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Project of Interest NEXTDATA

A national system for the retrieval, storage, access
and diffusion of environmental and climate data
from mountain and marine areas



SUMMARY OF THIRD YEAR ACTIVITIES (2014)

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A national system for the retrieval, storage, access
and diffusion of environmental and climate data
from mountain and marine areas



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Partners for the whole Project:

CNR-DTA, CNR-ISAC, CNR-IAMC, URT Ev-K2-CNR,
Università di Milano Bicocca, CMCC, INGV, ENEA

Partners involved after the first year:

CNR-IGG, CNR-IIA, CNR-IRPI, CNR-ISE, CNR-IDPA, CNR-IBAF, CNR-IMAA,
CNR-IREA, CINECA, ICTP, Università di Torino, Università di Padova, Università
della Tuscia, Università del Molise, Università di Parma, ARPA VdA, Fondazione
CIMA, Comitato Glaciologico Italiano, Parco Nazionale Gran Paradiso

Report on the project activity during the third year

01-01-2014 / 31-12-2014

SUMMARY OF THIRD YEAR ACTIVITIES



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The Abdus Salam International Centre for Theoretical Physics



UNIVERSITÀ DEGLI STUDI DI PADOVA



1. GOAL OF THE PROJECT

Mountains are sentinels of climate and environmental change and many marine regions provide information on past climate variations. The Project of Interest NextData will favour the implementation of measurement networks in remote mountain and marine areas and will develop efficient web portals to access meteorological and atmospheric composition data, past climate information from ice and sediment cores, biodiversity and ecosystem data, measurements of the hydrological cycle, marine reanalyses and climate projections at global and regional scale. New data on the present and past climatic variability and future climate projections in the Alps, the Himalaya-Karakoram, the Mediterranean region and other areas of interest will be obtained and made available. The Pilot Studies conducted during the Project will allow for obtaining new estimates on the availability of water resources and on the effects of atmospheric aerosols on high-altitude environments, as well as new assessments of the impact of climate change on ecosystems, health and societies in mountain regions. The system of archives and the scientific results produced by the NextData Project will provide a unique data base for research, for environmental management and for the estimate of climate change impacts, allowing for the development of knowledge-based environmental and climate adaptation policies. The NextData Project has defined three *Grand Challenges*: (1) the construction of a system of archives and portals for distributing climate and environmental data on current conditions and ongoing changes in mountain regions; (2) the reconstruction of climate and its variability in Italy in the last two Millennia, with special focus on the last 100 years; and (3) the development of an ensemble of high-resolution downscaled temperature and precipitation fields from future climate scenarios over Italy for the next few decades.

As a first comment, it is appropriate to stress the critical aspects related to the delays in the allocation of the 2014 funds, which have not been received till today. Notwithstanding this critical issue, the activities have continued, using the residual funds from the previous years and benefitting from the passion and dedication of the researchers involved in the Project. The results of the activities are reported in the Project web site, www.nextdataport.it, which has been regularly updated. During the third year, the request for a prolongation of the Project lifetime has led to a re-scheduling of the remaining activities, which are now expected to take place in the period 2014-2017 (instead of 2014-2015 as originally planned). **In the absence of the funding planned and expected for 2014 and 2015, it will be impossible to continue the Project activities in 2015 and beyond.**

2. GENERAL DESCRIPTION OF THE PROJECT

2.1 Scientific topics

The NextData Project intends to (1) favour new and ongoing experimental measurements, observational campaigns and numerical simulations on the present climate in high-altitude regions, with special focus on Italian mountains and the Himalaya-Karakoram region; (2) develop new climatic reconstructions for Italy and for the Mediterranean region; (3) produce climatic projections for the next decades in the Alps and Apennines, for the whole Italian territory and for other mountain areas of interest. This will allow for obtaining a characterization of present climate and of its changes, a reconstruction of past climate variability in Italy, and an improved estimate of the climatic changes expected in the coming decades for the national territory, with special focus on mountain regions.

Measurement and observation activities are devoted to the characterization of the present climate in mountain regions and include:

- (1) atmospheric, air quality and aerosol measurements in mountain regions. This will be based on global and regional WMO-GAW stations, newly installed stations in the framework of national and international monitoring networks, and measurement campaigns supported by the NextData Project;
- (2) characterization of the state of the cryosphere (snow and glaciers) in the Alps and of the hydrological cycle in mountain areas, through the use of existing and newly measured data;
- (3) measurement and quantitative observation of the state and dynamics of mountain ecosystems and biodiversity in high-elevation regions.

Reconstructions of past climate variability are devoted to the estimate of climatic conditions and their variability in Italy in the last two Millennia, and include:

- (1) recovery of existing data and new measurements in mountain environments, with particular focus on mountain glaciers, peat-bog samples, pollens and dendrochronologies;
- (2) recovery of existing data and new measurements in marine sediments from the Italian continental platform;
- (3) identification and recovery of data and information from pollen data, dendroclimatology and lake sediments for the reconstruction of recent climate and environmental variability;
- (4) reconstruction/reanalysis (RR) of the climatic variability of the Mediterranean Sea in the last 60 years.
- (5) High-resolution reconstruction of the recent climatology of temperature and precipitation in Italy, and of its variability in specific protected areas;
- (6) Numerical simulations of climatic variability in the last 1000 years.

Future climate scenarios include:

- (1) Global and regional climate projections for the next decades for the areas of interest.
- (2) High-resolution simulations for target mountain areas.
- (3) Development and implementation of climate downscaling methods to provide high-resolution downscaled climate scenarios for Italy, with specific focus on mountain areas.
- (4) Development and implementation of impact models to assess the response of the mountain environment to climate change, with specific focus on the cryosphere, the hydrological cycle, and ecosystems.

A central goal of the Project is to create a **system of archives and thematic portals** which will make environmental and climate data and scientific results openly available. The core of the system will be a General Portal for accessing the data and metadata, which will become an important Italian contribution to the international programme **GEO/GEOS**.

The **Pilot Studies** carried out during the Project, based on the use of the data and simulations obtained during the project, will address a suite of specific scientific and applied issues on the impacts of climate change on the mountain environment. In 2013, the Project activities have been complemented by a set of new Special Projects, selected from those presented at the call for projects issued at the end of 2012. In October 2013, a new call has been published, and the Special Projects that have been selected have started their activities at the beginning of 2014.

The NextData Project includes an ensemble of intense **training activities**, based on the activation of research, Post-Doc and Doctorate fellowships, teaching at Master and PhD level courses, and the organization of summer schools and residential scientific and technological training courses. In June 2013, it was organised the summer school "Climate Change and the Mountain Environment" in Valsavarenche (Aosta, Italy).

The activities of the NextData Project are linked with international programmes and initiatives, such as the activities of **GAW-WMO, UNEP, ECRA, Belmont Forum** and constitute an important contribution to the **Global Earth Observation System of Systems of GEO**, and particularly to the activities of **GEO-GNOME**: the GEO Network for Observations and information in Mountain Environments.

2.2. The *Grand Challenges*

During the third year, the Project activities were largely devoted to respond to the *Grand Challenges* of the NextData Project. These *Grand Challenges* address issues of central interest for the Italian territory and have the goal of harmonizing and guiding the Project activities, especially for what concerns the impact on the national territory. The *Grand Challenges* are:

1. **Create a system of archives and portals**, to access measured data, simulation and reanalysis results and the scientific findings in an open-access, integrated and easy-to-use way. This system of archives will allow researchers, stakeholders, policy-makers and citizens to have full access to the available information on the present and past conditions of the mountain environment and on future projections.
2. **Italy-2k**: Provide information on the climatology and climate variability in Italy in the last two thousand years, by a blend of paleoclimatic data information (ice and sediment cores, pollens, peat bog data, dendroclimatology) and numerical simulations. Station data, numerical simulations and marine reconstructions/reanalyses will allow for a more detailed representation of climate variability in the last 100 years.
3. Develop a set of **downscaled climatic projections** for the whole Italian territory, using an ensemble of methods which include global and regional climate models, high-resolution non-hydrostatic models, statistical downscaling techniques and stochastic rainfall downscaling. The validated downscaled scenarios will be made available, together with the appropriate technical documentation, on the NextData portals. The high-resolution, downscaled climatic information will become an open-access national database of forcing conditions for impact studies (water resources, risk assessment, ecosystems, air quality).

