



Project of Strategic Interest NEXTDATA

Scientific Report
for the reference period 01 - 01 -2014 / 31 -12 - 2014

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

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Partners

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1. Scheduled activities, expected results and Milestones (as indicated in the Executive Plan)

During the third year of the Project, in the framework of WP2.3 other proxy data were collected, in order to increase the data set available for the reconstruction of climate change in northern Italy during the last 3000 years. So, two new research lines have been started, one based on the collection of stratigraphic and pollen data derived from limnic sediment cores, the other concerning the collection of dendrochronological chronologies.

Regarding pollen data, a literature review has been made to find the pollen successions available in Northern Italy. Pollen and chronological data useful to derive climate parameters have been extracted and adapted to be stored in a pollen database. More than 60 published palynological stratigraphic successions from limnic/wet environment, partially or entirely covering the last 3 thousand years, were collected and also the EMPD (European Modern Pollen Database) dataset and other data was acquired. All data have been revised and harmonized. Preliminary tests of paleoclimatic transfer on fossil pollen spectra have been carried out, in order to assess the potential of pollen data for quantitative paleoclimatic reconstructions in the late Holocene

The dendrochronological data provided by Universities and Italian Research Centers have been structured and organized according to the WP requirements and then incorporated into the Project database. An updated overview of the data distribution at the national level has been carried out; for this reason have been contacted various groups operating in Italy in the field of dendrochronology. Available data from online databases, such as ITRDB of NOAA have been also collected. Overall, metadata of 89 sites and 25 chronologies (data) were collected. Both metadata and data have been periodically sent to the other components of the NextData Project, and for the metadata a dedicated free-access website has been predisposed (<http://geomatic.disat.unimib.it/dendro>).

2. Deliverables expected for the reference period

D2.3.4 Collection of available palynological studies in Northern Italy and Alpine area from different chronological contexts.

D2.3.5 Revision and harmonization from data from EMPD (European Modern Pollen Database), for pollen data quantitative reconstruction.

D2.3.6 Dendrochronological data provided by University and Research Centres will be structured and organized according to the requirements of NextData and then incorporated in to the Project database.

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

3.1 Research activities

Pollen analysis is applied since decades on sediments from marine and continental settings to reconstruct the history of environments and climate over short to very long time span. The potential of pollen as a proxy for quantitative estimations of climate parameters (temperature, precipitation) has not yet been fully understood and explored. So, during this year, available palynological studies in the geographical and chronological context have been collected and carefully evaluated. More than 60 published palynological stratigraphic successions from limnic/wet environments, partially or entirely covering the last 3 thousand years, were picked up. The palynological sequences detected have been critically analyzed, with a special attention to the quality of their chronostratigraphical resolution. The acquisition of the numerical data (pollen percentages) was then started, in order to obtain the numerical data for further graphical and statistical elaborations. In the same time with the acquisition of the published data, the schema of the Pollen database has been structured, following the specific requirements of the NextData Project. The EMPD (European Modern Pollen Database) dataset was acquired, revised and harmonized. This dataset contains pollen

and observed climatic data at continental (euroasiatic) scale, to be used for a comparison of fossil and modern pollen spectra aimed at paleoclimate reconstructions. Preliminary tests of paleoclimatic transfer on fossil pollen spectra were carried out, in order to assess the potential of pollen data for quantitative paleoclimatic reconstructions in the late Holocene.

The dendrochronological activities, developed during this year, comprise four main groups: data analysis, predisposition of a database of metadata and data, publications, communications. As regards data analysis, the activities have been focused on the creation of a methodology for increasing the summer temperature signal in reference chronologies from high-altitude Alpine sites. This methodology allows the selection of individual chronologies that better respond to required quality levels and it has been applied to the 1° x 1° Alpine grid point lat. 46°N long. 10°E, that is rich of dendrochronological data. Based on these elaborations, it was possible to reconstruct the summer temperature for periods prior to instrumental records and to underline the different contribution of climatic information given by the different species used. The species comprised in these analyses are conifers, in particular European larch (*Larix decidua*), Swiss stone pine (*Pinus cembra*) and Norway spruce (*Picea abies*). The creation of a system for the collection of dendrochronological metadata and data has been started. These activities have been subdivided in a first phase of organization of a collection system, the subsequent involvement of the various groups operating in Italy in the dendrochronology field and finally the collection, the quality control and the elaboration of all metadata and data obtained. The collection system of metadata and data from groups within and outside the Project has been strategic for visualizing the consistency of the data potentially available at the national level and of their spatial distribution. The purpose was to obtain an updated view of the data distribution at the national level and to contact the various groups operating in Italy for reaching the NextData Italy 2k objective of climate reconstruction. Until now, 6 Groups have sent their metadata (namely University of Milan, University of Pisa, Second University of Naples, University of Molise, University of Basilicata and Civic Museum of Rovereto - former Italian Institute of Dendrochronology). Other information regarding the Italian territory was derived from the ITRDB (<http://www.ncdc.noaa.gov/>) and other groups have assured their metadata. Overall, metadata of 89 sites and 25 chronologies (data) were collected. Both metadata and data have been periodically sent to the other components of the NextData Project, and for the metadata a dedicated free-access website has been prepared (<http://geomatic.disat.unimib.it/dendro>). Moreover, some GIS elaborations have been performed for evaluating the forest recolonization dynamics in the glacier forefield of the Forni Glacier (Sondrio), according to glacier retreat phases and ongoing climatic trends. In particular, by means of a dendrochronological analysis and the data spatialization, it has been possible to underline the role of active geomorphological processes in modulating the colonization patterns in the various physiographic units along the proglacial area defined by the morainic arches and the hydrographic network. In November the manuscript has been submitted to the journal *AAAR* for the peer review process and in December some elaborations have been started for the new paper on the dendroclimatic reconstruction for the grid point 46°N 10°E.

