

WadBOS
Version 2.1 International Edition

WadBOS User Manual

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Important

Please take notice of the following remarks when installing or using **WadBOS 2.1 International Edition**

WadBOS 2.1 International Edition is a translated and further developed version of **WadBOS 2.0 Dutch Edition**. Compared with **WadBOS 2.0 Dutch Edition** it has a number of features and functions that improve the reliability and processing speed of the program. Both the support tools **--OVERLAY-TOOL** and the **ANALYSE-TOOL--** have been further developed. Finally, the **Beleidswizard** tool is not available in the International Edition.

WadBOS 2.0 Dutch Edition has been developed for the **Directorates Noord Nederland** and **Noord Holland** as well as the **National Institute for Coastal and Marine Management (RIKZ)** of the **Ministry of Transport, Public Works and Water Management**. **RIKS bv**, **INFRAM bv**, **Delft Hydraulics** and the **Institute for Environmental Studies** are responsible for its development. **Alterra** took part in the improvement of the ecological models. **Resource Analysis** developed the **Beleidswizard** tool.

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The files accompanying this demo are solely meant to provide an insight into the way the product works. They are usable to evaluate the product technically, but should not be used for the carrying out policy cases and policy analysis as the information may not be up-to-date or entirely relevant.

The RIKS-demos are shortened versions of more enhanced software products. Every demo has been made in such a way that the user can get a clear insight into the whole software product. If you are interested in a demonstration of the full version, you can contact RIKS bv.

It is prohibited to develop software by using materials used in **WadBOS**, and/or to apply **WadBOS** in a case study. If you would like to use **WadBOS** in a case study or/and if you would like to use software developed by RIKS in your own application then you should contact RIKS bv.

We wish you a lot of pleasure discovering our demos and await your reactions.

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1 Introduction: The WadBOS–system

1.1 Integrated policy

Apart from government a range of other parties are involved in the management and policy-making of the Wadden Sea: the business community, environmental organizations and interest groups. All parties involved have their own interest, responsibilities and knowledge. For a satisfying management of the Wadden Sea it is important that these different and sometimes adverse interests are weighted against each other on the basis of the best available knowledge and in consultation with all parties involved. For this process the terms ‘integrated management’ and ‘integrated policy-making’ are used. Its main emphasis is on enabling human usages within the function of the Wadden Sea as a natural reserve in ways that permit the natural environment, but also the economic activities, to develop in a sustainable manner.

With the aim to enable the above mentioned integrated policy analysis, the policy making institutions of the Wadden Sea, united in the commission responsible for the execution of the management plan for the Dutch part of the Wadden Sea (CUBWAD), decided in 1995 to develop a Decision Support System. In 1997 the first version of this Decision Support System was developed and in 1999 the second version was finished. The information system got the name **WadBOS**. Both versions of **WadBOS** were developed as part of the Land Water Environment Information Technology Program of the Dutch Government (LWI).

This manual was written to support the user in the use of **Version 2.1 International Edition** of **WadBOS**. More information on **WadBOS** can be found in the following reports: Engelen *et al.* (1999) and Engelen (2000).

1.1.1 Why WadBOS?

The two main functions of **WadBOS** as a support instruments for integrated policy analysis in the Wadden Sea are: *linking knowledge* and *facilitating communication*.

- *Linking Knowledge*
The information about the ecologic and economic systems of the Wadden Sea is usually not centrally available rather is spread among many different authorities. This makes an integrated analysis of the effects of policy and management decisions very difficult. The linking of this knowledge is nevertheless a very important prerequisite in order to come to an integrated approach. Therefore ‘Linking Knowledge’ is a very important function of **WadBOS**. With knowledge linking we do not mean the simply act of gathering and offering data but, more than this, the integration of the data and the information in an operational form as part of coupled models usable

for carrying out integrated analysis. This requires enabling insight into the Wadden system at a high level of abstraction.

- *Facilitating Communication*
When policy analysis is carried out with **WadBOS**, the effects of policy and management actions can be made explicit and demonstrated. A comparison can be made between alternatives on the basis of a large set of criteria and norms. This functionality is very important when different stakeholders are involved in policy formulation and management because the outcome of the analysis will become the input for the discussion between the parties involved. This discussion should eventually lead to a unanimous choice for a particular alternative. Thus, and in this way **WadBOS** supports the communication between the various parties involved.

Aside from these two main functions **WadBOS** has a few more or less important functions. Particularly:

- *A Library function*: by enabling access to information about the Wadden Sea;
- *A Knowledge management function*: by presenting a structure and a operational instrument to keep information about the Wadden Sea up to date;
- *A Tutorial function*: by offering learning material and instruments to further the understanding about the processes that make and change the Wadden Sea.

1.1.2 How does WadBOS work?

WadBOS is created based on the idea that improved policy-making in the Wadden region is possible if there is a better understanding of how the Wadden Sea functions as an integrated system. That is why a spatially dynamic model is at the basis of **WadBOS**, wherein the ecological, the social, and the economic functions of the region are represented in a mutually linked manner. The processes and influences that cause the continuous and autonomous changes in the region are represented at their typical spatial and temporal scales. This way of working does right to the complexity of the region. To the extent possible, existing models have been used and have been adapted to the needs of the policy-users with the help of experts and knowledge institutes that are active in the region. The policy user will explore with the help of the integrated model of **WadBOS** how his policy measures are affecting the systems in the Wadden Sea. With this use in mind it was decided to keep **WadBOS** simple and transparent, so that the policy maker can keep track of the actions that he or she undertakes with the information system. Not just knowledge and analysis are important but so is the communication between different interest groups and policy organizations. A very important aim of **WadBOS** is to show how the Wadden system works in a very plastic and transparent way, and above all, to demonstrate the effects of exogenous scenarios and those of deliberate policy interventions. In this way the **WadBOS** system can play its role as a communication tool to the full extent. The use of dynamic maps, graphs, graphical and interactive software-instruments to define the policy parameters and variables and to view the results play an important part in this.

1.1.3 Building WadBOS

The typical users of **WadBOS** are to be found in the various governments, but also among interest groups such as environmental organizations and the business sector. In a large number of sessions and workshops with potential end users, information was gathered on the required functionality and the expected user friendliness of the system. This information was used to define and fine-tune the functionality of the system, its models, and its analytic tools. The software architecture of the system enables this form of evolutionary development. **WadBOS** takes advantage of the newest Object-Oriented and Component Technology software development methods: the whole system consists of hundreds of relatively small, interconnected, and easily exchangeable building blocks. As soon as new knowledge about the region becomes available or as soon as more functionality is asked for, new building blocks are added to the system or new building blocks replace old ones. This renewal of knowledge can be done quickly and efficiently.

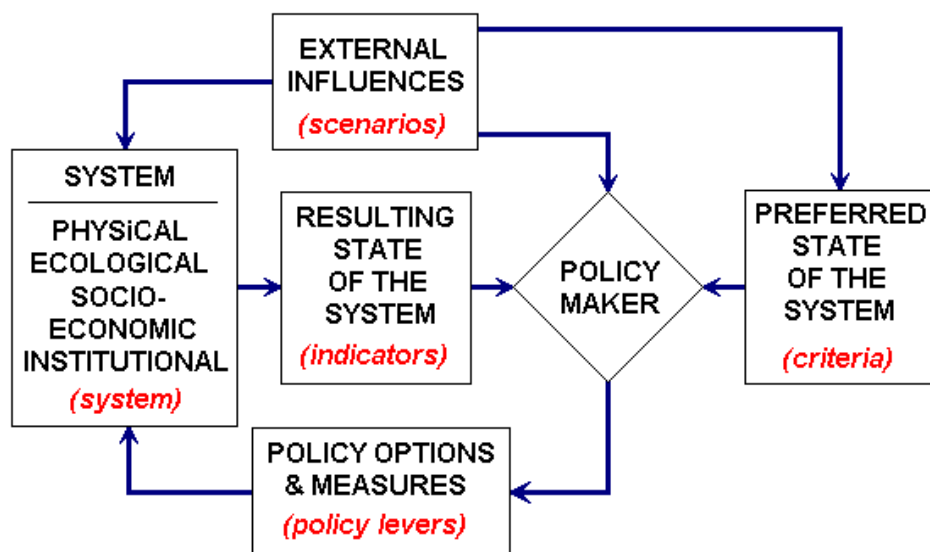
1.1.4 Further developing WadBOS

WadBOS is still an unfinished system. In fact it can never be completely finished. The continuous stream of new knowledge, the new developments in the society, in the policies, and in the relationship between man and the environment will always give rise to new requirements for this information system. The system points out the gaps in our knowledge that require further research and deepening. As **WadBOS** will be developed further it will grow to become a very valuable knowledge base of the Wadden region. Moreover, this knowledge is stored in a causally linked manner and is available in an operational form, so that it can be used immediately for the analysis of the latest policy problems.

It is the clear aim of the owners and developers of **WadBOS** to continue the development on a problem-orientated basis. Although the most important human activities (recreation, industry, electricity generation, gas mining, defence, shipping of goods and people, fishery, and shell mining) present in the Wadden Sea have been represented generally, the work carried out so far has been aimed at making **WadBOS** useful in three policy areas: shell mining, water sports, and shellfish fisheries. For both the water sports and fishery policies the main goal is 'durable' development. Concretely this means that the adverse effects of recreation and fishery on the physical and ecological system are to be kept as limited as possible. For the fishery this means that the food requirements of the birds need to be guaranteed. Based on a set of selectively chosen ecological, economical and social indicators **WadBOS** aims at rendering the term durable explicit. Numbers are not limited to turnover and money but include just as well the food supplies for wildlife, emissions of pollutants, and employment. The equal weighing of each aspect is central in this. Furthermore durability is expressed in its full spatial and temporal dimensions in **WadBOS**, because **WadBOS** clearly shows where, when, and what is causing unacceptable pressure on the environmental system, and which species, ecosystem landscape, but also which activity, is endangered by this in the long or short term.

1.2 Policy analysis with WadBOS

As stated above, **WadBOS** is developed on top of an integrated simulation model. This model was built with the aim to represent the linked processes characterizing the Wadden system at a high level of abstraction, but in as complete and realistic a manner as possible. Because of this model, **WadBOS** is very suitable for performing ‘What if’ analyses. By means of this kind of analysis the user tries to find out how policy and scenario sensitive variables and parameters influence autonomous and anthropogenic developments in the Wadden Sea. The policy analysis mainly focuses on the consequences of changing policy sensitive parameters on the Wadden system. In a number of iterative runs, during which the policy relevant parameters are fine-tuned, an attempt is made to bring the system as closely as possible to a predefined and preferred goal state.



The robustness of the chosen values is tested by submitting the system to a number of elements that are not controlled by the policy maker. These are the so-called scenarios.

The different elements that are part of this analysis can be seen and changed interactively (see Chapter 3 for more information) by means of the user interface of **WadBOS**:

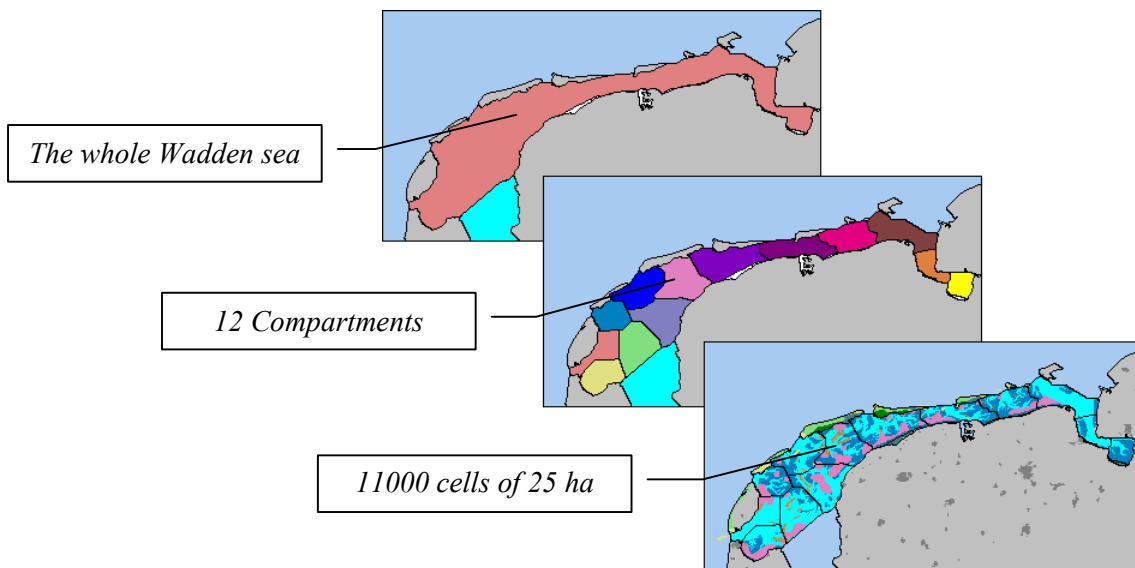
- The *Policy-options* View permits access to the parameters representing the policy choices in the model and shows the parts of the integrated model that are directly influenced by the policy choices;
- The *Scenarios* View permits access to the parameters representing influences beyond the control of the policy maker and shows the parts of the integrated model that are directly subject to these influences in the model;
- The *Impacts* View shows the parts of the model that contain variables used as policy indicators. It is also the window where the desired state of the Wadden system can be set in terms of norms or target values for the policy indicators. The user can read from these whether his interventions in the system is bringing him any closer to the target state;
- The *System diagram* View gives an overview of the structure of the integrated model at the most synthetic level. It permits access to all the

details of the model at this level, but also at all lower levels. The integrated model is the actual calculation kernel of **WadBOS**. It contains relations in the form of mathematical equations, formal rules, or transfer functions representing the real world processes.

A sensitivity analysis was carried out with an eye on the use of the model for policy exercises. The results of this analysis have been integrated in **WadBOS** in the form of a simple 'Goal-seeking' function. It is accessible via the Impacts View: for the most important goal variables (indicators), a list of policy and scenario parameters is presented that affect most the value of the goal variable. In this way the user can estimate beforehand if any important effects will occur when specifying a certain policy measure or scenario.

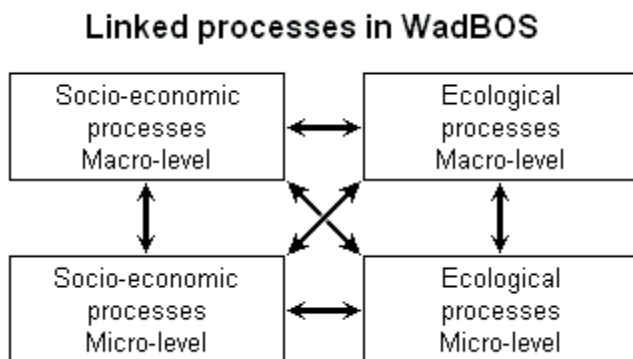
1.3 The Integrated System model

The integrated systems model of **WadBOS** describes the linked processes occurring in the Dutch Wadden Sea at two geographical levels: the so-called *Macro-level* and the so-called *Micro-level*.



At the Macro-level it concerns processes that operate at the scale of the whole Wadden Sea or the 12 (macroscopic) compartments constituting the Wadden Sea. The Micro-level deals with processes that get a very accurate localization at the level of some 11000 cells of 500 by 500 meters.

Between these two levels exist strong linkages and exchanges. This is because a great number of processes are partly described at the one level and partly at the other. Consequently, a strict division between Macro and Micro processes is not always possible.



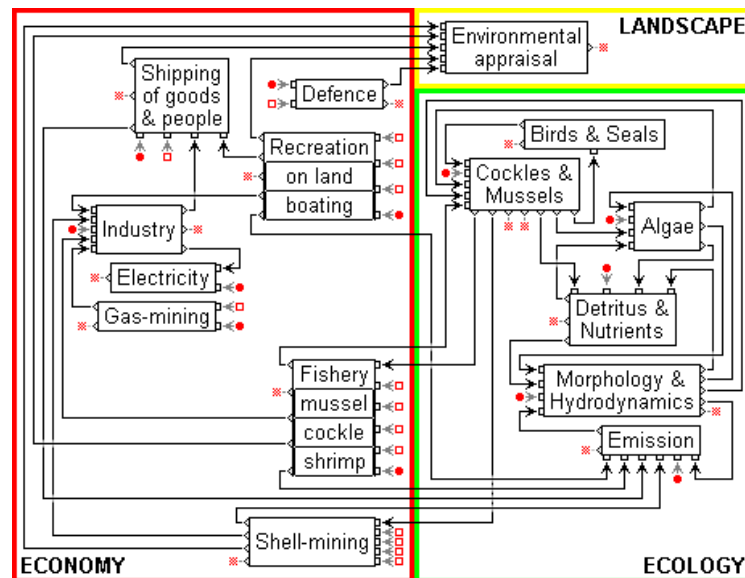
Further to this, the integrated systems model consists of *Socio-economic* and *Ecological* processes. Again, between both exist strong

linkages and exchanges, and, therefore it is difficult to speak of purely socio-economic or ecological processes.

The following economic activities are part of the *Socio-economic sub-system*:

- Recreation, consisting of *Shore recreation* and *Recreational boating*;
- *Shell mining*;
- *Fishery*, consisting of *Mussel fishery*, *Cockle fishery* and *Shrimp fishery*;
- *Shipping of Goods and People*;
- *Industry*;
- *Electricity generation*;
- *Gas mining*;
- *Defence*.

In this version of **WadBOS**, the activities *Recreation*, *Shell mining*, *Mussel fishery* and *Cockle fishery* are worked out in greater detail. The other activities are described in less detail and are generally strongly driven by scenarios that can be modified by the user.



For modelling the *Ecological sub-system*, the Wadden Sea is represented as consisting of 12 compartments. The model calculates the following for each compartment:

- The concentration of *Detritus* and *Nutrients* (Nitrogen, Phosphates and Silicon);
- The biomass of *Algae*, *Cockles* and *Mussels*;
- and *Emissions* of a number of substances (Copper, Oil, TBT and PAK).

The *Morphology* is not dynamically modelled and the *Hydrodynamics* are dealt with at the level of the 12 compartments. The interactions between the economic part and the ecological parts of the model concern mainly the extraction of species (Cockles and Mussels) and shells, as well as the emissions, exposures, and pressures caused by the economic activities.

While developing the models an effort was made to represent both the economic and the ecological processes in as uniform a manner as possible. This eases the transparency and the learnability of **WadBOS**: if you understand how one economic activity is represented you can safely say that you understand them all, because they are all built according to the same general

scheme. The same is true for the ecological model, if you understand how one pollutant moves through the Wadden Sea, you will easily understand how the other substances, the nutrients and algae do.

1.4 Modelling at the micro-level

1.4.1 General approach at the Micro-level

For the processes operating at the Micro-level the Wadden Sea is represented as a two dimensional matrix of some 11.000 cells of 500 by 500 meter. A modelling principle is used that is applied at both the ecological part and the economic part of the model. It uses principally GIS (Geographical Information system) data to dynamically allocate quantities obtained from the Macro-level models (for example: Total biomass, Number of recreational boats, est.) to the cells of the Micro-level representation. Different allocation algorithms are used. Every algorithm takes into account both the *suitability* of a cell to accommodate a particular species or economic activity and the *zoning* status of the cell awarded to it by the policy maker. In general, the combined suitability and zoning scores determine with which *intensity* an activity or species is found in a cell. As the quantities from the Macro-level and the zoning status can change in time, the intensities change dynamically as well. The intensity of an activity can be such that in some cells it can potentially *expose indicator species* and cause unacceptable *pressure* on the natural state of the Wadden Sea. Thus, the *ecological* and *perceived value* can seriously drop. To get an insight into the latter, **WadBOS** has been equipped with so called indicator maps, exposure maps, pressure maps, and environmental appraisal maps.

Suitability

The suitability maps consist of dimensionless numbers between 0 and 1 that are the result of a assessment of the ecological, physical, technical, economical aptness of the cells to accommodate a particular function. Each suitability map is calculated in a GIS application or with the help of the **OVERLAY-TOOL** (see Chapter 6). It remains constant during the simulation, unless the user manually changes it. For example, the suitability map of the cockles will be calculated on the basis of ecological characteristics like: depth, flow velocity, seabed composition and nutrient availability. The suitability map for the cockle fishery on the other hand points at technical boundary conditions, like draught of the cockle vessels and rules to prevent conflicts with the other navigation in the Wadden Sea.

Suitability maps of the following species and activities are available in **WadBOS**: Mussels, Cockles, Recreational boating, Shell mining, Gas mining, Shipping of goods and people, Mussel fishery, Cockle fishery and Defence.

Zoning

The zoning maps indicate where and when a certain human activity is allowed or prohibited. Areas can be *open*, closed *permanently* or closed *periodically* for an activity. The manager can interactively adjust the zoning status of a cell as well as the period of temporary closure. The following activity have a zoning map: Recreational boating, Shell mining, Mussel fishery, Cockle fishery, Gas mining, Shipping of goods and people and Defence.

Intensity

General speaking the intensity represent a spatial measure of the presence of a species or activity in a cell. The intensity of a species is determined on the basis of its concentration calculated per compartment. The concentration is an average value that is distributed over the cells in the compartment proportional to their suitability value for the species. Also activities have a spatial intensity. The intensity of an activity is the result of a calculation based on the suitability map, the zoning map, and the actual size of the activity in the whole Wadden Sea. The intensity of Recreational boating is expressed in the number of boats per square kilometre. The intensity of Shell mining, Mussel fishery and the Cockle fishery are expressed in the number of mining hours, respectively the number of fishing hours, while the intensity of the Shipping of goods and people is expressed in turnover.

Indicator

An indicator is a spatially distributed target variable, mostly a valuable species. In this version of **WadBOS** they are: Eiders, Oystercatchers, Dunlins and Seals. The indicator maps are used in **WadBOS** in combination with the presence of the species in the Wadden Sea in the course of time. This enables to calculate the seasonal and year-to-year changes in the occurrence of the species and their exposure dynamically.

Exposure

On this dynamic map the effects of a *potential* pressure exerted by a human activity on an indicator species is represented. The term potential is relevant here as it concerns an estimate of the real exposure. The exposure map is based on a combination of four quantities: activity, exposure type, indicator species, and the (seasonal) presence of the indicator species in the area. There can only be an exposure if on the same location (cell) and at the same time both the activity and the indicator species are present. The exposure map indicates the number of indicator animals exposed to the pressure.

WadBOS is equipped with the most relevant exposure maps:

- Cockle fishery, Shell mining and Recreational boating are the activities causing exposure;
- The pressure consists of Disturbance (noise + presence), Mechanical influences or Extraction;
- The effects on the following indicators species can be determined: Seals, Eiders, Oystercatchers and Dunlins.

Pressure

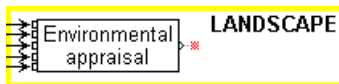
There are five forms of pressure that are of particular importance for the Wadden Region: Presence (of people and human objects), Disturbance, Mechanical Influences, Extraction and Emission. Every economic activity in **WadBOS** is carried out with a particular intensity and thus contributes to one or more forms of pressure. The importance of the contribution is calculated on the basis of the intensity and a transfer function. The latter is a two-dimensional curve showing the relation between the level of intensity and the effect caused on the natural state of the Sea. The pressure is spatially represented on a map by means of values in the range 0 to 1. A value of 0 means that the specific cell is not under pressure, while a value of 1 means an unacceptable level of pressure. Determining good transfer functions for converting intensity into pressure is often very difficult because of a lack of knowledge, information and consensus. In **WadBOS** use is made of functions

based on expert judgment. Most are subject to fine-tuning and further improvement. The pressure maps are calculated dynamically just like the intensities. In this version of **WadBOS** the following three types of pressure are available on a map: Presence and disturbance, Mechanical Influences, and Extraction.

From the above it will be clear that the models at the Micro-level of **WadBOS** make extensive use of maps for their input, but also that they generate large quantities of output maps. Two instruments have been developed for generating and processing this map material and have been added to **WadBOS** (see Chapter 5 and 6):

- The **OVERLAY-TOOL** (Chapter 6) is meant for creating and changing suitability and zoning maps. Both types of maps play an important part in **WadBOS**. They are composite maps, created on the basis of factor maps and map layers available in a GIS. With the tool, the user can quickly and interactively change the maps taken into account and weigh them more or less in the calculation of the suitability and zoning.
- The **ANALYZE-TOOL** (Chapter 5) allows the user to analyse the cartographical output of **WadBOS**. The tool supports cell-by-cell comparisons of maps. To that effect it produces result maps (result of the comparison) on the basis of a number of comparison methods. The similarity between the compared maps is also expressed by means of the so-called Kappa-statistic, a single number expressing similarity between images.

1.4.2 Appraisal of the natural environment



In **WadBOS** an attempt was undertaken to work with concepts and policy criteria at a higher abstraction level such as: ‘Wadden landscape’, ‘Naturalness’, ‘Perceived Value’, and ‘Ecological Value’. These concepts are used as criteria in the actual management plan of the Wadden Sea but it has been very difficult to find good formal measures to measure them. With an aim to make them more tangible, a sub-model was included to estimate the degree of naturalness of the Wadden Sea, meaning the degree to which the Wadden Sea can still be considered a purely natural system. In the calculation, the sub-model departs from a purely natural state. Next, the effects of human uses are added to the calculation. Thus, depending on the intensity of the human activities, parts of the Sea will get level of naturalness varying from *nearly natural* to *nearly human*. The sub-model mainly calculates on the basis of maps and generates a number of dynamic maps.

The natural elements are considered at two spatial scales: the Ecotope scale and the Landscape scale. An ecotope is defined as a specific set of both abiotic and biotic characteristics in a certain area. A landscape consists of a specific combination of ecotopes and is subject to certain level of cultural influences. The ecotope and landscape classifications used in **WadBOS** are based on the nature-target-types-classification (Natuurdoeltypen-classificatie) of the Ministry of Agriculture, Nature and Fisheries (LNV). The *Ecotope* map is an input in **WadBOS** and the *Landscape* map is dynamically calculated on the basis of the ecotopes on the one hand and the human influences in the area on the other hand.

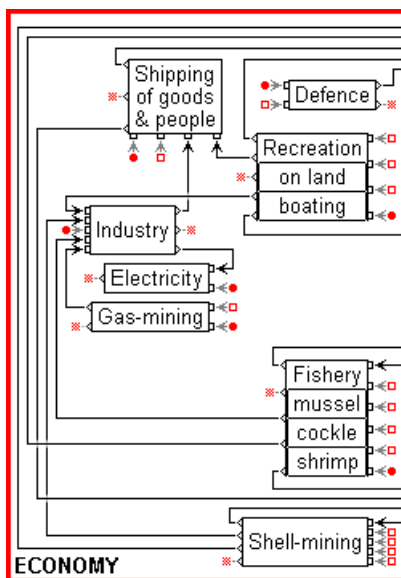
The human influences are present in **WadBOS** in the form of static elements, including among others: oil platforms, church towers, and yacht harbours, as well as dynamic elements, more in particular the economic activities. The static elements are represented in the *Cultural elements map*, while the economic activities are represented in the *Intensity maps*. Changes in the intensity as the result of model calculations, but also the addition or removal of cultural elements in the Cultural elements map, affect the perceived value and the ecological value of the region.

The (total) perceived value of a cell depends on the perceived value of the natural element present in the cell (initial situation) and on the influences exerted by the cultural elements in the cell proper and the surrounding cells. The strength of the influence of the cultural elements depends on their intensity as well as their level of visibility in the cell. The visibility in turn depends on the distance of a cultural element to the cell. There are two maps present in **WadBOS** with regards to the perceived value: the *Perceived value without human activity*, which is a static map, and the *Perceived value with human use*, which is a dynamic map.

The ecological value of a cell is calculated in a similar way. Hence with regards to the ecological value there are two maps available in **WadBOS**: the static map *Ecological value without human activity* and the dynamic map *Ecological value with human activity*. However, the ecological value can be an overall ecological value representing the interest of the ecotope for the natural environment in the Wadden region or a habitat suitability value representing the significance of the ecotope as a ‘potential home’ for a specific group of species. On the bases of this last interpretation the *Number of potential species* map is generated indicating the number of species that potentially live in the Wadden Sea.

1.5 Modelling at the macro-level

1.5.1 The economic sub-model

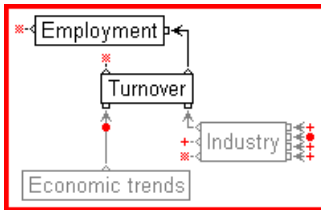


In the economic sub-model, all the major economic activities present in the Wadden Sea are represented at some level of detail. Shell-mining, Cockle and Mussel Fishery, and Recreation (consisting of recreational boating and on land recreation) have been worked out in detail. The rest of the activities: Shrimp fishery, Defence, Gas-mining, Electricity generation, Industry and Shipping of people and goods are modelled in less detail: by means of fewer linked variables, mostly limited to the turnover and the employment.

Different alternatives were considered when formulating the economic model. Finally, a system dynamics representation was chosen. The main body of this model is a series of interlinked state variables and relations, which are processed at their appropriate time step: monthly or yearly. Most economic activities are modelled according to this general scheme. As example the Mussel fishery is

explained here.

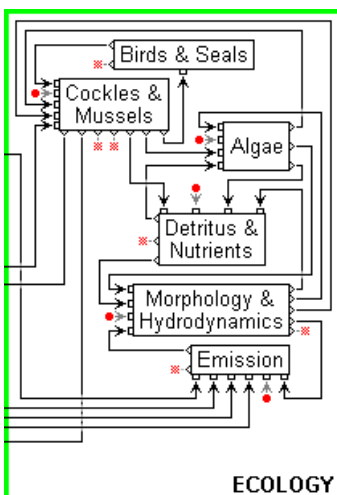
biomass to determine the number of overnight stays, there are other factors that are of interest to determine the number of overnight stays of tourists. For the recreational boating the number of lock passages (between the Wadden Sea and Lake IJssel and the rivers) and indirectly the prosperity are of importance. The level of prosperity only influences the number of overnight stays of on land tourists. The *spending* per person per day is now used to determine the *turn over, added value, profit and investments*.



The six other activities: Shipping of goods and people, Industry, Gas-mining, Shrimp fishery, Electricity generation (shown in the figure to the left), and Defence have been incorporated in **WadBOS** to complete the representation of all relevant activities occurring in the Wadden Sea. These activities are not modelled to the full extent, rather are described on the basis of scenarios and a few simple interactions. For all these activities an autonomous development is assumed, which is set by means of a scenario. The scenarios are expressed in terms of annual turnover. All other quantities, including the level of employment, are directly derived from the turnover. Furthermore the activities are interdependent as they supply raw materials, intermediate or final products to one another. The interactions between sectors are specific per activity. As **WadBOS** could not get hold of usable economic Input-Output tables, the assumption is made that 75% of the size of each activity is determined by its autonomous development and that the remaining 25% is determined by the other activities.

