Project of Strategic Interest NEXTDATA

Deliverable D1.2.3
Report describing the activities, data transfer to archives and to the General Portal

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Italian Institutions are managing two Global Stations belonging to the GAW-WMO programme: the Italian Climate Observatory "O. Vittori" at Monte Cimone (2165 m asl, northern Apennines) and the Nepal Climate Observatory – Pyramid (5079 m a.s.l., Nepal). Thanks to their location at high altitudes, the measurements performed at these Global Stations are considered well representative of wide geographical areas, which allows an effective characterization of atmospheric variability over large regions and long time frames for two regions (the Mediterranean basin and the Himalayas) particularly affected by anthropogenic pressures and climate change. Here we provide information about the activities, data transfer to archives and to the General Portal during the first year of the NextData Project.

The observations and study activities have been continued at the GAW-WMO global station Monte Cimone (GAW ID: CMN) and Nepal Climate Observatory – Pyramid (GAW ID: PYR), as already started within the SHARE project (Figure 1). Within this framework, activities were carried out concerning instrument calibrations and data validations for trace gases (greenhouse and reactive), atmospheric aerosol (chemistry and physics), meteorological parameters and solar radiation fluxes (short-wave and long-wave) observations, according to the guidelines of the GAW-WMO and BSRN (Baseline Surface Radiation Network) programme. The list of the atmospheric measurements is reported in the Annex 1.
During the reference period, data of atmospheric composition were submitted to the GAW-WMO data-bases (http://ds.data.jma.go.jp/gmd/wdcgg/, http://ebas.nilu.no/Default.aspx). Data will be also shared with the NextData General Portal, once it is available. The status of data availability at the two global stations, is reported in this deliverable D1.2.3. To have a timely update of data behavior and availability at these stations, a near-real time (NRT) visualization system has been implemented at the ISAC HQs in Bologna. This allow for timely pre-validation and inspection of data. During the reference period, after final QA/QC processing, we submitted the data of atmospheric composition to the GAW-WMO reference data-bases (World Data Center for Greenhouse gases: http://ds.data.jma.go.jp/gmd/wdcgg/, World Data center for Aerosol: http://ebas.nilu.no/Default.aspx). Annex 1 reports the parameters that were submitted to these data-bases. These data will be also shared with NextData General Portal, once it will be operative.

Nepal Climate Observatory – Pyramid (NCO-P)

At the Nepal Climate Observatory – Pyramid (NCO-P), the technical upgrade of the power supply system was performed, as well as the enlargement of the station laboratories (a photovoltaic system for the production of 10.3 kW/h was built and a new set of batteries for energy storage was installed). The experimental set-up was strengthened by installing a new system for the monitoring and on-line characterization of PM1, PM10, and the aerosol size distribution in the accumulation and coarse fraction ranges. Moreover, technical and logistic support was provided, as well as the electrical power for the installation of a Mercury analyzer working within the UE Project GMOS (Global Mercury Observation System).
In collaboration with ENEA-UTMEA, the Partners are redefining the strategy for the measurements of solar radiation fluxes at the GAW-WMO Global Station NCO-P by acquiring new instrumentation (pyranometer and pirgeometer).
During March – April 2012, a maintenance campaign was undertaken at NCO-P for checking and calibrating the experimental set-up. Technicians and researchers from URT Ev-K2-CNR, ISAC BO, LGGE-CNRS and the Pyramid personnel, participated in this campaign. Taking advantage of the scheduled inspection, ISAC-BO personnel also assessed the results of the major technical interventions carried out at NCO-P, as also reported in deliverable D1.2.1.

To fulfill the recommendations of the GAW-WMO Joint Scientific Committee (JSC) to begin measurements of precipitation chemistry at the GAW-WMO Global Station NCO-P, during June – July, URT Ev-K2-CNR personnel implemented and upgraded the set-up for rainfall analysis (both sampling and storage systems). The sampling activity started on 18 June, 2012 on a daily basis until the middle of August and afterwards on a weekly basis until the end of October 2012. Starting from winter, a protocol for snow precipitation sampling has been adopted (one sample/week)

Figure 1. The NCO-P GAW-WMO Global Station after the upgrade.