Further information and access to the results and to the data obtained in the framework of these *Grand Challenges* is provided by the NextData web site.

2.3 Geographical regions of interest - third year

The activities of NextData are centered on specific mountain areas and on the Mediterranean region. During the second year, the main geographical areas of interest of the Project have been:

Italian Alps and Apennines, where measurements of atmospheric parameters, air quality and biodiversity have been carried out, mountain glacier drilling has been supported and

hydrological and snow cover data have been collected and the construction of a new database of Italian glaciers has started.

Hindu-Kush Karakoram Himalaya (HKKH), where field measurements of atmospheric and air quality parameters have been conducted, hydrological and cryospheric data have been collected, gridded data sets on precipitation, temperature and snow cover/depth have been analysed, together with the results of climate simulations.

Mediterranean region, where marine sediment cores have been identified and analysed, and the build-up of a new reconstruction/reanalysis of the recent variability of the Mediterranean Sea has started.

The NextData Project is organized in two Sub-Projects, which during the first year included 11 Work Packages (WP). From the beginning of the second year, owing to the Project needs identified in the first year and the activation of the Special Projects, new WPs have been created. The Project now includes 15 Work Packages devoted to the different activities.

WP0 deals with the Project coordination and management.

Sub-Project 1 aims at creating an integrated observation system and it is divided into seven different Work Packages, according to the type of data measured. They are associated with diverse requirements of research, and of climate, environmental, experimental, instrumental and technological applications:

WP1.1 High-altitude climate observation system.

WP1.2 GAW-WMO climate observatories.

WP1.3 Marine observation systems and climate reconstructions.

WP1.4 Environment and climate data from ice cores.

WP1.5 Paleoclimate data from marine sediments.

WP1.6 Paleoclimatic data from continental regions.

WP1.7 Mountain ecosystems and biodiversity.

Sub-Project 2 is devoted to the creation of environmental and climatic archives, data analysis and interpretation and to the Pilot Studies:

WP2.1 Archive of high-altitude observation networks.

WP2.2 Archive of marine observation networks and climate reconstructions.

WP2.3 Archive of data from non-polar ice cores.

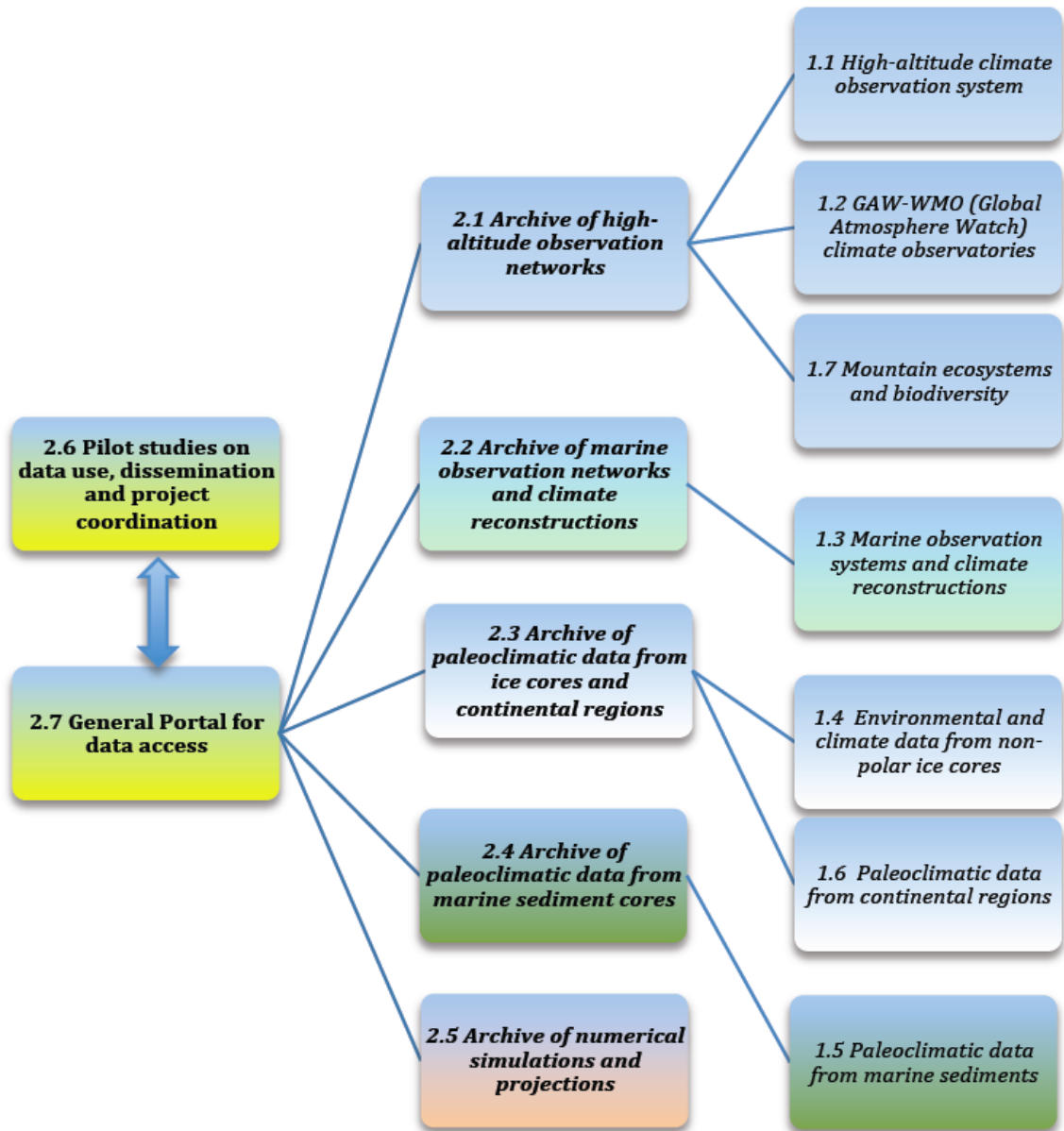
WP2.4 Archive of paleoclimatic data from sediment cores.

WP2.5 Archive of numerical simulations and projections.

WP2.6 Pilot Studies on data use.

WP2.7 General Portal for data access.

The following figure shows a scheme of the structure of the NextData Project.



Structure of the NextData Project in 2014.
 The figure reports the technical WPs. In addition to these, WP0 deals with the Project coordination and management.

2.5 Project Partners - 2014

CNR-DTA. State research institution. International excellence in the running of experimental and observation programmes in remote areas, the drilling of cores in marine sediments and processing of sediment cores, data analysis and paleoclimate research activities.

CNR-ISAC. State research institution. International excellence in the field of climate observations in remote regions, measurement of atmospheric parameters and air quality, design, management and implementation of measurement campaigns, development of innovative technologies for data measurement and transmission, data analysis, numerical simulations of the global climate and high-mountain climates, downscaling techniques and analysis of climate change impacts on the mountain environment. It is involved in the management of European projects and participates in international programmes (GAW-WMO, ABC-UNEP, SHARE, ACTRIS, GEO/GEOSS, GEWEX, EC-Earth, ECRA).

CNR-IAMC. The Institute for the Coastal and Marine Environment (IAMC) has five territorial branches and one research unit, with headquarters in Naples. With over 190 staff members and more than 80 postdoctoral researchers, IAMC conducts research on biological, geological, chemical and physical scientific topics and technology transfer. Supported by modern technical equipment, both in the laboratory and at sea, the Institute's mission is to conduct interdisciplinary research in coastal marine science, with a primary emphasis on Southern Italy and the Mediterranean.

