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Validation report of Portuguese case study – 2nd intermediate report

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Short abstract	This intermediate report of WP8 describes the user validation activities for the Portuguese case study. An overview about developments, improvements, and alerts system that have been implemented according to the users feedbacks is given. The main Professional and public user validation has been positive and reveals very important for lenvis services developments.		
Keywords	End-users, evaluation, validation, Lenvis portal, alert system, bathing water quality.		
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COOPERATION

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Glossary and Acronyms

TERM	DEFINITION
ABAE (Blue Flag Association)	ABAE (Blue Flag Association)
AdC	Cascais Waters (Water Utility)
API	Application Programming Interface
ARH-Tejo	Tejo Regional Hydrografic Administration
Business Intelligence	Computer-based techniques mainly devoted to provide historical and current business information and identify prediction of future trends. Main BI functions concern reporting, on-line analytical processing, statistical and data mining analyses and business performance management
Carcavelos	Bathing Water of Portuguese case study
CMC	Câmara Municipal de Cascais (Cascais Municipality)
CMO	Câmara Municipal de Oeiras (Oeiras Municipality)
DAC	Data Access Component
DGS	National Health Directorate
Estoril Coast	Coast area where the Portuguese case study is located
Gadget	Dynamic web content which can be embedded on a web page. A gadget can be developed using the Google Gadgets API
HIDSS	Health Impact Decision Support System
HMM	Hidden Markov Model
INSA	National Institute for Public Health
INAG	National Water Authority
REPOS	A Service Oriented Reporting Business Intelligence tool developed by the lenvis partner ESA
Torre	Bathing Water of Portuguese case study
LENVIS	Localised environmental and health information services for all
SANEST	SANEST, SA
Santo Amaro de Oeiras	Bathing Water of Portuguese case study
SMS	Mobile phone Message

1. Introduction

1.1. Objective of this deliverable

This document is an intermediate report of Deliverable 8.3. It reports the evaluation activities carried out by the Consortium on Task 8.4 in the framework of the Portuguese case study until month 40. This intermediate report assesses the accomplishment of the case study objectives and the operability and robustness of lenvis platform, as defined on Deliverable 8.2. The report will be updated by the end of 2011.

1.2. Objective of user validation

User validation aims to collect user's feedback about lenvis technical developments - services and tools, including the alert system - in order to evaluate how the project responds to user's requirements and to identify suggestions for improvements. Presentations and demonstrations are being carried out by lenvis researchers and user's feedback and evaluation are being reported, in order to consider the entire user's point of view about the products and recommendations for their exploitation.

1.3. Outline of report

Portuguese case study is dealing with bathing water quality forecasts and includes the implementation of an early warning system for Estoril Coast Region. In early 2009 a user's group including all the institutions involved on the management of Bathing waters in Estoril Coast and the main non-governmental institutions was formed. The project was explained to this group in a meeting organised in main quarters of Sanest, the company managing residual water in the region. This group was maintained and is assessing the products and services developed in the project, which include a warning system. On January 2001 a meeting was held to present lenvis gadgets and developments for all users. During 2011 bathing Season (April- September) several meetings were held with lenvis users, in order to receive theirs suggestions and evaluation about lenvis gadgets and alert system implementation.

This document describes the activities carried on up to now and is composed by 5 chapters, including this first introduction chapter. In Chapter 2 the development of the Portuguese case study is summarised, including the problem description, users definition and their requirements (WP1), technical developments and validation (WP's 4 to 7), and the chosen strategy for user validation as described in D8.2. In Chapter 3 the application of the lenvis products in the Portuguese case study are described. In Chapter 4 the performed user validation is described, including all the inter-active sessions with users and the received user evaluation feedback and recommendations. The main user's evaluation results are presented on Chapter 5, discussed and analysed on Chapter 6. The main conclusions about Portuguese case study evaluation are explained on Chapter 6.

2. Case study general description

2.1. Problem description

The Portuguese case study (described in detail in D8.1) addresses bathing water quality and related health issues, on three bathing waters nearby Lisbon - Carcavelos, Torre and Santo Amaro de Oeiras, located west of Lisbon in a densely urbanised region (about 400.00 people live in the Costa do Estoril Region). Bathing water quality is under threat due to sporadic pollution events in the small streams discharging along the coast that might affect bathing waters quality and impair bathers' health.

The main goal for the Portugal case study is to narrow the communication between beachgoers, public authorities (local and national), professionals with responsibilities or competence over these beaches, and share all the data available about bathing waters and environmental quality.

Lenvis platform aims to develop a system allowing all these users to remain connected, to communicate and share relevant information among themselves, and to gain tools that will help them to better understand the local situation regarding bathing water quality and consequently helping the professional users to take better management actions.

Lenvis early warning system was implemented, and tested during 2011 bathing season. Responding to the new bathing water directive requirements, providing daily bathing water quality forecasts, and sending real time in case of short term pollution events (caused by stream level rise, and prepared for sending alerts in case of bad water quality forecasts). The professional users had an important role to validate and suggest progresses on this alert system.

2.2. Lenvis foreseen contributions and products

Lenvis platform aims to centralize the access to all the information about the Portuguese case study. Lenvis by now is making available the information about weather forecasts, waves forecast, water quality and quantity forecasts, data from meteorological and hydrometric automatic stations, and from monitoring work plans developed by SANEST, IST, INAG. This data is available for lenvis users by web services and gadgets. In order to share information and data between all the users (professional, data providers, bathers, surfers and general public), specific restricted rules are being developed considering users permission to see the data.

These tools are sharing data produced by public and professional users and spreading bathing water quality warnings fro professional users. These tools were evaluated by lenvis users, and their development and functionality were improved considering users feedback, this continuous evaluation and development work will go on until the end of 2011. Also contributions and agreements with national websites and enterprises (like sapo.pt) are still being established in order to take this lenvis platform to a national and international internet spreading level.

2.3. Users and User requirements

From the beginning of the lenvis project potential users groups were defined and contacted (D1.2). The first meetings with the user platform had the aim of knowing the main users necessities about bathing waters quality, the information that they would like to have about them, the fragilities and lacks of the current system, and the potentialities of a new information system (lenvis.eu). On beginning 2011 lenvis gadgets and services were presented to lenvis users, and their feedback was essential to evaluate them and optimising the lenvis platform.

Next table presents the lenvis end users who gave feedback about the Lenvis tools, on the several data types (Air quality/Health; Water quantity; and Water quality health).

Table 1. Portuguese user platform and their user group.

Users	Professional user	Public/NGO
SANEST (Water Utility)	X	
CMO (Oeiras Municipality)	X	
CMC (Cascais Municipality)	X	
INSA (National Institute for Public Health)	X	
INAG (National Water Authority)	X	
ARH – Tejo (Water Agency)	X	
Águas de Cascais (Water Utility)	X	
ABAE (Blue Flag Association)	X	X
DGS (National Health Directorate)	X	
SURFERS (Surfers schools)		X
PUBLIC (General Public)		X

The most important user requirements that have been identified in the Portuguese case study by the professional and public users can be summarised as follows:

Professional Users:
- The system has to incorporate the needs from the professional users (real time data, historic data, etc.), which are distinct from the public users, so that the professionals can use it to improve bathing water management, by optimizing their use of time and resources;
- The communication system that lenvis will offer is seen as an opportunity to speed procedures of cooperation between the entities that manage the several elements of the sanitation system on the case study area.
- Users must register in the system to guarantee from the beginning that only people with serious intentions will use it (to avoid harm use).
- A service that allows the public users to upload relevant information should be created (e.g. information about pollution events or illegal discharges). This information has to be appropriately documented and sent directly to the relevant entity.

Public Users:
- Surfer teachers refer that they need to be warned timely in the case of a pollution event that has a risk of undermining bathing water quality, since they give classes to young children and these are a particularly sensitive group of the population.
- Surfer ad bathers would like to know who is accountable for beach management, so that they can actually ask for proper action to the right entity, as well as make suggestions or even ask information. Thus, they see lenvis as an opportunity to fill up these gaps.

2.4. Technical validation

On Portuguese case study, the lenvis portal, developed gadgets and webservices, such as time series and grid data web-services, were tested in order to evaluate their performance. In Chapter 3 details of these application products developed for the Portuguese case studies can be found. Beside the user validation also a technical validation is performed. The technical validation work is part of WP7 and it is reported in Deliverable 7.3. Users also performed gadgets technical evaluation during their tests, these results were considered and are descript on Chapter 6.

2.5. User validation (WP8 evaluation plan)

The services and tools developed for the Portuguese case study, considering the user requirements (D1.2) and the detailed description of the case studies (D8.1) were validated by users, considering their different evaluation criteria, defined in WP8 evaluation plan (D8.2).
These programmed evaluation activities follow three principles:
- The development of lenvis system and services;
- The relevant seasons of the year for water, air, and related problems in portuguese case study;
- The presentation of lenvis services to users (including the alert system) , in order to collected the feedback from the different users point of view.

This evaluation was performed during all WP8 time period, and considering the gadgets development and the bathing season period, two main evaluation periods were adopted.
A first round of tests was performed from month 29 to 33, where the services and developments were presented to end-users. Their feedback was collected and considered in order to improve the implemented lenvis gadgets and services which were evaluated between months 33 to 42.

The first evaluation (month 29-33), consists in a general portal evaluation, where the professional users give feedback on modelling functionalities and web-services based on the use for their daily activities and decision making. Surfers are also contributing to validate wave forecast results to improve the options for their publication. Citizens and general public are mostly validating lenvis services publishing data and simulation/forecast results.

The second evaluation stage (Month 33-39), focus on the alert system implemented for bathing water quality forecast and on the improvements resulting from the feedback provided during the first evaluation period. This evaluation was performed during 2011 bathing season, has a bigger contribution of professional users (due to alert system evaluation), but surfers and public users also had contributed. The alert messages distribution tools and the communication tools used to gather data provided by themselves or by other users was evaluated.

Two testing periods - in 2010 and in 2011 bathing seasons - were initially planned for the bathing water quality forecast and alert system in the Portuguese case study. However with the 6 months suspension that lenvis project suffered, was not possible to perform the evaluation during 2010 summer season because hydrometric gauges could not be installed in winter/spring. The alerts system evaluation started on April 2011 (during bathing season preparation), and was done during all the bathing season. Frequent contacts are done with professional users, in order to evaluate the alert system performance. A detailed description of the testing activities and user evaluation to date are reported in Chapter 4.

3. Case study application products

3.1. Introduction

Applications were created for the Portuguese case study mostly for water quantity and quality issues although some tools were developed for managing meteorological forecasts. Table 2 contains the main information about these products, the local where the results are presented, and their target users. These applications are available on the lenvis portal or mobile phones, being the

data available to anyone or restricted for authorised users. Deliverable 7.2 reports a detailed description of all model applications developed on lenvis.

Table 2. List of Portuguese case application products, publication platform and target users.

Application product	Publication platform	Target users
Air quality products		
Meteorological data	Portal	Professional and public
Meteorological forecasts	Portal and mobile phone	Public
Grid Data Services	Portal	Professional and public
Water quantity products		
Water quantity monitoring	Portal and mobile phone	Professional and public
Water quantity forecast	Portal	Professional
Grid Data Services	Portal	Professional and public
Water quality products		
Coastal Water Quality monitoring	Website	Professional (dedicated public)
Coastal bathing water quality forecast and alert system	Portal and website	Public
Coastal bathing water now-cast	Portal and website	Public
Feedback application	Portal and mobile phone	Professional and public
Mobile Monitoring application	Mobile phone and website	Professional
Forecasts for Surfers	Portal	Professional and public
Grid Data Services	Portal	Professional and public

3.2. Data streaming (sensors)

Several data providers' collects useful monitoring data for portuguese case study, by automatic stations, or by manual monitoring work, as described on Deliverable 8.1. With lenvis communication tools these monitoring data is gathered and made accessible on lenvis portal, or by lenvis services - Table 3 summarizes all the data and the current service or location where it is available. All these data are useful to run models for the Portuguese case studies, improving forecasts and validating results.

Table 3. List of applications and services developed to present Portuguese data streaming, respective data sources, parameters and web locations.