Also thanks to the interaction with WCC-EMPA personnel and according to the GAW-WMO guidelines and strategic plans (2008-2013), a feasibility study was performed to upgrade the greenhouse gas observations at the GAW-WMO Global Station NCO-P (and at other remote observatories) by installing a CRDS (cavity ring-down spectroscopy) system (see deliverable D1.2.2). The system will allow simultaneous and continuous measurements of carbon dioxide, carbon monoxide, methane and water vapor. In particular, the availability of continuous measurements of CO and CO_2 (well-known tracers of combustion processes) will allow to perform the evaluation of the emission and enhancement ratios for other atmospheric compounds (both trace gases and aerosol), thus permitting the study of the influence of anthropogenic emissions (e.g. biomass burning vs. industrial). Also to support these observational activities, from November 2012 a fellowship (1 year) has been activated at the ISAC-BO. In this framework, in order to estimate the biomass burning emission impact at NCO-P, a preliminary analysis concerning black carbon (BC) measurements at 7-wavelength (λ= 370, 470, 520, 590, 660, 880 and 950 nm) has been carried out. Data were collected in the framework of the SHARE Project during the spring campaign 2011 at NCO-P by using an aethalometer (Magee Scientific). According to Wang et al. (Characterization of residential wood combustion particles using the two-wavelength aethalometer. Environ. Sci. Technol. 45, 7387-7393, 2011), we derived a parameter (Delta C = $BC_{370\ nm} - BC_{880\ nm}$, Fig. 2), capable to estimate the BC fraction directly deriving from biomass burning. These wavelenghts were specifically selected since the organic fraction within the biomass burning plumes is usually characterized by a stronger absorption at 370 nm than at the 880 nm wavelength. The analysis will be continued in the next reference period of the Project, also comparing the obtained results with independent analysis (e.g. source-receptor analysis based on the combined investigation of open fire detection by satellite and atmospheric transport modeling).

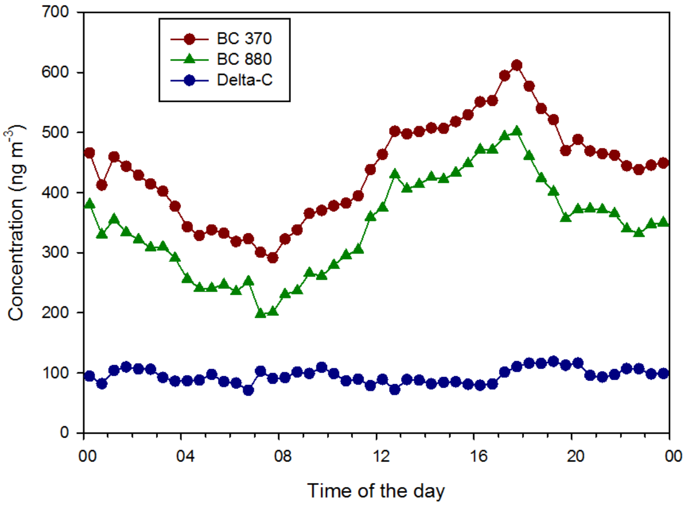

Figure 2. NCOP: 13rd April – 28th May 2011. Average diurnal variations for BC concentrations at 370 nm (red dots), 880 nm (green triangles) and Delta-C (blue dots).

Monte Cimone – "O. Vittori" Station (ICO-OV)

At the GAW-WMO Global Station Monte Cimone (fig. 3), the first audit by the WCC ("World Calibration Center for Surface Ozone, Carbon Monoxide, Methane and Carbon Dioxide" of GAW) was hosted on 24-26 September, 2012. ISAC-BO, in collaboration with WCC personnel (hosted by EMPA), managed and coordinated both the preparation of the audit as well as the research activities carried out during the audit at the Italian Climate Observatory "O. Vittori". This activity, whose results will be made available in the coming months, focused on the measurement of surface ozone, carbon monoxide, methane and nitrous oxide, with special emphasis on the instrumental set-up, calibration scales and QA/QC procedures at the station.
According to the "scientific questions" (deliverable D1.1.1), also thanks to the interaction with the EU Project ACTRIS, a project was defined for the realization of an advanced monitoring system for the measurement and investigation of NOx at the GAW-WMO Global Station Monte Cimone and at other remote Observatories (see deliverable D1.2.2). Moreover, the implementation of SO2 measurements has been planned.

