



## **Project of Strategic Interest NEXTDATA**

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

### **WP 1.1 High altitude climate observation system**

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

Continuation of measurement and study activities within the regions of interest of the Project: Himalayas, Karakorum and Rwenzori. Continuation of QA/QC and data validation activities. Implementation/upgrade of the high-altitude AWS network (Himalayas).

Continuation of the measurement activity of atmospheric composition within the Kathmandu hot-spot (Nepal, Himalaya foothills) and measurement QA/QC. Strengthening of the atmospheric Observatory at the Deosai National Park (Pakistan) by using transportable measurement systems for air quality and environmental-climatic parameters.

Execution of *trans-national access* (TNA) activities at the Pyramid International Laboratory in Himalayas.

Continuation of the support activities devoted to the upgrade of the Mt. Portella high-mountain Observatory (central Apennines, Abruzzo National Park) and the AWS network on the Italian Alps.

Continuation of data integration and sharing with international programs and projects (es. GMES, GEO, SUSKAT, ABC, CCAC).

Submission of data recorded during the second year to the General Portal and to other databases.

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

D1.1.5: Third year activity report and data submission to the Project archives and to the General Portal.

D1.1.6: Report of the measurement campaign execution.

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

### *3.1 Research activities*

Due to the lack of funding, the third year activities were revised. Nevertheless, we continued the work related to the in-situ weather monitoring and related quality control activities at Mt. Rwenzori, in the Himalayas and Karakorum. Part of these activities were carried out in the framework of a research agreement between ISAC-CNR and Ev-K2-CNR.

During the maintenance campaigns on spring and autumn 2014, we continued the upgrade activities of the meteorological network in the Khumbu valley (Nepal). In particular, we completed the harmonization of the AWS acquisition system as well as the harmonization of data file formats (both in terms of recorded parameters and acquisition time rate). This implementation allowed the activation of procedures for real-time data delivery from the Periche AWS (4528 m asl). Currently, five of the seven AWS in the upper Khumbu valley are equipped by telemetry, allowing the real-time delivery of the data.

We also carried out two quality check campaigns with the aim of verify the proper operation of the stations AWS Lukla (spring 2014) and AWS Pyramid (autumn 2014). The Lukla AWS was intercompared with the travelling reference AWS-QC (Automated Weather Station for Quality Check) for 20 days and the Pyramid AWS for 10 days. These activities were made possible thanks to the close cooperation between the URT Ev-K2-CNR staff, who operated in-situ, and the ISAC-CNR staff in Italy. In particular, in Italy, inter-comparison results were analysed (see D1.1.5) and indications to the URT staff were provided concerning instrument maintenance or sensor replacement.

During summer 2014, the AWS-QC instrumental equipment was sent back to Italy where the sensors were calibrated. The pyranometer, after being calibrated at the WMO World

Radiation Center at PMOD in Davos (Switzerland), was installed at the Lampedusa reference site (managed by ENEA –UTMEA) to calculate the calibration factors. Furthermore, in order to facilitate the in-situ QA/QC intercomparison, the URT EV-K2-CNR implemented the AWS-QC experimental set-up with a further "pyranometer + pyrgeometer" set.

We completed the validation activities of meteorological and radiometric data recorded in the period 2010 - 2012 at the AWS in the Khumbu valley and in the Baltoro region (Pakistan). In particular, after further refinements in the validation procedures, we used the QA/QC guidelines defined in the previous years of activities. The data series have been validated and submitted to the NextData General Portal by way of the GeoNetwork system. URT Ev-K2-CNR and ISAC-CNR also managed the data sharing to external users: during the reporting period 14 data requests were fulfilled.

A preliminary investigation about long-term (2000 - 2012) variability of meteorological parameters measured by the meteorological network of the Khumbu valley has been carried out. For Lukla, Namche, Periche and Pyramid, we summarized the results by a "climate atlas" reporting typical diurnal seasonal variations, monthly and yearly time series, as well as basic descriptive statistical parameters for the following parameters: temperature, relative humidity, atmospheric pressure, speed and wind direction, precipitation and solar radiation. A study concerning the presence of long-term trend for the above mentioned variables has been also carried out.

As part of TNA activity, at the international Pyramid Laboratory, a measurement campaign involving personnel and equipment from the Paul Scherrer Institute - PSI (CH) and the University of Helsinki - UH (FI) was organized. The purpose of this measurement campaign, which was held in autumn 2014, was to better define the atmospheric aerosol formation processes (i.e. particle nucleation) with a special emphasis on the role of sulphuric acid. Specifically, an API-TOF (*atmospheric pressure interface Time-of-Flight mass spectrometer*) and a NAIS (*neutral cluster and aerosol ion spectrometer*) were installed. In particular, the URT Ev-K2-CNR handled the complex logistic activities connected with the experimental campaign (transport of personnel and equipment, installation of the experimental set-up). Data on the atmospheric composition recorded at the NCO-P Observatory (WP1.2) were shared with the PSI and UH staff.