Data	Parameters	Source	Service/web site	Location
Online Atmospheric data	Rainfall, Solar radiation, Wind (x, y), etc	Sanest meteorological station in Costa do Estoril	Lenvis Timeseries Client	http://webserver.mohid.com/webservices/lenvis/meteo/LenvisTimeSerieService.svc
Mohid results Online	currents velocity, current direction, water temperature, wind velocity, wind direction	IST models	MOHID On Line	http://www.hidromod.com/Lenvis/LenvisMohidOnline2/Lenvis/AllInOne/MOHIDOnline.htm
Tagus River Water quantity	Flow, level	Automatic buoys in Tagus	Internal link on Lenvis.eu	http://www.maretec.mohid.com/projects/lenvis/
Tagus River Water quality	Temperature, chlorophyll, etc.	Automatic buoys in Tagus	Internal link on Lenvis.eu	http://www.maretec.mohid.com/projects/lenvis/
Streams Water quantity	Real time-Hydrometric level	IST river level sensor (installed for Lenvis)	Lenvis Timeserie Client	http://webserver.mohid.com/webservices/lenvis/water/hydrometrics/LenvisTimeSerieService.svc
Streams Water quantity	Hydrometric level and flow	IST and SANEST field Campaigns	Internal link on Lenvis.eu	http://www.maretec.mohid.com/projects/Lenvis
Streams Water quantity	Hydrometric level	INAG	Lenvis Timeseries Client	http://lenvis.hidromod.com/INAG/LenvisTimeSerieService.svc
Bathing Water quality archived	Faecal microbiological parameters , and model results (MOHID validation)	IST and SANEST monitoring field work	Internal link And Lenvis Timeseries Client	http://www.maretec.mohid.com/projects/Lenvis
Bathing Water quality archived	Faecal microbiological parameters	INAG	Lenvis Timeseries Client	http://lenvis.hidromod.com/INAG/LenvisTimeSerieService.svc
Official bathing water quality analysis	Coliforms, E. Coli	SANEST	Lenvis Timeserie Client	http://webserver.mohid.com/webservices/lenvis/water/waterquality/LenvisTimeSerieService.svc
Bathing water quality forecast	Contamination risk	IST	Lenvis Timeserie Client	http://webserver.mohid.com/webservices/lenvis/water/waterquality/LenvisTimeSerieService.svc
Grid Data Services	all	All lenvis users and data roviders	Services Map Viewer	Portal

3.3. Modelling applications

Forecast model results for the Portuguese case study are provided by a complex system of numerical models, managed by IST and Hidromod. Fig. 1 (from D5.2) shows the coupled atmospheric and ocean models used on Portuguese case study. This system uses a downscaling approach for the atmospheric and ocean compartments going from the global scale to the local scale (e.g. beach scale) and couples different processes (e.g. atmospheric forcing, wind wave, hydrodynamics and water quality processes) as described in D5.2. The system also uses data acquired directly by IST and data provided freely via web by the national water authority (INAG)

from the national aquatic monitoring program. All these data sources have been encapsulated using the lenvis web services, and the results are available through grid and timeserie services, gadgets, mobile and desktop applications, exposed on chapter 3.4.
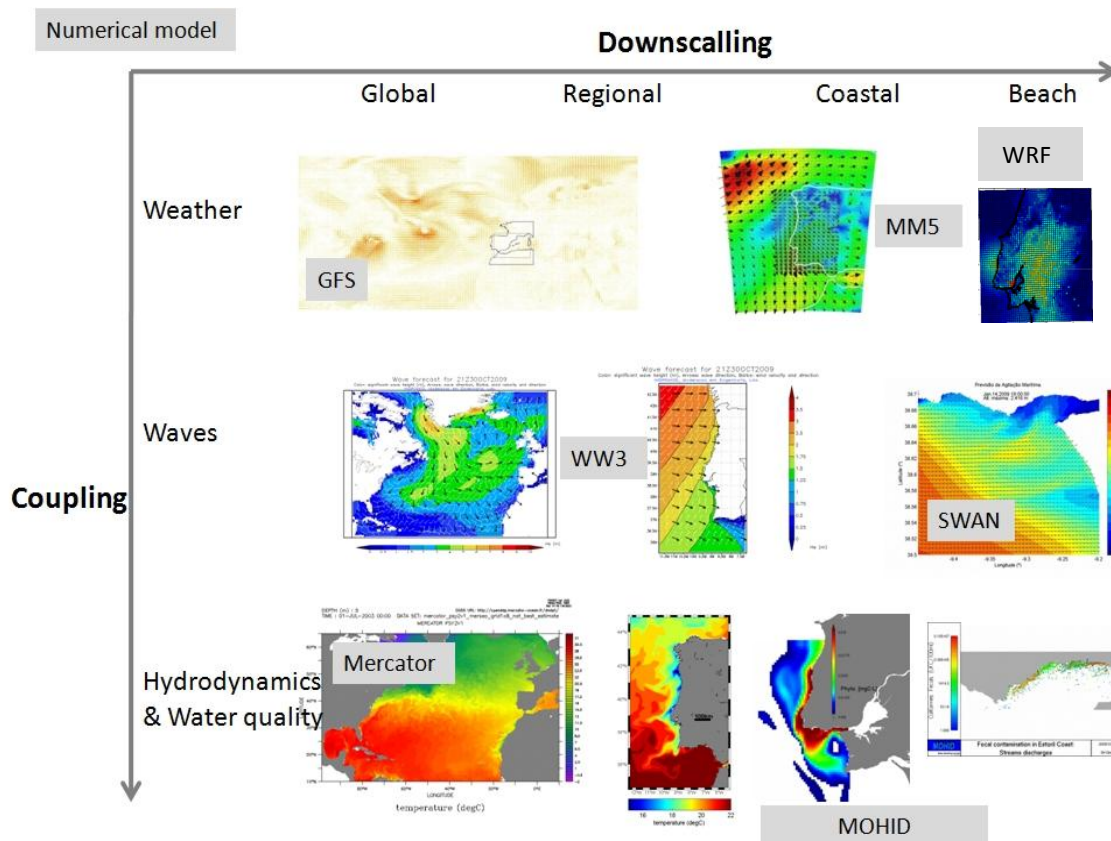
Fig. 1. The coupled atmospheric and ocean modelling components for Estoril Coast test case, described on D5.2

3.4. Lenvis Products

3.4.1. Web Services

TimeSeries Client

As described on Table 3, sensor results are available on Lenvis platform through Timeseries developed by Hidromod. Fig. 2 shows an overview of this application, where it is possible to choose for each location the different stations and parameters, and see the information on graphs. This gadget was improved bringing the opportunity for the users to add a horizontal or vertical line, in order to evaluate the data qualitatively. This function is mainly useful to evaluate when streams water level had increased above a threshold value, or when the water quality data or bathing water quality risk is above or under the reference quality level. Also the presentation of graphs has changed considering users recommendations (Fig. 3).
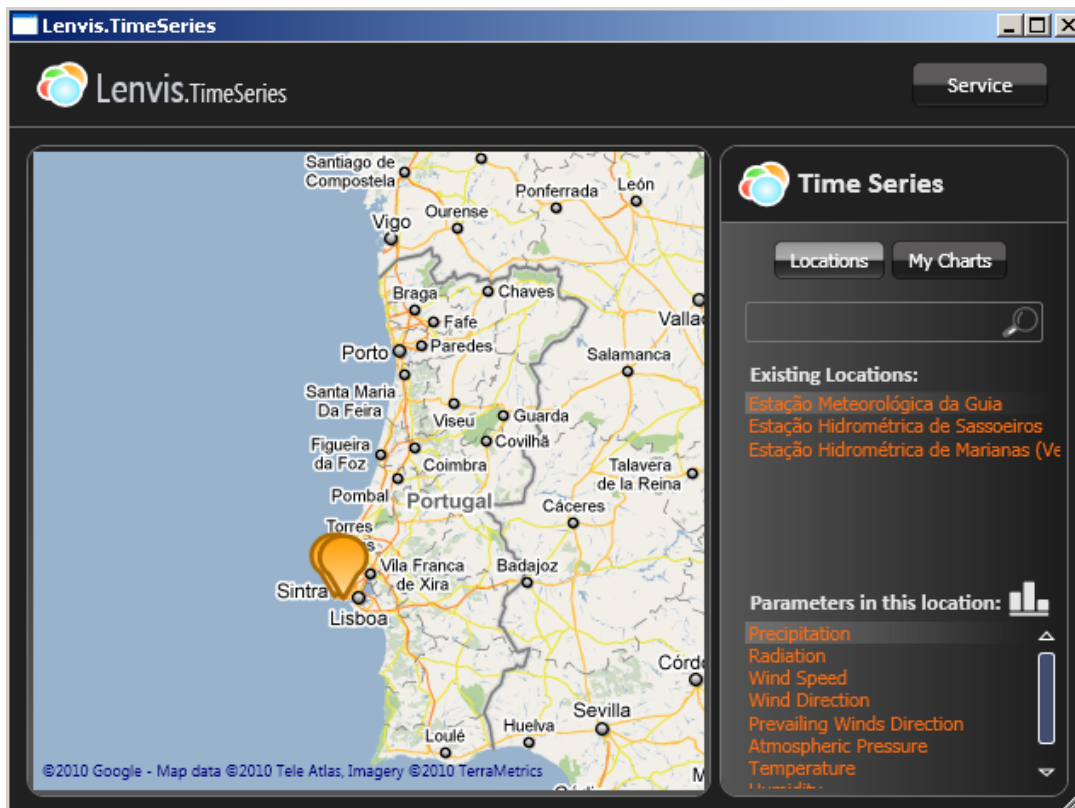
Fig. 2. Overall image of Lenvis TimeserieClient.
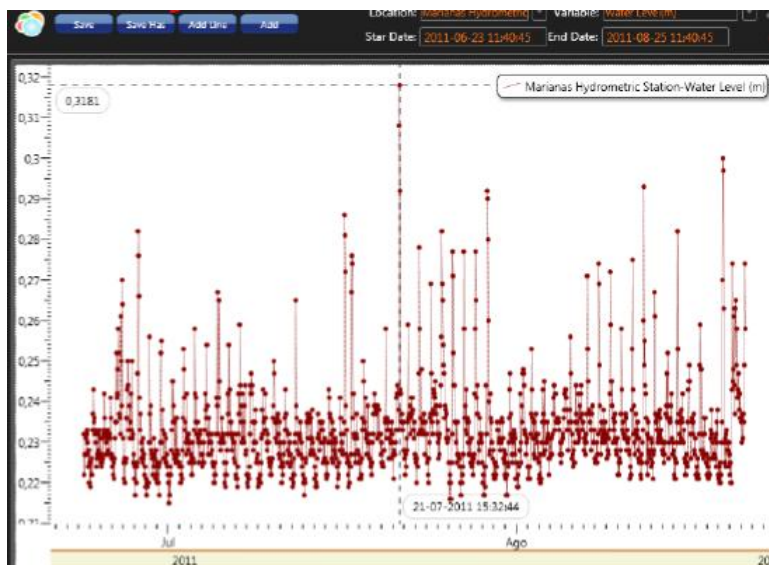
Fig. 3. Image of TimeSerieClient graph for Marianas Hidrometric station

Services Map Viewer

One of the main goals of lenvis portal is to integrate all the available data sources (model results and sensors data) via web services. Data from sensors and monitoring plans are integrated by the services presented on Table 1, also model results used on lenvis are available by grid data services (described Table 4). Service Map Viewer gadget presents all grid and timeserie services available in lenvis (for the 3 case studies) in a map (Fig. 4). Beside the service location, this gadget also gives information about each service. For time series services, provides the service name, domain,

data provider, and some description (local, type of data, case study or kind of data). For grid services provides the name, information about its domain, data provider and some additional description. When selecting a service on the map, the description of all parameters appears, with information about name, units and data type.
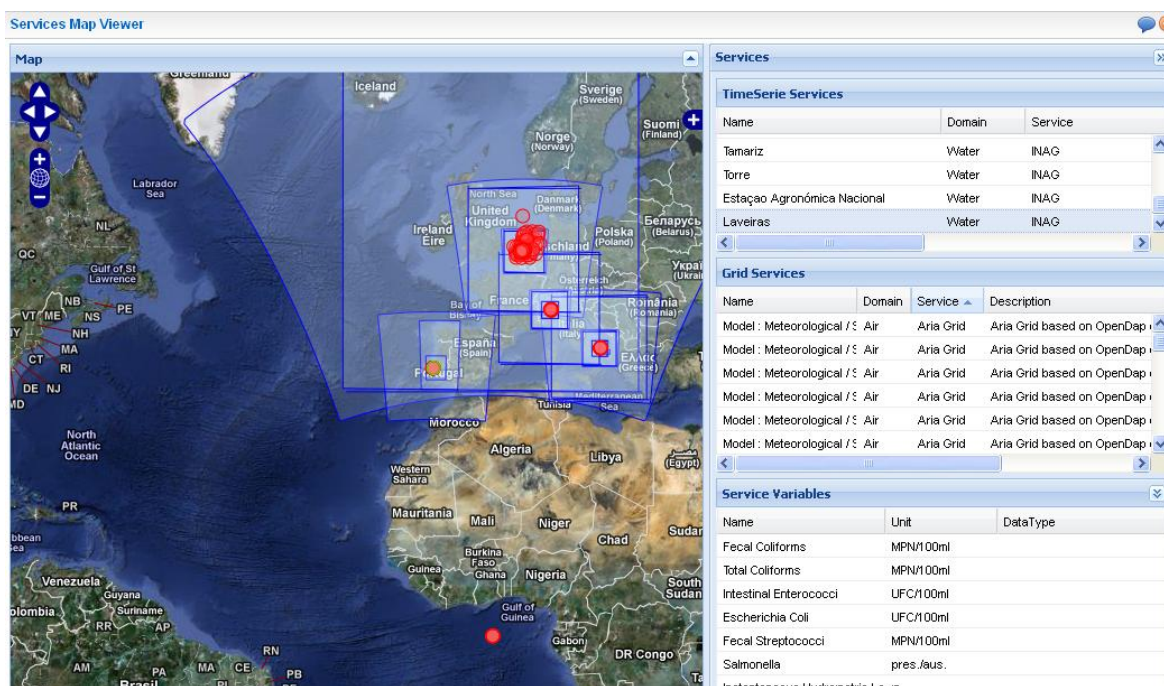
Fig. 4. Screenshot of Service Map Viewer.

Table 4. Grid Data Services implemented for the Portuguese Case.