Figure 3. Italian Climate Observatory "O. Vittori" part of the GAW-WMO Global Station at Monte Cimone during winter.

On July 2012, at the GAW-WMO global station Monte Cimone, the NDIR system for the continuous monitoring of carbon monoxide concentrations has been upgraded. To adapt such an instrument for working in a remote site like Monte Cimone, according with specific indication from the WCC-EMPA, we performed a feasibility study (see deliverable D1.2.2) that lead to the implementation of several modifications to the instrumental set-up as well as to the procedures for the handling of the measurement. This allowed for a significant improvement of the measurement accuracy. In particular, the accuracy of the measurements, in terms of relative standard deviation over daily repeated analysis of the 500 nmol/mol certified CO standard (15 minutes per day) is 4 %, with a total expanded uncertainty of 8 % (k=2).
At the GAW-WMO Global Station Monte Cimone, the experimental set-up for monitoring the atmospheric aerosol was upgraded by installing a new system for the on-line determination of PM1 and PM10 (β-absorption) offering the possibility of storing samples for off-line chemical analysis. The system was the object of a feasibility study reported in deliverable D1.2.2, finalized to improve the sampling system in extreme weather conditions. The instrument (SWAM 5A MONITOR, FAI Instrument S.r.L), which provides 12-hour average values of PM1 and PM10, was coupled with an optical particle counter (OPC monitor, FAI Instrument S.r.L), which provides the on-line aerosol size distribution in the accumulation and coarse ranges with 1-min resolution. This system is currently under technical maintenance. Also with the aim of supporting the new experimental programmes with suitable manpower, a fellowship (duration: 1 year) was activated at CNR-ISAC Bologna in October 2012. In this framework, an automatic procedure for the validation of BC data has been developed and applied to the Mt. Cimone time series. The procedure was based on the adoption of the following validation rules:
1. a despiking function conceived for removing spike noise from data is used. This function considers first and second derivatives of time series signals; further details are reported in Mori et al., (*Noise of acoustic Doppler velocimeter data in bubbly flow, Journal of Engineering Mechanics, American Society of Civil Engineers, Volume 133, Issue 1, pp.122-125; 2007*);
2. a quality check on whole data has been performed, by setting an arbitrary threshold to the relative variation between contiguous data collected on one-minute intervals;
3. according to the elaboration level (one-minute, 30-minute or daily) the instrumental detection limit is used to filter the whole time series.
In September 2012, a new surface ozone analyzer (Thermo Tei 49i) was installed at the "O. Vittori" Station. After one year of intercomparison with this new instrument, the UV-absorption analyzer (Dasibi 1108) which has been working at this station from 1996, will be de-activated or used as a back-up instrument.
In October 2012, a self-built LIDAR system (developed at the CNR-ISAC laboratories in Rome) with backscatter (BL) depolarization lidar (DL) with night-time Raman capabilities (RL) was installed at Monte Cimone, with the aim of evaluating the feasibility of upgrading remote observatories with similar advanced instrumentation. The laser is a diode pumped Nd-YAG (manufactured by Bright Solutions), with second-harmonic generation and active Q switching. Technical details are given in the deliverable D1.2.2. The instrument was located on the equipped terrace of the laboratory. Even if the system was already operative immediately after the installation, the beginning of experimental activity had to be postponed until 16 November, 2012, due to the delay in obtaining the permit to operate (NOTAM) from the National Aviation Authorities. The results of this study (see deliverable D1.2.2) indicated that the LIDAR systems appeared to be working properly (see Fig. 4) even if at this remote observatory no continuous presence of personnel is possible. However, despite a specifically-designed cleansing system (already successfully operated at Artic locations) embedded within

the LIDAR, the feasibility study indicated the necessity to deploy the system in the interior of the station, due to the very adverse weather conditions that can occasionally affect the measurement site.

