Knowledge for Climate

Tailoring information about climate change and its impacts

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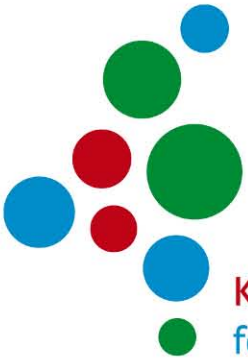

Tailoring information about climate change and its impacts

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Summary

Results from research on climate change and possible impacts are often not available in a format that can be used directly. Besides this, users of climate and climate impact information often do not have a cross-sectoral overview of available data and information and results are sometimes inconsistent between sectors.

In this project a pilot web portal was developed to overcome these problems. The pilot is a first attempt to:

- provide overview of available data and information;
- synchronize means of presentation of available data and information for the various sectors;
- tailor data and information.

To provide overview, in the pilot web portal (Climate Impact Guide) available data and information are presented in a similar way for each sector (climate, water, nature, agriculture and land use). Similar information is given per sector to make it easier for users to find information from other sectors. Besides, on the common web pages information is presented on the (lack of) exchange of data between sectors and discrepancies and the possible consequences.

The pilot web portal was reviewed by 30 users of climate information in the beginning of 2011. The results confirmed the need for more overview. The most important points of improvement are the better synchronization of the web pages of the different sectors and adding more information and overview.

Samenvatting

Resultaten van onderzoek naar klimaatverandering en de mogelijke effecten zijn vaak niet beschikbaar in een vorm waarin ze direct door anderen gebruikt kunnen worden. Gebruikers van klimaat- en impactinformatie hebben vaak ook geen goed overzicht over de beschikbare gegevens van alle sectoren en resultaten van de verschillende sectoren zijn soms inconsistent.

In dit project is een pilot web portal ontwikkeld om de bovenstaande problemen te overkomen. De pilot is een eerste aanzet tot:

- het geven van een overzicht van beschikbare data en informatie;
- het synchroniseren van de presentatie van gegevens en informatie voor de verschillende sectoren;
- het op maat maken van data en informatie.

Om meer overzicht te geven, is op de pilot web portal (KlimaatEffectWijzer) de beschikbare data en informatie voor elke sector (klimaat, water, natuur, landbouw en landgebruik) op een vergelijkbare manier gepresenteerd. Vergelijkbare informatie wordt gegeven per sector, zodat geïnteresseerden sneller informatie over andere sectoren kunnen vinden. Daarnaast geven de overkoepelende web pagina's informatie over (het gebrek aan) uitwisseling van data tussen sectoren, discrepanties en de mogelijke gevolgen.

De pilot web portal is begin 2011 gereviewed door 30 gebruikers van klimaatinformatie. De resultaten hiervan bevestigen de behoefte aan meer overzicht van de beschikbare informatie. De belangrijkste verbeterpunten zijn het beter synchroniseren van de web pagina's van de verschillende sectoren en het toevoegen van meer informatie en overzicht.

Extended summary

Background and objectives

Recent research on climate change, possible impacts and adaptation options in the Netherlands has been substantial in the Netherlands. There are, however, some shortcomings which hamper the dissemination, the proper use of data and information and the integration of information from the various sectors:

- no cross sectoral overview on available information on climate change and its impacts;
- results sometimes inconsistent between sectors. For example, for land use scenarios a time horizon of 2040 is used, whereas for other sectors often 2050 is used;
- results often not available in format that can be used directly. For example, percentages change in rainfall have to be translated into time series with daily data for hydrologists to simulate the impact on groundwater levels.

In this project a pilot web portal was developed to overcome these problems. The pilot is a first attempt to:

- provide overview of available data and information;
- synchronize means of presentation of the available data and information form the various sectors;
- tailor data and information.

This project focused on data and information for the physical climate system, water, nature, agriculture and changes in land use due to socio-economic developments. These subjects comprise the most important factors in land use in the Netherlands. In this pilot version researchers were the target group.

Approach

To provide more overview a pilot web portal (Climate Impact Guide (CIG)/KlimaatEffectWijzer (KEW): see www.klimaatportaal.nl/) was developed in which the available data and information were presented in a similar way for each sector and with similar information. A common structure was used, with on all sub portals the headings 1. data/information; 2. documentation; 3. uncertainties; 4. links; and 5. contact information. The idea is that this synchronization will make it easier for users to find information from other sectors. The sub portals per sector are connected to each other with the help of several common web pages. On these common web pages among others information is presented on the (lack of) exchange of data between sectors (e.g. models on ecosystems and agriculture often generate their own information on water supply from the soil) and discrepancies and the possible consequences. For example, using land use data with a time horizon of 2040 for around 2050 may lead to a relatively small overestimation of the area with agriculture.

The nature of the tailoring activities within this pilot project differed considerably. They can be subdivided in several groups:

- improving access to available data: information is given on which data are available,;
- processing of available data;

- tools for making/selecting specific data;
- guidance on the use of data.

The first two activities were executed by all partners, but the others not. Table 8.1 gives an overview of the tailoring per sector now included in the CIG/KEW.

Evaluation

The pilot of the Climate Impact Guide was reviewed by 30 users of climate information in the beginning of 2011. The reviewers were asked to comment on the common web pages and the web pages per sector. The results confirmed the need for more overview on available data and information. For 38% of the reviewers it was already easier to find data and information, 48% mentioned that the portal does not yet contain enough data and information. The most important points of improvement are the further synchronization of the web pages of the different sectors and adding more information and overview. This report contains the reactions to all remarks of the reviewers and suggestions for improvements during the follow-up of the project (Chapter 3-8). Some suggestions are already carried out.

It is difficult to give a complete overview of all research and data on climate change and climate change impacts in the Netherlands and outside the Netherlands. A short overview of the organisations working on a specific subject, such as currently available for 'nature', is useful for all sectors. A short overview of international research activities and data also is useful. The CIG/KEW web portal should contain more extensive information on relevant Knowledge for Climate (KfC) and Climate changes Spatial Planning projects, but should not try to include all possible data and information.

At the moment the structure of the web pages of the various sectors still differs considerably. It seems not easy to use a similar structure for each sector. This is partly due to the different nature of the data and information that is presented: some present data and information that stem from individual projects (e.g. for nature and agriculture), some present databases with long term observations (e.g. for climate). In some cases the results of models can be made available through internet (e.g. for water and land use), in other cases this is not possible. Some suggestions are presented to improve synchronization without disregarding the specific aspects of the sectors.

User requirements for tailoring may differ greatly between sectors. However, in all cases there are requests for:

- easy access to data and metadata;
- synchronization of the use of climate and land use scenarios and time horizons;
- processing to specific formats (maps, gridded data, etc.);
- guidance on the use of the data.

A portal that is developed for researchers is not automatically the most useful for policy makers.

Follow-up of the project

The pilot web portal will be further elaborated within Theme 6 of the KfC programme, taking into account the remarks of the reviewers. The added value depends on the usefulness for the intended users. This report mentions some suggestions to improve the interaction with and feedback from users.

1 Background and objective of the KKF-Tailoring project

1.1 Problem definition

Recent research on climate change, possible impacts and adaptation options in the Netherlands has been substantial in the Netherlands. There are, however, some shortcomings which hamper the dissemination, the proper use of data and information on climate change and its impacts, and the integration of information from the various sectors:

- **no cross-sectoral overview on available information on climate change and its impacts.** Research in the Netherlands on climate, climate change and its impacts is scattered over several organizations, all with their own methods and websites. Even for the same sector sometimes research may be scattered over several organizations (e.g. as is the case for water management and nature). The websites of the research programmes Climate changes spatial planning (CcSP) and Knowledge for Climate (KfC)[1] present the results of the individual projects within these programmes per sector, theme or hotspot, but the results are often not integrated. For adaptation studies and policy making often an overview of the available information per sector and information for several sectors is needed at the same time;
- **results sometimes inconsistent between sectors.** There are no generally used guidelines or agreements between sectors on the use of climate scenarios, time horizons, spatial and/or temporal scales and reference periods to generate information on climate impacts. What is considered relevant also varies between sectors: for water safety it is relevant to look at the time horizons 2050 and 2100 [VenW/VROM/LNV, 2009], however land use projections often are not considered possible beyond 2040 [Janssen et al., 2006]. Furthermore, inconsistencies in approaches exist. E.g. different methods are used to calculate potential evaporation in climate-, hydrological, agriculture and nature modeling. This may result in differences in projected water needs, droughts and water excess;

[1] For more information see: http://knowledgeforclimate.climateresearchnetherlands.nl/ and http://climatechangesspatialplanning.climateresearchnetherlands.nl/.

- **results often not available in format that can be used directly** by stakeholders who need to develop climate adaptation strategies. For example, the information on climate change in the brochure on the KNMI'06 climate scenarios [KNMI, 2006] only indicates the percentage change in the average and extreme rainfall. Hydrologists, ecologists and agricultural researchers need time series on a daily basis or statistics to simulate the impact of changes in rainfall on groundwater levels, nature and crop production.

1.2 Objectives

In order to overcome some of the above mentioned shortcomings, the 'Climate Knowledge Facility –Tailoring' project was started. In this project a pilot web portal was developed in order to:

- **give overview of available data and information on climate change and impacts** by means of a common (pilot) web portal;
- **synchronize the means of presentation of data and information of several sectors** by presenting the information per sector on the web portal in a similar way and by identifying relations between sectors (inconsistencies in approaches and exchange of data/information);
- **tailor data and information** on climate, hydrology, nature/ecosystems, agriculture and land use scenarios to stakeholder needs. The focus was on tailoring of existing databases and existing tools/methods and the accompanying guidance for the use of the data.

The main target group for both the tailoring and the web portal are researchers who search for data and background information for climate impact analyses and adaptation studies.

Land uses: transport

Coastal protection

1.3 Partners in the project

Adaptation to climate change in the Netherlands often has a spatial component. Since the Netherlands are densely populated and highly occupied, adaptation in one sector will often affect other sectors. Besides, changes in land use may influence the impact of climate change. In this project those sectors are

included that represent the main factors in land use and climate change in the Netherlands: water, agriculture, nature. Also a research group specialized in land use scenarios is included, to take into account developments in all other land uses in the Netherlands.

The following institutes and sectors were involved in the project:

- Royal Netherlands Meteorological Institute: climate ;
- Wageningen UR (University & Research centre): agriculture, nature and water;
- Deltares: water;
- VU University Amsterdam: nature, land use;
- KWR Water cycle Research Institute: nature.

These institutes were and are involved in the large research programmes CcSP and KfC in the Netherlands on climate change.

Land uses: water management

wind energy

1.4 Structure of the report

In chapter two, first, the approach used in this project is explained. A common pilot web portal was developed with access to pilot web portals of the five involved sectors, all with a uniform structure and similar content. In this way we tried to improve the overview on available data and information and at the same time show the interactions between the sectors. Chapters 3 to 7 describe for each of the involved sectors a selection of results of the various subsections of each pilot website: data and information, methods and used data (documentation), and uncertainties. The last paragraph of these chapters describes on which points improvements could be made, based on the review of the web portal at the end of the project. In chapter 8 the overall pilot web portal is described which contains general information on uncertainties, but also on interactions and discrepancies between sectors. Chapter 9 describes the conclusions, discussion points and follow-up of this project.

2 Approach

The objectives behind the development of the pilot web portal in this project were based on experiences in other projects within the CcSP programme. The three problems mentioned in Chapter 1 were elaborated through several sub-elements. The elements mentioned below (in bold) are discussed in more detail in the Sections 2.1-2.5.

Giving overview to users:

- development of **a pilot web portal** with a uniform structure and similar type of information for each sector. Researchers or policy makers often need information from various sectors. Generally, they know how to find information and data for their own sector, but they find it difficult to get overview of available data and information from other sectors. By using a uniform set-up of the web portals for each sector, it will be easier to find similar information on other sectors and get some overview of available data. An overview of interactions and discrepancies may also improve the use and correct interpretation of data and information of other sectors;
- **user consultations** were used to find out which data and information is required by users (among others during a work shop at the start of the project) and to check whether the web portal indeed improves the overview for users (inquiry at the end of the project). One workshop is not sufficient to find out what users need, however, all partners in this project have extensive experience with users from former projects.

