WMO/IOC/UNEP/ICSU
GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)

Doc. 4.7
(23.II.09)

1st GRUAN Implementation-Coordination Meeting (ICM-1)
Norman, Oklahoma, USA
2-4 March 2009

Item 4.7

Site report: Italy – Potenza (Tito Scalo)

(Submitted by V. Cuomo (CNR-IMAA))

Summary and Purpose of Document

This document contains an overview of the Potenza (Tito Scalo) measurement programme run by CNR-IMAA with respect to GRUAN requirements, and addresses the questions to be discussed in this session.

GRUAN ICM-meeting

CNR-IMAA

Description of the site

The IMAA (Istituto di Metodologie per l'Analisi Ambientale) is an Institute of the Italian National Research Council (CNR), a public organization of great relevance in the field of scientific and technological research.

The CNR-IMAA research activities involve more than 100 researchers and make use of laboratories and facilities of international relevance in the field of the Earth Observation. CNR-IMAA is characterized by a high scientific productivity and a concrete support and technological transfer to end users. IMAA participate in a large number of national and international projects. The main research activities of CNR-IMAA concern the study of the atmosphere and the Earth's surface using remote sensing techniques, environmental and geophysical monitoring, the evaluation of the impacts of the anthropogenic activities and the implementation of models to assess the best resources allocation. The CNR-IMAA also operates a receiving/processing and storage system for satellite data: this system includes a HRPT (High Resolution Picture Transmission) antenna for receiving NOAA data.

The ground-based atmospheric observatory, operative at the CNR-IMAA, is located in Southern Italy on the Apennine mountains (40.60N, 15.72E, 760 m a.s.l.), less than 150 km from the West, South and East coasts. The site is in a valley surrounded by low mountains (<1100 m a.s.l.) and this location offers an optimal opportunity to study different kinds of weather and climate regimes. In fact, the observatory operates in a typical mountain weather strongly influenced by Mediterranean atmospheric circulation, resulting in generally dry, hot summers and cold winters. In this location phenomena like the orographic effects on cloud formation can be studied. Moreover the large number of dust and volcanic aerosols outbreaks observed each year at the facility along with the availability of simultaneous measurements of aerosol and clouds make the site optimal for the investigation of aerosol-cloud interactions within a continental boundary layer.

At present, in the frame of the ground-based atmospheric research, the CNR-IMAA is coordinating EARLINET-ASOS (European Aerosol Research Lidar Network - Advanced Sustainable Observation System) EU FP6 project, risen on the basis of the EARLINET infrastructure addressed to aerosol research and is partner of GEOMON EU FP6 project (Global Earth Observation and Monitoring). The facility also performs continuous aerosol measurements in the frame of AERONET. The infrastructure has been involved in several international experiment for the study of clouds and their modelling, such as EAQUATE, LAUNCH-2005, COPS-2007.

1. a) What is the site status with respect to the requirements outlined in GCOS-121 and GCOS-112 (priority 1 and 2)?

Priority 1

The status of the CNR-IMAA ground-based atmospheric observatory with respect to the minimal criterion of GRUAN priority 1 is the following:

a. Standard surface variables (pressure, temperature, humidity and wind) are routinely monitored using the VAISALA MILOS520 Automatic Weather Station. In the following table the main specifications of the sensors equipping the station are reported.

Parameters	Sensor	Measuring range	Measuring interval	Measuring accuracy
Air temperature	HMP45D	-50...+50 °C	60 s	±0.2 °C (at 20 °C)
Relative humidity	HMP45D	0....100 %	60 s	±1 % RH (0 ... 90 % RH), ± 1.7 % RH (90…100%)
Precipitation	RG13H	0...200 mm	60 s	0.2 mm (Sensitivity)
Wind Speed	WAA151	0...75 m/s	1 s	± 0.17 m/s (Standard deviation)
Wind Direction	WAV151	0....360°	1 s	better than ± 3°

Moreover, additional sensors for the measurements of present weather and rain gauge are available.

b. Balloon-based observations of temperature, pressure, humidity and winds using different measurement techniques can be performed with three different systems. The VAISALA AS13 autosonde system is able to perform up to 24 fully automatic launches. Other two manual VAISALA radiosouding systems are available (MW21 and PP15). The MW21 is able also to collect wind measurements. These three systems allow to perform multiple radiosoudings. Recently, several tests with multiple balloon launches using different radiosonde types (RS-80, RS-90 and RS-92) taking advantage of the availability of multiple channels have been performed to assess and diagnose instrument failure and characterize instrument biases. In this sense a first comparison with a frost hygrometer is planned in 2009. GPS/radar height on balloons is also available. Radiosouding launches are usually performed using RS92-SGP. The equipment to perform ozonesoudings is also available. Measurements are usually made both on ascent and descent of the balloon.

c. GPS measurements are not currently performed in Potenza. However, at the CNR-IMAA a ground-based Trimble GPS receiver is available even though it is used for different applications. The data are freely accessible and the implantation of the suitable algorithm, in cooperation with the experts in this field, could allow to implement measurements of total column water vapour.

