Observing System Simulation Experiments (OSSE) for Future Geostationary Satellite to Constrain Aerosol Emissions

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Accurate knowledge of aerosol sources is required to investigate how aerosol affects weather, climate, and human health. This study conducts observing system simulation experiments (OSSE) for future geostationary satellite and aims to assesse the potential of using hourly aerosol optical depth (AOD) retrievals to constrain emission estimates of aerosols and gaseous precursors. The OSSE system comprises WRF-Chem model for synthetic simulation, and GEOS-Chem chemical transport model and its adjoint for emission inversion. We have developed the AOD observation operator for GEOS-Chem adjoint model and verified with a pseudo-observation experiment. Hourly synthetic AOD observations for one-month period are generated in North America by WRF-Chem. Our experiments define two types of "observations" that are assimilated into GEOS-Chem adjoint model to optimze aerosol emissions. In the first experiment, AOD observations are provided once a day over each grid box, which follows polar-orbiting satellite observation cycle. The other expetiment is corresponding to high temporal resolution geostionary satellite observation concept—hourly AOD within daytime are assimilated. While cost functions are reduced and posterior emission inventories get better agreement with WRF-Chem emission invetories in both experiments, more improvements are found in the posterior aerosols emissions constrained with hourly synthetic observtaions. These results show that the future geostionary satellite data are likely to have a significant impact on emission inventories estimation.