Synchronization of data and information and improving consistency:

- **promoting consistency** was done in different ways: though form and content. The developed pilot **web portal** has a uniform structure and similar type of information for each sector. Also an overview was prepared on the interactions and discrepancies between sectors;
- **describing uncertainties:** information on uncertainties in climate change and impacts often is presented differently in each sector. Some uncertainties can be quantified more easily than others, and uncertainties are dealt which differently. In this project the way of presenting was made more uniform.

Tailoring of data and information:

- **tailoring of existing data and tools** is based on the inventarisations of user requirements and the experiences of the partners in former projects. The form of tailoring differs greatly per sector. E.g. for 'climate' it consists of developing a guidance for the use of climate scenarios, for 'water' it consists of developing a web tool for making data sets from the National Hydrological Instrument (NHI) more easily available for potential users. In each of the chapters three to seven examples of this tailoring are given;
- information from the **user consultations** was used to check whether the proposed ideas for tailoring were useful and to check whether the results as presented on the pilot web site are useful for potential users;

- presenting the available data and information on climate change and its impacts in a uniform and consistent way in **a web portal** can also be considered a form of tailoring.

2.1 Construction of a pilot web portal

The development of a pilot web portal consisted of two elements:

- uniform structure of sub portals per sector to present data and information in a uniform/similar way;
- common web portal with information on e.g. interactions, discrepancies, uncertainties, and links to the sub portals.

The first step in developing a common web portal was designing a common structure for the sub portals per sector. Generally, each sector and institute presents its information and data in its own way and with its own setup for the web pages. A uniform setup of the web pages and a uniform structure of the menu is, therefore, not easily made. However, uniformity in the set-up of web portals per sector can be useful in giving overview of available data and information, and it may also improve accessibility of the data.

Table 2.1. Current common structure of the sub portals of the Climate Impact Guide (Klimaat Effect Wijzer).

English	Dutch (on portal)
Home Climate Impact Guide	Home Klimaat Effect Wijzer
Home climate/water/nature/ agriculture/land use	Home klimaat/water/natuur/ landbouw/landgebruik
Data/information	Data/informatie
Documentation	Documentatie
Uncertainties	Onzekerheden
Links	Links
Contact	Contact

For practical reasons the partner organisations will remain responsible for the content and updating of the sub portals on their own sector. Therefore, the sub portals per sector are in most cases hosted by web sites of the partner organizations. As a consequence, synchronization of presentation is limited to the structure of the menu and the content of the web portals. After several discussions, a first common structure of the menu was accepted and elaborated by the various sectors (Table 2.1). During the setup of the pilot portals and adding content, the problems encountered in keeping to the agreed uniform structure were discussed.

To improve uniformity on the websites of the various institutes also a common logo was developed, that is used on all sub portals (see Figure 2.1).

Figure 2.1. Logo of the Klimaat Effect Wijzer/Climate Impact Guide. The left version is used to link to the sub portals, the right version is used to indicate which web pages are part of the Climate Impact Guide.

Figure 2.2. The starting page of the Climate Impact Guide (Klimaat Effect Wijzer).

The portals per sector were integrated into one pilot web portal: 'KlimaatEffectWijzer'/'Climate Impact Guide'[2] (see Figure 2.2; hereafter called KEW/CIG) with the help of a common web portal. This common web portal is hosted by the 'Klimaatportaal'[3], a website that represents a large number of research institutes working on climate change and impacts, as is also the case for the KEW/CIG. The common web portal leads researchers to information about the specific sector, by clicking on one of the pieces of the 'puzzle', an enlarged version of the common logo (Figure 2.1, left). The common portal also gives general information on the project and on uncertainties, and on interactions between the sectors and discrepancies between studies. The information on interactions and discrepancies between sectors and studies was collected during presentations and discussions during the project team meetings.

2.2 User consultation

User consultations in this project can be divided into two groups:

- inventarisations of user requirements, especially during the first part of the project;
- review of the pilot web portal at the end of the project.

All involved partners regularly have contact with users of their information through projects and meetings. In the workshop and with the review of the pilot website we tried to get additional information on user requirements and preferences.

Inventarisations of user requirements

Short inventarisations of requirements of the KfC hotspots were carried out, based on discussions with hotspot coordinators and project leaders, together with 'Knowledge Transfer' of the KfC programme.

Specific for the KKF Tailoring project the workshop 'User demands for climate data and climate impact information' was organized on 10 November 2009 for project leaders of the KfC hotspots. The workshop gave insight in user demands for climate information and climate impact information.

The results of this workshop were used together with other user consultations (interviews, workshops and sessions) for an overview of user demands concerning climate data, given in the Report 'Inventory of user demands for climate information' [Bessembinder et al., 2011a] [4].

[2] Other 'climate guides' are being constructed for different target groups, including policymakers and companies: 1. 'De Klimaatwijzer'/ 'the Climate Guide' a project of the New Urban developments and Restructuring sub-programme; 2. 'Het Praktijkboek'/the 'book of practice' a project of the Climate for Knowledge and Climate changes Spatial Planning Programmes. These guides will refer to the web portal for information for climate impact analyses;

[3] See www.klimaatportaal.nl;

[4] http://www.knmi.nl/klimaatscenarios/maatwerk/Rapport_gebruikers_april_2011.pdf (with English summary).

Review of the pilot web portal
To review the pilot website users of climate information, involved in one or more of the sectors climate, hydrology, nature, land use or agriculture, were contacted. The final review group consisted of 30 researchers, policy makers, NGOs and engineering agencies. Although in this project the target groups of the web portal are especially researchers, also others were included in the review process to find out whether the web portal was also useful for other target groups.

The reviewers were led through an on-line questionnaire of about 15 minutes. Purpose of the questionnaire was to get insight in:

- the background of the reviewer to be able to frame the comments and to get understanding about the application of requested data;
- the assessment of the web portal in general: are the purposes of the website accomplished?, is information more easily found and is the use of information from different sectors made easier?;
- the assessment of the web pages per sector: do they contain the needed data and information, is the documentation clear?, is the information about uncertainties useful?

The results of the review are used to improve the KEW/CIG. Simple improvements were implemented as part of this KKF Tailoring project. More structural improvements will be implemented during the follow-up of the project in work package 4 of research theme 6 'Climate projections' of KfC[5]. Reactions of the project team on the remarks of the reviewers are included in the chapters three to seven.

2.3 Tailoring of existing data and tools

Existing data, information and tools were made more easily accessible. The idea behind this step was to provide users in KfC projects and hotspots with some basic data to start and proceed with their research. We consolidated on efforts from earlier projects (e.g. CcSP).

Tailoring of data and information comprised the following different aspects:

- making data more easily accessible by presenting an overview of existing data sets (for all sectors);
- processing data/preparing specific data sets (for hydrology, land use);
- tools for selecting or making datasets for e.g. specific locations (for hydrology);
- providing guidance in the use of the available data and the required data for impact modeling (for climate, nature, agriculture).

(Presenting an overview can also be considered as a form of tailoring.)
Examples of tailoring are described per sector in chapter three to seven.

[5] See: http://knowledgeforclimate.climateresearchnetherlands.nl/highqualityclimateprojections.

2.4 Promoting consistency

Promoting consistency can be done in the following ways, used in this project:

Form and presentation:

- using a uniform structure at the web pages of the different sectors. On the sub portals the same headings are used: home, data/information, documentation, uncertainties. With the help of this uniform structure it was tried to give similar information for each sector (see Section 2.1).

Content:

- using the same set of scenarios and time horizons by all sectors (as far as possible). For this project no new runs with impact models were preformed, however, when possible information and data for a similar set of scenarios is presented;
- when there is agreement among experts when to use which data sets/scenarios/methods in certain situations, following this expert judgment may result in more consistency in the approaches followed. A first attempt was made for 'climate' by indicating when to use which climate scenarios.

Relations/discrepancies[6]:

- to be able to use data consistently, insight in the use and delivery of data to other sectors is important. For example: In the sector hydrology until recently no changes in land use were included in explorations of the future. However, land use changes may have a large impact on hydrology or the required water safety levels. Projections on land use changes are delivered through land use scenarios, which are based on socio-economic scenarios. A structured overview of relations and data exchange (or lack of exchange) between the sectors was made, based on discussions during the project team meetings;
- related to the above point an overview of discrepancies in methods, data use, etc. between sectors was made. Where possible the effects of the discrepancies were indicated. For example: in the sectors hydrology, nature and agriculture information on potential evapotranspiration or reference evapotranspiration is used. However, often different methods are used, which could result in differences in the fresh water demand.

[6] http://www.klimaatportaal.nl/pro1/general/start.asp?i=7&j=4&k=0&p=0&itemid=868.

Table 2.2. Examples of the type of information provided about discrepancies and the consequences.

Discrepancies	Use of climate data within other sectors	Consequences
Land Use	Projections for future land use are made for 2040, whereas in many other impact studies on climate change a time horizon of 2050 is used	Changes in land use during 10 years are often not large, but the area per land use may be somewhat overestimated or underestimated due to the difference of 10 years
Water	Within the NHI data on reference evapotranspiration according to Makkink are used, whereas other sectors use (sometimes) other methods for calculating the potential evapotranspiration	This may lead to other values for the potential and actual evapotranspiration, and therefore to overestimation or underestimation of water demand, drought and water excess. Differences in methods between sectors to calculate the actual evapotranspiration may have more influence
Agriculture	Extreme events pose a bigger problem for Dutch agriculture than gradual change, so data on climate variability is needed.	Currently the climate variability in time series for the future for the Netherlands are based on transformed historical data sets, causing that projections on changes in extreme events largely depend on the time period used for transformations.
Nature	For several studies on ecosystems climate information for Europe is needed	Information from studies for Europe are often difficult to integrate with studies for the Netherlands, due to the use of different climate scenarios

2.5 Describing uncertainties

On all sub-portals attention is paid explicitly to uncertainty in data about climate change and its impacts. Various types of uncertainty can be distinguished. These types are described on the general pages of the pilot web portal[7] and more explicitly per sector. An attempt was made to use the typology of Walker et al. [2003] as the basis for the description of the types of uncertainties per sector. They differentiate between the location of the uncertainties (where do the uncertainties occur in models, e.g. in the input data?) and the level (between deterministic knowledge and complete lack of knowledge?) and source (is the uncertainties caused by lack of knowledge or due to natural variability?) of uncertainties. If available also some quantitative information on uncertainties is presented.

[7] http://www.klimaatportaal.nl/pro1/general/start.asp?i=7&j=5&k=0&p=0&itemid=869.

3 Climate

3.1 Background

From 2004 on, climate data have been tailored for users within the Climate changes Spatial Planning (CcSP) programme, especially after the publication of the KNMI'06 climate scenarios[8]. As part of the CS7 project [Bessembinder et al., 2011b] tools and methods were developed for tailoring for various sectors. However, in a densely populated and occupied country such as the Netherlands, results from different sectors often have to be integrated.

To promote consistency in methodology, and therefore to be able to integrate results from various impact studies, locations, and sectors, among others generic guidelines are needed on when to use which climate data and tools. The development of such guidelines was not included in other projects. Furthermore, new climate data and information were and will become available (e.g. in the accompanying Future Weather project[9]) and should be made available for use.

To provide more overview on available climate data and make the tailored climate data available, the following pilot web pages were constructed as part of the KEW/CIG: **http://www.knmi.nl/klimaatmaatwerk/KEW**. Below some examples of the information on this website are presented.

3.2 Data and information

Users of climate data, such as impact researchers, often do not have a complete overview of the available climate data sets and the differences between the data sets. To provide more overview, related to the possible use of the data sets, a structured overview of climate data sets was presented in tables, categorized by type of information, geographical area of interest, observa-

[8] For examples see: www.knmi.nl/klimaatscenarios/maatwerk/;
[9] For more information see: http://kennisvoorklimaat.klimaatonderzoeknederland.nl/projecten/projectendatabank (project KKF-01A).

tions/climate model output and period. The data and information include: time series, tables, maps and graphs etc. for past, present en future climate in the Netherlands and other areas. The following tables with climate information were constructed:

- The Netherlands: observations, past-present (Table 3.1);
- Europe, world: observations, past-present;
- The Netherlands: climate scenarios, future;
- The Netherlands and Europe: climate model output, past-future.

The tables provide the users with direct links to the databases or tools with the requested data (e.g. time series of point observations, gridded datasets, climate model output, historical datasets that are transformed into time series for the future with the help of information from climate models, statistics on extreme precipitation). The tables are not yet complete, but give a first overview of the variety of data sets and tailored data. A lot of the links to data sources lead to KNMI web pages, as most data about the Netherlands is generated by KNMI. These tables will be extended in the follow-up of the project[10].

