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**Improving Cloud Microphysics and Their Interactions with Aerosols in the NCEP Global Models**

We propose a two-year research-to-operation project to the NOAA MAPP Program to enhance the NOAA/NCEP weather-climate modeling capabilities by improving the representations of cloud microphysics, aerosol processes, and aerosol-cloud-radiation interactions in the NCEP global models (i.e., the Global Forecast System, GFS, and the Climate Forecast System, CFS). Our proposed work responds directly to Competition 2 of the MAPP 2014: Climate Test Bed - Research to Advance NOAA's Operational Systems for Climate Prediction.

While understanding the climate impacts of the complex cloud-aerosol-radiation interactions remains a major frontier in climate sciences, there have been significant processes in developing process-level representations of clouds and aerosols as well as in understanding the processes relevant to aerosol-cloud-radiation interactions. NASA GMAO is revamping the existing treatments of clouds and aerosols in Goddard Earth Observing System Model, Version 5 (GEOS-5) by introducing a double-moment cloud microphysics scheme (Morrison and Gettleman, 2008) and coupling it with a modal aerosol model (Liu et al., 2012). Both schemes are developed and implemented in the Community Atmosphere Model (CAM5.1), the atmospheric component of the Community Earth System Model (CESM) primarily at the National Center for Atmospheric Research (NCAR). This project will adopt the physically-based cloud/aerosol package at GMAO, which in turn leverage scientific advances by a broad climate research community.

At NCEP, major development work is underway to advance the representation of atmospheric physical processes in the GFS and CFS. This proposal is closely aligned with, and complementary to, these ongoing GFS/CFS research and development activities. Furthermore, this SUNYA-NCEP-GMAO collaborative project builds on and further strengthens the existing NCEP-GMAO partnership. The outcomes of this project support NOAA's long-term goals and objectives as highlighted in its Next Generation Strategic Plan (NGSP). Specifically, this project will contribute toward achieving the first of the NGSP climate objectives, an improved scientific understanding of the changing climate system and its impacts, by improving two core capabilities: understanding and modeling, and predictions and projections.