As a consequence of the limited model representation of the six activities, their spatial representation is rather limited too. For the activities Shipping of goods and people, Gas-mining, and Defence, zoning and suitability maps have been included on the basis of which the intensity is calculated. These intensities are expressed in terms of turnover per cell. However, a change in the zoning status of cells does not lead to an increase or decrease in turnover. Also the ecological effect of the activities is handled in a limited way: Shipping of goods and people creates disturbance and thus contributes to the pressure map, while Gas mining causes three kinds of pressure: disturbance, mechanical influence and extraction and thus contributes to each of the three pressure maps.

1.5.2 Ecosystem and morphology



The natural dynamics in the ecosystem are modelled on the basis of the ecosystem model EcoWasp (Brinkman, 1993). In EcoWasp three main processes are modelled: primary production by algae, mineralisation of organic matter in a detritus pool, and fauna dynamics. The natural system is horizontally divided in a number of compartments and vertically in a number of layers. The basis for the process description is the mass balance. Mass balances are calculated for biomasses and inorganic components required to build up the biomass. The mass balances are calculated per geographical compartment and per layer. So-called forcing functions are: temperature, exchanges with the North Sea and Lake IJssel, light intensity, and number of days with frost.

The ecosystem model of **WadBOS** is on the one hand a simplified and on the other hand a more elaborate version of

EcoWasp. It is a simplification, because only one vertical layer is taken into consideration. It is more elaborate, because it operates on 12 compartments covering the entire Wadden Sea (and not only the Western part as in EcoWasp) and also, because the extraction of biomass by fishermen (of cockles and mussels) is represented explicitly.

The ecosystem model contains the following primary dynamic components that are calculated per compartment:

- Detritus pool in the seabed;
- Detritus in the water;
- Primary producers (Algae);
- Cockles;
- Mussels;
- Total inorganic nitrogen (NO_x);
- Phosphate (PO₄);
- Silicon (Si)

The following emissions are also calculated dynamically in the model:

- Concentration 6 PAK of Borneff;
- Concentration Copper (Cu);
- Concentration TBT;
- Concentration of Oil in suspension;

The emissions have no further influence on the ecosystem, as the resulting concentrations are low against the EC50 and LC50 norms.

Lastly the following processes are modelled in more or less detail in the ecosystem model:

- Growth and mortality (of biological species);
- Sedimentation (not for filter and deposit feeders);
- Grazing (by species as well as birds);
- Catch (only filter and deposit feeders);
- Transport (exchange of the biomass and substances with Lake IJssel, the North Sea and between the compartments);
- Mechanical influence.

Algae

The calculation of the change in time of the algae biomass per compartment is based on equation 6 in Brinkman (1993). It includes the following terms:

Change of the biomass of algae in a compartment

- $$=$$
- + growth speed at reference conditions
 - effect of changes in the light intensity on the growth
 - mortality
 - sedimentation
 - grazing by cockles and mussels
 - + inputs across the boundaries of the compartment
 - outputs across the boundaries of the compartment

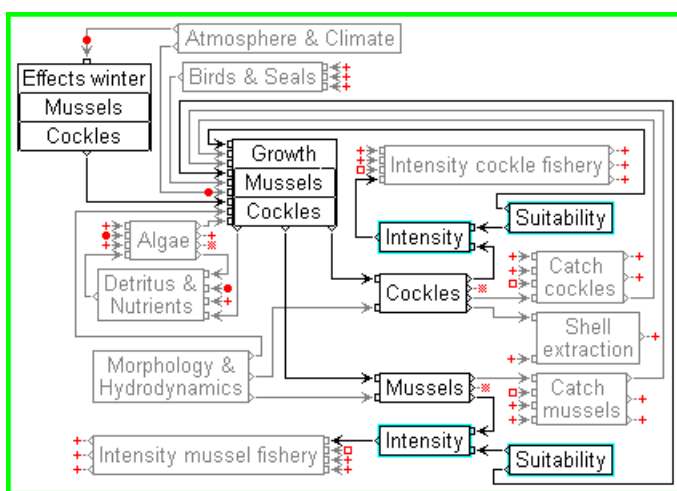
The inputs from the North Sea and Lake IJssel have been derived from monitoring data available from the Ministry of Transport, Public Works and Water Management. The data for phosphate, nitrogen and silicon are entered as monthly averages.

Cockles and Mussels

The calculation of the change in time of the cockle and mussel biomass per compartment is based on the equations 42 and 43 in Brinkman (1993). It includes the following terms:

Change of the biomass of Cockles and Mussels in a compartment

- =
- + growth speed at reference conditions (including effects of temperature, strong winters and algae limitation)
- mortality (including effects of temperature, strong winters and algae limitation)
- grazing by Oystercatchers
- grazing by Eiders
- caught by fishermen



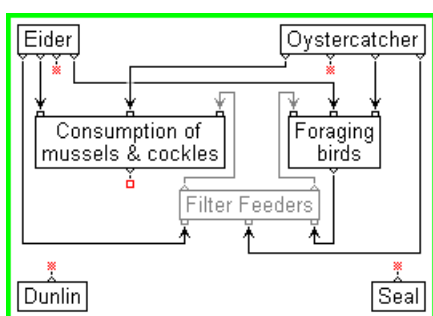
A distinction is made between grazing by Oystercatchers and Eiders. It affects cockles and mussels differently: Eiders forage mostly on mussels because of the availability, while Oystercatchers are better equipped to catch both species.

The effect of strong winters is also taken into consideration in the model. Strong winters are expressed in the number of frost days per year and are a scenario in **WadBOS**. They affect the

reproduction and mortality of both cockles and mussels, but affect cockles more than mussels. Strong winters will result in a sharp decline in the number of shellfish during the winter months, as they freeze to death, but this is typically followed by a strong rise in the reproduction in the following summer. As a consequence, algae too will indirectly feel the effects of a strong winter. After a strong winter a strong algae growth occurs because of the lack of predators. But, when the predators have recovered in the summer, the grazing picks up very rapidly and algae disappear from the system.

The size of the shrimp biomass is not yet explicitly modelled in **WadBOS**.

Birds and Seals



The seals and important bird species (Dunlin, Oystercatcher, and Eider) are indicator species in **WadBOS**. Thus they are considered to be a good measure for estimating the potential level of exposure inflicted by human activities on the natural system. But birds, in particular Oystercatchers and Eiders, are also predators of cockles and mussels in the model. Moreover, they have a protected status in the Wadden Sea: prior to determining the quota for the fisheries, food in the form of cockles and mussels is set aside for the

birds. The size of the bird populations is represented in **WadBOS** in the form of a scenario with seasonal patterns and their spatial distribution is represented

on a map. The number of birds in the region strongly fluctuates from year to year. Within the year a certain pattern in the presence of both Oystercatchers and Eiders can be discerned: a small group of Oystercatchers and Eiders breed in the Wadden Sea region, and thus live there all year round, but most use the Wadden Sea as a winter home. The population is thus at a maximum during the winter months. The fluctuation during the year is taken into account in the calculation of the consumption by birds.

The distribution of the Oystercatchers and the Eiders is shown dynamically. They are distributed over the whole region per month on the basis of a simple foraging model and the average food density per cell. For each species the food supply is estimated per cell and the birds are allocated in a proportional manner. Thereby it is assumed that Oystercatchers only forage on the mud flats.

Pressures

Five types of pressures influence the ecosystem: Presence, Noise, Mechanical influences, Extraction and Emissions of substances. The last two types of pressures are taken into consideration in the respective mass balances in the model. The mechanical influence disturbs seabed materials and brings them into suspension. Presence and noise have a specific influence on the spatial aspects of the ecosystem.

Morphology and hydrodynamics

Morphology and hydrodynamics are described in **WadBOS** at a high level of abstraction and on the basis of a number of characteristics of the compartments, such as: area, average volume, dispersive exchange debits, and transport debits. The area and volume of the compartments are obtained from maps with the compartment boundaries and the bathymetry. The debits are always related to the flows between adjacent compartments, or between the North Sea and compartments, between fresh water sluices (including Lake IJssel) and compartments. The dispersive exchange represents the mixing of water in the compartments caused by the tides. As a result, the tidal wave does not need to be explicitly modelled. The dispersive exchanges take place between the compartments in the Western Wadden Sea, between the compartments in the Eems estuary, between the compartments and the North Sea, and between the Dollard compartment and the Eems. The two last ones do not influence the North Sea or the Eems River itself. The external compartments only influence the compartments within the Wadden Sea. The data for the dispersive exchanges in the Western Wadden Sea are taken from EcoWasp. Those for the Eems estuary are taken from the BOEDE-research project.

Transport deals with the exchanges of biomass and substances with Lake IJssel, the North Sea and between the compartments mutually. The transport processes are modelled per compartment and in time steps of 12 hours. It is assumed that after each time step the compartments are mixed completely. For the needs of **WadBOS** the exchange debits suffice. This means that per compartment the following applies:

$$\begin{aligned} \text{Sum of exchange debits} &= 0 \\ \text{Sum of exchanges loads} &= 0 \end{aligned}$$

The concentrations of substances and algae are determined on the basis of the loads. The fact that the exchange debits and loads amount to zero, means that there are no sources or sinks of substances in the compartments, or that the

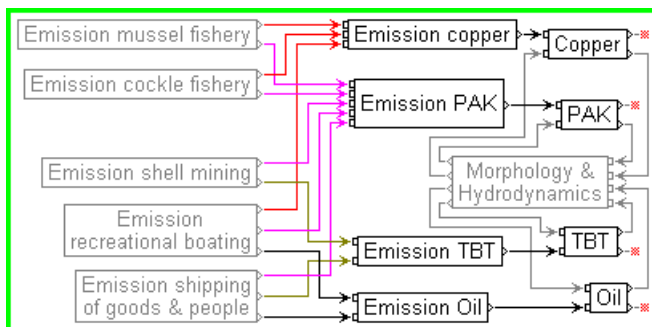
sources and sinks are negligibly small in comparison to the exchange debits and loads.

Emissions

The emissions represent the total load of each individual activity into the Wadden Sea. This enables to get an impression of the relative contribution of the different activities. In the ecosystem sub-model, the loads are spatially distributed and transported, which enables to calculate the contribution of the emissions to the final concentration in the Wadden Sea. In principle the emissions of an activity are taken into consideration only if they represents at the least 1 percent of the load to the Wadden Sea. An exception to this rule is the copper emission by recreational boating. The emissions are defined in tons per year. Given that the amount of emissions as well as their decomposition rate is known, then a simple water movement model at the compartment level suffices to calculate the effect of the emissions on the concentrations of the substances.

Ships that are sailing or anchored cause all emissions. The latter are therefore related to the number of sailing hours and anchored hours. The following emissions are described in **WadBOS**:

- Recreational boating causes the emission of PAK, copper and oil.
- Shell mining causes the emission of PAK and TBT.
- Mussel fishery and Cockle fishery cause the emission of PAK and copper.
- Shipping of goods and people cause the emission of oil, PAK and TBT.



These are the most important substances emitted by the main activities in the Wadden Sea. Apart from these, there are other substances (such as cadmium and chrome) that are only transported into the Wadden Sea from the surrounding water systems (Lake IJssel, North Sea) and substances that are no longer discharged into the Sea but still

present in high concentrations (above the norm values) in the sediment (for example: mercury). These substances are not as yet modelled in **WadBOS**.

The emissions that occur while recreational boats are anchored are distributed over the compartments on the basis of the number of mooring places per compartment. The emissions of the mussel fishery and cockle fishery are distributed over the compartments on the basis of ports used by the cockle and mussels vessels.

2 Starting up WadBOS

This **WadBOS**-package consists of this printed manual and a CD-Rom. On the CD-Rom you will find a number of compressed files and a executable 'Setup.exe' with which you can install **WadBOS version 2.1 International Edition** and its two support instruments: **OVERLAY-TOOL** and **ANALYSE-TOOL**.

In the remainder of the text we will use the term **WadBOS** to mean **WadBOS version 2.1 International Edition**, unless there is a risk for confusion. In the latter case we will be explicit on what we refer to.

In this chapter the installation and starting up of **WadBOS** is described. It also contains a description of important characteristics of the user interface.

2.1 Installing WadBOS

2.1.1 Hardware- en software requirements

WadBOS can be used on personal computers with an Intel Pentium (or a compatible type) processor. To use **WadBOS** you will need a computer with the following hardware components:

- at least 32Mb RAM (preferably 64 Mb);
- a Pentium-processor(or a compatible type) with a processing speed of minimal 150 Mhz (preferably 450 Mhz);
- a hard drive with at least 30 MB free memory (exclusively for **WadBOS** and its directories). If you want to save simulation results, more disk space is required;
- a SVGA-video card and SVGA-screen (preferred resolution 1024*768 pixels, 265 colours or more).

The following software should be installed on your computer:

- Microsoft® Windows 98®, Windows NT®, Windows 2000® or Windows XP®;
- Microsoft® Excel® (version 7.0 or more recent) (optional);
- A GIS-packet: IDRISI® for Windows (version 2.0) or Arc/View® or Arc/Info® with GRID function (optional)

MS Excel and/or a GIS-application are not essential to work with **WadBOS**, but many of the import and export functions work with these applications.

2.1.2 Installation procedure

In this paragraph the step-by-step installation of **WadBOS** is explained. The installation or removal of **WadBOS** is compliant with the Windows standards.

If you have a previous version of **WadBOS** on your PC, it is advisable to remove it before installing the new version.

- Make sure that all your windows applications have been closed prior to running the installation.
- Insert the **WadBOS** CD-Rom into the drive.
- Click the Start button in the Windows Taskbar. Move the mouse pointer to the Settings command and move on to the Control Panel option. As a result the *Control Panel* dialogue window will open. Select Add/Remove Programs by double clicking it. Next click the Install button in the Install/Uninstall view of the *Add/Remove Programs* dialogue window.
- Next, the installation program will be started. It will display the About dialogue window. Press the Yes button to continue the installation or the No button to cancel it. In the following dialogue windows you need to click the Next button until (1) the program has selected your CD-drive as the installation medium, and (2) until it will have found the Setup.EXE program for **WadBOS** on the CD-Rom. Then, the command line '[drive]:\setup.EXE' will appear in the edit field of the *Install* window. Press Finish to continue the installation.
- Continue clicking Next until the *Read Me* window appears. Make sure to read this page. After clicking Next again, a second dialogue window appears asking you where to install **WadBOS**. You can accept the default path, which is 'c:\Program Files\WadBOS' or replace it in the edit box by one of your own choice. You may use the Browse button to select this alternative path as well.
- To go on, press the Next button. Otherwise to cancel the installation process, press the Cancel button.
- Next the installation program suggests to add **WadBOS** to the new Program Group "**WadBOS 2**". You are free to create another Group or to choose an existing one from the list shown.
- Next the installation program asks you which components need to be installed: (1) WadBOS Program and Data Files, (2) Overlay-Tool, and (3) Microsoft system software. You need all three to run WadBOS, but may already have installed the other components on an earlier occasion. Deactivate the check-boxes of the components that you do not want to install. In order to install the Microsoft system software components on Windows NT, 2000, and some XP systems you need to have Administrators rights to complete the operation successfully.
- From that moment the installation application is decompressing the necessary files and puts them in the directory structure of **WadBOS**.
- If everything went OK, a last dialogue window will inform you about the fact that the installation is finished. Once the installation on the hard disk is completed, the program creates a group named '**WadBOS**' under the Start button and Programs command. The group contains the pictogram of the **WadBOS**-application as well as those of both the support tools: **OVERLAY-TOOL** and **ANALYSE-TOOL**. When you double click the pictogram, **WadBOS** will be started and the *About* window will appear. Click OK to enter the Application window.

2.2 Starting WadBOS

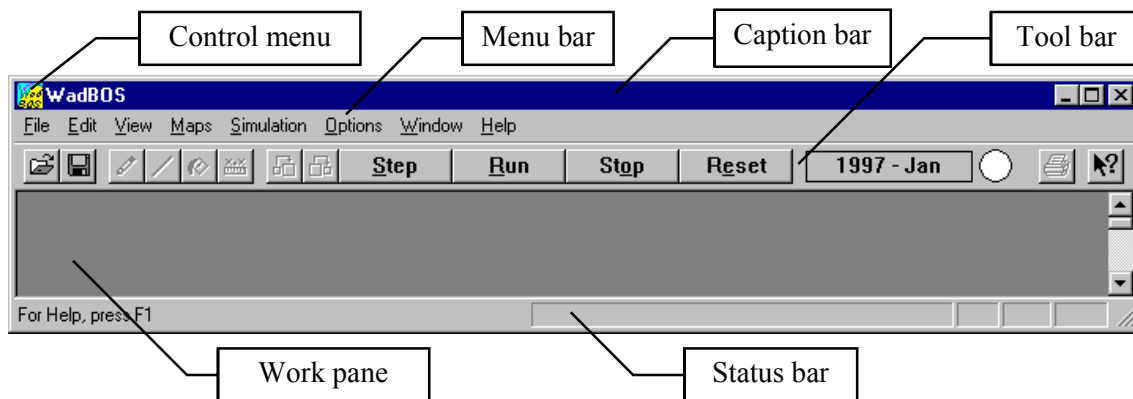
After installing the program as is explained in Paragraph 2.1, the program can be started in the following manner:



Under the Windows Start button and the Programs group, you will find a group called **WadBOS**. Double-click on the **WadBOS**-icon in the **WadBOS** group. **WadBOS** will be started and you will see the **WadBOS** Application window on your screen.

2.3 Screen layout of WadBOS

When you start **WadBOS**, the Application window of **WadBOS** will open immediately. This is the window in which you will run your simulations. You can arrange input and output windows as you like in the application window. Before a simulation file has been opened, the window is empty except for its Caption bar, Toolbar and Menu bar. The different components of this window will be described in the next paragraphs.






2.3.1 The Caption bar

The Caption bar in the application window shows the name of the application: **WadBOS**. Left of the title is the Control menu icon containing the Control menu of the Application window, which controls how windows are arranged on the desktop. The list below summarizes the Control menu commands.

Use this command	To ...
<u>R</u> estore	restore the window to its previous size
<u>M</u> ove	move the window using the arrow keys.
<u>S</u> ize	change the size of the window. You can use the mouse or the arrow keys to change the size.
<u>M</u> inimize	shrink the window to an icon
<u>M</u> aximize	enlarge the window to the full size of the screen
<u>C</u> lose	close the application window

To the right of the Caption bar three buttons are positioned that enable you to re-size the Application window.

Use this button	To ...
	shrink the application window to an icon. Pressing this button has the same effect as selecting the Minimize command from the menu Control;
	enlarge the application window to the full size of the screen. Pressing this button has the same effect as selecting the Maximize command from the menu Control;
	close the application window, and thus quit the application. Pressing this button has the same effect as selecting the Close command from the menu Control.

2.3.2 The Menu bar




The Menu bar of the Application window contains the main menu of **WadBOS**. The commands are logically organized in the menu so that you will quickly become comfortable with the various functions of the program. The menus are summarized in the table below; subsequent chapters elaborate on the description. Chapter 4 gives an overview of all menu commands.









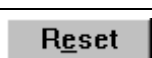


Use this menu	To ...
<u>F</u> ile	manage your simulation files. The printing facilities are also located in this menu, and if you want to exit the program, you can do it from here.
<u>E</u> dit	edit maps, parameters and variables. All commands for editing are located here. Depending on the type of map that is active, the appropriate edit features are listed and accessible.
<u>V</u> iew	change the way a map is displayed. Commands to zoom in and out as well as commands to display information on the foreground or background of the maps are part of this menu.
<u>M</u> aps	open a new window with one of the maps of the modelled region.
<u>S</u> imulation	control the simulation. The commands in this menu are the same as the buttons in the Toolbar .
<u>O</u> ptions	customise the workspace. With the help of these commands you can for example show or remove the status bar and the Toolbar , link WadBOS to Microsoft Excel, and make .LOG files of your simulations.
<u>W</u> indow	manage your windows on the screen.
<u>H</u> elp	get access to the help function.

2.3.3 The Toolbar

The Toolbar, also known as Speed bar, gives faster access to some of the more frequently used commands that are also accessible via the menu.



Use this button	To ...
	open a simulation file from the disk.
	save a simulation file to disk.
	change the pointer to a pen. The pen is used to pick a value from the legend and enter it in a cell on the map.

Use this button	To ...
	change the pointer to a pen. The pen is used to pick a value from the legend and enter it in a row of cells on the map.
	change the pointer to a bucket. The bucket is used to pick a value from the legend and enter it in larger, contiguous areas on the map.
	change the pointer to a ruler. The ruler is used to enter detailed information cell by cell. When a cell is clicked, a dialogue will open to enter the exact value.
	zoom-in. Increase the size of the map on the display.
	zoom-out. Decrease the size of the map on the display.
	advance the simulation with one simulation step.
	advance the simulation till the next pause is reached (as set with the Pauses... command).
	stop the simulation.
	reset the simulation. State variables and maps take their initial values; parameters keep their actual values.
	print the Micro-scale dynamics window.
	To change the pointer into a Help-pointer. If there is no help pointer in a menu or window the relating help page will open

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Besides this set of buttons, the Toolbar also displays the simulation clock. Each time step, the clock is updated by a value of 1 month. A simulation runs typically from January 1997 till December 2006.

The Toolbar command in the View menu gives the option to display or hide the Toolbar in the **WadBOS** Application window.

2.3.4 The Status bar

The Status bar is displayed at the bottom of the Application window. This zone provides information to the user on his actions while he is working with the application.

The left area of the Status bar describes actions of menu items as you use the mouse or arrow keys to navigate through menus. This area similarly shows messages describing the actions of Toolbar buttons when pressed. At start-up and while running simulations, the program provides information on the tasks that it currently carries out. This enables the (experienced) user to follow the progress of the simulations.

The right area of the Status bar indicates which of the following keys are latched down:

Indication	Description
CAP	De Caps Lock key is latched down.
NUM	De Num Lock key is latched down.
SCRL	De Scroll Lock key is latched down.

The **Status bar** command from the **View** menu enables to display or hide the Status bar in the **WadBOS** Application window.

2.4 The Help functions of WadBOS

WadBOS has a simple on-line Help function. Its composition and use is compliant with the Microsoft Windows-standard.

To open the Help function press F1 or the key-combination ALT-H.

The Help menu consist of three parts:

- Index provides access to the contents of the Help file;
- Using Help provides a general directive about the use of a Windows Help-system.
- Info... provides information about the version of the **WadBOS** with which you are working.

Apart from this there is an extensive on-line documentation of the **WadBOS**-model. This can be consulted by pressing F1 while a window is opened or by selecting the Help-pointer from the **Toolbar** and clicking the window (see Paragraph 3.3)

2.5 Closing WadBOS

Closing and exiting **WadBOS** is simply done by selecting the **Exit** command from the **File** menu. If you have simulation files open and you have made any changes, the application will ask whether you want to save simulation results before exiting. If you confirm to be interested in saving results you will get the **Save** dialogue window. More information on saving simulation results is given in Paragraph 3.4 of this manual.

2.6 If you experience problems

If you experience problems installing or running **WadBOS**, contact:

Research Institute for Knowledge Systems bv.
To the attention of **Inge Uljee** or **Guy Engelen**
P.O. Box 463
6200 AL Maastricht
The Netherlands
Tel: +31 43 388.33.22
Fax: +31 43 325.31.55
E-mail: info@riks.nl
Http: www.riks.nl
Ftp: [ftp.riks.nl](ftp://riks.nl)

3 Working with WadBOS

This chapter explains in an elementary manner the way **WadBOS** works. More information about the functions of **WadBOS** can be found in Chapter 4.

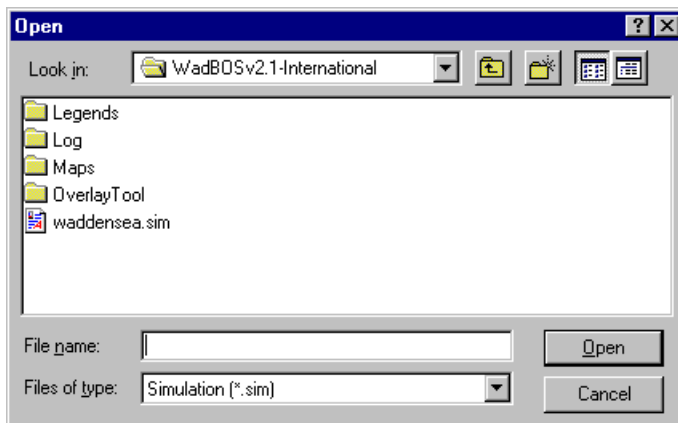
This chapter does not include details about the integrated model of **WadBOS**. More information about the model itself can be found in Chapter 1, in the on-line documentation of the model, or in other publications and documents that have been written about **WadBOS**. An overview of relevant documents can be found in the References.

The installation of **WadBOS** has been described in the previous chapter. We assume that you have read this information, that you are familiar with the various technical terms, and that you succeeded in installing **WadBOS** on your computer.

3.1 Opening a simulation



Press the Start button in the Taskbar of Windows and move the mouse pointer to the Programs group. Move through the menu until you find the WadBOS 2-group and open WadBOS by clicking the WadBOS icon. If the software was installed correctly, the application window will open. Directly after that the *About* window will open. After you have read the information and warnings, press the OK button (or the WadBOS icon). The *Open* dialogue window will appear directly afterwards. If this does not happen, select the Open command in the File menu.



Find the correct file with .SIM extension in the *Open* dialogue window. Using the manipulations that are standard in all Windows applications, it is possible to find the file of your choice by browsing through the directories on your own computer or on another computer in your network. If you have found the correct file select it and click on the Open button or double click on the name of the file.

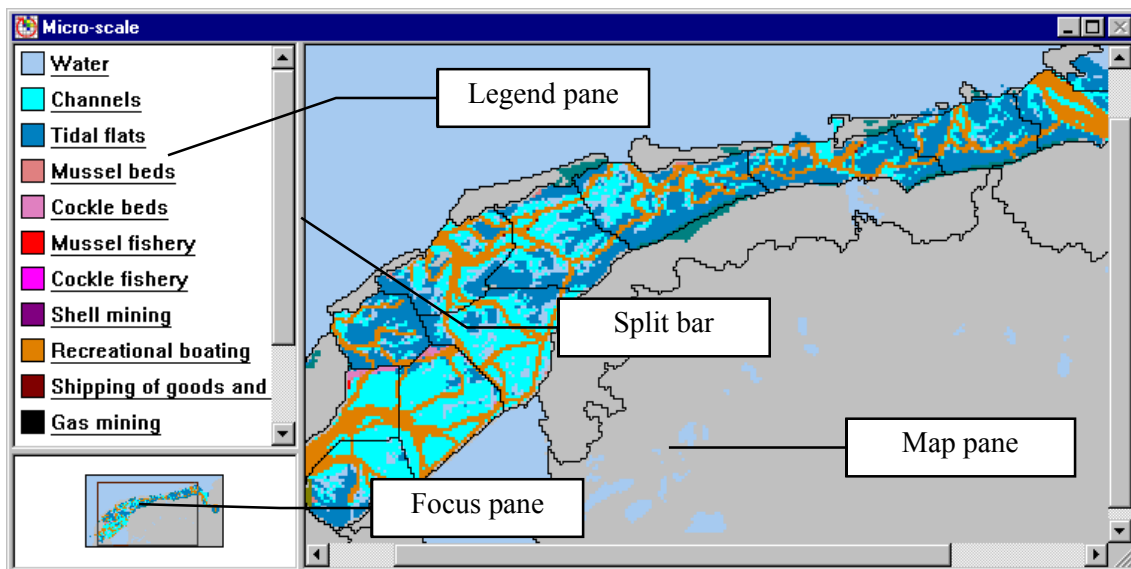
A .SIM-file contains references to all the files that are needed to run the model. More details will be given on the composition and the contents of the .SIM-files further on in this chapter

Once all files have been opened, two windows will appear in the application menu: the one is called *Micro-scale* and the other is called *Macro-scale*. They are both very essential for working with the model. That is why it is not

possible to close them. The Close button in their caption bars is greyed out and it is only possible to minimize or maximize them.

3.1.1 The Micro-scale window

The *Micro-scale* window consists of three parts, called *panes*. Split bars separate the three panes from each other. The split bars can be moved in order to enlarge or reduce the size of the panes. To this effect place the mouse pointer on the split bar. The pointer will then change into a Sizing pointer (see appendix B). Press the left mouse button and keep it pressed while dragging the split bar to the desired location.



The pane to the right side of the *Micro-scale* window --the *Map pane*-- contains a map of the modelled region. To be precise, this map shows the use of space in the Wadden Sea at each time step during a simulation. The meaning of the colours and signs are presented in --the *Legend pane*-- that can be seen in the top left hand corner. The pane in the bottom left hand corner --the *Focus pane*-- shows the mapped area in small. On this map you will see a small black rectangle frame delimiting the part of the map shown in the map pane. By placing the pointer inside this frame, pressing the left mouse button, and moving the mouse with the left mouse button pressed down, it is possible to change the focus of the map shown in the map pane. Notice that the map in the map pane changes according to the position of the frame in the focus pane. Using the scroll bars of the map pane also changes the area shown in the map pane. The legend pane too has a vertical scroll bar. This enables to see the legend items that are not displayed due to the length of the legend.

Using the commands of the View menu can change the way in which results of the Micro-model are shown in the map pane. This is the case for the Micro-scale window, but for all other map windows too. The options are: Zoom out, Zoom in and Show compartments. A complete overview of the View menu can be found in Paragraph 4.3.

Most components of the Micro-model are accessible via the menus of the system. Details of the diverse menu commands can be found in Chapter 4. In this paragraph we will only describe the parts that are essential for

understanding how the Micro-model functions and how parameters can be changed interactively.

3.1.1.1 *Micro-scale map*

The Micro models contain momentarily mostly subsystems and processes that relate to the waters of the Wadden Sea. The parts of the model that relate to the land may be developed at a later stage. This means that, at the Micro-scale, only cells that are part of the sea are modelled and dynamically updated during the simulation. Information in relation to the land is shown but this information is static. The name 'Land use' in the context of WadBOS is therefore misleading. In fact it should be interpreted to mean 'Sea use'.

As a result of the calculations in the Micro-model of **WadBOS** the location of the activities on the water will change at every simulation step (every month). The *Micro-scale* window is updated every month and the new distribution of activities is shown in the Micro-scale map.

