Applying Computational Efficient Schemes for Biogeochemistry

ACES4BGC

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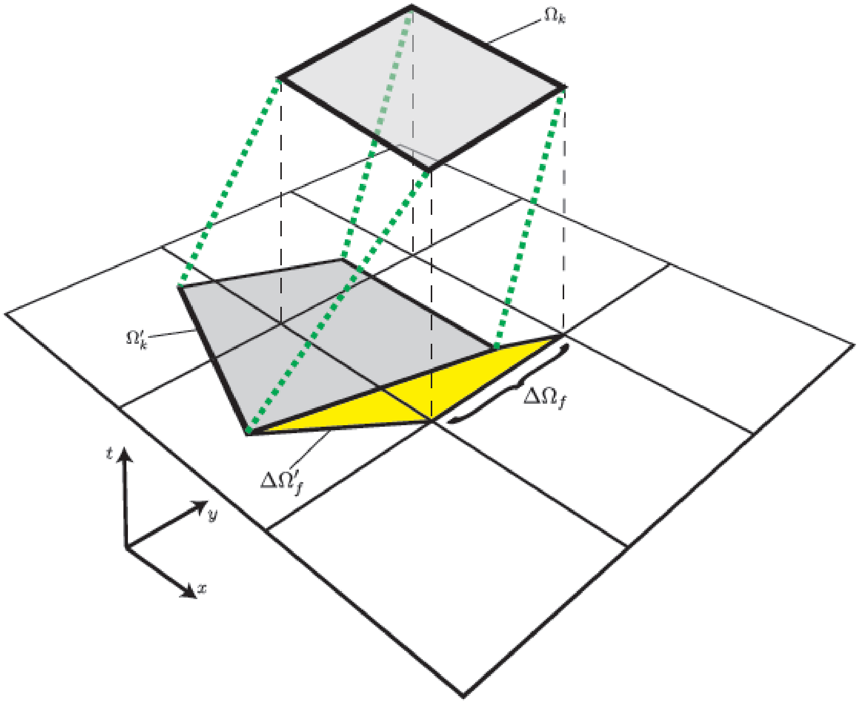
