The Boundary-layer Air Quality-analysis Using Network of Instruments (BAQUNIN) Super-Site for Satellite Atmospheric Chemistry Products Validation


1) Serco SpA
2) Physics Department, “Sapienza” University of Rome
3) EUMETSAT
4) CNR-ISAC
5) ARPA Valle d'Aosta, Saint-Christophe, Aosta
6) ESA/ESRIN
**Context**: IDEAS+ support contract (ESA/ESRIN SPPA) and PANDONIA project (ESA)

**Purpose**: Joint instrumental suite for validating the satellite atmospheric composition and optical products (level 2), and for Planetary Boundary Layer (PBL) studies.

**Super Site concept**: Ground based active and passive remote sensing instruments are operating in synergy, offering quantitative and qualitative information for a wide range of atmospheric parameters for atmospheric chemistry (satellite) validation activities and Planetary Boundary Layer (PBL) studies.
The atmospheric data acquired during BAQUNIN lifetime will be made available to the scientific community, and will contribute to the validation of the aerosol and tropospheric trace gases products produced by the Copernicus Sentinel-5p, Sentinel-4 and Sentinel-5 and by the ESA Third Party Missions (TPM), such as the Ozone Monitoring Instrument (OMI).
The list of the **BAQUNIN** Super Site instrumentation comprises:
The list of the BAQUNIN Super Site instrumentation comprises:

- **CIMEL** photometer
  - H2O, AOD
  - [340, 380, 440, 500, 675, 870, 1020] nm

[LINK](http://aeronet.gsfc.nasa.gov/)
The list of the **BAQUNIN** Super Site instrumentation comprises:

- **CIMEL** photometer
- **PANDORA 2S** Spectrometer
  
  [290 - 900] nm
  
  O$_3$, NO$_2$
  
  (Other trace gases, H$_2$O, AOD)

PANDORA 2S #115
The list of the BAQUNIN Super Site instrumentation comprises:

- **CIMEL** photometer
- **PANDORA 2S** Spectrometers
  - [290 - 900] nm
  - $O_3$, $NO_2$
  - (Other trace gases, $H_2O$, AOD)

Pandonia Network
http://www.pandonia.net

PANDORA 2S #117
The list of the **BAQUNIN** Super Site instrumentation comprises:

- **CIMEL** photometer
- **PANDORA 2S** Spectrometers
- **POM 01 L PREDE** sun-sky radiometer
  
  [340, 400, 500, 675, 870, 940, 1020] nm

**Aerrosols:**
  
  Optical depth
  Angstrom coefficient
  Volume size distribution
  Asymmetry factor
  Refractive index
  
  (Column amount of H2O)

[Euroskyrad network](http://www.euroskyrad.net/)
The list of the BAQUNIN Super Site instrumentation comprises:

- **CIMEL** photometer
- **PANDORA 2S** Spectrometers
- **POM 01 L PREDE** sun-sky radiometer
- **Multi Filter Rotating Shadow-band Radiometer**
  - AOD [496, 624, 670, 878] nm
  - (O₃, H₂O)
  - Integration time 1 min
The list of the **BAQUNIN** Super Site instrumentation comprises:

- **CIMEL** photometer
- **PANDORA 2S** Spectrometers
- **POM 01 L PREDE** sun-sky radiometer
- **MFRSR** radiometer
- **LIDAR**, Raman and elastic (total and parallel polarization) 
  [355, 532, 1064] nm
  Day/night measurements
  Aerosol and H$_2$O profiles
  Top and bottom heights of clouds
  Vertical resolution 7.5 m
  Integration time $\geq 1$ min
The list of the BAQUNIN Super Site instrumentation comprises:

- **CIMEL** photometer
- **PANDORA 2S** Spectrometers
- **POM 01 L PREDE** sun-sky radiometer
- **MFRSR** radiometer
- **LIDAR**, Raman and elastic
- **SODAR**
  - Day/night measurements
  - Wind speed and direction profiles in PBL
  - Vertical resolution 1.5 m
  - Integration time ≥ 1 sec
The list of the **BAQUNIN** Super Site instrumentation comprises:

- **CIMEL** photometer
- **PANDORA 2S** Spectrometers
- **POM 01 L PREDE** sun-sky radiometer
- **MFRSR** radiometer
- **LIDAR**, Raman and elastic
- **SODAR**
- **BREWER** spectrophotometer
  \(\text{O}_3, \text{NO}_2\)

EuBrewnet

http://rbcce.aemet.es/eubrewnet
The list of the BAQUNIN Super Site instrumentation comprises:

- **CIMEL** photometer
- **PANDORA 2S** Spectrometers
- **POM 01 L PREDE** sun-sky radiometer
- **MFRSR** radiometer
- **LIDAR**, Raman and elastic
- **SODAR**
- **BREWER** spectrophotometer
- **PYRANOMETER** radiometer [290 -3000] nm
The list of the BAQUNIN Super Site instrumentation comprises:

- **CIMEL** photometer
- **PANDORA 2S** Spectrometers
- **POM 01 L PREDE** sun-sky radiometer
- **MFRSR** radiometer
- **LIDAR**, Raman and elastic
- **SODAR**
- **BREWER** spectrophotometer
- **PYRANOMETER** radiometer
- **YES** broad-band UV radiometer
  UV radiation
- **Meteorological** sensors
  Air temperature and relative humidity
The list of the BAQUNIN Super Site instrumentation comprises:

- **CIMEL** photometer
- **PANDORA 2S** Spectrometers
- **POM 01 L PREDE** sun-sky radiometer
- **MFRSR** radiometer
- **LIDAR**, Raman and elastic
- **SODAR**
- **BREWER** spectrophotometer
- **PYRANOMETER** radiometer
- **YES** broad-band UV radiometer
- **Meteorological** sensors

**Rural**

**CIRAS** (CNR Isac Rome Atmospheric Supersite) Tor Vergata

**Urban**

CIRAS website:
http://www.isac.cnr.it/it/infrastrutture/ciras-cnr-isac-rome-atmospheric-supersite
Water Vapor Total Column amount
CIMEL photometers

CIMEL data: http://aeronet.gsfc.nasa.gov/

Time lag ≤ 1 min

Location altitude:
- ESA/ESRIN 200m
- CNR 130m
Aerosol Optical Depth
CIMEL photometers

CIMEL data: http://aeronet.gsfc.nasa.gov/

Rural
Aerosol Optical Depth
MFRSR/Prede radiometers

Urban
O3 total column amount

Rural

Urban

OMI data: giovanni.sci.gsfc.nasa.gov
NO2 total column amount

Rural

Urban

OMI data: giovanni.sci.gsfc.nasa.gov
Aerosol Backscattering coefficient profiles
Elastic LIDAR system

Δz = 7.5 m
Δt = 5 min
Water vapor mixing ratio profiles
Raman LIDAR system

Δz = 7.5 m
Δt = 5 min
Strategy for Satellite Validation

- All instruments (except Lidars) operate continuously
- Synchronisation of Lidar acquisitions with Satellite(s) overpass (2 hours before and after overpass time)
- Pandora operated in order to maximise FOV overlap at overpass
- Most of the acquired data processed in near-real-time
- Satellite and BAQUNIN data stored on 16 TB NAS

Strategy for PBL studies

- Campaign-based
- All instruments operate continuously (Lidar day & night)
- Off-line processing
- Data analysis
Conclusions

- Instruments located in urban and rural environments
- Some instruments to be properly calibrated
- Other products from the instruments will be available

- Measurements strategy for Satellite Atmospheric Chemistry Validation
- Urban Boundary Layer studies

- The overall system should be ready by the first months of the next year
- Website for BAQUNIN data download
- Possible collaboration with CNR Isac
## BAQUNIN Staff

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jonas von Bismarck</td>
<td><a href="mailto:Jonas.Von.Bismarck@esa.int">Jonas.Von.Bismarck@esa.int</a></td>
<td>ESA ESRIN</td>
</tr>
<tr>
<td>Stefano Casadio</td>
<td><a href="mailto:Stefano.Casadio@esa.int">Stefano.Casadio@esa.int</a></td>
<td>SERCO / ESA ESRIN</td>
</tr>
<tr>
<td>Anna Maria Iannarelli</td>
<td><a href="mailto:Annamaria.Iannarelli@serco.com">Annamaria.Iannarelli@serco.com</a></td>
<td>SERCO / Univ. Sapienza</td>
</tr>
<tr>
<td>Marco Cacciani</td>
<td><a href="mailto:Marco.Cacciani@uniroma1.it">Marco.Cacciani@uniroma1.it</a></td>
<td>Univ. Sapienza</td>
</tr>
<tr>
<td>Andrea Scoccione</td>
<td><a href="mailto:AndreaScoccione@libero.it">AndreaScoccione@libero.it</a></td>
<td>Univ. Sapienza</td>
</tr>
<tr>
<td>Monica Campanelli</td>
<td><a href="mailto:Campanellimonica@gmail.com">Campanellimonica@gmail.com</a></td>
<td>CNR Tor Vergata</td>
</tr>
<tr>
<td>Annamaria Siani</td>
<td><a href="mailto:Annamaria.Siani@uniroma1.it">Annamaria.Siani@uniroma1.it</a></td>
<td>Univ. Sapienza</td>
</tr>
</tbody>
</table>
Thank you for your attention!