.080
6	-1.6430	-0.4090	10.00	0.080
7	-1.0420	-0.3680	10.00	0.080
8	-0.3350	-0.1880	10.00	0.087
9	0.9550	0.3390	10.00	0.087
10	1.9820	0.5870	10.00	0.087
11	2.1580	0.4990	10.00	0.087
12	1.7750	0.3910	10.00	0.088
	0.0386	0.0014	10.00	1.000

Individual tidal conditions tidal climate station no. 1
(for all individual conditions, viz. 12 classes)

Station	2			
Cond [-]	ha [m]	va [m/s]	d [m]	p [-]
1	0.9550	0.3140	8.92	0.080
2	0.3800	0.0520	8.92	0.080
3	-0.4030	-0.1400	8.92	0.080
4	-1.1340	-0.2570	8.92	0.080
5	-1.4760	-0.3070	8.92	0.080
6	-1.3160	-0.3800	8.92	0.080
7	-0.9580	-0.3720	8.92	0.080
8	-0.5860	-0.2300	8.92	0.087
9	0.0510	0.0040	8.92	0.087
10	1.1680	0.3370	8.92	0.087
11	1.7950	0.4690	8.92	0.087
12	1.6430	0.4490	8.92	0.088
	0.0377	0.0022	8.92	1.000

Individual tidal conditions tidal climate station no. 2
(for all individual conditions, viz. 12 classes)

Station	3			
Cond [-]	ha [m]	va [m/s]	d [m]	p [-]
1	0.9730	0.4060	10.85	0.080
2	0.5800	0.2350	10.85	0.080
3	-0.0540	-0.0020	10.85	0.080
4	-0.7080	-0.2540	10.85	0.080
5	-1.0500	-0.4490	10.85	0.080
6	-0.9410	-0.5730	10.85	0.080
7	-0.7730	-0.5660	10.85	0.080
8	-0.6220	-0.4400	10.85	0.087
9	-0.2130	-0.2530	10.85	0.087
10	0.6110	0.1100	10.85	0.087
11	1.4280	0.5290	10.85	0.087
12	1.4750	0.5290	10.85	0.088
	0.0755	-0.0552	10.85	1.000

Individual tidal conditions tidal climate station no. 3
(for all individual conditions, viz. 12 classes)

Station	4			
Cond [-]	ha [m]	va [m/s]	d [m]	p [-]
1	1.0080	0.2280	10.00	0.080
2	-0.0860	-0.0270	10.00	0.080
3	-0.9910	-0.3440	10.00	0.080
4	-1.6910	-0.4190	10.00	0.080
5	-1.9480	-0.4100	10.00	0.080
6	-1.6430	-0.4090	10.00	0.080
7	-1.0420	-0.3680	10.00	0.080
8	-0.3350	-0.1880	10.00	0.087
9	0.9550	0.3390	10.00	0.087
10	1.9820	0.5870	10.00	0.087
11	2.1580	0.4990	10.00	0.087
12	1.7750	0.3910	10.00	0.088
	0.0735	0.0285	8.48	1.000

Individual tidal conditions tidal climate station no. 4
(for all individual conditions, viz. 12 classes)

Station	5			
Cond [-]	ha [m]	va [m/s]	d [m]	p [-]
1	0.7560	0.5300	7.73	0.080
2	0.7280	0.4420	7.73	0.080
3	0.5620	0.3150	7.73	0.080
4	0.3400	0.1140	7.73	0.080
5	0.1290	-0.2000	7.73	0.080
6	-0.0330	-0.4020	7.73	0.080
7	-0.2920	-0.3980	7.73	0.080
8	-0.5220	-0.3670	7.73	0.087
9	-0.6000	-0.3000	7.73	0.087
10	-0.5740	-0.1720	7.73	0.087
11	-0.3350	0.0760	7.73	0.087
12	0.3890	0.4860	7.73	0.088
	0.0333	0.0084	7.73	1.000

Individual tidal conditions tidal climate station no. 5
(for all individual conditions, viz. 12 classes)

Station	6			
Cond [-]	ha [m]	va [m/s]	d [m]	p [-]
1	0.1130	0.5200	7.32	0.080
2	0.4400	0.4980	7.32	0.080
3	0.5430	0.3830	7.32	0.080
4	0.6580	0.2360	7.32	0.080
5	0.7200	0.0100	7.32	0.080
6	0.5380	-0.2420	7.32	0.080
7	0.1760	-0.4040	7.32	0.080
8	-0.1650	-0.3900	7.32	0.087
9	-0.3960	-0.3260	7.32	0.087
10	-0.6060	-0.2510	7.32	0.087
11	-0.7420	-0.1080	7.32	0.087
12	-0.4840	0.2120	7.32	0.088
	0.0477	0.0054	7.32	1.000

Individual tidal conditions tidal climate station no. 6
(for all individual conditions, viz. 12 classes)

Station	7			
Cond [-]	ha [m]	va [m/s]	d [m]	p [-]
1	-0.6900	0.1230	8.42	0.080
2	-0.0860	0.4580	8.42	0.080
3	0.2920	0.4500	8.42	0.080
4	0.5880	0.3650	8.42	0.080
5	0.8380	0.2710	8.42	0.080
6	0.8710	0.1390	8.42	0.080
7	0.6600	-0.0400	8.42	0.080
8	0.2650	-0.2940	8.42	0.087
9	-0.0710	-0.3560	8.42	0.087
10	-0.3690	-0.3330	8.42	0.087
11	-0.6920	-0.2890	8.42	0.087
12	-0.8610	-0.1800	8.42	0.088
	0.0480	0.0155	8.42	1.000

Individual tidal conditions tidal climate station no. 7
(for all individual conditions, viz. 12 classes)

Station	8			
Cond [-]	ha [m]	va [m/s]	d [m]	p [-]
1	-1.0680	-0.1250	9.02	0.080
2	-0.9670	0.0070	9.02	0.080
3	-0.3530	0.2870	9.02	0.080
4	0.1800	0.3440	9.02	0.080
5	0.5790	0.3150	9.02	0.080
6	0.8650	0.2570	9.02	0.080
7	0.9200	0.1700	9.02	0.080
8	0.8120	0.0180	9.02	0.087
9	0.4470	-0.1860	9.02	0.087
10	-0.0020	-0.2510	9.02	0.087
11	-0.3660	-0.2220	9.02	0.087
12	-0.7320	-0.1940	9.02	0.088
	0.0261	0.0281	9.02	1.000

Individual tidal conditions tidal climate station no. 8
(for all individual conditions, viz. 12 classes)

Station	9			
Cond [-]	ha [m]	va [m/s]	d [m]	p [-]
1	-1.0030	-0.0680	8.08	0.080
2	-1.1010	-0.0030	8.08	0.080
3	-0.8160	0.2330	8.08	0.080
4	-0.1880	0.4170	8.08	0.080
5	0.3050	0.4010	8.08	0.080
6	0.6810	0.3560	8.08	0.080
7	0.8630	0.2860	8.08	0.080
8	0.9280	0.1650	8.08	0.087
9	0.7230	-0.0140	8.08	0.087
10	0.2600	-0.2100	8.08	0.087
11	-0.1640	-0.1810	8.08	0.087
12	-0.5510	-0.1200	8.08	0.088
	0.0027	0.0991	8.08	1.000

Individual tidal conditions tidal climate station no. 9
(for all individual conditions, viz. 12 classes)

t [yr]	dh [m]	dh/dt [m/cent]
1970	-0.066	
1990	-0.026	0.200
2003	0.000	0.200
2053	0.100	0.200

Mean sea level (scenario 1)

t [yr]	dh [m]	dh/dt [m/cent]
1970	-0.066	
1990	-0.026	0.200
2003	0.000	0.200
2053	0.300	0.600

Mean sea level (scenario 2)

t [yr]	P(Hs)
1970	1.000
1990	1.000
2003	1.000
2053	1.000

Wave heights

t [yr]	dPhi
1970	0.000
1990	0.000
2003	0.000
2053	0.000

Wave direction

t [yr]	P(ha)
1970	1.000
1990	1.000
2003	1.000
2053	1.000

Tidal range

t [yr]	P(va)
1970	1.000
1990	1.000
2003	1.000
2053	1.000

Tidal velocity

X [m]	qd [m3/m1/yr]
0	-2.000
400000	-2.000

Cross-shore transport across dunes
(negative denotes export)

NOTE: NOT APPLIED

X [m]	qs [m3/m1/yr]
0	-5.000
400000	-5.000

Cross-shore transport across seaward boundary
(negative denotes input)

NOTE: NOT APPLIED

0.2 m / century	
T [yr]	Q [Mm3/yr]
1970	-3.500
1980	-3.300
1986	0.360
1988	0.976
1993	1.373
2000	1.563
2010	1.696
2020	1.722
2030	1.675
2050	1.464

0.6 m / century	
T [yr]	Q [Mm3/yr]
1970	-3.500
1980	-3.300
1986	0.360
1988	0.976
1993	1.373
2000	1.565
2010	1.695
2020	1.692
2030	1.605
2050	1.312

Nett input from Western Scheldt
(positive denotes input)

Xmin [m]	Xmax [m]	Zmin [m]	Zmax [m]	Tmin [yr]	Tmax [yr]	Vol [Mm3]	dX [m]	dV/dX [m3/m1]	dT [yr]
13788	15265	0	3	1992.83	1993.00	0.067	1476	45	0.17
13788	18203	0	3	2001.50	2002.00	0.905	4415	205	0.50
14176	15431	-7	-4	1990.00	1991.00	0.388	1255	309	1.00
14176	15431	0	3	1997.00	1997.25	0.095	1255	76	0.25
14341	15589	0	3	1990.75	1990.92	0.319	1248	256	0.17
14341	15589	-7	-4	1990.75	1990.92	0.319	1248	256	0.17
14565	15176	0	3	1994.75	1994.92	0.091	611	149	0.17
15265	17467	0	3	1988.17	1988.50	1.029	2202	467	0.33
15265	18080	0	3	1994.50	1995.00	0.560	2815	199	0.50
16740	18203	0	3	1998.50	1998.58	0.314	1463	215	0.08
17467	18203	0	3	1990.83	1991.00	0.368	736	500	0.17
17467	18203	-7	-4	1990.83	1991.00	0.270	736	367	0.17
19072	19994	0	3	1994.33	1994.67	0.348	922	377	0.34
19104	20291	0	3	2001.58	2001.75	0.295	1188	248	0.17
21573	22349	0	3	1989.67	1989.92	0.437	776	563	0.25
21726	22516	0	3	2001.58	2001.67	0.060	791	76	0.09
23727	24255	0	3	1997.50	1997.58	0.185	528	351	0.08
23884	25337	0	3	2001.58	2001.67	0.185	1453	127	0.09
24055	24839	0	3	1989.58	1989.83	0.227	784	290	0.25
24055	24601	0	3	1993.33	1993.42	0.090	546	165	0.09
25097	25289	0	3	1971.33	1971.92	0.206	192	1,073	0.59
28655	28855	0	3	1992.42	1992.58	0.169	200	845	0.16
28712	29081	0	3	1995.25	1995.58	0.463	369	1,254	0.33
28767	28855	0	3	1997.17	1997.25	0.125	88	1,414	0.08
28785	28838	0	3	1966.00	1966.25	0.032	53	604	0.25
28785	28838	0	3	1975.00	1975.25	0.045	53	849	0.25
28785	29475	0	3	1998.25	1998.67	0.564	689	817	0.42
28804	29963	0	3	2002.00	2003.00	2.300	1159	1,985	1.00
29081	29622	0	3	1993.17	1993.83	0.619	541	1,144	0.66
29181	29283	0	3	1984.33	1984.50	0.090	101	889	0.17
29181	29305	0	3	1988.25	1988.42	0.230	124	1,858	0.17
29181	29225	0	3	1988.25	1988.33	0.075	43	1,736	0.08
29181	29285	0	3	1990.25	1990.33	0.105	104	1,010	0.08
29243	29411	0	3	1988.33	1988.50	0.153	168	909	0.17
29348	29452	0	3	1995.25	1995.33	0.054	104	519	0.08
29386	29607	0	3	1997.25	1997.42	0.700	221	3,163	0.17
29391	29432	0	3	1991.25	1991.83	0.788	41	19,220	0.58
29411	29524	0	3	1992.33	1992.50	0.192	112	1,708	0.17
31762	34033	0	3	1995.25	1995.50	0.550	2271	242	0.25
31762	36634	0	3	2000.17	2000.83	0.886	4871	182	0.66
33234	34435	0	3	1986.67	1986.75	0.225	1201	187	0.08
34636	36422	0	3	1994.25	1994.50	0.453	1786	254	0.25
34837	36027	0	3	1989.25	1989.42	0.211	1190	177	0.17
34837	36027	0	3	1990.25	1990.42	0.246	1190	206	0.17
34837	36422	0	3	1993.00	1993.33	0.318	1585	201	0.33
36225	37991	0	3	1992.00	1992.42	0.637	1766	361	0.42
39532	41513	0	3	2000.25	2000.50	0.323	1981	163	0.25
39917	41513	0	3	1996.25	1996.58	0.464	1595	291	0.33
40110	40688	0	3	1990.25	1990.33	0.020	578	35	0.08
40110	41234	0	3	1993.42	1993.58	0.287	1124	255	0.16
43249	43299	0	3	1993.42	1993.58	0.225	50	4,482	0.16
44516	46253	0	3	1996.33	1996.42	0.435	1737	250	0.09
44686	46079	0	3	1993.33	1993.42	0.411	1393	295	0.09
44686	46253	0	3	2000.33	2000.42	0.524	1567	335	0.09
45906	46427	0	3	1973.33	1973.42	0.210	521	403	0.09
53711	53904	0	3	1975.25	1975.33	0.112	193	580	0.08
53744	53904	0	3	1999.25	1999.33	0.105	160	657	0.08
53759	54835	0	3	1987.25	1987.50	1.974	1076	1,835	0.25
53904	55873	0	3	1991.50	1992.00	2.673	1969	1,358	0.50
53982	57208	0	3	2003.25	2003.83	1.000	3226	310	0.58
54999	56254	0	3	1996.17	1996.75	0.733	1254	584	0.58
60643	64892	0	3	2003.25	2003.50	0.300	4248	71	0.25
60778	63305	0	3	1995.17	1995.75	0.818	2527	324	0.58
60778	64892	0	3	1999.33	1999.75	0.560	4114	136	0.42
63449	64892	0	3	1990.25	1990.58	0.415	1443	288	0.33
64260	64537	0	3	1994.17	1994.25	0.089	278	320	0.08
70701	70855	0	3	1972.75	1972.83	0.100	155	646	0.08
70701	70867	0	3	1976.75	1976.83	0.050	167	300	0.08
70976	73452	0	3	1973.75	1974.17	2.300	2476	929	0.42
70976	73452	0	3	1977.25	1977.42	1.267	2476	512	0.17
70976	73452	0	3	1984.58	1984.83	0.330	2476	133	0.25
70976	73452	0	3	1985.33	1985.75	0.530	2476	214	0.42
71193	71468	0	3	1972.75	1972.83	0.100	275	364	0.08
71316	73040	0	3	1966.42	1966.58	0.150	1724	87	0.16
71912	72985	0	3	1969.83	1970.25	0.401	1073	374	0.42
71912	72985	0	3	1971.33	1971.75	0.610	1073	569	0.42
75471	77113	0	3	1994.25	1994.50	0.506	1642	308	0.25
76419	78039	0	3	1998.25	1998.75	0.745	1620	460	0.50

Xmin [m]	Xmax [m]	Zmin [m]	Zmax [m]	Tmin [yr]	Tmax [yr]	Vol [Mm3]	dX [m]	dV/dX [m3/m1]	dT [yr]
80413	81538	0	3	1970.25	1970.42	0.200	1125	178	0.17
85377	85940	0	3	1986.42	1986.50	0.750	563	1,332	0.08
85525	86324	0	3	1974.25	1974.33	0.150	799	188	0.08
85900	86458	0	3	1983.75	1984.00	0.440	558	789	0.25
85980	88624	0	3	1984.00	1985.00	2.700	2644	1,021	1.00
86067	86324	0	3	1974.25	1974.33	0.110	257	429	0.08
86067	86436	0	3	1993.25	1993.42	0.160	368	434	0.17
86115	87226	0	3	1987.33	1987.42	1.100	1111	990	0.09
86324	87824	0	3	1977.75	1978.00	1.100	1500	733	0.25
87467	91323	-7	-4	2000.17	2000.25	1.100	3856	285	0.08
87530	88959	0	3	1991.17	1991.25	0.100	1429	70	0.08
87597	90929	0	3	1996.00	1997.00	2.045	3332	614	1.00
87675	88762	0	3	1992.00	1993.00	1.150	1088	1,057	1.00
87675	91323	0	3	1997.00	1998.00	2.724	3649	747	1.00
87675	89944	0	3	2000.17	2000.67	0.580	2269	256	0.50
89353	90929	0	3	1998.00	1999.00	1.266	1576	803	1.00
95076	101128	0	3	1977.00	1977.42	0.870	6052	144	0.42
95076	98962	0	3	1990.17	1990.25	0.183	3886	47	0.08
95076	98962	0	3	1991.17	1991.25	0.223	3886	57	0.08
95076	98962	0	3	1992.17	1992.42	0.560	3886	144	0.25
95076	102810	0	3	1993.08	1993.33	0.463	7735	60	0.25
95076	98962	0	3	1994.17	1994.33	0.200	3886	51	0.16
95076	98962	0	3	1995.17	1995.33	0.200	3886	51	0.16
95076	98962	0	3	1996.17	1996.33	0.200	3886	51	0.16
95076	98962	0	3	1997.17	1997.33	0.200	3886	51	0.16
97943	99214	0	3	1998.00	1998.08	0.200	1271	157	0.08
97943	98703	0	3	1988.17	1988.25	0.200	760	263	0.08
97943	98703	0	3	1989.17	1989.25	0.100	760	132	0.08
97943	98962	0	3	1999.17	1999.33	0.201	1019	197	0.16
97943	99214	0	3	2000.17	2000.33	0.200	1271	157	0.16
97943	99214	0	3	2001.17	2001.33	0.200	1271	157	0.16
97943	99214	0	3	2003.17	2003.33	0.200	1271	157	0.16
98450	99718	0	3	2002.17	2002.33	0.200	1268	158	0.16
100875	109179	-7	-4	1986.33	1986.83	3.226	8303	389	0.50
101855	103769	-7	-4	1997.33	1997.42	1.029	1913	538	0.09
102049	104588	0	3	1995.33	1995.50	0.300	2540	118	0.17
103576	109179	-7	-4	2001.17	2001.33	1.600	5602	286	0.16
103769	108830	0	3	2001.17	2001.83	0.800	5062	158	0.66
104156	109487	0	3	1997.17	1997.75	0.834	5331	156	0.58
104345	110722	0	3	1993.33	1993.50	1.143	6377	179	0.17
115518	117080	0	3	1969.67	1969.83	0.045	1562	29	0.16
115518	118595	0	3	1975.25	1975.67	0.700	3077	228	0.42
115659	118344	0	3	1985.17	1985.33	0.330	2685	123	0.16
115659	119402	0	3	1991.08	1991.42	1.006	3742	269	0.34
116036	118090	0	3	1981.17	1981.25	0.010	2054	5	0.08
116036	118090	0	3	1982.17	1982.25	0.015	2054	7	0.08
116036	118090	0	3	1987.17	1987.25	0.008	2054	4	0.08
116036	119602	0	3	1996.08	1996.42	0.800	3566	224	0.34
116544	119402	-7	-4	1999.25	1999.42	1.426	2857	499	0.17
119857	126198	-7	-4	2002.50	2002.75	3.000	6341	473	0.25
120361	123141	0	3	1997.33	1997.75	0.553	2780	199	0.42
120613	122888	0	3	1994.33	1994.75	0.700	2275	308	0.42
123395	126198	0	3	1996.33	1996.75	0.500	2804	178	0.42
127449	129730	-7	-4	1998.42	1998.50	0.753	2281	330	0.08
132521	136835	-7	-4	1998.33	1998.42	1.266	4314	294	0.09
137088	144450	-7	-4	2002.25	2002.50	3.000	7361	408	0.25
149727	151250	0	3	2001.58	2001.67	0.248	1522	163	0.09
149982	152518	0	3	1994.58	1995.00	0.334	2536	132	0.42
149982	151502	0	3	1998.17	1998.42	0.250	1521	164	0.25
152771	156069	0	3	2001.58	2001.83	0.604	3298	183	0.25
153787	156069	0	3	1998.33	1998.50	0.193	2282	85	0.17
154041	155563	0	3	1990.58	1990.83	0.262	1522	172	0.25
154041	157084	0	3	1993.58	1994.00	0.255	3043	84	0.42
166489	167505	0	3	1996.33	1996.42	0.180	1017	177	0.09
167252	168270	0	3	1997.33	1997.50	0.304	1018	299	0.17
177698	182048	-7	-4	2003.33	2003.50	1.500	4350	345	0.17
178215	181537	-7	-4	2003.33	2003.58	3.000	3322	903	0.25
178726	181282	-7	-4	1999.33	1999.42	0.880	2556	344	0.09
178982	180770	0	3	1995.33	1995.42	0.306	1789	171	0.09
178982	181792	0	3	1997.33	1997.50	0.314	2811	112	0.17
178982	180514	0	3	1998.33	1998.50	0.244	1532	160	0.17
178982	180770	0	3	1999.33	1999.42	0.215	1789	120	0.09
178982	180006	0	3	2000.33	2000.42	0.207	1024	202	0.09
179238	181027	0	3	1990.33	1990.42	0.323	1788	181	0.09
179238	192241	0	3	1992.33	1992.92	1.473	13002	113	0.59
179238	180514	0	3	1992.67	1992.92	0.069	1276	54	0.25
179751	180259	0	3	1994.42	1994.50	0.106	508	209	0.08
182048	183586	0	3	1997.33	1997.42	0.158	1538	103	0.09

Xmin [m]	Xmax [m]	Zmin [m]	Zmax [m]	Tmin [yr]	Tmax [yr]	Vol [Mm3]	dX [m]	dV/dX [m3/m1]	dT [yr]
183586	185904	-7	-4	2000.33	2000.42	0.994	2318	429	0.09
184100	185904	0	3	1990.33	1990.50	0.386	1804	214	0.17
184100	185647	0	3	1999.33	1999.50	0.206	1547	133	0.17
184360	185391	0	3	1994.42	1994.50	0.101	1031	98	0.08
184360	185647	0	3	1995.33	1995.42	0.306	1288	238	0.09
184360	187193	0	3	1998.33	1998.50	0.352	2833	124	0.17
184616	185391	0	3	2000.33	2000.42	0.225	775	291	0.09
187964	192518	0	3	1997.33	1997.58	0.547	4554	120	0.25
187964	189950	0	3	2001.33	2001.58	0.511	1986	257	0.25
187964	191996	-7	-4	2002.33	2002.50	1.972	4033	489	0.17
197860	199195	0	3	1998.33	1998.50	0.229	1335	171	0.17
198028	199630	0	3	1995.67	1995.83	0.362	1603	226	0.16
198028	200159	0	3	2002.33	2002.67	0.501	2132	235	0.34
198225	200519	0	3	1991.67	1991.83	0.371	2294	162	0.16
200159	204787	0	3	1987.25	1988.00	1.850	4628	400	0.75
200797	202360	0	3	1995.67	1995.83	0.307	1562	196	0.16
201334	202153	0	3	2000.33	2000.42	0.120	819	147	0.09
201334	204579	-7	-4	2003.33	2003.42	1.000	3245	308	0.09
204176	206253	0	3	1996.33	1996.50	0.459	2077	221	0.17
204176	207290	-7	-4	2001.33	2001.50	1.500	3114	482	0.17
204377	207439	0	3	1991.33	1991.50	0.538	3061	176	0.17
204377	208359	0	3	1999.33	1999.42	0.144	3982	36	0.09
204377	207439	-7	-4	2003.33	2003.50	1.500	3061	490	0.17
204579	205509	0	3	1976.67	1976.75	0.342	930	368	0.08
204579	207587	0	3	1986.58	1986.83	1.320	3008	439	0.25
205509	207290	0	3	1979.67	1979.75	0.470	1781	264	0.08
206104	208359	0	3	1996.33	1996.50	0.459	2255	204	0.17
210650	217369	0	3	1992.58	1992.67	0.616	6719	92	0.09
210650	216769	0	3	1996.33	1996.50	0.867	6119	142	0.17
210650	216769	0	3	2003.33	2003.75	1.300	6119	212	0.42
211830	214406	0	3	1999.33	1999.50	0.287	2576	112	0.17
212421	214999	0	3	1993.33	1993.42	0.280	2578	109	0.09
212421	216769	0	3	2001.33	2001.83	1.290	4348	297	0.50
224190	231842	-7	-4	2003.25	2003.42	1.500	7652	196	0.17
224455	227176	0	3	1994.25	1994.42	0.761	2721	280	0.17
225004	226986	0	3	2000.25	2000.50	0.357	1982	180	0.25
225319	226434	0	3	1997.25	1997.58	0.340	1114	305	0.33
226986	233075	0	3	1993.25	1993.58	2.245	6089	369	0.33
227928	231477	0	3	2000.25	2000.75	0.702	3550	198	0.50
230164	233647	0	3	1996.25	1996.83	1.491	3483	428	0.58
231763	237766	-7	-4	2002.25	2002.67	5.397	6003	899	0.42
231842	233265	0	3	2000.25	2000.42	0.245	1423	172	0.17
232885	238155	0	3	1991.25	1991.75	2.009	5270	381	0.50
233265	238936	0	3	1984.50	1985.00	3.021	5671	533	0.50
233457	235746	0	3	1997.25	1997.83	0.659	2289	288	0.58
236710	238155	0	3	1996.25	1996.58	0.493	1445	341	0.33
239524	245250	0	3	1985.50	1985.75	2.850	5727	498	0.25
239915	245250	0	3	1979.67	1979.92	3.050	5335	572	0.25
239915	242867	0	3	1994.33	1994.67	1.331	2952	451	0.34
239915	242474	0	3	2000.25	2000.75	0.884	2559	345	0.50
240110	245125	0	3	1990.58	1990.92	2.543	5015	507	0.34
240505	243261	0	3	1999.25	1999.83	1.219	2756	442	0.58
242671	244174	0	3	1995.25	1995.42	0.835	1503	556	0.17
244174	244934	0	3	1995.25	1995.42	0.300	760	395	0.17
260205	262683	0	3	2001.25	2002.00	1.000	2478	404	0.75
260730	262683	0	3	1997.42	1997.83	0.280	1952	143	0.41
262859	264249	-7	-4	2001.25	2001.33	0.500	1390	360	0.08
266224	266962	0	3	1995.42	1995.83	0.111	738	150	0.41
266224	266962	0	3	1995.42	1995.83	0.080	738	108	0.41
286440	290961	-7	-4	1993.25	1993.92	2.000	4521	442	0.67
305478	306035	0	3	2000.25	2000.33	0.401	557	720	0.08
305486	306155	0	3	1997.33	1997.50	0.511	670	763	0.17
305493	305766	0	3	1979.42	1979.50	0.300	273	1,098	0.08
305544	306165	0	3	1994.50	1994.83	0.190	621	306	0.33
310409	314698	0	3	1996.33	1996.75	1.555	4289	362	0.42
313268	319604	0	3	1980.75	1981.00	2.200	6336	347	0.25
313268	317560	-7	-4	2003.25	2003.42	1.500	4292	350	0.17
314698	323286	0	3	1992.50	1992.75	1.442	8589	168	0.25
314698	316331	0	3	1992.50	1992.75	0.230	1633	141	0.25
315719	320630	0	3	1990.58	1990.75	0.930	4910	189	0.17
316331	324698	-7	-4	1998.25	1998.50	2.498	8368	299	0.25
317148	318786	0	3	1990.58	1990.75	0.040	1638	24	0.17
						160.210			
						4.855			

Specification of nourishments in period 1970 - 2003

Xmin [m]	Xmax [m]	Zmin [m]	Zmax [m]	Tmin [yr]	Tmax [yr]	Vol [Mm3]	dX [m]	dV/dX [m3/m1]	dT [yr]
54137	57780	-2	3	2003.00	2053.00	5.046	3643	1,385	50.00
63003	64806	-2	3	2003.00	2053.00	7.091	1803	3,933	50.00
75690	78271	-2	3	2003.00	2053.00	2.045	2581	792	50.00
86020	86423	-2	3	2003.00	2053.00	1.001	403	2,484	50.00
90063	91626	-2	3	2003.00	2053.00	7.091	1563	4,537	50.00
97943	99719	-2	3	2003.00	2053.00	3.602	1776	2,028	50.00
103836	111029	-2	3	2003.00	2053.00	1.796	7193	250	50.00
116067	119602	-2	3	2003.00	2053.00	0.903	3535	255	50.00
120106	126198	-2	3	2003.00	2053.00	1.197	6092	196	50.00
127193	144450	-2	3	2003.00	2053.00	0.903	17257	52	50.00
149474	157591	-2	3	2003.00	2053.00	2.100	8117	259	50.00
166743	168779	-2	3	2003.00	2053.00	0.390	2036	192	50.00
177954	182048	-2	3	2003.00	2053.00	2.130	4094	520	50.00
184101	188221	-2	3	2003.00	2053.00	2.712	4120	658	50.00
197489	200428	-2	3	2003.00	2053.00	0.768	2939	261	50.00
201432	208360	-2	3	2003.00	2053.00	18.000	6928	2,598	50.00
210337	217269	-2	3	2003.00	2053.00	11.250	6932	1,623	50.00
224190	226880	-2	3	2003.00	2053.00	9.000	2690	3,346	50.00
226880	231763	-2	3	2003.00	2053.00	6.750	4883	1,382	50.00
231763	237572	-2	3	2003.00	2053.00	7.508	5809	1,292	50.00
239524	245250	-2	3	2003.00	2053.00	8.993	5726	1,571	50.00
286837	290765	-2	3	2003.00	2053.00	0.600	3928	153	50.00
306579	308080	-2	3	2003.00	2053.00	1.800	1501	1,199	50.00
310199	314309	-2	3	2003.00	2053.00	1.200	4110	292	50.00
313268	317354	-2	3	2003.00	2053.00	2.400	4086	587	50.00
317354	324495	-2	3	2003.00	2053.00	21.000	7141	2,941	50.00
29499	44516	-2	3	2003.00	2053.00	21.228	15017	1,414	50.00
260115	266468	-2	3	2003.00	2053.00	27.000	6353	4,250	50.00
54137	57780	-8	-5	2003.00	2053.00	11.774	3643	3,232	50.00
63003	64806	-8	-5	2003.00	2053.00	16.545	1803	9,176	50.00
75690	78271	-8	-5	2003.00	2053.00	4.771	2581	1,849	50.00
86020	86423	-8	-5	2003.00	2053.00	2.335	403	5,794	50.00
90063	91626	-8	-5	2003.00	2053.00	16.545	1563	10,585	50.00
97943	99719	-8	-5	2003.00	2053.00	8.404	1776	4,732	50.00
103836	111029	-8	-5	2003.00	2053.00	4.190	7193	583	50.00
116067	119602	-8	-5	2003.00	2053.00	2.107	3535	596	50.00
120106	126198	-8	-5	2003.00	2053.00	2.793	6092	458	50.00
127193	144450	-8	-5	2003.00	2053.00	2.107	17257	122	50.00
149474	157591	-8	-5	2003.00	2053.00	4.900	8117	604	50.00
166743	168779	-8	-5	2003.00	2053.00	0.910	2036	447	50.00
177954	182048	-8	-5	2003.00	2053.00	4.970	4094	1,214	50.00
184101	188221	-8	-5	2003.00	2053.00	6.328	4120	1,536	50.00
197489	200428	-8	-5	2003.00	2053.00	1.792	2939	610	50.00
201432	208360	-8	-5	2003.00	2053.00	42.000	6928	6,062	50.00
210337	217269	-8	-5	2003.00	2053.00	26.250	6932	3,787	50.00
224190	226880	-8	-5	2003.00	2053.00	21.000	2690	7,807	50.00
226880	231763	-8	-5	2003.00	2053.00	15.750	4883	3,225	50.00
231763	237572	-8	-5	2003.00	2053.00	17.518	5809	3,016	50.00
239524	245250	-8	-5	2003.00	2053.00	20.983	5726	3,665	50.00
286837	290765	-8	-5	2003.00	2053.00	1.400	3928	356	50.00
306579	308080	-8	-5	2003.00	2053.00	4.200	1501	2,798	50.00
310199	314309	-8	-5	2003.00	2053.00	2.800	4110	681	50.00
313268	317354	-8	-5	2003.00	2053.00	5.600	4086	1,371	50.00
317354	324495	-8	-5	2003.00	2053.00	49.000	7141	6,862	50.00
29499	44516	-8	-5	2003.00	2053.00	49.532	15017	3,298	50.00
260115	266468	-8	-5	2003.00	2053.00	63.000	6353	9,917	50.00
						585.008			
						11.700			

Specification of nourishments in period 2003 - 2053 (scenario A)

Xmin [m]	Xmax [m]	Zmin [m]	Zmax [m]	Tmin [yr]	Tmax [yr]	Vol [Mm3]	dX [m]	dV/dX [m3/m1]	dT [yr]
54137	57780	-2	3	2003.00	2053.00	2.958	3643	812	50.00
63003	64806	-2	3	2003.00	2053.00	4.157	1803	2,306	50.00
75690	78271	-2	3	2003.00	2053.00	1.199	2581	465	50.00
86020	86423	-2	3	2003.00	2053.00	0.587	403	1,457	50.00
90063	91626	-2	3	2003.00	2053.00	4.157	1563	2,660	50.00
97943	99719	-2	3	2003.00	2053.00	16.979	1776	9,560	50.00
103836	111029	-2	3	2003.00	2053.00	8.465	7193	1,177	50.00
116067	119602	-2	3	2003.00	2053.00	4.257	3535	1,204	50.00
120106	126198	-2	3	2003.00	2053.00	5.643	6092	926	50.00
127193	144450	-2	3	2003.00	2053.00	4.257	17257	247	50.00
149474	157591	-2	3	2003.00	2053.00	9.900	8117	1,220	50.00
166743	168779	-2	3	2003.00	2053.00	2.438	2036	1,197	50.00
177954	182048	-2	3	2003.00	2053.00	13.313	4094	3,252	50.00
184101	188221	-2	3	2003.00	2053.00	16.950	4120	4,114	50.00
197489	200428	-2	3	2003.00	2053.00	4.800	2939	1,633	50.00
201432	208360	-2	3	2003.00	2053.00	27.000	6928	3,897	50.00
210337	217269	-2	3	2003.00	2053.00	16.875	6932	2,434	50.00
224190	226880	-2	3	2003.00	2053.00	13.500	2690	5,019	50.00
226880	231763	-2	3	2003.00	2053.00	10.125	4883	2,074	50.00
286837	290765	-2	3	2003.00	2053.00	0.750	3928	191	50.00
306579	308080	-2	3	2003.00	2053.00	2.250	1501	1,499	50.00
310199	314309	-2	3	2003.00	2053.00	1.500	4110	365	50.00
313268	317354	-2	3	2003.00	2053.00	3.000	4086	734	50.00
29499	44516	-2	3	2003.00	2053.00	12.444	15017	829	50.00
260115	266468	-2	3	2003.00	2053.00	7.500	6353	1,181	50.00
54137	57780	-8	-5	2003.00	2053.00	6.902	3643	1,895	50.00
63003	64806	-8	-5	2003.00	2053.00	9.699	1803	5,379	50.00
75690	78271	-8	-5	2003.00	2053.00	2.797	2581	1,084	50.00
86020	86423	-8	-5	2003.00	2053.00	1.369	403	3,397	50.00
90063	91626	-8	-5	2003.00	2053.00	9.699	1563	6,205	50.00
97943	99719	-8	-5	2003.00	2053.00	39.617	1776	22,307	50.00
103836	111029	-8	-5	2003.00	2053.00	19.751	7193	2,746	50.00
116067	119602	-8	-5	2003.00	2053.00	9.933	3535	2,810	50.00
120106	126198	-8	-5	2003.00	2053.00	13.167	6092	2,161	50.00
127193	144450	-8	-5	2003.00	2053.00	9.933	17257	576	50.00
149474	157591	-8	-5	2003.00	2053.00	23.100	8117	2,846	50.00
166743	168779	-8	-5	2003.00	2053.00	5.688	2036	2,794	50.00
177954	182048	-8	-5	2003.00	2053.00	31.063	4094	7,587	50.00
184101	188221	-8	-5	2003.00	2053.00	39.550	4120	9,600	50.00
197489	200428	-8	-5	2003.00	2053.00	11.200	2939	3,811	50.00
201432	208360	-8	-5	2003.00	2053.00	63.000	6928	9,094	50.00
210337	217269	-8	-5	2003.00	2053.00	39.375	6932	5,680	50.00
224190	226880	-8	-5	2003.00	2053.00	31.500	2690	11,710	50.00
226880	231763	-8	-5	2003.00	2053.00	23.625	4883	4,838	50.00
286837	290765	-8	-5	2003.00	2053.00	1.750	3928	446	50.00
306579	308080	-8	-5	2003.00	2053.00	5.250	1501	3,498	50.00
310199	314309	-8	-5	2003.00	2053.00	3.500	4110	852	50.00
313268	317354	-8	-5	2003.00	2053.00	7.000	4086	1,713	50.00
29499	44516	-8	-5	2003.00	2053.00	29.036	15017	1,934	50.00
260115	266468	-8	-5	2003.00	2053.00	17.500	6353	2,755	50.00
						650.008			
						13.000			

Specification of nourishments in period 2003 - 2053 (scenario B)

X [m]	dX [m]		
5000	1000		
96000	500	91	91
98000	500	4	95
103000	1000	10	105
112000	500	9	114
120000	1000	16	130
135000	500	15	145
140000	1000	10	155
156000	500	16	171
168000	1000	24	195
175000	500	7	202
185000	1000	20	222
190000	500	5	227
202000	1000	24	251
325000	500	123	374
346000	0	42	416

Dutch Coast

Longshore grid definition

X [m]	dX [m]		
98000	500		
103000	1000	10	10
112000	500	9	19
120000	1000	16	35
135000	500	15	50
140000	1000	10	60
156000	500	16	76
168000	1000	24	100
175000	500	7	107
185000	1000	20	127
190000	500	5	132
202000	1000	24	156
325000	500	123	279
346000	0	42	321

Holland & Dutch coast

X [m]	dX [m]		
202000	1000		
325000	500	123	123
346000	0	42	165

Wadden coast

X [m]	dX [m]		
98000	500		
103000	1000	10	10
112000	500	9	19
120000	1000	16	35
135000	500	15	50
140000	1000	10	60
156000	500	16	76
168000	1000	24	100
175000	500	7	107
185000	1000	20	127
190000	500	5	132
202000	0	24	156

Holland coast

X [m]	dX [m]		
5000	1000		
96000	500	91	91
98000	0	4	95

Delta coast

	t [yr]
1	**1970**
2	1975
3	1980
4	1985
5	**1990**

1970 - 1990

	t [yr]
1	**1990**
2	1995
3	2000
4	**2003**

1990 - 2003

	t [yr]
1	**2003**
2	2008
3	2013
4	2018
5	2023
6	2028
7	2033
8	2038
9	2043
10	2048
11	**2053**

2003 - 2053

Time range definition

bnd	X [m]	dX [m]	
1	**5000**		
2	14000	9000	9000
3	96500	82500	91500
4	**98000**	1500	93000
5	161500	63500	156500
6	162500	1000	157500
7	**202000**	39500	197000
8	232000	30000	227000
9	257000	25000	252000
10	287000	30000	282000
11	317000	30000	312000
12	**346000**	29000	341000

cell	X_l [m]	dX [m]	X_r [m]
1	**5000**	9000	14000
2	14000	82500	96500
3	96500	1500	**98000**
4	**98000**	63500	161500
5	161500	1000	162500
6	162500	39500	**202000**
7	**202000**	30000	232000
8	232000	25000	257000
9	257000	30000	287000
10	287000	30000	317000
11	317000	29000	**346000**
		341000	

Longshore balance section definition

X [m]	Z_low [m]	Z_up [m]
10000	-7.00	3.00
90000	-4.50	3.00
225000	-5.00	3.00
305000	-4.50	3.20
350000	-4.50	2.90
370000	-4.90	3.20

Longshore BCL-levels definition

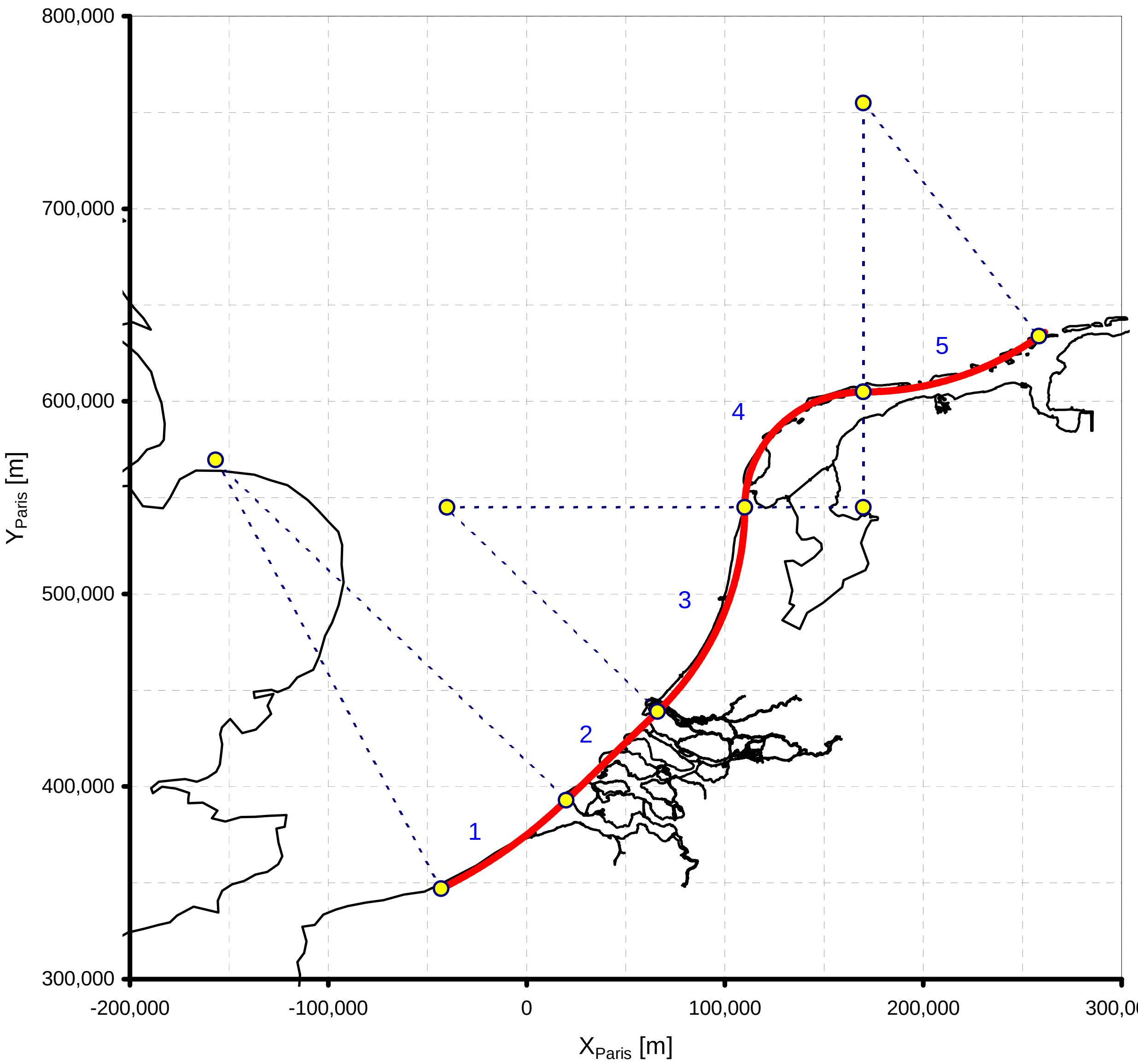
X [m]	CW1
5000	4.50
97000	4.50
98000	2.00
161500	2.00
162500	2.00
202000	2.00
350000	5.50

X [m]	CW2
5000	1.20
98000	0.20
145000	0.35
202000	0.20
350000	0.45

X [m]	CW3
5000	0.90
98000	0.16
120000	0.22
161500	0.22
162500	0.13
196000	0.13
350000	0.60

X [m]	CW4
5000	0.50
97000	0.50
98000	0.75
161500	0.75
162500	0.55
202000	0.55
202500	0.40
350000	0.40

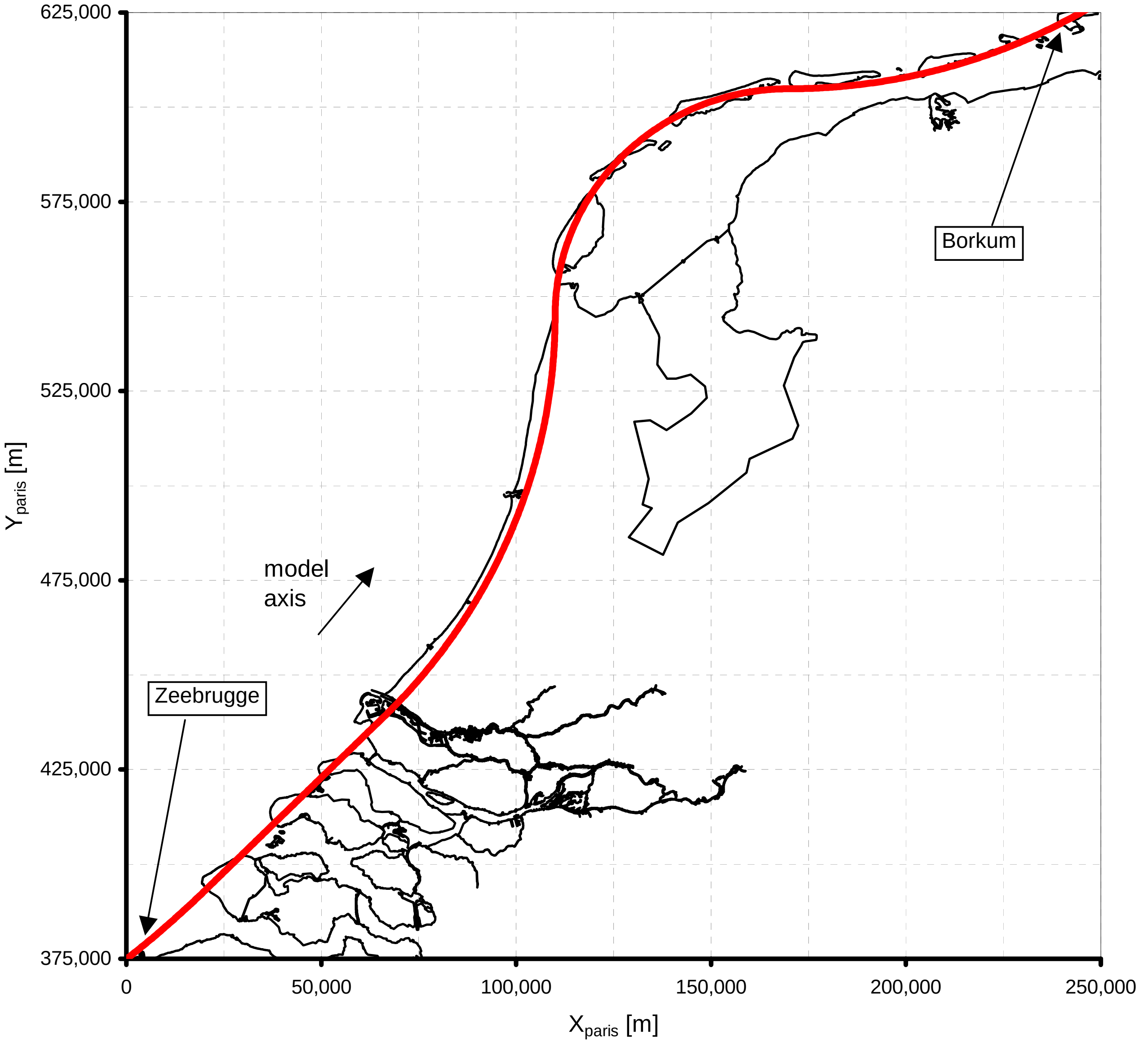
Longshore equilibrium profile correction factor



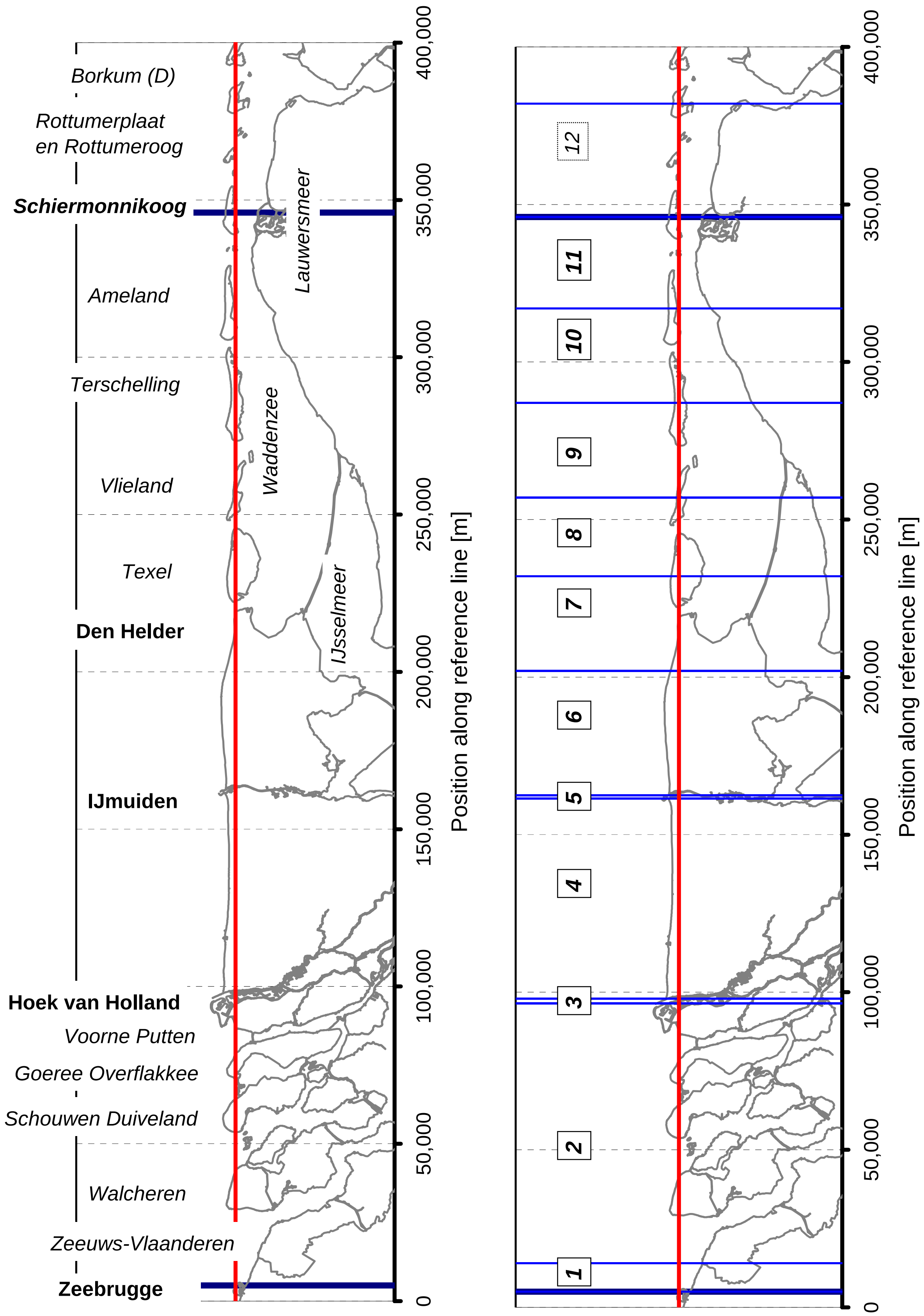
Overview of the North Sea Coast
Position of the applied reference line

PONTOS-2.0		
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL / Alkyon**	Fig. 2.1

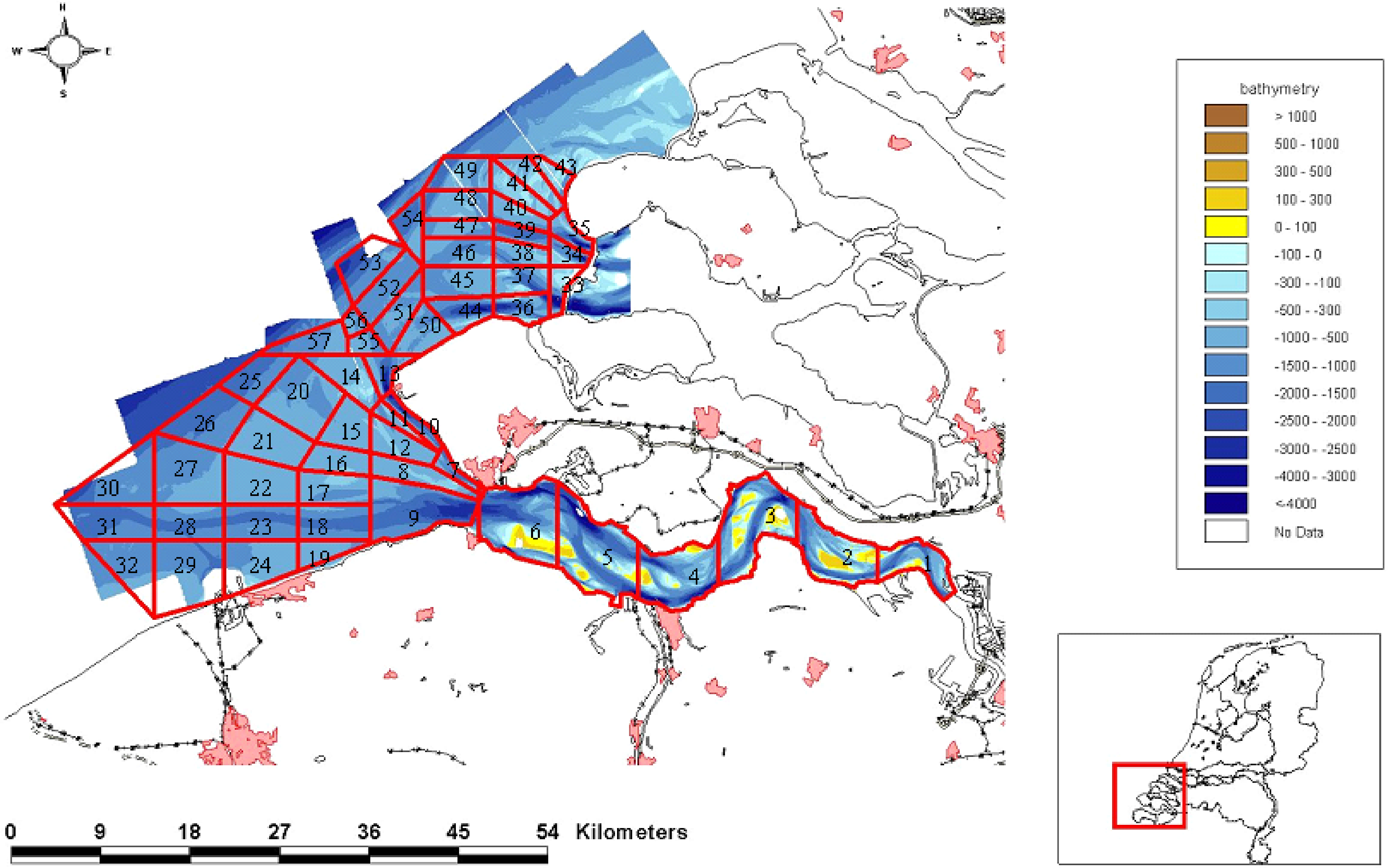
file: A1000F6-II_2_r0.xls; October 2004



Detail of the Dutch North Sea Coast Position of the applied reference line	PONTOS-2.0	
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL / Alkyon**	Fig. 2.2



Overview of North Sea coast along the reference line Location of large-scale coastal cells	PONTOS-2.0	
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL / Alkyon**	Fig. 2.3