URT Ev-K2-CNR. CNR institution of research for Third Parties. International excellence in the implementation of climate monitoring and measurement campaigns in remote high-mountain areas, the set up and management of experimental facilities in extreme environments, the running of the participation in international measurement programmes (SHARE, GAW-WMO, UNEP, bilateral programmes). It conducts activities in high-altitude areas in the Alps, Apennines, Hindu-Kush Himalaya Karakorum, Rwenzori, and the Andes.

DISAT-UNIMIB. State university. The group involved in the Project has international excellence in paleoclimate research based on ice cores, in ice drilling and data analysis, in the development of techniques for the drilling and analysis of ice cores in extreme environments.

ENEA UTMEA. National Agency for new technologies, energy and sustainable economic growth: Governmental research institution. The ENEA UTMEA groups involved in the Project have competences of international excellence in the measurement of atmospheric parameters in remote areas, the development and use of numerical regional-scale and climate models, Earth-atmosphere interactions in the Mediterranean area, paleoclimate studies by means of ice-core analysis, and participation in the management of international projects.

CNR-IGG: The Institute of Geosciences and Earth Resources of CNR (CNR-IGG) conducts basic and applied research on the geological and environmental processes occurring in the Earth System, on the management of Earth resources for sustainable development and on the impact of global change. In the framework of NextData, CNR-IGG works on mountain geomorphology and geology, on the impacts of climate change on mountain water resources and on paleoclimatic reconstructions.

CNR-IIA: IIA is involved in the monitoring and modelling of atmospheric pollution on all scales. The Institute has a long history of air quality studies, instrument and technology and methodology design. The Institute is involved in polar research projects, and at the high altitude monitoring site (Ev-K2-CNR) in the Himalayas. A key thematic area is the development of methodologies and interoperable systems for data sharing, data brokering, and dissemination of environmental knowledge. The Institute contributes to GEO, the Group on Earth Observations which coordinates the building of a Global Earth Observation System of Systems(GEOSS).

CNR-IRPI: Research Institute for Geo-hydrological Protection. The Institute's mission is to plan, promote and conduct scientific research and technological development in the field of geo-hydrological risks. It has over 20 years of experience in studies of glacial and periglacial

areas, in the Alps and in other mountains around the world, with a focus on changes over time, as terrestrial indicator of climate change, and as an essential knowledge to investigate present and future hazards in such areas, also in the framework of international projects (GLACIORISK, PERMADATAROC, GLARISKALP, GEONATHAZ).

CNR-ISE: CNR-ISE develops basic and applied research activities in the field of water and land ecosystems, and it is involved in understanding how ecosystems react to the impact of global climate change and anthropogenic pressure. A key thematic area is development of methodologies to study anthropogenic impacts, climate changes and their effects on water bodies. The Institute is involved in research projects at high altitude sites in several areas of the globe.

CNR-IDPA: The Institute for the Dynamics of Environmental Processes of CNR (CNR-IDPA) in Venice is active in the field of interdisciplinary environmental research with the main research themes including: environmental chemistry (e.g. heavy metals and persistent organic pollutants in polar and temperate ice and snow, lagoon, marine and lake waters, etc.), climate change (e.g. long-term paleoclimate and atmospheric chemistry from ice cores) and analytical chemistry (e.g. development of mass spectrometry-based advanced analytical methodology for trace and ultra-trace determinations in environmental and biological matrices).

CNR-IMAA: The Institute of Methodologies for Environmental Analysis (IMAA) is specialized in the development and integration of technologies for Earth observations from satellite, airborne and ground base platforms. The IMAA takes advantage of advanced research infrastructures such as the atmospheric observatory named CIAO (CNR-IMAA Atmospheric Observatory) and the system for direct receiving and on-line archiving of satellite data (eg NOAA, EOS, METOP, NPP, MSG). IMAA coordinates and participates in several FP7 projects, and in networks and programs for research and monitoring.

CNR-IBAF: Its scientific mission is to carry out the activities of basic and applied research on the following areas: interactions between plants and the environment; anthropogenic effects on the ecological balance; biological and evolutionary processes and mechanisms in plants in relation to the environment; ecophysiological mechanisms and productivity of agricultural and forest plants. The Institute is involved in Long Term Ecological Research activities (LTER-Italia) and in forest monitoring. Within Nextdata the Institute will study gas-exchanges between biosphere and atmosphere with the ecological implications. Furthermore, IBAF will coordinate the activities to provide NextData with datasets of ecological and biological parameters with the needed informatic standards and tools. Examples will come from LTER-Italy mountain sites.

CNR-IREA: The mission of the Institute for Electromagnetic Sensing of the Environment is the development of methodologies and technologies for acquisition, processing, fusion and interpretation of images and data obtained by electromagnetic sensors - operating on satellite, aircraft and in situ - and the dissemination of information extracted, aimed at monitoring environment and territory, at non-invasive diagnostic and at electromagnetic risk assessment. The Institute has consolidated expertise in the fields of optical and microwave remote sensing, diagnostics in situ for environment and territory, combined with the biological one for risk assessment from exposure to electromagnetic fields but also for their possible applications in medicine.

CINECA: Cineca is a non profit Consortium, made up of 56 Italian universities, and 3 Institutions. Today it is the largest Italian computing centre. It operates in the technological transfer sector through high performance scientific computing, the management and development of networks and web based services, and the development of complex information systems for treating large amounts of data. It develops advanced Information Technology applications and services, acting like a trait-d'union between the academic world, the sphere of pure research and the world of industry and Public Administration.

ICTP: The Abdus Salam International Center for Theoretical Physics. International institution funded by the Italian Government, UNESCO and IAEA. Competences of international excellence in high-resolution numerical simulations of regional climate in the areas involved in the Project, including the Himalayan zone.

NatRisk: The Interdepartmental Research Centre on Natural Risks in Mountain and Hilly Environments at the University of Torino it's a network of Departments for research on risk prevention and management in mountain areas. It is an interdisciplinary research team, specifically devoted to the analysis of the interactions between climate, pedological-geological environment and morphodynamic processes. UniTo has long-term expertise on mountain soil and snow investigations, with particular emphasis on the biogeochemistry of seasonally snow-covered areas (gas fluxes, C and N dynamics in soil and soil solution). Within NextData, the Università degli Studi di Torino - NatRisk unit will provide access to existing data and possible collection of new data for the research sites IT19-001-T "Mosso" and IT19-005 T "Torgnon", in collaboration with the Environmental Protection Agency of the Valle d'Aosta Region.

Università di Torino: The groups participating in the Project conduct research aimed at assembling historical hydrometeorological data, land surface parameterization models, and field energy and mass flux monitoring.

Università di Padova: The group from University of Padova is actively involved in research projects concerning the development of historical hydro-meteorological archives, runoff prediction and forecasting at hillslope and basin scale, and monitoring of mass and energy flows in mountain basins. The research activity is also focused on precipitation estimation and forecasting by means of remote sensing (satellite and weather radar), and on the evaluation of the impact of climatic variability and change on runoff regime.

Università della Tuscia: The Department for Innovation in Biological, Agro-food and Forest systems (DIBAF) of UNITUS has been created by combining scientific expertise from the former Agriculture and Biological Sciences Faculties. It is a multidisciplinary research and teaching department whose aim is the scientific innovation and technological processes of exploitation, conservation and the management of biological systems and forest resources. Other research topics are related to transformation processes and food safety, human health and environment chemistry, with special attention to environmental sustainability (green economy, blue economy, white economy). The research group involved in NextData

Università del Molise: It has long-term expertise on ecological research applied to the high elevation ecosystems of Apennines mountains, concerning the spatial pattern analysis of plant communities and its changes in the last decades, the effects of global warming on vascular plant diversity along elevation gradients, the anatomical plasticity of woody vegetation at high elevation, the detection of changes in tree cover and the influence of land use changes and global warming at the treeline ecotone. In NextData, UniMol will provide access to data from sites which consists of "orographic islands" with high elevation vegetation in central Mediterranean basin, along the Central and Southern Apennine mountain range, and permanent plots are placed between 2000 and 2700 m a.s.l.

