Convective Storm Forecasting 1-6 Hours Prior to Initiation

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Project Motivation and Goal

One of the greatest difficulties in severe storm forecasting is deciding where and when storms will initially form. Current numerical models struggle with this problem and often have large errors in their 1-6-hour forecasts for convective initiation (CI). **The overall goal of this proposal is to develop a single objective system that predicts where and when storms will form 1-6 hours prior to initiation**.

Institutional Plans

CIRA: Utilize the split window difference (10.35–12.3 μm) to identify regions of enhanced or deepening low-level water vapor to help predict where and when convective clouds will form

CIMSS: Produce Mesoscale Atmospheric Motion Vectors matching ABI temporal resolution and calculate fields of convergence, divergence, vorticity, and shear

UAH: Heating Index and Land Surface Variability indices, and their associated gradients, will be examined for their utility to predict CI on “synoptically calm” days

NSSL: Wind observations from the WSR-88D network using the Variational Doppler Radar Analysis System(VDRAS) will be used to provide a more complete picture of the pre-storm wind and moisture fields.

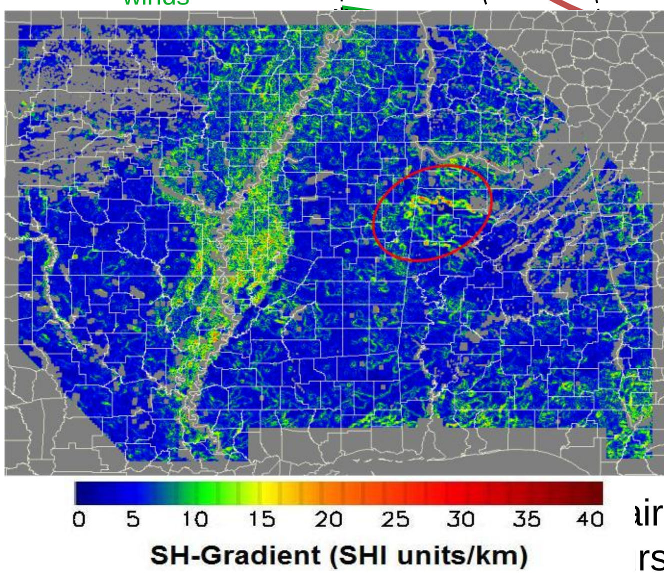
CREST: To assist with algorithm validation, radar echoes and National Lightning Detection Network data will be used to catalogue when CI occurs, and the WDSII Segmotion algorithm, along with satellite and model winds, will be used to back-track clouds into the cloud free regions.

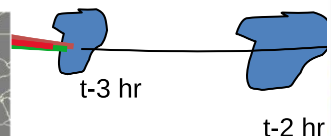
Project Components…

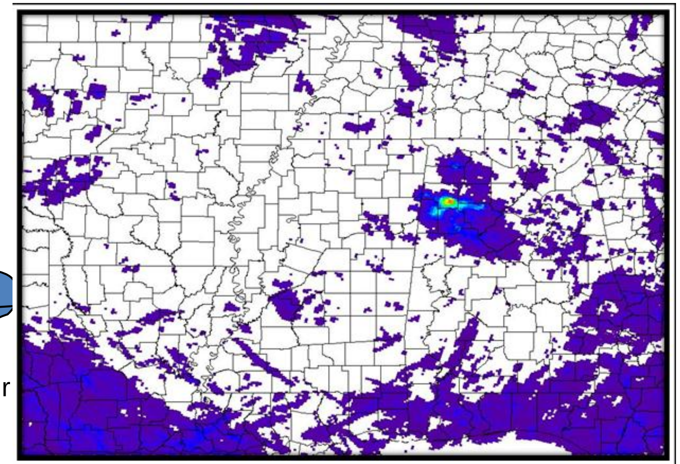
Differential Surface Heating Evaluation

$$LSV = \frac{SD_{land\,cover\,height}}{Max(SD_{land\,cover\,height})} + \frac{SD_{elevation\,gradient}}{Max(SD_{elevation\,gradient})} + \frac{SD_{NDVI}}{Max(SD_{NDVI})}$$

Land-Surface Variability (LSV) is a means of evaluating locations where elevation gradients, land cover type, and gradients in NDVI, can enhance the occurrence of convective cloud development.







Antecedent rainfall is used to estimate how heating is partitioned between latent and sensible.

