# Real-Time Green Vegetation Fraction for Land Surface and Numerical Weather Prediction Models


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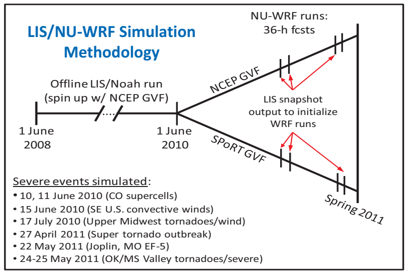
## Hypothesis and Project Objectives

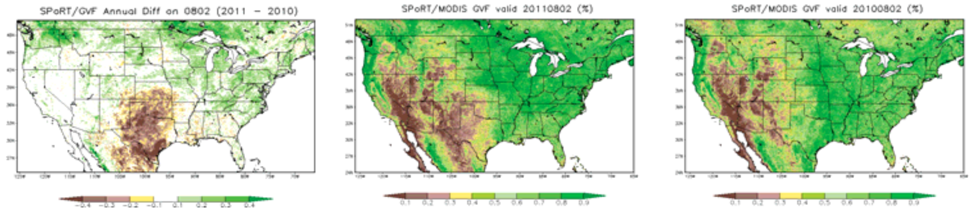
- **Hypothesis: *Incorporating high-resolution, real-time vegetation information can improve model simulations of land-atmosphere heat and moisture exchanges, and ultimately warm-season severe convective weather events***
- **Experiment objectives**
  - Demonstrate how real-time vegetation derived from the Moderate Resolution Imaging Spectroradiometer (MODIS) adjusts to weather and climate phenomena
  - Show sensitivity of Noah land surface model (LSM) to real-time, daily MODIS vegetation compared to monthly climatology vegetation as is currently used in models
  - Identify events/regimes when real-time MODIS vegetation improves short-term simulations of severe weather events
  - Provide guidance on potential impacts of vegetation information from next-generation sensors (e.g., VIIRS)

## Real-Time MODIS GVF Data and Simulation Methodology

- **SPoRT runs a real-time Green Vegetation Fraction (GVF) product from MODIS and is made available for download via anonymous FTP**
- **CONUS coverage at 0.01° resolution in WRF and LIS binary formats**
- **Updated daily with previous 20 days of MODIS data**
  - Up to 6 NDVI values at a given grid pixel
  - No viewing angle corrections
  - Inverse time-weighted to produce daily NDVI composite
  - NDVI converted to GVF following method described in Miller et al. (2006) & Zeng et al. (2000)
- **Product is read into LIS and WRF and can be used to test hypothesis outlined above**
- **NU-WRF simulations of severe weather events**
  - Cold start run on 4-km CONUS domain with same configuration as real-time NSSL-WRF runs [Refer to http://www.nssl.noaa.gov/wrf/ for physics & grid configuration details]
  - NU-WRF runs with full coupling between ARW and LIS configured to run the Noah LSM
  - control: NU-WRF with AVHRR monthly GVF climatology (NCEP GVF)
  - sportgvf: NU-WRF with daily MODIS GVF (SPoRT GVF)

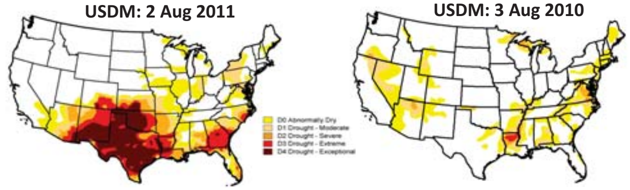



## MODIS GVF Response to 2011 Southern Plains Drought

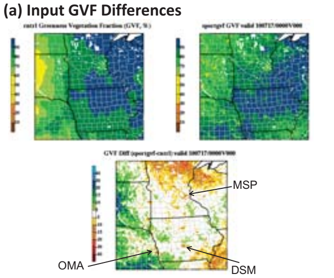



- **Real-time GVF captures regional drought characteristics**
- **Texas was very wet in early summer 2010, with virtually no rain in 2011**
- **1-year reduction in GVF of up to 40%**
- **Shows how much GVF can change from year to year, so use of climatology is not optimal**

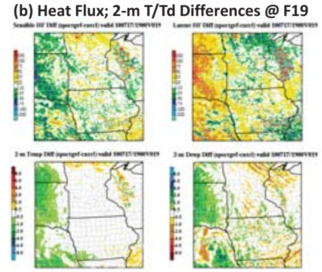
**USDM: 2 Aug 2011** **USDM: 3 Aug 2010**



