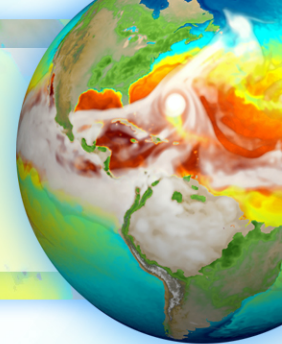


Regionally refined model updates for the E3SMv2 atmosphere model



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DOE ESMD/E3SM Annual All-Hands Meeting
October 26-29, 2020

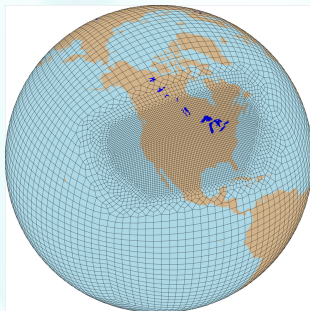
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC. LLNL-PRES-815833

Background

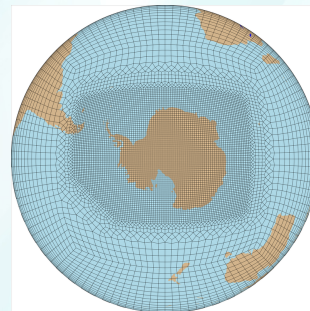
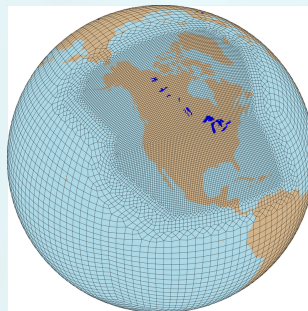
- In E3SMv1, we established the regionally refined model (RRM) as an efficient tool to develop the high-res atmosphere model (Tang et al., 2019).
- Need to retune RRM due to poor scale-aware atmospheric physics
- E3SMv2 focuses on the North American (NA) RRM and will release NA RRM production simulations.

Atmosphere RRM configurations in regular use

E3SMv1



E3SMv2

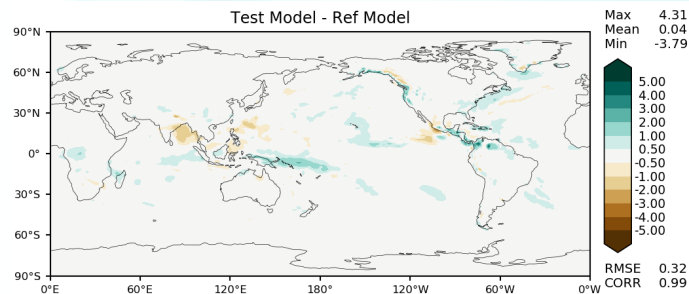


Improved atmosphere RRM strategies for E3SMv2

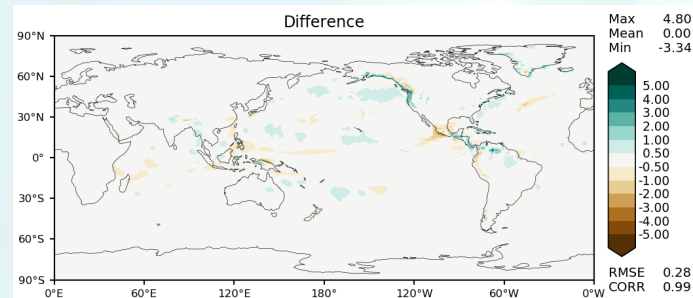
- Hybrid time steps (high-res dycore + low-res physics) for RRM
- **No (minimum)** retuning required for RRM in addition to low-res model
- theta-l dycore, Semi-Lagrangian tracer transport, and pg2 physics grid increase the throughput by **2x** (3 years/day on 113 cori-knl nodes).
- Becomes possible to release RRM DECK with E3SMv2

Smaller RRM-ne30 diff with hybrid time stepping (RRMdt)

