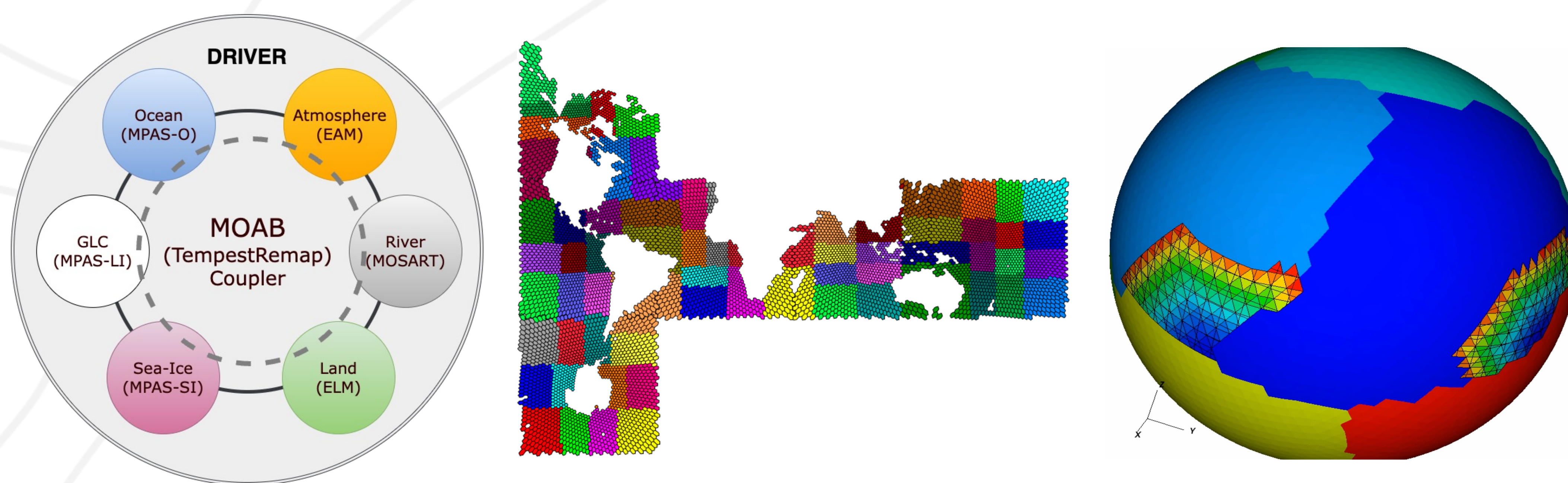


Boosting the Numerical and Computational Performance of the E3SM Coupler

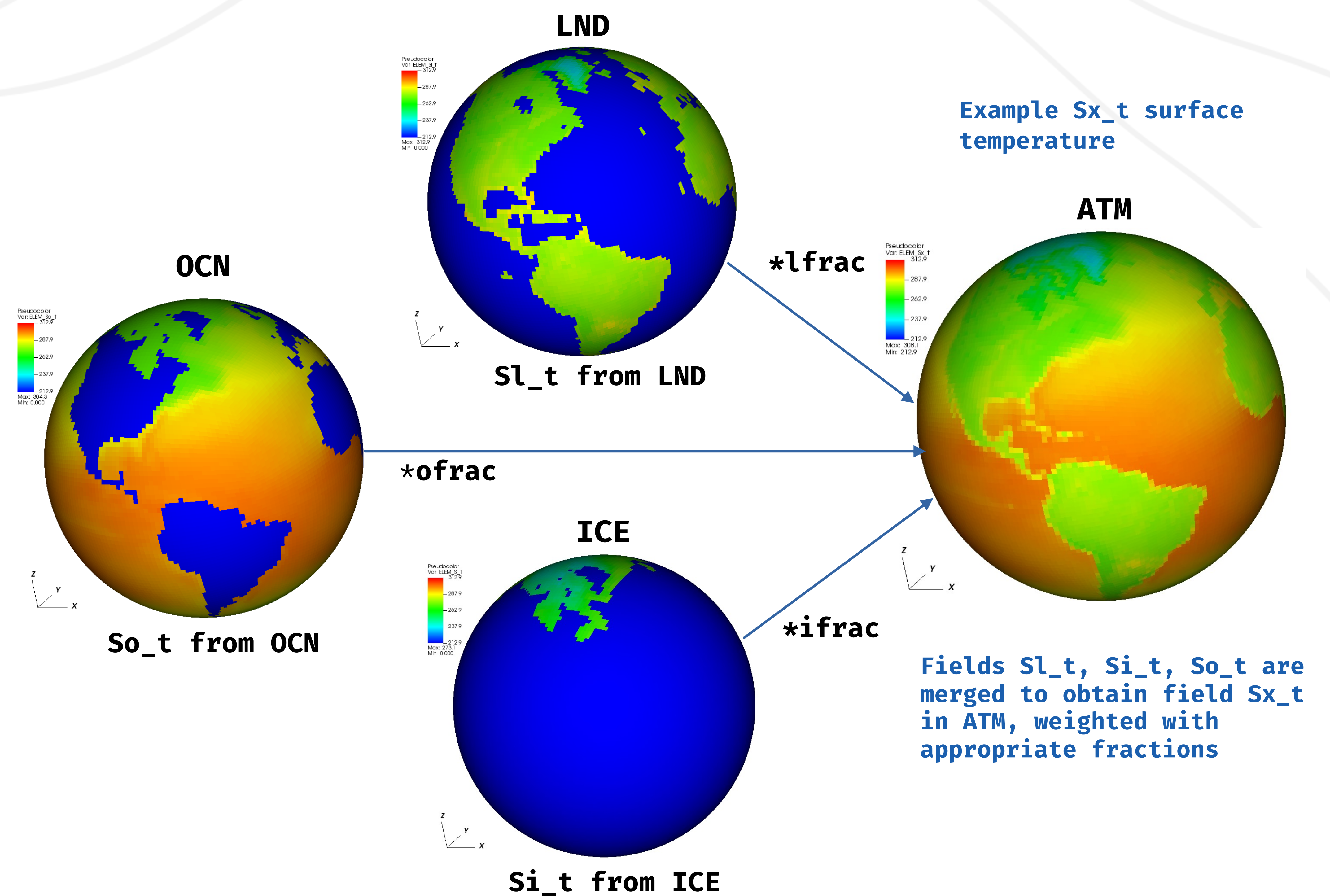
Vijay Mahadevan, Iulian Grindeanu, Danqing Wu, Robert Jacob