Schematisation of the ASMITA model for the Delta region

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

Fig. 2.4

file: A1000F#_#_r0.xls; October 2004

Sediment exchange between Western Scheldt and coast

LARGE-SCALE MODEL OF THE DUTCH COAST	Z3334/A1000	**WL / Alkyon**	Fig. 2.5

LARGE-SCALE MODEL OF THE DUTCH COAST

Overview of the applied model input

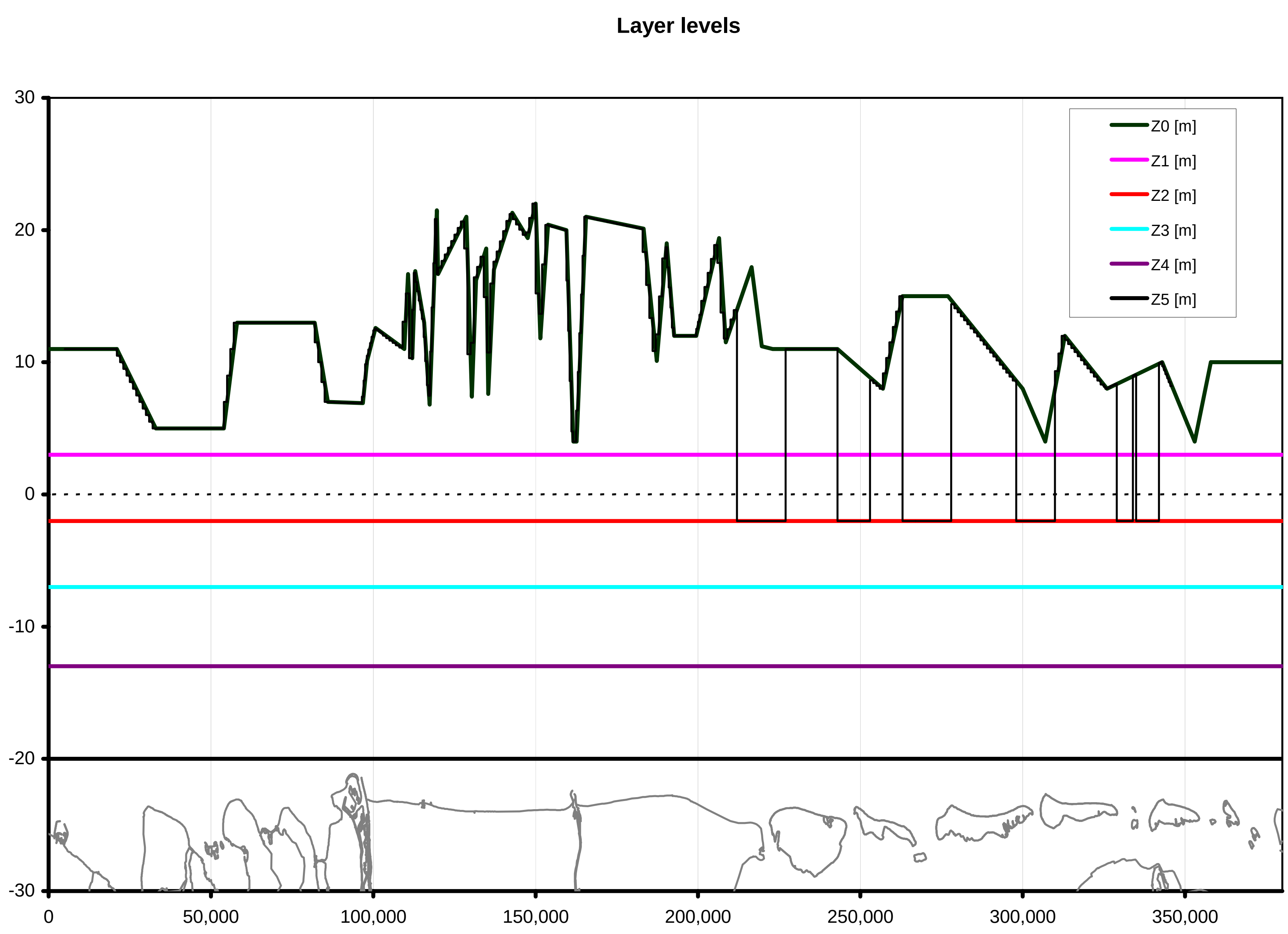
Overview of the applied layer levels

Z3334/A1000

WL / Alkyon

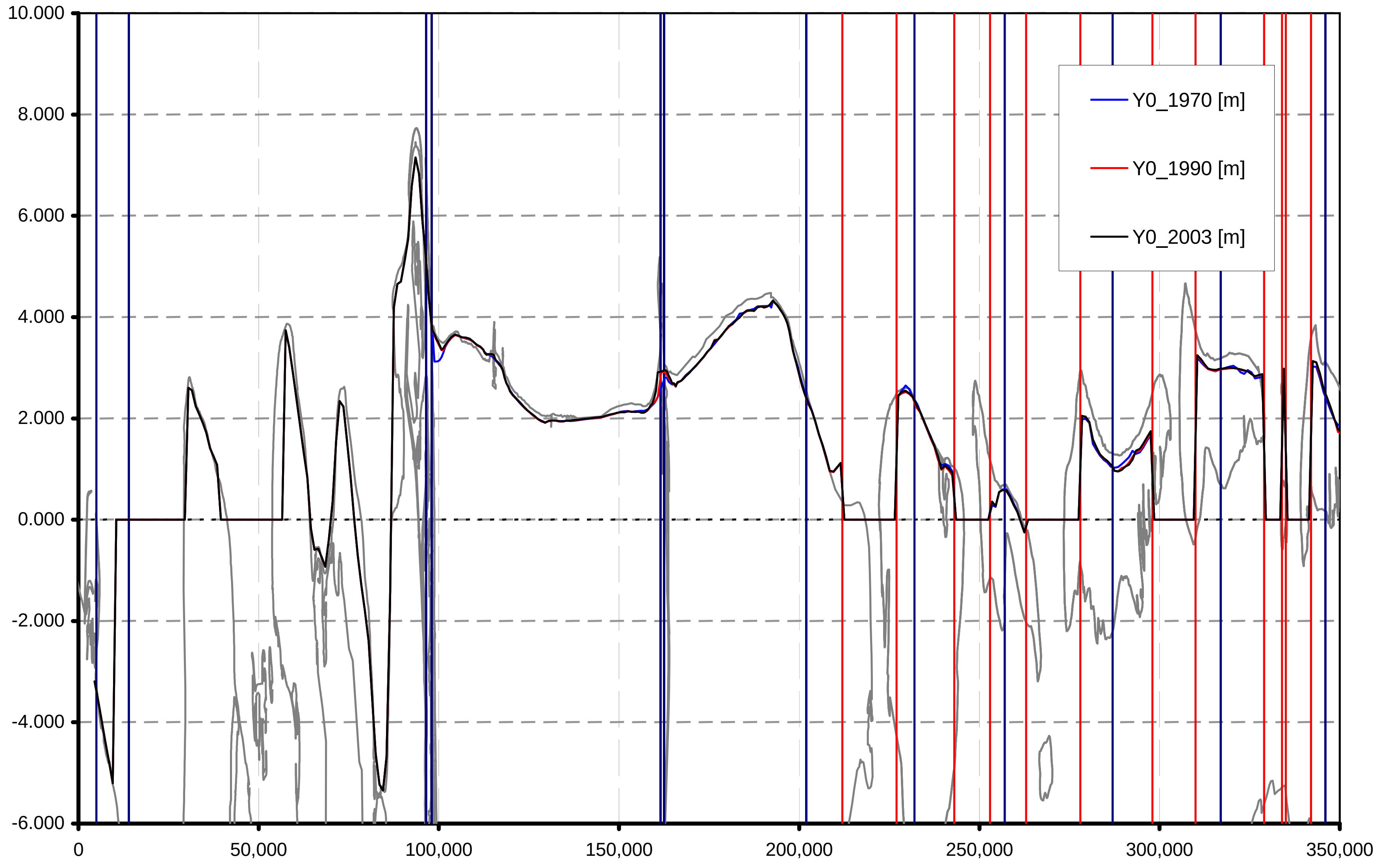
PONTOS-2.0

Fig. 3.1



file: PonTos_input_r16.xls; November 2004

Overview Y0-positions



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input
Applied layer positions for layer Y0
Position in 1970, 1990 and 2003

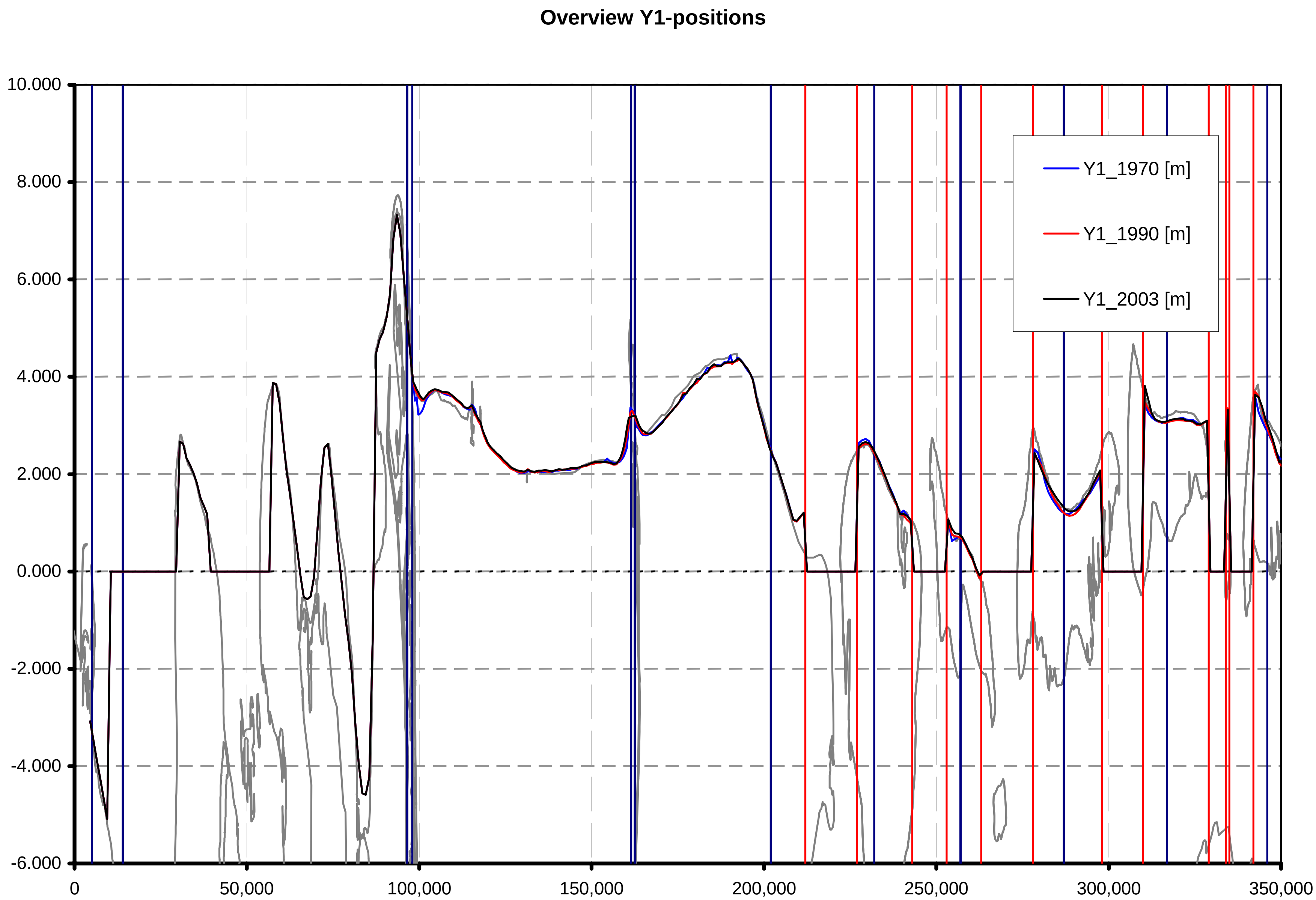
LARGE-SCALE MODEL OF THE DUTCH COAST

PONTOS-2.0

Z3334/A1000

WL / Alkyon

Fig. 3.2



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input
Applied layer positions for layer Y1
Position in 1970, 1990 and 2003

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

PONTOS-2.0

WL / Alkyon

Fig. 3.3

LARGE-SCALE MODEL OF THE DUTCH COAST

Position in 1970, 1990 and 2003

Applied layer positions for layer Y2

Overview of the applied model input

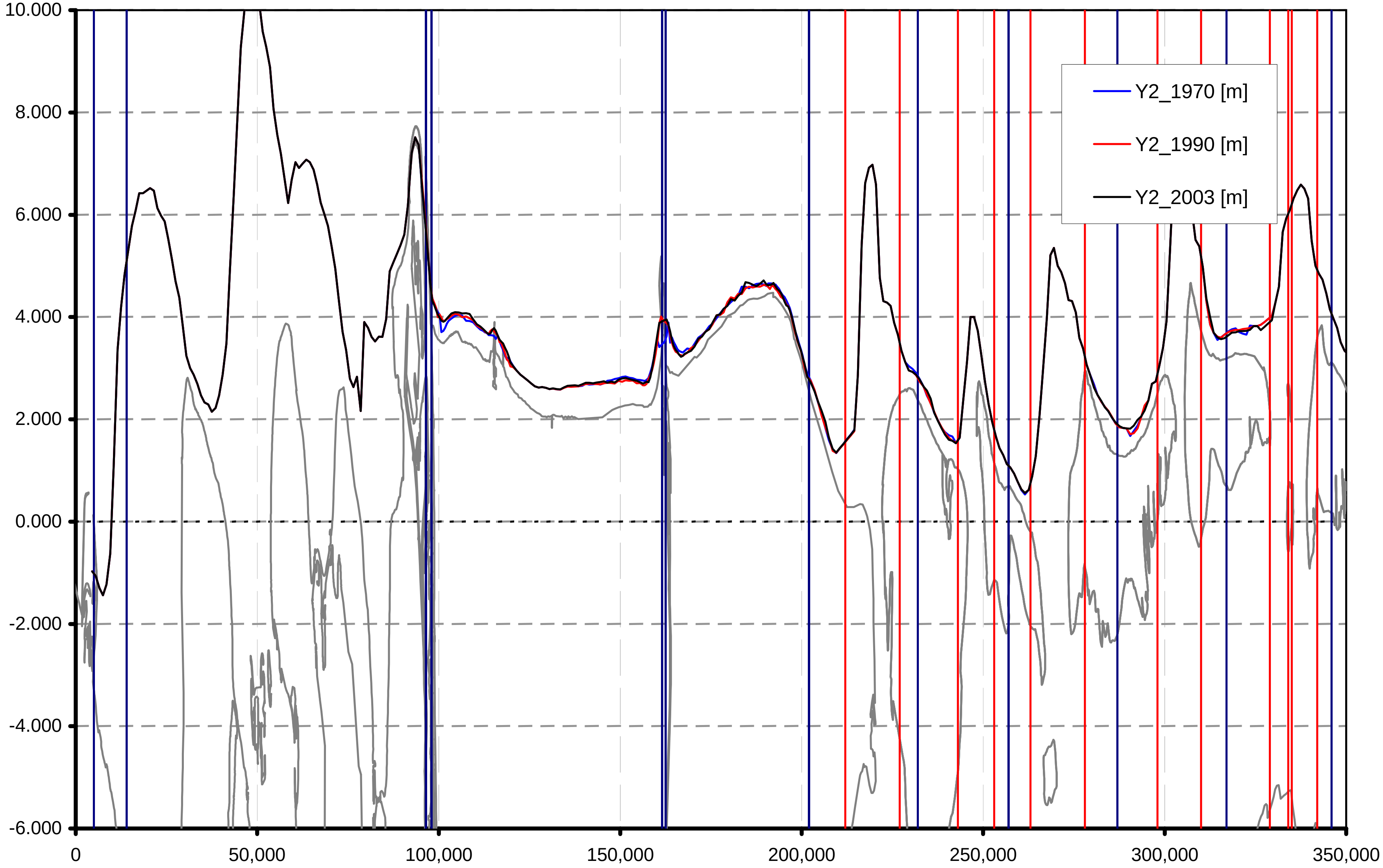
Z3334/A1000

WL / Alkyon

PONTOS-2.0

Fig. 3.4

Overview Y2-positions



file: PonTos_input_r16.xls; November 2004

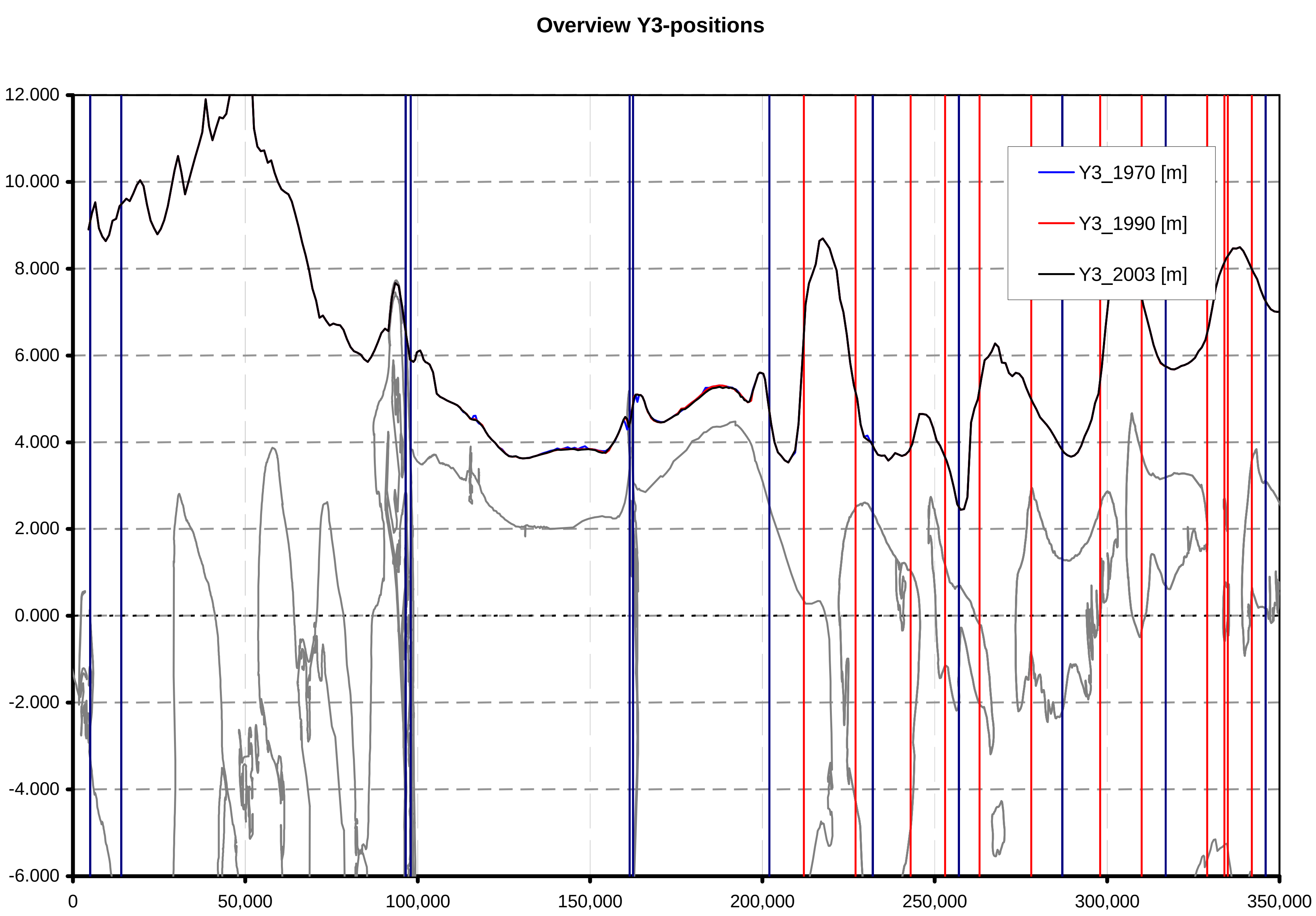
Overview of the applied model input
Applied layer positions for layer Y3
Position in 1970, 1990 and 2003

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

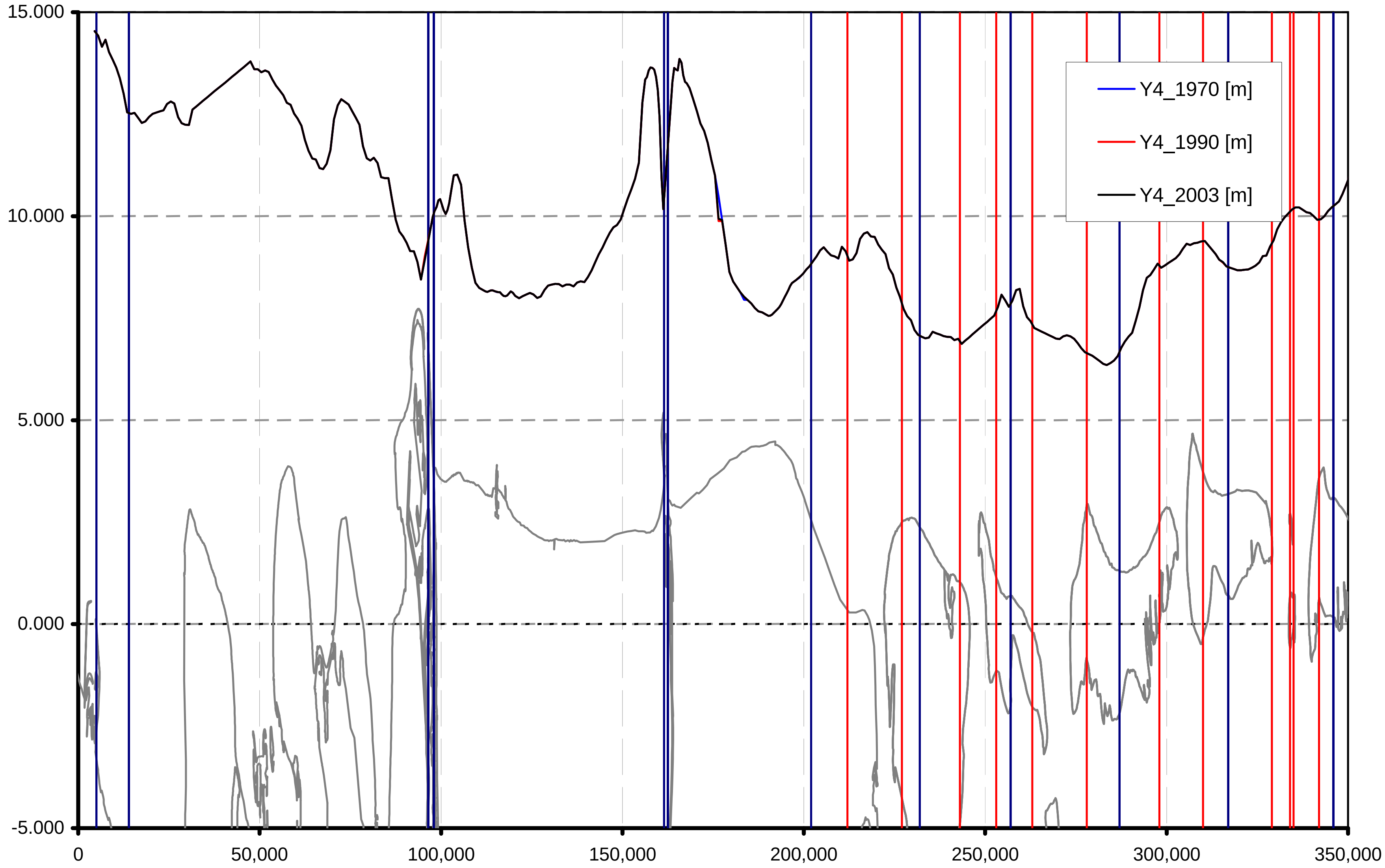
PONTOS-2.0



file: PonTos_input_r16.xls; November 2004

Fig. 3.5

Overview Y4-positions



Overview of the applied model input
Applied layer positions for layer Y4
Position in 1970, 1990 and 2003

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

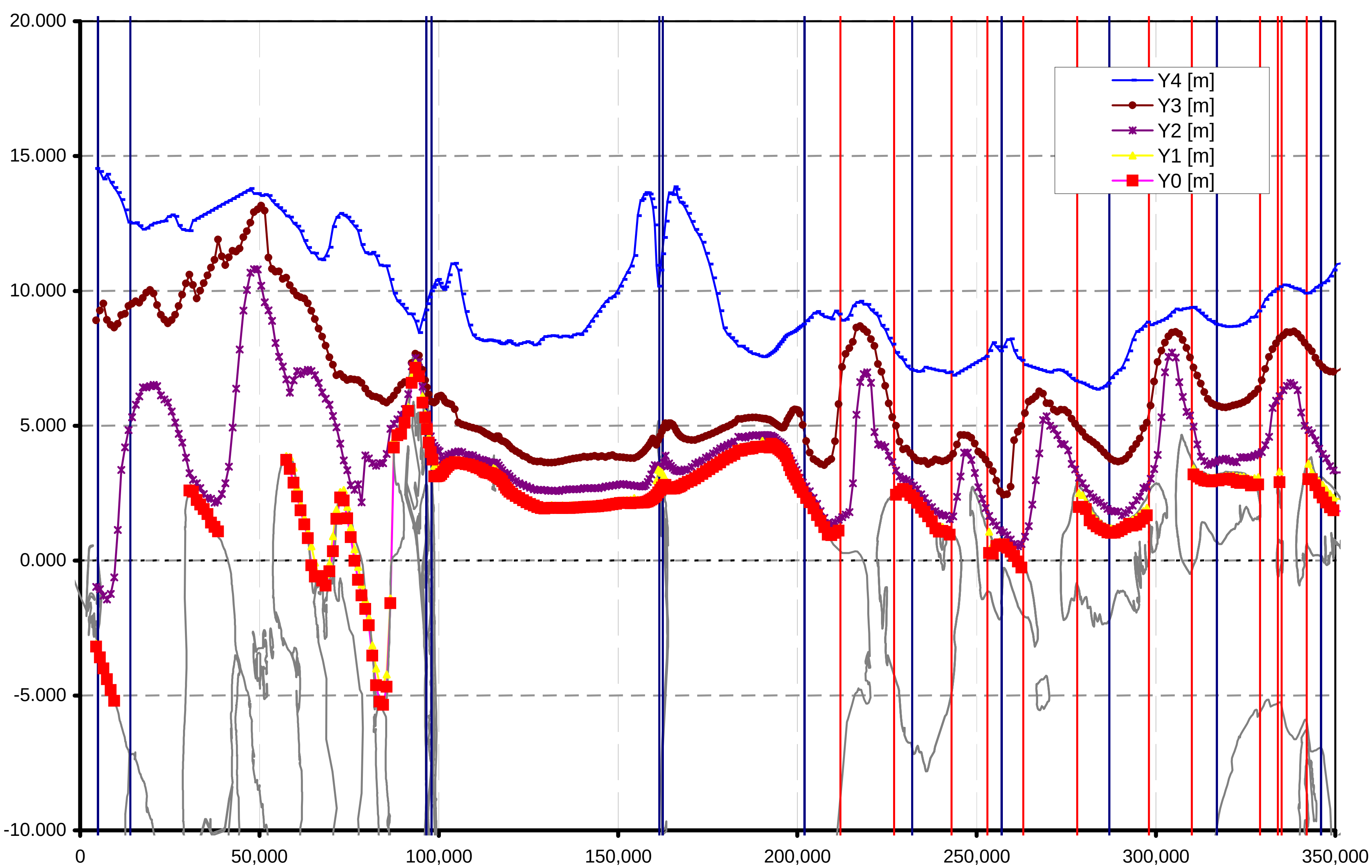
PONTOS-2.0

WL / Alkyon

Fig. 3.6

file: PonTos_input_r16.xls; November 2004

Overview of 1970-positions



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input
Applied layer positions in 1970
Position of all relevant layers

LARGE-SCALE MODEL OF THE DUTCH COAST

PONTOS-2.0	1970	**WL / Alkyon**
Z3334/A1000		Fig. 3.7

LARGE-SCALE MODEL OF THE DUTCH COAST

Position of all relevant layers

Applied layer positions in 1990

Overview of the applied model input

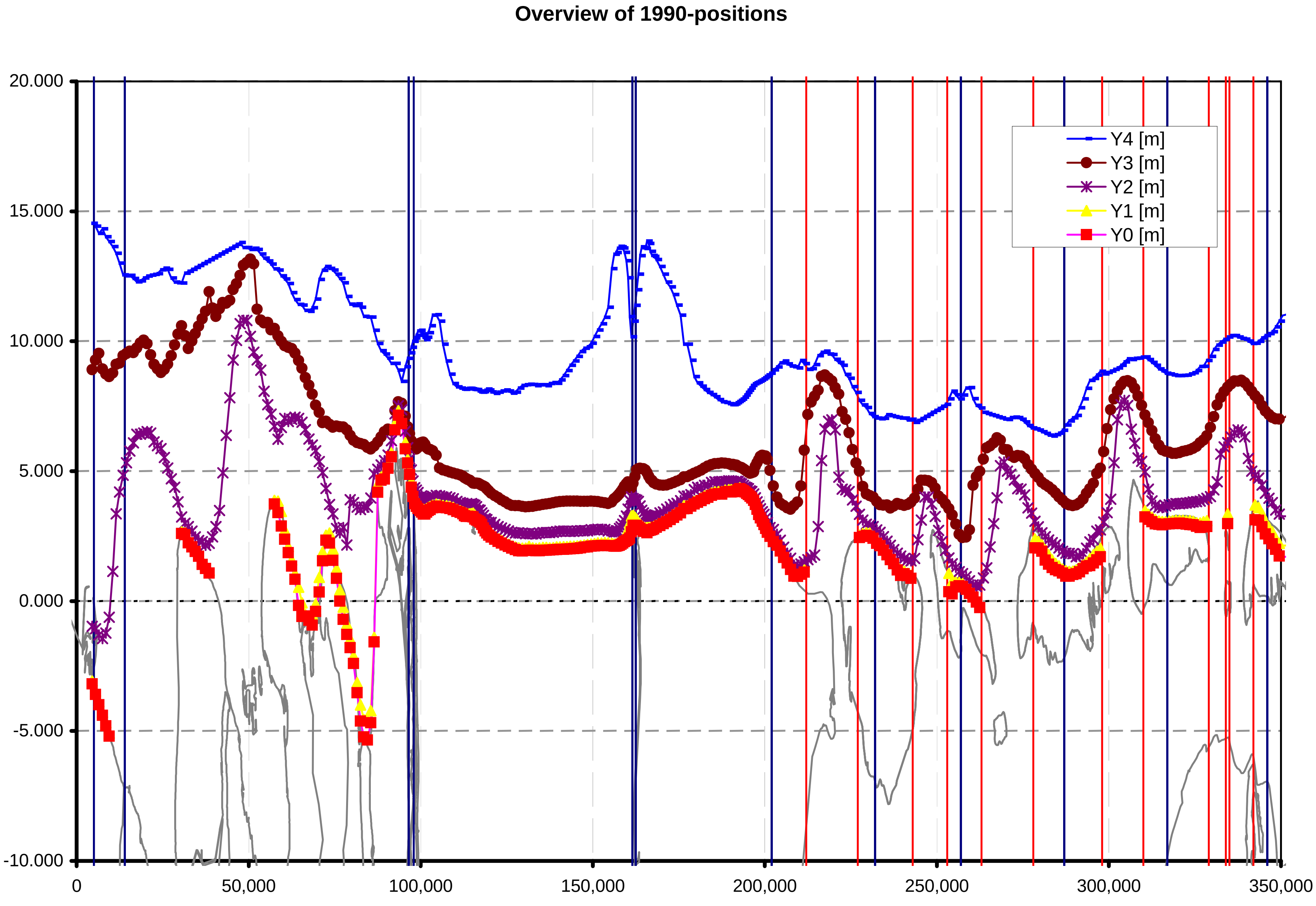
Z3334/A1000

WL / Alkyon

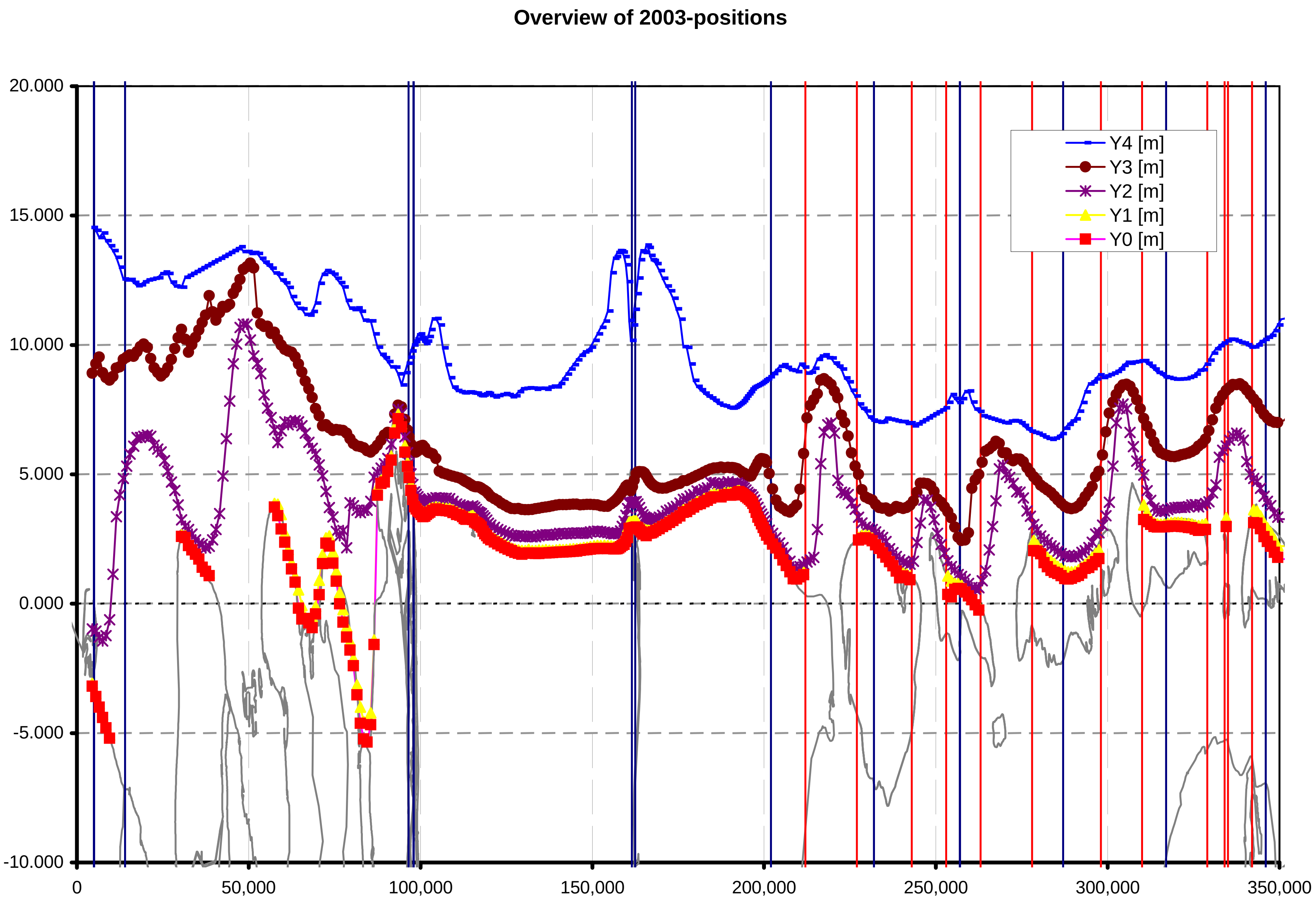
1990

PONTOS-2.0

Fig. 3.8



file: PonTos_input_r16.xls; November 2004



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input Applied layer positions in 2003 Position of all relevant layers	PONTOS-2.0
	2003
LARGE-SCALE MODEL OF THE DUTCH COAST	
Z3334/A1000	**WL / Alkyon**
	Fig. 3.9

LARGE-SCALE MODEL OF THE DUTCH COAST

Overview of the applied model input

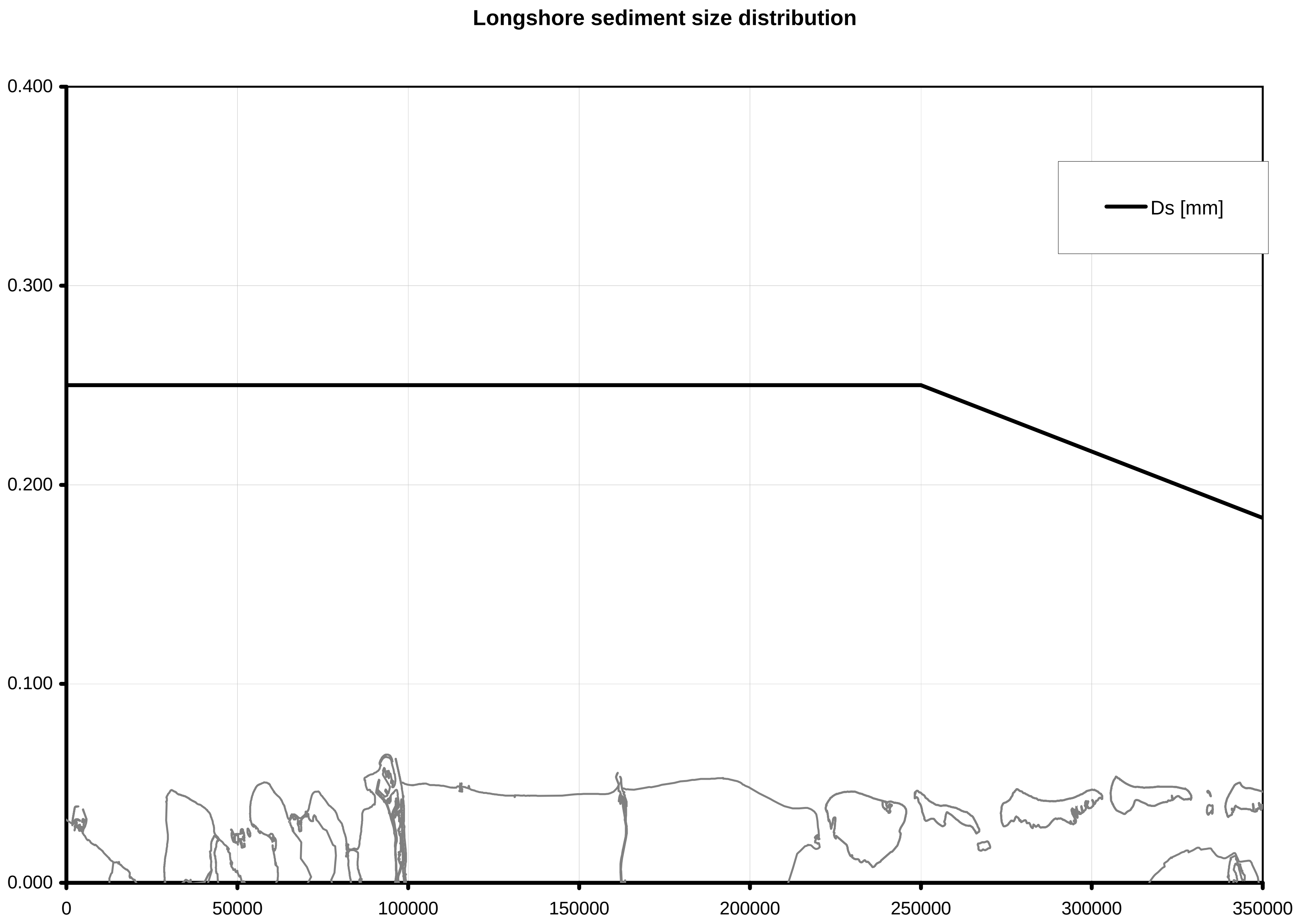
Applied characteristic sediment diameter

Z3334/A1000

WL / Alkyon

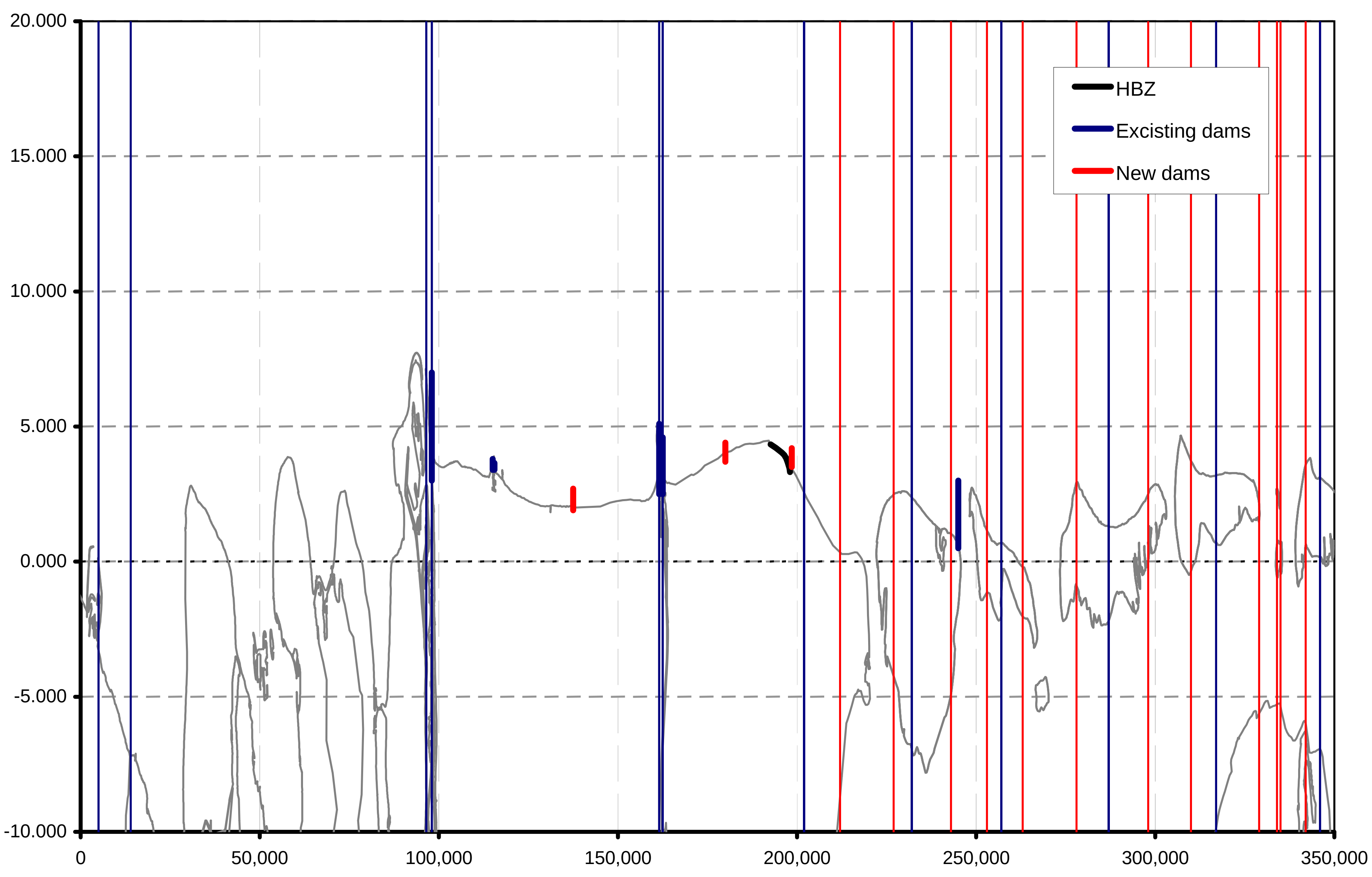
PONTOS-2.0

Fig. 3.10



file: PonTos_input_r16.xls; November 2004

Overview of groynes and (new) dams



LARGE-SCALE MODEL OF THE DUTCH COAST

Overview of the applied model input

Existing structures and new structures

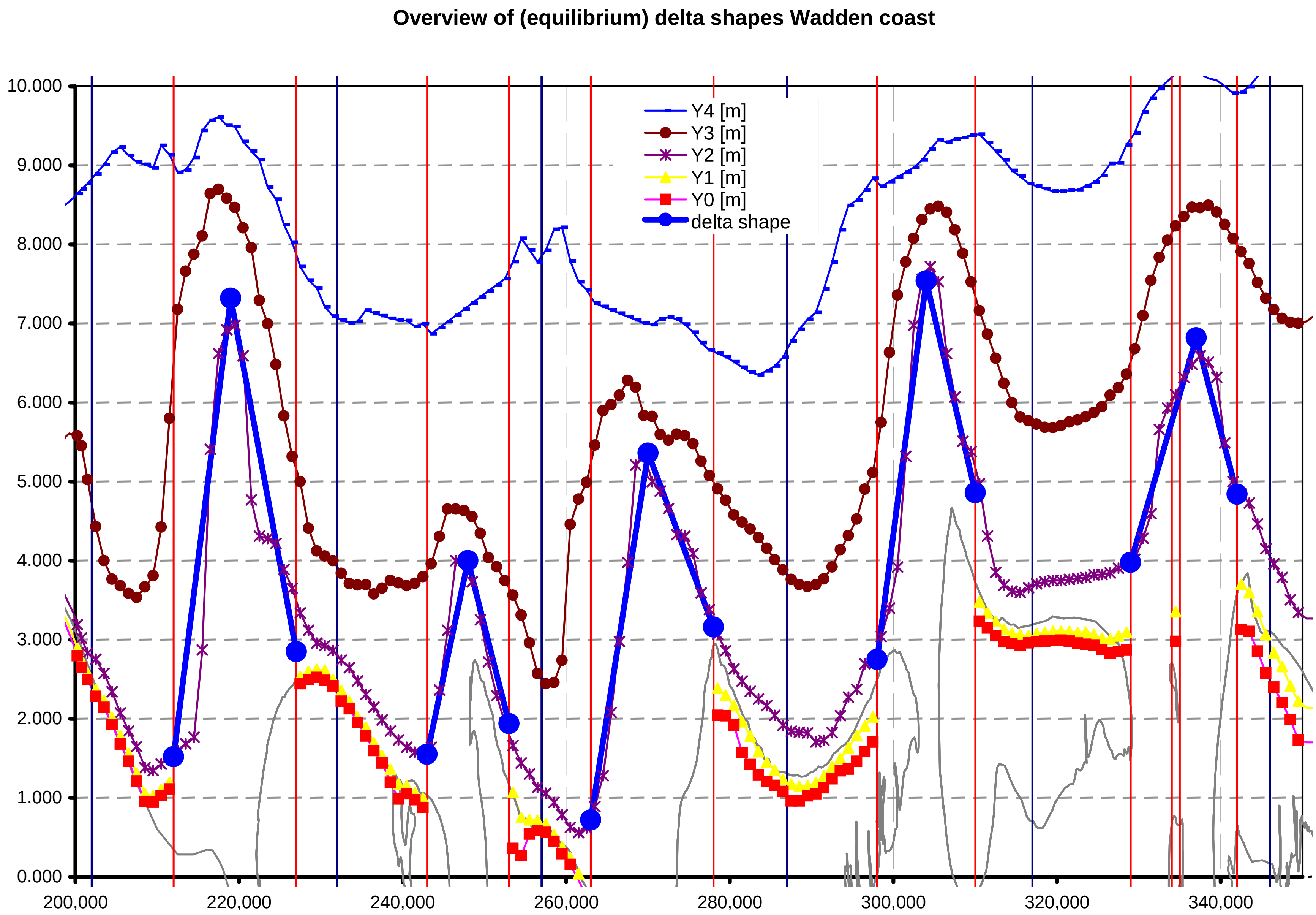
Z3334/A1000

WL / Alkyon

PONTOS-2.0

Fig. 3.11

file: PonTos_input_r16.xls; November 2004



LARGE-SCALE MODEL OF THE DUTCH COAST

Relative protrusion and offset

Definition of the equilibrium shape of the Wadden delta's

Overview of the applied model input

Z3334/A1000

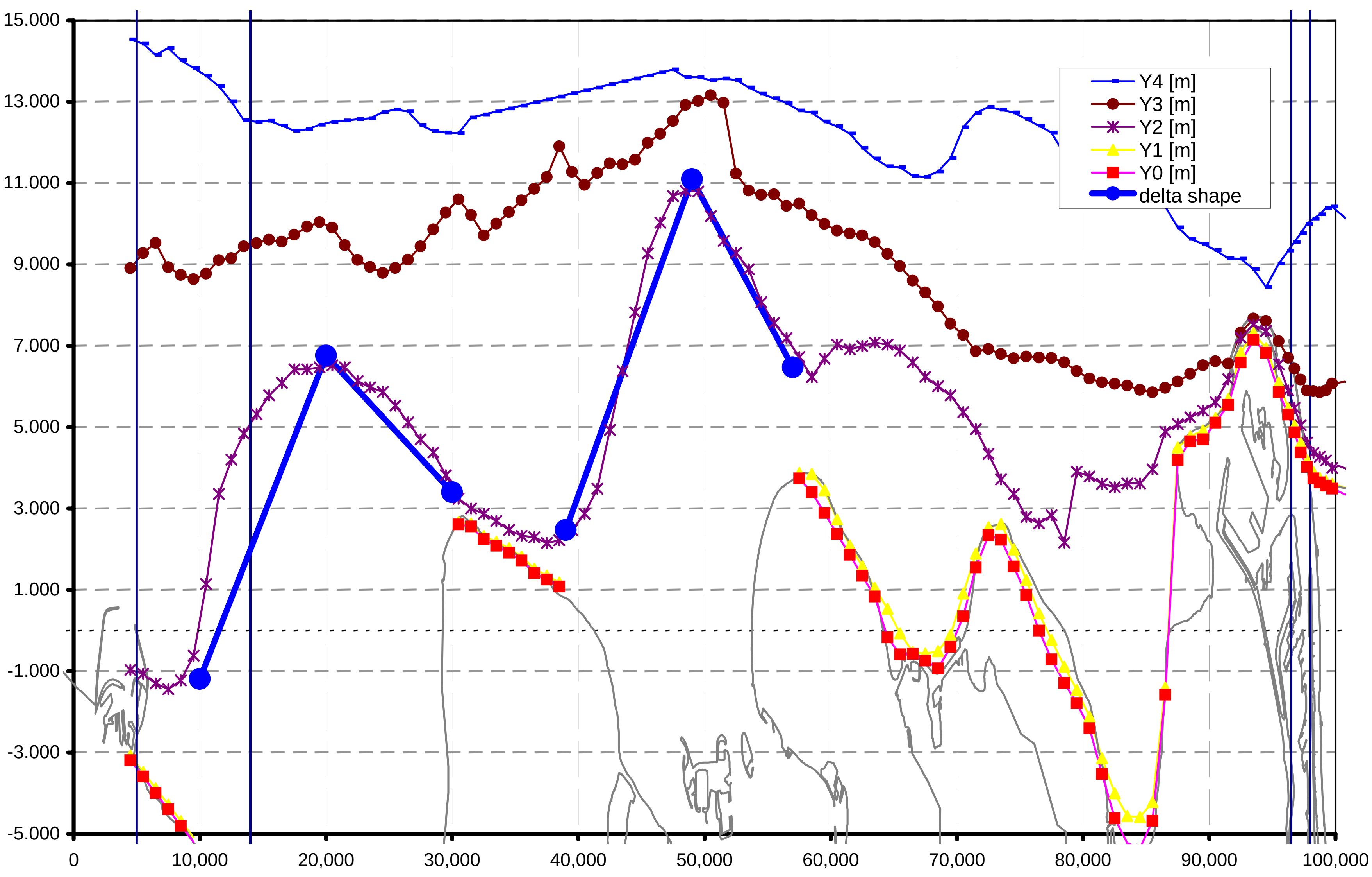
1990

PONTOS-2.0

WL / Alkyon

Fig. 3.12

Overview of (equilibrium) delta shapes Delta coast



Overview of the applied model input

Definition of the equilibrium shape of the Delta delta's

Relative protrusion and offset

PONTOS-2.0

1990

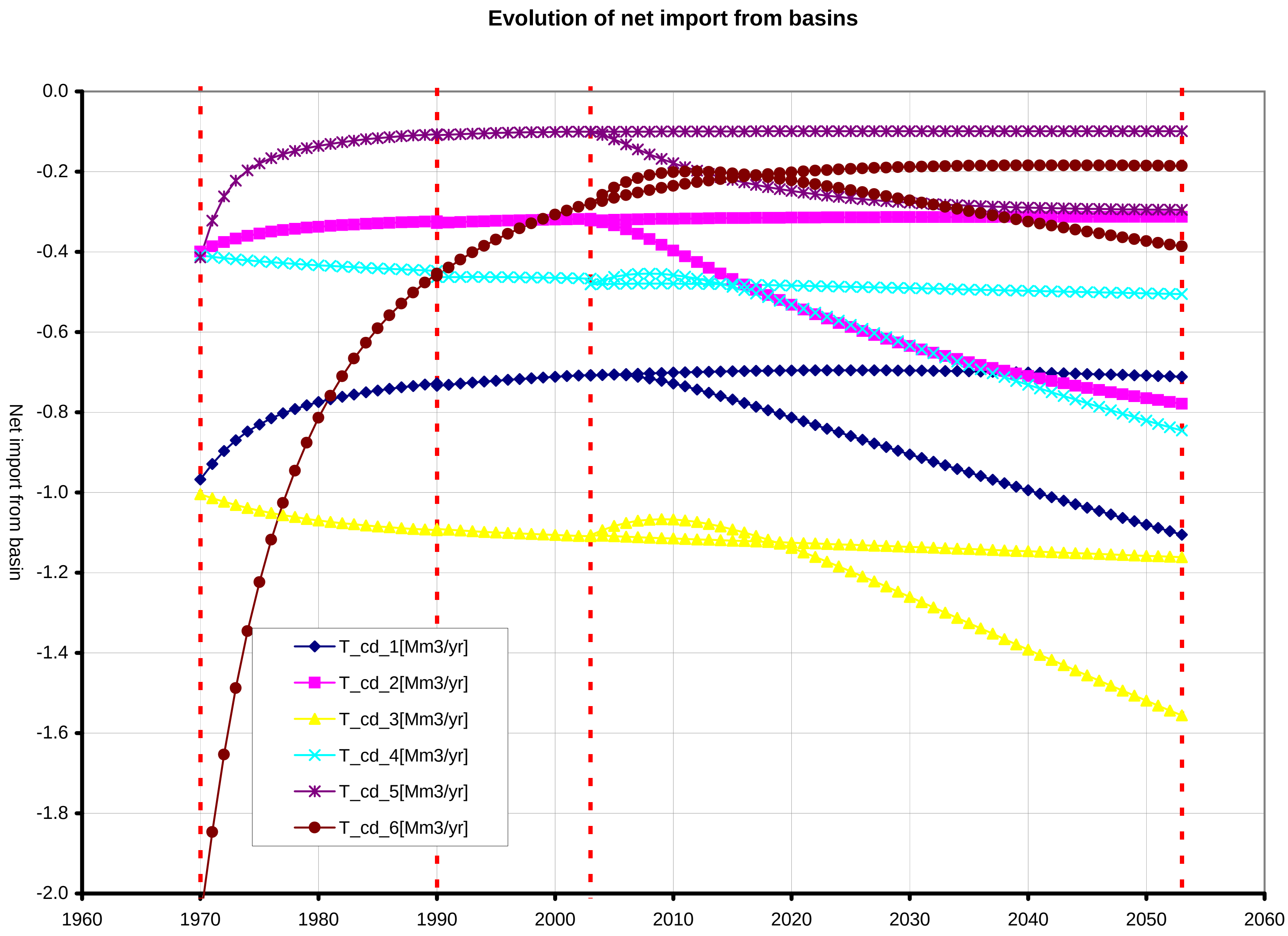
LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

Fig. 3.13

file: PonTos_input_r16.xls; November 2004



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input
Nett import from tidal basins for the Wadden coast
For two sea level rise scenario's

