Project of Strategic Interest NEXTDATA

WP2.1

D2.1.A – Report on the Archives of mountain observation networks.

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This deliverable provides a description of the archives of mountain observation networks. It includes an explanation of each archived dataset as well as the description of the software used to manage, i.e. discovery, download and visualize them.

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1. INTRODUCTION (Contributions by: E. Trumpy)

The main goal of the NextData project is to produce and provide quantitative information on the status and on past, present and future environmental changes in the Italian mountain regions. The information, the data and the achieved results are made available through digital archives, in the spirit of open access and free data.

Work Package (WP) 2.1 implements the archive of the databases from the mountain monitoring networks of the project. In particular, the archive provides a detail frame of the on-going weather and climate changes, the atmospheric composition, cryosphere, surface and underground water resources and on ecosystems and biodiversity. The data collected in this archive allow the monitoring of present as a base for future scenarios (i.e., modelling archives set-up by WP2.5, 2.6) and past reconstructions (i.e., archives implemented in WP2.2, 2.3, 2.4). The WP2.1 archive provide also data to the General Portal of the project realized by WP2.7.

The WP2.1 archive makes available the data in the form of spatial datasets, table data or time series together with their associated metadata. Metadata are crucial to facilitate data organization, data discovery and even data providing. Metadata can be defined as the second level of data, that are useful to describe and classify other data or digital contents. Metadata become crucial when we face large data repositories, as is the case for the WP2.1 archives, as well as for the General Portal of the NextData project.

The WP2.1 archive is built ensuring data interoperability, firstly with the General Portal of the NextData project and also with the most relevant global data collection systems, as those implemented by the Group on Earth Observation (GEO) Global Earth Observation System of Systems (GEOSS), Copernicus, Belmont forum.

This report describes the data collected in the WP2.1 archive and the chosen software that enable data and metadata management, discovery, visualization and download. In particular section 2 deals with the system of climate observation at high altitude and the network of climate stations and their produced data. Section 3 describes the datasets for underground water resources and for terrestrial environments. Section 4 is devoted to cryosphere, Alpine glaciers and snow cover data. Section 5 considers ecosystem and biodiversity data. Section 6 reports the description of the hardware and software set-up to manage the WP2.1 archive of databases.

Each section describing data reports a general description of the dataset (e.g., what it represents, what is the source of data or dataset update timing, …). The dataset typology, the reference system, possible bibliographic references as well as terms of use of the data are indicated. Where possible, information on the used metadata standards, the specific data model and the level of formalization/standards adopted were included.

2. CLIMATE OBSERVATION SYSTEM AT HIGH ALTITUDE AND NETWORK OF CLIMATIC STATIONS (Contribution by P. Cristofanelli)

2.1. *Climate stations network for monitoring the composition of the atmosphere in remote areas* (Contribution by P. Cristofanelli)

In the framework of WP1.1, we archive and make available the time series of Essential Climate Varibles (ECV) recorded in different remote and high-altitude regions of Italy. We handle time series of atmospheric trace gases and aerosol (climate-altering and pollutants) as well as meteorological parameters recorded by the climatic station network for the monitoring of background atmospheric composition (Task 1), data about stable isotope ratios and geochemical parameters in atmospheric precipitation as well as monthly depositions sampling, surface water, pore water and sphagnum peat in several sites of the Dolomiti region (Task 2), data for the assessment of the Elevation Dependent Warming in the Italian mountain regions (Taks 3), climatology of monthly temperature and precipitation at high spatial resolution (30 arc-seconds) for Italian mountain areas with altitude above 1500 meters (Task 4).

2.1.1. Dataset description

The datasets which are submitted to the NextData archive are time series of Essential Climate Variable (ECV) observed at remote and high-altitude measurement stations located within the Italian national borders and participating in the climate station network for the atmospheric composition monitoring. These variables can be tagged into 5 classes of data, in agreement with the WMO/GAW Focal Areas: (i) reactive gases, (ii) greenhouse gases, (iii) atmospheric aerosol, (iv) total ozone and (v) UV radiation. As ancillary variables, the "classical" meteorological variables are also considered: air temperature and relative humidity, atmospheric pressure, wind direction and speed. Most of the considered ECVs are produced by stationary "near-surface" and continuous (24/24 hr and 365/365 d) platforms, i.e. by sampling activities carried out over specific locations not far from the Earth's surface (from 5 to 10 m a.g.l.). In general, the original time resolution of data is varying from a few seconds to 1 minute. However, the NextData archive will receive (in agreement with the WMO/GAW data publication strategy), only validated data aggregated (by averaging) over 60 minutes. The time series will be updated yearly: the time series recorded during the solar year X, will be submitted during the solar year X+1.

Summary of ECV submitted to NextData under WP1.1 (PRS: Plateau Rosa; MRG: Col Margherita; CMN: Monte Cimone; CMP: Mt. Portella/Campo Imperatore; CUR: Mt. Curcio; CGR: Capo Granitola; LMP: Lampedusa).

2.1.2. Dataset format

Each ECV will be submitted as a time series. The submitted file will report single or multiple ECVs.

2.1.3. Data model, standard and formalization

To optimize the interoperability of the data system, the submitted data are formatted in agreement with the guidelines of WMO/GAW global data-centres. The greenhouse gases (CO2, CH4, N2O, CFCs, HFCs, HCFCs, SF6) and the carbon monoxide (CO) data are formatted in agreement with formats and metadata indicated by the World Data Centre for Greenhouse Gases (WDCGG), reported by "Revision of the WDCGG Data Submission and Dissemination Guide" (GAW Report No. 188).

“Near-surface” reactive gases (O3, SO2, NO, NO2) are submitted by using the NASA-Ames format, as indicated by the Word Data Centre for Reactive Gases (WDCRG). This format is based on the textual format ASCII NASA-Ames 1001 with additional metadata (as a function of the different ECV). The template to be used for the different ECV can be found at the web page http://ebas-submit.nilu.no/Submit-Data/Reporting-Templates/all-templates-temporary.

The aerosol physical properties (particle number size distribution, particle number concentration, coarse mode particle size distribution, particle light absorption coefficient, particle light scattering coefficient) and AOD (Aerosol Optical Depth) are also submitted by using the NASA-Ames format, in agreement with Word Data Centre for Aerosol (WDCA). As for reactive gases, this format is based on the textual format ASCII NASA-Ames 1001 with additional metadata (as a function of the different ECV). The file template is reported at http://ebas-submit.nilu.no/Submit-Data/Reporting-Templates/all-templates-temporary.

Total ozone and UV radiation are submitted in agreement with formats reported by World Ozone and Ultraviolet Radiation Data Centre (WOUDC). WOUDC adopts a textual ASCII format defined as “extCSV” and based on Comma Separated Values (CSV) UTF-8 which allows to specify multiple tables, variables and comments. As for the other ECVs, these files will have a specific section for metadata (i.e. a file header) and a specific section for the time series. The submission template can be found at: http://guide.woudc.org/en/#31-the-woudc-data-format-standard.

All files will contain the data from observations carried out during a full solar year.

2.1.4. Metadata standard

Each file has a file header providing the metadata indicated by the reference WMO/GAW World Data Centre. WDCGG recommend to adopt the metadata indicated within the document http://ds.data.jma.go.jp/gmd/wdcgg/pub/products/manual/WDCGG_GUIDEV11.pdf. WDCRG and WDCA adopted the meta-data ASCII NASA-Ames 1001. Data referring to WDCGG and WOUDC must adopt the ISO 8160 standard for date and time. Data referring to WDCA and WDCRG are expressed as fraction of day from a “reference point” that must be indicated by the file header (typically, for each solar year, January 1st, 00:00 UTC).

2.1.5. Reference system

Dates and times are expressed as UTC for data referring to WDCRG (reactive gases), WDCA (aerosol e AOD) and WOUDC (total ozone and UV radiation). Data referring to WDCGG (greenhouse gases) are expressed as UTC+1. The data are recorded at stationary platform, which geographical position is expressed in WGS84 (Nord latitudes, positive).

2.1.6. Quality check/validation

Only “level 2” data will be submitted to the NextData archives. This data level is resulting from extended quality checks and quality assurance procedures (consistency checks, plausibility checks, full calibrations, daily instrumental checks).

2.1.7. Terms of use of the dataset

We adopt the NextData data-policy. In the case of scientific utilization of data, data providers and/or data originators must be contacted for offering co-authorship. Acknowledgments to the NextData Project, to eacanyh other Projects supporting the observation of the selected ECV and to the Institutions managing the stations are mandatory for each use.

2.1.8. Reference

Revision of the World Data Centre for Greenhouse Gases Data Submission and Dissemination Guide, WMO/ TD - No. 1507 GAW report No. 188, November 2009.
EBAS data submission manual (Version: 17 August 2017, on-line), http://ebas-submit.nilu.no/Data/Getting-started.
WOUDC Contributor Guide (Version 2.0.1, on-line). http://guide.woudc.org/en/#31-the-woudc-data-format-standard.
WMO/GAW Aerosol Measurement Procedures, Guidelines and Recommendations. GAW Report No. 227
2nd Edition 2016WMO/GAW AEROSOL MEASUREMENT PROCEDURES GUIDELINES AND RECOMMENDATIONS GAW Report No. 153

2.2. ***Network of deposimeters in dolomitic environment*** (Contribution by Jacopo Gabrieli)

2.2.1. *Dataset description*

Bulk precipitation gauges have been installed in 5 fixed sampling sites for the monthly monitoring of stable isotopes ratios (δD, δ18O), see table 2.1.

Table 2.1 – Description of the 5 sites

Sampling site	code	Elevation (m)	Starting from	Samples (n)	Meteo data
Venezia-Mestre	VE	0	30/06/2015	27	UniVE
Belluno Aeroporto	BL	390	01/07/2016	14	ARPAV
Col Indes	IND	1183	01/07/2016	14	ARPAV
Nevegal	NVG	975	04/08/2017	1	CNR-IDPA
Col Margherita	MRG	2550	06/07/2017	3	CNR-IDPA

In all the samples (n=59) stable isotopes ratios (δD, δ18O) have been determined. Aliquots were also sampled for the geochemical analysis (trace elements, heavy meals, Hg, rare earth elements). In all the sampling sites the main meteorological variables (T, RH, precipitation) are continuously recorded. In spring 2018 the installation of further 5 bulk precipitation gauges in the Alpine and Pre-alpine of the Veneto Region is foreseen.

