

Urban Air Quality Monitoring with Low-Cost Sensors

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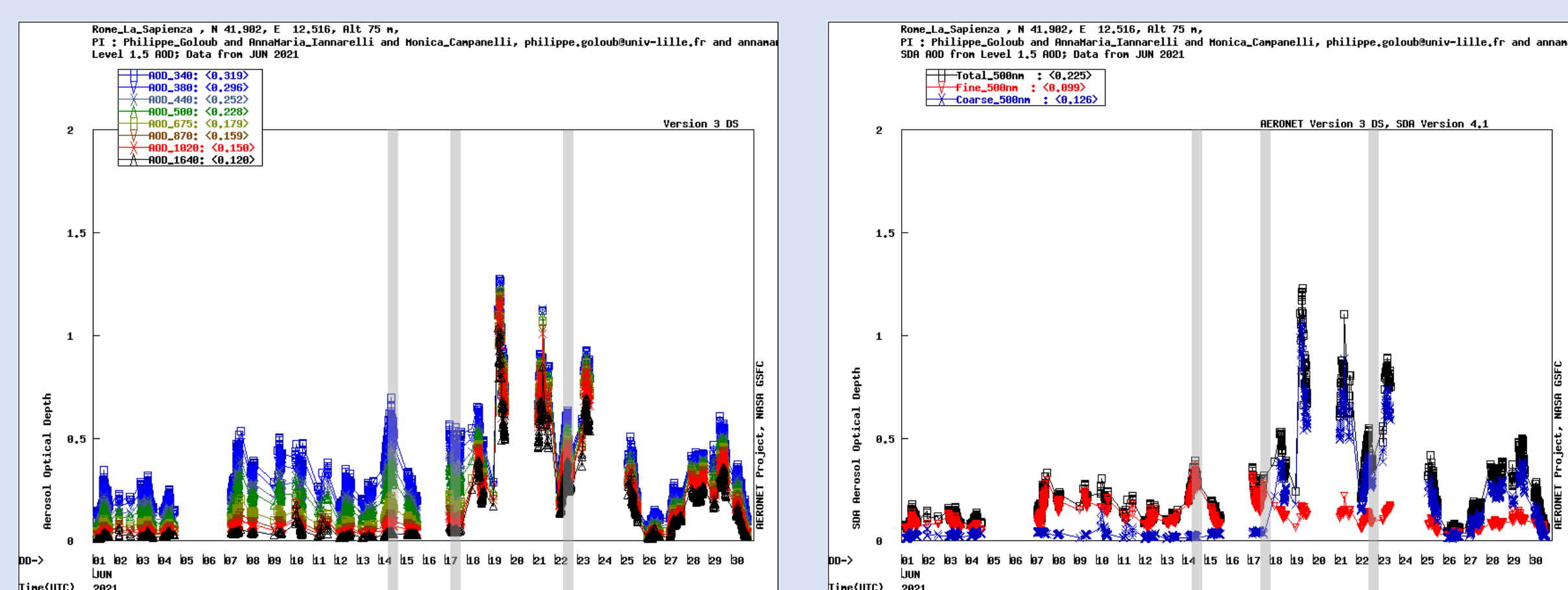
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Nowadays, dozens of air low costs sensors are commercially available on the market with costs ranging from a few to several hundred euros. At the same time, recent scientific studies have demonstrated through detailed reports independent evaluations of the performance of such sensors showing very promising results [1].

In the framework of the **BAQUININ** project (Boundary-layer Air Quality-analysis Using Network of Instruments) [2] funded by **ESA**, a set of low-cost off-the-shelf sensors has been selected, tested and integrated for building a dedicated Air Quality sensors unit. The main goal of this exercise was to create a portable and cost-effective station able to qualitatively measure the principal pollutant components in the urban areas environment with the possibility to perform also mobile measurements.

Measurements collected during one year of use were compared with in situ high accuracy instrumentation (e.g., Pandora, Sun-photometer, etc.) in order to perform an accurate and rigorous inter-comparison activity. In detail, the following air components and weather parameters have been monitored and cross-compared: NO₂, CO, CO₂, PM-2.5, PM-10, O₃, Air Temperature, Air Humidity, Atmospheric Pressure. General good agreements have been found when data have been compared with high reliability (and expensive!!!) sensors.

