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Machine Learning for Surface NO_2 Estimation from GEMS Satellite Data

Janek Gödeke

(Department of Mathematics, Uni Bremen)

Abstract

Launched in 2019, the Korean Geostationary Environmental Monitoring Spectrometer (GEMS) mission has been the first geostationary satellite mission for observing trace gas concentrations in the Earth's atmosphere over Asia.

Geostationary orbits allow for hourly measurements, which leads to a much higher temporal resolution compared to measurements taken from low Earth orbits, such as TROPOMI. Thus, Machine Learning approaches become more attractive due to these larger datasets. Within the next years, two further geostationary missions will follow: NASA‘s TEMPO and ESA‘s Sentinel-4P mission, providing additional data with high temporal resolution over North America and Europe.

The GEMS data products are used within the IUP algorithm for retrieving vertical, tropospheric column densities of NO2 (VCDs). In this project, we use these VCDs combined with e.g. meteorological data to estimate the surface concentration of NO2. The validation of the network‘s prediction is realized by the consideration of in-situ NO2 observations from the air quality network of South Korea.

A central question is how Machine Learning models should be trained in order to being able to predict surface NO2 at every location in South Korea, and not only at those locations where we have access to in-situ measurements of surface NO2.
Another question is whether machine learning models can benefit from time-contiguous inputs, meaning that not only measurements at some time are fed into the model, but in addition measurements from previous hours. This strategy is only realizable due to the geostationarity of the GEMS satellite.

In my talk I will present current strategies and experiments for investigating these questions.