Evaluation of the ultrafine aerosol particle mode in MAM5 with airborne and ground-based measurements at ARM sites

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Realistically representing aerosol concentration, size distribution, and its interaction with clouds in GCMs are important to accurately simulate the aerosol direct and indirect radiative effects and further impact the prediction of Earth’s energy budgets and future climate. Efforts are being made to improve the current Modal Aerosol Module (MAM4) in Energy Exascale Earth System Model version 1 (E3SMv1). The new aerosol scheme includes MAM5 which adds a nucleation mode to explicitly represent the condensational growth and coagulation process for ultrafine particles (3 – 10 nm). We will present preliminary results evaluating the new results with in-situ measurements from the Atmospheric Radiation Measurement (ARM) field campaigns: Hi-Scale field campaign at the Southern Great Plains (SGP) and ACE-ENA field campaign at the Eastern North Atlantic (ENA). In these field campaigns, extensive measurements from both ground-based and aircraft instruments are available. Synthetic flight trajectories will be performed in model output for comparison with airborne measurements. We will evaluate aerosol number concentration, size distribution and CCN concentration to examine how the ultrafine particles are represented in MAM5 and whether it improves the overall performance of aerosol simulation comparing to MAM4 in different seasons and different climate regimes. This evaluation work will be extended to other variables related to aerosol and cloud processes and to other regions such as the Southern Ocean and North Eastern Pacific.