Table 3.1. Climate information for the Netherlands: observations, past-present. (part of the table on internet, translated to English).

Type of data	Explanation	Area	Period	Link
KNMI, precipitation	Time series, daily data for 8-8 UTC	Whole of the Netherlands (>300 stations)	From 1906 on until now	link
KNMI, all climate variables	Time series, daily data for 0-24 UTC	Whole of the Netherlands (about 30 stations)	From 1901 on (for temperature) until now	link
KNMI, several climate variables	Frequency tables per month	Whole of the Netherlands (15 stations)	1981-2000	link
KNMI, precipitation	Statistics on extreme precipitation, regional differences	The whole of the Netherlands	1951-2005	link
KNMI, several climate variables	Maps, averages, extremes	The whole of the Netherlands	1971-2000 1981-2010	link link
ECA&D, several climate variables	Time series, indices, trends, etc.	The Netherlands, Europe	From 1901 until now	link
Climate Explorer, several climate variables	Time series, visualization tools, statistical processing, etc.	The Netherlands, Europe, World	Differs per location, climate variable	link

[10] At KNMI also a 'data centre' is under development, and a link to this data centre will be included on the KEW/CIG portal. It is not yet clear whether this data centre will provide similar information on available climate data sets.

Table 3.2. When to use which climate scenarios: influence of the time horizon of the study (translated to English, and presentation slightly adapted compared to the internet version).

Time horizon for the	Advice on the use of climate scenarios
Coming 10 years	It is not useful to use climate scenarios, since the natural variation between years is much larger than the climate change signal in the coming 10 years. Probably a good description of the current climate and its natural variability are more useful
2020-2050	It may be useful to use climate scenarios, since the climate change signal may be larger than the natural variability of the current climate
2050-2100	It is useful to use climate scenarios, since the climate change signal may very well be larger than the natural variability of the current climate

On the pilot web site guidelines are given on the use of climate scenarios. With the help of questions, examples and additional information, the users are guided to the answers on questions when to use which climate scenarios. Tables 3.2 and 3.3 give two examples from this guidance. The information can be approached in two ways:

- through tables such as 3.2 and 3.3. The user should combine the information from the tables, but gets an overview of the options and differences in advice;
- through a sequence of questions ('flow diagram') with a combined answer at the end.

Table 3.3. When to use which climate scenarios: influence of the aim of the study (translated to English, and presentation slightly adapted compared to the internet version).

Aim of the study	Advice on the use of climate scenarios
Orientation	The use of one or several scenarios can be sufficient to get a first impression of the importance of climate change
Impact analysis	Use 2-4 climate scenarios that cover well the uncertainties relevant for the sector under study to get a good overview of the range of impacts
Adaptation analysis	Use 2-4 climate scenarios that cover well the uncertainties relevant for the sector under study to get a good indication of the robustness of adaptation measures
Development of policies	Determine which climate scenario (or scenarios) are most relevant. The choice of the climate scenario to be used as basis for policy depends also on many other factors (e.g. financial budget, public support)

3.3 Documentation

On the pilot web portal under 'documentation' links are included to documents about the methods used for observations, climate scenarios, glossaries, and the library of KNMI with access to all published documents. This is a first selection of documents, which may be relevant for users.

3.4 Uncertainties

The web page 'uncertainties' has two purposes:

- to give users insight in existing uncertainties in climate information: an overview of types of uncertainties is given (location, level and source of uncertainties) with examples. Climate models use concentrations of Green house gases (GHG's) as input, however, there is uncertainty about future GHG-concentrations due to uncertainties in socio-economic developments (input uncertainties). At the same time there are many uncertainties about the climate system itself (uncertainties in parameters in the climate models);
- to give users insight in how one can deal with uncertainties in climate data for the current and future climate. The use of climate scenarios is a way of dealing with uncertainties in data on the future climate. Uncertainties due to natural variability are dealt with by statistics or longer time series (e.g. often about 30 years; the transformation program for generating time series for the future is designed to produce longer time series). The advice on how to use climate scenarios (see Section 3.2) is an example of how users can deal with uncertainties.

Autumn in Utrecht

Spring in Zuid-Holland

3.5 Review and possible improvements

In the review of the pilot web portal also questions about the web portal for climate were included. Seven reviewers gave specific comments on these web pages. Most of them considered the web portal useful. Although is does not contain new information, much of the information is combined in such a way that it gives more overview.

The reviewers also had several comments and suggestions for improvements. These are described below, with in italics our reply and intended improvements. The main part of these improvements will be carried out in the follow up of this project as part of KfC Theme 6.

Data/information:

- time series of precipitation per hour according to the four climate scenarios are missing.

Time series of precipitation per hour for the future are not available at the moment. In the KfC project HSHL05/HSRR04 a method was developed to generate hourly precipitation series for the future, however, little information is available on the possible changes of hourly precipitation.

- a comparison between future climate change in the Netherlands and other countries would be a valuable addition.

A link has been included under 'documentation' to the overview of climate scenarios in several European countries that was made in 2007. This information may be updated as part of KfC Theme 6.

- information about the performance of climate models, based on tests with long observational time series, to diminish doubts about the capability of climate models to predict the future climate.

In several (international) projects the performance (and biases) of regional and global climate models is compared (e.g. in ENSEMBLES). Links to documents about these comparisons will be included, but should be combined with some explanation about biases and how they are determined. This is a valuable extension for Theme 6 of KfC.

- a more prominent mentioning of the transformation programme is suggested.

It is now included in the table on time series for the future in the Netherlands. Under data/information more explanation is needed on the various methods for generating time series for the future, with their advantages and disadvantages. The overviews presented in the synthesis report of the CcSP-project CS7 and the report on the transformation tool can be used as a basis for extension of the portal in Theme 6 of KfC.

Summer in Noord-Holland

Winter in Zuid-Limburg

Uncertainties:

- more specific (quantitative) information about uncertainties is requested

Quantitative information is not always available on uncertainties. On the website some information is given on the hierarchy of the uncertainties. We expect that more quantitative information on uncertainties will become available from several projects within KfC Theme 6.

- a summary in a table would give a better overview

Could be a good idea to include for all sectors a table with some examples of the various types of uncertainties.

- give answers to questions such as ‘can the outcome of my impact study be totally wrong due to the uncertainties in climate data?’

As a climate researcher it is often difficult to judge the effect of uncertainties in climate data on impacts. However, when during the generation of time series for the future care was taken to present relevant climate variables well (e.g. extreme 10-day rainfall for river discharges), the result of the impact study will not be ‘completely wrong’. The result of impact studies can be incomplete and give a ‘wrong’ idea about what will happen in the future when uncertainty about the future climate is not taken into account (e.g. in summer precipitation).

It is a good idea to add questions like this with answers to the Frequently Asked Questions section with links to the relevant pages.

4 Water

4.1 Background

The scope of the hydrological effects of climate change is wide. It concerns changes in actual evapotranspiration, groundwater levels, river discharge regimes, fresh water availability, supply and demand of surface water. This information is essential for estimating the effect of climate change on land use, e.g. nature, agriculture, building locations of houses, safety measures against flooding.

Information on the hydrological effects of climate change is usually generated using hydrological models or using hydrological modules in impact models. Different types of hydrological models exist to study a variety of hydrological processes. Catchment-scale rainfall-runoff modeling to project future discharges of the river Rhine requires a different approach than the 'slower' groundwater dominated hydrology that controls water availability for vegetation and eventually water shortages in the Netherlands. In the past various hydrological models for the latter kind of assessment were used simultaneously. In 2005 Alterra, MNP, RWS-RIZA, STOWA, TNO and WL decided to develop the Netherlands Hydrological modeling Instrument (NHI; www.nhi.nu). The NHI combines models for the unsaturated and saturated soil, and the regional and national surface waters, and is now the de facto standard for hydrological information for national policy making [Delsman et al., 2008].

Water courses near greenhouses in Zuid-Holland

Pastures along the coast of Groningen

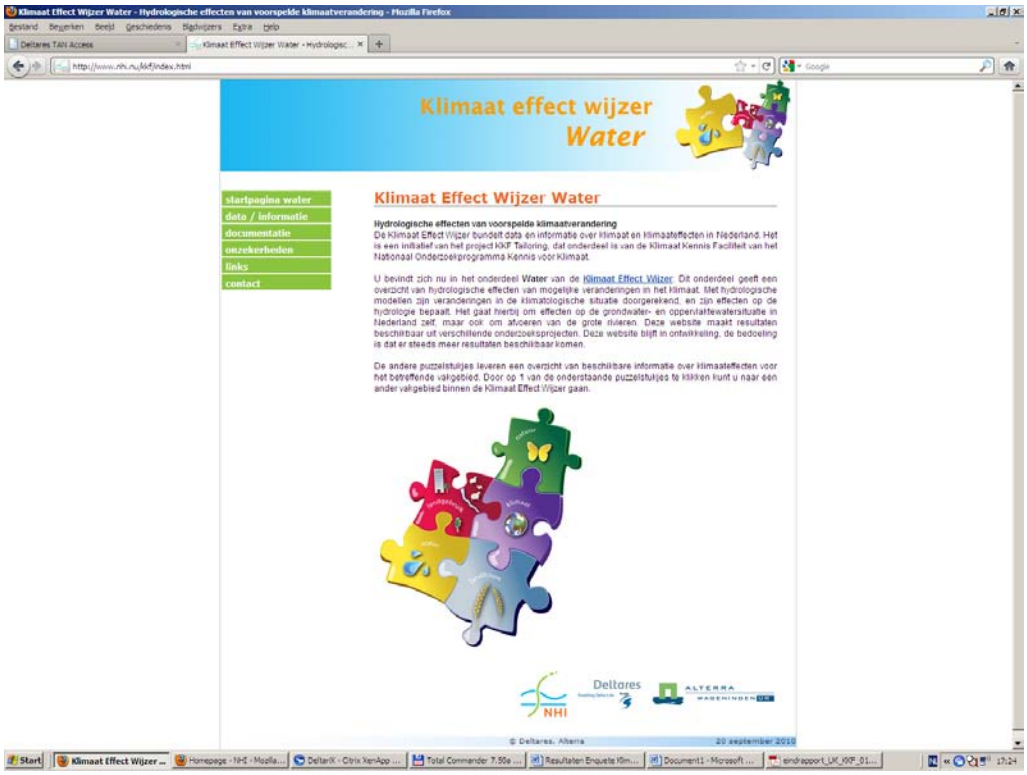

Figure 4.1. Starting page for the sub portal on water of the Climate Impact Guide.

The NHI is used among others within the Delta programme. In KfC Theme 6 [11] the link between the NHI and climatological data for the current and future climate will be improved. Also land use scenarios will be included. River basin hydrology, in the Netherlands notably for the rivers Rhine and Meuse, is modeled using models as HBV and Sobek.

To promote the use of the results from the NHI and the results of other hydrological models, tools need to be developed to make the results easily accessible. A pilot version of a user interface is developed within this project and included as part of the KEW/CIG: **http://www.nhi.nu/kkf/.** Below some examples of the information on this website are presented.

4.2 Data and information

A user interface through internet for the results of the NHI is under development (Figure 4.2). This user interface provides a user-friendly and flexible way of viewing the different kinds of output, of interest to different groups, generated by the NHI model. These outputs can be viewed at different scales in the hydrological system, e.g. at the basin outlet points, but also at sub basins and so forth.

