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Defining the requirements for future satellite air quality chemistry observations

D. Edwards (1), A. Arellano (1), and M. Deeter (1)

(1) National Center for Atmospheric Research, Boulder Colorado, USA (edwards@ucar.edu)

If a satellite mission related to atmospheric composition and air quality is to become a reality within the next decade, the atmospheric chemistry community will need to establish clear scientific motivation for the new measurements. For this, there is considerable interest in using chemical observing system simulation experiment (OSSE) studies to help define quantitative measurement requirements for satellite missions and to evaluate the expected performance of proposed observing strategies. These experiments will hopefully provide a practical way of defining a traceability matrix mapping science requirements through measurement requirements onto instrument requirements.

OSSEs must be driven by well-defined scientific questions and the experiment formulation constructed accordingly. We present a framework for this comprising the following key elements: (1) a science-driven requirement for a chemical species observation, (2) a satellite instrument simulator and observing strategy that might be capable of making a useful measurement, (3) a simulated retrieval of the species with nature defined by an appropriate chemical transport model, (4) a forecast of the species distribution using an assimilation of the retrieval in the model, and (5) a quantitative assessment of the value of the measurement. This will be illustrated with an example OSSE motivated by the desire to measure the distribution and time evolution of carbon monoxide in the lower-most troposphere for air quality applications using candidate satellite multispectral measurements in the thermal and near infrared.