LARGE-SCALE MODEL OF THE DUTCH COAST

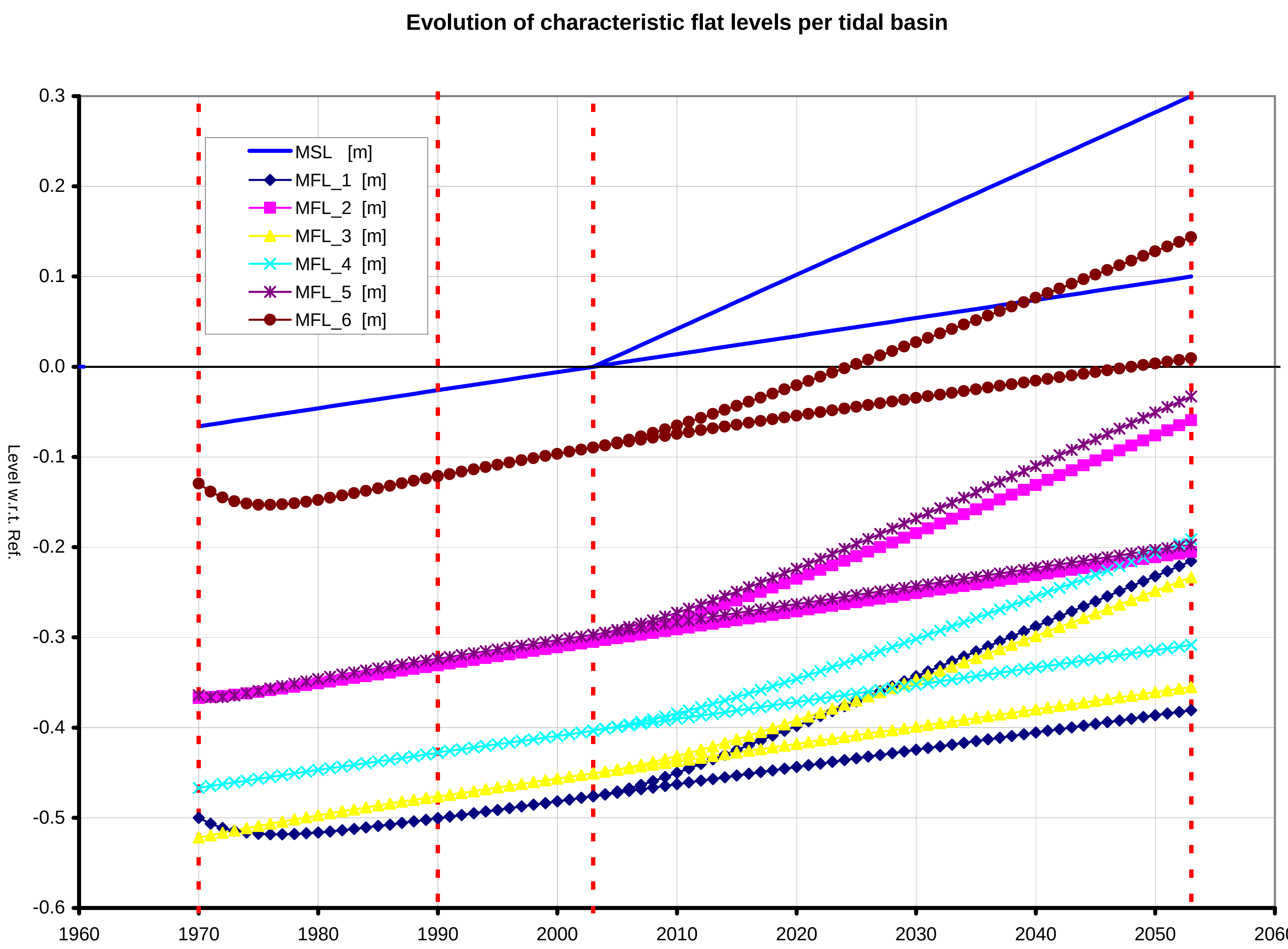
Z3334/A1000

PONTOS-2.0 | ASMITA

1970 - 2053

WL / Alkyon

Fig. 3.14



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input

Related evolution of tidal flat level per individual basin

For two sea level rise scenario's

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

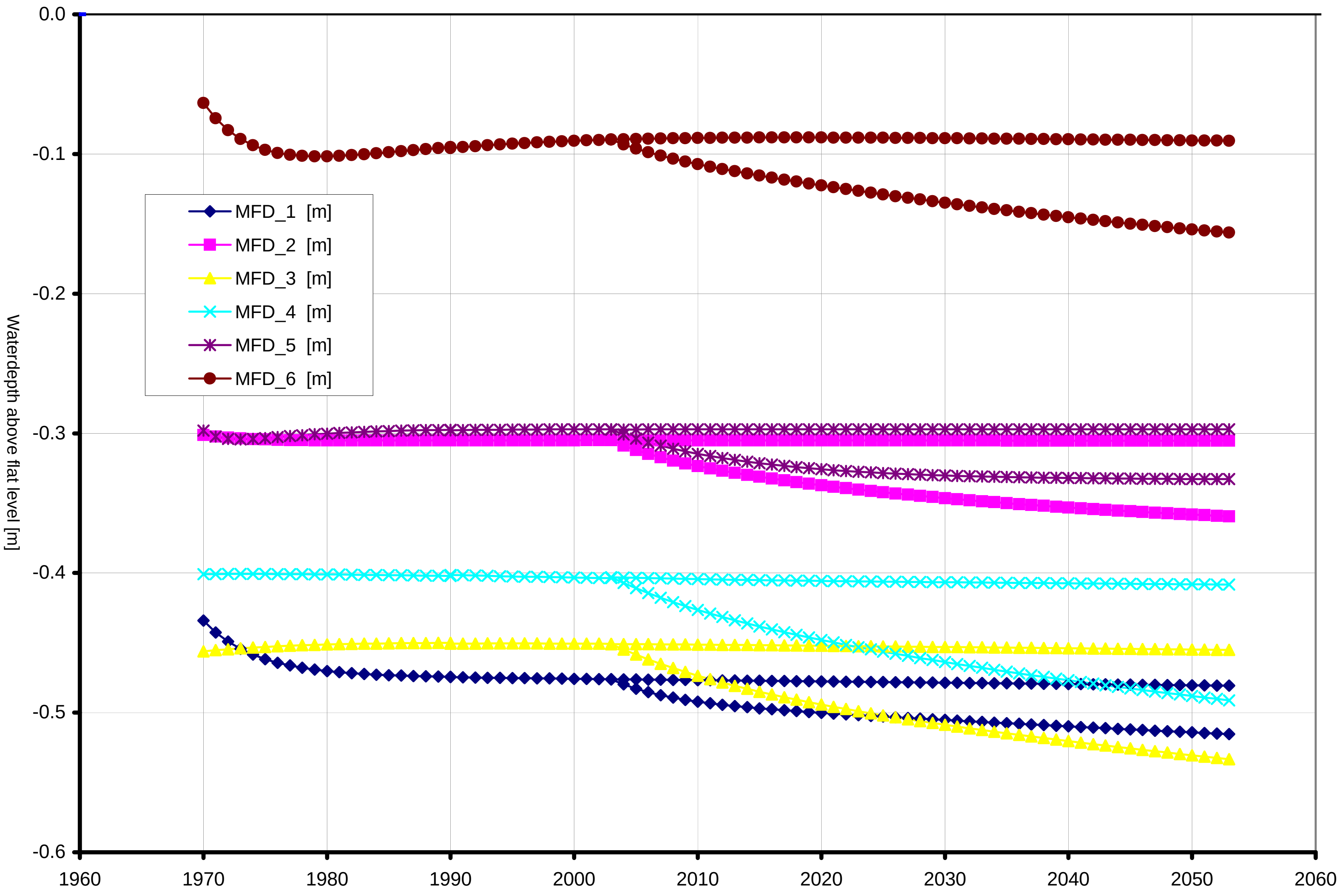
PONTOS-2.0 | ASMITA

1970 - 2053

WL / Alkyon

Fig. 3.15

Evolution of characteristic flat depths per tidal basin



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input

Related evolution of water depth above tidal flats per individual basin

For two sea level rise scenario's

PONTOS-2.0	ASMITA
1970 - 2053	

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

Fig. 3.16

LARGE-SCALE MODEL OF THE DUTCH COAST

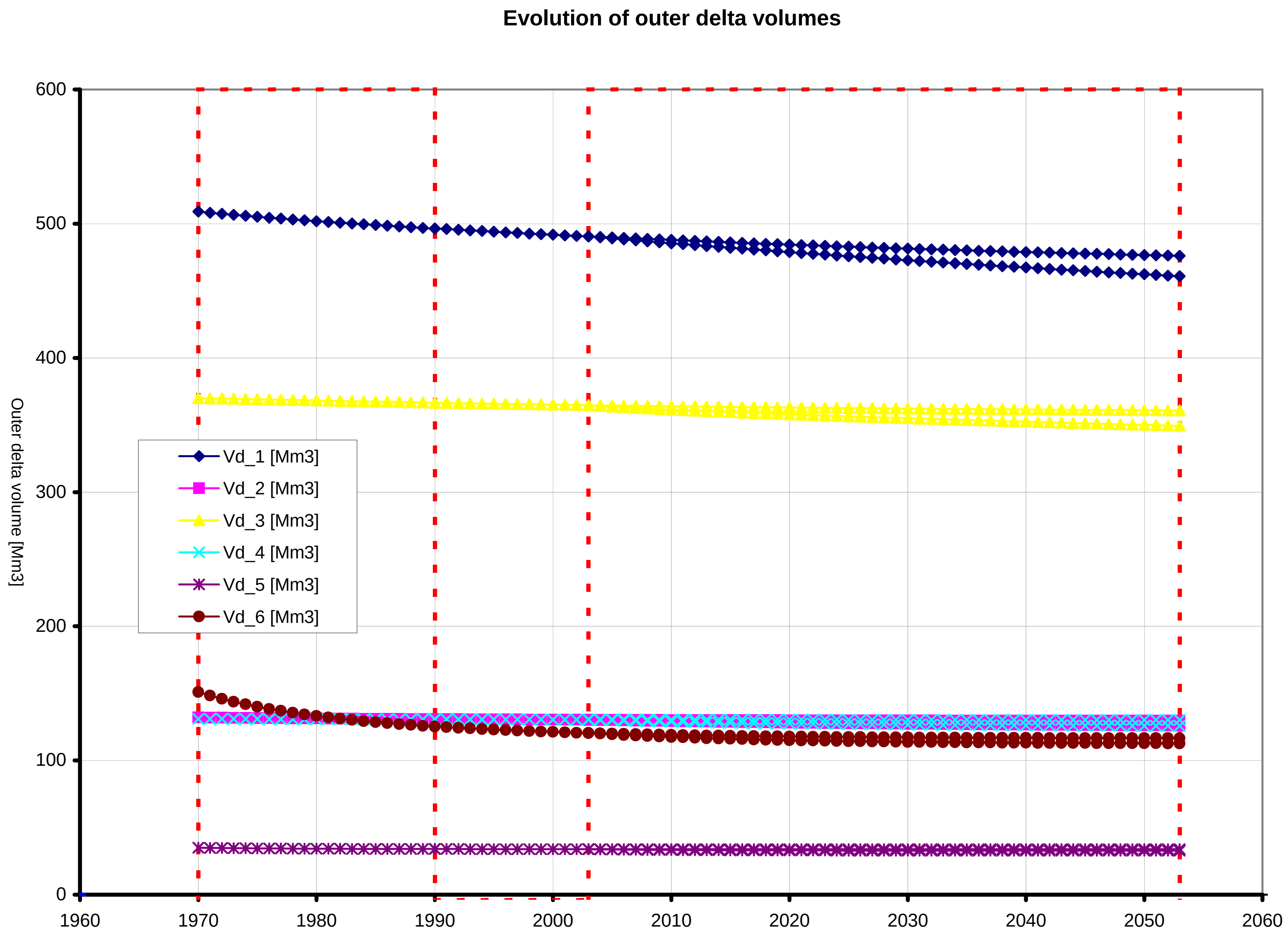
For two sea level rise scenario's

Related evolution of outer delta volumes per individual basin

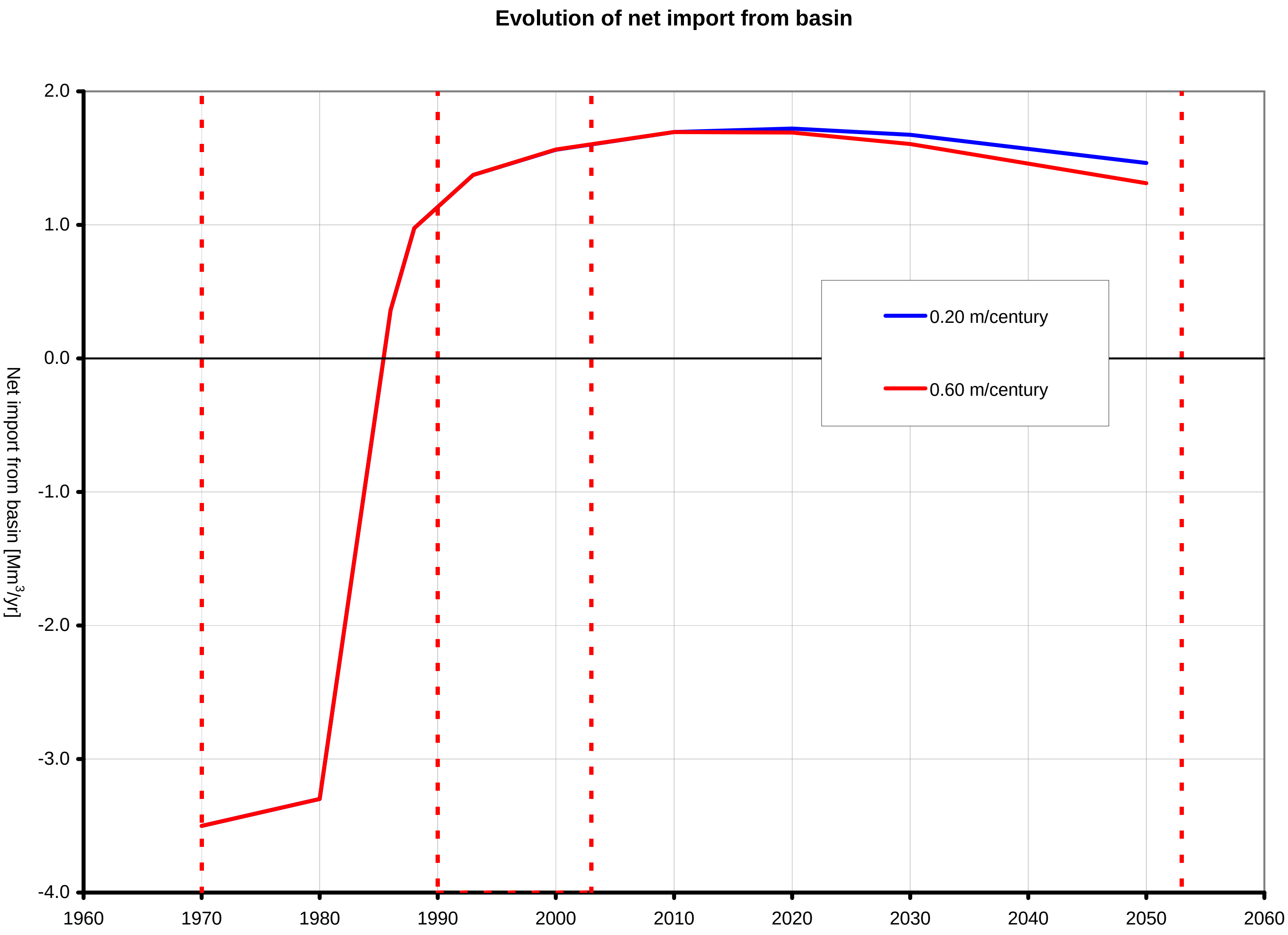
Overview of the applied model input

WL / Alkyon	1970 - 2053	PONTOS-2.0
Fig. 3.17		ASMITA

Z3334/A1000



file: PonTos_input_r16.xls; November 2004



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input

Nett import from tidal basins for the Western Scheldt

For two sea level rise scenario's

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

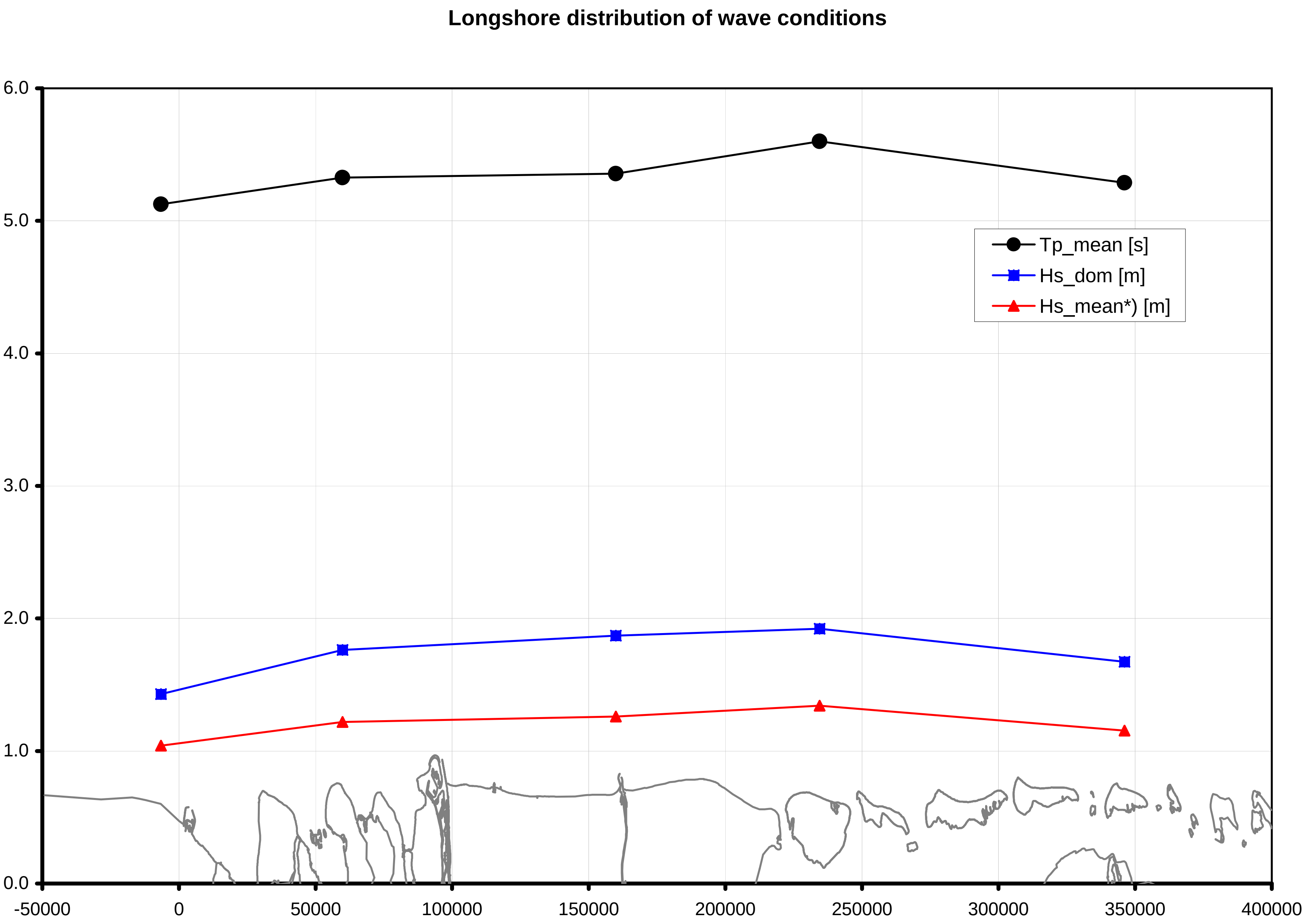
PONTOS-2.0

ASMITA

1970 - 2053

WL / Alkyon

Fig. 3.18



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input
Characteristics of applied wave climate
Longshore variation of wave heights and periods

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

PONTOS-2.0

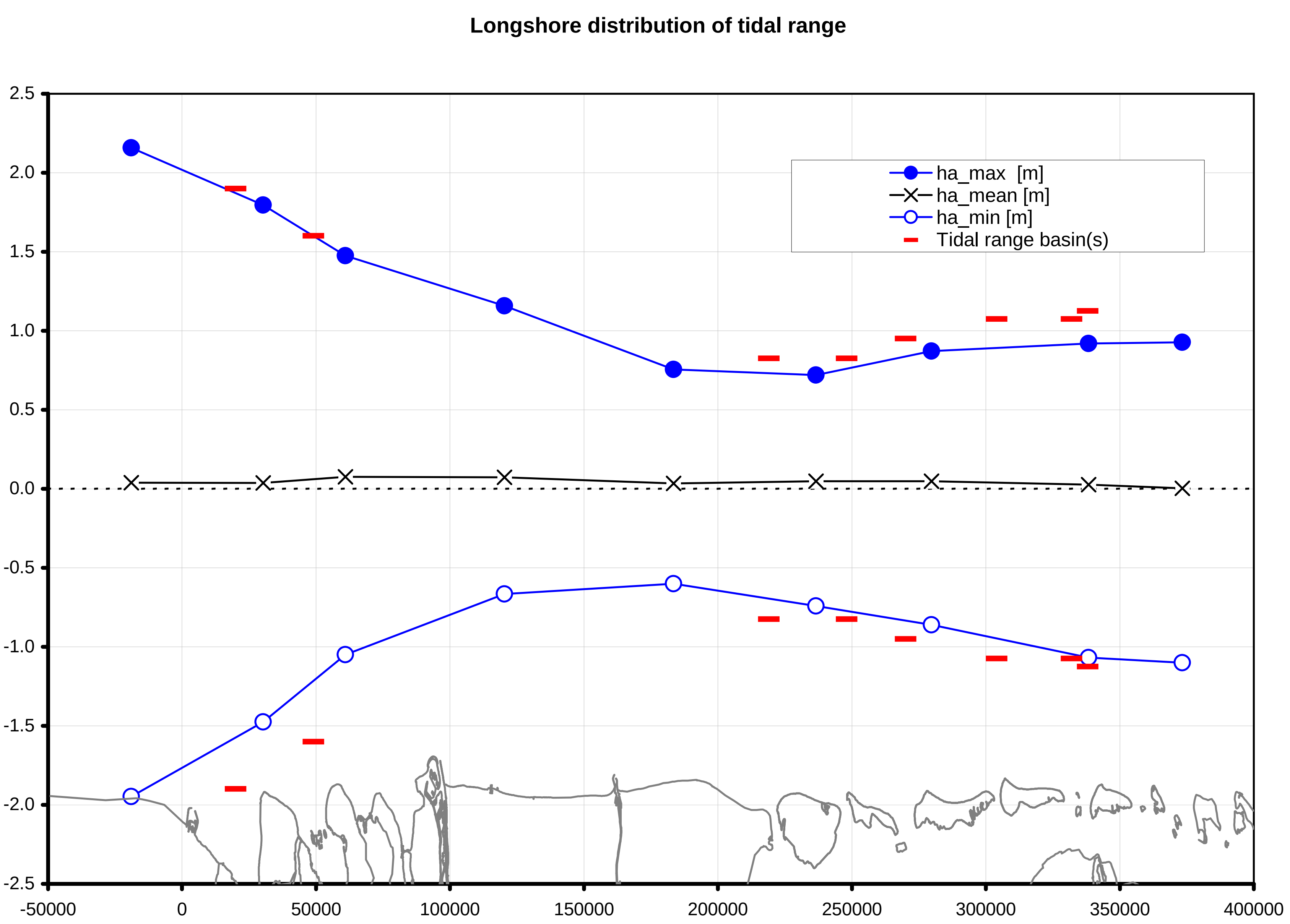
WL / Alkyon

Fig. 3.19

Overview of the applied model input

Characteristics of applied tidal climate

Longshore variation of tidal range



LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

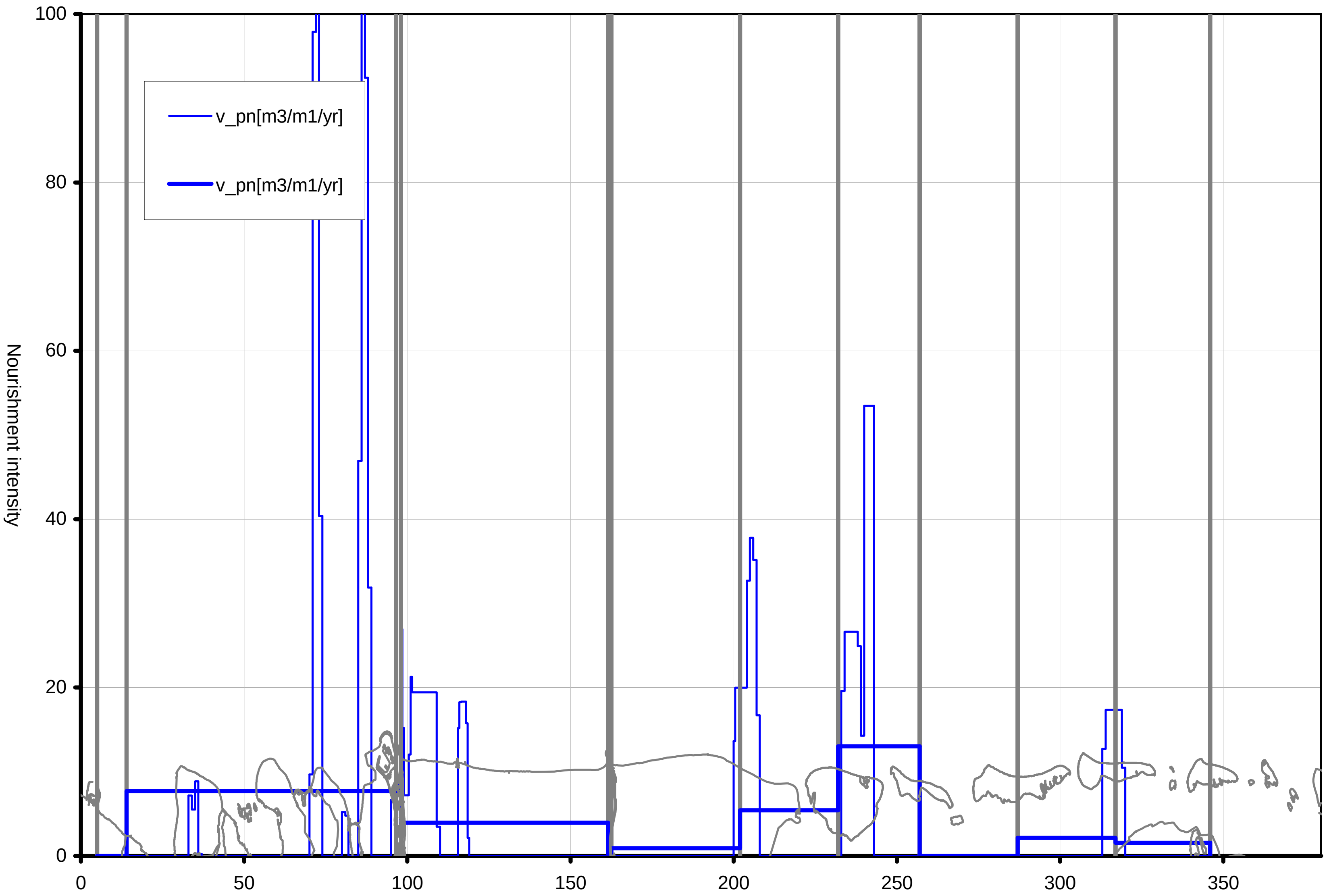
WL / Alkyon

PONTOS-2.0

Fig. 3.20

file: PonTos_input_r16.xls; November 2004

Nourishments - pre-defined (1970-1990)



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input

Applied nourishment scheme for calibration period

Based om performed nourishments

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

PONTOS-2.0

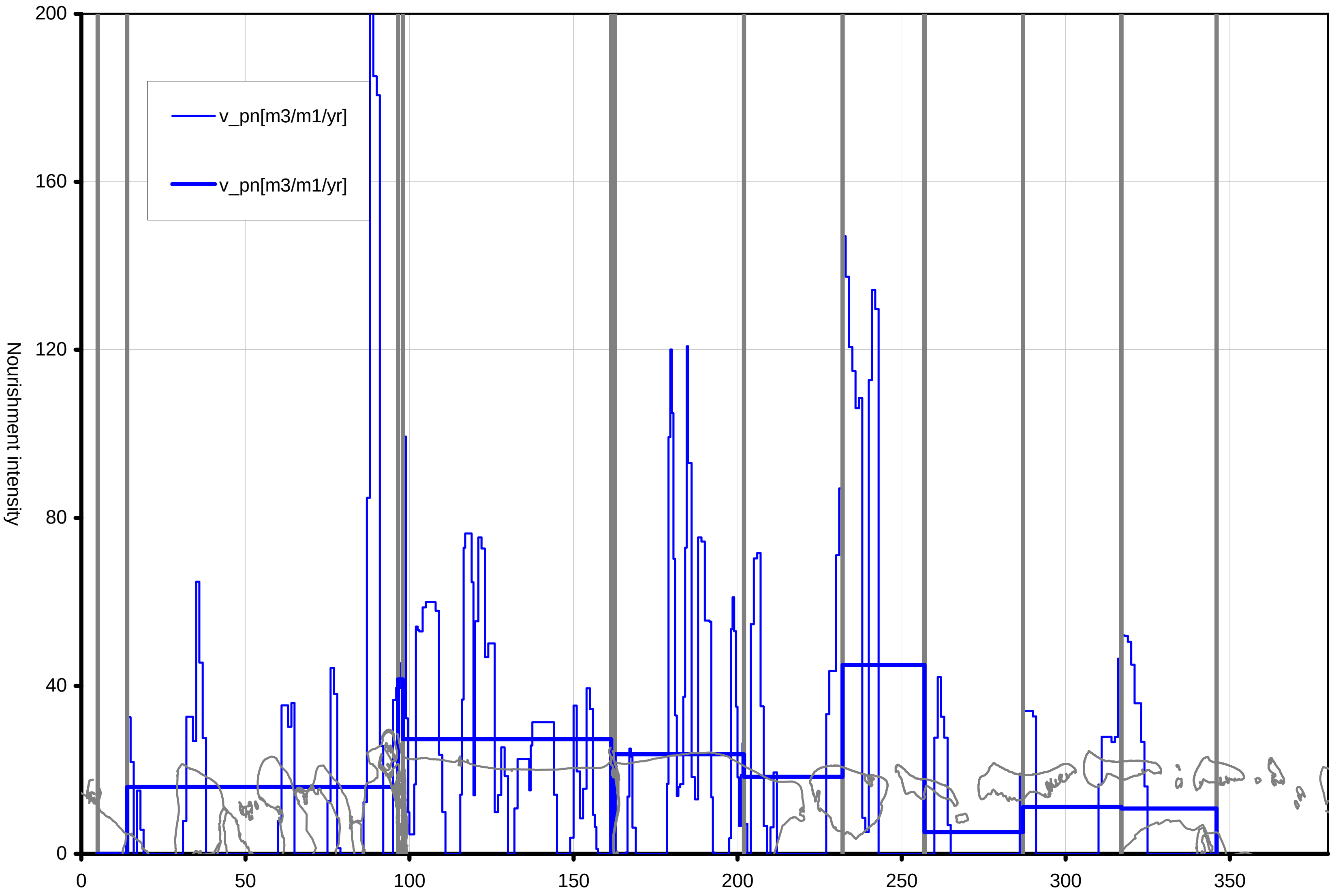
1970 - 1990

Dutch coast

WL / Alkyon

Fig. 3.21

Nourishments - pre-defined (1990-2003)



LARGE-SCALE MODEL OF THE DUTCH COAST

Based om performed nourishments

Applied nourishment scheme for verification period

Overview of the applied model input

Z3334/A1000

WL / Alkyon

Dutch coast

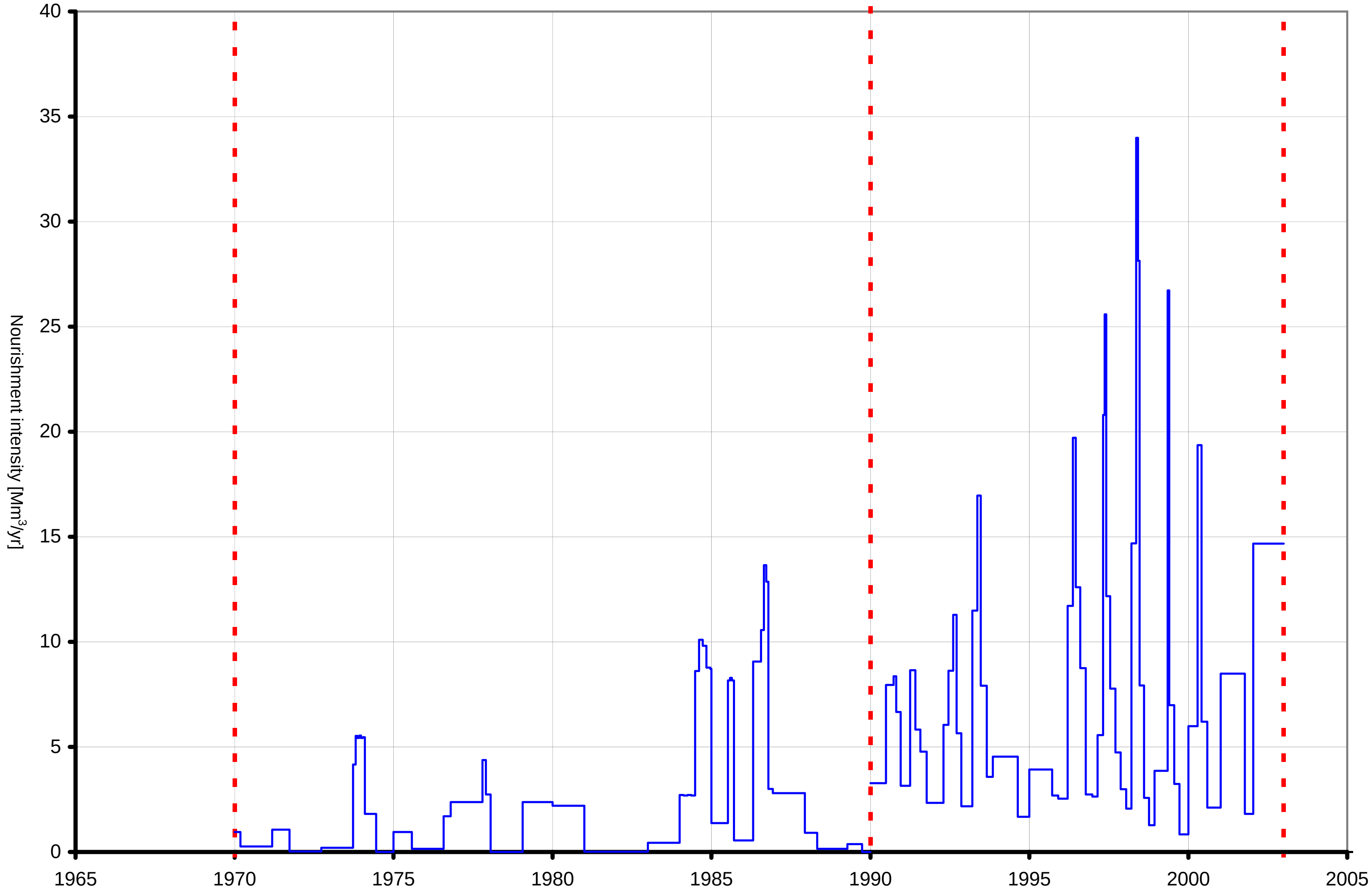
1990 - 2003

PONTOS-2.0

Fig. 3.22

file: PonTos_input_r16.xls; November 2004

Evolution of nourishment intensity



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input

Evolution of nourishment intensity

Based om performed nourishments

Dutch coast	1970 - 2003	PONTOS-2.0

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

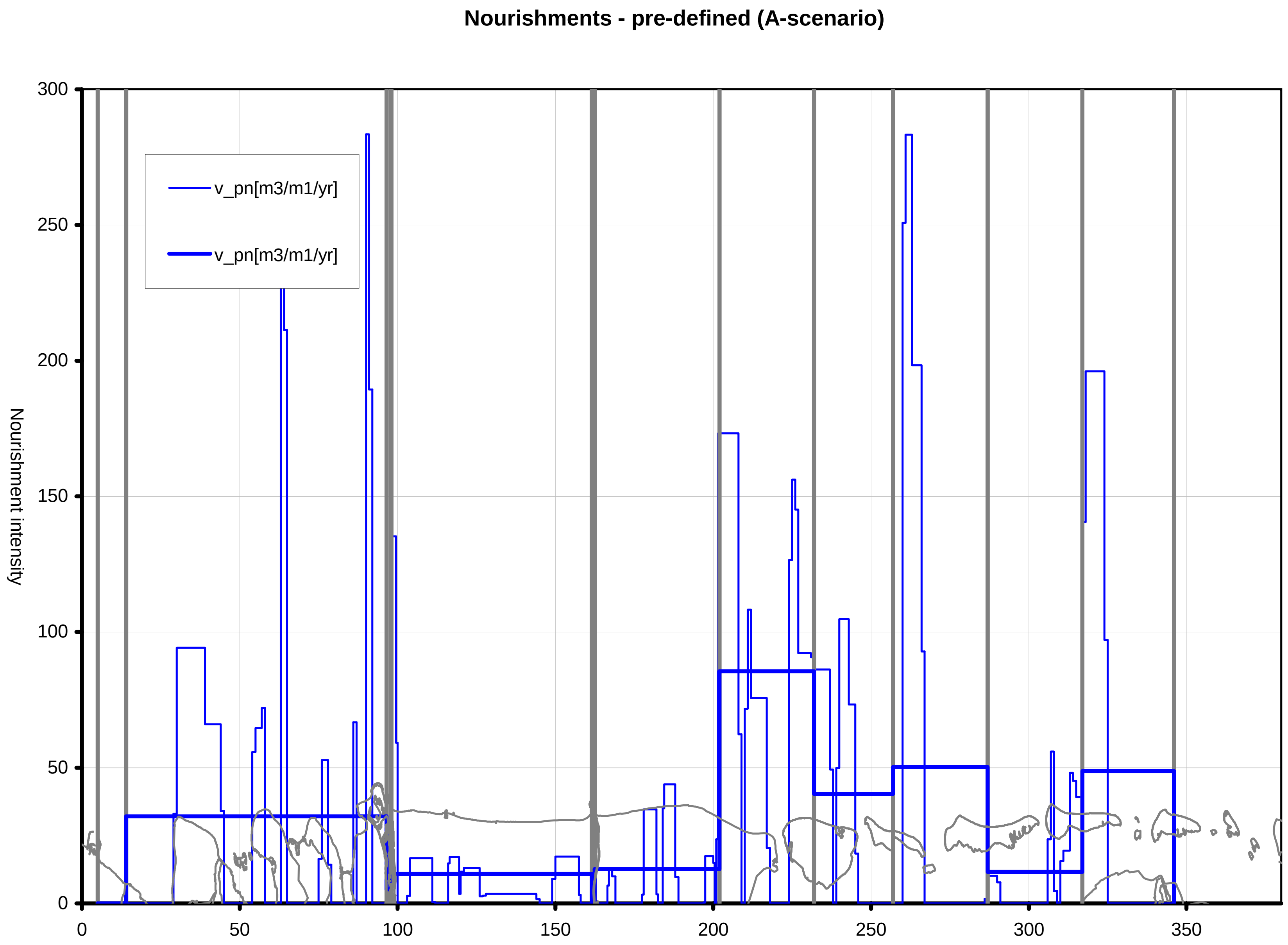
WL / Alkyon

Fig. 3.23

Overview of the applied model input

Future nourishment scheme based on scenario A

Based on a 10-year average



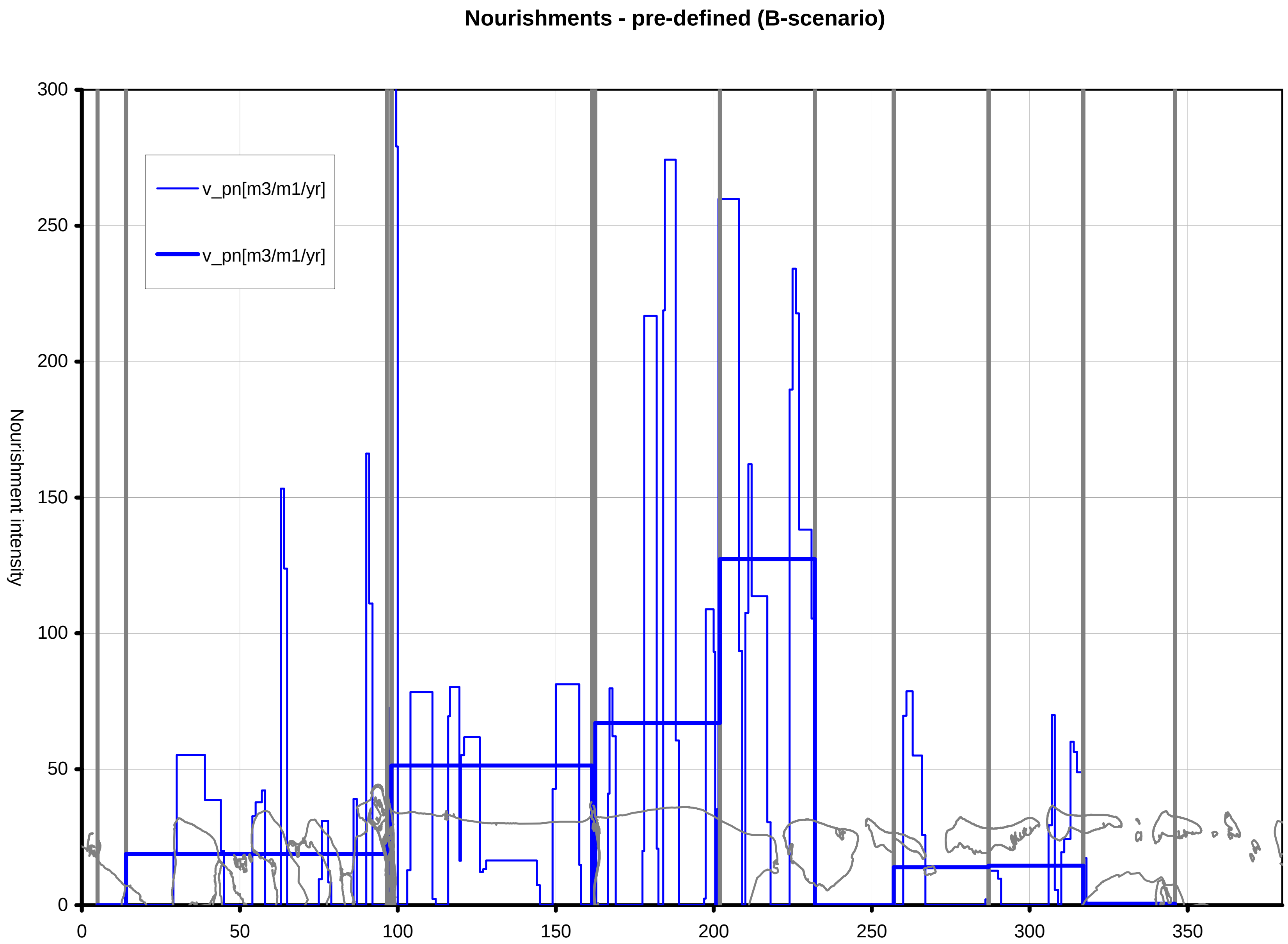
file: PonTos_input_r16.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST		Z3334/A1000
PONTOS-2.0	2003 - 2053	Dutch coast
WL / Alkyon		Fig. 3.24

Overview of the applied model input

Future nourishment scheme based on scenario B

Based on recent nourishments



PONTOS-2.0	2003 - 2053	Dutch coast

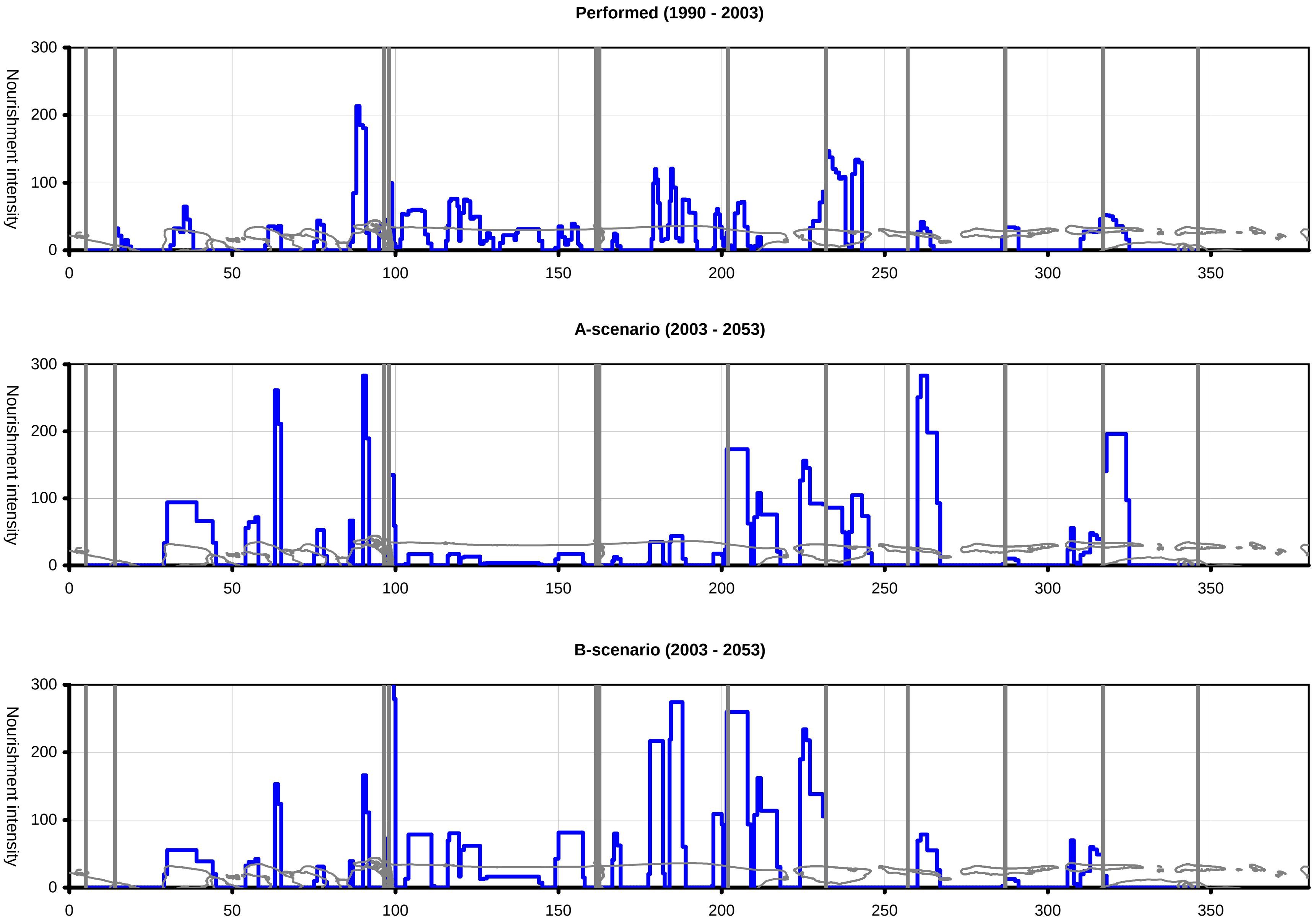
LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

Fig. 3.25

file: PonTos_input_r16.xls; November 2004



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input

Overall comparison between performed scheme (1990 - 2003) and future nourishment schemes (scenario A and B) for the Dutch coast

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

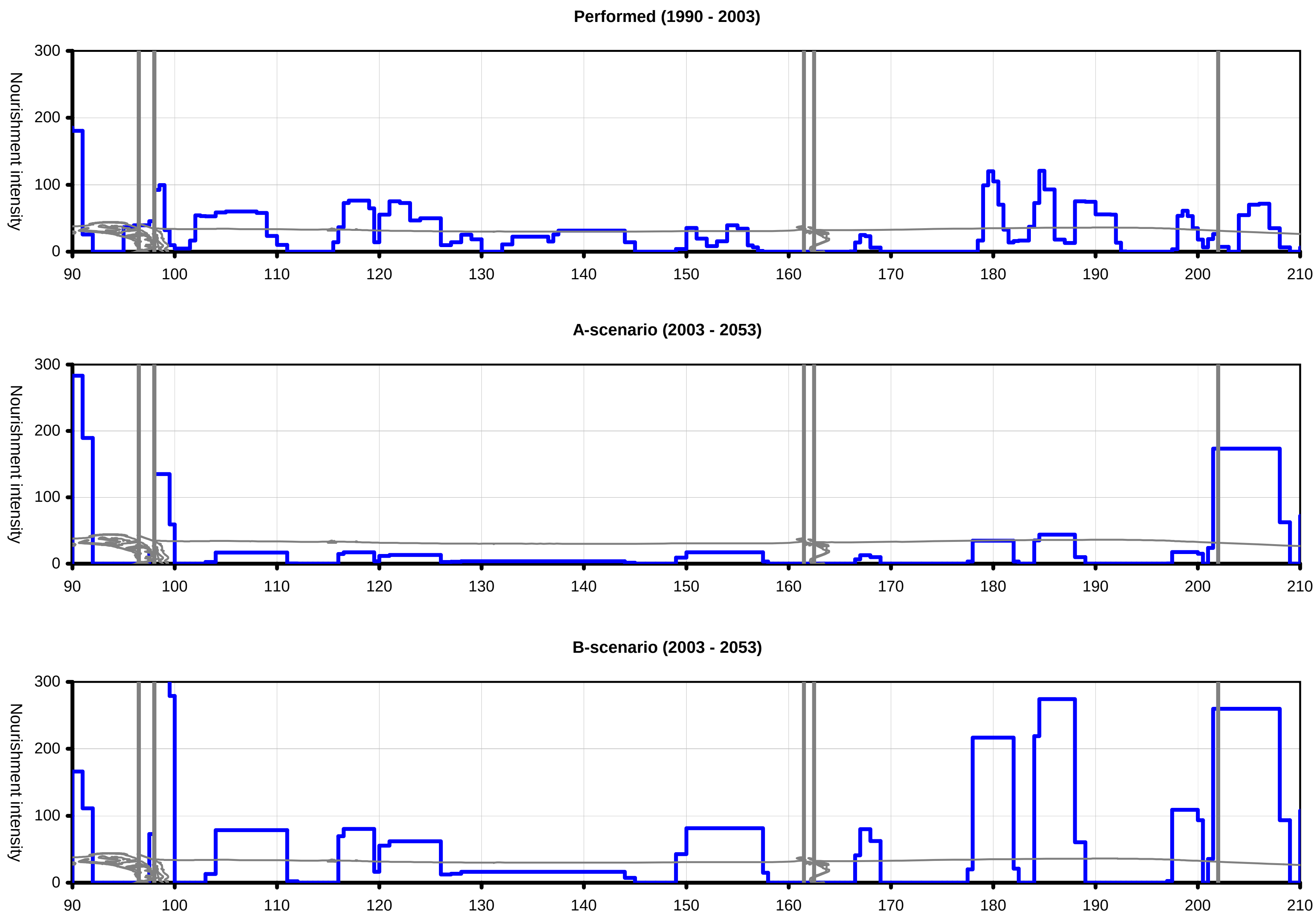
PONTOS-2.0

1990 - 2053

Dutch coast

WL / Alkyon

Fig. 3.26



file: PonTos_input_r16.xls; November 2004

Overview of the applied model input

Detailed comparison between performed scheme (1990 - 2003) and future nourishment schemes (scenario A and B) for the Holland coast

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

PONTOS-2.0

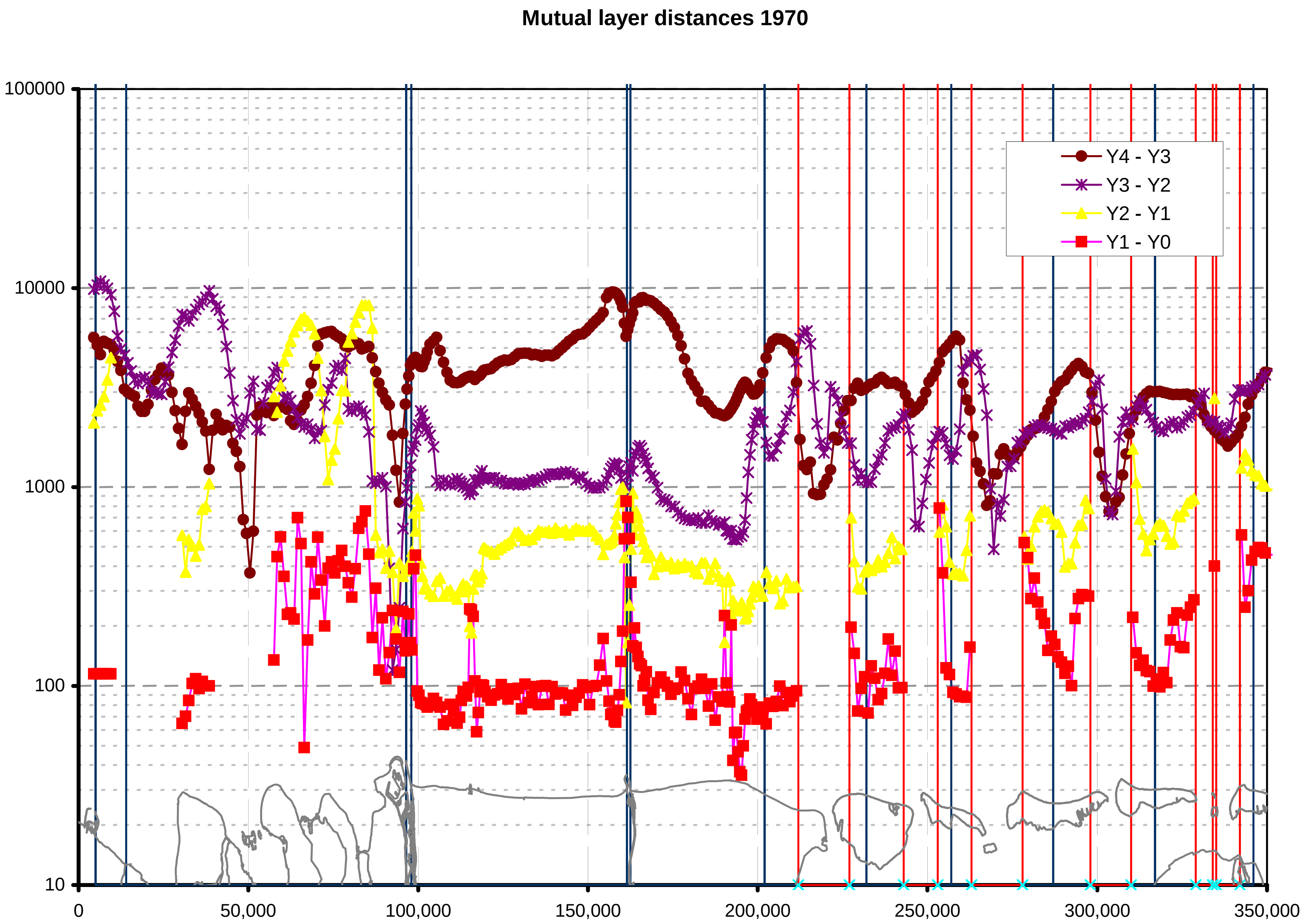
1990 - 2053

Holland coast

WL / Alkyon

Fig. 3.27

file: PonTos_input_r16.xls; November 2004



Calibration of the model

Longshore distribution of mutual layer distances

Based on initial layer positions in 1970

LARGE-SCALE MODEL OF THE DUTCH COAST

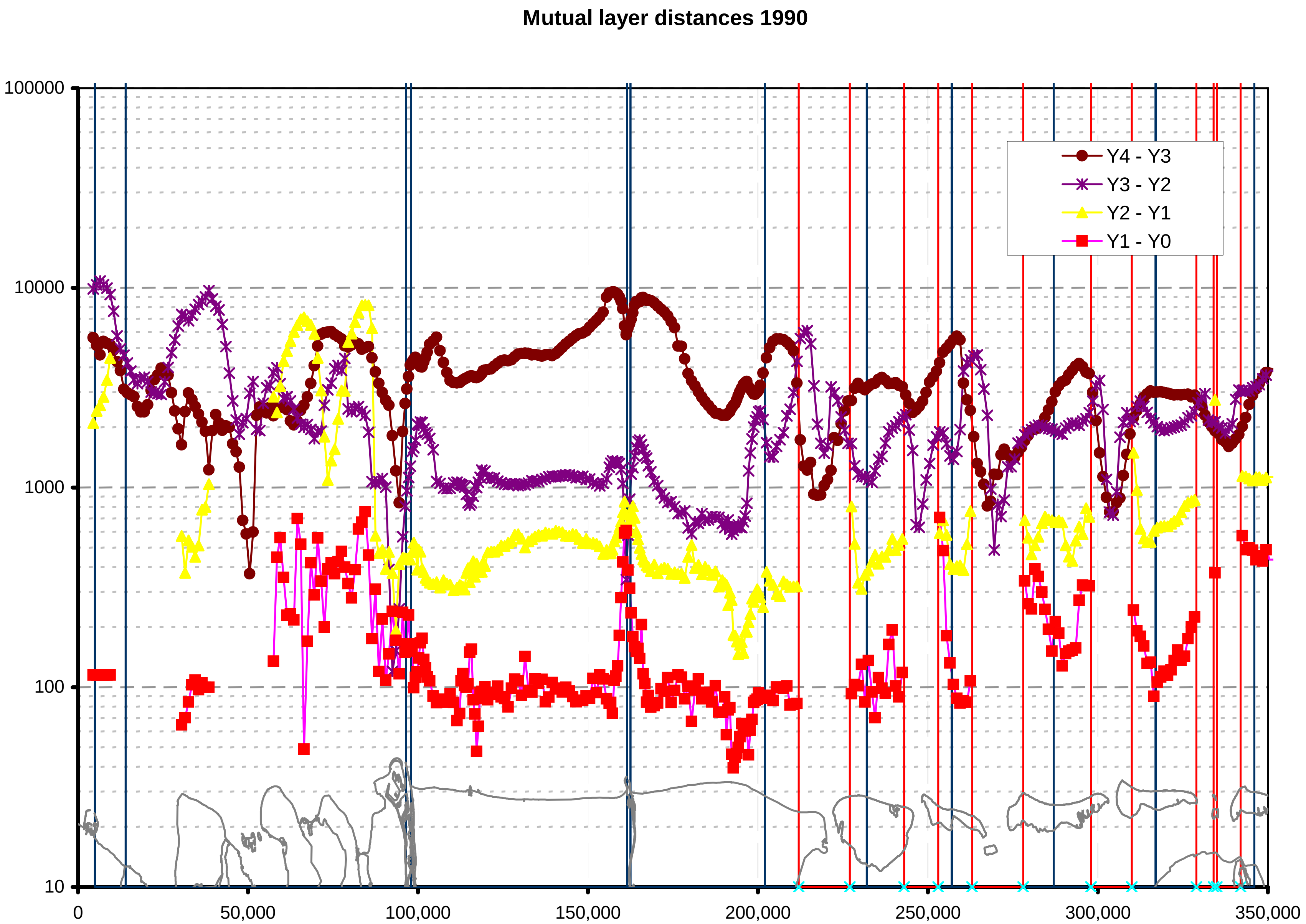
Z3334/A1000

WL / Alkyon

1970

PONTOS-2.0

Fig. 4.1



file: PonTos_input_r16.xls; November 2004

Calibration of the model

Longshore distribution of mutual layer distances

Based on initial layer positions in 1990

LARGE-SCALE MODEL OF THE DUTCH COAST

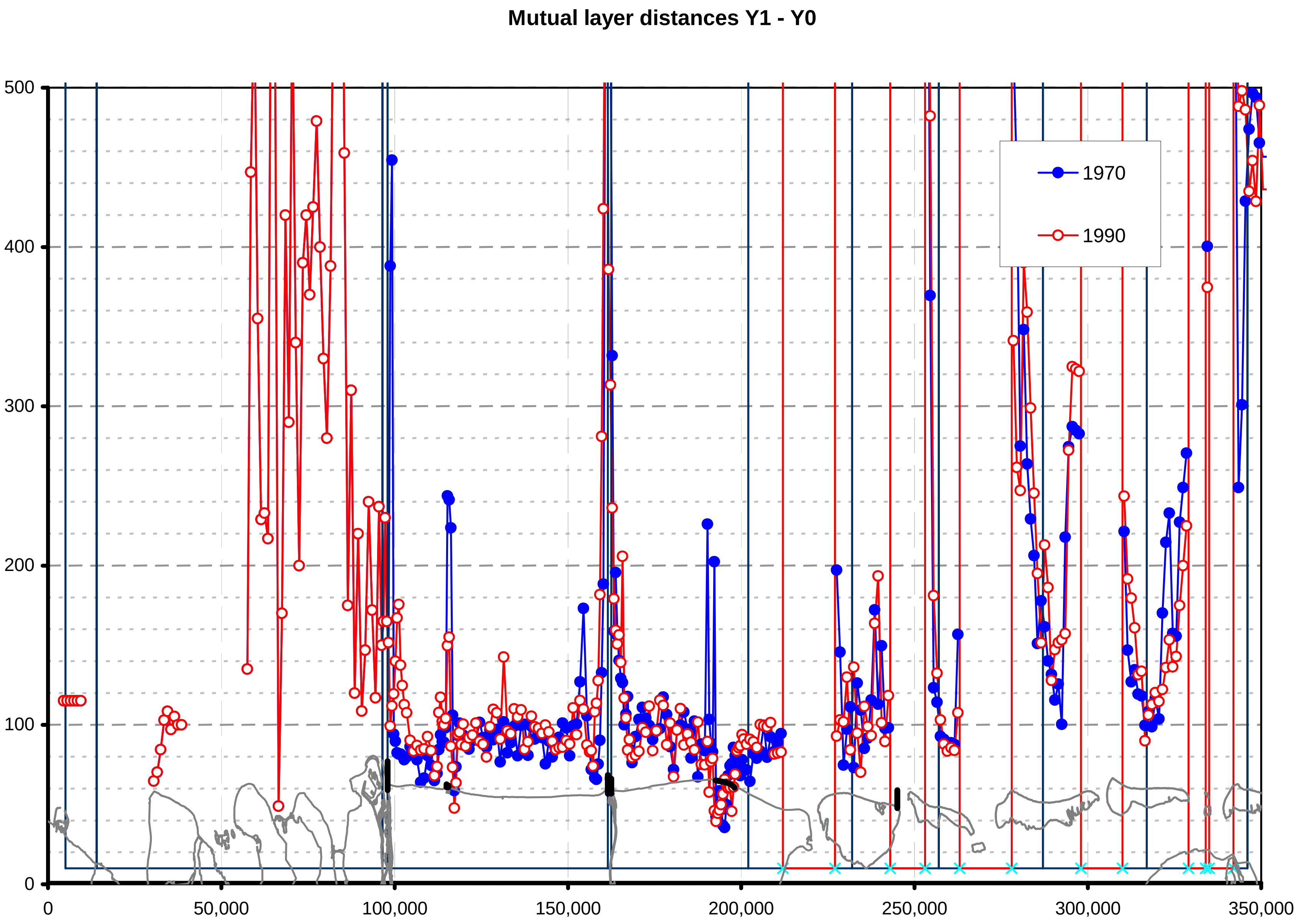
Z3334/A1000

WL / Alkyon

1990

PONTOS-2.0

Fig. 4.2



LARGE-SCALE MODEL OF THE DUTCH COAST

Calibration of the model

Overview of mutual layer distances for layers Y0 and Y1

Z3334/A1000

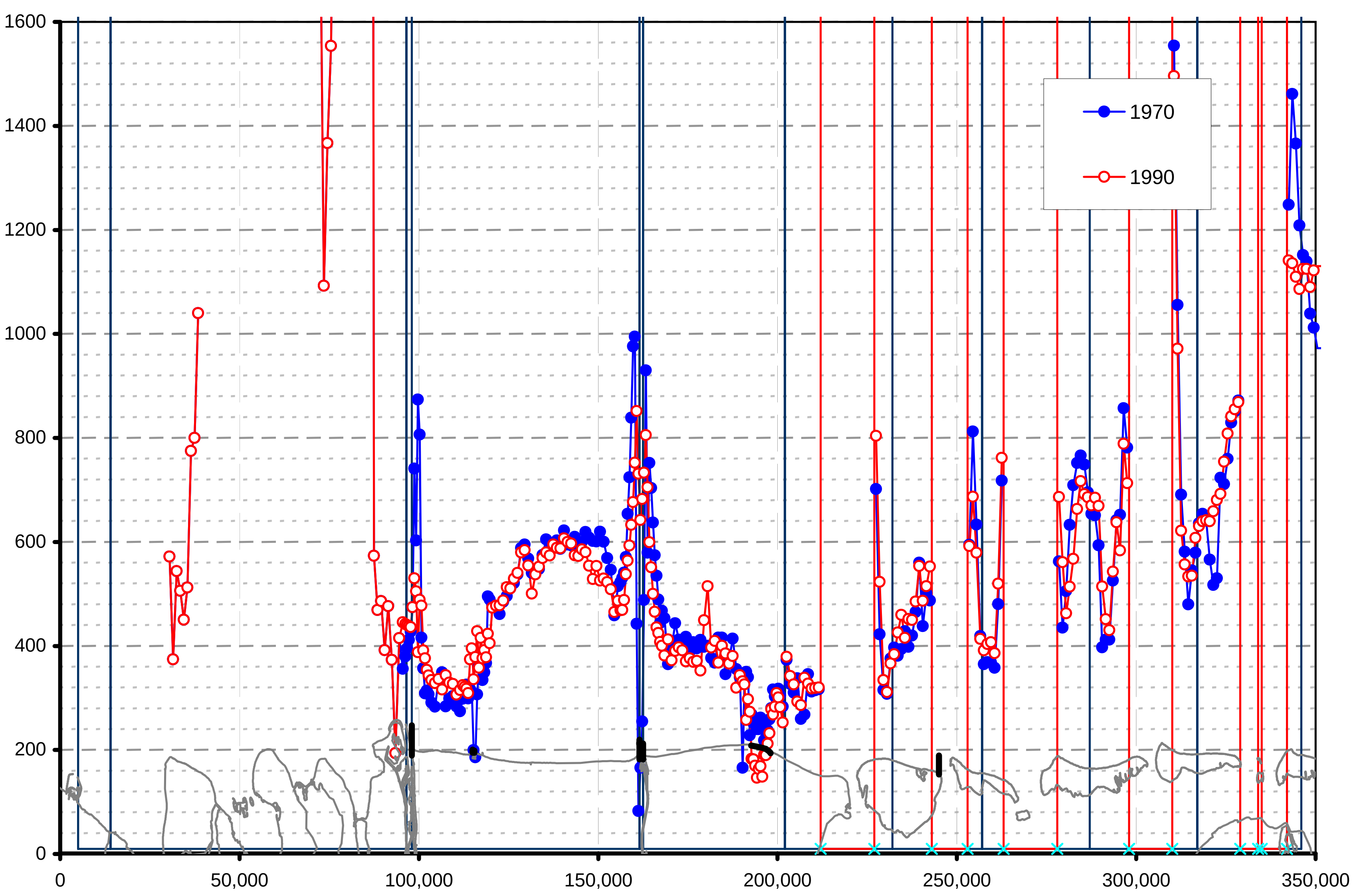
PONTOS-2.0

1970 and 1990

WL / Alkyon

Fig. 4.3

file: PonTos_input_r16.xls; November 2004



Calibration of the model

Overview of mutual layer distances
for layers Y1 and Y2

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

1970 and 1990

PONTOS-2.0

Fig. 4.4

file: PonTos_input_r16.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Calibration of the model