	Threshold	Priority
Mussel beds	25	9
Cockle beds	15	9
Mussel fishery	35	2
Cockle fishery	35	2
Shell mining	15	2
Recreational boating	5	1
Shipping of goods and people	5000	6
Gas mining	500	8
Defence	10	7

The dominant activity displayed is determined on basis of the morphology of the sea (Channels, Tidal flats, and other Water), the most important economical species (Mussel and Cockle beds) and the intensity of the activities that take place at sea (Mussel fishery, Cockle fishery, Shell-mining, Recreational boating, Shipping of goods and people, Gas-mining and Defence). The Micro-scale map is therefore a synthesis map: as soon as the importance of a mussel bed, a cockle bed, or the intensity of an activity rises above a user-defined threshold value, they become eligible for being displayed. But they will only be displayed effectively if the user has also

given them a sufficiently high (display-) priority. The definition of the threshold values and priorities is done by means of the *Landuse micromodel* dialogue window that opens when the Land use... command in the Edit menu is activated.

Given the fact that very little is known about the geographical distribution of activities in the Wadden Sea, it is assumed in **WadBOS** that the suitability for the activity is a good estimate for where it will take place in reality. Therefore the *Suitability maps* in combination with the *Zoning maps* are the determining factors for calculating the location and intensity of the activities in the Wadden Sea.

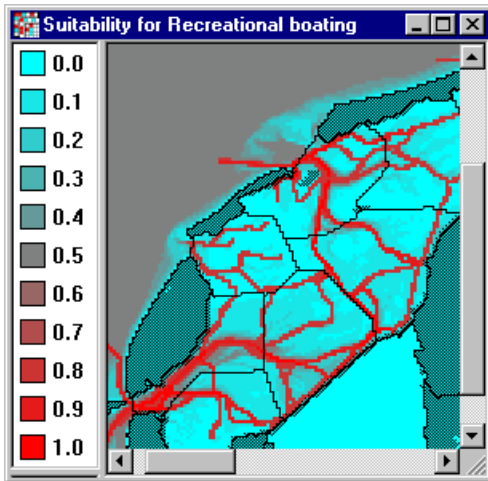
3.1.1.2 *Intensity maps*

In the general sense an Intensity map in **WadBOS** shows the spatial extent, location and amount, of an activity or species. It should be interpreted as an average and potential; rather than absolute and effective spatial distribution. It translates the importance of the activity or species as calculated at the Macro-scale into a spatial distribution at the Micro-scale. Simply put, the total activity is distributed over the cells proportional to their suitability for hosting the activity and 'open' for the activity according to the Zoning map. The intensity

is therefore a dynamic measure that changes every month as the result of the opening and closing of areas for the activity and the changes in the effort in the specific activity and the whole region.

The information in the Intensity maps is also used to calculate other types of dynamic maps, such as: the Exposure maps, the Pressure maps, and the maps relative to the Environmental appraisal sub-model. More information about this can be found in Paragraph 4.4 or the on-line documentation pages.

3.1.1.3 Suitability maps



The model also has one Suitability map for each type of land use. These represent on a scale of 0 to 1, and in shades varying from cyan to red, to what extent a cell is apt for the specific land use. Suitability is a composite measure and is usually calculated on the basis of a number of underlying spatial factors. Suitability calculations are standard GIS-operations supported by most commercial GIS programs. It is possible to import suitability maps into **WadBOS** that are prepared in IDRISI (.IMG files) or Arc/Info (.ASC files). But, **WadBOS** also has its own instrument --the **OVERLAY-TOOL**-- to quickly and interactively generate suitability maps. The **OVERLAY-TOOL** is extensively described in Chapter 6.

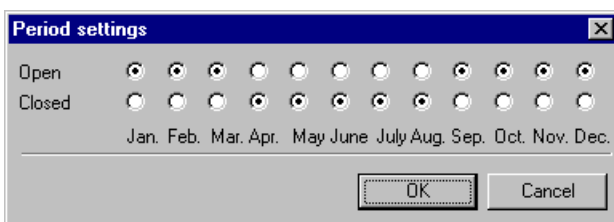
Suitability maps created with the **OVERLAY-TOOL** can be imported into **WadBOS** per scenario: a complete set of suitability maps for all land uses (see Paragraph 4.1.5 the command Import scenario...).

The suitability map for all the activities and the species Cockles and Mussels can be selected from the Maps menu. Their presentation on the screen can be adjusted with the help of the commands in the View menu.

3.1.1.4 Zoning maps

The model has to its disposal a Zoning map for each type of land use. These maps can be edited to indicate if a cell can be taken in or not, by the specific activity. There are three possibilities for each cell:

1. the specific activity is allowed to take place in the cell (white cell);
2. the specific activity is not allowed to take place in the cell (red cell);
3. the specific activity is allowed to take place in the cell periodically (yellow cell).



For the last group of cells (3) the user has to indicate for which months during the year the Sea is open or closed. This can be done by means of the dialogue that opens when the Period Settings... command in the Edit menu is selected. This last command is only accessible if

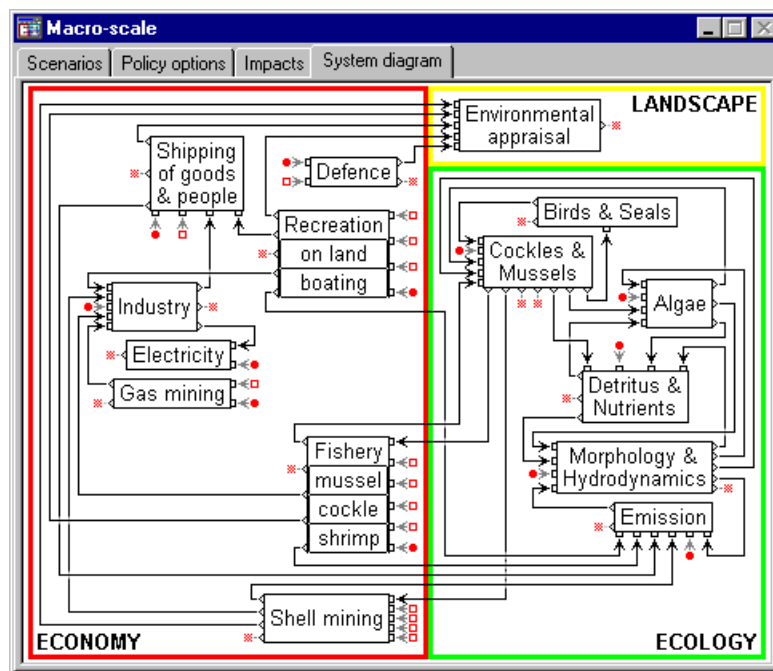
the Zoning map of the specific activity is active.

Similar to the Suitability maps, the Zoning maps can be imported or prepared with the **OVERLAY-TOOL** (see Chapter 6).

Providing that your PC has enough memory available there is no limit to the number of maps that you can open or close (except for the *Micro-scale* window or the *Macro-scale* window, that can neither be closed). But you should be aware of the fact that during a simulation all opened windows are refreshed at every simulation step. As this takes up processing time, the program will slow down. Therefore it is a good practice to close or minimize windows that are not of immediate interest to you. It may speed up your simulations considerably.

3.1.2 The Macro-scale window

The *Macro-scale* window is the graphical user interface for the macro models. It consists of four tab-pages or so called views. When a simulation is opened, the default view, the so-called *Impacts View*, is shown. The other views are named: *Scenarios*, *Policy options* and *System diagram*. These names are found in the tab fields located just underneath the Caption bar of the *Macro-scale* window. Changing views is possible, by pressing the tab field of your choice.



Every Macro-scale view contains a specific graphical representation of the macro models:

1. View # 1, *Scenarios*, shows the parts of the model that are most affected by exogenous influences and is also the place where hypothesis relative to these influences can be entered.
2. View # 2, *Policy options*, shows the parts of the model that are susceptible to policy measures. This view is used to select and characterize the policy measures analysed in a run with the simulation model.
3. View # 3, *Impacts*, shows the parts of the model that contain summarized information relative to the policy indicators and other output needed to evaluate the effects of the diverse scenarios and policy options tried out with the model.

4. View # 4, The *System diagram*, shows an overview of the structure of the modelled system at the most synthetic level. It gives access to all the details of the model at this level, but also at lower levels. It should be used as a graphical explorer of the model.

In this version of **WadBOS** it is not possible for the user to change the graphical representation or the structure of the model in any of the 4 views.

The **WadBOS** model has been implemented by means of the Decision Support System Generator **GEONAMICA**[®]. **GEONAMICA** models consist of *Model Building Blocks* (MBB's) that contain the code and/or data required to calculate and execute mathematical operations varying from a single operation (such as the sum of two numbers) to a complex set of interlinked operations (set of mathematical equations). MBB's are stored in the *MBB-library* and are connected to one another by means of *MBB-Connectors*. Model Building Blocks are graphically represented in the interface by means of a rectangle with the name of the MBB in it. To improve the readability of the diagrams, some parts of the model have been grouped in so-called *SuperMBB*'s and are shown as a single building block.

Appendix A contains some more details about **GEONAMICA**[®]

The representation of the Macro-model in the Systems diagram-View, as well as all the other views of the *Macro-scale* window, have been created with the help of the following basic elements: *Model Building Blocks*, *MBB-Connectors*, *Connections*, and *MBB-Dialogue windows*.

3.1.2.1 *Model Building Blocks (MBB)*

The diagrams in the 4 views of the *Macro-scale* window provide insight into the structure of the model and enable access to the active Model Building Blocks of the model. Model Building Blocks are represented graphically by means of a rectangle with the name of the MBB printed in it.

Emission




An active Model Building Block is represented in the views in black. When the mouse moves over such block its colours are inverted. Next, if you click in it, the reaction of the system will depend on the type of MBB clicked.

- If the MBB is not a SuperMBB, a dialogue window will open. This dialogue window is the user interface of the MBB. It has the double function to receive the user inputs and to display the model outputs.
- If the MBB is a SuperMBB, then a more detailed diagram of the underlying sub-model is shown, in which each of the MBB's functions as has been explained previously.

Emission

A non-active MBB is represented in grey in the diagrams. They are copies of MBB's that are located elsewhere in the *Macro-scale* window (usually on a different hierarchical level). Their only function is to improve the readability of a diagram.








3.1.2.2 Connectors and Connections

	In-Connector
	Out-Connector
	Connection

Values of variables and parameters can be exchanged between MBB's via Connections. MBB's send information to the rest of the model via *Out-Connectors* and receive information from other MBB's via *In-Connectors*.

Real exchange between MBB's is possible if a *Connection* exists between the Out-Connector of the broadcasting MBB and the In-Connector of the receiving MBB. For each variable or parameter a connection is made (except if one of the MBB's is a SuperMBB).

There are In- and Out-Connectors that are not linked to other MBB's in the diagrams. These are represented by means of a special red symbol. They represent the connections that interlink the views. In the following table an overview of all the symbols used is given.

Connector	Description
	Standard In-Connector taking in information from another MBB.
	In-Connector taking in information from a MBB in the System diagram, but not represented (not repeated).
	In-Connector taking in information from a Scenarios MBB.
	In-Connector taking in information from a Policy options MBB.
	Standard Out-Connector emitting information to another MBB.
	Out-Connector emitting information to a MBB in the System diagram, but not represented (not repeated).
	Out-Connector emitting information to an Impacts MBB.

3.1.2.3 Dialogue windows

Each MBB has a Dialogue window associated with it. It is the vehicle that permits the interactive exchange of information between the user and the Model Building Block: the MBB will communicate the results (output) of its numerical operations to the user, and it will take in the data entered (input) by the user that are required for the execution of the MBB. It concerns data that are internal to the MBB and that it does not get from other MBB's via its In-Connectors.

Colour of the text in the Edit Fields of MBB-dialogue	Description
RED	<u>Input</u> . Parameter value (can be changed during the entire simulation) or State variable at the initial state.
PURPLE	<u>Input</u> . Variable value. If the edit field is clicked, an extra dialogue will pop-up requesting input necessary for the calculation of the variable
GREEN	<u>Input / Output</u> . State variable that can be changed at the start of the simulation, and that displays output for the remainder of a simulation.
BLUE	<u>Output</u> . Variable value. (read-only)
BLACK	<u>Output</u> . Values copied from other MBB's. (read-only)

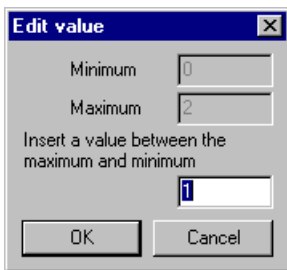
In the dialogue window, model results and model inputs are presented in Edit Fields. The difference between input and output fields is indicated by the colour of the text: green for state variables (to be entered as initial values and for the remainder output of the MBB); purple and blue for intermediate variables; black for variables or parameters copied from other MBB's (output of the MBB); and finally red for internal parameters of the MBB (input for the MBB).

A simple way of finding out whether a field will accept input or not is by simply moving the mouse over it. If the field can be edited, the mouse pointer will change shape in function of the type of data that are to be entered. If the mouse is clicked, the appropriate editor is opened. In Annex B, the meaning of the different pointers is explained.

One of four dedicated editors will open:



Single value editor



This editor enables the user to enter a single numerical value. More precisely it will display a default setting --the result of the calibration of the model-- with the request to replace it by a value within the range specified:

Minimum ≤ value entered ≤ Maximum

If values outside this range are entered, the user is warned.



Table (of values) editor

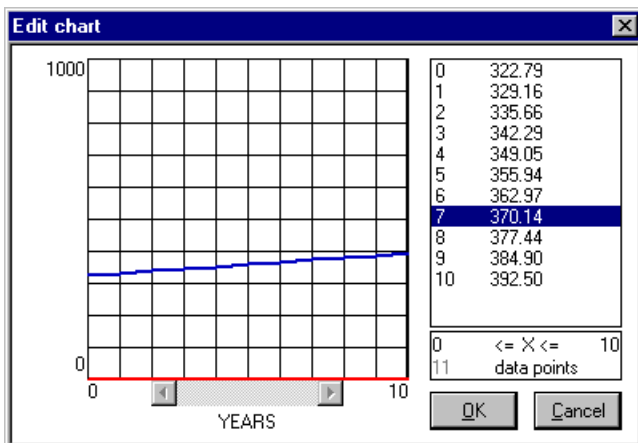
This editor enables the user to enter a series of numerical values. More precisely it will request the user to adjust default values. The values entered will all have to be inside a range specified:

Minimum ≤ value entered ≤ Maximum

If values outside this range are entered, the user is warned.



Graph editor



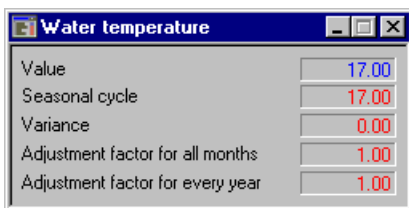
This editor is used extensively in both the Micro-scale and the Macro-scale model of **WadBOS** to change two-dimensional relations: time series, distance decay functions, etc. It consists of two main parts: to the left is a graphical representation of the two-dimensional relation, and to the right a list box with the co-ordinate pairs defining the relation. The relation can be edited in both parts. Changes made in one part of the graph editor are immediately visible in the other part.

The easiest way to enter data is via direct manipulation of the graph. Move the cursor to the abscissa position for which you want to enter a new (ordinate) value. The pointer will change to a pen-symbol indicating that it is positioned correctly on top of a vertical grid line for which it will accept an ordinate value. Move the pointer to the vertical position equal to the ordinate value that you want to enter. Then click the left mouse button to enter the new ordinate of the point in the graph.

The second manner of editing is useful if you have to enter exact numbers rather than trends or approximate numbers. It consists in clicking in the list box the co-ordinate pair that you wish to change. Next a dialogue window will open in which you can enter the new ordinate value. The number of values to be entered as well as the range is displayed.



Dialogue editor

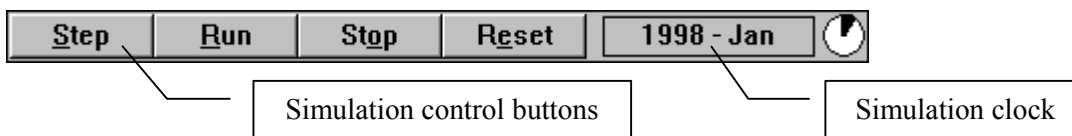


The dialogue editor is opened to enter the data for a dedicated sub-model required to calculate the value of an intermediate variable (printed in purple). This editor is used among others to edit data that are subject to stochastic perturbations

For example the water temperature is estimated on the basis of an average Seasonal cycle (editable by the user), a monthly variance around this average (also editable) and two adjustment factors (also editable).

3.2 Running a simulation

Once the *Micro-scale* and the *Macro-scale* windows have been opened, the program has read the default values for all the parameters as well as the initial values for all the state variables of the model. The program is ready to run a simulation. You can run a simulation with the Simulation control buttons in the Toolbar or with the commands in the Simulation menu.



The outer right box displays the Simulation clock, which indicates the progress of the simulation: it displays the actual month and year until which the simulation has run. The initial month is January 1997.

Step

To verify that the program is ready to run, press the Step button. Once pressed, **WadBOS** will go through a number of essential phases (such as the initialisation and testing of its inputs) that are of no direct interest to the user before it will make 1 simulation step. This will take a while. You will notice that the action is finished when the simulation time changes from [1997 - Jan] to [1997 - Feb] and the land-use map in the *Micro-scale* dynamics window is updated.

Reset

You can undo the simulation step by pressing the Reset button from the Toolbar. This action will reset all the state variables of the model to their initial

value, but will not do so for the values of the parameters. The latter are not influenced by Reset and remain unchanged. Since we have not changed parameter values the latter is of no importance now, but it will be an important issue once you will be changing parameter settings while running and testing different scenarios and policy options with the system.

Run

To perform the simulations for the whole simulation period, press the Run button. The simulation will start running and its progress can be followed as the Micro-scale dynamics window and the simulation clock are updated. The simulation can be paused by pressing the Stop button. Pressing the Run button will resume the simulation. You can also pause the simulation at predefined instances, by using the Pauses... command in the Simulation menu (see Paragraph 4.5.6).

Stop

3.3 Viewing simulation output of the model

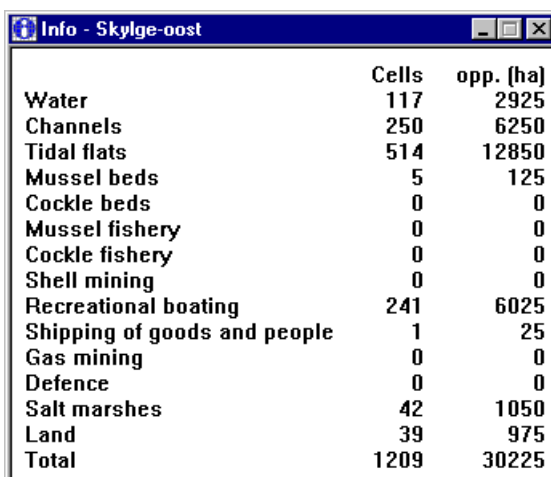
Micro-model

As most important (most synthetic) result of the Micro-model, the land use will change at each simulation step: the *Micro-scale* window will be updated and the new distribution of the land use will appear in the map pane.

Other results of the Micro-model are also shown by means of maps in their respective windows.

Maps can be opened with the help of the commands in the Maps menu. By using the commands in the View menu, the user can change the way in which the results of the Micro-model are shown in the map pane. A complete overview of the View menu can be found in Paragraph 4.3 of this manual. The options are: Zoom in, Zoom out and Show Compartments.

To open the *Info* window, click with the left mouse button on the map in the *Micro-scale* window.



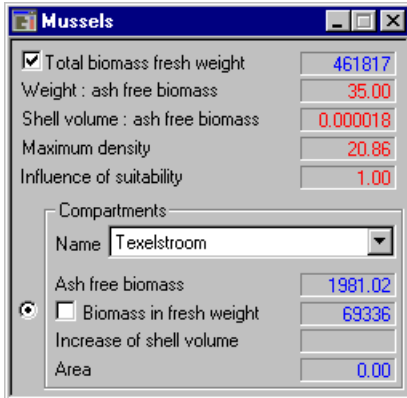
	Cells	opp. [ha]
Water	117	2925
Channels	250	6250
Tidal flats	514	12850
Mussel beds	5	125
Cockle beds	0	0
Mussel fishery	0	0
Cockle fishery	0	0
Shell mining	0	0
Recreational boating	241	6025
Shipping of goods and people	1	25
Gas mining	0	0
Defence	0	0
Salt marshes	42	1050
Land	39	975
Total	1209	30225

The first column of the *Info* window shows the name of the land uses represented on the map. The second column indicates the number of cells occupied by each land use and the third column the number of cells weighted with the weighing factor. A weighing factor can be defined per land use and can be entered using the Edit menu (see Paragraph 4.2.9). This facility enables to show the number of cells in another measurement unit, for example: ha. The overview in the *Info* window is updated dynamically while the simulation is running thus giving the user an insight into the changes that occur during a simulation.

If Show Compartments is enabled, the *Info* window will show the results of the compartment that you have clicked.

Macro-model

The results of the Macro-model are not visible, unless you have opened the parts of the model (the dialogue windows) that you want to consult. As an example we will show what the model has to offer in the Cockles & Mussels MBB.

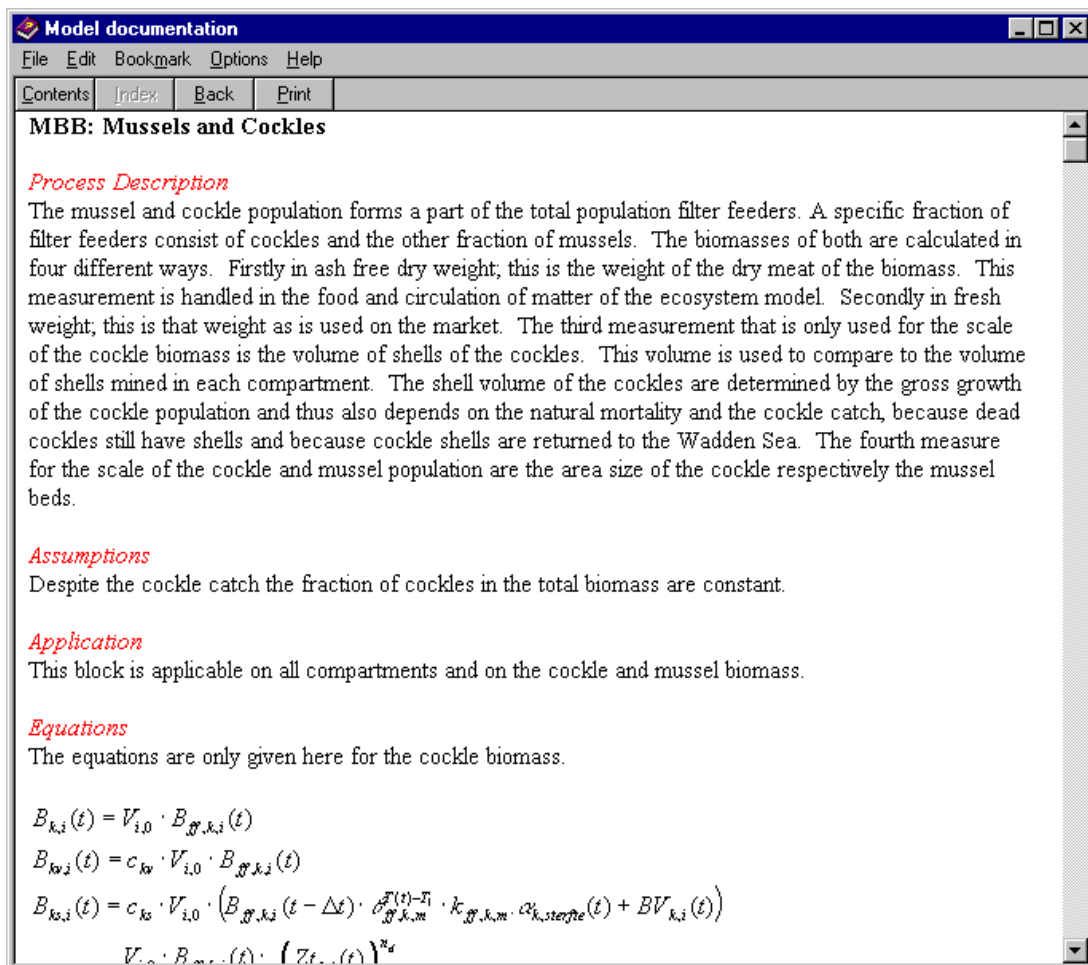


Move the mouse to the (Super) MBB with the name Cockles & Mussels. As soon as the pointer is positioned inside the border of the MBB its colour will invert. Now click the left mouse button. The diagram of the Cockles & Mussels sub-model will open. Now click the Mussels MBB to open the dialogue window. Let the simulation make a few steps. Notice how the value of the variables, such as the variable 'Total biomass fresh weight' is updated every month.

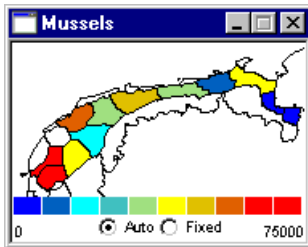
Also notice that the map in the *Micro-scale* window is repainted every month. This demonstrates the fact that

WadBOS has linked micro and macro components that run simultaneously.

As soon as a dialogue window is active, the corresponding (to the dialogue window and the MBB) *on-line documentation page* can be opened by pressing the F1-key.

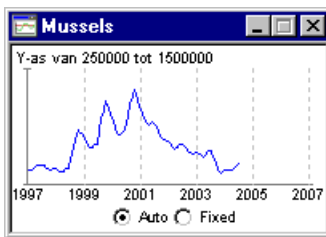


The documentation page contains useful information about the process that is modelled in the MBB, the mathematical expressions that are used, the output that is generated, the input that is needed from other parts of the model, the MBB-specific input parameters that are to be entered for the MBB. The units of measurement of the input and output variables as well as references to the source materials used are also available in the documentation page.



Left of the names of the most important state variables of the model, you will often find a radio button. If you click this radio button, a small compartments map will open, which will show the geographical distribution of the specific state variable. This map is dynamically updated: if you keep it open during the simulation, you will be able to see how the distribution of the variable changes in time and space. This mapping tool is equipped with a legend that automatically ('Auto') sets the lower limit of the lowest class and the upper limit of the highest class so that all the values for all compartments can be shown. If you prefer to work with fixed classes, then click the radio button 'Fixed', the *Legenda* dialogue window will then open in which you can set the lower limit (Minimum) of the lowest class and the upper limit (Maximum) of the highest class. The number of classes has been set to 10 and cannot be changed.

If you prefer to work with fixed classes, then click the radio button 'Fixed', the *Legenda* dialogue window will then open in which you can set the lower limit (Minimum) of the lowest class and the upper limit (Maximum) of the highest class. The number of classes has been set to 10 and cannot be changed.



Next to some important state variables there is very often also a check box. If you click this check box, the variable is shown in a time graph. The value of the graph is drawn from month to month or from year to year. The Y-axis of the graph is set automatically ('Auto'), similar to the compartment maps, so that the minimum and the maximum value of the time scale is shown. If you prefer to set the limits yourself you can do this by clicking the radio button 'Fixed', and enter the Minimum and Maximum value of the Y-axis.

If you prefer to set the limits yourself you can do this by clicking the radio button 'Fixed', and enter the Minimum and Maximum value of the Y-axis.

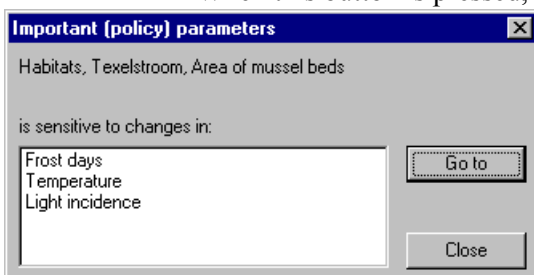
Indicator	Criteria	Value	Score
<input type="checkbox"/> Area of mussel beds	0.00	7544.44	7544.44
<input type="checkbox"/> Area of cockle beds	0.00	90596.59	90596.59
<input type="checkbox"/> Area of salt marshes	0.00	0.00	0.00

Indicators per Compartment			
Compartment: Texelstroom			
<input type="checkbox"/> Area of mussel beds	0.00	0.00	0.00 >>
<input type="checkbox"/> Area of cockle beds	0.00	8766.39	8766.39 >>
<input type="checkbox"/> Area of salt marshes			>>

The dialogue windows that are linked to the Model Building Blocks of the Impacts view are presented as a score table. To the right of the names of the policy indicators, there is a column with the name Criteria in which the user can enter the values (in red) that he wishes the indicator to reach. In the column Value the actual value of the indicator during the simulation is given. In the last column, with the name Score, the difference between the Criterion and the actual Value is given.



To the far right of some of the indicators, the user will find the button [>>]. When this button is pressed, the *Important (policy) parameters* dialogue window is opened.



This dialogue window contains a list of parameters that the policy indicator is particularly sensitive to. If the user changes these parameters it can be expected that the policy indicators will undergo a more or less strong change. To set the parameters from the list, simply click on the parameter and then click on the Go to button. As a result of this action,

the dialogue window is opened in which the parameter can be specified.

WadBOS is a very open and flexible tool. This is clear from the way the results can be consulted. You can by your own choice select, open and order dialogue windows. **WadBOS** has tens of windows available with results and information that relate to the model. All these windows are accessible via the earlier explained structures and logic, and can be selected via the *Macro-scale* window or the main menu. When you open a window, dialogue window, map or graph or one of the documentation pages, then this interface object stays open until you close it. While the simulation is running all the opened interface objects are updated. This offers the important advantage that information about different parts of the model can be seen simultaneously and enables analysis aimed at finding out how changes in different parts of the model happen and are linked.

If you place the pointer on the caption bar of the window, you can then move the window to another position by keeping the left mouse button pressed. During a simulation exercise it is advisable to order the dialogue windows so that they are all grouped on the one side of the application window and the maps on the other side. This enables you to view the effects of the simulation simultaneously on the Macro and Micro-level.

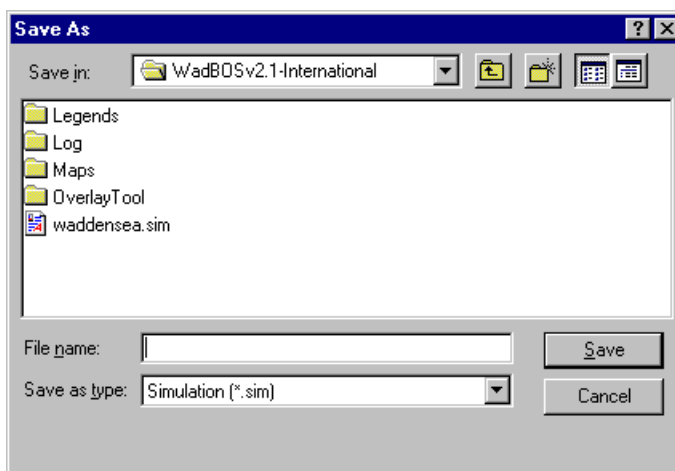


Tip

Important ! We warn you that you should learn to work cautiously with output windows and that windows that are not directly of importance should be closed or minimized as much as possible. If this is not done you run the risk that the screen will become overloaded with, 'residual' information that is not really used. But, every opened window is updated by **WadBOS** and this takes a lot of (calculation) time and memory space. This can make the program a lot slower. It is most important to close as much as possible the maps that are not used.

