

## WP5

# Integration and testing of DSS for coastal flood and extreme weather early warning

## Activity 5.1

### Integration of coastal remote sensing data into early-warning DSS

#### D5.1.1 Integration of coastal remote sensing data into early-warning DSS

## PROJECT AND ACTIVITY DETAILS

<b>Project Acronym</b>	AdriaMORE
<b>Project title</b>	Adriatic DSS exploitation for Monitoring and Risk management of coastal Extreme weather and flooding
<b>Funding Line</b>	Priority Axis 2, Specific Objective 2.2
<b>Project Partners</b>	LP Abruzzo Region (Italy) P1 Dubrovnik and Neretva Region (Croatia) P2 Meteorological and hydrological service (Croatia) P3 National Research Council (Italy)
<b>Starting date</b>	January 1, 2018
<b>Activity number</b>	5.1
<b>Activity Title</b>	Integration of coastal forecasting modules into early-warning
<b>Work Package</b>	WP5: Integration and testing of DSS for coastal flood and extreme weather early warning
<b>Activity Summary</b>	Activity 5.1, within Work Package 5, is devoted to the integration into myDEWETRA platform of data flow coming from the new remote sensing data as wind profiler, radar and satellite products for prevention of coastal flood and extreme weather early warning". It was realize the personalized updating of the myDEWETRA Adriatic-Ionian system, the new data visualization, integration, transmission and distribution of sensors data and models generated by AdriaMORE project.
<b>Deliverable number</b>	5.1.1
<b>Deliverable Summary</b>	This deliverable is aimed at describing the myDEWETRA platform as improved by integration of the new remote sensing data coming from the AdriaMORE project. In the platform are integrate and published the new data related the wind profiler, radar network, chlorophylls maps and particulates suspended maps.
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## Table of Contents

1. INTRODUCTION .....	4
2. SOFTWARE ARCHITECTURE.....	5
2.1 High level Architecture .....	5
2.2 Dewetra Data Server .....	6
2.3 DDS Workflow .....	8
2.4 Business Model.....	8
2.5 Final Map Workflow .....	9
2.6 Dewetra Node Architecture .....	11
3. DEWETRANET.....	13
4. DEWETRA 2.0 APPLICATION .....	15
4.1 Description.....	15
4.2 New datasets implemented through AdriaMORE project .....	16
5. DATA INTEGRATION IN THE MYDEWETRA PLATFORM .....	17
5.1. Integration of Wind Profiler data .....	17
5.1.1 Implementation of a DDS component for the data delivery.....	17
5.1.2. Publication of data in the Dewetra2 application.....	18
5.2. Integration of AdriaMORE radar data .....	20
5.2.1 Import of radar data into the myDEWETRA platform.....	20
5.2.2. Implementations in a DDS component for deploying radar data .....	20
5.2.3. Publication of radar data in the Dewetra2 application.....	21
5.3. Integration of Chlorophylls and Particulate suspended maps .....	23
5.3.1. Import data into the myDEWETRA platform .....	23
5.3.2. Implementation of a DDS component for the data delivery .....	24
5.3.3. Publication of data in the Dewetra2 application.....	25

## 1. INTRODUCTION

CIMA Foundation is involved in the AdriaMORE project, thought CETEMPS and Abruzzo Region partner, in the project and in charge for the implementation of the activities related the WP5 “Integration and testing of DSS for coastal flood and extreme weather early warning”. In this framework is foreseen the personalized updating of the myDEWETRA Adriatic-Ionian system, their visualization, integration, transmission and distribution of sensors data and models generated from the AdriaMORE project: <https://www.italy-croatia.eu/web/adriamore>. Particularly, this report describes the integration of sensors data developed under WP3.

This is based on the definition of the exploitation of the DSS developed within the ADRIARadNet project for hazard mitigation taking into account marine, coastal, airport and metropolitan environment. Specifically CIMA Foundation it was in charge of enhancing ICT web based platform, called DEWETRANet, for building real-time risk scenarios in the Adriatic and Ionian sea.

The myDEWETRA Adriatic-Ionian platform as an web platform is accessible in the link below: <http://adriatic-ionican.mydewetra.org/>, with specific user and password for all the contribution partners.



Figure 1. myDEWETRA Adriatic-Ionian interface.

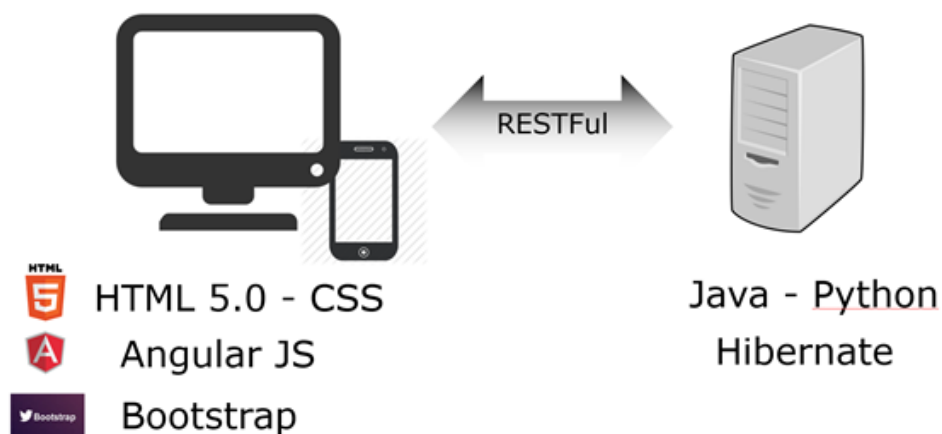
## 2. SOFTWARE ARCHITECTURE

The architecture and design of the myDEWETRA Platform is described briefly in this report, in order to understand the functionality of the system. myDewetra is a 2.0 web application for environmental monitoring; it is a real-time integrated system of risk forecasting, monitoring and prevention of the Italian Prime Minister Office - National Department for Civil Protection- Centro Funzionale Centrale. The system is technically and operationally certified.

The system is developed by CIMA Research Foundation on behalf of the Italian Department for Civil Protection under the agreement for the development of knowledge, methodologies and technologies for the fulfillment of civil protection activities in Italy and in the context of International Cooperation. This system it was adapts to the Adriatic regions through the AdriaRadNet project, and has had further development under the CapRadNet project, both financed under the IPA Adriatic programme.

### 2.1 High level Architecture

The high level architecture of the system can be introduced with this schema:



myDEWETRA is a RESTful Web 2.0 application. On the server side two languages are used: Java for some retro compatibility and for integration with the GeoServer platform. Python is mostly used for all the REST API Server.

On the client side native web technologies, mobile ready, are used: based on HTML5.0 and CSS the well-know and spread used Bootstrap library and Angular JS framework are the base of the user interface. Being the evolution of Dewetra, myDEWETRA inherited the experience of this system: first of all the know-how regarding the Monitoring Web Application, the most used tools, the user experience and the performance issues; then the growing of correlated services, like the publication of bulletins, the report tools and the correlated losses database, has been taken in account. This lead

to evolution from a single application to a portal that can contain all the Civil Protection related applications.

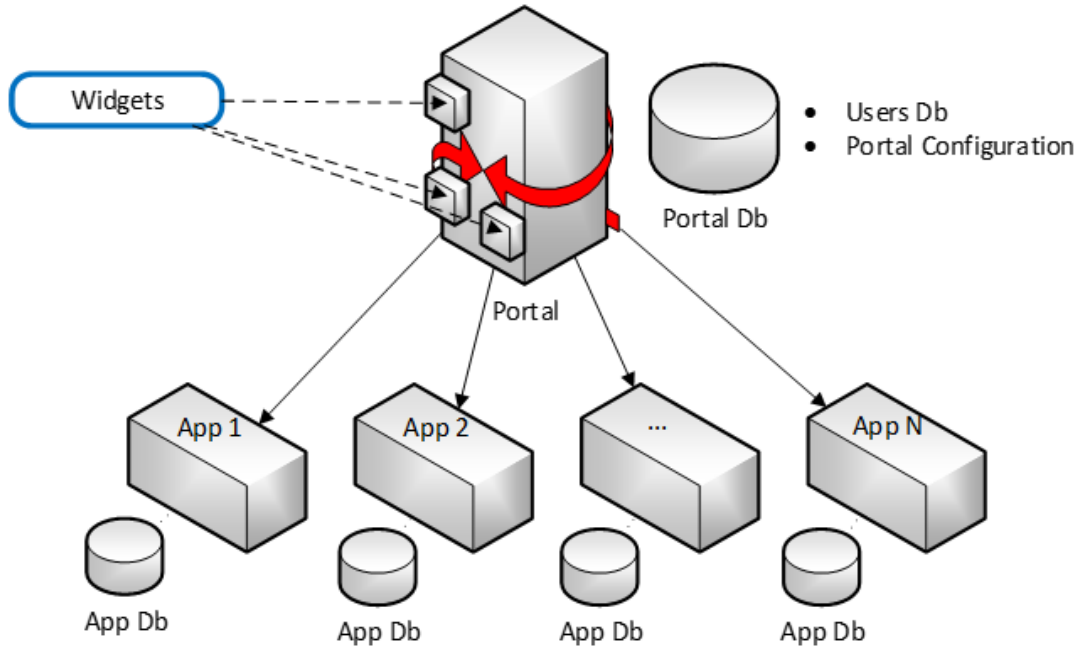
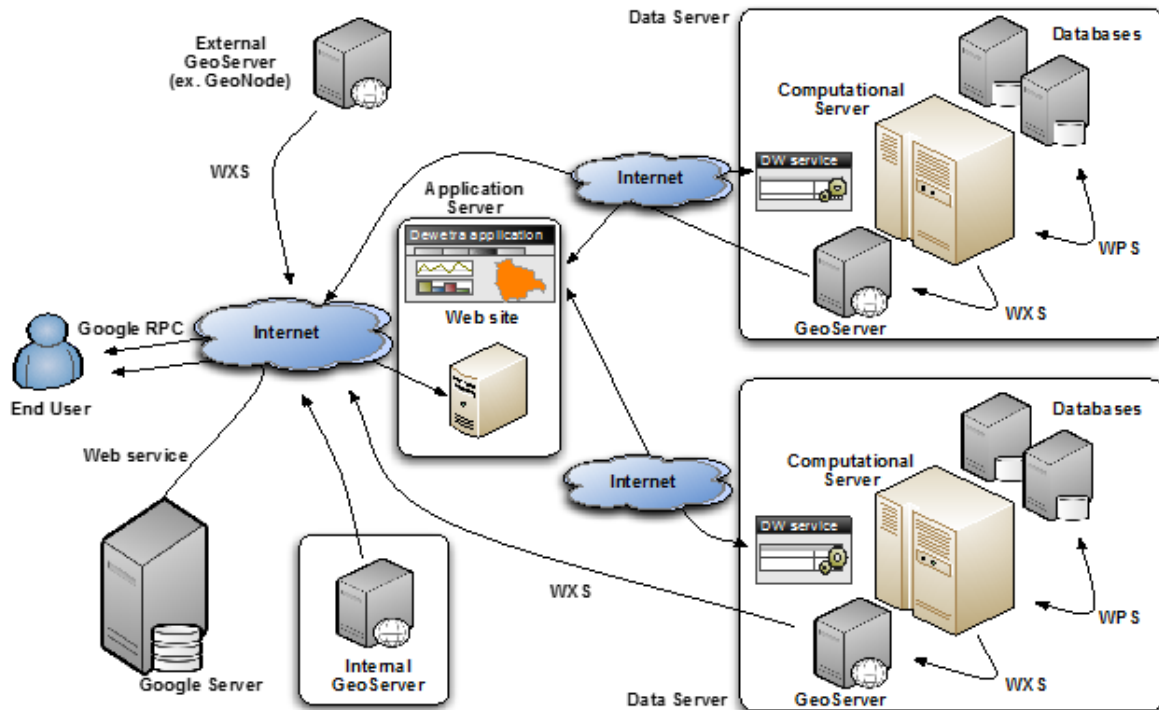