Low Cost PM - AERONET

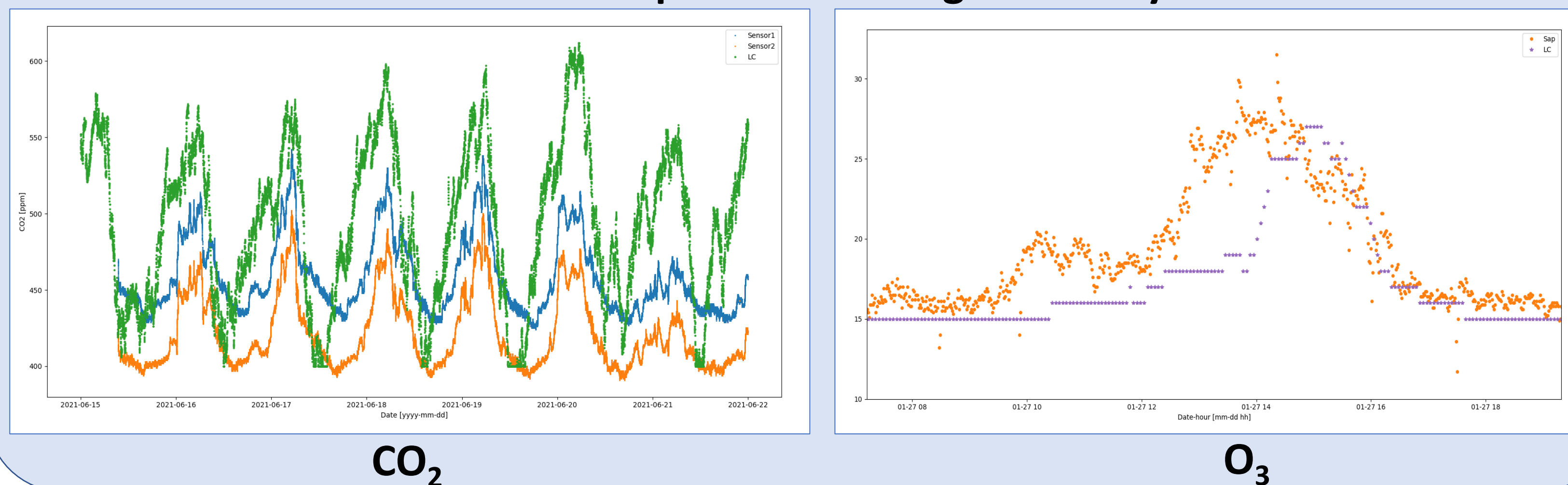


AERONET
Upper left: spectral AOD
Upper right: **Fine** and **Coarse** AOD

APL low-cost
Centre left: PM_{2.5}
Centre right: PM₁₀

Lower panel:
AERONET aerosol size distributions for:
Left -> 14th
Centre -> 17th
Right -> 22nd

APL Low-Cost comparison with high accuracy sensors



Conclusions:

In this work we presented the preliminary results of one year of data collected from our low-cost air quality station (APL Low-Cost) showing how the information can be exploited after a proper Intercomparison / calibration process. Despite data measured by low-cost sensors are often affected by unpredicted biases such sensors would allow the deployment of several copies to assess qualitatively air pollution at a finer spatial resolution than could be possible with traditional monitoring systems. This solution is particularly interesting for remote areas or developing countries, which do not have air quality monitoring networks and the necessary budgets for the acquisition of conventional analyzers.

References:

- [1] Federico Karagulian, Maurizio Barbiere, Alexander Kotsev, Alexander Kotsev et al. "Review of the Performance of Low-Cost Sensors for Air Quality Monitoring", DOI: 10.3390/atmos10090506
- [2] Anna Maria Iannarelli, Annalisa Di Bernardino, Stefano Casadio, Cristiana Bassani, Marco Cacciani, Monica Campanelli, Giampaolo Casasanta, Enrico Cadau, Henri Diémoz, Gabriele Mevi, Anna Maria Siani, Massimo Cardaci, Angelika Dehn, Philippe Goryl "The Boundary-layer Air Quality-analysis Using Network of Instruments (BAQUININ) supersite for Atmospheric Research and Satellite Validation over Rome area", Bulletin American Meteorological Society.



The portable station has been also tested during a mobile measurements campaign over the Rome G.R.A highway in November 2020.

Results showed a general agreement with TROPOMI coincident data.

