

New CESM Gridding Capability (and MPAS Update)

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New CESM Infrastructure

● Utilities

- new regridding capability
- new offline utilities greatly simplify and speedup addition of new model grids
- new port validation functionality

● Scripts

- new xml based build functionality (simplifies porting and debugging)
- new unified namelist generation capability
 - unified mechanism for component namelist modification
 - access to all component namelists from easy to view web page
- new hierarchical approach to specify compsets

Challenge of New Grids

- Past grids were global and logically rectangular
- Ocean/Sea-Ice grids
 - displaced pole, tripole, new MPAS regionally refined icosohedral
- Atmosphere/Land grids
 - lat/lon, cubed sphere, new regionally refined cubed sphere, new regionally refined MPAS
- Grids span wide range
 - low res (3 degree) to ultra-high res (0.125° ATM/LND and 0.1° OCN/ICE)
- Regridding done in parallel at runtime using mapping files generated offline
 - both conservative and non-conservative mapping files needed

New Mapping Capabilities

- In past new mapping files were rarely generated – this has changed!!!
- New simplified tool chain to create mapping files (and other grid specific datasets) *as a pre-build step*
 - leverage new ESMF offline regridding capability (parallel and robust)
 - workflow went from hours to minutes
 - new support for *user specified grids* in new top level mapping directory

Workflow for user-specified grid

- New top level mapping directory (`mapping/`) – user can create new grids without editing any model source code or model namelist scripts
- Required user input – SCRIP format description files of atm/ocn grids
 1. `gen_atm_ocn_maps/` – generates all mapping files needed by coupler
 2. `gen_domain/` – uses `ocn_to_atm` conservative map to generate domain files for CLM, CICE (prescribed) data models
 3. `gen_runoff_ocn_maps/` – generates smoothed map for runoff to ocn mapping
 4. `check_maps/` – checks for integrity of mapping files

New Component Grid Capabilities

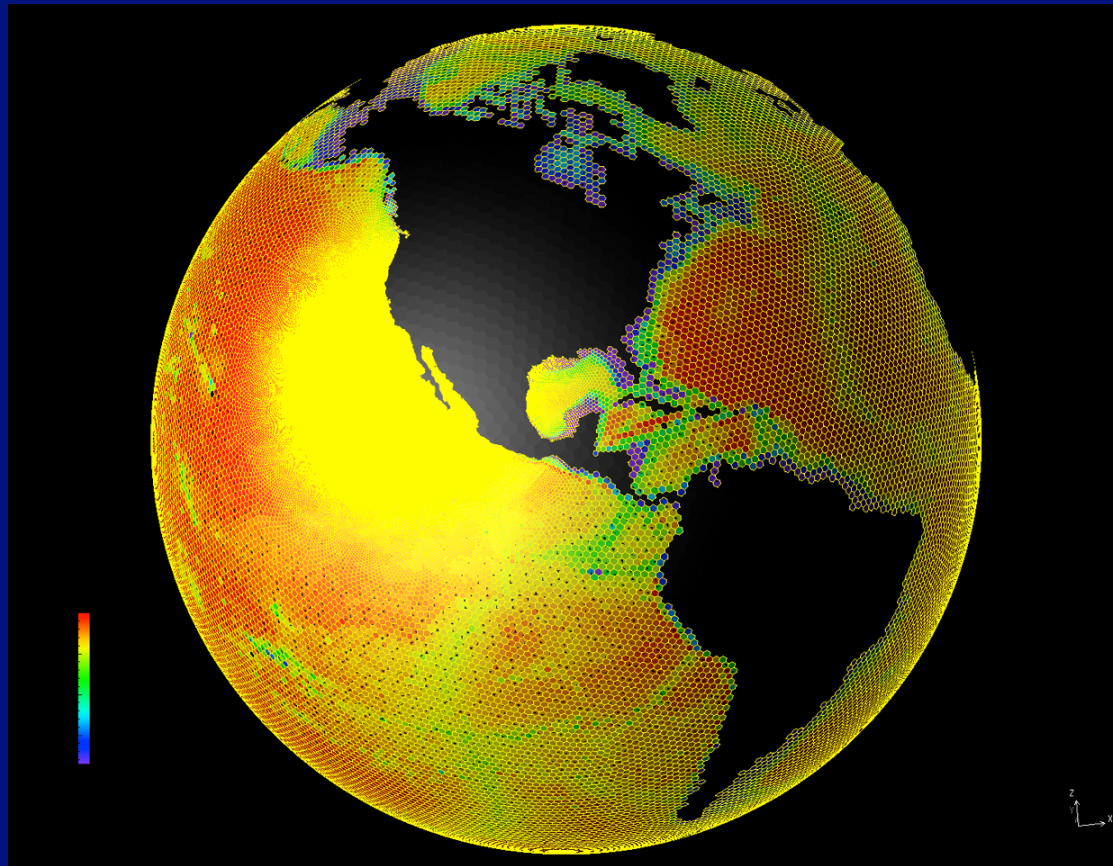
- CLM, CICE (prescribed), DOCN can now
 - be run on any unstructured grid
 - match target CAM grid (including locally refined grids)
- Can now carry out CAM prescribed forcing runs – *with all models on the same grid* (traditional approach)
 - Significant speed up for hi-res CAM-SE prescribed forcing runs