2.3. ***Elevation Dependent Warming in Italian mountain regions*** (Contribution by Elisa Palazzi)

2.3.1. *General description and data needs*

There is growing evidence that high-mountain environments experience more rapid changes in temperature than environments at lower elevations, a phenomenon which is referred to as Elevation-Dependent Warming (EDW). High-elevation regions, in particular, have experienced and are expected to experience more rapid warming than the adjacent regions at lower elevation or with respect to the global mean - a common feature to all mountain areas of the world even though with regional differences.

In the Alpine region, for example, from the late 19th century until the end of the 20th century, temperatures have risen at a rate about twice as large as the northern-hemispheric average (mean temperature increase of about 2°C, Auer et al, 2007). Warming occurred with a rate of 0.5°C/decade from 1980 onwards (EEA, 2009) mainly caused by water vapor-enhanced greenhouse warming as suggested in the study by Philipona (2013). Previous studies also suggested that the Swiss Alps experienced larger increases in average surface air temperature at higher elevations in winter and spring than in other seasons (Beniston et al, 1997), mainly associated with a strong snow-albedo feedback. Minimum temperatures in the Swiss Alps have risen at a higher rate than maximum temperatures, especially during winter, in the 1980s and at the beginning of the 1990s.

To detect and understand EDW, surface air temperature measurements at ground stations in mountain areas are essential. In spite of advancements in the observational effort, the current available measurement network is still sparse and the stations are mostly located in valley floors rather than in mountain tops and slopes. Measurements are, therefore, mostly biased towards lower elevations, and **special efforts should be made to extend observations upwards to the highest summits, with transects of accurate instruments. These stations should include a broad array of variables such as humidity, radiation, clouds, precipitation, soil moisture and snow cover, besides temperature**, since they are useful to understand the mechanisms driving EDW and the role of feedbacks involving the presence of snow and ice at ground, clouds, water vapour, longwave radiation. New measurements should be established at selected sites, possibly close to locations where EDW driving mechanisms are expected to be focused, e.g. near the 0°C isotherm. These stations would also represent a reference to calibrate and evaluate satellite-derived estimates.

This NextData task/activity is not intended to produce new datasets but to exploit and take advantage of those made available by other partners, such as the high resolution temperature climatology of the Italian mountain regions described in Section 2.4, by highlighting, at the same time, new data needs.

EDW is being analysed also using model data, and in particular the outputs of the simulations produced in the framework of WP2.5, which have the great advantage of incorporating all the variables useful to understand EDW at the same temporal and spatial (though coarse) resolution.

2.3.2. References

Auer I et al.: HISTALP–historical instrumental climatological surface time series of the Greater Alpine Region, Int J Climatol 27:17–46, DOI doi:10.1002/joc.1377 (2007)

Beniston M, Diaz H, Bradley R, Climatic change at high elevation sites: an overview, Clim Chang 36:233–251, DOI 10.1023/A:1005380714349 (1997)

EEA. Regional climate change and adaptation: the Alps facing the challenge of changing water resources. 2009;8. [143 pp.]

Philipona R, Greenhouse warming and solar brightening in and around the Alps, Int J Climatol 33:1530–7 (2013).

2.4. *Definition of high resolution climatology (30seconds) of the Italian mountain regions with altitude higher than 1500m* (Contribution by M. Brunetti)

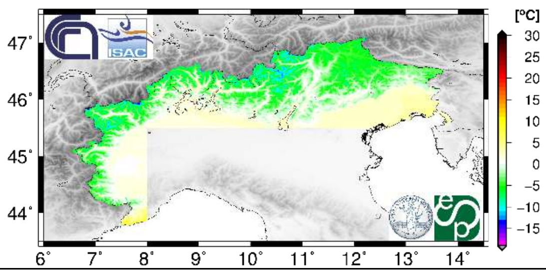
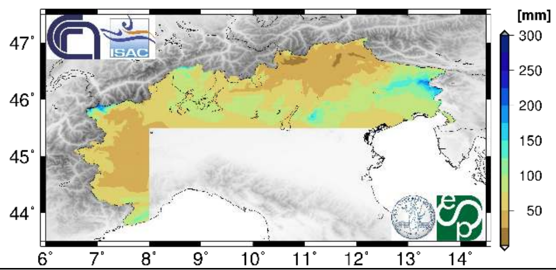
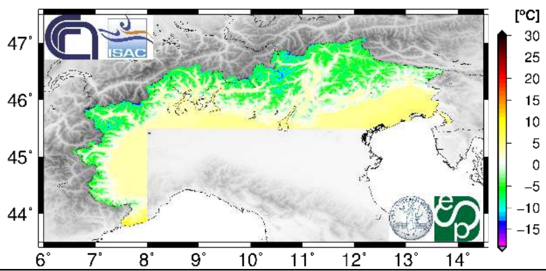
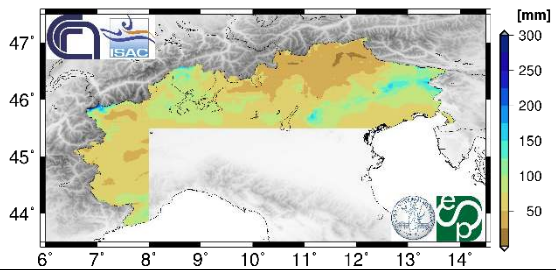
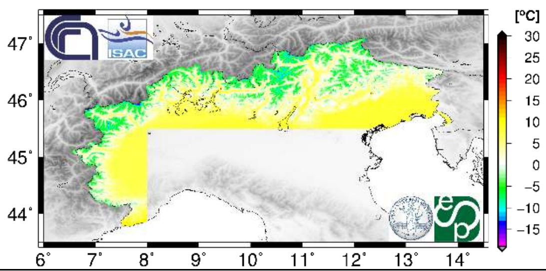
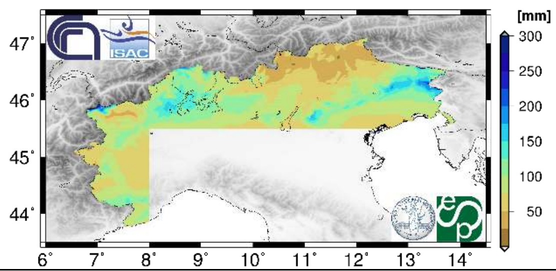
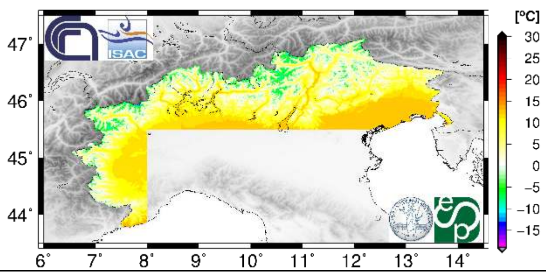
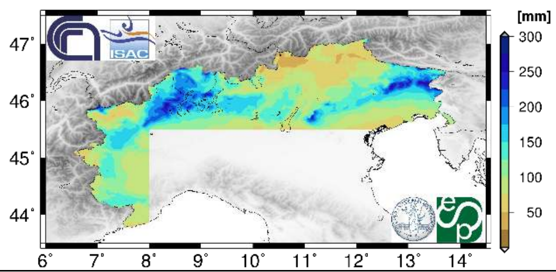
2.4.1. Dataset description

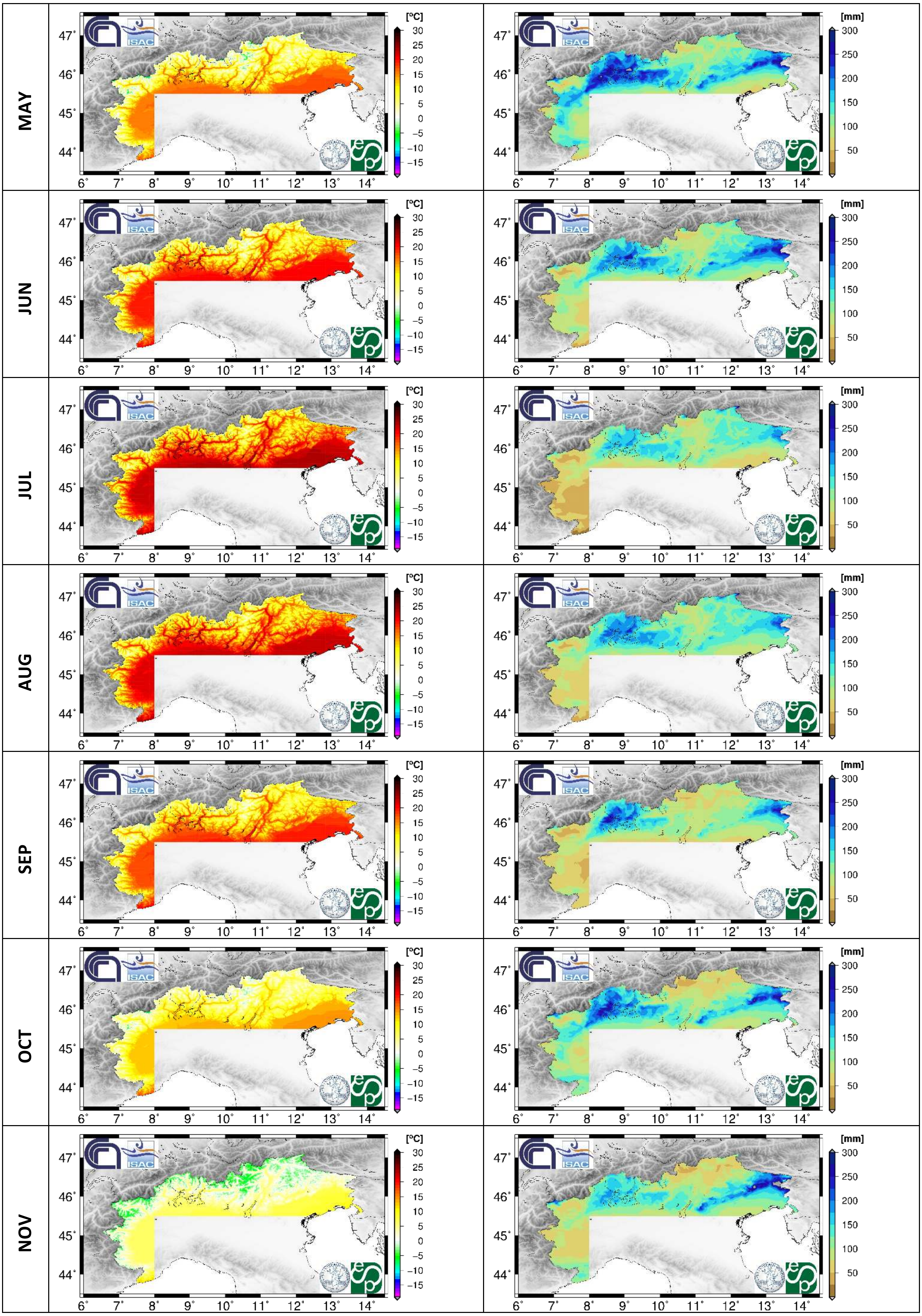
This database consists of mean monthly values of temperature and precipitation (referred to the standard period 1961-1990) for any box of dimension 30 arc-second x 30 arc-second over the Italian alpine region.
The database has been realized starting from a high density observational data-set and by estimating for each grid point of the domain a weighted linear fit of the meteorological variable versus elevation. Weights are chosen to assign more importance to those stations that have geographical characteristics as much similar as possible to those of the grid point itself (close to it, similar elevation, similar slope steepness and orientation and similar distance from the sea).