Figure 2 IT architecture of MyDewetra Adriatic-Ionian.

## 2.2 Dewetra Data Server

The DEWETRA platform is a distributed system, which allows the collection and publication of real time information from different sources.

The system is composed by a “master node” (“Application Server” in next schema, in the middle), which provides the web application and a collection of data source “simple node”, which make information available to the World Wide Web according to international standard OGS-WMS. The respect of this standard will also ensure interoperability with any other third party systems that it could be possible to interface with in the future.



No actual data exchange is carried out from one source to other nodes nor to the user, by only the content of the information.

This mechanism, nowadays commonly used by geospatial applications “static data”, it has been extended also to dynamic data, which cannot automatically and permanently be published, unless wasting a huge storage capacity.

The Dewetra platform allows the instantaneous publication and visualization of dynamic layers user requests. This is the main feature of Dewetra.

User’s request is interpreted by the “Application server”, which engages the node (where the necessary raw data resides), for the generation of the requested layer. The engaged node generates, the requested layer and publish it as WMS.

The End User triggers the request through the Web Application Interface, asking for example one Meteo Model layer or an interpolated map. The request is handled by the main Dewetra Application node that holds the configuration of the complete distributed system. This configuration controls the User Interface Menu of the web application and tells to the Web Application Server where to find that specific resource; in this way, the main Application Server knows the address of the remote node who is responsible for that request.

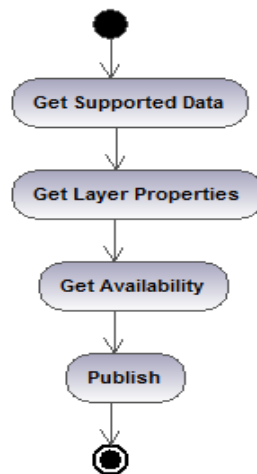
The main Application Server forwards the request the remote Dewetra Service that holds the data. The Dewetra Service queries the Dewetra Database, access the requested data and publish it on the fly on the local geoserver instance obtaining a unique layer id. The Dewetra Node returns this layer id to the Dewetra Main Application Server that, in turn, returns it to the client with the address of the remote node to contact.



Now the client has the address and layer id that can be used to add the new layer to the Map using WxS standard.

## 2.3 DDS Workflow

The workflow of the operations supported by Dewetra Data Server can be represented in this activity diagram:



Operations are:

1. Get Supported Data: the client ask the server which data are supported;
2. Get Layer Properties: the client ask the server the properties of a single layer. Then here the client sets the properties in the requested way;
3. Get Availability: the client ask the real availability of data in a time range with the properties set
4. Publish: the client ask the server to publish the data to obtain layer id to add to the map

The same operations are available for the series.

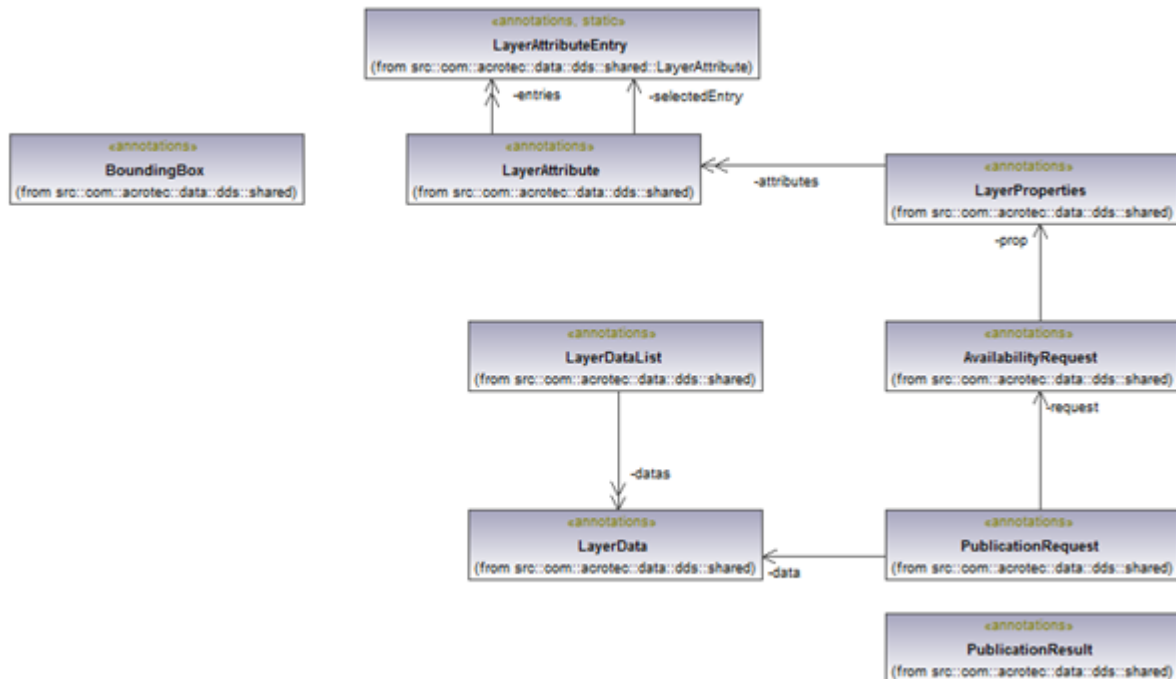
## 2.4 Business Model

The Business Model of the Dewetra Data Server relies on two main data types:

- Maps (or Layers): any layer that can be published using WxS and added to a map;
- Serie: single or multi sequence of data that, usually, can be shown in a chart;

In this section all the entities involved in the use of DDS are explained. The full diagram is the following:





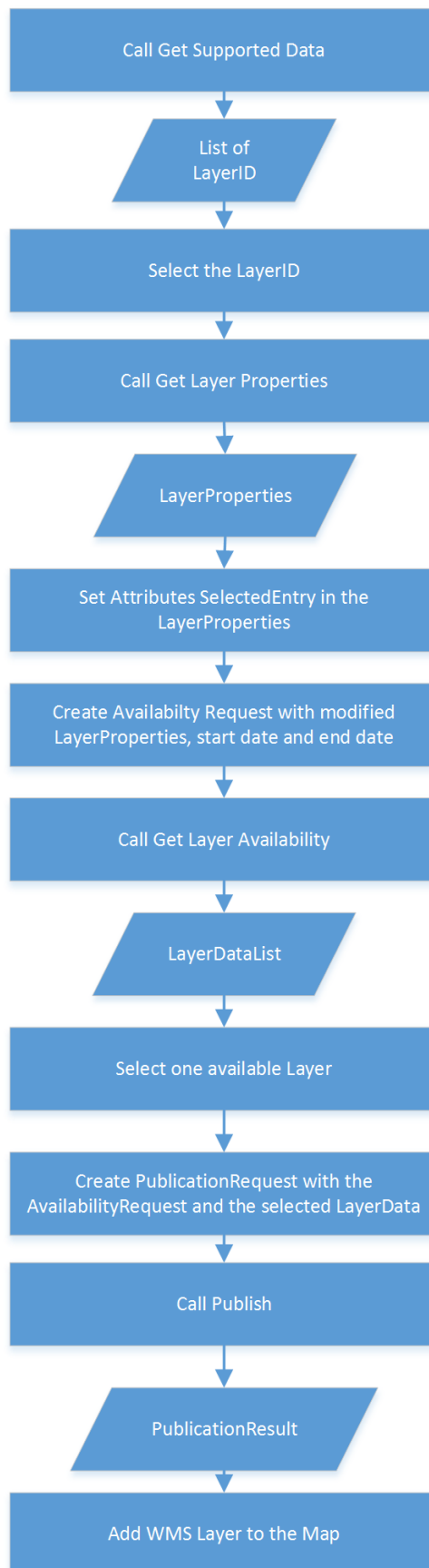
The LayerProperties is the main entity. Each layer can have many properties that the user or the client can set to make a specific instance of that layer. In the LayerProperties object there is a list of LayerAttributes that represents the different available settings; for each attribute there is a list of possible entries and a pointer to the selected one.

