UMCUR Abstract: The Skyentists

Earth system models are computer simulations of processes that exist in the natural world. As one example, these models can be used to simulate how both plants and soil respond to changes in short-term variability. In order for the computer model to accurately estimate the impacts on the terrestrial carbon balance, we need information on how specific plants in different parts of the world respond to changes in temperature and moisture. This information comes partly from expert knowledge and published papers. The rest of the required information has to be learned from data. This is described as model calibration, in which real-world data from observations of the carbon fluxes of plants "teach" the model. The simulation is done for the entire globe each day of the year.

The current calibration process is manually intensive, difficult to verify, and a serious challenge for reproducibility. Our group was tasked with creating new calibration software that was organized well and could support different models that are also calibrated on carbon fluxes. This process began with specifying software requirements, modeling software architecture and creating prototypes, got feedback from users, and created an implementation plan. Our team of four subsequently split tasks in the implementation plan and developed the software over several phases. Users tested the calibration software, and needed changes were incorporated.

We created a clean, well-documented piece of calibration software that is easy for others to use and change for future models. The new software benefits from best practices that result from our team’s expertise in software engineering, a skillset that is not always available to the scientists that rely on earth system models. Computer Science is the idea that no matter what process is being performed, processes and data can be cleanly organized so that others can easily understand that process. This understanding is essential for members so that members the scientific community to communicate complex ideas with each other and facilitate interdisciplinary discoveries and creations. Our calibration software successfully helps in this regard.