Università di Parma: The Department of Life Sciences at the University of Parma has gained extensive expertise in the study of terrestrial and aquatic ecosystems in mountain regions. One of the most important research areas is the study of Northern Apennine water bodies. Systematic surveys began in the 1950s, when the research was oriented to the physiographic and hydrochemical characterization of temporary and permanent lentic systems and the description of the seasonal succession and distribution of zooplankton. More recently, the analysis of biodiversity and biogeographical patterns of invertebrates in both lentic and lotic (including springs) ecosystems has been addressed using a rigorous taxonomic approach. Other currently active research topics include population and community ecology of plankton, phenological responses to climate change, whole-ecosystem analysis using trophic flow networks. UniPar is coordinating the LTER site "Mountain lakes" and will provide access to existing data and possible collection of new data.

ARPA VdA: Regional Agency for Environmental Protection of the Aosta Valley. Expertise in environmental monitoring and prevention. The ARPA VDA group involved in the Project (Climate Change Unit) has expertise in monitoring climate change effects in the alpine region, and, in particular, in monitoring and modeling snow properties.

Fondazione CIMA: CIMA Research Foundation is a non-for-profit organization under the Italian Legal Regulations. The Foundation supports and promotes research, technological development, and high level training in weather forecasting and observations, hydrology, climate, natural and man-made risk, ecosystem and social system modelling, environmental chemical processes, and renewable energy sources. The CIMA group involved in the Project has experience in snowpack modelling, operational hydrometeorological chains, integration of satellite observations, models and ground measurements.

Comitato Glaciologico Italiano: the ITALIAN GLACIOLOGICAL COMMITTEE (CGI) has been working in Italy since 1895, with the task of promoting and coordinating research in the field of glaciology. First born as a commission of the Italian Alpine Club (CAI) for the study of Italian glaciers, the CGI became an independent organism in 1915, with the support of the National Research Council (CNR) and of other organizations and associations interested in the glaciological research.

Parco Nazionale Gran Paradiso: The Gran Paradiso National Park has its vigilance service since several decades, allowing for continuous monitoring of the protected area. PNGP conducts scientific research applied to nature conservation and cooperates with several universities and research Institutions. Current projects focus on monitoring and measurement of habitats and ecosystems, censuses of target species (Alpine ibex, chamois) and eco-ethology of species with conservation interest. In 2006, PNGP started a new long-term project on the measurement of animal biodiversity and its changes.

3. ACTIVITIES AND RESULTS IN THE THIRD YEAR (2014)

3.1 Research activities: measurements, climate reconstructions, numerical simulations

Owing to the delay in funding with respect to what was originally planned, at the beginning of 2014 most of the activities have been distributed on a longer time span (till 2017) and a revised Executive Plan for the period 2014-2017 was prepared (in Italian). In 2014, however, no funding was assigned, but most activities planned in the revised Executive Plan were carried out anyway and most of the corresponding results, Deliverables and Milestones were obtained. Activities include measurement and observation of atmospheric, cryospheric, hydrological and ecological variables, the collection of paleoclimatic proxy data from marine sediments, mountain ice cores and other terrestrial archives (peat bogs, pollens, dendrochronologies), the set-up of the reanalysis/ reconstruction of the Mediterranean Sea dynamics for the last 60 years, the starting phase of the reconstruction of the climatology of Italy in the last two Millennia, and the census and realization of numerical climatic simulations at global and regional scale. The reports of the different Work Packages provide detailed descriptions of the activities and the results obtained in the third year.

In the following, we provide a short summary of the results obtained in the third year.

WP0: Project Coordination

Coordination of the Project activities and organization of a meeting of all participants in the NextData Project (June 2014). Organization of several thematic meetings on specific scientific aspects of the Project. Definition of the three "*Grand Challenges*" of the Project and completion of some of the related tasks. Activation of new Fellowships and Scholarships. Selection and activation of the new Special Projects proposed at the end of 2013. Contribution to the organization of the Conference "Climatic Variability in Italy in the Last 2000 yr - Italy 2k" at the Accademia dei Lincei, December 2014. Outreach and dissemination activities on the Project results, in Italy and abroad. First activities of GEO-GNOME: the GEO Global Network on Observations and information in Mountain Environments. Contribution to the activities of the Collaborative Program "Changes in the Hydrological Cycle" of the European Climate Research Alliance (ECRA). It was established a new Collaborative Research Action of the Belmont Forum on "Mountains as Sentinels of Change", and the related call for proposals was issued at the beginning of 2015.

WP 1.1: High altitude climate observation system

Continuation of the measurement and analysis activities in the different geographical regions of interest for the Project: Himalaya, Karakoram and Rwenzori. Continuation of the QA/QC and validation activities of the data provided by the AWS in Himalaya, Karakoram e Rwenzori. Implementation and updating of the meteo-climatic network of high-altitude AWS stations in Himalaya. Continuation of the atmospheric composition measurements at the Kathmandu hotspot, Nepal, and of the QA/QC of the data. Atmospheric composition measurements in Deosai National Park (Pakistan), also using mobile systems for the measurement of air quality and climatic and environmental parameters. Owing to technical problems, in May 2014 the air quality measurement activities in Deosai were suspended; the data analysis is ongoing. Trans-national access (TNA) activities at the Pyramid Laboratory in Himalaya have been ongoing. Continuation of the support to the activities at the Mt. Portella Observatory (Apennines, Abruzzo national Park) and to the Italian AWS network. Continuation of the data integration and sharing activities with other measurement networks (GMES, GEO, SUSKAT, ABC, CCAC). Inclusion of the data in the NextData archives and portals.

WP 1.2: GAW-WMO climate observatories

Continuation of the activities at the GAW Station at Mt. Cimone (GAW ID: CMN) and at the Nepal Climatic Observatory – Pyramid (NCO-P, GAW ID: PYR). Start-up of new observational programs at CMN (NO_x ed SO₂) e NCO-P (SO₂). At NCO-P, a measurement campaign by PSI-

University of Helsinki is ongoing, devoted to the study of the chemical composition of ultrafine particles during nucleation events using the API-TOF. Part of the data acquired in 2013 have been inserted in the GAW-WMO database and in the NextData archives. NRT data-delivery services in the framework of MACC-2 (Plateau Rosa), SDS-WAS of WMO (CMN) and ACTRIS-NRT (CMN) have started. Re-start of the measurements of the dimensional distribution of fine and ultrafine particles (SMPS) at NCOP in May 2014, after taking into account the indications of ACTRIS-WMO. Publication of scientific papers on the observations at CMN and NCO-P and seasonal reports on the atmospheric composition at CMN.

WP 1.3: Marine observation system and climate reconstructions

During 2014, the research activities have been devoted to:

- Completion of the reconstruction/reanalysis (RR) production;
- Evaluation of the RR quality indices; discussed the future developments for a new and higher quality RR, which would cover a shorter time period than the actual 1955-2012 but with increased quality.

The RR was carried out on the INGV Cray supercomputer machine and stored on the INGV archiving system.

WP 1.4: Environment and climate data from non-polar ice cores

The collection of palinological data from northern Italy and the Alps was concluded. The datasets from the *European Modern Pollen Database* (EMPD), focused on paleoclimate reconstruction, were checked and harmonized. The atmospheric dust record from the ice cores drilled in 2012 was reconstructed. The dataset was integrated with the IDB data to reconstruct climatic and environmental variability from different sources, including the Mount Blanc, Monte Rosa and Fiescherhorn cores. Dendrochronological data from research centers not participating in the Project were identified, collected (through specific agreements) and included in the NextData database. The "Minimal Glacier Model" was applied to the simulation of the retreat of the Careser glacier (Ortles-Cevedale group, north-eastern Italian Alps).