MOAB Coupler for E3SM

- Current MCT coupler in E3SM uses a hybrid workflow: remapping weights are computed offline, and at runtime, use buffered reading from disk and distributed application
- MOAB provides a full topological surface mesh representation, and remapping weights are computed fully online during E3SM initialization with TempestRemap backend
- MOAB coupler is enabled with option “`--driver moab`”
- MOAB algorithmic infrastructure supports:
 - ✓ uniform API for offline (`mbtempest`) and online (`iMOAB`) remap workflows,
 - ✓ component mesh and data migration between PE layouts,
 - ✓ mesh intersection computation between distributed component pairs,
 - ✓ generation of high-order, consistent and conservative mapping weights,
 - ✓ adaptive decompositions and property-preservation algorithms,
 - ✓ send/rcv of coupled field data using optimized communication graphs



Example Merge Workflow with MOAB Coupler

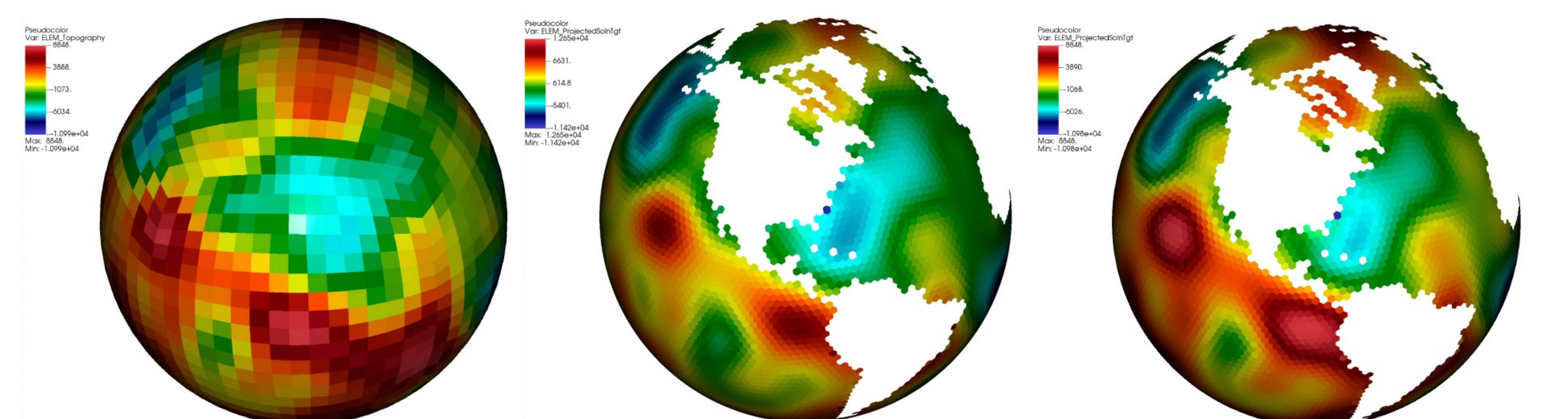
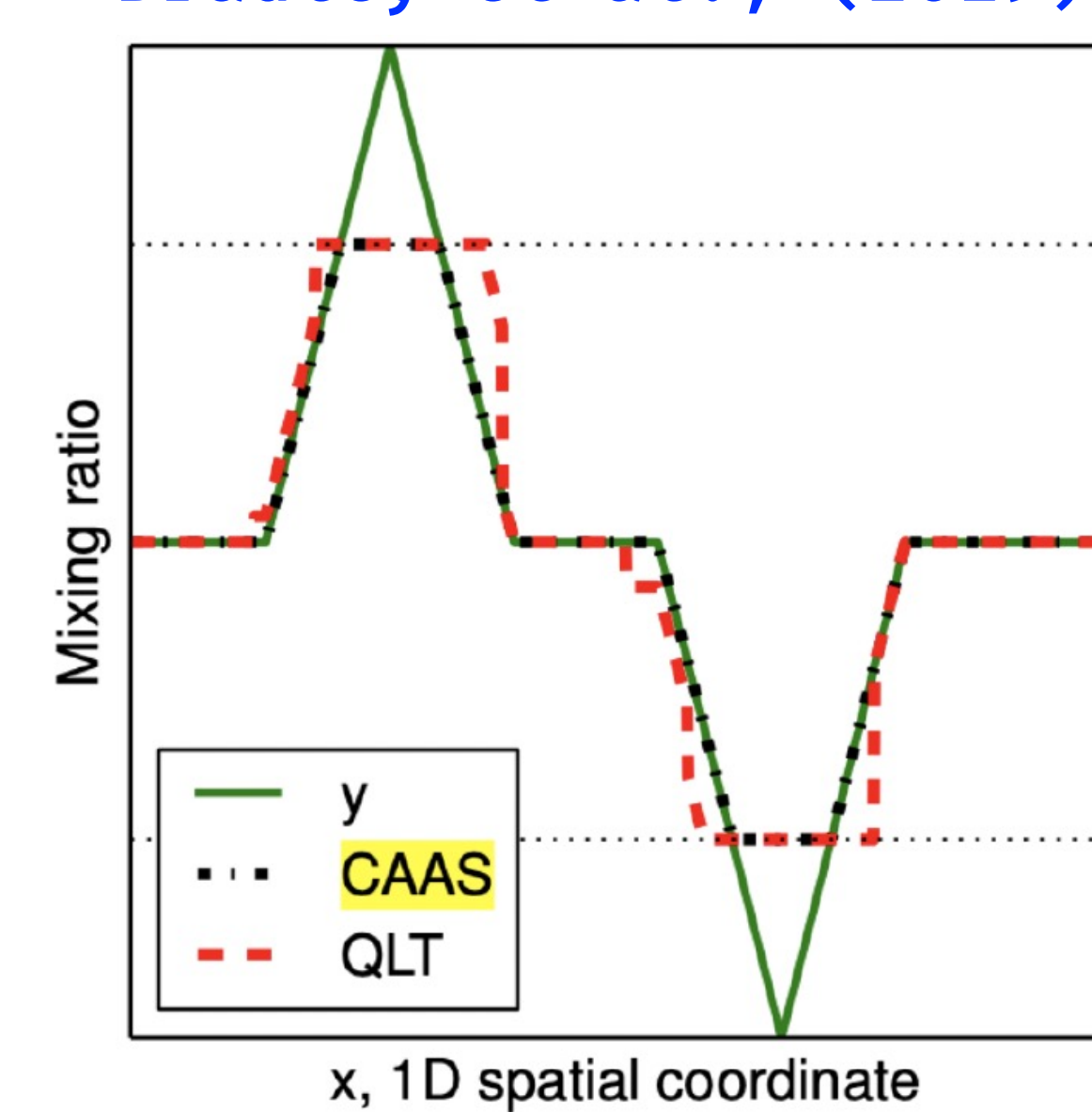


“-DMOABCOMP” preprocessor definition enables verification of MOAB against MCT coupler, for each variable in coupled components. e.g., ATM comp, MCT-MOAB difference for Sx_t = 6.289345036138E-12

High-Order, Conservative and Monotone

- MOAB (master) now exposes Clip-And-Assured-Sum (CAAS) monotone limiter for property preservation in high-order map projections
