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Validation report of the case study in the Netherlands - intermediate report

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Short abstract	This intermediate report of WP8 - Case studies, presents for the lenvis case study in the Netherlands the technological developments and the user validation activities to date. Air quality models, real-time monitoring data streams, and water quantity and quality applications zooming in to the province of Noord Brabant have been developed and are being presented in the lenvis portal, mobile phones, and to a web-application for communication between the province and public users about bathing water quality and health risks. Professional and public user validation has been positive. Feedback received focused on further improvement of clarity and localisation. The feedback has been used for an inter-active development. The ongoing user validation activities in 2011 will focus on testing periods with dedicated public users groups.		
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COOPERATION

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1. Introduction

1.1. Objective of this deliverable

The objective of this intermediate deliverable is to report on the work done so far in lenvis in Work Package 8 to develop and validate the Dutch case study of the Noord-Brabant province. Application products have been prepared and user validation has been carried out to receive feedback and evaluations in order to inter-actively develop and validate the lenvis products. This intermediate report also includes the planning of the ongoing user validation activities in 2011. The report will be updated by the end of 2011.

1.2. Objective of user validation

The objectives of user validation are:

- To evaluate the current products on user functionality, robustness, user-friendliness, and user usefulness and attractiveness;
- To receive feedback to guide inter-active development during the lenvis project;
- To raise interest and actively involve, build a relationship with, potential users of the lenvis products in dissemination and exploitation after the closure of the lenvis project.

1.3. Outline of the report

In Chapter 2 the development of the case study throughout the project is being summarised. It includes the problem description, the contributions lenvis aims to provide, the users identified and their requirements as developed in WP1, the technical developments and technical validation in WPs 4 to 7, and the chosen strategy for user validation as described in D8.2. In Chapter 3 the application products developed for the case studies in the Netherlands are being described. In Chapter 4 the user validation performed up to date is described. The inter-active development with users and the user feedback and evaluations received are presented. In Chapter 5 the user validation activities in 2011 are described.

2. Case study description

2.1. Problem description

The case study in the Netherlands concerns the Noord-Brabant province. Three domains are addressed in this case study: air quality, water quality and water quantity. The problems arising in these three domains are described and summarised in this section. A detailed description about the case study area and the problems associated with it has been reported in a previous deliverable: D8.1.

In the Province of Noord-Brabant there are sometimes episodes of locally bad air quality (smog). This drives governmental authorities (e.g. the province and the municipalities) to develop measures (e.g. traffic regulation) that reduce emissions and to monitor the effects of these measures, and to communicate with the public in real-time about the air quality, to warn for potential health effects, and to learn from the public additional information about episodes of bad air quality and their impact on the inhabitants. Inhabitants, especially those practising outdoor sports or having respiratory diseases, are sometimes hampered by SMOG events directly (troubled breathing or just unpleasant dirty and unhealthy feeling), and on the long run face impact on their health from poor air quality.

With respect to water quantity the Province of Noord Brabant sometimes sees events of excess of water (risk of flooding) and periods of shortage of water in summer. Excess of water requires early warning to responsible authorities, water boards, municipalities, and the province, and to the public as a warning. Water shortage in the Province of Noord-Brabant generally is not felt by the public but is more a concern for authorities, water boards, province and the ministry, which in turn are responsible for water allocation amongst professional users for example farmers and industries.

With water quality the particular problem in the Province of Noord Brabant that is addressed in the lenvis project is the occurrence of episodes of bad water quality in outdoor recreational freshwater bathing waters (e.g. lakes). The province cooperates with water boards to manage these events. Water boards are responsible for the monitoring of bathing water quality. The province is responsible for taking appropriate measures when health risk levels are exceeded, such as placing warning signs or temporarily closing of the particular location. For the authorities involved the problem is two-fold. First the monitoring of water quality is largely based on sampling and therefore not continuous. On top of this the analysis of the samples, the communication of results from laboratory to water board, and from water board to province causes additional delays. This makes it a problem to have up-to-date information about the water quality in all the recreational bathing waters. Secondly the authorities have to implement the implications of the EU Bathing Water Directive in terms of informing the public about the water quality of the bathing waters. For the public the problem is that they are sometimes not informed or wrongly informed about bathing water quality, which may leave the visitors with health complaints after swimming.

2.2. Lenvis foreseen contributions and products

For province and municipalities lenvis can provide easy access and overview of real-time air quality monitoring and customised air quality predictions local to the area of interest, through internet and mobile phone. For inhabitants lenvis can provide customised SMOG alerts local to the area of interest and a platform to provide feedback to the authorities on the information received and health impacts felt. The lenvis portal would allow customising the overview of data, forecasts, alerts, and feedback, both for professional and public use.

For province, water boards, municipalities and the public, lenvis can provide an easy and customisable overview of the real-time and forecasted water excess or shortage for the local area of interest. The problem of up-to-date bathing water quality information can benefit from lenvis through more automatic and easy and fast communication of the sample results and interpretation of the samples between the laboratories, water boards, and province. On top of this a special contribution of lenvis can be the provision of easy feedback from public bathers to the authorities involved. In this way, if bathers see polluted water, or feel sick after a swim, they can more easily inform the authorities. This provides additional up-to-date information about the bathing water quality and health risks in between the samples taken.

In addition to the domain-specific advantages (water / air / health), the lenvis portal can provide easy finding and access to environmental and health information across domains, and allows for comparing this information for different locations in Europe. The lenvis portal allows customising the overview, access, and information shown, and allows further analysis of cross-domain or cross-location information. A simple example can be that a person who practices both running and swimming outdoors, in lenvis portal can find all the information he needs, instead of having to search the internet for different websites informing him about weather prediction, smog alerts, or closed bathing water locations depending on what he plans to do a particular day.

2.3. Users and User requirements

From the beginning of the lenvis projects potential users were defined and contacted (D1.2). For the Netherlands this has resulted in the following users that take actively part in the User Platform for continuous inter-active development of application products and for validation in the case studies (Table 1):

Table 1. Overview of dedicated user platform.

	Air quality - health	Water - health
Professional users		
Province of Noord Brabant (1 representative)		X
Province of Noord Brabant (2 representatives)		X
Province of Noord Brabant (1 representative)	X	
Municipality of Eindhoven (2 representatives)	X	
Water boards (6)		X
National directorate of water resources (1)		X
Municipality of Bergen op Zoom (1)		X
National Institute for Health and Environment (RIVM)	X	
Public users		
Running association	X	
Swimming association		X
Traffic and outdoor recreation association	X	

The most important user requirements that were identified in the Netherlands can be summarised as follows:

Professional

- Provision of up-to-date localised environmental data;
- Meteorological and air quality models for forecasts and simulation;
- Water quality and quantity models for forecasts, alert and simulation;
- Health exposure and risk assessment models;
- Public administrations, like the Province of Noord-Brabant, have a stronger need for increased communication with and involvement of their citizens. Therefore, feedback services are important in the Dutch case studies.

Public

- Information should be easy to find, without the need for downloading. This points to the need for customisable websites.
- Focus on advice or orders on what to do, in for example condensed and clear alerts.

A detailed overview of the user requirements found and the methods used to acquire these have been reported in D1.2

2.4. Technical validation

On the basis of the problems defined, the requirements expressed by the users, and feedback of the user platform during the lenvis project, a number of application products have been developed. These include real-time or up-to-date data streams, domain and case study location numerical models for making predictions, lenvis portal gadgets, web-applications and mobile phone applications. Where appropriate these applications make use of lenvis technologies, such as time series data web-services, grid data web-services, localisation services such as GPS, and portal registration and user profiling services. In Chapter 3 details of the application products developed for the Dutch case studies can be found. Applications have been subject to technical validation by the lenvis project team, on the basis of user profiles and use cases. This work is part of WP7 and is reported in D7.3. The user profiles and use cases have been defined in cooperation with WP8 case studies.

