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High-resolution satellite measurements of NO₂ and CO₂ in power plant plumes

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The Environmental Mapping and Analysis Program (EnMAP) satellite is a hyperspectral satellite instrument for the monitoring of terrestrial and aquatic ecosystems. It provides high spatial resolution (30 x 30 m²) but relatively low spectral resolution (~6.5 nm FWHM in the visible to near-infrared spectral range and ~10 nm FWHM in the shortwave IR spectral range). Although the spectral information of ENMAP observations is limited, it is possible to analyse the atmospheric NO₂ and CO₂ contents from ENMAP spectra for strong emission plumes using differential optical absorption spectroscopy. While the CO₂ signal is close to the detection limit, the evolution of the downward NO₂ plumes from power plants can be well quantified.

We present the spectral analyses of both trace gases and show measurement results for power plant plumes from Riyadh in Saudi Arabia and the Highveld in South Africa. We compare the ENMAP NO₂ results to observations from the TROPOMI satellite instrument and aircraft measurements. Our results show that ENMAP NO₂ and CO₂ measurements can be used to study the chemical and dynamical evolution of power plant plumes. For example, the conversion of NO to NO₂ can be quantified, or turbulence elements of the plumes can be clearly identified. The simultaneous observation of NO₂ and CO₂ might also allow the characterization of different power plants by their emission ratio. Due to the high spatial resolution of ENMAP also plumes from nearby power plants with distances of only a few hundred meters can be separated.