Verification of high-efficiency chemistry numerical solver in the global model using E3SM

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Abstract

The atmospheric chemical component is a critical factor in climate predition. The gas and solid phase of chemical compounds are essential precursors in cloud formation, aerosols' concentration, AAOD, and AOD, causing a huge difference in short- and long-term climate projections. Although chemistry interaction is critical in climate prediction, most of the time in Earth system models are still using a prescribed chemistry emission and reaction in their simulations to avoid the heavily loaded calculations and longer runtime in high performance computing (HPC). To overcome it and model a reality in ESMs, the two stages Rosenbrock solver has been approved and used in regional models as an efficiency chemical solver, yet few global models have brought it in. We embed this explicit solver into the current E3SM verion 2 with an interactive UCI chemistry and TROP_MOZART modules. Our preliminary results showed a 36 % reduced computation time with the pre-processed version of the UCI chemistry box model successfully. The detailed and more complete results of this implementation in E3SM will be presented to keep the high efficiency in a fully coupled in the E3SM Atmosphere Model (EAM) of the E3SM that is potential inclusive in the long-term climate simulations with dynamic chemistry reaction in E3SM in the all-hands meeting.