Real-Time Monitoring and Short-term Forecasting of Phenology from GOES-R ABI for the Use in Numerical Weather Prediction Models

Principal Investigators: Yunyue Yu (NESDIS-STAR), Xiaoyang Zhang (South Dakota State Univ.), Michael Ek (NWS-EMC), Yihua Wu (NWS-EMC)

Abstract

We propose to use GOES-R ABI data to build an operational system for monitoring and forecasting the seasonality of the green vegetation fraction, or phenology, in response to GOES-R Risk Reduction research topic of *(A) Improving NWS Operational Numerical Weather Prediction (NWP)*. In this context, phenology at the spatial resolutions relevant to NWP ***quantifies the seasonal progression of green vegetation fraction*** (GVF), especially its timing, magnitude, and variation across the vegetated land surface. Accurate measurement of phenology has broad significance to key environmental, social, cultural, and economic processes, including food supply and human health. In particular, real-time monitoring and short-term forecasting of green vegetation fraction could greatly benefit numerical weather modeling by incorporating a key determinant in albedo, surface energy balance, and evapotranspiration. However, the timing of critical phenological events are not explicitly defined and spatiotemporally consistent GVF is actually not produced in GOES-R ABI Option 2 GVF product. Therefore, we will use the high frequency of diurnal observations from GOES-R ABI to generate daily cloud-free trajectories of the vegetation index (VI) for real-time monitoring and short-term forecasting of phenological metrics, including the timing and GVF magnitude in spring leaf-out, summer growth peak, and fall foliage development. The specific goals of this proposal are:

- Monitor in real time and forecast in the short term phenological metrics using simulated ABI vegetation greenness trajectories.
- Produce a daily enhanced GVF dataset that is free of gaps caused by clouds and other factors, in real time and a week ahead, respectively.
- Evaluate and validate the stability, precision, and accuracy of the proposed GOES-R phenological metrics.
- Demonstrate the influence of the enhanced phenological metrics on improving NWP systems at the National Center for Environmental Prediction (NCEP).

To develop the GVF phenological product, this proposal plans to employ *GOES-R ABI Baseline and Option 2 Products* (including *Vegetation Index (NDVI), Green Vegetation Fraction (GVF), Land Surface Temperature (LST), Fire/Hot Spot Characterization product*, and *Solar/Satellite View Geometry data*) to generate pixel-based models of VI temporal trajectories. The modeled trajectories will be updated daily with the near-real-time ABI observations. Combining prior knowledge and near-real-time ABI vegetation index data, we will produce real-time monitoring and short-term forecasting of vegetation phenological metrics over full disk coverage (North-America and South-America) at a spatial resolution of 2km. This operational approach will be tested and evaluated using MSG SEVIRI and MODIS data and other measurements.