3.4 Saving the simulation results

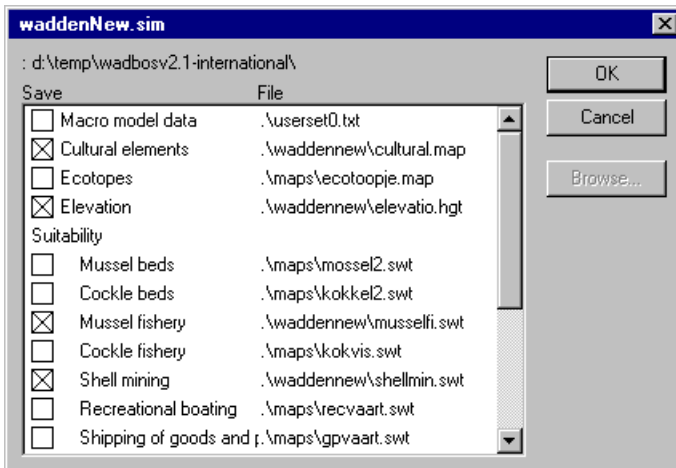
Working with simulation models is to a large extent an iterative process: the user is exploring different combinations of alternatives to find out interactively which are likely to satisfy his set of criteria. These explorative exercises require a capacity to store simulation results in an efficient manner.



The Save simulation as... command from the File menu allows the user to store simulation results in a more or less sophisticated manner. More particularly it allows the user to efficiently manage the different kinds of files that constitute a single simulation. Indeed, a simulation requires not just one, but 10 to 20 files, hence, saving a large number of simulation runs requires a large storage space on your hard disk(s).

When you select Save Simulation as... from the File menu, the *Save As* dialogue window will open, requesting you to enter the name of the file. If the name of the current simulation file is

entered, then it will be overwritten, and the original will be lost. Overwriting files can be avoided by simply choosing a file name different from the current one. Once the name of the file is entered, and the Save button has been pressed, the system will display the *Simulation fileSIM* dialogue window. If you are a relatively new user of **WadBOS**, simply press the OK button to complete the action of saving the simulation and skip the remainder of this paragraph. If however, you are more experienced with the system this dialogue window will help you to change the composition of your simulation file before saving it. The dialogue window shows an overview of all the file types of files --and their respective names-- that are used in a simulation.



In the dialogue window, the files are organised in groups (for example Suitability, Indicator, ...) and are preceded by a check box. Files preceded by a crossed check box will be saved as part of the simulation file and with the name mentioned to their right. The program keeps track of the actions that the user has performed during a simulation session and knows what files are affected by it. These files are shown with their check box crossed, and that is why the

program suggests saving them. The files that are preceded by an empty check box have not been changed during the simulation. There is no need to save them and the new simulation file will simply keep references to them.

If however you do not want a new copy --for example because the corrections made in one or the other map are not important to you-- then simply click on the check box to remove the cross. Although this procedure might seem cumbersome at first sight, it will become a great help to you once you are more familiar with the system.

WadBOS can work with both readable and binary versions of the files. The readable files can be opened and read with standard word processing applications. However, the processing speed will be a lot higher when you work with binary files. To change from readable to binary and back again click the radio button in the format box of the dialogue window.



Important ! In some protected versions of **WadBOS** it is not possible to change the format of the files. In the latter case the format box will not be shown.

WadBOS saves its output in exactly the same format as its inputs. Hence, you can always use saved simulations as the input for a new run. Keep in mind however that the simulation clock will be set back to [1997 - Jan] when you continue a simulation in this way.

The *Save simulation as...* command will only save final results of the model (current values of state variables and parameters). It will not store intermediate results. To save these, you should make use of the *Log...* command and the *Link to Excel...* command from the Options menu.

The Log... command saves the Micro-model simulation results in a so-called .LOG file. When you select the Log... command you can choose from a list of available maps the ones that you like to store and you can set the time interval for which you like to have a map available (see Paragraph 4.6.6).

The command Link to Excel... writes the results of the Macro-model in an Excel spreadsheet. This spreadsheet (Impact.XLS) can be saved and is available for further analyses (see Paragraph 4.6.5).

3.5 Printing simulation results

WadBOS supports very directly the printing of maps. To this end, you can invoke from the File menu the commands Page Setup..., Print Preview, Print Setup... and Print.... **WadBOS** prints the map and legend on separate pages.

The maps of **WadBOS** are generally raster maps with a resolution of 500 meters per cell. You can print them on your preferred scale. Select firstly the Page Setup... command from the File menu and decide on the amount of cells per measurement unit. For example set 20 cells per cm for a map on the scale of 1/1.000.000. Select the Print Preview command to get an idea of how the map will look like when it is printed. Then select the Print... command from the File menu or the Print button in the Toolbar to print the result.

To print the results of the Micro-model, select the Link to Excel... command from the Options menu and then use the print functions of Excel. If you would like to print the results of a certain MBB, click the MBB to open the related dialogue window. When the dialogue window has been opened, press on the keyboard the following buttons simultaneously 'ALT + Print Screen'. By doing this the dialogue window is copied to the clipboard. Then open a drawing program or a text processor and select the Paste command from the Edit menu of the receiving program. When the dialogue window has been pasted, you can print the dialogue window by using the printing facilities of the program. This procedure can be used for all **WadBOS** windows.

4 The WadBOS Menu System

This chapter explains the different functions that are available from the menus of **WadBOS**. The menus are treated as they appear in the *Menu bar* from left to right and per menu from the top to the bottom.

4.1 File Menu



Use the File menu to create a new simulation file or open an existing one, save and print files, and to exit **WadBOS**.

WadBOS saves simulation files with a .SIM extension attached to the filename.

4.1.1 New simulation... Command

Use the **GEONAMICA**[®]-command New simulation... to create a new simulation file.

When New simulation... is selected, a new simulation file can be created, for which you can enter the relevant values for variables, parameters, maps, etc.



Important ! In this version of **WadBOS** the **GEONAMICA**[®]-command New simulation... is not available and is therefore greyed out.

New simulation files can be created in **WadBOS** in a relatively easy way, by adjusting the values of parameters and variables via the user interface and by then saving the simulation under a different name by means of the Save simulation as... command from the File menu.

4.1.2 Open simulation... Command

Use the Open simulation... command to open a simulation file stored on a disk. You can open only one simulation file at the time. Use the Windows menu or the mouse to switch among the different windows opened by the simulation.

When you select the Open simulation... command, the *Open* dialogue window appears. If the name of the file of your choice is not visible in the list box, use

the scroll bar to move through the list of filenames in the directory or disk you are working in. If the file you want to open is not in the current directory or on the current disk, use the scroll list or browse symbols in the section named 'Look in' to change directories, disks or network sites.

Double-click the name of the file you want to open. You can also type the name and path of the file in the 'File name' Edit field. Press the Open button after you have typed the name of the file.

You can achieve the same results by clicking the Open button in the Toolbar.

4.1.3 Save simulation as... Command

Use the Save simulation as... command to save a simulation to a disk. When you save a simulation, the *Save As* dialogue window will open. This window allows you to specify the name of the file and the location where you want to store it. When you click the Save button, **WadBOS** displays the *Simulation file...* dialogue window showing an overview of the different files that constitute the simulation you are storing. The file names that are preceded by a crossed check box have been changed during the simulation session and will be saved if the OK button is pressed. If you want to save them under a different name, click on the name and enter the new name of your choice.



Tip

Important ! Be careful not to change the extensions of the files!

You can achieve the same results by clicking the Save button in the Toolbar.

4.1.4 Import map... Command

Use the Import map... command to insert a file (containing map information) from disk into a simulation. Importing of maps is only possible for the maps that can be changed by the user (Cultural elements, Ecotopes, Elevation, Suitability, Zoning and Indicator). The map can be selected from the Maps menu and has to be in the active window before the Import map... command can be activated.

When selected, the Import map... command will open the *Open* dialogue window displaying all the files in the working directory with the correct extension. If you change the type of file to import in the appropriate scroll list, you will be able to import IDRISI files with .IMG extension or Arc/Info ASCII grid files with the .ASC extension.

4.1.5 Import scenario... Command

Use the Import scenario... command to import a set of Suitability maps or Zoning maps (a set consists of one map per modelled land use) that have been created by means of the **OVERLAY-TOOL**.

The map can be selected from the Maps menu and has to be in the active window before the Import scenario... command can be activated. The Import scenario... command will open the *Import scenario* dialogue window displaying

a list of scenarios in the working directory. It enables to select the required scenario.

4.1.6 Export map... Command

Use the Export map... command to export a map from the simulation to a file on the disk. Exporting maps is possible for all maps. The type of map has to be selected from the menu and has to be in the active window before the Export map... command will be active. When selected, the Export map... command will open a *Save As* dialogue window displaying all the files in the working directory with the correct extension. If the user changes the type of file to export in the appropriate scroll list, he will be able to export files to IDRISI with the .IMG extension or to Arc/Info ASCII grid files with the .ASC extension.

4.1.7 Page Setup... Command

Use the Page Setup... command to determine the dimensions and scale for printing the maps used and generated by the Micro-model. As soon as the command is selected, the *Page Setup* dialogue window is opened, enabling you to enter how many cells (of 500 meters) you wish to print per measurement unit (cm or inch). If for example you wish to print a map on a scale of 1/1.500.000, then you enter: 30 cells per cm. You can switch on the options to print the 500m grid or a coarser 5000m major grid on the map. Lastly it is also possible to adjust the margins of the page.

4.1.8 Print... Command

Use the Print... command to print the maps used and generated by the Micro-model. The map to be printed has to be selected from the menu and has to be in the active window before the Print... command is active.

You can achieve the same results by pressing the Print button in the Toolbar.

4.1.9 Print Preview... Command

Use the Print Preview... command to get a preview of the printed document on the screen.

4.1.10 Print Setup... Command

Use the Print Setup... command to prepare your printer so that **WadBOS** will correctly print the simulation results.

4.1.11 List of Recent Files [1, 2, 3, 4]

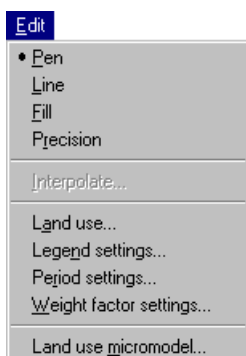
WadBOS keeps track of the 4 most recently opened simulation files. It will display their names in the File menu. If you select one of the 4 files, it will be opened.

4.1.12 Exit Command

Use the Exit command to quit **WadBOS** and return to Windows.

If you have made changes to simulation files since the last time that you saved the simulation, the *WadBOS* dialogue window appears asking whether you want to save the simulation file before exiting **WadBOS**.

4.2 Edit Menu



Use the commands of the Edit menu to edit the maps of the Micro-models.

The first four commands on the Edit menu are standard, although they may not all be active for every map. In the latter case they are shown greyed out. More specific commands become available from the menu to make changes to particular maps. These are described in some detail as part of the description of the maps for which they are available in Paragraph 4.4 of this chapter.



Tip

Be careful when editing maps ! WadBOS is not equipped with a so-called Undo command. Hence, all corrections made are definite!



Tip

Be careful when editing maps ! For every map that has edit facilities the edit facilities and the corresponding commands in the Edit menu will only be active when the grid is visible in the map pane of the active (map) window. As long as the grid is not visible, you should select the Zoom in command from the View menu, or press the Zoom-in button in the Toolbar. If a grid does not appear after the afore mentioned actions, then the map can only show output and can therefore not be edited by the user.

4.2.1 Pen Command

Selecting this command will change the pointer into a pen.

Use the Pen command to pick a value from the legend of the map (by clicking the radio button next to the text) and entering it in the map by clicking the cell of your choice.

This command is identical to pressing the Pen button on the Toolbar.

4.2.2 Line Command

Selecting this command will change the pointer into a pen.

Use the pen to select a value from the legend of the map (by clicking the radio button next to the text). Next place the pen in a cell from where you want to draw a line of cells with the selected value. Keep the left mouse button pressed down while you draw the line till the last cell on the line. The line becomes definite when the left mouse button is released.

This command is identical to pressing the Line button on the Toolbar.

4.2.3 Fill Command

Selecting this command will change the pointer into a bucket.

Use the Fill command to pick a value from the legend of the map (by clicking the radio button next to the text) and entering it in larger, contiguous areas of the map. The Fill command will change the values of the all joined (directly adjacent, not diagonally) cells that have the same state as the one that is clicked. Subsequently the neighbours of the cells that were changed are updated. All these adjacent cells will get the value that is selected from the legend.

This command is identical to pressing the Bucket button in the Toolbar.



Tip

Important ! When using the Fill command ensure that all cells bordering and outside the area that you like to fill have a different value from the cells inside. If you ignore this, the fill algorithm will try to find the border and might end up changing the whole map to the new value.

4.2.4 Precision Command

Use the Precision command to enter precise information on a cell-by-cell basis. When a cell is clicked, a dialogue window will open enabling you to enter the exact value.

This command is identical to pressing the Ruler button in the Toolbar.

4.2.5 Interpolation... Command

Use the Interpolation... command to interpolate missing values of the elevation map or the suitability maps. This is very useful when you have a map that is only partially filled with values. When this command is selected the dialogue window *Interpolation* appears. You can choose from one of the three interpolation algorithms available.



Tip

Important! In WadBOS the GEONAMICA[®]-command Interpolation... is not active. It is greyed out.

4.2.6 Land use... Command

When the Cultural elements map or the Ecotopes map is active, the Edit menu will contain an extra command: Land use.... This command enables to change the name and colour of the land use functions. When this command is selected, the dialogue window *Change landuse* will appear. The name and colour of the selected land use can then be changed.

4.2.7 Legend settings... Command

When the Elevation map or one of the Indicator maps is active, the Edit menu contains an extra command: Legend Settings.... This command enables to change the classes used to represent the data. When this command is selected,

the *Legend* dialogue window opens. You are then asked to enter the maximum of the highest class, the interval of the classes with positive values, the minimum of the lowest class and the interval of the classes with negative values.

4.2.8 *Period settings... Command*

When a Zoning map is active, the Edit menu contains an extra command, *Period settings...* When this command is selected, the dialogue window *Period settings* will open. You are then asked to set the months during which the periodically closed areas are opened or closed for the activity represented on the map. For each map (activity) the periods can be specified separately.

4.2.9 *Weight factor settings... Command*

When the Compartment map is active, the Edit menu contains an extra command: *Weight factor settings...* When this command is selected, the *Weight factor settings* dialogue window opens, in which you can enter the weights assigned to each type of land use. These weights are multiplied with the total number of cells of the type that on the Micro-scale map in **WadBOS**. This function allows to transform the number of cells into another measurement unit that adds more meaning to the land use (For example: if the weight factor is an estimate of the load of emissions (of a certain substance) per cell and per type of land use, then the result of the calculation is the total load of emissions generated by the type of land use. The result of the multiplication appears in the information window that can be opened, by double clicking the Micro-scale map. If you have selected the *Show compartments* command from the View menu, the information window will show the results of the compartment that you have double clicked.

4.2.10 *Land use micromodel... Command*

When the Micro-scale map is active, the Edit menu contains an extra command: *Land use micromodel...* When this command is selected, the *Landuse micromodel* dialogue window opens in which you can set the threshold value and the priority assigned to each (dynamic) land use class. Both values combined determine whether the specific land use will come more or less to the foreground of the Micro-scale map. If for a particular cell the intensity of an activity (as available from the corresponding Intensity map) is below the threshold value, then the activity will not be withheld for representation. The priority value will determine which of the activities withheld will eventually be represented. The threshold value is expressed in the same units as the intensity. The priorities are set on a scale from 1 to 9. The land use with the priority 1 has precedence on any higher value.

4.3 View Menu



Use the View menu to change the manner in which the different maps of the Micro-scale model are displayed.

The first three commands on the View menu are standard. For each type of map one or more commands will be added enabling more specific views.

Type of map	Which command in the View menu is executable?			
	Show Compartments	Show Land	Show Species	Show Elevation
Micro-scale	yes	no	no	yes
Cultural elements	yes	no	no	no
Ecotopes	yes	no	no	no
Elevation	yes	no	no	no
Compartments	yes	no	no	no
Suitability	yes	yes	species ¹	no
Zoning	yes	yes	no	no
Indicator	yes	yes	no	no
Intensity	yes	no	no	no
Pressure	yes	no	no	no
Exposure	yes	no	no	no
Environmental appraisal	yes	no	no	no

¹species¹: the command Show Species is only available for the suitability maps of the species Mussels (beds) or Cockles (beds).

4.3.1 Go to... Command

Use the Go to... command to move the cursor to a specific location on the map. Selecting this command from the View menu will open a dialogue window requesting to enter the co-ordinates of the desired location.

The cell in the upper left corner of all maps in **WadBOS** has the coordinate pair (row 1; column 1). The bottom right corner has the coordinate pair (row 191; column 364).

If you move the pointer in the map pane of the active map window, then you can read the cell-coordinates of the pointer in the Status bar of the application window.

4.3.2 Zoom in Command

Use the Zoom in command to increase the size of the map in the active map window by a factor 2.

This command is identical to pressing the Zoom-in button in the Toolbar.

4.3.3 Zoom out Command

Use the Zoom out command to reduce the size of the map in the active map window by a factor 2.

This command is identical to pressing the Zoom-out button in the Toolbar.

4.3.4 Show Compartments Command

Use the Show Compartments command to draw (or remove) the boundaries of the compartments, as defined in the Compartment map, on top of the map in the active window. This command is available for all the maps.

While the function is selected, the menu option is preceded with a mark.

4.3.5 Show land Command

Use the Show land command to mark (or unmark) the cells that are on land. This command is available for Suitability maps, Zoning maps and Indicator maps.

While the function is selected, the menu option is preceded with a mark.

4.3.6 Show Species Command

Use the Show Species command to mark (or unmark) the cells where the species is present. This command is available for the Suitability map of the species, Cockle beds and Mussel beds.

While the function is selected, the menu option is preceded with a mark.

4.3.7 Show Elevation Command

Use the Show elevation command to change the flat land-use map of the *Micro-scale* window into a 3D representation. The relief of this representation is as defined in the Elevation map.

While the function is selected, the menu option is preceded with a mark.

When you execute this command the command 3D-settings... becomes active in the same menu.

It is not possible to zoom in or zoom out when the Show Elevation command is on.

4.3.8 3D settings... Command

The command 3D settings... is only active when the Show elevation command is on.

When you select the 3D settings... command, the *3D settings* dialogue window is opened enabling to specify the angle of rotation, the perspective and the vertical exaggeration of the diagram.

4.4 Maps Menu



Use the Maps menu to select the different maps and associated edit functions that are used in the Micro-model. Every type of map is opened in its dedicated window. Maps that can be edited by the user are opened with the associated edit facilities.



Important ! Dynamic maps, like the Intensity maps, adjust the boundaries of the legend classes automatically while the simulation is running. As soon as all the values to be represented on the map fit the legend classes, the legend does not change anymore. As a result of this the colours on the map may represent different values in the course of a simulation.



Be careful when editing maps ! For every map that has edit facilities the edit facilities and the corresponding commands in the Edit menu, will only be active when the grid is visible in the map pane of the active (map) window. As long as the grid is not visible, you should select the Zoom in command from the View menu, or press the Zoom-in button in the Toolbar. If a grid does not appear after the afore mentioned actions, then the map can only show output and can therefore not be edited by the user.

4.4.1 Cultural elements Command

Use the Cultural elements command to open the Cultural elements map and the corresponding edit facilities in the *Cultural elements* window. You can change the Cultural elements map by assigning different land uses to the cells.

When the Cultural elements map is opened, the Land use... command in the Edit menu becomes active. When this command is selected, the *Change landuse* dialogue window will open. This window enables to change the name and colour of the cultural elements on the map.

When the Cultural elements map is active, the Show compartments... command in the View menu becomes active.

4.4.2 Ecotopes Command

Use the Ecotopes command to open the Ecotopes map and the corresponding edit facilities in the *Ecotopes* window. You can change the Ecotopes map by assigning different land uses to the cells.

When the Ecotopes map is active, the Land use... command in the Edit menu becomes active. When this command is selected, the *Change landuse* dialogue

window will open. This window enables to change the name and colour of the ecotopes represented on the map.

When the Ecotopes map is opened, the Show compartments... command in the View menu becomes active.

4.4.3 Elevation Command

Use the Elevation command to open the Elevation map and the corresponding edit facilities in the *Elevation* window. You can change the Elevation map by assigning different elevation values to the cells.

When the Elevation map is active, the Legend settings... command in the Edit menu becomes active. When this command is selected, the *Legend* dialogue window will open. This window enables to change the classes for representing the elevation of the cells. You are asked to enter the maximum of the highest category, the interval of the classes with an elevation above sea level, the minimum of the lowest classes and the intervals of the classes with an elevation below sea level.

When the Elevation map is opened, the Show compartments... command in the View menu becomes active.

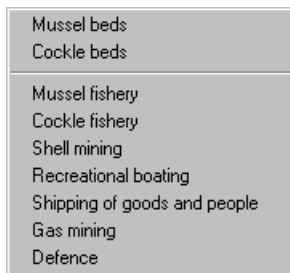
4.4.4 Compartments Command

Use the Compartments command to open the Compartments map and the corresponding edit facilities in the *Compartments* window. The Compartment map shows the geographical entities that some sub-models of the Macro-model perform calculations for. The compartments are fixed spatial entities in the model and therefore the user cannot change the map.

When the Compartment map is active, the Weight factor settings... command in the Edit menu becomes active. When this command is selected, the dialogue window *Weight factor settings* opens, in which you can enter the weight assigned to each type of land use. These weight factors are multiplied with the total number of cells of the type that occurs on the Micro-scale map in **WadBOS**. This function allows to transform the number of cells into another measurement unit that adds more meaning to the land use (For example: if the weight factor is an estimate of the load of emissions (of a certain substance) per cell and per type of land use, then the result of the calculation is the total load of emissions generated by the type of land use. The result of the multiplication appears in the information window that can be opened, by double clicking the Micro-scale map. If you have selected the Show compartments command from the View menu, the information window will show the results of the compartment that you have double clicked.

When the Compartments map is active, the Show compartments... command in the View menu becomes active.

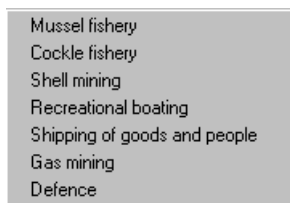
4.4.5 Suitability Command



Use the Suitability command to open one of the Suitability maps and the corresponding edit facilities in the *Suitability* window. You can change the Suitability map by assigning a different Suitability value to a cell. Cells can be given one of the 11 suitability values in the interval [0 - 1] (in steps of 0.1).

When a Suitability map is active, the commands Show compartments..., Show Land... and Show Species... (the latter only if the suitability map for Mussel beds or Cockle beds is opened) in the View menu become active.

4.4.6 Zoning Command

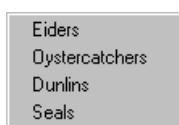


Use the Zoning command to open one of the Zoning maps and the corresponding edit facilities in the *Zoning* window. You can change the Zoning map by assigning a different Zoning value to a cell. Cells can be given one of the following 3 zoning values: (0) if the specific activity is allowed to take place in the cell all year long (white cell); (1) if the specific activity is allowed to take place in the months that the area is periodically opened for the activity (yellow cell); (2) if the specific activity is not allowed to take place in the cell the whole year (red cell).

When the Zoning map is active, the *Period settings...* command in the Edit menu becomes active. When this command is selected, the dialogue window *Period settings* will open. You are then asked to set the months during which the periodically closed areas are opened or closed for the activity represented in the map. For each map (activity) the periods can be specified separately.

When a Zoning map is active, the commands Show compartments... and Show Land... in the View menu become active.

4.4.7 Indicator Command



Use the Indicator command to open one of the Indicator maps and the corresponding edit facilities in the *Indicator* window. You can change the Indicator map by assigning different values to the cells. An indicator represents the spatial distribution of a species that is considered appropriate for estimating the effects of both human activities and policies on the ecological status of the Wadden Sea. You can select four species: Eiders, Oystercatchers, Dunlins and Seals.

When an Indicator map is active, the *Legend settings...* command in the Edit menu becomes active. When this command is selected, the dialogue window *Legend* will open. This window enables to change the classes for representing the indicator values of the cells. You are asked to enter the maximum of the highest category, the interval of the classes with a positive value, the minimum of the lowest class and the interval of the classes with a negative value. None of the indicators represented in the model have negative values; hence the last two settings are not useful and need not be defined.

When an Indicator map is opened, the commands Show compartments... and Show Land... in the View menu become active.

4.4.8 Intensity Command

Mussel beds
Cockle beds
Mussel fishery
Cockle fishery
Shell mining
Recreational boating
Shipping of goods and people
Gas mining
Defence

Use the Intensity command to open one of the Intensity maps and the corresponding Edit facilities in the *Intensity* window. The Intensity map shows the intensity of the activity in every cell and for each simulation step.

When the Intensity map is active, the Show compartments... command in the Edit menu becomes active.

4.4.9 Pressure Command

Disturbance
Mechanical influences
Extraction

Use the Pressure command to open one of the Pressure maps and the corresponding Edit facilities in the *Pressure* window. For each cell and every simulation step, a Pressure map shows the level of pressure exerted by the combined activities on the state of the Wadden sea.

A distinction is made between three types of pressure.

When a Pressure map is active, the Show compartments... command in the Edit menu becomes active.

4.4.10 Exposure Command

Exposure of Eiders to Disturbance of Recreational boating
Exposure of Oystercatchers to Disturbance of Recreational boating
Exposure of Dunlins to Disturbance of Recreational boating
Exposure of Seals to Disturbance of Recreational boating
Exposure of Eiders to Disturbance of Shell mining
Exposure of Oystercatchers to Disturbance of Shell mining
Exposure of Dunlins to Disturbance of Shell mining
Exposure of Seals to Disturbance of Shell mining
Exposure of Cockle beds to Extraction of Shell mining
Exposure of Eiders to Extraction of Cockle fishery
Exposure of Cockle beds to Extraction of Cockle fishery

Use the Exposure command to open one of the Exposure maps and the corresponding Edit facilities in the *Exposure* window. For each cell and every simulation step, an Exposure map is showing the potential effect that a particular human activity may have on an Indicator species.

A distinction is made between eleven types of exposure.

When the Exposure map is active, the Show compartments... command in the Edit menu becomes active.

4.4.11 Environmental appraisal Command

Ecological value without human activity
Ecological value with human activity
Perceived value without human activity
Perceived value with human activity
Landscape
Number of potential species

Use the Environmental appraisal command to open one of the Environmental appraisal maps in its dedicated window. The maps are the result of calculations performed in the Environmental appraisal sub-system of **WadBOS**. The user cannot edit the maps.

The maps displaying the Ecological value without human activity and the Perceived value without human activity do not change during a simulation. All the other maps displaying: Ecological value with human activity, the Perceived value with human activity, Landscape and the Number of potential species are recalculated for every cell at every simulation step.

When an Environmental appraisal map is active, the Show compartments... command in the Edit menu becomes active.

4.5 Simulation Menu



Use the Simulation menu to control the simulation.

The commands Step, Run, Stop and Reset can also be invoked when pressing the respective buttons in the Toolbar.

4.5.1 Init Command

Use the Init command to initialise the simulation. After the model has been initialised all the variables are displaying the correct initial condition (values) of the model. If the Step or Run command is selected the simulation will be automatically initialised if this has not been done manually.

The command Init can also be used to have the model perform a step without advancing the simulation clock. This is especially handy to test the immediate effects of a newly entered (set of) parameter(s) before running the model.

4.5.2 Step Command

Use the Step command to advance the simulation with one time step (of 1 month). This command is identical to clicking the Step button from the Toolbar. If the Step command is selected the simulation will be automatically initialised if this has not been done manually.

4.5.3 Run Command

Use the Run command to advance the simulation until the next pause tab is reached. This command is identical to clicking the Run button from the Toolbar. Unless pause tabs have been set by means of the Pauses... command, the simulation will halt at the end of the simulation period.

Once the simulation is running, the user can halt it by selecting the Stop command from the Simulation menu or by pressing the Stop button from the Toolbar. The model is updated on a monthly basis. The standard simulation run is ten years (January 1997 – December 2006).

4.5.4 Stop Command

Use the Stop command to interrupt the simulation. This command is identical to clicking the Stop button from the Toolbar. Once interrupted, the simulation will halt until the user selects the Step or Run command from the Simulation menu or until the Step or Run button from the Toolbar is pressed.

4.5.5 *Reset Command*

Use the **Reset** command to switch the clock of the simulation back to the month January of the year 1997. This command is identical to clicking the **Reset** button from the **Toolbar**. Parameters keep their actual values and so do the **Suitability**, **Zoning**, **Indicators**, **Ecotopes** and **Cultural** elements maps. Once the **Reset** command is executed the simulation will be automatically initialised.

4.5.6 *Pauses... Command*

Use the **Pauses...** command to set the pause tabs for the simulation. When **Pauses...** is selected, a dialogue window will open requesting the user to enter the time interval (in months) for which he wants the simulation to halt. If you then run the simulation it will automatically stop every time the set value has expired. When a simulation is paused, it will remain in this state until the **Step** or **Run** command is invoked from the **Simulation** menu or the **Toolbar**.

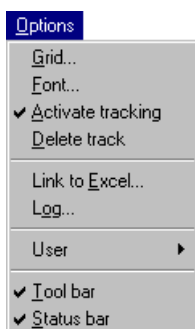
4.5.7 *Random... Command*

Use the **Random...** command to set the stochastic mode for the simulation. When the **Random...** command is selected, the *Random Settings* dialogue window is opened, enabling the user to enter the value of the parameter (α) representing the stochastic element in the transition potentials as well as a seed number for the random generator.



Important ! In this version of **WadBOS** the spatial dynamics on the **Micro**-scale are not sensitive to the random parameter. So setting this random value has no effect on the results of the model.

4.6 Options Menu



Use the Options Menu to personalize your workspace.

