



## **Project of Strategic Interest NEXTDATA**

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### **WP 1.3 Marine observation system and climate reconstructions**

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## **1. Scheduled activities, expected results and Milestones**

The results of the first year of activity and a budget reduction bring about the need to revise the activity for the second year of the project. More time will be dedicated to implement a localization technique within the data assimilation scheme and the validation of AMIP data, while it will start the production of the RR of the Mediterranean Sea at 1/16 of degree, covering a period of sixty years from 1953 up to 2012. This RR will use AMIP forcing or another atmospheric forcing that will be evaluated in this new configuration.

Activities during the second year of the project will concern:

- the analysis of AMIP atmospheric data and the other atmospheric data for AMIP validation;
- the improvement and calibration of the data assimilation scheme OceanVar;
- the starting of RR production covering a sixty years time period.

The expected milestone (M24) concerns the availability of RR data through the NextData Infrastructure. This milestone has been fulfilled by the release of 20 years of Mediterranean RR data of the principal climatic variables (temperature, salinity, currents, surface fluxes).

## **2. Deliverables expected for the reference period**

D1.3.3: Report on atmospheric forcing, model calibration and data assimilation.

D1.3.4: Preliminary report on the Mediterranean Sea RR and data transmission to the data archive and the web portal.

## **3. Activities, which have been actually conducted during the reference period**

### *3.1 Research activities*

During the second year of the NextData Project, WP1.3 activity concentrated on completing the feasibility study of a Mediterranean RR to cover a time period of 60 years from 1953 to 2012. This involved validating the atmospheric forcing and implementing a localization technique in the *OceanVar* (Dobricic and Pinardi, 2008) data assimilation scheme, as described in D1.3.3. In the meantime, the RR system has been calibrated to assure good quality data to be delivered to the users through the NextData infrastructure.

One of the main issues in the NextData RR implementation was the choice of the atmospheric forcing dataset, which should include the entire RR time period proposed (1953-2012).

We took into consideration the quality of the AMIP forcing data. AMIP data are available from 1900 to 2003, and were created through a set of experiments performed with the ECHAM4 atmospheric AGCM on a T126 grid (1.125° of horizontal resolution) forced by HadISST1.

Seven different AMIP realizations were considered, each of them different only by the initial conditions at year 1900. The assessment strategy involved comparing the AMIP dataset versus official and well-known ECMWF reanalysis products: ERA-40 and ERA-Interim.

The second phase of AMIP validation was dedicated to wind data analysis through the comparison with QuickScat product for the years 2000-2003. Precipitations data have been also evaluated to select the best input data. AMIP data have been compared to ERA-Interim and CMAP (Climate Prediction Center Merged Analysis of Precipitation) precipitations.

In order to produce a 60-year NextData RR we had to find a good quality SST dataset to apply the consolidated heat flux correction and thus keep under control RR SST temporal and

spatial evolution. Met Office Hadley Centre SST dataset (HadSST1) was archived during the first year of the NextData Project, consistently with the idea to use AMIP data. We applied the same approach of atmospheric forcing validation, considering the best available product in literature, a Mediterranean SST reconstruction which covers the time period 1985-2008 and has been already used in previous Mediterranean reanalyses with good results.

The RR system and *OceanVar* calibration activities permitted to identify code bugs, to reduce the correlation length scale and minimize the occurrence of overshooting phenomena and to improve the horizontal recursive filter. However, at the end of the first year of the project, we did not solve the *OceanVar* overshooting problem that appears occasionally, thus we dedicated the second year of the project to the implementation of a localization technique into the *OceanVar* data assimilation scheme. Targeted experiments and sensitivity test have been performed and presented in D1.3.4.

Last year validation and calibration activities focused on the time period 1985-2012 on which we matured a good experience and knowledge. We produced, in fact, a new Mediterranean Reanalysis (MedReanV4bis) 1985-2012 that improves Adani et al (2011) results and extends it of five years. MedReanV4bis has been a preparatory product to RR and its validation has been performed in order to assess its quality and deliver it as monthly averages through the NextData Infrastructure. MedReanV4bis allowed the development of a validation procedure that we could apply straightaway on the new RR.

The production of the new Mediterranean RR started during last year of the NextData Project, once the feasibility study ended and all the input data were defined, the OGCM model was set up and the *OceanVar* assimilation scheme was updated with the localization procedure. Nowadays RR covers the time period 1953-1973 but we presented (D1.3.4) its assessment analysis until December 1972. The validation process has been partly automated in order to follow the evolution of the principal diagnostics and promptly detect possible anomalies in the RR evolution. The diagnostic analysis is updated and checked for each year of the RR in order to enable RR data dissemination with a short time delay.