Priority 2

The status of the CNR-IMAA ground-based atmospheric observatory with respect to the minimal criterion of the priority 2 is the following:

a. A surface radiation automatic station is currently deployed in Potenza, even though it is not yet operational. The objective is to operate it during 2009 and to ask for the access to the Baseline Surface Radiation Network. The station is designed according to the BSRN requirements and it is equipped with the following sensors:

Instrument	Spectral Range	Sensitivity
Pyrheliometer CH1	200 - 4000 nm (50 % points)	11 μV/W/ m^2
Pyrgeometer CG4	4.5 - 42 μm	10 μV/W/ m^2
2 Pyranometer CM22	200 - 3600 nm (50% points)	10 μV/W/m^2

The sensors are managed by a sun tracker.

b. A microwave profiler MP3014, manufactured by Radiometrics Corporation, for temperature water vapour and cloud profiling in the troposphere up to 10 km above the ground. The MP3014 also provides retrievals of the integrated water vapour and liquid water. The system is able to perform a 3D scanning of the sky and is equipped with a special system for the mitigation of rain effects.

c. Measurements of the cloud base height are routinely performed with three different sensors: the Jenoptik CHM15k ceilometer, able to measure cloud base height up to 15 km above the ground with a vertical resolution of 15 m; the VAISALA CT25k ceilometer, able to measure cloud base height up to 7.5 km above the ground with a vertical resolution of 30 m; measurements of the cloud base temperature are available from an Heimann ElectroOptics infrared thermometer measuring the zenith sky brightness temperature within the spectral range of 9.6 to 11.5 μm, with a resolution of 0.1 K and an accuracy of 0.5 K.

d. Measurements of the water vapour mixing ratio of the optical properties of clouds are routinely performed with PEARL (Potenza EArlinet Raman Lidar), using the EARLINET time schedule. Water vapour measurements accuracy is of 5-10 % up to 8 km above the ground with a temporal resolution of 10 minutes. On 30 minutes resolution similar accuracies are achievable up to 12 km.

e. The CIMEL CE-318 sunphotometer measures atmospheric aerosol columnar properties and it is operative within AERONET. It is able to provide the aerosol optical depth (AOD) at 340, 378, 440, 500, 613, 870, 940, 1020 and 1640 nm, along with the water vapor column content and the retrieval of the microphysical aerosol properties, such as the refractive index and the size distribution.

f. MIRA36 meteorological Ka-Band cloud radar. It is a magnetron based pulsed Ka-Band Doppler radar for unattended long term observation of atmospheric clouds. This system is able to provide high accurate measurements of the cloud top height with a vertical resolution up to 15 m. The system is also equipped with 3D scanning unit.

g. AERI multi-channel infrared radiometer could be available by the end of 2010.

h. Integrated trace gas measurements are currently not available, but they could be available, in particular for ozone, methane and COx by the end of 2010.

Moreover, the retrieval of aerosol optical and microphysical properties and their vertical and temporal variability is performed using measurements provided by PEARL multi-wavelength lidar.

b) Which guidelines/manuals do you use when taking measurements, if any?

Currently, no guidelines/manuals are used for taking the measurements of interest for GRUAN. Aerosol/water vapour lidar measurements are systematically performed on the base of a fixed scheduling. A rigorous quality assurance program is applied both for instruments and evaluation algorithms, and a standardized data exchange format is used. The writing of guidelines for each instrument of the observatory is currently under evaluation.

c) What is your data dissemination practice?

Dissemination of the CNR-IMAA scientific results are achieved in the following ways:

- Participation and organization in conferences and workshops;

- Organization and participation to measurement campaign, also with mobile facilities;
- Participation to activities at Pan-European level, sponsored by the EU;.
- Results published in the regular scientific media;
- An active policy to invite users to the observatory and for the exchange of expertise;
- The existent web-site (www.imaa.cnr.it) advertises the national and international activities of the observatory as well as its methodologies, objectives, publications and new scientific results;
- Open days events;

A dedicated website will be implemented by the end of 2010 for the visualization of the quick-looks of the measurements performed with all the instruments operative at the facility.
The access to the data archive of Potenza site is based on the request of the data to an instrument PI or to the coordinator of the experimental field

2. What do you need from the Lead Centre / working group / secretariat?

The starting of the GRUAN activities will better evidence the need of the sites with respect to the Lead Center. At this level, we requires to the Lead Centre / working group / secretariat an effort in a "fast response" support in case of questions about the network operation and about news on actions to gain support from the scientific community, sponsors, and funding agencies.
Moreover, we expect a strong support from the Lead Centre / working group regarding to the methodologies to apply for the instrument calibration/intercomparison/validation and for the protocols for data dissemination.