***The bounding box of a layer is encapsulated in a specific class.***

One availability request has a member representing the LayerProperties and a time range. The result of an availability request is a LayerDataList that contains many LayerData: this class is a short version of the properties containing just few data the choose one specific layer in a range of time. The PublicationRequest has the original AvailabilityRequest and the selected LayerData as members. The output of a PublicationRequest is a PublicationResult that just contains the address of the server and the final layered.

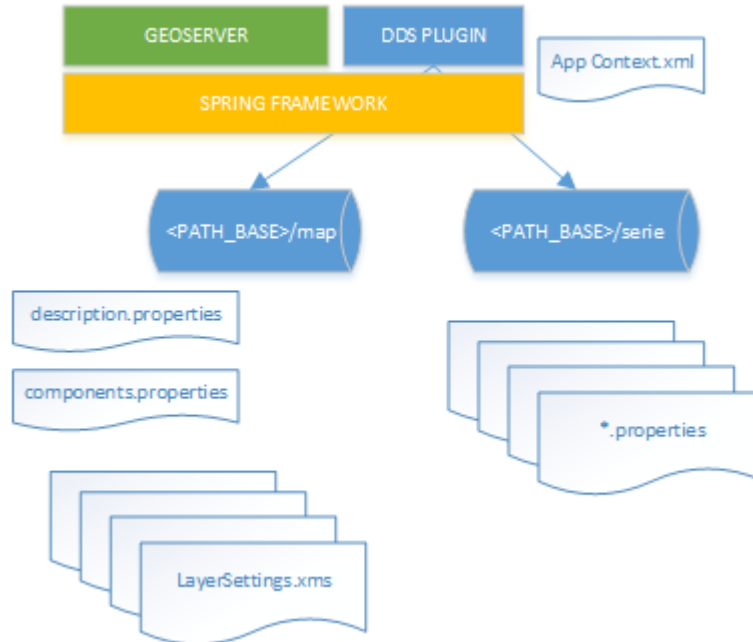
## 2.5 Final Map Workflow

The following schema integrates the workflow with the exchanged objects and show how to select and publish one layer with Dewetra Data Server.



## 2.6 Dewetra Node Architecture

DDS is a Java Geoserver plugin.



Geoserver is based on spring framework: DDS plugin is declared in the applicationcontext.xml file.

DDS is based on two main components: map and serie. The map component relies on a map subfolder on the server disk. In that folder there are these files:

- [layersettings].xml: xml file that configures a supported data type;
- Components.properties: for each xml file can set a specific Java component to use;
- Description.properties: for each xml file can set a description;

The syntax of the layer settings xml is inherited from the previous version of Dewetra and is very similar to the xml representation of the LayerProperties Object.

### <dynamicLayer

Dynamic Layer ROOT

**id**="?"

Unique dynamic layer identifier (es. ***sensorMapPluvio***)

**descr**="?"

- Layer description >

<**attribute**

Open an attribute tag

**descr="?"**

- Attribute Description

**hidden="?"**

- Set if the attribute is visible or not in the Layer Properties. For Dynamic Layers is true (hidden) by default

**id="?"**

Identifier of the attribute to configure

**type="Text"**

Sets the attribute Type (Text or List)>

**<attributeEntry**

Attribute Entry

**descr=""**

Attribute Entry description

**id=""**

- Id of the attribute entry

**default= "" />**

- Default Value

**<referredValue**

- Specific Attribute Entry Value

**id=""**

referredValue identifier (ie paletteID)

**value="" />**

- Specific Value (ie Geoserver style name of the Dynamic Layer Palette)

### **WRF Sample**

```
<dynamicLayer descr="WRF" id="WRF">
  <attribute descr="Variable" id="variable" type="List">
    <attributeEntry descr="T2" id="T2;-">
      <referredValue id="paletteId" value="DDS_T"/>
    </attributeEntry>
  </attribute>
</dynamicLayer>
```

### 3. DEWETRANET

#### *The evolution of DewetraNet: myDEWETRA web portal*

The improvement of the DewetraNet platform has been carried out in a twofold way. The first part of process has been currently devoted to the update of the already existing nodes of the system. CIMA Foundation's ICT experts have remotely worked on the client servers to install the latest version of the platform. DewetraNet, deployed during the AdriaRadNet Project, has been substituted with the recently developed myDEWETRA web portal (<http://adriatic-ionian.mydewetra.org/>), taking advantage from the most up-to-date technologies in order to optimize the response time and the end-user experience.

All the already-operational components have been fitted into the new platform. The update version of DewetraNet (hereinafter: myDEWETRA) uses the same criteria for data sharing and visualization. myDEWETRA includes:

- the updated version of the tool designed for hydro-meteorological and geological data analysis and visualization of geo-specialized information (Dewetra2.0)
- the real-time integrated system for Mediterranean Marine Ecosystem Monitoring (SeaWetra),
- an expert-dedicated blog (Kumalè)
- an on-line User Guide (DeWiki)
- a public dashboard to provide free access to real-time observational data (e.g., weather radars and raingauges) to the general public

As it turned out, the installation of new nodes was not necessary: the Geologic Survey of Slovenia have provided a public WMS by means of which the data they agreed to share<sup>1</sup> have been ingested into Dewetra 2.0.

The present data inside the myDEWETRA Adriatic-Ionian are represented in the table 1 below. All this data are provide from different institutions partner in the projects mentioned in the report, but are managed, integrate, visualised through the platform by CIMA Foundation.

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<sup>1</sup> For further information on those data the reader is referred to Section **Errore. L'origine riferimento non è stata trovata.**

Data	Type	Coverage	Frequency of update
Italian observational network	observation	Italy	15 minutes
Cingoli radar	observation	Central Italy	10 minutes
Tortoreto radar	observation	Central Italy	10 minutes
Durres radar	observation	Central Albania	10 minutes
Dubrovnik radar	observation	South Croatia	10 minutes
Italian radar network	observation	Italy	10 minutes
MSG	observation	Western hemisphere	15 minutes
MICRA <sub>dria</sub>	observation	Italy	10 minutes
IMERG	observation	global	3 hours
GSMaP	observation	global	1 hour
SSM/I	observation	global	Twice a day
GFS 0.5°	forecast	Global	daily (10-day forecast)
COSMO-I7	forecast	Southern-central Europe	twice a day (3-day forecast)
WRF 3km	forecast	Southern-central Europe	daily (2-day forecast)
WRF 12km	forecast	Europe	daily (4-day forecast)
FloodPROOFS	forecast	Drini-Buna (Albania), Marche (Italy)	daily
CHyM	forecast	Central Italy, Drini-Buna (Albania), Neretva (Croatia)	daily
Aladin	forecast	Southern-central Europe	daily
SFLOC	observed	Italian territory.	daily
SM_MOD_ASCAT	observed	Europe	daily
PR OBS 3 / PR OBS 5	observed	Europe	daily
FloodPROOFS	forecast	Italy (Marche region)	daily
Geological Survey of Slovenia	observed	Slovenia	daily

Table 1. List of the observational and forecast data currently available on DewetraNet.

## 4. DEWETRA 2.0 APPLICATION

### 4.1 Description

According to the AdriaMORE typology of data we will use the Dewetra 2.0, for the integration, visualization, transmission, and distribution of this data through the platform. Following the experience gain with myDEWETRA Adriatic-Ionian, the spatial data are organized in four macro categories according to the classification of elements suggested by the EU Floods Directive: environmental data, human health and social data, cultural and heritage data and economical data. The interface has been specifically designed to allow the user to view layer and information and easily navigate and search through the data. The data are collected and organized in order to provide information about flood hazard and risk over the territory, the elements exposed, as population and infrastructure that may be affected by an adverse event, and the resources and measures to mitigate the risk. The restyling of the application has been specifically designed, implemented and optimized to be accessed from mobile devices.

The user interface is updated with the new logos of the AdriaMORE project and organized as follows:

- Control Map
- Toolbar
- Display
- Layer List
- Additional Tools

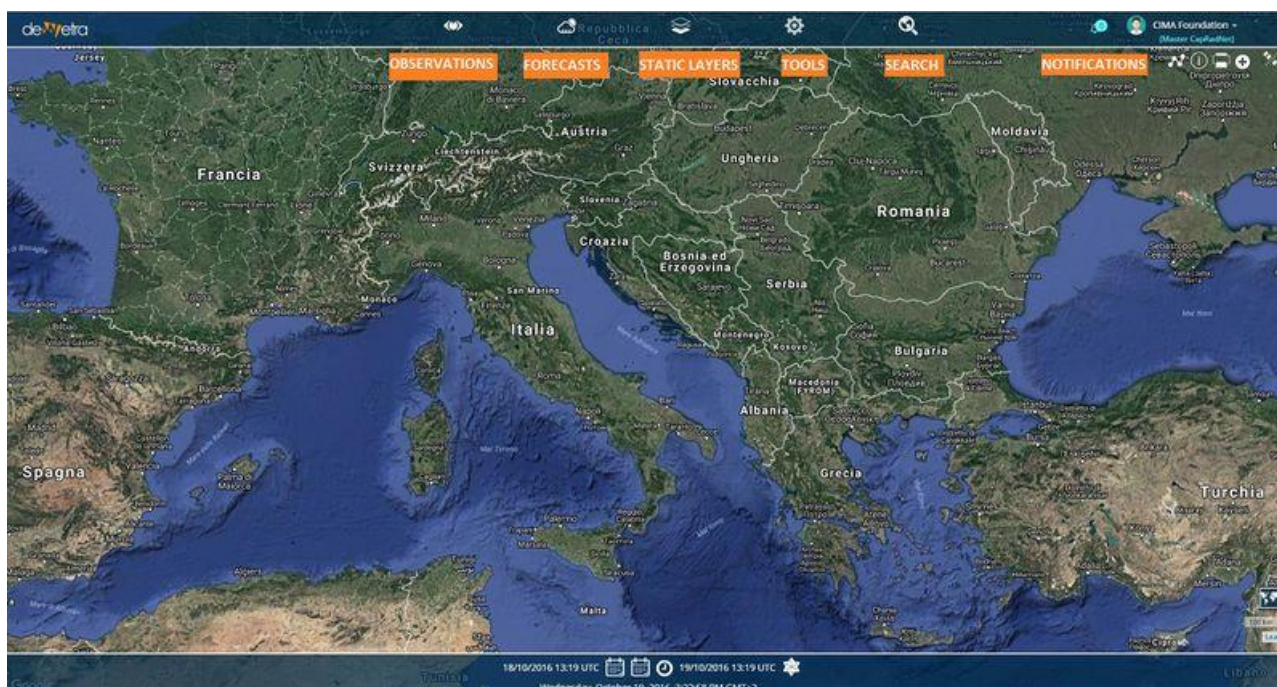


Figure 3. The DEWETRA 2.0. interface



## 4.2 New datasets implemented through AdriaMORE project

The platform is populated from data produced by two main previous projects described above in the table 1. With the AdriaMORE project myDEWETRA platform is enriched with new data which are added to the existing ones.

The new dataset that are integrated into the myDEWETRA Adriatic-Ionian platform (<http://adriatic-ionic.mydewetra.org>) provided by this project described in the work packages 3, is related to the elaboration, visualization, transmission, and distribution of all the data generated from sensors and models of the ADRIAMORE project partners.

This report describes the integration of sensors data developed under WP3 actions 3.1, 3.2 and 3.4, the new dataset is composed by:

- 1. Wind Intensity & Direction profiles (act. 3.4 - indicatively 1 map each 10 min);**
- 2. Composite Radar products (act. 3.2 - indicatively 1 map each 10 min);**
- 3. Chlorophylls maps from satellite (act. 3.1 - CHL indicatively 1 map each hour);**
- 4. Particulate suspended map from satellite (act. 3.1 - TSM indicatively 1 map each hour);**

For each of the four new data the description of the integration in myDEWETRA from technical point of view as well as some example images will be provided in the chapter 5.

## 5. DATA INTEGRATION IN THE MYDEWETRA PLATFORM

### 5.1. Integration of Wind Profiler data

The integration of the wind profiles data into the myDEWETRA platform involves the display of the wind direction and intensity graphs for the Dubrovnik LAP3000 station.

To make the data compatible with the *myDEWETRA* platform and to be able to integrate it in the same, it is necessary to enter in the system the data of the registry and the geographical position of the station. This information is essential to be able to view the station in the map control of *Dewetra2*. For this reason we proceeded to create a database called "*wind\_profiler*" containing the "stations" table in which the station database is defined. Specifically, the registry contains the details and geographical coordinates of the LAP3000 Dubrovnik station.

The database to support station information is published in the *Postgresql* service in the Eagle DDS node on the *adriaserver.aquila.infn.it* server.

At the same time, images of the wind direction and intensity of the Dubrovnik LAP3000 station are found directly on the website: <https://radar.dhz.hr/~celio/wp/dubrovnik/>.

#### 5.1.1 Implementation of a DDS component for the data delivery

A specific component of *Dewetra Data Server (DDS)* has been implemented for managing and publishing the **Wind Profiler** data so that it can be viewed and queried by the *Dewetra2* application of the *myDEWETRA* platform.

The *DDSMAPAdriaWindProfiler* component implements the interface that defines the list of available "data" in the required interval. In the specific case, the list of all the **Wind Profiler** graphs available in the requested time interval is returned.

Once the date of the graph to be displayed has been selected, the DDS component supports the publication of the Wind Profiler data by means of the WFS service implemented by the geoserver published at <http://adriaserver.aquila.infn.it/dds/>. This data is complete:

- from the station registry;
- the geographical position of the station (longitude and latitude);
- from the URL relative to the selected graph  
(es. [https://radar.dhz.hr/~celio/wp/dubrovnik/plots/windbarbs\\_2019-11-13\\_02.png](https://radar.dhz.hr/~celio/wp/dubrovnik/plots/windbarbs_2019-11-13_02.png))

The DDS component is configured through an XML file (*ADRIA\_WIND\_PROFILER.xml*) regarding the basic *http* address where the image of the graphs and the geoserver style for the station display reside:

```
<dynamicLayerdescr="Wind profiler" id="ADRIA_WIND_PROFILER">
<attribute descr="url" hidden="true" id="url" type="Text">
<attributeEntrydescr="url" id="https://radar.dhz.hr/~celio/wp/dubrovnik/plots ">
</attributeEntry>
</attribute>
```

```
<attribute descr="Variable" id="variable" type="Text">
<attributeEntrydescr="Wind profiler date" id="WIND_PROF_GRAPH" default="1">
<referredValue id="style" value="DDS_WIND_PROFILER_ADRIA"/>
</attributeEntry>
</attribute>
</dynamicLayer>
```

### 5.1.2. Publication of data in the Dewetra2 application.

The Wind Profiler data is viewable from the *Dewetra2* application present at the address: [http://adriaticionian.mydewetra.org/apps/dewetra2/index\\_crn.html](http://adriaticionian.mydewetra.org/apps/dewetra2/index_crn.html)

By accessing Dewetra2 with the *MasterCapRadNet* profile it is possible to load the data in the menu: *OBSERVATION* -> *WIND* -> *ADRIAMORE\_WIND\_PROFILER*.

Of course the name of the data and the path to access it can be modified and redefined as desired.

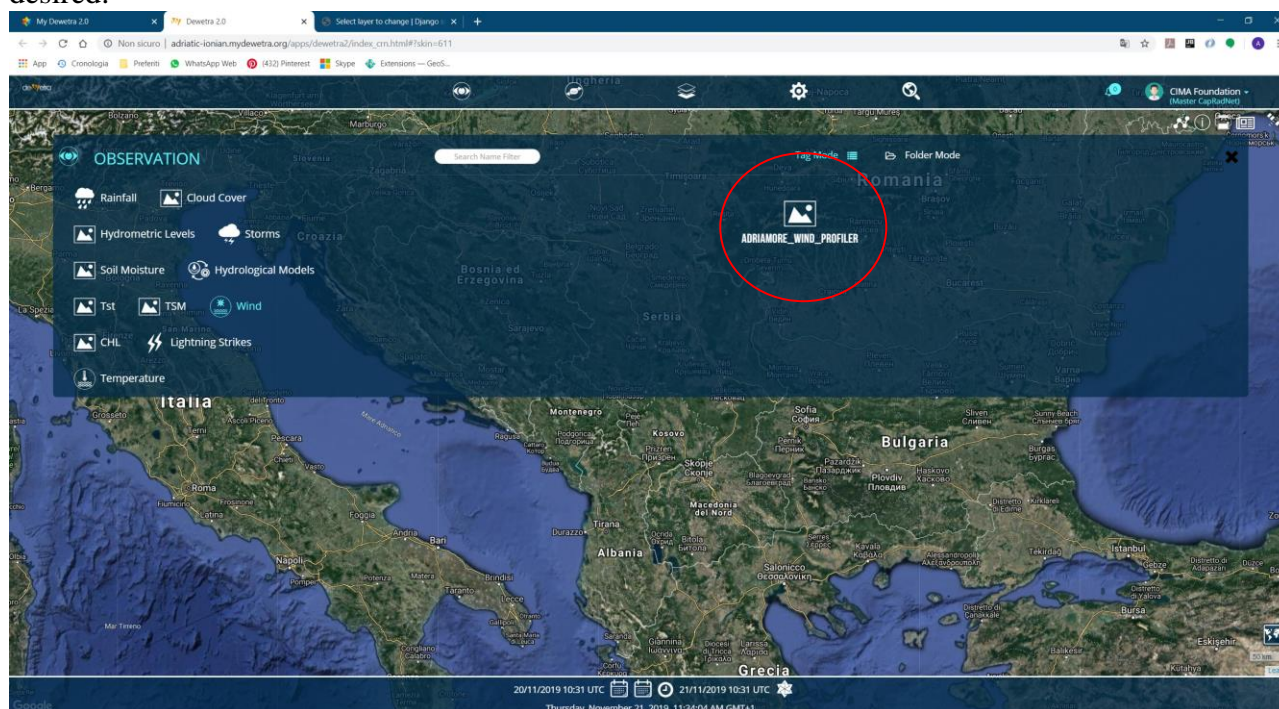


Figure 4. The publication of the ADRIAMORE Wind Profile data in the Dewetra2 application, under the observation menu .

It is possible to load the data in *Dewetra2* once the search time interval has been selected, understood as the period for which you want to get the graphs of wind direction and intensity relative to the Dubrovnik LAP3000 station.

The search period is defined by means of the standard *Dewetra2* dashboard.

The visualization of the station responds to a predefined style, present on the *DDS geoserver* which can obviously be modified in the off-line configuration phase of the data. By default the most recent graph is loaded in the chosen range.

By accessing the data properties menu, we can choose to load any of the available data in the required interval.