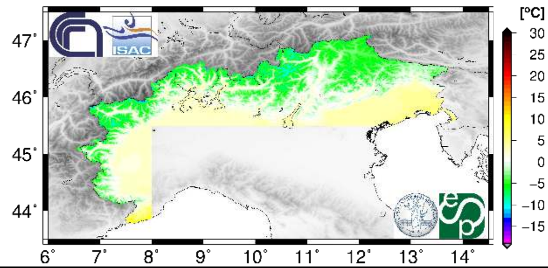
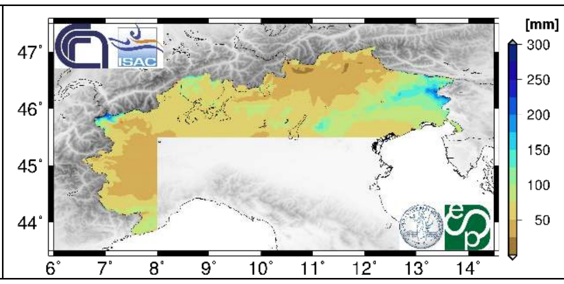
2.4.2. Dataset format

The monthly climatology of each variable is organized in one matrix composed by 12 blocks of 421 rows x 901 columns, each block representing one monthly raster, see table 2.2.

Table 2.2 – Examples of monthly climatology

	MEAN MONTHLY TEMPERATURE	TOTAL MONTHLY PRECIPITATION
JAN		
FEB		
MAR		
APR		


MAY
JUN
JUL
AUG
SEP
OCT
NOV
[°C]
30 25 20 15 10 5 0 −5 −10 −15
[mm]
300 250 200 150 100 50
ISAC
47° 46° 45° 44°
6° 7° 8° 9° 10° 11° 12° 13° 14°

DEC		

2.4.3. Reference frame

The climatologies are constructed over the USGS GTOPO30 Digital Elevation Model (WGS84)

2.4.4. Quality check/validation

The model has been validated with a leave-one-out approach and error estimation were provided on the relative papers published in open access on the International Journal of Climatology (see reference below).
The interpolation method allows us also to estimate the confidence interval, which is provided together with the data in the same format.

2.4.5. Terms of use of the dataset

Creative Commons: Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0)
Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.
NonCommercial — You may not use the material for commercial purposes.
NoDerivatives — If you remix, transform, or build upon the material, you may not distribute the modified material.
No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.

2.4.6. References

Brunetti M., M. Maugeri, T. Nanni, C. Simolo, J. Spinoni; 2014. High-resolution temperature climatology for Italy. interpolation method intercomparison. International Journal of Climatology (ISSN 0899-8418), 34, 1278-1296. DOI: 10.1002/joc.3764.
Crespi A., M. Brunetti, G. Lentini, M. Maugeri. 2017. 1961-1990 high-resolution monthly precipitation climatologies for Italy, International Journal of Climatology (ISSN 1097-0088), DOI: 10.1002/joc.5217, in press.

3. DATA FROM UNDERGROUND WATER RESOURCES IN MOUNTAINOUS AND TERRESTRIAL ENVIRONMENTS (Contribution by M. Doveri)

The WP1.2 provides data on groundwater quantity and quality, hydro-meteorological parameters and ground deformation in selected mountain sites. We handle time series of piezometric levels and spring flowrates as well as chemical concentrations and isotope signatures of groundwater hosted in Apennines and Alpine aquifer systems (Task 1), hydro-meteorological time series concerning rainfall, temperature and water-surface level, in two pilot Apennines basins, and data about ground deformation achieved by different methodologies on several landslides and sites located in Apennines, Alps, Pyrenees and Atacama Desert (Task2).

3.1. *Monitoring and estimation of water content and chemical and physical characteristics of aquifers* (Contribution by M. Doveri, B. Raco, M. Lelli, M. Menichini)

3.1.1. Dataset description

The dataset concerns the quantitative monitoring, the yield and the physical-chemical features of aquifer systems in selected mountain and foothill areas (Apuan Alps-Apennines, Amiata Mount, Piedmont zones). It will be implemented by using data of scientific researches and data produced by water management companies and authorities, with which we are cooperating. These data represent the base for developing the conceptual models of the aquifers and the numerical models of the groundwater resource, which are the targets of the task 1.

3.1.2. Dataset format

The dataset is constituted of data-sheets, as follows:

- daily piezometric levels registered in several wells/piezometers;
- daily flowrate concerning some springs;
- monthly or multi-monthly data on hydro-chemical parameters and water isotope signatures related to several points of groundwater monitoring.

3.1.3. Data model, standard and formalization

Each water point will be geo-referenced and described by a table containing the main features, as coordinates, type of point (e.g., well, spring, etc.), use of the tapped water, etc. This table will also contain the “id-code” of the point, that will enable the join with the data-sheet.

3.1.4. Reference system

WGS84UTM32

3.1.5. Quality check/validation

For the quantitative parameters (e.g. piezometric level and spring flowrate), the quality control mainly concerns the identification of non-operational periods or periods of registration affected by extreme events that can lead to instrumental full-scale or damages and consequent out-of-calibration of the instruments. When possible the data will be recovered or corrected by using a comparative method with consistent data observed in other stations. The quality of the geochemical data will be checked by means of a simple charge balance (%dev) and comparative diagrams (e.g. δ2H vs. δ18O‰).

3.1.6. *Terms of use of the dataset*

Most data will be Open Data by referencing the original source. A part of the dataset will be accessible by password.

3.2. *Meteo-climatic parameters and ground surface deformation in mountain areas* (Contribution by F. Ardizzone, M. Cignetti, D. Giordan, P. Allasia, M. Manuta)

The activity from June 2017 to September 2017 regarded the organization and publication on the website http://geonetwork.nextdataproject.it/ of data and metadata prepared in the framework of HAMMER Project (http://www.nextdataproject.it/sites/default/files/docs/D2.6.3_0.pdf).

In particular, on the website are present measurements of ground deformation obtained by in situ measurements and by satellite measurements. These datasets have been provided from previous projects. Moreover, a new dataset of ground deformation and time series has been produced by the exploitation of the ENVI and ERS images and of the processing tools provided by the G-POD (Grid Processing On-Demand) ESA platform (Cignetti et al., 2016, https://gpod.eo.esa.int/).

The following test sites were considered:

- Landslide at Grange Orgiera (Western Alps, Piemonte, Italy)
- Landslide at Gardiola (Western Alps, Piemonte, Italy)
- Landslide at Montaldo di Cosola (Piemonte, Italy)
- Landslide at Ivancich (Central Apennines, Umbria, Italy)
- Regione Valle d'Aosta (Italia)
- Study area in El Portalet (Spain, Central Pyrenees)
- Salar de Atacama (Atacama Desert, Chile)
- The data are organized according to a "parent and child", as shown in figure 3.1.

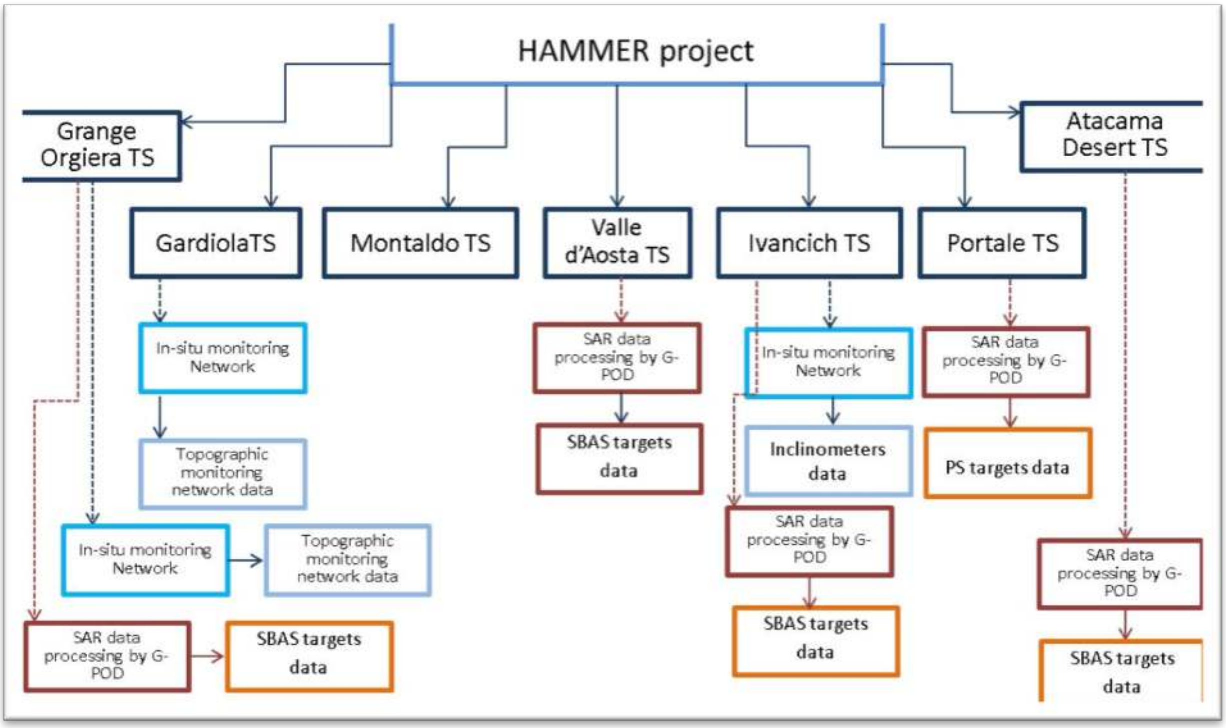


Figure 3.1. Schema of the organization of the data in the website http://geonetwork.nextdataproject.it/

The website contains 9 metadata sheets (ISO19139):

- Description or the original HAMMER project.
- Description of the test sites.
- Description of the Ground Deformation Map of the territory of Valle D'Aosta region prepared by using G-POD.

