Climate Variability and Soybean Rust Forecasts

X.B. Yang
Xun Li

Dept. of plant pathology
Iowa State University

Zaitao Pan
Lulin Xue

Dept. of Earth & Atmospheric Sci. St. Louis University

Supports and Distribution

- This research is supported by

  Iowa Soybean Association

  Syngenta Corporation

- Our weekly forecasts were distributed to producers.

Outlines

- Prediction model system
  - Model experiments
  - Validation
- 2007 climate conditions for rust dispersion
  - Enhanced low-level jet
  - Heavier rainfall in Texas
- Climate implication of rest dispersion
  - Western Texas – hot spot
  - South Coasts – Wind hole

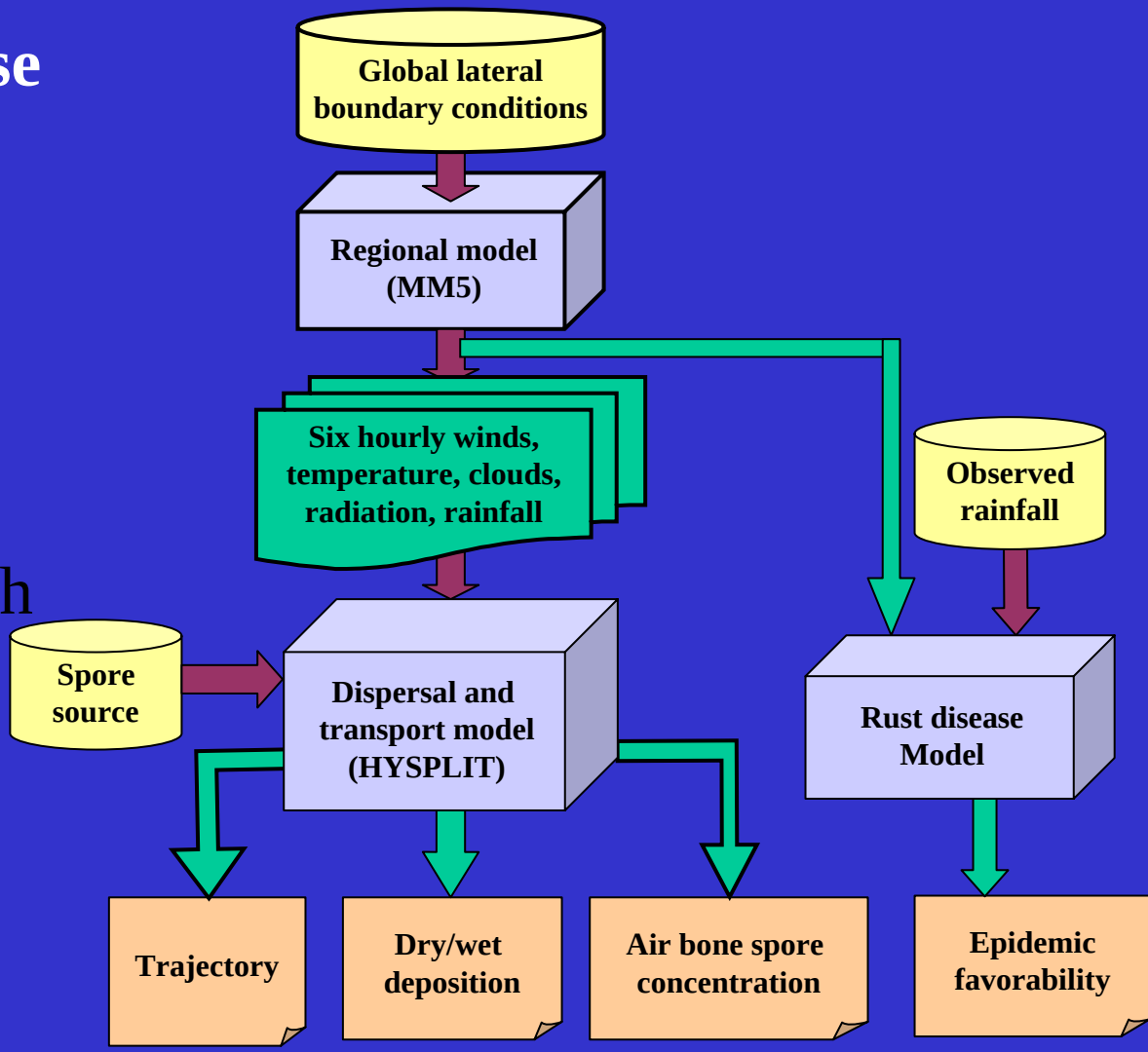
SLU/ISU Rust prediction model – An climate-dispersal-disease integrated system