WP 1.5: Paleoclimate data from marine sediments

The research activities developed during the third year of the Project have been focused to complete the paleoclimatic reconstruction for the last two millennia of the central Tyrrhenian Sea and to analyze the marine cores ND14O_SW104 (Gulf of Taranto), ND11_SW104 (Sicily Channel) and ND-14Q_SW104 (south Adriatic Sea). A new research activity on central Tyrrhenian Sea (core SW104_C5-C5, Gulf of Gaeta) has been focused of past runoff reconstruction from reworked Coccoliths. During the third year of the Project, the following new cores - GIOVE_4, GIOVE_5, ND_14M_bis, ND_14O, ND_14Q, ND_14R, ND_14S, ND_14T, ND_14U, ND_14V, ND8_2014, ND11_2014 - have been collected in the Adriatic Sea and Gulf of Taranto. Holocene (last 11ka) pollen maps of Italy, using a database of hundred pollen records was plotted at time intervals of 500 years, have been produced in cooperation with the Laboratory of Palynology and Palaeoecology of the CNR, Milan, and the Laboratory of Palaeobotany and Palynology of Sapienza University of Rome.

WP 1.6: Paleoclimatic data from continental regions

Pollen content analysis of the Danta di Cadore and Coltrondo peat-bog cores was continued. For Coltrondo, the record of the last 2000 yr (corresponding to the upper 110cm) was determined. The core datings of Danta di Cadore and Coltrondo were refined, the geochemical profiles of the Coltrondo core were obtained by ICP-MS analysis. In September 2014, a new drilling at the Danta di Cadore site was carried out, in collaboration with the group of Prof. Klaus Oeggl of Innsbruck University. This new drilling extended the record to a depth of 10.1 m. The survey of the scientific literature and of international databases was continued to gain further information on the sedimentary cores drilled in high-altitude lakes in the Alps.

Collaborations with the Laboratoire Chrono-Environnement, UFR Sciences et Techniques, Besançon and with the UMR CARRTEL Laboratory, Alpine Research Centre on Lake Food webs, Thonon les Bains, were established to allow comparisons across the Alps. Together with IDPA-CNR, a new campaign to obtain sedimentary cores in the Fosses and Federa lakes (Dolomites) was started. The cores obtained during the campaign (four 1-m-long cores in each lake) will be dated and analyzed to determine geochemical and biological parameters. The isotopic analysis of the Ortles ice core was continued.

WP 1.7: Mountain ecosystems and biodiversity

Data recovery and digitalization from different collections and databases. Data analysis and development of distribution and ecological models of selected mountain species. Collection and harmonization of data and metadata from the mountain LTER sites included in the Project. Measurement of micro-climatic parameters and monitoring of two taxonomic groups (butterflies and birds) along two altitudinal transects in the Gran Paradiso National Park. Completion of the species-level classification of the samples collected in 2012-2013. Organization of the database of the 2006-2007-2008 biodiversity monitoring campaigns. Preparation of the layers of meteo-climatic variables and soil cover for the 3 protected areas included in the monitoring effort. Continuation of the net CO₂ and H₂O ecosystem exchange at the Torgnon prairie and at the Collelongo woods. At the Brocon site, seasonal monitoring of soil respiration was carried out. Soil sampling at Brocon and Torgnon was completed.

WP 2.1: Archive of high-altitude observation networks

Owing to the request by several participants in the Project, the type and amount of data managed by the SHARE Geonetwork platform significantly increased in 2014. This aspect is essential in that it emphasizes the importance of the data sharing systems used in the Project to allow data use in the widest framework. During the third year, the system was installed in the production environment. Web-GIS navigation was improved by the integration of an advanced navigation system (<http://geonetwork.nextdataport.it>). The data from the meteo-climatic AWS network and from the high-altitude GAW-WMO observatories have been made fully available. Two new DB, devoted to marine sediment cores and ice cores, have been created and made operational. In collaboration with IRPI, in the framework of the Special Project DATAGRALP, a new metadata base for the archive of Italian glaciers has been made available. In the third year, the training of personnel in Pakistan was continued.

WP 2.2: Archive of marine observation networks and climate reconstructions

Following the user requirements, the INGV-NextData Geoportal was implemented and fully tested in each of its three components. The web application is reachable at the following link <http://medsearr.bo.ingv.it/> and it allows to discover, visualize and download the reanalysis products of the Mediterranean Sea, open and free of charge.

The specific activities developed during the third year of the Project were:

- implementation of alpha version Data Layer;
- implementation of alpha version Presentation Layer;
- implementation of alpha version Application Layer;
- test of the three components (beta version);
- final release of the Web Portal.

WP 2.3: Archive of data from non-polar ice cores

Creation of a database and portal for mountain ice cores data, metadata and information (<http://geonetwork.nextdataport.it/>; <http://geomatic.disat.unimib.it/wp2.3>). Creation of databases and archives for paleoclimate proxies from ice cores, pollen analyses and dendrochronologies. All metadata are public, while the data are available to the researchers

involved in the Project through ftp (ftp:\\149.132.38.77). A general methodology for mountain ice core drilling was defined.

WP 2.4: Archive of paleoclimate data from sediment cores

Updating of the database for spatial and non-spatial data. This database will manage both the information provided by sedimentary cores from the literature, and the information from the cores drilled during the Project.

WP 2.5: Archive of numerical simulations and projections

In 2014, archiving of the global and regional climate simulations was concluded. The data and metadata are now available through a network of THREDDS servers managed by the various partners of the Project, and carefully described on the NextData web site. Using these data, several studies on climate dynamics and variability in the areas with complex orography of interest for the Project have been conducted.

WP 2.6: Pilot studies on data use, dissemination and project coordination

2.6.a: The research activities were devoted to understanding the relationships between the North Atlantic Oscillation (NAO) and winter precipitation in the Karakoram region, using reanalysis datasets.

2.6.b: These activities are now included in WP1.7.

2.6.c: The research activities focused on the comparison between the outputs of the snow models "UTOPIA" (University of Torino) and CHTESSEL and observed data at the selected site of Torgnon (Aosta Valley). Special attention was paid to the role of the spatial resolution of the meteorological data driving the snow models.

2.6.d: The activities were devoted to the comparison between the results on atmospheric aerosols provided by regional models (RegCM4) and the available observations (MACC reanalyses and MODIS satellite data). The outputs of an ensemble CMIP5 global climate models have also been analysed to understand the impact of the aerosol representation in the models and the simulated precipitation.

2.6.e: Part of the the research activities were devoted to obtain preliminary simulations with the Earth System Model of Intermediate Complexity "PLASIM" coupled with a simplified ocean dynamical model (LSG). A second activity was the identification of the uncertainties associated with the reference datasets used to calibrate and validate proxy reconstructions.

2.6.f: Special Project NextSnow. A dataset of snow measurements in Val d'Aosta was constructed, leading to high-quality snow-cover regional maps. The underestimate of the snow component by rain gauges was identified. Snow density measurements in the Piedmont region were collected. Activities on the parameterization of the snow cover in models and energy balance measurements at the snowline were ongoing.

2.6.g: Special Project DATAGRALP. Implementation of the information system for Italian glaciers. Orthophoto characterization of Italian glaciers updated to 2006-2007. Use of previous photographic information to determine glacier evolution in the last 50 years. Inclusion of the metadata and data in the NextData Geoportal.

2.6.h: Special Project HR-CIMA. Thermopluviometric data for northern Italy (for the regions which provided the data) were collected. A data quality check procedure was developed and implemented for pluviometric data and it is in progress for thermometric data.

2.6.j: Special Project HAMMER. In 2014, the following activities were carried out: (i) collection of the ground deformation records (from *in-situ* measurements and satellite observations); (ii) collection of meteorological data in the Alps and Apennines; (iii) analysis of the technical literature on ground deformation in mountain areas; (iv) processing of SAR (ERS-1/2 and ENVISAT, 1992-2010) images using the ESA service (G-POD, <http://gpod.eo.esa.int/>) for the Val d'Aosta valley.

2.6.k: Special Project for the creation of a hydrological database for the Apennines. i) Conduction of measurement campaigns for soil humidity and runoff in specific sections; ii) post-flood measurements in the two basins under study; iii) acquisition and analysis of hydrological and climatic time series; iv) creation of a web-gis platform for managing the hydrological data.

