The Boundary-layer Air Quality-analysis Using Network of INstruments (BAQUNIN) supersite for Atmospheric Research and Satellite Validation over Rome area

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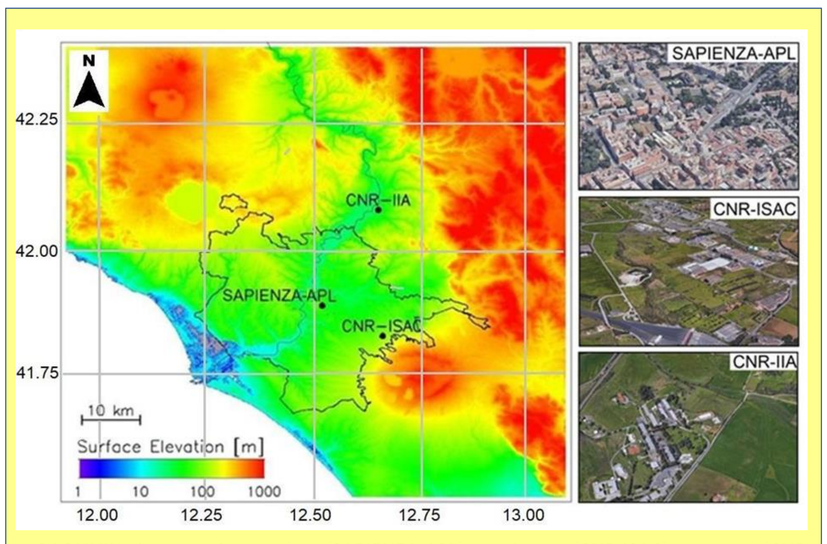
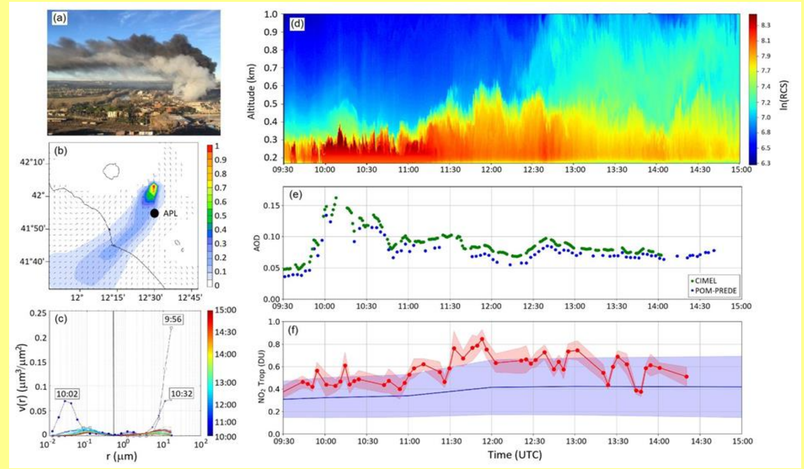
Abstract The Boundary-layer Air Quality-analysis Using Network of Instruments (BAQUNIN) supersite has been collecting pollutant concentrations/columns and meteorological parameters since 2017. Currently, BAQUNIN consists of three sites located in the city centre of Rome (Italy), and in the neighbouring semi-rural and rural areas. BAQUNIN is one of the first observatories in the world to involve several passive and active ground-based instruments installed in multiple measuring locations, managed by different research institutions, in a highly polluted urban environment not far from the Tyrrhenian coast. BAQUNIN has been promoted by the European Space Agency to establish an experimental research infrastructure for the validation of present and future satellite atmospheric products and the in-depth investigation of the planetary and urban boundary layers. Direct access to data and documentation is open to the citizen and scientific community at https://www.baqunin.eu. Specific datasets are available through international networks:

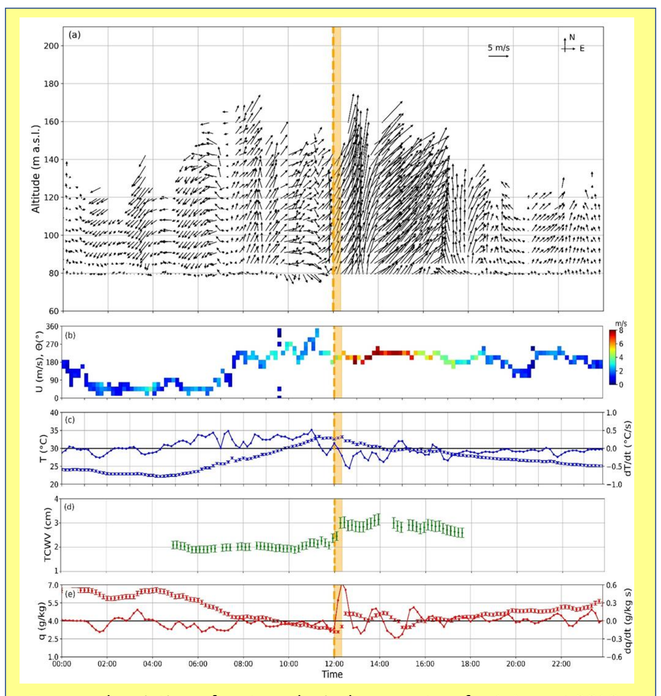
EVDC (https://evdc.esa.int/)
EUBREWNET (http://www.eubrewnet.org/eubrewnet)
AERONET (https://aeronet.gsfc.nasa.gov/)
PGN (https://www.pandonia-global-network.org/)
EUROSKYRAD (http://www.euroskyrad.net/)



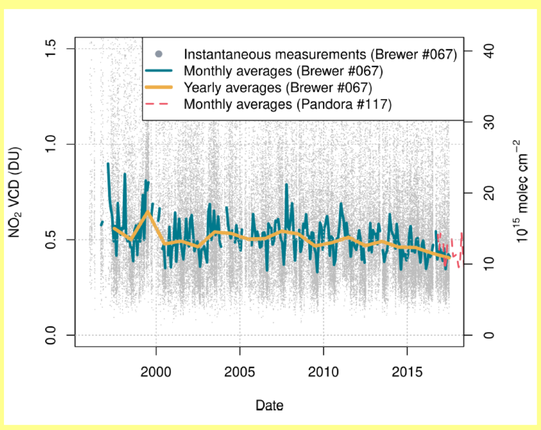
BAQUNIN sites locations: urban (SAPIENZA-APL), semi-rural (CNR-ISAC) and rural (CNR-IIA). Colours depict the Shuttle Radar Topography Mission (STRM) digital elevation model in log-scale. The black line displays the boundaries of the Rome municipality. Iannarelli et al. 2021



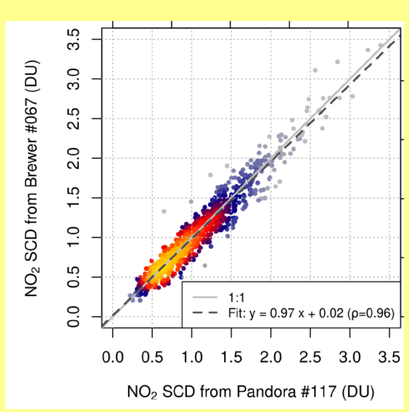
Plume generated by organic waste disposal plant fire on 11 December 2018 (Rome): (a) photo of the plume, (b) WRF dimensionless smoke concentration and wind field (150 m.a.s.l.) at 10:00 UTC, (c) volume size distribution from Prede-POM, (d) LIDAR LOG(RCS)1064 nm, (e) AERONET (green) and EUROSKYRAD (blue) AOD at 500nm, (f) NO2 tropospheric amount (red dotted line) with its uncertainty (red shaded area) compared to the 2016-2019 reference (blue line and shaded area).Iannarelli et al. 2021