Overview of mutual layer distances for layers Y2 and Y3

Z3334/A1000

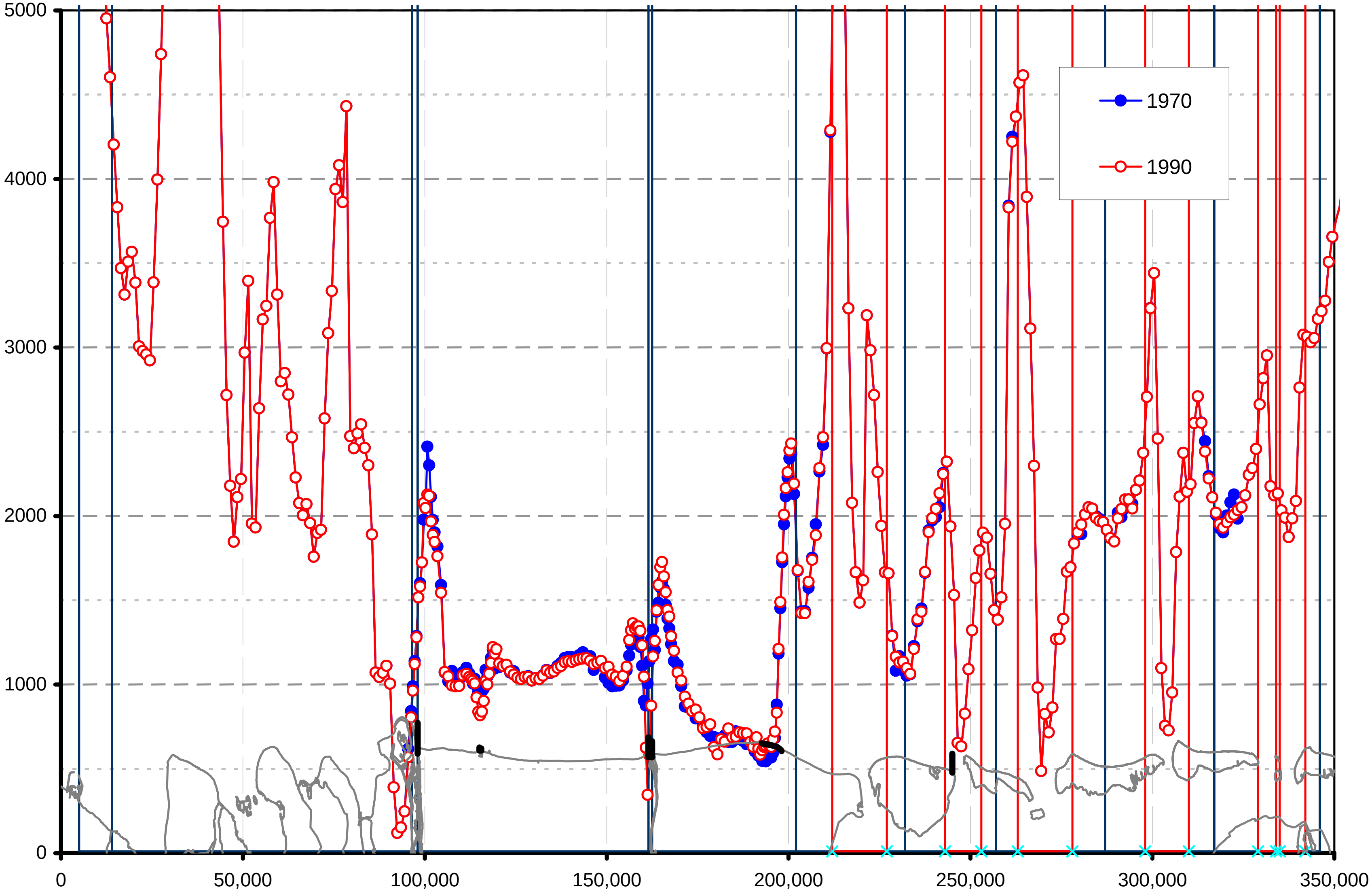
WL / Alkyon

PONTOS-2.0

1970 and 1990

Fig. 4.5

Mutual layer distances Y3 - Y2



file: PonTos_input_r16.xls; November 2004

Calibration of the model

Overview of mutual layer distances
for layers Y3 and Y4

1970 and 1990

PONTOS-2.0

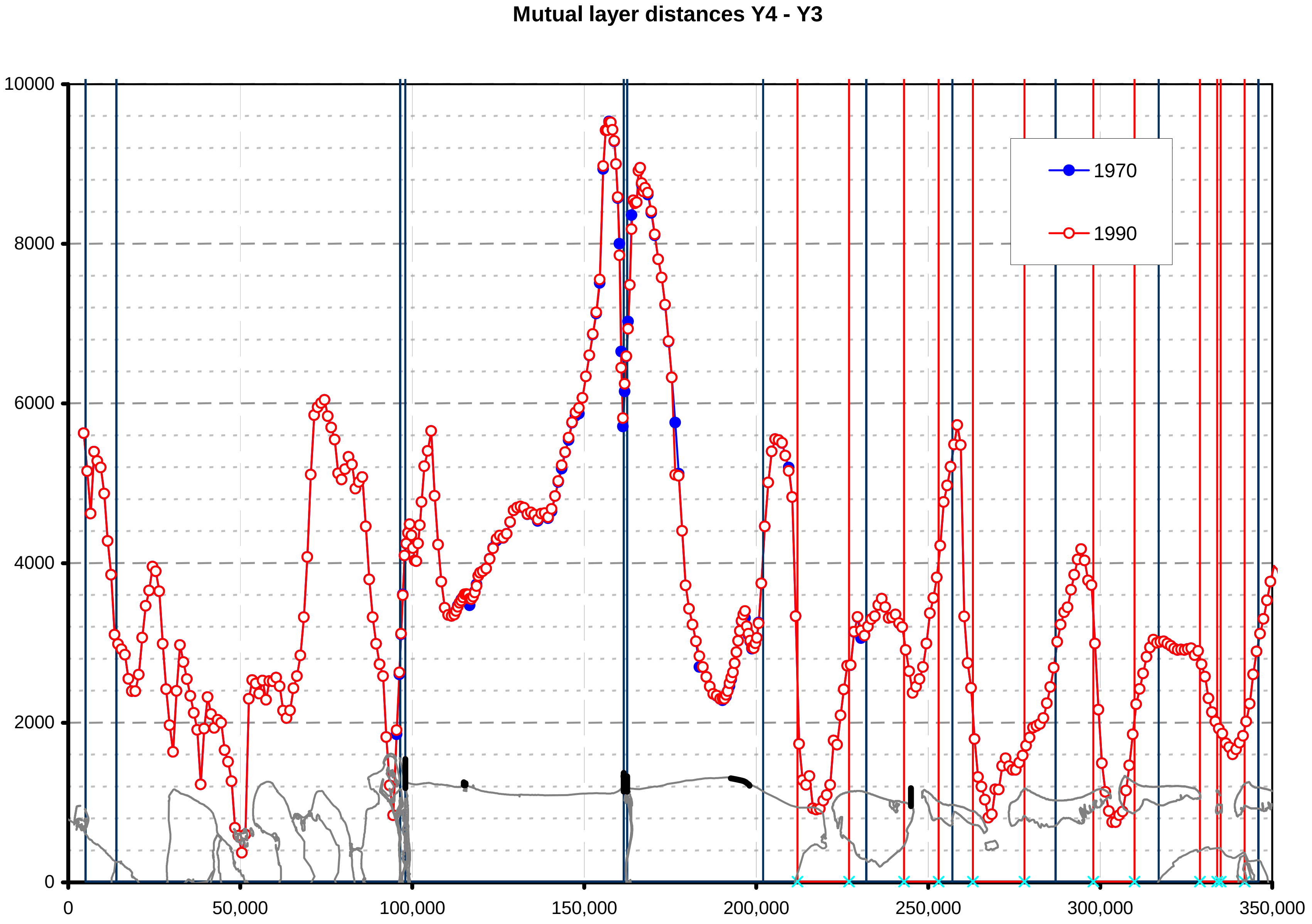
LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

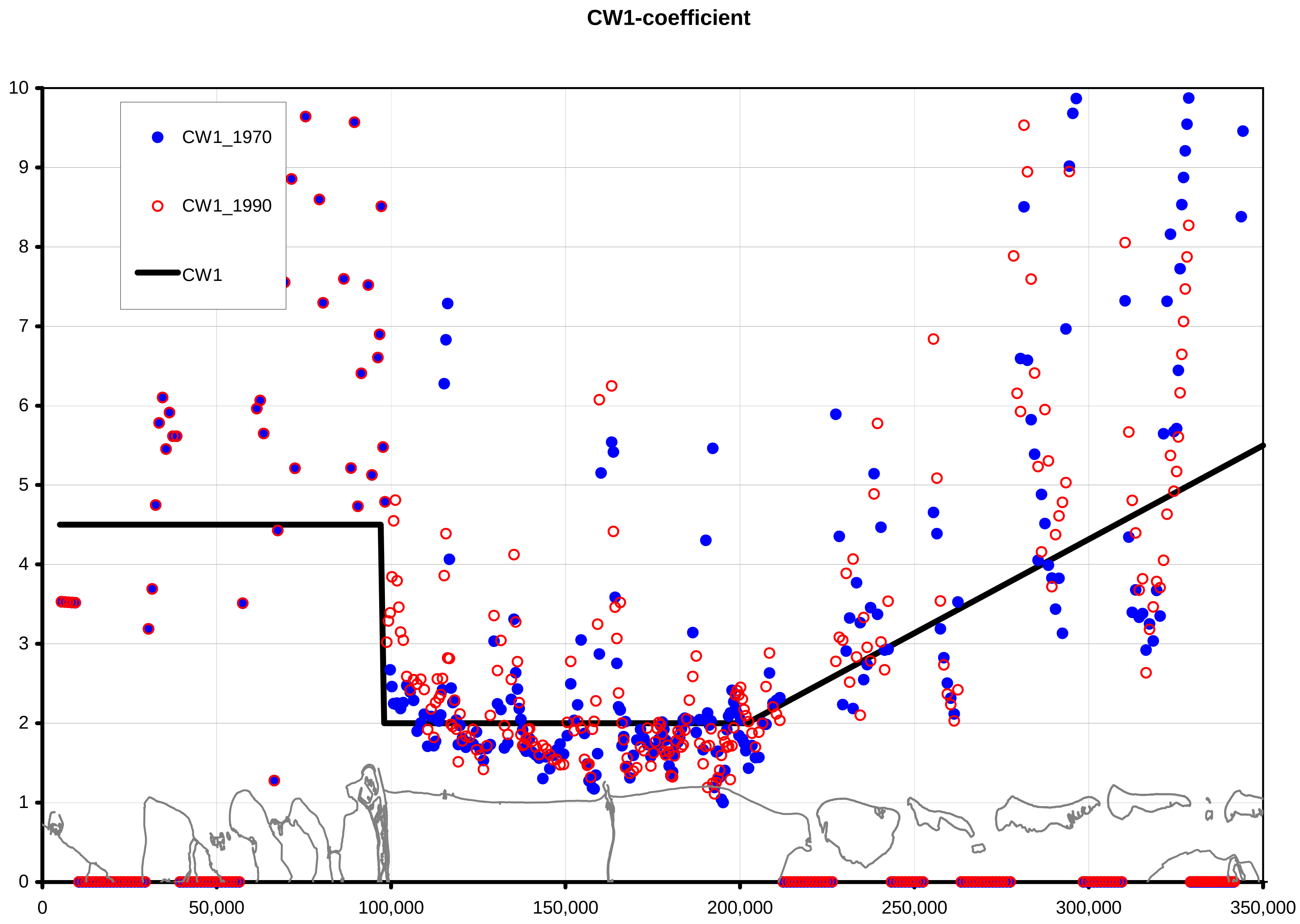
Fig. 4.6

file: PonTos_input_r16.xls; November 2004



Calibration of the model

Definition of cross-shore calibration coefficient for layer distance between Y0 and Y1



file: PonTos_input_r16.xls; November 2004

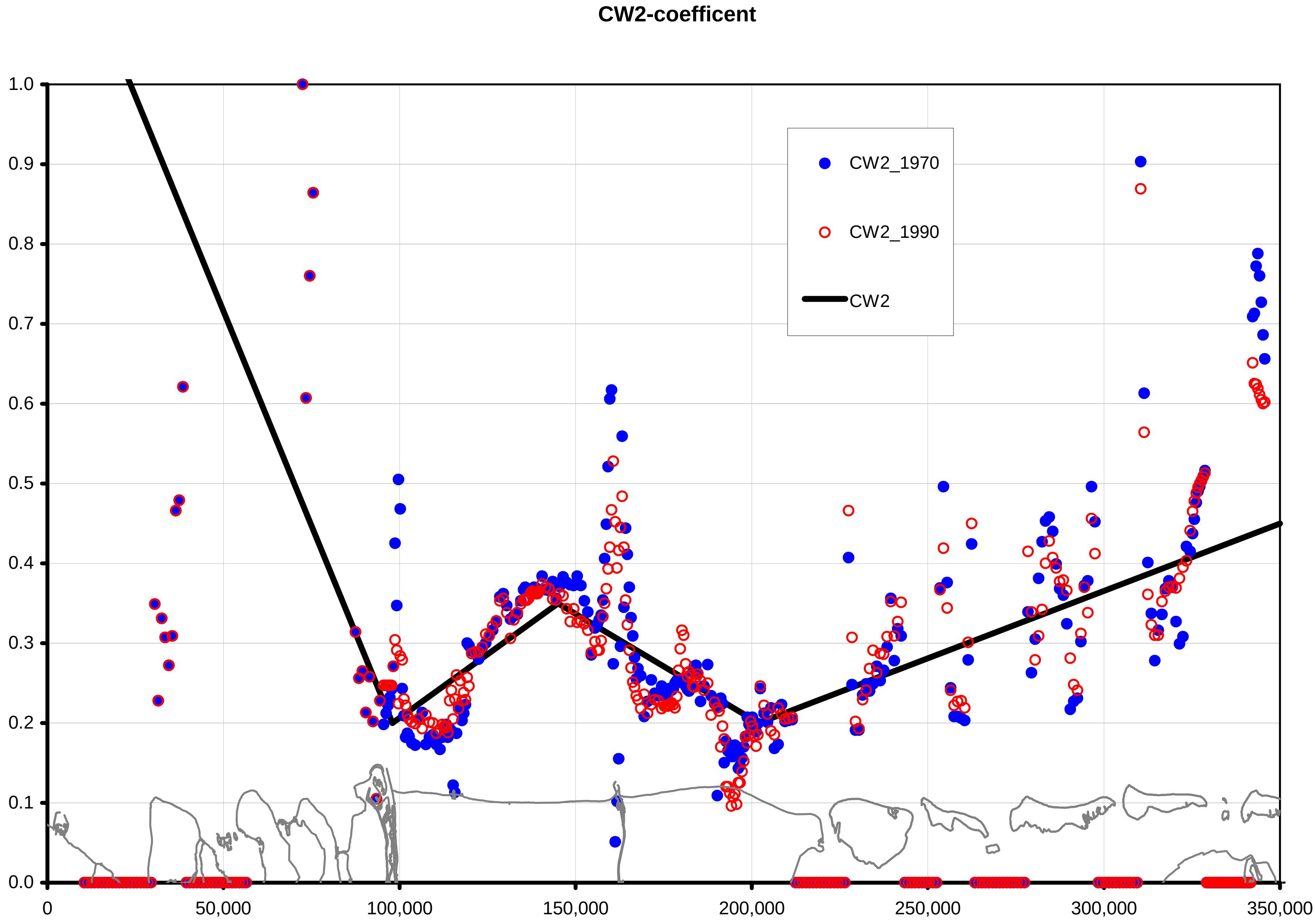
LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

PONTOS-2.0

WL / Alkyon

Fig. 4.7



Calibration of the model

Definition of cross-shore calibration coefficient for layer distance between Y1 and Y2

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

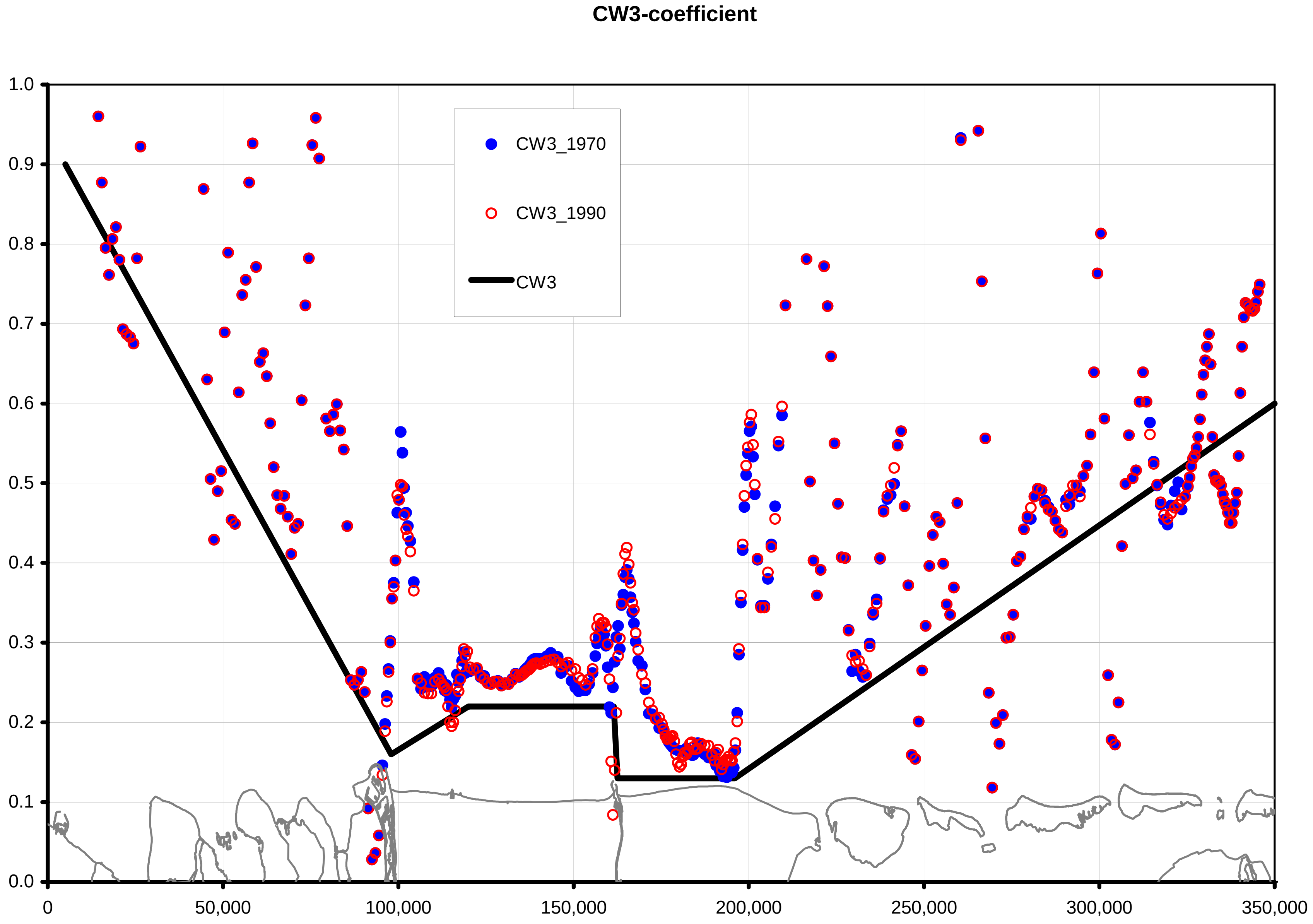
PONTOS-2.0

Fig. 4.8

file: PonTos_input_r16.xls; November 2004

Calibration of the model

Definition of cross-shore calibration coefficient
for layer distance between Y2 and Y3



LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

PONTOS-2.0

Fig. 4.9

file: PonTos_input_r16.xls; November 2004

Calibration of the model

Definition of cross-shore calibration coefficient
for layer distance between Y3 and Y4

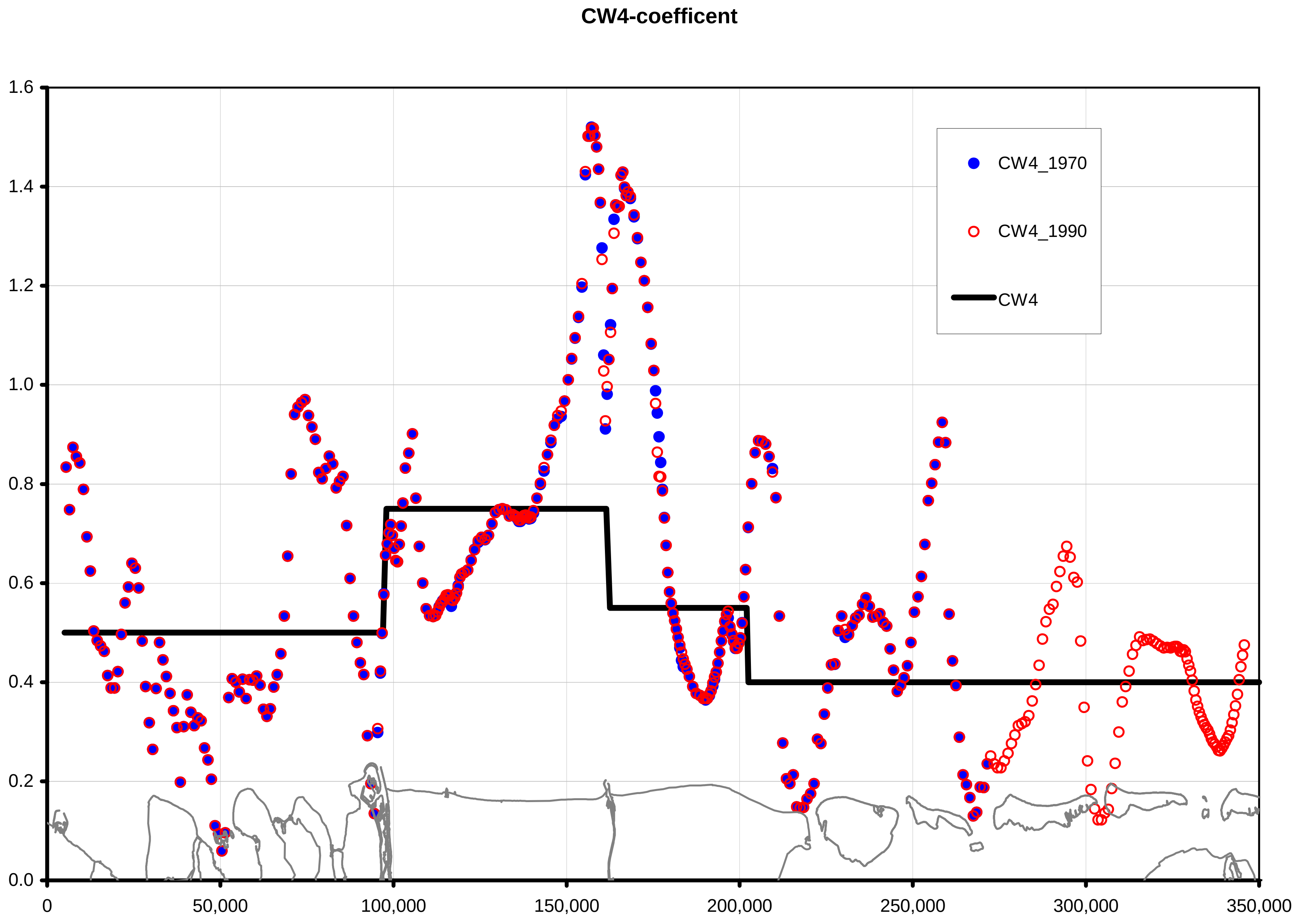
LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

PONTOS-2.0

Fig. 4.10



Calibration of the model

Cross-shore transport at the NAP-7m contour

Overview for the whole Dutch coast

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

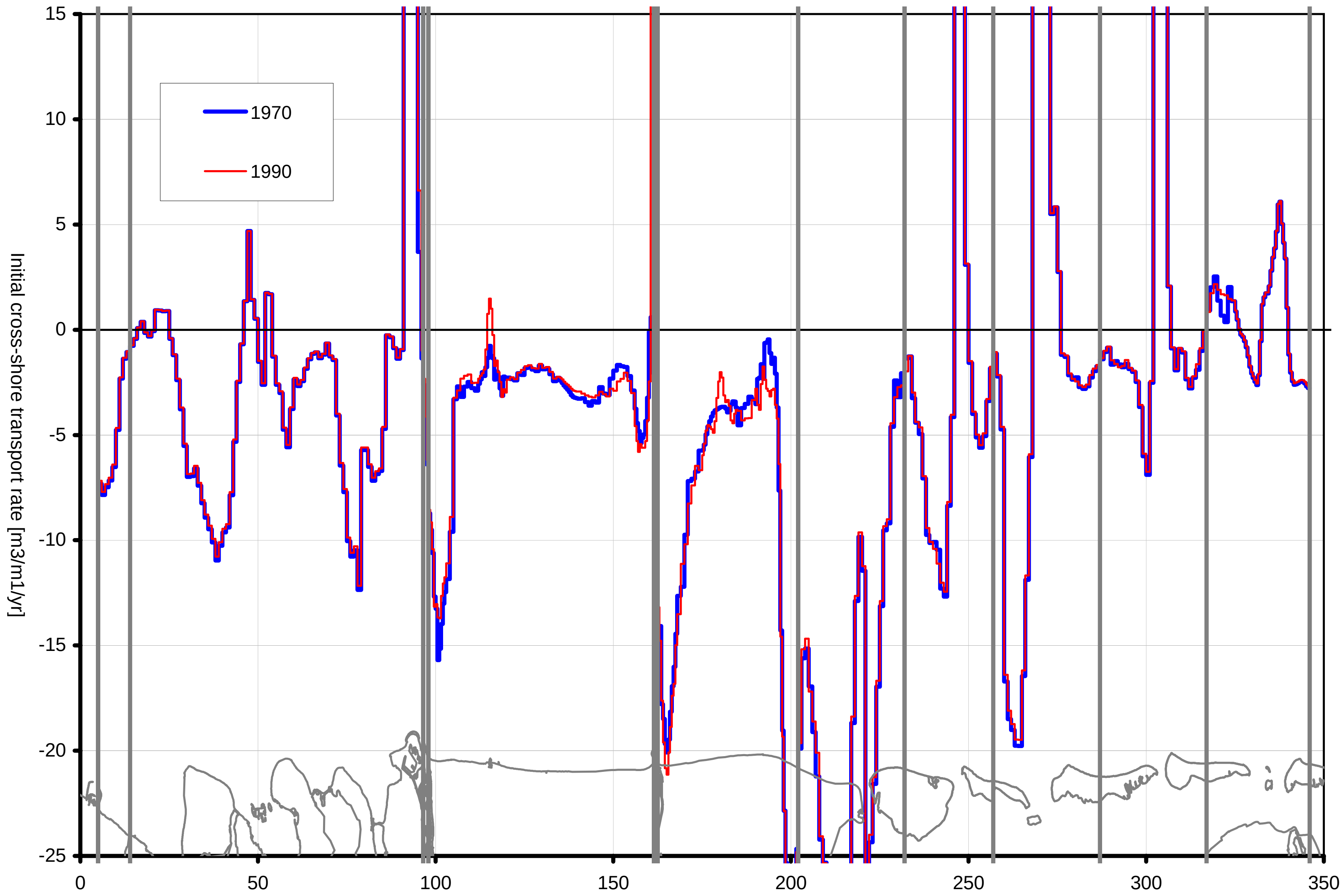
PONTOS-2.0

1970 and 1990

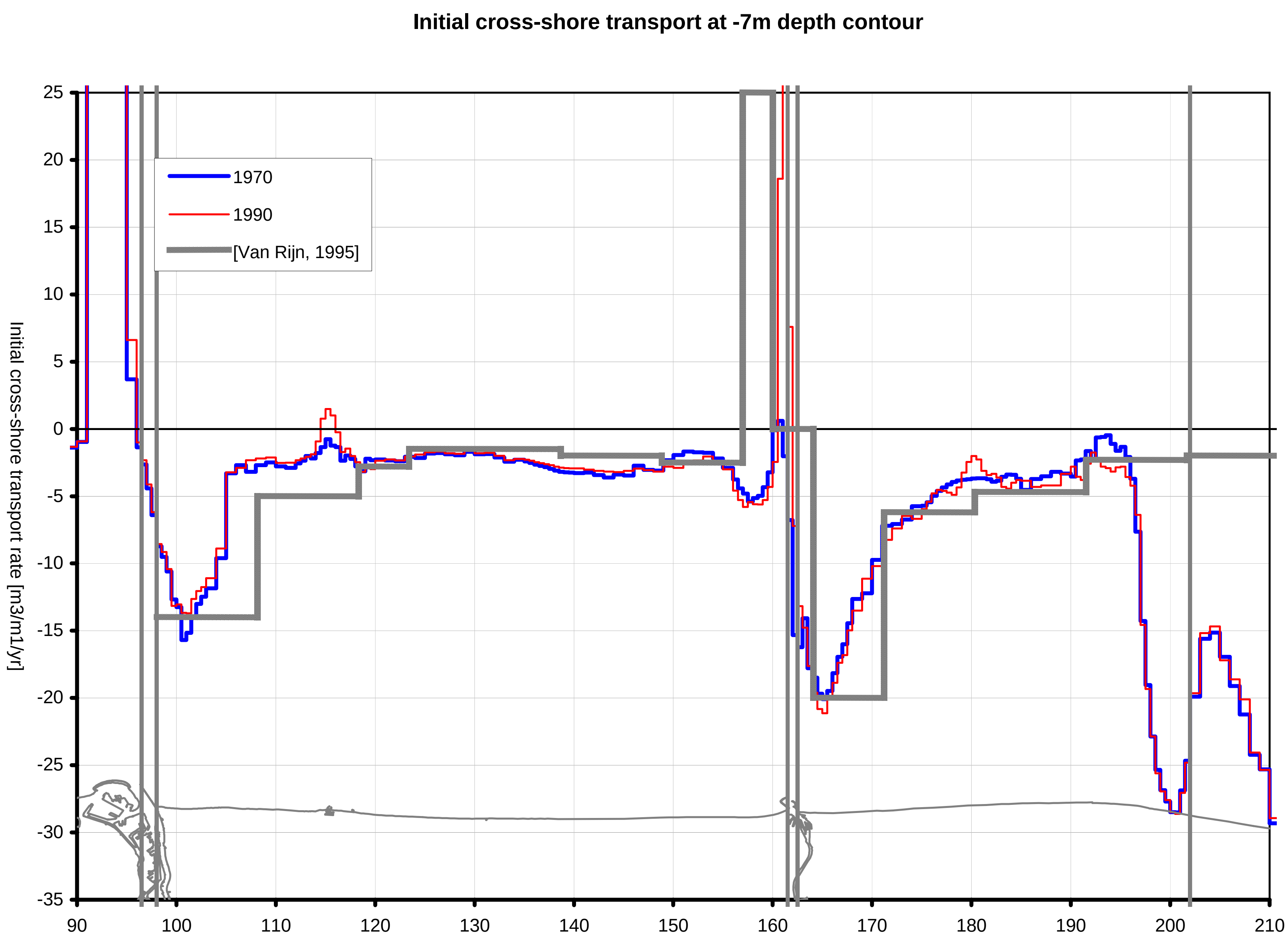
WL / Alkyon

Fig. 4.11

Initial cross-shore transport at -7m depth contour



file: PonTos_input_r16.xls; November 2004



Calibration of the model

Cross-shore transport at the NAP-7m contour for the Holland coast

Comparison with data from Van Rijn

LARGE-SCALE MODEL OF THE DUTCH COAST

PONTOS-2.0	
1970 and 1990	
[Van Rijn, 1995]	
Z3334/A1000	**WL / Alkyon**
Fig. 4.12	

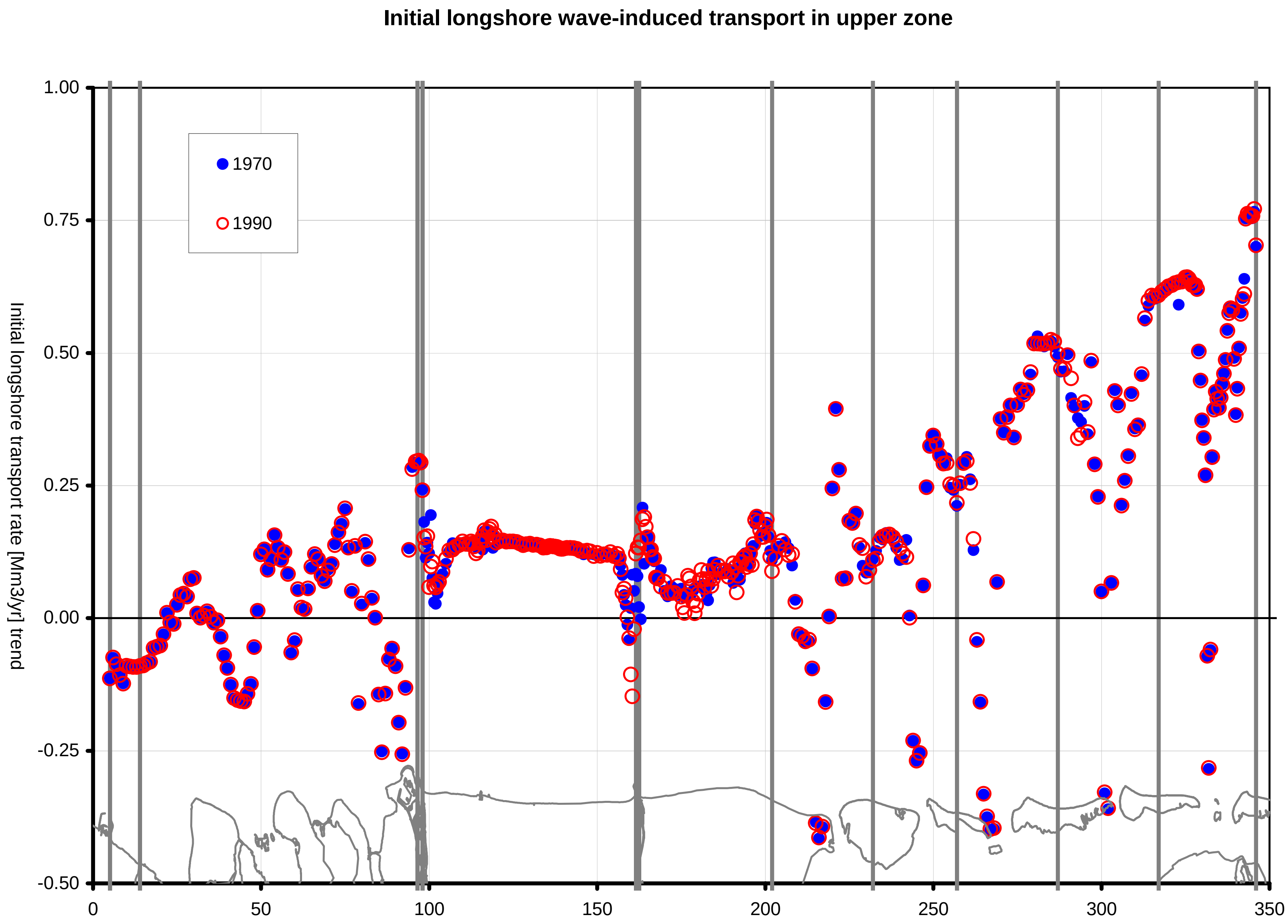
file: PonTos_input_r16.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Calibration of the model

Wave-induced transport in the upper layer

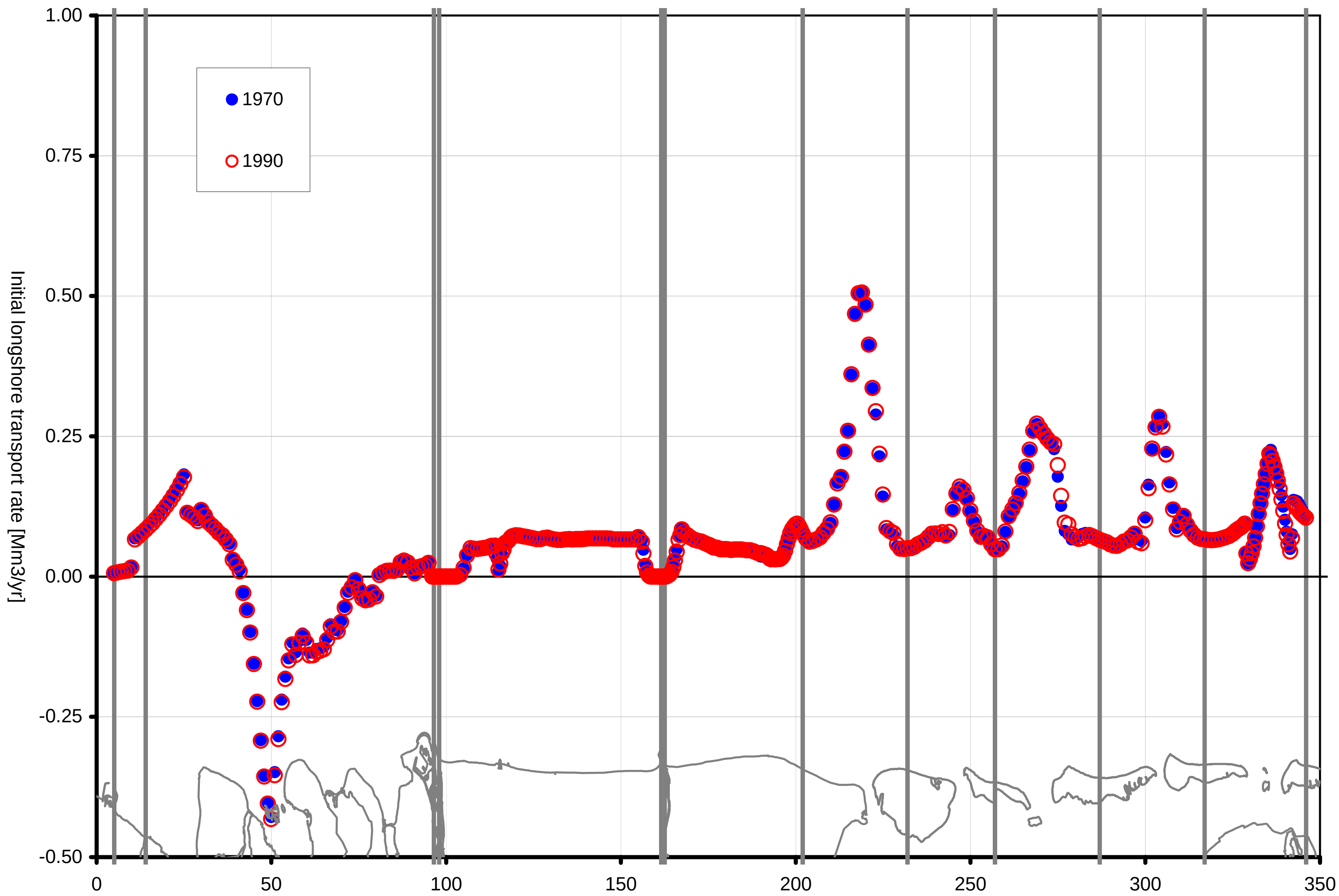
Landward of NAP-7m contour



file: PonTos_input_r16.xls; November 2004

Z3334/A1000	PONTOS-2.0	1970 and 1990
WL / Alkyon		**Fig. 4.13**

Initial longshore tide-induced transport in upper zone



file: PonTos_input_r16.xls; November 2004

Calibration of the model

Tide-induced transport in the upper layer

Landward of NAP-7m contour

LARGE-SCALE MODEL OF THE DUTCH COAST

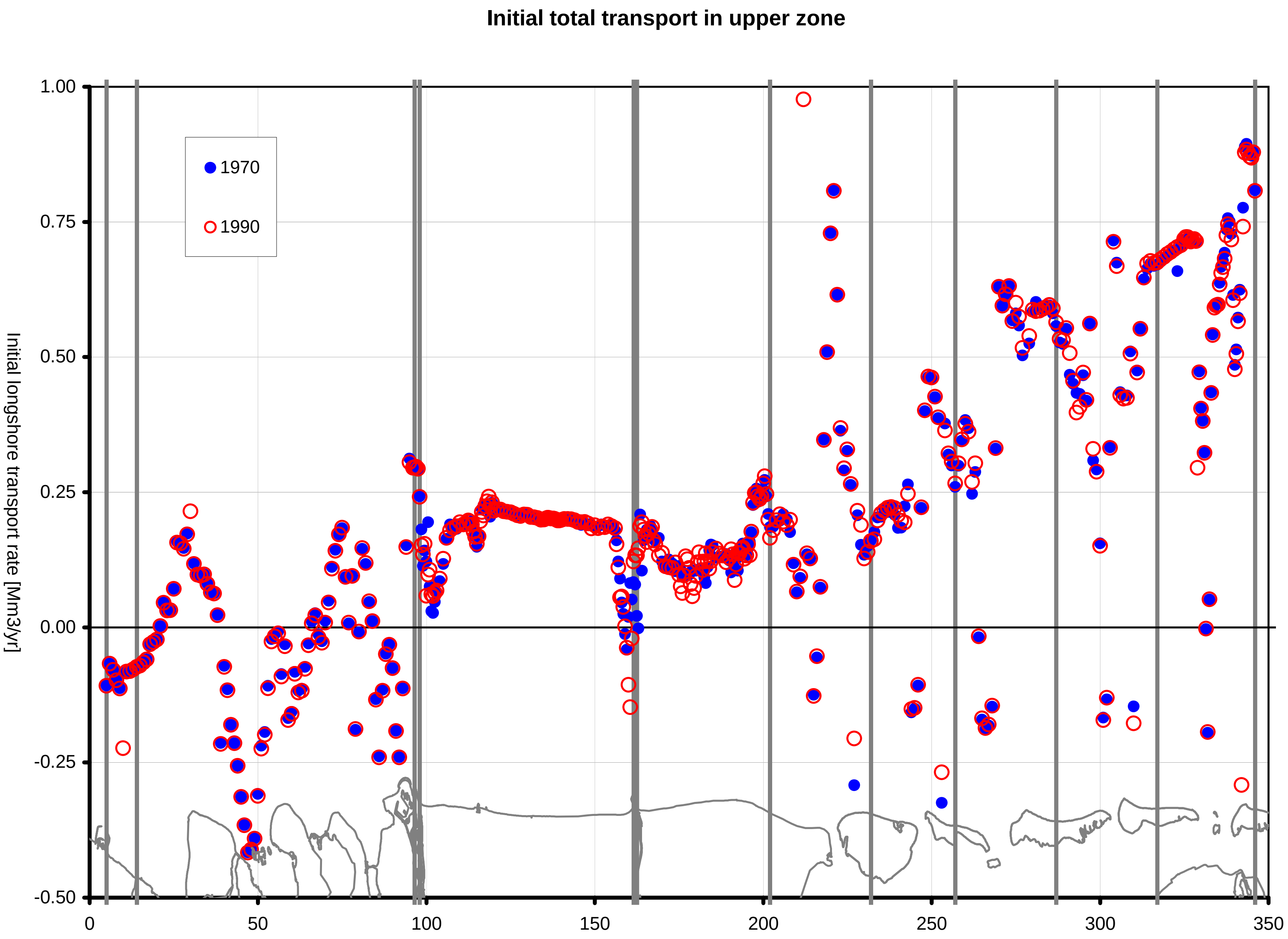
Z3334/A1000

PONTOS-2.0

1970 and 1990

WL / Alkyon

Fig. 4.14



Calibration of the model

Total transport in the upper layer

Landward of NAP-7m contour

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

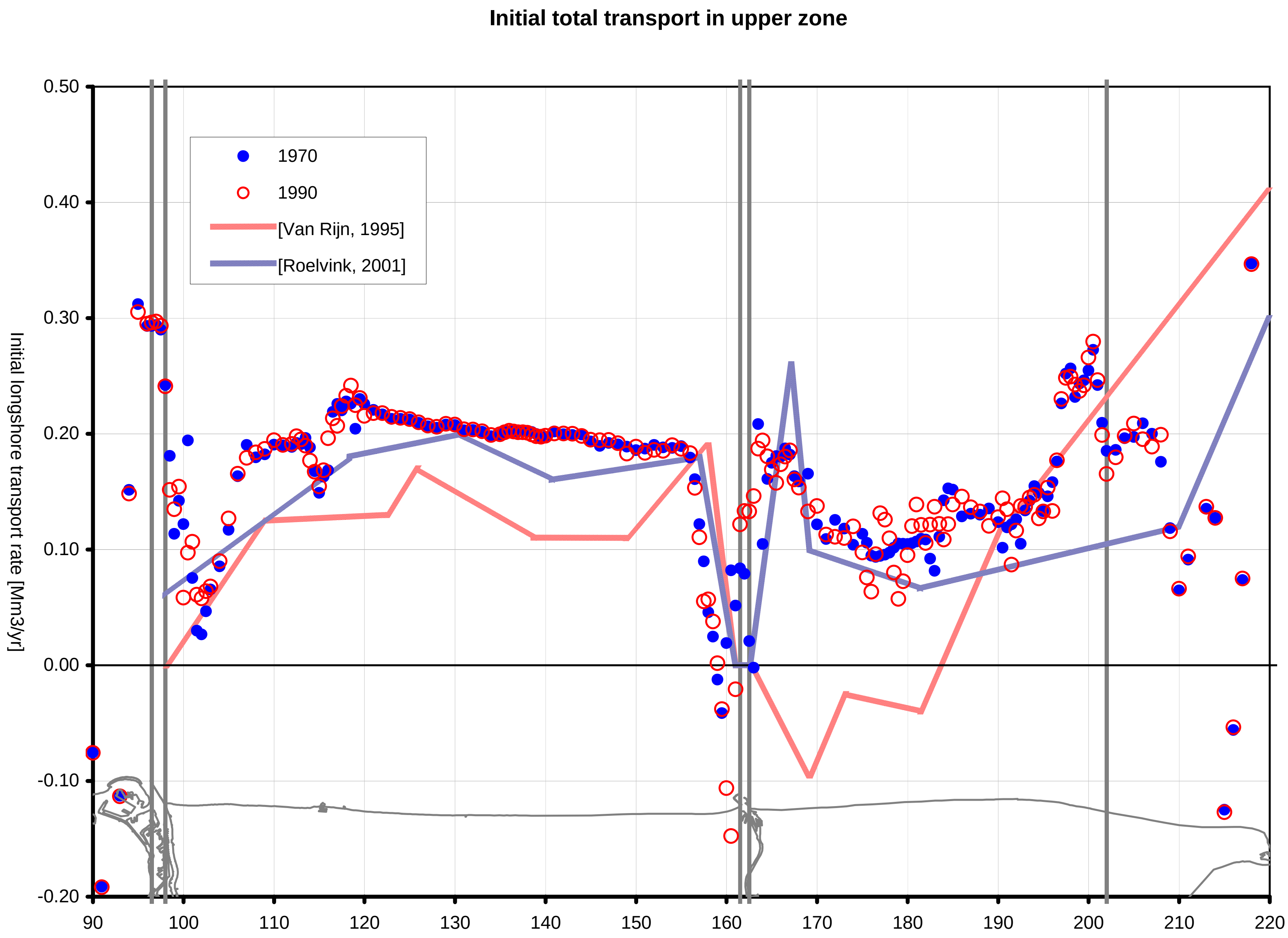
PONTOS-2.0

1970 and 1990

WL / Alkyon

Fig. 4.15

file: PonTos_input_r16.xls; November 2004



file: PonTos_input_r16.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST	Z3334/A1000
Comparison for the Holland coast	WL / Alkyon
Total transport in the upper layer	1970 and 1990
Calibration of the model	PONTOS-2.0
	Fig. 4.16