Data Source	Parameters	Site	Code name	Status
Coastal model	Currents (direction and intensity)	http://www.hidromod.com/lenvis/PCOMSIST/	GDS1	Online (running over openDAP)
	Water Level			
Wave model	Wave direction	http://www.hidromod.com/lenvis/SWAN/	GDS2	Online
	Wave Height			
	Period			
Atmospheric model	Wind velocity	http://www.hidromod.com/lenvis/MM5/	GDS3	Online
	Air temperature			
	Relative humidity			
	SW radiation			
	Up LW radiation			
	Down LW radiation			
	Atmospheric pressure			
	Latent heat			
	Sensible heat			

Particle tracking model

An oriented model service was developed by Hidromod enabling to run a particle tracking model on request for emergency situations. In this case the entire shell is encapsulated by a web service. In the present status it is possible via the shell SOA connecters:

- access to input data (Grid Data Service – currents and wind fields),
- to run the model (model service)
- to visualize the results (map service)

Available at
http://www.hidromod.com/Lenvis/LenvisMohidOnline2/Lenvis/AllInOne/MOHIDOnline.htm, this
shell uses the hydrodynamics generated by IST in the framework of the routine bathing water
forecasts.
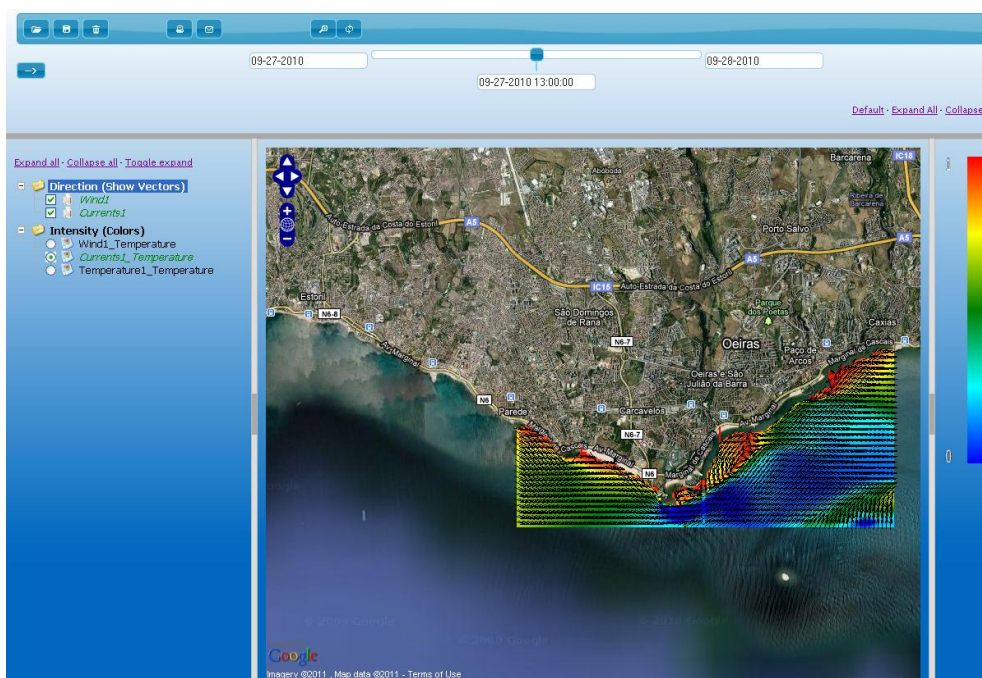
Fig. 5. Screenshot of Particle tracking model application on MohidOnLine gadget.

3.4.2. Alerting and Bathing Water Quality Forecasts

In the scope of lenvis several alert were developed:
- email alerts, related to automatic stations acquisition data;
- bathing water forecast results;
- and automatic SMS alerts.

One of these alert services are related with automatic station acquisition, sending a hourly email
confirming that all data acquired by the automatic stations are available, with accuracy (considering
stipulated limits), informing when values out of bound, or if there is no new data acquired (as
expected). This alert system allows the developer, to know if the automatic acquisition system is
running, and in a second level to know if the data is accurate. During summer time the system is
continuously evaluating if streams level data are above the safety level (for dammed streams, this
safety level correspond to the dam level, and for other streams is the hydrodynamic level above
which stream discharge can causes short terms pollution events on bathing waters. These alerts are
sent to data providers (IST and SANEST), but can also be sent to professional users and water
quality decision makers.
Bathing water quality alert system was implemented on 2011, and was operational during 2011
bathing season, providing daily 48h bathing water quality forecast. These forecasts are published
on lenvis portal and web site. The system is ready to send email alerts, and after the validation done

on Lenvis project, professional users show their will to use this system during 2012 bathing season.

The specifications of these email alerts can be adapted for each professional users, two options are available:

- to receive every day the predicted water quality results, like presented on the lenvis website;
- to receive only an email if a bad water quality result (or any other quality level that SANEST require) is predicted.

The SMS alert system was implemented in 2011, and start to being tested by users, in April 2011, before the beginning of the bathing season. The system works operationally during all the bathing season, and 3 real alerts occurred due to streams level rising, after raining events.

SMS alerts are sent when streams hydrometric level is above a threshold value. The hydrometric stations are continuously reading the hydrometric level, and when recognized a high level, they send the data automatically for the central station in IST (Fig. 5). Than the levels data are sent automatically to the database, and if they are above the threshold value, an SMS alert is sent to the defined users with information about data, hour, station, and hydrometric level. The system is prepared to send a new alert, only when the stream water level is under the threshold value. On this way is possible for the users to know when the levels are normal again. Municipalities also show their will to use this alert system during winter time in order to know in real time about flood problems caused by streams water level rising.

The bathing water forecast are actualized hourly, so up to one hour after an alert, the system runs again, considering the most recent stream discharges, calculated from the real hydrometric level, and the respective relation level-dishcarge. On this way a new model forecast is performed, giving the best forecast of bathing water risk (Fig. 7).
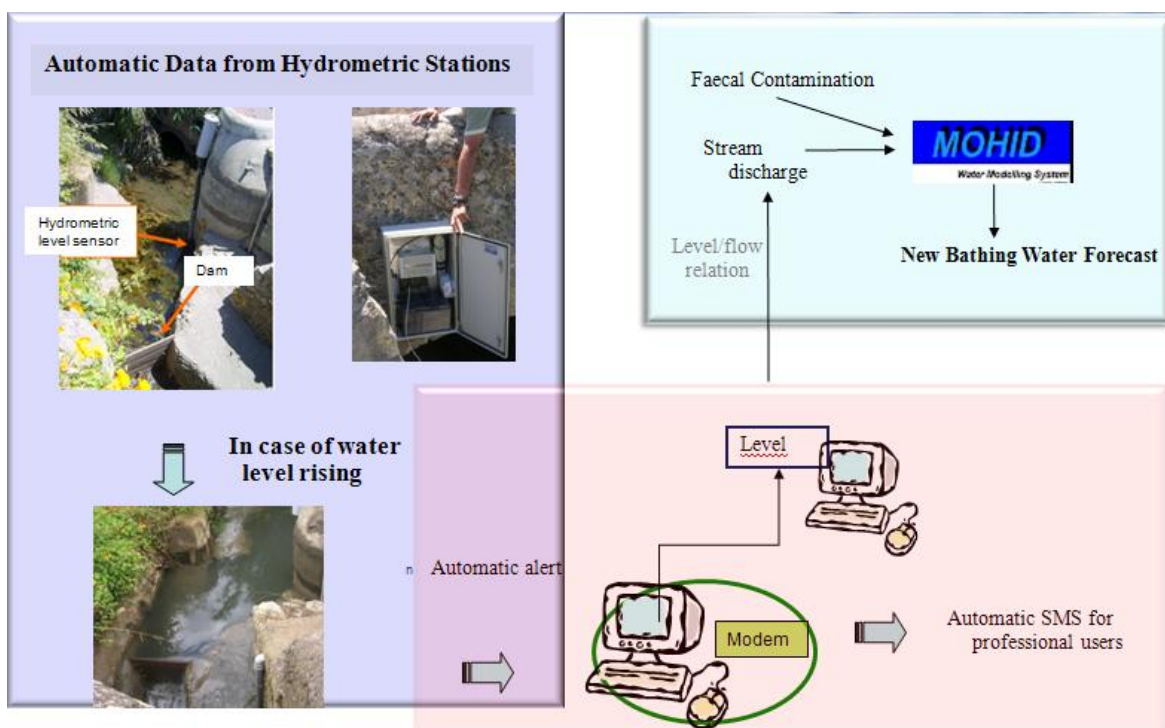
Fig. 6. Alert system configuration for streams water level rising.

Beach Contamination Risk Levels Day Forecasted:20/12/2010			
Time Period	Carcavelos	Torre	Santo Amaro
00:00 - 03:00	🟩	🟩	🟥
03:00 - 06:00	🟩	🟨	🟨
06:00 - 09:00	🟩	🟨	🟥
09:00 - 12:00	🟩	🟨	🟨
12:00 - 15:00	🟩	🟩	🟨
15:00 - 18:00	🟩	🟩	🟨
18:00 - 21:00	🟩	🟩	🟨
21:00 - 00:00	🟩	🟩	🟥

Fig. 7. Figure of beach contamination risk levels, published on lenvis site.

During bathing season validation activities, professional users suggest another bathing water risk forecast methodology. This methodology was developed and is currently being validated considering the monitoring results.

Beside the risk levels, the new methodology forecast the possible contamination values on bathing water giving more information for the decision maker (hourly results, and information about the maximum, minimum and average values).

Data 01-09-2011	Carcavelos			
	Maximum	Average	Beometric mean	Minimum
0h-1h	0	0	1	0
1h-2h	0	0	1	0
2h-3h	0	0	1	0
3h-4h	0	0	1	0
4h-5h	584	97	3	0
5h-6h	641	505	208	0
6h-7h	834	509	83	0
7h-5h	1656	974	128	0
5h-9h	2593	1827	606	0
9h-10h	0	0	1	0
10h-11h	0	0	1	0
11h-12h	0	0	1	0
12h-13h	0	0	1	0
13h-14h	0	0	1	0
14h-15h	0	0	1	0
15h-16h	0	0	1	0
16h-17h	0	0	1	0
17h-18h	0	0	1	0
18h-19h	0	0	1	0
19h-20h	0	0	1	0
20h-21h	0	0	1	0
21h-22h	0	0	1	0
22h-23h	0	0	1	0
22h-23h	0	0	1	0

Legenda	🟥	🟨	🟩
Contaminação fecal (UFC/100ml)	>1200	]100-1200[	<100

Fig. 8. Figure of beach contamination risk levels, published on lenvis site Bathing water forecast results with the new methodology forecast the faecal contamination results on bathing waters.

3.4.3. Lenvis portal

The applications described above can be combined in the lenvis portal to make a user defined domain page. The user has a group of gadgets available and the possibility of add them to a customized web portal.

The next figure shows an example of a possible choice for a Portuguese surfer, with a selection of 2 gadgets on his portal, Beach Lisbon Quality, and Beach Lisbon Waves.
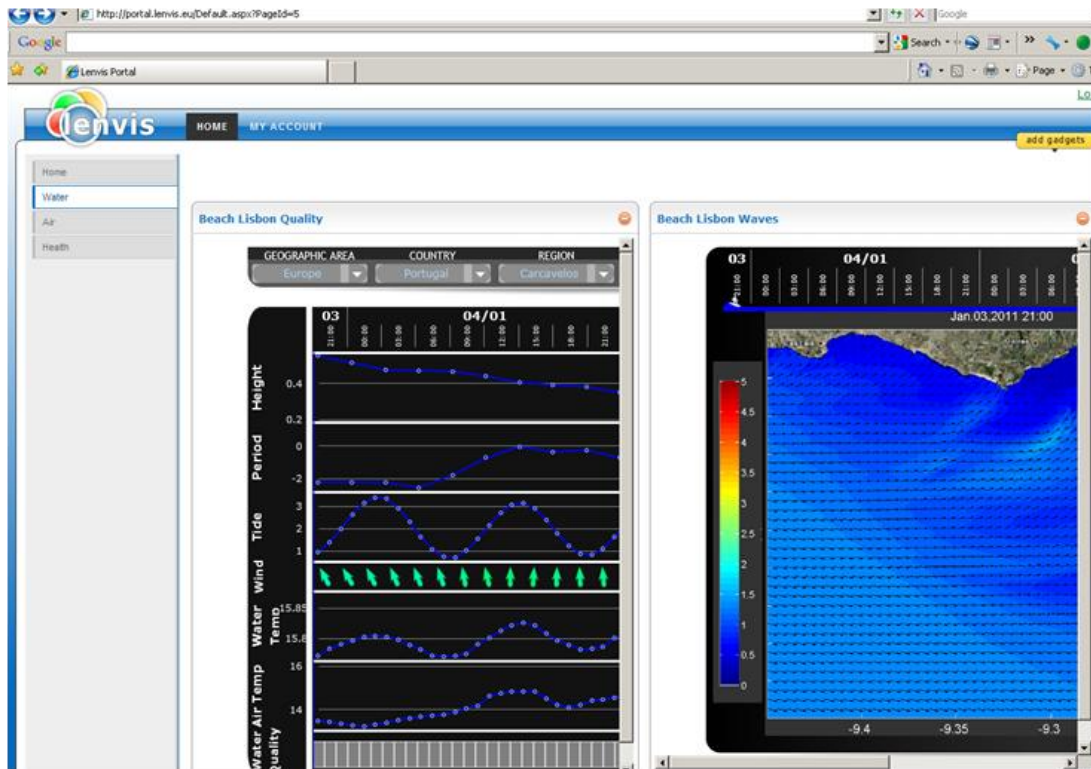
Fig. 9. Screenshot of Portuguese case study portal, with dedicated gadgets.

3.4.4. Mobile phone gadgets

Model results and time series are able to be viewed on smartphones (optimized for iPhone), as shown in Fig. 10, a photo form the smartphone gadget presented to users on September seminar.
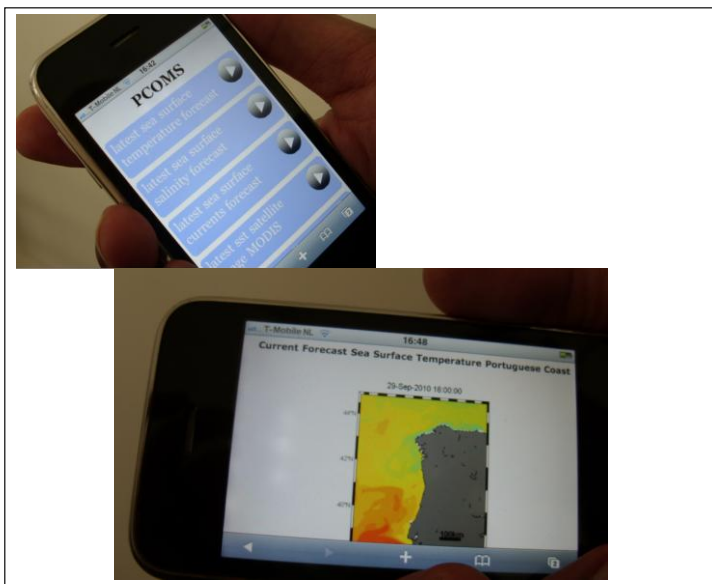
Fig. 10. Images of model results in a smartphone.