[11] http://knowledgeforclimate.climateresearchnetherlands.nl/highqualityclimateprojections

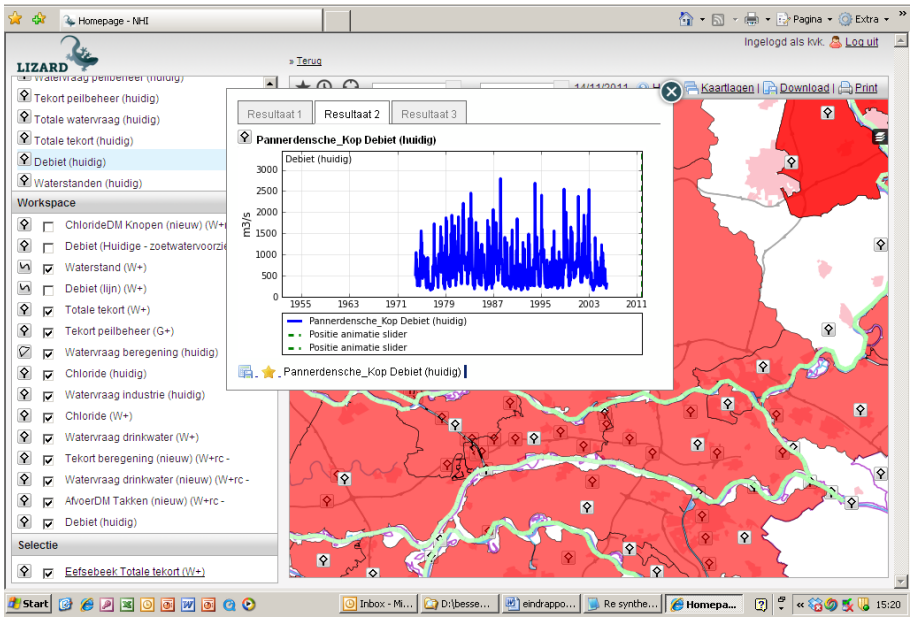

Figure 4.2. Developed user interface to the hydrological data: example of a page with a figure of the discharge near the Pannerdensche Kop for the current climate.

Currently[12] the interface contains information for the current climate and the KNMI'06 scenarios G, G+, W and W+ around 2050. To obtain this information NHI version 2.1 was run, with for the current climate the period of 1977 -2005. In addition, different NHI-model runs are available that were generated during the preliminary National Water distribution study as part of the Delta programme. These runs are made for different 'representative years'. In this method different years are chosen to represent various climatic conditions, based on a combination of precipitation deficit and Rhine discharge. The years are ranked as follows: 1967: average, 1989: moderately dry, 1976: extremely dry.

The user interface will be updated continuously, as new model runs and new NHI model versions become available. In parallel projects, most notably the NMDC project, work is underway on facilitating this continuous update of the portal. Also the current lack of adequate meta data is mentioned in this project. As the step from raw model output to visualized output is shortened considerably through this portal, more types of information can be added. Information on modeled soil and vegetation characteristics would seem a logical first extension.

The following hydrological parameters and parameters on hydrological effects are included in the menu (but not all already with data):

- chloride;
- water demand for irrigation;
- water shortage irrigation;

[12] In November 2011 part of the pilot was filled with data.

- water demand for flushing of the water system for water quality reasons;
- water shortage for flushing;
- water demand for drinking water;
- water shortage for drinking water;
- water demand for industrial use;
- water shortage for industrial use;
- water demand for water level control;
- water shortage for water level control;
- total water demand;
- total water shortage;
- discharge at nodes of the water distribution model;
- water levels at nodes of the water distribution model;
- average highest groundwater level (GHG);
- average lowest groundwater level (GLG);
- average springtime groundwater level (GVG);
- groundwater regimen description (GT);
- river discharge;
- river velocity;
- river water level.

(information on water temperatures of surface waters will be generated partly in the KfC Coupling project KKF-01B).

4.3 Documentation

On the pilot web portal under 'Documentation' information is given on the background, the objectives and the used models for the NHI. The page also contains a link to the documents about the methods, input- and output data and other relevant background information of the described data/information. No new information was generated with the NHI in the KKF-Tailoring project, existing model runs were made available.

4.4 Uncertainties

On the web page about uncertainties the following information is presented:

- the current status and shortcomings of the NHI model: how well does the NHI model simulate several hydrological parameters, which parameters are overestimated or underestimated, which hydrological parameters are checked for their performance, etc. For example, it is known that the dunes and the Veluwe are too dry in the simulations. On the web page only a short summary is given, but a link to the background documents with more information is included;
- interactions with other sectors. Climatological information is an important driver in hydrological simulations. Uncertainties in climatological data or in the translation of the KNMI'06 climate scenarios may, therefore, also affect the output of the hydrological simulations. Furthermore, it is indicated that changes in land use (among others crops, crop

management, ecosystems) are until now (version 2.1 of the NHI) not included in the simulations of hydrology for the future.

Ship on the Meuse

Mist in the vicinity of water courses

4.5 Review and possible improvements

In the review of the pilot web portal also questions about the web portal for water were included. Ten reviewers gave specific comments on these web pages. Five of them considered the web portal useful; others found it difficult to judge, since the pilot web portal did not contain a large amount of data at the time of review (January 2011).

The reviewers also had several comments and suggestions for improvements. These are described below, with in italics our reply and intended improvements. The main part of these improvements will be carried out in the follow up of this project as part of KfC Theme 6.

Data/information:

- the available data is limited. It contains only fresh water supply data, no water safety.

The available data are indeed limited in the pilot phase of the portal. New data (results of the Delta program Fresh water supply) are added since the review. Water safety data will be added as part of the follow-up project.

Documentation:

- differences with the Delta portal, Delta model, NMDC[13]? Who will keep this up-to-date?

The difference lies mostly in the intended user group. All named projects use the same data, but may find it using a different approach. The focus of this portal is on researchers from other sectors and the interested public, looking for data on hydrology. The projects mentioned above aim mostly at hydrology specialists

[13] Delta model: http://www.deltaportaal.nl/ en http://www.deltaportaal.nl/nl/deltamodel/; NMDC = National Model and Data Centre http://nmdc.eu/.

and policy makers already working on fresh water supply and/or water safety, who are familiar with the presented data.
The data from the different projects stem from the same data source. As such, it is updated along with the other projects. In the follow-up project focus will be on keeping also the accompanying explanation and documentation accurate and up-to-date.
It is useful to include a short overview on this portal of the organisations and institutes working on the various aspects of water.

Uncertainties:

- uncertainties have not been quantified.

Quantification of uncertainties was beyond the scope of this Tailoring project. However, we support the plea for a thorough quantification of the uncertainties in the hydrological modeling. If such a quantification becomes available, it will be added to the uncertainties section of the portal e.g. within Theme 6 of KfC.

5 Nature

5.1 Background

Climate change impacts on nature are among the most discussed, on a global scale in relation to feedbacks to the climate system as well as on a national scale in terms of biodiversity loss and mitigation and adaptation measures. Three approaches are available to estimate future climate impacts on nature:

- experimental approaches. These approaches are insightful, but deal almost exclusively with short term effects, whereas long term effects may be qualitatively and quantitatively different;
- meta-analysis of available data. A number of databases are available for meta-analysis and contain data that have been collected with different purposes, e.g. www.nlbif.nl; www.waarneming.nl; http://www.synbiosys.alterra.nl/natura2000/. In meta-analyses of large datasets trends in data can be generalised. However, if environmental conditions change and particularly if new combinations of environmental drivers emerge, current data alone may not be sufficient;
- modelling. Climate change has both direct (drought, heat, flooding) and indirect effects, i.e. through changes in the nutrient and water cycle, changes in fire regimes and changing food webs. With models, both direct and indirect effects can be evaluated and different scenarios can be compared.

After the development of a series of models in the Netherlands dealing with succession, effects of groundwater and nutrients at equilibrium for the current climate, there was a need for new models to account for climate change effects on nature and ecosystems. Alterra/WUR and KWR/VU are both actively involved in developing such models, e.g. within the CcSP programme. Alterra/WUR mainly focuses on spatial ecological effects of climate change on plants and animals. KWR/VU has models on direct and indirect effects of climate change through water and nutrient cycling on vegetation.

Both modelling approaches are still under development, but are increasingly demanded for by users, e.g. for the evaluation of nature restoration, adaptation and mitigation measures at regional and national scales. There is a strong need for central information on the models available (including their concepts, assumptions and uncertainties) and, importantly, for information on data requirements and data formats needed to have the models run by Alterra/WUR

and KWR/VU. The latter aspect is critical to facilitate a swift tailored model analysis for users. The models itself are not provided through internet, but can be run on request.

To provide this information, we developed a series of pilot web pages. A sub portal on nature was developed as part of the KEW/CIG, briefly describing the modelling approaches available for nature (as outlined above). This portal guides to individual web pages of Alterra/WUR (**www.klimaatennatuur.wur.nl**) and KWR/VU (**http://klimaatennatuur.kwrwater.nl**) with detailed information on the two modelling approaches and other climate-related datasets and research. Below, it is indicated which information is available on the pilot web portals and some examples of the information on these web sites are presented.

Nature: De Peel

Ackerdijkse Plassen

5.2 Data and information

5.2.1 Alterra/WUR: data and information

The website gives an overview of three projects carried out by Alterra within the CcSP programme. All three projects focussed on spatial adaptation of the ecological network and the underlying ecological processes that indicate range shifts as a result of climate change:

- the climate response database (see http://www.klimaatennatuur.wur.nl/NL/Klimaatresponsdatabase/) is a database with all known information about range shifts of Western-European species, both plants and animals, and data from empirical studies and climate envelope models as well as expert knowledge. The database is described and can be downloaded. It can be used to retrieve information on whether species are expanding in the Netherlands in response to climate change, retracting, or whether the Netherlands is central in their distribution, i.e. neither expansion nor retraction are expected;
- the nature targets and climate study (see http://www.klimaatennatuur.wur.nl/NL/natuurdoelen_en_klimaatstudie/) built upon the climate response database, but also gathered information for nature types such as dry heath lands, wet heath lands, wet

oligotrophic grasslands, dry forests, wet forests. It reviews and analyses information on the direct and indirect effects of climate change on these nature types. Species from the climate response database are linked to nature types where they occur, and per nature type statistics are presented on % of species expanding, retracting and not expanding/retracting due to climate change according to the W+ scenario. This gives an impression of the possible changes in species composition of various nature types in the future: some species become extinct, while others enter our ecosystems from the south. The website presents the main results and links to relevant publications;

- in the BRANCH project (see http://www.klimaatennatuur.wur.nl/NL/BRANCH/) climate envelope modelling from the University of Oxford was combined with ecological connectivity modelling from Alterra on two spatial scales: regional scale (Kent and Limburg) and the scale of NW-Europe. The website describes the main results and provides links to relevant papers and models.

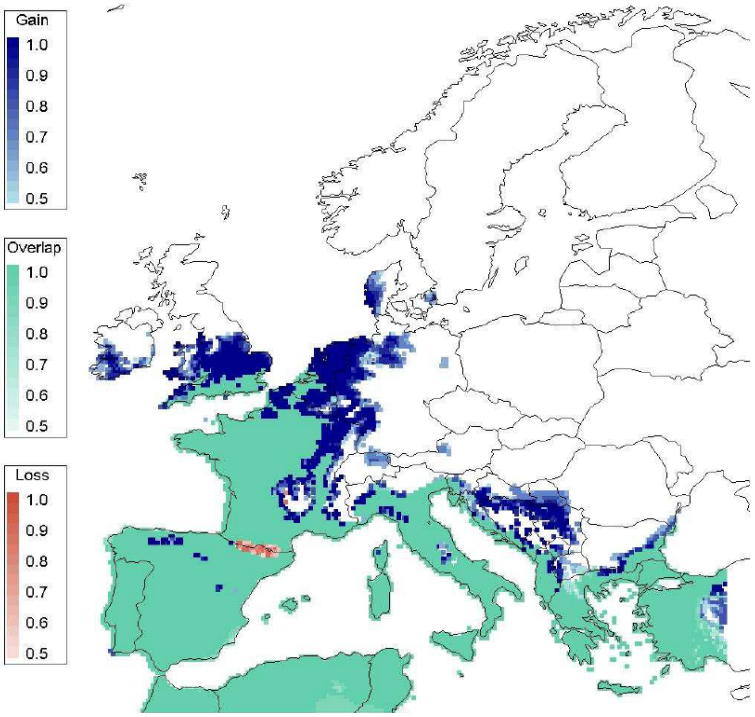

Figure 5.1. Example form the BRANCH study: projected change in dispersion of the Cettis warbler: for around 2050 under the HadCM3 A2 scenario compared to the current situation [Pearson et al., 2002].

5.2.2 KWR/VU: data and information

The website gives an overview of completed and ongoing research by KWR/VU, in the framework of the CcSP and KfC programmes, in which the impact of climate change on both soil water balance components and vegetation composition is studied. Briefly, the website is divided into three parts:

- empirical studies: describes studies in which climate change effects on vegetation are measured in the field or mimicked in pot experiments;

- modelling: describes a modelling approach (Probe) to simulate the climate change effects on vegetation composition and the soil water balance. Crucial in this modelling approach is the use of plant traits[14], as a functional and climate versatile link between climate and vegetation. Via a number of subsections the visitor of the website is guided to various aspects of the approach a) effects of climate change on soil water balance components, b) effects of changes in soil temperature and in the soil water balance on the nutrient availability in the root zone of plants, c) measured relationships between water, nutrients and plants traits, d) relationships between plant traits and vegetation composition, e) feedbacks of plant traits on soil characteristics;
- 'climate sketch map': since we recognise that both empirical research and modelling have their limitations, we combined the results of the previous parts with literature surveys and expert judgement to compile a national sketch-map, showing the most-likely climate change effects on ecosystems of the Netherlands (Bodegom et al., 2011).

