Monitoring of Urban Atmosphere using remote sensing and in situ technique at the BAQUNIN (Boundary-layer Air Quality-analysis Using Network of Instruments)

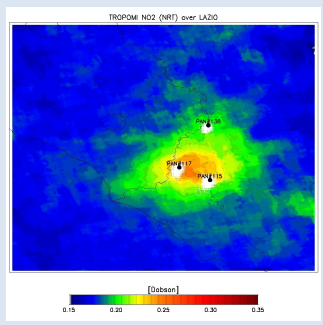
Marco Cacciani (1), Stefano Casadio (2,3), Anna Maria Iannarelli (3), Monica Campanelli (4), Anna Maria Siani(1), Stefania Argentini (4), Enrico Cadau (5), Daniele Di Erasmo (3), Gabriele Mevi (3) e Cristiana Bassani (6), G. Liberti (4), D. Dionisi (4)

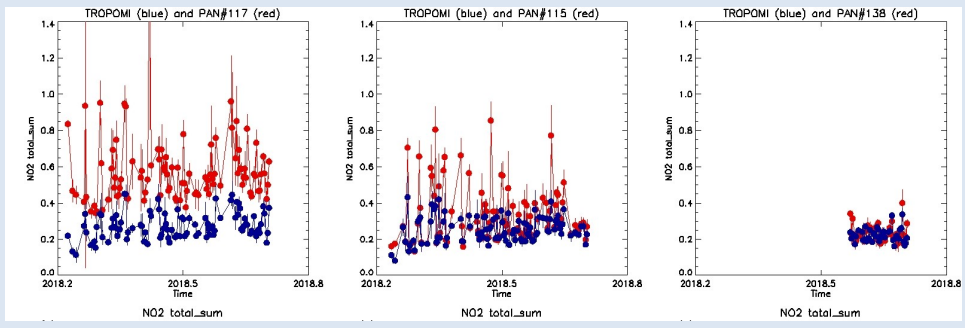
(1) Sapienza Università di Roma, (2) ESA/ESRIN EOP-GMQ, Frascati, Italy, (3) SERCO, Frascati, Italy, Italy, (4) CNR-ISAC,Roma, Italy, (5) Sardegna Clima Onlus, (6) CNR-IIA, Monterotondo, Roma, Italy

Satellite validation

The Sentinel 5p ground resolution (7 × 3.5 km) is so high that validation of tropospheric species for inhomogeneous environment (e.g. urban) requires a "dense" network in order to investigate the role of:

- Highly variable surface reflectance on retrieval algorithms
- Seasonal changes of probed atmosphere/surface from satellite and ground based instruments
- Possibility to validate the "background" NO2



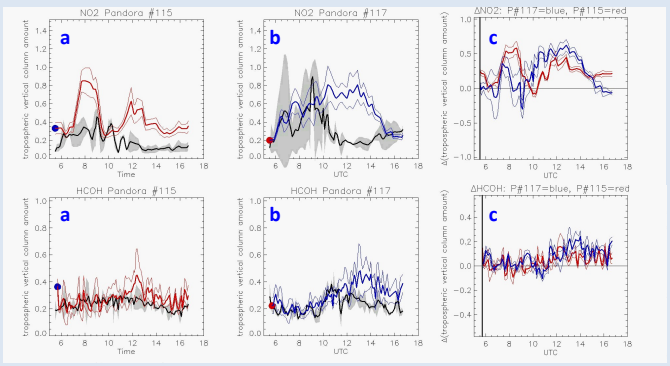


In this panel the NO2 values acquired by TROPOMI (Sentinel 5p) during the period 9 March - 5 June are compared to the observation obtained by the Pandora instruments belonging to BAQUNIN Super Site.
The figure on the left shows NO2 values from TROPOMI in urban and semi-rural and the white dots indicates the location of Pandoras.
The comparison between NO2 values from TROPOMI (blue) and each Pandora instrument (red):

- TROPOMI agrees with Pandora in semi-rural environment
- TROPOMI significantly underestimates Pandora in urban environment

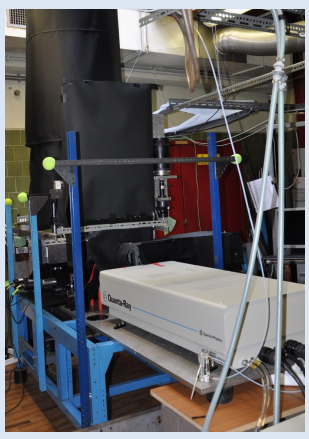
Air quality monitoring

On 5th of May, at around 6 UTC, a blaze started at the ECO-X rubbish depot in Pomezia, a municipality in the Metropolitan City of Rome (41°41′N, 12°30′E). The fire was active for about two days and the cloud of smoke was visible from several kilometres away. Observations from the BAQUNIN instruments revealed that the smoke plume was transported over Rome and in the Tiber Valley on May 5 and 6. In particular, data from the two PANDORA instruments #115 and #117 showed statistically significant increases of nitrogen dioxide (NO2) and formaldehyde (HCOH). These quantities are most suitable for the detection of pollution events, which usually impact the lowest portion of the atmosphere. It can be clearly seen that the tropospheric amounts of NO2 and HCOH are significantly higher with respect to the reference values. This exercise demonstrates that the BAQUNIN instrumental set-up is providing high quality and very significant information on air quality of the Rome area.