3.4.5. Surfers and bathing water oriented Gadgets

SurferOracle

The site www.SurfersOracle.com (Fig. 11) combines relevant information for surfers and is an example of a service developed by HIDROMOD within Lenvis. Some of the information provided by SurfersOracle.com will be restricted to some professional or defined users.
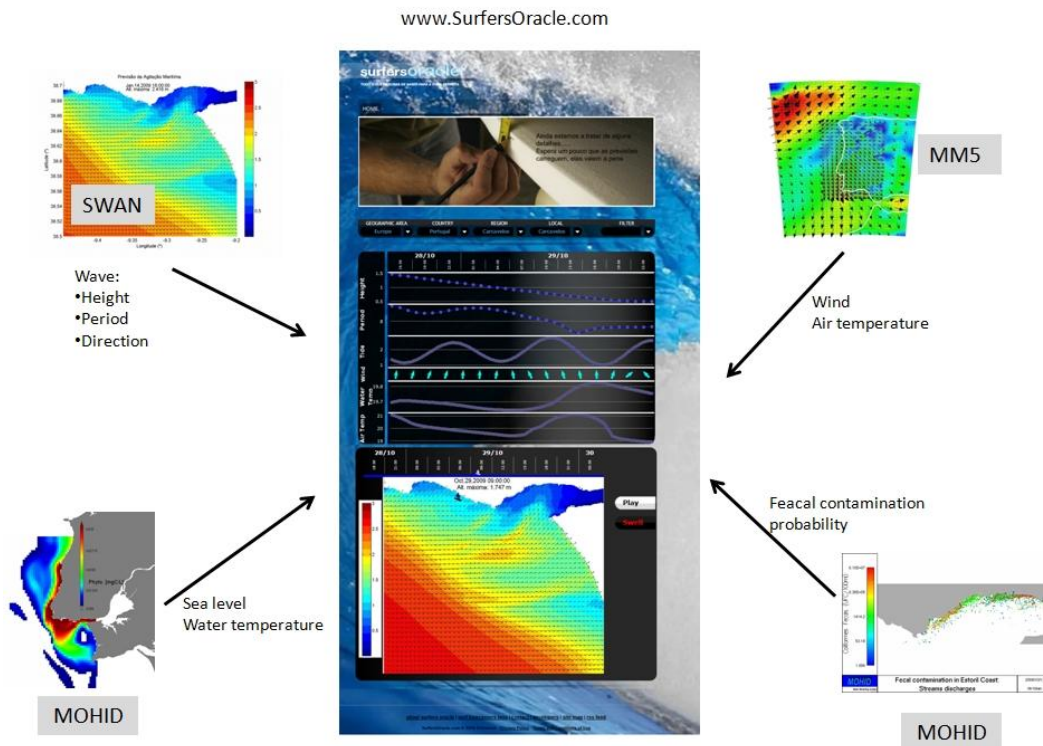
Fig. 11. The data sources that are feeding the www.SurfersOracle.com gadget (figure from D 7.1).

Bathing Water Quality

Bathing water quality, and relevant information for surfers like wave forecasts (height, and period), weather predictions (temperature), tide level, and water temperature are compiled on a Gadget: *Beach Lisbon Quality*, (Fig. 12), available on Lenvis portal, being part of it available on SurfersOracle website (www.SurfersOracle.com).
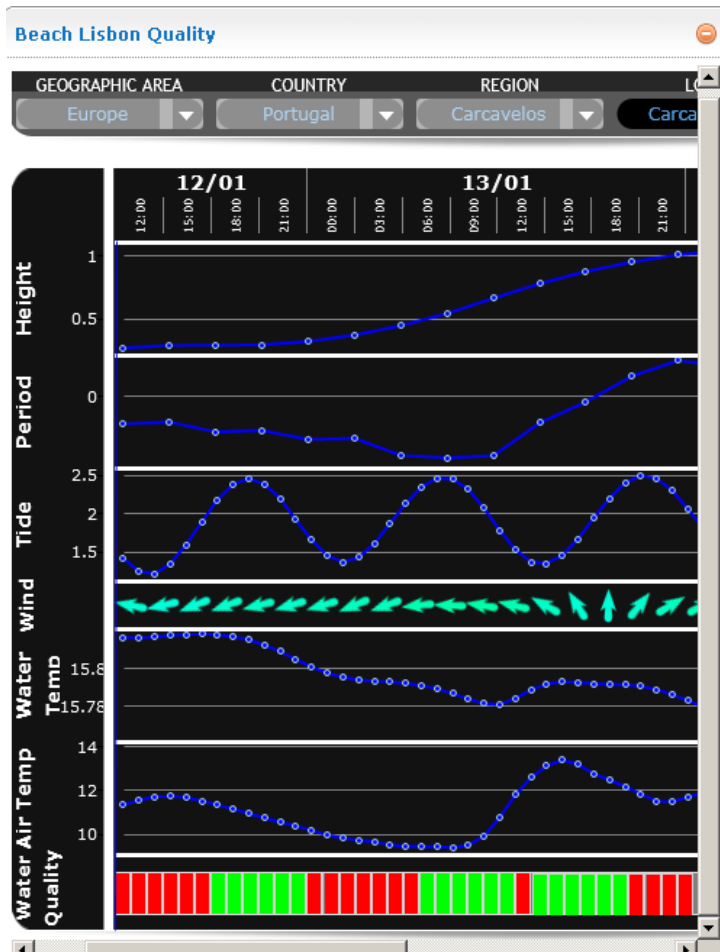
Fig. 12. Beach Lisbon Quality gadget.

Waves Forecast

A wave forecast for lenvis case study bathing waters is provided on the Beach Lisbon Waves Gadget (Fig. 13). This gadget developed by Hidromod provides a 3 days forecast for wave conditions using a animation tool.
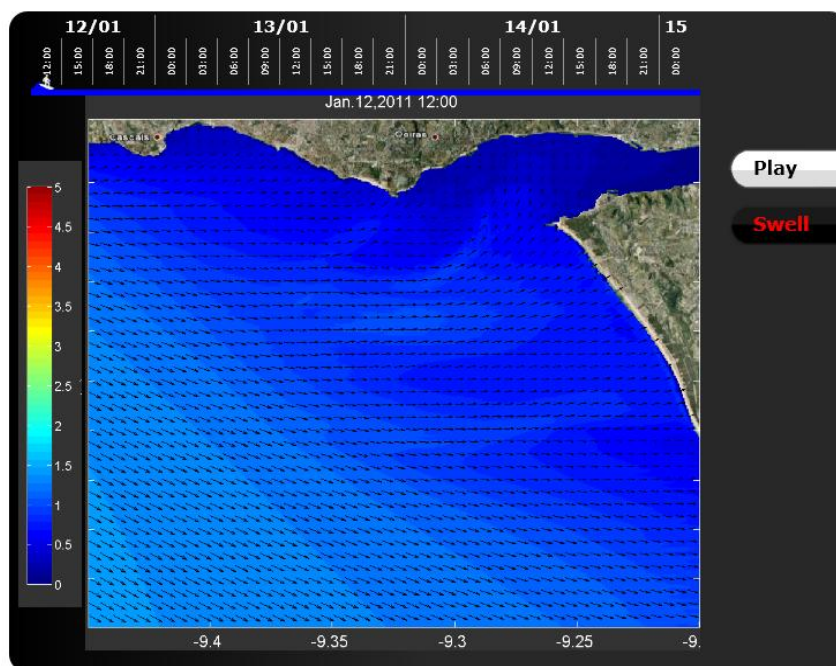
Fig. 13. Beach Lisbon Waves gadget.

4. User validation

4.1. Evaluation strategy

The evaluation plan, aims to determine the effectiveness and technical performance of lenvis system, and the assessment of the public and professionals to use it, as was defined in D8.2. This evaluation is being performed during the whole WP8 period (month 13 to 38). This second intermediate report describes all the Evaluation results and activities preformed on the Portuguese case study.

As was explained on Chapter 2.5, evaluation activities were planned for 2010 and 2011 bathing seasons. However the new lenvis schedule (after the 6 months suspension) did not allow the implementation of the alert system for 2010, it only came out on 2011. All lenvis gadgets and services were operational on January 2011 and the evaluation procedure has restarted. The alert system and the communication tolls were implemented and evaluated during 2011.

The evaluation was performed following two main approaches: The evaluation of the effectiveness of lenvis system, and afterwards the evaluation of its technical performance. These approaches are both evaluated on two main periods, the first one between month 29 and 33, and the second one between month 33 and 38.

The first phase was based on suggestions from public and professional users, obtained on user meetings and questionnaires. The main activities performed on the first evaluation period aims to evaluate the use of the lenvis portal for interacting with the public providing and collecting information, and to collect user's feedback. All the users' feedback and considerations obtained on the first evaluation period were considered for gadgets development and improvements.

During the second part of lenvis evaluation the technical performance of lenvis gadgets was performed, mainly by real time gadget tests, and evaluating if the gadgets are responding to users expectations.

During the second part of lenvis evaluation the alert system was tested by lenvis professional users, as well the lenvis gadgets and portal, in order to get them closer to lenvis users needs.

These continuous users evaluation and testing activities follows the planned on D8.2:

- Professional users from the established user group use forecasts produced by lenvis and validate their results according to their own data, knowledge and perception.

- Users also validate model suitability and functionality in helping them to assess conditions and make decisions.

- Public and professionals are continuing to validate the system, filling questionnaires and giving opinions and suggestions.

User's evaluation aims to determine the effectiveness and the technical performance of lenvis system, and help on gadgets developments, considering users recommendations and suggestions. Evaluation results were collected by questionnaires but mainly by user's feedback and suggestions during meetings and gadgets tests. In order to better evaluation this evaluation, several indicator were selected considered the established on D. 8.2.

4.2. User validation activities

User validation activities started since the beginning of lenvis project, and will occur until the end of the project, once that was established a good link, between lenvis developers and lenvis users. The first session for Portuguese end-users was organised in spring 2009. The session was attended by around 20 people. A presentation in the 10th Portuguese Water Congress has been used for presenting the project for the Portuguese water community. However, the first public presentation of the Portuguese case study gadgets and web services was held during the lenvis mid-term seminar, September 2010 in Delft, where a large group of Dutch users have seen demonstrations and carried out the hands-on tests. On the 18th January 2011 an open session was carried in Costa do Estoril in the Sanest quarters for 30 people. After an introductory presentation, participants also carried out a hands-on exercise, assessing the portal and the gadgets. All user's groups were present, the professional ones (municipalities, waste water management institutions, governmental health institutions, and surfer schools), and public users (surfers and the general public).

On 19th April, a meeting with professional user was held, to presenting all the lenvis gadgets, the alert system and the bathing water forecast results, in order to prepare lenvis for 2011bthing season. Since the preparation of 2011 bathing season (April 2011) weekly contacts with SANEST and ARH-Tejo, were performed, in order to assess the quality of the results obtained, and the alerts system implementation. Several meetings were performed with professional users, in order to test lenvis gadgets performance on their own computers, to discuss personally lenvis gadgets performance and functionalities and to obtain users feedback about the alert system.

A summary of the user evaluation meetings held is provided in table 5, and a description of the most relevant is done in this chapter.

The main activities for this period were:

- Bathing water quality *nowcast* based on online measurements provided by the hydrometric stations, and basin models.
- Weekly comparison of field data gathered by Sanest and ARH with model forecasts.
- Assessment of bathing water quality relation with stream discharges measure by the hydrometric stations data in order to choose early warning levels for professionals also based on hydrometric data.

Table 5. Overview of main user evaluation activities.

Date	Subject
29th May 2009	Seminar with end users, todefine user requirements
23th March 2010	Presentation bathing water forecast application in a Congress, with the presence of SANEST, and other professional users.
30th September 2010	Mid-term seminar end user meeting, International and national professional and public users present
16th January 2011	Internal final tests with HIDROMOD and IST
18th January 2011	Seminar with end users,
18th January – 4th February 2011	Users tests
4th February2011	Submission of questionnaire answers.
25th March 2011	Meeting with SANEST in order to discuss alert system implementation, and to prepare lenvis system and tests during 2011 bathing season.
19th April 2011	Meeting with lenvis professional users, presenting all the lenvis galdets, alert system and bathing water forecast results, in order to prepare lenvis for 2011bathing season.
May 2011	Phone and email contact with SANEST and ARH-Tejo to discuss system functionalities
15th May 2011	Alert system tests- A fake alert was held, and all the users were contacted in order to ensure that all of them were receiving the SMS.
28th -31th May 2001	Real SMS alert .Contact with users in order to get their feedback about the alert system.
30th -31th May 2011	Lenvis meeting in Bari- presentation of Portuguese case study for Italian end users.
14th June	Hydrometric station functionalities, new location, and new alert system funcionalities.
18th -19th July 2011	Alert system tests (SANEST, ARH-Tejo, CMOeiras, CMCAscais).
20th July 2011	Meeting with CMO. Presentation of Lenvis developments and their evaluation
20th July 2011	Meeting with ARH-Tejo. Presentation of Lenvis developments and their evaluation
9 th September 2011	Meeting with CMC. .Presentation of Lenvis developments and their evaluation
13thSeptember 2011	Meeting with SANEST. Presentation of Lenvis developments and their evaluation
13th October 2011	ARCOPOL/MOHID worksop presentation of Faecal Coliforms Dispersion on Bathing Water, Lenvis project)
23rd November 2011	Environmental IST Journey- Poster presentation about lenvis results and bathing water alert systems.

4.2.1.2010 evaluation activities results

User's validation results obtained during 2010 can be summarised as:
- The web service modelling tool to simulate the impact of faecal discharge events has good visibility and applicability. User's recommended to host the web service in a high-performance web server in order to minimize the response time.
- Aplications to view model results on smartphones / iPhone was very well accepted.
- The possibility of using geographic and localized applications on smartphones was proposed, enabling end-user to localize the bathing water nearby, providing the main characteristics of that beach, through a phone with gps. This service should also give the opportunity for the user to see the characteristics of the surrounding bathing water.
- Tools should be in two languages (at least), in English, and Portuguese.
- The main images of the beaches should be larger.
- The extension of the application to other bathing waters was suggested;
- Applications developed for Portuguese case study should have demos to other case studies.
- Map and model services should have manuals or personal contacts, in order to help to replicate model and map services to other case studies and research projects.