The visitor of the website is able to gather more information on certain topics by means of downloads to research reports, articles in professional journals, articles in peer-reviewed papers and an excel file to compute the effect of CO_2 on the water use efficiency of vegetation. Results of model simulations, in the form of maps (like Fig. 5.3) and tables, will be placed on the website as soon as they are available (in 2012 results for the Baakse Beek catchment area are expected). In addition, specific analysis can be done by order against payment

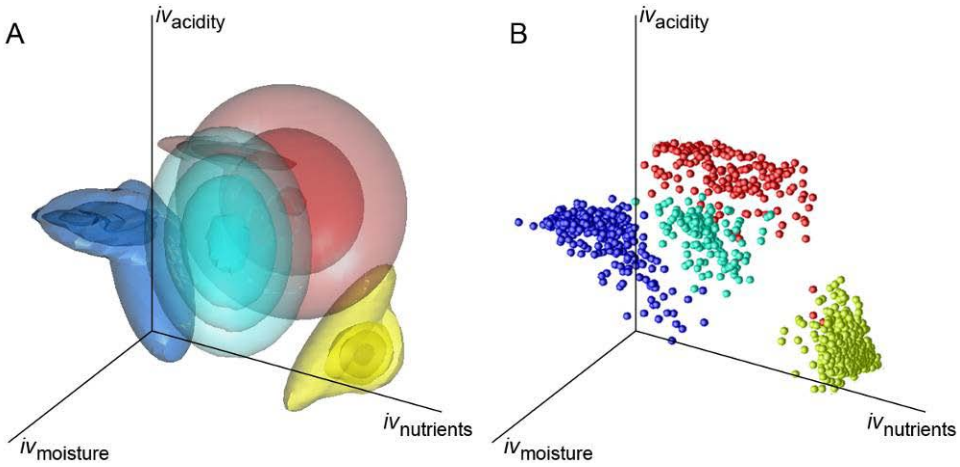

Figure 5.2. Relation between average ecosystem characteristics and the presence of different ecosystem types (indicated by different colours); A: modelled relation based on field measurements in B.

[14] Plant trait = a morphological, physiological or phenological feature measurable at the individual level, from cell to organism, and describes the fitness of an individual within a particular environment.

5.3 Documentation

Both pilot websites developed within this project contain a short summary of the approaches followed in the described projects. The web pages also contain links to documents about the methods, input and output data and other relevant background information of the described models and data. These documents are often freely available for downloading and describe the scientific concepts as well as some applications (to provide users with a taste for the possibilities).

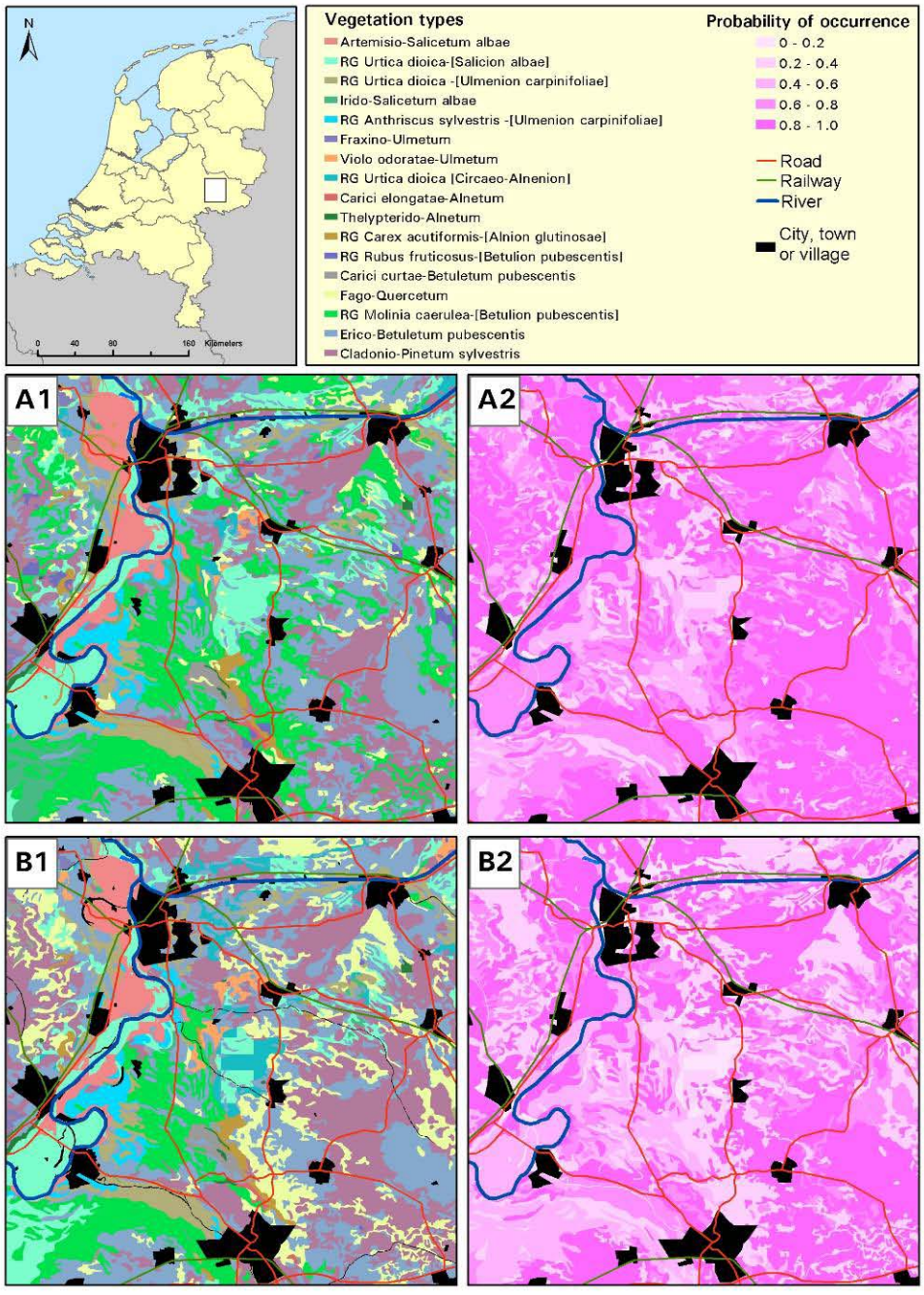

Figure 5.3. Example of dealing with uncertainty in the PROBE modeling approach [Witte et al., 2004]. The figures on the left show the potential distribution of vegetation types before (A1) and after (B1) a 25 cm fall of the groundwater table ('potential' means that land-use and atmospheric deposition of nitrogen were not taken into account). Figures on the right (A2 and B2) show the occurrence probability of the predictions, hence give the uncertainty of the vegetation maps.

5.4 Uncertainties

For each project or aspect of the modelling approach PROBE the type of uncertainties are shortly described. Both groups use statistical information from observations (own observations or from other databases) to determine relations between nature, climate and environment (e.g. Climate Response Database and PROBE). The relations, therefore, contain statistical uncertainties (primarily due to measurement errors and interpolation/extrapolation errors).

These statistically determined relations are used in the models (uncertainties in input parameters). Model assumptions and the processes that are not included are not well known and are also a major source of uncertainties. For example, in the PROBE approach the effect of drought stress on the percentage of bare soil in the vegetation is very complex and not well understood. However, the fraction of bare soil has a strong effect on the evapotranspiration and, therefore, on the water balance of the soil and the amount of water that percolates to the groundwater, i.e. the groundwater recharge. This again affects the water availability for the plants and groundwater flow. Uncertainties in this chain of processes may have large effects on the model output. The models that simulate the dispersal of species as a response to climate change use assumptions on dispersal distances[15] and behaviour of species. These assumptions are based on observations, but contain a lot of uncertainty. This could clearly affect the results as presented in the climate response maps (see e.g. Figure 5.3).

The pilot web portals present mainly qualitative information on these uncertainties. However, for the PROBE approach the uncertainties in some of the modelling steps can be quantified to some extent. Examples are given on the web site.

Orchids in the province of Groningen

Chestnut in the province of Utrecht

[15] Dispersal distance = average distance travelled by an individual seed or vegetative reproductive tissue (e.g. clones).

5.5 Review and possible improvements

In the review of the pilot web portal, specific questions about the web pages for nature data and modelling had been included. Six reviewers gave specific comments on these web pages. Three of them considered the information useful, two did not (yet) and one person did not have an opinion.

The reviewers also had several comments and suggestions for improvement. These are described below, with in italics our response/intended improvement. The main part of these improvements will be carried out in the follow up of this project as part of the Knowledge for Climate theme 6.

Data and information

- most information seems to be limited to the Netherlands, while many consequences for nature occur internationally.

We fully agree that the consequences for nature occur internationally. However, the aim of the website was to show what happens in the Netherlands in terms of climate impact studies for nature and approaches developed to deal with those. At the same time, the approaches presented are all rooted in international developments and concepts. In addition, they use species abundance data from neighbouring countries to account for those influences.

- the web sites contain hardly information on nature measures in response to changes in the phenology of species or to optimise the habitats of species (i.e. to make nature climate proof or climate robust).

Indeed, nature measures have been given less emphasis. Our primary aim was to present the approaches available. The approaches presented on both websites have been used, however, to evaluate nature measures in particular regions. There is no general rule or measure and it will all depend on the region (i.e. really has to be tailored). We will add some examples of these measures to the websites as part of the follow-up project.

Documentation

- the difference between plants and vegetation is unclear. The structure of these individual components is dissimilar.

In fact, 'plants' should be used when dealing with single species and 'vegetation' for mixtures of plant species. We will check the websites for consistent use of these terms.

Uncertainties

- the Alterra/WUR website has not done anything about this and KWR/VU does not even mention it.

The Alterra/WUR website gives an overview of three different large projects and various subprojects with their own often complex and multifaceted methodologies. Uncertainties are currently only briefly discussed. More information can be found in the many scientific papers and reports that describe the projects in detail. This can be made more explicit.
Currently, the KWR/VU does indeed not have a separate webpage on uncertainties. To be able to give better and more specific information on the assumptions, concepts and uncertainties of the individual steps involved in the model, this information is presented under 'Modelling climate impacts'. Apparently,

this has not become clear. In the follow-up project the structure of this sub portal will be synchronized more with the other sub portals.

- my impression is that in general one seldomly tries to quantify or qualify uncertainties. Only the sources are mentioned.

Quantifying the uncertainties is central to the approach presented at the KWR/VU website. It seems that this has not become clear and will be improved in the follow-up project.
Alterra/WUR: indeed, the methodologies are so complex and multifaceted that performing full uncertainty analysis for the whole model and data chain is quite a challenge. We were able to quantify uncertainty only in some cases which are documented in the provided publications.

6 Agriculture

6.1 Background

Agriculture is an important pillar of the Dutch economy. As a large part of the Dutch land area is occupied by agriculture, the sector also contributes to societal and ecological functions. These include landscape quality, recreation and biodiversity. So far, the strongest incentives for management and technology improvements in agriculture were provided by market forces and policy [Hermans et al., 2008]. With climate change, and especially rapid changes, incentives to adapt could increasingly become climate related. Climate change can have large impacts on agriculture, not only because of changing conditions for crops, but also because of changes in the occurrence of pests and diseases, the need for energy crops, and the risks of farm management.

Information is required on the impacts and adaptation strategies at crop and farm level. Furthermore, for governments it is of interest to have insights in the required investments (e.g. water management) to keep the agricultural sector viable in the long term. To provide more overview on available data on the impact of climate change on agriculture and adaptation measures, the following pilot web pages were constructed as part of the KEW/CIG: **http://www.klimaatenlandbouw.wur.nl/NL/**. Below some examples of the information on this website are presented.

