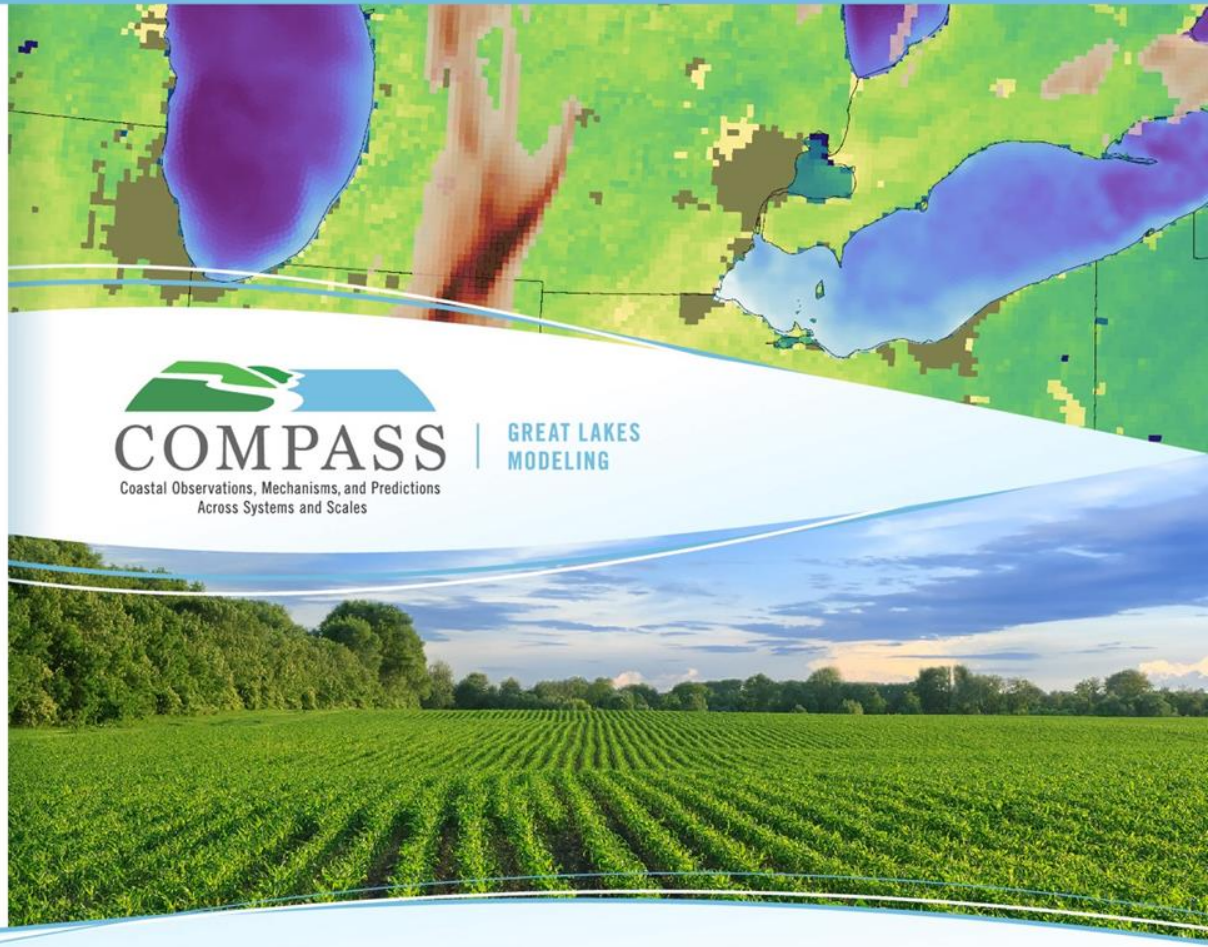
Progress toward a high-resolution 3D regional land model for agricultural systems

Scott Painter[1], Ethan Coon[1], Saubhagya Rathore[1], Phong Le[1], Daniil Svyasky[2]

[1]ORNL, [2]LANL



U.S. DEPARTMENT OF ENERGY

COMPASS is a multi-institutional program led by PNNL and funded by the Earth and Environmental Systems Science Division of the U.S. Department of Energy's Office of Science

