# Integrating remote sensing and in-situ measurements to assess the impact of PBL dynamics on air pollution in Milan, Po valley (Italy)

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The Planetary Boundary Layer (PBL) is the atmospheric layer where most mixing of aerosols and gases occurs. Understanding its dynamics is crucial to interpret ground-level pollutant variability. This study combines remote sensing and in-situ measurements to investigate the interplay between emissions and atmospheric dilution, focusing on Milan during the year 2023 (Po Valley), one of Europe’s most polluted regions. The work is part of the EU H2020 RI-URBANS project.

An ACTRIS-RI platform near Linate airport (hotspot site) measured aerosol optical properties, size distribution, nitrogen oxides, and meteorological data. A second, urban background site monitored aerosol and gas composition, black carbon, and greenhouse gases. Two Automated Lidar-Ceilometers (ALCs), operating at Bicocca University and Rubattino within the ALICENET network, provided continuous aerosol vertical profiles. Using the ALC-tool, the Mixed Aerosol Layer (MAL) height was derived as a proxy for the PBL.

We compared seasonal and site-dependent variations in MAL height and key aerosol parameters, including equivalent black carbon (eBC). As expected, eBC concentrations were higher in winter, while MAL height was greater in summer, highlighting the importance of vertical mixing in pollutant dispersion. The diurnal cycle of primary pollutants at the hotspot site was strongly linked to MAL evolution.

In August 2023, for instance, daily variation of eBC at Linate closely followed MAL dynamics from Bicocca. A strong anti-correlation (R² = 0.81) confirmed the role of vertical dilution in shaping primary pollutant levels. Conversely, secondary pollutants like fine particles showed no correlation with MAL, suggesting additional formation processes.

A ventilation index was also derived to assess the efficiency of vertical mixing. Future work will explore its variability and pollutant-specific sensitivity to both vertical and horizontal atmospheric dynamics.

**Keywords: PBL dynamics, ground-level concentrations, Po valley**