The website contains fourteen ground deformation maps, available in visualization mode together with the metadata (ISO19139).

The website contains nine times series available in download mode. These data have been classified in three types of dataset:

I. Time series of ground deformation acquired by in situ monitoring.
II. Time series of ground deformation acquired by satellite measurements.
III. Time series of ground deformation prepared by using G-POD.

3.2.1. Dataset description

I. Time series of ground deformation acquired by in situ monitoring

The dataset contains: data on topographic monitoring networks for the Grange Orgiera and Gardiola landslides and data on the inclinometric network for the Ivancich landslide.
For Grange Orgiera and Gardiola landslides the data were acquired by the Geohazard Monitoring Group of the CNR IRPI (http://gmg.irpi.cnr.it/).
For the Ivancich landslide the data were acquired by the Geomorphology Group the CNR IRPI (http://geomorphology.irpi.cnr.it/). For each landslide site a map was created for the GIS (Qgis software). At present, the network of Grange Orgiera contains data on 13 prisms constituting the topographic network. The Gardiola network contains 21 prisms of the topographic network. The Ivancich network contains data of 4 inclinometers.
The size of the dataset is 13,85 Mb.

II. Time series of ground deformation acquired by satellite measurements.

The dataset contains data about the Ivancich landslide and the El Portalet landslide ground. For the Ivancich landslide the data was provided by the DORIS project (FP7) and described by Calò et al. (2014).
The data was generated from the satellite images acquired by COSMO SkyMed in H resolution and Very High Resolution, by ERS-1/2 and ENVISAT Low Resolution. The images were processed by SBAS technique. The observation period was from December 2009 to February 2012 for COSM SkyMed from April 1992 to November 2010 for ERS-1/2 and ENVISAT.
For the El Portalet landslide the data was available in the framework of the Framework Agreement between NextData Project and Terrafirma (the agreement was signed in July 2014), da Altamira information (http://www.altamira-information.com/). The data was processed by the PSInSAR technique. The period of observation was from June 1995 to July 1998, for the ERS-1/2 and from July 2001 to September 2007, for Envisat.
The size of the dataset is 920 Mb.

III. Time series of ground deformation prepared by using G-POD.

The dataset contains the new ground deformation maps generated using the tool G-POD of ESA. The ground deformation maps were generated for the following test sites: Valle d'Aosta; Grange Orgiera landslide; Salar de Atacama.
For the Valle D'Aosta the observation period was from June 2004 to October 2010 (Cignetti et al., 2016). For the Grange Orgiera landslide the observation period was from April 2005 to October 2010. For Salar de Atacama the observation period was from March 2003 to September 2009.
The size of the dataset is 1,5 Gb.

3.2.2. *Dataset format*

The files are in .cvs format.

3.2.3. *Metadata standard*

INSPIRE (ISO19139)

3.2.4. *Reference system*

UTM WGS84

3.2.5. *Terms of use of the dataset*

Data available at the website http://geonetwork.nextdataproject.it/

3.2.6. *References*

Cignetti, M., Manconi, A., Manunta, M., Giordan, D., De Luca, C., Allasia, P., & Ardizzone, F. (2016). Taking advantage of the ESA G-pod service to study ground deformation processes in high mountain areas: A Valle d'Aosta case study, northern Italy. Remote Sensing, 8(10), 852

Calò, F., Ardizzone, F., Castaldo, R., Lollino, P., Tizzani, P., Guzzetti, F., ... & Manunta, M. (2014). Enhanced landslide investigations through advanced DInSAR techniques: The Ivancich case study, Assisi, Italy. Remote sensing of environment, 142, 69-82

On line resource:
http://www.nextdataproject.it/sites/default/files/docs/D2.6.3_0.pdf
http://geonetwork.nextdataproject.it/
https://gpod.eo.esa.int/
http://gmg.irpi.cnr.it/

3.3. *Hydrometeorological database for the Apennine basins – 'high' Chiascio and Magra* (Contribution by T. Moramarco and S.Barbetta)

3.3.1. *Dataset description*

DIBA has been implemented by using the architecture of MVC based on framework ZEND v1 PHP. The Dataset consists of hydro-meteorological time series (rainfall, temperature, water level) for two pilot Apennines basins: i.e. Chiascio basin, in central Italy, and Magra basin, in northwest Italy.
The data quality is tested using control procedures after data are geo-referenced and processed to get reliable assessment of hydrological variables. The dataset is also designed to provide climate scenarios using Global Circulation Models, downscaling techniques and hydrological modeling.
The original "Work Plan" of project was updated in December 2016 in terms of activities, milestones and deliverables for the period 2017-2018. Specifically, the dataset holds hydro-meteorological and climate data for the analysis of climate in the two pilot Apennines areas with reference to:

- rainfall data (8 and 58 raingauges in the Chiascio and Magra basins, respectively)
- temperature data (7 and 56 sensors in the Chiascio and Magra basins, respectively)
- hydrometric data (2 and 6 sensors in the Chiascio and Magra basins, respectively)
- hygrometric data (3 sensors in the Chiascio basin)

- direction and intensity of wind (2 sensors in the Chiascio basin)
- solar radiation data (1 sensor in Chiascio basin)
- atmospheric pressure data (1 station in Chiascio basin)
- snowing data (1 station in Chiascio basin)
- soil moisture data (1 station in Chiascio basin)

For the Chiascio basin, the recorded data are half-hourly and relative to different periods according to the measurements availability for the different monitoring stations (the time series length ranges from 7 years to 26 years). Daily data are also available. For the Magra basin,at stations different time series are available for hourly and daily data. For the two pilot basins, DIBA also holds rainfall data from radar and satellite (TMPA rainfall product, H05 rainfall product) as well as soil moisture satellite products (ASCAT, AMSR-E, MODIS, SMOS).
The database allows to manage cartographic maps as hydrography, sub-basins, land use, lithology and SCS Curve Number. Moreover, climate scenarios are available for GCM as HadCM3, CMCC-CM e EC-Earth starting from the baseline period (1960-1990) and for downscaled future scenarios. Finally, the soil moisture and surface flow velocity measurements carried out during the campaigns in the period 2014-2015 in the two pilot basins are in the database. The structure of DIBA is shown in Figure 3.2.

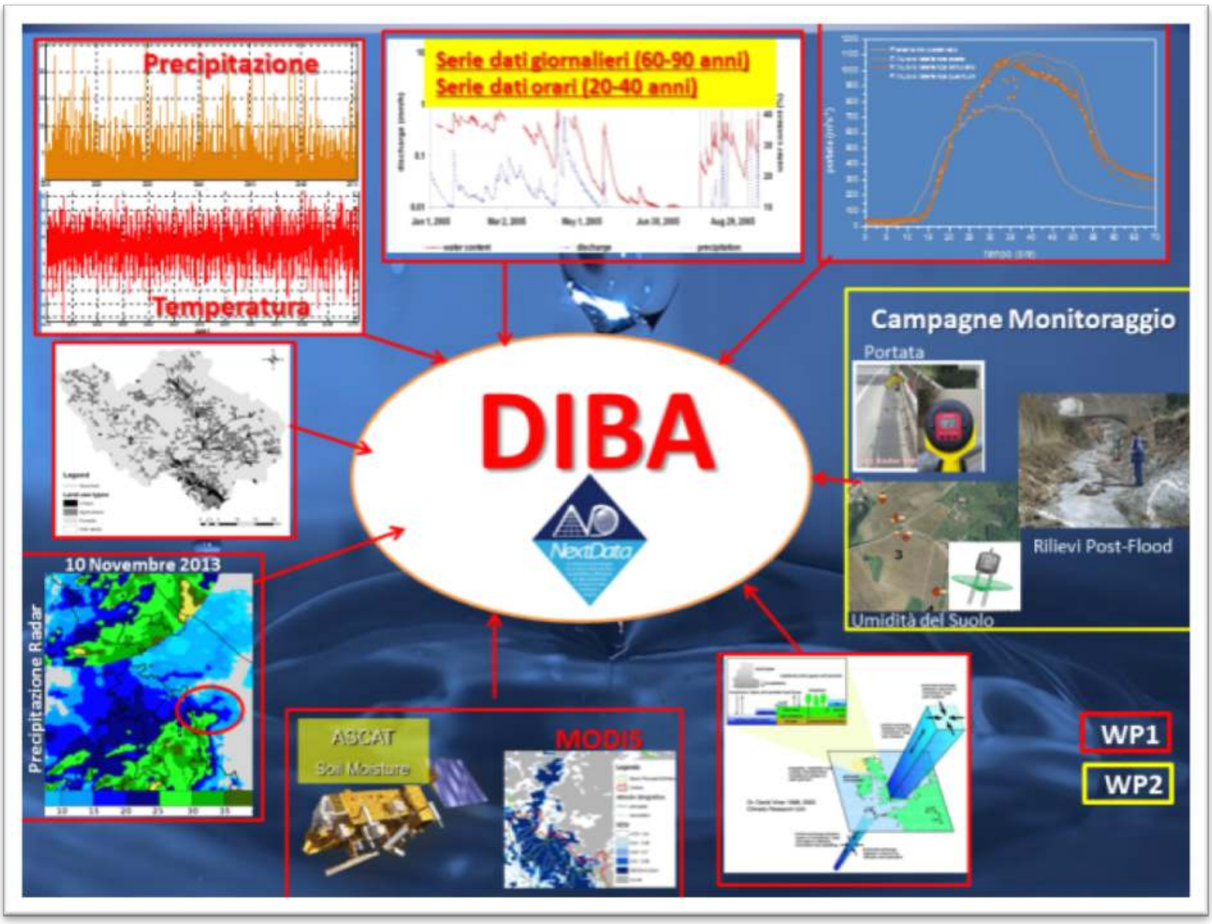


Figure 3.2. DIBA structure.

3.3.2. *Dataset format*

The dataset is made available through a GIS platform (Web-Gis database) based on DBMS Mysql, which allows to view, select and display data on available time scales (hourly, daily, monthly) along with the different statistics parameters characterizing the series. The WebGis platform for the management of hydrological ground observation, satellite and climatic scenarios is accessible through the temporary link http://nextdata.altervista.org/public. It is also possible to download selected data in CSV format.

3.3.3. Data model, standard and formalization

Each station, basin, satellite product, climate model is identified by a geo-referenced marker. Each marker opens a dialog box that provides fields of interest for each site such as Area, Level, Name, Coordinates and a brief description of the river basin followed by tables and/or graphical data of the time series associated to the site. By opening the interactive menu, one can also make more selective queries using the appropriate filters such as year, month or day of interest or a range for the year, month or day.