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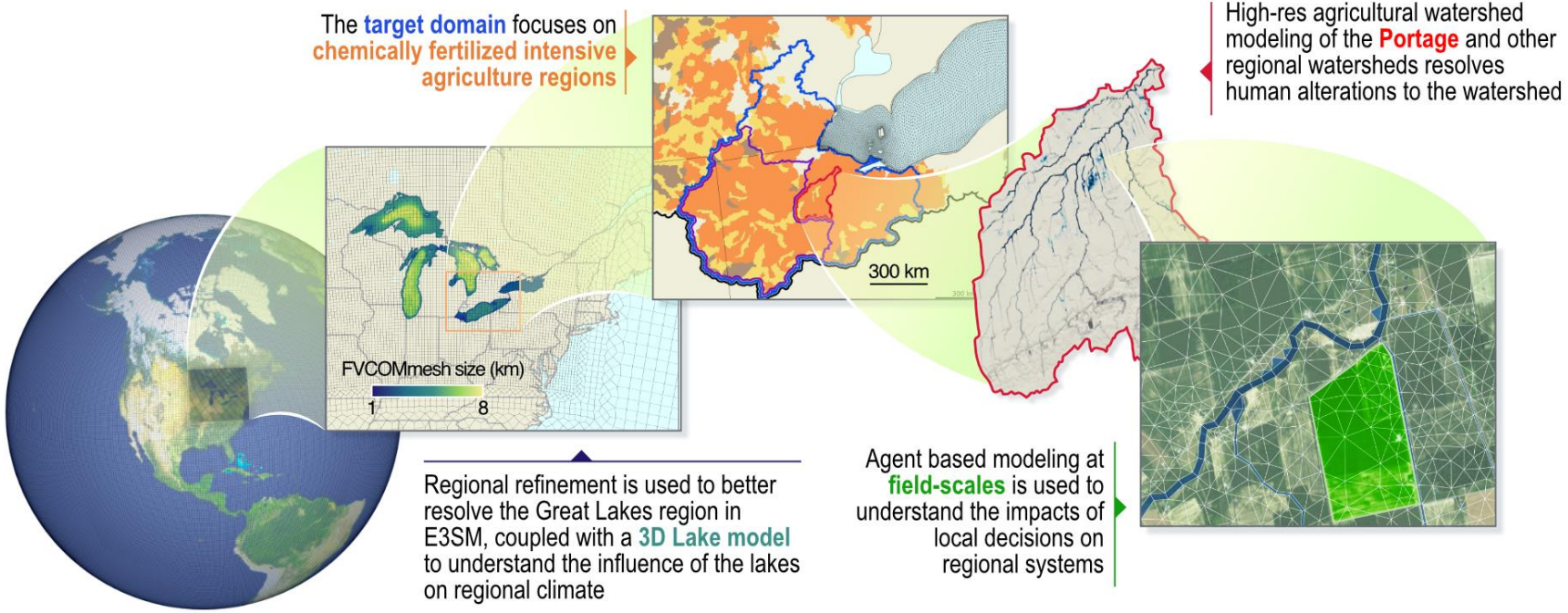
COMPASS-GLM is developing a regional-scale ESM that couples human and Earth system components, each with application-appropriate detail, to understand the evolution of coastal regional systems, using the Great Lakes Region as a test bed.



ATS (Coon et al 2019)

