

Crop Yield Forecast Models that Maximize Explanatory Power of Climate Based Inputs from Satellite Observations

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The most essential factors influencing variability in crop yields at a particular location are inter-annual variations of moisture and temperature. These factors are often used to predict the yields for corn, soybean and wheat and variables representing these factors can be derived from the Special Sensor Microwave Imager (SSM/I). Another important factor is the trend increase due to improvements in seed stock and agricultural practices. Yield predictions based on the trend and weather factors have proven valuable. Nonetheless, additional predictors exist for yield predictions, including the greenness index (measured by NDVI) for monitoring plant growth. Unfortunately, many of these predictors are correlated, which weakens the accuracy and stability of regression-based models. Moreover, the spatial resolution of the historical yield data and the satellite observations of the weather, soil, and plant growth conditions can have spatial autocorrelations. To effectively remove the collinearity between predictor variables in both time and space, we have chosen to use Canonical Correlation Analysis (CCA) to make predictions in spectral space. At the meeting, we will present procedures and results, and demonstrate the value of this work and its application. The regions and crops presented are Iowa corn, Illinois soybean, and Kansas Wheat. The study contains 20 years of analyses for each crop-state pair.

SSMI Data Sets

Land Surface Wetness includes:

- Surface water from all sources: precipitation, snowmelt, and irrigation,
- Water near the surface and in the top soil,
- Water in the canopy,
- Wetlands and other water bodies.

Land Surface Temperature Data

- Identifies heat for germination, vegetative growth and plant development,
- Identifies areas where crops are undergoing heat stress,
- Monitors available heat for pathogen growth.

Snow Cover

- Identifies the extent of snow cover relative to normal,
- Monitors availability of snow cover to protect winter wheat and other crops,
- Detects the availability of melt-water and irrigation supplies.

Crop Model Generation

- Use SSMI wetness and temperature anomalies from important stages of the growing season as predictors of yield
- Calibrate model on past year yield outcomes
- Make unique models for each region – crop combo
- Generate and run models multiple times as the growing season progresses