

Adaptive Vertical Grid Enhancement for E3SM

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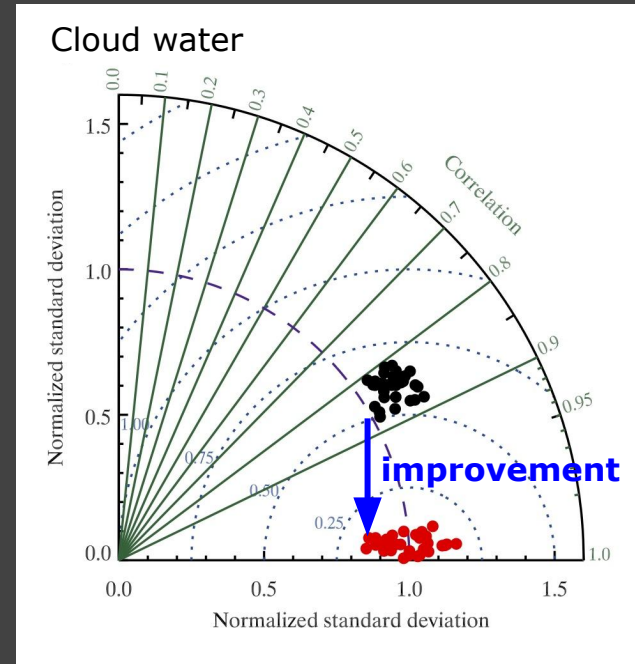
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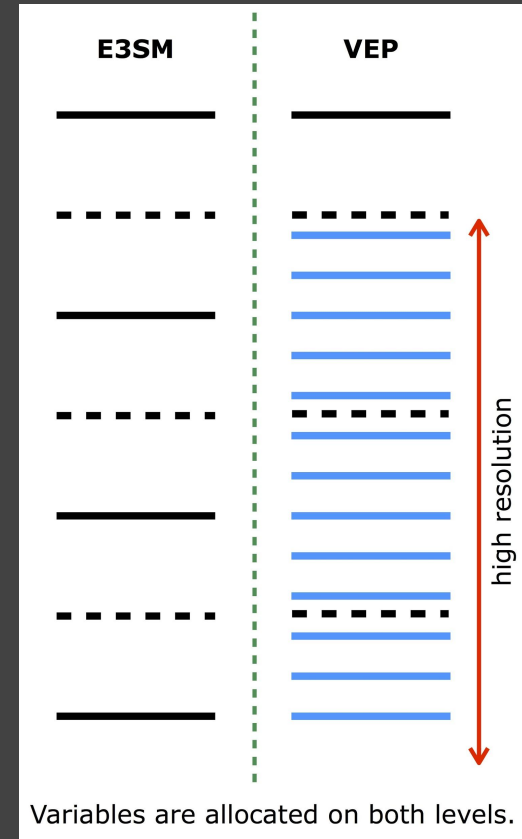
Framework for Improvement by Vertical Enhancement (FIVE)

- Yamaguchi et al. (2017 JAMES) show improved representation of stratocumulus with FIVE.
- This SciDAC project will implement FIVE into E3SM and also evolve FIVE into a computationally efficient version.



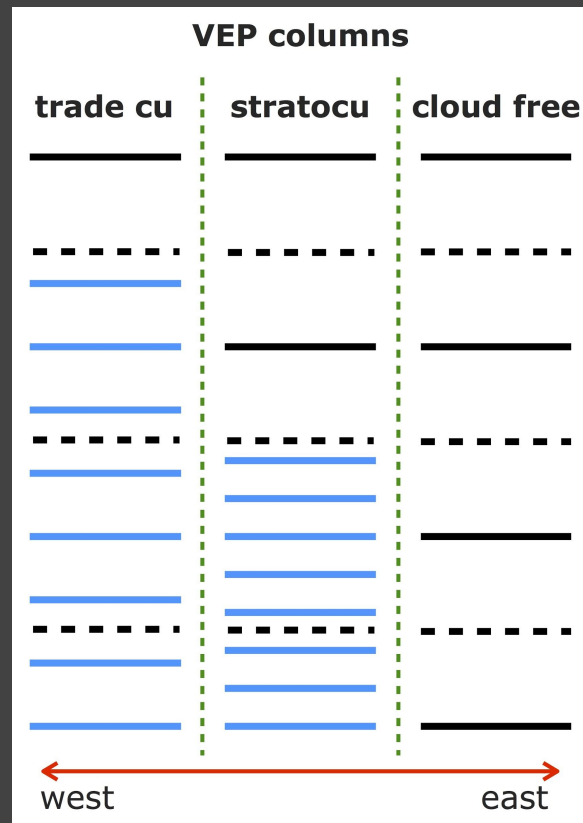
FIVE

- Set up an additional vertical grid with “locally” high resolution (PBL, cirrus region).
- On the locally high resolution grid,
 - Prognostic variables are allocated.
 - Selected processes are computed.
 - Vertically Enhanced Physics (VEP)
 - High resolution information is kept.
- Synchronization between host model and VEP is done by passing tendencies back and forth.
- FIVE contains aspects of MMF, multigrid method, and grid nesting but in the vertical direction.