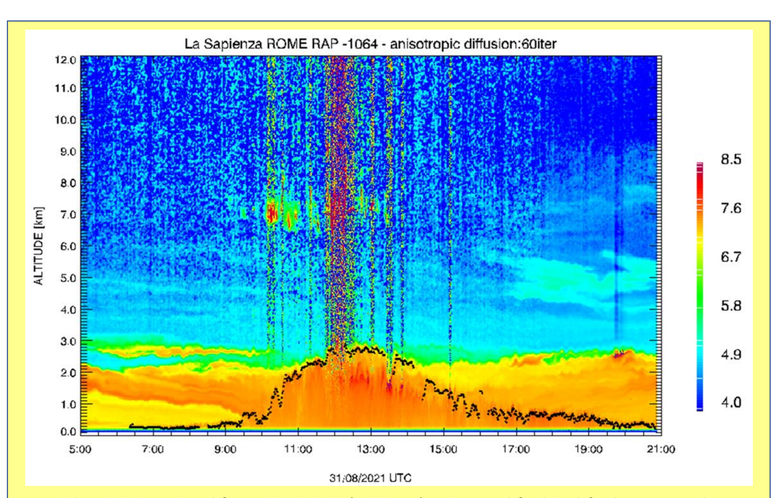
Temporal variation of meteorological parameters for 1 August 2019.
(a) 10-minutes averaged vertical profiles of horizontal wind velocity
(b) vertical-averaged wind velocity U (colours) and direction θ
(c) ground air temperature T
(d) total column water vapor TCWV
(e) specific humidity q
Continuous lines in panels (c) and (e) refer to the gradient of T and q. The orange-dotted line represents the arrival of the Sea-Breeze front. The orange-filled area depicts the time interval required for the complete development of the Sea-Breeze. Di Bernardino et al. 2021



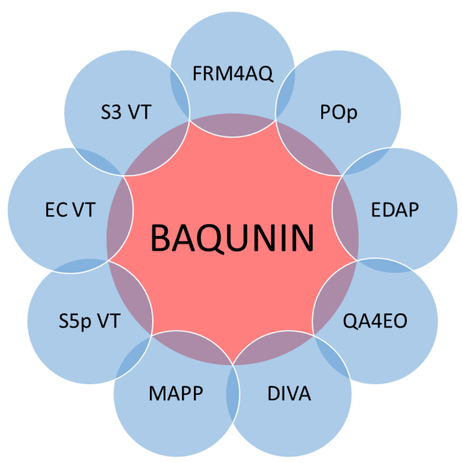
NO2 Total Column from Brewer (APL): instantaneous measurements (grey dots), monthly and yearly averages (continuous lines). The monthly averages of the retrievals from Pandora #117 are also shown for comparison (dashed line). Diémoz et al. 2021



Comparison of the NO2 slant column densities retrieved at APL from Brewer #067 and Pandora #117 considered as the reference. Diémoz et al. 2021



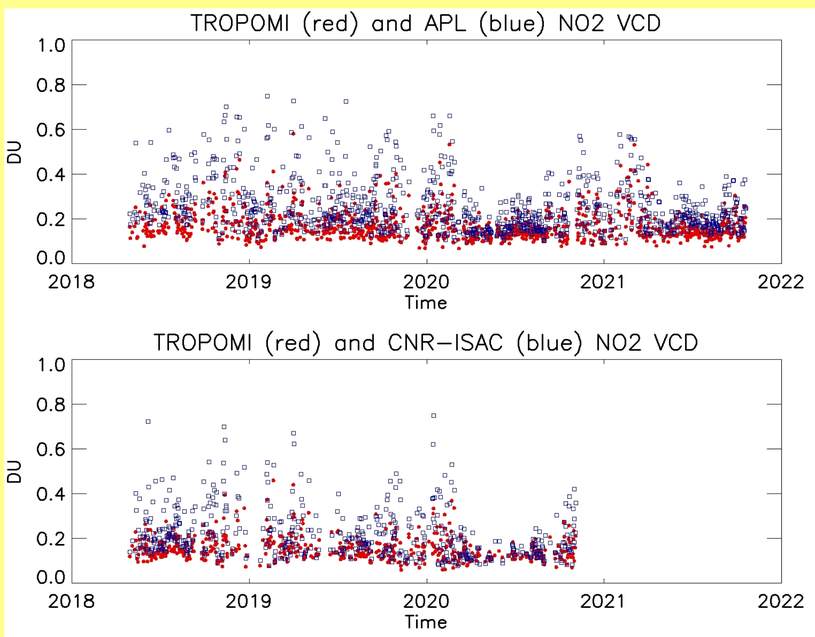
Urban MLH retrieval from LIDAR RCS (1064nm) using modified Pathfinder approach.