For the case studies in the Netherlands the following example use case is relevant because it is testing the user feedback applications both in the portal and in the mobile phone (Fig. 1):

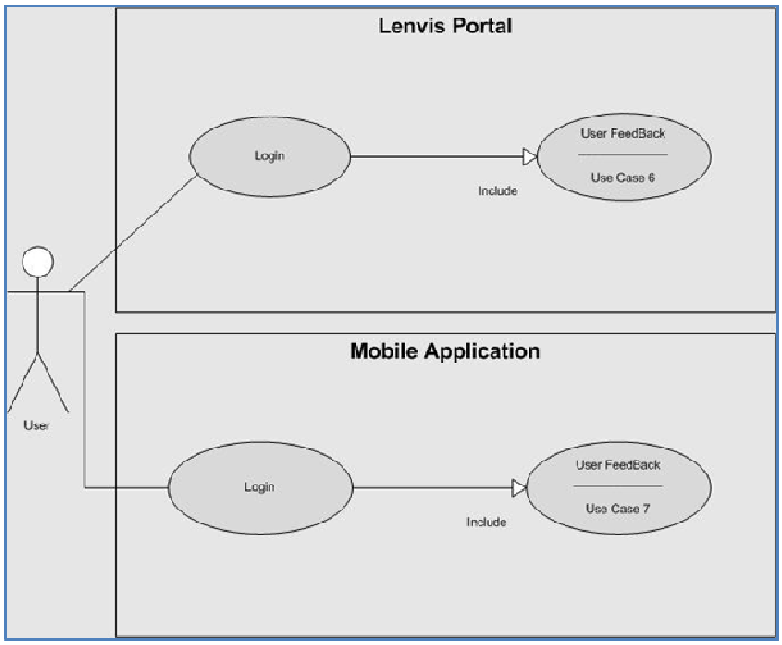

Fig. 1. Use case of user feedback in the lenvis portal and mobile phone applications. (D7.3)

In the lenvis web portal, users can assess the quality of the information displayed on lenvis services and also to report evidences to support the feedback given. The user must have an account in the

lenvis network and should be able to login in the lenvis portal. It is tested whether the portal or the mobile phone accept the feedback provided. These kind of technical tests are performed in WP7.

2.5. User validation

In parallel of the developments, following the user requirements (D1.2) and the detailed description of the case studies (D8.1), the evaluation strategy and testing methods for user validation were defined in WP8 evaluation plan (D8.2).

The evaluation strategy in the case study of the Netherlands can be summarised as a two-stage approach. The first stage is the continuous user involvement and feedback combined in inter-active development of the case-study application products. In this stage in the Netherlands mainly professional users have been involved from provinces, water boards, national health, environment and water organisations, and consultancy bureaus. According to the evaluation plan this phase was concentrated in the summer months (June – August) of 2010, especially for the bathing water applications. The air quality user evaluation also started in summer of 2010, and takes a more continuing approach into winter 2010/2011, whereas it is not restricted to summer (such us the bathing in open-water in the Netherlands).

The second phase focuses more on public user evaluation, concentrated in clearly defined testing periods in the summer of 2011, both for air quality and water applications. In these testing periods on the one hand the dedicated users from the user platform will be engaged, and on the other hand, for selected application products, also existing larger web-based user platforms will be requested for their evaluation, through web-questionnaires. The basic structure of evaluation forms, also to keep coherence amongst the different case study countries, was already outlined in the evaluation plan D8.2, and has now been worked out in a generic evaluation form (Attachment A).
The detailed testing activities in the Netherlands and the resulting user validation to date are reported in Chapter 4.

3. Case study application products

3.1. Introduction

The main developments for the three domains for the Dutch case study are:

- Air quality domain prediction service and model on demand service;
- Bathing water quality domain inland bathing water website and portal web-parts for public and professional users;
- Mobile phone android applications for inland bathing water quality general information and data and text feedback.

The specific application products that have been developed for the case studies in the Province of Noord-Brabant are listed below (Table 2).

Table 2. Overview of lenvis application products for case studies in the Netherlands

Application product	Presentation platform	Target users
Air quality products		
Monitoring data stream	Website	Professional and public
Emissions model	Portal and mobile phone	Professional and public
Meteorological predictions	Portal and mobile phone	Professional and Public
Air quality predictions	Portal and mobile phone	Professional and public
Water quantity products		
Meteorological information stream	Portal	Professional and public
Water-balance predictions	Portal	Professional
Groundwater predictions	Portal	Professional
Water quality products		
Monitoring data stream	Website	Professional (dedicated public)
Bathing water health warnings	Portal and website	Public
Bathing water meta-information	Portal and website	Public
Feedback application	Portal and mobile phone	Professional and public
Layer application	Mobile phone	Public and professional

These applications are described in more detailed in the sections below.

3.2. Data streaming

Air quality

Archived emission data of the Netherlands has been acquired for the years 2000-2009 from the public emission registry website (www.emissieregistratie.nl). The data has been processed to build the 3 x 3 km grid emission inventory for the AT air quality numerical prediction model. Over regional and European scale the EMEP emissions inventory has been processed to build a 27 x 27 and 9 x 9 gridded emissions inventory.

Real-time data streaming has been set-up from the Netherlands Environmental and Health Institute (RIVM). RIVM provides in real-time the measurement results of the monitoring stations in the Noord-Brabant pilot city of Eindhoven to the lenvis project (exchange through web-application). The data is on an hourly time-resolution.

Water quantity

For water quantity real-time and recent archived (6-months) meteorological data streams of Precipitation and Evaporation have been set-up. These include monitoring stations of the Netherlands Meteorological Institute (KNMI, Fig. 3), precipitation radar of the KNMI, and numerical model ensemble forecasts (EPS) of the European Centre for Medium-range Weather Forecasts (ECMWF) with up to 15 days forecast horizon (Fig. 2). Localisation is implemented through the map, where the users can select the station nearby their location.

The data is streamed and has been made available on the lenvis portal gadget with the lenvis data-series web-service. Users can select station names, variables of their interest, time period, and plot graphs. The data is being used by the Water-balance portal gadget. The data is also being archived by the SOBI REPOS to allow professional users to analyse it later.

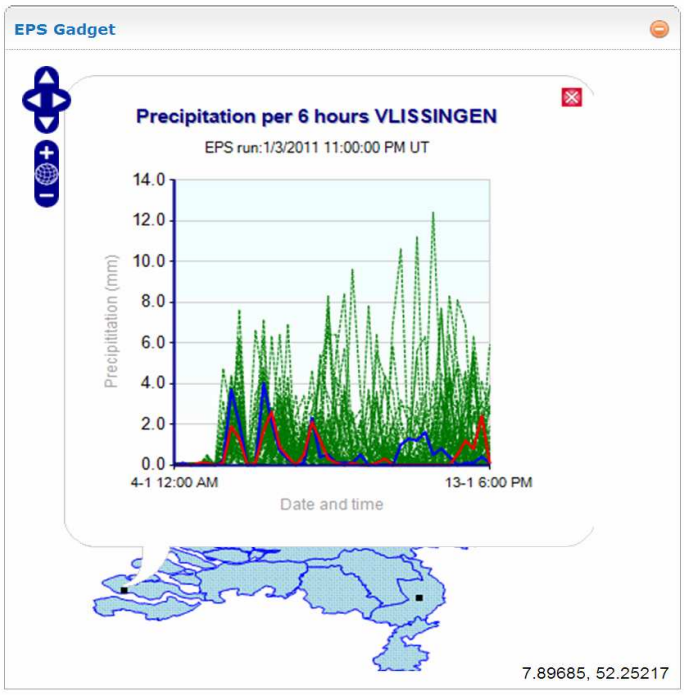

Fig. 2. Numerical weather prediction model results for precipitation for stations in the Netherlands

Fig. 3. Temperature graph from the KNMI Lelystad automatic station. The slider makes it possible to select the time frame for the graph and the icons above give access to the wind direction, wind speed and precipitation variables.

Water quality

For bathing water quality real-time data streaming of the most recent samples taken is provided through the water-boards. The water-boards automatically publish reports on a dedicated ftp-server. These reports contain the relevant variables as selected by the professional users of the Province Noord-Brabant and the water boards. Currently these variables are:

- Chlorophyll-a (as indirect indicator of possible presence of Blue Algae)
- Intestinal Entero-bacteria
- Escherichia Coli
- Oxygen
- Visibility (clearness)
- Temperature

The report is published directly after new information is available and validated. The lenvis data streaming application updates in regular intervals with the most recent report available on the ftp-server.

The data can be accessed per bathing water recreational location. Localisation is done by the user through Google maps (Fig. 4). The data is presented both in a graph containing all the samples of the current bathing season, and the latest measurement values are provided in numbers (Fig. 4).