3. Are there any scientific or organizational developments we should be aware of?

The long expertise gained in lidar remote sensing and more recently also in using passive techniques has conducted to have a role of excellence in the international community of atmospheric studies. Highlights in their expertise include:
- design and implementation of lidar systems for aerosols, water vapour and cloud measurements.
- development of Raman lidar systems for the night-time/daytime measurements of water vapour and liquid water.
- definition of measurement protocols, quality assurance and data managing;
- definition of suitable strategy for the satellite CAL/VAL;

In the last few years, the scientific developments allowed to extend the atmospheric research at CNR-IMAA also to the following topics:
- development of algorithms for the integration of lidar and microwave measurements for cloud profiling;
- measurement campaigns involving the full exploitation of the synergy between active and passive sensors;
- evaluation of the performance of numerical weather prediction models using lidar and radiometry.

Concerning the organizational developments, so far the CNR-IMAA strongly operates in order to provide quality-controlled data on the vertical profiles of clouds, humidity, temperature and aerosols. Long-term measurements for aerosols and clouds climatology represent the main topic of the CNR-IMAA ground-based atmospheric observatory. They have been performed following the EARLINET measurement protocol and using operational active and passive instruments. The data quality has been pursued through several actions:

- Established protocol for lidar measurement (EARLINET) aerosol/water vapour, according to the needs for the establishment of a long-term statistically significant database for climatological studies.
- Intercomparison of instruments both by comparing different techniques measuring the same atmospheric key variables and by comparing instruments of the same type (e.g comparison of two MP3014 microwave profiler carried out in Lindenberg at DWD during LAUNCH-2005 measurement campaign).
- Exchange of expertise with the main European atmospheric observatories (e.g. Lindenberg, Cabauw, Chilbolton).
- Participation to GAW-GALION (Global Atmospheric Watch - LIdar Observation Network), with the aim to provide the vertical component of the spatio-temporal distribution of aerosol properties through advanced laser remote sensing in a network of ground-based stations (http://www.wmo.int/pages/prog/arep/gaw/gaw-reports.html).
- Contribution to the WMO Sand and Dust Storm Warning System (SDSWS), in the frame of the World Weather research programme, to improve dust storm forecasts (http://www.wmo.int/pages/prog/arep/wwrp/new/documents/SDS_WAS_draft_implementation_plan.pdf).

Main references

- Mona, L., A. Amodeo, M. Pandolfi, Pappalardo G. (2006). Saharan dust intrusions in the mediterranean area: three years of lidar measurements in potenza. journal of geophysical research. vol. 111, d16203 ISSN: 0148-0227. doi:10.1029/2005jd006569.
- Pappalardo G., A. Amodeo, L. Mona, M. Pandolfi, N. Pergola, V. Cuomo. (2004). Raman lidar observations of aerosol emitted during the 2002 etna eruption. geophysical research letters. vol. 31 issn: 0094-8276. doi:10.1029/2003gl019073.
- Pappalardo G., A. Amodeo, M. Pandolfi, U. Wandinger, A. Ansmann, J. Bosenberg, V. Matthias, V. Amiridis, F. de Tomasi, M. Frioud, M. Iarlori, L. Komguem, A. Papayannis, F. Rocadenbosch, X. Wang. (2004). Aerosol lidar intercomparison in the framework of earlinet. part III. Raman lidar algorithm for aerosol extinction, backscatter and lidar ratio. Applied Optics. vol. 43 n. 28, pp. 5370-5385 issn: 0003-6935.
- J. P. Taylor ,W. Smith, V. Cuomo, A. Larar, D. Zhou, C. Serio, T. Maestri, R. Rizzi, S. Newman, P. Antonelli, S. Mango, P. Di Girolamo, F. Esposito, G. Grieco, D. Summa, R. Restieri, G. Masiello, F. Romano, G. Pappalardo, G. Pavese, L. Mona, A. Amodeo, G. Pisani, EAQUATE – An International Experiment For Hyper-spectral Atmospheric Sounding Validation, accepted for pubblication on Bullettin of American Meteorology Society, 2007.
- L. Mona, C. Cornacchia, G. D'Amico, P. Di Girolamo, G. Pappalardo, G. Pisani, D. Summa, X. Wang, V. Cuomo, Characterization of the heterogeneity of the humidity and cloud fields as observed from a cluster of ground-based lidar systems, Volume 133, Issue S3, Pages: 257-271, Date: December 2007.
- Daniel K. Zhou, W.L. Smith, V. Cuomo, J.P. Taylor, C.D. Barnet, P. Di Girolamo, G. Pappalardo, A.M. Larar, X. Liu, S.M. Newman, C. Lee, and S.A. Mango, Retrieval validation during the European Aqua Thermodynamic Experiment, Volume 133, Issue S3, Date: December 2007, Pages: 203-215.