WP4
Forecast numerical modelling for coastal extreme weather and flooding risk management

Activity 4.1
Implementation of coastal monitoring data assimilation into a high resolution forecasting model

D4.1.2 Meteorological forecast model valuable products for coastal surveillance

PROJECT AND ACTIVITY DETAILS

Project Acronym	AdriaMORE
Project title	Adriatic DSS exploitation for MOnitoring and Risk management of coastal Extreme weather and flooding
Funding Line	Priority Axis 2, Specific Objective 2.2
Project Partners	LP Abruzzo Region (Italy) P1 Dubrovnik and Neretva Region (Croatia) P2 Meteorological and hydrological service (Croatia) P3 National Research Council (Italy)
Starting date	January 1, 2018
Activity number	4.1
Activity Title	Implementation of coastal monitoring data assimilation into a high resolution forecasting model
Work Package	WP4: Forecast numerical modeling for coastal extreme weather and flooding risk management
Activity Summary	Activity 4.1, within Work Package 4, is devoted to improve the effectiveness of high resolution forecasting model trough the assimilation of coastal monitoring data
Deliverable number	4.1.2
Deliverable Summary	This deliverable is aimed at describing the meteorological valuable products for coastal surveillance
Main Author	Ida Maiello, ida.maiello@aquila.infn.it
Main Author's organization	CETEMPS
Other Author's	Rossella Ferretti
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Table of contents

1. INTRODUCTION

Hydro-meteorological and other marine hazards triggered by meteorological events, affecting the Adriatic areas represent a dramatic threat which needs to be faced by enhancing monitoring and forecasting systems. In this respect, **AdriaMORE project** proposes increasing of the management capacity of the response to marine and coastal hazards in the Adriatic basin.

AdriaMORE goal is to improve an existing integrated hydro-meteorological risk management platform focusing on the Adriatic coastal areas of Italy and Croatia capitalizing the major achievements of ADRIARadNet and CapRadNet projects. The latter, successfully completed under the IPA Adriatic CBC Programme, were devoted to create a cross-border infrastructure of observing and forecasting systems for building real-time risk scenarios for civil protection purpose.

To this end, one of AdriaMORE's specific objective is devoted to improve the effectiveness of high resolution forecasting model trough the assimilation of coastal monitoring data. This objective has been performed in the action 4.1 of the WP4 of AdriaMORE project whose the main result is constituted by the **Output entitled "a newly numerical weather prediction model improved by assimilating coastal monitoring data".**

Two deliverables have contributed to the achievement of the above project Output:

- **deliverable 4.1.1** aimed at describing the meteorological model and the assimilation technique developed;
- **deliverable 4.1.2** aimed at describing the meteorological valuable products for coastal surveillance.

The first is described in another document while the **deliverable 4.1.2**, subject of this paper, has been organized as follows.

In the **chapter 2** why and how to monitor the coasts is explained.

In the **chapter 3** a description of the products of the meteorological model is presented.

The references here used are listed in the **chapter 4**.

2. How to monitor the health of our coasts and why?

With a rapidly changing climate and more frequent extreme events like floods and droughts, comprehensive environmental monitoring will be increasingly important for coastal planners, farmers and others invested in natural resource management.
Monitoring efforts can cover the whole spectrum of environmental and socio-economic concerns to provide a holistic picture of ecosystem health over the short- and long-term. This can help to inform for future decisions and planning based on the most recent conditions and trends. However, it can be difficult to coordinate monitoring efforts across political boundaries and agencies, and monitoring is expensive to maintain over time.

Coastal regions are tremendously important for Europe's economy. Approximately 40 % of the EU's population lives within 50 km of the sea. Almost 40 % of the EU's Gross Domestic Product (GDP) is generated in these maritime regions, and a staggering 75 % of the volume of the EU's foreign trade is conducted by sea.

But the important role played by our coasts has come at a cost to the environment. Activities such as shipping, resource extraction, renewable energy and fishing are all putting under pressure marine and coastal areas. These pressures have been felt across most of Europe's coastal regions and have resulted in habitat loss, pollution and accelerated coastal erosion. Climate change is likely to make these regions and the societies that live in them more vulnerable.

This deterioration threatens the continued health of our coastal areas. If these regions are to continue to power our economies, shelter a rich biodiversity, and remain home to millions of Europeans, they must be managed more carefully. This management must also be conducted in an integrated fashion, balancing the competing interests of human development with the need to ensure healthy and resilient coastal ecosystems.