LARGE-SCALE MODEL OF THE DUTCH COAST

Seaward of NAP-7m contour

Wave-induced transport in the lower layer

Calibration of the model

Z3334/A1000

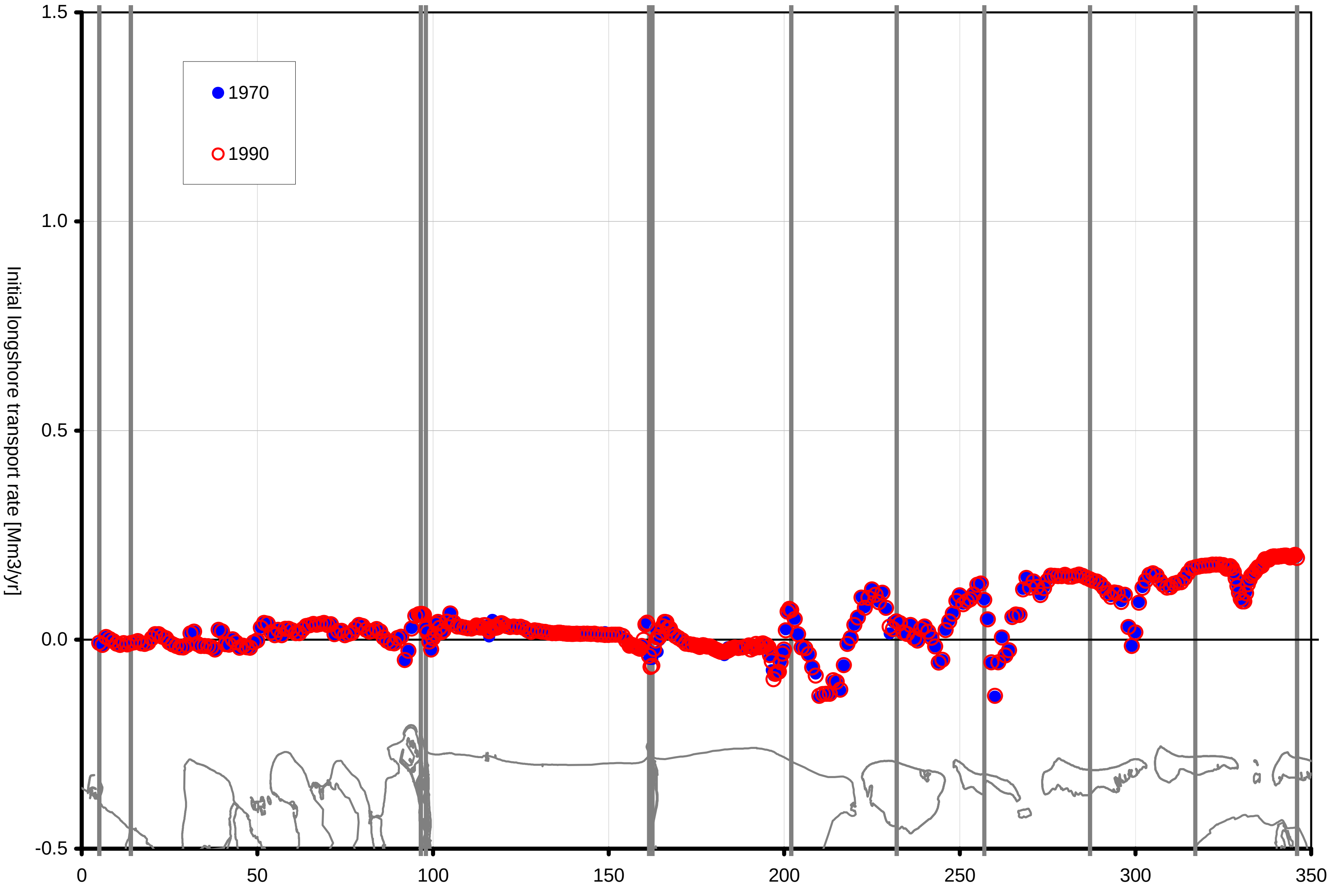
WL / Alkyon

1970 and 1990

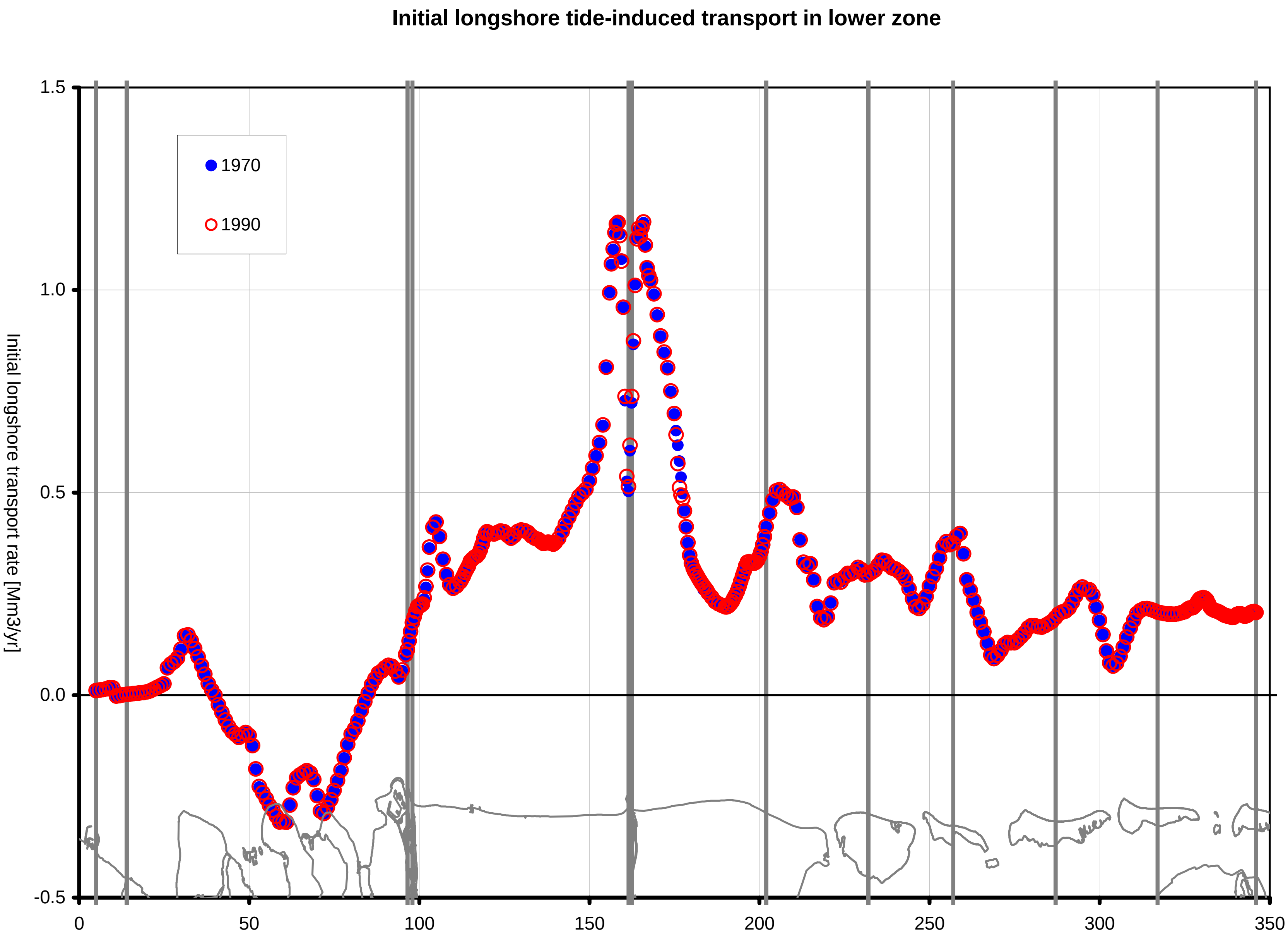
PONTOS-2.0

Fig. 4.17

Initial longshore wave-induced transport in lower zone



file: PonTos_input_r16.xls; November 2004



file: PonTos_input_r16.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

Calibration of the model

Tide-induced transport in the lower layer

Seaward of NAP-7m contour

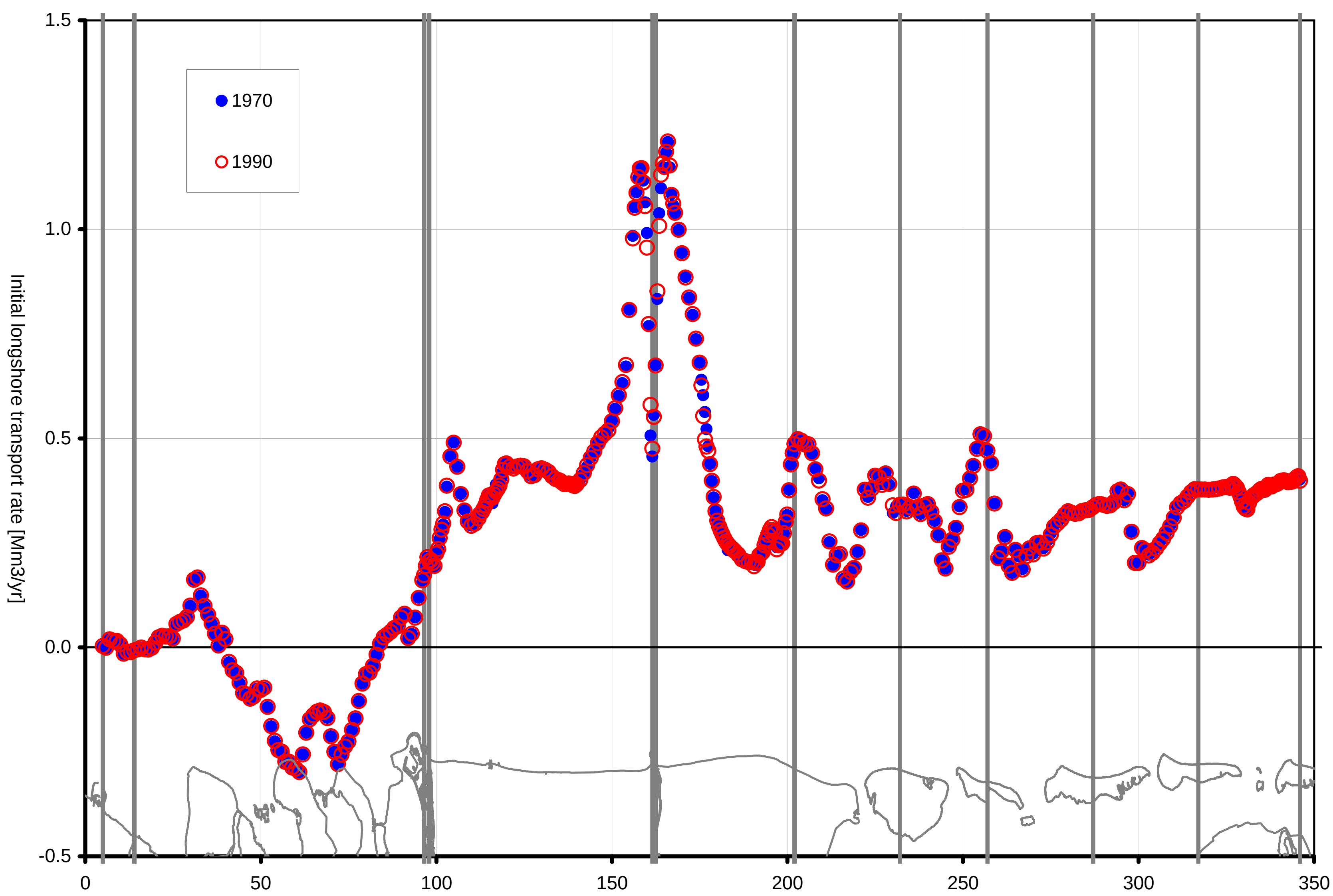
PONTOS-2.0

1970 and 1990

WL / Alkyon

Fig. 4.18

Initial longshore total transport in lower zone



file: PonTos_input_r16.xls; November 2004

Calibration of the model
Total transport in the lower layer
Seaward of NAP-7m contour

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

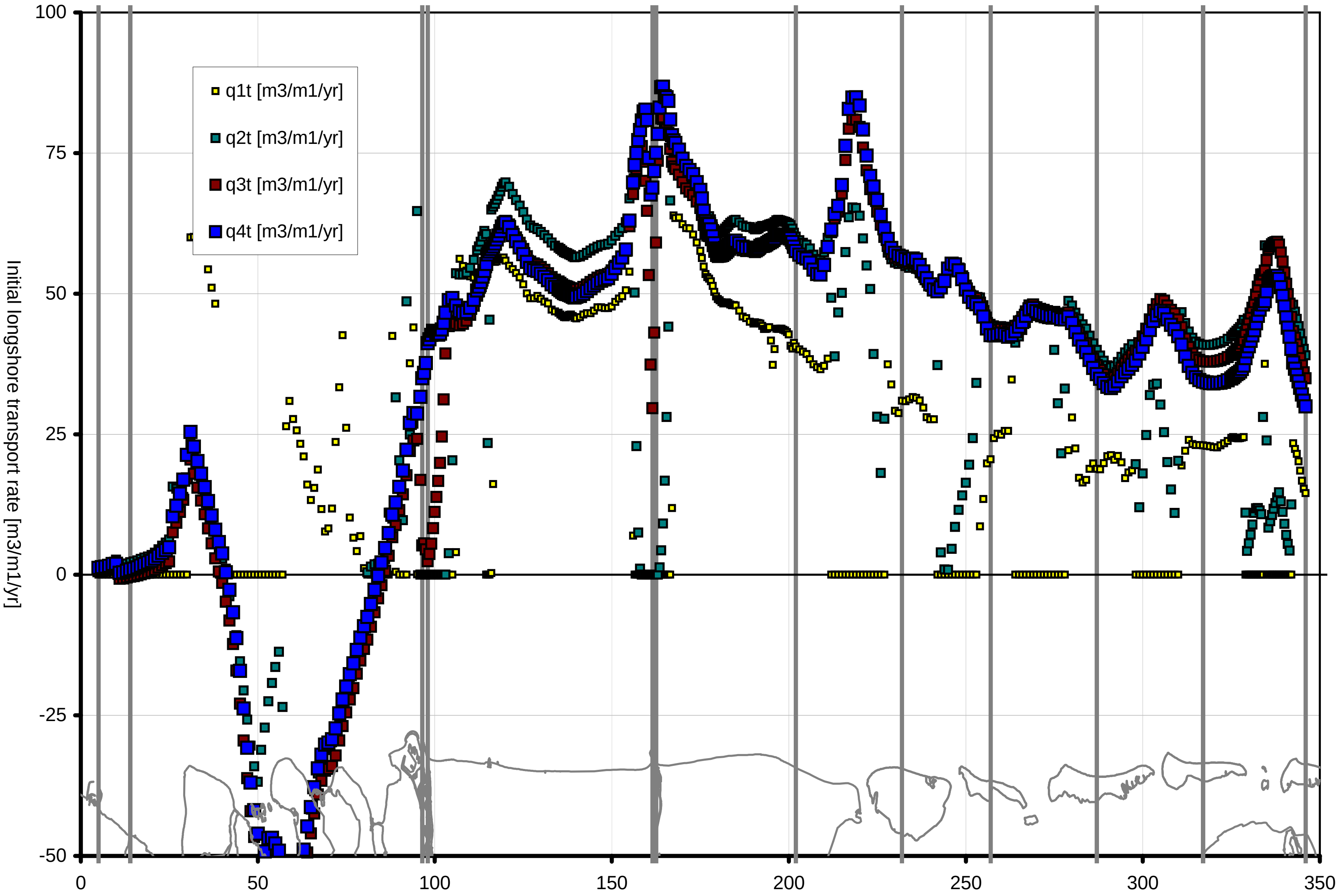
PONTOS-2.0

1970 and 1990

WL / Alkyon

Fig. 4.19

Initial longshore tide-induced transport at various depths



file: PonTos_input_r16.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Average tide-induced transport capacity in various zones

Calibration of the model

Z3334/A1000

WL / Alkyon

1990

PONTOS-2.0

Fig. 4.20

Calibration of the model

Average tide-induced transport capacity in various zones

Comparison with data from Van Rijn for the Holland coast

LARGE-SCALE MODEL OF THE DUTCH COAST

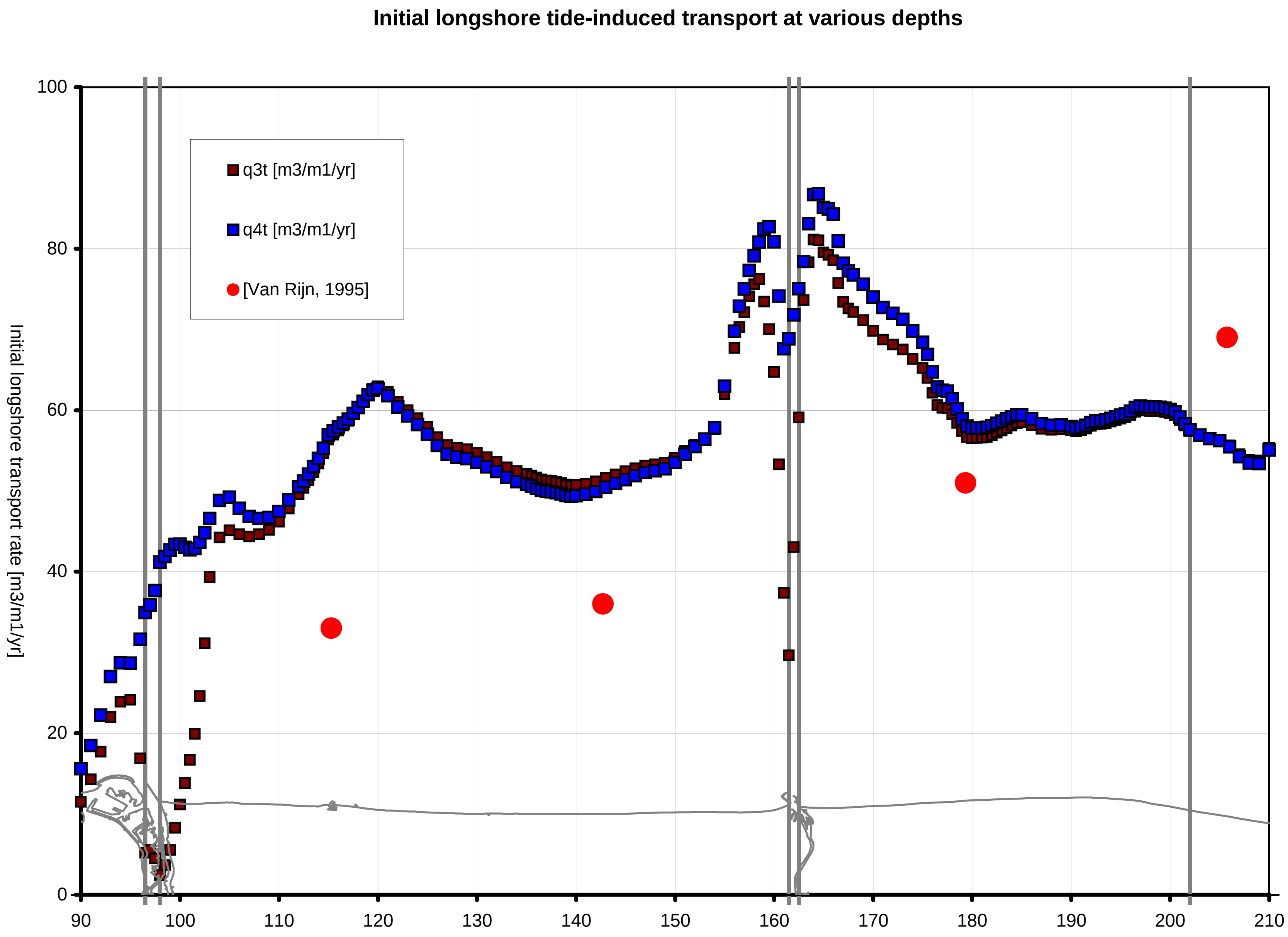
PONTOS-2.0

1990

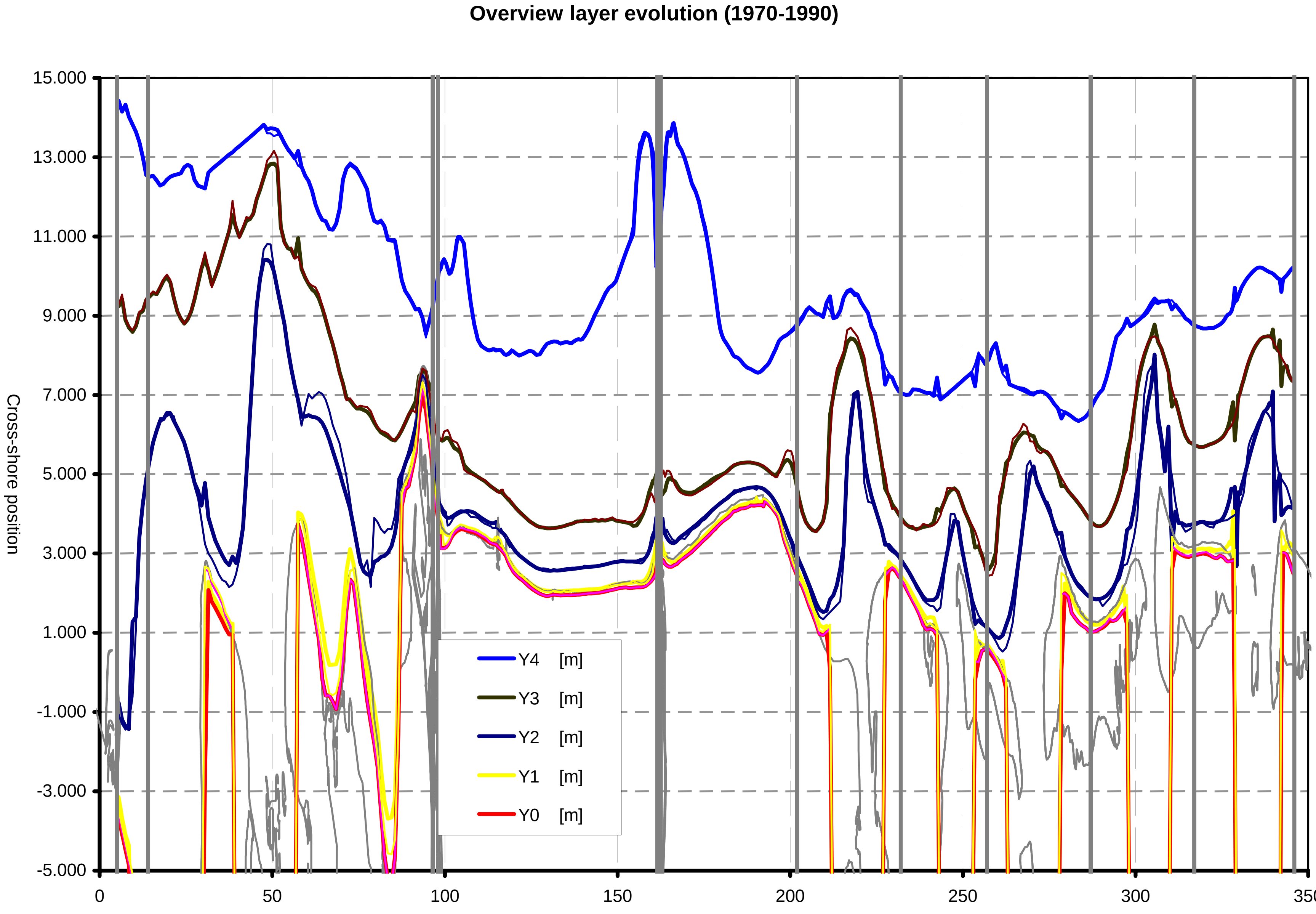
Z3334/A1000

WL / Alkyon

Fig. 4.21



file: PonTos_input_r16.xls; November 2004



file: PonTos_input_r16.xls; November 2004

Calibration of the model
Computed layer evolution
Overview for the whole Dutch coast

PONTOS-2.0

1970 - 1990

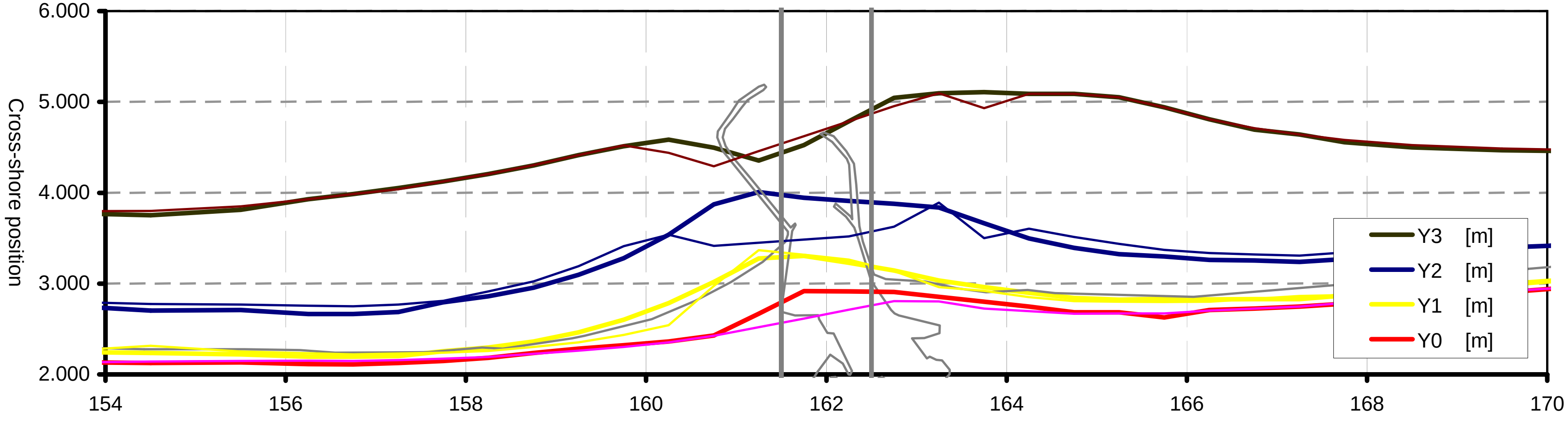
LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

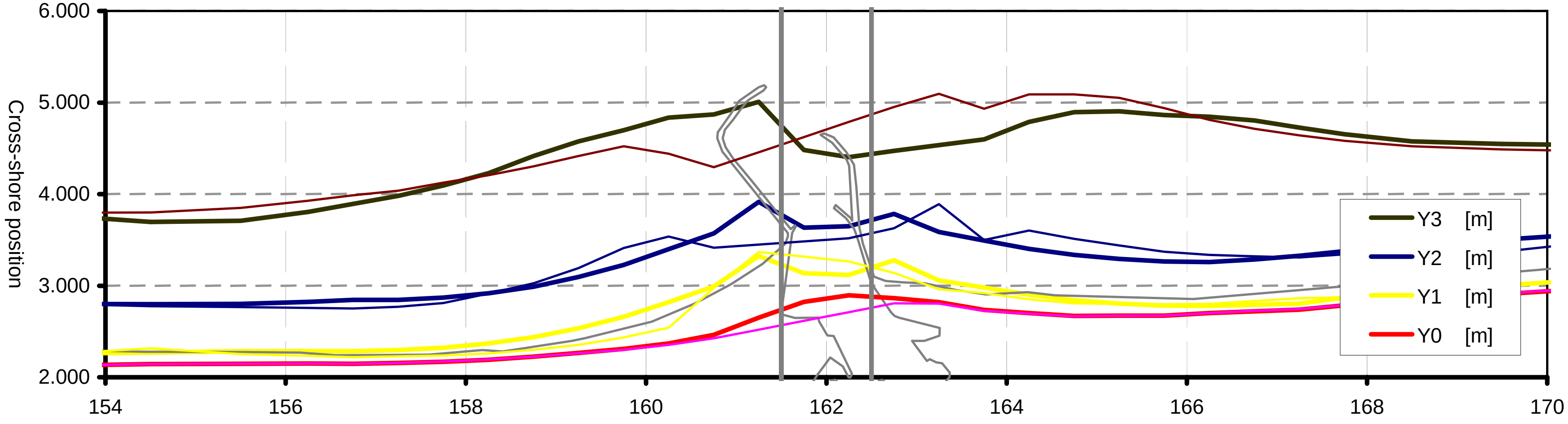
WL / Alkyon

Fig. 4.22

Observed layer evolution (1970-1990)



Computed layer evolution (1970-1990)



Calibration of the model

Computed layer evolution

Comparison between observed and computed evolution near IJmuiden

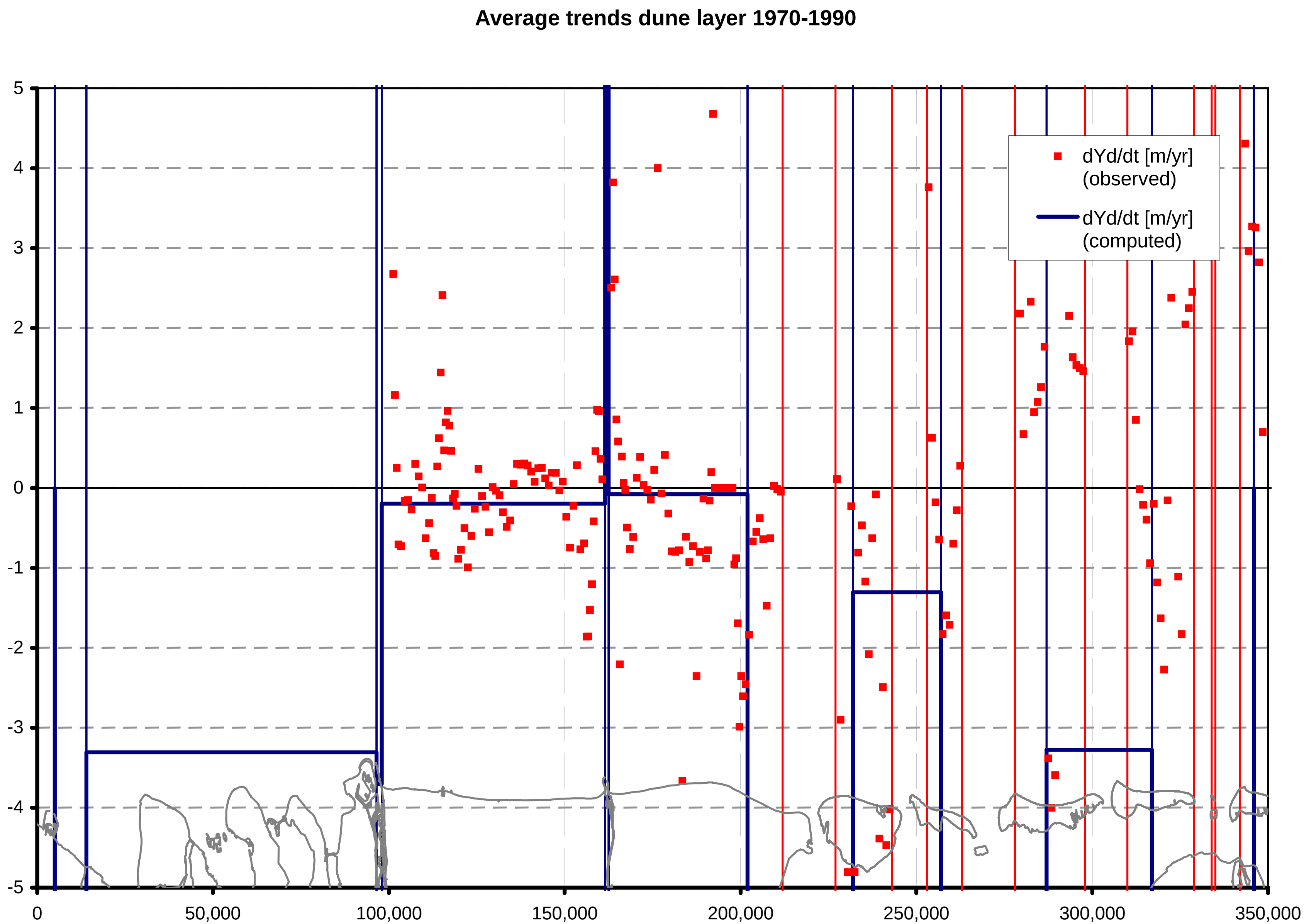
LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

Fig. 4.23

file: PonTos_input_r16.xls; November 2004



file: PonTos_input_r16.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Calibration of the model

Comparison average change for the dune layer

Computed and observed changes

Z3334/A1000		
WL / Alkyon	1970 - 1990	PONTOS-2.0
Fig. 4.24		

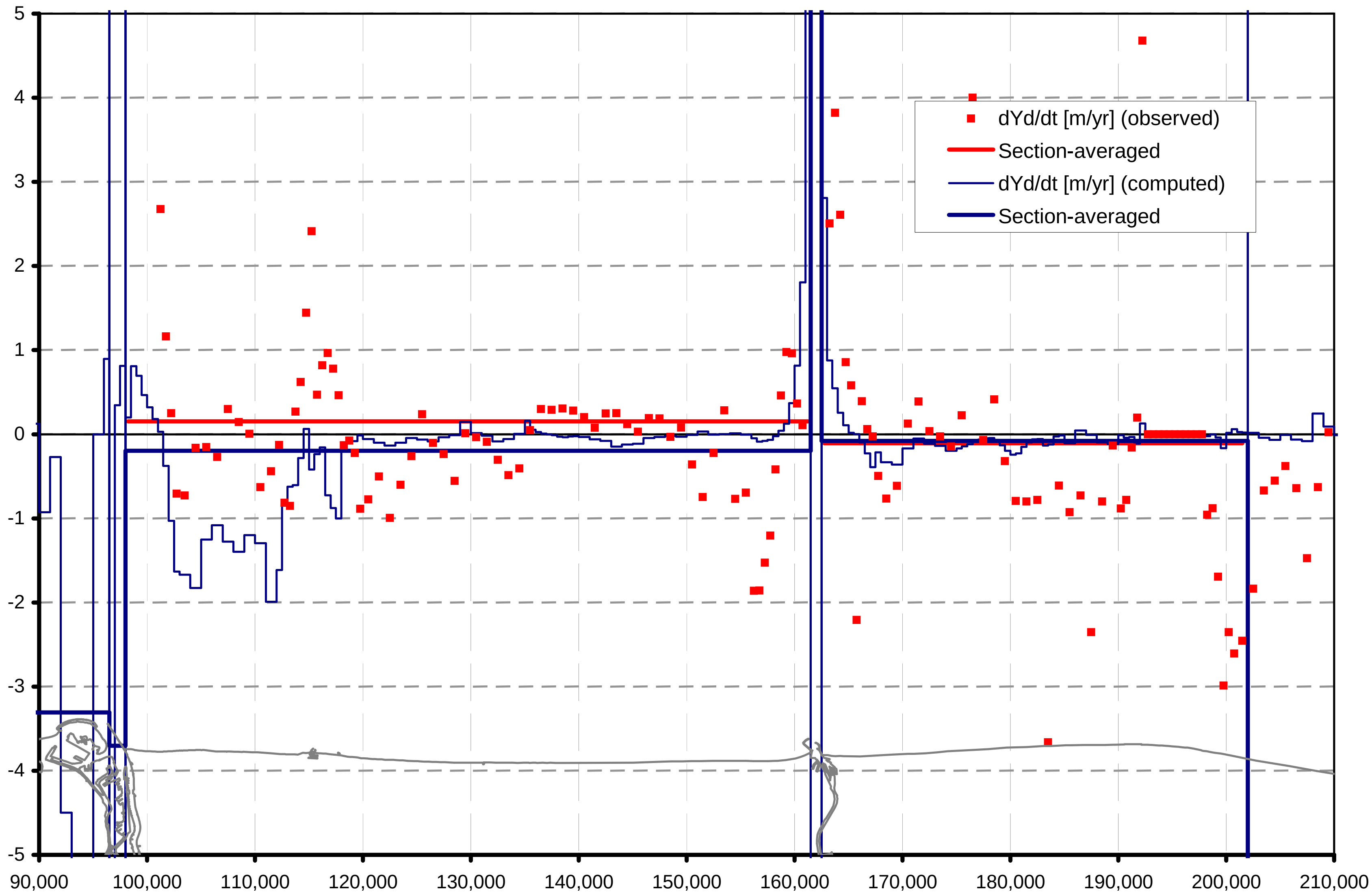
LARGE-SCALE MODEL OF THE DUTCH COAST

Computed and observed changes for the Holland coast

Comparison average change for the dune layer

Calibration of the model

Average trends dune layer 1970-1990



Z3334/A1000

WL / Alkyon

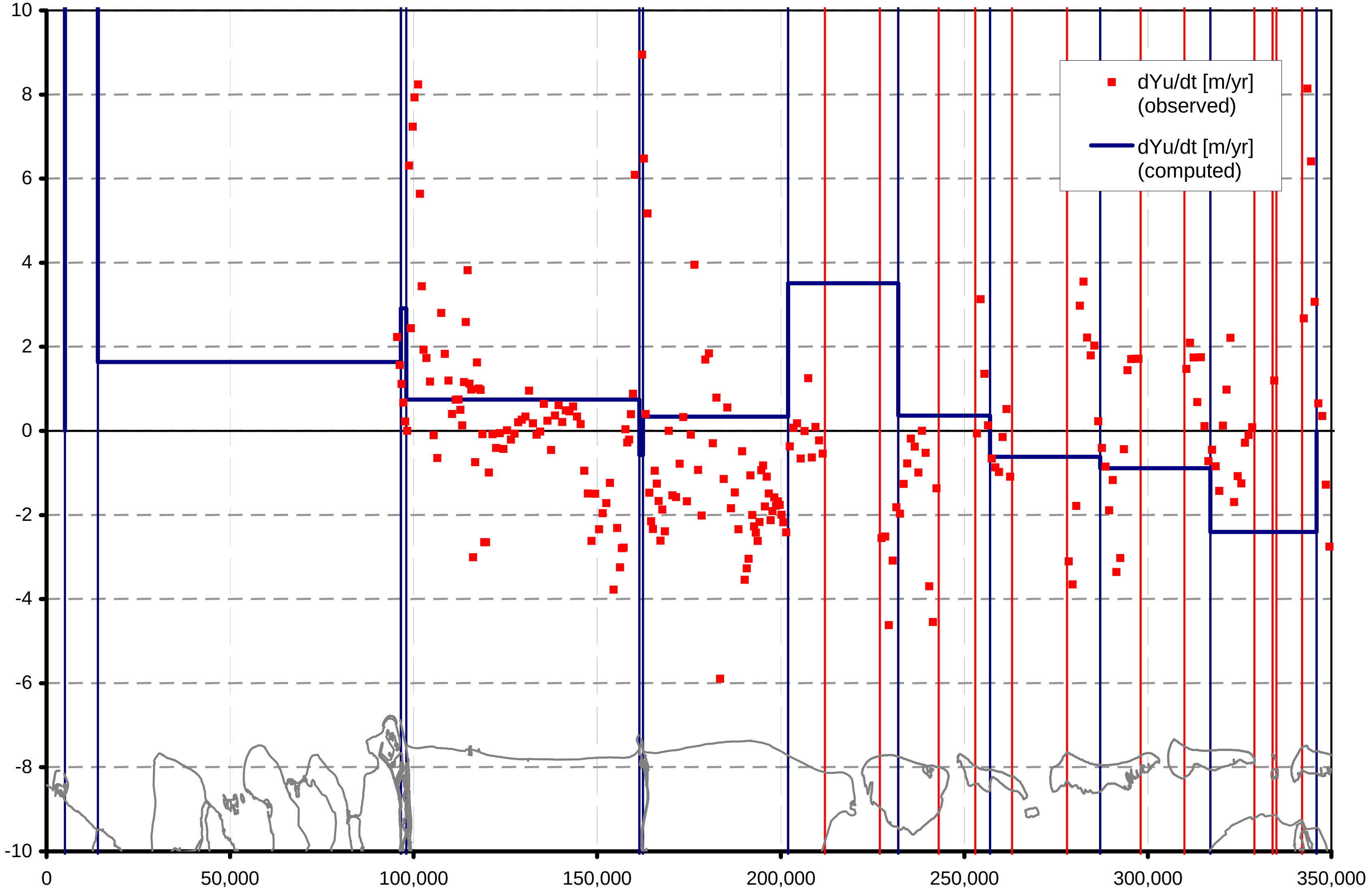
1970 - 1990

PONTOS-2.0

Fig. 4.25

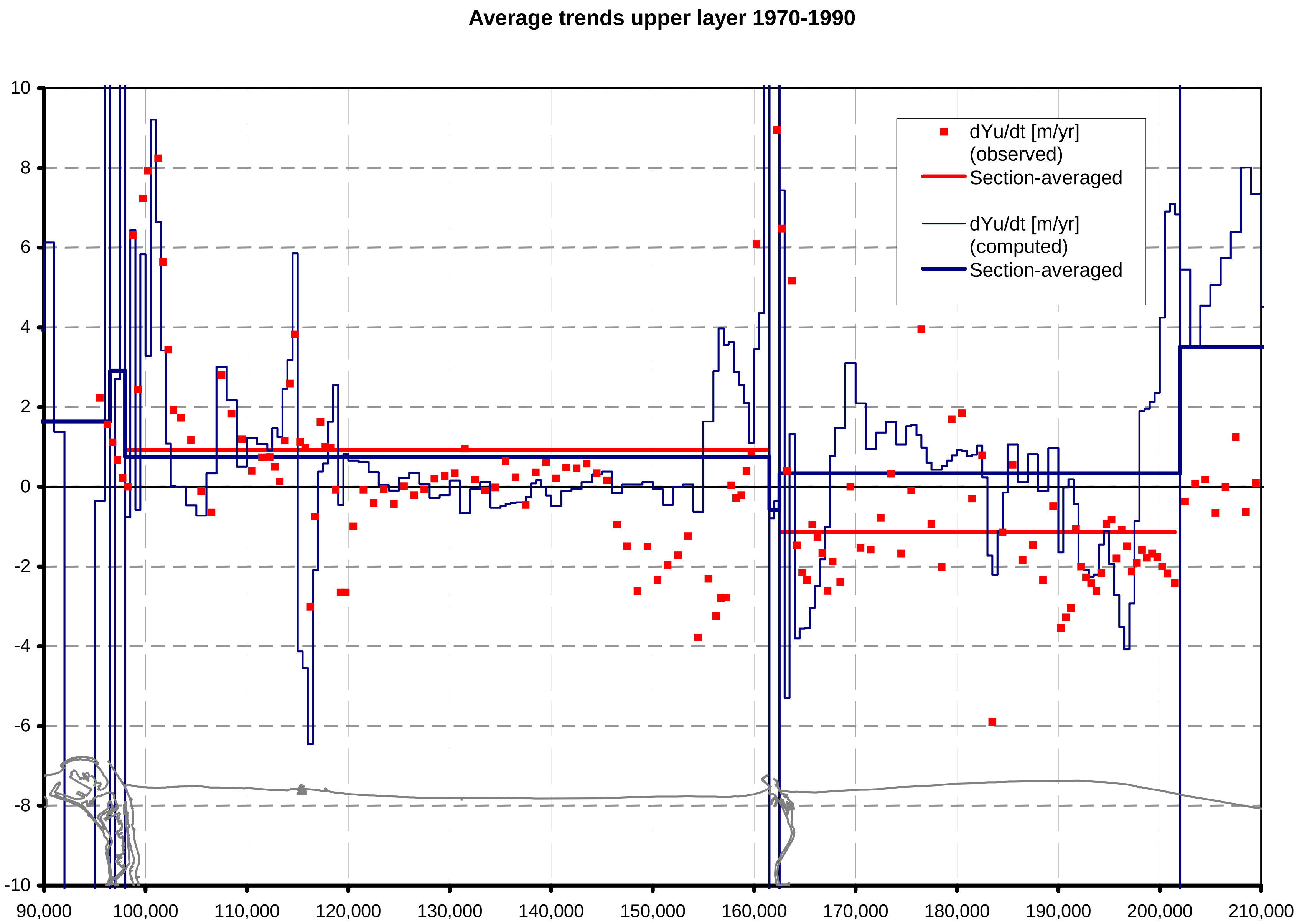
file: PonTos_input_r16.xls; November 2004

Average trends upper layer 1970-1990



file: PonTos_input_r16.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST	Z3334/A1000
Calibration of the model	PONTOS-2.0
Comparison average change for the upper layer	1970 - 1990
Computed and observed changes	
WL / Alkyon	Fig. 4.26



file: PonTos_input_r16.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Computed and observed changes for the Holland coast

Comparison average change for the upper layer

Calibration of the model

Z3334/A1000

PONTOS-2.0

1970 - 1990

WL / Alkyon

Fig. 4.27

LARGE-SCALE MODEL OF THE DUTCH COAST

Calibration of the model

Comparison average change for the lower layer

Computed and observed changes

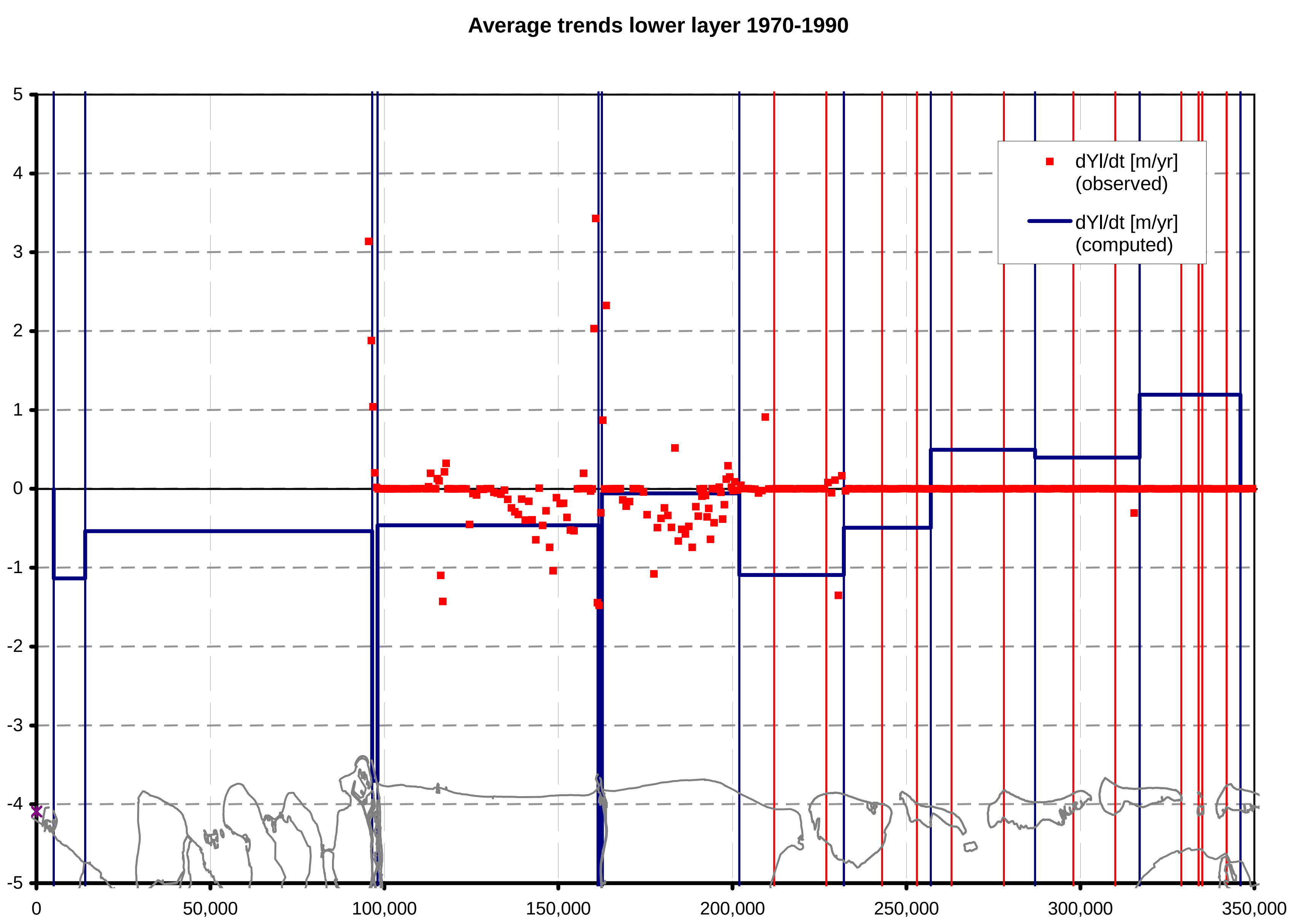
Z3334/A1000

1970 - 1990

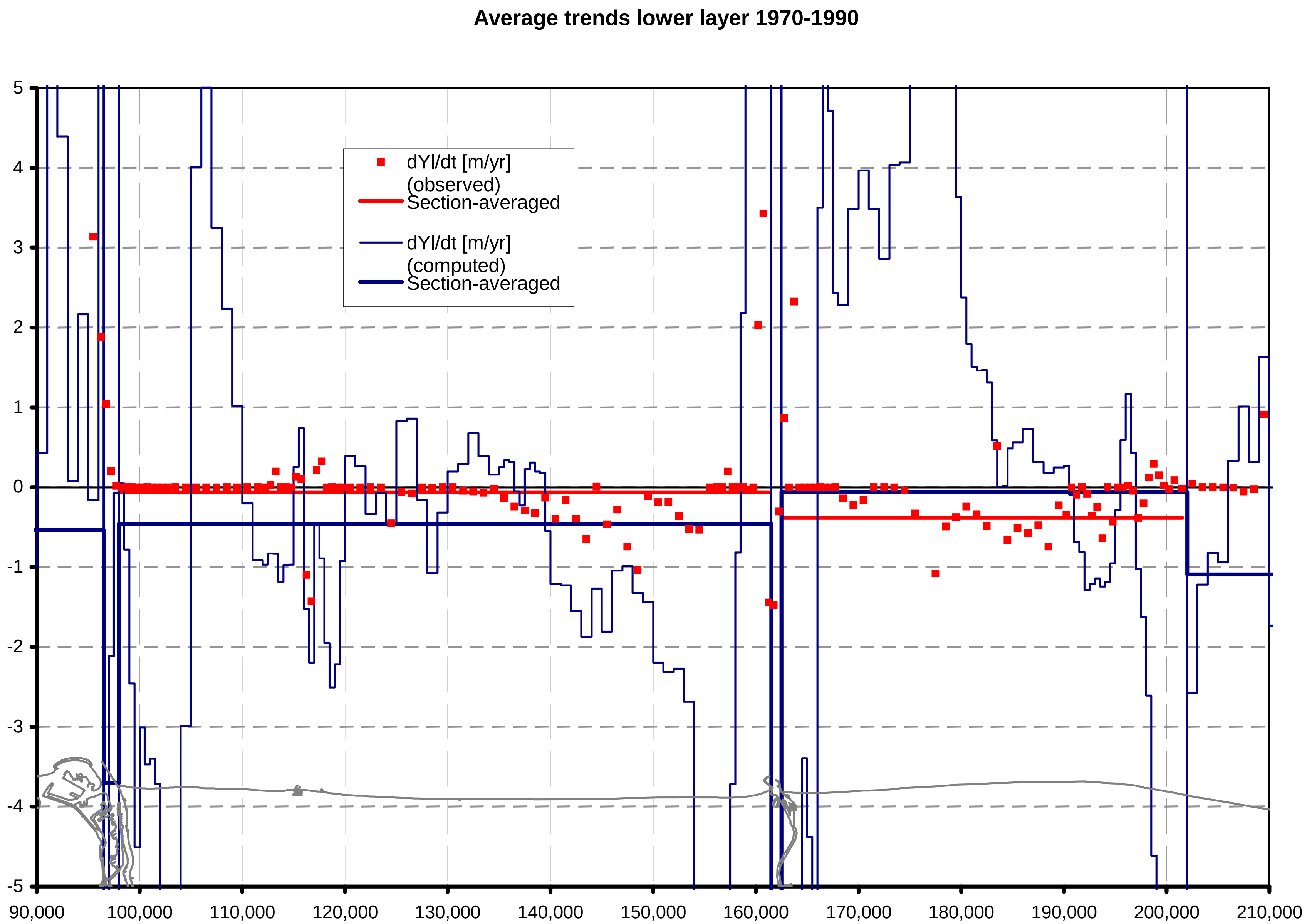
PONTOS-2.0

WL / Alkyon

Fig. 4.28



file: PonTos_input_r16.xls; November 2004



Calibration of the model

Comparison average change for the lower layer

Computed and observed changes for the Holland coast

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

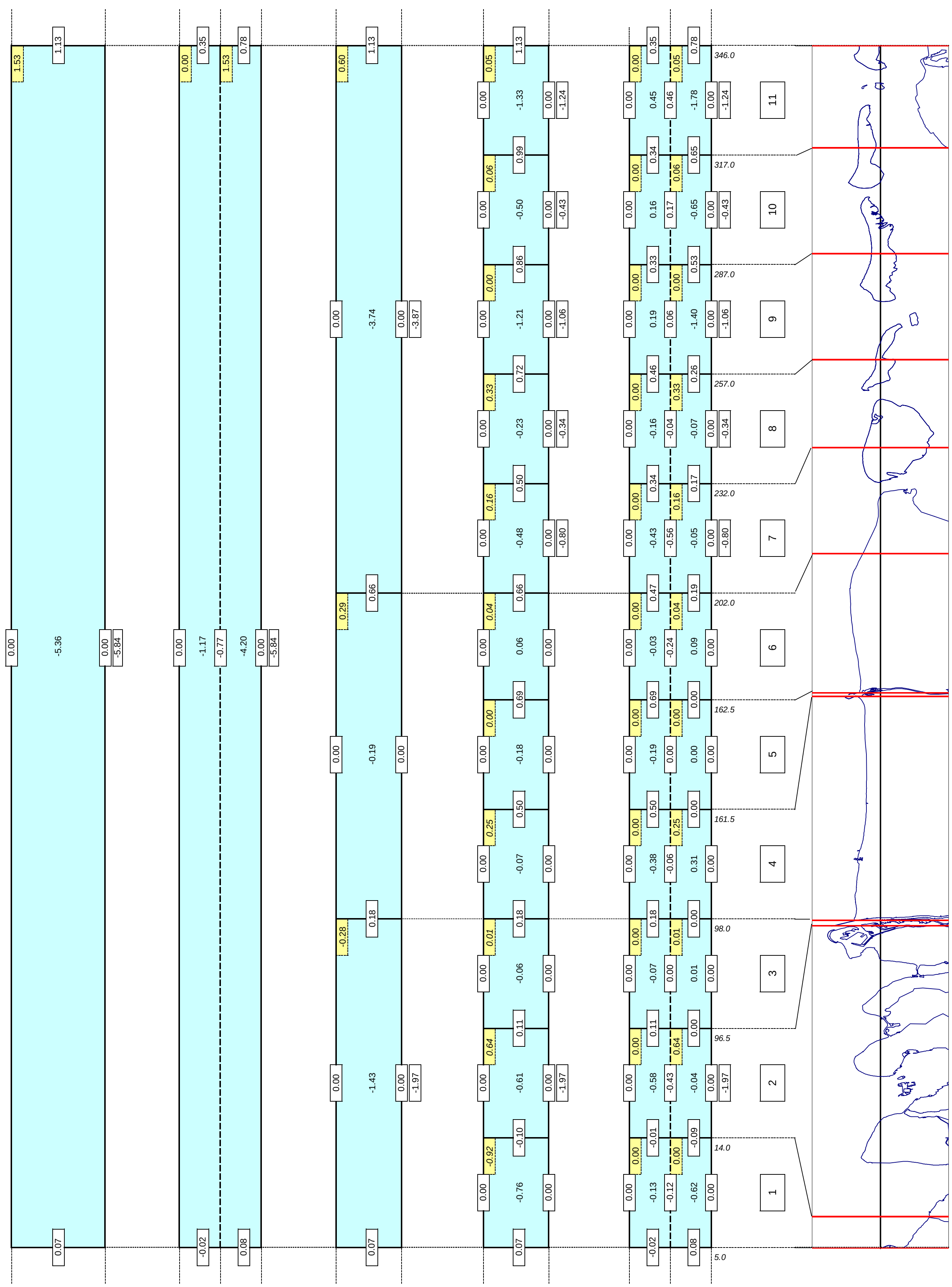
1970 - 1990

PONTOS-2.0

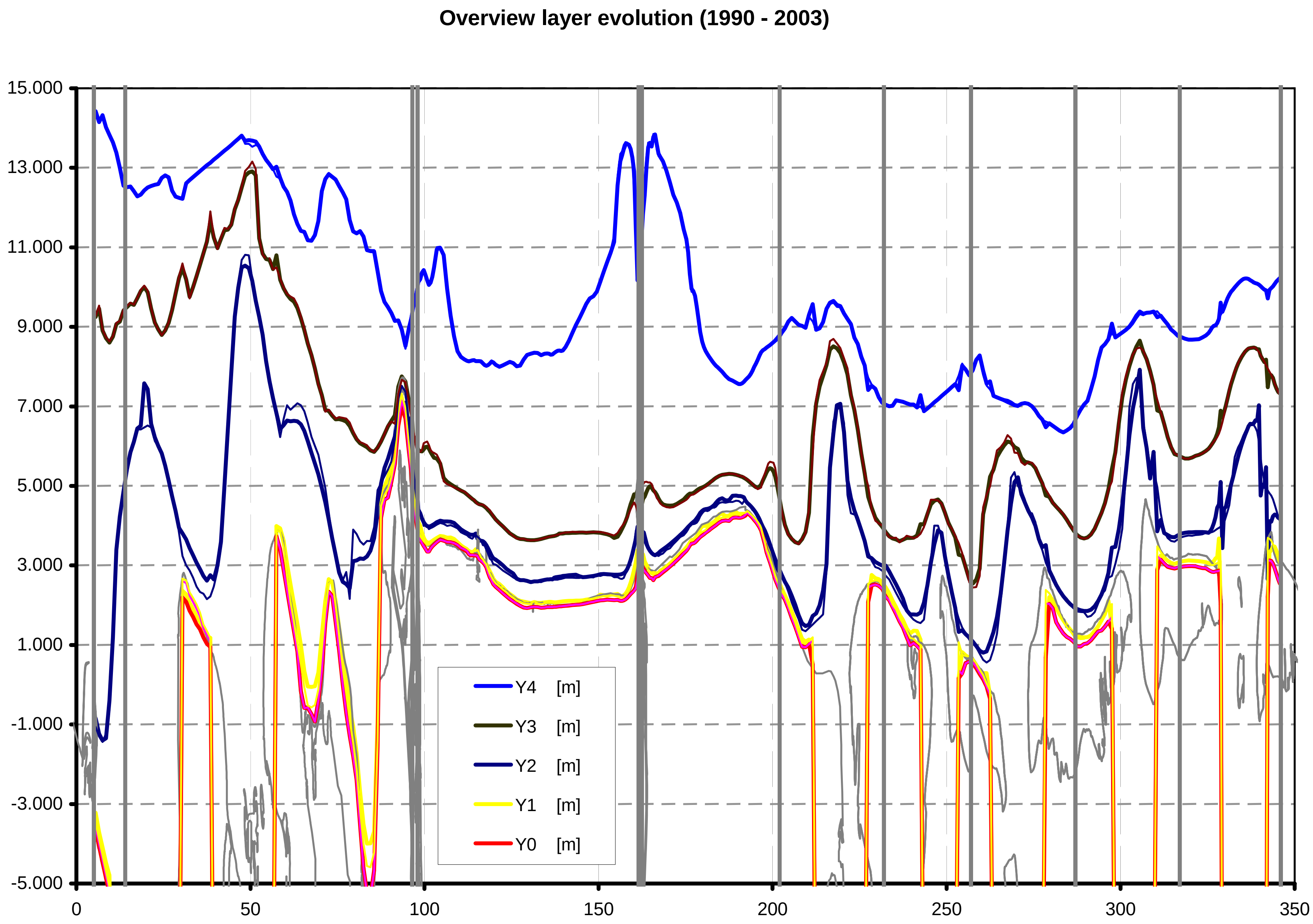
Fig. 4.29

file: PonTos_input_r16.xls; November 2004

file: PonTos_volumes_r10.xls; November 2004



Calibration of the model	PONTOS-2.0
Overview of computed large-scale developments	1970 - 1990
For the period 1970 - 1990	Run_CC
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 4.30



file: PonTos_input_r16.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Computed layer evolution

