

**MARINEMET PROJECT.**  
**CONSULTANT TYPE I**  
*(Annual Report: 2011)*

This report refers to the tasks developed by WMO consultant type I (Josep Coca Sáez de Albéniz) at the University of Las Palmas de Gran Canaria (ULPGC). This consultant is responsible for developing and updating the processes and procedures that ULPGC provides to the project. In the general project framework this consultant is responsible for the following tasks actividades ([http://www.afrimet.org/marinemet/index.php/es/documentos/doc\\_download/28-consultants-general-tor](http://www.afrimet.org/marinemet/index.php/es/documentos/doc_download/28-consultants-general-tor)):

1. Coordination and management of real time satellite observations and its transmission to the RSMC-Dakar.
2. Coordination, management and maintenance of the hardware system associated with the L-band antenna.
3. Maintenance and management of the Operational dedicated Servers.
4. Models and remote sensing observations operational validation the together with data of the sea level radars networks and that of the available buoys in the Region.
5. Maintenance of the Private Virtual Communication Network with RSMC-Dakar and eventually with the NMHS involved in the project.
6. Exchange of technical information with the technical personnel and experts of the NMHS of Senegal, Mauritania, The Gambia and Cape Vert, both by email and telephone.
7. Support of the development and implementation of the new products and services developed by AEMET, Las Palmas University and State Ports.
8. Update and develop procedures in satellite processing chains
9. Elaboration of annual reports both in Spanish and English and an annual abstract in French.
10. Provide marine meteorology research and capacity building to the participants, with the logistic support of WMO and financial matters ensured by the Trust-fund Africa, and in particular, develop specific capacity building activities on the project.
11. Provide a web-based portal, shared or joint with RSMC-Dakar, for user access to a regional marine meteorology research and forecast activities and services.
12. Organization and participation in the training activities.

Under MARINEMET project framework during the year 2011, tasks developed can be itemized into the following sections, as detailed in the ToR of the project consultants for the year 2011 ([http://www.afrimet.org/marinemet/index.php/es/documentos/doc\\_download/29-tor-consultants-2011](http://www.afrimet.org/marinemet/index.php/es/documentos/doc_download/29-tor-consultants-2011)):

1. Maintenance of the virtual antenna
2. Products generation
3. Updating and developing procedures in the processing chain of remote sensing products
4. Website development
5. Remote sensing products users support
6. Documents

## **1. Virtual antenna maintenance**

### **1.1 Virtual antenna operation summary**

Virtual antenna starts from L1a files available at Ocean Color Web (<http://oceancolor.gsfc.nasa.gov/>) and finish producing PNG (Portable Network Graphics) images of geophysical interest products, Sea Surface Temperature (SST), Chlorophyll-a concentration, and maps for real time service according to spatial user's windows in the same. From PNG images of sea surface temperature thermal fronts images are derived.

#### **Software in the earliest development**

- Linux **Mandriva** 2010 <http://www2.mandriva.com/en/>
- **Bash** <http://www.gnu.org/s/bash/>
- **Seadas** 6.1: <http://oceancolor.gsfc.nasa.gov/seadas/>
- **Predict** 2.2.3: <http://www.qsl.net/kd2bd/predict.html>
- **IDL**: <http://www.itvis.com> (replaced by R cran)
- **Tcl** 8.5 or higher <http://www.tcl.tk/>

Final products of virtual antenna are PNG images that can be divided in two types, which are described in remote sensing products guide ([http://www.afrimet.org/marinemet/index.php/es/documentos/doc\\_download/22-products-guide](http://www.afrimet.org/marinemet/index.php/es/documentos/doc_download/22-products-guide)):

- Maps of products over project windows generated using the images produced by the specific operational processing for the real time service. These maps allow visual interpretation to any user.
- PNG images of products that allow for scientific use so from them geographic and geophysical can be derived.

### **1.2 Control of processes and procedures**

Operationally, the consultant reviews that virtual antenna works properly in every step, the download of the starting files and that the all processing steps to obtain the final products were properly achieved. Both, the generation of the maps service in real time, as the operational remote sensing imagery is controlled.