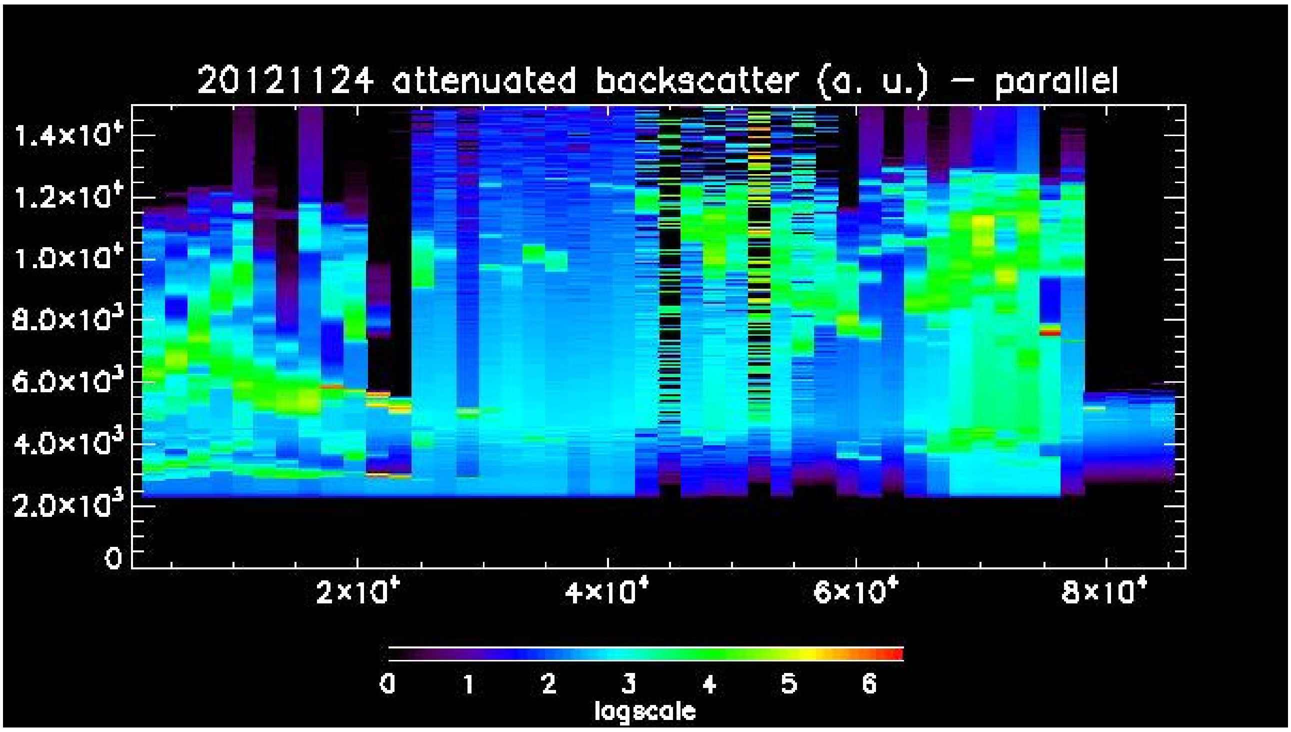

Figure 4. Colour coded time series of background subtracted range corrected signal from the polarized channel, from subsequent 30 s measurement sessions, vs altitude. The evolution of the atmospheric aerosol content can be traced during the day. Data are reported in arbitrary units.