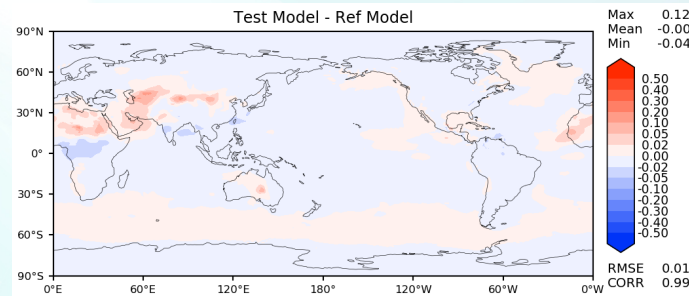
RRM – ne30, PRECT



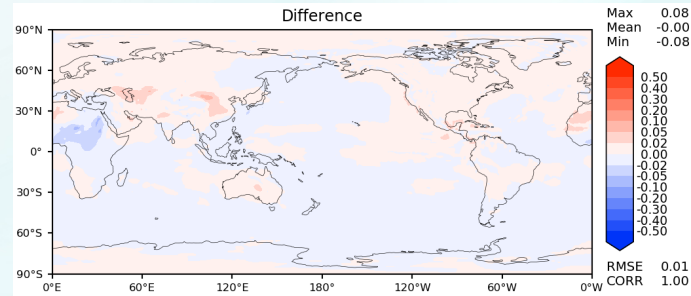
RRMdt – ne30, PRECT



RRM – ne30, AODVIS

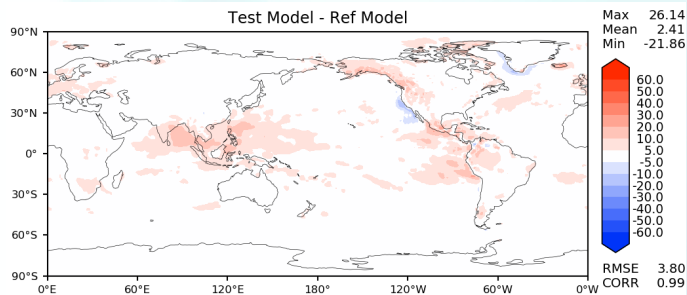


RRMdt – ne30, AODVIS

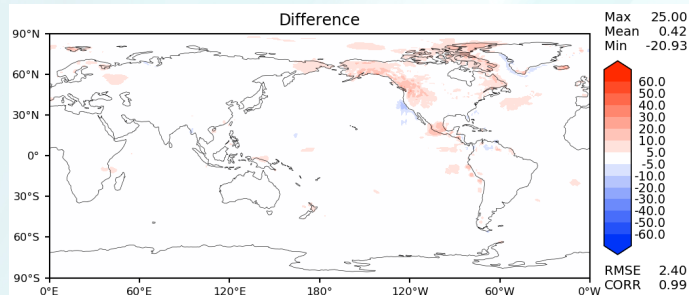


Smaller RRM-ne30 diff with hybrid time stepping (RRMdt)