Occasionally, the processes have been interrupted or delayed due either to delayed availability of the starting files, or network or electrical problems. When this occurs, the output files and process logs are reviewed. Sometimes is required to act manually to up to date the entire system.

During the first part of the year, occasionally there were some delays due to the reasons mentioned above; however, during the second half of the year, these have been virtually non-existent.

### **1.3 Maintenance and management of dedicated servers**

The consultant is responsible for maintaining and managing (software updates and operating system...) the machines at the ULPGC dedicated to the project. At this moment they are three:

- PC dedicated operational processing (initially two).
- PC dedicated to procedures development and tests.
- PC server which receives the products from the centers participating in the project (AEMET and state ports).

During the year, there was a fatal fault in the machine hosting the ftp server enabled for receiving state's ports and AEMET products. Due to the availability of equipment, it was necessary to reorganize the available machines. Thermal fronts processing was transferred to the operational virtual antenna processing PC. It was installed and configured a server running on **Ubuntu** Server 10.10 (more ISPConfig-3). Its main functions are providing SSH server (for remote access) and ftp server for MARINEMET products reception.

## **2. Products generation**

Real time service of maps of sea surface temperature, chlorophyll-a and thermal fronts is performed daily for the four windows of MARINEMET project (project general window, Mauritania, Cape Verde and Senegal - Gambia).

The maps are sent by email to the focal point in each country. Since May 2011, are uploaded on the web operationally to be publicly accessible.

In addition to maps, images of remote sensing products (usable both geographical and geophysical) are generated. These images are divided into:

- Daily syntheses, data available for the date are used.
- Five days synthesis, data of two days prior to date, of the date and of the two days after are used.
- Real time images services, data of three days prior to service date and quality flags are slightly relaxed.

Images are processed operationally and weekly uploaded on the web site to make them publicly available. The entire data base of images can be queried on the web site.

## **3. Updating and development of procedures in the processing chain of remote sensing products**

### **3.1 Changes in data download routines**

The script that adds the file names of MODIS level L1a data to download, not add more names, if the number of pending files is greater than 20. Otherwise, add the following date to the download file and rewrites the file passes forecast, removing files corresponding to that date. It was modified to check that only dates prior to the current date are added. This modification is introduced to avoid excessive download requests to the server if there is a delay in the availability of L1a files.

It was also modified to handle the last day of the cycle available in passes forecast file, to avoid interruptions for the second run of the day due to the fact that there are not dates to add.

### **3.2 Full automation of satellite files forecast**

The generation of the necessary L1a filenames to download that the script does, is called from a new script. It controls the files that have yet to be downloaded to add them to the new forecast, without duplicating files or deleting pending. This script allows for the fully automation of the process and can be added to the system cron. With this modification in the absence of other constraints virtual antenna can operate fully autonomous.

### **3.3 Seadas 6.2 update**

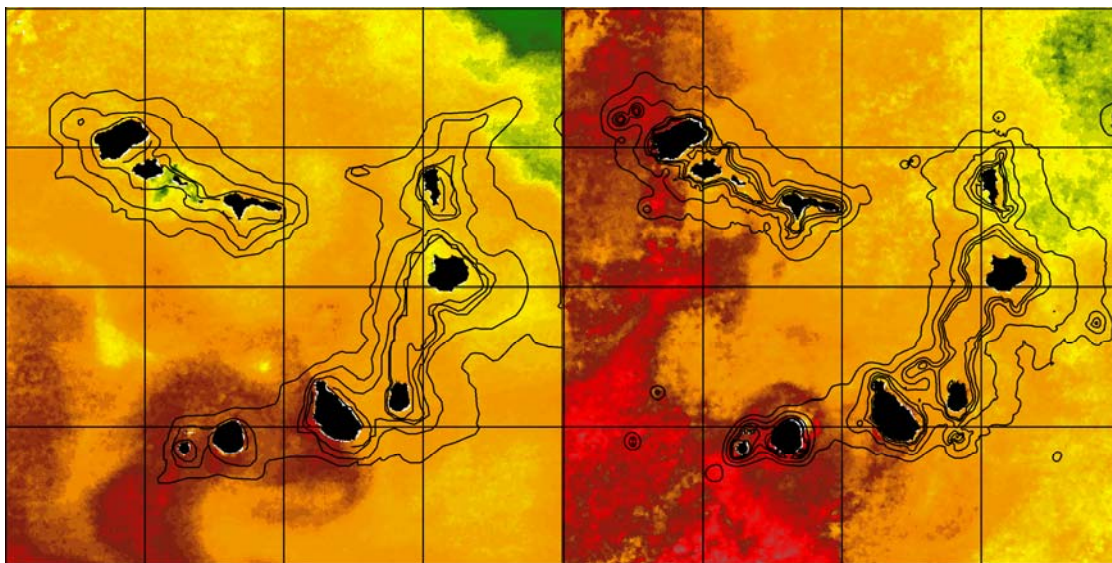
Upgrade to the new version of **seadas** was done that also involved small changes in processing scripts. There were problems in the update process, the \*. GEO (MODIS geolocation data) generation failed due to architectures conflict.