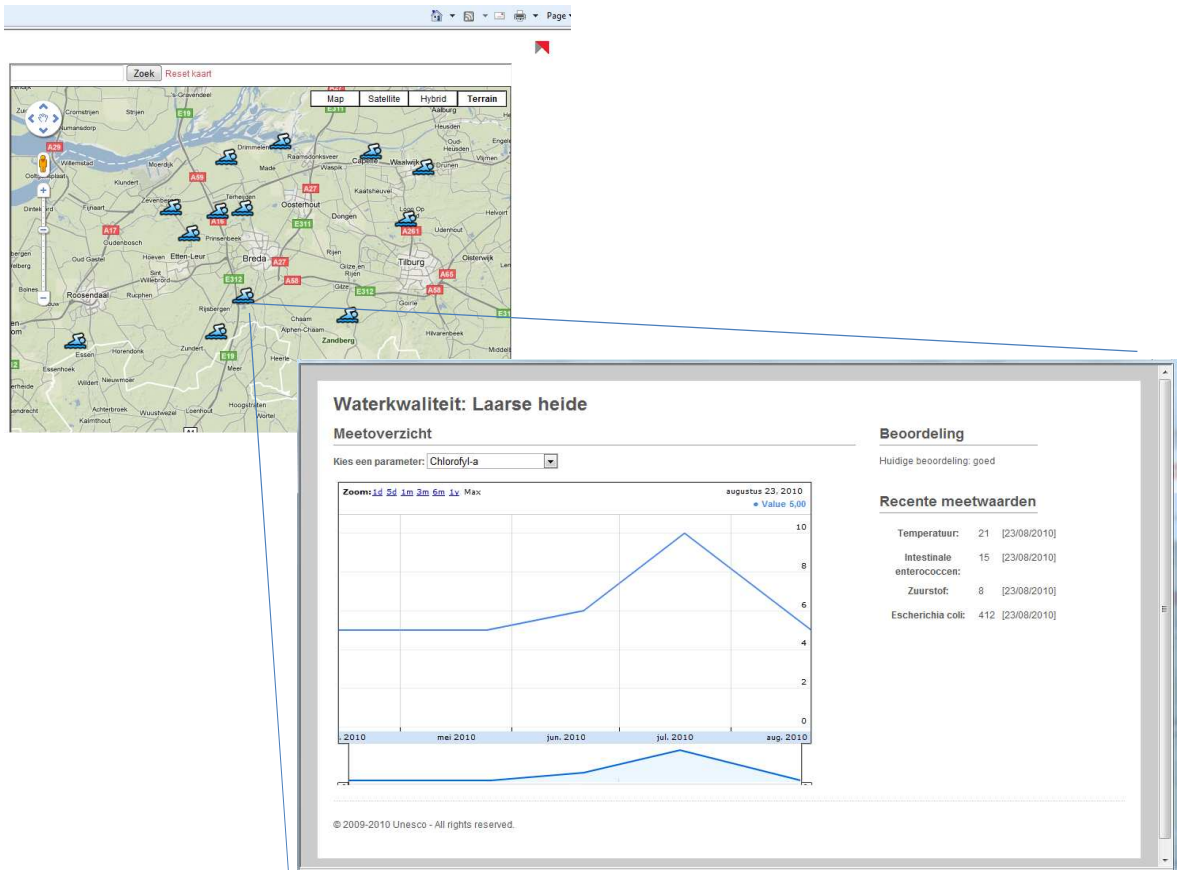

Fig. 4. Localisation and display of up-to-date bathing water quality data.

3.3. Modelling applications

Air quality

The Air quality system fully described in the LENVIS Deliverable 5.2 consists of three different sub-systems:

1. MM: Meteorological Model. This is a system giving the description of wind, temperature, water content and turbulence fields in the atmosphere, in three dimensions and with a spatial resolution going down to three km (nesting).

2. EM: Emissions Model. This is the subsystem where all emissions are compiled and organized in order to be ready to drive the chemical-transport Air Quality Model.

3. AQM: Air Quality Model. This is the core system, using input from EM and MM in order to estimate 3D concentrations and 2D depositions for a complete list of substances (gas and particles) present in the atmosphere, taking into account the full system of chemical reactions and physical processes that can occur.

The Air quality system has been configured for the simulation of meso-scale meteorological flows over the over the Noord-Brabant province.

MM: meteorological model

As presented in Fig. 5, the meso-scale meteorological simulations over Noord-Brabant province area, must start from a very large outer geographical domain, and proceed through the use of nested (Deliverable 5.1) domains down to the scale for which dispersion modelling can be efficiently applied.

Both the initialization conditions and the boundary conditions for a meso-scale simulation must be provided by a global scale model (covering the entire globe). The NCEP in the U.S.A. (National Center for Environmental Prediction) daily provides 10 days of forecast free of charge the ftp connections to download sites, where data from the global model are available. The resolution is in 1 degrees (about one grid cell every 100km), so that nested models must go from that resolution down to 3 km resolution.

It has been decided to nest the WRF model to a final resolution of 3 km. Even if the model doesn't run on 2-way nesting mode (Deliverable 5.1), a classical ratio of 3 is defined between each domain.

The Noord Brabant province domains are specified in Table 3 and Fig. 5, and the time step and domains were chosen according to the usual practice at Aria Technology for mid-latitude simulations. The time step in seconds was taken typically as 6 times the horizontal resolution in kilometers. This is a recommended value given by the WRF developer (NCAR)

In the domain denomination:

- LS stands for Large Scale,
- RS stands for Regional Scale
- LcS stands for Local Scale

Table 3. Computational domains covered the Noord Brabant Province

Domain	Number of points	Resolution	Domain size	Time step
LS	55* 55	27 km	~1500 km * ~1500km	**120 seconds**
RS	55*55	9 km	~500 km * ~500 km	**40 seconds**
LcS	73*55	3 km	219 km * 165 km	**13 seconds**

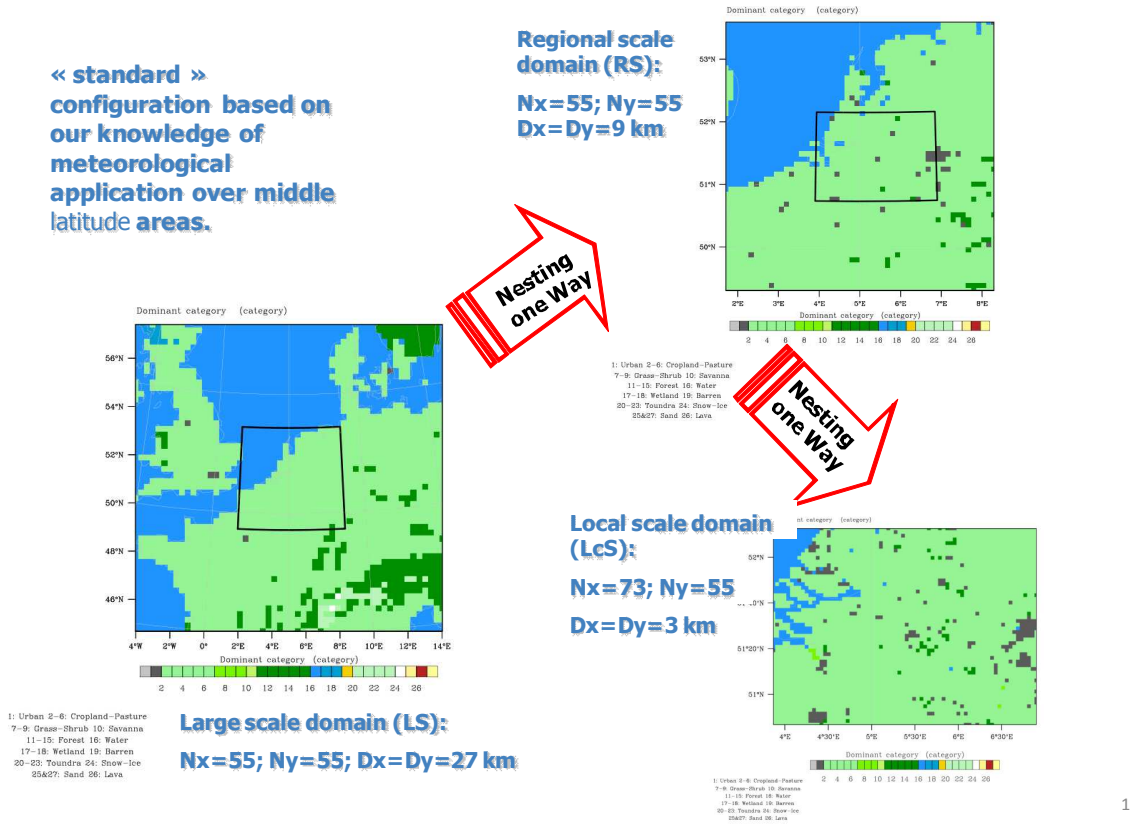

Fig. 5. WRF domains covered Noord Brabant province.

WRF comes with 51 vertical levels as recommended by NOAA. The standard vertical distribution given by the NCAR has 37 layers and mainly dedicated to meteorological application. The NOAA vertical grid adds many layers in the boundary layer (from ground au 2000m in the middle latitude) which is critical for Air quality application. This parameter is likely to impact all of the results, as it has an influence on the numerical stability as well as the vertical heat exchanges from the ground to the atmosphere. Both the Digital Terrain Model (DTM) and the land-use characteristics were extracted from the USGS-based database used by WRF, without specific refinements or corrections. This choice is probably sufficient for topography and land use, considering that we only reach a relatively low resolution (3 km). Finally, the implementation has been done with "default" parameterization as given by the NCAR. This set is supposed to work best in most of the cases for site in the middle latitude.

EM: Emissions model

This section gives an overview of the emission Inventory Implemented in the LENVIS case study.

The operation of AQM requires an emission inventory at the Large Scale (LS) and Regional scale which must be derived (if possible) from internationally approved databases.