LAP3000 Dubrovnik 42°38'41"N 18°25'6"E  
MainDataCombined

Recorded 'C:\SR\workspace\_LAP\_LAP 3000 Dubrovnik\Data\Retrieved'  
2019-11-12 02:15:00 UTC+01:00 to 2019-11-13 02:15:00 UTC+01:00

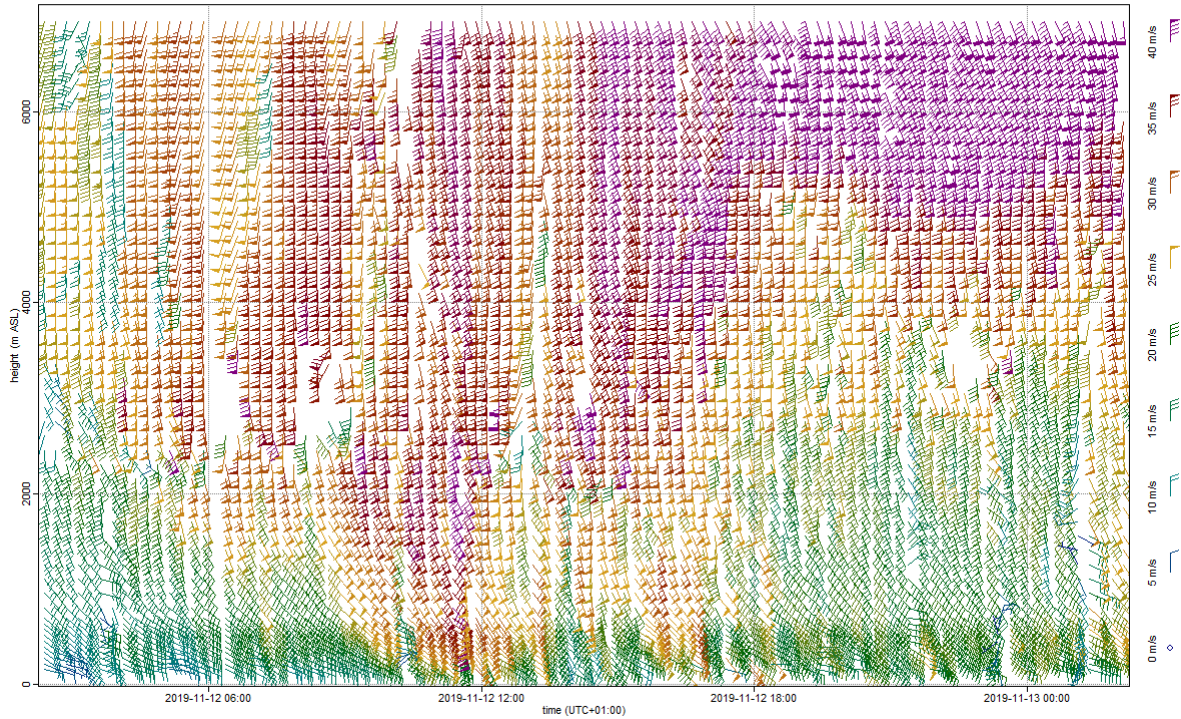


Figure 5. The Wind Profile output data – run of 12 November 2019(UTC – 01:00)

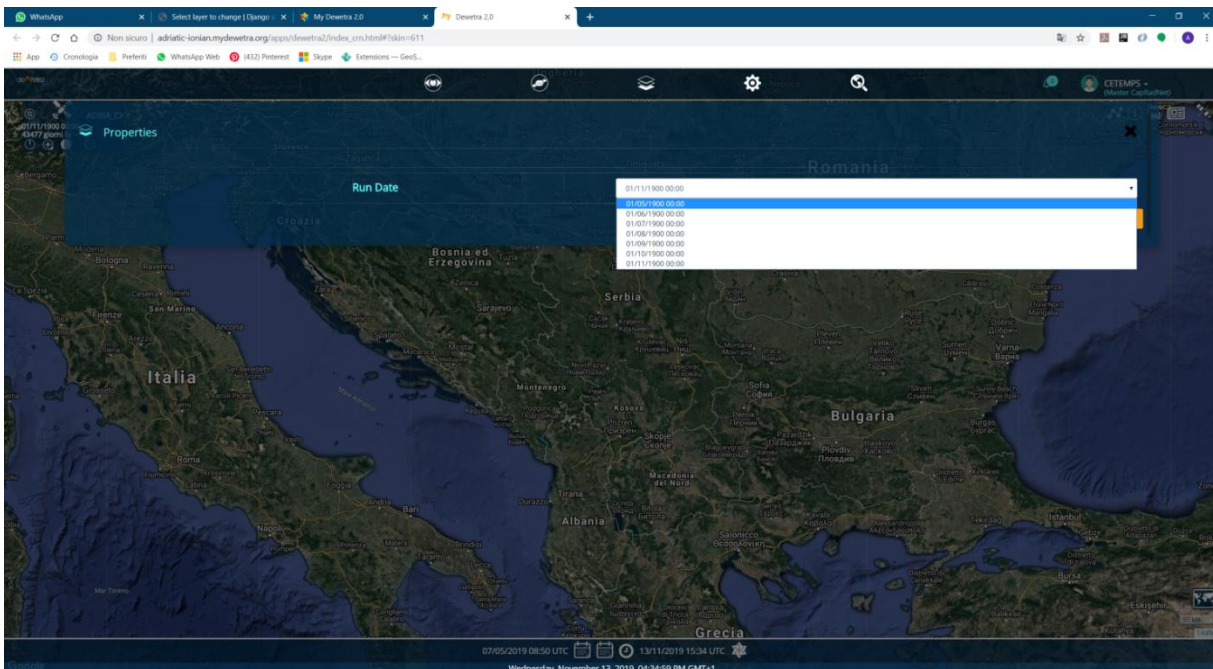


Figure 6. The selection of the time interval of the run date for Wind profile data available.

## 5.2. Integration of AdriaMORE radar data

The activities related this report are also devoted to the reinforcing of the monitoring and forecast system within the existing DSS by the integration of radar remote sensing data as well as models data. The methodology for integration, visualization and transmission of the radar data is the same for all radar products. Moreover within the framework of the AdriaMORE project a new network has been implemented using the data of available radar. The *ADRIAMORE\_NETRADAR* are loaded daily into the exchange directory (experience date *MeteoModels ADRIAMORE\_NETRADAR\_HDF*) of the CIMA Foundation server 19.

It is a series of files in *geotiff* format related to data with 10 minutes resolution observed by the sensors for the different variables available.

Currently the following files are loaded:

- VMI
- SRI

Where the date is expressed in the format *yyyyMMddhhmm*

### 5.2.1 Import of radar data into the myDEWETRA platform

The procedure for acquiring the system and organizing the radar data in the *Dewetra Data Server (DDS)* archive takes place by means of a bash script that is launched in a scheduled manner through the server's "*crontab*" 19.

Basically the acquisition script creates the folders in the format */YYYY/MM/DD* within the base directory of the radar data ("*/MeteoModels RADAR\_ADRIAMORE\_HDF*"), in a manner consistent with the date contained in the name of the file itself. The file is then copied to the above defined folder.

For example, the complete path of a file in the *Dewetra Data Server (DDS)* archive is:

*130.251.104.19 experience date MeteoModels RADAR\_ADRIAMORE\_HDF geotiff 201915  
VMI\_201911150000.tif*

### 5.2.2. Implementations in a DDS component for deploying radar data

A specific component of *Dewetra Data Server (DDS)* has been implemented to manage and publish the radar data in *Web Map Service (WMS)* format so that it can be viewed and interrogated by the *Dewetra2* application of the *myDEWETRA* platform.

The *RadarNetworkManager* component implements the interface that defines the list of all the radar data available in the time interval required for a specific model variable.

Once the data to be displayed has been selected, the DDS component reads the required radar data of the affected variable, in the *geotiff* format and publishes it by means of the WMS service implemented by the *geoserver* present at the address: <http://dds.cimafoundation.org/dds/web/>

The DDS component is configured using the *XML* file (*ADRIAMORE\_NETRADAR\_[VARIABLE]\_[var].xml*) as regards: the base directory where the model data resides, the file name and the model description.



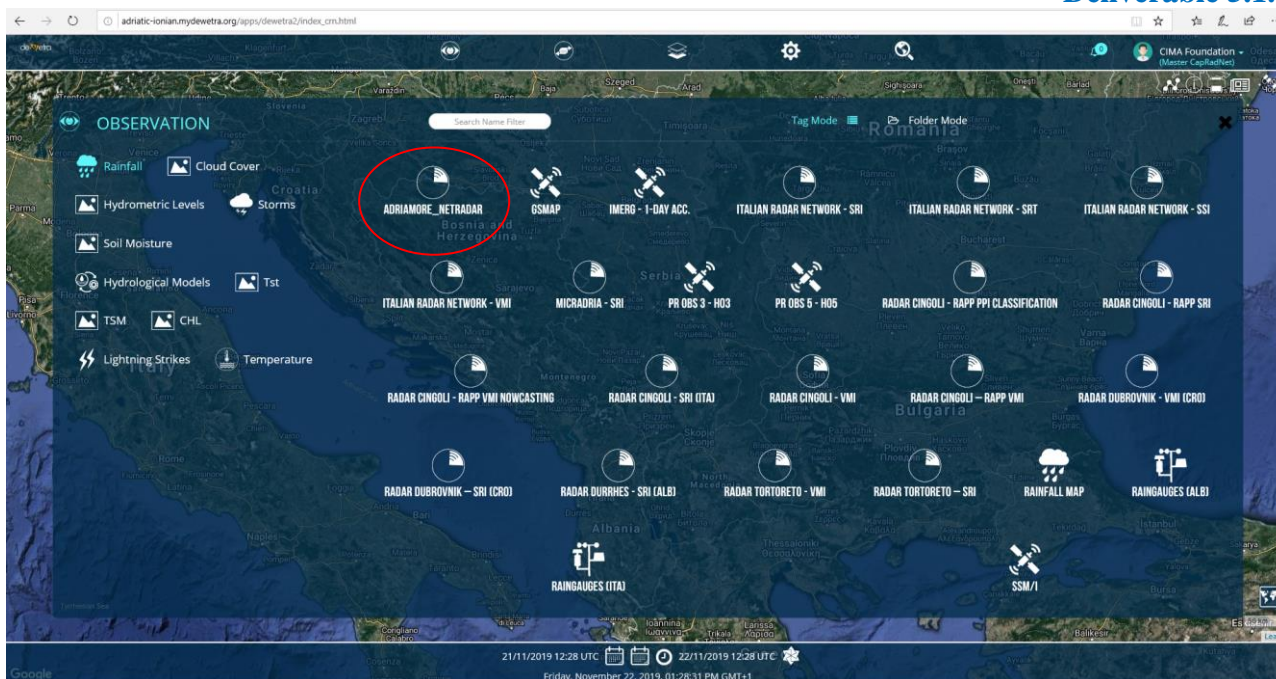


Figure 7. The publication of the ADRIAMORE NETRADAR data in the Dewetra2 application, under the observation menu.