- Surfers consider that the wave forecast results have improved since the beginning of the project, with better results.
- The possibility of putting results of two or more stations on the same graph is an advantage of the developed time series client.
- The possibility for the time-series client to accept data from new stations, and monitoring results, to read and graph those data, is an advantage of this lenvis service.
- Cascais Atlantico Agency shows available to share fish data in Estoril Coast.
- Lenvis users discussed the possibility of using the Business Intelligence tools to compare different monitoring results, like stream levels, and precipitation, or stream level and bathing water quality, streams level and meteorological data, in order to find relations between the different parameters and better know the dynamic of the bathing water quality.
- Public users comment that is not clear who is the responsible of the bathing water quality, or to who they should contact if they want to claim or announce illegal discharges, blooms of jellyfish on water, or any event that can be an hazard for bathing water quality and bathers.
- Surfers suggest adding more useful data, like tide tables and more detailed information about swell and winding direction.
- The users refer that they would recommend lenvis portal and services to professional colleagues to improve their work activities, and friends to plan their leisure activities.

The main feedback about the lenvis portal itself:
- Portuguese users shown worried about the user's access to lenvis site and their authorization to access the data, problem that are being solved.
- The available gadgets names should appear on the first lenvis portal page or the possibility of adding gadgets should be more evident.
- Most users like the possibility of drag and drop gadgets. The users suggest gadgets should have a small pictures or image suggesting the kind of information that it will offer.
- The page should appear on the case study languages.
- Lenvis portal login is not working properly. Users suggest having a more intuitive first webpage.

During the September 2010 mid-term seminar important feedback to the lenvis developments as a whole were also provided summarised in the bulleted list below (see WP9 D9.5 Report of the mid-term seminar):
- The portal and the demonstrated widgets are covering the three domains and case studies. The main focus in the second half of the project should be the integration between services and domains, as planned in WP7 and 8.
- Possibilities of communication between widgets in the portal should be researched.
- Generic user feedback services should be researched, as now the feedback services are specifically developed for a particular widget in the portal.
- While the portal is already customisable in the choice of active widgets, the size of the frames should also be available for customization.
- When developing widgets care should be taken in order to keep them as simple as possible, to fit in a limited sized i-frame, still all the necessary information needs to be 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 relevant, while the added value of applications that explicitly make use of unique mobile phone functionalities, such as GPS for localisation, become clearer.
- While lenvis should retain its innovative character through research and development towards a range of environmental and health information services, care should be taken to ensure that products remain sufficiently simple, self-explanatory, selectable and functioning reliably, for the users.

- Preferably every service that may be interesting to international users, and that communicates to or with public users, should be both in local language and in English to maximise its potential use.

4.2.2. 18th January 2011 meeting

This meeting was held in Sanest HeadQuarters, with a participation of several participants (more detail on Table 6, and Annex I).   After an introduction about lenvis project and lenvis Portuguese case study, were presented by IST, HIDROMOD and GMV, the main gadgets and portal improvements developed for the Portuguese case study, and the users involvement on lenvis progress.

The following services were presented during the users session:
- Lenvis portal: selecting the gadgets to show and use;
- Bathing Water Quality Gadget, with beach water quality and relevant information for surfers like wave forecasts (height, and period), weather predictions (temperature), tide level, and water temperature.
- Waves Forecast Gadget, provides a 3 day forecast for waves condition using a animation tool.
- Particle tracking model, enabling to run a particle tracking model on request for emergency situations.
- Time series Client, with the possibility to choose the different stations and parameters data of each location, and see the information on graphs.

During the presentation were discussed several items, mainly about bathing water quality monitoring plans, and risk forecasts. After the presentation, participants also carried out a hands-on exercise, assessing the portal and testing gadgets.

The feedback obtained during the users session and by the questionnaires distributed at the end of the session, shows that users consider lenvis portal and available gadgets and services as an advantage to manage, and spread the information about bathing waters for professional and public users.

Surfers also shows satisfied with the better waves forecast presented by Surfersoracle.

Lenvis users see these users meetings as an opportunity to discuss face to face the bathing water quality and management questions between all the professional users. The increase of participations from the first meeting to the 18th January shows the importance that the users are giving to lenvis platform.

Table 6. 18th January 2011 meeting

Meeting	18th January 2011
Meeting Place:	Cascais, SANEST HeadQuarters, 18th January 2011
End users participants:	26 professionals, from 12 Entities Detailed information on Annex 1
Lenvis participants:	9 participants, form 3 partners (IST, HID, GMV)
Aim	Discuss more details of proceeding lenvis action and alert system implementation.

Fig. 14. Pictures of Portuguese end-user meeting, in SANEST, Portugal January 2011.

4.2.3. 25th January 2011 meeting

On 25th January 2011 meeting (Table 7) were discussed in detail the upcoming actions of lenvis project, and discussed questions about the hydrometric stations used for lenvis, and the possibility of monitoring new parameters. Also was discussed the proposed alerts system to implement during the bathing season, its alert limits, and methodology.

Table 7. 25th January 2011 meeting

Meeting	25th January 2011 meeting
Meeting Place:	SANEST HeadQuarters, Cascais, Portugal
End users participants:	3 professionals, from SANEST (Catarina Lopes, Catarina Correia, João Santos Silva)
Lenvis participants:	2 participants, form IST (Ramiro Neves, Cláudia Viegas)
Aim	Discuss more details of proceeding lenvis action and alert system implementation.

4.2.4. 25th March 2011 meeting

In this meeting (descript on Table 8) were discussed the details for preparing 19th April professional end users meeting and discussed details of alert system implementation, and model results spreading on web. Some time was spent discussing Portuguese lenvis web-site, dedicated to spread the bathing water quality for Portuguese end-users, and give a better description about bathing waters. Also all lenvis work around Portuguese bathing water quality was discussed and clarified.

Table 8. 25th March 2011 meeting

Meeting	25th March 2011 meeting
Meeting Place:	SANEST HeadQuarters, Cascais, Portugal
End users participants:	1 professional, from SANEST (Catarina Correia)
Lenvis participants:	2 participants, form IST (Cláudia Viegas)
Aim	Prepare the 29th April meeting, and define some item about alert system implementation.

4.2.5.19th April 2011 meeting

19th April 2011 meeting (Table 9) has the aim of discuss the alert system being implemented, the bathing water monitoring, and model forecasts. Due to these aims, only the users directly related to bathing waters monitoring and management were contacted.

Was presented the Portuguese case study web site, the implemented alert system, and was explained how the bathing water quality risk alerts are calculated, and were discussed how the alerts should be spread for the several end users.

Durinh this meting Bathing Water Forecast was the big discussion issue, mainly its monitoring work and classification. According to the new bathing water legislation settings, the water quality is classified at the end of the bathing season (after 3 years). However there is another classification for the punctual monitoring results. These different evaluations can be confused and a methodology providing forecast results for both methodologies were required.

The forecast methodology used in Lenvis for provide bathing water quality risk was discussed, and users express they will for having different information, not only related to risk, but also with predicted contaminated values.

IST proposed to develop a new methodology to present model forecast responding to both classifications and user requirements.

Also were proposed some changes on the alert system in order to have it more quickly, providing new and more frequent model results in case of any pollution accident.

This meeting was also considered as an preparation meeting for the beginning of bathing water, staring on 1st of May in Cascais Municipality, and on 15th May in Oeiras Municipality.

Table 9. 19th April 2011 meeting

Meeting	19th April 2011meeting
Meeting Place:	SANEST HeadQuarters, Cascais, Portugal
End users participants:	26 professionals, from 12 Entities Detailed information on Annex 1
Lenvis participants:	2 participants, form IST (Cláudia Viegas, Ramiro Neves)
Aim	This meeting as the aim of discuss the alert system being implemented, the bathing water monitoring, and the model forecasts.

4.2.6.14th May 2011 validation activity

On May 2011 SMS alert system was start working for all defined users. On 14th May was held an validation activity to test the system performance (Table 10). Was performed a test with a fake water level rising, in order to evaluate all the alert system. All the users were contacted by IST, and confirmed the SMS reception.

Table 10. Description of SMS alert implementation activity

Validation Activity:	SMS alerts implementation
End users participants:	9 professionals form 4 institutions: SANEST (Catarina Lopes, Luís Pamplona), CMOeiras (Domingos Leitão, Selma Rodrigues), CMCascais (Nunes Carcavalho, Maria João Nogueira), ARH-Tejo (Helena Alves, Cristina Soares, Susana Nunes)
Lenvis participants:	2 participants, form IST (Cláudia Viegas, Eduardo Jauch)
Aim	First tests on alerts implementation system. Evaluation of its performance.

4.2.7.17-20th May 2011 validation activity

During 17-20th May 2011 a real test to the alert system was done (Table 11) due to raining events. SMS alerts system was tested on a real situation, during raining events. During this week all the users were contacted in order to confirm that all of them were receiving alert sms, in case of stream level rising. Also the model forecast conditions facing streams rising was discussed and clarified for users.

Table 11. Description of SMS alert implementation activity

Validation Activity:	SMS alerts system, and forecast evaluation
End users participants:	9 professionals form 4 institutions: SANEST (Catarina Lopes, Luís Pamplona), CMOeira (Domingos Leitão, Selma Rodrigues), CMCascais (Nunes Carvalho, Mª João Nogueira), ARH-Tejo (Helena Alves, Cristina Soares, Susana Nunes)
Lenvis participants:	2 participants, form IST (Cláudia Viegas, Eduardo Jauch)
Aim	SMS alert system evaluation - Real alert test

4.2.8.28-30th May 2011 validation activity

SMS alerts system was tested on a real situation, during raining events (Table 12). The stations sent new values for IST central station, as expected, and the system send the alert SMS. All users were contacted later and confirmed the reception of SMS alerts, announcing the water level rising, and after it, a new SMS when the water level became normal again.
Was also possible to confirm the performance of the forecast bathing water quality, that has produced new bathing water forecast after the alert, considering the new streams level and meteo-hidrodynamic conditions.

Table 12. Description of alert system evaluation on May 2011

Validation Activity:	SMS alerts system, and forecast evaluation
End users participants:	9 professionals form 4 institutions: SANEST (Catarina Lopes, Luís Pamplona), CMOeiras (Domingos Leitão, Selma Rodrigues), CMCascais (Nunes Carcavalho, Maria João Nogueira), ARH-Tejo (Helena Alves, Cristina Soares, Susana Nunes)
Lenvis participants:	2 participants, form IST (Cláudia Viegas, Eduardo Jauch)
Aim	SMS alert system and bathing water forecast evaluation - Real alert test

4.2.9.30-31 May 2011 meeting- Bari

This meeting was one of the general Lenvis meetings, it was held on Villa Framarino, in the Regional Natural Park of Lama Balice, Municipality of Bari, with the aim of presenting lenvis project to Italian users (Table 13).
On May 30, 2011 occurs a work meeting with project partners, to verify the operation of the informatics lenvis system, and prepare the presentation for the users meeting.

On 31 May was done a overall lenvis presentation for Italian users, followed by presentation of Italian, Portuguese, The Netherlands, case studies, and also about Air quality actions. The present end users were more interested with questions related with air pollution, the Italien case study issue, but they also showed interest on lenvis gadgets and developments.

Good feedbacks were received about the Portuguese alert system. While the meeting was held in Italy, in Portugal was raining end alert SMS has been sent, and just before the Portuguese case presentation, a new SMS was received announcing that streams level were OK again, in Portugal. This raining event gives the opportunity to present to the users the forecast before an alert system, and other one after it, showing the importance of the automatic SMS alerts, but also the importance of using modelling tools to forecast bathing waters quality risks.

Table 13. Description Lenvis users meeting in Bari, Italy on May 2011

Meeting	30-31 May 2011 Lenvis meeting
Meeting Place:	BARI, Villa Framarino, located in the Regional Natural Park of Lama Balice. 30-31 May 2011
End users participants:	– Managers and technicians – Professional users
Lenvis participants:	11 participants from 7 lenvis partners: UNIMIB (Francesco Archetti, and Ilaria Giordani), IHE (Schalk Jan van Andel, and Ioana Popesco),HD (Arnold Lobbrecht and Sead Kolic), ARIA(Claude Derognat, and Jacques Moussafir), IST (Cláudia Viegas), HID(Pauulo Chambel and Eduardo Aires)
Aim	Lenvis project meeting, and Lenvis presentation for Italian end users

4.2.10. 14th June 2011 – validation activities

On June the location of Laje hydrometric station was changed, in order to have accurate results. During this activity (Table 14) were discussed the alert settings between Sanest and IST, and new alerts were defined by SANEST and IST, in order to have a second alert immediately after the water level returns to the normal values. Until this time these second alerts informing about normal streams values were only sent on schedule data transmissions (twice a day), and not immediately after an alert.

Table 14. Description of 14th June activity

Validation Activity:	Changes on Laje hydrometric station location, and alerts warnings
End users participants:	3 participants from Sanest (Catarina Correia, and 2 operationals)
Lenvis participants:	2 participantes from IST (Cláudia Viegas, Eduardo Jauch), and from Quantific, the enterprise who sell the hydrometric stations
Aim:	New hydrometric station location, new alerts details

4.2.11. June, July, August and September validation activities

During June, July, August and September were performed weekly contacts between IST and SANEST and ARH (Table 15). The main results can be summarised as: ARH-Tejo provided new data from official bathing water monitoring work campaigns; SANEST provided data from their bathing water monitoring campaigns, and streams water quality campaigns; IST sent MOHID daily forecast results from the past weeks; SANEST and IST discussed the results and was decided

to make different forecast scenarios considering different streams water quality results: a) a annual average (June 2010-June2011); b) 2011 average (January-June2011); c) the last result. After several contacts with SANEST was decide to use 2011 average to forecast the bathing water results.

Table 15. Description of June, July and August validation activities

Validation Activity:	Weekly contacts with share of bathing water monitoring and model forecast results
End users participants:	SANEST (Catarina Correia, Catarina Lopes), ARH-Tejo (Susana Nunes)
Lenvis participants:	IST (Cláudia Viegas)
Aim:	Data sharing, different scenarios for bathong water forecast

4.2.12. 18th-19th July 2011 validation activities

Since any real alert occur during June was decided to do an alert test in order to show to the professional users that the system was operational. Users were contacted and was planned to do it on 18th-19th July (Table 16). All users received the rising level alerts, with the correct information; after it, when the level returns to the "normal" values, all the users received a new SMS indicating that the water level has returned to the normal levels. Some users ask some more details about the alerts, IST responds to all the questions.