The European Commission in 2013 issued a proposal for a new directive. This directive would establish a framework for integrated coastal management and for 'maritime spatial planning' (public policy that deals exclusively with managing maritime space but not land space). Following the debates in the EU institutions, the proposal was modified and adopted as Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning. The directive highlighted the need to integrate in a coherent whole all of the EU policies that touch on maritime and coastal issues (such as the Habitats Directive, the Water Framework Directive, Marine Strategy Framework Directive etc.). It set up the legal framework providing guidance for how to better manage the competing claims of economic sectors on space and resources in marine areas.

In order to enact, enforce and ensure that Member States abide by the regulations which derive from the relevant European Directives, and also in order to optimize the use of coastal areas in a sustainable development framework, there is a need for reliable monitoring tools of the ecological status of the coast and shoreline, namely:

1. coastal zones mapping;
2. monitoring of the coastal zones dynamics, addressing bio-geophysical phenomena of mutual importance for the oceanic and terrestrial coastal zone.

3. Description of the products of the meteorological model

The WRF model depicted in the deliverable 4.1.1 is showed at the following link: at http://magritte.aquila.infn.it/meteo/adriaradnet/ people can find the home page of WRFAdria model as showed in the figure below (figure 1).

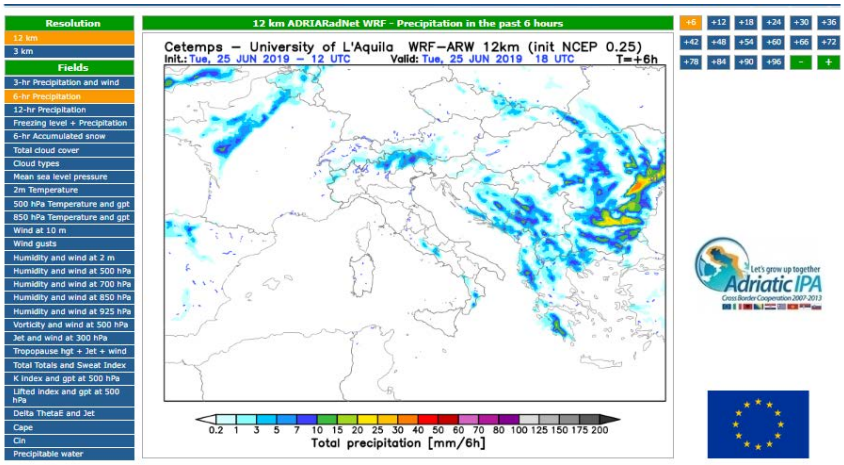

Figure 1. WRFAdria home page website. 6-hr precipitation is the first model product displayed.

On the left side of the page there is a forecast model menu where visitors can choose among several WRF output: precipitation, freezing level, 6-hr cumulated snow, total cloud cover, mean sea level pressure, 2m temperature, temperature and geopotential height both at 500 and 850 hPa, wind at 10m, wind gusts, humidity (2m/925hPa, 850, 700, 500), vorticity at 500 hPa, jet stream at 300 hPa, Total Totals Index, K-Index, Lifted Index, CAPE, CIN and precipitable water.
If the selected variable is a precipitation value the user can select a cumulate time range among: 3-hr, 6-hr, 12-hr. In the figure 18 we show an example of the 12-hr cumulated rainfall.

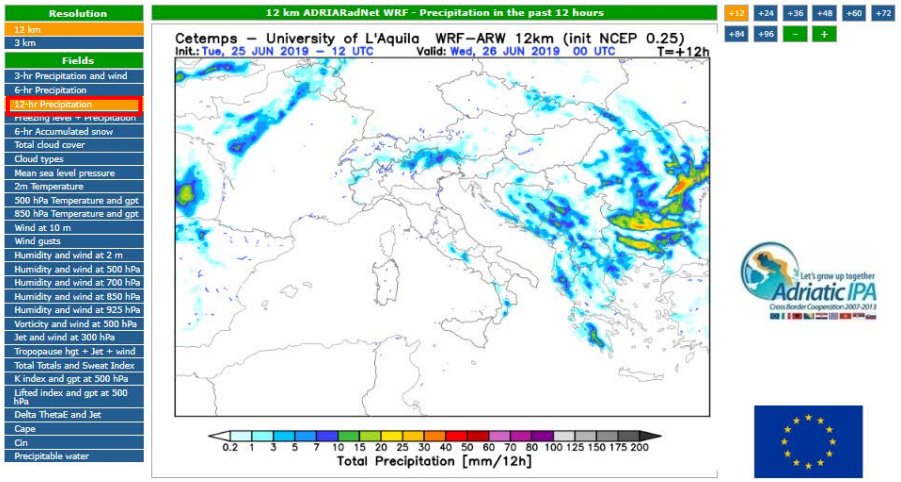

Figure 2. An example of 12-hr cumulated precipitation selected from the forecast model menu.