- CAAS recovers conservation and monotonicity by redistributing mass-defect globally (local variations available); can be made BfB.
- Quasi-local tree-based (QLT) mass redistribution using local (intersection) and geometric neighborhood information

Bradley et al., (2019)



Topography (CS16) field L₂ Projection (holes) L₂ Projection (holes) + CAAS
CS-ICOD Conservative O(4) Projection of Topography field (ETOP01)

Progress

Current Status

- ✓ **Coupled watercycle case works!**
- ✓ **Prognostic Models:** EAM, ELM, MPAS-O, MPAS-SI, MOSART
- ✓ **Data Models:** DATM, DOCN, DROF, DICE

In Progress

- **Models:** *EAMxx*, MPAS-LI, WAV, DWAV, *DLND* Snapshot of merged net shortwave down
- Field projections are reproducible to machine precision on different PEs, but BfB guarantees require changes in MOAB and TempestRemap
- Remove MCT scaffolding to compare performance characteristics of MCT/cpl7 and MOAB couplers on verified high-resolution cases
- Support heterogeneous architectures by abstracting data and topological operators in MOAB to be device-compatible

Cross-collaboration Efforts

The coupling technology developed for E3SM is being applied to other BER projects ([SEAHORCE/COMPASS-GLM](#)). Other agencies ([NOAA/ESMF](#)) are also integrating MOAB in their coupling infrastructures.

