

A sensor web simulator: project status and the benefits to the atmospheric sciences

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Abstract

We are developing a Sensor Web Simulator (SWS) with funding from NASA's Earth Science Technology Office (ESTO). The need for the SWS is founded in the idea of a future global, interactive, sensor web observing system that autonomously reconfigures its nominal measurement modes and observing strategies. The goal of such a dynamic, reactive observing system is to maximize useful science return. Changes to instrument measurement modes would be in response to events detected by other spacecraft instruments and information derived from numerical weather prediction models. The sensor web operations concept offers the compelling notion of the potential to constrain forecast model error growth and thus improve forecast predictive skill. Missions and instruments in formulation will benefit from simulations of sensor web operations concepts. Using the SWS, scientists and engineers will be able to objectively assess their potential viability before making significant investments in the design, implementation, and deployment of such a system which would be costly and involve significant risk.

The SWS is an analytical tool that will provide scientists and engineers with the ability to define, model, and objectively assess alternative sensor web observing system designs, and to quantitatively measure any anticipated improvement in numerical weather prediction forecast skill. Our team has selected three future earth science missions recommended by the National Research Council's Decadal Survey report (XOVWM, 3D-Winds, and PATH), and NOAA's next generation meteorological satellite (GOES-R). These missions will serve as a hypothetical sensor web observing system with which we will perform Observing System Simulation Experiments (OSSEs) for a hurricane use case scenario that we have developed. The SWS software application we are developing leverages NASA's extensive experience in the development and application of OSSE software, and the integration of off-the-shelf simulation software with custom developed applications. Using the SWS, it will be possible to objectively answer questions such as: What measurable improvement to the forecast process might be realized if the number and types of observing system platforms remain the same, but the rules of interaction between sensors and the modeling/data assimilation systems are modified to facilitate dynamic reconfiguration and targeted measurements?"

We will present our progress to date including: (i) a hurricane scenario that serves as our use case to test the SWS software; (ii) the methods used to create realistic synthetic instrument measurement data representative of the selected Decadal Survey mission instruments and the GOES-R instrument; and (iii) the results of several OSSEs we will execute using various combinations of spacecraft and instrument measurement modes.

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