Table 16. 18th-19th July alert system validation test

Validation Activity:	Alert system tests
End users participants:	9 professionals form 4 institutions: SANEST (Catarina Lopes, Luís Pamplona), CMOeiras (Domingos Leitão, Selma Rodrigues), CMCascais (Nunes Carcavalho, Maria João Nogueira), ARH-Tejo (Helena Alves, Cristina Soares, Susana Nunes)
Lenvis participants:	IST (Cláudia Viegas)
Aim:	To evaluate alerts system functionality- fake alert.

4.2.13. 20th July 2011 meeting

On 20th July a meeting with CMOeiras was held, (Table 17) with the aim of presenting and testing lenvis gadgets. For better evaluation, and to identify system incompatibilities, normally related with informatics systems and internet access limitations, usual in enterprise offices, lenvis services were tested on users computers.
Were identified two limitations, one was solved with CMO informatics department, other by HID. With these tests, held on user's desktops we assure that all the gadgets and lenvis tools were working on CMO computers. All the gadgets were explained and tested. Users gave their feedback about lenvis tools mainly related with TimeSerieClient service.
CMO also shows interest in using the automatic hydrometric stations and alerts system for other streams, and for other uses, like stream floods during heavy raining events.
Also the new methodology for bathing water quality forecast was presented, and users found it useful. The feedback of all gadget tests was noted during the meeting in order to answering the questionnaires.

Table 17. Lenvis meeting with CMOeiras

Validation Activity:	Face to face meeting with CMOeiras
End users participants:	2 professionals from: CMOeiras (Domingos Leitão, Selma Rodrigues).
Lenvis participants:	IST (Cláudia Viegas)
Aim:	Implementation testing and evaluatin of lenvis gadgets

4.2.14. 21th July 2011 meeting

On 21st July a meeting with ARHTejo was held, (Table 18) with the aim of presenting and testing lenvis gadgets. For better evaluation, and to identify system incompatibilities, normally related with informatics system limitations all the services were tested on users computers. All the gadgets were working without any problem. All the gadgets were tested.
Also the new methodology for bathing water quality forecast was presented, and ARH-Tejo found it useful, and suggests some presentation improvements. ARH-Tejo also suggests some improvements on TimeSerie Client, like the option of presenting the threshold values, in order to better evaluate data. ARH also suggests that MohidOnLine should present a time evolution indicator during discharge simulation. ATH-Tejo showed satisfied with the presented lenvis developments. The feedback of all gadget tests was noted during the meeting in order to be answer to the questionnaires.

Table 18. Lenvis meeting with ARH-Tejo

Validation Activity:	Face to face meeting with ARH-Tejo
End users participants:	2 professionals from: ARH-Tejo (Susana Nunes and Cristina Soares).
Lenvis participants:	IST (Cláudia Viegas)
Aim:	Implementation testing and evaluatin of lenvis gadgets

4.2.15. 9th September 2011 meeting

On 9th September a meeting with CMCascais was held, (Table 19) with the aim of presenting and testing lenvis gadgets. For better evaluation, and to identify system incompatibilities, normally related with informatics system limitations all the services were tested on user's computers. One gadget was not working due to limitation on internet access.
All the gadgets were tested on CMCcascais computers, and in one personal computer.
Also the new methodology for bathing water quality forecast was presented, and CMCascais found it useful, and also suggests some presentation developments. CMCascais also shows some willingness to pay for expand the alert system to other bathing water in Estoril Coast. CMCascais enhance the usefulness of Lenvis TimeSerie Client for sharing and consulting monitoring data between the different users. They will provide their data to be present also by lenvis timeserie client. The feedback of all gadget tests was noted during the meeting in order to be answer to the questionnaires.

Table 19. Lenvis meeting with CMCascais

Validation Activity:	Face to face meeting with CMCascais
End users participants:	5 professionals from: CMCascais (Nunes Carvalho, Maria João Nogueira, Josival Barreto, Flávio Mateus, Alexandra Giraldes
Lenvis participants:	IST (Cláudia Viegas)
Aim:	Implementation testing and evaluatin of lenvis gadgets

4.2.16. 15th September 2011 meeting

On 15th September was held a meeting with SANEST, (Table 20) with the aim of presenting and testing lenvis gadgets. This meeting had the aim of presenting and testing lenvis gadgets. For better evaluation, and to identify system incompatibilities, normally related with informatics system limitations all the services were tested on user's computers.
Also the new methodology for bathing water quality forecast was presented, and SANEST found it functional, because it gives more information, and could answer do the classification of punctual monitoring work, and for the final bathing season classification (considering Directive 2006/07 requirements). SANEST also shows some willingness to pay for expand the alert system to other bathing water in Estoril Coast, item to be discussed with other professional users (the municipalities (CMO, CMC), and ARHTejo. SANEST found the service TimeSerie Client, very useful, enabling them to compare monitoring results, meteorological and streams level data. Also the capability of sharing SANEST data with this tool was noted. SANEST found also useful the MohidOnLine gadget that permits to do small discharge simulation, and to visualize model results. The feedback of all gadget tests was noted during the meeting in order to be answer to the questionnaires.

Table 20. Lenvis meeting with SANEST

Validation Activity:	Face to face meeting with SANEST
End users participants:	1 profissional fromSANEST (Catarina Lopes)
Lenvis participants:	IST (Cláudia Viegas)
Aim:	Implementation testing and evaluatin of lenvis gadgets

4.2.17. ARCOPOL- MOHID Workshop Congress Center IST, 13th October 2011

Presentation of lenvis results and developments on *ARCOPOL- MOHID Workshop* Congress Center IST, with "*Faecal Coliforms Dispersion on Bathing Waters*" presentation.
ARH-Tejo and SANEST lenvis users were present. Up to 40 people were present, including other interested stakeholders, like ARH-Center, Águas de Santo André (institution similar do SANEST, but responsible for coastal water in SINES), CIIMAR, Porto University, Paraná Federal University- Brasil, Coruña University- Spain, etc.. Several questions related to model developments, ways of predict and simulate faecal pollution fate were discussed. Users show interest on the proposed methodology to predict bathing water quality.

Fig. 15. Pictures ARCOPOL Workshop, with a presentation of Lenvis developments and results.

Table 21. ARCOPOL Workshop details

Validation Activity:	Presentation on ARCOPOL Workshop
End users participants:	2 profissional from SANEST (Catarina Lopes), 1 professional for ARH-Tejo
Lenvis participants:	IST (Cláudia Viegas, Ramiro Neves),HIDROMOD (Paulo Chambel, Pedro Galvão).
Aim:	Faecal Coliforms Dispersion on Bathing Waters" presentation
Total participants:	40

4.2.18. Paper and oral presentation submissions for 11th Portuguese Water Congress.

A submission was developed together by IST, Hid and Sanest, was submitted and accepted. Will be presented on the 11th Portuguese Water Congress, that will be held on February, in Oporto, Potugal.

4.2.19. 2nd November 2011 users action

Due to the good weather condition, the SMS alert system, and all the managing works around bathing water quality, were maintained by the several professional users (SANEST, Municipalities, and ARH) until the end of October 2011. After the first Autumn raining events ARH contact IST in order to turn off the SMS alert system. Both SANEST and municipalities were contacted and the system was turned off for Sanest and CMCascais. Oeiras Municipality asked to adapt the alert system to the winter levels, in order to have alerts on winter level raising levels, in order to know in real time about flood events.

Table 22. Lenvis users action with SANEST, ARH, CMC, CMO

Validation Activity:	Telephone contacts about SMS alerts system actualization
End users participants:	1 profissional from SANEST (Catarina Lopes), from RAH (Susana Nunes), and CMO (Domingos Leitão).
Lenvis participants:	IST (Cláudia Viegas)

Aim:	Alert system actualization

4.2.20. IST Environmental Journeys- Poster presentation about Lenvis results and bathing water quality, 23th November 2011

Poster presentation with the alert system and modelling tolls related with bathing water quality developed in the scope of Lenvis.

4.2.21. 16th November 2011 meeting

On 16th November was held a meeting with SANEST, (Table 20) in order to evaluate the possibility of expand the alert system to other areas in Estoril Coast. SANEST shows some willingness to pay for expand the alert system to other bathing area in Estoril Coast, buying a new hydrometric station, and installing it in a new stream.

Table 23. Lenvis meeting with SANEST

Validation Activity:	**Face to face meeting with SANEST**
End users participants:	2 profissional fromSANEST (Catarina Lopes, Santos Silva)
Lenvis participants:	IST (Ramiro Neves)
Aim:	Alert system expansion

4.2.22. Activities after Lenvis

IST is planning to do a meeting open to professional users from other regions in order to disseminate the lenvis products having subsequent exploitation in mind.

Also exploitations activities are already planned after Lenvis, on February 2012, the alert system implemented on Estoril Coast in the scope of Lenvis, will be present on 11º Portuguese Water Congress. Documentation will be prepared oriented towards dissemination among professional users, the public and the scientific and technological communities dealing with similar issues.

5. User validation results

5.1. Indicators

The user feedback has been gathered up during the several contacts and meetings with users, with their continuous feedback, and by questionnaires as described in D8. Results obtained from these investigations are analysed based on the following 5 important indicators already reported in D8.2. Different groups of indicators have been evaluated based on the different applications under analysis:

- Indicators used on Web services: timeseriesclient, Services MapViewer, Particle Tracking model

    1-System quality (easy of use, usefull of system features and functions, system efficiency,

2- Information use (voluntariness of use, nature of use
3- Information quality (informativeness, understandability clarity
4- User satisfaction (information satisfaction,
5- Individual impact (decision effectiveness, Information use

- Indicators used on Surfers applications
  1- Information quality (usefulness, informativeness)
  2- User satisfaction (enjoyment, Overall satisfaction , satisfaction with specifics)
  3- Individual impact (personal valuation, decision quality)
  4-System quality (usefull of system features and functions)
  5- Information use (Nature of use, voluntariness of use)

- Indicators used on Portal evaluation
  1- Information quality (Data accuracy, Ease of use, Convenience of access, Realization of user requirements, Usefulness of system features and functions, System flexibility, System reliability, Integration of systems, System efficiency)
  2- User satisfaction (Overall satisfaction, realization of users requirements
  3- Individual impact (Information use)
  4-System quality (easy of use, convenience of access)
  5- Information use (nature of use, Information understanding)

- Indicators used on Alert system and bathing water forecast evaluation
  1- Information quality (Usefulness, timeliness, Data accuracy, informativeness, understandability)
  2- User satisfaction (realization of users requirements, satisfaction with specifics)
  3- Individual impact (Information use, decision analysis, willingness to pay)
  4-System quality (usefull of system features and functions, data accuracy)
  5- Information use (nature of use, frequency of access, motivation to use)

5.2. Web Services evaluation

5.2.1. Lenvis Timeserie Client

The first version of web services was presented on January 2011, with a demonstration of Lenvis Timesiere Client, and a short description of MohidOnLine. Users showed satisfied with the possibility of graphing monitoring results form automatic hydrometric stations and from monitoring data collected by different data providers (SANEST, INAG, ARH-Tejo, IST, ect.). Users suggest changing graphs presentation, using a lightly colour instead, the darker one, firstly proposed. Considering user recommendations collected during 2011 bathing season, some improvements were done: bigger and better axes data, better graph presentation, with a smooth line connecting all the data values, the possibility of adding a horizontal or vertical line, in order to evaluate data easily.

The possibility of adding a horizontal line was really well seen by users, being a useful communication tool, allowing to share their own data on lenvis platform, but simultaneously to use and consult other users and entities data. This tool is an advantage for professional users, helping them to analyse qualitatively data results. With this tool, professional users can evaluate when the bathing water quality results are above threshold values, or when streams levels rises above the safety value (between several other options). This gadget has an important individual impact on professional users, helping them on their decision effectiveness, to better understand bad water quality results (comparing the bathing water monitoring data, and the hydrometric streams levels, with the threshold values).

Users reveal very satisfied with information and system quality, once gadgets allow seeing different data from different data providers at the same time.

Some users volunteered and suggest sharing their on data by this gadget, enhancing the technical performance of this gadget. The results of all users evaluation is presented on Fig. 16.
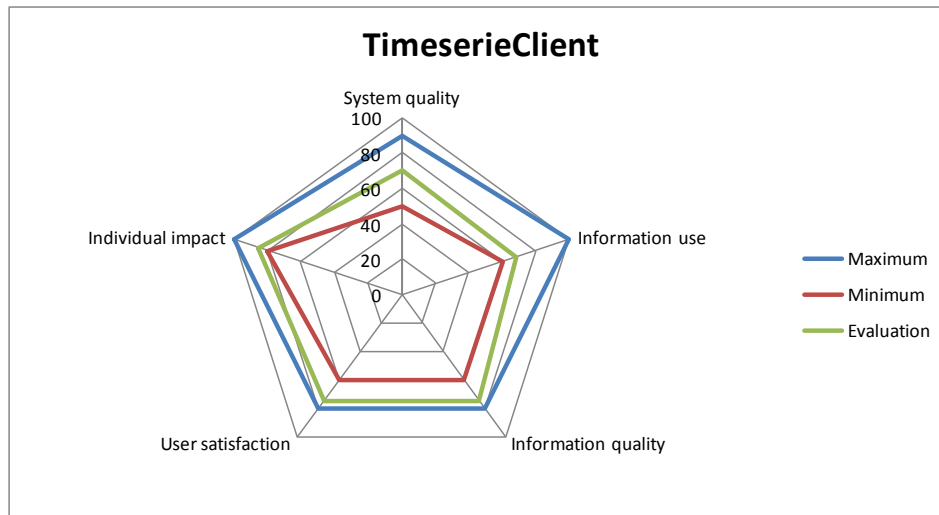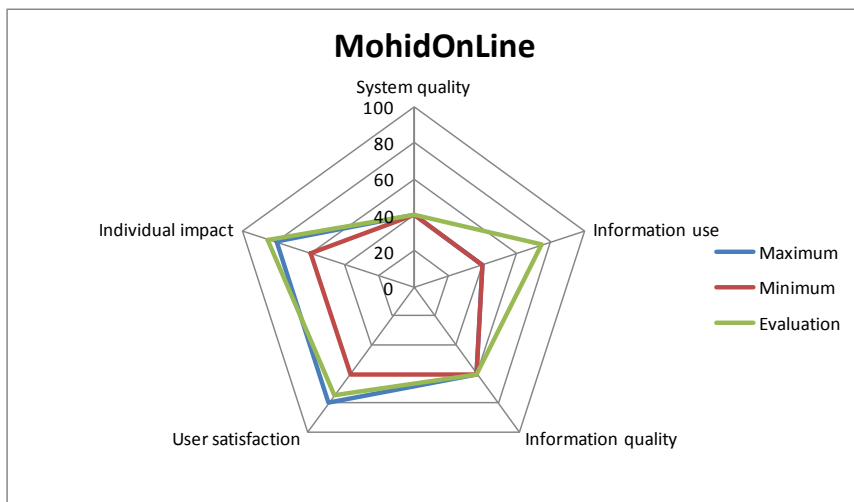
Fig. 16. Spider diagram of TimeseriesClient evaluation, considering System quality, Information use, Information quality, user satisfaction and individual impact indicators.