3.3.4. Reference system

All features (basin boundaries, hydro-meteorological stations, hydrography, land use, etc.) are geo-referenced on Google Map providing tables with their locations in terms of latitude and longitude.

3.3.5. Quality check/validation

Data in DIBA are verified through data quality control procedures and reconstruction periods of malfunction. The precipitation and temperature control procedure is articulated into five different steps that, by evaluating the consistency of the data with the station's statistic properties (mean, variance, maximum observed) and neighbouring stations, assigns a quality code of data. For hydrometric data, the quality control mainly concerns the identification of non-operational periods that are corrected on the basis of linear approaches for short periods or on observations of upstream/downstream hydrometric stations. The control also concerned the off-set of the stations which for some of them have had variations during the recording period used.

3.3.6. Terms of use of the dataset

At present, the Webgis platform is designed for user access by password. The user can see the website but without any access to the reserved area.

4. CRYOSPHERE, ALPINE GLACIERS AND SNOW COVER DATA (Contribution by C. Baroni)

Reduction of Alpine glaciers and snow-cover resources is ongoing since a few decades, inducing important consequences on river regimes and discharge as well as on the availability of water during the dry season. WP1.6 is devoted to the implementation of a coherent information database on Italian Alpine glaciers and on snow cover in Italian mountains.

WP 1.6 pursues three tasks regarding:

1) Monitoring and quantitative inventory of glaciers of the entire Italian Alps during different time intervals considering also quantitative and geo-referenced data on glaciers mass balance, changes in the Equilibrium Line Altitude, and collection of iconographic and photographic/ photogrammetric material, (developed in collaboration with the Italian Glaciological Committee).

2) Development and validation of conceptual and/or empirical models on the dynamics of alpine glaciers. The case study to check the best solution for coupling GIS with a Minimal Glacier Model is the Rutor glacier (western area of Val d'Aosta). The activity involves the implementation and application of a tool to define the series and the evolution equations of the various types of Alpine glaciers, grouped by geographic (macro-areas) and geomorphological criteria.

3) Estimation of snow cover in Alpine environments and of snowfall intensity from Remote Sensing data (satellite data). The project is a pilot project and concentrates on the alpine regions of Piedmont and Valle d’Aosta.

4.1. *Monitoring and quantitative census of alpine glaciers* (Contribution by M. Salvatore)

4.1.1. Dataset description

The dataset provides a series of snapshots on the state of Italian glaciers, each of them relating to a specific hydrological period and providing information on all the glaciers of the Italian Alps and Central Apennines (Ghiacciaio del Calderone). Datasets containing multi-temporal quantitative inventory data of Italian glaciers (2006-2007 and 1988-1989 hydrological periods) include geographic location, area, length, orientation, elevation, and classification. The data source is based primarily on the new generation of ortho-rectified aerial photos at high resolution provided by the National Geoportal of the Ministry of Environment and Protection of Land and Sea and by regional geoportals, through Web Map Services (WMS). The availability of data acquired using the same instruments and during the same time interval represents a key tool to perform a high-quality monitoring and quantitative inventory of glacial bodies, particularly relevant if we consider the diffuse and fast withdrawal occurred during the last decades and still ongoing. Additional source data are provided by terrestrial photos (available in the archives of the Italian Glaciological Committee and/or in local archives) and other remote sensing images (e.g., Lidar) acquired in the same time interval, which allow to improve the dataset and favour a correct interpretation of glacier extent.

4.1.2. *Dataset format*

The dataset is provided as a vectorial file (shapefile); glacier (features) characteristics are stored in the dBASE table. In addition to the shapefile, the dataset can be provided in other formats (e.g., .csv, .xls, .kmz) .

4.1.3. *Data model, standard and formalization*

The structure of the dBASE table, the attribute table from the shapefile where glacier characteristics are stored, follows the World Glacier Monitoring Service (WGMS) guidelines for the compilation of glacier inventory data from digital sources (WGMS and NSIDC, 1999, updated 2012; Paul & alii , 2009). Below a brief description of the database fields.

CODE	ID number assigned to the glacier as defined by the Italian Inventory (CGI-CNR, 1959-1962) or new code if glacier was not inventoried before.
SUB_CODE	number attributed to glaciers originated from fragmentation of wider body
WGI_CODE	ID number is assigned to the glacier as defined by the WGMS
TIME_STEP	Hydrological year of survey (yyyy)
MAX_ELEV	Maximum elevation of the highest point of the glacier in meters above sea level
MIN_ELEV	Minimum elevation of the lowest point of the glacier in meters above sea level
TOT_AREA	The total area of the glacier in a horizontal projection in square kilometers
DEB_AREA	Debris-covered area in a horizontal projection in square kilometers
EXP_AREA	Debris-free area in a horizontal projection in square kilometers
MAX_WIDTH	The maximum width of the glacier in a horizontal projection in kilometers
MIN_WIDTH	Minimum width of the glacier in a horizontal projection in kilometers
MAX_LENGTH	Maximum length of the glacier in kilometers measured along the main flowline in a horizontal projection
MEAN_OR	Mean orientation of the glacier using 8 classes centered on cardinal points (N, NW, W, SW, S, SE, E, and NE).
OR_ACC	Mean orientation of the accumulation area using 8 classes centered on cardinal points (N, NW, W, SW, S, SE, E, and NE). FACULTATIVE
OR_ABL	Mean orientation of the ablation area using 8 classes centered on cardinal points (N, NW, W, SW, S, SE, E, and NE). FACULTATIVE
MEAN_SLOPE	Mean slope angle of glacier surface
DATE_	Orthophoto or satellite image acquisition date (ddmmyyyy)
X_COORD	The longitude of the glacier in decimal degrees East GW. Longitude is given to a maximum precision of 3 decimal places
Y_COORD	The latitude of the glacier in decimal degrees North. Latitude is given to a maximum precision of 3 decimal places
GL_NAME	Name of glacier following Italian Inventory (CGI-CNR, 1959-1992) or new name in case of fragmentation of glacial body or in case the glacier was not inventoried before.
PRIMARY_CL	The primary classification of the glacier
FORM	The form of the glaciers

In addition, other fields describe the geographic location according to the International Standardized Mountain Subdivision of the Alps-ISMSA (SOIUSA CLASSIFICATION (Group, Group Name, Supergroup, Supergroup Name, Subsection, Section, Part).

The flexibility of the dBase will allow to include additional fields for further information, if required.

4.1.4. Metadata standard

To be discussed and defined, but ready to be prepared following INSPIRE standards.

4.1.5. Reference system

The adopted coordinate system is WGS84 UTM32.

4.1.6. Quality check/validation

All datasets (glacier outlines and related attribute table for different time steps, trends of spatial-temporal variations of glacier fronts) will be checked by specialists of the Italian Glaciological Committee. The accuracy of glacier boundaries is assessed following the approach suggested by Vögtle & Schilling (1999) and applied in alpine environments by several authors. Data gave an estimated error of less than ± 2%; this value increase with in few cases with continuous supraglacial debris coverage, for which the estimated maximum value is of approximately ±5%.

4.1.7. References

CGI – Comitato Glaciologico Italiano (1928-1977) – Relazioni delle campagne glaciologiche – Reports of the glaciological surveys. Bollettino del Comitato Glaciologico Italiano, Series I and II, 1–25. (http://www.glaciologia.it/en/i-ghiacciai-italiani/le-campagne-glaciologiche/)

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CGI-CNR – Comitato Glaciologico Italiano & Consiglio Nazionale delle Ricerche (1961b) – Catasto dei Ghiacciai Italiani, Anno Geofisico Internazionale 1957-1958. Ghiacciai della Lombardia edell'Ortles-Cevedale. Comitato Glaciologico Italiano, Torino, vol. 3, 389 pp.

CGI-CNR – Comitato Glaciologico Italiano & Consiglio Nazionale delle Ricerche (1962) – Catasto dei Ghiacciai Italiani, Anno Geofisico Internazionale 1957-1958. Ghiacciai delle Tre Venezie (escluso Ortles-Cevedale) e dell'Appennino. Comitato Glaciologico Italiano, Torino, vol. 4, 309 pp.

Paul F., Barry R.G., Cogley J.G., Frey H., Haeberli W., Ohmura A., Ommanney C.S.L., Raup B., Rivera A. & Zemp M. (2009) – Recommendations for the compilation of glacier inventory data from digital sources. Annals of Glaciology, 50 (53), 119-126.

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Vögtle T. & Schilling K. (1999) – Digitizing Maps. In: Bähr H.P. & Vögtle T. (Eds.) GIS for Environmental Monitoring. Schweizerbart, Stuttgart, 201-216.

WGMS and NSIDC. 1999, updated 2012. World Glacier Inventory. Compiled and made available by the World Glacier Monitoring Service, Zurich, Switzerland, and the National Snow and Ice Data Center, Boulder CO, U.S.A. doi: 10.7265/N5/NSIDC-WGI-2012-02.

4.2. ***Estimate of snow cover state and changes over Italian mountains*** (Contribution by V. Levizzani)

Task 3 of WP 1.6 was originally called NextSnow, and it deals with the estimation of snow cover in alpine environments and the estimate of snowfall intensity from satellite data. The project is a pilot project and concentrates on the alpine regions of Piedmont and Valle d'Aosta.

Datasets produced by the participating groups:

4.2.1. Dataset of point measurements of snow height (HS), snow density (RHO) and Snow Water Equivalent (SWE) over the Valle d'Aosta region

ARPA Valle d'Aosta (Dr. Umberto Morra di Cella, u.morradicella@arpa.vda.it).
Area of the dataset: Valle d'Aosta region.
Period: 2005-present.
Characteristics: database of point measurements constantly updated till present.
Height: from 900 to 3800 m asl.
Format: date/time, coordinates (UTM ED50), snow height (cm), mean weighted density (kg m-3), SWE (mm).
ASCII file [id, coord, date, HS, RHO, SWE].
Access through the NextData geoportal using an access control to be decided.

4.2.2. Dataset of regional SWE maps over the Valle d'Aosta region

ARPA Valle d'Aosta in collaboration with CIMA (Dr. Umberto Morra di Cella, u.morradicella@arpa.vda.it).
Area of the dataset: Valle d'Aosta region.
Period: 2002-present in the November-May period of each year with periodic simulations (nominally every 8 days synchronous with the availability of MODIS-SCA products).
Input data: point measurements of HS (from automatic stations and from manual samples) and point measurements of SWE (from automatic stations and from manual samples).
Spatialisation obtained by means of regression kriging and subsequent redistribution of residuals on the basis of the snow cover area (SCA) of the satellite sensor MODIS.
The product is released when the area is covered by clouds under 6% (following MODIS observations) and if the available snow height data are more than 17.
Grid risolution: 500 m.
Format: ASCII GRID UTMED 50.
Datasetproduced with selected metadata.
Data available through ftp.