Data availability

Data Availability for the "O. Vittori" GAW-WMO Global Station at Monte Cimone (part of the data-series were obtained in the framework of SHARE and other Research Projects):

Meteorology: Start date: January 1996; End date: Ongoing; Instrument: IRDAM WS7000: Vaisala WS425; Validated data availability: from January 1996 to December 2011; Data Format: Excel files; Data provider: CNR-ISAC

O3 mixing ratio: Start date: January 1996; End date: Ongoing; Instrument: Daisibi 1108 W/GEN; Validated data availability: from January 1996 to December 2011; Data Format: WDCGG Version 1.0; Data provider: CNR-ISAC

CO mixing ratio (NDIR): Start date: June 2012; End date: Ongoing; Instrument: Thermo Electron Tei 48C; Validated data availability: from June 2012 to December 2012; Data Format: Excel files; Data provider: CNR-ISAC

CO mixing ratio (GC-RGD and GC-FID): Start date: February 2007; End date: Ongoing; Instrument: customized GC-RGD (RGD2-Trace Analytical) and GC-FID (Agilent 6890N); Validated data availability: from February 2007 to December 2011; Data Format: WDCGG Version 1.0; Data provider: Urbino University/CNR-ISAC

CH4 mixing ratio (GC-FID): Start date: January 2008; End date: Ongoing; Instrument: Agilent GC6890; Validated data availability: from January 2008 to October 2012; Data Format: WDCGG Version 1.0; Data provider: Urbino University/ CNR-ISAC

N2O, SF6 mixing ratio (GC-ECD): Start date: November 2008; End date: Ongoing; Instrument: Agilent GC6890; Validated data availability: from January 2008 to October 2012; Data Format: WDCGG Version 1.0; Data provider: Urbino University/ CNR-ISAC

Solar radiation (at λ 350 – 1100 nm and λ 280 – 315 nm): Start date: April 2004; End date: Ongoing; Instrument: silicon cell pyranometer (Skye SKS110) and a silicon photodiode (Skye SKU 430); Validated data availability: from April 2005 to December 2009; Data Format: Excel files; Data provider: CNR-ISAC

Size distribution of atmospheric aerosol in the 10 – 500 nm range: Start date: November 2005; End date: Ongoing; Instrument: customized Differential Mobility Particle Sizer (DMPS); Validated data availability: from November 2005 to December 2011; Data Format: NASA-AMES; Data provider: CNR-ISAC

Size distribution of atmospheric aerosol in the 300 – 20000 nm range: Start date: August 2002; End date: Ongoing; Instrument: Grimm 1.108 Optical Particle Counter; Validated data availability: from August 2002 to December 2011; Data Format: Excel files; Data provider: CNR-ISAC

Aerosol scattering coefficient at 525 nm: Start date: May 2007; End date: Ongoing; Instrument: M9003 integrating nephelometer (ECOTECH); Validated data availability: from May 2007 to December 2011;Data Format: NASA-AMES; Data provider: CNR-ISAC

Aerosol number concentration: Start date: March 2008; End date: Ongoing; Instrument: condensation particle counter (TSI model 3772); Validated data availability: from March 2008 to December 2011; Data Format: NASA-AMES; Data provider: CNR-ISAC

Aerosol absorption coefficient at 635 nm: Start date: May 2005; End date: Ongoing; Instrument: MAAP, Model 5012 – Thermo Electron Corporation; Validated data availability: from May 2005 to December 2011; Data Format: NASA-AMES; Data provider: CNR-ISAC

Concentration of 222Rn: Start date: 2008; End date: Ongoing; Instrument: Genitron Radon Monitor; Validated data availability: from 2008 to December 2012; Data Format: Excel files

Data Availability for the Nepal Climate Observatory - Pyramid GAW-WMO Global Station (these data-series have been obtained in the framework of the SHARE and UNEP-ABC Projects):

Aerosol number concentration and size distribution in the range 250 nm to 32 µm: Start date: March 2006; End date: Ongoing; Instrument: Grimm 190 Optical Particle Counter; Validated data availability: from March 2006 to December 2011; Data Format: MS Excel.

Aerosol number concentration and size distribution in the range 10 nm to 650 µm: Start date: March 2006; End date: Ongoing; Instrument: Self-built SMPS; Validated data availability: from March 2006 to February 2008; Data Format: MS Excel.

Aerosol absorption coefficient at 635 nm: Start date: March 2006; End date: Ongoing; ; Instrument: MAAP, Model 5012 – Thermo Electron Corporation; Validated data availability: from March 2006 to December 2011; Data Format: NASA-AMES.