### 5.2.3. Publication of radar data in the Dewetra2 application

Data from the AdriaMORE radar network can be viewed from the *Dewetra2* application at [http://adriaticionian.mydewetra.org/apps/dewetra2/index\\_crn.html](http://adriaticionian.mydewetra.org/apps/dewetra2/index_crn.html)

Accessing *Dewetra2* with the *MasterCapRadNet* profile it is possible to load the data through the menu **Observations** -> **Rainfall** -> <product name>. It is possible to load the data in *Dewetra2* once the search time interval has been selected, understood as the period for which you want to obtain the radar data available for a specific model variable.

The search period is defined by means of the standard *Dewetra2* dashboard.

The display responds to a predefined style, present on the *DDS geoserver*, which can obviously be modified during data configuration. By default the most recent data present in the chosen interval is loaded.

By accessing the data properties menu, we can choose to aggregate the data on the administrative limits or on the river basins.



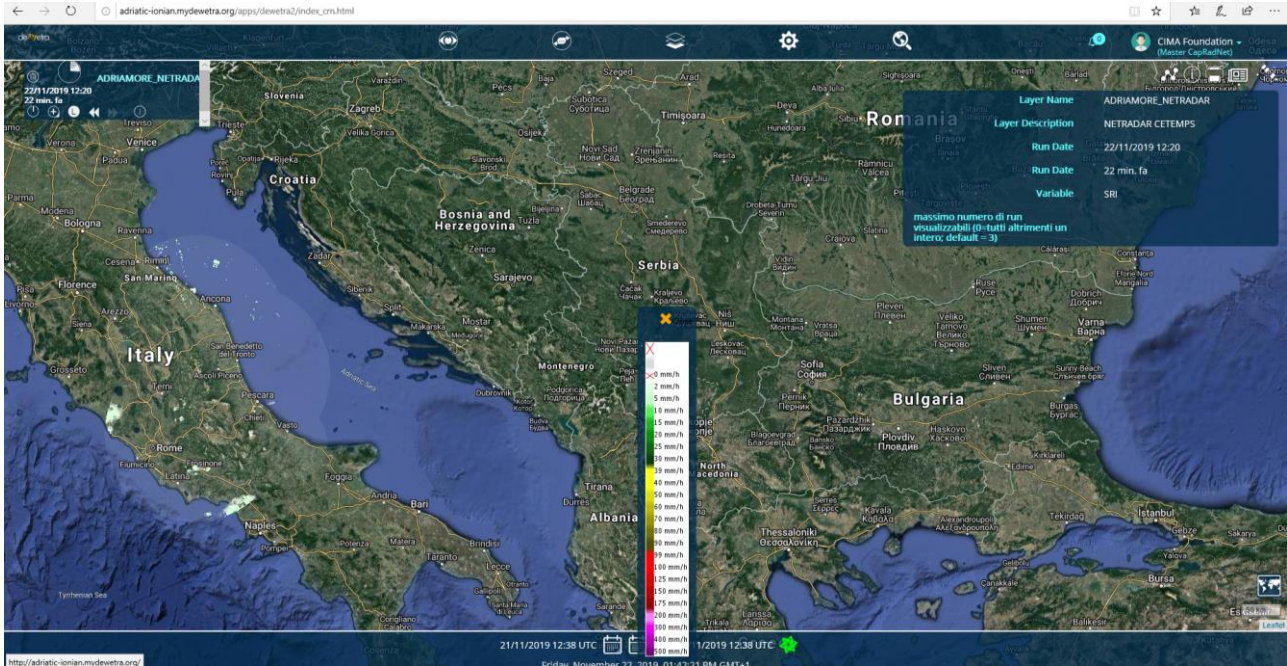


Figure 8. The ADRIAMORE NETRADAR data output – rain observations on 22 /11/2019 at 12:20 UTC

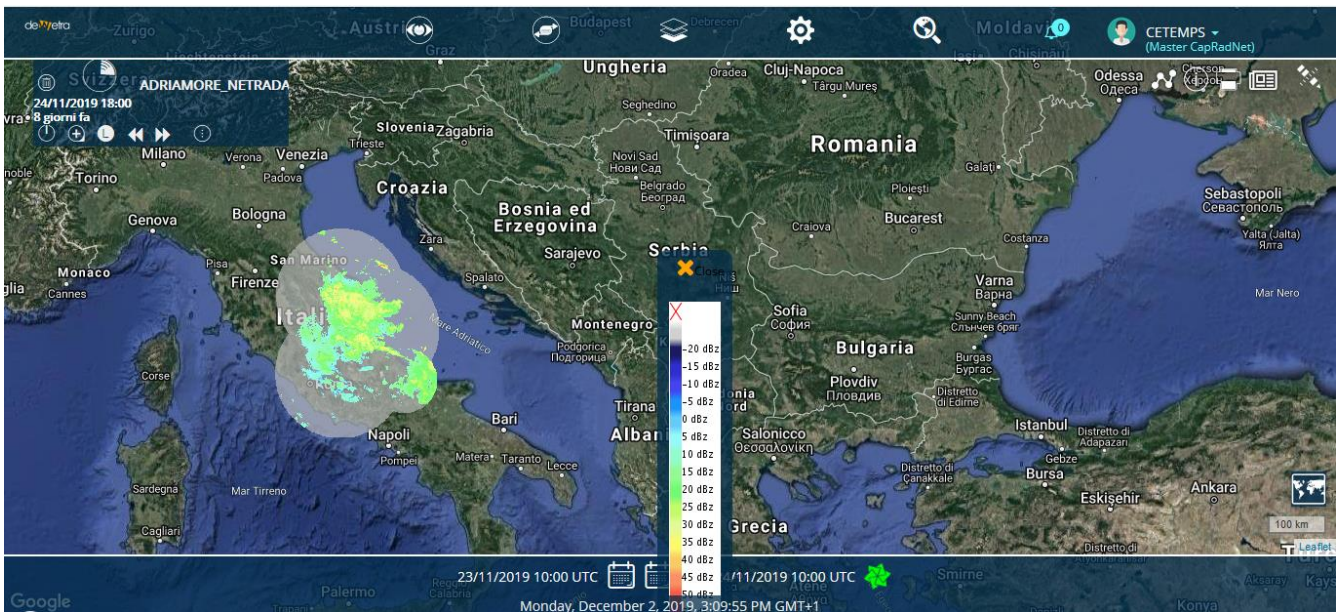


Figure 9. The ADRIAMORE NETRADAR data output – reflectivity observations on 24 /11/2019 at 18:00 UTC



### 5.3. Integration of Chlorophylls and Particulate suspended maps

The main data related the *costal forecasting modules*, produced or update under the AdriaMORE project that is integrate in the platform are: Chlorophylls maps(**CHL**), Particulate suspended map(**TSM**) from SAT, Wave forecasting model, ChyM hydrological model and their integration into the Early Warning System. All the data have been uploaded to the exchange directory "*scratch*"(/home/adriauser/scratch) of server *adriasever.aquila.infn.it*.

Each of the data above has their proper syntax name and format NetCDF. The files are named according to the following syntax: **CHL\_[Jan .. Dec]\_climatology\_2002-2012.nc**, **TSM\_[Jan ... Dec]\_climatology\_2002-2012.nc**, ect. In the follow is described the data import, implementation and publication in the DSS – myDEWETRA Adriatic-Ionian Platform, using the same approach and methodology.

#### 5.3.1. Import data into the myDEWETRA platform

A series of operations had to be carried out to make the data compatible with the myDEWETRA platform and to be able to integrate it into it.

- Definition of the geographic coordinate system: *WGS84*;
- Re-definition of the geographical *extent* of the data itself;
- Reading of the matrix of values from the NetCDF format;
- Transposition of the matrix of values and inversion of the order of the elements of the same matrix;
- Data saving in geoTiff format.