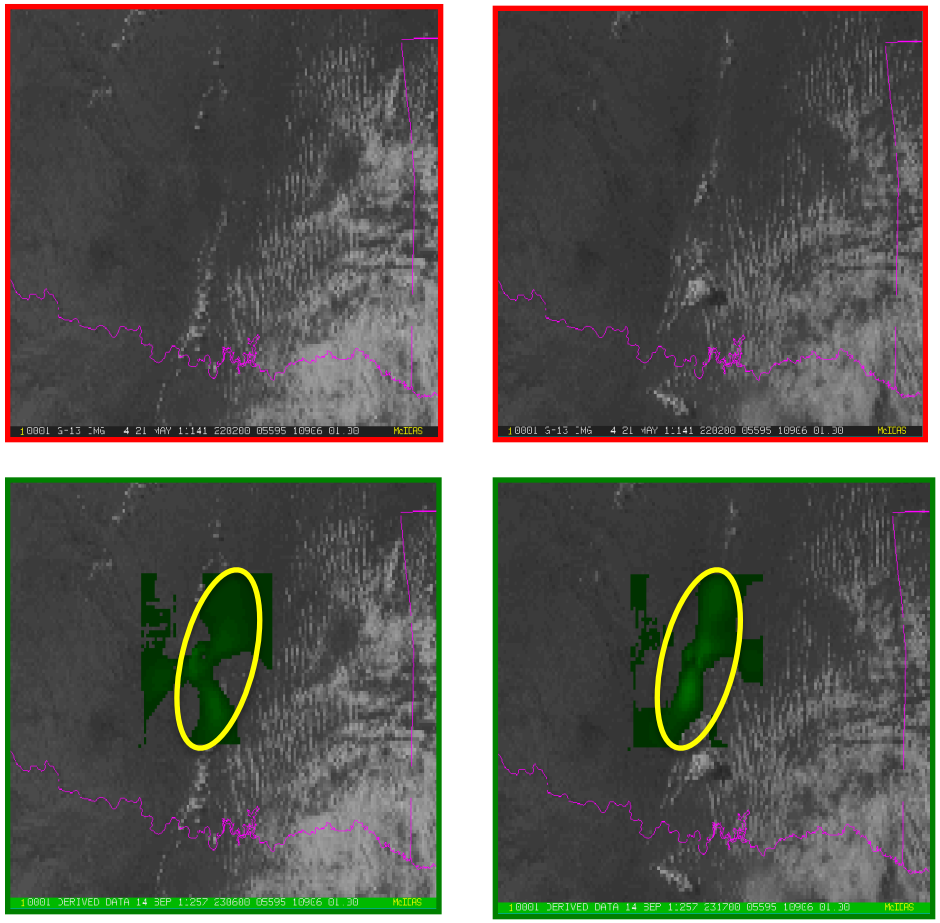
… followed from … on IR satellite using … air trajectories will be … rs using NWP analysis winds at several different levels below the one that best matches the cloud trajectory. Maps to be created of differential heating for each location.

Sensible heating gradients are formed once incoming net radiation is known (from GOES), and hence locations where differential heating may lead to the formation of non-classical meso-scale circulations, and hence regions where CI is more favored in 1-6 h timeframes

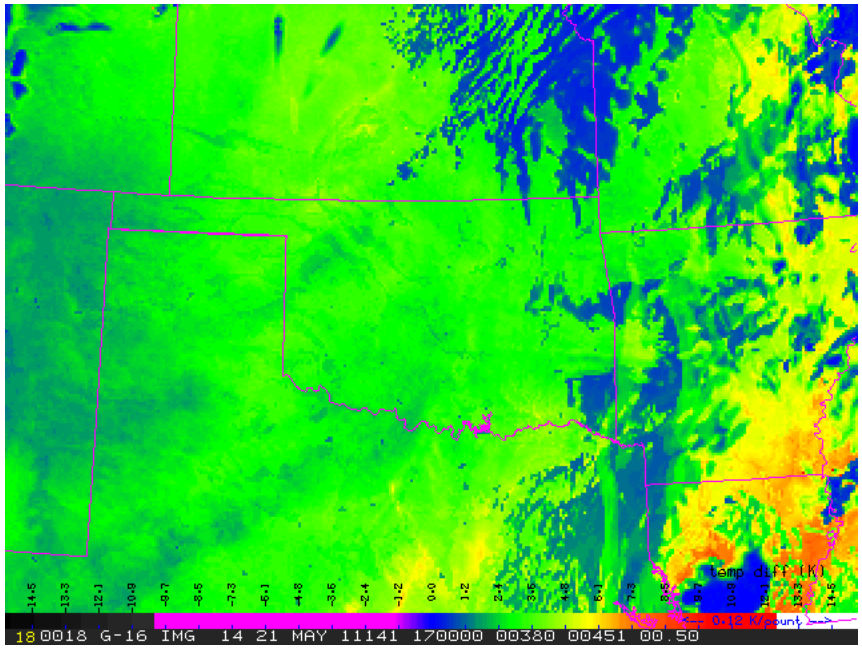
Project Challenge

The formation of an automated probabilistic system that predicts CI 1-6 hours in advance. To produce a continuous forecast in space and time, one approach is to use NWP CI forecasts as a first guess, then modify it from information gleaned from these satellite techniques.

Work completed to date…



- Green areas indicate Doppler radar-derived convergence, overlaid on parallax-corrected GOES-13 Visible imagery from 21 May 2011
- The yellow circles highlight regions of dryline convergence detected by the clear-sky radar technique



- 21 May 2011 was chosen for the initial case study, and the NSSL WRF was re-run so that 5-minute data could be saved
- WRF output was used to generate simulated split window difference output, and the loop above shows that regions with locally increasing values (green to yellow to red) predicted where clouds (blue) would form.