It has to be pointed out that users can also select a forecast time in the 'chessboard' on the right side of the page to go ahead through the forecast. In the two figures below an example of total cloud cover and wind at 10m is shown, respectively.

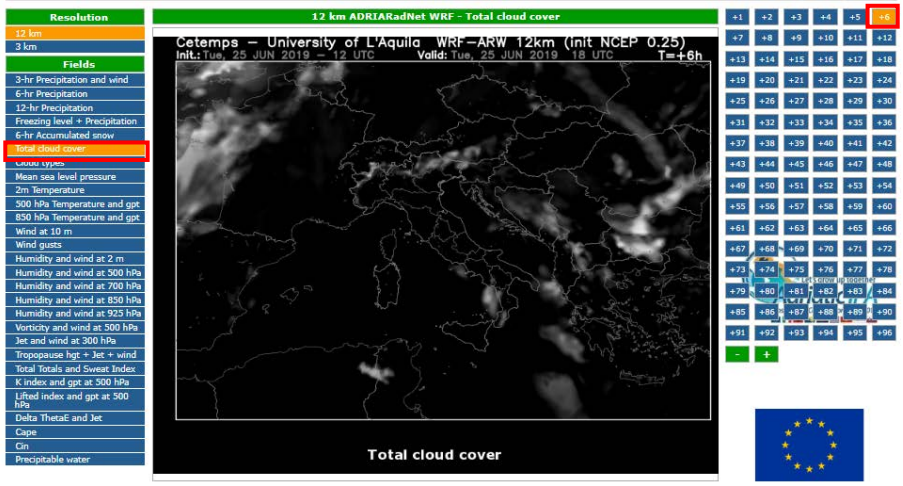

Figure 3. Total cloud cover output from the WRFAdria home page website. Red boxes indicate the field and the forecast time selected, respectively.

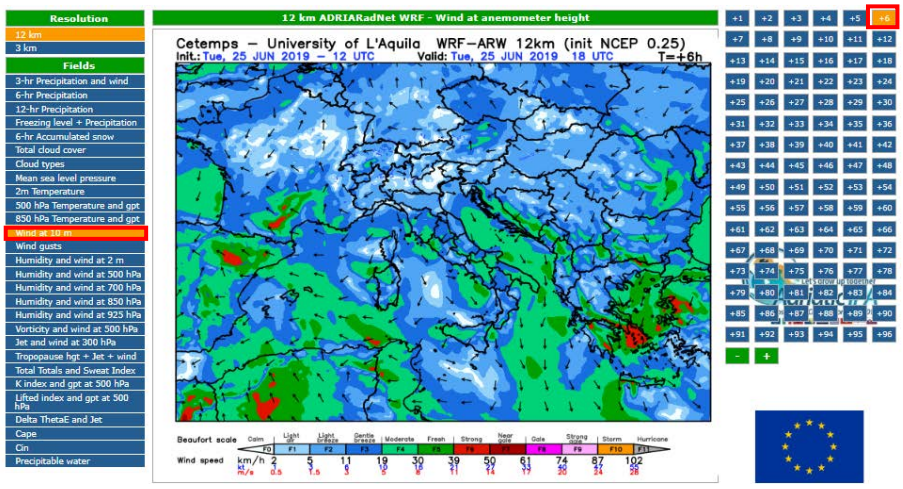

Figure 4. Wind at 10m output from the WRFAdria home page website. Red boxes indicate the field and the forecast time selected, respectively.