It was created a python script for the implementation of the data import procedure, as in follow example of CHL Chlorophyll maps, but the same is for TSM Particulate suspended maps:

```
from osgeo import gdal, osr
import numpy as np

dataset = gdal.Open("%s.nc" % filePath, gdal.GA_ReadOnly)

band = dataset.GetRasterBand(1)

array = band.ReadAsArray()

#Trasposizione della matrice dei valori
traspose = array.transpose()

#Inversione dell'ordine degli elementi della matrice
flipped = np.flip(traspose)

#Salvataggio del dato in formato geoTiff
dst_format = 'GTiff'
dst_datatype = gdal.GDT_Float32
dst_file = "%s.tif" % filePath
dst_xsize = flipped.shape[1]
```

```
dst_ysize = flipped.shape[0]
dst_nbands = 1

driver = gdal.GetDriverByName(dst_format)
dst_ds = driver.Create(dst_file, dst_xsize, dst_ysize, dst_nbands, dst_datatype)

#Definizione del sistema di coordinate geografiche: WGS84
srs = osr.SpatialReference()
srs.ImportFromEPSG(4326)
dst_ds.SetProjection(srs.ExportToWkt())

#Ri-definizione dell'extent geografico del dato stesso
ulx, xres, xskew, uly, yskew, yres = dataset.GetGeoTransform()
print(ulx, xres, xskew, uly, yskew, yres)
newulx = uly + (yres * dst_xsize)
newuly = ulx + (xres * dst_ysize)

dst_ds.SetGeoTransform([newulx, -yres, xskew, newuly, yskew, -xres])
print(newulx, -yres, xskew, newuly, yskew, -xres)

dst_ds.GetRasterBand(1).WriteArray(flipped)

dst_ds = None
dataset = None
```

The Python script for acquiring chlorophyll maps in NetCDF format, in addition to harmonizing the data, saves the 12 geoTiff files produced in the folder. *home/adriauser/sat\_data/CHL* of *mydewetra* with the following syntax in the name: **CHL\_[Jan .. Dec]\_climatology\_2002-2012\_MM.tif** .

The same steps are followed for all the required data associated to the costal forecasting modules describe in this report.

### 5.3.2. Implementation of a DDS component for the data delivery

A specific component of *Dewetra Data Server (DDS)* was implemented for the management and publication of the data in *Web Map Service (WMS)* format so that it can be viewed and queried by the *Dewetra2* application of the *myDEWETRA* platform.

The *DDSMapAdriaChlTsmGeotiffComponent* component implements the interface that defines the list of available "runs" in the required interval.

In the specific case of Chlorophylls example above, the list of all the **CHL** data related to the months considered in the selected time interval is returned. The same methodology is used also for the TSM maps.

Once the data to be displayed has been selected, the DDS component supports the publication of the **CHL** data by means of the WMS service implemented by the geoserver published at the address <http://adriasever.aquila.infn.it/dds/wms>.

The DDS component is configured through an XML file (*ADRIA\_dataname.xml*), regarding the directory where the geoTiffs of the data reside and the *geoserver* style for the visualization.

```
<dynamicLayerdescr="CHL" id="ADRIA_CHL">
```

```

<attribute descr="dir" hidden="true" id="dir" type="Text">
  <attributeEntrydescr="dir" id="/home/adriauser/sat_data/CHL">
    </attributeEntry>
  </attribute>
  <attribute descr="Variable" id="variable" type="Text">
    <attributeEntrydescr="CHL    monthly    analysis"    id="CHL"
default="1">
      <referredValue id="style" value="DDS_CHL_ADRIA"/>
    </attributeEntry>
  </attribute>
</dynamicLayer>

```

The same approach is used for management and publication all the other data in the DSS system.

### 5.3.3. Publication of data in the Dewetra2 application.

The data publishing is visualize through the myDEWETRA Adriatic-Ionian Platform, and can be viewed from the Dewetra2 application present at the address: [http://adriaticionian.mydewetra.org/apps/dewetra2/index\\_crn.html](http://adriaticionian.mydewetra.org/apps/dewetra2/index_crn.html).

By accessing *Dewetra2* with the *MasterCapRadNet* profile (but also can be used the credentials of each partner) all the partners it is possible to load the data in the menu:

*OBSERVATION-->dataname-->ADRIAMORE\_dataname.*

Of course the name of the data and the path to access it can be modified and redefined as desired.

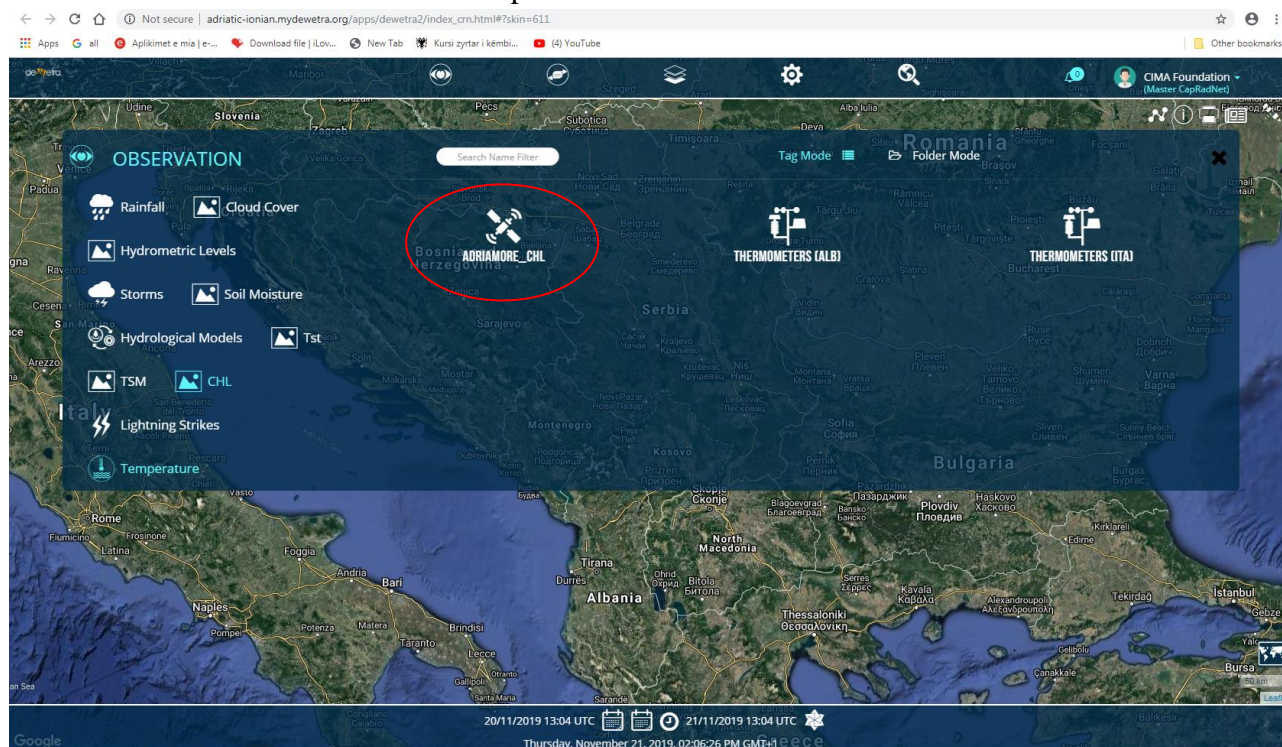


Figure 10. The publication of the ADRIAMORE CHL data in the Dewetra2 application, under the observation menu OBSERVATION-->CHL-->ADRIAMORE\_CHL.



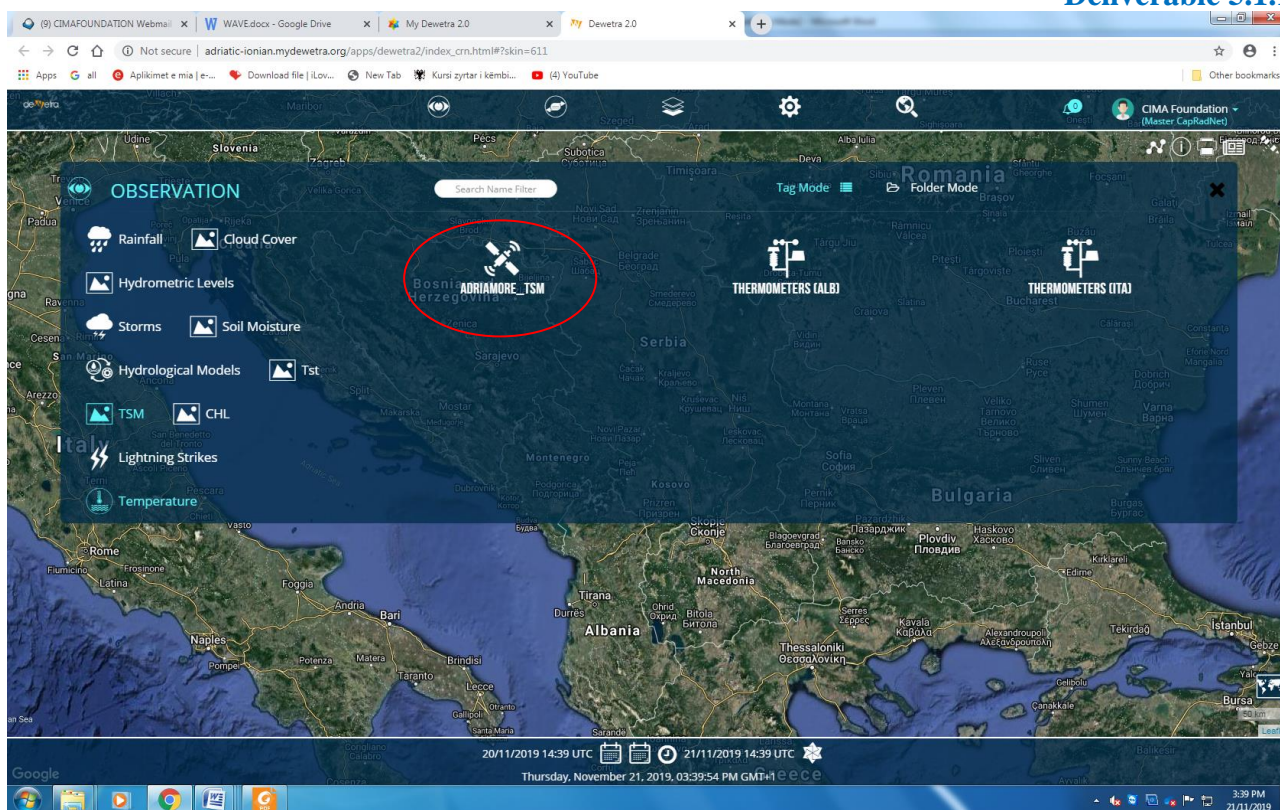


Figure 11. The publication of the TSM data in the Dewetra2 application, under the observation menu OBSERVATION-->TSM-->ADRIAMORE\_TSM.

