



Project of Strategic Interest NEXTDATA

Scientific Report for the reference period **01/01/2012-31/12/2012**

Unit ENEA

WP 2.1- Archive of high-altitude observation networks

WP 2.5 - Archive of numerical simulations and projections

WP 2.6 - Portal for access to data and pilot studies on data use

1. Activity and results

WP 2.1

In collaboration with URT EvK2-CNR and CNR-ISAC: inventory of data from mountain and remote stations participating in the project and from GAW-WMO stations. Implementation of data from the Station for climate observations at Lampedusa within the high mountain stations and the remote stations data base, based on the SHARE GeoNetwork architecture.

Milestones:

Contribution to M2.1.1 (PM12) relatively to the Station at Lampedusa. Inventory of the data acquired within the project.

WP 2.5

In the first year of activity, following the DoW, ENEA has conducted a census about the climate simulation present in the ENEA archives. We have specified the memory requirements, the output format and the description of single files in order to harmonize the different protocols to store and to access the data, afterwards. Moreover, ENEA has performed a preliminary activity on the 'scientific questions' in particular about the possibility of the production of high resolution simulations for the Andes region.

WP 2.6

In the first year of activity, following the DoW, the ENEA group has provided the out of regional climate simulations performed by PROTHEUS model for the model RainFarm (Rainfall Filtered Auto Regressive Model), optimized for climatic applications (Rebora et al., 2006). More in detail, the rainfall field has been analysed. The same downscaling procedure is applied also to the precipitation fields from ERA40, the large-scale driver of PROTHEUS (Artale et al. 2010). The statistics of the downscaled rainfall fields are compared with rainfall data from a network of 122 rain gauges located in the Piemonte region, North-West of Italy, for the time period from 1958 to 2001. ENEA has started a postprocessing procedure in order

to provide new input for statistical downscaling from the new regional simulation recently performed by PROTHEUS model.

Moreover, ENEA has performed a preliminary activity on the 'scientific questions' in particular about the feasibility study of a multi secular simulation for the Mediterranean region and on aerosol effects at high altitude sites and in the Mediterranean.

The following activities were carried out with reference to the aerosol effects at high altitudes and in the Mediterranean:

-Investigation of the effects produced by desert dust on the radiation budget of the Mediterranean, based on observations made at Lampedusa.

-Investigation of the role played by atmospheric aerosols on the radiation budget in the Himalaya, based on observations made at NCO-P.

Milestones:

Contribution to M2.6.1 (PM12): Preliminary results of first pilot studies.

2. Deliverables in the period

WP 2.1

Contribution to D2.1.1 relatively to the Station at Lampedusa. PM12: Report on existing datasets and on the database structure.

WP 2.5

The materials for Del 2.5 and M 2.5.1 have been sent on time.

WP 2.6

The material for Del 2.6.1 has been sent on time.

3. Activities developed in the period

WP 2.1

The activity of ENEA group has been done accordingly with the original planning of NEXTDATA.

WP 2.5

The activity of ENEA group has been done accordingly with the original planning of NEXTDATA.

WP 2.6

The activity of ENEA group has been done accordingly with the original planning of NEXTDATA.

3.1 Research Activity

WP 2.1

The ENEA group has attended the planned NEXTDATA meetings(meeting, call conference...).

WP 2.5

The ENEA group has attended the planned NEXTDATA meetings(meeting, call conference...).

WP 2.6

The ENEA group has attended the planned NEXTDATA meetings (meeting, call conference...).

Training

A laurea thesis, discussed by dr. Daniele Gasbarra during the summer 2012 at the University Sapienza of Rome, was dedicated to investigate the influence of aerosols on the surface radiation budget at NCO-P, in the Himalaya.

Conferences

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Kishcha, P., B. Starobinets, A. di Sarra, R. Udisti, S. Becagli, and P. Alpert, Sea-salt aerosol mass concentration oscillations after rainfall, derived from long-term measurements, European Geophysical Union General Assembly, Wien, 2012.

Kishcha, P., B. Starobinets, R. Udisti, S. Becagli, A. di Sarra, S. Nickovic, and P. Alpert, Sea-salt aerosol forecasts over the Mediterranean sea compared with daily measurements in Lampedusa from 2006 – 2010, 32nd NATO/SPS International Technical Meeting on Air Pollution Modelling and its Applications, Utrecht, 2012.

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4. Results obtained

WP 2.1

Measurement activities related to GAW have been carried out during the reporting period at the Station for Climate Observations at Lampedusa. In particular, the activities include measurements of greenhouse gases, aerosol optical properties, and meteorological parameters. A first analysis has been carried out aimed at supplying the collected data to the high mountain/remote stations database.

Data collected at Lampedusa were reported to several international databases referred to GAW. In particular, greenhouse gases and aerosol optical property data were submitted.

In collaboration with CNR-ISAC, an inventory of instruments and available data was made.