4.6.1 Grid... Command

Use the Grid... command to draw a (major) grid on the maps. When Grid... is selected the *Major Grid...* dialogue window opens. The user is requested to switch on or off the Major Grid check box. Next he is to enter the size of the grid expressed in number of cells. Finally he can offset the origin of the grid by a certain amount of cells (in order to have the major grid coincide with another reference system).

4.6.2 Font... Command

Use the Font... command to change the font, font style and size of the character set used to print the legends of maps and the information windows.

4.6.3 Activate tracking Command

Use the Activate tracking command to switch-on or switch-off the tracking function. When the tracking function is on, a mark is drawn in the cells where the user makes adjustments. This mark is not only visible in the map where the changes have been made but also in all the other maps of **WadBOS**. This enables to recognize easily the places where corrections on maps have been made when you change from map to map. You can remove the marks at any time with the Delete track command.

While the function is selected, the menu option is preceded with a mark.

4.6.4 Delete track Command

Use the Delete track command to erase all marks made by the tracking function since it has been switched on.

4.6.5 Link to Excel... Command

Use the Link to Excel... command to establish (or interrupt) a link between **WadBOS** and the Microsoft Excel Workbook Impacts.XLS. This link is a DDE (Dynamic Data Exchange) link. Via this link **WadBOS** is sending model output to the Workbook while the simulation is advancing. The Workbook Impacts.XLS is available to the user once the simulation is finished. It can be used for further analysis of the simulation data. While a link is established, the menu option is preceded with a mark.

It is strongly recommended to save the workbook data under another name than Impacts.XLS, because the file Impacts.XLS is overwritten every time it is linked to a simulation.



Tip

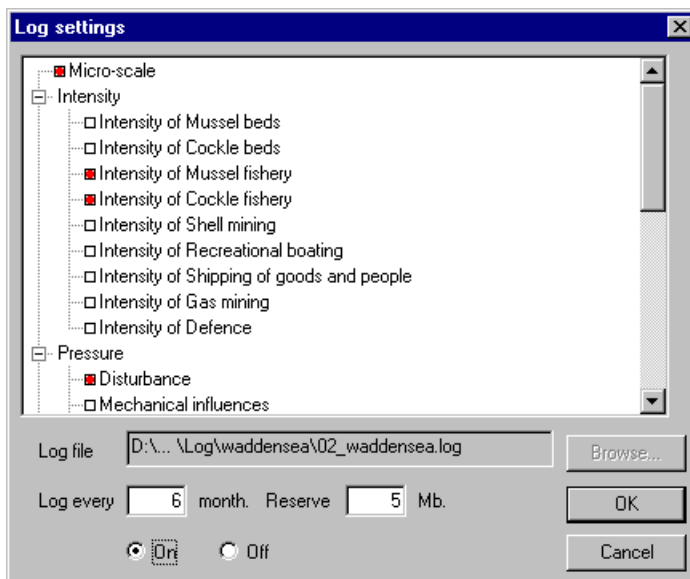
Important ! Note that in order to establish a successful link, it is required that Excel is installed on your machine and that the Workbook Impacts.XLS is in the working directory. If **WadBOS** cannot find Excel or the workbook Impacts.XLS, the menu option will be greyed out.



Tip

Important ! Do not Quit Excel or Close the workbook Impacts.XLS manually while the link with **WadBOS** is established, rather interrupt the link by selecting the command again. If you ignore this, **WadBOS** will produce error messages caused by the ill-interrupted connection.

4.6.6 Log... Command



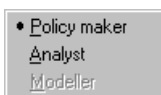
Use the Log... command to store dynamic maps produced by the Micro-model. When this command is selected the *Log settings* dialogue window opens. To activate the logging function you have to click the radio button 'On' or to stop the logging the radio button 'Off'. Then the path and name of the file where the maps are stored will appear in the Log file text field. The program automatically sets the filename and location where the information will be stored. You cannot change it or enter it yourself. Because .LOG files can be extremely big, you can indicate how big a part of

your hard disk you want to keep free. **WadBOS** will check whether sufficient space is left over before storing the .LOG file.

As soon as you have clicked the radio button 'On' the selection tree in the window will become active. In this tree you can indicate which maps you want to store in the .LOG file. To this effect click on the small square situated just left of the name of the map of your choice or double click on the name. The map is selected for logging when the square is filled with a red dot. While the function is selected, the menu option is preceded with a mark.

You can analyse .LOG files with the help of the **ANALYSE-TOOL** (see Chapter 5).

4.6.7 User Command



Use the User command to select one of the three user types supported by **WadBOS**: Policy maker, Analyst and Modeller.

User type Policy Maker can change all parameter values and maps, except for the minimum and maximum of permitted ranges of parameters. User type Analyst has full control of all functions and parameters. He can change the minimum and maximum limits of the parameters and variables in the Macro-model. User type Modeller has full control of all functions and parameters. He can change the minimum and maximum limits of the parameters and variables in the Macro-Model. In future versions of **WadBOS** he can also change existing models. For the user type selected, the menu option is preceded with a mark.



Tip

Important! In this version of **WadBOS** the user type modeller is not fully supported, therefore this function has been greyed out in the menu.

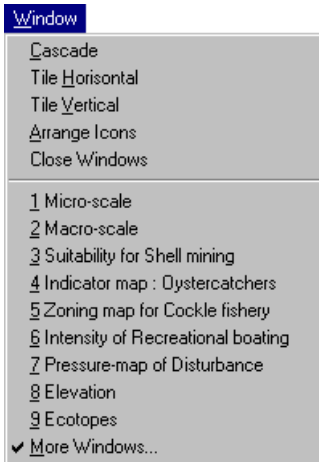
4.6.8 Toolbar Command

Use the Toolbar command to view or hide the Toolbar in the **WadBOS** applications window. While the function is selected, the menu option is preceded with a mark.

4.6.9 Status bar Command

Use the Status bar command to view or hide the Status bar in the **WadBOS** applications window. While the function is selected, the menu option is preceded with a mark.

4.7 Window Menu



Use the Window menu to arrange the contents of the screen and to activate one of the opened windows.

4.7.1 Cascade Command

Use the Cascade command to arrange multiple opened windows in an overlapped fashion so that the Title bar of each window is visible.

4.7.2 Tile Horizontal Command

Use the Tile Horizontal command to arrange multiple opened windows one above another in a non-overlapped fashion so that all windows are visible.

4.7.3 Tile Vertical Command

Use the Tile Vertical command to arrange multiple opened windows side by side in a non-overlapped fashion so that all windows are visible.

4.7.4 Arrange Icons Command

Use the Arrange Icons command to arrange the icons for minimized windows at the bottom of the screen.



Tip

Important ! If windows are positioned at the bottom of the screen, they may hide some or all of the icons.

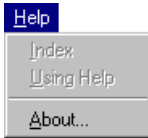
4.7.5 Close windows Command

Use the Close windows command to close all opened windows except for the ones that cannot be closed (*Micro-scale* window and *Macro-scale* window).

4.7.6 *List of Windows (1, 2, 3, 4, ... , 9)*

At the bottom of the Windows menu a list of open windows is presented. A check mark marks the name of the active window. Choose a window from this list to make it active.

4.8 Help Menu



Use the Help menu to select the type of Help you want **WadBOS** to display on the screen. The different commands in this menu will permit to look up information about **WadBOS**, its commands, options, and tools.

4.8.1 Index Command

Use the Index command to get the opening screen of the Help file of **WadBOS**. From the opening screen, you can jump to context sensitive instructions for using **WadBOS**. Click the topic you want help on. Once you have opened Help, you can click the contents button whenever you want to return to the opening screen.

4.8.2 Using help Command

Use the Using help command for getting general instructions on how to use the Windows Help System.

4.8.3 About... Command

Use the About... command to get the copyright notice and version number of the **WadBOS** application that you are using. The latter is important if you need assistance with the software from the developers or when you request an update of the software.

5 Working with the Analyse-Tool

This chapter explains how you can analyse and compare the .LOG files generated by **WadBOS** in an interactive manner. All .LOG files generated by **WadBOS** are compatible and can be read into the **ANALYSE-TOOL** in a straightforward manner.

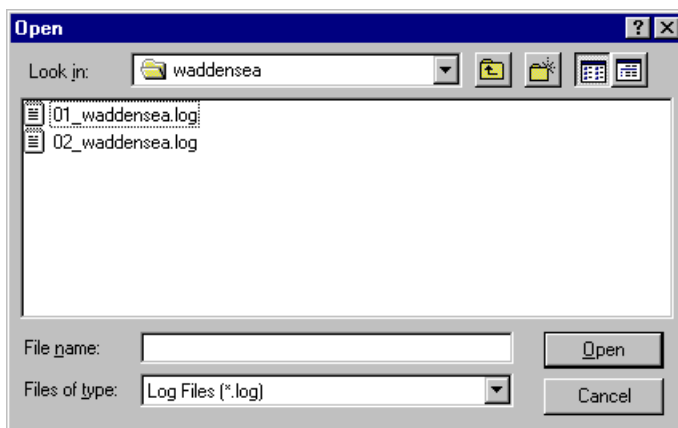
The **ANALYSE-TOOL** in its current version compares maps on a cell-by-cell basis. This is the simplest form of map comparison but also the most rigorous one. Indeed, a visual map comparison may reveal that maps are very similar, without being similar on a cell-by-cell basis. Methods aimed at revealing qualitative similarities are under development at RIKS (Power et al. 2001; Hagen, 2002) and will be implemented in later versions of the **ANALYSE-TOOL**.

5.1 Opening the Analyse-Tool

With the installation of **WadBOS** both the main program and the **ANALYSE-TOOL** are installed on your PC.



Press the Start button in the *Task bar* of Windows 98/NT/2000/XP and place the (mouse) pointer on the Programs group. Walk through the menu until you find the group containing **WadBOS** and open the **ANALYSE-TOOL** by clicking the Analyse icon. If the software was installed correctly, the *Analyse* application window will open. The *Open* dialogue window will appear next. If this does not happen, then select the Open... command in the File menu.



Find the correct file with .LOG extension in the *Open* dialogue window. Usually **WadBOS** will save the log files in the *Log* directory associated with **WadBOS**.

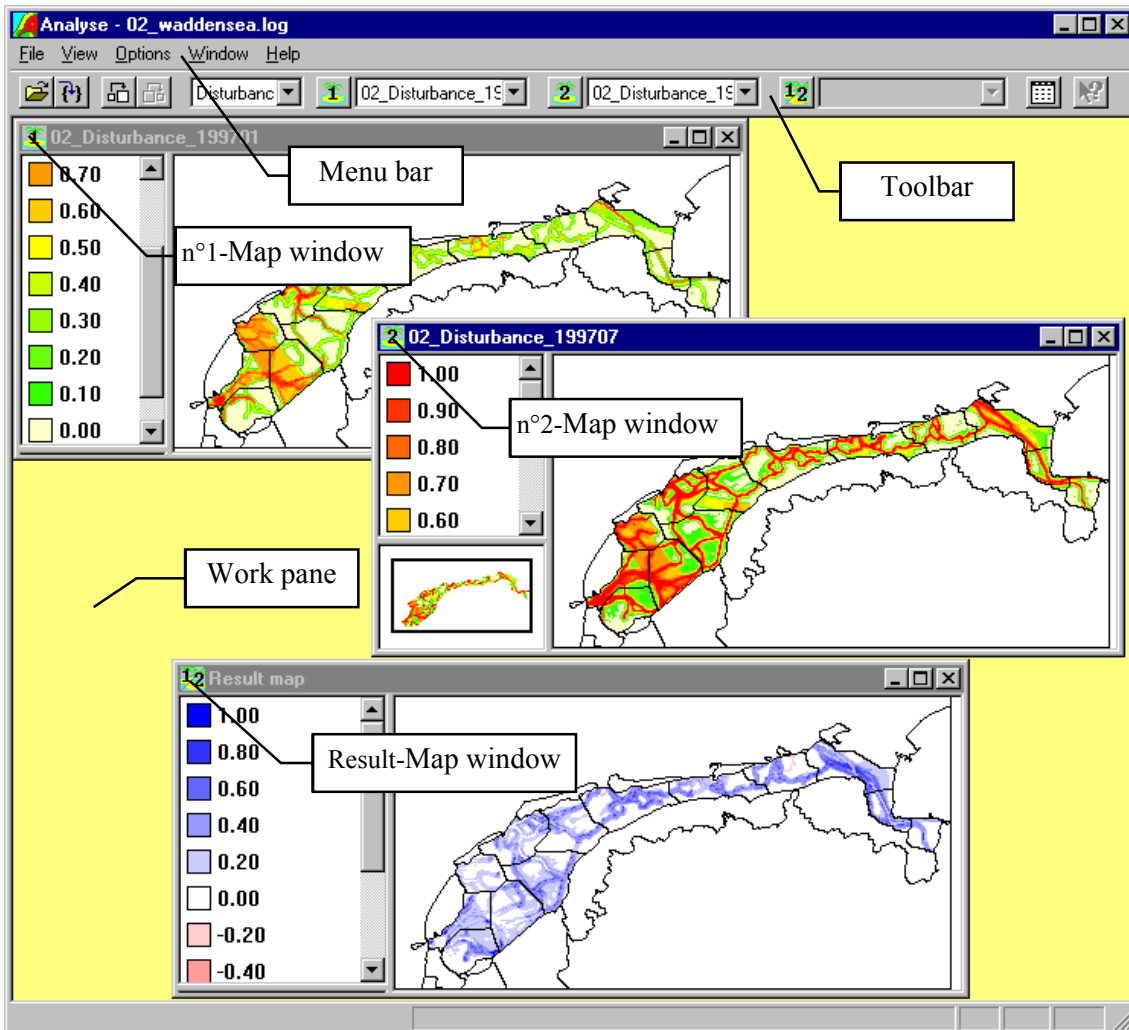
The **ANALYSE-TOOL** is build according to the Windows standards. Hence, it is possible to find the file by browsing through your own computer or another computer in your network. If you have found the correct file select it and click the

Open button or double click on the icon of the file.

The .LOG files created by **WadBOS** contain references to a series of maps that are the result of a simulation. After opening the .LOG file, and all the associated files, the *n*^o1-Map window appears, in the *Analyse* application window, displaying the first map of the .LOG file. To change the contents of *n*^o1-Map window, choose another map from the drop down list next to the *n*^o1-button on the *Toolbar*.

5.1.1 The Analyse application window

The *Analyse* application window consists of the *Caption bar*, the *Menu bar*, the *Work pane* and the *Toolbar*.

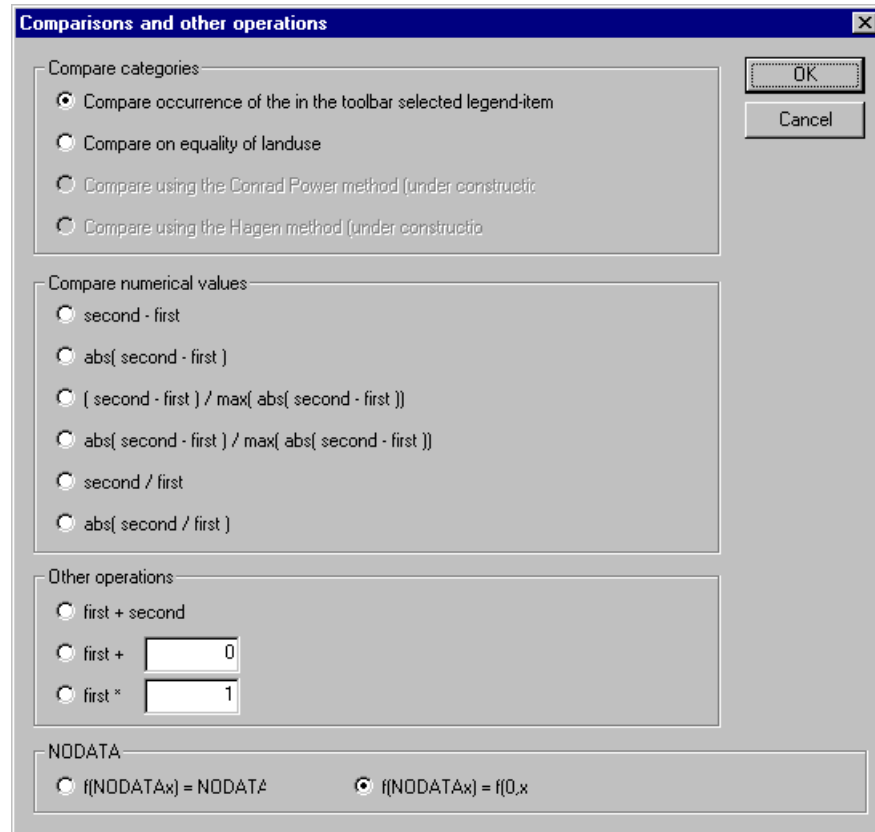


You can simultaneously open four windows maximum: three map windows and one table window:

- The $n^{\circ}1$ -Map window contains the first map to compare/analyse. To change the contents of $n^{\circ}1$ -Map window, choose another map from the drop down list next to the $n^{\circ}1$ -button on the *Toolbar*. If the $n^{\circ}1$ -Map window is not open yet, then you can do so by clicking on the $n^{\circ}1$ - button.
- The $n^{\circ}2$ -Map window contains the second map to compare/analyse. To change the contents of $n^{\circ}2$ -Map window, choose another map from the drop down list next to the $n^{\circ}2$ -button on the *Toolbar*. If the $n^{\circ}2$ -Map window is not yet open, then you can do so by clicking on the $n^{\circ}2$ -button.
- The $\frac{1}{2}$ -Map window is a discrepancy map. This map shows the discrepancies between the maps in the $n^{\circ}1$ -Map window and the $n^{\circ}2$ -Map window. According to the type of the maps that are compared, the numerical discrepancies or the categorical discrepancies are shown. In the first instance discrepancies are represented in a continuous scale ordered from the smallest to the biggest discrepancy. In the last instance the discrepancy map only represents discrepancies related to one category (for

example: a land use type or a landscape type). The category can be selected from the drop down list next to the ½- button in the *Toolbar*.

- The table window contains a table in matrix form that shows the detail of the discrepancies on the basis of a cell-by-cell comparison. Furthermore the Kappa-statistics (Monserud and Leemans, 1992) are calculated. This statistic shows how alike the two maps are, expressed as a single value between 0 and 1 per category and for all categories combined.



You can select a comparison method to calculate the discrepancies presented in the ½-Map window. Most methods are related to the comparison of data on a ratio scale. Use the Comparison Method... command from the Options menu and select the method of your choice.

You can also adjust the legend of the map. Use to that effect the Legend... command from the View menu and open the **LEGEND EDITOR**. This editor enables you to choose the number of classes in the legend, the lower and the upper limits of the classes and the way in which the legend is represented on the screen. Lastly you can also change the colour palette of the legend. To this end you can either click on the colour boxes of the classes in the legend or select the Palette... command from the View menu to open the **PALETTE EDITOR**.

You can save the discrepancy maps that are created with the **ANALYSE-TOOL** as an IDRISI image file (.IMG extension) or an ArcInfo ASCII file (.ASC extension) by means of the Export... command from the File menu.

You can compare maps from one and the same .LOG file or maps from more than one .LOG files. To open another .LOG file without closing the existing one, you need to use the Import... command from in the File menu. Lastly it is also possible to compare maps from a .LOG file with IDRISI maps (in .IMG

format) or with ArcInfo ASCII grid maps (in.ASC format). Using the Import... command from the File menu you can select the right file type in the box *Files of type* and then click the Open button to open these files. The maps that are part of additional .LOG, .IMG or .ASC files are added to the list of the .LOG file(s) already opened and shown in the drop down lists of the *n*^o1-Map window and the *n*^o2-Map window.

5.1.2 The Menu bar

The menu of the ANALYSE-TOOL is situated on the menu bar of the *Analyse* application window. The commands are ordered in accordance with the Windows conventions thus ensuring quick familiarization with the software. The following overview gives a short description of each menu. The menus are described in more detail later.





Use this menu	To...
File	manage your files. The printing facilities are also located in this menu. If you want to exit the program, you can do it from here.
View	change the presentation of a map in the active window: zoom in ,zoom out, and add administrative boundaries.
Options	customize the workspace. These commands are among others to overlay a grid on the map in the active window and to change the font in the legends.
Window	manage your windows in the <i>Analyse</i> application window.
Help	access the help function.

5.1.3 The Toolbar

Just underneath the *Menu bar* there is a *Toolbar*. The *Toolbar*, also known as Speed bar, gives a fast access to the principal functions of the ANALYSE-TOOL that are also found in the main menu. Opening the map and table windows, as well as selecting the maps for the comparison can be done from the *Toolbar*.



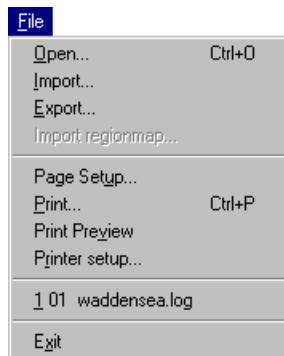
Use this button	To...
	open a Log file from the disk
	insert a Log file or map to current analysis
	zoom in. The size of the map increases 2x with each click.
	zoom out. The size of the map decreases 2x with each click.
	select from the .LOG file the variable to compare
	open the <i>n</i> ^o 1-Map window
	select the map to be shown in the <i>n</i> ^o 1-Map window
	open the <i>n</i> ^o 2-Map window
	select the map to be shown in the <i>n</i> ^o 2-Map window
	open Map window-½ containing the result of the comparison

Use this button	To...
	Select the category to be compared in the ½-Map window
	display a numerical overview of differences between the two maps
	displays the table with the posterior analysis
	not operational in the current version

5.2 The Analyse Menu System

This paragraph explains the different functions that are available from the menus of the **ANALYSE-TOOL**. The menus are treated as they appear in the *Menu bar* from left to right and per menu from the top to the bottom.

5.2.1 File menu



Use the File menu to open, import, or export a file, to print maps, and close the **ANALYSE-TOOL**.

5.2.1.1 Open... Command

Use the Open... command to open a .LOG file stored on disk. You can open more than one .LOG file at the time. However, you have to open additional files by using the Import... command (see Paragraph 5.2.1.2).

When you select the Open... command, the *Open* dialogue window appears. If the name of the file of your choice is not visible in the list box, use the scroll bars to move through the list of filenames in the directory or disk you are working in. If the file you want to open is not in the current directory or on the current disk, use the scroll list or browse symbols in the section named *Look in* to change directories, disks or network sites.

Double-click the name of the file you want to open. You can also type the name and path of the file in the *Filename* box. Press the Open button after you have typed the name of the file.

This command is identical to pressing the Open button from the *Toolbar*.

5.2.1.2 Import... Command

Use the Import... command to open additional .LOG, .IMG, or .ASC files stored on disk. More than one file can be imported into the ANALYSE-TOOL at a time.

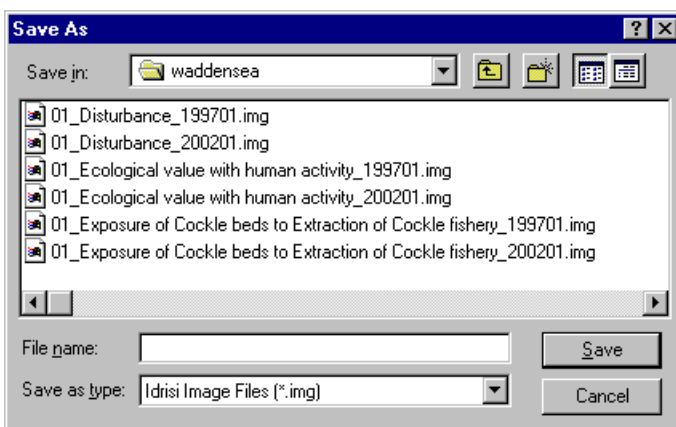
When you select the Import... command, the *Open* dialogue window appears. If the name of the file of your choice is not visible in the list box, use the scroll bar to move through the list of filenames in the directory or disk you are working in. If the file you want to open is not in the current directory or on the current disk, use the scroll list or browse symbols in the section named *Look in* to change directories, disks or network sites.

Double-click the name of the file you want to import. You can also type the name and path of the file in the *Filename* box. Press the Open button after you have typed the name of the file.

If you select in the File type box the file type, it is possible to import .LOG files that are generated by the same **WadBOS** application and also IDRISI files (.IMG format) or Arc Info ASCII grid files (.ASC format).

This command is identical to pressing the Import button from the *Toolbar*.

5.2.1.3 Export... Command

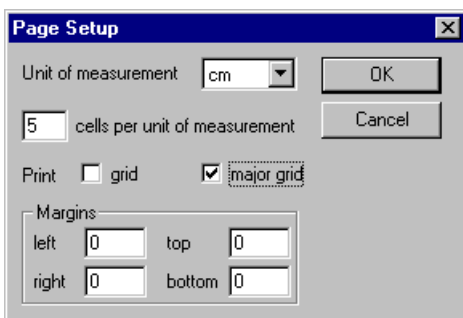


Use the Export... command to save the map in the active map window on the disk. Maps from all the map windows can be saved in this manner.

When you select the Export... command, the *Save As* dialogue window appears. It contains all the files in your work directory with the right extensions. If you select in the *Save as type* box the type that you want to save the map, you can save

maps in IDRISI format (.IMG extension) or Arc Info ASCII grid format (.ASC extension).

5.2.1.4 Page Setup... Command



Use the Page Setup... command to decide on the size and scale at which you want the ANALYSE-TOOL to print the active map.

As soon as this command is active the *Page Setup* dialogue window appears enabling you to specify how many cells you want to print per measurement unit (cm or inch). Furthermore it is also possible to indicate if you want to print the grid on your map and you can also set the margins of the pages to be printed.

5.2.1.5 *Print...Command*

Use the Print... command to print the map displayed in the active map window.

This command is identical to pressing the Print button from the *Toolbar*.

5.2.1.6 *Print Preview Command*

Use the Print Preview command to get a preview of the printed document on the screen.

5.2.1.7 *Print setup...Command*

Use the Print setup... command to change the settings on the printer enabling correct printing.

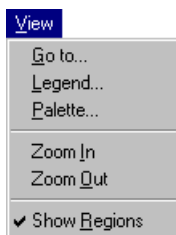
5.2.1.8 *List of Recent Files (1,2,3,4)*

The **ANALYSE-TOOL** keeps track of the four most recently opened .LOG files. It will display those in the File menu. If you select one of the four files, it will be opened.

5.2.1.9 *The Exit Command*

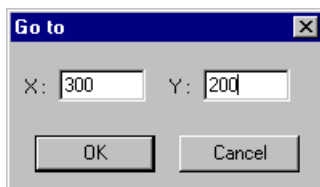
Use the Exit command to quit **ANALYSE-TOOL** and return to Windows.

5.2.2 *View menu*



Use the View menu to change the manner in which the maps are presented in the active map window.

5.2.2.1 *Go to... Command*



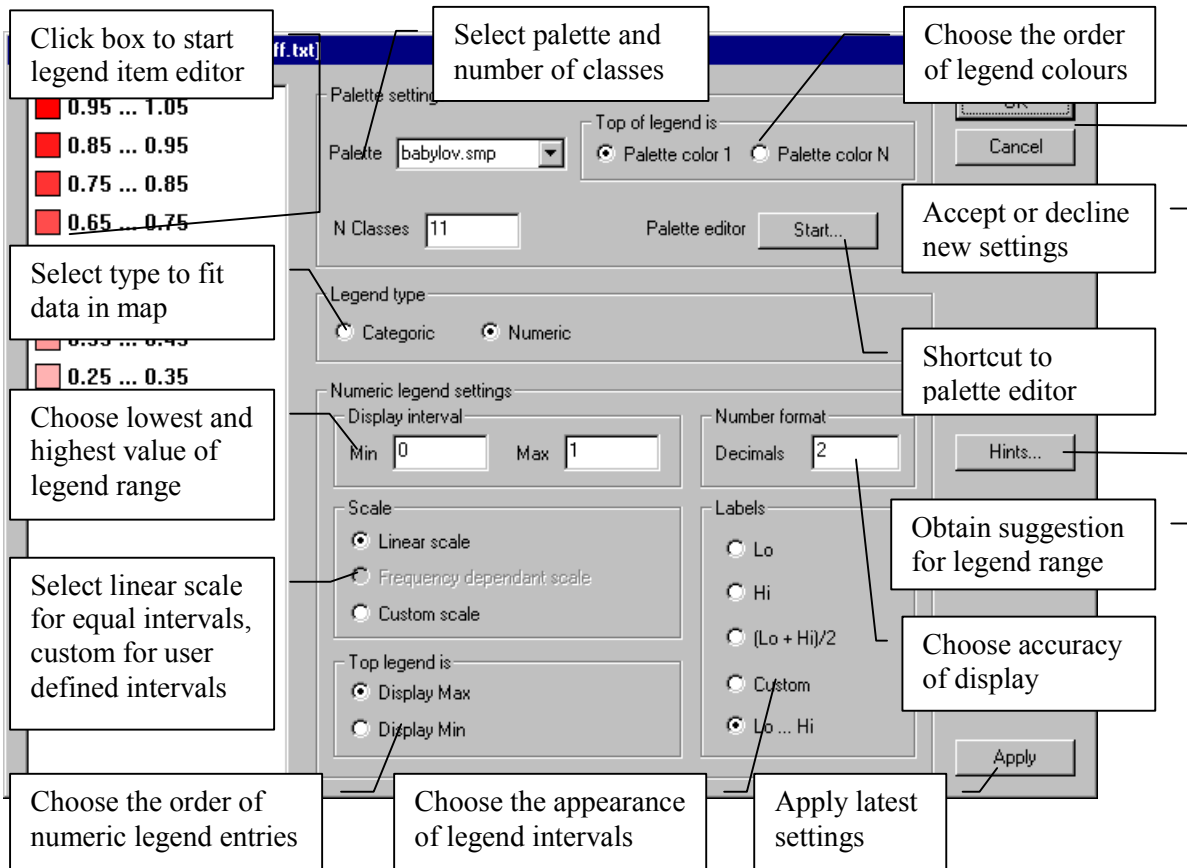
Use the Go to... command to move the cursor to a specific cell on the map. Selecting this command from the View menu opens the *Go To...* dialogue window requesting to enter the co-ordinates of the desired cell. When you have entered the co-ordinates and clicked OK the pointer will move to the desired cell in the active map.

5.2.2.2 *Legend... Command*

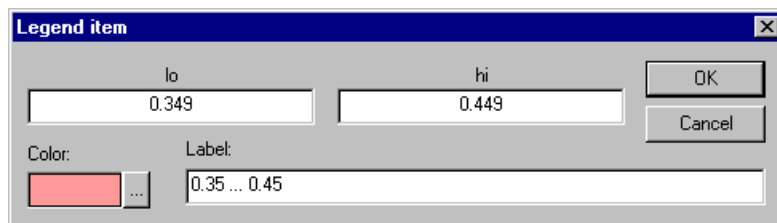
Use the Legend... command to open the **LEGEND-EDITOR**.