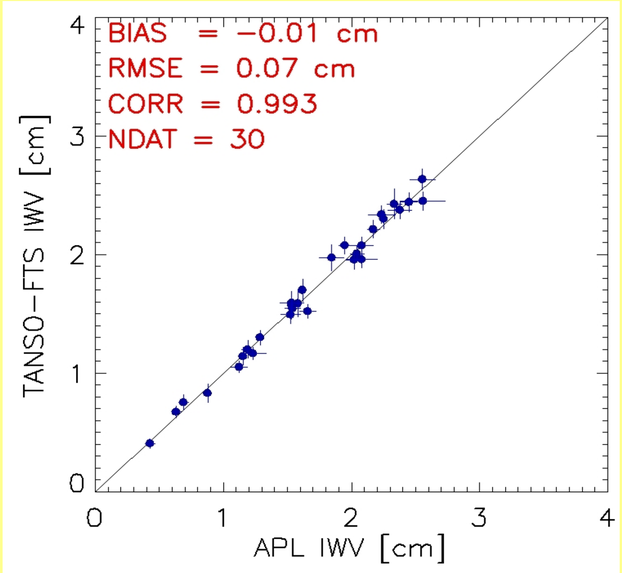
BAQUNIN links to other ESA activities

Remote sensing: LIDAR(s), Ceilometer, Pandora(s), SODAR, PREDE-POM(s), CIMEL, Pyranometer, Sky-Camera(s), Brewer
In situ: micro-barometer, air-quality (low-cost), meteorological station(s)
Atmospheric modelling: Weather Research and Forecasting (WRF) modeling system
Next to come (2022): FTIR (EM27SUN), disdrometer, air-quality (medium-cost)

https://www.baqunin.eu
@BaquninProject



TROPOMI (red) and BAQUNIN-PGN (blue) collocated NO2 Total Column time series. Upper panel APL (urban); lower panel: CNR-ISAC (semi-rural). For matchup data and methodology see: https://mpc-vdaf-server.tropomi.eu/



GOSAT TANSO-FTS vs. BAQUNIN-APL (AERONET) IWV. For more detailed description of methods and results see: BAQ-SCI-TEN-SER-016.pdf

Sun-Photometers inter-comparison QUATRAM-3 Campaign (Sep 2021). For more details on QUATRAM series:
https://www.isac.cnr.it/en/news/sorbetto2-international-school-quatram3-intercalibration-campaign
http://www.euroskyrad.net/quatram.html

References (most recent publications)

Di Bernardino et al., 2021, "*On the effect of sea breeze regime on aerosols and gases properties in the urban area of Rome, Italy*", Urban Climate 37, https://doi.org/10.1016/j.uclim.2021.100842

Diémoz et al., 2021, "*Advanced NO2 retrieval technique for the Brewer spectrophotometer applied to the 20-year record in Rome, Italy*", Earth Syst. Sci. Data, 13, 4929–4950, https://doi.org/10.5194/essd-13-4929-2021

Iannarelli et al. , 2021, "*The Boundary-layer Air Quality-analysis Using Network of INstruments (BAQUNIN) supersite for Atmospheric Research and Satellite Validation over Rome area*", accepted by Bull. Amer. Meteorol. Soc.

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