Over Europe, the UNECE/EMEP continental emissions inventory gives you access to national total, sector and gridded emissions for the listed areas, years, pollutants/activity classes and total/sector categories. Several different types of data sets can be accessed: To fuel the AQM model the Emissions used in EMEP models are taken into account. In the EM model only Main Pollutants (the main acidifying and eutrophying pollutants) and PM (PM10, PM2.5, TSP) are used.

For the local scale domain, data from The Netherlands Pollutant Release & Transfer Register have been used. The register contains the yearly releases (emissions) of the most important pollutants in the Netherlands. The database is accessible through a public website, www.emissieregistratie.nl. The yearly releases on a 5 by 5 km grid from 2008 have been n downloaded. Yearly emissions of the main pollutants for each sector (e.g. Transport, Agriculture, etc) are given. These sectors have been translated to SNAP code with standard time modulation estimation.

AQM: Air quality model

As detailed in the Deliverable 5.2, the AQM is based on the CHIMERE chemical- transport model. It is treating the main physical processes, considering the following challenges:

- Describing properly the transport (advection and diffusion) in and above the boundary layer up to 500 Hpa. CHIMERE does not contain any meteorological driver. The physical properties of the atmosphere are provided in this case by the WRF meteorological model (MM).
- Take into account the influence of solar radiation on the chemical reactions (Gas-phase and aqueous) taking place in the lower atmosphere,
- Represent the contrasting effects of two main groups of emitted pollutants (VOCs and NOx) in the dynamics of atmospheric chemistry and ozone production,
- Represent aerosols physical processes: Nucleation; condensation/evaporation, coagulation, aqueous chemistry.
- Estimate the natural emissions of COV from Biosphere and aerosols (dust) due to wind erosion.
- Represent correctly all the removal processes: depositions dry and wet (in-cloud and sub-cloud scavenging, sedimentation.

Model result Presentation

The MM, EM and AQM model run daily and produce 48-hour forecasts. The results are presented in maps, and the user can localise by zooming and scrolling the map, and the user can customise forecast period, forecast horizon, variables to display and type of animation. 3-D visualisation with topography in Google maps, allows for showing intuitive animations that allows professional and public users to see an upcoming episode of SMOG developing (Fig. 6, Fig. 7).

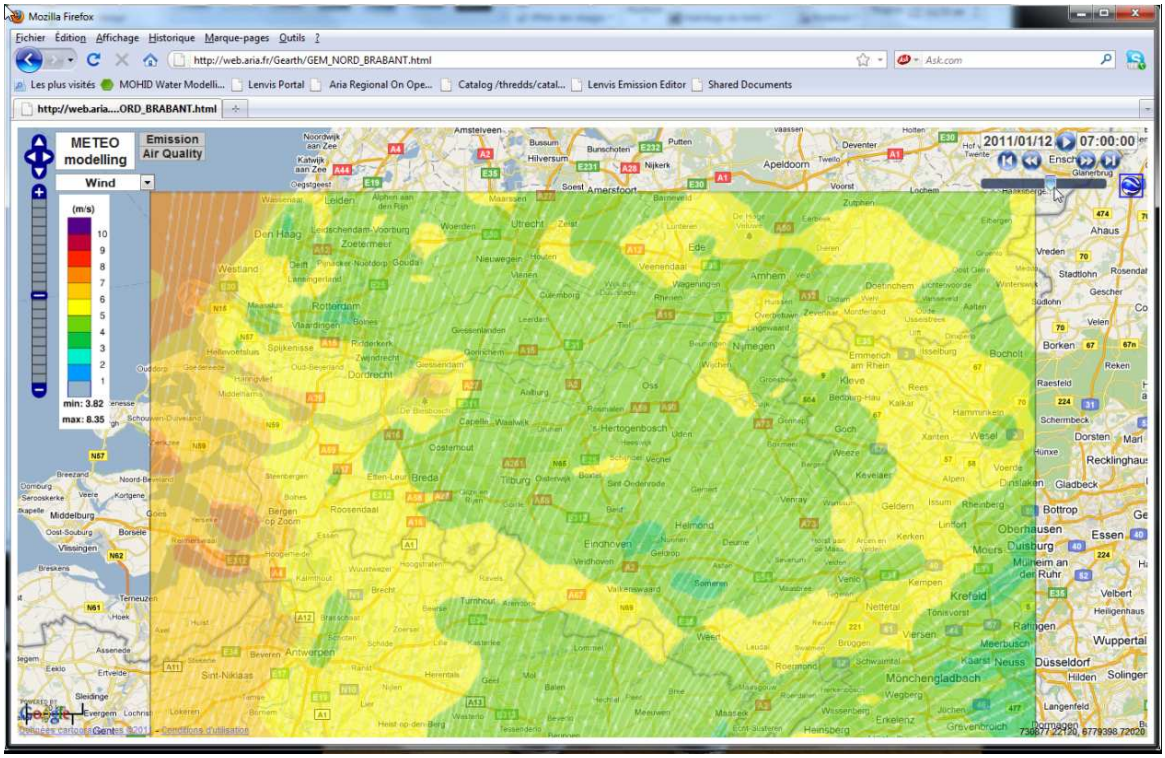

Fig. 6. Meteorological modelling for air quality in the province of Noord Brabant. Wind speed. Open layer feature.

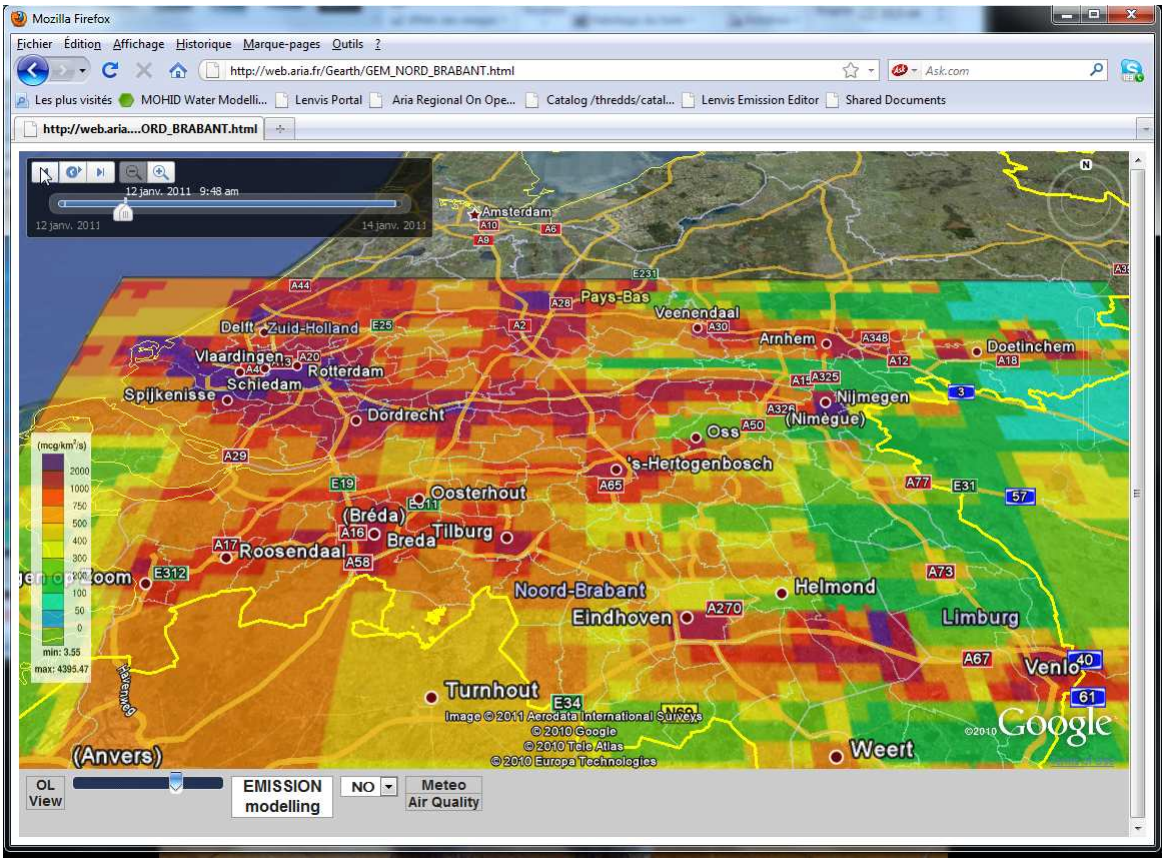

Fig. 7. Emission modelling for air quality in the province of Noord Brabant. Nitrous oxide emissions flux. Google Earth feature (Only supported by Chrome, Firefox and Internet Explorer).

Water quantity

The meteorological monitoring and predictions information is used in a water-balance model and groundwater prediction model (SIMGRO) for the Netherlands. The results are available in lenvis portal gadgets through lenvis web services. Localisation can be done by zooming in on a map. Easy selection of date and time is provided (Fig. 8).