4.2.3. Dataset of modelled SW from two eddy-covariance sites in Valle d'Aosta

ARPA Valle d'Aosta in collaboration with CIMA, CNR-ISAC and Università di Torino (Dr. Umberto Morra di Cella, u.morradicella@arpa.vda.it).
In particolar, the data from the analysis are available from the Torgnon – Tellinod site.
Model output onsidered in the analysis: Ta, RH, wind, SWin, SWout, LWin, LWout, H, LE, G, Tsoil, PRE, HS, SWE measurements (periodic manual and continuous automatic).
Empirical models usedi: Amundsen, S3M.
Energy balance models used: Geotop, AchabSNOW, UTOPIA, CHTessel.
Period: winters from 2011 till 2016.
ASCII format available via e-mail.

4.2.4. *Dataset of fresh snow*

Politecnico di Torino (Prof. Pierluigi Claps, pierluigi.claps@polito.it).
Dataset of manual samples taken after snowfall events at 65 stations in mountain regions over the Piemonte region and in nearby valleys.
Heights of measurements: from 700 to 2700 m asl.
Data structure: date, minimum temperature (from the 24 h before the snowfall event), maximum temperature (from the 24 h before the snowfall event), mean temperature, bulk thickness of the snow mantle, thickness of fresh snow, density.
The order of magnitude of available data is of the order of 5000 measurements.
Format: ASCII.

4.2.5. *Dataset of snow height, eddy-covariance, soil moisture, solar radiation at a measurement site in Valle d'Aosta subject to repeated event of rapid fusion during the year*

Dipartimento Interateneo DIST Politecnico e Università di Torino (Prof. Stefano Ferraris, stefano.ferraris@polito.it).
Data are available for the Cogne site.
Measured quantities: Ta, RH, wind, SWin, SWout, LWin, LWout, H, LE, G, Tsoil, Tsurface, Soil moisture, HS.
Model used for the analyses: SNOWPACK (Davos).
Period: winters from 2010-2011 to the present.
ASCII format available via e-mail.

4.2.6. *Dataset of manual daily time series*

Università degli Studi di Torino (Prof. Simona Fratianni, simona.fratianni@unito.it).
Dataset area: Valle d'Aosta and Piemonte regions.
Period: from 1950 till the end of recordings (in the years 2000).
Number of stations: 32 in Valle d'Aosta and Piedmont.
Height: from 701 to 2520 m asl.
Dataset: daily data, HS (cm) and fresh snow HN (cm) registered manually every 24 hours by an observer.
Input data: year, month, day, snow at the ground, fresh snow.
Metadata: detection of discontinuities due to malfuntions or changes in the instrumentation indicated by the observers on the paper recording.
Format: csv.
Output data: year, month, day, fresh snow, snow at the ground, validation flag.
Format: csv.

5. ECOSYSTEMS AND BIODIVERSITY DATA, LTER-EUROPE AND ILTER (Contribution by G. Matteucci)

5.1. ***Data from LTER mountain Italian stations*** (Contribution by A. Oggioni and G. Amori)

5.1.1. Dataset description: population dynamics of rodents in central Italy

The dataset consists of data obtained through Capture-Mark-Recapture (CMR) method concerning two rodent species (*M. glareolus* e *A. flavicollis*) for a period of 14 years. The study area was located in central Italy (Majella National Park, 42°08’ N, 14°05’E, 1000 m. a.s.l.), and is characterized by a thermophilous beech forest (*Fagus sylvatica*).
Capture were carried out from spring to fall (i.e., monthly, from May to October) in 1988-1996 and 2000-2005 using 100 live-traps. Trapping was suspended during the winter months (from November to April). Rodents were live-trapped in a 1.44 ha square grid, calculated including an outer boundary strip equal to half of the minimum distance between traps. Each trapping session was 3 nights-long.
Overall, 960 individual rodents (491 *M. glareolus* and 469 *A. flavicollis*) have been captured, with about 2000 recaptures.

Time series of data have been stored on excel sheets.

The dataset is available and is part of the NextData project.

AMORI G., LUISELLI L., 2011. Growth patterns in free-ranging bank vole, Myodes glareolus (Schreber, 1780) from a montainous area in central Italy. Mammalia, 75: 41-44.

AMORI G., LUISELLI L., 2011. Growth patterns in free-ranging yellow-necked wood mice, Apodemus flavicollis. Mammalian Biology,76: 129-132.

AMORI G., LOCASCIULLI O., LUISELLI L., 2011. Non-random distribution across habitat types in sympatric, hardly catchable small mammals at a mountainous site in central Italy. Rendiconti Lincei, 22: 17-23.

AMORI G., CASTIGLIANI V., LOCACIULLI O., LUISELLI L. 2015.Long-term density fluctuations and microhabitat use of sympatric Apodemus flavicollis and Myodes glareolus in central Italy. Community Ecology, 16: 196-205.

5.1.2. Dataset description: small mammal dataset

The dataset was built up using bibliographic data published over the last 40 years in Italy regarding the diet of a nocturnal bird of prey, the Barn owl (*Tyto alba*). The diet of the barn owl is based mainly on small mammals Rodents and Shrews).
Thus, it was possible to obtain data on small mammal communities of 212 sites obtained from 49 publications for a total of about 85,000 individuals belonging to 26 species.

The data has been stored on excel sheets and the locations have been georeferenced (shapefile).

Reference dataset system WGS 84 (UTM 32 or UTM 33)

The dataset is available and is part of the NextData project.

MILANA G., LAI E., MAIORANO L., LUISELLI L., AMORI G., 2016. Geographic patterns of predator niche breadth and prey species richness. Ecol. Research. 31: 111-115.

5.1.3. Dataset description: mountain butterflies

The dataset refers to the distribution of mountain butterflies belonging to *Erebia tyndarus* species complex, *Parnassius phoebus* species complex and to *Parnassius Apollo*.

Various sources of data (GBIF, CKmap5.3.8, Collection, Literature).

Update Timeline not evaluated.

Dataset format: vector (points) - 14,272 records.

The table is made up of the following fields: id, species, species_(original), date_(yyyy-mm-dd), locality_(original), country, elevation, latitude_WGS84, longitude_WGS84, georeferencing_locality, georeferencing_source, source, GBIF_key

Reference dataset system WGS84.

Manually georeferenced data.

Bibliography

Marta et al., 2016. Journal of Biogeography 43, 2186–2198

5.2. ***Animal biodiversity monitoring in mountain areas*** (Contribution by R. Viterbi)

Dataset described in a specific Deliverable, D1.7.A

5.3. ***Nivolet Earth Critical Zone and Ecosystem Observatory*** (Contribution by A. Provenzale)

In 2016 and 2017 we established a new Earth Critical Zone and Ecosystem Observatory in the high-altitude environment of Col Nivolet in the Gran Paradiso National Park, a highly-protected, closed hydrological basin between about 2500 and 2700 meters amsl. This area, covered with snow from November to June, is characterized by a complex environment of alpine pastures, oligotrophic lakes, peat bogs, rock outcrops and meandering streams, and it is the habitat of ibex, chamois, eagles and marmots. Domestic ungulates (cattle, sheep, goats) are brought up during the short mountain summer. The geological substrate includes areas with gneiss, carbonates, glacial deposits and alluvial soil. Currently, measurements include water and carbon fluxes (by both eddy covariance and flux chamber), soil temperature, moisture and chemistry, stream discharge, vegetation characteristics and invertebrate biodiversity. Lake ecosystem structure and water properties are monitored since 2006. Two weather stations provide daily records of temperature, precipitation and snow cover since more than 50 years. The study currently focuses on (i) how CO_2 and H_2O fluxes are modulated by bedrock characteristics (acidic vs basic) and soils properties; (ii) how isotopic measurements can be used to identify pathways and time scales of water and solute transport. On the longer term, the Nivolet ECZ and Ecosystem Observatory intends to quantify the processes coupling geosphere and biosphere in high-altitude natural ecosystems exposed to climate change. The datasets will be described and made available in 2018.

5.4. *Alpine grasslands dynamics at high altitudes* (Contribution by C. Calfapietra)

Alpine grasslands are the vital support systems for many target flora and fauna species. They represent also a crucial environment for cattle grazing. Alpine grasslands are the products of thousands of years of interaction between the mountain environment and human activities. This fragile environment currently exhibits substantial changes caused by a combination of climate change with abandonment of traditional pastoral activities. The main aim of this Task is to quantify and analyse ongoing changes in alpine grasslands, through the evaluation of water and carbon fluxes between soil, vegetation and atmosphere, changes in flora species composition in areas with and without grazing pressure, modifications in chemical-physical properties of soil induced by changes in the management regime and climate variations. For these purposes continuous measurements of carbon fluxes between the ecosystem and the atmosphere are performed in two eddy covariance sites characterized by contrasting management regime: Brocon and Torgnon sites. The measurements are complemented by gas exchange measurements at the soil level, monitoring of the local climate, phenological and biomass surveys, satellite observations, as well as models which will be generated to characterize ongoing processes in alpine grasslands, see table 5.1 for dataset details.

Brocon. Brocon eddy covariance site is a grazed grassland located at the 1700 m height in the alpine chain (Trento Province). The site was established in 2002 by the University of Tuscia and CNR IBIMET within the framework of the EU founded project GREENGRASS. Besides, the site was involved in a series of national and European funded projects (CARBOEUROPE IP and CarboItaly) and was continuously acquiring data up to 2007. IBAF CNR, considering the importance of long-term surveys in vulnerable mountain ecosystems, has re-activated the research in Brocon in 2012 in the frame of CARBOSOIL project (2011-2014). The research focused on plant-soil interactions where the effects of grazing regime on different steps of the C cycle were studied on a small-plot scale. Since 2013 Brocon makes part of NextData project, which permitted a complete re-activation of eddy covariance measurements (since 2015). The site is divided into three areas with different pressure and duration of the grazing which are applied by the local farmers: prolong two months grazing, one month grazing and no grazing. The effects of different grazing regimes are studied on a small plot scale and on the ecosystem level by spatial partitioning of CO2 fluxes.

Torgnon. The Torgnon site is an abandoned grassland at 2100 m asl in the Western Italian Alps. Eddy Flux measurements are collected here since 2008. Since 2009, field campaigns of continuous soil respiration measurements are conducted with automatically-operated soil flux chambers. Image-based phenology and NDVI data are available since 2009. At this study site, the relationship between phenology and environmental drivers is studied, with particular attention to the relationship between the timing and duration of the snow-covered season and plant phenology and productivity.