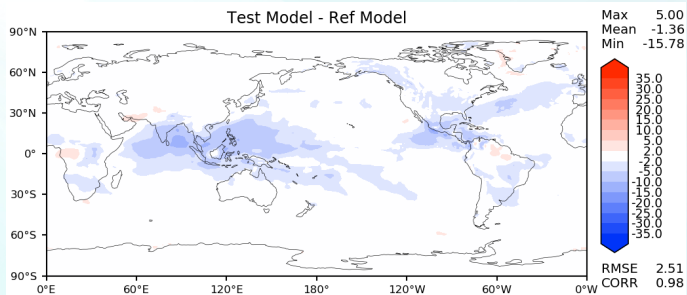
RRM – ne30, SWCF



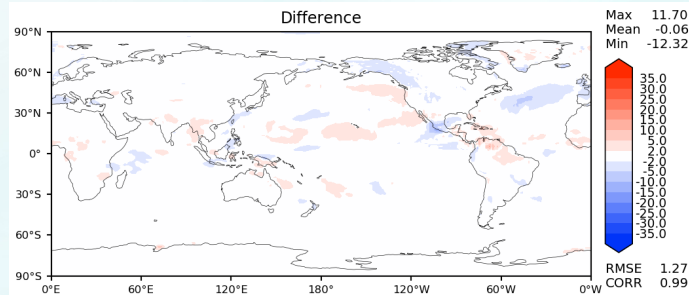
RRMdt – ne30, SWCF



RRM – ne30, LWCF



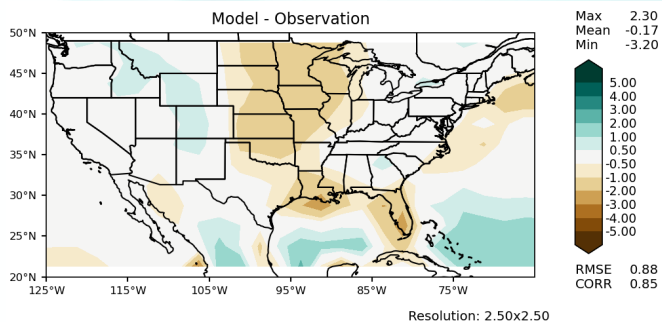
RRMdt – ne30, LWCF



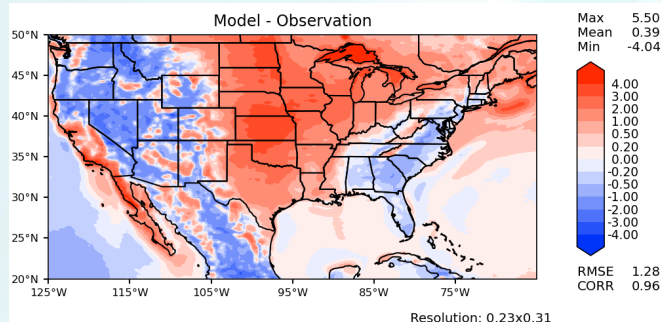
- Over low-res grids, the differences are much smaller with RRMdt.
- Over high-res grids, the differences are somewhat similar.

RRMdt CONUS results vs. observations, summertime

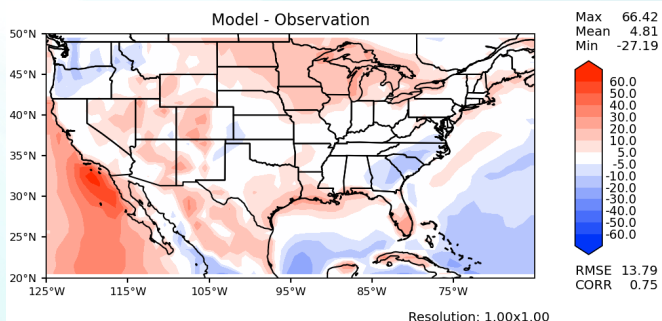
PREC



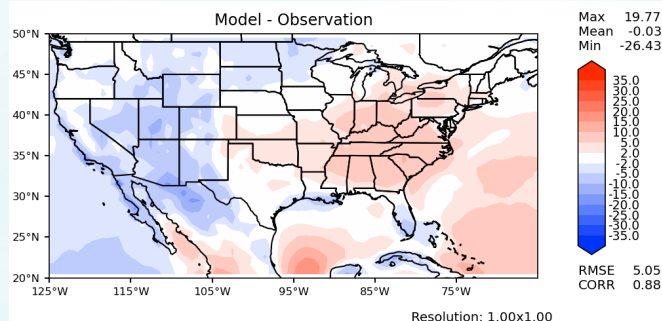
T_{2m}



SWCF



LWCF



- Summertime warm, dry biases at the central US seem similar to Tang et al., 2019.

Summary

- With the hybrid time stepping, we unified the low-res and RRM physics development for the E3SMv2 atmosphere model.
- The North American (NA) atmosphere RRM mimics the low-res model biases at coarser grids, and the high-res model biases at finer grids.
- The new theta-l dycore, Semi-Lagrangian tracer transport, and pg2 physics grid doubled the RRM throughput, enabling the NA RRM DECK simulations.
- The coupled NA RRM was configured to study resolution impacts in coupling.