BLUE WATERS
SUSTAINED PETASCALE COMPUTING

Allocation: BW Professor/240 Knh

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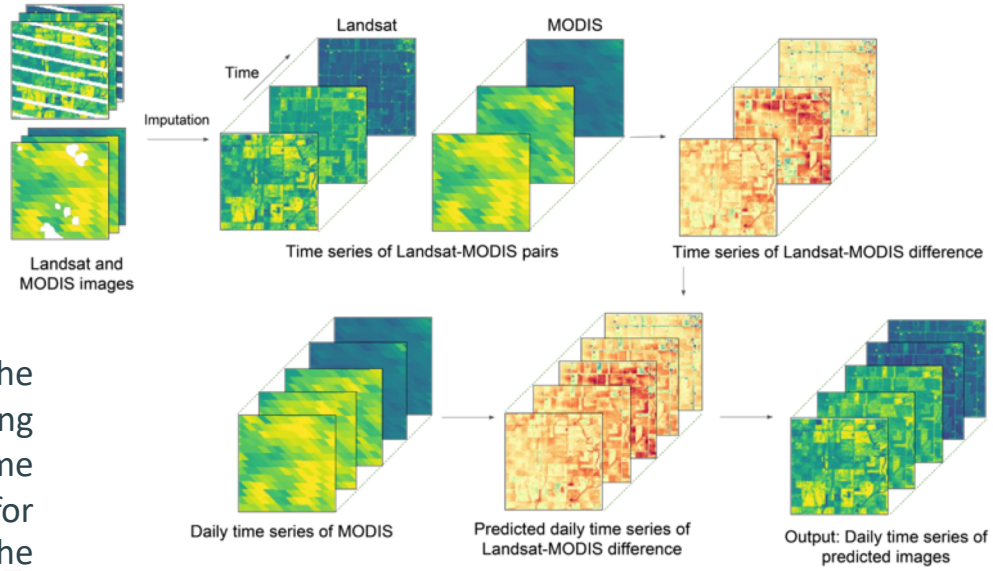
Geoscience

FORECASTING GLOBAL CORP PRODUCTIVITY THROUGH INTEGRATING NOVEL SATELLITE DATA AND PROCESS-BASED MODELS

Research Challenge

Global food security is under continuing pressure from increased population and climate change. The goal of this project is to improve the predictability of regional and global crop yields by integrating advanced remote-sensing and process-based modeling. Satellite observations can provide real-time monitoring of crop acreage and growth condition. Process-based crop models are effective tools for studying the impacts of climate change on regional and global food production, for assessing the effectiveness of adaptations and their potential feedback to climate, and for attributing different pathways through which climate can impact crop yields.



Conceptual frameworks for STAIR fusion algorithm.

Methods & Codes

We developed new multi-satellite (Landsat, Sentinel, MODIS, VIIRS) data fusion algorithm STAIR to generate high spatio-temporal resolution (30m and daily) and gap/cloud free satellite images for the contiguous United States. We trained machine learning algorithms for within-season crop type classification based on time series of satellite data. We improved the crop growth representation in the Community Earth System Model (CESM), and used SALib package for parameter sensitivity analysis and PyDREAM package for Bayesian parameter calibration.

Results & Impact

Our results show that STAIR can provide good quality fused data for crop monitoring. By using time series of satellite data, our machine learning approach showed a relatively high overall accuracy of 96% for classifying corn and soybeans from 2000 to 2015, and achieved 95% overall accuracy for classifying corn and soybeans by late July of each year. The new process-based model (CLM-AgSys) corrected deficiency of CLM in simulating carbon allocation and showed better performance in simulating yield as well as surface fluxes.

Why Blue Waters

Blue Waters is essential for our research since other resources, such as those available from XSEDE, are not suitable for our project considering the petabyte-level storage demand, data availability, and intensive I/O and computational demands.