We continued the support activities for the upgrading of the high altitude Observatory at Mt. Portella (Abruzzo, Italy), managed by the University of L'Aquila and CETEMPS. In particular, ISAC-CNR provided a state-of-art instrument for the ozone monitoring (Thermo 49i) and implemented the system for the execution of automatic zero/span checks.

As defined by the original Project plan, at the Mont Blanc (4,720 m) preliminary works for the installation of a new AWS have been carried out (base realization). The weather station has already been assembled during the first year of the Project: it will be installed in collaboration with ARPA Valle d'Aosta in the year 2015. The management of the station and the validation of the data collected will be carried out by URT Ev-K2-CNR in collaboration with ARPA Val d'Aosta.

As part of the International collaboration within the SusKat (Sustainable Atmosphere for the Kathmandu Valley) Project, we continued the observation activities and the study of atmospheric composition at the Observatory "Paknajol" in Kathmandu. Suskat contribute to the ABC Project by UNEP and it is coordinated by the Institute for Advanced Sustainability Studies (IASS) in Potsdam in collaboration with ICIMOD (International Centre for Integrated Mountain Development). ISAC-CNR, in collaboration with the URT Ev-K2-CNR, verified the correct execution of the measurements (ozone, black carbon equivalent, size distribution of particles, particle count full, meteorology, solar radiation). In particular, we analyzed the day-to-day variations of the different monitored parameters, by interacting with the local Nepali staff in order to fix instrumental problems. The data obtained for the period February 2013 - January 2014 were submitted to the General Portal by way of the GeoNetwork system. In May 2014, the ozone analyzer was compared against a reference instrument.

We continued the analysis of the data collected at the Observatory of Paknajol (see D1.1.5). In particular, the results concerning the comparison of the SLCFs (Short - Lived Climate Forcers) at Paknajol and at the NCO-P Observatory in the Himalayas were presented at the *EGU 2014 General Assembly* (Vienna, 2014). We also presented the results concerning the possible influence of synoptic scale transport, biomass burning emissions and intrusion of stratospheric air masses at the Kathmandu measurement site.

During the reference period, the staff by URT EV-K2-CNR and ISAC-CNR participated to institutional meeting in the framework of programs and projects related to the investigation of atmospheric composition in mountain environment (GEO, CACC).

Measurement site	Country/Continent		Class	Elevation (m a.s.l.)
Osservatorio Portella del Gran Sasso (centralApennines)	Italy	Europe	ATM	
Suskat Observatory (Kathmandu, Nepal)	Nepal	Asia	ATM	1,250
Pyramid Laboratory Observatory (Khumbu valley, Himalayas)	Nepal	Asia	AWS	5,050
Pheriche (Khumbuvalley, Himalayas)	Nepal	Asia	AWS	4,258
Namche Bazaar (Khumbu valley, Himalayas)	Nepal	Asia	AWS	3,560
Lukla (Khumbuvalley, Himalayas)	Nepal	Asia	AWS	2,660
Kala Patthar (Khumbu valley, Himalayas)	Nepal	Asia	AWS	5,600
ChangriNup Station (Khumbu valley, Himalayas)	Nepal	Asia	AWS	5,700
Urdukas (Baltoroglacier, Karakorum)	Pakistan	Asia	AWS	3,926
Askole (Baltoroglacier, Karakorum)	Pakistan	Asia	AWS	3,015
Concordia (Baltoroglacier, Karakorum)	Pakistan	Asia	AWS	4,700
Deosai Observatory (Karakorum)	Pakistan	Asia	ATM	4,200
Mt. Stanley (Elena glacier, Rwenzori)	Uganda	Africa	AWS	4,700

**Tab. 1. Measurement stations within WP1.1 (AWS: automatic weather station, ATM: atmospheric composition observatory).**

### 3.2 Applications; technological and computational aspects

Implementation of a system for the automatic execution of zero/span check for the ozone analyser Thermo 49i.

### 3.3 Formation

Davide Putero – PhD in Geophysics (Bologna University).

Dr. Giacomo Agrillo – participation to the seminar on data validation of snow level data by automatic sensors at the Genova University (June, 25<sup>th</sup>, 2014).

The new Paknajol station leader has been trained and, during the maintenance campaign on Spring 2014, the local staff at the Pyramid Laboratory was trained also.

During the spring and autumn campaigns, URT Ev-K2-CNR trained the local Nepali staff about the new configuration of the AWS along the Khumbu valley.

### 3.4 Dissemination

None planned.

### 3.5 Participation in conferences, workshops, meetings

PUTERO D., CRISTOFANELLI P., ADHIKARY B., MARINONI A., DUCHI R., CALZOLARI F., LANDI T.C., VERZA G.P., ALBORGHETTI M., VUILLERMOZ E., RUPAKHETI M., LAWRENCE M., BONASONI P., (2014): Study of short-lived climate forcers atmospheric variability at Kathmandu and at the WMO/GAW Global Station. *European Geoscience Union General Assembly 2014*, Vienna, Austria, 27 April - 2 May.