### 3.4 Seadas 62 update 2 update

**Seadas** development begins to migrate **csh** scripts to **python**. In the tests, they produced problems. For the moment **seadas** **csh** scripts are hold, waiting for fully successful migration. **Seadas** in interactive mode still uses **csh** scripts.

### 3.5 Isobaths

The isobaths that were displayed on the maps were generated from the data of 1 minute GEBCO grid (General Bathymetric Chart of the Oceans, <http://www.gebco.net/>). In the new version of the GEBCO data, a higher resolution version (30 seconds) is included. From these new data, new isobaths in vectorial ESRI Shapefile format were generated, that allows use it in the real-time maps service. Both, **mandriva** and **kubuntu** development were changed. They are included in the generation of maps both using **IDL** and for **R-cran** migration.



**Figure 1:** Comparison between old isobaths (1 minute) and new ones (30 seconds) for Cape Verde

The maps show the isobaths of 200, 500, 1000, 2000 and 3000 meters. Figure 1, shows the differences between the isobaths generated with 1 minute previous data (left) and with the 30-second new ones (right) for Cape Verde. The new isobaths contain information more precise and complete. Prior data do not allow generating good isobaths for 200 and 500 meter depths.

### 3.6 Change in the schedule service delivery

The users requested that the maps should be delivered early to fit their needs. Scripts of real-time service, generation of fronts, maps and cron were modified, to forward the maps generation from 12:30 to 6:30 in the morning, local time. This advance is possible thanks to the improvement on availability schedule of starting data during 2011 in relation to the previous year.

### 3.7 Migration of IDL procedures to R-cran

With this migration, the use of commercial tools in the generation of products is avoided. The whole system of Virtual Antenna is now based on free tools. Two fundamental processes initially developed in **IDL** were migrated to **R**:

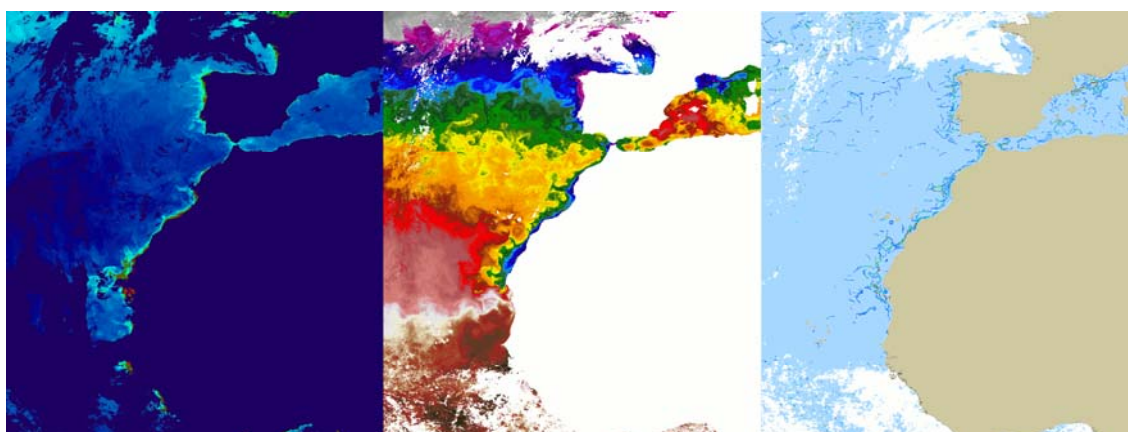
- Generating the PNG images from binary data produced by the processing chain **seadas / tcl**.
- Map generation from real-time products PNG images.