The **LEGEND-EDITOR** enables you to adjust the legends of all the maps in the **ANALYSE-TOOL** and to create new legends.

When the Legend... command is selected, the *Legend editor* dialogue window opens. In the figure below, the window is shown and the relevant settings are explained.



When you click in a colour box of a legend, the *Legend item* dialogue window opens. In this window you can define the names of the labels of the legend classes and set the lower (lo) and upper (hi) limits of the class range. Also you can select a new colour to represent the cells belonging to the class. If you have configured the **LEGEND EDITOR** to create a linear scale, then you can only set a new colour with the **LEGEND EDITOR** itself.



Your configurations are saved as part of a legend file associated with the map that you are defining the new legend for. This file is saved as soon as you press the OK button in the *Legend editor* dialogue window.

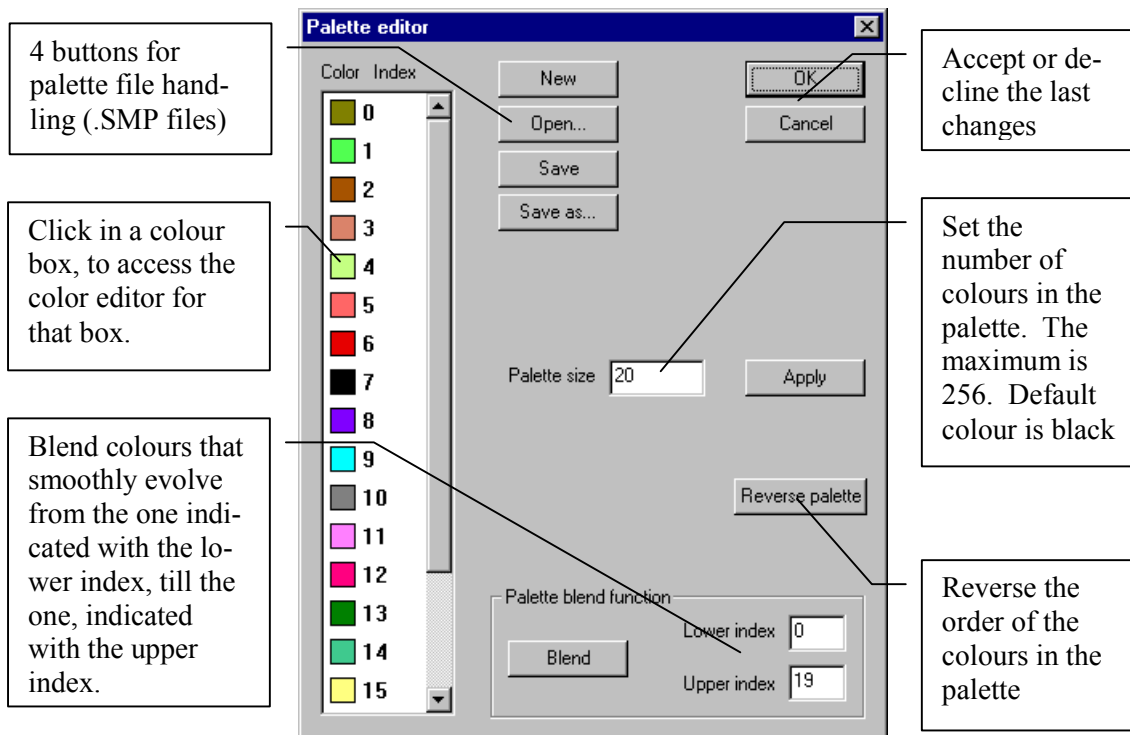
The **LEGEND-EDITOR** is associated with the **PALETTE-EDITOR**. With the latter, the colours of the legends can be chosen (see Paragraph 5.2.2.3).

5.2.2.3 Palette... Command

Use the Palette... command to open the **PALETTE-EDITOR**.

With the **PALETTE EDITOR** you can edit the legends of all the maps in the **ANALYSE-TOOL** and create new colour palette files (.SMP extension).

When the Palette... command is selected, the **PALETTE EDITOR** dialogue window opens. In the figure below, the window is shown and the relevant settings are explained.



The changes that you make to a palette can be saved by clicking the Save or Save as button. The changes are then saved in a palette file (.SMP). Every legend requires a palette file in order to display the colours, and every map requires a legend file to show the contents. A legend can make use of two kinds of palettes, they are either palette files entirely created with the **PALETTE EDITOR** and 'custom palettes' that are created by defining colours and other legend items in the *Legend item* dialogue window.

The **PALETTE EDITOR** is closely associated with the **LEGEND EDITOR**. The latter enables to define the way in which data are presented on a map.

5.2.2.4 Zoom in Command

Use the Zoom in command to increase the size of the map in the active map window by a factor 2.

This command is identical to pressing the Zoom in button from the *Toolbar*.

5.2.2.5 Zoom out Command

Use the Zoom out command to reduce the size of the map in the active map window by a factor 2.

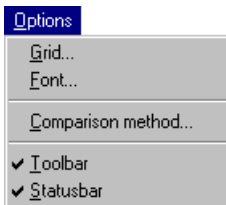
This command is identical to pressing the Zoom out button from the *Toolbar*.

5.2.2.6 Show Regions Command

Use the Show regions command to draw (or remove) the boundaries of the regions on top of the map in the active window. The boundaries drawn are those defined in the *Regions* map.

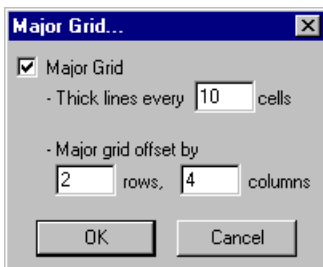
While the function is selected, the menu option is preceded with a mark.

5.2.3 Options menu



Use the Options Menu to personalize your workspace.

5.2.3.1 Grid... Command



Use the Grid... command to draw a (major) grid on top of the maps. When Grid... is selected, the *Major Grid...* dialogue window will open and you are requested to switch on or off the Major grid check box. Next you have to enter the size of the grid expressed in number of cells. Finally you can offset the origin of the grid by a certain amount of cells (in order to coincide with another reference system).

5.2.3.2 Font... Command

Use the Font... command to change the font, font style and size of the character set used to print the legends of maps.

5.2.3.3 Comparison method... Command

Use the Comparison method... command to determine the method used to calculate the discrepancy maps. When the command is executed the *Comparison method and other operations* dialogue window is opened. In this dialogue window you can select the method of your choice.

5.2.3.4 The Toolbar Command

Use the Toolbar command to view or hide the *Toolbar* in the application window.

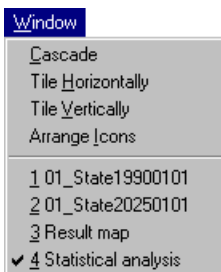
While the function is selected, the menu option is preceded with a mark.

5.2.3.5 The Statusbar Command

Use the Statusbar command to view or hide the *Status bar* in the application window.

While the function is selected, the menu option is preceded with a mark.

5.2.4 Window menu



Use the Window menu to arrange the contents of the screen and to activate one of the opened windows.

5.2.4.1 Cascade Command

Use the Cascade command to arrange multiple opened windows in an overlapped fashion so that the *Caption bar* of each window is visible.

5.2.4.2 Tile Horizontally Command

Use the Tile Horizontally command to arrange multiple opened windows one above another in a non-overlapped fashion so that all windows are visible.

5.2.4.3 Tile vertically Command

Use the Tile Vertically command to arrange multiple opened windows side by side in a non-overlapped fashion so that all windows are visible.

5.2.4.4 Arrange Icons Command

Use the Arrange Icons command to arrange the icons of minimized windows at the bottom of the application window.



Tip

Important ! If the map windows are arranged at the bottom of the application window, they may hide some or all of the icons.

5.2.4.5 *List of Windows (1,2,3,4...)*

At the bottom of the Window menu a list of open windows is presented. A check mark marks the name of the active window. Choose a window from this list to make it active.

5.2.5 *Help menu*



Use the Help menu to select the type of help that you want the **ANALYSE-TOOL** to display on the screen. The different commands in this menu will permit to look up information about the **ANALYSE-TOOL**, its commands, options, and tools.

5.2.5.1 *The Index Command*

Use the Index command to get the opening screen of the *Help* file of the **ANALYSE-TOOL**. From the opening screen, you can jump to step-by-step instructions for using the **ANALYSE-TOOL**. Double click the topic that you want help on. A help screen will appear. Once you open help, you can click the Contents button whenever you want to return to the opening screen.



Tip

Important ! In this version of the **ANALYSE-TOOL** the on-line help is not operational.

5.2.5.2 *About... Command*

Use the About... command to get the copyright notice and version number of the **ANALYSE-TOOL** that you are using. The latter is important if you need assistance with the software from the developers or when you request an update of the software.

6 Working with the Overlay-Tool

This chapter explains how you can produce the Suitability and Zoning maps for **WadBOS** in an interactive manner by using the **OVERLAY-TOOL**. The resulting Suitability and Zoning maps can be imported into **WadBOS** in a straightforward manner.

The term suitability is used here to describe the degree to which a cell is fit for a particular activity (see for example: Wright, 1990). The suitability maps articulate the degree of suitability of a cell based on *physical* and *environmental* characteristics, while the Zoning maps express the suitability of the cell as the result of *institutional* and *organizational* characteristics. For the analysis of policy and planning alternatives, it is paramount that both forms of suitability can be handled separately, because suitability is most often a fact of life, while zoning is a man made instrument for imposing particular spatial policies onto a system. This does not exclude that suitability can be altered, but it usually will mean an intervention in the physical environment (for example; deepening navigation channels, altering slopes, filling in land, etc), while altering zoning requires an intervention into the legal and institutional environment.

Technically speaking, suitability is a composite measure that is calculated on the basis of so called *factors*. A factor is a unique geographical characteristic of a location such as a slope, soil composition, master plans or protected habitats. Variations within a factor such as slope gradient classes, a soil classification classes, designation categories and habitat types, are called *factor types*. A *factor map* represents the geographical location and distribution of factor types of 1 specific factor. Factor maps can be combined and weighted to generate a map that will show how good or bad the conditions are in a given geographical unit to maintain a particular activity, land use or land cover. In **GEONAMICA** applications these maps are called *Suitability maps* if the factors are physical and environmental characteristics and *Zoning maps* if the factors are institutional, organizational and legal characteristics.

With the **OVERLAY-TOOL** it is possible to interactively specify the *factors* and *factor types* that are considered paramount in determining the suitability or zoning for a particular activity or land use.

6.1 Opening the Overlay-Tool



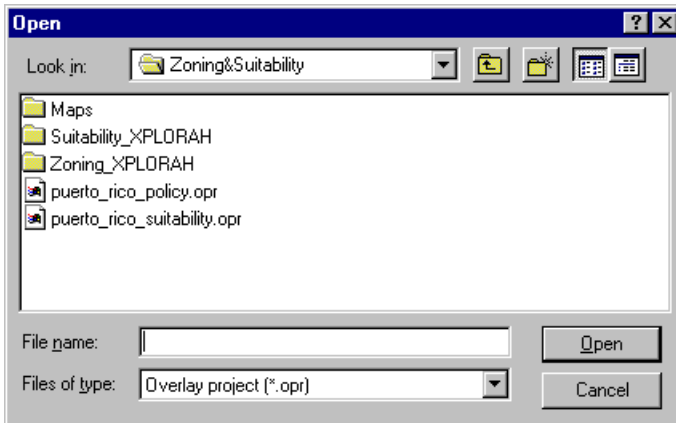
With the installation of **WadBOS** (see Chapter 2) both the main program and the **OVERLAY-TOOL** are installed on your PC.



Press the Start button in the *Task bar* of Windows 98/NT/2000/XP and place the (mouse) pointer on the Programs group. Move through the menu until you find the group containing **WadBOS** and open the **OVERLAY-TOOL** by clicking the Overlay icon. If the software was installed correctly, the *Overlay* application window will open. The Open dialogue window will appear next. If this does not happen, then select the Open... command in the File menu.



Find the correct file with .OPR extension in the *Open* dialogue window.



The **OVERLAY-TOOL** is built according to the Windows standards. Hence, it is possible to find the file by browsing through your own computer or another computer in your network. If you have found the correct file select it and click the Open button or double click on the icon of the file.

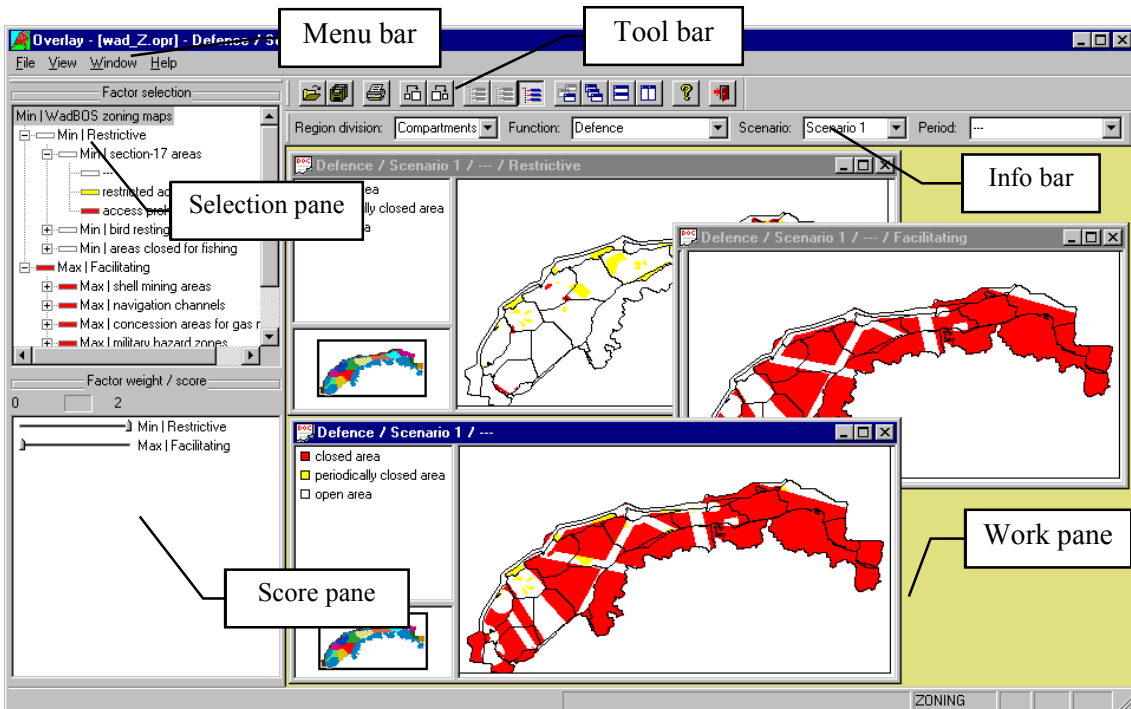
The .ORP file contains references of all files that are needed to create the suitability maps or zoning maps.

Later on in this chapter the contents and composition of these files will be revealed.

After opening the .ORP file and all the associated files, the map window will appear in the work pane of the *Overlay* application window.

6.1.1 The Overlay application window

The *Overlay* application window is divided into three parts, called panes. The pane on the right in the *Overlay* application window –the *work pane*– contains one or more map windows. In each of these the map is shown that is the result of the user set factor scores and factor weights. The map windows have the same layout as the Micro-scale window explained in Chapters 2 and 3 of this user manual.



The actions invoked via the *Menu system*, the *Toolbar* or the *Info bar* only affect the active map window (last selected).

The *Selection pane* can be found in the top left hand corner of the *Overlay* application window. It gives an overview of all the different maps that are included in the project and that are relevant for the calculation of the suitability maps or zoning maps. The maps are shown in the form of a tree in the selection pane. The root of the tree is named *[XXX] Suitability* or *[XXX] Zoning* (in which *[XXX]* stands for the name of the **GEONAMICA** application) depending on the type of maps the user wants to produce, respectively suitability maps or zoning maps.

The branches of the tree are the different maps (factors), and the leaves are the categories (factor types) in each map.

Setting factor weights and factor scores happens in the bottom left pane called *Score pane*. The score pane contains a number of slides, with which the factor weights and factor scores can be adjusted interactively. More in particular there is 1 slide per map (factor) if the root of the tree is selected and 1 slide per category (factor type) if a map is selected.

- When you click the root of the tree the slides per map (per factor) appear in the score pane and you can weigh the importance of each individual factor (a complete map) in the suitability or zoning calculation. These are called the *factor weights*.
- When you click a branch of the tree (a specific map or factor) the slides for the categories (the factor types) of the map will appear and you can weigh each category. These are called *factor scores*.

For the map manipulations and their categories the actual version of the **OVERLAY-TOOL** has three operators. In later versions new operators may be added. The three operators are:

- **Min**: The value of a cell is equal to the minimum value found for this cell in all the maps involved in the analysis;
- **Max**: The value of a cell is equal to the maximum value found for this cell in all the maps involved in the analysis;
- **Mean**: The value of a cell is the average of the values for this cell in all the maps involved in the analysis.

You can set an operator per map and/or per category by clicking with the left mouse button on the name of the map or category. The Operator context menu will open and you can select the operator that you wish to apply. The operator preceded by a bullet is the one currently applied.

With the help of the operators it is possible to implement the different algorithms currently used to create the suitability map and the zoning maps.

The two different algorithms that are used are:

- For calculating the suitability the so-called *linear combination method* is applied. In this method the importance of a category of a specific map in the final suitability map is calculated as the product of the factor weight and the factor score. The **Mean** operator is therefore applied to all the maps and categories. Weight and scores are set as a value in the interval [0 - 100]. For the calculation of the final suitability map there is an additional

operation to assure that the results are presented in the interval [0 - 1]. The value 1 is assigned to the cell with the highest suitability value.

- For the zoning, the scores and weights are to result in the values 0, 1 or 2 thus representing the zoning status:
 - Cells with a value **2** in the zoning map may be taken in by the land use function or activity the whole year.
 - Cells with a value **1** in the zoning map may be taken in by the land use function or activity in the months that the activity is periodically allowed. These months can be specified by means of the Period settings... command in the Edit menu of **WadBOS**.
 - Cells with a value **0** in the zoning map are closed for the land use function or activity all year long.

Another important aspect of zoning is the fact that some policy maps contain *restrictive* policy information while others contain *facilitating* policy information. Maps that prohibit the development of specific activities or land uses are called *restrictive*. On the contrary, maps that stimulate the development of a particular activity or land use are called *facilitating*. When creating zoning maps with the **OVERLAY-TOOL** the maps of the two types are best separated. This most of all allows for the fact that the restrictive policy maps have precedence over the facilitating policy maps in the final deliberation of the status of a cell. The policy maps are thus organised in two packages one *Restrictive* and one *Facilitating*. It is also possible that one map can be part of both packages, especially if it holds different consequences for different land uses. For example a map with protected nature areas is *facilitating* for the development of wilderness land uses, but at the same time also *restrictive* for some or all other land uses.

The algorithm will make a cell available for a land use function and a policy period if at least one factor motivates it. This is when the zoning value for at least 1 factor is equal to 2 or 1). Depending on the exact value, the cell is available year round or periodically: year round if the value is 2, periodically if the value is 1. Cells that have a value of 0 for all the factors are closed for the land use.

The **Max** operator is usually applied for facilitating policy maps. It retains the biggest value for a cell; meaning that a cell is made available for a function as soon as a single factor enables its presence. This is when the cell has a value of 1 or 2 for such factor. The **Min** operator is usually applied for restrictive policies. It retains the smallest value for a cell; meaning that a cell is not available for a function as soon as 1 factor prohibits its presence. This is when the cell has a value of 0 for such factor. The **Min** operator is also used to express dominance, as it will typically select the highest value for a cell from a set of maps, which in the present application is the most restrictive value (0).

The operators shown are typical. Other combinations of operators and operations are possible and may lead to usable zoning maps.

The algorithm will produce the final zoning map in a hierarchical procedure (see the Figure at the beginning of this Paragraph). First all restrictive maps are compiled into a Restrictive zoning map, and all the facilitating policy maps will be compiled into a Facilitating Zoning map. Subsequently the Facilitating and the Restrictive zoning maps are merged into the final Zoning map.

6.1.2 The Menu bar















The menu of the **OVERLAY-TOOL** is situated on the menu bar of the *Overlay* application window. The commands are ordered in accordance with the Windows conventions thus ensuring quick familiarization with the software. The following overview gives a short description of each menu. The menus are described in more detail later.

Use this menu	To...
F ile	manage your project files. The printing facilities are also located in this menu. If you want to exit the program, you can do it from here.
V iew	change the presentation of a map in the active window: zoom in ,zoom out, and add administrative boundaries.
W indow	manage the map windows in the <i>Overlay</i> application window.
H elp	access the help function.

6.1.3 The Toolbar

Just underneath the *Menu bar* there is a *Toolbar*. The *Toolbar*, also known as Speed bar, gives a fast access to the principal functions of the **OVERLAY-TOOL** that are also found in the main menu. Opening projects, printing and organizing the map windows can be done from the *Toolbar*.



Use this button	To...
	open a project from the disk.
	save the maps. The complete set of maps of certain scenario will then be saved.
	print the active map window.
	zoom in. The size of the map increases 2x with each click.
	zoom out. The size of the map decreases 2x with each click.
	show the original factor map in the map window.
	show the weighted factor map in the map window.
	show the suitability or zoning map in the map window. This map shows the final result of all the weights and scores.
	create a new map window
	cascade map windows
	tile map windows horizontally.
	tile map windows vertically
	change the pointer to the help pointer. If the help pointer is used in the menu or window the related help page will be displayed.
	exit the OVERLAY-TOOL .

6.1.4 The Info bar



Below the *Toolbar* you will find the *Info bar*. From the *Info bar* you can select for which land use the suitability and zoning maps are produced. To that effect choose the appropriate land use function from the *Function* scroll list. As soon as a new function is selected the contents of the active map window changes and the information of the selected function is shown. In a similar way you can select a new scenario from the *Scenario* scroll list. The latter feature enables you to define more than one suitability or zoning map per land use in a single project. In fact the current version of the **OVERLAY TOOL** enables you to produce 3 scenarios concurrently. Mind you that when a new scenario is selected, all the weights and all the scores for the scenario are to be entered as there is no facility to copy weights and scores in between scenarios. Similarly, it is possible to generate maps that apply for different periods. To that effect, the period can be selected from the *Period* scroll list. Finally, from the *Region division* scroll list it is possible to select a representation of larger regions to be drawn on top of the map. It is possible to select the Compartments, the Municipalities, or the entire Wadden region.

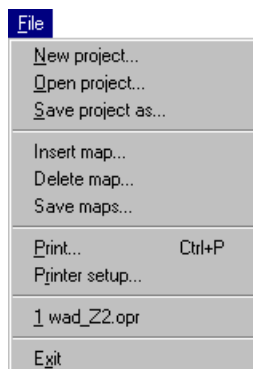
6.1.5 The Status bar

The status bar is positioned at the bottom of the *Overlay* application window and displays information about the type of map that you are working on: Suitability or Zoning. It will also display the coordinates of the cell pointed at with the cursor.

6.2 The Overlay Menu System

This paragraph explains the different functions that are available from the menus of the **OVERLAY-TOOL**. The menus are treated as they appear in the *Menu bar* from left to right and per menu from the top to the bottom.

6.2.1 File menu



Use the File menu to create new projects, to open and edit existing projects, save and print maps, and to close the **OVERLAY-TOOL**.

The **OVERLAY-TOOL** saves project files with an .OPR extension attached to the filename.

Project files contain the information about the maps used for calculating suitability and zoning maps, as well as the factor weights and scores for all functions and scenarios.

The suitability and policy maps that are the end result of the exercise itself are not included in the project files. They can be saved by means of the command Save maps... in .IMG, .ASC or .SWT format and can be imported into your **GEONAMICA** application in a straightforward manner.

6.2.1.1 New project... Command

Use the New project... command to gather the information required to set up a new application for the **OVERLAY-TOOL**.



Important ! In this version of the **OVERLAY-TOOL** the command New project... has been disabled. It is greyed-out in the menu. You can create new Suitability and Zoning projects on the basis of those that come with your **GEONAMICA** application. The other commands in the File menu will enable you to make copies of the projects and add new maps to projects and/or remove existing maps. Thus you can in fact create as many projects as you like that are compatible with your **GEONAMICA** application.

6.2.1.2 Open project... Command

Use the Open project... command to open a project file stored on disk. You can open only one project file at the time.

When you select the Open project... command, the *Open* dialogue window appears. If the name of the file of your choice is not visible in the list box, use the scroll bars to move through the list of filenames in the directory or disk you are working in. If the file you want to open is not in the current directory or on the current disk, use the scroll list or browse symbols in the section named *Look in* to change directories, disks or network sites.

Double-click the name of the file you want to open. You can also type the name and path of the file in the *Filename* box. Press the Open button after you have typed the name of the file.

This command is identical to pressing the Open button from the *Toolbar*.

6.2.1.3 *Save project as... Command*

Use the Save project as ... command to save a project on a disk. When you select the Save project as... command, the Save As dialogue window appears. It allows you to specify the name of the file and the location where you want to store it. If you want to save the file under a different name, click on the old name and enter the new name of your choice. The **OVERLAY-TOOL** automatically adds the extension .OPR to the name of a project file.



Important ! Be careful not to change the extension of the files.

6.2.1.4 *Insert map... Command*

Use the Insert map... command to add a map to the set used in the project. You can only insert one map at the time. Maps can be inserted that are available in the .IMG (IDRISI) or the .ASC (ArcInfo ASCII grid) formats. If IDRISI files are inserted, the associated .DOC file has to be available on the disk as well.

When you select Insert map..., the *Open* dialogue window appears with all the files that are in the work directory and have the right extension (.IMG). If the name of the file of your choice is not visible in the list box, use the scroll bars to move through the list of filenames in the directory or disk you are working in. If the file you want to insert is not in the current directory or on the current disk, use the scroll list or browse symbols in the section named *Look in* to change directories, disks or network sites.

The inserted map is shown as the last map in the selection pane. The weights of a newly inserted map are set so that it has no effect on the calculation of suitability and zoning until you specify and fine-tune them.

6.2.1.5 *Delete map...Command*

Use the Delete map... command to delete a map from the project file. First select the map that you want to delete from the selection pane. Then select the command Delete map... from the File menu. Before the map is deleted you are prompted to confirm the decision to delete the map. If you accidentally delete a map you can always reinstate it by means of the Insert map... command.

6.2.1.6 *Save maps...Command*

Use the Save maps... command to save the suitability or zoning maps that are the result of a project.

When you select the Save maps... command the **OVERLAY-TOOL** will save for the selected scenario 1 suitability or 1 zoning map per land use function. Hence, in order to prevent that the wrong set of maps are saved, it is imperative

that you check dully the scenario and the period selected before invoking this command. You can define in which format the maps are saved. As first option the IDRISI (.IMG) format is offered, but it is also possible to save the maps in the ArcInfo (.ARC) format or the **GEONAMICA** (.SWT) format.

This command is identical to pressing the **Save** button from the *Toolbar*.

6.2.1.7 *Print... Command*

Use the **Print...** command to print the map displayed in the active map window.

This command is identical to pressing the **Print** button from the *Toolbar*.

6.2.1.8 *Print setup... Command*

Use the **Print setup...** command to change the settings on the printer enabling correct printing.

6.2.1.9 *The List of Recent Files (1,2,3,4)*

The **OVERLAY-TOOL** keeps track of the four most recently opened project files. It will display those in the **File** menu. If you select one of the four files, it will be opened.

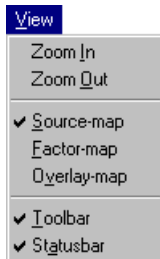
6.2.1.10 *Exit Command*

Use the **Exit** command to quit the **OVERLAY-TOOL** and return to Windows.

If you have made changes to the project file since the last time that you saved it, a dialogue window appears asking whether you want to save the project file before exiting the **OVERLAY-TOOL**. If you answer yes to this question, then you are given the opportunity to save your project files as is explained in **Save Project as...** command (see Paragraph 6.2.1.3).

This command is identical to pressing the **Exit** button from the *Toolbar*.

6.2.2 *View menu*



Use the **View** menu to change the manner in which the map is presented in the active map window and to rearrange the *Overlay* application window.

6.2.2.1 *Zoom in Command*

Use the Zoom in command to increase the size of the map in the active map window by a factor 2.

This command is identical to selecting the Zoom in button from the *Toolbar*.

6.2.2.2 *Zoom out Command*

Use the Zoom out command to reduce the size of the map in the active map window by a factor 2.

This command is identical to selecting the Zoom out button from the *Toolbar*.

6.2.2.3 *Source-map Command*

Use the Source-map command to display the selected source map in the active map window. The colours used to present the maps are taken from the colour palette file DEFAULT.SMP. This file is read in when the **OVERLAY-TOOL** is started. If this file is no longer in the work directory, a random palette is created and used to present the map.

This command is identical to selecting the Source-map button from the *Toolbar*.

While the function is selected, the menu option is preceded with a mark.

6.2.2.4 *Factor-map Command*

Use the Factor-map command to display the factor map associated with the selected map in the active map window. This map is the result of weighing (the application of the factor scores of all categories and the factor weight of the map) the selected map. This map is shown in the colour palette that is also used in your **GEONAMICA** application to display the suitability or the zoning map.

This command is identical to selecting the Factor-map button from the *Toolbar*.

While the function is selected, the menu option is preceded with a mark.

6.2.2.5 *Overlay-map Command*

Use the Overlay-map command to display the overlay map in the active map window. This map is the result of weighing (the application of the factor scores of all categories and the factor weights of all the maps) of all the maps in a project. This map is shown in the colour palette that is also used in your **GEONAMICA** application to display the suitability or the zoning map.

This command is identical to selecting the Factor-map button from the *Toolbar*.

While the function is selected, the menu option is preceded with a mark.

6.2.2.6 *Toolbar Command*

Use the *Toolbar* command to view or hide the *Toolbar* in the *Overlay* applications window.

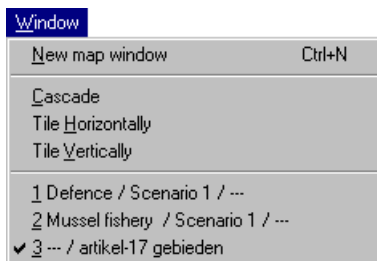
While the function is selected, the menu option is preceded with a mark.

6.2.2.7 *Statusbar Command*

Use the *Statusbar* command to view or hide the *Status bar* in the *Overlay* applications window.