Leverage New Mapping in CLM

- New surface dataset generation and new CLM→RTM mapping
 - Uses offline generated mapping files
 - MUCH faster, supports high-res and non lat/lon grids
 - high resolution option for RTM (1/10th degree 5X increase)
- Interpolation of non-lat/lon output to lat/lon grids

CSSEF: Can MPAS grid be supported?

with Michael Duda (NCAR), Todd Ringler (LANL)



CAM,CLM

1° FV

Pres-CICE/DOCN

120 km MPAS 10x

refined on Cal Coast

SST/ICE-COV Forcing

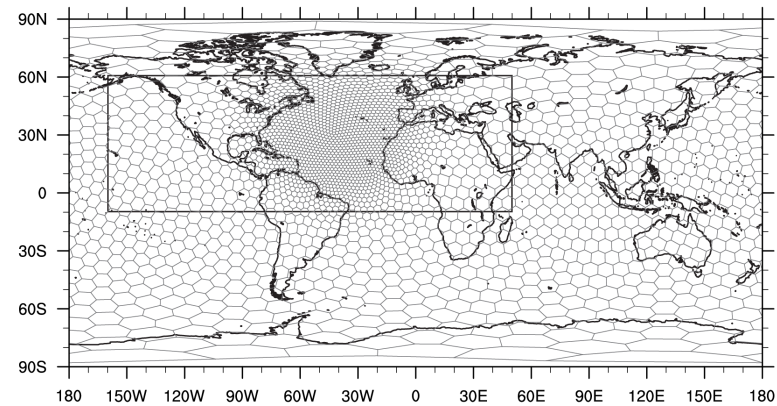
10 km POP/CICE

coupled data

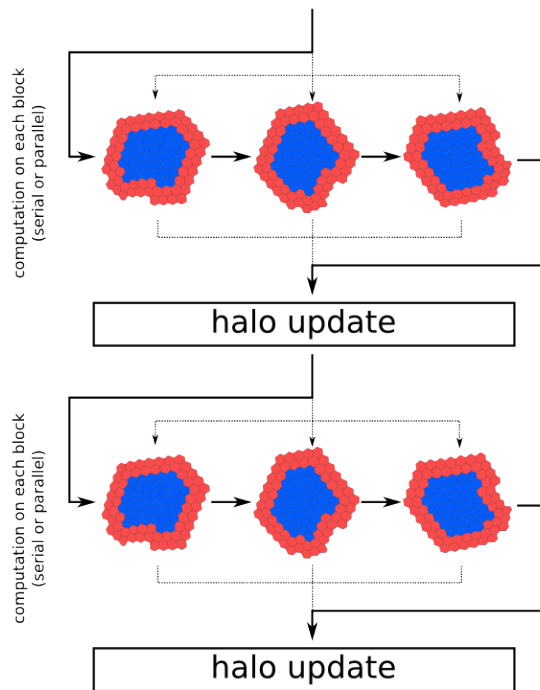
An Update on MPAS-A Developments

Model evaluations:

- Running variable resolution MPAS-A for comparison with WRF-NRCM (Laura Fowler, NCAR)
- Idealized test cases to examine the effect of transition in mesh resolution on solution quality (Sang-Hun Park, NCAR)



MPAS variable-resolution mesh (25-100km; plotted at a coarser resolution) with WRF-NRCM 36-km domain



Blocks (of columns) are the basic unit of mesh decomposition in MPAS.

Software development:

- MPAS now has a completely re-implemented IO layer based on PIO
- Effort underway to implement shared-memory parallelism at the “block” level (Doug Jacobsen, LANL)
- Will soon begin testing of MPAS-A scalability and robustness on yellowstone
- **Work continues on implementation of the non-hydrostatic dycore in CAM (Michael Duda, Brian Eaton, NCAR)**
 - Generalizations to MPAS, modifications to hydrostatic dycore interface, which was used as a starting point

Next Steps

- ESMF online regridding
 - Collaborating with ESMF to look at leveraging on-line regridding in driver
 - ESMF now also supports 3d conservative mapping
- MCT/MOAB (Rob Jacob/CSSEF)
 - Longer term effort that will enable support for adaptive mesh refinement and fault recovery