Verification of the model

Z3334/A1000

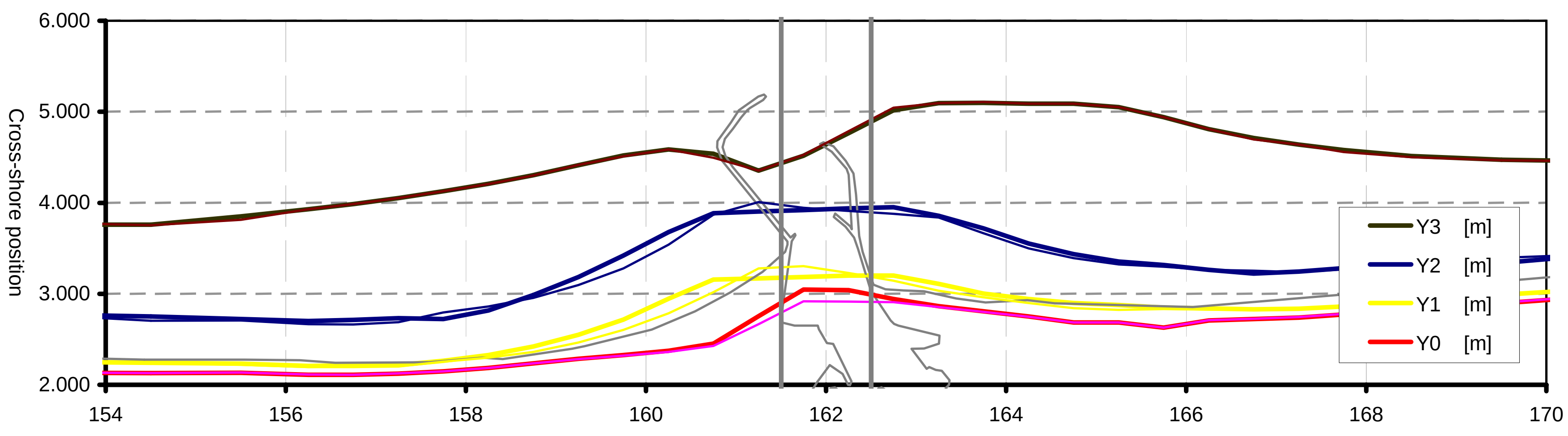
WL / Alkyon

1990 - 2003

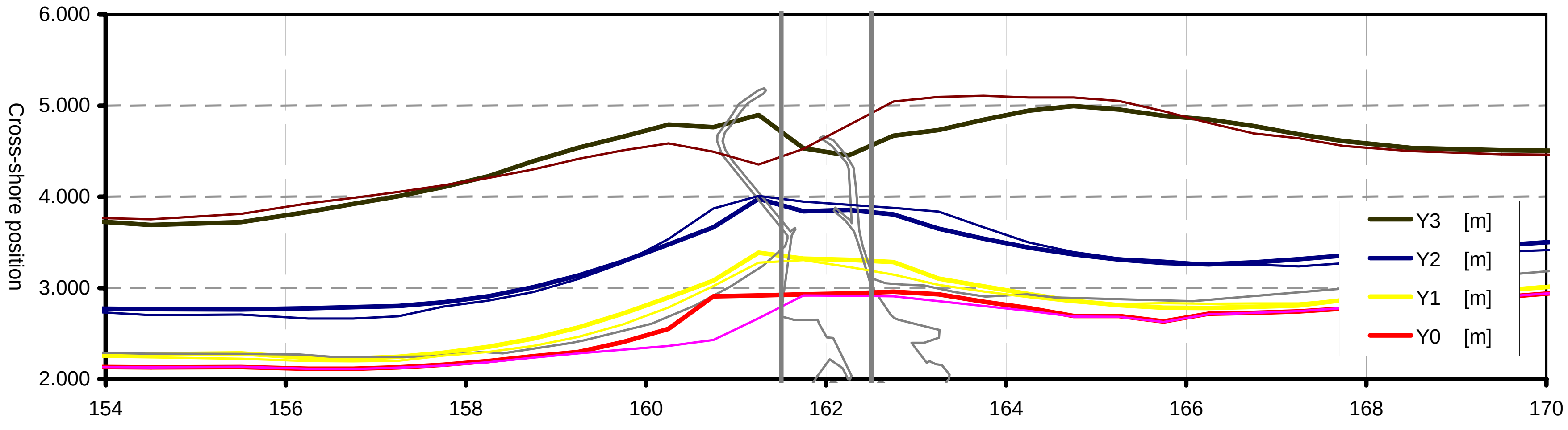
PONTOS-2.0

Fig. 5.1

Obseverd layer evolution (1990 - 2003)



Computed layer evolution (1990 - 2003)



file: PonTos_input_r16.xls; November 2004

Verification of the model

Computed layer evolution

Comparison between observed and computed evolution near IJmuiden

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

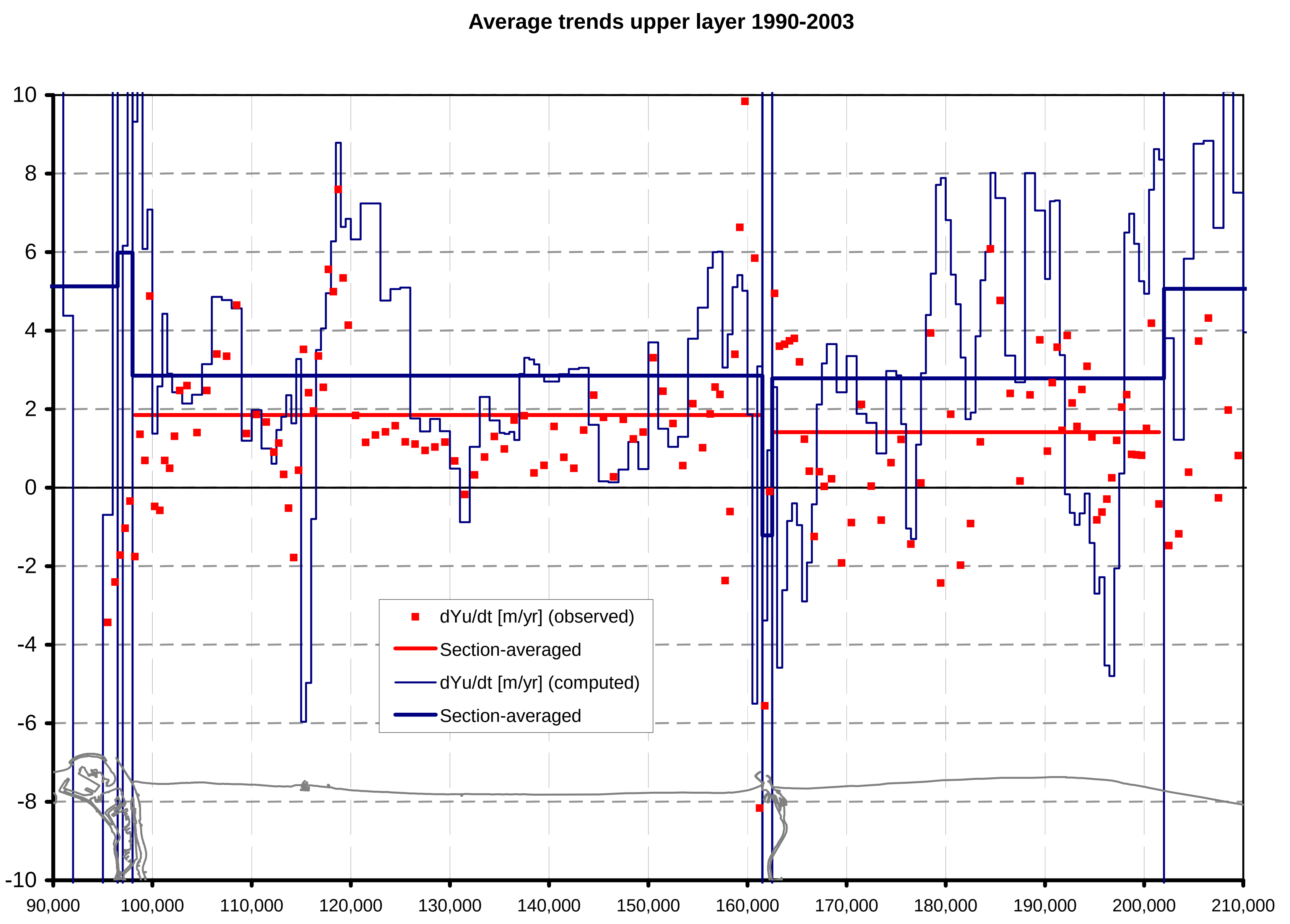
WL / Alkyon

Fig. 5.2

LARGE-SCALE MODEL OF THE DUTCH COAST

Comparison average trend upper layer

Verification of the model



file: PonTos_input_r16.xls; November 2004

Z3334/A1000

WL / Alkyon

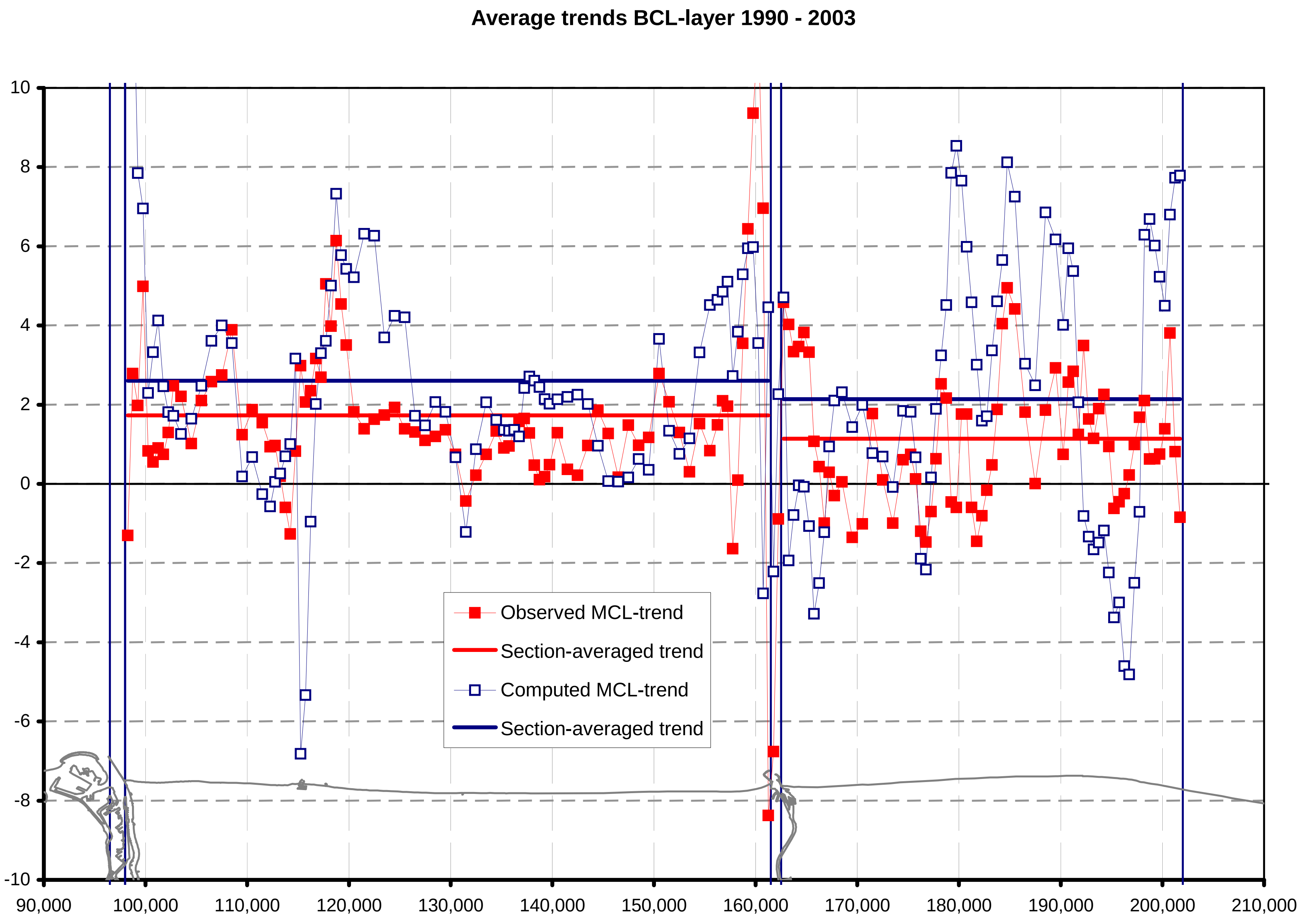
Holland coast

1990 - 2003

PONTOS-2.0

Fig. 5.3

Average trends BCL-layer 1990 - 2003



Verification of the model

Comparison average MCL-trends

Comparison between observed and computed trends

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

PONTOS-2.0

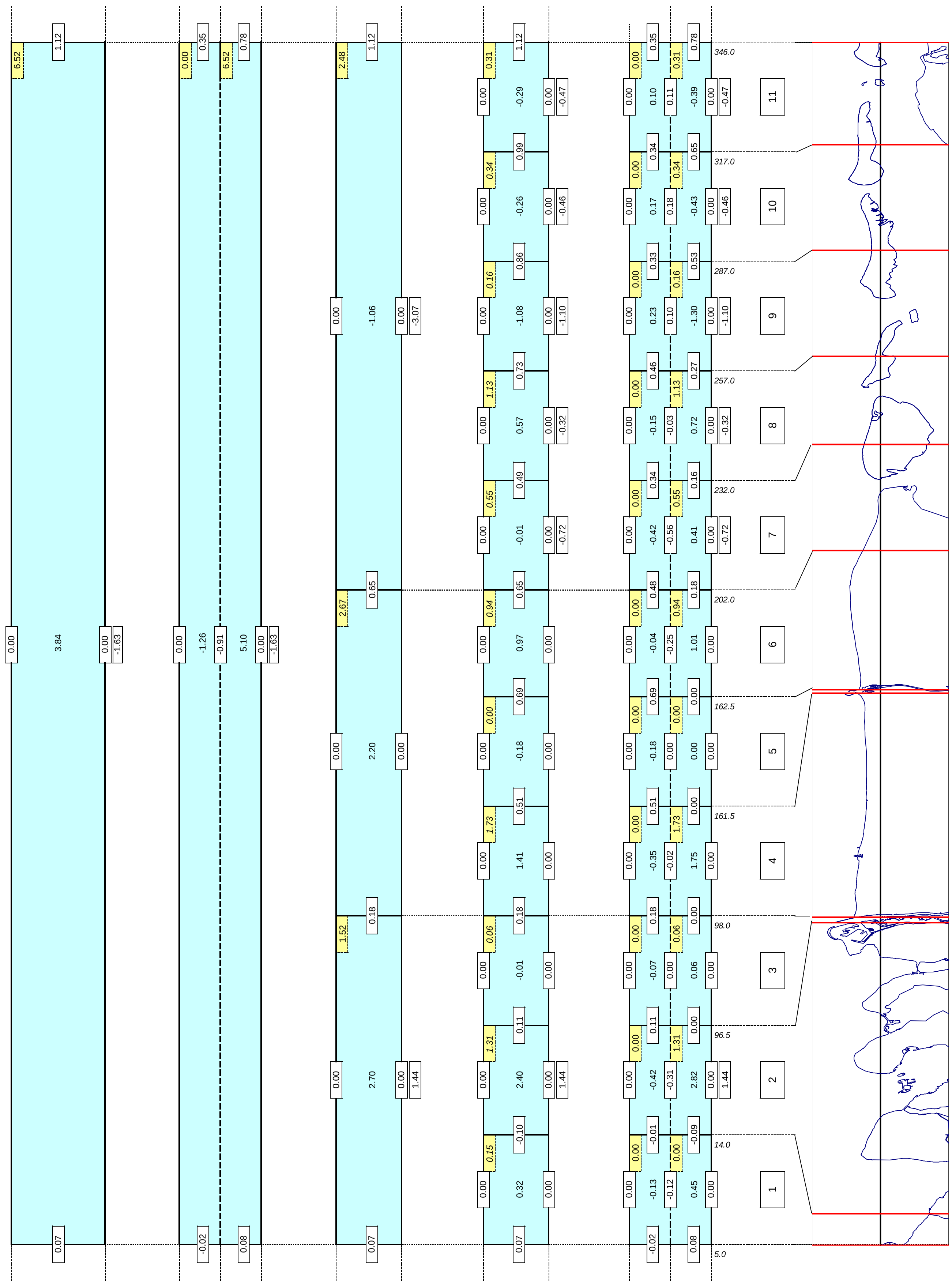
1990 - 2003

Holland coast

WL / Alkyon

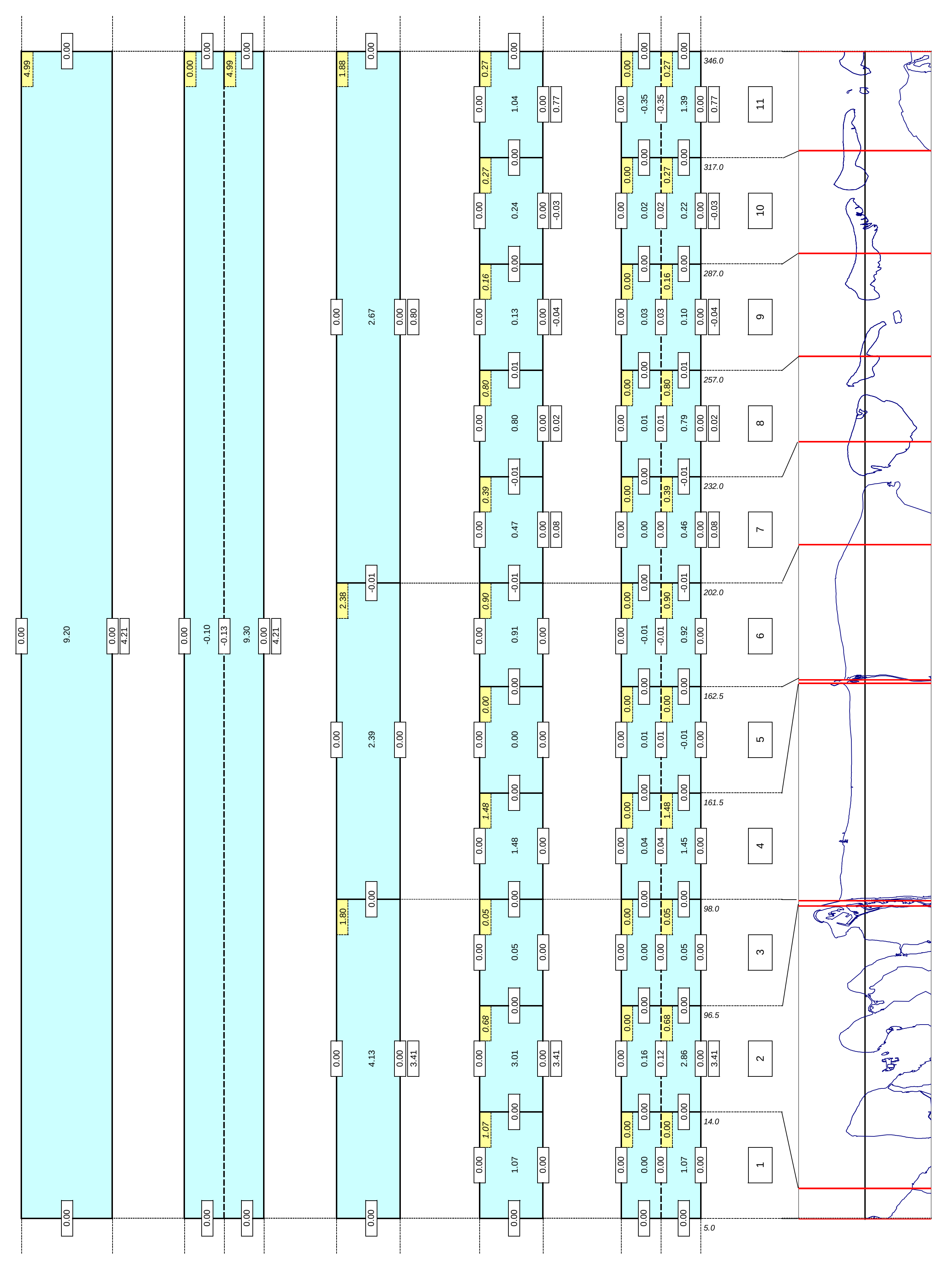
Fig. 5.4

file: PonTos_volumes_r10.xls; November 2004



Verification of the model	PONTOS-2.0
Overview of computed large-scale developments	1990 - 2003
For the period 1990 - 2003	Run_CV
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 5.5

file: PonTos_volumes_r10.xls; November 2004

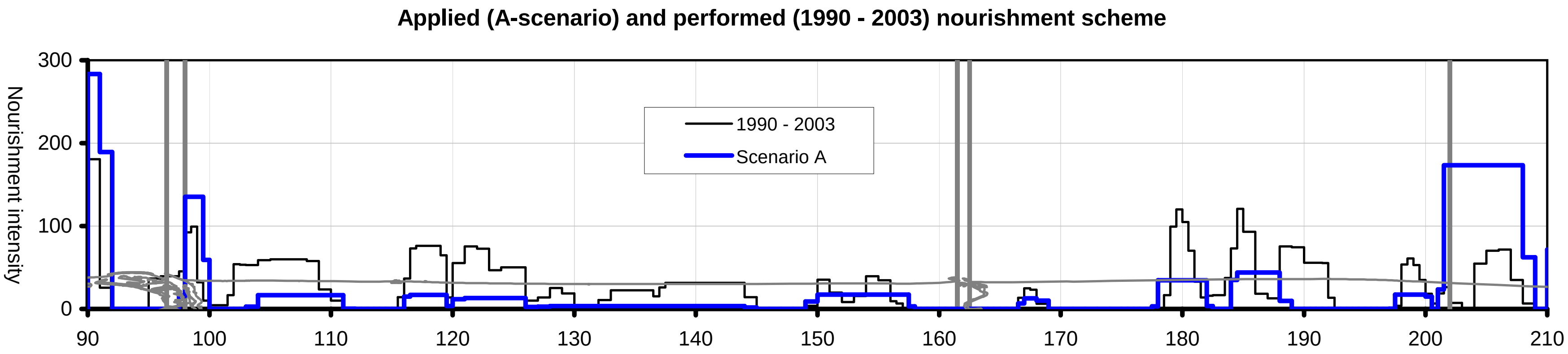


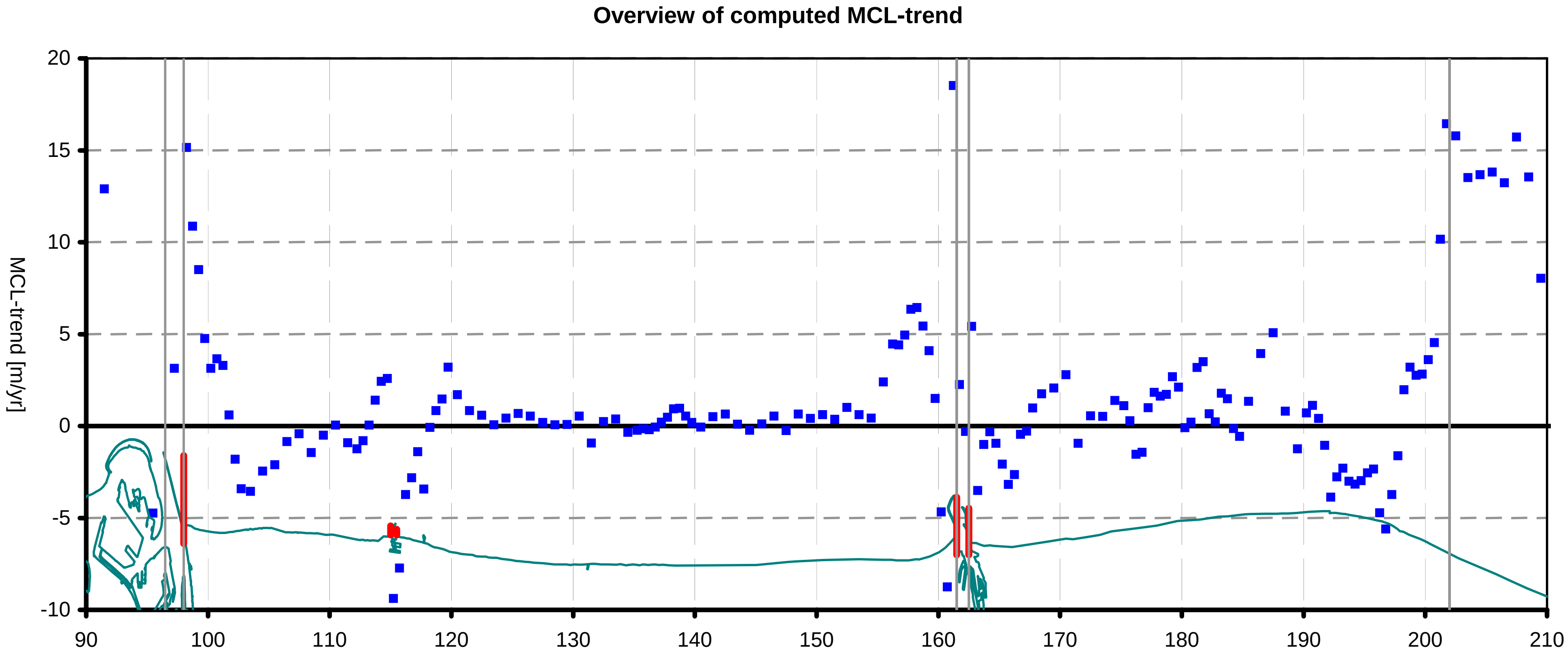
Verification of the model Overview of computed large-scale developments Differences between the trends of 1990 - 2003 and 1970 - 1990 period	PONTOS-2.0 1970 - 1990 - 2003 Run_CV - Run_CC
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 5.6

Application of the model for period 2003 - 2053

Computed time-averaged MCL-trend for the Holland coast

Comparison applied nourishment scheme and 1990-2003 scheme





LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

WL / Alkyon

Fig. 6.1

PONTOS-2.0

Scenario 1A

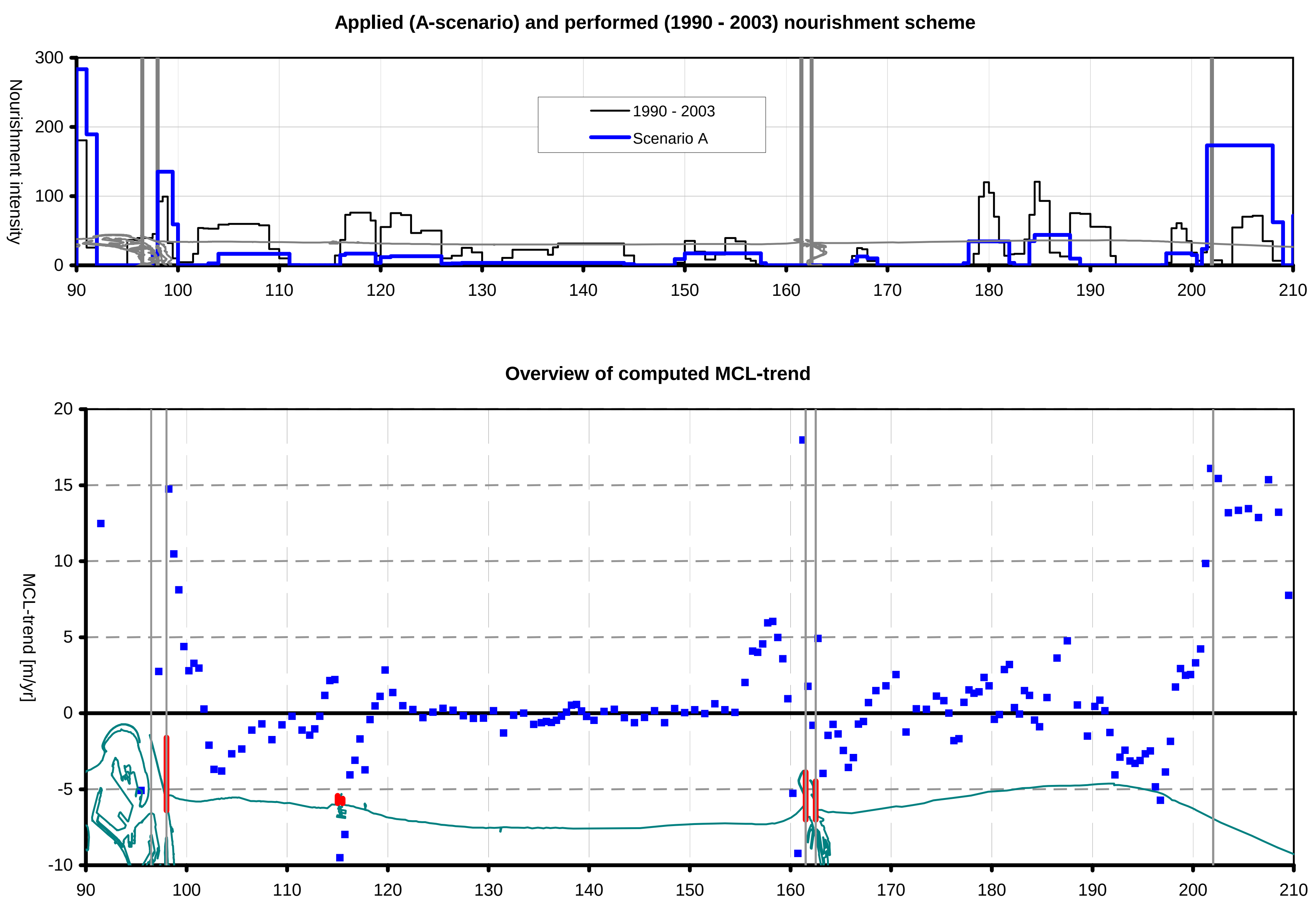
file: PonTos_results_r11.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Comparison applied nourishment scheme and 1990-2003 scheme

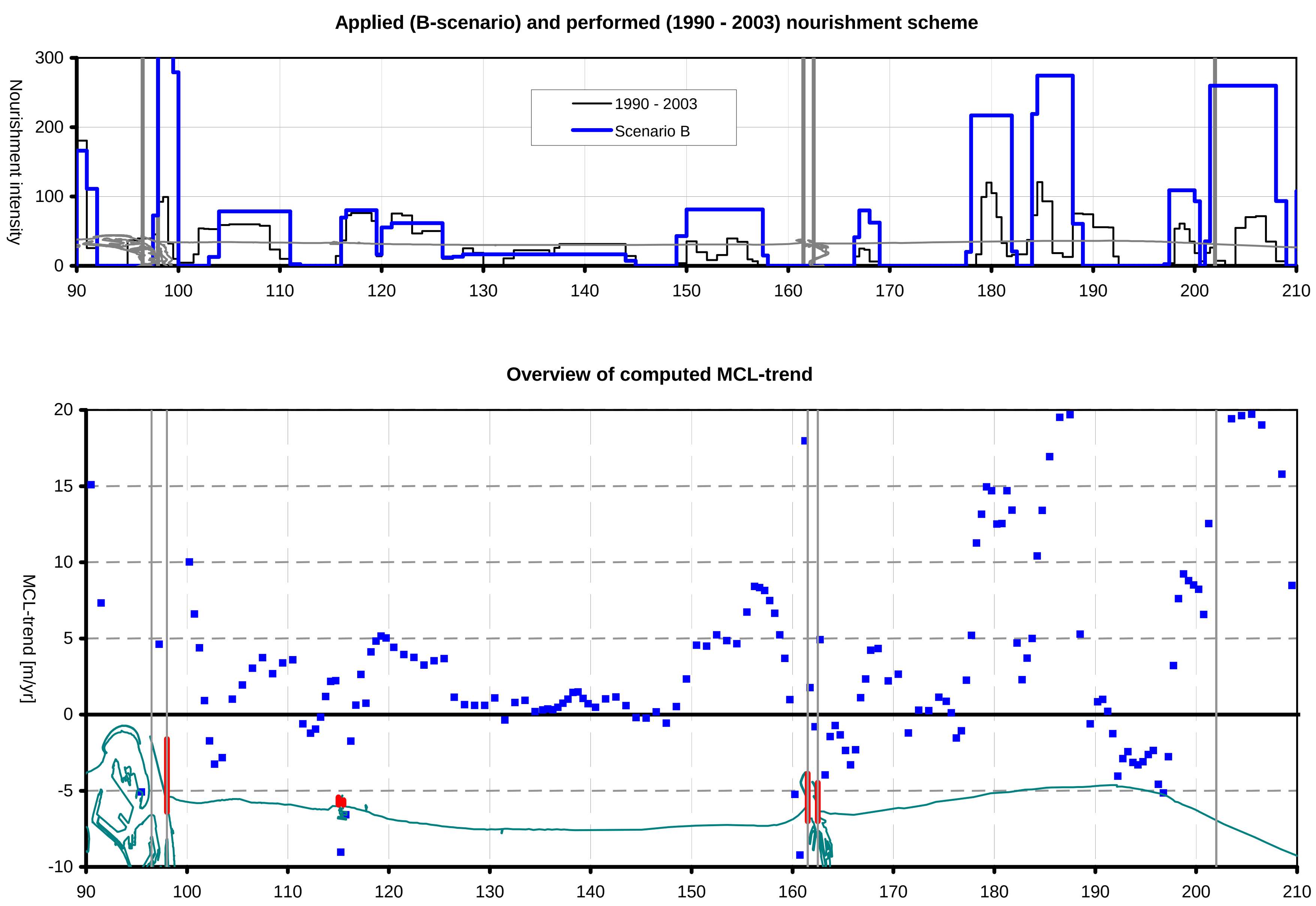
Computed time-averaged MCL-trend for the Holland coast

Application of the model for period 2003 - 2053



file: PonTos_results_r11.xls; November 2004

Z3334/A1000	PONTOS-2.0	Scenario 2A
WL / Alkyon		
Fig. 6.2		



LARGE-SCALE MODEL OF THE DUTCH COAST

Comparison applied nourishment scheme and 1990-2003 scheme

Computed time-averaged MCL-trend for the Holland coast

Application of the model for period 2003 - 2053

Z3334/A1000

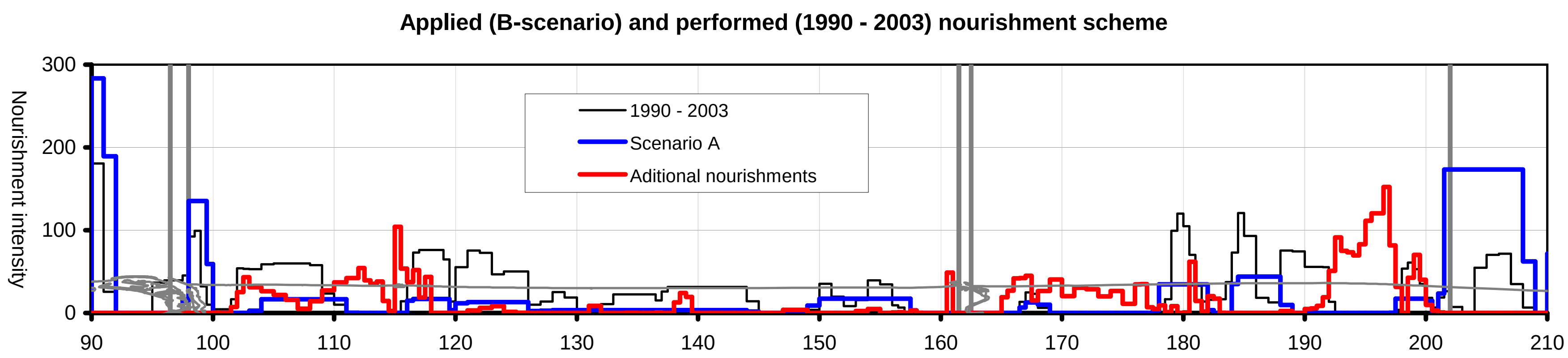
WL / Alkyon

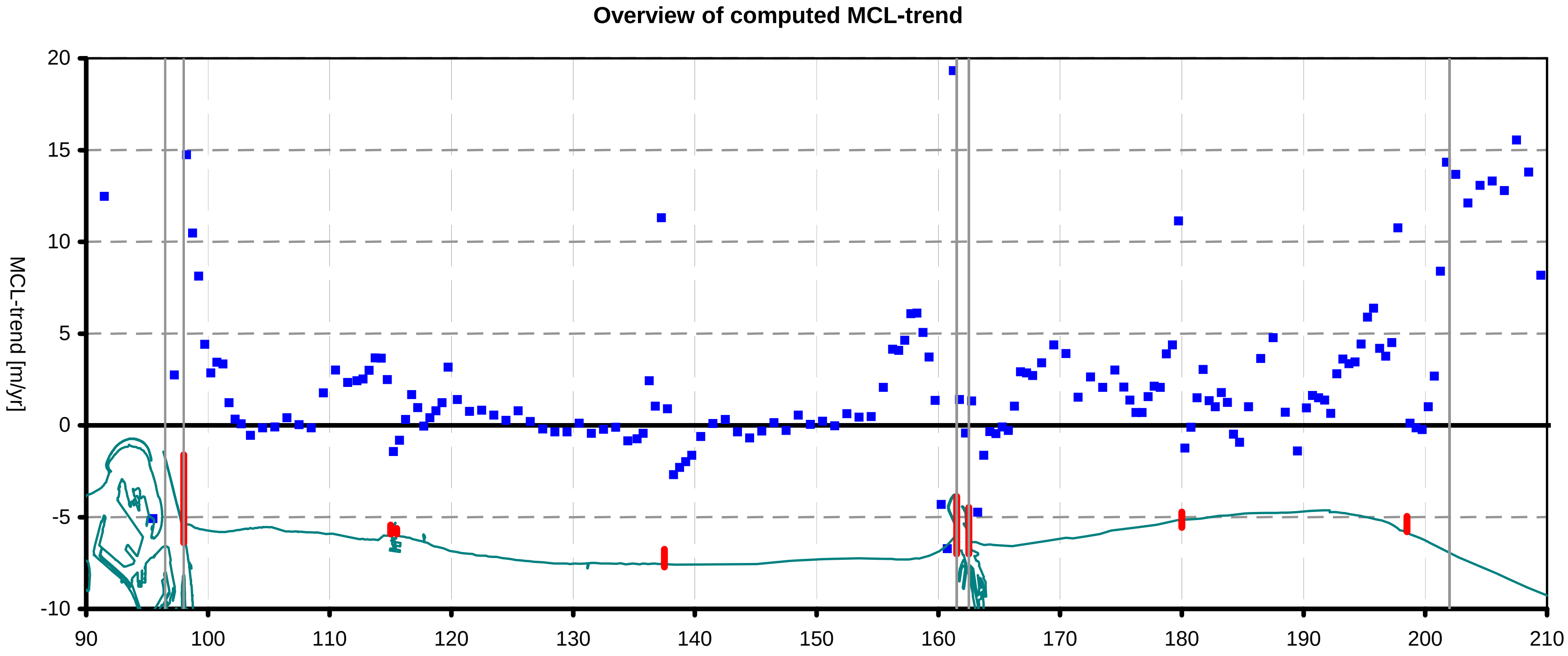
Scenario 2B

PONTOS-2.0

Fig. 6.3

file: PonTos_results_r11.xls; November 2004





file: PonTos_results_r11.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Comparison applied nourishment scheme and 1990-2003 scheme

Computed time-averaged MCL-trend for the Holland coast

Application of the model for period 2003 - 2053

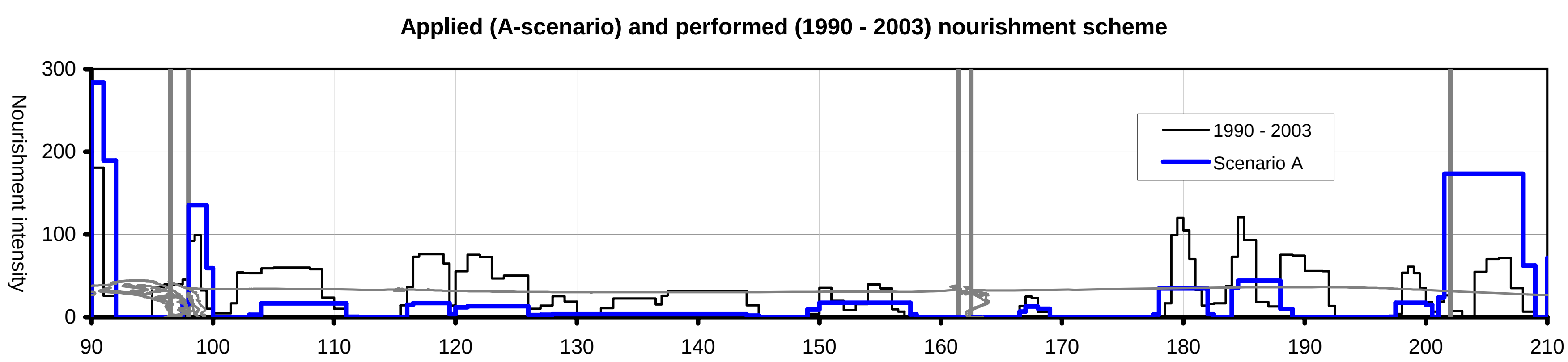
Z3334/A1000

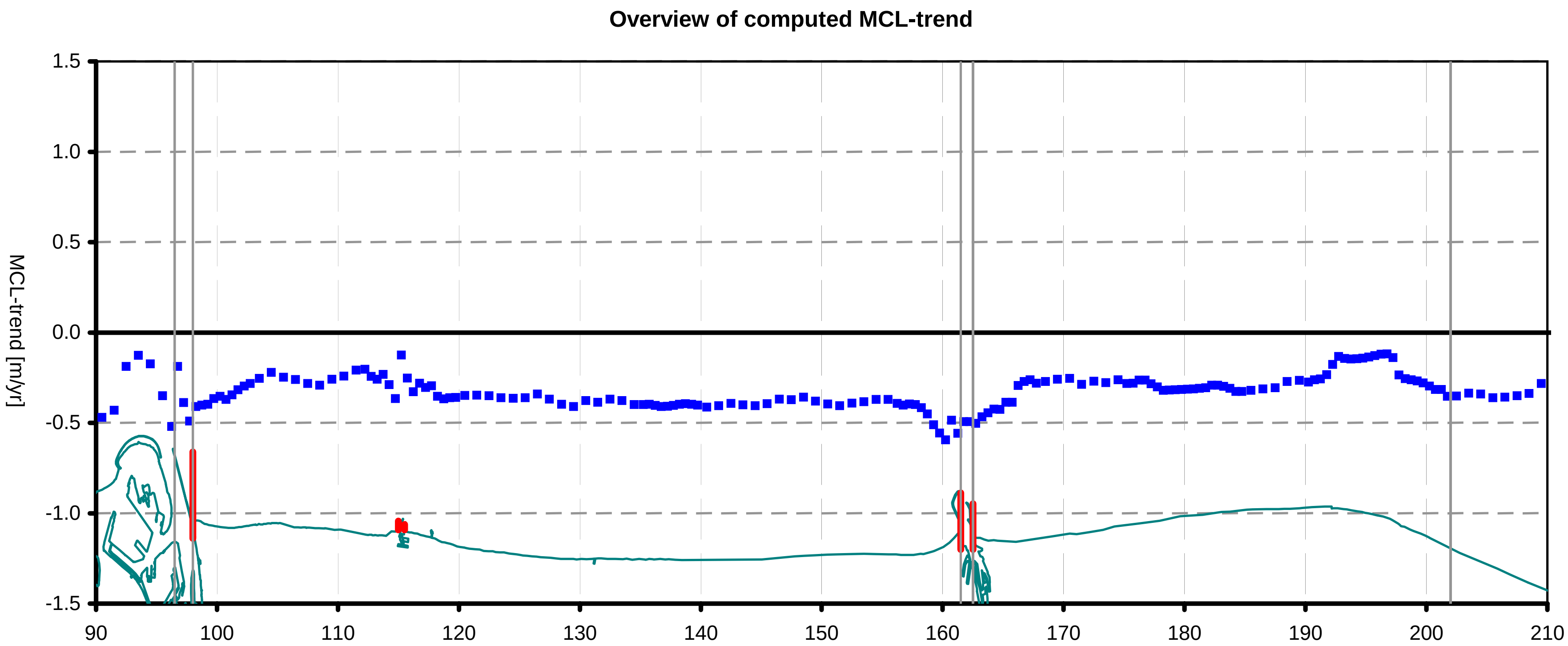
WL / Alkyon

Scenario 2C

PONTOS-2.0

Fig. 6.4





file: PonTos_results_r11.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

Difference between 0.60 ad 0.20 m/century for the Holland coast

Relative effect of increased sea-level rise on MCL-trend

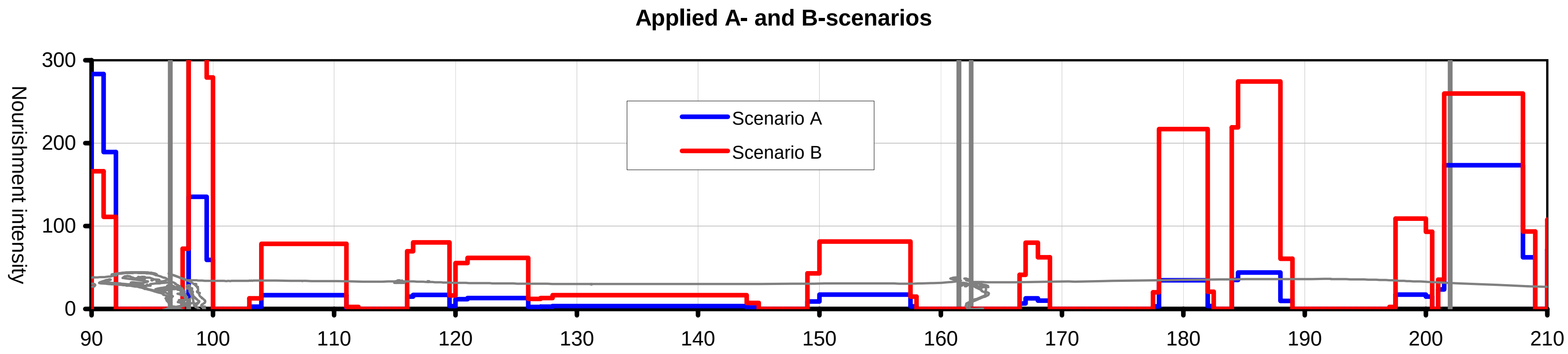
Application of the model for period 2003 - 2053

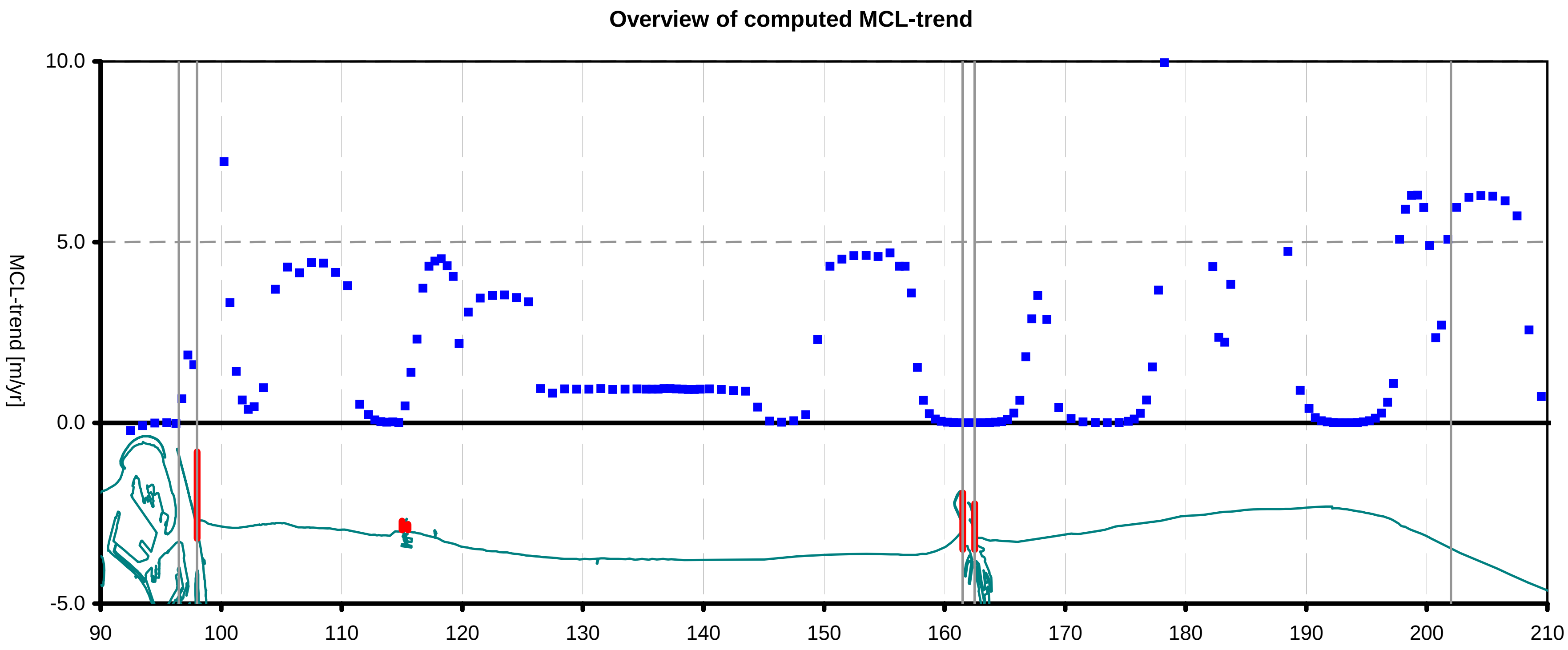
WL / Alkyon

Scenario 2A - 1A

PONTOS-2.0

Fig. 6.5





Application of the model for period 2003 - 2053
Relative effect of other nourishment scheme on MCL-trend
Difference between B- and A-scenario for the Holland coast

PONTOS-2.0
Scenario 2B - 2A

LARGE-SCALE MODEL OF THE DUTCH COAST
Z3334/A1000
WL / Alkyon
Fig. 6.6

file: PonTos_results_r11.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Application of the model for period 2003 - 2053

Relative effect of structures and updated nourishment scheme on MCL-trend; Difference between C- and A-scenario for the Holland coast

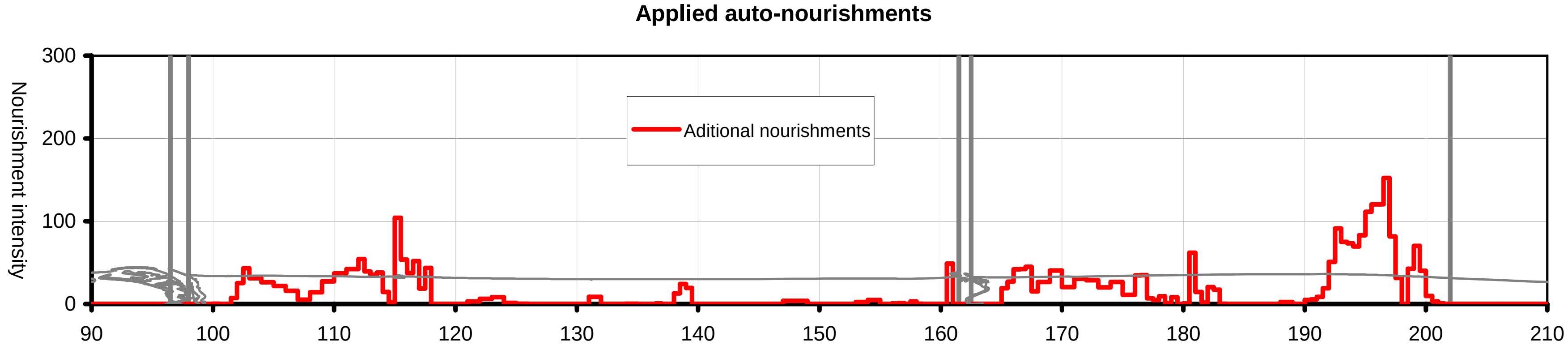
PONTOS-2.0

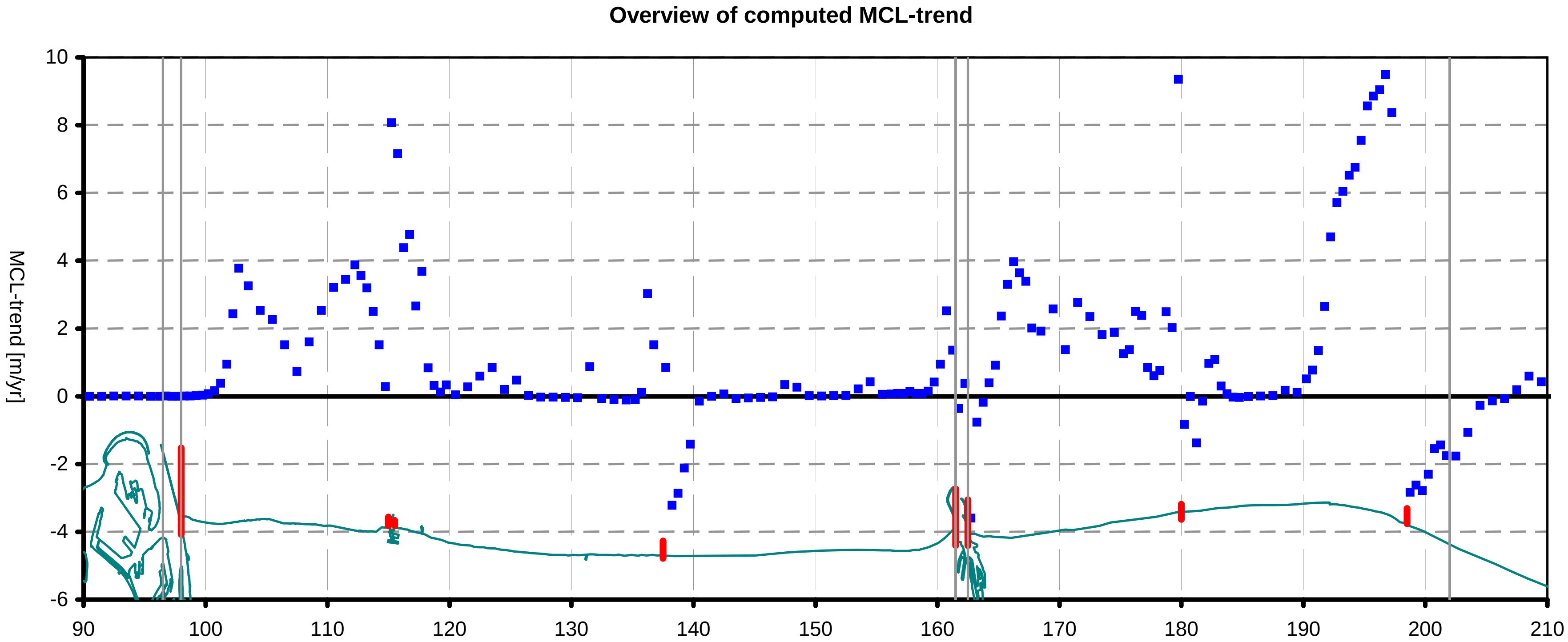
Scenario 2C - 2A

WL / Alkyon

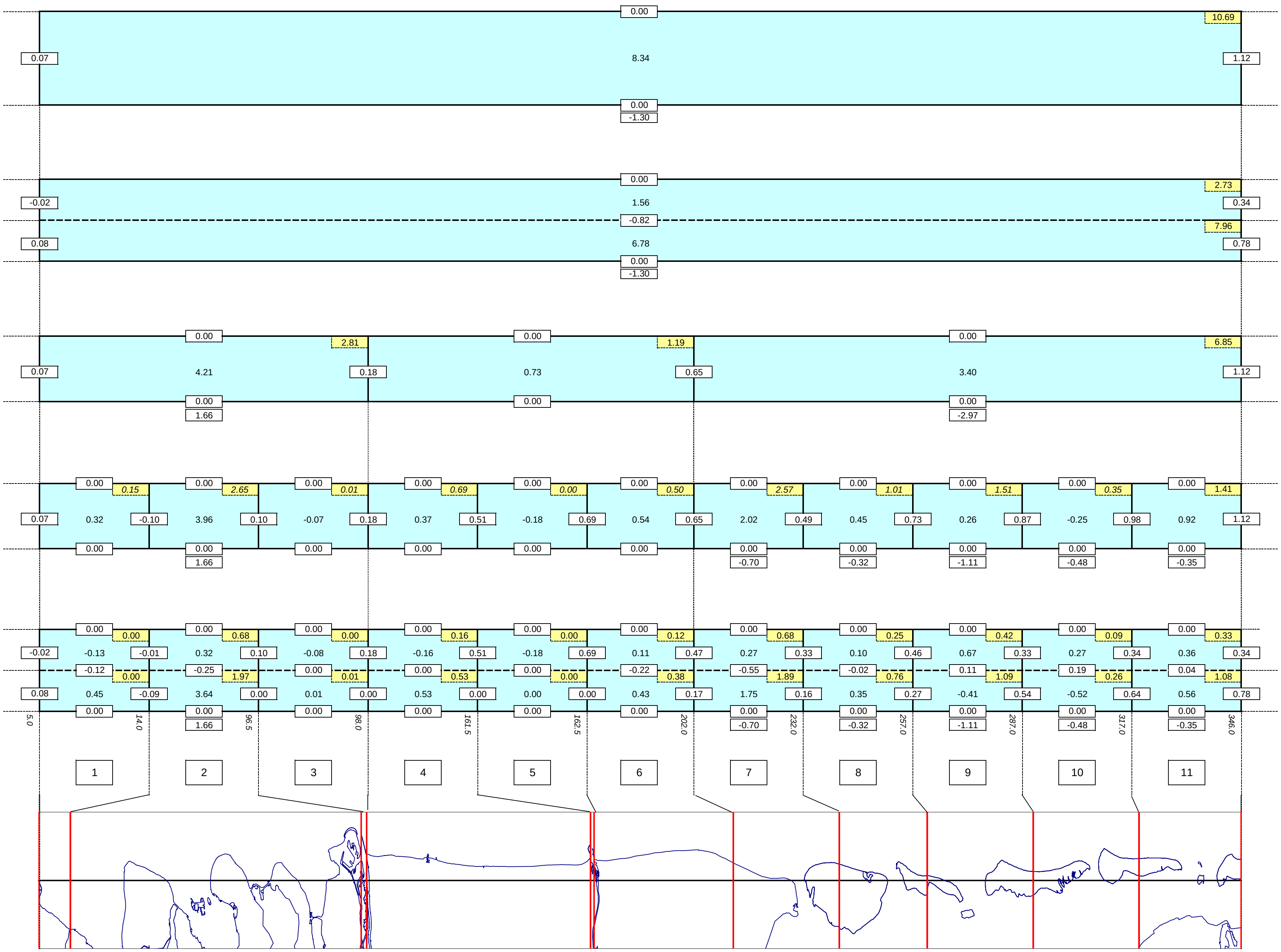
Z3334/A1000

Fig. 6.7





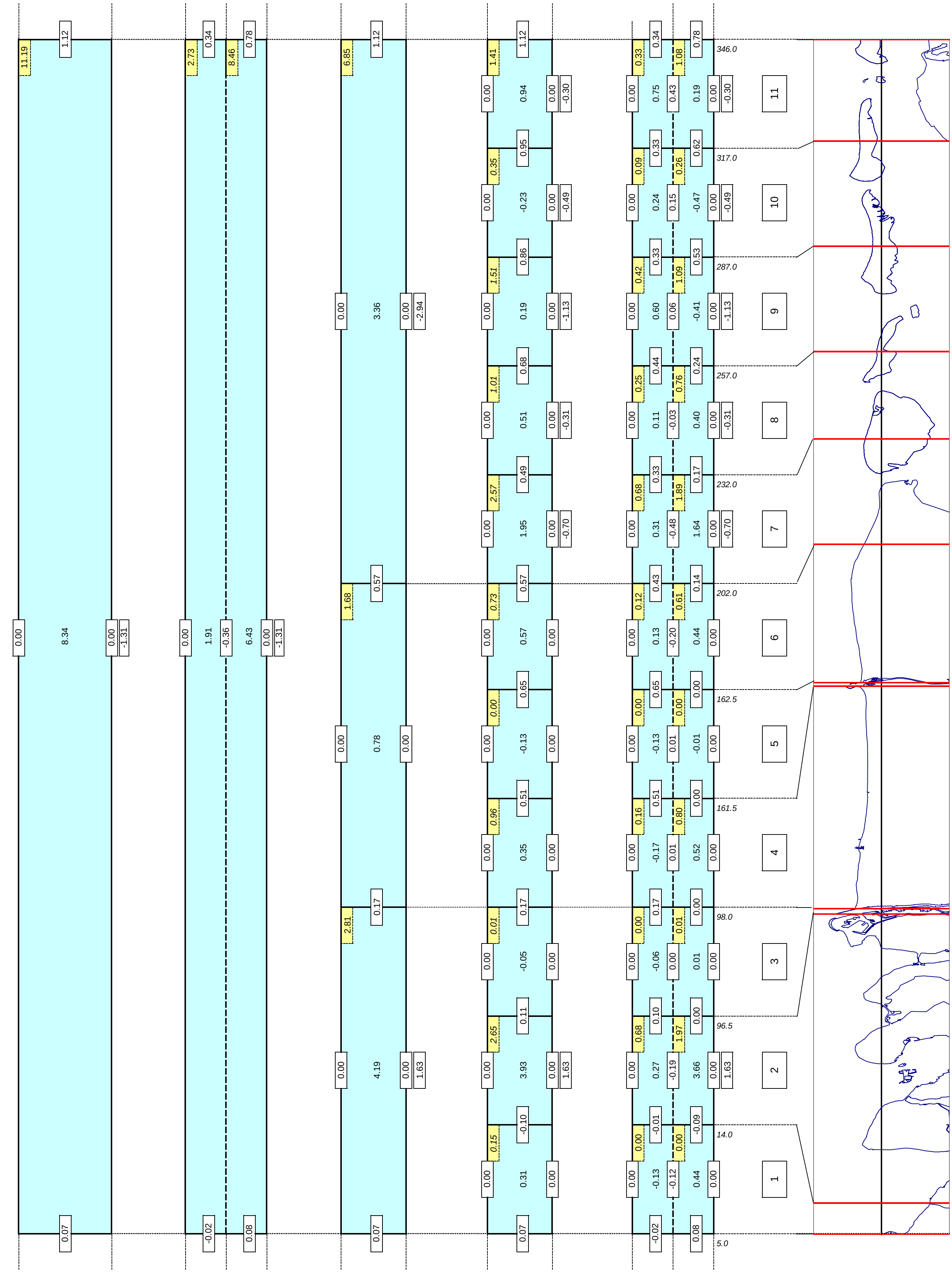
file: PonTos_results_r11.xls; November 2004