## Generating the PNG images from binary data produced by the processing chain seadas / tcl

The last step of the **IDL** based procedures includes data filtering prior to image generation and their generation. Remote sensing images generated under the project framework are indexed PNG 8-bit (one layer with color palette). In addition to color, his generation must keep the pixel value, because it is used to derive from them the value of geophysical variable.

This produced some difficulties using free tools. They were solved using **R-cran** and **gimp**. Several **R** libraries were tested. Using **R** neither could be created an indexed PNG of the desired characteristics, nor were found how to do the required filtering with **R**. At the end it was decided to create grayscale TIFF (Tagged Image File Format) image with **R**. The output is passed to indexed, filtered and the palette is applied developing a **gimp** script. Tests were also conducted with **imagemagick**, but desired results were not achieved.

This involved creating **gimp** palettes sst.gpl (SST) and chl.gpl (concentration of chlorophyll-a). The \*. Gpl files are copied in the **gimp** palettes user directory or to the general one in order to be accessible to any user. This allows loading the palette on the indexed image interactively. The script should be copied to the **gimp** scripts user directory, or to the general one in order to be accessible to all and to can be called from a script. The script needs a reference image to apply the palette; chl\_pal.png and sst\_pal.png were created to get color palettes. Land masks with ocean transparency are needed for this script, so they were created one for sea surface temperature images and other for chlorophyll-a concentration images. The script needs a transparency mask for each product. Figure 2 shows an example image of the virtual antenna outputs obtained with the processes migrated to **R/gimp**, from left to right: chlorophyll-a concentration, sea surface temperature and thermal fronts.



