F: Improving Coupling Workflow in ACME

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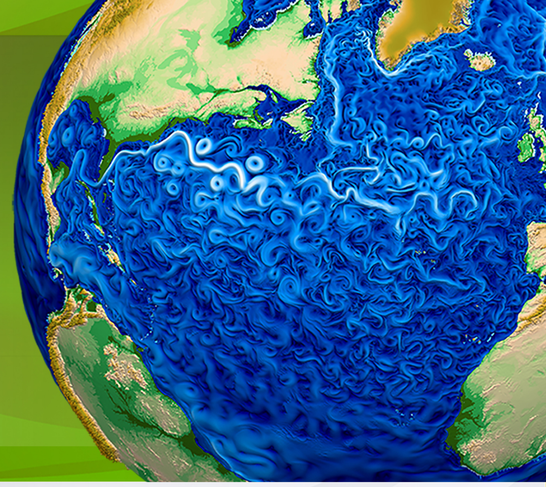
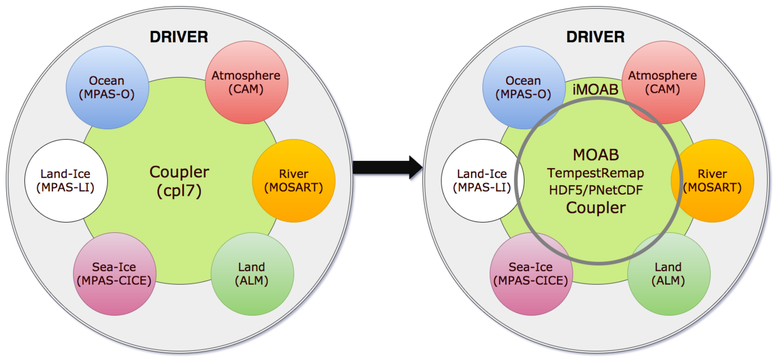
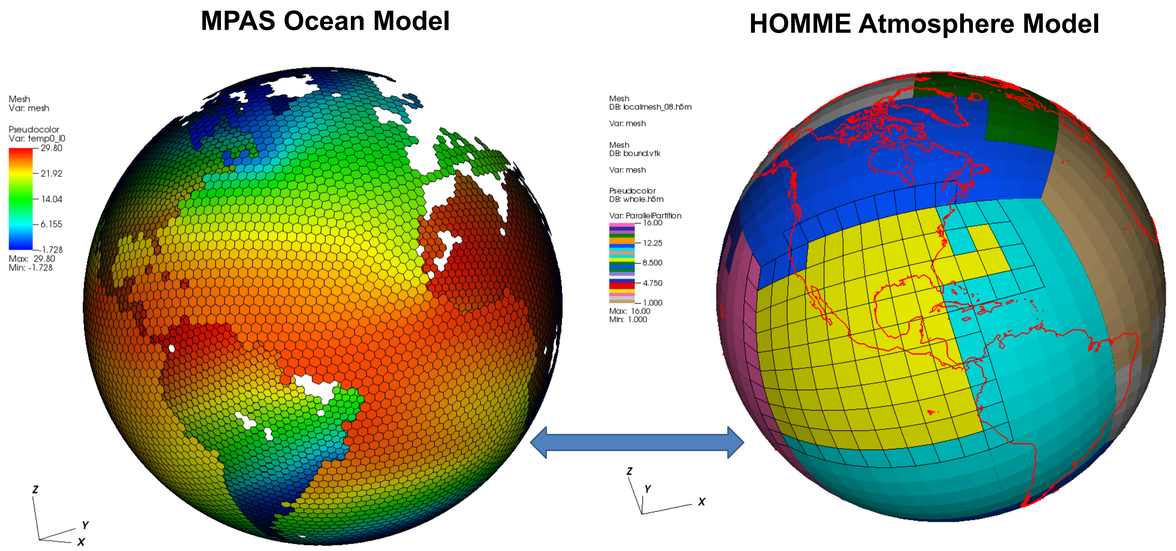


Motivation

The coupler is a complex and central component that plays a critical role in all ACME simulations. The ACME-CMDV project is driven to rewrite and rethink many parts of the coupler to better meet ACME's near-term science and technical goals. The changes are primarily motivated to improve and simplify the current ACME coupler workflow.