3.2 Applications; technological and computational aspects

A pollen and a dendrochronological database has been created.

3.3 Formation

CINECA: Python for computational science. Milano, 18-20 March 2014.

Milano-Bicocca e i cambiamenti climatici: Ricerca, Formazione, Divulgazione. Università degli studi di Milano-Bicocca, 9 April 2014.

3.4 Dissemination

A web Page concerning Paleodata and dendrochronological data has been implemented:

<http://geomatic.disat.unimib.it/paleodata>

<http://geomatic.disat.unimib.it/dendro>

3.5 Participation in conferences, workshops, meetings.

3 PhD position has been activate from the 1st January 2013 about WP1.4 and WP2. About WP2.3 the didactical activities followed by the PhD candidate and the collaborator are:

Conference *Climate variability in Italy during the last two millennia - Italy 2k*, Accademia Nazionale dei Lincei, Roma, 1-2 December 2014.

9th European Palaeobotany – Palynology Conference. Padova, 26-31 August 2014.

SIGI-SIMP: the future of the italian geosciences the italian geosciences of the future, Milano, 10-12 September 2014.

Comitato Glaciologico Italiano, International Symposium: *The Future Of The Glacier*, Torino, 18-21 September 2014.

4. Results obtained during the reference period

4.1 Specific results (Data libraries, Measurements, Numerical simulations, etc)

Pollen

4.2 Publications

PINI R., CASTELLANO L., BADINO F., CHAMPVILLAIR E., DE AMICIS M., FURLANETTO G., MAGGI V., RAVAZZI C., (2014): From fossil pollen to climate: preliminary quantitative climate reconstructions for the last 3 ky in northern Italy. Conference *Climate variability in Italy during the last two millennia - Italy 2k*, Roma, Accademia dei Lincei, 1-2 December 2014. Abstracts volume: 15-16.

FURLANETTO G., CASTELLANO L., BADINO F., PINI R., RAVAZZI C., MAGGI V., (2014): When did the modern landscape emerge in the Northern Italy? Reconstructing the last 2k years landscape history by a multidisciplinary approach. *9th European Palaeobotany and Palynology Conference*, Padova, August 26-31, 2014. Abstract Book, pp. 69-70.

MAGRI D., AGRILLO E., DI RITA F., FURLANETTO G., PINI R., RAVAZZI C., SPADA F., (2014): Holocene dynamics of tree taxa populations in Italy. *9th European Palaeobotany and Palynology Conference*, Padova, August 26-31, 2014. Abstract Book, pp. 150-151.

LEONELLI G., COPPOLA A., BARONI C., SALVATORE M.C., PELFINI M., (2014): An innovative approach to high-resolution summer-temperature reconstructions for the last centuries using large tree-ring datasets from the Central Alps. *87° Congresso della Società Geologica Italiana e 90° Congresso della Società Italiana di Mineralogia e Petrologia: The Future of the Italian Geosciences - The Italian Geosciences of the Future*; Milano, 10-12 September 2014.

PELFINI M., LEONELLI G., (2014): Tree-ring climate reconstructions in the Italian Alps. Convegno Accademia Nazionale dei Lincei, *Climate variability in Italy during the last two millennia – Italy 2k*, Roma 1-2 December 2014.

MORETTI M., MATTAVELLI M., DE AMICIS M. & MAGGI V., (2014): GIS analysis to apply theoretical Minimal Model on glacier flow line and assess glacier response in climate change scenarios. *Rend. Online Soc. Geol. It.*, 31 (1), 110.