**Figura 2:** Example image of the virtual antenna outputs obtained with the processes migrated to **R/gimp**.

## Map generation from real-time products PNG images

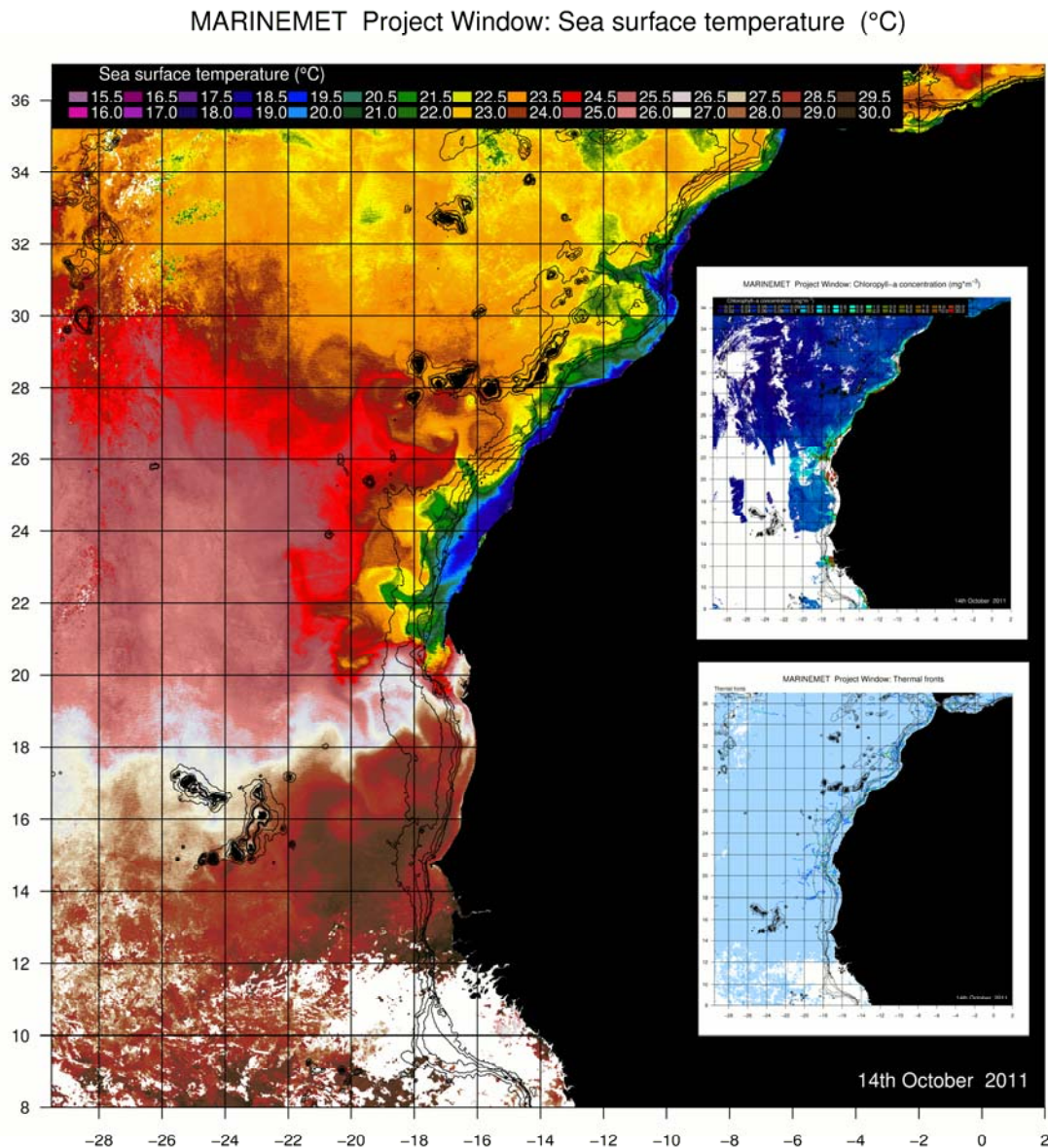
The map generation is the second important process developed on **IDL** in early project. The quality and design of the maps generated is equal to that achieved using **IDL**. This aspect has been particularly emphasized; the products after the change are equal to the previous ones. It was developed for sea surface temperature, concentration of chlorophyll-a and thermal fronts.

Several libraries to handle geospatial data with **R** (both vector and raster) were tested. Maps generation is done by developing an **R** script. The output of **R** is a three layers RGB PNG and through a **gimp** script is converted to indexed mode (one layer with color palette).. The indexing step intends to reduce the size of the image without quality loss. Figure 3 shows an example for the overall project window of the maps produced by the procedures migrated to **R/gimp**. It shows a map of sea surface temperature with the concentration of chlorophyll-a and thermal fronts as thumbnails inside.

The **R** script for generating maps of sea surface temperature, chlorophyll-a, and thermal fronts, for the four project windows (window of the project, Mauritania, Cape Verde and Senegal - Gambia), allows for its use both automatic for real time execution and prompt execution specifying dates for a delayed reprocessing.



**Gimp** script shrinks the size of the **R** image output. **Gimp** tests give better results than **imagemagick** ones. The script must be putted in **gimp** user scripts directory or in the general one. Must be called from the directory where the maps are placed.



**Figure 3:** Example for the overall project window of the maps produced by the procedures migrated to **R/gimp**.

### 3.8 Linux kubuntu migration

To avoid diversity in the developments of the project, was decided to migrate the virtual antenna system from linux **mandriva** to **kubuntu**, which is the operating system used by SAPOs being developed by the State Ports. In the **kubuntu** migration process was decided to implement the developments involving the elimination the use of commercial tools. The development was initially done in a virtual machine using **VirtualBox** (figure 4).

The whole system is mounted on a single computer: passes forecast, controlled download, processing from L1a to PNG, thermal fronts processing and the generation of maps. With regard to cron, schedule changes with respect to the **IDL**

processing (is slower). Incorporating **R** migration involves changes in several processes altering scripts; some were discontinued and new were needed. The system has successfully migrated and all processes are working properly.