### *3.2 Applications; technological and computational aspects*

MedReanV4bis and Mediterranean RR data validation required the development of an automated diagnostic and a post-processing analysis that enable a rapid and shared evaluation of the results. The results have been plotted and inserted in a dedicated web page, visible internally.

Moreover, the data release required the development of post processing procedure to adapt data formats to the defined standards, as detailed in D2.2.3

### *3.3 Formation*

None during the reference period.

### *3.4 Dissemination*

None during the reference period.

### *3.5 Participation in conferences, workshops, meetings*

N. PINARDI et AL.: Mediterranean large scale circulation, water mass variability and sea level low frequency variability. *NCAR Seminar*, 29 August, 2013.

N.PINARDI et AL.: The low frequency variability of the Mediterranean Sea circulation from reanalysis. *The 4<sup>o</sup> China-Italy collaboration workshop on operational oceanography and regional climate change in the Adriatic and East China Sea.*

## 4. Results obtained during the reference period

### 4.1 Specific results

During the second year of WP1.3 activity, all expected issues were analyzed in detail in order to start a production of a 60 years Mediterranean RR starting from 1953. The atmospheric forcing has been validated and the amp106-9a AMIP member has been used in RR production, until now covering a first period 1953-1972, as described in D1.3.4. Validation of atmospheric variables has been performed considering the ECMWF reanalysis products ERA-40 and ERA-Interim, while for wind it could be possible to compare with QuickScat observations.

A detailed study that brought about the use of CMAP monthly climatological values, due to the lack of other data sources that could cover the RR time period before 1979, was dedicated to precipitations too.

HadSST1 dataset has been evaluated versus the reference Mediterranean product and its quality allowed to maintain the surface heat flux correction procedure based on the difference between modeled and observed SST. The RR model has been calibrated to define a relaxation coefficient in the temperature surface boundary condition.

The localization technique has been implemented in the *OceanVar* data assimilation scheme to avoid spurious signals inside the correction fields. However, the results of localization experiment did not give substantial improvements in terms of model performance, but we believe that this it might be due to the sparseness of observations and to the short time period considered. However, we decided to include it in the new RR, since we believe this will generally improve the quality of the RR and its resulting circulation.

A preparatory Mediterranean reanalysis 1987-2012 has been produced and released through the NextData infrastructure, while the RR could start. An automated diagnostic procedure has been developed and implemented in order to check the quality of the reanalysis products and compare their results. This constant monitoring of RR quality allows the delivery of RR data through NextData Web Portal with a small temporal delay.

The main success has been the appreciation of Mediterranean RR good quality. This result was fulfilled thanks to the experience matured during the previous reanalysis systems development and implementation and their analysis that only partially has been included in scientific publications (Adani et al., 2011 and Pinardi et al., 2013).

### 4.2 Publications

N. PINARDI, M. ZAVATARELLI, M. ADANI, G. COPPINI, C. FRATIANNI, P. ODDO, S. SIMONCELLI, M. TONANI, V. LYUBARTSEV, S. DOBRICIC, A. BONADUCE: Mediterranean Sea large-scale low-frequency ocean variability and water mass formation rates from 1987 to 2007: A retrospective analysis. *Progress in Oceanography*. Available online 5 December 2013, ISSN 0079-6611, doi: <http://dx.doi.org/10.1016/j.pocean.2013.11.003.CGD>

#### *4.3 Availability of data and model outputs*

MedReanV4bis and Mediterranean RR data have been disseminated as detailed in D.2.2.3.

#### *4.3 Completed Deliverables*

We completed D1.3.3 and D1.3.4.

### **5. Comment on differences between expected activities/results/Deliverables and those actually performed.**

WP1.3 activity has been intense and productive during last year. We could achieve all the required results, with only a small time delay of RR production that it should have covered 30 years instead of the 21 actually produced. This time delay can be ascribed to the data quality analysis and its implementation. We believe that this does not affect negatively WP1.3 future activities since we plan to finish RR production within the next three/four months and then have enough time for the subsequent analysis.

### **6. Expected activities for the following reference period**

During next year we will work to two publications: one is in preparation about MedReanV4bis and a new one will start as soon as the Mediterranean RR will finish. In the meantime, we will further develop the automated validation procedure and we will study and implement new quality indices. This is in fact a unique possibility to study such a long time series (60 year) of data that will permit to study long time variability phenomena in the Mediterranean Sea from inter-annual to inter-decadal time scales. In specific we will also start a trend analysis that is a demanding topic of the climate scientific community.