It is possible to load the data in *Dewetra2* once the analysis of time interval (year/months/hours/minutes depends on data availability) has been selected, understood as the months for which it is desired to obtain the maps. The search period is defined by means of the standard *Dewetra2* dashboard.

The visualization responds to a predefined style, present on the *DDS geoserver* that can obviously be modified during the configuration, offline, of the data. The data relative to the most recent time with respect to the chosen interval is loaded by default.



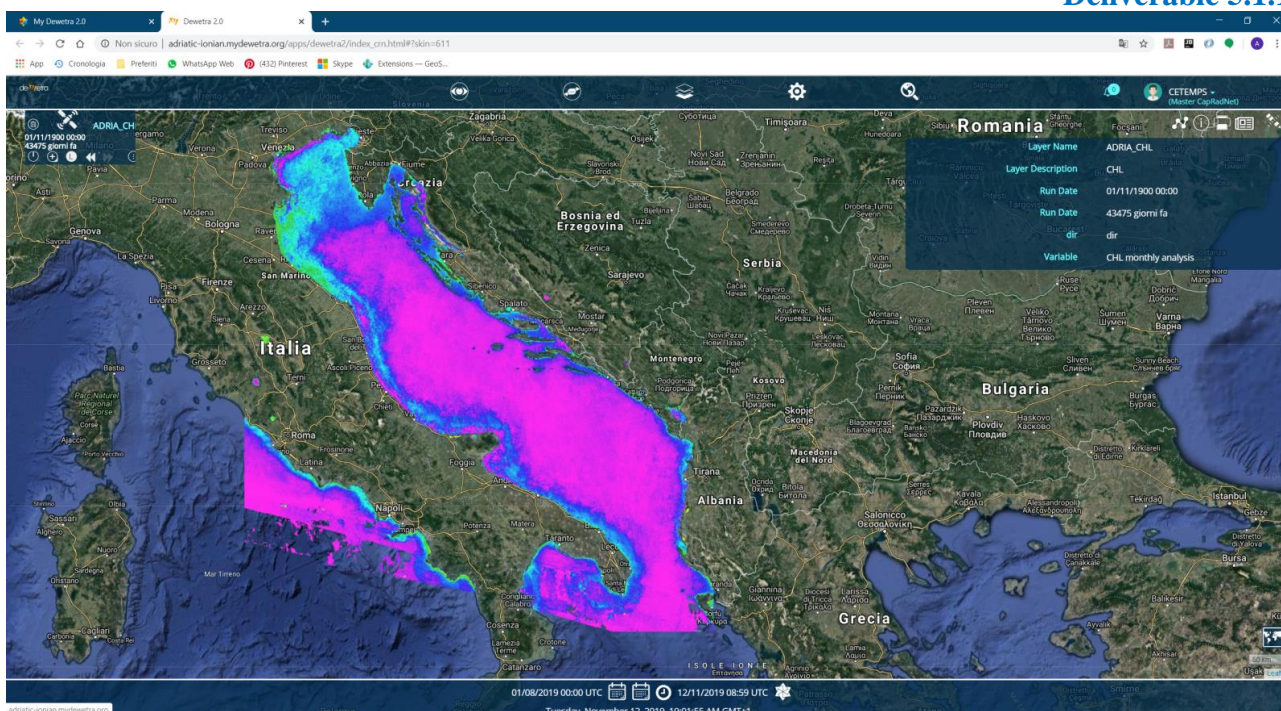


Figure 12. The visualization of chlorophyll map (CHL) run of 1/11/2019.

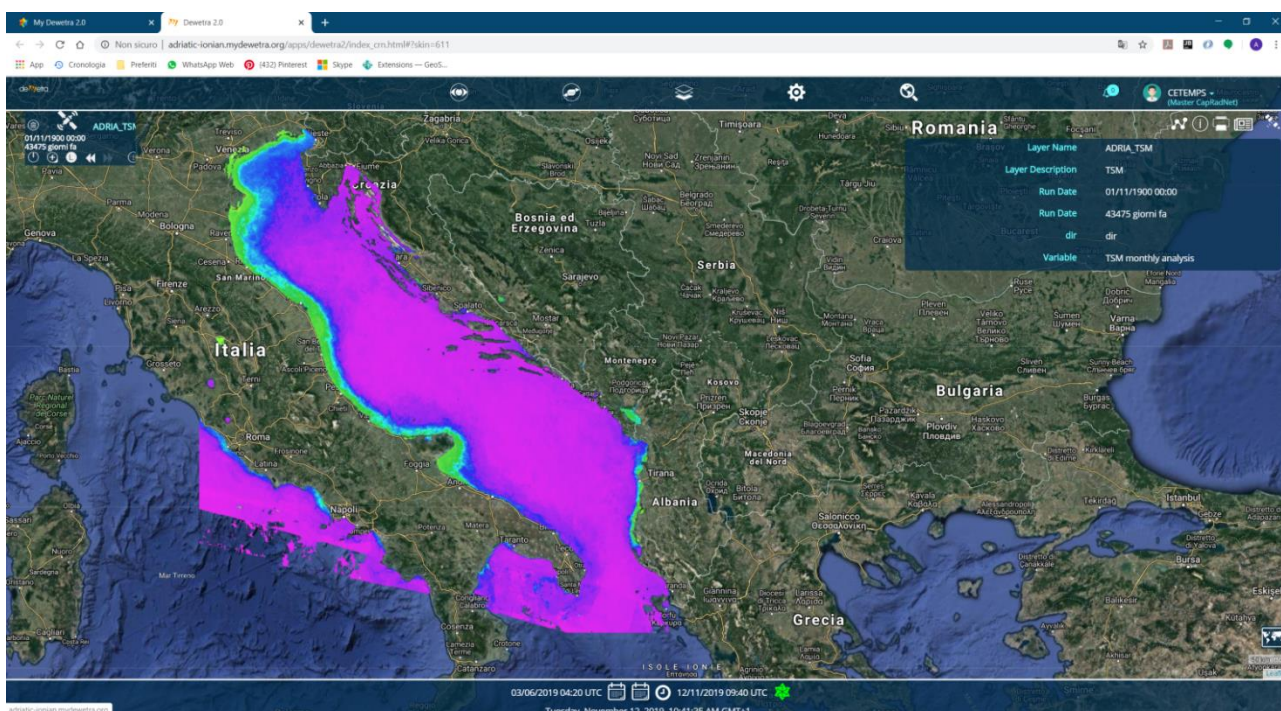


Figure 13. The visualization of the Particulate suspended map(TSM), run of 1/11/2019

By accessing the data properties menu, you can choose to load any of the available data in the required interval.

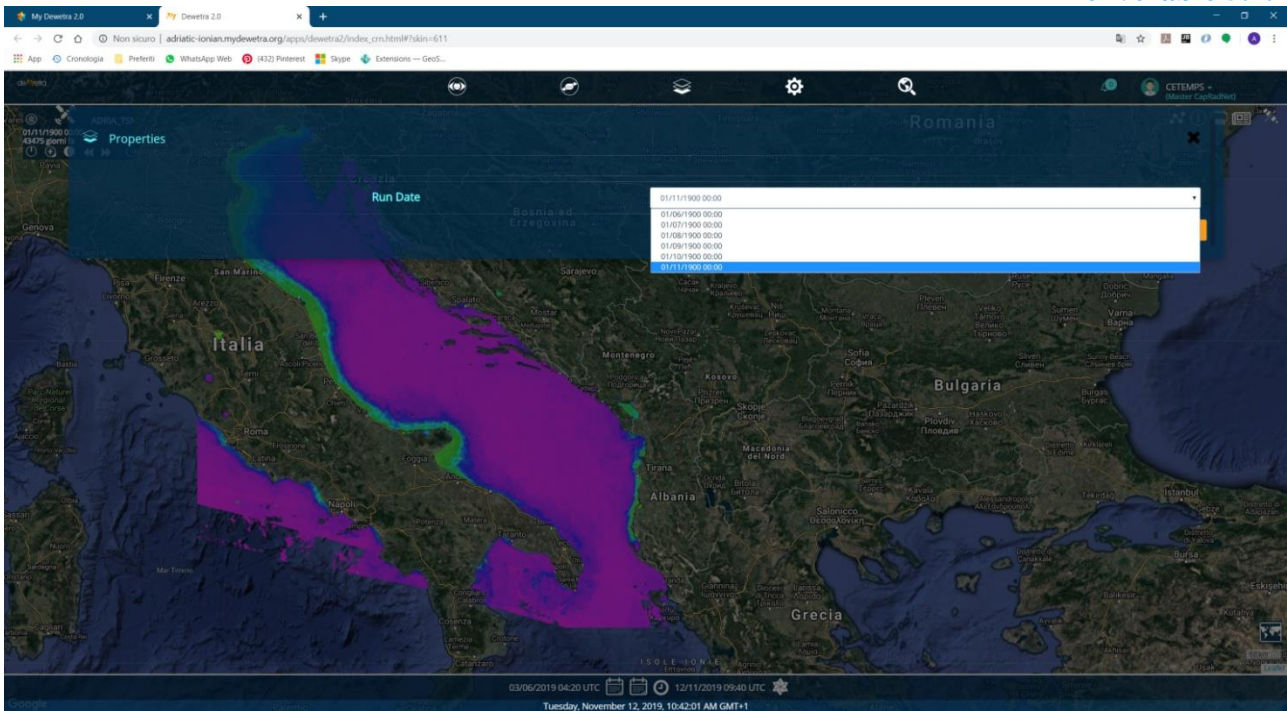


Figure 14. The visualization of Particulate Suspended map(TSM), selecting the run date required.