AMANZI ATS

R&D 100 AWARDS

Integrated surface/subsurface flow and energy transport

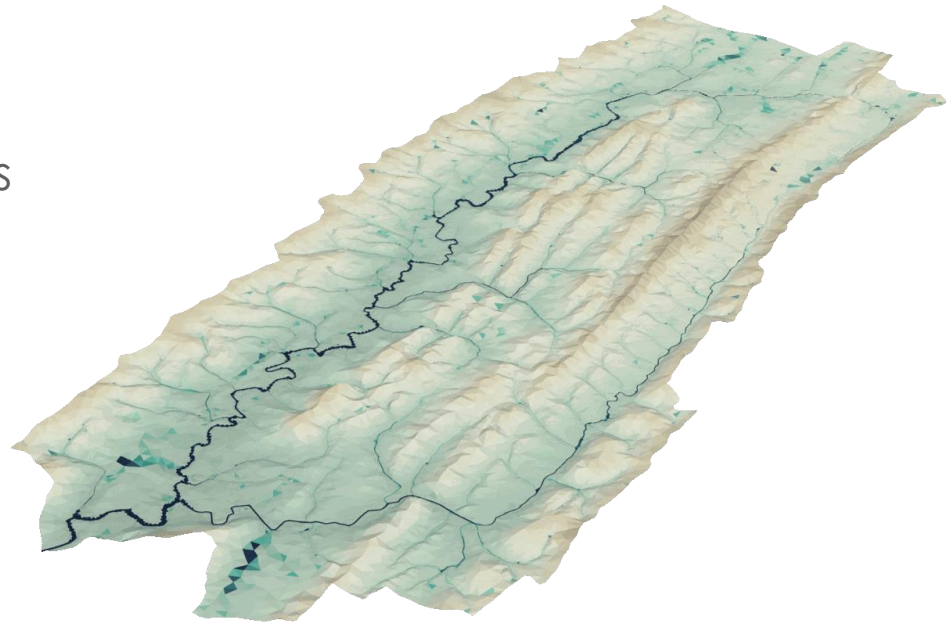
Surface/subsurface transport

Interface to PFLOTRAN for reactions

Unique system for managing multiphysics complexity

Advanced meshing capabilities

Multiscale river corridor model



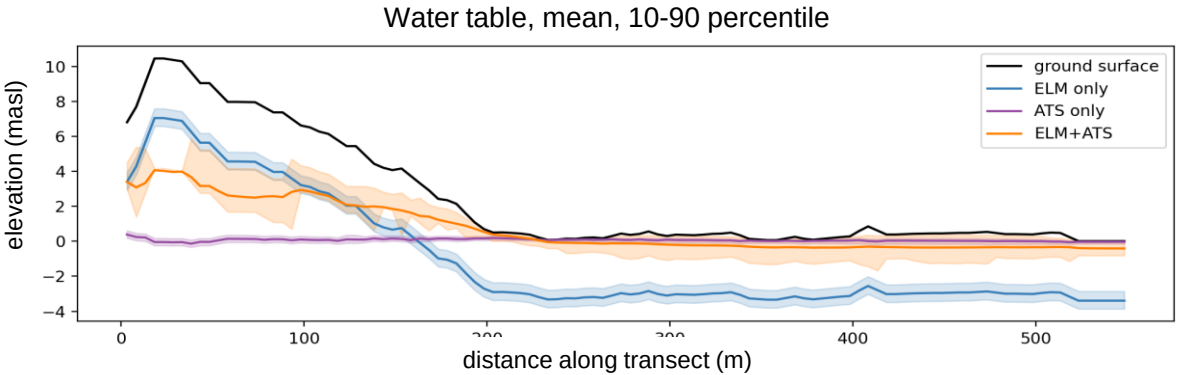
Reduced need for calibration improves confidence in projections

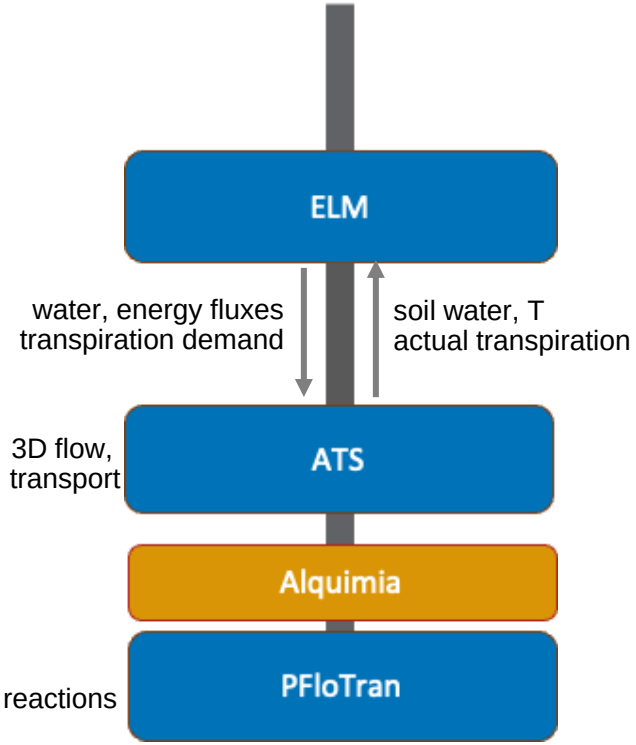
ELM + ATS coupling

Key science questions related to watershed response to changing climate and human actions require online coupling between E3SM and a 3D flow and reactive transport model.