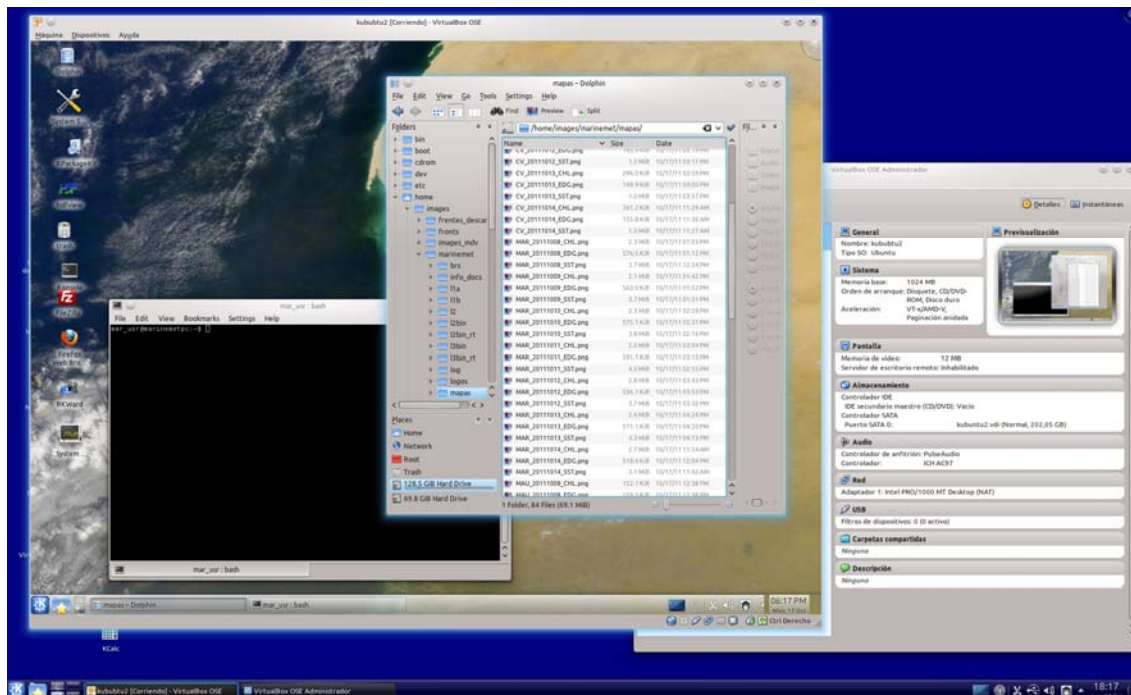


Figure 4: Kubuntu migration development running on a VirtualBox virtual machine

Necessary software:

- Linux **kubuntu** [www.kubuntu.org](http://www.kubuntu.org)
- **Bash** <http://www.gnu.org/s/bash/>
- **Gimp** [www.gimp.org](http://www.gimp.org)
- **Seadas** 6.2 update 2: <http://oceancolor.gsfc.nasa.gov/seadas/>
- **Predict** 2.2.3: <http://www.qsl.net/kd2bd/predict.html>
- **R- Cran** (<http://www.r-project.org/>)
- **Tcl** 8.5 o posterior <http://www.tcl.tk/>

**R** processes require the installation of various **R**. The latest versions of **kubuntu** come with **tcl** 8.5 but by default use **tcl** version 8.4. The virtual antenna requires at least version 8.5, so you need to change the default link in the system (or call in the scripts version 8.5).

So fronts are running on the same machine, a script was created to call fronts generation in the real time service executing the entire process continuously. **Kubuntu** has a package for **predict** software, this simplifies their installation. With regard to **mandriva** changes on directories of the files needed for execution were found. This involves modifying the script to accommodate the changes.

## 4. Web site development

### 4.1 Development of procedures to automate the ingestion of remote sensing products in the project's website

Tools that allow for automatic ingestion of remote sensing products on the web were developed. The processes developed are suitable both for real time maps service as for operational images. The script that generates maps in real time automatically sent them to the web service via ftp. The intake mechanism on the web every hour checks for new products to ingest. The intake process moves the images to your final directory create the thumbnails and insert the images into MySQL web database.

Sending and ingestion process for maps is automatic, operational processing images are weekly sent manually, and the ingestion process is manually launched. This part is also likely to be automated, but for the moment is chosen to do it manually, after a products review.

