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The GEMS IUP-UB tropospheric NO₂ product – sensitivity studies and first results

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Nitrogen oxides (NO_x = NO + NO₂) are among the most important pollutants in the atmosphere. They impact tropospheric ozone chemistry, contribute to particle formation and adversely affect human health.

The monitoring of NO₂ is mainly performed by surface in-situ networks. Satellite observations can contribute by providing a large-scale picture and covering regions without in-situ observations. The satellite instruments traditionally used for NO₂ retrieval (GOME, SCIAMACHY, OMI, TROPOMI) operate on low-earth orbiting platforms, providing global coverage but only one or two measurements per day. The Korean GEMS instrument, launched in February 2020, is the first in a series of geostationary observation platforms allowing hourly measurements of NO₂ from space.

Based on the work performed in preparation for the European S4 satellite, a tropospheric NO₂ retrieval for GEMS has been developed at IUP-UB. This product focuses on achieving low noise and high accuracy by optimising the fitting window and including corrections for instrument polarisation sensitivity and scene inhomogeneity. Stratospheric correction is performed using different approaches to investigate the impact on the tropospheric columns. For the air mass factors, cloud correction is applied using cloud fractions derived after correction for calibration issues in GEMS irradiance measurements. The resulting tropospheric columns for the first three years of GEMS operation show excellent agreement with the operational TROPOMI NO₂ product at the time of TROPOMI overpass. They also exhibit systematic and variable daily patterns, which depend on season and location.