The SIMGRO prediction results can also be plotted in time series graphs (Fig. 9). Professional users like regional water managers and farmers can follow the ground water level developments in their region to assess critically low or high levels in time and take appropriate actions, or use the information in negotiations about water resources allocation.

Fig. 8. Water-balance model.

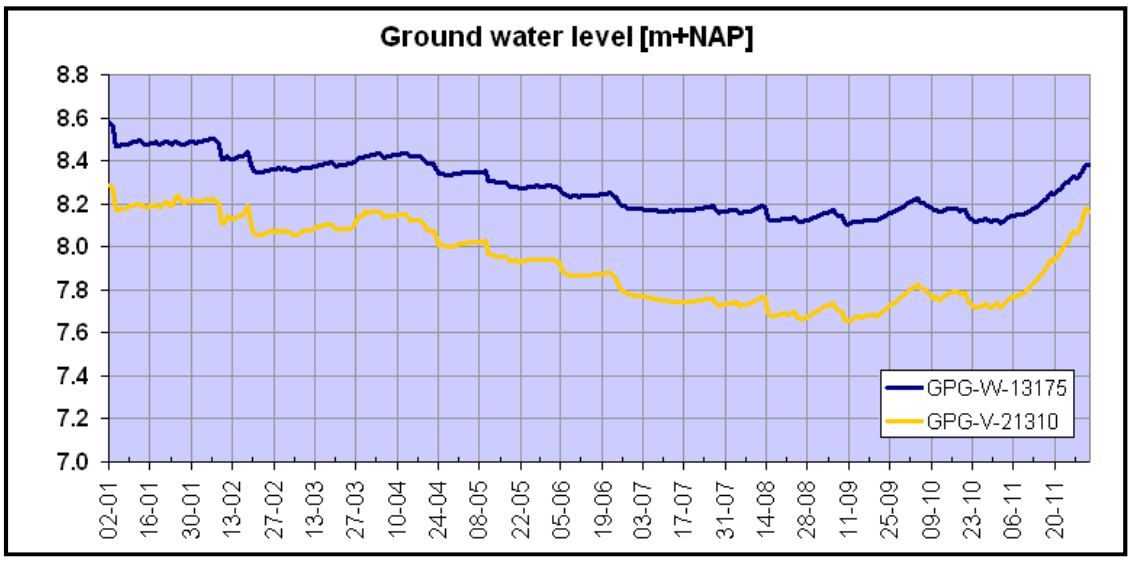

Fig. 9. SIMGRO water-balance, ground water level modelling.

3.4. Web- applications

Water quality

For bathing water quality of freshwater lakes in the province of Noord-Brabant a dedicated website has been developed that focuses on communication with and from the public users visiting these recreational lakes in the summer months.

The website has been designed with a simple overview with a clear lay-out for users to intuitively understand the purpose of the website and find the lakes in their neighbourhood through a map with clear icons. Mouse-over shows labels with the names of the lakes. When clicking on a particular lake, a tabulated pop-up shows up-to-date information on health risk warning or closures of the lake, water temperature, EU classification of the quality of the lake, more general touristic information, such us the location of bathing area for small children and restaurant and sanitary facilities, and address and directions on the third tab, with direct links to Google map directions and Dutch public transport sites (Fig. 10).

When clicking on the up-to-date bathing water qualification icon, a pop-up appears with explanation of what are the grounds for the qualification and three main indicators shown (Fig. 11). A link is provided for more information for professional users and public users that are interested in looking at the up-to-date sample data. This will direct the user to a graph showing the measuring points for a number of variables (see Fig. 4 on data streaming).

Users can visit this website to check current conditions in lakes in their neighbourhood or in the area where they will be for holidays.

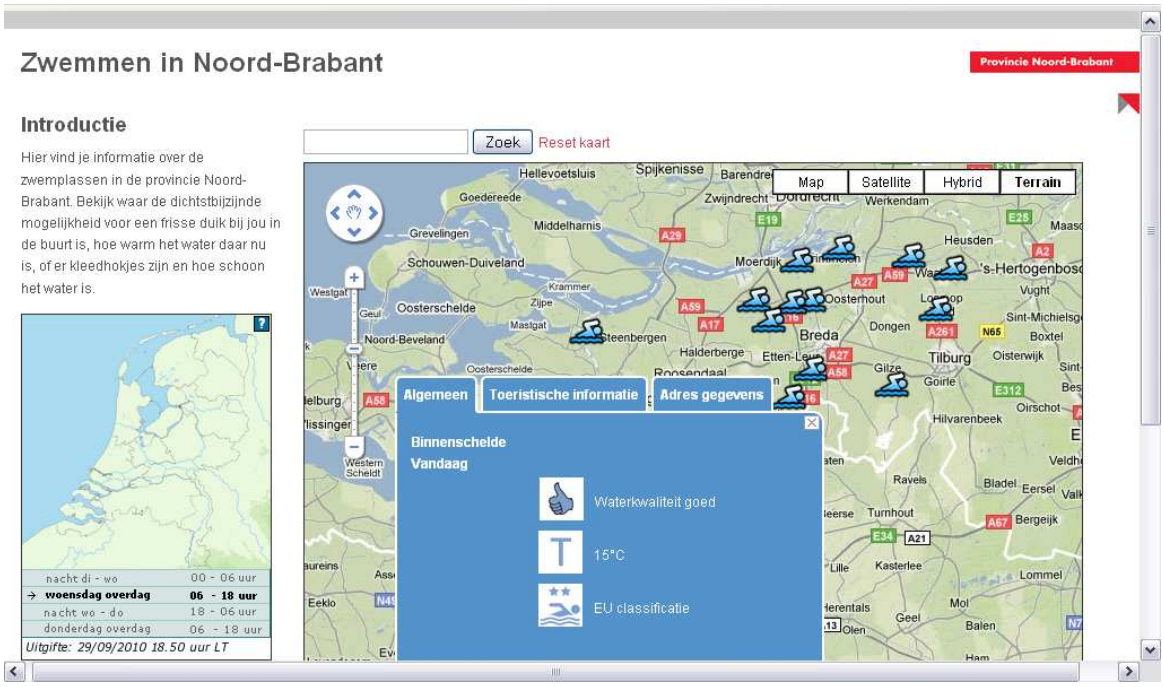

Fig. 10. Bathing water quality and health alert website.

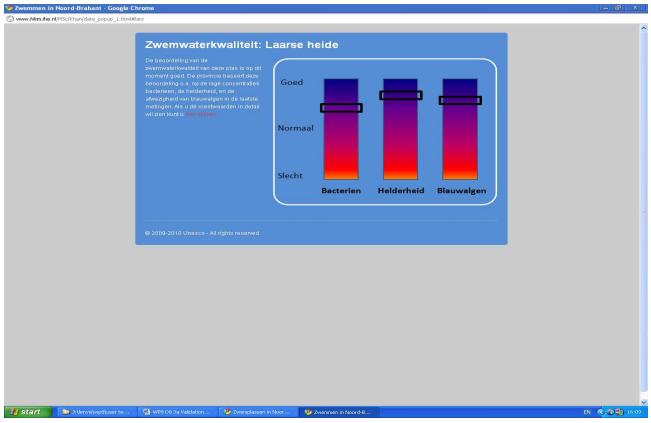

Fig. 11. Explanation of up-to-date bathing water classification, and graphical representation of three main parameters (Bacteria, visibility, and Blue Algae), for a particular lake.

3.5. Mobile phone applications

Air quality

The air quality model prediction results can also be accessed for viewing by mobile phone. Dedicated menu's for easy access have been developed (Fig. 12) for Google Android and I-phone platforms.

