Poster #22-12

IDEAS-Watersheds Continental Modeling Platform and Simulations

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BER Program: SBR
Project: IDEAS-Watersheds (University)
Project Website: https://ideas-productivity.org/ideas-watersheds/

Continental hydrology is one of three cornerstones of the IDEAS-watersheds project. Our goal is to develop a high resolution, integrated hydrologic modeling platform for the Continental US (CONUS) that bridges across the IDEAS-watersheds study areas and provides a scaling framework from the reach to the watershed and the continent. This framework provides unique capabilities to generate multiscale workflows and address outstanding questions regarding large scale groundwater surface water interactions. An initial CONUS model spanning the majority of the continental US was developed using ParFlow-CLM in the first phase of the IDEAS project. Moving forward, the proposed continental modeling will build from the existing CONUS model, applying a phased approach over the next three years to explore multiscale, multi-physics treatments of terrestrial hydrology modeling from the bedrock into the atmosphere. The CONUS research falls under three categories: (1) model development, (2) software development and sustainability, and (3) continental simulations.

This year *model development* is focused on the expansion of the initial CONUS domain to the entire contributing area of the US. The new domain is designed to align with the National Water Model, incorporating coastlines and improving the treatment of internally draining basins. We are developing improved subsurface parameterizations for the new model, increasing the vertical depth and including better representations of alluvial systems and geologic layering.

Our *software development* efforts are focused on building shared infrastructure and tools to improve simulation efficiency and create reproducible workflows. This includes new tools for model compilation available through GitHub and Docker and new metadata and workflow tracking for simulations implemented with Kepler workflows. Additionally, we have developed the EcoSLIM particle tracking code which provides new capabilities to track particles through the land surface component of the system, in addition to the existing groundwater particle tracking capabilities. EcoSLIM is a critical component of our shared software ecosystem which can be implemented across spatial scales relevant to the broader IDEAS-watersheds team.

Continental simulations with the original CONUS domain are also ongoing. We completed a series of warming simulations to explore connections between groundwater storage and watershed response to increased temperatures. Our results provide the first, large scale evaluation of warming impacts within a modeling platform that directly captures lateral groundwater flow. We show that storage changes in shallow groundwater systems can support increased evapotranspiration with warming thus mitigating plant water stress.