6.2 Data and information

As a first step, information and data is provided on the impacts of climate change on a range of crops in the Netherlands towards 2050. In Table 6.1 it is indicated which information is made available. Three different methods are used, which provide different types of information:

- a crop growth model can calculate the impacts of climate change scenarios on the potential and water limited yields[16]. The KNMI'06 climate scenarios are used, and yields were calculated for the province Flevoland, which can serve as a good example for arable farming in the Netherlands. Although in Flevoland actual yields are quite close to the potential and water limited yields, in general the actual yields are lower due to less than optimal management, pests and diseases and certain weather extremes that can not be simulated with crop growth models. Furthermore, crop growth models can only estimate the impact of two major adaptation options, changing the cultivar and changing the sowing date, and therefore, two other methods complement these crop model simulations;
- the agro climate calendar (ACC) identifies weather extremes that can pose a problem for crop growth and quality. The impacts of these weather extremes on major crops are estimated with the help of information from the past, and the frequencies of occurrence in the current situation and around 2050 under the KNMI'06 scenarios are estimated with the help of time series. Based on this, major climate risks are identified and adaptation options are selected based on expert knowledge and stakeholder workshops;
- to put the impacts of climate change in context of other trends, results from the crop model and the ACC are integrated in calculations of changes in actual yields. These include the influence of farm management and technological development.

Wheat

Maize

[16] Potential yield = maximum yield that can be obtained in a given physical environment and for a plant species. It depends on the growth-defining factors radiation intensity, carbon dioxide concentration, temperature and crop characteristics. Water-limited yield = yield limited by the growth-limiting factor water, including precipitation and irrigation. Actual yield is also influenced by growth-reducing factors including weeds, pests and diseases.

In the first version of the portal, a set up was made on how to present results (Table 6.1). The information is presented per crop, and per crop different types of impacts are presented using the above mentioned approaches. All these data and information are collected in other projects (e.g. in CcSP-projects) and described in articles and reports. As a start, the data and information was presented on web pages for three important crops: winter wheat, potato and sugar beet. Table 6.2 gives an example of the information provided with the help of crop growth models. Users indicated that they do not care whether information is provided on a webpage or in a pdf-file. For the moment, we will therefore stick with these three crops as an example, and forward users that are interested in other crops to the available documentation.

Table 6.1. Information and data provided in the CIG/KEW for agriculture. Per crop it is indicated which data on impacts, linked to specific methods, are available on the portal. The 'X' in blue are currently on-line, the 'X' in grey are available, in a report that can be downloaded, but not online as web pages.

	CROP MODEL	AGRO CLIMATE CALENDAR		INTEGRATION
Impacts	Potential impacts of climate change	Impacts and frequency of extremes	Climate risks and adaptation options	Climate change in context
Winter wheat	**x**	**x**	**x**	**x**
Seed potato	x	x	x	x
Consumption/starch potato	**x**	**x**	**x**	x
Grass		X	x	
Spring wheat	x			x
Spring barley	x			x
Sugar beet	**x**	**x**	**x**	x
Lilly		x	x	
Tulip	x			x
Winter carrots		x	x	
Onion	x	x	x	x
Rapeseed	x	x	x	x
Artichoke		x	x	
Grape		x	x	
Cherry		x	x	
Reed		x	x	
Sunflower	x	x	x	x
Tomato		x	x	
Maize				

Table 6.2.Example of information provided: Potential and water limited yield of winter wheat in the current and future climate for high and low CO_2 concentrations. Adaptation is here the use of a different cultivar (longer growing period) and earlier sowing. SD-standard deviation.

CO_2 (µmol/mol)	Yield (ton/ha)	Current	G	G+	W	W+
			2050	2050	2050	2050
567	Potential yield (SD)		12,3 (1,0)	11,8 (0,9)	11,5 (0,8)	10,6 (0,9)
	Water limited yield (SD)		11,8 (1,2)	11,1 (1,2)	10,9 (1,2)	9,7 (1,4)
567 + adaptation	Potential yield (SD)		12,6 (1,1)	12,2 (1,1)	12,0 (1,0)	11,0 (0,9)
	Water limited yield (SD)		11,9 (1,6)	11,2 (1,6)	11,1 (1,5)	9,5 (1,4)
478	Potential yield (SD)		11,4 (0,9)	11,0 (0,8)	10,7 (0,7)	9,9 (0,8)
	Water limited yield (SD)		10,9 (1,2)	10,2 (1,2)	10,0 (1,2)	8,8 (1,3)
369	Potential yield (SD)	10,3 (0,8)				
	Water limited yield (SD)	9,9 (1,0)				

6.3 Documentation

On the pilot web portal under 'Documentation' further information is given and links are included to documents about the methods and their input- and output data. For agriculture, this refers to three methods as mentioned in Table 6.1: crop growth model, agro climate calendar and integration.

Crop model
To estimate changes in potential and water limited yields, the model WOFOST (WOrld FOod STudies) has been used. It is explained where general information on this model can be obtained, and which assumptions have been made for the application presented on the web portal.

Input data include meteorological time series, crop parameters and the specification of adaptation options. Output data include results from the simulation runs, which have been performed for the thirteen crop types for:

- the current climate conditions for Lelystad, the Netherlands;
- the four KNMI scenarios for Lelystad with the high CO_2 concentration of emission scenario A1FI;
- the four KNMI scenarios for Lelystad and the moderate CO_2 concentration of emission scenario B2;
- the four KNMI scenarios with the high CO_2 concentrations of emission scenario A1FI plus adaptation to climate change.

Potatoes

Sugar beets

Results are given for respectively winter wheat, spring wheat, ware potato, seed potato, sugar beet, fodder maize, grain maize, winter rape seed, spring barley, sunflower, peas, onion and tulip (see also Table 6.1). The simulations have been performed for both potential (i.e. irrigated optimal nutrient supply and management) and water-limited conditions (i.e. rain fed conditions, optimal nutrient supply and management). Both mean yield values and the standard deviation (SD) of the simulated potential and water limited yields over 17 years[17] are given in the tables per crop. Much more outcomes from the simulation runs than presented at the pilot portal are available: e.g. dates of flower-

[17] For Lelystad only 17 years with observations were available.

ing, transpiration coefficients, total soil evapotranspiration and total crop transpiration. A list of possible outputs is given and can be obtained if requested.

Agro climate calendar
The agro climate calendar (ACC) is not a model, but an approach. The method includes: 1) selection of crops, 2) identification of climate factors influencing crop yield and quality, 3) using current climate data and KNMI'06 scenarios to estimate frequency of occurrence of climate factors, 4) estimate impacts of climate factors on crop yield and quality, 5) identify major climate risks, 6) identify adaptation options for major climate risks.

The method is semi-quantitative and participatory. In workshops relevant adaptation options to reduce the impacts of major climate risks have been discussed with farmers and other stakeholders.

Integration
Projected yields in 2050 are not only dependent on the impacts of climate change (including increase of CO_2 concentrations). Other factors of importance are technological development (including adaptation) related to a) plant breeding and b) reduction in yield gap, i.e. difference between potential and actual yield. Formulas are given for an example for winter wheat and the assumptions that are important for the projections of yields around 2050.

Projects on agriculture and climate change
Besides the information on the three methods, also information is presented on projects related to agriculture and climate change. Projects are mentioned in which the groups 'Plant Production Systems' and 'Agrosystems' are involved. These include the projects that provide the information at crop level (under 'data/information'), but also the ones that provide information at farm and regional level. At farm and regional level also other indicators are projected, like nitrate leaching and biodiversity. As this is work in progress, data and information is not yet presented on the pilot web portal. The 'Documentation - Publications' part includes additional reading on agriculture and climate change.

6.4 Uncertainties

Uncertainties in projections of the impacts of climate change on agriculture are related to four main groups: model structure, parameterization, input parameters and scenarios. The influence of these four types is described in detail for crop model simulations in a qualitative way. However, under 'Data/information' some quantitative information can be found on the effect of some of these uncertainties (see e.g. Table 6.2). For the integration the influence of assumptions in scenarios is discussed in a qualitative way. In the current version, no information is given on uncertainties in the ACC.

6.5 Review and possible improvements

In the review of the pilot web portal, specific questions about the web pages for agriculture had been included. Six reviewers gave specific comments on these web pages. Two of them considered the information useful (e.g. as basic information for the Netherlands), one did not and three persons did not have an opinion.

The reviewers also had several comments and suggestions for improvement. These are described below, with in italics our response/intended improvement. The main part of these improvements will be carried out in the follow up of this project as part of the KfC Theme 6.

Animal husbandry

Fruit production

Data and information

- more information on the relative importance of the effects of climate change. Many developments in agriculture are much faster.

On the introduction page it is mentioned that until now the strongest incentives for management and technology improvements were provided by market forces and policy. Also under 'Data/Information' one can get information on 'climate change in context' (comparison with trends in actual yields due to farm management and technological developments).

Documentation

- too scientific.

We assume that this means that the explanation is not clear enough. We will look for some (popular scientific) documents where e.g. the principles of crop growth modelling are explained in more detail and for a broader public.

- no direct links to the mentioned reports (where can they be found?).

The main reports can be downloaded from the website, but not from all pages directly (users indicated that not all information has to be provided through web pages; pfd-files are also a good alternative) . Links will be improved. This will be done in the follow up of the project.

Uncertainties

- not clear what are the uncertainties for areas in Groningen, since the presented uncertainties are for the model results for Flevoland.

The data presented on the web portal refers indeed mainly to Flevoland. In the uncertainties section it is indicated that the results for other regions in the Netherlands with clay soils and almost optimal management will be comparable. Maybe this can also be indicated at other parts of the portal.

- my impression is that in general one seldomly tries to quantify or qualify uncertainties. Only the sources are mentioned.

In modelling exercises uncertainties are quantified. There is a wide range of uncertainties however, including a range of parameters, the modelling approach, the inputs, and it is impossible to present all these quantitative results. This would imply an endless table with numbers. By explaining the major uncertainties, which we understand from such exercises, we hope to give a better background to interpret the results.

7 Land use

7.1 Background

Studies on impact and adaptation measures for climate change also demand information about possible socio-economic developments and related changes in land use. An increase in the urban area or the area with greenhouses may result in more problems due to water excess due to the larger sealed area, even in the current climate. In the CcSP project LANDS [Riedijk et al., 2007; Koomen et al., 2008] a spatially explicit land use model was applied already to simulate future spatial patterns as an intermediate step in defining appropriate adaptation measures. However, in CcSP climatic changes were not an integral part of socio-economic scenarios. Information on climatic changes and socio-economic developments was used to help develop adaptation strategies. These projects made clear that climatic and socio-economic changes are not linked in direct cause-effect relations and, furthermore, indicated a lack of knowledge in specific fields that calls for further research attention. For example, in exploring the relation between climate change, hydrology and land use, as will be the topic of new KfC research. Defining opportunities and to further integrate land use scenarios with other sectoral models and scenarios was therefore part of KfC-tailoring.

Recent studies [e.g. Koomen et al., 2008b] point out that the demand for land as specified in the national-level socio- economic scenarios that underlie these land use simulations (WLO-scenarios [Janssen et al., 2006]) is partly outdated. This problem can be overcome by incorporating more recent assessments on the demand for land using updated demographic and economic projections [e.g. MNP, 2007; Bollen et al., 2004]. Updating and making data and information on land use available for climate change impact studies is a prerequisite for more integration. At the same time this may contribute to more consistency in the use of scenarios in impact and adaptation studies.

To make the available land use data for the current and future more easily accessible and to provide overview on the methods used to generate land use scenarios the following pilot web pages were constructed as part of the KEW/CIG: **http://www.feweb.vu.nl/gis/research/kkf/index.html**. Below some examples of the information on this website are presented.

7.2 Data and information

Scenarios of future land use changes are applied to incorporate socio-economic changes in the development of adaptation measures. The underlying assumptions of these scenarios as well as the methods to produce the resulting land use scenario maps have been updated. The steps that were undertaken in this update were:

- an update of the reference year for land use scenarios from 2003 to 2006;
- an inventory of currently available scenario-based projections of future land use demand (carried out in close cooperation with Planbureau voor de Leefomgeving (PBL)), resulting in updated assumptions of future land demand in the currently implemented socio- economic scenarios;
- updated maps of future land use based on the new reference year data and the revised land demand projections (Table 7.1).

Table 7.1.Claims for changes in land use in 2040 compared to the current situation (2006) for the socioeconomic scenarios Global Economy (GE) and Regional Communities (RC).