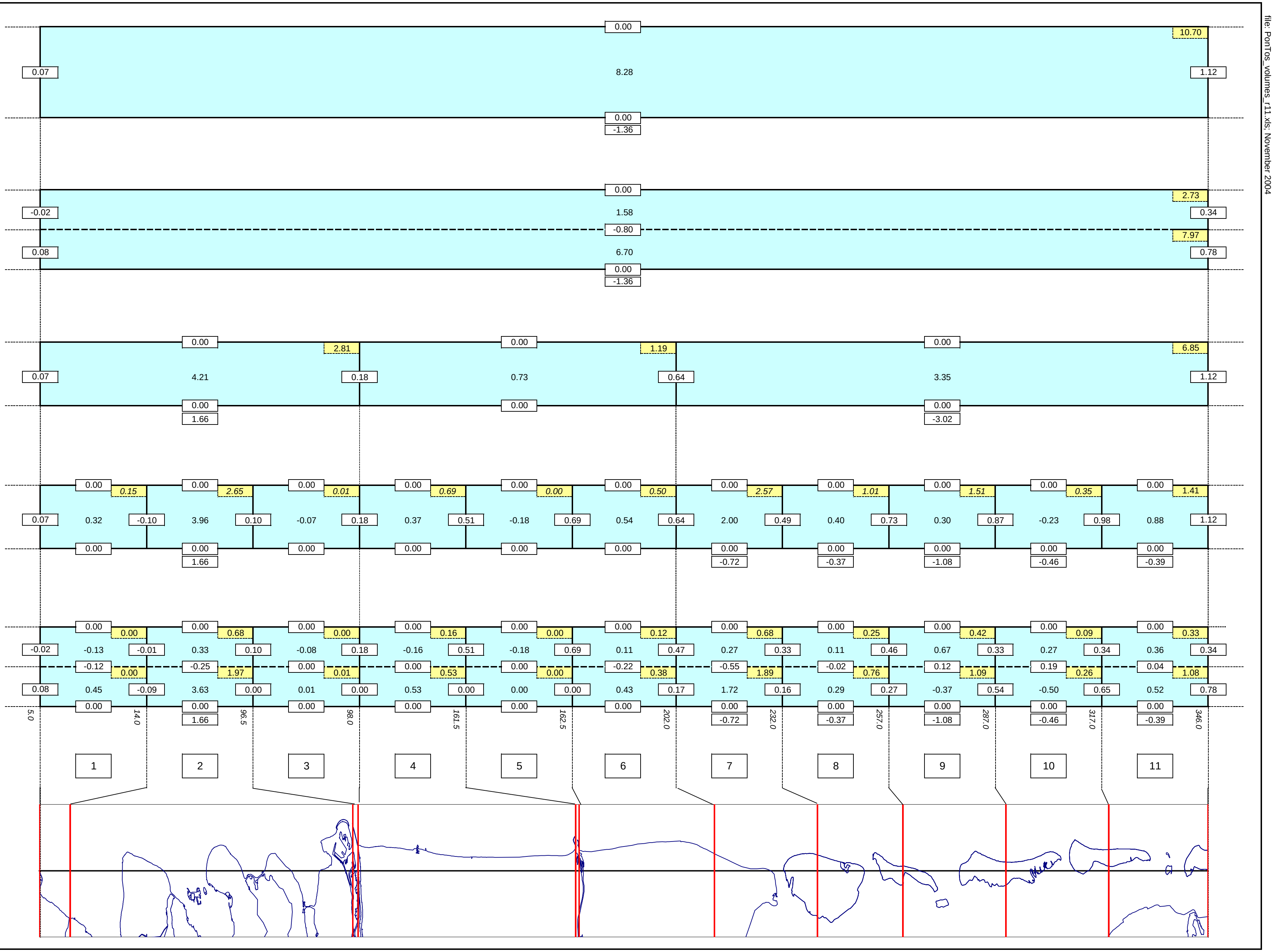
file: PonTos_volumes_r11.xls; November 2004

Application of the model	PONTOS-2.0
Overview of computed large-scale developments	2003 - 2013
For scenario 1A; 10-year averaged	Run_P1A
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL | Alkyon** Fig. 6.8a

file: PonTos_volumes_r11.xls; November 2004



Application of the model	PONTOS-2.0
Overview of computed large-scale developments	2003 - 2053
For scenario 1A; 50-year averaged	Run_P1A
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.8b



Application of the model

Overview of computed large-scale developments

For scenario 2A; 10-year averaged

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

PONTOS-2.0

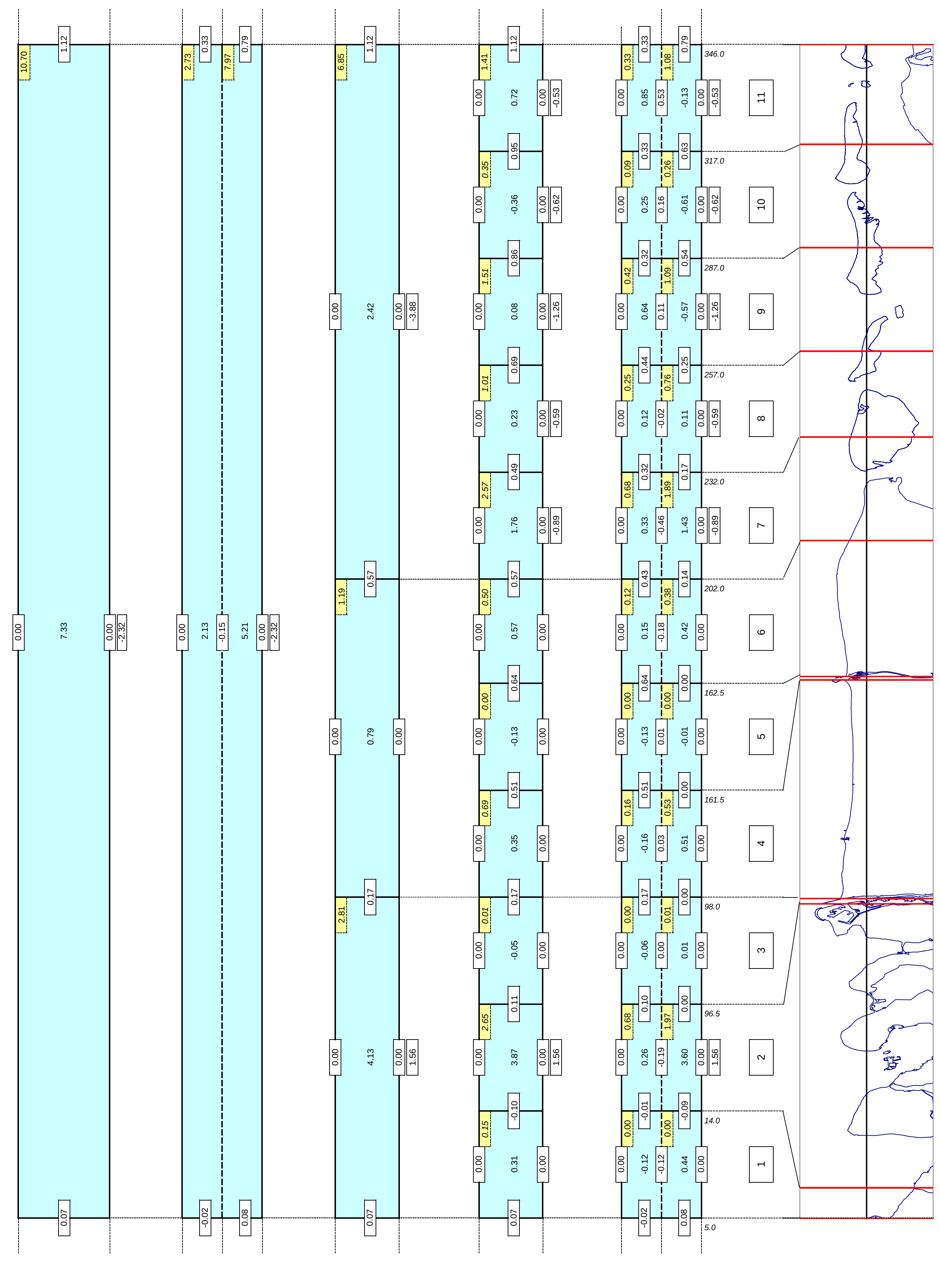
2003 - 2053

Run_P2A

WL / Alkyon

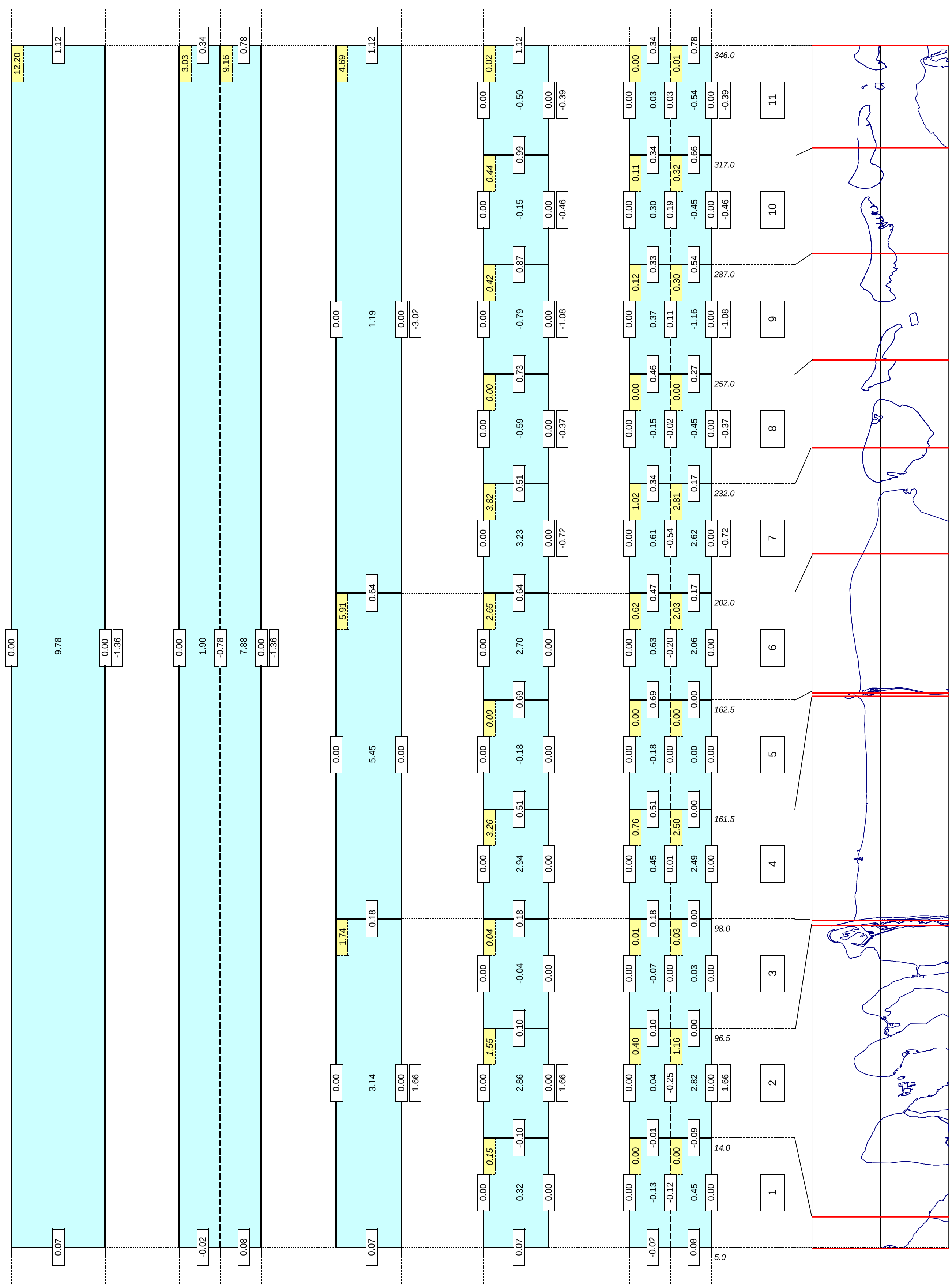
Fig. 6.9a

file: PonTos_volumes_r11.xls; November 2004

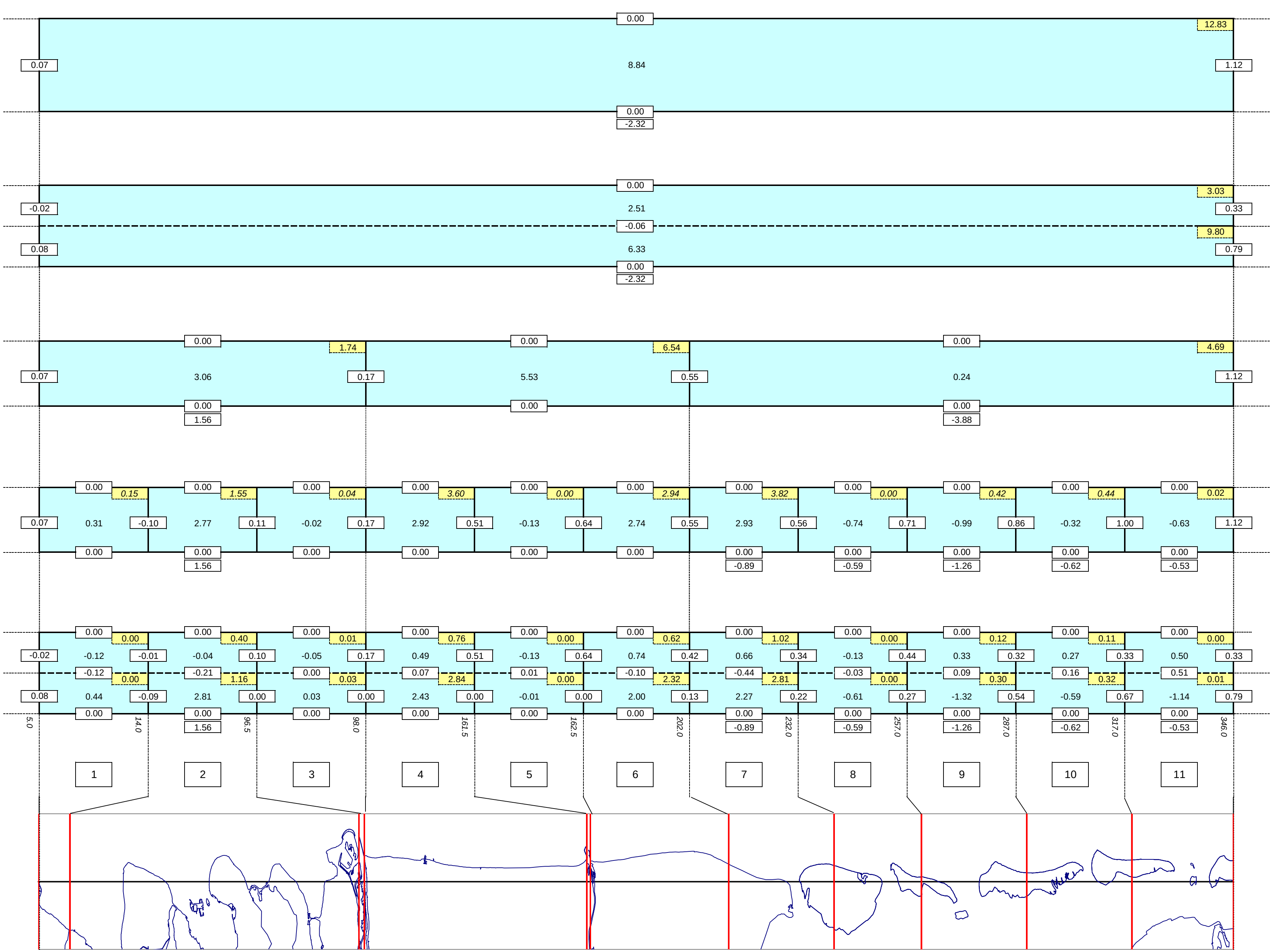


Application of the model	PONTOS-2.0
Overview of computed large-scale developments	2003 - 2053
For scenario 2A; 50-year averaged	Run_P2A
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.9b

file: PonTos_volumes_r11.xls; November 2004



Application of the model	PONTOS-2.0	
Overview of computed large-scale developments	2003 - 2053	
For scenario 2B; 10-year averaged	Run_P2B	
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon**	Fig. 6.10a



file: PonTos_volumes_r11.xls; November 2004

Application of the model

Overview of computed large-scale developments

For scenario 2B; 50-year averaged

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

PONTOS-2.0

2003 - 2053

Run_P2B

WL / Alkyon

Fig. 6.10b

Application of the model

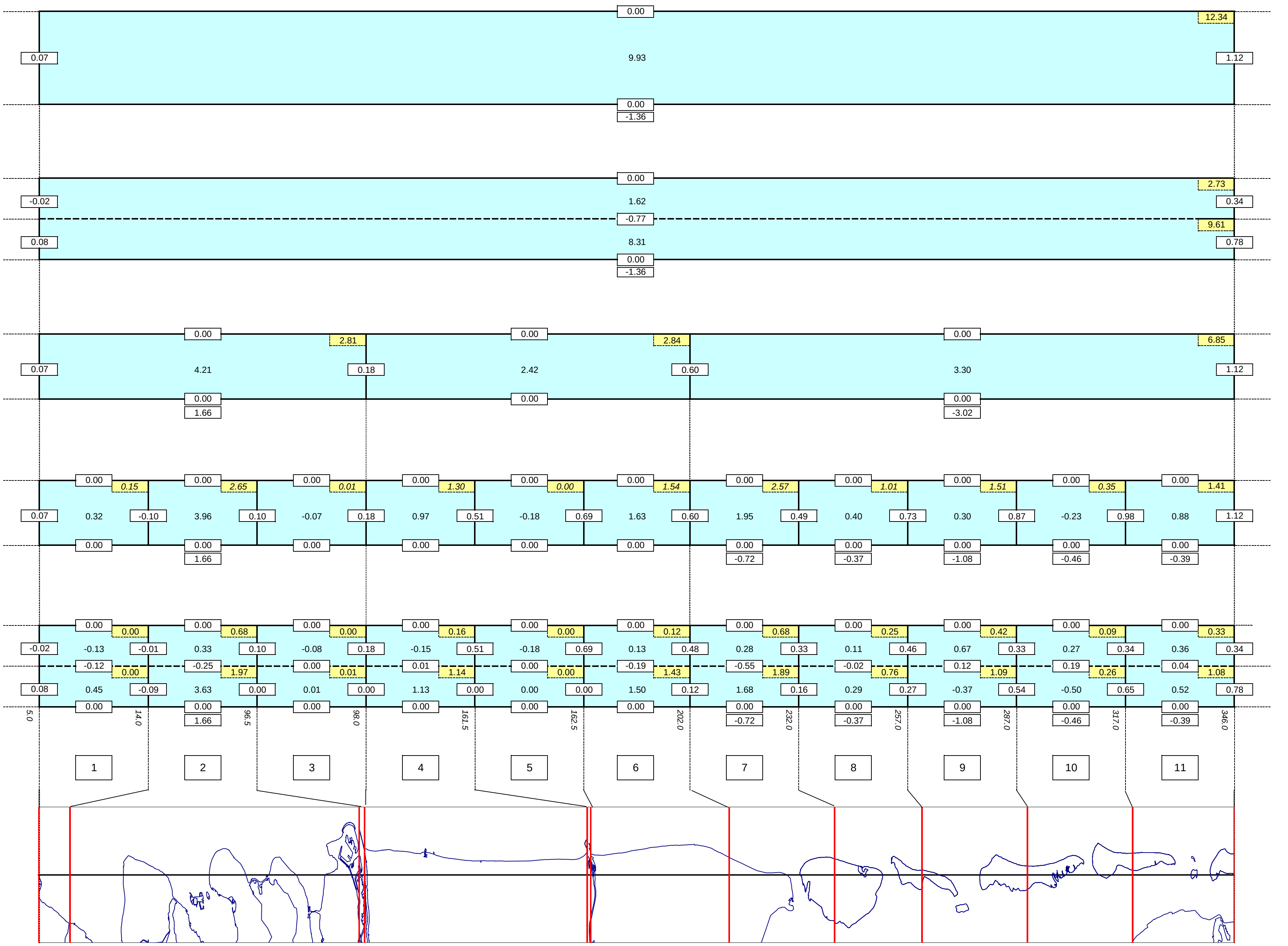
Overview of computed large-scale developments

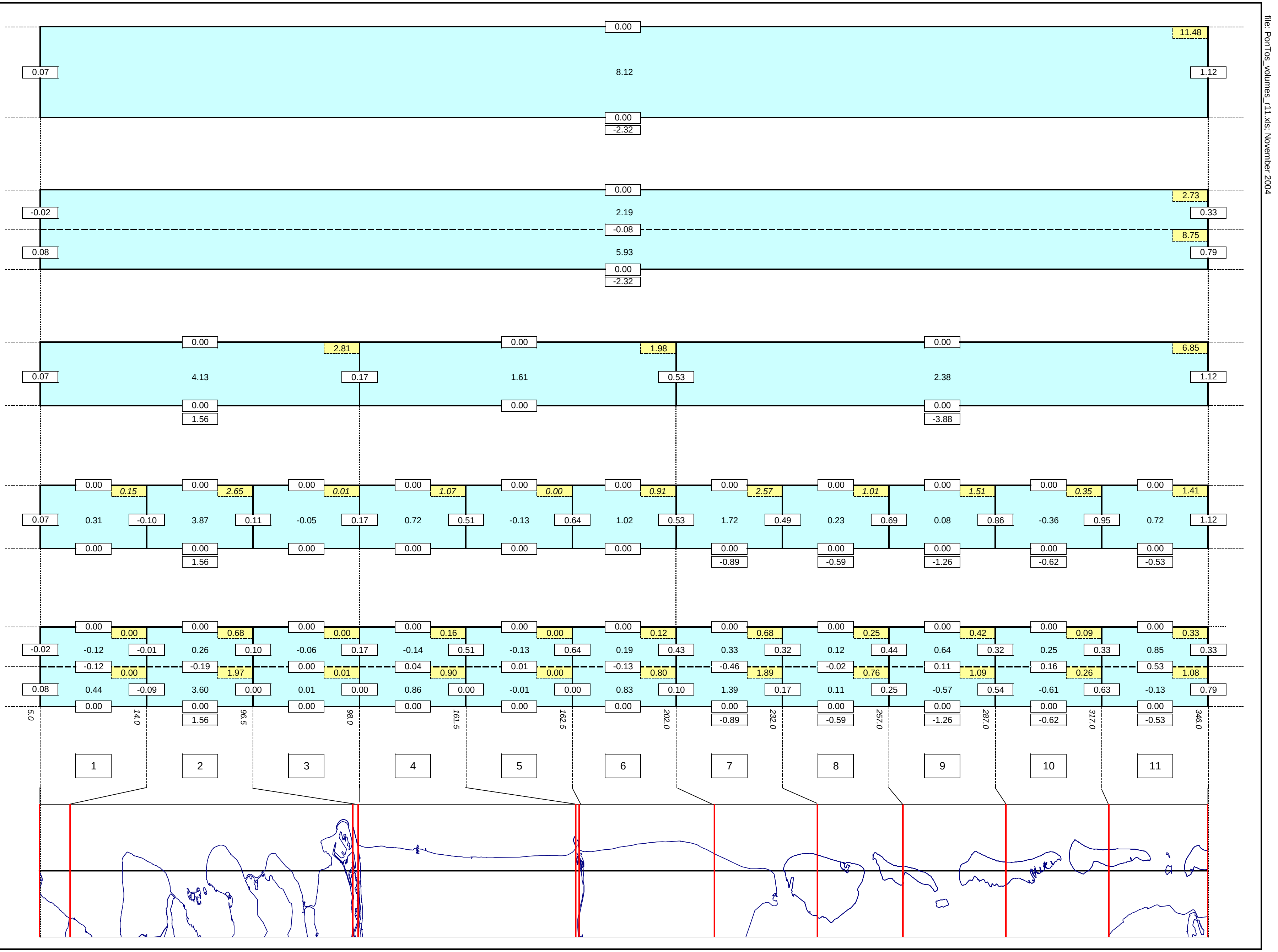
For scenario 2C; 10-year averaged

LARGE-SCALE MODEL OF THE DUTCH COAST

Z3334/A1000

PONTOS-2.0	
2003 - 2053	
Run_P2C	
WL / Alkyon	Fig. 6.11a



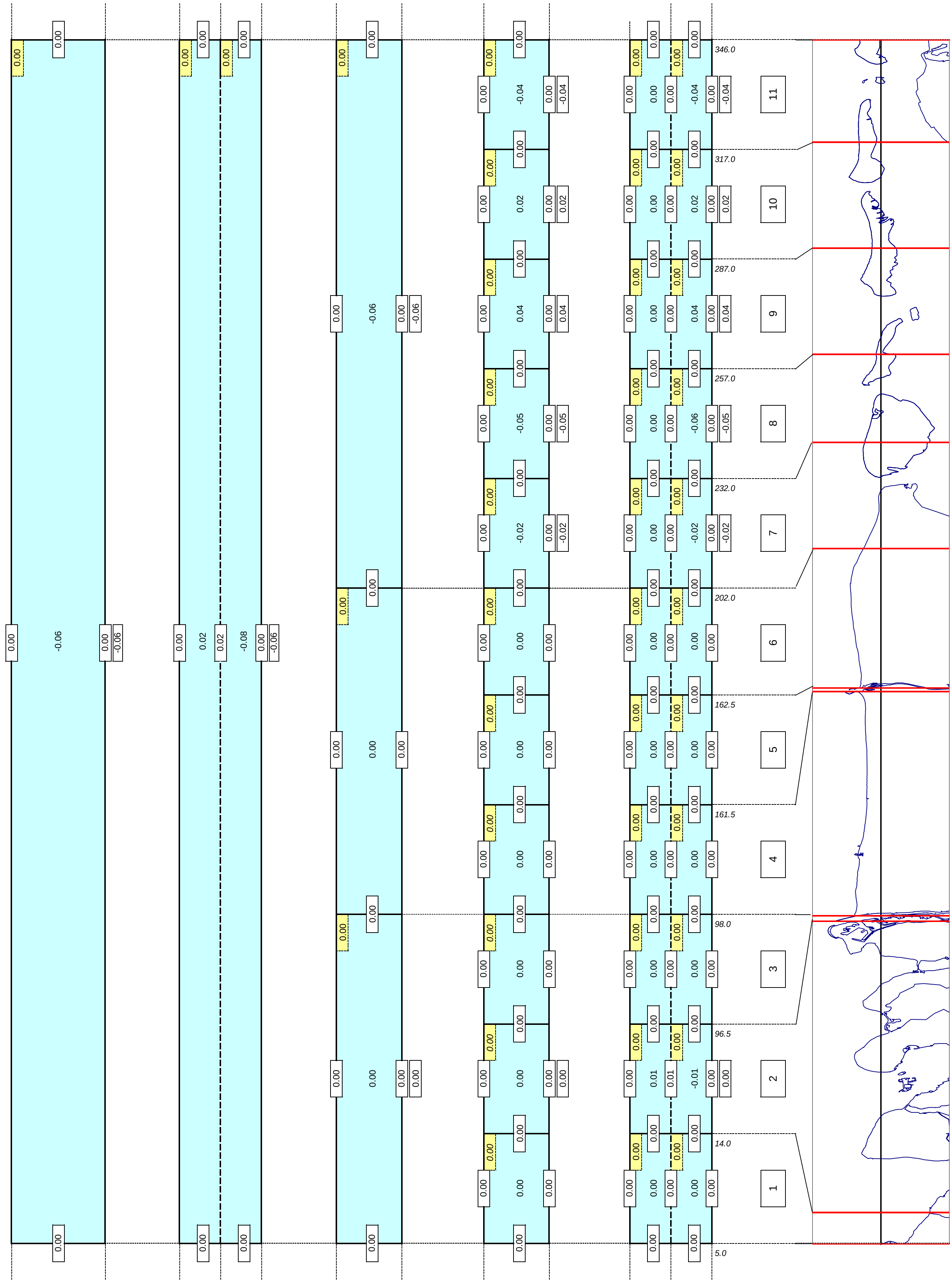


Application of the model
Overview of computed large-scale developments
For scenario 2C; 50-year averaged

LARGE-SCALE MODEL OF THE DUTCH COAST

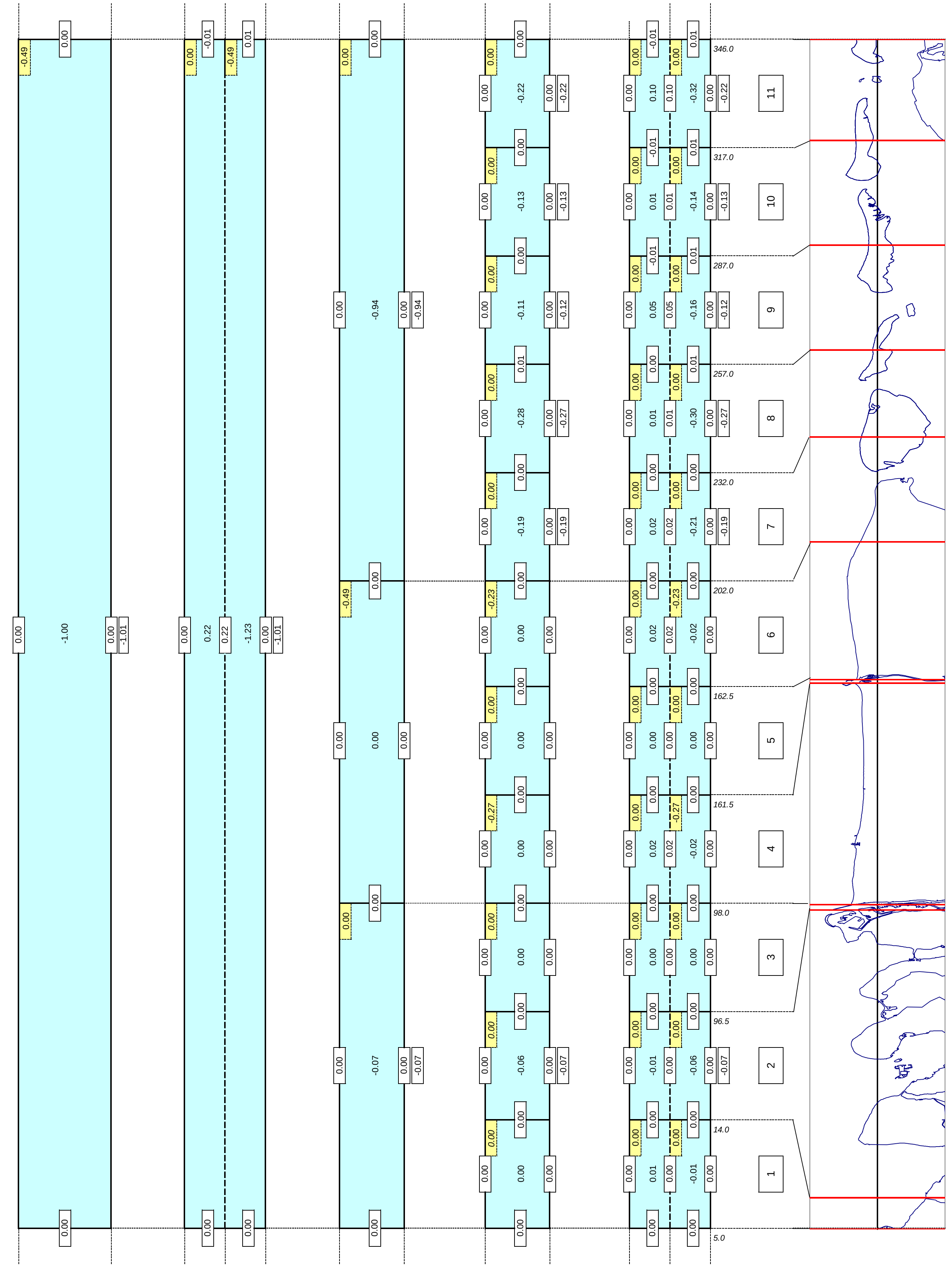
PONTOS-2.0	2003 - 2053	Run_P2C
Z3334/A1000	**WL / Alkyon**	Fig. 6.11b

file: PonTos_volumes_r11.xls; November 2004



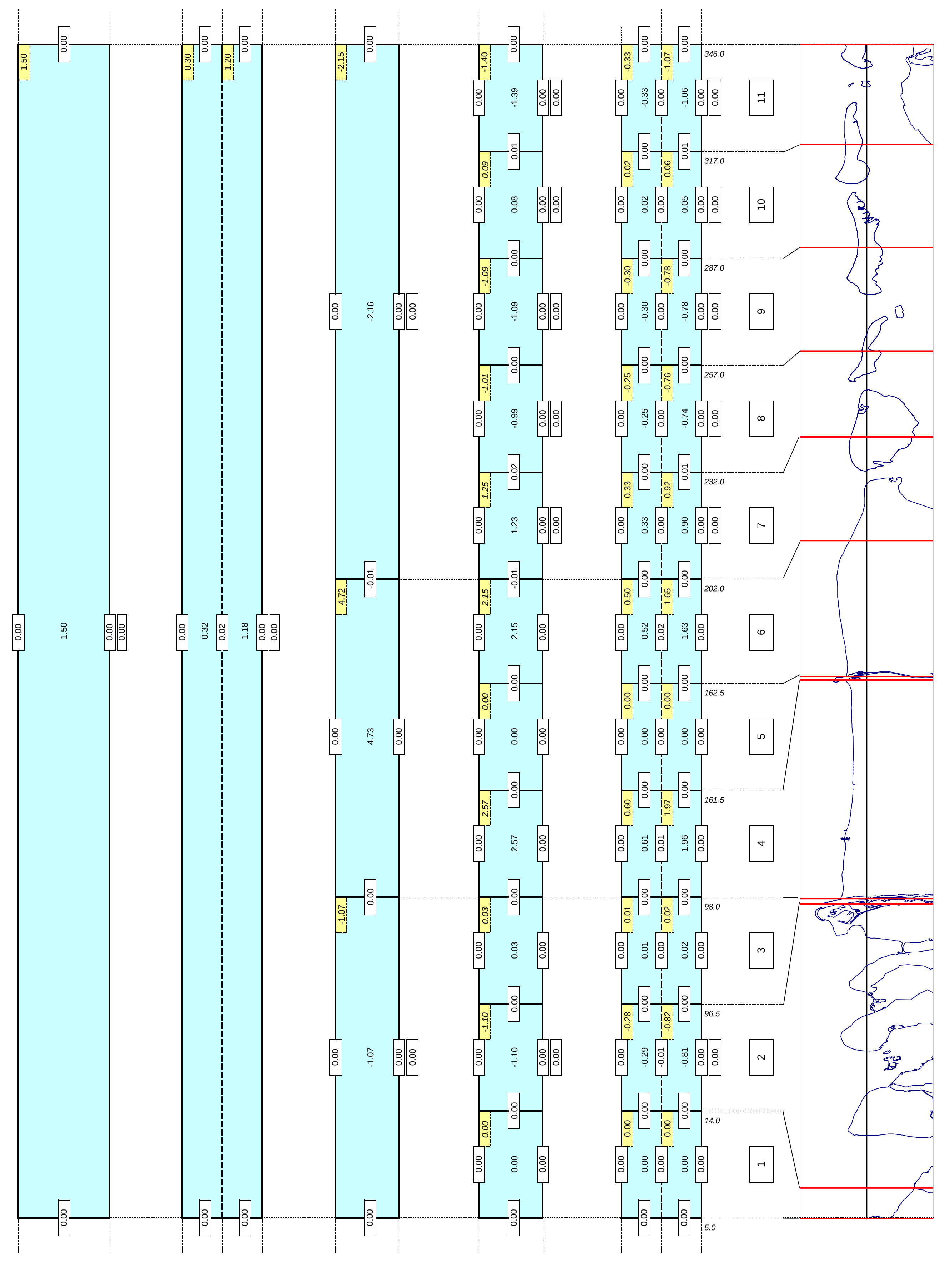
Application of the model	PONTOS-2.0
Overview of relative large-scale developments	2003 - 2053
Effect of increased sea level rise based on 10-year averaged trends	Run_P2A - Run_P1A
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.12a

file: PonTos_volumes_r11.xls; November 2004



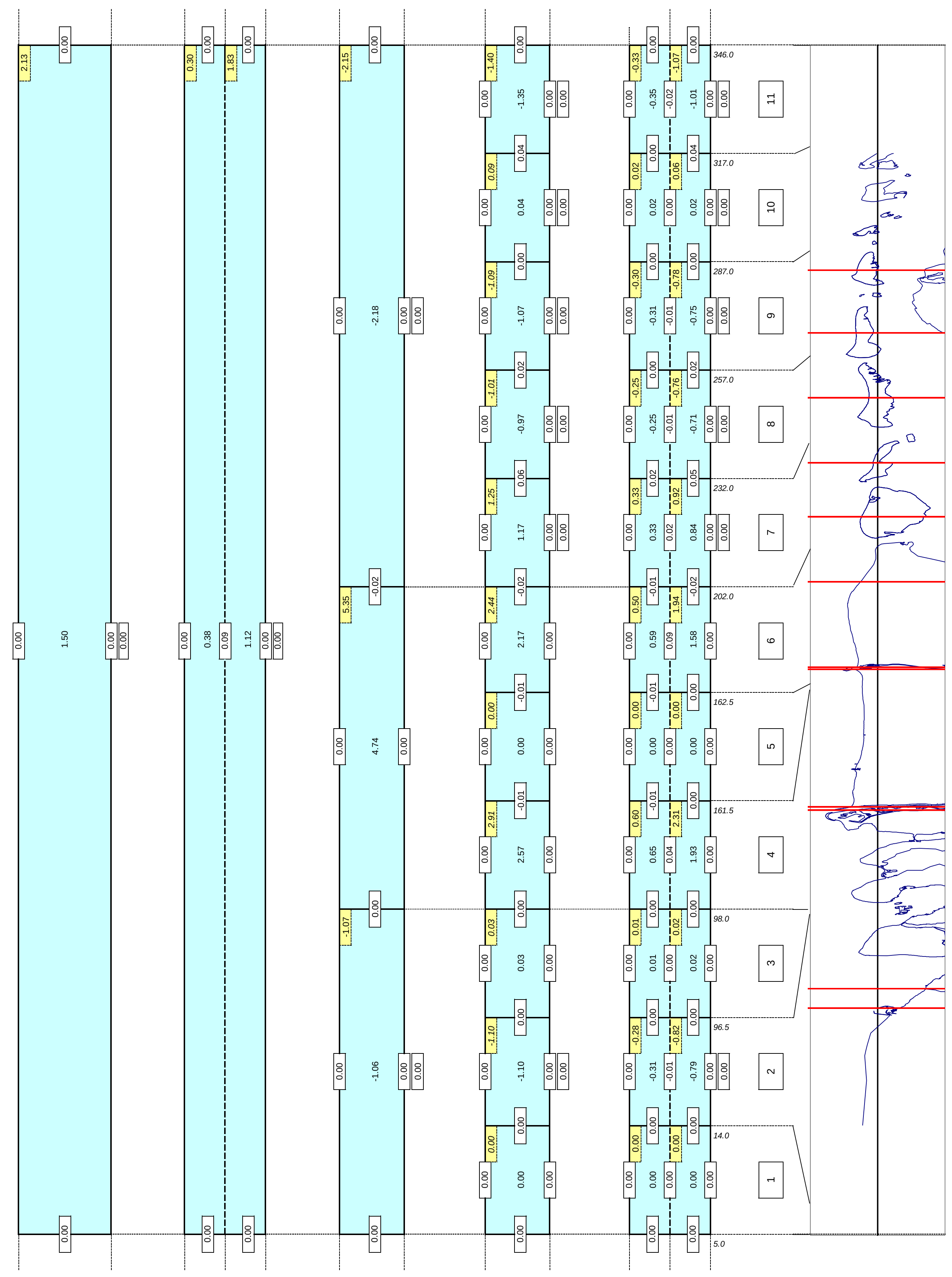
Application of the model	PONTOS-2.0
Overview of relative large-scale developments	2003 - 2053
Effect of increased sea level rise based on 50-year averaged trends	Run_P2A - Run_P1A
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.12b

file: PonTos_volumes_r11.xls; November 2004



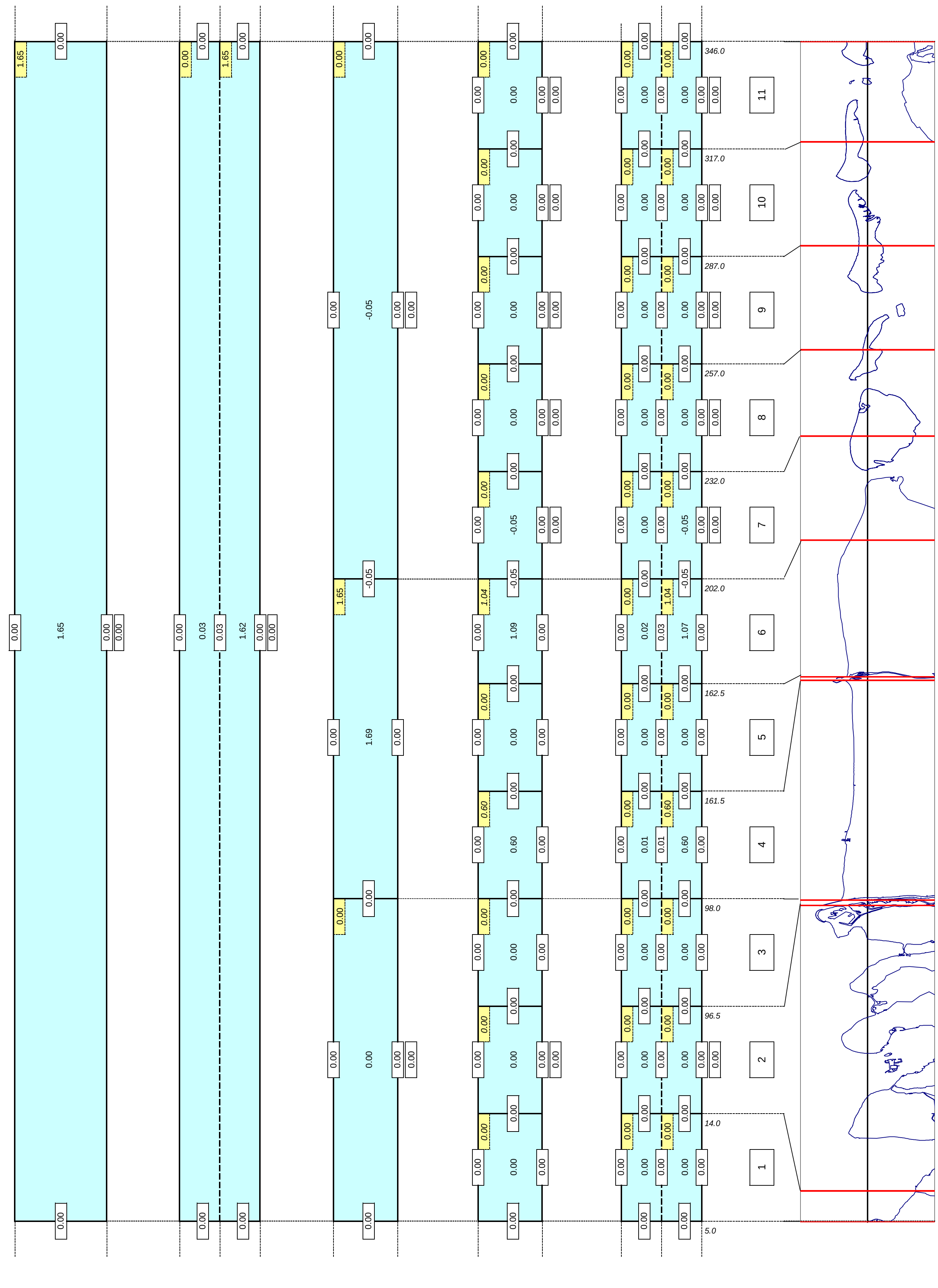
Application of the model	PONTOS-2.0
Overview of relative large-scale developments	2003 - 2053
Effect of other nourishment scheme based on 10-year averaged trends	Run_P2B - Run_P2A
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.13a

file: PonTos_volumes_r11.xls; November 2004



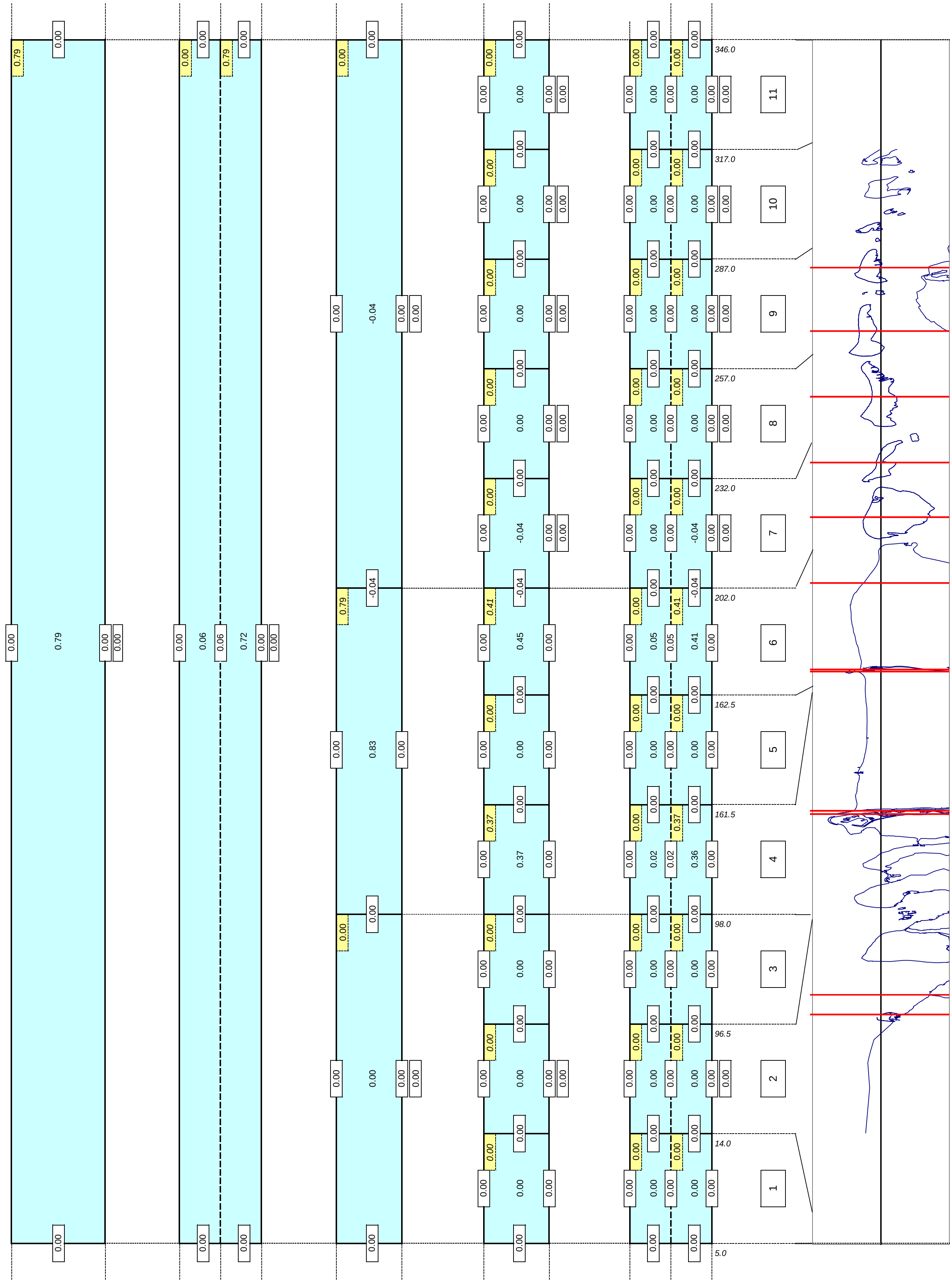
Application of the model	PONTOS-2.0
Overview of relative large-scale developments	2003 - 2053
Effect of other nourishment scheme based on 50-year averaged trends	Run_P2B - Run_P2A
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.13b

file: PonTos_volumes_r11.xls; November 2004



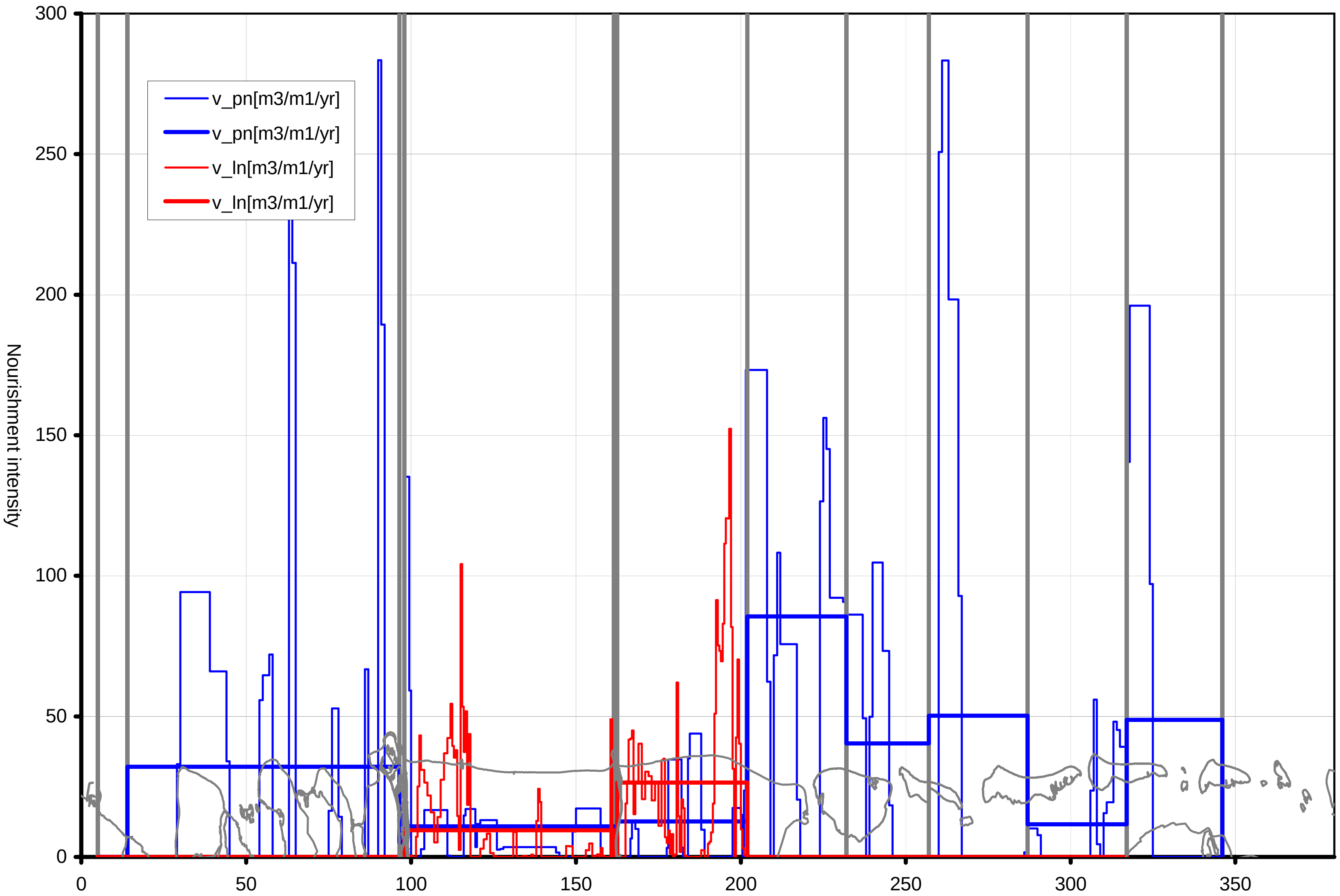
Application of the model	PONTOS-2.0
Overview of relative large-scale developments	2003 - 2053
Effect of additional structures based on 10-year averaged trends	
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.14a

file: PonTos_volumes_r11.xls; November 2004



Application of the model Overview of relative large-scale developments Effect of additional structures based on 50-year averaged trends	PONTOS-2.0 2003 - 2053
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.14b

Nourishments - pre-defined (v_pn) & auto-nourished (v_ln) (P2C)



