High-order, property-preserving, semi-Lagrangian tracer transport in E3SM

Passive tracer transport is an important and computationally demanding component of the E3SM standard atmosphere configuration and the biogeochemistry ocean configuration. This component advects trace constituents species and related data used in physics and chemistry parameterizations according to the flow field. The COMPOSE SciDAC is developing a toolkit of mathematical and software tools from which we assemble high-order, property-preserving, semi-Lagrangian transport algorithms. Semi-Lagrangian passive tracer transport can take the time step of a fully implicit method while having the computational characteristics of a fully explicit one. With these tools, we speed up atmosphere tracer transport by a factor of 3 to 5, depending on architecture, in the E3SM Atmosphere Model (EAM) version 2 relative to version 1, for an overall dynamical core speedup of 2 to 3 times. Currently, we are focusing on MPAS-Ocean passive tracer transport for E3SM version 3. This talk will describe our methods and tools, show accuracy and performance results, and discuss our plans for E3SM version 3.