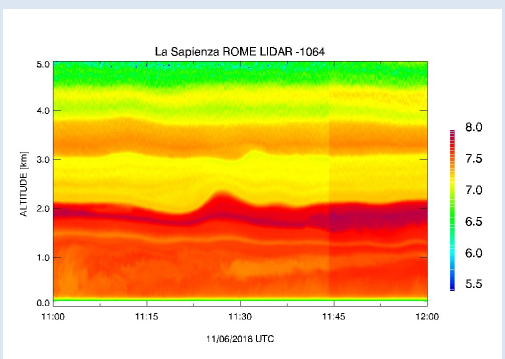


First line: time evolution of NO2 tropospheric column for the 5th of May from [a] PANDORA #115 (red lines) and [b] PANDORA #117 (blue lines). The black line is the average of same quantity using data from 4th and 7th of May, considered as reference values for "clean days". [c] Time evolution of the difference between NO2 values of May 5th and the "clean day" reference. This quantity indicates if a statistically significant difference is observed. Second line: the same of first line for Formaldehyde (HCOH)

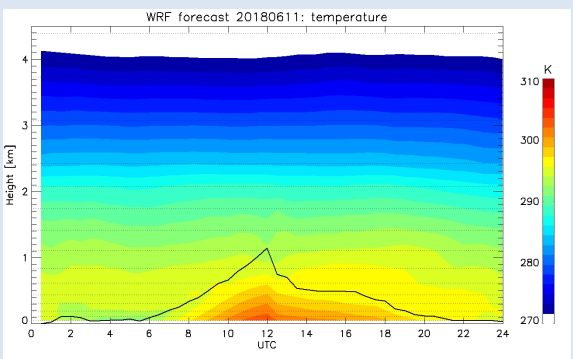
Urban Boundary Layer



A view of the Lidar system



Lidar is a powerful instrument for the observation of the Urban Boundary Layer (UBL), an environment characterized by large spatial inhomogeneities and fast time evolution. BAQUNIN Lidar provides vertical profiles of aerosol optical behaviour and of water vapour content with time and vertical resolutions large enough to observe most of the physical processes going on in the UBL. In this panel the observation of a wave, generated by the interaction between a breeze front and the diurnal UBL stratification, is reported as an example. Left plot shows the time evolution of the Lidar Range Corrected Signal at 1064 nm in a day characterized by a large dust loading in the lower troposphere, at the time when the breeze front passes above the site. The wave vertical and horizontal propagation is marked by the undulations in the boundaries of the aerosol layers. In the WRF simulation of the atmospheric temperature for the same period and location (right plot), provided by the SERCO/Sardegna Clima ONLUS, it is possible to observe the presence of a similar wavelike signature.



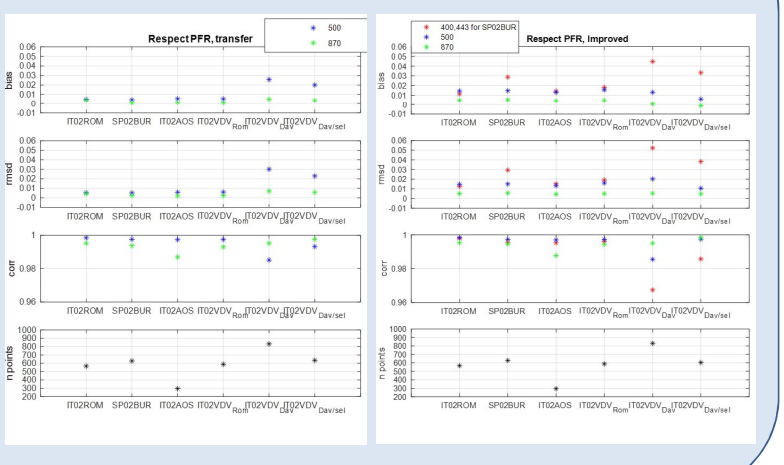
1st QUATRAM Campaign - QUAlity and TRaceabiliy of Atmospheric aerosol Measurements

Instrument	Institutions	Personnel
PREDE POM 01	ISAC-CNR	M.Campanelli
PREDE POM 01	University of Valencia	V. Estelles
PREDE POM 02	Arpa Valle D'Aosta	H. Diemoz
PREDE POM 01	Italian Air Force	Magg. S. Vergari
Cimel CE 318	ESRIN	M.Campanelli, A.M. Iannarelli
Pandora	ESRIN	A.M. Iannarelli (SERCO)
PFR	PMOD	S. Kazadzis, N.Kouremeti
MFRSR	University of Rome La Sapienza	M. Cacciani
MFRSR	ENEA	A.G. di Sarra
2 Middleton	ENEA	G. Pace
Microtop	ISAC - CNR	F. Barnaba

Aims:

1. Calibration of a primary master SKYNET sun-photometer by PMOD/WRC, Davos .
2. Transfer of calibration to other instrumentation, Rome.
3. Validation of on site calibration procedures for all the instruments where it is possible

Statistic analysis of the AOD's comparison between PFR and all the PREDE POM's involved in the campaign using calibration transfer (left) and on site calibration procedure (right).
Results show very good agreement also using the latter methodology, with both bias and RMSD below 0.01 and 0.02 at 870 and 500 nm, respectively.



BAQUNIN contribution to other Campaigns

- Lidar&Radiometer Measurement Campaign (LRMC-2017 - ACTRIS)
- Effect of Megacities on the Transport and Transformation of Pollutants on the Regional to Global Scales (EMeRGe)
- SOlar Radiation Based Established Techniques for aTmospheric Observations (SORBETTO) international summer school
- Valutazione Integrata dell'Esposizione a Particolato in ambiente indoor (VIEPI)

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