While the function is selected, the menu option is preceded with a mark.

6.2.3 *Window menu*



Use the *Window* menu to arrange the contents of the screen and to activate one of the opened windows.

6.2.3.1 *New map window Command*

Use the *New map window* command to open a new map window in the work pane. The new map window will automatically open with the same contents as the active window and will become the active window. Next you can change the contents of the new map window by using the commands from the menus, the buttons from *Toolbar* and the scroll lists from the *Info bar*.

6.2.3.2 *Cascade Command*

Use the *Cascade* command to arrange multiple opened windows in an overlapped fashion so that the *Caption bar* of each window is visible.

This command is identical to pressing the *Cascade* button from the *Toolbar*.

6.2.3.3 *Tile Horizontally Command*

Use the *Tile Horizontally* command to arrange multiple opened windows one above another in a non-overlapped fashion so that all windows are visible.

This command is identical to pressing the *Tile horizontally* button from the *Toolbar*.

6.2.3.4 *Tile vertically Command*

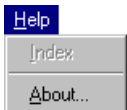
Use the Tile Vertically command to arrange multiple opened windows side by side in a non-overlapped fashion so that all windows are visible.

This command is identical to pressing the Tile vertically button from the *Toolbar*.

6.2.3.5 *List of Windows (1,2,3,4...)*

At the bottom of the Window menu a list of open windows is presented. A check mark marks the name of the active window. Choose a window from this list to make it active.

6.2.4 *Help menu*



Use the Help menu to select the type of help that you want the **OVERLAY-TOOL** to display on the screen. The different commands in this menu will permit to look up information about the **OVERLAY-TOOL**, its commands, options, and tools.

6.2.4.1 *The Index Command*

Use the Index command to get the opening screen of the *Help* file of the **OVERLAY-TOOL**. From the opening screen, you can jump to step-by-step instructions for using the **OVERLAY-TOOL**. Double click the topic that you want help on. A help screen will appear. Once you open help, you can click the Contents button whenever you want to return to the opening screen.



Tip

Important ! In this version of the **OVERLAY-TOOL** the on-line help is not operational.

6.2.4.2 *About... Command*

Use the About... command to get the copyright notice and version number of the **OVERLAY-TOOL** that you are using. The latter is important if you need assistance with the software from the developers or when you request an update of the software.

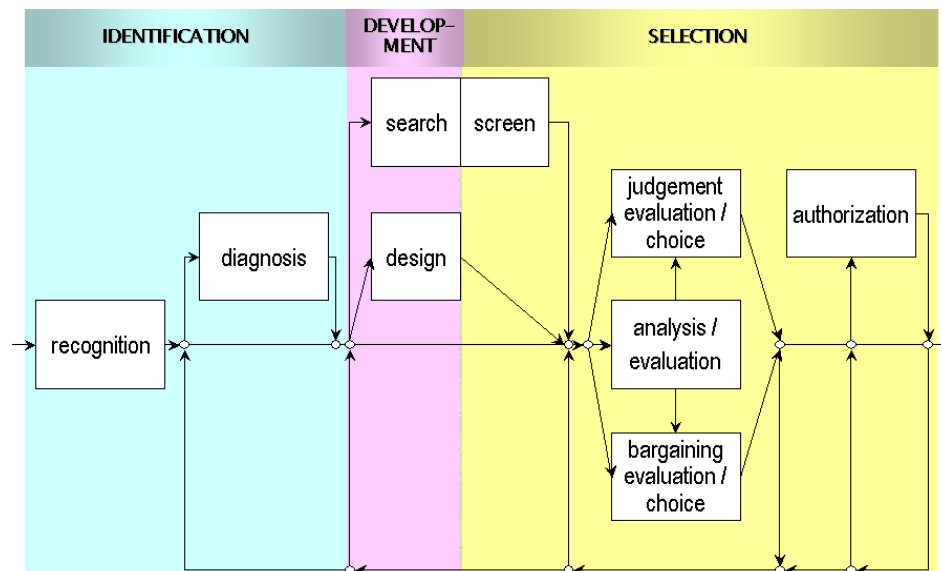
7 Policy exercises with WadBOS

Now that the general functionality has been explained, this chapter will concentrate especially on the use of **WadBOS** as a support instrument for policy preparation and exploration. The chapter will limit itself to three exercises; set up in such a way that you need progressively more knowledge about the system to complete them. Generally we will make a proposal on how to prepare **WadBOS**, we will explain the purpose of the exercise, and what to pay attention of during the exercise.

It is strongly emphasized that the exercises in this chapter are only meant to gain insight in the capabilities and possibilities of this version of WadBOS as a tool for policy analysis. As the instrument is not completed yet and only part of the available data relative to the policy cases has been gathered, the outcome of the policy exercises presented are not to be used for solving real policy questions.

7.1 Introduction

Policy support or --more generally policy analysis-- is a process that generally involves a few phases that are gone through sequentially in one or more iterations. Depending on the consulted author, application area, and the instruments used, we distinguish a few phases and we use different names for the phases.



As example the schema proposed by Mintzberg *et al.* (1976) is presented here. This schema has been shown to be very usable for the analysis of policy questions (see among others, Janssen, 1992).

Generally speaking, we can distinguish the following three phases:

The *identification phase*. In this phase we try to get a better understanding of the true nature of the particular policy problem. During this phase we first try to focus on the true causes of the problem before we focus on solutions for it.

The *development phase*. In this phase we try to find the solutions to the recognized problem and we design and search a large number of alternative solutions to the problem.

The *selection phase*. In this phase we finally try to find the solution among the possible solutions that is the best possible solution for the problem.

Although these three phases are presented in a sequential manner, decision making is most often a cyclic process, wherein the named phases --in part or in full-- are gone through a few times, and whereby we systematically: (1) get a better view on the true nature of the problem, (2) are able to present more focused solutions and (3) are able to present a single intervention in the system, or a combination of interventions, that may solve the problem completely or partially.

Fully-fledged Decision Support Systems (DSS) are systems that support all three of the above-mentioned phases. Often a (partial) DSS will specifically focus on one or two of the phases. For example, quantitative models are mostly used to generate alternatives in the development phase while multi-criteria analysis methods focus mainly on the selection phase.

This version of **WadBOS** mainly offers support for the identification and the development phases. The selection phase itself is supported to a lesser extent. In order to improve this, **WadBOS** should be equipped with additional functionality enabling the comparison and ranking of alternatives on the basis of more than one criterion. For the time being this is only possible by means of the score tables in the Impacts View. Next to this, the **ANALYSE-TOOL**, MS Excel, and --for those having access to it-- a GIS-program like IDRISI enable more advanced analysis of data generated with **WadBOS**. **WadBOS** is most useful to work out the consequences of policy interventions and to test their robustness.

In the following three exercises we will try out the effects of external events and policy interventions on the Wadden system. The exercises have been kept simple. Their purpose is for you to get sufficiently acquainted with **WadBOS**, so that you can continue using it without further assistance. At first we will show how external events affect the Wadden system. Next we will experiment with policy interventions.

To get a better insight into the way certain interventions affect the system, it is useful to first get a good understanding of the structure of the main system diagrams of **WadBOS** and to get especially acquainted with the links between sub-models. To that effect it is best to work your way through the whole system diagram, selecting with your mouse sub-models, opening dialogue windows and maps, and frequently activating the help function (F1-key) for subjects you wish to learn more about.

We assume that you know now how to start **WadBOS**, how to open a simulation, how to run a simulation exercise, how to stop and reset it. If this is not the case we advise you to read chapters 2 and 3 first. Every exercise starts with opening **WadBOS** and opening the simulation file waddensea.SIM, unless it is stated differently.

7.2 Exercise A: Working with a scenario

The effectiveness of the management of the Wadden Sea is strongly influenced by the physical and socio-economic factors affecting the system from outside. Such factors are usually not under the control of the manager or policy maker. Confronted with them, their role is mostly limited to the early detection of possible dangers and the design and implementation of measures to counter them. Four types of factors have been incorporated in **WadBOS** in the form of scenario variables: (1) the level of prosperity of the Dutch population, (2) the general development of the economic activities in the region (and the world beyond), (3) the climate factors in the Wadden Sea, (4) the exchange of water, and the substances dissolved in the water, between the Wadden Sea on the one hand and the North Sea and the different freshwater sources on the other. In future version of **WadBOS**, more factors may be added to this list, including among others: energy scenarios (affecting the need for gas exploitation) and sea level rise scenarios (affecting the safety of the land against floods). Based on a scenario it is possible to estimate the effect of for example a temporary increase in temperature and/or light intensity on the production of Filter Feeders and further on the catch in the mussel fishery.

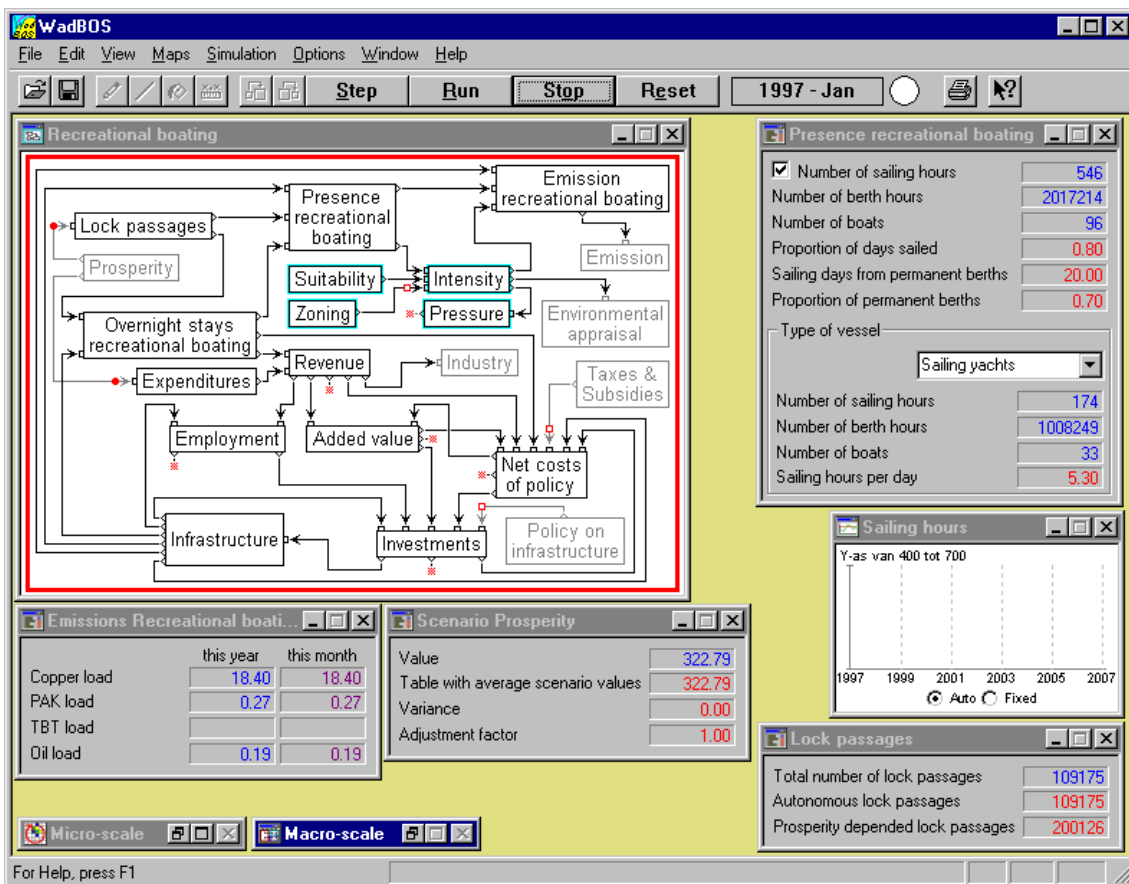
Aim of the exercise: The purpose of the first exercise is to examine the effects of the prosperity level on the overall levels of activity in the Wadden Sea region. We will specifically analyse the effects of an increasing level of prosperity on the volume of recreational boating.

Screen-layout: We will organize the screen in such a way that you can see all relevant input and output windows together on the screen. This way we can see how the variables change during the simulation. As mentioned in Chapter 3 you can arrange the screen contents to your own needs. This flexibility offers a number of important advantages while working with **WadBOS**, but it also has the disadvantage that you may get very quickly snowed under with windows that are not strictly necessary for the exercise. It thus takes a certain level of discipline to keep the screen contents limited and clear.

- Start **WadBOS** and open the simulation file waddensea.SIM.
- Minimize the *Micro-scale* window.
- Select the System diagram-View in the *Macro-scale* window. Then select the MBB-block (ModelBuildingBlock) '*Recreation boating*'. This is a so-called SuperMBB (see Paragraph 3.1.2.1). When clicked, the Recreational boating sub-model will open. Drag the *Recreational boating* window to the top left-hand corner of the application window. Then select the MBB '*Presence recreational boating*' in the *Recreational boating* window. When you click this MBB the *Presence recreational boating* dialogue window opens. This dialogue window shows the variables and parameters that are part of the sub-model that calculates the presence of recreational boaters. Drag the dialogue window to the top right hand corner of the application window. Select '*Sailing yachts*' in the '*Type of vessel*' combo box. Click on the checkbox '*Amount of sailing hours*' and the graph '*Sailing hours*' will open. Place the graph underneath the *Presence Recreational Boating* dialogue window.

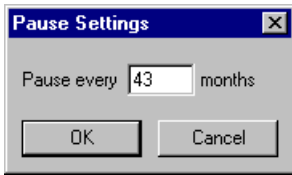
- Select in the *Recreational boating* window the MBB 'Lock passages'. The *Lock passages* dialogue window will open. Drag this window to the right side of the screen and place it underneath the 'Sailing hours' graph.
- Select in the *Recreational boating* window the MBB 'Emission recreational boating'. The *Emissions Recreational boating* dialogue window will open. Place the dialogue window underneath the *Recreational boating* window.
- Select in the *Macro-scale* window the Scenarios-View and select the MBB 'Prosperity'. The *Prosperity* window will open. Click in the 'Prosperity' edit field (with the number 322,79 written in purple). The *Scenario Prosperity* dialogue window will open. Drag the dialogue window to the left side of the screen and place it to the right of the *Emissions Recreational boating* dialogue window. Close the *Prosperity* window.
- Finally minimize the *Macro-scale* window.

As result of all this your **WadBOS** application window should look more or less like the picture below.



Simulation exercise A1: We will compare two prosperity scenarios: the first one is based on the expected average growth according to the Central Bureau of Statistics, namely 1,97% per year. The second is economically more optimistic with a growth that is twice the size namely 3,95% per year. We choose a growth that is twice the size in order to observe clear differences between them in the results of the simulations.

A normal simulation exercise runs for a period of 120 months (hence 10 years). This period can be manually interrupted with the help of the Stop command from the Simulation menu or the Stop button in the Toolbar.



But you can also have the program stop automatically after a number of preset months with the help of the command *Pauses...* from the *Simulation* menu. We choose here for the last option and will let the simulation run for 43 months, from January 1997 until August 2000. To this effect, select the *Pauses...* command and enter the value 43 in the edit field of the *Pause Settings* dialogue window. Then press the OK button to close the dialogue window.

The simulation will now automatically stop in august 2000 after it finishes calculating the values of the 43rd month. For this exercise it is also important to write down the values in August 1997, August 1998 and August 1999. For these intermediate months you will have to stop the simulation manually.

Record the following values for the months of August in 1997, 1998, 1999 and 2000 in the table underneath: ‘Number of sailing hours’ (total) and the ‘Number of sailing hours’ (for Sail yachts) (both taken from the *Presence recreational boating* dialogue window), the ‘Copper load’ and ‘Oil load’ (both taken from the *Emissions Recreational boating* dialogue window), and finally the ‘Total number of lock passages’ (from the *Lock passages* dialogue window). Enter the values in the columns with the title A1.

Table A: Results of Exercise A: Effect of Prosperity on Recreational boating.

Date #	1997 Aug		1998 Aug		1999 Aug		2000 Aug	
	A1	A2	A1	A2	A1	A2	A1	A2
VARIABLES								
Number of sailing hours								
Number of sailing hours for Sailing yachts								
Copper load								
Oil load								
Total number of lock passages								

Press the Start button in the Toolbar to start the simulation. Notice how the months tick away in the clock and how the numbers in the dialogue windows change monthly. Notice also how the number of sailing hours changes periodically with a peak in the summer and a low in the winter, and how the emissions follow the peaks and lows of the presence of recreational boaters. Stop the simulation in the months that you have to record the values in the table for. To be sure that the simulation stops in August, press the Stop button as soon as the results for the month of July appear on the screen. As soon as the Stop command is given, **WadBOS** calculates the current time step values and then halts.

As soon as the simulation reaches the month of August 2000, it halts. Record the values for August 2000.

What are the units of the numbers that you read in the dialogue ‘*Presence recreational boating*’?

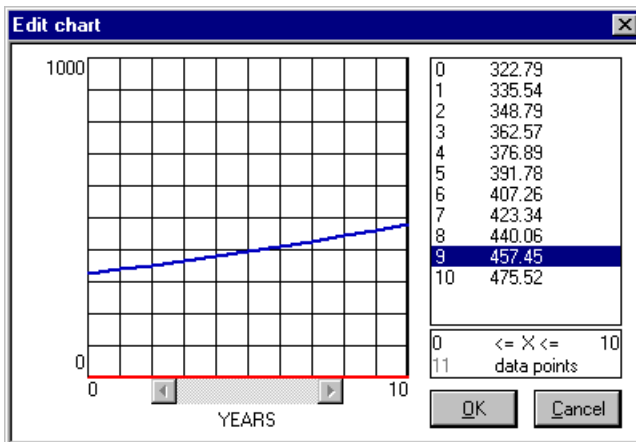
To find this out, activate the dialogue window and press the F1-key to open the accompanying documentation page. In this page you can find out under the headings *Output*, *Internal parameter(s)* and *Input* what the definitions are of the different variables and parameters and how they are used in the equation for calculating the presence of recreational boaters in the Wadden Sea. In the same way you can find information on just about every other part of **WadBOS**.

Press the Reset button in the Toolbar to return the simulation to the initial situation.

Simulation exercise A2: We will now repeat the same exercise with a prosperity growing at twice the initial rate (3,95% per year).

Click in the ‘Table with permanent trends’ edit field of the *Scenario Prosperity* dialogue window.

The graph editor facility will open, showing the expected development of the prosperity for the ten-year period between 1997 and 2007. The values that you can read from the graph are the ones representing a growth of 1,97% per year.



To represent a growth of 3,95 % you have to enter the values as is indicated in the figure to the left. Click to that effect in the left part (graphical part) or enter the values in the right (textual) part of the edit facility. The table values to enter are: 322.79, 335.54, 348.79, 362.57, 376.89, 391.78, 407.26, 423.34, 440.06, 457.45, and 475.52.

Close the graphical facility by pressing the OK button and click the Start button in the Toolbar to start the simulation.

Stop the simulation in the months that you need to record the values for and enter them into the table under the headings A2. End the simulation in August 2000.

What are the differences between the two simulation exercises and how small or big are the changes in the recorded variables? Are these the expected effects?

When comparing the two simulations you will notice that an increasing prosperity will increase the pressure on the Wadden system: both the number of sailing hours and the emissions of recreational boating score noticeably higher. You can see quickly how the pressure is distributed spatially by selecting the MBB ‘*Intensity*’ from the *Recreational boating* window. As a result of this you will see the distribution of the recreational boating in this month of the simulation. The effects on the ecosystem can be seen in the Pressure map, accessible from the MBB ‘*Pressure*’ and the Exposure maps accessible from the Maps menu. The following exercise will address the spatial consequences of policies in more detail.

To end this exercise, close **WadBOS** and answer No to the question asking whether you want to save the simulation results.

7.3 Exercise B: A Zoning policy for Recreational boating

From the previous exercise it will be clear that demographic and economic pressure on the Wadden system have their effects directly (visible in the number of sailing hours) but also indirectly (via the emissions). The managers of the Wadden Sea can do little or nothing about the prosperity level in the Netherlands. They will experience an increase in prosperity as a fact and will have to take it into account while designing their new policies. They will have to take measures to overcome the effects of a prosperity increase and safeguard the natural system from damage. The introduction of this kind of measures is the purpose of this exercise.

Aim of the exercise: The purpose of this exercise is to introduce a measure to safeguard the Eider colonies to the south of Ameland Island from the (increasing) pressure caused by recreational boating. The measures taken should not affect the economy all too much nor should they expose the species elsewhere.

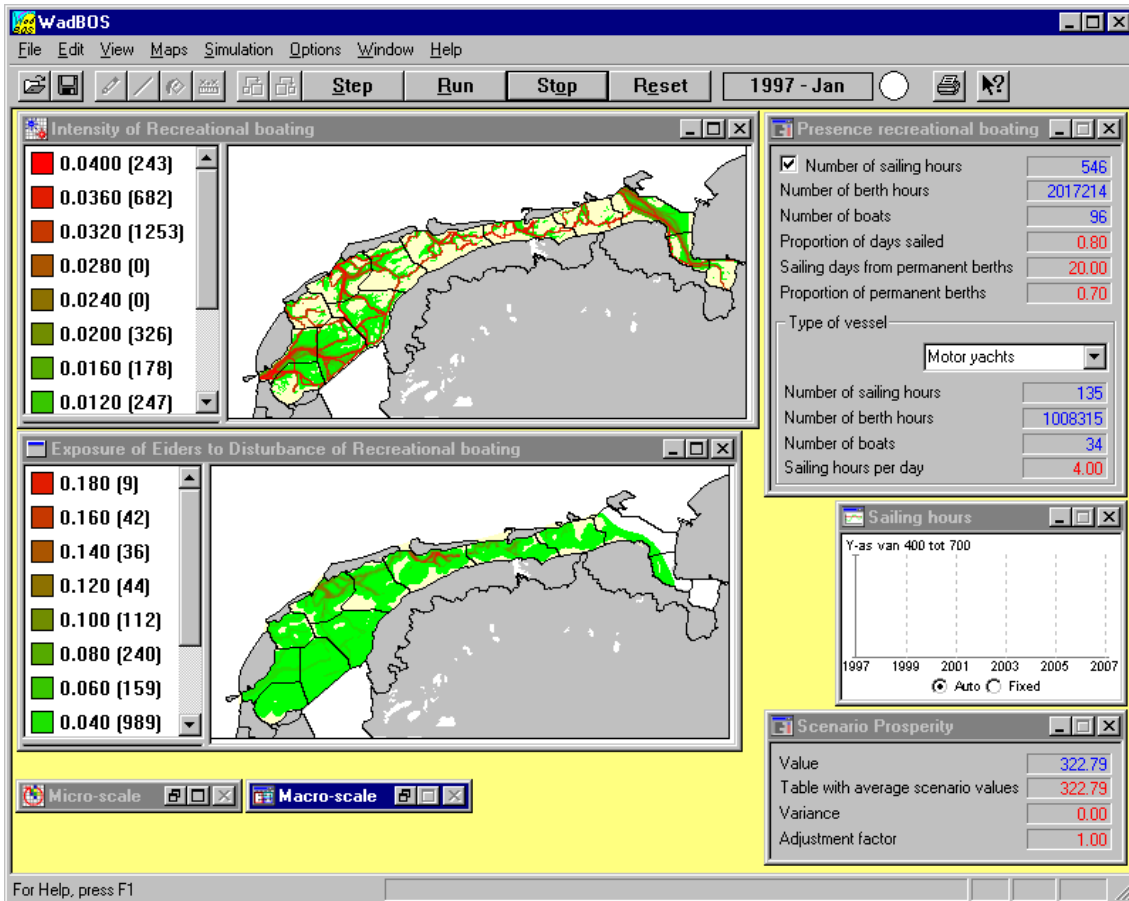
Screen-layout: We choose in part for the same screen-layout. This time we will add two maps, namely the Intensity map for recreational boating and the Exposure map for Eiders exposed to disturbance caused by recreational boating.

- Start **WadBOS** and open the simulation file waddensea.SIM.
- Minimize the *Micro-scale* window.
- Select the System diagram-View in the *Macro-scale* window. Then select the MBB '*Recreation boating*'. When clicked, the Recreational boating sub-model opens.
- Select in the *Recreational boating* window the MBB '*Intensity*'. The '*Intensity of Recreational boating*' map opens. Zoom out once so that it fits in the window completely and then drag it to the top left hand corner of the screen.
- Then select the MBB '*Presence recreational boating*' in the *Recreational boating* window. The *Presence recreational boating* dialogue window opens. Drag the dialogue window to the top right hand corner of the application window. Click on the checkbox '*Number of sailing hours*' and the '*Sailing hours*' graph will open. Place the graph underneath the *Presence recreational boating* dialogue window.
- Select in the *Macro-scale* window the Scenarios-View and select the MBB '*Prosperity*'. The *Prosperity* window will open. Click in the '*Prosperity*' edit field (with the number 322,79 written in purple). The *Scenario Prosperity* dialogue window will open. Drag the dialogue window to the right side of the screen to position it under the '*Sailing hours*' graph. Close the *Prosperity* dialogue window.
- Then select the Impacts-View (from the *Macro-scale* window) and click on the MBB '*Species*' to open the *Species* dialogue window. Next click the Eider button on the line Recreational boating - Disturbance - Eider (the first row). The map opens with the long title '*Exposure of Eiders to Disturbance of Recreational boating*'. We will call this map simply the

'*Exposure map*'. Reduce this map once, so that it fits perfectly on the screen and place it under the Intensity map.

- Close the *Species* dialogue window and the *Recreational boating* window and minimize the *Macro-scale* window.

Your **WadBOS** application window should now look like this:



Simulation exercise B1: In this exercise we will conduct a simulation for a predicted prosperity increase of 1,97% (as suggested by the CBS = Central Bureau of Statistics). We choose August 2000 as end date of the simulation again. Set (again) the Pause-settings on 43 months.

We will use the **ANALYZE-TOOL** to compare the results on the maps generated by two alternatives simulated. In order to do this, we need to switch on the Log... function. Select the Log... command in the Options menu. The *Log settings* dialogue window will open. Click the radio button 'On'. Enter the value 6 in the edit field 'Log every ... months'. Then select the following maps in the tree: '*Intensity of Recreational boating*', '*Disturbance*' (under the heading *Pressure*), '*Exposure of Eiders to Disturbance of Recreational boating*', '*Exposure of Oystercatchers to Disturbance of Recreational boating*', '*Ecological value with human activity*', '*Perceived value with human activity*'. To select the maps double click on the name of the map or click in the little square preceding the name. The map is selected as soon as a small red ball appears in the square. Then press the OK button. During the simulation maps will now be saved for the following month 1 (January 1997), month 7 (July 1997), month 13 (January 1998), month 19 (July 1998), ..., and so on every six months till the end of the simulation period. **WadBOS** decides on the name of

the .LOG file automatically. The name can be read from the edit field named 'Log file'. The name consists of a sequential number, followed by the name of the simulation file 'waddensea', followed by the extension .LOG. Every time you create a new .LOG file the sequential number will increment with 1.

Start the simulation and watch closely what happens on the maps. The intensity map shows the distribution of recreational boaters in the Wadden Sea. The colour scale in the legend indicates the number of vessels that are on average present per cell (25 hectare) in the region. The numbers between brackets indicate the number of cells in each category. You will notice that initially the border values of the legend classes vary. This is because **WadBOS** is searching for a classification scheme that enables to show the extreme values. **WadBOS** is adjusting its classification until the recreational boating reaches its peak in August.

You can read the number of Eiders that is potentially exposed to recreational boating from the Exposure map. A double dynamic is visible in the exposure map: namely that of the recreational boaters and that of the Eiders. The first reach their maximum in the region in the summer months (as can be seen in the intensity map), while the Eiders reach their peak in the winter when they come to spend the winter. If you like to check the seasonal cycle in the presence of Eiders, select the SuperMBB '*Birds and Seals*' in the System diagram-View of the *Macro-scale* window and then select the MBB '*Eider*' to open the *Eider* dialogue window. Click in the edit field '*Population*' which indicates the total number of Eiders and then click in the edit field '*Seasonal cycle*'.

The management plan of the Wadden Sea, sets as a guideline for limiting the pressure of recreational boating, a norm of 1 boat per 20 ha beached channel. It is a common problem to translate the density of boats in the Wadden Sea to factual effects on the state of the sea and further for determining the limit of allowed effects. For this problem **WadBOS** handles a practical and simplified solution: the transfer curve. This curve is set on the basis of expert knowledge on how the potential exposure caused by recreational boating increases as the density of the boats increases. A second curve indicates at what distance the disturbance caused by recreational boating is felt. By practicing with different settings for the curves (for example by trying out different expert opinions) an insight into the sensitivity can be found. The transfer curves indicating the level of potential exposure in relation to the presence of recreational boaters can be adjusted via the System diagram-View of the *Macro-scale* window. If you like to see the function or adjust it, then select the SuperMBB '*Recreational boating*', select the MBB '*Pressure*' and lastly click in the fields named '*Contribution to disturbance*' and '*Distance decay*'.

In the first part of this simulation exercise we want to know how many Eiders are potentially exposed to recreational boating under a base line scenario relative to the increase in prosperity. Secondly we want to know how we can safeguard the area south of Ameland Island from too large a recreational pressure.

Run the simulation with the base line scenario for prosperity, as is described in the previous exercise. The simulation stops after 43 months in August 2000. Read the maximum exposure value from the Exposure map (in the rectangle between the cells (row-column)) 60-157 and 65-164. Also record the exposure value of the cell 63-142. To read this value, it is important to enlarge the map until the cells are clearly noticeable on the screen. When you move over the

screen with your mouse, you'll see in the status bar the column and row value of the cell you are pointing at with the cursor.

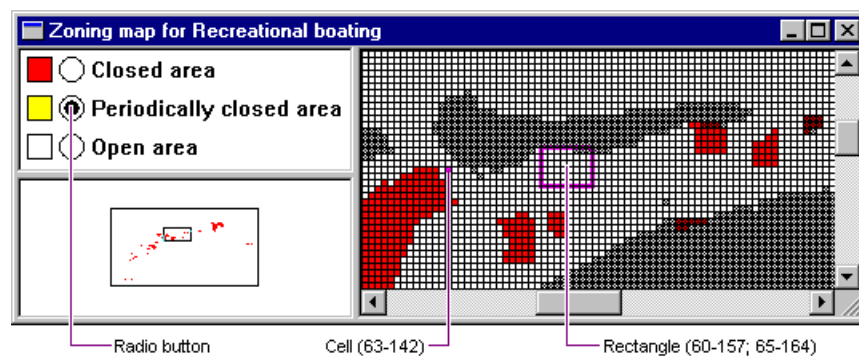
Next we want to intervene to decrease the exposure south of Ameland, in the rectangle 60-157 to 65-164. To that effect, **WadBOS** offers a number of policy options that more or less directly affect the (the causes of the level of) exposure. The most obvious ones are:

- You can generally restrict the recreational boating by limiting the infrastructure of the recreational boating with the help of the Policy option '*Infrastructure*'. In practical terms this can mean that the number of mooring sites is reduced, or that limiting measures are introduced relative to the overcapacity of ports;
- You can close a specific region for recreational boating by means of the Policy option '*Zoning*'.

