A High-Performance Modal Aerosol Dynamics Library Based on MAM

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Abstract

The convection-permitting (3.5 km) resolution planned for E3SMv4 provides an opportunity for more detailed and realistic representation of atmospheric processes. However, with this opportunity come substantial challenges associated with computational performance and accuracy requirements. To meet these challenges, the v4 atmosphere model, SCREAM, is designed to run efficiently on DOE’s Leadership Class Facilities, and is implemented using the Kokkos performance portability C++ library.

One of the objectives of the EAGLES project is to provide an aerosol model to this new cloud-resolving E3SM atmosphere component. Having assessed MAM, the modal aerosol model used in E3SMv1, the EAGLES Computation team is designing and developing a Kokkos-based software library that implements the parametrizations that quantify the evolution of aerosols and their contributions to other physical processes. This library emphasizes the evaluation of the parametrizations themselves within the modal (particle-size-based) framework, delegating the implementation of time integration and inter-process coupling to a separate component implemented within SCREAM. By narrowing the focus of the library to only the aerosol parametrizations, we hope to provide a flexible modal representation of aerosols that can be embedded within several atmospheric models that take different approaches to coupling. A stand-alone column-based driver with a simple 1D dynamics package provides a testbed for the library.