5.2.2. Mohid On Line

During 2011 evaluation, users considered this gadget useful mainly to visualize model results, presenting them on maps, bringing an overall view of the local hydrodynamic system.
Also the possibility of presenting weather and sea temperature was seen as an advantage. The possibility of presenting currents and wind intensity with vectors was seen as an additional advantage. However the bigger advantage could be the possibility of simulating small discharges, helping decision maker on better understanding the local hydrodynamic, and possible discharge impacts.
This tool reveals to be a good way for the users to see model results, being a useful information tool connecting the model results with users and general public. The individual user impact was high, because it could help to improve decision analysis. However this gadgets technical performance is medium, due to difficulties on gadgets uses. These difficulties were faced by users mainly because of the numerous and different functions that it has. Users also considered that with the gadget manual (developed during 2011 bathing season), and with more use, these limitations could diminish. The results of all users evaluation is presented on Fig. 17.

Fig. 18 shows the general users evaluation about all these lenvis information services. It evidences the bigger individual impact on users, mainly due to the usefulness on decision making. Also newer information, gathered on timeserieclients, MohidOnLine and also on ServicesMapViewer, brings a bigger user satisfaction, and individual impact users. During the several meeting and evaluation sessions, the professional users enhanced the advantage of using this webservices, on their professional tasks.

Fig. 17. Spider diagram of MohidOnline evaluation, considering system quality, information use, information quality, user stisfaction and indivifual impact indicators.
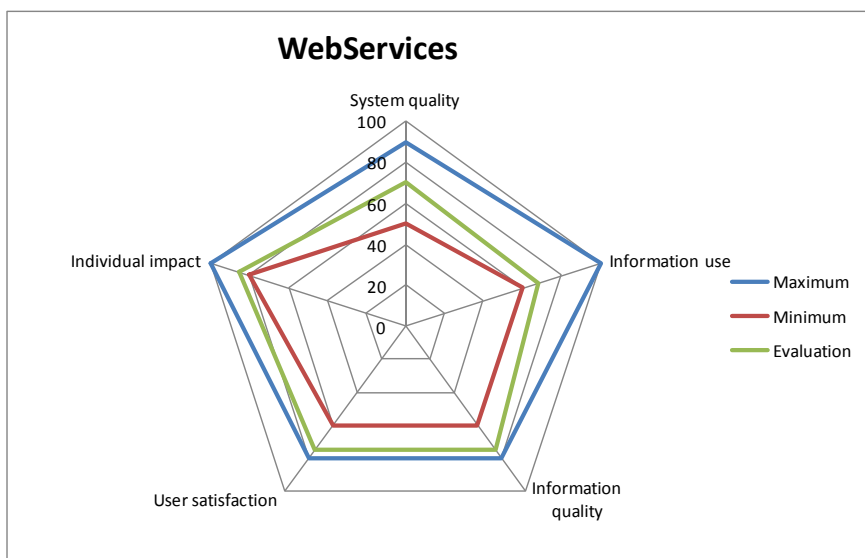

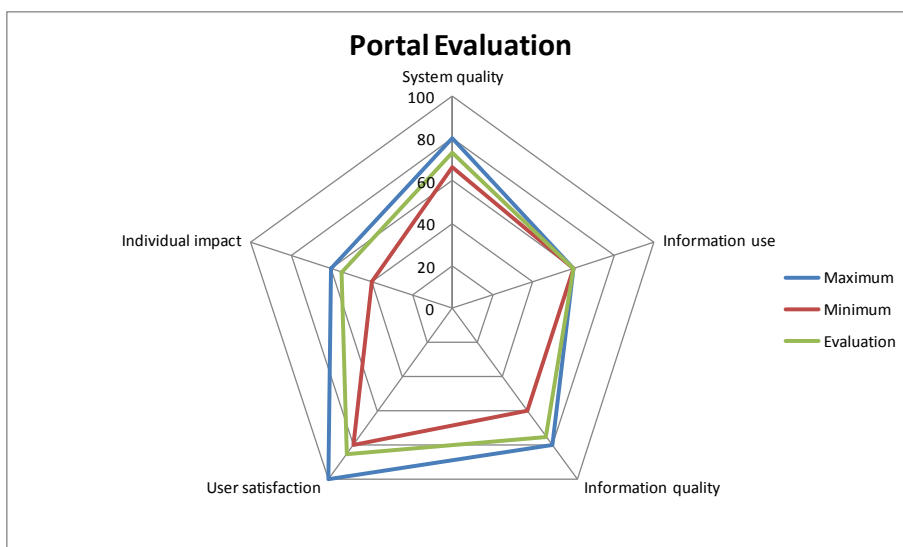Fig. 18. Spider diagram of Web services lenvis evaluation, considering System quality, Informatin use, Information quality, user stisfaction and indivifual impact indicators.

5.2.3. Portal

During the evaluation period lenvis portal faces some developments, mainly on technical performance. After the first user's evaluation, where the users notice that gadgets names should appear on the first lenvis portal page or the possibility of adding gadgets should be more evident, some improvements were done.

The overall view of gadgets lists as improved considering user's recommendations.

During 2011 bathing season tests, users could easily register on the portal, and drag and drop gadgets. Users identify the widgets size as a limitation, because not all the widgets fit correctly in all the spaces. However after testing some possibilities, they could get the better widget position for their needs.

Users propose a better presentation of gadget list, suggesting the presentation of small pictures or images suggesting the kind of information of each widget.

A portal demonstration movie should be developed in order to explain and show easily how to use lenvis portal. This movie should be on lenvis home page and should have up to one minute.

In general professional users consider the portal, useful, but not extremely useful for professional use, mainly because the other services shown more advantages on decision making. However they recognize that for personal use, and for the bathers, lenvis portal could be very useful, with the advantage of gathering different data on the same page. Professional users also refer that portal has good appearance. The possibility for the users to choose their own gadgets is an advantage, as like the possibility of using the other case study gadgets.

On the first lenvis portal evaluation professional users were worried about data security and accessibility. On lenvis portal improvements was decided to allocate different security and limitations use for the different users. For instance the bathing water forecast results, presented on *Beach Water Quality* gadget, is prepared to be available only for specific users. Like this all the other gadgets can have different availability levels.

In general users are satisfied with lenvis portal, and its system and information quality. The results of all users evaluation is presented on Fig. 19.

Fig. 19. Spider diagram of Web services lenvis evaluation, considering System quality, Informatin use, Information quality, user stisfaction and indivifual impact indicators.

5.2.4. Surf and bathing water oriented Gadgets

Since the first gadget presentations, surf and bathing water oriented widgets had improved. Considering surfers recommendations, Surfers Oracle and Beach Lisbon Quality gadgets also present information about tide level, information unusual on the most used surf websites.

Surfers see the *Beach Lisbon Waves gadget* as additional information, useful for planning their activities. Its animations are also an advantage when comparing to other usual surf forecasts sites. Considering the recommendations of the first users meetings, was proposed to present the bathing water forecast on these gadgets. This information is now available on lenvis portal, helping the bathers and surfers to choose the best beach to go.

Theses gadgets and the *SurfersOracle* have a good individual impact from surfers and bathers. Surfers also consider that these gadgets had a good system quality, due to accuracy data and useful systems features. Surfers also enhance the fact of these results having 60 meter resolution, when others well known sites has hundreds, or kilometres resolution. However the surf community is so used to consult other surf forecast sites that will be difficult for they to substitute them by Surferoracle.

Lenvis consortium knows about this limitation, mainly because the most famous surf forecast sites has more additional data, like photos, real time cameras, surf trips and circuits. To face this fact are being established contacts with big Portuguese web sites (like sapo.pt) in order to present these lenvis gadgets on their portals. The results of all users evaluation is presented on Fig. 20.
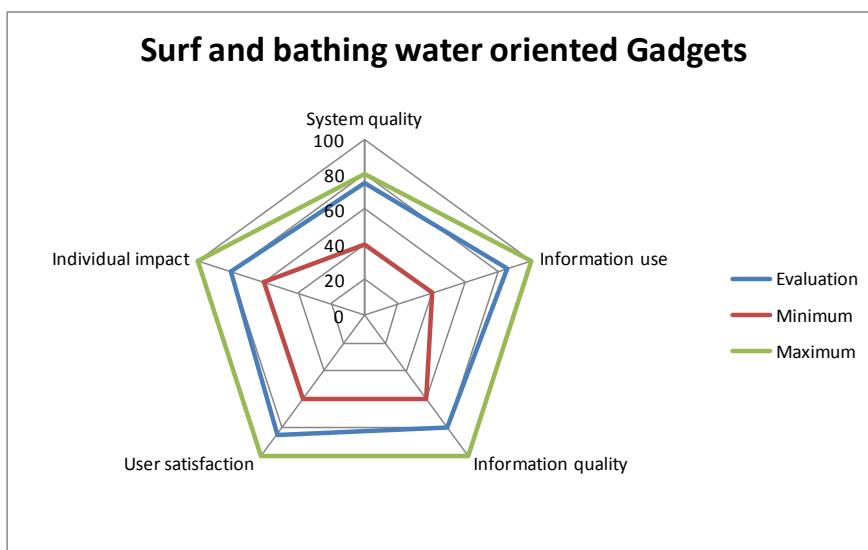

Fig. 20. Spider diagram of Surf and bathing water oriented Gadgets evaluation, considering system quality, information use, information quality, user stisfaction and indivifual impact indicators.

5.2.5. Alerts and Bathing water forecasts

Users showed very satisfied with the alert system implementation. This toll has timeliness, and it is a good tool for helping professional users on their decision making. Even with the limitations that a forecast system can have, when considering bathing water forecasts, the validation done by now brings assurance for bathing water quality forecast. The alerts occur after every water level rising above the limit level, like it was expected, and all users received the SMS alerts. All information received by lenvis tolls, by the alert system and bathing water forecasts helps professional users to better understand bad water quality accidents, and to justify them. All these information can help professionals during the following bathing season activities.

Professional users were satisfied with the evolution of bathing water forecasts that was improving along the evaluation plan responding to user's requirements. CMCascais and SANEST show some willingness to pay for implement the alert system on other bathing waters of Estoril Coast. The results of all users evaluation is presented on Fig. 21.

In order to respond to EU bathing water directive and to the Portuguese statements for weekly monitoring work, a second methodology for bathing water quality forecast in being developed. Users will have access to both results, or only for the ones that have interest for them.
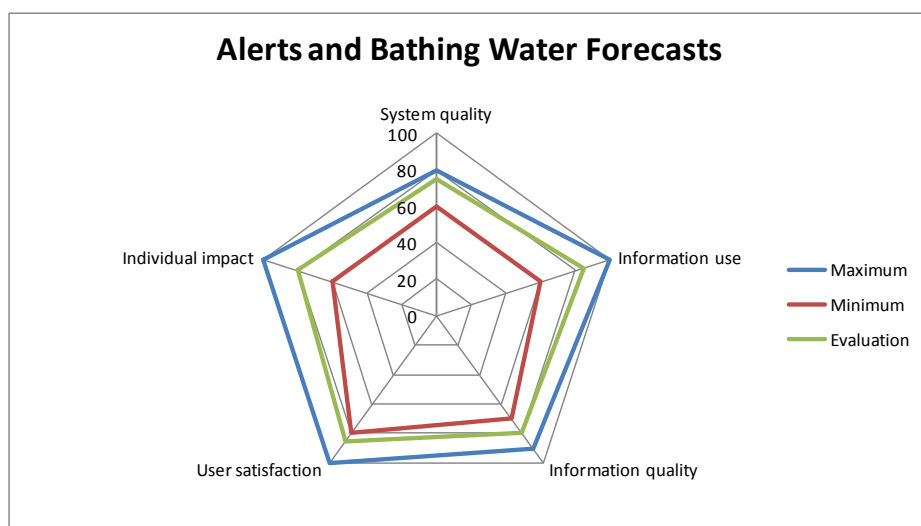
Fig. 21. Spider diagram Alerts and bathing water forecast develop on Lenvis, considering system quality, information use, information quality, user stisfaction and indivifual impact indicators.

6.   Analysis and discussion

6.1. Commenalities and differences in user evaluation results amongst the products

On Portuguese case study the most concerning task for the second evaluation period was to validate the alert system, during the bathing season. This period overlap with the year period when professional lenvis end-users are less available, because of the amount of work and responsibilities that they have on bathing water management, but also because it is the holiday's period. So the availability to do face to face meetings was low, however it was possible to obtain good feedback and recommendations from users.

During the evaluation period the gadgets and information services have been improved, qualitatively and technically, in order to better answer to user's requirements.

