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THE POTENTIAL IMPACT OF SMALL SATELLITE INSTRUMENTS FOR MONITORING AIR QUALITY: A NO2 CASE STUDY (OSSE)

Abstract

Within the space industry a trend towards smaller satellite instruments is emerging. The main reason for this trend is the reduced mass and therefore the cost of such instruments compared to their larger predecessors. It remains to be established however whether this approach is effective for monitoring atmospheric composition, both in performance, risk management and cost effectiveness. Potential benefits should be examined in the light of observation needs from different user communities. How many small instruments are needed to achieve the same impact as one 'traditional' instrument? What would be the requirements for such a small instrument and what would be the cost of building and launching these smaller instruments compared to a single traditional instrument?

In this paper we will demonstrate the potential of Observing System Simulation Experiments (OSSEs) to answer these questions for a specific application, i.e. the monitoring of NO2 air pollution over Europe from LEO satellites at an altitude of ca. 800 km. In an OSSE, simulated future satellite observations are combined with a state-of-the-art model using data assimilation to investigate the added value of different instrument designs for the specific application. The added value of a small sized instrument may be different for the application, e.g. 1) assessment of annual/daily distributions, 2) assessment of emission patterns and trends or 3) forecasting of air pollution. In this paper we will focus on the assessment of daily distributions as these are the basis for the other applications. The question that will be answered is: Is it possible to quantify whether it is better to use one advanced LEO satellite instrument or a number of simpler LEO instruments to make observations of air pollutants? In addition we will give a first qualitative answer to which of these options shows a larger added value for monitoring NO2 concentrations.

The study focuses on the differences in impact from two different designs for a small instrument of around 20 kg in comparison to the impact of a traditionally sized instrument. The first design has a high spatial resolution of 1x3 km in combination with a 945 km swath, the second design has a spatial resolution of 2x6 km with a 2,725 km swath, similar to the swath of the traditional instrument. The

traditional instrument has a resolution of 7x7 km. First results show that the increased impact from improved resolution outweighs the loss of coverage from reducing the field of view.