LARGE-SCALE MODEL OF THE DUTCH COAST

Application of the model for period 2003 - 2053

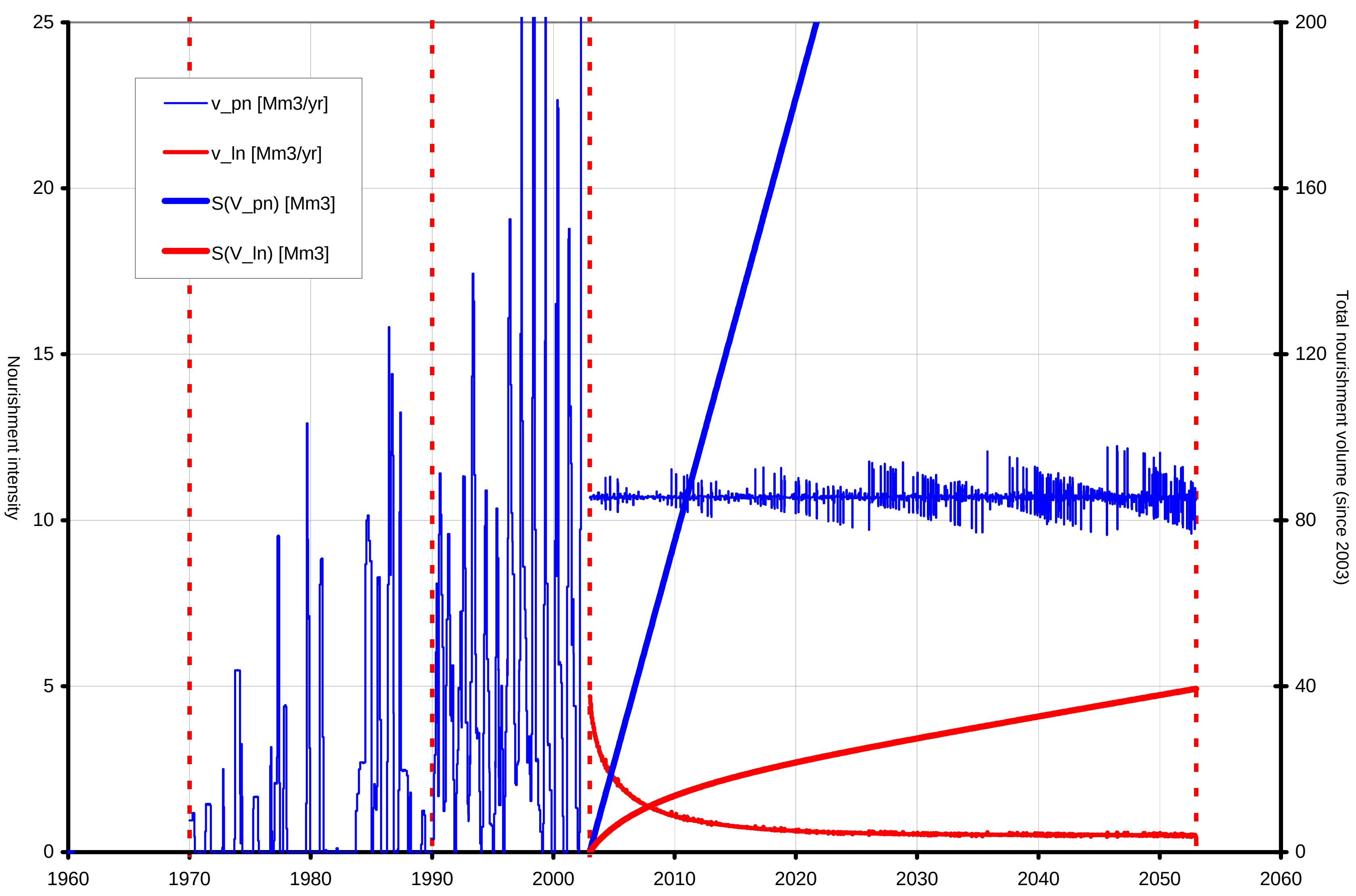
Longshore distribution of auto- an predefined nourishments

For both gridcells and sections

Z3334/A1000	PONTOS-2.0
	Scenario 2C
	2003 - 2053
WL / Alkyon	Fig. 6.15

file: PonTos_results_r11.xls; November 2004

Evolution of nourishment volumes and intensity (P2C)



file: PonTos_results_r11.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Application of the model for period 2003 - 2053

Evolution of nourishment intensity

Z3334/A1000

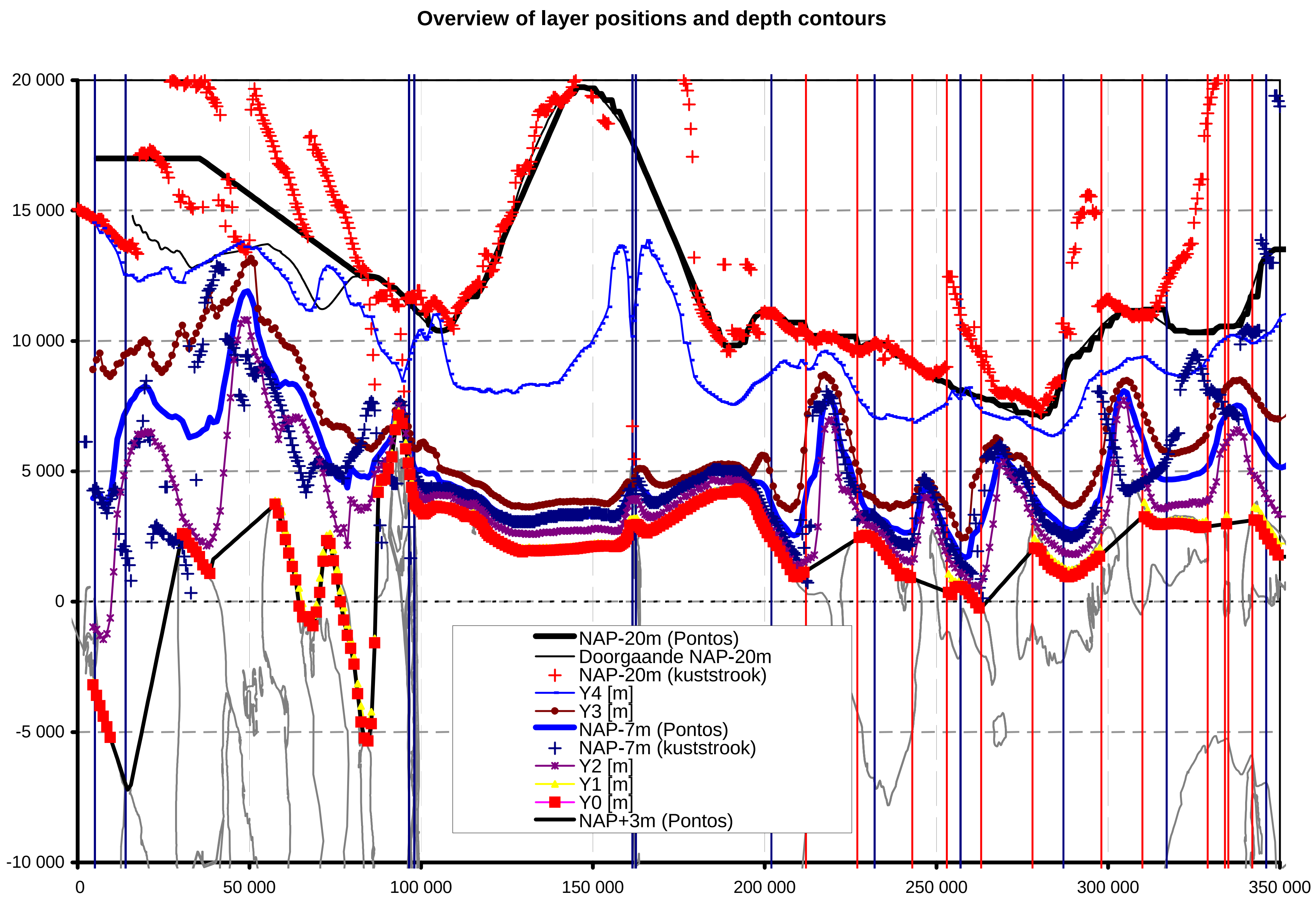
WL / Alkyon

1970 - 2053

Scenario 2C

PONTOS-2.0

Fig. 6.16



=file: PonTos_volumes_r11.xls; November 2004

LARGE-SCALE MODEL OF THE DUTCH COAST

Definition of cross-shore boundaries of upper and lower cells

Overview of relevant layer positions for area assessment

Z3334/A1000	2003	PONTOS-2.0
WL / Alkyon		
Fig. 6.17		

LARGE-SCALE MODEL OF THE DUTCH COAST

Overview of estimated areas (expressed in km^2) per individual coastal cell used for assessment of basic erosion rates

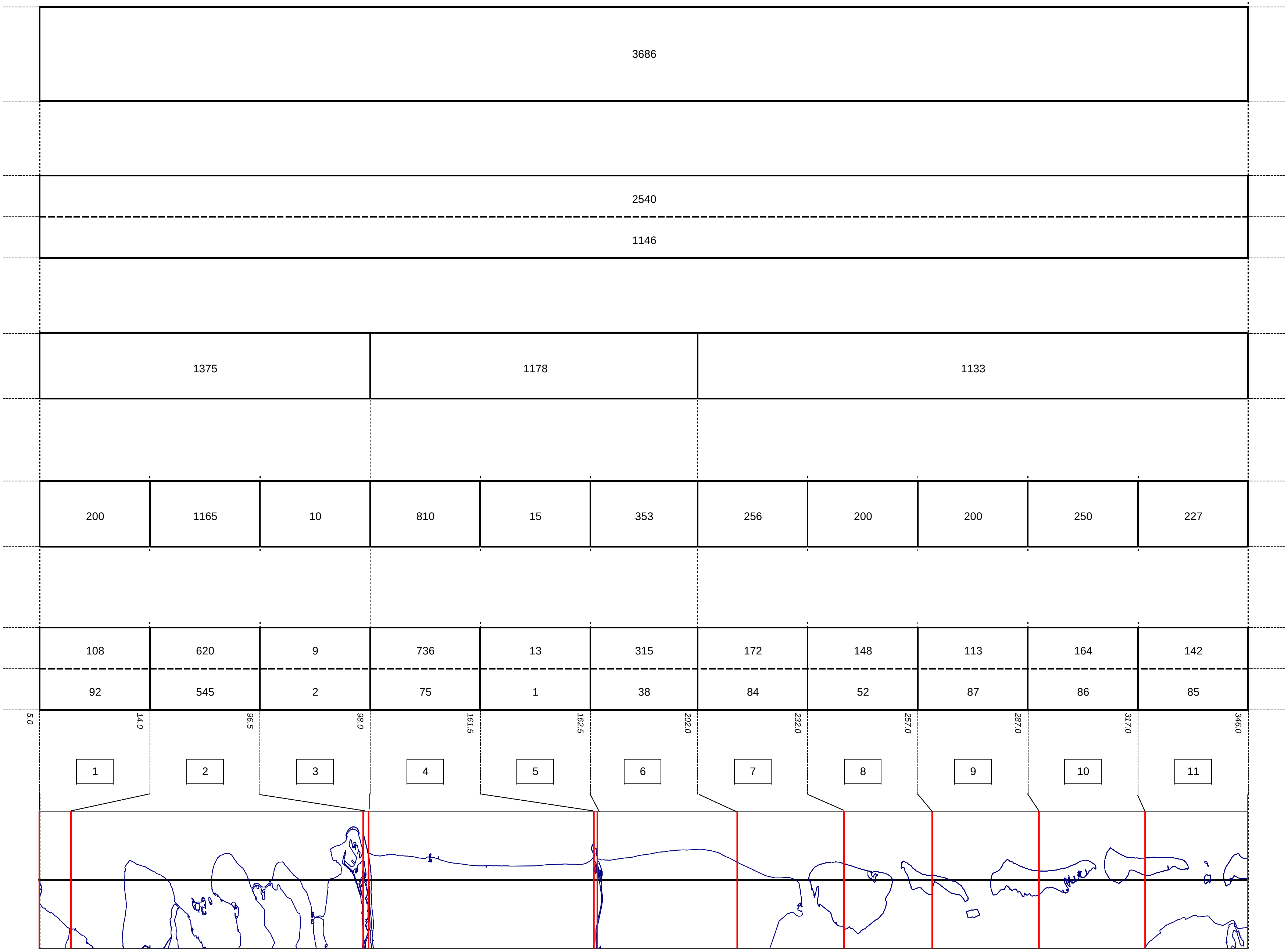
PONTOS-2.0

2003

Z3334/A1000

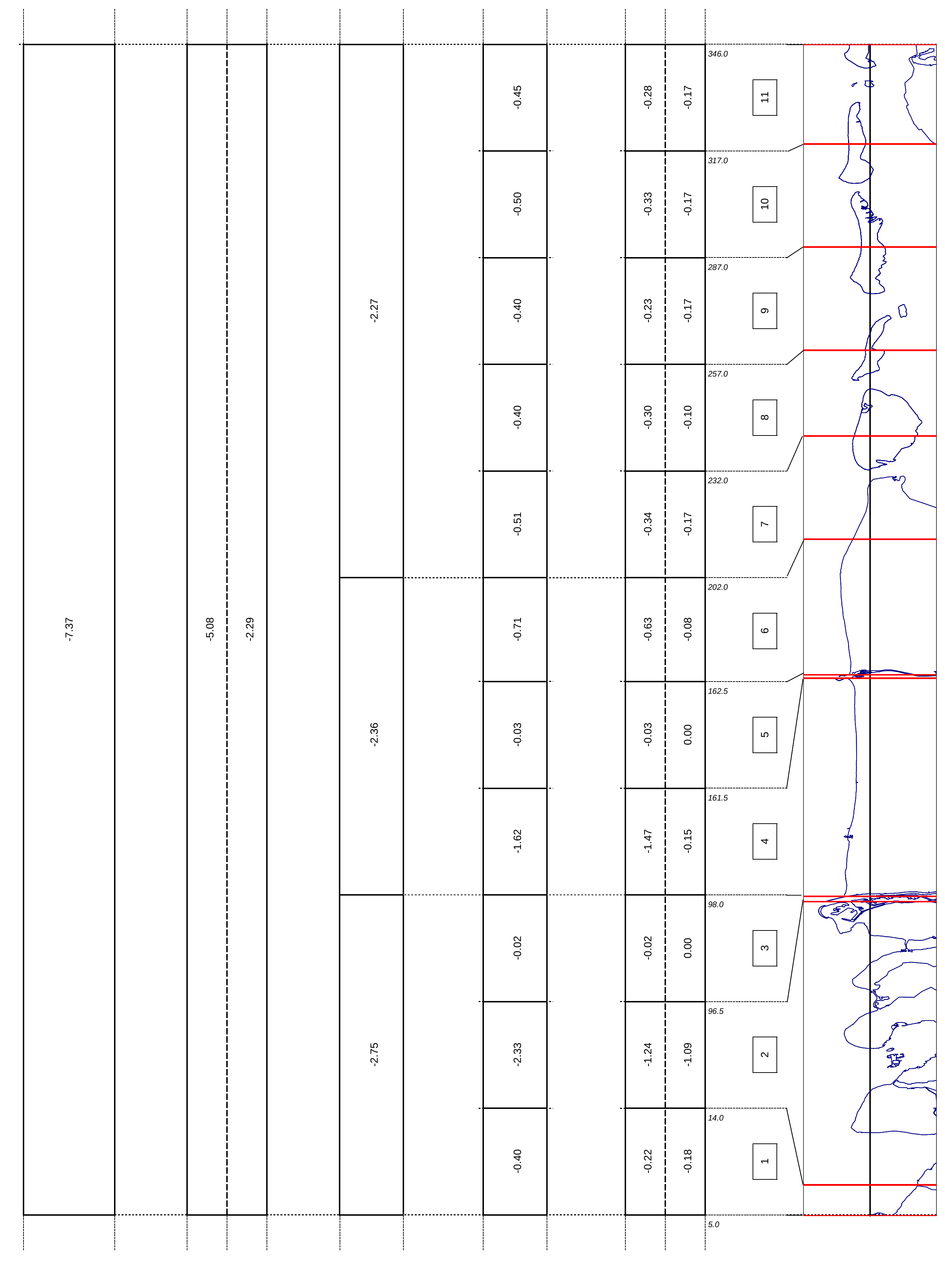
WL / Alkyon

Fig. 6.18



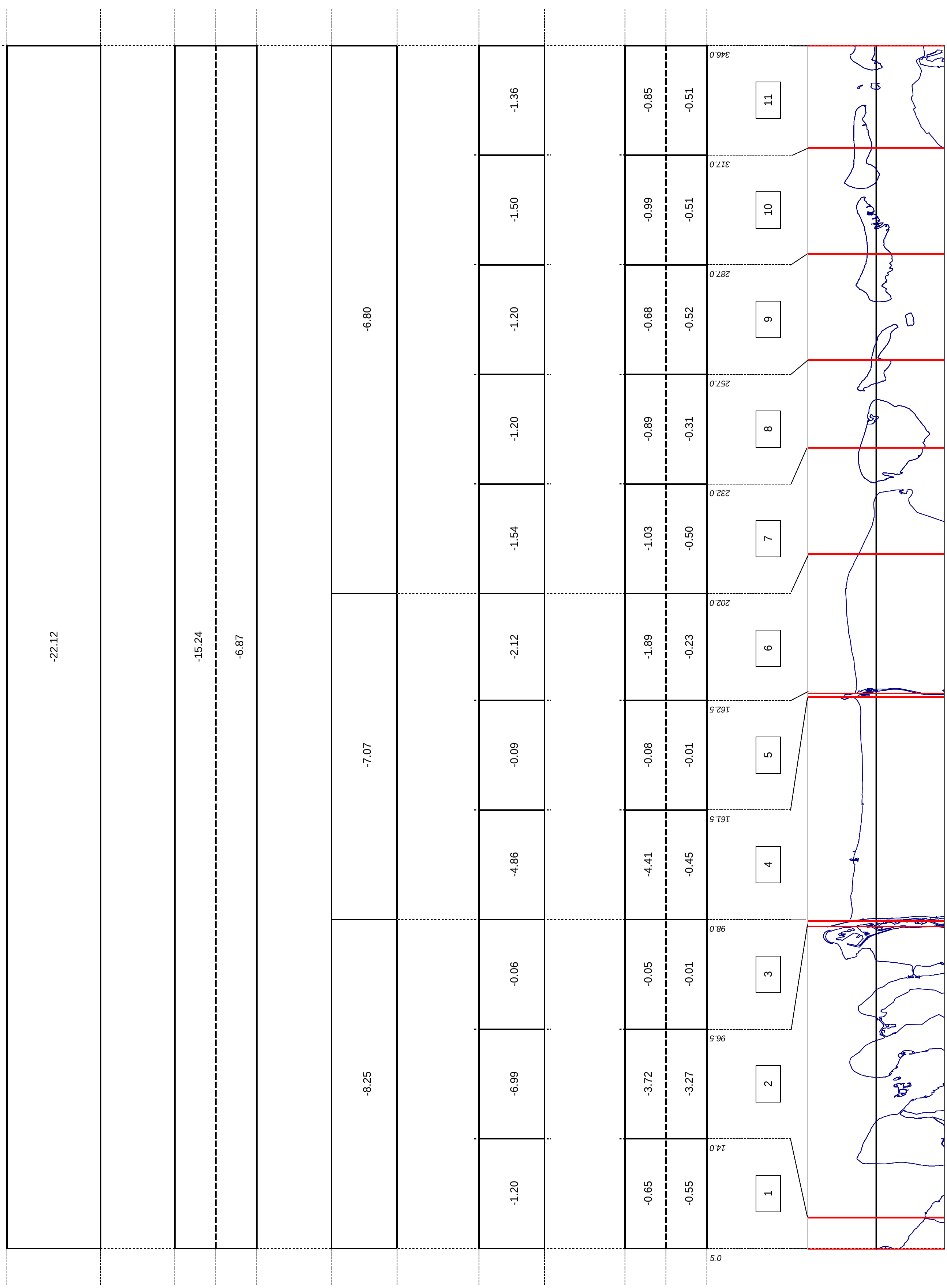
file: PonTos_volumes_r11.xls; November 2004

file: PonTos_volumes_r11.xls; November 2004



Overview of basic erosion rates (expressed in Mm^3/yr) for static sea level rise Results for 0.20 m per century	PONTOS-2.0 2003 - 2053 Scenario 1 (0.2 m/century)
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	WL /Alkyon — Fig. 6.19

file: PonTos_volumes_r11.xls; November 2004

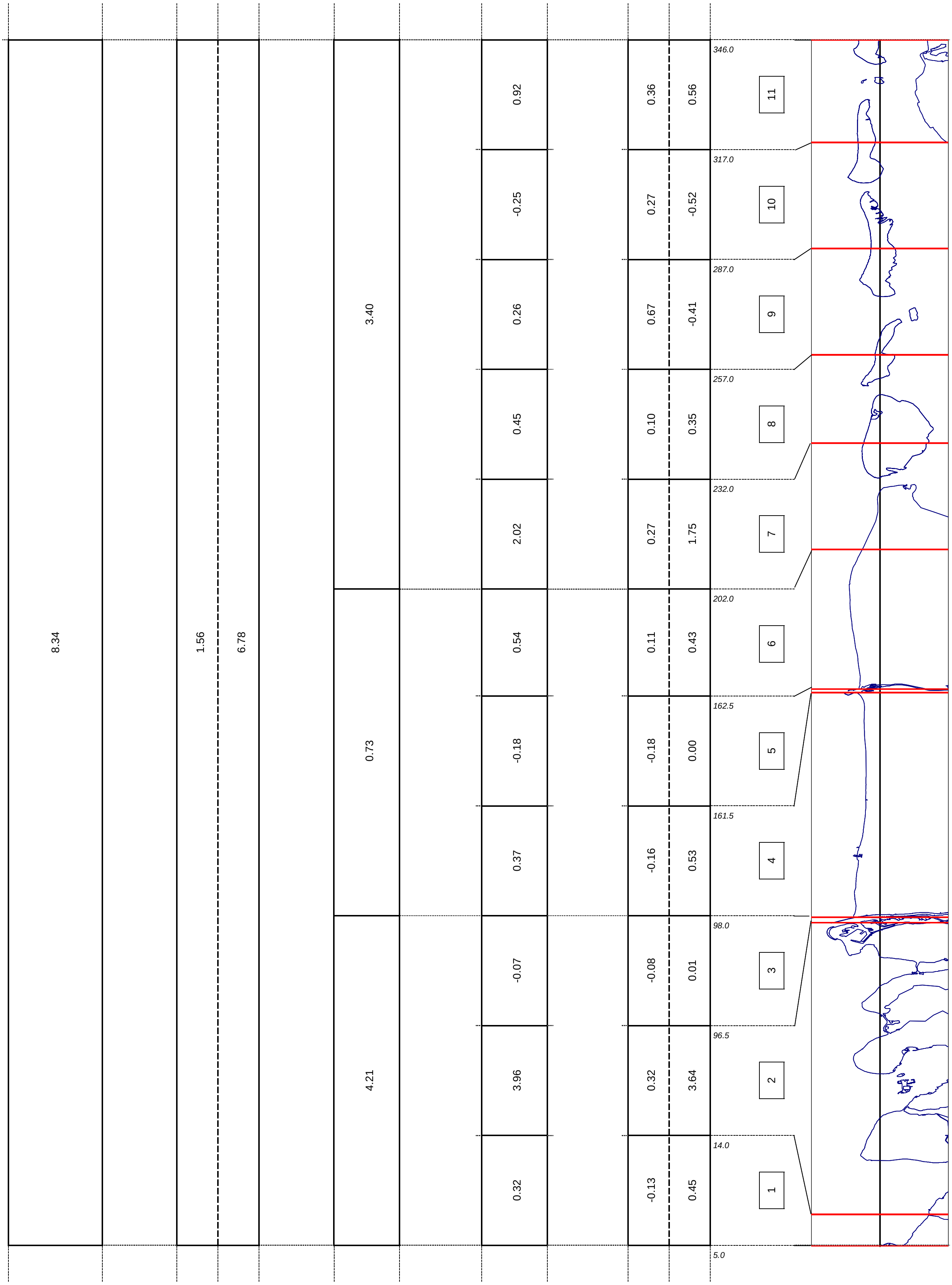


Overview of basic erosion rates (expressed in Mm^3/yr) for static sea level rise

Results for 0.60 m per century

PONTOS-2.0	
2003 - 2053	
Scenario 2 (0.6 m/century)	

LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000 **WL /Alkyon** Fig. 6.20

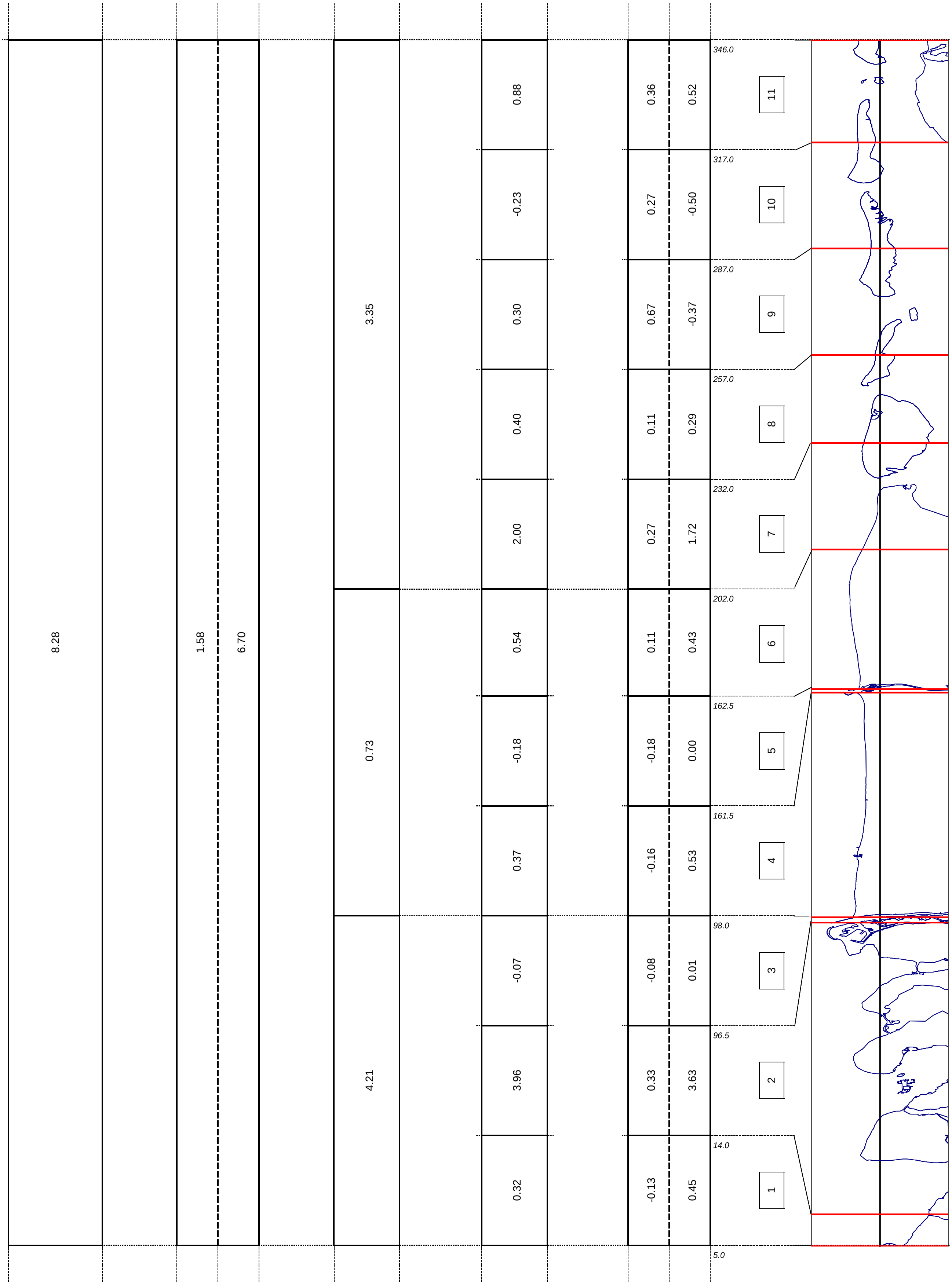


Overview of time-averaged erosion rates for scenario 1A	PONTOS-2.0
Relative to fixed vertical reference level	2003 - 2053
Based on 10-year averaged trends	Run_P1A
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.21

file: PonTos_volumes_r11.xls; November 2004

Overview of time-averaged erosion rates for scenario 1A	PONTOS-2.0	
Relative to mean sea level	2003 - 2053	
Based on 10-year averaged trends	Run_P1A	
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon**	Fig. 6.22

file: PonTos_volumes_r11.xls; November 2004

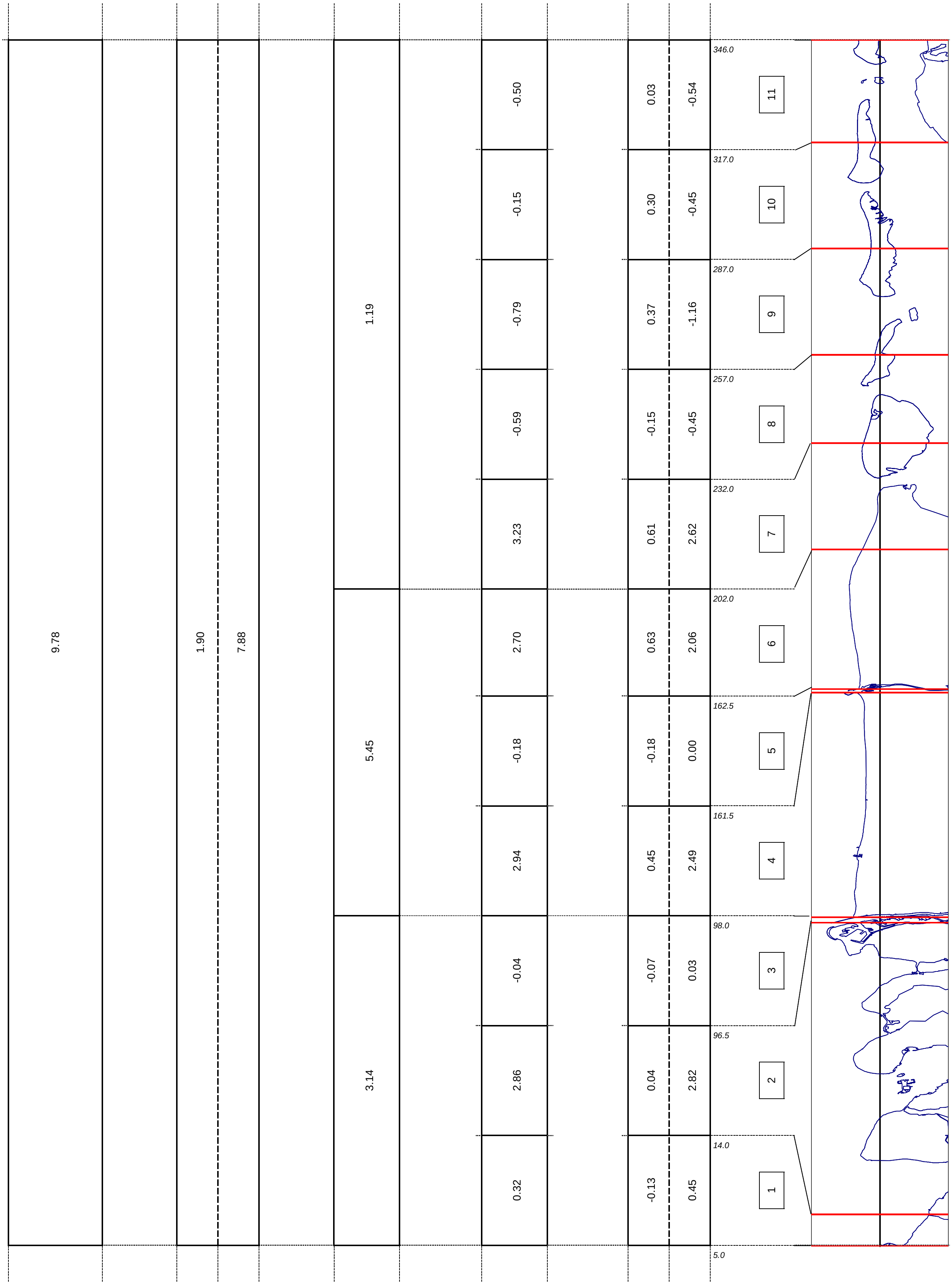


Overview of time-averaged erosion rates for scenario 2A	PONTOS-2.0
Relative to fixed vertical reference level	2003 - 2053
Based on 10-year averaged trends	Run_P2A
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.23

file: PonTos_volumes_r11.xls; November 2004

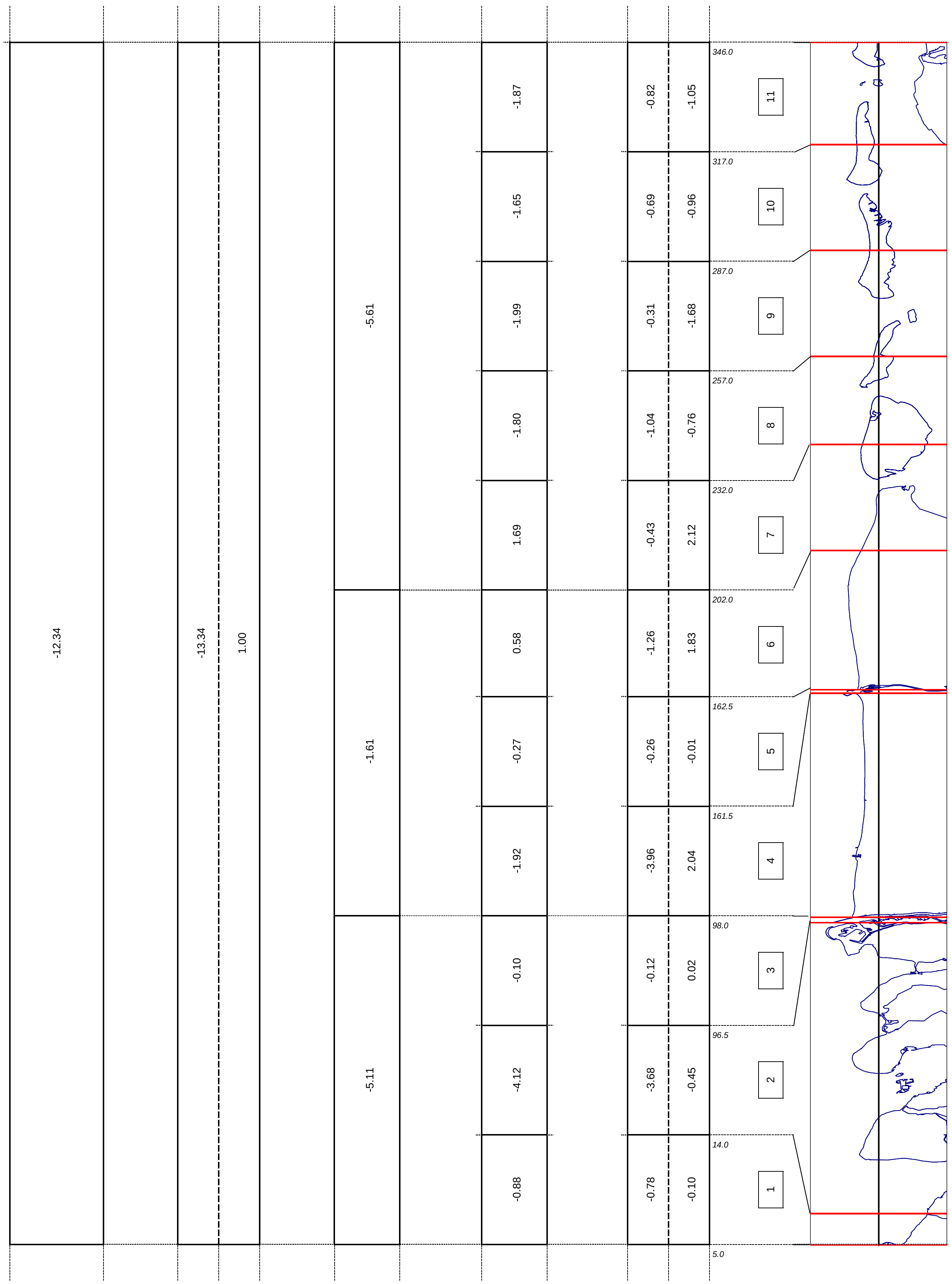
Overview of time-averaged erosion rates for scenario 2A	PONTOS-2.0
Relative to mean sea level	2003 - 2053
Based on 10-year averaged trends	Run_P2A
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.24

file: PonTos_volumes_r11.xls; November 2004



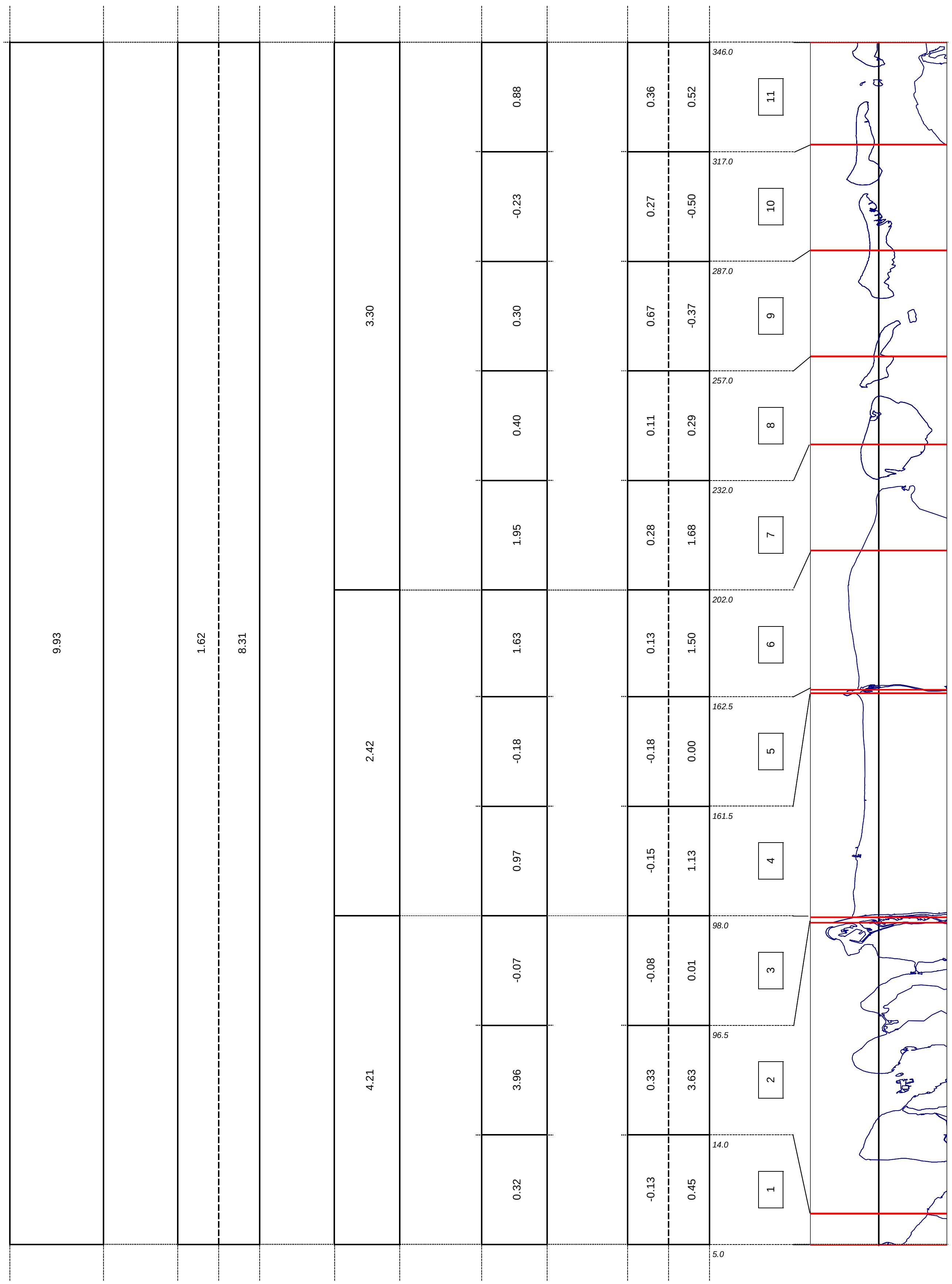
Overview of time-averaged erosion rates for scenario 2B	PONTOS-2.0	
Relative to fixed vertical reference level	2003 - 2053	
Based on 10-year averaged trends	Run_P2B	
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon**	Fig. 6.25

file: PonTos_volumes_r11.xls; November 2004



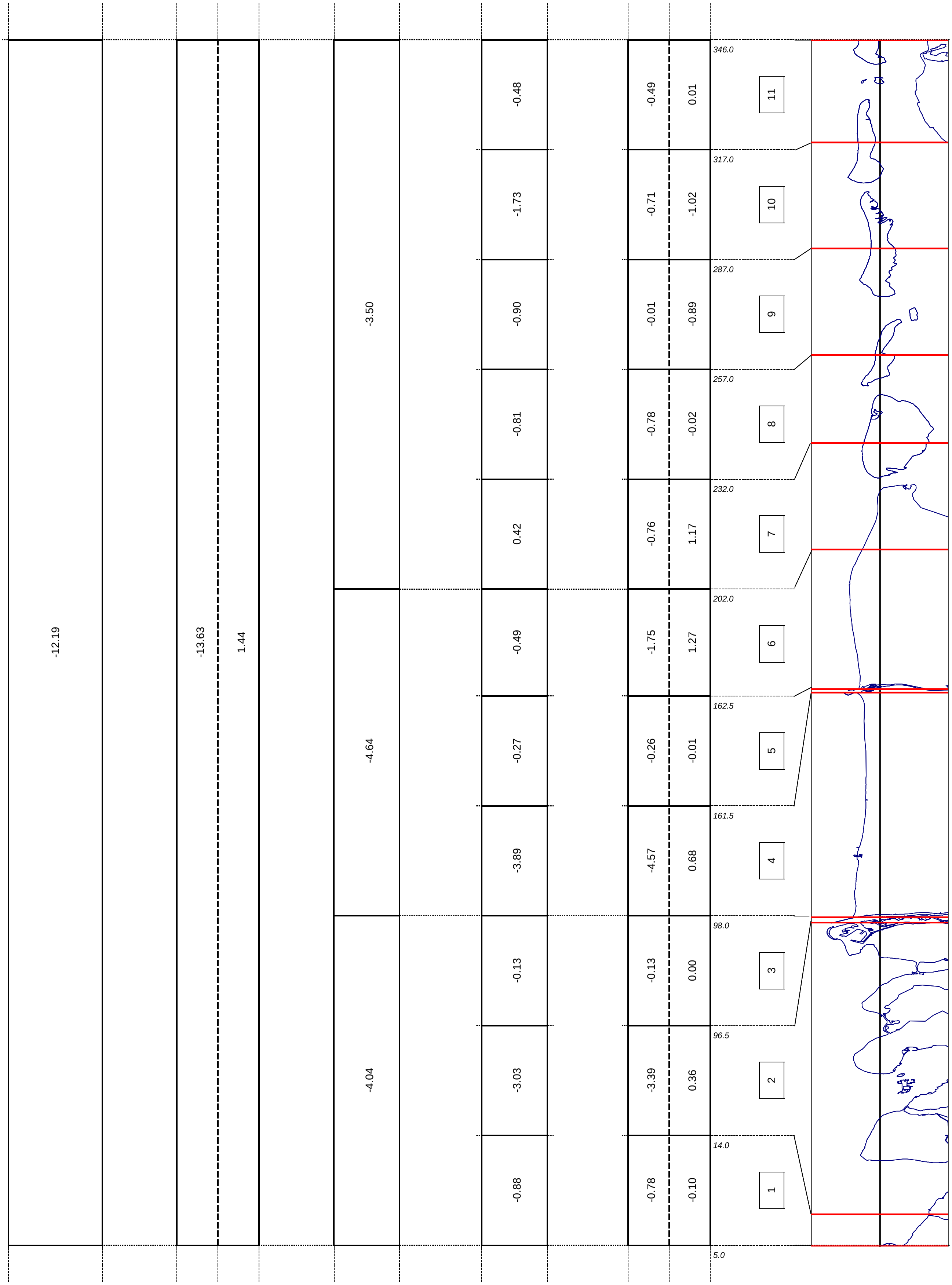
Overview of time-averaged erosion rates for scenario 2B	PONTOS-2.0
Relative to mean sea level	2003 - 2053
Based on 10-year averaged trends	Run_P2B
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon** Fig. 6.26

file: PonTos_volumes_r11.xls; November 2004



Overview of time-averaged erosion rates for scenario 2C	PONTOS-2.0	
Relative to fixed vertical reference level	2003 - 2053	
Based on 10-year averaged trends	Run_P2C	
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon**	Fig. 6.27

file: PonTos_volumes_r11.xls; November 2004



Overview of time-averaged erosion rates for scenario 2C	PONTOS-2.0	
Relative to mean sea level	2003 - 2053	
Based on 10-year averaged trends	Run_P2C	
LARGE-SCALE MODEL OF THE DUTCH COAST Z3334/A1000	**WL /Alkyon**	Fig. 6.28

LARGE-SCALE MODEL OF THE DUTCH COAST

Period 2003 - 2013

Computed evolution of the Holland coast

Application of the model for period 2003 - 2053

Z3334/A1000

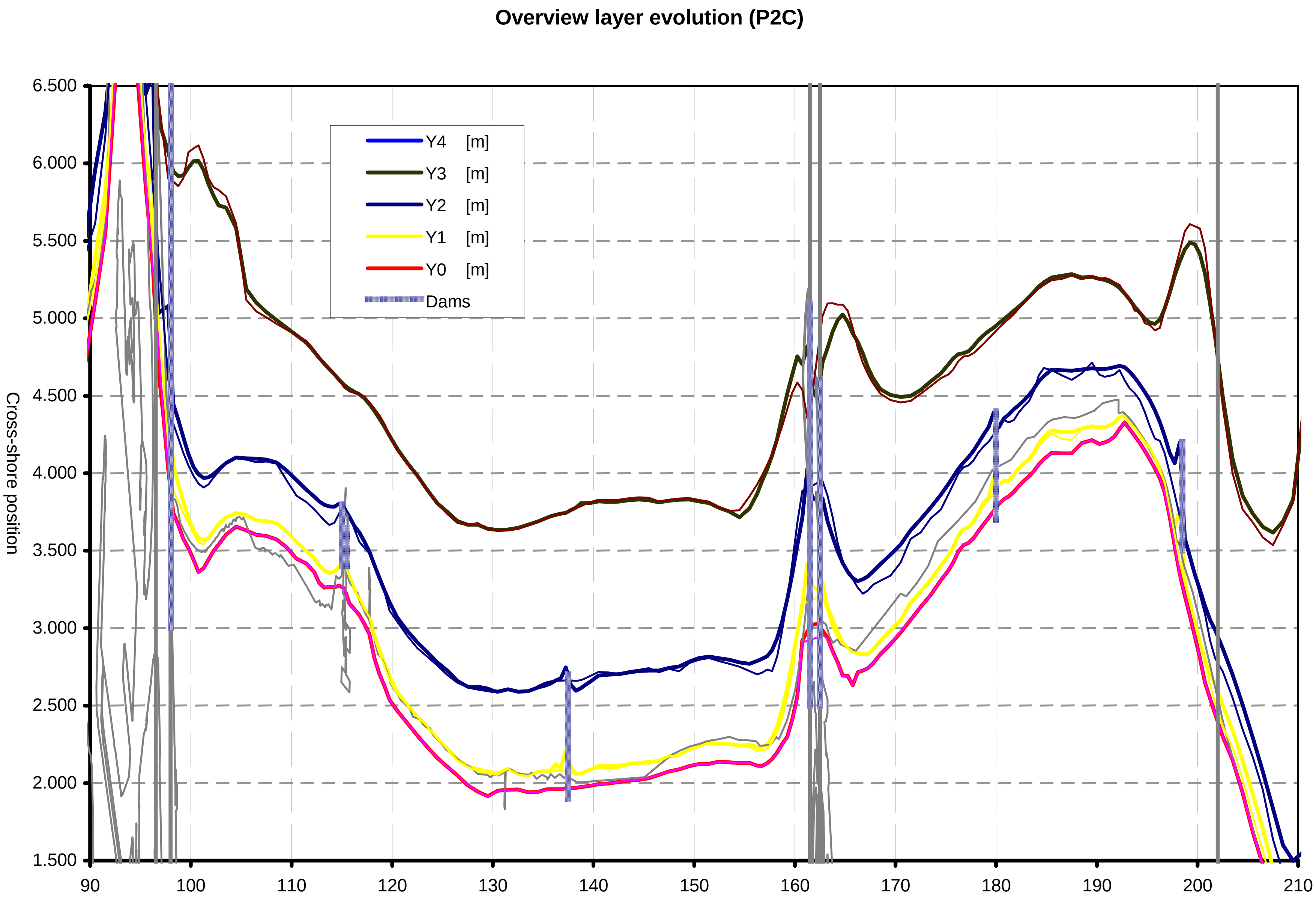
WL / Alkyon

2003 - 2053

Scenario 2C

PONTOS-2.0

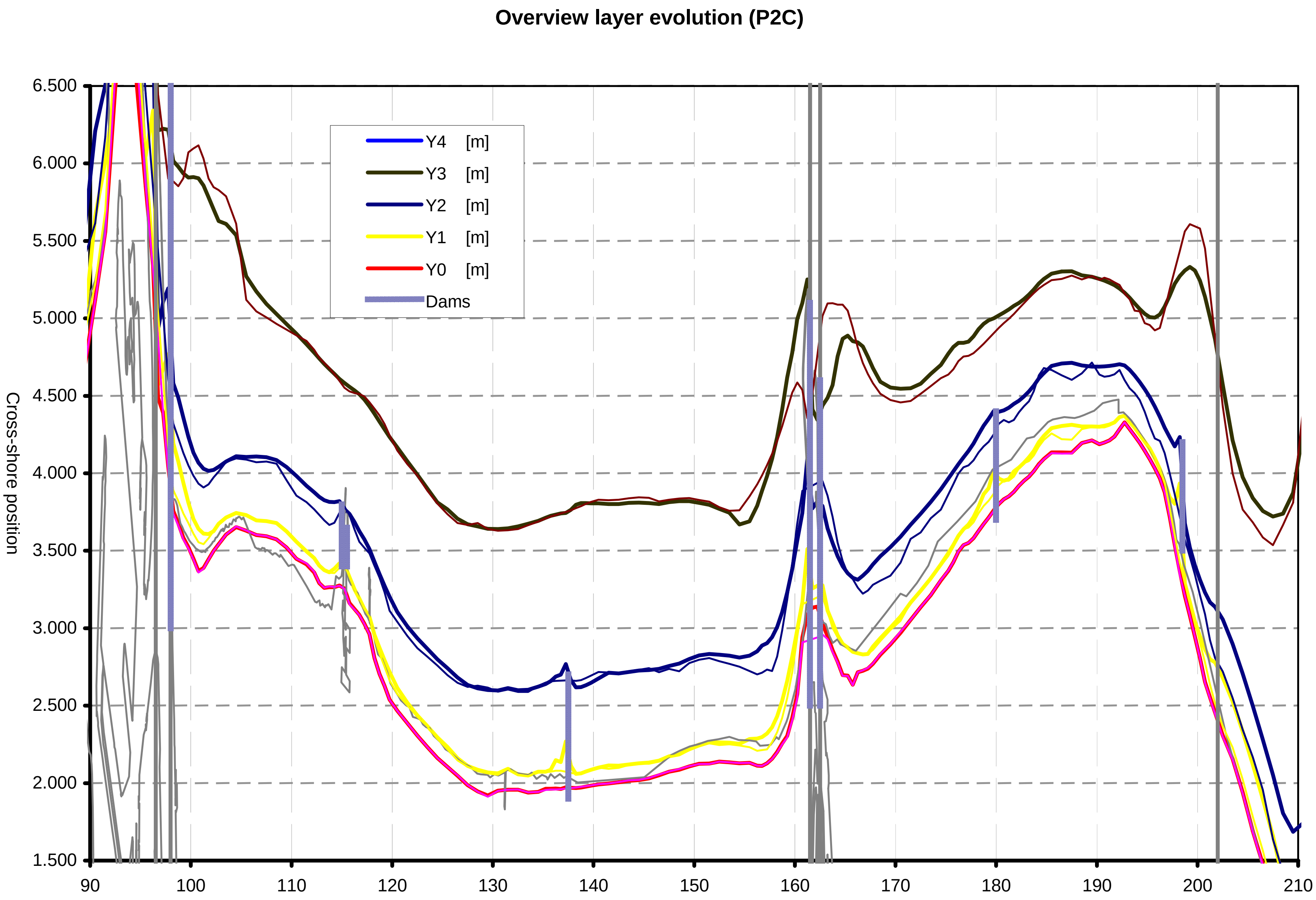
Fig. 6.29



file: PonTos_results_r11.xls; November 2004

Application of the model for period 2003 - 2053
Computed evolution of the Holland coast
Period 2003 - 2028
LARGE-SCALE MODEL OF THE DUTCH COAST

PONTOS-2.0	
Scenario 2C	
2003 - 2053	
Z3334/A1000	**WL / Alkyon**	Fig. 6.30



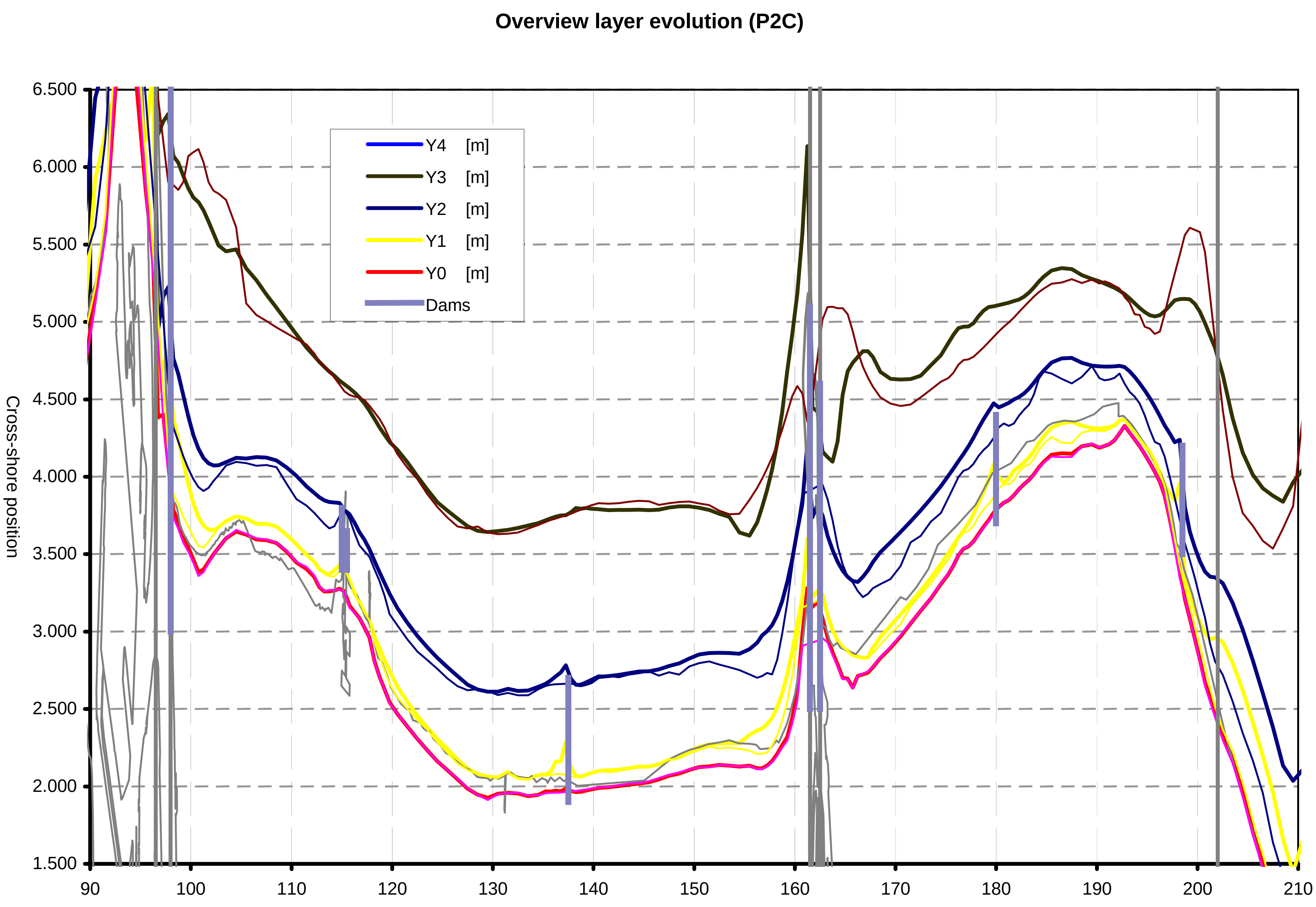
file: PonTos_results_r11.xls; November 2004

Application of the model for period 2003 - 2053

Computed evolution of the Holland coast

Period 2003 - 2053

LARGE-SCALE MODEL OF THE DUTCH COAST



file: PonTos_results_r11.xls; November 2004

PONTOS-2.0	
Scenario 2C	
2003 - 2053	
Z3334/A1000	**WL / Alkyon**
	Fig. 6.31