Total and back scattering coefficient at 450, 550 and 700 nm: Start date: March 2006. End date: Ongoing. Instrument: Integrating Nephelometer TSI 3563: Validated data availability: from March 2006 to December 2008; Data Format: NASA-AMES.

Aerosol optical depth: Start date: March 2006. End date: Ongoing. Instrument: CIMEL Electronique 318A; Validated data availability: from March 2006 – December 2012 (Level 1.5 data). Data Format: AERONET.

Ozone mixing ratio: Start date: March 2006; End date: Ongoing; Instrument: Thermo Electron Tei49C; Validated data availability: from March 2006 to December 2011; Data Format: WDCGG Version 1.0.

Greenhouse Gases mixing ratio (halogenated): Start date: March 2006; End date: Ongoing; Instrument: flask sampling (off-line analysis at the Mt. Cimone GAW-WMO station); Validated data availability: from March 2006 to October 2011; Data Format: MS Excel.

Chemical mass closure of aerosol (PM_{10}): Start date: March 2006; End date: Ongoing; Instrument: home made high-volume (Hi-Vol) system running behind a DIGITEL PM10 pre-separator. Validated data availability: from March 2006 to June 2008; Data Format: MS Excel.

Wet precipitation chemistry: The sampling campaign started in June 2012 and end in October and will be repeated in the summer monsoon season of 2013. Chemical analysis of rain samples are in process; Data format: MS Excel.

Solar irradiance (at λ: 200 - 3600 nm): Start date: March 2006; End date: Ongoing; Instrument: Pyranometer CMP21 Kipp&Zonen; Validated data availability: from March 2007 to March 2011; Data Format: ASCII.

IR irradiance (at λ 3.5 to 50 \302\265m): Start date: March 2006; End date: Ongoing; Instrument: Precision Infrared Radiometer-PIR Eppley; Validated data availability: from March 2007 to March 2011; Data Format: ASCII.

Meteorology (temperature, relative humidity, atmospheric pressure, wind direction and intensity): Start date: March 2006; End date: Ongoing; Instrument: Vaisala WXT520; Validated data availability: from March 2006 to December 2011;Data Format: WDCGG Version 1.0.

The temporal availability, for the year 2012, of the measurements in the framework of GAW-WMO, is reported in the Annex 1, for the two Global Stations "O. Vittori" – Monte Cimone and Nepal Climate Observatory – Pyramid.

In addition to the data-set already inserted in public data-bases (GAW-WDCGG, GAW-WDCA, ABC-DISC, ABC_ADAC, AERONET, see Annex 2 and 3 for details) and until the NextData General Portal will be activated, the validated data from the two global stations are available on-request by contacting the WP responsible.

ANNEX 1- TEMPORAL AVAILABILITYOF THE MEASUREMENTS IN THE FRAMEWORK OF GAW-WMO FOR THE TWO GLOBAL STATIONS “O. VITTORI” – MONTE CIMONE AND NEPAL CLIMATE OBSERVATORY – PYRAMID

“O. VITTORI” – MONTE CIMONE (GAW-ID: CMN)

Measurements	**JFM**	**AMJ**	**JAS**	**OND**
Carbon monoxide (NDIR)				
Carbon monoxide (GC-FID)				
Surface ozone				
Methane				
Nitrous Oxide				
Sulfur Hexafluoride				
Total particle number concentration				
Equivalent black carbon concentration/aerosol absorption coefficient 635 nm				
Aerosol scattering coefficient at 525 nm				
Size distribution of atmospheric aerosol in the 10 – 500 nm range				
Aerosol chemistry				

NEPAL CLIMATE OBSERVATORY – PYRAMID (GAW ID: PYR)

Measurements	**JFM**	**AMJ**	**JAS**	**OND**
Surface ozone				
Air temperature				
Atmospheric pressare				
Relative humidity				
Wind direction				
Wind Intensity				
Rain precipitation				
Equivalent black carbon concentration/aerosol absorption coefficient 635 nm				
Wet precipitation chemistry				