Land use	Current (ha)	GE (ha)	Increase (%)	RC (ha)	Increase (%)
Urban centres/outside urban centres	83.643	24.191	29%	3.689	4%
Urban green area/centre of villages	180.107	70.081	39%	20.748	12%
Rural living	60.706	30.508	50%	9.806	16%
Recreation	24.941	15.318	61%	15.318	61%
Working	87.936	34.206	39%	-4.597	-5%
Sea ports	8.277	4.187	51%	-434	-5%
Arable land	721.687	0	0%	0	0%
Grassland	1.388.598	0	0%	0	0%
Green houses	16.440	723	4%	723	4%
Zero grazing (intensive animal husbandry)	2.012	-678	-34%	-678	-34%
Perennial crops	43.354	-6.769	-16%	-6.769	-16%
Nature	613.069	92.516	15%	2.516	15%

The updated land use scenario maps (Figures 7.1 and 7.2) have been made available through the CIG/KEW website. Data on 22 land use classes are available for two of the four WLO socio-economic scenarios: Global Economy and Rural Communities. These two scenarios cover for most land uses the largest part of the uncertainties described with the WLO-scenarios. Therefore, they are used most often in impact studies. The data on land use cannot be downloaded directly, due to the size of the files, however, the data can be obtained through the link.

7.3 Methods and used data

The available land use scenario maps have been created by means of the Land Use Scanner model ('Ruimtescanner' in Dutch). An overview of that model can be found on the CIG/KEW web pages. More detailed information on the model

has been published in books and international peer-reviewed journals, of which most can be accessed through the links provided under 'Documentation - Publications'.

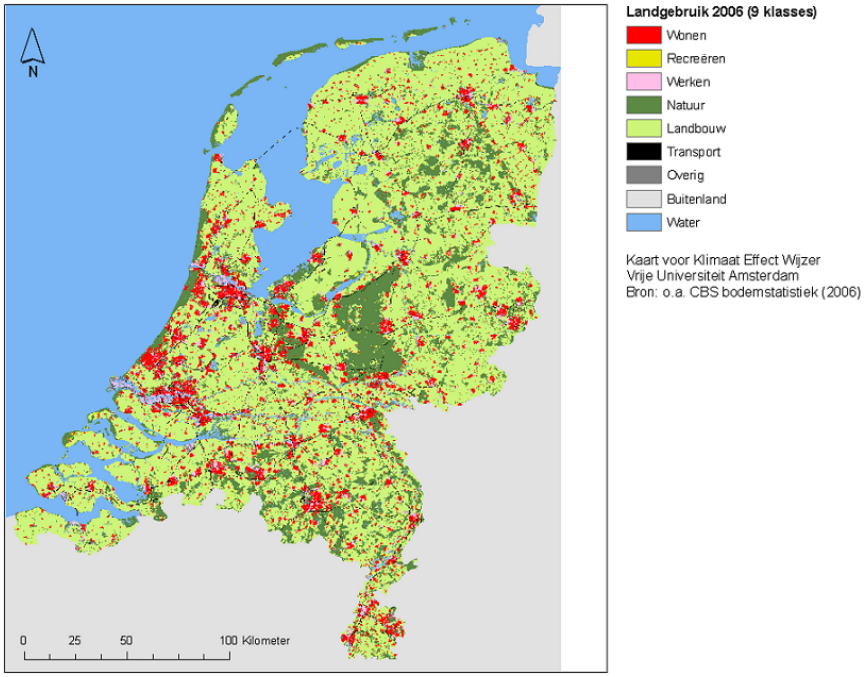

Figure 7.1. Map of current land use (2006) in the Netherlands. The classes mentioned are, from top to bottom: living, recreation, working, nature, agriculture, transport, rest, other countries, water.

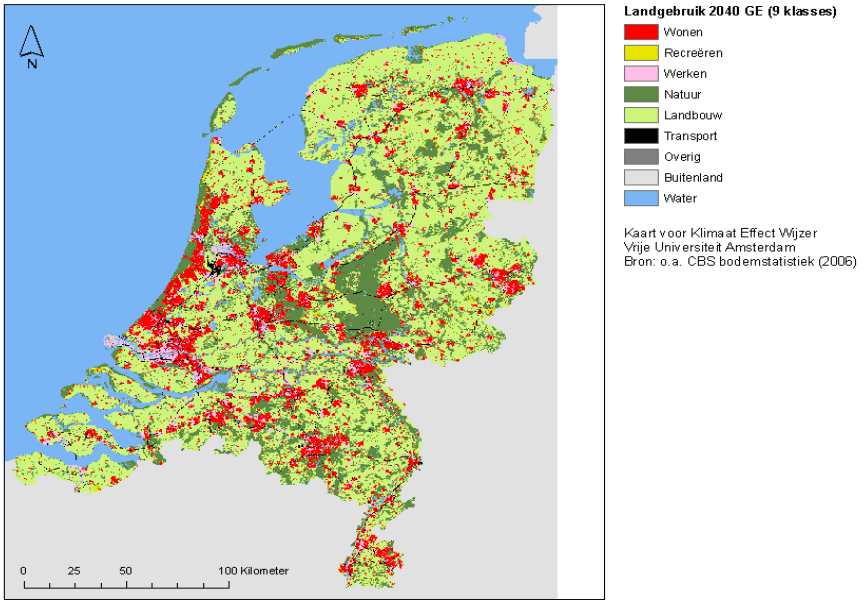

Figure 7.2. Map of projected land use in 2040 in the Netherlands under the Global Economy scenario. The classes mentioned are, from top to bottom: living, recreation, working, nature, agriculture, transport, rest, other coun-

A large number of input datasets are applied in the Land Use Scanner model. The input datasets on the reference year and the projected land demand figures (Table 7.1) have been updated. The reference year data now primarily consists of `soil statistics' on the Netherlands in 2006 produced by CBS. Before application in the Land Use Scanner model, PBL has enriched the data by adding data from a number of sources. Residential area typologies have been

added from 4-digit postcode-level data supplied by ABF research [2006). Industrial area typologies have been added from industrial-park level data supplied by IBIS [2004]. Areas designated by CBS as 'agricultural purposes terrain' have been designated to crops growing on the terrain by means of LGN5 data (supplied by Alterra), while orchard typologies have been supplemented by means of top10Vector data [supplied by Kadaster, 2006]. Lastly, by means of LEI and top10Vector data, agricultural land in the CBS data has been designated to 'zero grazing'. The land demand figures are provided by PBL as well. The CIG/KEW pages present the input land claims in aggregate form.

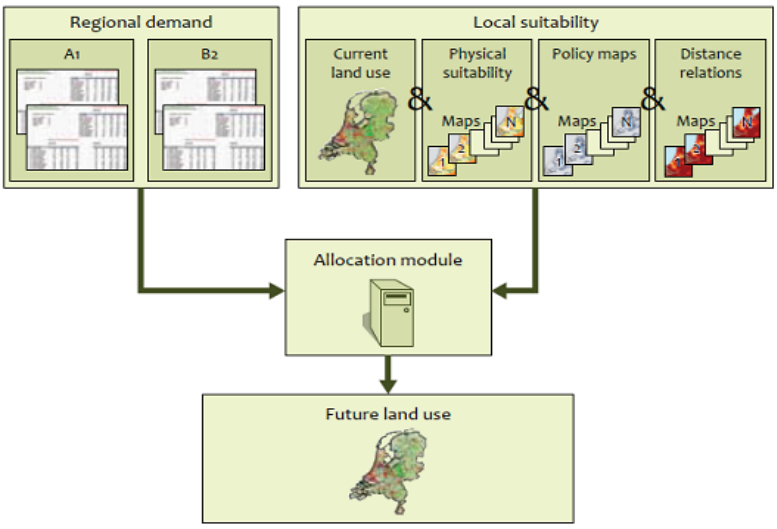

Figure 7.3. Schematic overview of how the Land use scanner works.

The output data consists of maps that show discrete land uses in 2040 according to two land use scenarios, based on the socio-economic scenarios Global Economy and Rural Communities. The maps are available as GIS raster data with a fine spatial resolution (100 by 100 meters per cell).

On the pilot web portal under 'documentation' further information is given and links are included to documents about the methods, input- and output data and other relevant background information of the described data/information.

Land uses: greenhouses

Urban areas

7.4 Uncertainties

The web page 'uncertainties' describes in a qualitative way several kinds of uncertainties in the modelling of land use changes ('internal uncertainties'):

- in input data, e.g. the projected changes in land use;
- in model parameters, e.g. the number of persons per house or land suitability for certain land uses.

Some information is given on efforts to quantify some of these uncertainties.
By using several land use scenarios, especially the scenarios Global Economy and Rural Communities (Table 7.1), much of the uncertainties on claims for land use changes can be taken into account.

The following aspects are not or hardly included in the projections, but may also cause uncertainties in the projected land uses ('external factors'):

- climate change (hardly included as factor determining land use);
- technological developments that may result in changes of life styles;
- extreme economic and demographic crises.

Land uses: transport (Schiphol)

Agriculture (potatoes)

7.5 Review and possible improvements

In the review of the pilot web portal, specific questions about the web pages for land use had been included. Two reviewers gave specific comments on these web pages. One reviewer considered the web pages potentially useful, however at the moment of the review only limited information and explanation on the provided maps was available.

The reviewers also had several comments and suggestions for improvement. These are described below, with in italics our response/intended improvement. The main part of these improvements will be carried out in the follow up of this project as part of the Knowledge for Climate theme 6.

Data and information/ Documentation

- I would like to have some more information as introduction.
- this page lacks information; the reviewer misses a thorough introduction, information on which data is used, as well as a general description of the scenarios is missing.

The website currently provides little information on the scenarios, but mostly links to reports in external documents. The provided information on the available scenarios will be elaborated upon. This is pending a general report on the update of land use scenarios which will be published in 2011.

Uncertainties

- the reviewer misses information on attempts to quantify or qualify the uncertainties; according to the reviewer the website only links to some external documents where these uncertainties have been described. The reviewer further proposes to summarize the text in this section in a table.

The website, indeed, mostly links to external documents. These links will be categorized and added to a table to provide a better overview. The main findings on uncertainties in land use modelling will be added to the website in 2011.

8 Discussion, conclusions and proposed improvements

In this chapter we discuss how far the three main objectives of the KKF-Tailoring project have been reached and what are points of improvement during the continuation of this project within Theme 6 of KfC. In the Sections 8.1 to 8.3 also several of the general remarks of the external reviewers are presented. Again the answers are given in italics. At the end of this chapter some additional points are discussed: 1. user feedback, and 2. anchoring of results and how to guarantee maintenance and updating of the sub portals.

8.1 Improving overview for users

The sub portals in the CIG/KEW give an overview of, especially, the results of projects executed within CcSP and KfC projects. It is meant as a pilot to see whether more overview of available data and information can be given by using a similar set up of the web pages of the various sectors. Information on these CcSP and KfC projects is also available through the web sites of CcSP and KfC. This means that currently the added value of the CIG/KEW portal for finding information and data may still be limited. According to 48 % of the reviewers the pilot (December 2010-January 2011[18]) did not make it easier to find information, because it does not yet contain enough information. For 38% of the reviewers the pilot portal made it already easier to find information. At the CIG/KEW portal the available information is presented in a different way than at the CcSP and KfC web sites. Especially, more attention is given to information on interactions and discrepancies between sectors. Also the similar structure of the web pages per sectors makes it (potentially) easier to find information, although at the moment there are still considerable differences in structure (Section 8.2).

It is difficult to give a complete overview of all research and data on climate change and climate change impacts in the Netherlands and outside the Netherlands. A short overview of the organisations working on a specific subject, such as for nature (which organization is working on which subjects), is useful for all sectors. In this overview the most important international organisations[19] and/or projects per sector should also be included. The CIG/KEW web portal should contain more extensive information on relevant KfC and CcSP projects, but should not try to include all possible results, but only links to relevant projects outside the CcSP and KfC programmes.

[18] After the external review some improvements were made in the first half of 2011, partly based on this review. In the second half of 2011 the work of Theme 6 on extending the portal has started;

[19] A good example of a website with information on international data and information on climate change impacts is 'Climate-adapt' (http://climate-adapt.eea.europa.eu/),

Remarks from the reviewers:

- the CIG/KEW contains too much text.

The portal should provide information and data for various types of users: for those that want a short overview and for those that want more detailed information. At the moment often a lot of information is given. The intention is to provide more summaries for the various sub pages to provide short overviews of the available information.

- it should be made clear to the users of the CIG/KEW at the introduction page that they are referred to web pages of the partner organisations.