- ❑ Simplify coupling workflow through unified infrastructure for mesh and data handling
- ❑ Uniform methodology to impose mesh decomposition to minimize *time to solution*
- ❑ Move away from the current offline-online weight generation model and support *fully online* capability with high-order conservative remapping schemes; Adaptive grids ?
- ❑ Utilize scalable algorithms to compute re-usable overlap meshes between models
- ❑ Thinking beyond the current split-coupling methods and reduce spatiotemporal inaccuracies



Near term goal: Scalable and high-order conservative field transfer between polygonal (MPAS) and Cubed-Sphere (HOMME) models

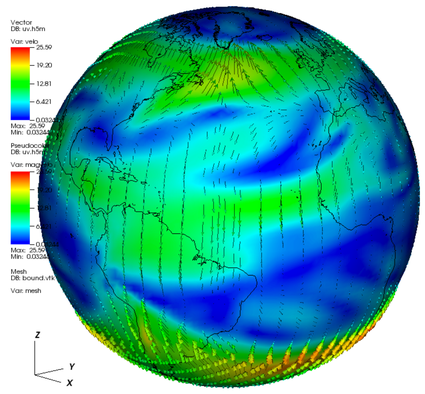
- Visualizations performed using the parallel MOAB-VisIt plugin

Developments

Completed:

MOAB (v5.0) serves as a mesh and coupler infrastructure to unify model interfaces

- ❑ Language agnostic interfaces (Fortran/C/C++) through iMOAB implementation
  - Tightly integrated with HOMME and MPAS currently
- ❑ Unified scalable serialization and loading of meshes, partitions and solution
- ❑ Fully parallel visualization of meshes and fields with VisIt-MOAB plugin
  - Avoid re-partitioning data for visualization
  - Perform analysis with a rich in-memory data-model
- ❑ Interpolation weights computed online with:
  - Optimized advancing-front intersection algorithm
  - Integration to TempestRemap for weight generation
- ❑ Verified configuration/installation on various platforms
  - ANL: Blues, Mira, Theta,
  - NERSC: Edison, Cori, ORNL: Titan

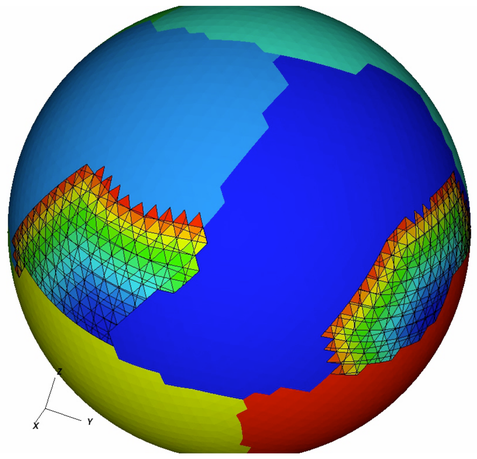


Required:

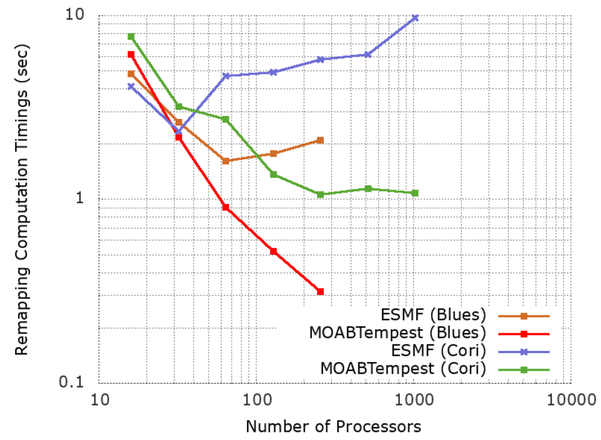
- ❑ Interface with Mosart, CLM, other MPAS components
- ❑ Perform atmosphere->ocean interpolation online
- ❑ Generate Cubed-Sphere (CS), polygonal (MPAS) meshes and conformal local refinement
- ❑ Improved mesh partitioning schemes for coupler performance and to minimize data-transfer
- ❑ Re-design and implement strategies for optimal coupled solution convergence

Expected Impact

More efficient and accurate coupling workflows



Parallel advancing front intersection algorithm, amenable to hybrid MPI+task parallelism



Remapping between CS-CS meshes with varying resolutions on Blues and Cori (Haswell)

- ❑ Higher-order conservative remapping algorithms and better coupling techniques will improve solution accuracy and reduce numerical stability restrictions
- ❑ An unified infrastructure can simplify long-term maintenance of ACME software suite
- ❑ Increased scientific productivity for ACME users (smaller learning curve for new models)

ACME Accelerated Climate Modeling for Energy

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