LEGEND:
♦ More than 75 % of data available
♦ Data availability between 50 and 75 %
♦ Less than 50 % of data available
♦ Instrument not installed

ANNEX 2- PUBLIC DATA AVAILABILITY FOR THE GLOBAL STATION "O. VITTORI" – MONTE CIMONE

"O. VITTORI" – MONTE CIMONE (GAW-ID: CMN)

Measurements	GAW-WDCGG	GAW-WDCA
Carbon monoxide (GC-RGD)	2007-02-01 - 2010-03-01	
Carbon monoxide (GC-FID)	2008-01-01 - 2011-12-31	
Surface ozone	1996 - 2011	
Methane	2008-07-01 - 2011-12-31	
Nitrous Oxide	2008-01-01 - 2011-12-31	
Sulfur Hexafluoride	2008-01-01 - 2011-12-31	
Total particle number concentration		2008-01-01 2011-01-01
Equivalent black carbon concentration/aerosol absorption coefficient 635 nm		2007-01-01 2010-01-01
Aerosol scattering coefficient at 525 nm		2007-01-01 2012-01-01
Size distribution of atmospheric aerosol in the 10 – 500 nm range		2006-01-01 2011-12-31
Aerosol chemistry		2009-02-24 2009-12-16

LEGEND:

♦**GAW-WDCGG**: Global Atmosphere Watch - World Data Center for Greenhouse Gases (http://ds.data.jma.go.jp/gmd/wdcgg/wdcgg.html)

♦**GAW-WDCA**: Global Atmosphere Watch - World Data Center for Aerosol (http://ebas.nilu.no/Default.aspx)

ANNEX 3- PUBLIC DATA AVAILABILITYOF FOR THE GLOBAL STATION NEPAL CLIMATE OBSERVATORY – PYRAMID

NEPAL CLIMATE OBSERVATORY – PYRAMID (GAW ID: PYR)

Measurements	**GAW-WDCGG**	**GAW-WDCA**	**ABC-DISC**	**ABC-ADAC**	**AERONET**
Aerosol number concentration and size distribution in the range 250 nm to 32 µm			2006-3-1 2006-12-31	2006-3-1 2010-12-31	
Aerosol number concentration and size distribution in the range 10 nm to 650 µm			2006-3-1 2006-12-31	2006-3-1 2006-12-31	
Total and back scattering coefficient at 450, 550 and 700 nm			2006-3-1 2006-12-31	2006-3-1 2006-12-31	
Aerosol optical depth			2006-3-1 2007-2-28	2006-3-1 2007-2-28	2006-3-27 2011-12-31
Surface ozone	2006-3-1 2011-12-31		2006-3-1 2006-12-31	2006-3-1 2011-12-31	
Chemical mass closure of aerosol			2006-2-20 2006-12-6	2006-2-20 2006-12-6	
Greenhouse Gases mixing ratio (halogenated)			2006-3-1 2007-2-28	2006-3-1 2007-2-28	
Meteorology	2006-3-1 2011-12-31		2006-3-1 2006-12-31	2006-3-1 2011-12-31	
Equivalent black carbon concentration/aerosol absorption coefficient 635 nm		2006-3-1 2011-12-31	2006-3-1 2006-12-31	2006-3-1 2011-12-31	

LEGEND:

♦**GAW-WDCGG**: Global Atmosphere Watch - World Data Center for Greenhouse Gases (http://ds.data.jma.go.jp/gmd/wdcgg/wdcgg.html)

♦**GAW-WDCA**: Global Atmosphere Watch - World Data Center for Aerosol (http://ebas.nilu.no/Default.aspx)

♦**ABC-DISC:** Atmospheric Brown Clouds Data and Information Service Center (http://www.rrcap.ait.asia/abc/data/abc/)

♦**ABC-ADAC:** Atmospheric Brown Clouds Asia Data Analysis Center (http://abc-data.snu.ac.kr/; autentication required)

♦**AERONET**: Aerosol Robotic Network (http://aeronet.gsfc.nasa.gov/cgi-bin/webtool_opera_v2_new)