DESIGN AND IMPACTS OF LAND-BIOGENIC-ATMOSPHERE COUPLING IN THE NASA-UNIFIED WRF (NU-WRF) MODELING SYSTEM

Qian Tan (1,2), Joseph A. Santanello, Jr. (2), Shujia Zhou (3,2), Zhining Tao (1,2), Christa D. Peters-Lidard (2), and Mian Chin (2)
(1) University of Maryland Baltimore County, Baltimore, MD, USA
(2) NASA-GSFC Hydrological Sciences Branch, Greenbelt, MD, USA
(3) Northrop Grumman Information Technology, McLean, VA, USA

QianTan@nasa.gov

Land-Atmosphere coupling is typically designed and implemented independently for physical (e.g. water and energy) and chemical (e.g. biogenic emissions and surface depositions)-based models and applications. Differences in scale, data requirements, and physics thus limit the ability of Earth System models to be fully coupled in a consistent manner. In order for the physical-chemical-biological coupling to be complete, treatment of the land in terms of surface classification, condition, fluxes, and emissions must be considered simultaneously and coherently across all components.

In this study, we investigate a coupling strategy for the NASA-Unified Weather Research and Forecasting (NU-WRF) model that incorporates the traditionally disparate fluxes of water and energy through NASA's LIS (Land Information System) and biogenic emissions through BEIS (Biogenic Emissions Inventory System) and MEGAN (Model of Emissions of Gases and Aerosols from Nature) into the atmosphere. In doing so, inconsistencies across model inputs and parameter data are resolved such that the emissions from a particular plant species are consistent with the heat and moisture fluxes calculated for that land cover type. In turn, the response of the atmospheric turbulence and mixing in the planetary boundary layer (PBL) acts on the identical surface type, fluxes, and emissions for each. In addition, the coupling of dust emission within the NU-WRF system is performed in order to ensure consistency and to maximize the benefit of high-resolution land representation in LIS. The impacts of those self-consistent components on the simulation of atmospheric aerosols are then evaluated through the WRF-Chem-GOCART (Goddard Chemistry Aerosol Radiation and Transport) model. Overall, this ambitious project highlights the current difficulties and future potential of fully coupled components in Earth System models, and underscores the importance of the iLEAPS community in supporting improved knowledge of processes and innovative approaches for models and observations.