STRIGARO D., MATTAVELLI M., FRIGERIO I. & DE AMICIS M., (2014): PaleoProxy Data Base (PPDB): A comprehensive geodatabase to archive and manage paleoproxies data. *Rend. Online Soc. Geol. It.*, 31 (1), 118.

LOCCI F., DESSI F., DE AMICIS M., FRIGERIO I., STRIGARO D., MATTAVELLI M., PROVENZALE A., VUILLERMOZ E., MELIS M.T.: A structured server architecture to stock and share ice core data. From database to a WebGIS application. Speech presented during the *GIT – Geology and Information Technology*, Chiavenna (SO), Italy.

GARZONIO R., DI MAURO B., STRIGARO D., DE AMICIS M., MAGGI V., COLOMBO R.: Definition of a methodology to map the suitability of mountain glaciers for ice core drilling using morphometric and climatic indicators. International symposium on The Future of the Glaciers, Torino (IT), September 2014.

4.3 Availability of data and model outputs (format, type of library, etc)

Metadata of available dataset have been published on the website <http://geomatic.disat.unimib.it/dendro>, <http://geomatic.disat.unimib.it/paleodata>

4.4 Completed Deliverables

D2.3.4: Collection of available palynological studies in Northern Italy and Alpine area from different chronological context.

D2.3.5: Revision and harmonization of data from EMPD (*European Modern Pollen Database*), for pollen data quantitative reconstruction.

D2.3.6: Dendrochronological data provided by Universities and Research Centres will be structured and organized according to the requirements of NextData and then incorporated into the Project database.

5. Comment on differences between expected activities/results/Deliverables and those which have been actually performed.

The main Deliverables of the second year scheduled the report has been carried out.

6. Expected activities for the following reference period

Activity 2015

During the year 2015 a new version (IDB2) of the database will be released. It will allow to store spatial information about glacier derived from other DB such as GLIMS, WGI etc and also parameters from DTM elaboration useful to evaluate the suitability for ice core drilling.

In particular the v2.0 will have this improvements:

- A new structure to archive data in a better way, 4 tabs containing information about perforation project, perforation site, principal attribute of the ice-core (diameter, altitude) and a tab, which will archive all the references for every ice-core, will be created and filled up.
- Increase of the spatial accuracy for the ice-core creating a replacement index that has been developed and applied to the entire dataset.
- Introduction of creative commons policy to protect the production, the dissemination and the re-analysis of archived data.
- Association of IDB with other geodb (WGI, WGMS, RGI, GLIMS) that stored info about glacier and glacier analysis such as mass balance, elevation, area, etc.
- Dust measurement of the first NextData ice-core (LYS12) and data upload in IDB.

Regarding the pollen group, palynological and stratigraphical database will be populated with the data and the metadata collected. The palynological data will be then processed and elaborated to depict the history of vegetation in Northern Italy during the last 3 thousand years.

The dendrochronological data provided by Universities and Research Centers will be structured and organized according to the requirements of NextData and then incorporated into the Project database. Also data already available in online databases such as ITRDB of

NOAA will be collected. Climate data will be collected and sorted in order to get a complete representation of those available, in terms of geographical coverage, temporal extension, type of data available, and so on. In collaboration with researchers of University of Milan and of University of Pisa, in the first phase of analysis the quality of the climatic signal in the master chronologies (tree-ring widths) from the Italian territory will be tested. The climate reconstructions for periods previous instrumental records will be carried out according. Finally, the reconstructed climatic series (Alps) and the identified climate trends (central and southern Italy) will be compared with the reconstructions based on different proxies and made by other working groups. This validation will allow to produce a coherent reconstruction, as consistent as possible for the map Italy 2k

About the suitability for ice core drilling, the maps generation for the drilling evaluation will be finished. In particular, when the maps useful to the characterization will be completed, some statistical analysis will be set up to select the principal variables useful to identify a probable perforation site. Following the Factorial Scoring System implemented by Vogt et al. (2003) a methodology to extract drillable area will be proposed. This area will be used to create a suitability map for ice core drilling of the Alpine and Himalayan glaciers. Furthermore a method to estimate ice thickness will be implemented at regional scale. Drainage networks will be estimated from DEM using different algorithms (e.g. D-8, D-Infinity, Rho-8) and ice thickness will be estimated based on local surface slope, total vertical extent and basal shear stress. For some glaciers the result will be validated making a comparison with known thicknesses. The map of glacier thickness will be created for Alpine and Himalayan areas. Results will be integrated to the map of suitability for ice core drilling to have a complete view of drilling areas.