Table 5.1 – Table of the datasets related to the two study sites. Standard metadata is compliant with ICOS.

Parameter	Dataset description	Dataset format	Model of data, standard and formatting	Quality control /validation	Terms and conditions for use	References
CO_2/H_2O	Temporal half-hour series of turbulent fluxes of CO_2 and H_2O between the ecosystem and the atmosphere; Comma-separated-values (csv)	Temporal series	Decimal number, date in the format YYYY-mm-dd HH:MM	ICOS	Request to PI	Marta Galvagno, Georg Wohlfahrt, Edoardo Cremonese, Gianluca Filippa, Mirco Migliavacca, Umberto Mora di Cella, Eva van Gorsel: Contribution of advection to nighttime ecosystem respiration at a mountain grassland in complex terrain. Agricultural and Forest Meteorology 05/2017; 237-238:270-281., DOI:10.1016/j.agrformet.2017.02.018
Climate data	Temporal half-hour series of meteorological parameters; Comma-separated-values (csv)	Temporal series	Decimal number, date in the format YYYY-mm-dd HH:MM		Request to PI	
Digital imaging	Temporal daily series of vegetation indices obtained by digital imaging; Comma-separated-values (csv)	Temporal series	Decimal number, date in the format YYYY-mm-dd HH:MM	Phenocam	Request to PI	Gianluca Filippa, Edoardo Cremonese, Mirco MIgliavacca, Marta Galvagno, Matthias Forkel, Lisa Wingate, Enrico Tomelleri, Umberto Morra di Cella, Andrew D Richardson: Phenopix: A R package for image-based vegetation phenology. Agricultural and Forest Meteorology 01/2016; 220., DOI:10.1016/j.agrformet.2016.01.006
NDVI	Temporal daily series of NDVI; Comma-separated-values (csv)	Temporal series	Decimal number, date in the format YYYY-mm-dd HH:MM		Request to PI	
biomass/lai	Temporal bi-weekly series of biomass and	Temporal series	Decimal number,		Request to PI	Gianluca Filippa, Edoardo Cremonese, Marta Galvagno, Mirco

	lai; Comma-separated-values (csv)		date in the format YYYY-mm-dd HH:MM			Migliavacca, Umberto Morra di Cella, Martina Petey, Consolata Siniscalco: Five years of phenological monitoring in a mountain grassland: inter-annual patterns and evaluation of the sampling protocol. International Journal of Biometeorology 05/2015; 59(12)., DOI:10.1007/s00484-015-0999-5
Soil CO2	Temporal half-hour series of soil respiration measured on small plot scale; Comma-separated-values (csv),	Temporal series	Decimal number, date in the format YYYY-mm-dd HH:MM		Request to PI	
Soil organic carbon	Punctual measure of SOC concentration and stock in different soil layers down to 1 m depth	Punctual measures for the year 2014	Decimal number		Request to PI	Chiti T, Certini G, Forte C, Papale D, Valentini R (2016) Radiocarbon-Based Assessment of Heterotrophic Soil Respiration in Two Mediterranean Forests. Ecosystems, 19:62-72.
Soil characterization (Texture, pH, Bulk density)	Punctual measures of texture, pH and bulk density for different soil layers down to 1 m depth	Punctual measures for the year 2014	Decimal number		Request to PI	Chiti T, Certini G, Forte C, Papale D, Valentini R (2016) Radiocarbon-Based Assessment of Heterotrophic Soil Respiration in Two Mediterranean Forests. Ecosystems, 19:62-72.
Radiocarbon (14C) on soil samples	Radiocarbon concentration for different soil layers down to 30 cm depth	Punctual measures for the year 2014	Decimal number		Request to PI	Chiti T, Certini G, Forte C, Papale D, Valentini R (2016) Radiocarbon-Based Assessment of Heterotrophic Soil Respiration in Two Mediterranean Forests. Ecosystems, 19:62-72.

Soil Heterotrophic respiration	Annual estimate of soil heterotrophic respiration for different soil layers down to 30 cm depth	Annual estimate for the year 2014	Decimal number	Yes. Validation has been performed contrasting the heterotrophic respiration data with eddy covariance data and net primary productivity data (see bibliographic reference)	Request to PI	Chiti T, Certini G, Forte C, Papale D, Valentini R (2016) Radiocarbon-Based Assessment of Heterotrophic Soil Respiration in Two Mediterranean Forests. Ecosystems, 19:62-72.
CO2/H2O	Temporal half-hour series of turbulent fluxes of CO2 and H2O between the ecosystem and the atmosphere; Comma-separated-values (csv)	Temporal series	Decimal number, date in the format YYYY-mm-dd HH:MM	FLUXNET	Request to PI	
Climate data	Temporal half-hour series of meteorological parameters; Comma-separated-values (csv)	Temporal series	Decimal number, date in the format YYYY-mm-dd HH:MM		Request to PI	
Biomass aboveground and belowground	Temporal monthly series (2014-2015) and annual series (2014-2017) of biomass; Comma-separated-values (csv)	Temporal series	Decimal number, date in the format YYYY-mm-dd HH:MM		Request to PI	
CO_2 soil	Temporal monthly series (2014-2015) and annual series (2014-2016) of soil respiration,	Temporal series	Decimal number, date in the format YYYY-mm-		Request to PI	

	autotrophic and heterotrophic respiration		dd HH:MM			
$\delta^{13}C$ e $\delta^{15}N$ vegetation	C and N isotope composition of plant species in grazed and non-grazed plots, Comma-separated-values (csv)	Punctual measures for the year 2017	Decimal number		Request to PI	
Species composition	Species composition and diversity indices in grazed and non-grazed plots	Punctual measures for the year 2017	Text and decimal numbers		Request to PI	
Soil organic carbon	Punctual measure of SOC concentration and stock in different soil layers down to 1 m depth	Punctual measures for the year 2014	Decimal number		Request to PI	Chiti T, Certini G, Forte C, Papale D, Valentini R (2016) Radiocarbon-Based Assessment of Heterotrophic Soil Respiration in Two Mediterranean Forests. Ecosystems, 19:62-72.
Soil characterization (Texture, pH, Bulk density)	Punctual measures of texture, pH and bulk density for different soil layers down to 1 m depth	Punctual measures for the year 2014	Decimal number		Request to PI	Chiti T, Certini G, Forte C, Papale D, Valentini R (2016) Radiocarbon-Based Assessment of Heterotrophic Soil Respiration in Two Mediterranean Forests. Ecosystems, 19:62-72.
Radiocarbon (14C) on soil samples	Radiocarbon concentration for different soil layers down to 30 cm depth	Punctual measures for the year 2014	Decimal number		Request to PI	Chiti T, Certini G, Forte C, Papale D, Valentini R (2016) Radiocarbon-Based Assessment of Heterotrophic Soil Respiration in Two Mediterranean Forests. Ecosystems, 19:62-72.
Soil Heterotrophic respiration	Annual estimate of soil heterotrophic respiration for different soil layers down to 30 cm depth	Annual estimate for the year 2014	Decimal number	Yes. Validation has been performed contrasting the heterotrophic respiration data with eddy	Request to PI	Chiti T, Certini G, Forte C, Papale D, Valentini R (2016) Radiocarbon-Based Assessment of Heterotrophic Soil Respiration in Two Mediterranean Forests. Ecosystems, 19:62-72.

				covariance data and net primary productivity data (see bibliographi c reference)		

1. **ARCHIVE SOFTWARE** (Contributions by: E. Trumpy)

1.1. System architecture

The WP2.1 archive implemented for the needs of NextData project is hosted in a server running in the CNR computing centre in Rome. In particular, the WP2.1 archive is served by a Docker container where a Geonetwork application has been specifically set-up and configured to meet the special need of the project. The main features of the physical machine that host the WP2.1 archive are reported in the Table 6.1.

Table 6.1 – Main Hardware and Software feature of the physical machine hosting the WP2.1 archive.

Hardware - Software	
CPU	Intel(R) Xeon(R) CPU E5-2630 v2 @ 2.60GHz
RAM	64 GB
OS	Ubuntu 14.04.5 LTS
Storage	6 TB
Core Software	Apache Tomcat 7.0.41 and
Firewall	Configured to give the access only on port 22 (ssh), 80 (http standard), 8080(tomcat standard)

As mentioned, the WP2.1 archive was build-up by using a Geonetwork Docker container. Dockers enables to rapidly deploy server environments in ‘containers’ by using the virtualization technology available in the Linux kernel of the server Operating System (OS). This architecture has not to be confused with the virtual machine server environments. Each Docker container run a single application, in our case Geonetwork application.

1.2. Geonetwork application description

The application chosen to manage different resources (i.e., data/datasets/metadata) of the WP2.1 archive is Geonetwork at version 3.2. Geonetwork is an open source catalogue specifically developed to manage spatially referenced resources. It catalogues local oriented information and cartographic products through descriptive metadata. Geonetwork enhances the spatial information exchange and share between organizations/department/project and their audience by using capacities and the power of internet.

The main goal of such software is to increase collaboration within and between the organizations for reducing duplication and enhancing information consistency and quality. It enables the accessibility of a wide variety of geographical information along with the associated information organized in a standard and consistent way.

The Geonetwork application implements widely accepted standards to guarantee to discovering, viewing and downloading of resources. It exploits Open Geospatial Consortium (OGC) standards such as dynamic internet map services (e.g., WMS, WFS, WCS), catalogue services

(CSW) and makes available different standards to register metadata (e.g., ISO19115, INSPIRE, FGDC, Dublin Core, …).

While the OGC standards for map services (e.g., WMS, WFS, WCS) allow to view, browse and download maps the metadata standards precisely define how geographic information and related services should be described, providing mandatory and conditional metadata sections.

The metadata editing, publication and distribution together with discovery operations performed by mean of defined search fields and filters are of the most important capabilities of Geonetwork. Moreover, it makes available an interactive web map to mash-up data available in the archive. Geonetwork guarantees also a fine grained access to the resources catalogued thanks to an effective system to bear dataset grants.

1.3. Geonetwork functionalities

The main menu offers to access the information by search tool or by map. The search tool can be used easily by typing a keyword on the free text field or, after to have clicked on the three vertical points, using more search fields (e.g., Categories, Keywords, Contact for the resources, Date of resource creation), see figure 6.1. In addition, below the search field on the left side, some filters are proposed based on the main fields filled-in during the metadating operations (e.g., Filter resources by: Sources, Years, Representation types, update frequencies, …), see figure 6.2. In the right side is displayed a map that can be used both for spatial search of the resources (drawing the boundary limits) and to visualise the datasets extension.

