Using Satellite Observations for Air Auality Assessment with an Inverse Model System

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The operational prediction of air quality as a computationally demanding task has become an important part of the assessment of risks for our environment and health. National and international agencies and policy makers are using numerical model applications to support their activities for air pollution reduction, for decision making and for informing the general public. However, assessing air pollution levels from global to local scale still remains a challenging mission, involving parameters with large uncertainties, e.g. emissions.

As an independent source of information, observations are playing a very important role and can therefore be used to ameliorate the simulation results. This can only be achieved in a satisfying way by applying advanced data assimilation techniques, producing consistent chemical estimates on regular grids. One strongly growing amount of environmental data is available as satellite based measurements, which are widely used for both model evaluation and data assimilation purposes in the air quality modeling community.

This study aims at identifying the benefit of tropospheric NO_2 column retrievals for air quality assessment, when a state-of-the-art chemistry transport model is used together with a spatio-temporal data assimilation technique (4d-var). To this end, the European Air Pollution Dispersion - Inverse Model system (EURAD-IM) is applied to one summer and one winter episode, operating on a European domain with a spatial resolution of 15 km, jointly optimising initial values and emission rates. NO_2 data from the OMI instrument is assimilated, while European ground based in-situ and independent satellite observations (GOME-2 and SCIAMACHY) are used for evaluating the influence of assimilated observations on estimating the air quality, especially levels of nitrogen oxides. Results show a strong improvement of surface level nitrogen oxides estimates for the summer episode, sustained even after the assimilation period through emission adjustments. For the winter period, the OMI NO_2 data is of limited value due to lower boundary layer heights and thus smaller impact on emission rate optimisation.