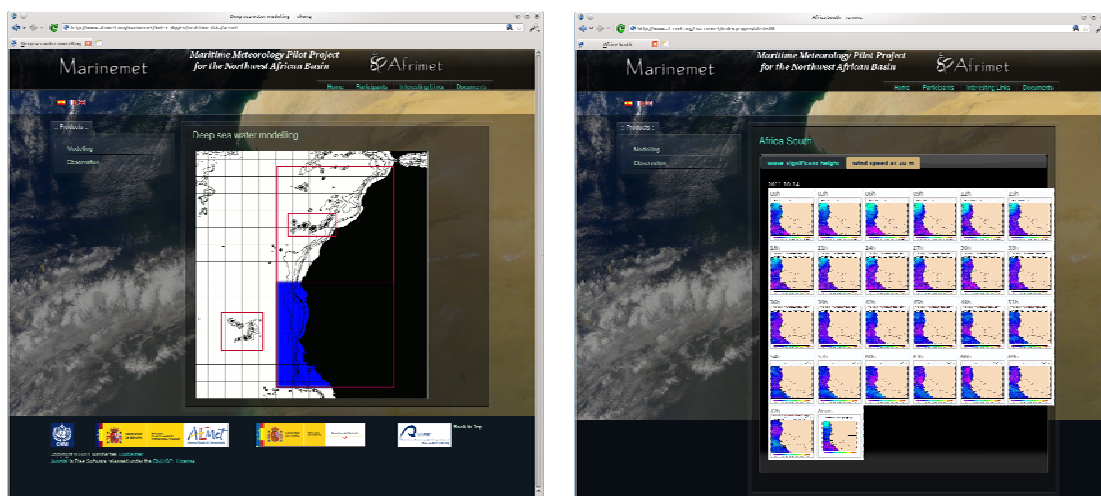
### 4.2 Web site frontend changes

During the year changes were made on page frontend, most of them due to requests and / or suggestions from users and project managers. There are three aspects to highlight on frontend changes:

- Deep sea water modelling display and window selection.
- Remote sensing service display and window selection.
- SAPOs display and selection.

#### Deep sea water modelling display and window selection

It is accessed via ocean modeling products menu. A selection of area of interest using an interactive map was developed. Moving the mouse over the map, modeling window on which we move is activated (Canary Islands, Cape Verde, North Africa, South Africa), which is highlighted by a color change. Clicking on the chosen area the latest available forecast is opened and disposed in two tabs, one for wind and the other for waves. A box of thumbnails is displayed showing the image for each forecasting horizon and the gif animation. Clicking on the thumbnail enlarges the image to view in full size and to download. Figure 5 shows the interactive window selection system (left) and the display of the latest deep sea water modeling available forecast (right).

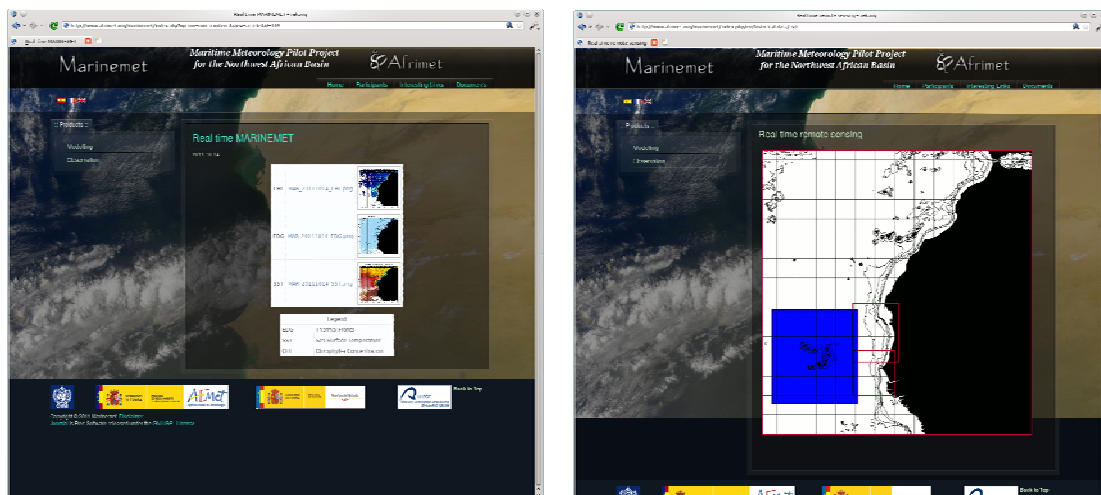


**Figure 5:** Interactive window selection system (left) and latest deep sea water modeling available forecast display (right).