A little more explanation can be given on the common portal on this.

- too little information on adaptive management.

Many of the projects within CcSP were focusing on impact assessments and less on adaptation measures. The KfC-programme focuses also on adaptation. When results from this programme become available they will be included.

- include also information on health and urban areas.

Currently no partners on these sectors are included in Theme 6. 'Air quality' has a link with these subjects and will be included in Theme 6. Although we see that it is interesting to include, there are currently no possibilities to do this.

- it is not clear whether all or only part of the available information will be made available/accessible through this site.

As indicated above it is impossible to include all information on climate change and climate change impacts through this portal. The focus will be on information and data from the CcSP and KfC programmes for the included sectors. By including links to other organisations working on similar subjects and databases with research projects, we can make it easier for users to find information on projects that are executed outside the CcSP and KfC programmes.

Proposed improvements for Theme 6 'Climate projections':

- include more information and data from especially KfC projects;
- include information and data on air quality;
- include more explanation on the structure of the portal on the common pages (links to web sites of partner organisations);
- include more summaries of the information on the individual web pages to provide a fast overview;
- included a short overview of the organisations working per sector in the Netherlands, and add the most important international organisations and/or projects per sector (short descriptions with links);
- include link to the CcSP/KfC project databases.

8.2 Synchronization

8.2.1 Synchronization of structure

At the moment the structure of the web pages of the various sectors still differs considerably. For some of the intended users (researchers) the current structure makes it already easier to find similar information for various sectors, but for a considerable part of the users not. It seems not easy to use a similar structure for each sector. This is partly due to the different nature of the data and information that is presented: some present data and information that stem

from individual projects (e.g. for nature and agriculture), some present databases with long term observations (e.g. for climate). In some cases the results of models can be made available through internet (e.g. for water and land use), in other cases this is not possible. Sometimes it seems better to present information on uncertainties together with the description of the model components (e.g. for nature), sometimes a summary of the uncertainties can be given on the separate web pages (e.g. for climate).

For the purpose of this synthesis report the pilot web pages of the sectors were compared by the project team, and several suggestions are made to improve the synchronization, without disregarding the specific aspects of the various sectors. A few examples:

- information on the projects from which the data and information is presented is useful, however this can be presented under 'Documentation - Publications';
- when it seems more useful to present information on uncertainties together with the documentation on the used models, an overview of these uncertainties can be given under 'Uncertainties' with direct links to the pages where more information is given under 'Documentation – publications'.

Remarks of reviewers:

- the web structure should be more similar for all sectors. Currently the structure differs a lot between the sectors (26% of the reviewers).
- the CIG/KEW does not make it easier to find information (at the moment) .
- uniform structure helps to find information and to scroll through the web pages.

Comparison of the pilot web portals per sector by the project team resulted in several point of improvement. See text above.
To make sure the website can remain a living portal, institutes responsible for the content need to be able to adapt the websites related to their own sector. This implies that own web sites need to be used. Each partner institute has its own format for websites. Therefore, we are restricted to the possibilities of the web sites per partner organization. This means that we have to focus on resemblance in the structure of the content. The logo was designed to let users know that they are on the Climate Impact Guide pages.

Proposed improvements for Theme 6 'Climate projections':

- implement the suggestions from the external and internal review to get a more uniform set up of the web pages of the various sectors.

8.2.2 Synchronization of content

Synchronization of the use of climate scenarios, land use scenarios, time horizons was not possible in this project, since no time and resources were available for new model runs. Only results form studies that were finished already were included. These studies often used one or two climate scenarios, a different time horizon, etc. Currently, there is no table with an overview of the sce-

narios for which data are available per sector. The synchronization of the use of scenarios is included in the Theme 6 in work package 3 ('Coupling of climate data to impact modeling'), where new simulation runs are planned. The overview of the discrepancies of the currently available data was made to make users aware of the differences in approaches and/or methods, reference periods, etc. and to give them an idea of the consequences of these discrepancies.

In the description of the various types of uncertainties per sector it is tried to use the typology as presented by Walker et al. [2003]. In most of the descriptions now explicitly a distinction is made between input uncertainties and parameter uncertainties. The internal comparison of the web pages also resulted in some suggestions for more streamlining of the description of uncertainties.

Remarks of reviewers:

- the central access to information on the various sectors provides more overview. This is an attempt for a really interdisciplinary data portal.
- my information/data requests are detailed enough to go directly to the web sites of the organisations in question. Added value can be provided when more integrated information is presented.

A first attempt on 'integration' was made by the overview of exchange (or lack of exchange) of data and the discrepancies between sectors. In Theme 6 we focus more on promoting consistency. Results form other KfC themes on integration can be included in the portal.

- too scientific.

The intended users are researchers. However, indeed on several points some more explanation can be given.

- I require more meta information: periods for which the data are presented, number of measurements locations, etc.

This was also a remark during the internal review by the project team. This type of information should be placed under 'Documentation'.

- I don't see the connection/interaction between the web pages of the various sectors

Currently information on the interactions and sectors is given on the common portal. Also some sub portals give some information on discrepancies (e.g. until now changes in land use are not included in the hydrological simulations). At the pages of the various sectors it is indeed not clear that this information is available and where it can be found. Links and some explanation will be included.

- rather qualitative information on uncertainties.
- I would like to have more quantitative information on uncertainties.
- more quantitative information needed on uncertainties, among others for policy makers.

It is often difficult to quantify uncertainties. We agree that, whenever possible, quantitative information should be provided. When this is not possible, sometimes the hierarchy of uncertainties can be indicated.

- general information about uncertainties is very useful, however maybe difficult to understand for many people. Some more explanation about what uncertainties are and how they are dealt with (with examples) would be useful.

We will look if we can elaborate the general description on uncertainties further within Theme 6, and add examples form the various sectors to the general description of uncertainties (or include links to examples).

Proposed improvements for Theme 6 'Climate projections':

- implement the suggestions from the external and internal review (e.g. add missing meta information, links to the common portal);
- add more explanation about uncertainties at the common portal, add (quantitative) examples from various sectors;
- include more quantitative information on uncertainties on the sub portals (or on hierarchy), whenever possible;
- make better links from the sub portals to the information on exchange of data between sectors and the discrepancies on the common portal;
- add more synchronized data/information (synchronization of the use of scenarios and time horizons).

8.3 Tailoring

The tailoring activities can be subdivided in several groups:

- improving access to available data: information is given on which data are available,;
- processing of available data;
- tools for making/selecting specific data;
- guidance on the use of data.

The nature of the tailoring activities within this pilot project differs considerably. The first two activities were executed by all partners, but the others not. Table 8.1 gives an overview to the tailoring per sector now included in the CIG/KEW.

User requirements for tailoring may differ greatly between sectors. However, in all cases there are requests for:

- easy access to data and metadata;
- synchronization of the use of climate and land use scenarios and time horizons;
- processing to specific formats (maps, gridded data, etc.);
- guidance on the use of the data.

In the follow up of this project especially the access to data will be further developed (more data/information), the synchronization of the use of scenarios and time horizons, and the guidance (e.g. how the data can and cannot be used). Other tailoring activities will depend on user demands and available resources.

For tailoring regular or constant contact with users is required, since users can not always specify their requirements directly and their requirements may change in time [Bessembinder et al., 2011b]. In the follow-up of this project regular meetings or reviews of the portal are included. Also additional options to get feed-back from users are explored (par. 8.4). For effective exchange of

data and information, the communication should be adjusted to the type of user and the type of problem or request [Bessembinder et al., 2011b]. This means that this portal developed for researchers may not be adapted in such a way that it also becomes useful for policy makers. Exchange of data and information with portals that focus explicitly on policy makers seems more useful.

Table 8.1. Overview of tailoring in the CIG/KEW portal per sector.

	Climate	Water	Nature	Agriculture	Land use
Access to data	Tables with direct links to different data sets	Data from the NHI by means of a viewing and download tool	Links to databases with information on species and drivers of species distribution Info on modeling approaches applied	Data on and links to documents on production potential of all crops and scenarios	Description of available data + contact to obtain the data
Processing data	Links to tools to analyze climate time series Links to maps on climate variables in the current and future climate	Time series for various locations for a large number of climate variables	Information on modeling approaches, incl. assumptions and uncertainties	Information is given on how climate data are used to estimate productions in the future	Classifications of land uses Maps with land use in the future
Tools	Transformation tool Links to tools to analyze climate time series	To select location, hydrological variable and time horizon	To make projections on shifts in ecosystem services are integral part of the modeling approach	The described tools are not provided, but can be obtained if needed	
Guidance	On the use of climate scenarios		On data formats needed to run the models	On the interpretation of climate impacts under 'Climate change in context'	On importance of difference in time horizon

8.4 User feed back

The added value of the CIG/KEW portal depends on the usefulness of the provided data and information for the intended users. For this, user feed back is essential. In the KKF-Tailoring project user feedback was obtained by organizing a meeting and an online review. There are some options to improve the interaction and the feedback of users and get more regularly feedback:

- feedback on the web portal can be stimulated by an on-line text box in which web visitors can easily give their remarks or ask questions. This would probably require an extra item in the menu of the web portals per sector;
- the above option can also be used to ask users to help the project team making the overview of projects more complete (users could notify the project team of other projects not mentioned yet in the short overview of work on climate change and climate change impacts per sector);
- include 'Frequently Asked Questions' (FAQ's) where answers are given to questions posed to the organisations included in this project (several of the questions/remarks form the review in this report can be included). Under these FAQ's also several of the requests of the users from the meeting and review can be answered.

Within Theme 6 we will explore the options to implement the above suggestions.

During the review also some policy makers were asked to review the pilot web portal, although the intended user groups are researchers. From the reactions it became clear that the information currently on the portal is often not of direct use for policy makers. Adding more summaries (Section 8.1) on the available information may be of help for policy analysts, however it is not clear whether this portal can and should supply information for other policy makers. Probably this could be better done by other portals, with which we can exchange information[20].

8.5 Anchoring of results and continuation

Follow-up of the project

The common web portal is hosted by the 'Klimaatportaal', since this represents all partner organisations and does give as much attention to climate change as to climate change impacts. The website of KfC does also satisfy this criterion, however, the programme will end in 2014, whereas the 'Klimaatportaal' is not set up for a limited time, just as the CIG/KEW.

This project will be continued until 2014, as part of work package 4 of research theme 6 'Climate projections' of the KfC programme. In the follow up, the partners will work on the proposed improvements mentioned in the Sections 8.1 to 8.4.

During this continuation of the project new information form Theme 6 will be included. Also information and datasets form other Themes within KfC can be connected to this portal. The partners working on climate change impacts and land use in Theme 6 are all also involved in other Themes of KfC (especially in Themes 1 to 3).

[20] E.g. the 'Klimaateffectatlas' portal, which was set up for policy makers of the Dutch provinces.

Updating the CIG/KEW

Whether a useful overview of available information and data can be given, depends strongly on the effort of the partner organisations in updating the web portal. For the coming years this is included in the Theme 6 project, which means that some time and money is available. Updating is also a common effort, since the usefulness also depends on the availability of similar information and data for each sector.

The set-up of the web pages should be such that the maintenance should not take much time: especially links to existing pages with little extra text that should be updated regularly.

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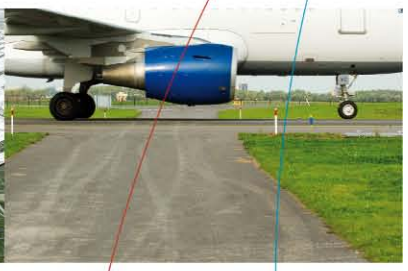
Colophon:

Sources of the photographs:
Sections 1.1, 1.3 (water management), 7.1: Beeldbank Rijkswaterstaat
Sections 1.2, 1.3 (wind energy), 3.1, 3.4, 3.5, 4.1 (pastures), 4.4 (ship), 5.1 (De Peel, Ackerdijkse Plassen), 5.4, 7.4 (potatoes): Gerard Hazeu
Sections 4.1 (greenhouses), 7.3: Noor van Mierlo (KvK@)
Sections 4.4 (mist), 7.4 (Schiphol): Peter de Vries
Section 5.1 (butterfly): Ruut Wegman
Sections 6.1, 6.2, 6.3 , 6.5: Bert Rijk



To develop the scientific and applied knowledge required for Climate-proofing the Netherlands and to create a sustainable Knowledge infrastructure for managing climate change

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