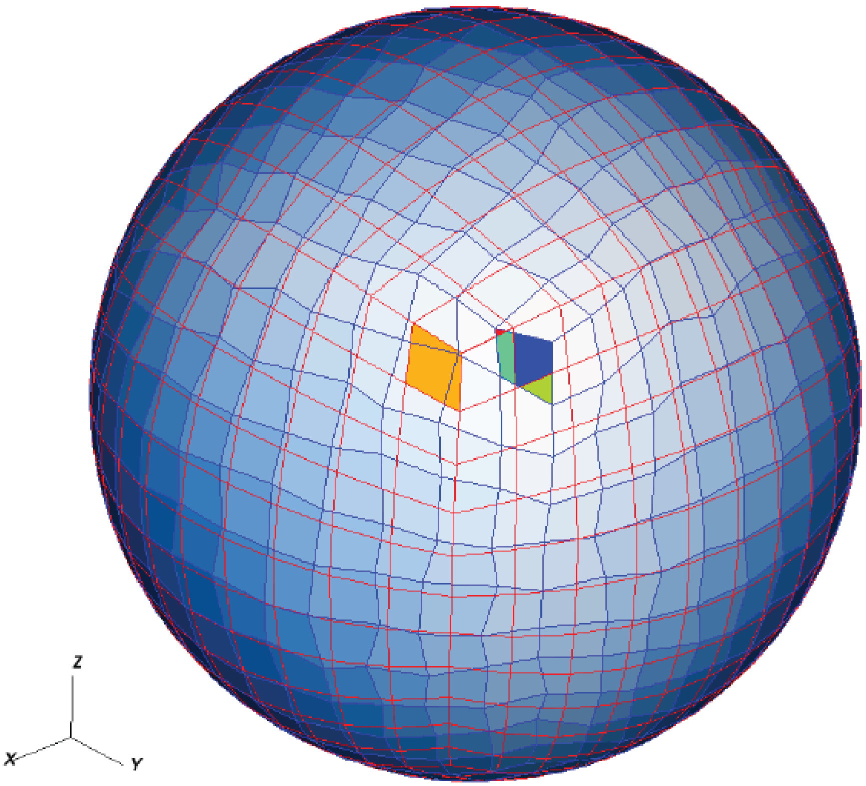
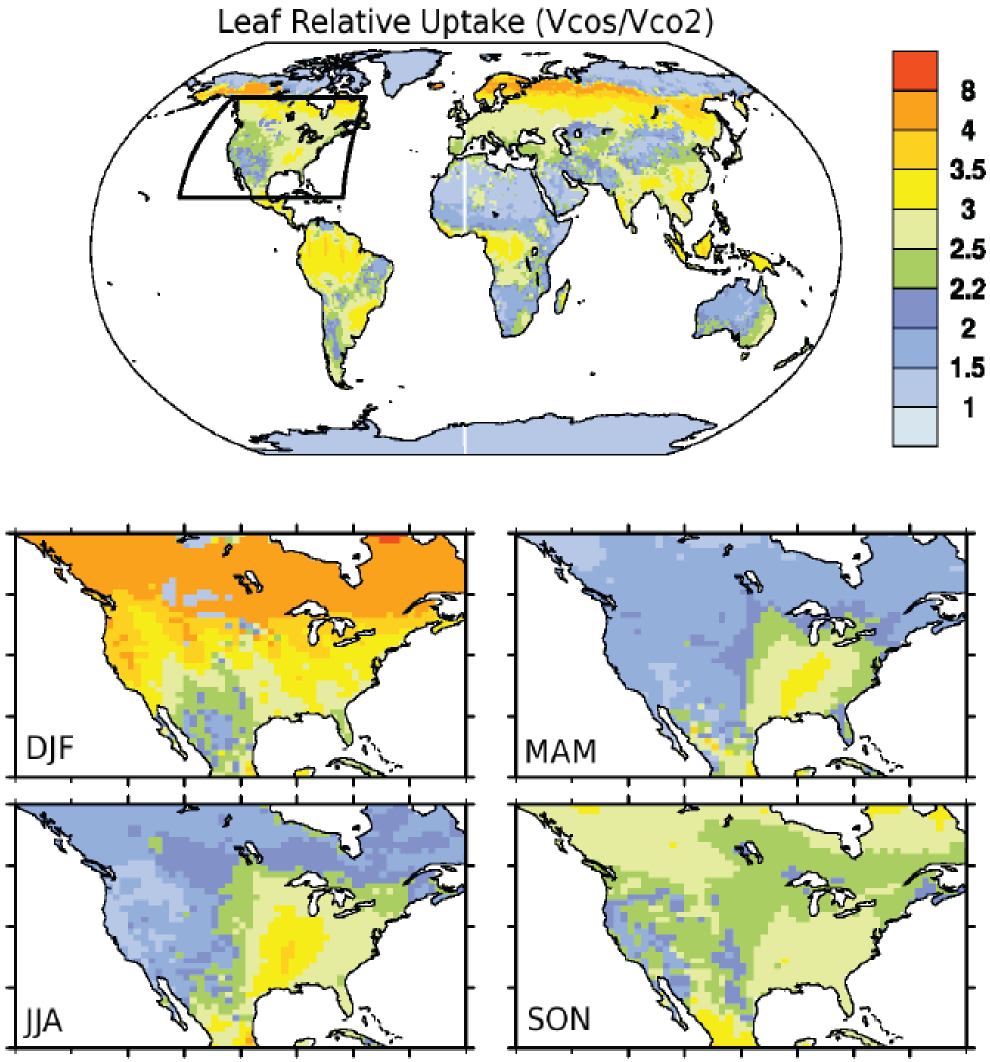
Implementing efficient advection algorithm for thousands of tracers