FUZZI S., MARINONI A., COGO A., CRISTOFANELLI P., MAIONE M., ARDUINI J., VUILLERMOZ E., BONASONI P. (2014): SCLP emissions impact on mountain regions of the Himalayas. *CCAC Side Event COP 20 UNFCCC*, Lima, Perù, 1-12 December 2014.

*GEO X Plenary Session*, Genève: Side event: *The role of Mountain Ecosystem in GEO Work Program*, 14 January 2014.

## 4. Results obtained during the reference period

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

- Database of meteorological measurements carried out by AWS listed by Table 1.
- Database of atmospheric composition measurements at Kathmandu: surface ozone, equivalent black carbon, integrated particle number (November - December 2014), aerosol size distribution (particle diameter from 280 nm to 10 µm), PM10, PM1, meteorological parameters and solar radiation fluxes (January - December 2014).
- Database of atmospheric composition measurements at the Deosai National Park: surface ozone, equivalent black carbon, aerosol size distribution (particle diameter from 280 nm to 10 µm), meteorological parameters (January - May 2014).

### 4.2 Publications

SALERNO F., GUYENNON N., THAKURI S., VIVIANO G., ROMANO E., VUILLERMOZ E., CRISTOFANELLI P., STOCCHI P., AGRILLO G., MA Y., AND TARTARI G., (2014): Weak precipitation, warm winters and springs impact glaciers of south slopes of Mt. Everest (central Himalaya) in the last two decades (1994–2013). *The Cryosphere Discuss.*, 8, 5911-5959.

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

- Meteorological data from the AWS network: see Deliverable D1.1.5.
- "Climatic Atlas" for the AWS Namche, Lukla, Periche e Pyramid (file xls).
- Kathmandu "Paknajol" Observatory (February 2013 - January 2014): ozone, equivalent black carbon, integrated particle number ( $20 \text{ nm} \leq D_p < 3 \text{ }\mu\text{m}$ ); aerosol size distribution ( $0.28 \text{ nm} \leq D_p < 10 \text{ }\mu\text{m}$ ), PM10, PM2.5 (only February - March 2013), PM1 (April - December 2013), meteorological parameter, solar radiation (measurement status: ongoing; format: ascii; status: validated data; data provider: ISAC-CNR, URT EV-K2-CNR; data accessibility: Geonetwork).
- Kathmandu "Paknajol" Observatory (February- December 2014): ozone, equivalent black carbon, integrated particle number ( $20 \text{ nm} \leq D_p < 3 \text{ }\mu\text{m}$ ); aerosol size distribution ( $20 \text{ nm} \leq D_p < 3 \text{ }\mu\text{m}$ ), PM10 - PM1 (February 2014), meteorological parameter, solar radiation (measurement status: ongoing; format: ascii; status: raw data; data provider: ISAC-CNR, URT EV-K2-CNR; data accessibility: upon request to data provider).

-Deosai Observatory (October 2014 – May 2015): ozone, equivalent black carbon; aerosol size distribution ( $0.28 \text{ nm} \leq D_p < 10 \text{ }\mu\text{m}$ ), meteorological parameters (measurement status: suspended; format: WDCGG and WDCA; status: validated data; data provider: ISAC-CNR, URT EV-K2-CNR; data accessibility: Geonetwork).

#### *4.4 Completed Deliverables*

D1.1.5: Report describing the third year activities and the data submission to NextData archives and to the general Portal.

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

Due to the lack of the expected funds, we were unable to strengthen and continue the atmospheric observation programs at the Deosai National Park (Pakistan). For the same reason, the upgrade activities at the Mt. Portella (Abruzzo) were limited. In the framework of the activities related to the execution of experimental campaigns, at the International Pyramid Observatory an international experimental campaign for the investigation of the aerosol particle formation processes was hosted. However, since due to customs problems, the campaigns was postponed to October – November 2014, we were still not able to compile the related Deliverable (D1.1.6).

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

Continuation of the measurement and investigation activities within the different “focus” regions: Himalayas, Karakorum e Rwenzori. Continuation of the QA/QC and validation activities for the data from the AWS network in Himalaya, Karakorum e Rwenzori. Conclusion of the upgrade activities of the AWS network in Himalayas.

Continuation of the measurement, QA/QC and study activities concerning the atmospheric composition at the Kathmandu hot-spot (Nepal).

Continuation of the upgrade activities at the Mt. Portella Observatory (Italian Apennines) and upgrade of the AWS network in the Italian Alps.

Continuation of the integration and data sharing with international programs and projects (es. GMES, GEO, ABC, CCAC).

Submission of the data recorded during the third year to the NextData archives.