Following other examples of valuable products on the 12km domain:

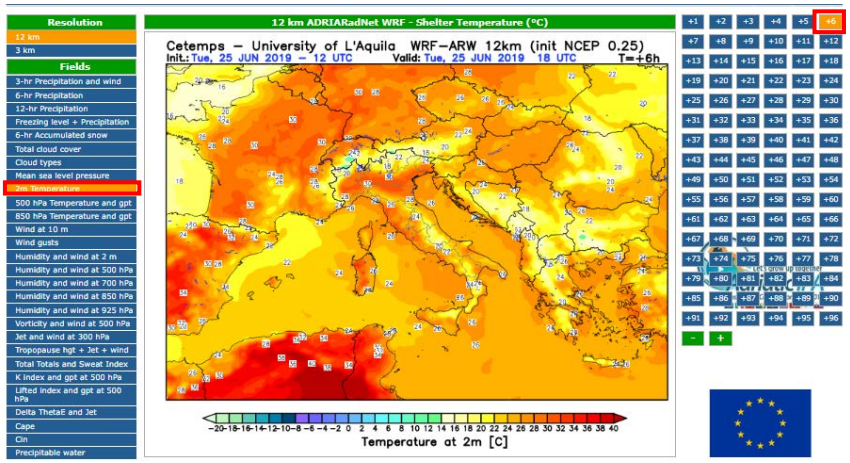

Figure 5. Shelter temperature output from the WRFAdria home page website. Red boxes indicate the field and the forecast time selected, respectively.

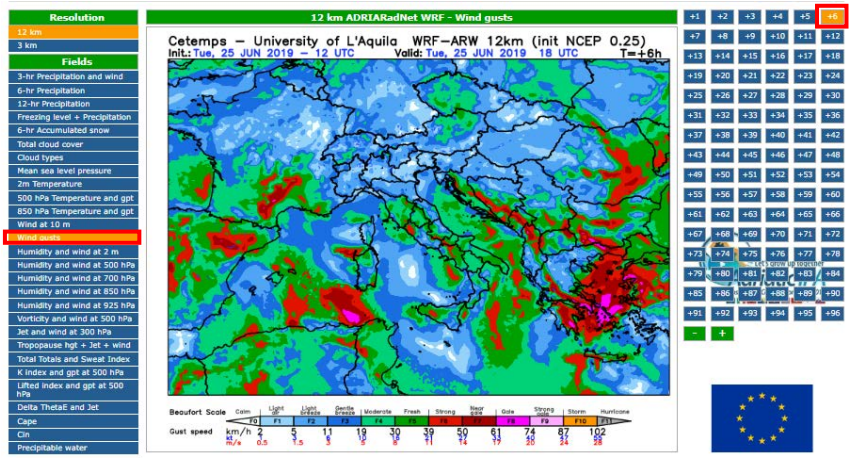

Figure 6. Wind gusts output from the WRFAdria home page website. Red boxes indicate the field and the forecast time selected, respectively.

Following other examples of valuable products on the 3km domain:

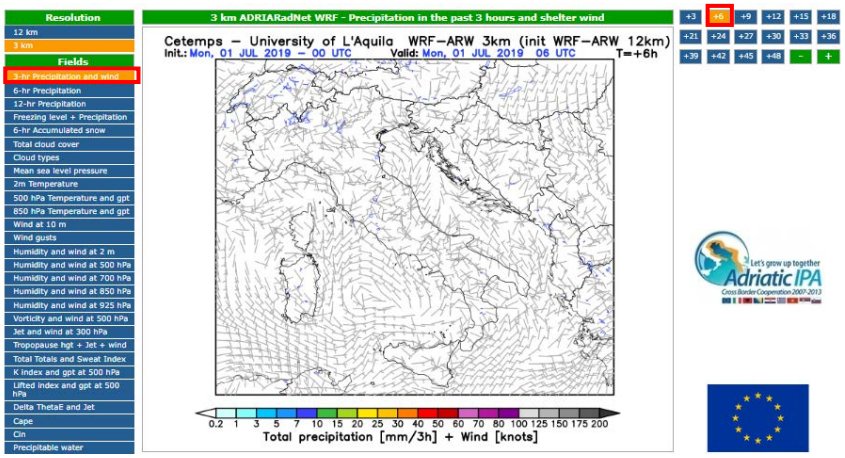

Figure 7. Precipitation in the past 3 hours and shelter wind output from the WRFAdria home page website. Red boxes indicate the field and the forecast time selected, respectively.