## Window selection and display of remote sensing products

It is accessed via observation menu real time remote sensing products. A selection of area of interest using an interactive map was developed. Moving the mouse over the map, remote sensing window on which we move is activated (General Project, Mauritania, Cape Verde and Senegal-Gambia), which is highlighted by a color change. Clicking on the chosen area the latest available remote sensing service is opened. The three thumbnails of products are displayed (sea surface temperature, chlorophyll-a concentration and thermal fronts). Clicking on the thumbnail enlarges the image to view in full size and to download. Figure 6 shows the interactive window selection system (left) and the display of the latest remote sensing service available (right).



**Figure 6:** Example of interactive window selection (right) and display of the latest remote sensing service available (left).

## SAPOs selection and display

It is scheduled for this year, but after the furnishing of this document. The system will be similar to deep sea water modeling visualization. They will let select SAPO, visualize images of every horizon forecasts and data tables.

### 4.3 Development of tools for the ingestion of deep sea water modeling products

Tools that allow for the ingestion of deep sea water modeling products on the web were developed. Products are sent from AEMET to the ftp server. The scripts generate gif animation from PNG images and automatically sent all to the web ftp site. The mechanism of the intake on the web, hourly checks for new available products. The intake processes moves the images to their final directory, creates the thumbnails and insert the images on the web MySQL database. The component on the web displays the latest available forecast. In is planned to include tables with forecast data values.

### 4.4 Development of tools for intake SAPOs products

It is scheduled for this year, but after the furnishing of this document. System will be similar to other products ingestion. Web cron will check the products reception directory. When new products will be found, will move them to the corresponding directory, will create thumbnails and insert products in web MySQL database.

#### **4.5 Search utilities on the products archive**

Tools were developed to access via web to the historical archive of project products. Tools provide access to products that are available in the website. Searches are available on remote sensing and deep sea water modeling products. The searches on SAPOs archive are scheduled for this year, but after the furnishing of this document. Search criteria and options depends on product type, planned document about web site for this year will describe searches on web archive.

#### **5. Users support**

During the course of the year have been resolved all issues and problems that users have sent. It is pointed the request to advance schedule of the real time remote sensing service to suit the needs of users.

#### **6. Documents**

##### **6.1 Weekly Report of services and incidents**

Weekly, every Friday, a short weekly report is sent to project managers with the services of real time maps made. Where applicable, explain and discuss the problems and incidents that have arisen.

##### **6.2 Product guide of remote sensing images**

It is a simple document that describes the products as presented in the database. Primarily describes naming codes that identify each product. It also describes how to extract geophysical and geographical information from products. This manual in English, French and Spanish is available on the web documents of the project in the section of remote sensing technical documents ([http://www.afrimet.org/marinemet/index.php/es/documentos/doc\\_download/22-products-guide](http://www.afrimet.org/marinemet/index.php/es/documentos/doc_download/22-products-guide)).

##### **6.3 Manual of remote sensing products: theoretical basis**

Addressed to users with more training and knowledge. This document allows the end user to know and to understand the theoretical basis and the obtaining of each satellite product. This manual in English, French and Spanish is available on the web documents in the project documents section on remote sensing techniques ([http://www.afrimet.org/marinemet/index.php/es/documentos/doc\\_download/25-products-basis](http://www.afrimet.org/marinemet/index.php/es/documentos/doc_download/25-products-basis)).

##### **6.4 Manual on the web site structure**

It is scheduled for this year, but after the furnishing of this document. This document will describe web structure and what are found in every part. This manual in English, French and Spanish will be available on the web documents in the project technical documents section about web.