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Validation of GEMS tropospheric NO_2 with the GEMS IUP-UB NO_2 product, the TROPOMI NO_2 product, and ground-based DOAS measurements

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Nitrogen dioxide (NO_2) is one of the most important air pollutants in the troposphere. NO_2 can be retrieved by differential optical absorption spectroscopy measurements, which can be performed from various platforms.

Measurements from low earth satellites in sun-synchronous orbits provide a global overview and have already contributed valuable insights into understanding NO_2. The latest instrument, TROPOMI, with its high spatial resolution of 3.5 x 5.5 km^2, has given new opportunities to disentangle and analyze NO_x sources. However, instruments in low-earth orbits usually provide only one measurement per day at each location.

To achieve diurnal cycles of trace gases, instruments on geostationary satellites are needed. The Korean instrument GEMS on GK2B, launched in February 2020, is the first instrument in geostationary orbit, delivering hourly daytime observations of NO_2 with a spatial resolution of 3.5 x 8 km^2 over a large part of Asia.

In this study, one year of tropospheric NO_2 vertical column densities (VCDs) of the operational GEMS product are compared to the scientific GEMS IUP-UB NO_2 VCD product, the operational TROPOMI NO_2 VCD product, and ground-based DOAS measurements in Korea. The diurnal variation of NO_2 observed by GEMS is compared to the diurnal variation observed at several

ground-based MAX-DOAS stations located in different pollution regimes in Korea. The large variety of observed diurnal cycles are interpreted regarding potential influencing factors. In this respect, the ERA5 10 m wind data provide valuable insights into the influence of transport effects on the tropospheric NO_2 VCD depending on station location and seasonality.