WP 2.7: General Portal for data access

Design and implementation of the General Portal architecture. Set-up of the digital infrastructure and of the software platform for the brokering of some of the data systems included in the NextData Project. Development of the first version of the NextData General Portal, including (a) basic discovery; (b) metadata visualization & evaluation; (c) semantic discovery; (d) data download.

3.2 Project web site

The Project web site was regularly updated during the third year, providing information on the project activities. The web site is accessible at the links <http://www.nextdataport.it> and <http://www.nextdataport.eu>.

The web site contains (in Italian and English):

- a) general description of the Project and its structure;
- b) list of participating institutions;
- c) list of Scientific Advisors;
- d) description of the activities of the different WPs;
- e) description of the data collected by the Project archives;
- f) results of the pilot studies;
- g) scientific reports of the different WPs;
- h) Project Deliverables;
- i) Project news;
- l) slides and dissemination, schools and conferences;
- m) calls for research proposals;
- n) list of publications.

The web site includes links to the different data and metadata archives and thematic portals of the Project and to the General Portal. Most data and metadata can be downloaded from the thematic archives and portals.

The web site includes a section which is specifically devoted to the Project Grand Challenges, where it is possible to download information, presentations, data and results.

3.3 Activities of the Special Projects

Following the selection of the proposals submitted to the Call for Proposals of November 2012 and October 2013, the Special Projects listed below continued or started their activities in 2014. As described in the Executive Plan, the selection of the proposals was based on the reviews of the Scientific Advisors and of the Executive Committee of the NextData Project.

P1. NextData System of Systems Infrastructure (ND-SoS-Ina). PI: Stefano Nativi, CNR-IIA.

P2. NextSnow. PI: Vincenzo Levizzani, CNR-ISAC.

P3. Database for reconstructing the spatial-temporal evolution of the Glacial Resource in the Italian ALPs over the last 100 years in the Framework of the NextData Project (DATAGRALP). PI: Marta Chiarle, CNR-IRPI.

P4. Development of ensembles of regional climate change scenarios, with focus on variability, extremes and uncertainties in areas of complex topography, RECCO (REgional Climate in Complex Orography). PI: Silvia Trini Castelli, CNR-ISAC.

P5. The use of sedimentary proxies in high altitude lakes for inferring the environmental changes during the late Holocene. PI: Andrea Lami, CNR-ISE.

P6. Multy-proxy reconstruction of Eastern Alpine Holocene climate. PI: Carlo Barbante, CNR-IDPA.

P7. High Resolution Climate Information for Mountain Areas (HR-CIMA). PI: Michele Brunetti, CNR-ISAC.

PP1 - Harmonisation and standards for existing and newly collected Data and MetaData on LTER sites in Italian Mountain ecosystems. PI: Giorgio Matteucci, CNR-IBAF.

PP2 - Carbon and water fluxes in mountain forest and grassland ecosystems from leaf to ecosystem level: effects of climate variability and management. PI: Carlo Calfapietra, CNR-IBAF.

PP3 - Montane butterflies and mammals as ecosystem indicators of climate change effects: upgrading NextData bank. PI: Giovanni Amori, CNR-ISE.

PP4 - Experimental hydrological database for Apennine basin. PI: Tommaso Moramarco, CNR-IRPI.

PP5 - HAMMER - RelationsHips between meteo-climAtic paraMeters and ground surface deforMation time sEries in mountain enviRonments. PI: Francesca Ardizzone, CNR-IRPI.

3.4 Project meetings

A general meeting of the participants in the NextData Project, open to the external scientific community, was organized on 2-3 June 2014. The advancement of the Project activities and the potential critical issues, including the delay in funding, were discussed.

Many technical meetings of the WPs and Special Projects were organized, to discuss internal issues of the various WPs, to coordinate the activities of the different WPs which deal with similar topics and to enhance interaction with the participants in the Special Projects. Meetings with scientists not directly involved with NextData were also organized.

3.5 Training activities

In 2014, new Doctorate scholarships were assigned, and several research fellowships were continued and/or started. Research Doctorate Theses on the themes of the Project are ongoing.

The NextData Project has contributed to the organization of the Summer School "Dynamics, Stochastics and Predictability of the Climate System", held in Valsavarenche (Val d'Aosta) in the period 9-18 June 2014.

3.6 Dissemination

The Project activities were presented in several conferences and meetings at national and international level.

In collaboration with the Gran Paradiso National Park and several Italian nature photography associations, a new photographic exhibition on mountain ecosystems is in preparation. The selected images will be displayed in several locations starting from the end of 2015/beginning 2016.

4. INTERNATIONAL COLLABORATIONS DURING THE THIRD YEAR

The atmospheric and air quality measurement activities have been carried out in the framework of international programmes such as **WMO-GAW** e **ABC-UNEP**, as described in the individual WPs.

Climate simulation activities have been carried out in the framework of the **CMIP5** program and of the European Consortium **EC-Earth**. Some of the climate simulations have been carried out in collaboration with the LRZ Supercomputing Center in Munich (Germany). Some of the regional climate simulations are part of the international programme **CORDEX**.

The activities on the different aspects of the hydrological cycle are closely linked with the Collaborative Project "Changes in the hydrological cycle" of the European Climate Research Alliance (**ECRA**).

The activities of climatic reconstruction in Italy for the last two Millennia (Italy-2k) are conducted in synergy with the international initiative **PAGES-2k**.

The NextData Project has contributed to the launch of a new Collaborative Research Action (CRA) of the **Belmont Forum** on the theme "Mountains as sentinels of change", approved in 2014. A Call for Proposals has been issued in early 2015.

The NextData General Portal will be an important Italian contribution to the "Global Earth Observation System of Systems" (**GEOSS**) which is being built by the "Group on Earth Observations" (**GEO**). In particular, there will be a strong interaction between NextData and the **Ecosystems Task** of GEO, continuing to contribute to the new global initiative **GEO-GNOME**: the GEO Global Network for Observations and information in Mountain Environments.

5. SCIENTIFIC ADVISORS OF THE NEXTDATA PROJECT

The list of Scientific Advisors of the NextData Project was defined in the first project year and it can be found on the Project web site.

6. LIST OF PUBLICATIONS PRODUCED BY THE NEXTDATA PROJECT

2015

DAVINI P., VON HARDENBERG J., FILIPPI L., PROVENZALE A., (2015): Impact of Greenland orography on the Atlantic Meridional Overturning Circulation. *Geophysical Research Letters*. 42(3):871-879. DOI:10.1002/2014GL062668.

GARCIA ARISTIZABAL A., BUCCHIGNANI E., PALAZZI E., D'ONOFRIO D., GASPARINI P., MARZOCCHI W., (2015): Analysis of non-stationary climate-related extreme events considering climate change scenarios: an application for multi-hazard assessment in the Dar el Salaam region, Tanzania. *Natural Hazards*. 75(1):289-320. DOI:10.1007/s11069-014-1324-z.

TURCO M., PALAZZI E., VON HARDENBERG J., PROVENZALE A., (2015): Observed climate change hot-spots. *Geophysical Research Letters*. DOI: 10.1002/2015GL063891.

B. PIERI A., VON HARDENBERG J., PARODI A., PROVENZALE A., (2015, in press): Do precipitation rates from non-hydrostatic simulations agree with data? A view from the WRF model over Europe? *J. Hydrometeorology*.

2014

ABELI T., MONDONI A., ROSSI G., ORSENIGO S., (2014): Effects of summer heat waves on Europe's wild flora and vegetation. *Agrochimica*, LVIII (Special Issue): 128-132.