Incremental remapping using the FASTMath MOAB technology for unstructured, variable resolution grids.

Focus on Earth System Modeling



- Aerosol schemes (SECT & MAM),
- Emissions of biogenic VOCs, Uptake of COS (to constrain photosynthesis),
- Biogeochemical interactions between atmosphere, land, and ocean,
- UQ to constrain process parameters and feedbacks,
- Performance engineering for DOE supercomputers.

Leaf relative uptake of COS uptake in CLM (Fu et al., in prep.).

ACES4BGC Team

Name	Lab	Science Team	Topic
Pavel B. Bochev	SNL	Atmosphere	Advection
Philip J. Cameron-Smith†	LLNL	Atmosphere	Atm. BGC
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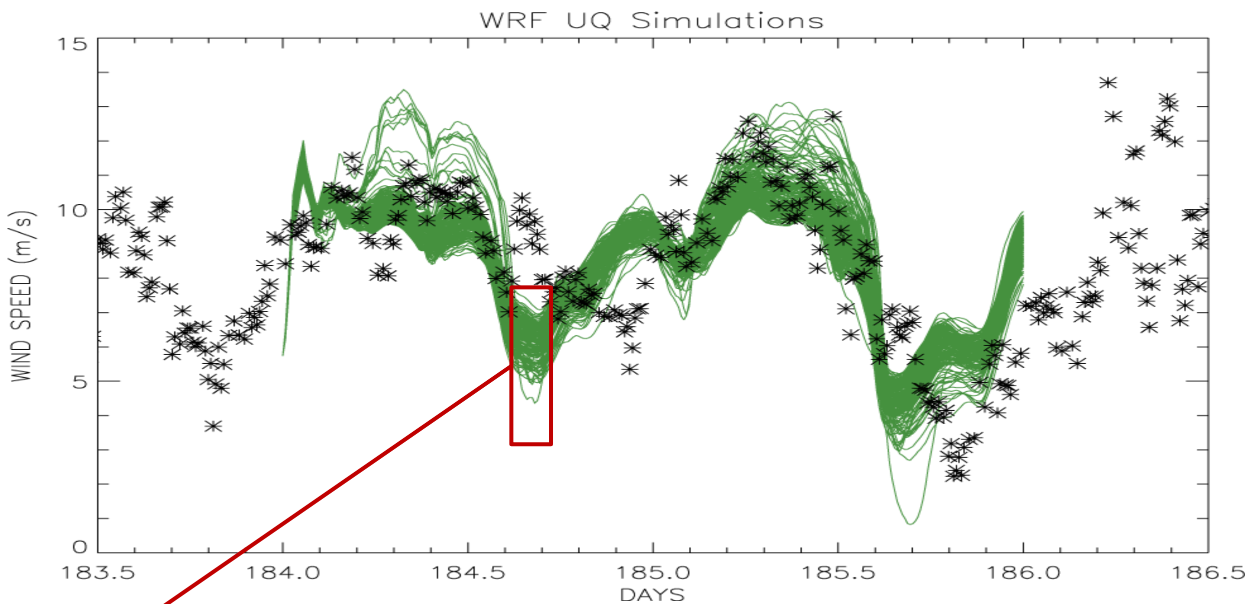
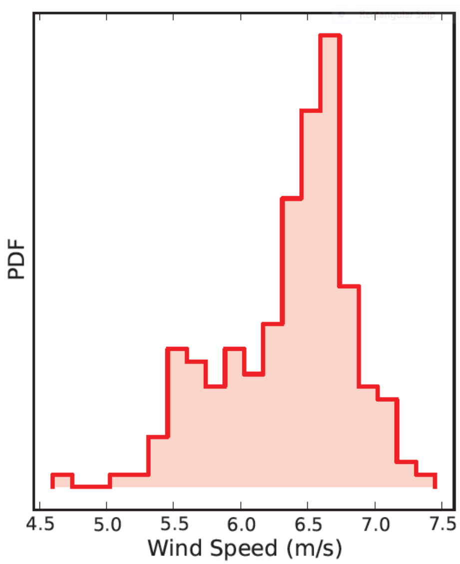
UQ for wind energy show source of uncertainty

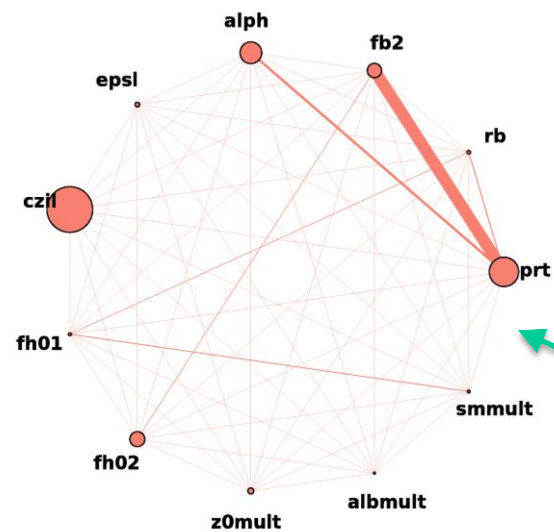
2-day wind speed forecasts at 80-meters

Ensemble spread from 11 parameters





What factors drive the variations?



Variance Network Graph

Model parameters and initial/boundary conditions

LLNL Chem-Aerosol Activities

- Sectional aerosol scheme (SECT) queued for trunk.
- Coupled super-fast mechanism to MAM for CAM5.
- Connect atmospheric chemistry to biogenic emissions.
- Implement OCS and $CO^{18}O$ tracers.
- Revitalize tracer test-suite in CAM with ^{222}Rn/^{210}Pb and SF_6
- Tracer conservation algorithms for MOAB.

UQ Activities

- Quantify sensitivities and uncertainties of atmospheric chemistry and biosphere-atmosphere interactions (O_3, NO_x, VOCs, SOA formation)

- Challenged by the "Curse of Dimensionality"

  Brute force sampling ~ M^N for *M* levels and *N* sources of uncertainty (about 10^{100}, a *googol*, for MOZART chemistry)

- Use computational and statistical methods to overcome the "Curse"
  - Single column ensembles with CAM5Chem
  - Latin hypercube sampling and machine learning based feature selection to reduce the dimensionality

- Apply UQ framework to calibrate/validate model chemistry with observations (targeting GOAMAZON)