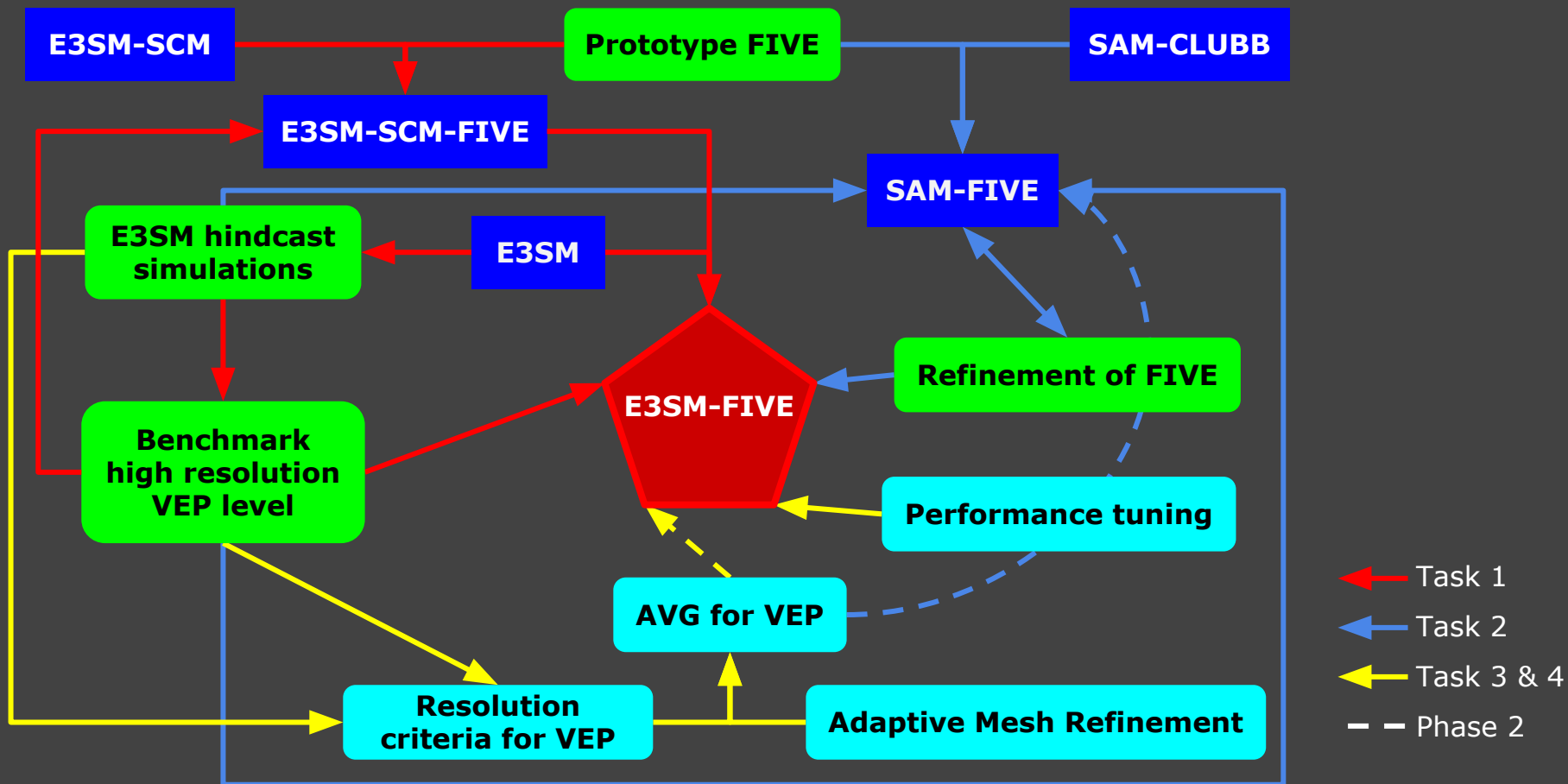


Adaptive Vertical Grid for VEP

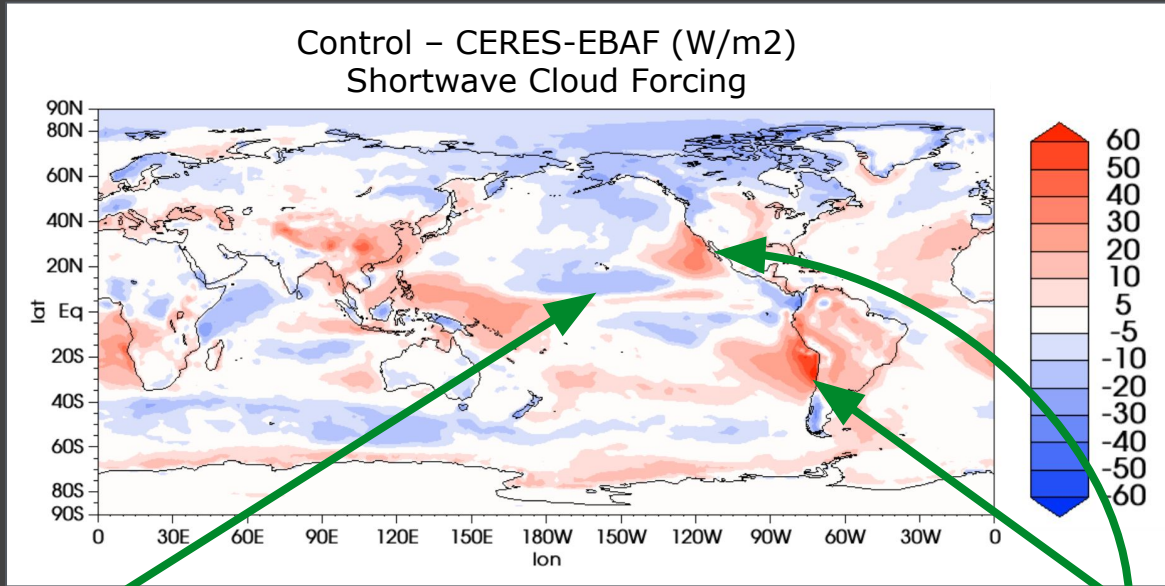
- E3SM-FIVE will be expensive.
- Computational cost may be reduced if vertical resolution of VEP is dynamically adjusted depending on the atmospheric state (Adaptive Vertical Grid; AVG).
- AVG does not guarantee efficiency for multi-core jobs due to heterogeneous workload.
- Resolution criteria for AVG based on atmospheric state will be developed.



Path to E3SM-FIVE



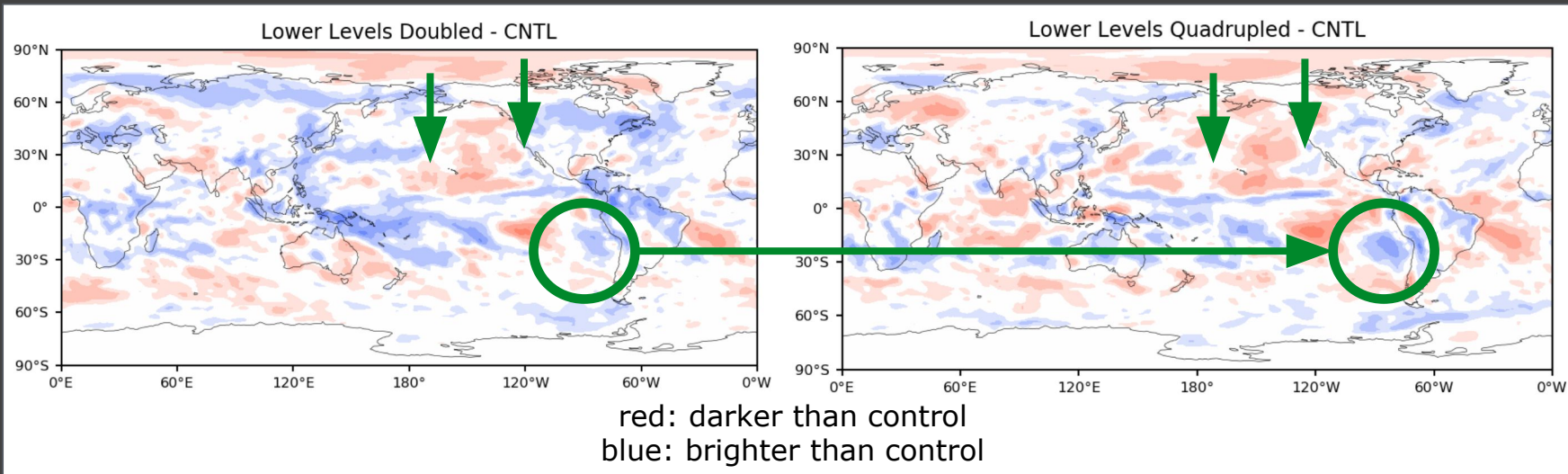
E3SM High Resolution Benchmark



Clouds TOO
reflective in trade
Cu regions

Clouds NOT
reflective enough
in Sc regions

E3SM High Resolution Benchmark



Increasing vertical resolution in boundary layer generally results in more reflective marine stratocumulus and less reflective trade cumulus (an improvement). We are confident that E3SM-FIVE can replicate these results, at reduced cost.

Summary



- Phase 1
 - E3SM-FIVE (fixed VEP resolution)
 - Evolved FIVE
 - Resolution criteria for PBL clouds
 - Research development for AVG
- Phase 2
 - E3SM-FIVE coupled with AVG
 - Cirrus
 - Faster/efficient AVG for parallel computation