- BUCCI S., CAGNAZZO C., CAIRO F., DI LIBERTO L., FIERLI F., (2014): Aerosol variability and atmospheric transport in the Himalayan region from CALIOP 2007-2010 observations. *Atmospheric Chemistry and Physics*. 14:4369–4381.
- CALMANTI S., DELL'AQUILA A., MAIMONE F., PELINO V., (2014, in press): Evaluation of climate patterns in a regional climate model over Italy using long-term records from SYNOP weather stations and cluster analysis. *Climate Research*. 10.3354/cr01256.
- CAVICCHIA L., VON STORCH H., GUALDI S., (2014): Mediterranean Tropical-Like Cyclones in Present and Future Climate. *Journal of Climate*. 27(19):7493-7501.
- CESSI P., PINARDI N., LYUBARTSEV V., (2014): Energetics of Semienclosed Basins with Two-Layer Flows at the Strait. *Journal of Physical Oceanography*. 44(3):967-979.
- CHIARLE M., NIGRELLI G., PROVENZALE A., (2014): A System for Assessing the Past, Present and Future of Glacial Resources. *Engineering Geology for Society and Territory*. 1:69-72.
- COPPOLA E., GIORGI F., RAFFAELE F., FUENTES-FRANCO R., GIULIANI G., LLOPART-PEREIRA M., MAMGAIN A., MARIOTTI L., DIRO G., TEFERA, TORMA C., (2014): Present and future climatologies in the phase I CREMA experiment. *Climatic Change*. 125(1):23-38.
- CRISTOFANELLI P., PUTERO D., ADHIKARY B., LANDI TC, MARINONI A., DUCHI R., CALZOLARI F., LAJ P., STOCCHI P., VERZA G. et AL., (2014): Transport of short-lived climate forcers/pollutants (SLCF/P) to the Himalayas during the South Asian summer monsoon onset. *Environmental Research Letters*. 9: 1-11
- D'ONOFRIO D., PALAZZI E., VON HARDENBERG J., PROVENZALE A., CALMANTI S., (2014): Stochastic rainfall downscaling of climate models. *Journal of Hydrometeorology*. 15:830-843.
- DA ROCHA R., REBOITA M., DUTRA L., LLOPART M., COPPOLA E., (2014): Interannual variability associated with ENSO: present and future climate projections of RegCM4 for South America-CORDEX domain. *Climatic Change*. 125(1): 95-109.
- DAVINI P., CAGNAZZO C., ANSTEY J.A., (2014): Blocking view of the stratosphere-troposphere coupling. *Journal of Geophysical Research: Atmospheres*. 119 (19): 11.100-11.115.
- DI BIAGIO V., CALMANTI S., DELL'AQUILA A., RUTI PM., (2014): Northern Hemisphere winter midlatitude atmospheric variability in CMIP5 models. *Geophysical Research Letters*. 41(4):1277-1282.
- DIRO G.T, GIORGI F., FUENTES-FRANCO R., WALSH K.JE, GIULIANI G., COPPOLA E., (2014): Tropical cyclones in a regional climate change projection with RegCM4 over the CORDEX Central America domain. *Climatic Change*. 125:79-94
- DUCHI R., CRISTOFANELLI P., MARINONI A., BOURCIER L., LAJ P., CALZOLARI F., ADHIKARY B., VERZA GP, VUILLERMOZ E., BONASONI P., (2014): Synoptic-scale dust transport events in the southern Himalaya. *Aeolian Research*. 13:51-57.
- FERRANTI L., CORTI S., JANOUSEK M., (2014): Flow dependent verification of the ECMWF Ensemble over the Euro-Atlantic sector. *Quarterly Journal of the Royal Meteorological Society*. DOI: 10.1002/qj.2411.
- FILIPPI L., PALAZZI E., VON HARDENBERG J., PROVENZALE A., (2014): Multidecadal Variations in the Relationship between the NAO and Winter Precipitation in the Hindu-Kush Karakoram. *Journal of Climate*. 27: 7890-7902.
- GIORGI F., COPPOLA E., RAFFAELE F., DIRO G.TEFERA, FUENTES-FRANCO R., GIULIANI G., MAMGAIN A., LLOPART M., PEREIRA, MARIOTTI L., TORMA C., (2014): Changes in extremes and hydroclimatic regimes in the CREMA ensemble projections. *Climatic Change*. 25 (1): 39-51.

- GRANT K.M., ROHLING E.J., C. RAMSEY B., CHENG H., EDWARDS R.L., FLORINDO F., HESLOP D., MARRA F., ROBERTS A.P, TAMISIEA M.E et AL., (2014): Sea-level variability over five glacial cycles. *Nature Communications*. 5:5076.
- LIRER F., SPROVIERI M., VALLEFUOCO M., FERRARO L., PELOSI N., GIORDANO L., CAPOTONDI L., (2014): Planktonic foraminifera as bio-indicators for monitoring the climatic changes occurred during the last 2000 years in the SE Tyrrhenian Sea. *Integrative Zoology Journal*. 9:542-554.
- LLASAT MC., MARCOS, LLASAT-BOTIJA M., GILABERT J., TURCO M., (2014): Flash flood evolution in North-Western Mediterranean. *Atmospheric Research*. 149:230-243.
- LLASAT M.C, TURCO M., QUINTANA-SEGUÍ P., LLASAT-BOTIJA M., (2014): The snow storm of 8 March 2010 in Catalonia (Spain): a paradigmatic wet-snow event with a high societal impact. *Natural Hazards and Earth System Science*. 14:427–441.
- LLOPART M., COPPOLA E., GIORGI F., DA ROCHA RP, CUADRA SV., (2014): Climate change impact on precipitation for the Amazon and La Plata basins. *Climatic Change*. 25 (1):111-125.
- MACCIONI P., KOSSIDA M., BROCCA L., MORAMARCO T., (2014, in press): Assessment of the Drought Hazard in the Tiber River Basin in Central Italy and a Comparison of New and Commonly Used Meteorological Indicators. *Journal of Hydrologic Engineering*. Available online 16 September 2014, ISSN 0034-6667, <http://dx.doi.org/10.1016/j.revpalbo.2014.08.012>.
- Magri D., Agrillo E., Di Rita F., Furlanetto G., Pini R., Ravazzi C., Spada F., (2014, in press): Holocene dynamics of tree taxa populations in Italy. *Review of Palaeobotany and Palynology*. <http://dx.doi.org/10.1016/j.revpalbo.2014.08.012>.
- MARCONI M., SFERLAZZO DM, BECAGLI S., BOMMARITO C., CALZOLAI G., CHIARI M., DI SARRA A., GHEDINI C., GOMEZ-AMO JL, LUCARELLI F. et AL., (2014): Saharan dust aerosol over the central Mediterranean Sea: PM10 chemical composition and concentration versus optical columnar measurements. *Atmospheric Chemistry and Physics*. 14:2039-20154.
- MARIOTTI L., DIALLO I., COPPOLA E., GIORGI F., (2014): Seasonal and intraseasonal changes of African monsoon climates in 21st century CORDEX projections. *Climatic Change*. 25(1): 53-65.
- MARRA F., FLORINDO F., (2014): The subsurface geology of Rome: Sedimentary processes, sea-level changes and astronomical forcing. *Earth-Science Reviews*. 136:1-20.
- MONDONI A., ORSENIGO S., DONA M., BALESTRAZZI A., PROBERT R., HAY FR, PETRAGLIA A., ABELI T., (2014): Environmentally induced transgenerational changes in seed longevity: maternal and genetic influence. *Annals of Botany*. 113:1257-1263.
- NEGRI A., AMOROSI A., ANTONIOLI F., BERTINI A., FLORINDO F., LURCOCK PC, MARABINI S, MASTRONUZZI G., REGATTIERI E., ROSSI V. et AL., (2014, in stampa): A potential global boundary stratotype section and point (GSSP) for the Tarentian Stage, Upper Pleistocene, from the Taranto area (Italy): Results and future perspectives. *Quaternary International*. <http://dx.doi.org/10.1016/j.quaint.2014.08.057>.
- NIGRELLI G., LUCCHESI S., BERTOTTO S., FIORASO G., CHIARLE M., (2014): Climate variability and Alpine glaciers evolution in Northwestern Italy from the Little Ice Age to the 2010s. *Theoretical and Applied Climatology*. 10.1007/s00704-014-1313-x.
- NIGRELLI G., CHIARLE M., (2014): Relevance of Database for the Management of Historical Information on Climatic and Geomorphological Processes Interacting with High Mountain Landscapes. *Engineering Geology for Society and Territory*. 8: 459-462.
- ORSENIGO S., MONDONI A., ROSSI G., ABELI T., (2014): Some like it hot and some like it cold, but not too much: plant responses to climate extremes. *Plant Ecology*. 215:677-688.
- PALAZZI E., VON HARDENBERG J., TERZAGO S., PROVENZALE A., (2014): Precipitation in the Karakoram-Himalaya: a CMIP5 view. *Climate Dynamics*. Doi: 10.1007/s00382-014-2341-z.
- PROVENZALE A., (2014): Climate models. *Rendiconti Lincei*. 25(1):49-58.