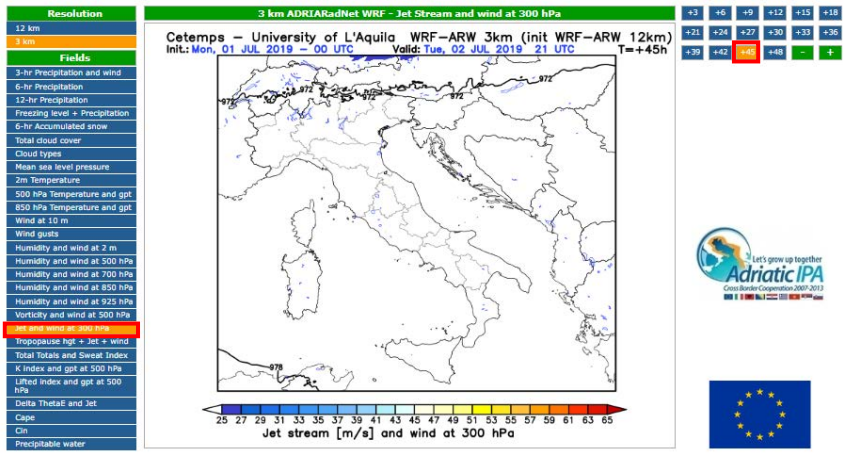

Figure 8. Jet stream and wind at 300 hPa from the WRFAdria home page website. Red boxes indicate the field and the forecast time selected, respectively.

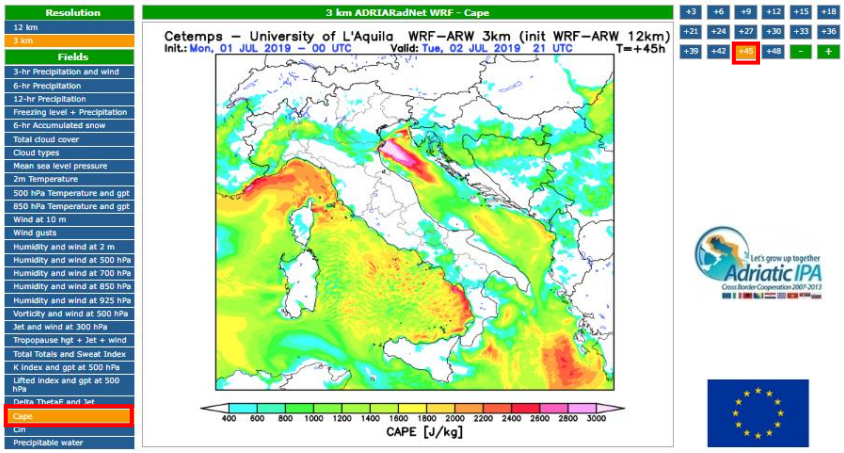

Figure 9. CAPE output from the WRFAdria home page website. Red boxes indicate the field and the forecast time selected, respectively.

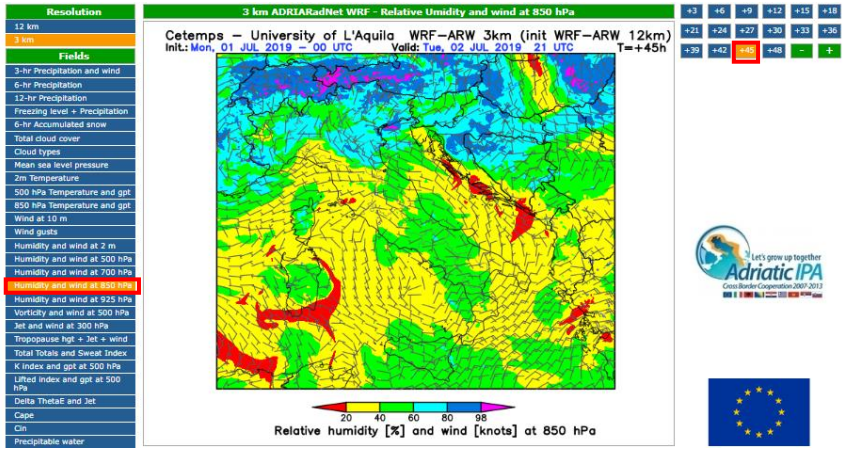

Figure 10. Relative humidity and wind at 850 hPa output from the WRFAdria home page website. Red boxes indicate the field and the forecast time selected, respectively.

4. References

- Barker, D.M., Huang, W., Guo, Y.-G., and Bourgeois, A.: *A Three-Dimensional Variational (3DVAR) Data Assimilation System For Use With MM5. NCAR Tech. Note*, NCAR/TN-453+STR, UCAR Communications, Boulder, CO, 68pp, 2003.
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