By now professional users are satisfied with the capabilities of lenvis information system. However they face some difficulties on using some gadgets, but recognize that with more use it can turns easier. However professional users are satisfied with lenvis tools, and consider that they can help on their professional tasks, mainly on managing the bathing water quality and understand and explain bad water quality events, and prevent bathers exposure to bad quality water.

Surfers also recognize that lenvis surfer utilities have new technical data that other websites don't have (a better wave forecast, with a better resolution, the tide level), however this could not be enough to convince them to use this tools daily, instead of the more famous websites, mainly due to the additional information that other websites have (information related to surf championships, real time webcams, etc). To answer these, efforts must be done to connect these lenvis tools, more detailed than general surf forecasts, to bigger and famous websites. An effort is being done to connect these tools to a Portuguese webchannel (sapo.pt). SANEST and Cascais and Oeiras Municipalities are interest in expand the implemented alert system to other streams and bathing waters of Estoril Coast. To answer this, lenvis platform will be prepared to receive new data from other monitoring stations and other data providers.

6.2. Discussion of user validation strategy and activities

During the evaluation period user's feedback were very useful for lenvis improvements. In fact the development of lenvis information systems platform helps to increase user's interaction with lenvis project and also between users. On the first Portuguese user's meetings, the interaction between all end-users was rather important because they could discuss a common problem (bathing water quality), but with different points of view from: Local Authorities and bathing water quality managers (SANEST, CMC and CMO), National Institute for Public Health (INSA), and Non Governmental Agencies, surfers and general public. Different points of view, worries, knowledge and interests about the same question "bathing water quality" helps to understand all the problematic around this topic, it's limitations, lacks, benefits, and potentialities. Lenvis users were available and participated actively on lenvis sessions, meetings and evaluation activities.
All the users were more open to give their feedback along the meetings, than by questionnaires, so in all the meetings all the questionnaires items were refered in order to have user's qualitative feedback.

7. Conclusion

This intermediate report provides an overview of the results in WP8 Portuguese case study. During all the evaluation period both professional and non professional lenvis users gave a constructive feedback. Users also recognize the importance of the several meetings for project improvements, and mainly being a communication link between different professional stakeholders.
Professional users were interested mainly on Alert System implementation, bathing water quality forecasts and the information tools developed by lenvis.
In general users consider that lenvis brings a new information system for bathing water item helping on information and data sharing, and on decision making mainly because:
- Lenvis allows to share their own information using Lenvis TimeserieClient;
- Lenvis timeserieclient allow to consult other users data (from different sources, monitoring stations, field work, forecasts, etc);
- Lenvis is providing alerts and bathing water forecasts, helping them to respond to the current bathing water legislation requirements;
- With MohidOnLine is possible to see maps with model results and study and simulate possible pollution discharges.
Also non professional users and surfers show their interest on lenvis progress, and found very productive the lenvis user meetings, mainly because they bring the opportunity to collect on the same room different entities, discussing the same item: bathing water quality.
Lenvis users would like to see these services expanded to other bathing waters, to help professionals to manage bathing water quality, but also to give more bathing waters information to bather and surfers.

Appendix A List of users present on Lenvis meetings

1- 27th May 2009

	Institution	Person	Contact
Water related management companies	SANEST	Carla Carvalho	ccarvalho@sanest.pt
		Catarina Vasques	cvasques@sanest.pt
		João Santos Silva	jsilva@sanest.pt
		ConceiçãoGranger	cgranger@sanest.pt
		Luís Patrício	lpatricio@sanest.pt
		Luis Pamplona	luis.pamplona@sanest.pt
	Agência Cascais Atlântico	Ana Ferreira	ana.ferreira@cascaisatlantico.org
		Maria João Faria	mariarfaria@cascaisatlantico.org
	SMAS Oeiras-Amadora	Maria Helena Santos Silva	mhsilva@smas-oeiras-amadora.pt
	Águas de Cascais	Madalena Oliveira	moliveira@aguasdecascais.pt
	SMAS Oeiras-Amadora	Maria Helena Santos Silva	mhsilva@smas-oeiras-amadora.pt
Nacional Government bodies & Agencies	INAG- National Water Institute	José Salvado	jsalvado@inag.pt
	CCDR-LVT (current Tejo Regional Hydrographic Administration))	Carlos Cupeto	carlos.cupeto@ccdr-lvt.pt
		Gabriela Nunes	Gabriela.nunes@ ccdr-lvt.pt
	APA (Portuguese Environmental Agency)	Cristina Garção	cristina.garcao@apambiente.pt
Municipalities	Câmara Municipal de Cascais	Vera Algarvio	vera.algarvio@cm-cascais.pt
		Silvia Duarte	silvia.duarte@cm-cascais.pt
	Câmara Municipal de Oeiras	Selma Sofia Rodrigues	selma.rodrigues@cm-oeiras.pt
		Domingos Manuel Leitão	domingos.leitao@cm-oeiras.pt
Nacional health public bodies	INSA- National Institute Dr Ricardo Jorge	Leonor Falcão	Leonor.Falcao@insa.min-saude.pt
	Direcção Geral de Saúde (General Health Direction)	Paulo Diegues	diegues@dgs.pt
NGO	Associação Bandeira Azul da Europa (ABAE) *(European Blue Flag Association)*	Catarina Gonçalves	bandeira.azul@abae.pt
Surfers		Paulo Costa	costa.paulinho@gmail.com
		Pedro Pekas	pedropekas@gmail.com
		Roman Ponte	romanaponte@msn.com
Lenvis Portuguese Partners	Hidromod	Paulo Chambel	paulo.chambel@hidromod.com
		Pedro Galvão	pedro.galvao@hidromod.com
	IST	Ramiro Neves	ramiro.neves@ist.utl.pt
		Cláudia Viegas	claudia.neto@ist.utl.pt
		Constança Belchior	c.c.belchior@gmail.com
	Hydrologic	Arnold Lobbrecht	arnold.lobbrecht@hydrologic.nl
		Sander Loos	sander.loos@hydrologic.nl
	IHE	Schalk Jan	s.vanandel@unesco-ihe.org

2- 18th January 2011

User	Institution	Person	contact
Water related management companies	SANEST	Catarina Correia	catarina.correia@sanest.pt
		Catarina Lopes	clopes@sanest.pt
		João Santos Silva	jsilva@sanest.pt
		Conceição Granger	cgranger@sanest.pt
		Luís Patrício	lpatricio@sanest.pt
		Luis Pamplona	luis.pamplona@sanest.pt
		Teresa Marçal	teresa.marcal@sanest.pt
		Fátima Paixão	fatima.paixao@sanest.pt
	Agência Cascais Atlântico	Cristina Alves	calves@aguasdecascais.pt
		Teresa Vicêncio	tvicencio@aguasdecascais.pt
	SMAS Oeiras-Amadora	Mª Helena Santos Silva	mhsilva@smas-oeiras-amadora.pt
	Águas de Cascais	Madalena Oliveira	moliveira@aguasdecascais.pt
Nacional Government bodies & Agencies	INAG- National Water Institute	Jorge Bochechas	jorge.bochechas@inag.pt
		Susana Ferreira	sferreira@inag.pt
	Administração da Região Hidrográfica do Tejo (ARH-Tejo)	Susana Nunes	susana.nunes@arhtejo.pt
		Cristina Soares	cristina.soares@arhtejo.pt
	APA (Portuguese Environmental Agency)	Cristina Garção	cristina.garcao@apambiente.pt
Municipalities	Câmara Municipal de Cascais	Alexandra Giraldes	alexandra.giraldes@cm-cascais.pt
		Vera Algarvio	vera.algarvio@cm-cascais.pt
		Silvia Duarte	silvia.duarte@cm-cascais.pt
	Câmara Municipal de Oeiras	Selma Rodrigues	selma.rodrigues@cm-oeiras.pt
		Domingos Leitão	domingos.leitao@cm-oeiras.pt
Nacional health public bodies	INSA- National Institute Dr Ricardo Jorge	Raquel Rodrigues	raquel.rodrigues@insa.min-saude.pt
NGO	ABAE- *European Blue Flag Associatio)*	Margarida Silva	margaridasilva@abae.pt
Surfer Schools	Surfers	Paulo Costa	costa.paulinho@gmail.com
		Roman Ponte	romanaponte@msn.com
Lenvis Partners	Hidromod	Paulo Chambel	paulo.chambel@hidromod.com
		Pedro Galvão	pedro.galvao@hidromod.com
		Helder Marques	helder.marques@hidromod.com
		Eduardo Aires	eduardo.aires@hidromod.com
	GMV	Nuno Guerreiro	nuno.guerreiro@gmv.com
		Fábio Oliveira	fabio.oliveira@gmv.com
	IST	Ramiro Neves	ramiro.neves@ist.utl.pt
		Cláudia Viegas	claudia.neto@ist.utl.pt
		Rodrigo Fernandes	rodrigo.maretec@ist.utl.pt

3- 19th April 2011

User	Institution	Person	contact
Water related management companies	SANEST	Catarina Correia	catarina.correia@sanest.pt
		Catarina Lopes	clopes@sanest.pt
		João Santos Silva	jsilva@sanest.pt
		Luís Patrício	lpatricio@sanest.pt
	SMAS Oeiras-Amadora	Mª Helena Santos Silva	mhsilva@smas-oeiras-amadora.pt
	Águas de Cascais	Carlos Alves	calves@aguasdecascais.pt
		Rute Lagartinho	rlagartinho@aguasdecascais.pt
Nacional Government bodies & Agencies	Administração da Região Hidrográfica do Tejo (ARH-Tejo)	Simone Pio	simone.pio@arhtejo.pt
		Inês Trindade	ines.trindade@arhtejo.pt
		Susana Nunes	susana.nunes@arhtejo.pt
		Helena Alves	helena.alves@arhtejo.pt
Municipalities Nacional	Câmara Municipal de Cascais	Nunes de Carvalho	jose.carvalho@cm-cascais.pt
		Maria João Nogueira	m.joao.nogueira@cm-cascais.pt
		Josival Barreto	josival.barreto@cm-cascais.pt
		Flávio Mateus	flavio.mateus@cm-cascais.pt
		Alexandra Giraldes	alexandra.giraldes@cm-cascais.pt
	Câmara Municipal de Oeiras	Selma Rodrigues	selma.rodrigues@cm-oeiras.pt

Appendix B User Evaluation Survey

Date: __ / __ / 2011
Name: _____
Age:_____
User: _____
Note: your name is needed, and user group information (professional or not, which institution?) only to combine the information you provide during the project time; your answers will be processed anonymously.

(Please check the appropriate box or add text)

A- Portal Evaluation

1. Is the structure of the web-site clear for the user starting to use the site for the first time enough? Please select the answer
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

2. It was easy to register in the portal?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

3. Is the web-site stable (Please, if you have the opportunity, re-visit the website several times to check this?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

4. Is the information published on lenvis portal useful for you?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

5. Is the information in the web-site up to date?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

6. This site was created to present the information related to bathing water quality (tables, graphs, model simulations), is this responding to your professional necessities?
   a. Strongly disagree ☐
   b. Disagree ☐
   c. Neutral ☐
   d. Agree ☐
   e. Strongly agree ☐

7. Considering lenvis system: web site and services provided (timeseries service, grid data services, particle tracking service, and mobile phone gadgets), please specify what type of information you find most useful?
   a. Maps ☐
   b. Graphs ☐
   c. Aplications on phones ☐
   d. Other (please specify):...

8. 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 ☐

9. 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 ☐

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

11. Please report to us any errors(bugs) you encounter while checking the website

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

Case specific question(s) to Surfers:

13. Do you think that you will use lenvis wave forecasts in your work daily?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

14. Do you think that you will use lenvis wave forecasts, instead to the site that you were using until today?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

B- LenvisTimeserieClient evaluation

1. Could you instal Lenvis Time serie client by your selft?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

2. Could you see the timeserie for the data that you need?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

3. This service was design to allow you to see and graph you timeserie, is this responding to yur necessities?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

4. Do you think that this tool usefull to share data between professionals?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

5. Would you recommend this lenvis service to your work colleagues?
   a. Strongly disagree ☐
   b. Disagree ☐
   c. Neutral ☐
   d. Agree ☐
   e. Strongly agree ☐

6. Can this tool be an advantage in your decision making in your work?
   a. Strongly disagree ☐
   b. Disagree ☐
   c. Neutral ☐
   d. Agree ☐
   e. Strongly agree ☐

7. The information available by this service is responding to your necessities?
   a. Strongly disagree ☐
   b. Disagree ☐
   c. Neutral ☐
   d. Agree ☐
   e. Strongly agree ☐

C- MohidOnline evaluation

1. It was easy to use this tool?
   a. Strongly disagree ☐
   b. Disagree ☐
   c. Neutral ☐
   d. Agree ☐
   e. Strongly agree ☐

2. Could you graph all the information? Currents and wind direction and intensity?
   a. Strongly disagree ☐
   b. Disagree ☐
   c. Neutral ☐
   d. Agree ☐
   e. Strongly agree ☐

3. With this tool you cans simulate small discharges. This functionality it is easy to use?
   a. Strongly disagree ☐
   b. Disagree ☐
   c. Neutral ☐
   d. Agree ☐
   e. Strongly agree ☐

4. With this tool you can simulate small discharges, can this tool be an advantage for you, to better now the hydrodynamic system of local bathing waters?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

5. Can this tool be an advantage in your decision making in your work?

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

D- Surf and Bathing Water Oriented Gadgets
These questions are dedicated to public users and surfers

1. Do you think that SurfersOracle have all the needed information related to wave forecast?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

2. Do you think that surfersoracle can be an advantage when comparing with other surf websites?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

3. Would you recommend lenvis information o to other colleagues and friends, for their leasure times?
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

4. Is this gadget usefull for you??
    a. Strongly disagree ☐
    b. Disagree ☐
    c. Neutral ☐
    d. Agree ☐
    e. Strongly agree ☐

5. The possibility of seeing an animation of waves forecast can be an advantage when comparing with other surfers sites??
   a. Strongly disagree ☐
   b. Disagree ☐
   c. Neutral ☐
   d. Agree ☐
   e. Strongly agree ☐