Phase 1 prototyped an ELM + ATS coupling

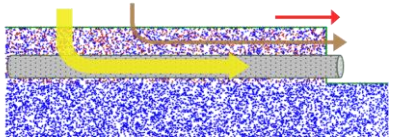
We will finalize and test in Phase 2

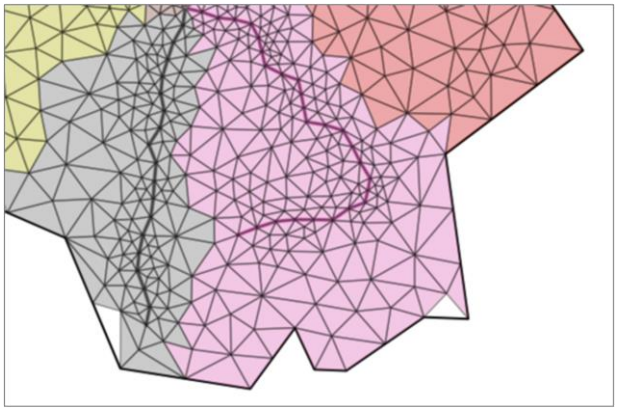


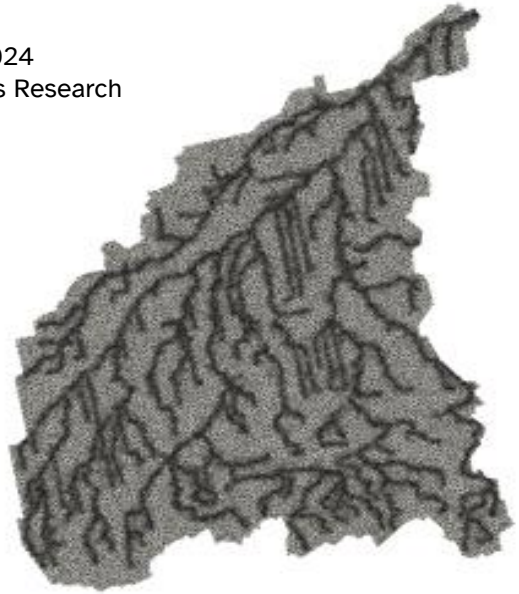


ATS and Watershed Workflow were modified to model artificial drainage, thus making them suitable for modeling agricultural watersheds.

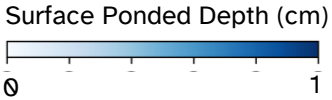
Rathore et al. 2024
Water Resources Research

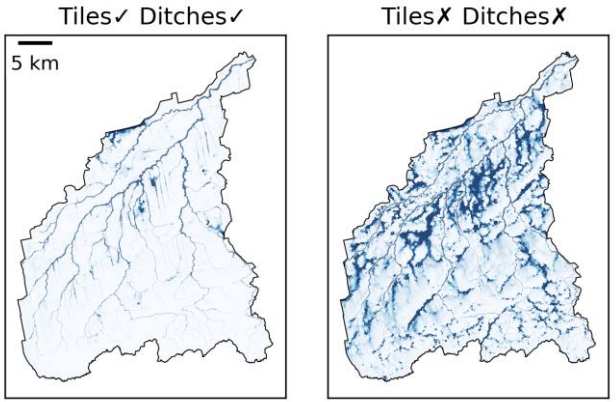


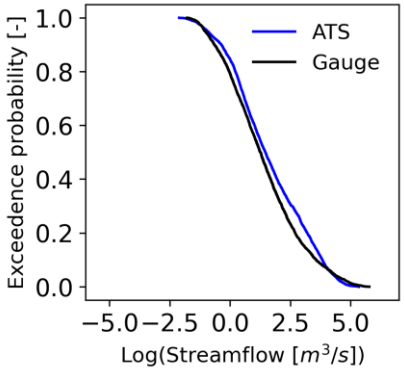




Uncalibrated ATS outperforms calibrated SWAT model







Conclusions

Regional ESMs with a representation of 3D flow and reactive transport are needed to provide actionable information on regional-scale impacts

3D land surface model based on ELM+ATS was prototyped and is undergoing further development in the COMPASS-GLM project

In Phase 2, we will use E3SM-GLR with ELM+ATS to simulate event-scale nutrient exports to western Lake Erie