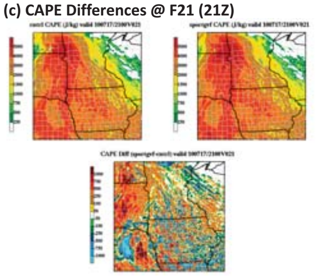

**(a) Input GVF Differences**



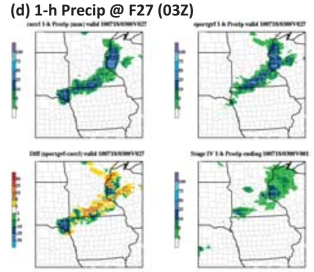

**(b) Heat Flux; 2-m T/Td Differences @ F19**



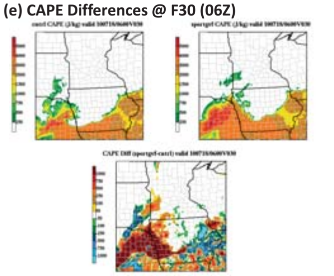
**(c) CAPE Differences @ F21 (21Z)**



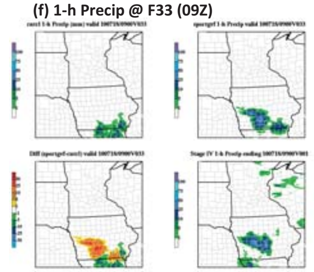
**(d) 1-h Precip @ F27 (03Z)**



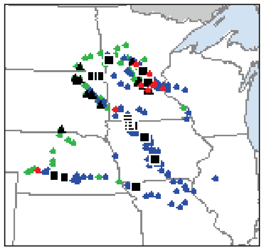
**(e) CAPE Differences @ F30 (06Z)**



**(f) 1-h Precip @ F33 (09Z)**



**(g) Storm Reports**

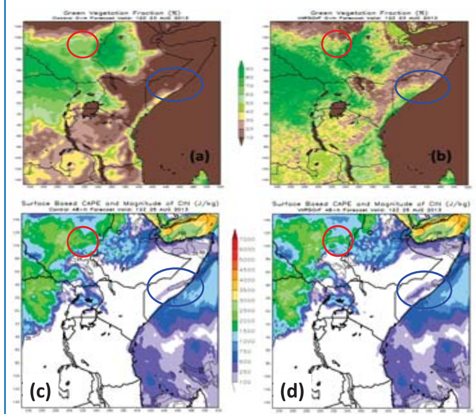


## Sensitivity Simulation Highlights of 17 July 2010 Upper Midwest Severe Weather Event

- **Higher GVF in the Dakotas (a) led to lower sensible HF, higher latent HF, cooler 2-m temperatures, and more moist 2-m dew points; opposite impact seen in Northern Minnesota where GVFs were lower (b)**
- **This leads to much higher CAPE differences in the sportgvf over the Eastern Dakotas at 1900 UTC (F19) just prior to convective initiation (c)**
- **Precipitation evolution is similar initially with the cntrl and sportgvf both overdoing the precipitation compared to Stage IV (d)**
- **Higher residual CAPE in sportgvf run over NE/IA (e) contributed to correct back-building & re-development of convection into central Iowa by 09z (f) corresponding to wind damage storm reports (g)**

## Integration of VIIRS GVF

- **NESDIS is working towards generation of a real-time GVF product from VIIRS**
- **Global coverage at 4-km resolution (10000 x 5000) in NetCDF4 format**
- **Updated daily with previous week of VIIRS swaths**
  - Surface reflectance composites based on view-angle adjustments
  - Max value from previous 7 days retained for each daily composite
  - GVF computed from Enhanced Vegetation Index (EVI) using 3 channels (NIR, red, blue)
- **Product is expected to be ready in Summer 2014**
- **SPoRT completed module to process VIIRS GVF data into LIS and WRF formats and have applied to a case study over East Africa from August 2013 (below) that demonstrates advantages of the hi-res GVF data**




## Summary and Collaboration Opportunities

- **Real-time GVF has potential to improve model simulations of severe weather events**
  - MODIS GVF responds realistically to weather/climate variation on regional scales
  - Better representation of sensible/latent heat fluxes in Noah
  - Selected forecast simulations show improvement in forecast QPF under conditions of substantial daytime heating without pre-existing clouds or precipitation
- **SPoRT has developed means to process real-time NESDIS VIIRS GVF data into LIS and WRF; anticipate public availability by Summer 2014**
- **Would like to work with JCSDA partners to explore how to bring real-time GVFs into their operational modeling systems**