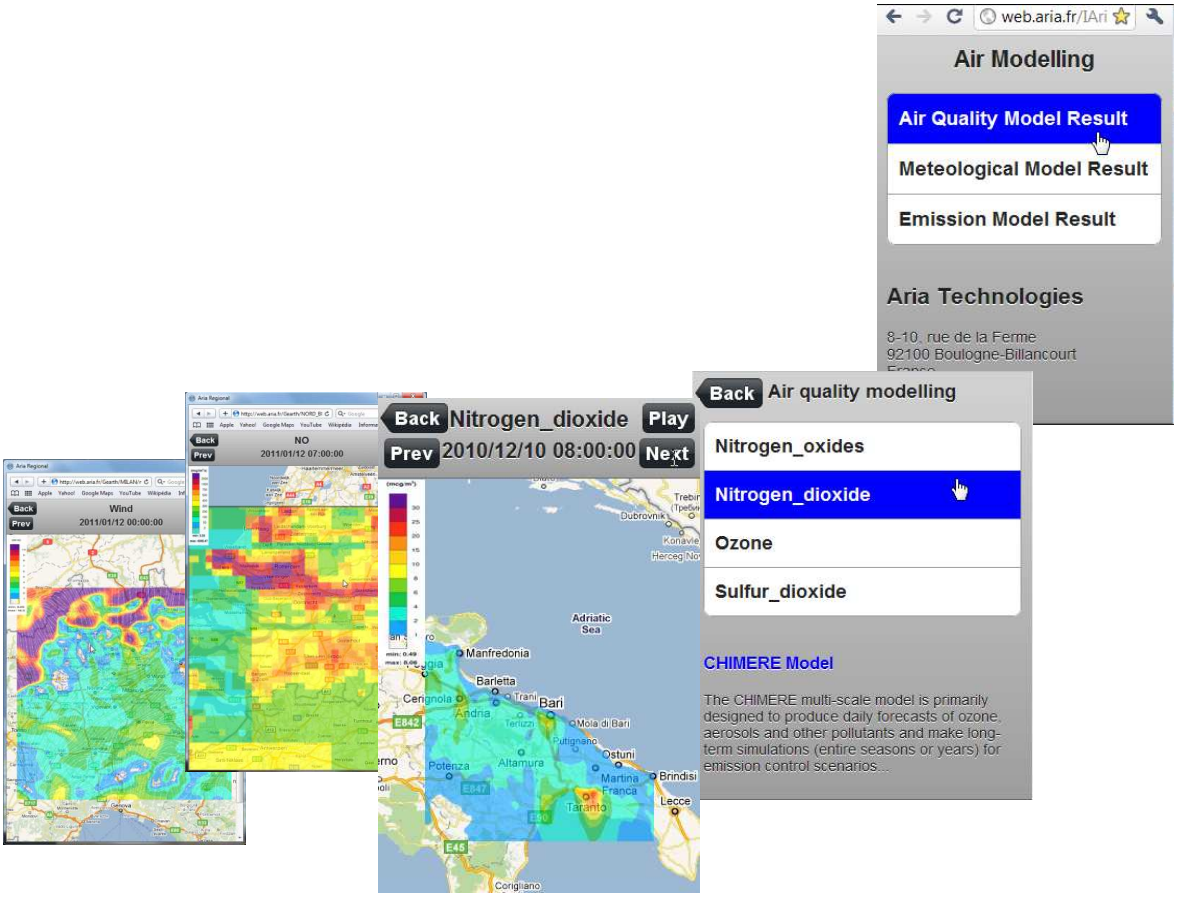

Fig. 12. Air quality model results.

Water quantity

The water-balance model results are next to the lenvis portal also accessible by mobile phone application in windows mobile (Fig. 13).

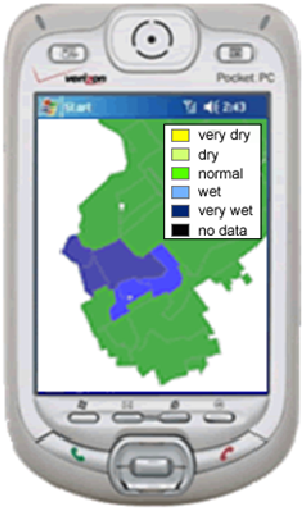

Fig. 13. Water-balance model results.

Water quality

The up to date water quality information of recreational lakes in the Province of Noord-Brabant can also accessed by Google Android. In addition this dedicated application includes structured and un-structured user feedback functionalities. Public users can provide text comments about their experiences on the bathing visit, and professional users can provide numerical measurements or indicators. Both feedbacks will appear on the application graphs and unstructured user-feedback overview.

A special application has been developed using layer technology on Google Android phone. Using the GPS and compass localisation functionalities, users can point their phone and see on a radar the nearby recreational lakes and their present condition (open or closed, good or bad water quality). Through the integrated Google maps directions, it is easy to select a particular lake and use the phone as navigation device driving or walking towards the lake (Fig. 14).

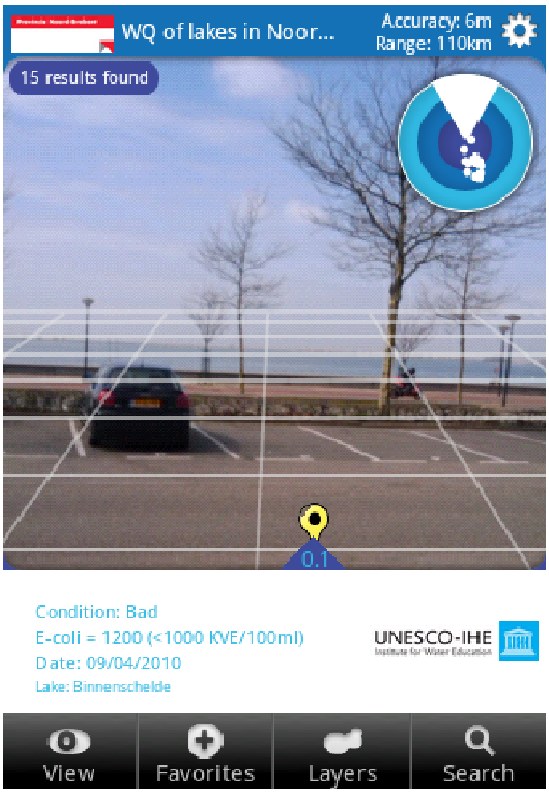

Fig. 14. Layer mobile phone application bathing water quality Noord Brabant.

3.6. Lenvis portal

The applications described above can be combined in the lenvis portal to make a user defined home page or a user defined domain page. Fig. 15 and Fig. 16 show examples of an air quality page and water page for the Netherlands. For the air quality page the air quality overview gadget is selected to allow identification of the available air quality model spatial domains (e.g. Netherlands and Italy). Next to it the real-time meteorological forecast for the Province of Noord-Brabant is shown.

For Water the bathing water quality and general information map is shown as a web-part, together for with the ensemble precipitation prediction for the coming days, and the water-balance prediction for the Netherlands. This provides an instant overview of relevant regional water conditions for water professionals.

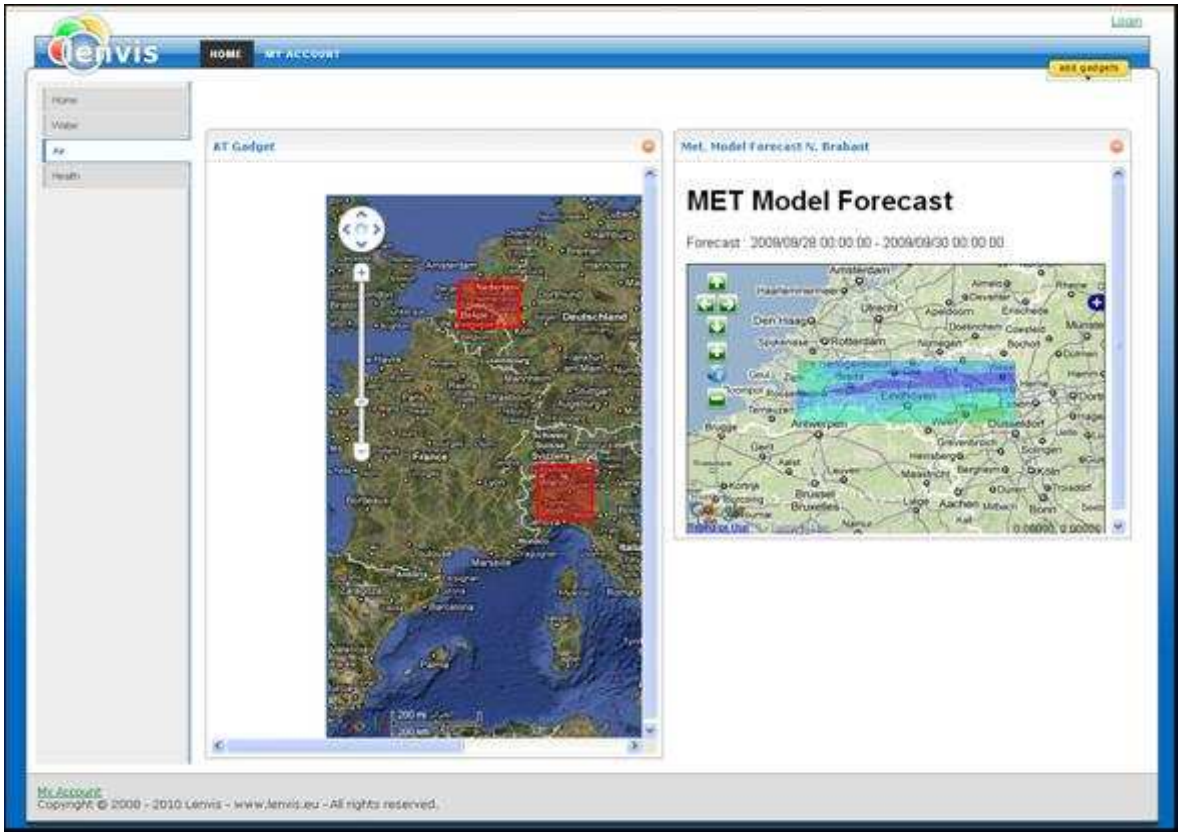

Fig. 15. User customisation of Air quality domain lenvis portal gadget.