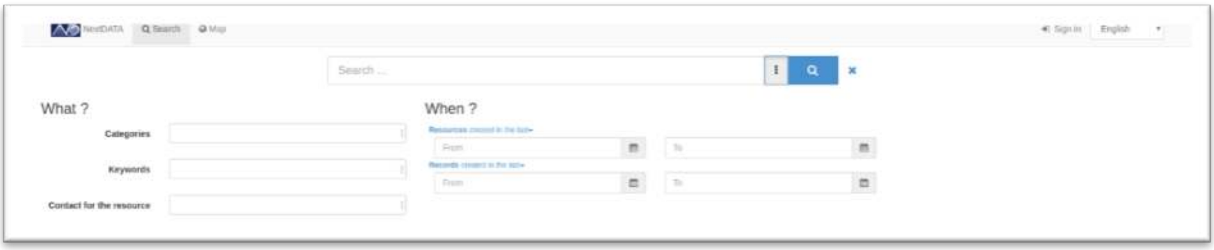

Figure 6.1 – Geonetwork search fields

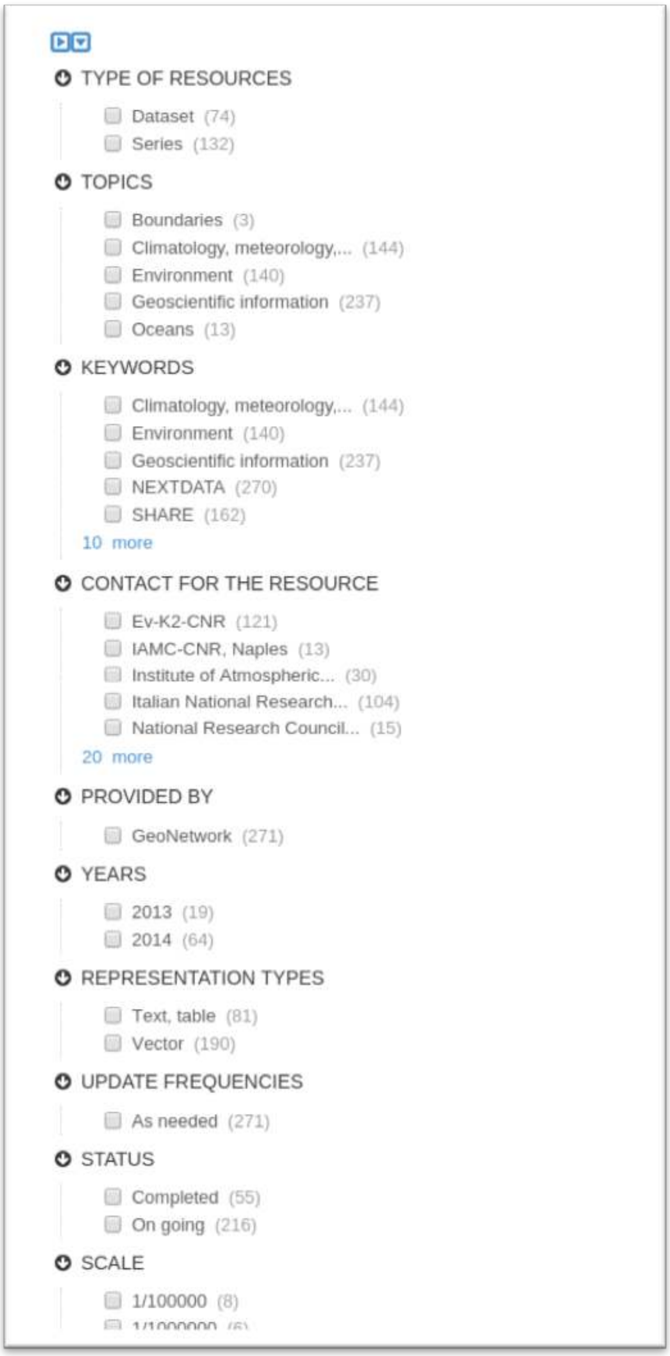

Figure 6.2 – Geonetwork filters

The listed resources (also those retrieved by search/filter operation) are shown in a preview mode in the centre of the page. On click, each resources can be visualised in more detail, so that a dedicated page presents the complete metadata as well as the existing links for downloading or access the resources.

The map functionality of Geonetwork is a powerful tool which allow to visualize the spatial dataset collected, but more than this it enables to add manually different dataset, even from other repositories. The created maps can be saved for future reuse (this functionality require user registration and login). From the map it is possible to query the visualized datasets by simply click on the map, and a table in the bottom shows the attribute values of the dataset queried.

1.4. *Geonetwork for NextData*

The WP2.1 archive is reachable at the URL: http://geonetwork.nextdataproject.it. In the home page, see figure 6.3, a main menu on the top, a search field, the latest new and most popular resources are shown.

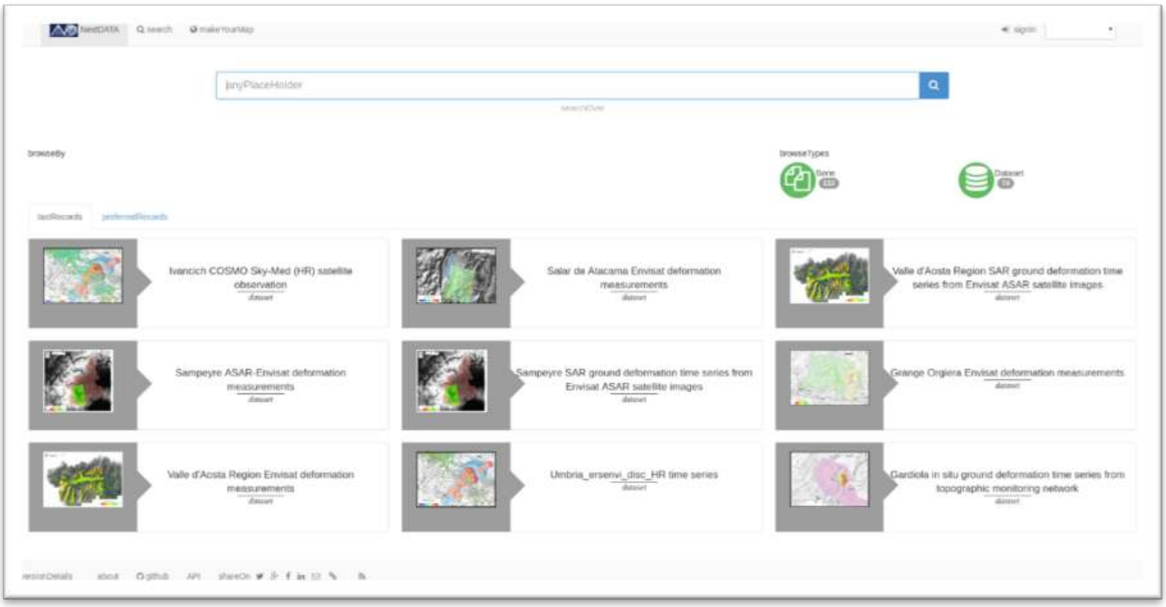

Figure 6.3 – Geonetwork home page

Currently the datasets collected are registered by using ISO19115 metadata standard. This international standard defines the schema for describing geographic information and services and it provides information about: i) identification; ii) extent; iii) quality; iv) spatial; v) temporal schema; vi) spatial reference and vii) distribution of digital geographic data.

The resources collected were organized also by topics to facilitate the discovery of the data. To this aim 9 categories were created:

- High Altitude Stations
- Atmosphere & Climate
- Instruments & Sensor
- Mountain ice cores
- Sea sediment cores
- DataGRALP: Alpine Glacers Database
- HAMMER: Ground Deformation inmountain
- Interactive resources
- Maps

As mentioned in section 6.2, Geonetwork guarantees data interoperability by using OGC international standards. In particular, the Catalogue Service for Web (CSW) endpoint set-up enables other data catalogues on web, as the Gran Portal (WP2.7), to harvest the resource available in the WP2.1 archive.

1.5. *A practical example on how to use the WP2.1 archive*

All the data described from section 2 to 5 can be accessed through Geonetwork application available at the URL: http://geonetwork.nextdataproject.it. The most important functionality is the search capability. To facilitate the users in data discovery here below are described the main operations to access the information.

1. Click on Search item on the top menu: this operation shows a page where on the top there is the generic search text field, the filters on left side, the resources in the centre and a little map on the right.
2. Click on three vertical bullet in the main search text field: this operation displays seven more search fields. Search can be performed by categories, keywords, contact person, date of creation of the resources or records. These fields have the suggested text in a combo box appearing once the user clicks on the three vertical points in the search field or in the calendar icons.
3. Click on the blue 'magnifying glass' icon beside the main search text field: to launch the search. In the centre of the page will be displayed the discovered resources.
4. Click on the checked box on the filters (left side): to include in the centre only the filtered resources.
5. Click on the pencil in the map on the bottom right and draw the area of interest: to apply spatial filter to the resources.
6. Click on the resource preview to display metadata: this operation makes available the metadata page of the resource (Description, Spatial extent, Temporal extent, Provided by, Download and Links, About the resource, Technical information, metadata information) in agreement with the international standard ISO19115.

The discovered resources are shown in the centre of the page. The resources present a preview of the description of dataset, possibly a thumb, the belonging categories, the logo of the data provider and three buttons: i) to get other related resources, ii) to view the resource on the Geonetwork map viewer and iii) to download the resources.

The resource can be also rated as well as shared on different social site by using the appropriate widget in the metadata page. Metadata can also be downloaded from the link available in the 'Metadata information' section.

An important part of the metadata sheet is the 'Download and Links' section. From the items available the users can download the dataset associated to the metadata or possibly visualise it in the interactive map viewer of Geonetwork.

The interactive map viewer of Geonetwork is reachable from the top menu 'makeYourMap'. In the right side of the map interface there are the buttons to browse (the five in the bottom) and to manage (eight on the top) the map. Here below the most important tools.

7. Click on the 'Plus' icon to add layers to the map. Layers can be added by choosing among those available in the catalogue or by typing the URL of other endpoint/map services.
8. Click on 'Layers' icon to manage each added layer.
9. Click on 'Funnel' icon to filter displayed data.
10. Click with the pointer on a feature on the map to query the map and view the value

1.6. References

Geonetwork – Open source: https://geonetwork-opensource.org/

Dublin Core: http://dublincore.org/

Metadata ISO 19115: https://www.iso.org/standard/26020.html

Docker: https://www.docker.com/

Open Geospatial Consortium (OGC): http://www.opengeospatial.org/