WP 2.5

As already pointed out in the preliminary material for Del 2.5 , the database of climate simulations present at ENEA has been reorganized in order to permit the future harmonization. In particular, the following regional simulations for the Euro-Mediterranean performed by the coupled model ENEA-PROTHEUS are now available:

i) PROTHEUS simulation ERA40: Lateral Boundary conditions from ERA40 for the 43-year period 1958-2000 (Simmons and Gibson, 2000). SST over the Atlantic is taken from the Global Ice and Sea Surface Temperature (GISST) dataset released by the UKMO (Rayner et al., 2006). The water mass characteristics in the ocean outside the Strait of Gibraltar are 3D relaxed to the Levitus climatology (Levitus 1982). The ocean model is initialized at rest with the MEDATLAS II data (MEDAR Group, 2002). The spin-up is done by using a 3D relaxation of

temperature and salinity to the climatological values. An Interactive River Scheme (IRIS) has been implemented, to provide a more consistent simulated hydrological cycle. The so called natural boundary conditions are implemented at the ocean surface.

ii) PROTHEUS simulation EH50M_20C3M: Same model configuration employed for simulation driven by ERA40 global Reanalysis system. The lateral boundary conditions for the atmosphere (1951-2000) are taken from the ECHAM5-MPIOM 20c3m global simulation (run3) included in the IPCC-AR4.

iii) PROTHEUS simulation EH50M_A1B: As for the previous one but the lateral boundary conditions are taken from the ECHAM5-MPIOM SRESA1B r3 global simulation (2001-2050). Temperature and salinity outside the Strait of Gibraltar are relaxed to the monthly means obtained from the oceanic component of the coupled global run.

The standard outputs are saved ever 6 hours and then post-processed, interpolated over pressure levels (from original vertical sigma-levels) and finally converted in NETCDF files. The structure is "*variable_name*"_ "*year*".nc.

The configuration employed for the atmospheric component has a uniform 150x160 horizontal grid spacing of 30 km on a Lambert conformal projection. In that configuration, the disk space required is about 25Gigabyte/year .

Moreover, some preliminary studies about the definition of the 'scientific questions' have been carried on in order to better define the strategy for future simulations over the region of interest. In particular, ENEA has conducted pilot works about the possible implementation of high resolution simulations for Andes region.

WP 2.6

As part of the pilot studies on the aerosol effects, observations collected at NCO-P during 2007-2010 using the CMP21 solar radiometer, the Cimel Sun photometer and the CNR-1 radiometer, were analyzed. The study shows that, mainly due to the effect of high altitude, aerosols at NCO-P produce very large radiative effects, comparatively much higher than those observed at the sea level.

In addition, it has been possible, by integrating observations collected at Lampedusa and radiative transfer modelling, to quantify the radiative effects produced by Saharan dust particles, both in the solar and in the IR spectral ranges. Measurements made at the surface and from aircraft in the period 2005-2012 were used for this investigation. The study shows that the IR radiative effect produced by dust are large and can not be neglected.

For what concerns modelling aspects, regional climate models have a temporal resolution which is often adequate for the application in climate change impact studies, but a spatial resolution which can be insufficient to resolve precipitation extremes and small-scale variability, particularly in the presence of complex terrain and heterogeneous orography. In the absence of fully deterministic models of small-scale rainfall, this scale gap can be bridged using stochastic downscaling techniques to generate ensembles of high-resolution scenarios of rainfall patterns.

The capability of a statistical downscaling has been evaluated in terms of its capability of reproducing the main properties of precipitation observed by a network of rain gauges. The ENEA groups has provided the output of regional climate simulation of PROTHEUS model (Artale et al 2010) climate for the model RainFarm (Rainfall Filtered Auto Regressive Model),

optimized for climatic applications (Rebora et al., 2006). More in detail, the rainfall field has been analysed. The same downscaling procedure is applied also to the precipitation fields from ERA40, the large-scale driver of PROTHEUS (Artale et al. 2010).

The statistics of the downscaled rainfall fields are compared with rainfall data from a network of 122 rain gauges located in the Piemonte region, North-West of Italy, for the time period from 1958 to 2001.

We find that the high-resolution precipitation fields obtained downscaling the PROTHEUS model outputs reproduce well the seasonality and the amplitude distributions of observed rain gauge precipitation during most of the year. Of course, a stochastic downscaling procedure cannot correct the model outputs at large-scales, as evidenced by the presence of a bias in average precipitation and a disagreement in the frequency of precipitation events, particularly during the winter season.

ENEA has started a postprocessing procedure in order to provide new input for RAINFARM from the new regional simulation recently performed by PROTHEUS model.

Moreover, some preliminary studies about the definition of the 'scientific questions' have been carried on in order to better define the strategy for future simulations over the region of interest. In particular, ENEA has conducted pilot works about the feasibility of multi secular simulation over Mediterranean region.

Publications

di Sarra, A., D. Fuà, and D. Meloni, Estimate of surface direct radiative forcing of desert dust from atmospheric modulation of the aerosol optical depth, Atmospheric Chemistry and Physics Discussions, 13, 527-548, 2013.

6. Next period activity

WP 2.1

Continuation of the scientific activities and data submission.

WP 2.5

The ENEA group would produce new climate simulations mainly focused on the region of interest of NEXTDATA in particular for the Mediterranean and Alpine region. The output data would also be validated and distributed. The ENEA simulations will be also compared against similar simulations produced in other international frameworks.

Finally, an analysis of existing simulations linked to the 'scientific questions' will be performed.

WP 2.6

For the second year ENEA group would provide new climate data from the new climate simulations to continue the work of statistical downscaling. Finally, an analysis of existing simulations and observational datasets linked to the 'scientific questions' will be performed.

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