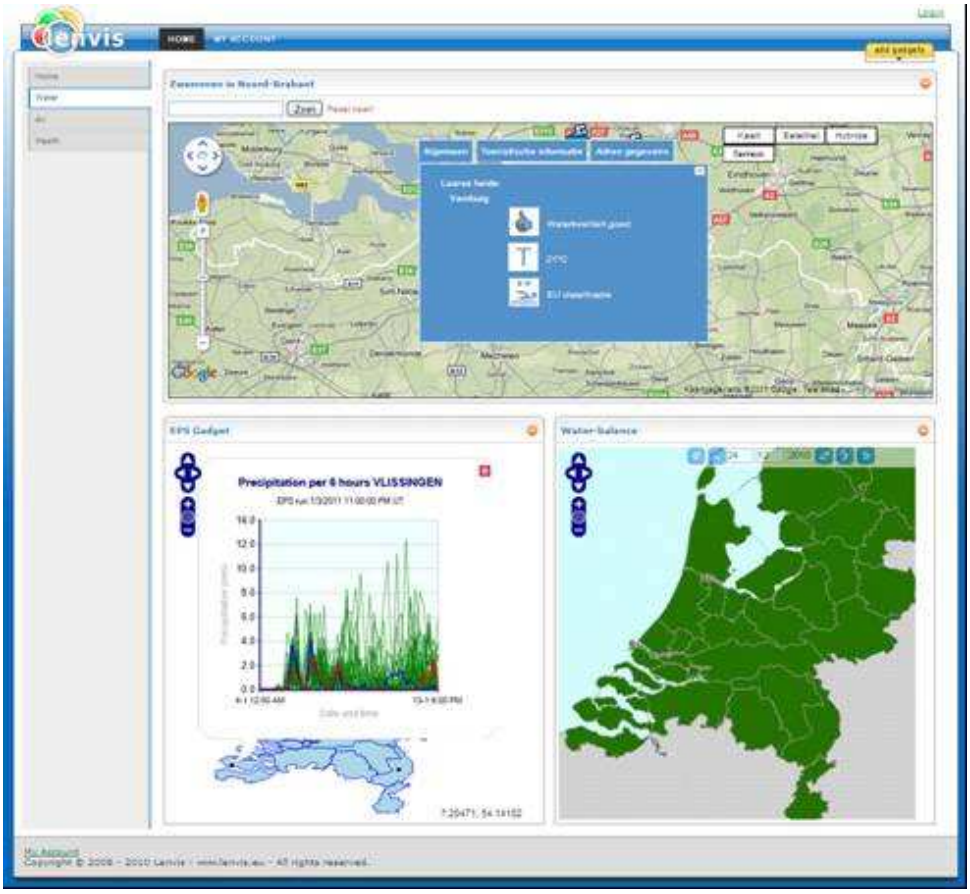

Fig. 16. User customisation of Water quality domain lenvis portal gadget for Dutch case study.

4. User validation

4.1. Evaluation strategy

The first stage in user evaluation in the Netherlands is the continuous user involvement and feedback combined in inter-active development of the case-study application products. In this stage in the Netherlands mainly professional users have been involved from provinces, water boards, national health, environment and water organisations, and consultancy bureaus. As of April 2010 this evaluation was mainly done through face to face meetings. The application product in development would be presented and hands-on tested by the users present, and feedback would be given and discussed, including ways of implementing suggested changes or additions.

In addition to these face to face meetings, users have been asked to give a more formal evaluation and feed-back on intermediate products through e-mail. It was chosen to use plain e-mail (e.g. instead of structured forms) in this stage to keep the threshold for response as low as possible and to be open for unexpected input from the users.

The third major source of feedback was the lenvis mid-term seminar, September 2010, during which a large group of various users received demonstrations and hands-on tests.

The second phase focuses more on public user evaluation, concentrated in clearly defined testing periods in the summer of 2011, both for air quality and water applications. In these testing periods on the one hand the dedicated users from the user platform will be engaged, and on the other hand, for selected application products, also existing larger web-based user platforms will be requested for their evaluation, through web-questionnaires. The basic structure of evaluation forms, also to keep coherence amongst the different case study countries, was already outlined in the evaluation plan D8.2, and has now been worked out in a generic evaluation form (see Appendix A) .
The detailed testing activities in the Netherlands and the resulting user validation to date are reported in Sections 4.2 and 4.3.

4.2. User validation activities

Face to face user evaluation meetings have been held throughout the year. According to the evaluation plan, in particular June, July, and August have been an intensified user-interactive development of the bathing water quality web-application, during which next to face-to-face meetings also e-mail feedback was provided on the basis of repeated usage of the web-application by the users at work or home. Also Air-quality monitoring and modelling services have been presented to and discussed with professional users of province and municipality. The mid-term seminar at the end of September was used to have the application products tested and evaluated by a wider group of users (Fig. 17). An overview of the user evaluation meetings held is provided below (Table 4).

Table 4. Overview of user evaluation meetings

Date	Subject
22 April 2010	Dutch water professional user meeting
26-April-2010	Dutch Air professional user meeting
25 May 2010	Dutch water professional user meeting
15 June 2010	Dutch Air professional user meeting
29 June 2010	Dutch water professional user meeting
21 July 2010	Dutch water professional user meeting
31 Aug 2010	Dutch water professional user meeting
30 Sept 2010	Mid-term seminar end user meeting, International and national professional and public users present
25 Jan 2011	Professional and public Dutch air quality user meeting

Fig. 17. Photos made during the hands-on user testing of mobile phone application at the lenvis mid-term seminar in Delft, September 2010. At the end of the pavilion demonstration sessions, the received feedback was summarised and discussed.

4.3. User validation results

Air quality products

The first meteorological information was provided as an embedded map of the Netherlands. Feedback received to this information was that it was not localised enough. Preferred option would be to have a zoomed-in map at the provincial level, having the service remember the zoom-level and location as set by the last visit of the user.

For Meteorological predictions the feedback was the same as for monitoring, previously described as preference to have it more localised.

The air quality modelling and representation services function well. Further development should focus on including time series handling and representation services (now only maps are presented). Detailed feedback about the maps was received, e.g. to add a scale bar, and to use 3-D effect if possible. Other feedback referred to the wish to have more detailed predictions, because the first modelling products for the Netherlands were based on publicly available data. Other feedback given was to include direct coupling to health risks and behavioural advice for communication with public users.

Water quality products

For the presentation of up-to-date bathing water quality sampling data, feedback included different levels of detail. On a generic level, a critical note was put that for public users to be confronted after one click with technical water quality parameter values in a graph would be too much detail. This is because in the early stages of development of the web-application, the up-to-date sample data was directly linked to from warning icons on a Google-map.

On a higher level of detail it was debated which variables should be shown, and which not. The type of graphs was also discussed. As bathing water quality samples are taken monthly or two-weekly, continuous graphs are not a proper representation. Point graphs or bar graphs are to be prepared.

For the bathing water health warnings it was discussed that this should not be done only automatically, because measurement errors cannot all be automatically detected, and interpretation by human experts is needed. Also the clear responsibility structure and information flow from laboratory, to water board, to province needs to be adhered to by the warning system. Always, the province has the responsibility to issue a warning, or to temporarily close a bathing-water.

The way bathing water information was originally presented together with the other bathing water applications in a too busy web-application. In inter-active development this has been changed and the latest version, following national and European developments in design of communication signs for recreational bathing waters, is positively received. Ongoing feedback mainly concerns details on which information to present and what terminology to use.

The Android mobile phone applications were positively received. A user friendliness test was done to see whether the application could be used intuitively without the need of explanation or user guide. This test had positive result. Critical feedback was done toward the poor readability of part of the information, and a good point was made that dedicated mobile phone applications should use unique mobile phone functionalities, such as GPS, because otherwise compatible web-applications are sufficient in a society where increasingly mobile phones have good web-browsing facilities. The structured and unstructured mobile phone feedback applications were considered very useful.

Technically it was suggested to show more clearly whether the feedback was submitted and received successfully or not (yet), e.g. progress indicators. Also the Android 1 phone's touch screen was not easy to use directly by a number of the users. This is considered normal, and users soon adapt after having used their own smart-phone for a while.