PUTERO D., LANDI TC, CRISTOFANELLI P., MARINONI A, LAJ P., DUCHI R, CALZOLARI F, VERZA GP, BONASONI P., (2014): Influence of open vegetation fires on black carbon and ozone variability in the southern Himalayas (NCO-P, 5079 m a.s.l.). *Environmental Pollution*. 184:597-604.

PUTERO D., CRISTOFANELLI P., LAJ P., MARINONI A., VILLANI P., BROQUET A., ALBORGHETTI M., CALZOLARI F, DUCHI R, LANDI TC et AL., (2014): New atmospheric composition observations in the Karakorum region: influence of local emissions and large-scale circulation during a summer field campaign. *Atmospheric Environment*. 184: 597-604.

SANDRINI S., GIULIANELLI L., DECESARI S., FUZZI S., CRISTOFANELLI P., MARINONI A., BONASONI P., CHIARI M., CALZOLAI G., CANEPARI S. et AL., (2014): In situ physical and chemical characterisation of the Eyjafjallajökull aerosol plume in the free troposphere over Italy. *Atmospheric Chemistry and Physics*. 14(2):1075-1092.

SCOCCIMARRO E., GUALDI S., BELLUCCI A., ZAMPIERI M., NAVARRA A., (2014): Heavy precipitation events over Europe: future projections. *Regional Environmental Change*. 10.1007/s10113-014-0712-y.

STANISCI A., FRATE L., MORRA DI CELLA U., PELINO G., PETEY M., SINISCALCO C., CARRANZA M.L., (2014): Short-term signals of climate change in Italian summit vegetation: observations at two GLORIA sites. *Plant Biosystems. An International Journal Dealing with all Aspects of Plant Biology*. doi.org/10.1080/11263504.2014.968232.

TERZAGO S., VON HARDENBERG J., PALAZZI E., PROVENZALE A., (2014): Snowpack changes in the Hindu-Kush Karakoram Himalaya from CMIP5 Global Climate Models. *Journal of Hydrometeorology*. 15:2293-2313.

TERZAGO S., VON HARDENBERG J., PALAZZI E., PROVENZALE A., (2014): Current Status and Future Projections of the Snow Depth in the Third Pole from CMIP5 Global Climate Models. *Engineering Geology for Society and Territory*. 1:39-42

TORMA C., GIORGI F., (2014): Assessing the contribution of different factors in regional climate model projections using the factor separation method. *Atmospheric Science Letters*. 15(4): 239-244.

TURCO M., SANNA A., HERRERA S., LLASAT M.C, GUTIERREZ J.M., (2014): Evaluation of the ENSEMBLES Transient RCM Simulations Over Spain: Present Climate Performance and Future Projections. *Engineering Geology for Society and Territory*. 1:199-203.

TURCO M., LLASAT MC, VON HARDENBERG J., PROVENZALE A., (2014): Climate change impacts on wildfires in a Mediterranean environment. *Climatic Change*. 125(3-4):369-380.

VITERBI R., IMPERIO S., ALPE D., BOSSER-PEVERELLI V., PROVENZALE A., (2014): Climatic control and population dynamics of black grouse (*Tetrao tetrix*) in the Western Italian Alps. *The Journal of Wildlife Management*. 79(1):156-166.

VUILLERMOZ E., SENESE A., DIOLAIUTI G., SMIRAGLIA C., CRISTOFANELLI P., MARINONI A., V PIETRO G., BONASONI P., (2014): The Case Study of the Changri Nup Glacier (Nepal, Himalaya) to Understand Atmospheric Dynamics and Ongoing Cryosphere Variations. *Engineering Geology for Society and Territory*. 1:73-76.

ZAMPIERI M., SCOCCIMARRO E., GUALDI S., NAVARRA A., (2014): Observed shift towards earlier spring discharge in the main Alpine rivers. *Science of The Total Environment*. 503-504: 222-232.

ZOLLO A.L, TURCO M., MERCOGLIANO P., (2014): Assessment of Hybrid Downscaling Techniques for Precipitation Over the Po River Basin. *Engineering Geology for Society and Territory*. 1:193-197.

2013

BONANNO R., RONCHI C., CAGNAZZI B., PROVENZALE A., (2013): Glacier response to current climate change and future scenarios in the northwestern Italian Alps. *Regional Environmental Change*. 14(2): 633-643.

CRISTOFANELLI P., DI CARLO P., ALTORIO, DARI SALISBURGO C, TUCCELLA P, BIANCOFIORE F, STOCCHI P, VERZA G.P, LANDI T.C, MARINONI A. et AL., (2013): Analysis of Summer Ozone Observations at a High Mountain Site in Central Italy (Campo Imperatore, 2388 m a.s.l.). *Pure and Applied Geophysics*. 170(11):1985-1999.

MELIS M.T., DESSÌ F., LOCCI F., BONASONI P, VUILLERMOZ E., (2013): Share Geonetwork: a web-service platform for environmental data sharing. *First International Conference on Remote Sensing and Geoinformation of Environment (RSCy2013)*. Proc. SPEI 8795: 1-8.

PALAZZI E., VON HARDENBERG J., PROVENZALE A., (2013): Precipitation in the Hindu-Kush Karakoram Himalaya: observations and future scenarios. *Journal of Geophysical Research - Atmospheres*. 118 (1): 85-100.

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

RICCIARDELLI E., CIMINI D., DI PAOLA F., ROMANO F., VIGGIANO M., (2013): A statistical approach for rain class evaluation using Meteosat Second Generation-Spinning Enhanced Visible and InfraRed Imager observations. *Hydrology and Earth System Sciences Discussions*. 10(11):13671-13706.

DI SARRA A., MELONI D., (2013): Estimate of surface direct radiative forcing of desert dust from atmospheric modulation of the aerosol optical depth. *Atmospheric Chemistry and Physics*. 13(11):5647-5654.

DI SARRA A., FUÀ D., MELONI D., (2013): 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.

TURCO M., ZOLLO A., VEZZOLI R., RONCHI C, MERCOGLIANO P., (2013): Daily precipitation statistics over the Po Basin: observation and post-processed RCM results. Climate change and its implications on ecosystem and society: *Proceedings of I SISC Conference*: 222-234.

TURCO M., ZOLLO A.L, RONCHI C, DE LUIGI C., MERCOGLIANO P., (2013): Assessing gridded observations for daily precipitation extremes in the Alps with a focus on northwest Italy. *Natural Hazards and Earth System Science*. 13(6):1457-1468.

VITERBI R., CERRATO C., BASSANO B., BIONDA R., VON HARDENBERG J., PROVENZALE A., BOGLIANI G., (2013): Patterns of biodiversity in the northwestern Italian Alps: a multi-taxa approach. *Community Ecology*. 14:18-30.

ZAMPIERI M., SCOCCIMARRO E., GUALDI S., (201): Atlantic influence on spring snowfall over the Alps in the past 150 years. *Environmental Research Letters*. 8: 1-7.

2012

BONASONI P., CRISTOFANELLI P., MARINONI A., VUILLERMOZ E., ADHIKARY B., (2012): Atmospheric Pollution in the Hindu Kush–Himalaya Region. *Mountain Research and Development*. 32(4):468-479.