In exercise C we will try out a policy option of the first type, but now we apply a measure of the second type.

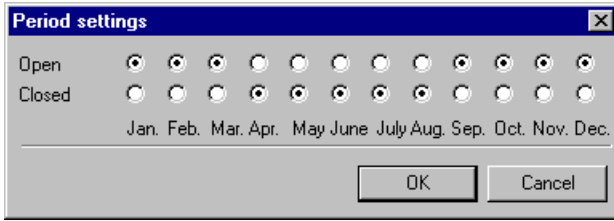
Simulation exercise B2: Press the Reset button to bring the simulation back to its initial state. Select the MBB '*Zoning*' in the Policy options-View to open the *Zoning* dialogue window. Then press the button '*Zoning map*' of the activity Recreational boating. As a result the '*Zoning map for Recreational boating*' will open. On this map you can see status of the cells relative to the activity: those that are always open (white), those that are periodically closed (yellow), or those that are permanently closed (red) for recreational boating. The periodically closed can be set with the help of the Period settings... command from the Edit menu. The user can also change the colour of each cell by means of the Pen and Fill commands.

Select the map and enlarge it until the grid is visible, and until you can easily distinguish the cells. As soon as the grid is visible, the edit facility, which enables to change the map, becomes active. As soon as the pointer moves inside the map window, it will change into an electronic pen.



Close the region situated in the rectangle, located between the cells (row, column) 60-157 and 65-164 during the summer period. To this end, click the radio button '*Periodically closed*' in the legend of the zoning map. The electronic pencil is now set to colour cells in yellow. Now colour all the cells in the rectangle between the cells (row, column) 60-157 and 65-164.

Select in the Edit menu the Period settings... command and click the radio buttons '*Closed*' for the months April till August. Now recreational boating is



prohibited in the rectangle region, as well as all the other yellow cells on the map, from the beginning of April till the end of August.

Enable again the storage of maps with the Log... command in the Options menu. In

the *Log settings* dialogue window the 'On' radio button has to be clicked again. Normally the other settings should still be intact. If this is not the case, then choose the same files as in exercise B1. Close the window by pressing the OK button.

Close all non-essential windows and then run the simulation until August 2000. Take a look at the intensity map and notice that during the summer months (April till August) recreational boaters are no longer present in the cells in the rectangular area that has been closed. They now have relocated to other cells. In other words, the measures taken might have only moved the problem somewhere else. Test this by stopping the simulation in August 2000, record the value of cell 63-142 and compare it with the value recorded in the previous run (B1). Also notice that on the borders of the rectangle (row, column) 60-157 and 65-164 the exposure has not become zero. This is a result of disturbance caused by the recreational activity in the direct environment (but outside the rectangle). Also look at the exposure of other species, like the Oystercatcher. Is the intervention unfavourable for this species?

Close **WadBOS** and answer No to the question asking whether you want to save the simulation results.

Analysis of the results of exercises B1 and B2 with the ANALYSE-TOOL: As is described in Chapter 5 of this manual the **ANALYSE-TOOL** is an instrument enabling a quick and interactive analysis of the simulation results generated with **WadBOS**. Moreover the **ANALYSE-TOOL** supports the comparison of maps that are created by one or more simulations.

Start the **ANALYSE-TOOL** and open the file with the name '02_waddensea.LOG' created in simulation exercise B1. You can find this file in the directory '**WadBOS**', the subdirectory 'Log', and finally in the subdirectory 'waddensea'. As soon as the file is opened, the **ANALYSE-TOOL** will show the first map stored in the file in the map window-1. Select in the File menu the Import... command and open from the same subdirectory the file '03_waddensea.log' created in the simulation exercise B2. The maps of the last opened file are appended to the list of maps already available in the **ANALYSE-TOOL**.

Choose the type of map that you like to compare from the most left list box in the Toolbar. Choose: 'Intensity of Recreational boating'. Then select in the list box of map window-1 (this is the one preceded by a button with the number 1 written on it) the map from the first exercise (B1) for July 2000 (02_Intensity of Recreational boating_200007). And, select in the list box of map window-2 (this is the one preceded by a button with the number 2 written on it) the map from the second exercise (B2) for July 2000 (03_Intensity of Recreational boating_200007). Then make the difference map (exercise B1 - exercise B2) by pressing the ½ button.

Where do you see changes in the intensity of the recreational boating in the months July of the year 2000? Could this be expected as a result from the zoning policy implemented in exercise B2?

Also look at the difference maps for ‘Disturbance’, ‘Exposure of Eiders to Disturbance of Recreational boating’, ‘Exposure of Oystercatchers to Disturbance of Recreational boating’, ‘Ecological value with human activity’, ‘Perceived value with human activity’. The selection of the other types of maps is possible in the left most list box in the Toolbar. Make sure to compare the correct map pairs and further make sure that you choose maps for the same months when comparing the two simulation runs.

The type of difference map presented can be selected with the help of the Comparison Method... command from the Options menu. By adjusting the legend you may be able to improve the readability of the map. Use to that effect the Legend... command from the View menu

What are the effects of the implementation of the Policy measure ‘Zoning’ on the Disturbance, the Exposure of Eiders and Oystercatchers and the Perceived value of the region?

7.4 Exercise C: Limiting Infrastructure and Quotas for Shell mining

Like in the previous exercise (B) this one involves a policy intervention in the Wadden system. This exercise focuses on the mining of fossil shells. It aims at developing a durable mining strategy, meaning a strategy that ensures a balance between the amounts of shells mined and the amounts of shells added to the system yearly.

With this exercise we want to find out more about the process itself and about which policies are relevant to intervene. The policy measures have to assure that the shell stocks are kept up but also that the employment in the region is not suffering too much under it.

Aim of the exercise: The purpose of this exercise is to come to a durable extraction of the shell stocks.

Screen-layout: In the layout of the screen we limit ourselves again to the most essential windows enabling to follow the developments of the important variables.

- Start **WadBOS** and open the simulation file waddensea.SIM.
- Minimize the *Micro-scale* window.
- Select in the System Diagram-View the MBB ‘*Shell-mining*’ to open the Shell mining sub-model. Then select the MBB’s ‘*Shell stocks*’, ‘*Infrastructure*’, ‘*Shell extraction*’, ‘*Effort*’ and ‘*Employment*’. Position the dialogue windows on the right side of the screen.
- Then select the Policy options-View and click the MBB ‘*Quota*’ to open the sub-model Quota. Select the MBB ‘*Quota shell mining*’ and keep the dialogue window visible on the screen at all times
- Minimize the *Macro-scale* window and close the *Quota* window.

Simulation exercise C1: In this exercise we will find out what are the effects on the shell mining of policy interventions such as restricting the infrastructure

and enforcing quotas. The simulation is run a few times to establish this. It is important to keep an eye on the values of the variables at the right instances during the simulation. The simulation has to be stopped in the month December of the years 1997, 1999, 2001, 2003 and 2005. If you forget to press the Stop button in one of these years, you can stop the simulation, press the Reset button and run it again with the same values. We are only interested in the general trend of the results anyway, so that it will not be the end of the world if we miss one value in the series.

Record the Shell stock at the beginning of the simulation. Start the simulation and keep an eye on the evolution of the Shell stocks in the Wadden Sea. Stop the simulation every two years in the month December (1997-Dec, 1999-Dec, 2001-Dec, 2003-Dec and 2005-Dec) and record the Shell stocks in the Wadden Sea and the Catch of the current year in Table C.

Table C. Results of exercise C: Policies relative to Shell mining and Shell stocks.

Variables	Date	1997	1999	2001	2003	2005
	#	Dec	Dec	Dec	Dec	Dec
Shell stocks in the Wadden Sea	C1					
	C2					
	C3					
	C4					
	C5					
Catch current year	C1					
	C2					
	C3					
	C4					
	C5					
Employment Shell mining	C1					
	C2					
	C3					
	C4					
	C5					
Infrastructure	C1					
	C2					
	C3					
	C4					
	C5					

Read in the *Infrastructure Shell mining* dialogue window that current mining takes place with an infrastructure (capacity) of 1800 Hp (the total pump capacity of the ships, in the case of shell mining: 6 ships) and in the *Quota Shell mining* dialogue window that the quota is set to 90.000 m³ per year. According to the current Management Plan of the Wadden Sea, only 90.000 m³ can be mined in the Wadden Sea. Another 120.000 m³ can be mined in the 3 miles zone, on the North Sea side of the Wadden islands. As **WadBOS** only deals with mining in the Wadden Sea itself, the quota of 90.000 m³ is considered here. Notice that in the *Effort Shell mining* dialogue window the Effort switches to zero as soon as the quota is reached (this happens for instance in November

1998). In other words the activities are stopped and no more mining takes place in the rest of the year.

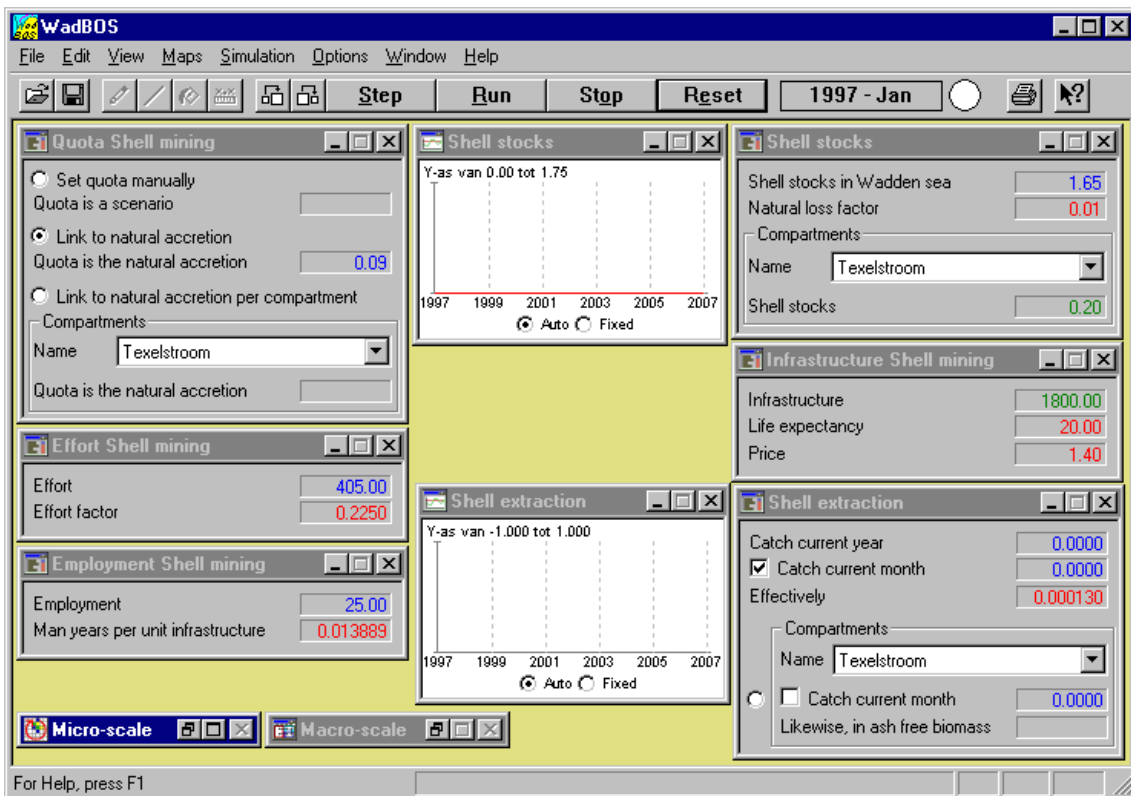
What is the trend in the shell stocks? And what is the trend in the extraction? How does the last relate to the quota?

Select the MBB 'Natural resources' from the Impacts-View (of the *Macro-scale* window). By clicking the check box for 'Shell stocks' the Shell stocks graph is shown with the progress of the yearly average shell stocks in the Wadden Sea. Give the graph a place in your **WadBOS** screen. What do you notice from this graph?

Simulation exercise C2: Let us first intervene in this development by adjusting the quota.

To this effect, Link the quota to the natural accretion of the shells in the previous year by selecting the appropriate radio button in the *Quota Shell mining* dialogue window. This should result in durable mining: the maximum amount of shells allowed to be mined is equal to the amount of shells added by natural accretion in the previous year.

By now, your **WadBOS** application window should look like this:



Press the Reset button and repeat the exercise. Stop the simulation every two years in the month December (1997-Dec, 1999-Dec, 2001-Dec, 2003-Dec and 2005-Dec) and complete Table C. What is now the development in the shell stocks and extraction?

Simulation exercise C3: Press the Reset button. Set the quota back to manually (similar to the exercise C1) and to the value of 0.09 million m³ per

year. This is in fact the current policy. In every exercise so far we have extracted shells with a very high capacity (infrastructure), actually double of what is allowed. Let us bring this maximum down and see how this affects the stocks and the extraction.

Maximize the *Macro-scale* window again and select in the Policy options-View the MBB '*Infrastructure*' to open the *Maximum Infrastructure* dialogue window. In this you will read the maximum infrastructure that can be deployed to carry out economic activities in the Wadden region. Decrease the maximum infrastructure of the shell mining to 1200. Close the dialogue window and minimize the *Macro-scale* window.

Press the Reset button and run the simulation again. Check the developments of the Infrastructure in the *Infrastructure Shell mining* dialogue Window. Do this as in the previous exercise every two years in the month of December.

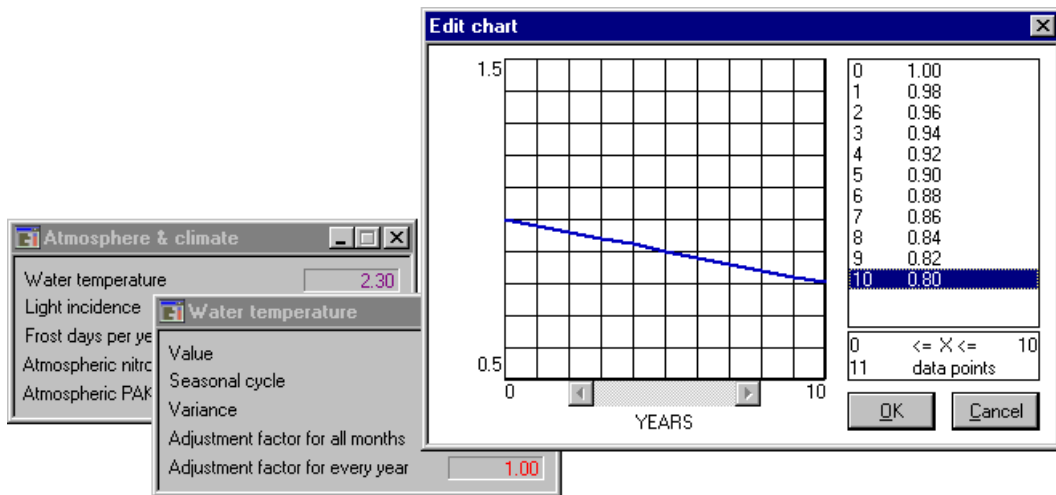
You will notice that the infrastructure will drop every year. The intervention as we have imposed it upon the system is that of an extinction policy: investments required to keep the surplus capacity in the business are no longer permitted. In practice this means that slowly a number of vessels are removed from the fleet. What effects does this have on the employment?

Simulation exercise C4: A policy that immediately removes the surplus capacity requires that also the existing capacity be set back to a maximum of 1200 in the *Infrastructure Shell mining* dialogue window.

To that effect, reset the simulation and set the existing infrastructure to 1200 (in the *Infrastructure Shell mining* dialogue window). Let the simulation run with these new values and complete Table C. What are now the developments of the shell stocks and the extraction? Also watch the development of the employment. What are now the effects of the policy on the employment in comparison with the previous exercise?

Simulation exercise C5: For each of the previous 'what if' exercises the growth of cockles runs down at the end of the simulation period. This is a result of the complex dynamics in the ecological system (and possibly insufficiently calibrated model), which has an immediate effect on the shell accretion and explains in part the decline in the shell stocks. The question that comes to mind is how the shell-mining business may suffer from changes in the ecosystem. For instance how sensitive is the business to changes in the climate?

Let us test this by trying out a rather extreme scenario. Select in the Scenario-View (of the *Macro-scale* window) the MBB '*Atmosphere & Climate*'. We will define a scenario in which the water temperature decreases in 10 years time to 80% of its current value. To that effect click the Water temperature edit field in the *Atmosphere & climate* dialogue window. The Water temperature dialogue window opens. Next click the Adapting factor in years edit field to open the graph editor and fill the table with a linear trend declining from 1 in year 0 to 0.8 in year 10.



Reset the simulation and run it again. What are the effects of this scenario on the shell stocks?

Close **WadBOS** and answer No to the question asking whether you want to save the simulation results.

8 References

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ANNEX A: GEONAMICA[®] DSS Generator




For the technical implementation, or software coding, of WadBOS, the DSS-Generators GEONAMICA[®] has been used. A DSS Generator is a term introduced by Sprague and Carlson (1982) as ‘*a package of hardware/software which provides a set of capabilities to build specific DSS[s] quickly and easily*’. Hence, this refers mostly to a special purpose software environment for the creation of new DSS applications in a more or less narrowly defined domain. GEONAMICA[®] is an *object-oriented application framework*, developed by RIKS bv for use by DSS developers. It is specially tailored for developing Spatial Decision Support Systems featuring models that run at multiple spatial and temporal resolutions. Typically it will combine *system dynamics* models and *cellular models* for this purpose. In particular use is made of *spatial interaction based models*, different kinds of *cellular automata models*, *multi agent* or other kinds of *rule-based models*. It is equipped with highly efficient computational techniques and algorithms for addressing spatial problems, but also with additional analytical tools, visualization tools, and input, import, export and output tools. It is equipped with a number of tools for interactive map manipulations, in particular: map editors and display tools for 1-D network and 2-D map objects, map comparison, and overlay-analysis.

The cornerstone of the GEONAMICA[®] application framework is the way in which it enables the DSS-developer to set up a new modelbase consisting of a set of exchangeable and interchangeable *Model Building Blocks* (MBB) that can be entered, exchanged, re-arranged and re-used in the modelbase of the DSS nearly as easily as Lego building blocks.

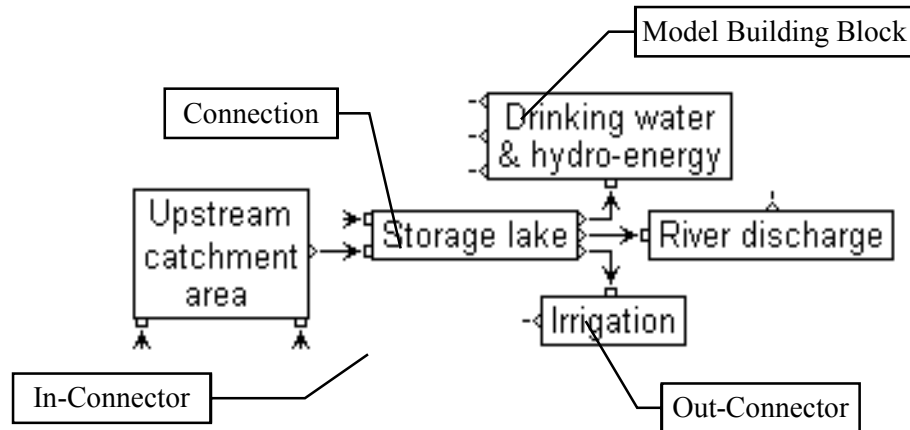
A Model Building Block represents a part of a model: an action or process. Hence, it is a more or less complete model varying from a simple mathematical operator to a complete model consisting of coupled mathematical equations performing large numbers of sophisticated calculations. MBBs may simply represent sources of information (i.e. entered from file), while others will transform information as it passes through them, and still others will simply communicate, in a synthetic manner, the outputs of the model to the user. Despite the fact that all these MBBs play different roles in the model, in Object-oriented jargon, they are all ‘*specializations*’ of the same ‘*abstraction*’, which is essentially a MBB capable of exchanging and transforming information.

Each MBB has two graphical representations:

- A **rectangle** (or *box*). A unique graphical object in the interface of the integrated model that shows how the MBB relates and is connected to other MBBs in the integrated model. A user can know from this connection scheme where the MBB gets its input(s) from, and where it sends its output(s);

	In-Connector
	Out-Connector
	Connection

Values of variables and parameters can be exchanged between MBB's via *Connections*. MBB's send information to the rest of the model via *Out-Connectors* and receive information from other MBB's via *In-Connectors*.



Real exchange between MBB's is possible if a Connection exists between the Out-Connector of the broadcasting MBB and the In-Connector of the receiving MBB. For each variable or parameter a connection is made (except if one of the MBB's is a SuperMBB).

A model block has a so-called In-Side and an Out-Side. The In-Side is where the In-Connectors are placed, the Out-Side is where Out-connectors are placed. The user can decide which of the four edges of the MBB are the In- and Out-Sides. The only limitation is that they should never be on one and the same edge.

- Its **user interface (UI)**, which presents itself as a *dialog window*. The user interface gives the user read/write access to all the MBB specific *parameters* as well as the initial (*input*) values of its state variables. While a simulation is running, it enables read-only access to all the updated values of *output* variables. Entering data in dialogs is done in a manner which will support and protect the user to some extent, because each edit box in a dialog window knows what type of data it should get from the user: a single number, a vector of numbers, a matrix, or a table (i.e. time series). For each type the appropriate editor is opened when the user clicks in the edit box.

Model results and model inputs are presented in Edit Fields. The difference between input and output fields is indicated by the colour of the text in the edit field: green for state variables (to be entered as initial values and for the remainder output of the MBB); purple and blue for intermediate variables; black for variables or parameters copied from other MBB's (output of the MBB); and finally red for internal parameters of the MBB (input for the MBB).

Colour of text in the Edit Fields of MBB-Dialogue Windows	Description
RED	<u>Input</u> . Parameter value (can be changed during the entire simulation) or State variable at the initial state.
PURPLE	<u>Input</u> . Variable value. If the edit field is clicked, a dialog will pop-up requesting input necessary for the calculation of the variable
GREEN	<u>Input / Output</u> . State variable which can be changed at the start of the simulation, and which display output for the remainder.
BLUE	<u>Output</u> . Variable value. (read-only)
BLACK	<u>Output</u> . Values copied from other MBB's. (read-only)

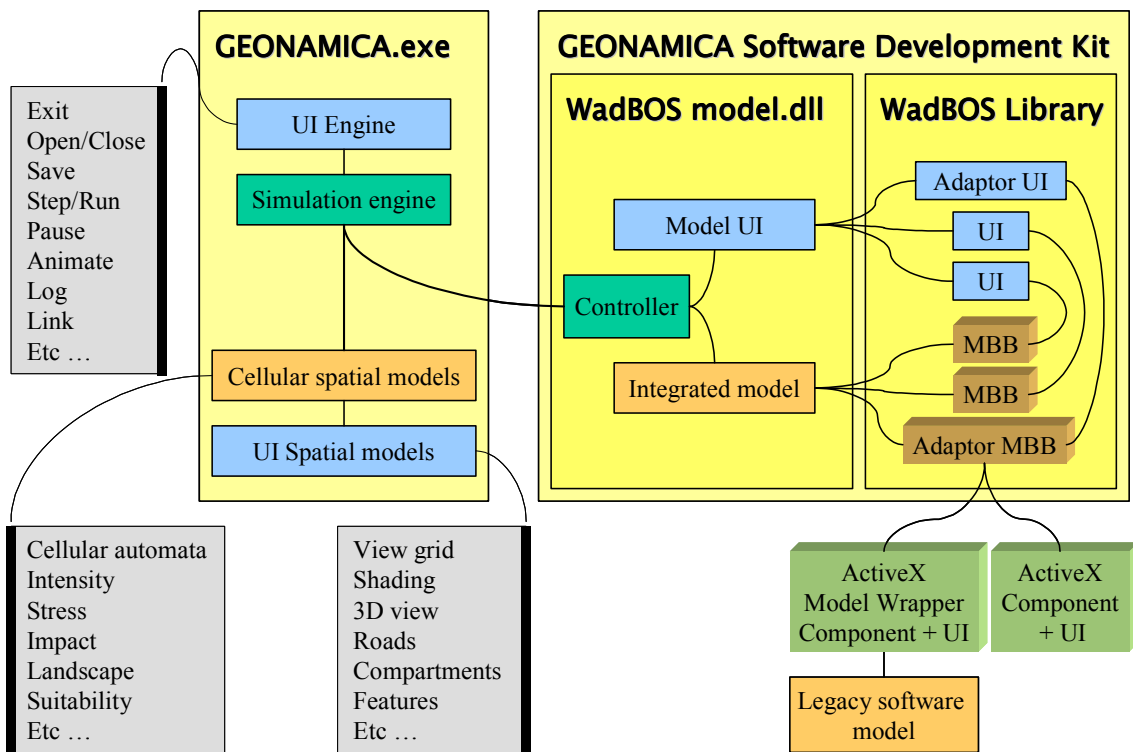
Each MBB has its *Documentation page* in the *Documentation system*. It is accessible when the dialog window of the MBB is opened (by pressing the F1-key or clicking in the dialog window by means of the Context Sensitive Help cursor). This Documentation page gives technical information about the MBB and may include the mathematical expression, scientific references, the specification of the input and outputs, etc.

The MBB manages the memory for its *parameters* and its *outputs*. An advantage of this design is that it makes the MBBs self-contained and independent. The *inputs* of a MBB are pointers to the memory location where the required output is residing. As an output X is always managed by the MBB producing that output X , the input is pointing to a memory location managed by the MBB producing the output X . A MBB does not know what MBB it receives input from. It is the responsibility of the simulation engine to connect the inputs of the receiving MBB to the outputs of the producing MBB while executing an integrated model.

The *Step* function of the MBB contains the software code that implements the mathematical model of the MBB. It specifies how each of the outputs of the MBB changes depending on the time, the current input values, and the current parameter values. Each MBB runs at its own pace. In WadBOS this is once per tidal cycle, monthly or yearly. The *Step* function of the MBB is called by the *simulation engine*, it is executed, and the MBB tells the simulation engine when it should be called again. The MBB does not know about other MBBs as they are kept as independent of one another as possible. It is the responsibility of the simulation engine to keep all the MBBs synchronized in time.

Libraries are repositories of MBBs. The entire definition of the MBB (its code, its graphical representation, its dialog, its connectors) is stored in the MBB Library. When a MBB is included in a model, the block itself is not copied to the model; rather a reference to the block in the library is made. MBBs can be reused in the same model more than once. For example the MBB calculating turnover in the mussel fishery is also used for calculating turnover in the cockle fishery. But, MBBs and Libraries can be re-used in other applications equally well. The factual re-usability will depend largely on the process modelled and the level of generic applicability attained in the implementation.

The *GEONAMICA SDK (Software Development Kit)* provides all the templates required to start a new application and a new library. *Building an application*, or to put it in other word, creating a modelbase and connecting the MBBs into an integrated model, is enabled by means of a piece of application specific software specifying which MBBs are part of the application, and how they are interconnected (which inputs are connected to which outputs). This application is the so-called *model.dll*. The *model.dll* for WadBOS is called *WadbosModel.dll*. Not all models have to be available as MBBs within the library in order to be integrated into an application. An external (existing) software model can become part of a GEONAMICA application via an *adaptor MBB*. This is done by means of an *ActiveX Model Wrapper Component*, which wraps the external model into a piece of software so that it looks from the outside like a GEONAMICA MBB, and thus can function within a model like all the other MBBs. The ActiveX Model Wrapper Component delegates most of the work to the actual external model, but performs some missing functionality, such as displaying and effecting the user interface or the conversion of data between the GEONAMICA framework and the external model. If the external model is developed according to the specifications of the COM/ActiveX component technology, hence is an *ActiveX Model Component* equipped with all the necessary interfaces, then, a specific Adaptor MBB can integrate it directly into the application.










The *user interface of an application* consists of a number of system diagrams with sensitive areas. The diagrams are graphical representations of the application. The MBBs, represented by rectangles are the sensitive areas. They are connected to either more specific diagrams, representing the MBB at a deeper level of detail (when the sensitive area is connected to a *SuperMBB*), or to the user interface (the dialog window) of the MBB (when the sensitive area is directly connected to a single MBB). The user can navigate through the system diagram hierarchy by clicking the sensitive areas.





GEONAMICA.exe is the piece of software capable of loading a specific application and thus launching the Decision Support System. *GEONAMICA.exe* is a generic executable, and the integrated model is a project-specific model.dll. *GEONAMICA.exe* features also a set of cellular spatial models. They perform operations on a grid representation of the region modelled. In WadBOS for example they are invoked to calculate among others: *Intensity* of activities, *Stress* caused by activities, *Disturbance* of species, *Wadden-Landscape* calculations, *Appraisal* of the Wadden sea, distribution of *Potential Species*, etc.

GEONAMICA.exe will also launch the *toolbase* and the *databases* of the application. While an application is running, the tools are automatically invoked as the result of user actions, or they can be purposely selected from the menu system of the DSS. Pre-processing and post-processing tools such as *OVERLAY.exe* and *ANALYSE.exe* are available as separate applications that are launched independently of *GEONAMICA.exe*.

ANNEX B: Pointer Shapes

Pointer Shape	Description
<i>Standard MS Windows Pointer Shapes</i>	
	Standard Windows© cursor.
	Standard I-beam cursor for editing windows.
	Sizing cursor to change the width of the window. Displayed when the pointer is on top of a vertical window border.
	Sizing cursor to change the height of the window. Displayed when the pointer is on top of a horizontal window border.
	Sizing cursor to change the width and/or the height of the window. Displayed when the pointer is on top of a window corner.
	Sizing cursor to change the width and/or the height of the window. Displayed when the pointer is on top of a window corner.
	Context Sensitive pointer to get on-line help on the command you click on.

Specific WadBOS Pointer Shapes

	Insert cursor to insert values in an MBB-dialog edit field by means of the text value and table editor.
	Insert cursor to insert values in an MBB-dialog edit field by means of the text value and graph editor.
	Pen cursor to pick a value from the legend of a map and to enter it in a cell; or to enter ordinal values in the X-Y graph part of the graph editor.
	Bucket cursor to pick a value from the legend of a map and to enter it in a group of contiguous cells.