In addition to the detailed, and case specific, feedback described above, during the mid-term seminar of September 2010 also important feedback to the lenvis developments as a whole were provided. These have been summarised in the bulleted list below (see WP9 D9.5 Report of the mid-term seminar):

- Overall the portal and the demonstrated widgets are covering the three domains and case studies. Focus in the second half of the project should be on integration between services and domains, as planned in WP7 and 8.
- Communication possibilities between widgets in the portal should be researched.
- Generic user feedback services should be researched, as now the feedback services are developed specifically for a particular widget in the portal.
- While the portal is already customisable in the choice of widgets to activate, it would add to the customisability if also the size of the frames could be varied by the user.
- When developing widgets for in the portal care should be taken that while it is kept as simple as possible fit in a limited sized i-frame, still all the necessary information is included (e.g. legends, units, etc.).
- With the choice of development of Mobile Phone applications, the increasing availability of good web-browsing functionalities on mobile phones should be taken into account. With this development the added value of general mobile phone applications becomes less apparent, while the added value of applications that explicitly make use of unique mobile phone functionalities, such as GPS for localisation, becomes all the more clear.
- While lenvis should remain its innovative character through research and development towards a range of environmental and health information services, care should be taken that the products should remain sufficiently simple, self-explanatory, selectable and functioning reliably, for the users.
- Preferably every service that communicates to or with public users and may be of interest to international users, should be both in the local language and in English to maximise the potential use of the service.

4.4. Impact on development

The meteorological information data services are now more localised such that users can select meteo-stations for their area of interest and display monitoring data, and predictions for that station.

For the air quality case study the focus of the feedback from professional users on the relationship with health impacts and communication with public users, re-assured the focus in development on a pilot air quality prediction system with customisable, both in localisation and forecast horizon, viewing of results. The detailed feedback concerning the maps, has already been incorporated by including a scale bar and by including the 3-D effect through the use of the Google Earth API. For the health impact the coupled modelling results of the air quality and health model for the Italian case study will be closely followed, and potential for adoption in the Netherlands will be analysed. Next to this, in response to the feedback on the level of detail of the predictions, the 5 by 5 km spatial resolution emission inventory is being included in the prediction model.

Because of the difficulty of retrieving detailed (high spatial and temporal resolution) emission inventory data for the Dutch case study, the web-application for updating the emission inventory was developed for air-quality professionals of the Province of Noord-Brabant. This allows further

improvement of the air quality model, and it allows for analysing the effect of management action to reduce emissions on the air quality predictions through scenario calculations.

For the water case studies the focus of the professional users of the Province of Noord Brabant, the Water Boards, and the national Directorate for Water Resources, on communication of the up-to-date bathing water quality of fresh water lakes to the public users according to the EU bathing water directive, directed the developments to a dedicated website. Where in the beginning the pilot web-site consisted of many technical functionalities from the start of the home-page, in later versions the home-page was simplified to make it easier to understand and to see the overview by public users. Through inter-active development with monthly meetings with the technical and communication professional users a layered website was built that primarily allows easy localisation of the lakes and their present water quality status.

To preserve consistency with EU bathing water directive and forthcoming Dutch national agreements on design of physical information boards at the bathing water location, similar design was applied to pop-up tabs on Google-maps api.

In response to feedback received, the bathing water quality sample data was put backward. Now, when clicking the quality qualification icon of a particular lake, first a short explanation about the grounds for the current qualification are given, then by clicking the detailed information option, the third information layer of the actual data can be accessed. In this way still interested pubic and professional users, can intuitively get to more detailed information about the bathing water quality, up to the actual data points of the relevant variables.

With respect to the mobile phone applications feedback that these should make use of functionalities unique to mobile phones, layer applications are currently probably the best examples. Layer applications make user of both the GPS and Compass functionalities of the newest smart phones. The positive feedback on the layer application for bathing water quality leads to a focus on improving that application and where possible integrating it in the testing activities in 2011.

4.5. Impact on continued user interaction

The inter-active development approach for the water applications and air-quality quality applications led to an actively involved dedicated professional user platform. Now that the pilot applications have reached a mature stage, and because of the positive reception of the bathing water quality applications, for the continuous user inter-action the user group is expanded. Now more water boards, other provinces, and consultancy bureaus, have joined the regular meetings.

Because for the public users the chosen approach has been more careful, now that the pilot applications have reached a mature stage, the continuous user interaction will involve more regular face-to-face meetings with public users in preparation for the testing periods in 2011. Still care has to be taken not to over-do it, because public users have to invest free-time or even take holiday hours to be able to come to these meetings.

5. Evaluation activities in 2011

5.1. Continuous user validation

The continuous user validation with the dedicated users of the User Platform will increasingly involve public users in 2011. These users will be prepared for the testing periods in dedicated meetings.

Because of the wider group of users that showed interest during the mid-term seminar, this seminar approach will be repeated to communicate about the final products and evaluation results of the testing periods. This will be combined with the final lenvis seminar. In this way, although it is not possible to involve all users in the testing periods, involvement of this wider group of users will be maintained. Also the continuing lenvis newsletters contribute to this end.

5.2. User testing events/periods

Next to the continuous user evaluation, in the Netherlands two specific evaluation activities are planned in 2011. The first are testing periods (of a month) with a selected user group, consisting of both professional and public users. These periods, both for air quality and water applications, will be held in the summer period (June-July-August).

Users will be asked to use lenvis application products regularly for specific activities. For air quality, for example, people that regularly run for exercise, will be asked to plan their training with the help of the lenvis air quality information. Their evaluation will be supported and structured through user evaluation forms. These forms will have a similar structure in all case study countries to allow inter-comparison. A basic evaluation form has already been prepared and is provided in Appendix A.

The second type of evaluation activity in the Netherlands will be through web-questionnaire. Because for dedicated public user groups, such us bikers or outdoor recreational users in general, user platforms for web-questionnaires are already in place. These will be approached with a dedicated evaluation form for selected lenvis case study application products.

5.3. Analysis and reporting

In September and October the evaluation results of the testing periods will be analysed and incorporated in the final version of this deliverable. The case study country reports will then be integrated and inter-compared in an overall lenvis case study report.

6. Conclusion

This intermediate report provides an overview of the development and validation results in WP8 case studies in the Netherlands to date. The user validation of the application products developed for the case study in the Netherlands has been positive. Part of the feedback with suggestions for

improvements in the application products have been already taken up in the updated versions of the lenvis products. Remaining developments will be completed in the first half of 2011. The user validation for the case study in the Netherlands in 2010 was mainly done with professional users and a limited number of public users. The positive results show that the lenvis products are ready to be tested focussing more on public users in 2011.

7. References

- Lenvis report D1.2
- Lenvis report D5.1
- Lenvis report D5.2
- Lenvis report D8.1
- Lenvis report D8.2
- Lenvis report D9.5

Appendix A Generic lenvis-user evaluation survey

Project lenvis
Work Package 8

Dear Addressee,

This letter with questionnaire is intended to receive your input on how the lenvis information system in development fulfils your needs.

We kindly ask you to evaluate the part of the lenvis system, which can be found at:
<< provide url here >>

This is...<<provide description of lenvis parts you want the addressee to evaluate>>

We thank you in advance for filling out this form and are looking forward to receiving your response before <<provide date>>. Please return the form by e-mail to <<provide e-mail address here>> or if you prefer to send a hardcopy, you can use the following address:

<<provide address here>>

Best regards,
<<provide your and colleagues names + organisation>> , for Workpackage 8 in LENVIS

---
*www.lenvis.eu

User Evaluation Survey

Date: __ / __ / __
Name: _____
Note: your name is needed only to combine the information you provide during the project time; your answers will be processed anonymously.

<<user profile, only to be kept in the form for new users. From existing users this information is already known>>

I. User profile – Personal profile

1. Age: ____ years
2. Sex: Female / Male
3. Country in which you live: _____
4. Highest educational degree that you earned:
    - Higher vocational education
    - Bachelor's degree
    - University master's degree
    - PhD
5. Current job function: _____
6. Outdoors hobbies
    a. Swimm
    b. Surf
    c. Biking
    d. Walking
    e. Running
    f. Football
    g. Other(please specify):_____

7. What type of environmental and health information do you use in your work or free time? (e.g. weather forecast, water temperature, wind, smog, etc)

8. Why do you use this information?

II. Questions about the application

9. Is the structure of the application clear from the beginning (intuitively)? Please select the answer:
    a. Strongly disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Strongly agree

10. Is the application stable and easy to get information from it (please re-visit the application several times to check this)?

    a. Strongly disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Strongly agree

11. Please specify what type of information you find most usefull in the aplication?
    a. Maps
    b. Graphs
    c. Text messages from phones
    d. Other:...

12. Is the information in the application up to date?
    a. Strongly disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Strongly agree

13. Is the information in the application usefull for you?
    a. Strongly disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Strongly agree

14. Does the application allow for easy reporting, from your side, on information you want to share?

a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

<<Examples of case study or application specific question, schange these accordingly>>

15. Can information be used for prediction of bathing water quality, in your work?

a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

16. Would you recommend lenvis information on bathing water to other colleagues for their work:

a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

17. Would you recommend lenvis information on bathing water to friends, as information for their leisure activities:

a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

18. What would you like to see, extra, as information or functionality? Please specify

19. Could you please give your feed back on any other issue that this questionnaire did not raise.