Global model – Scripps Institution of Oceanography

MM5 – National Center for Atmospheric Research

HYSPLIT – NOAA Air Resource Lab

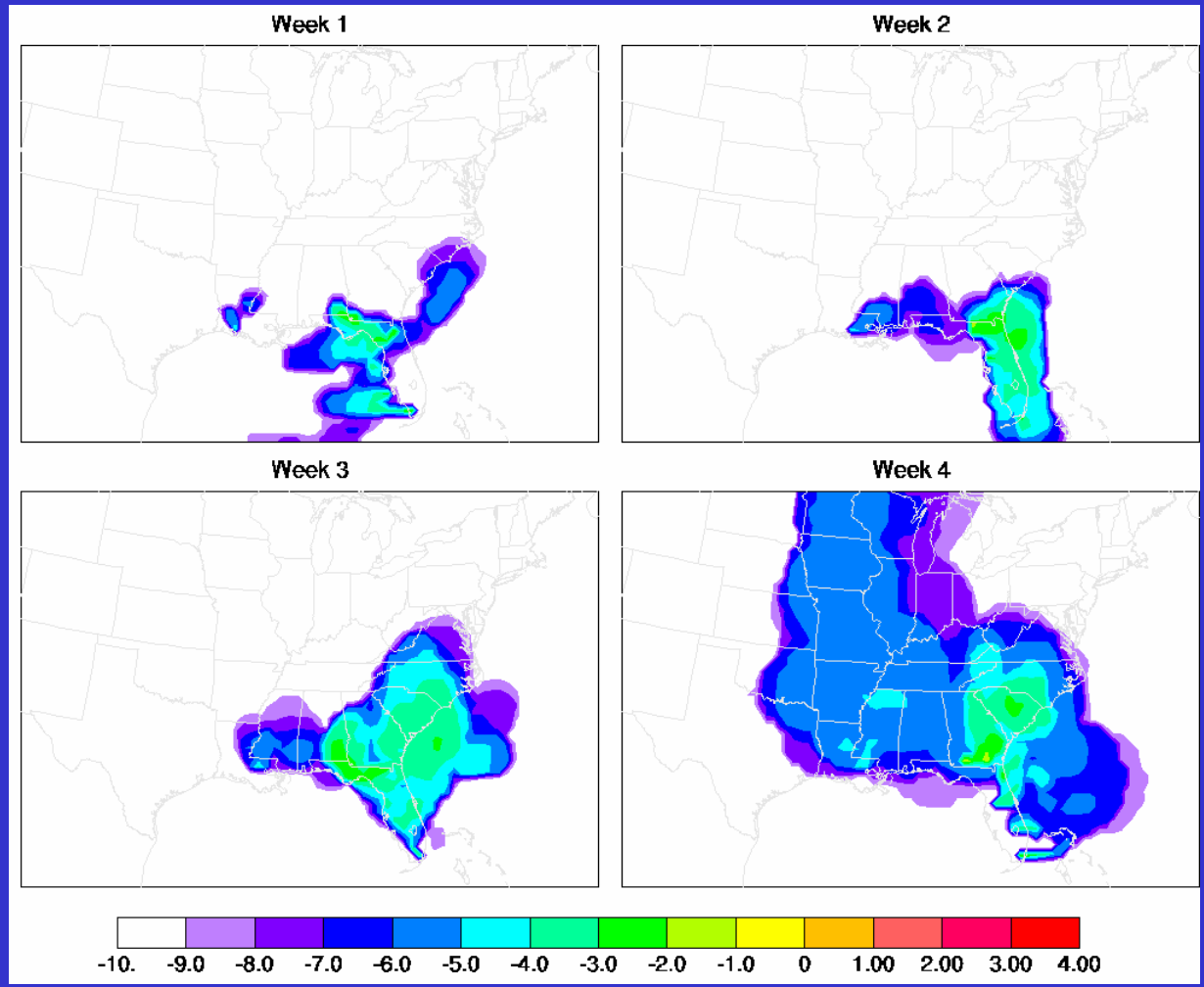
Disease model – Iowa State University



The Coupled Dispersal Model

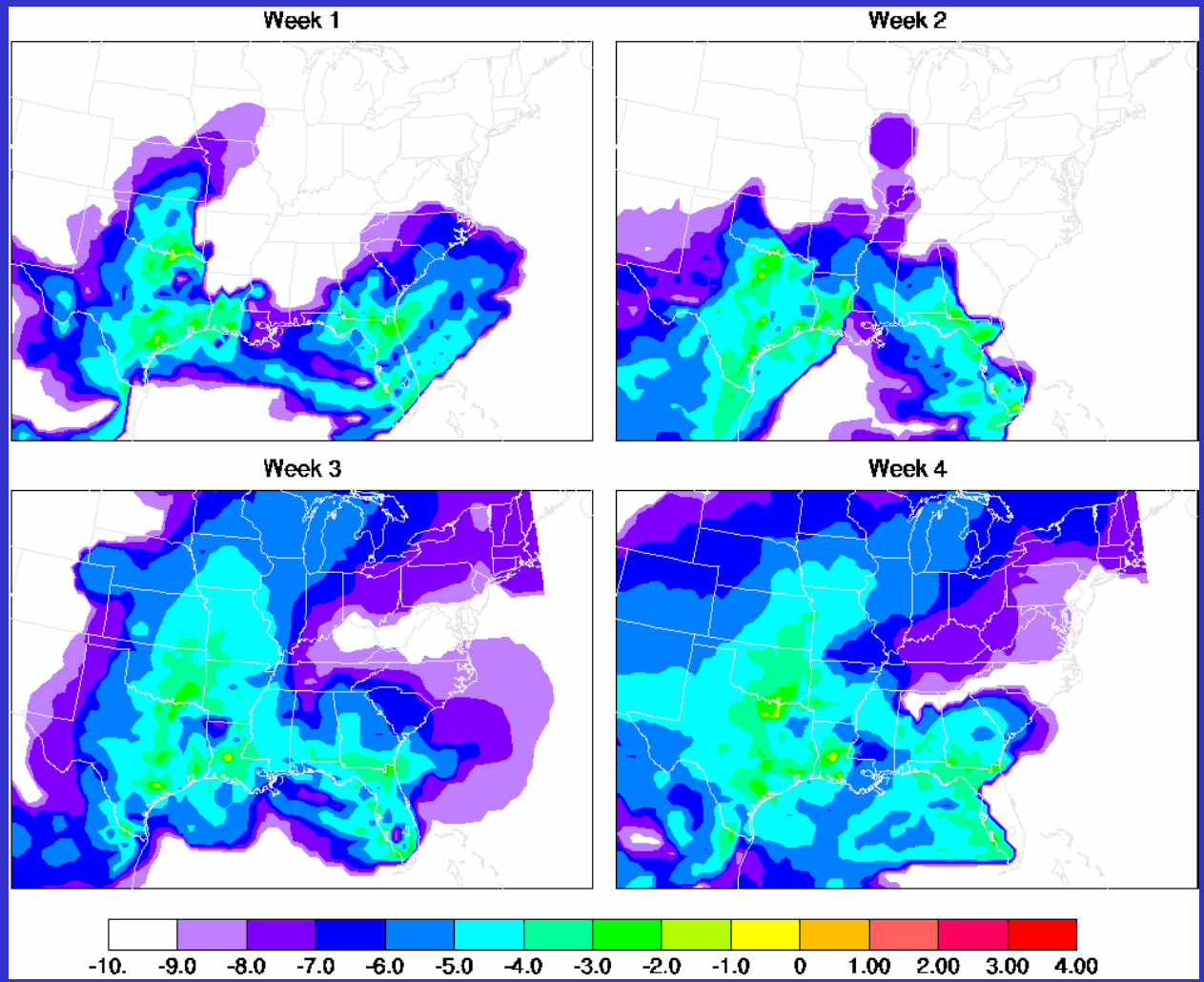
- **Runs in trajectory or concentration mode**
  - trajectory – forward/backward tracking
  - concentration – airborne and at surface
- **Treats spores as particles of plumes**
  - spores passively move with atmosphere once lifted
  - spore plumes dilute, split, merge
- **Considers dry and wet deposition**
  - gravitational settling
  - rainfall washout
- **Incorporates simple aerobiological viability criteria**
  - UV radiation, temperature

Weekly Spore Dispersal Predictions During June 2 - July 2, 2007



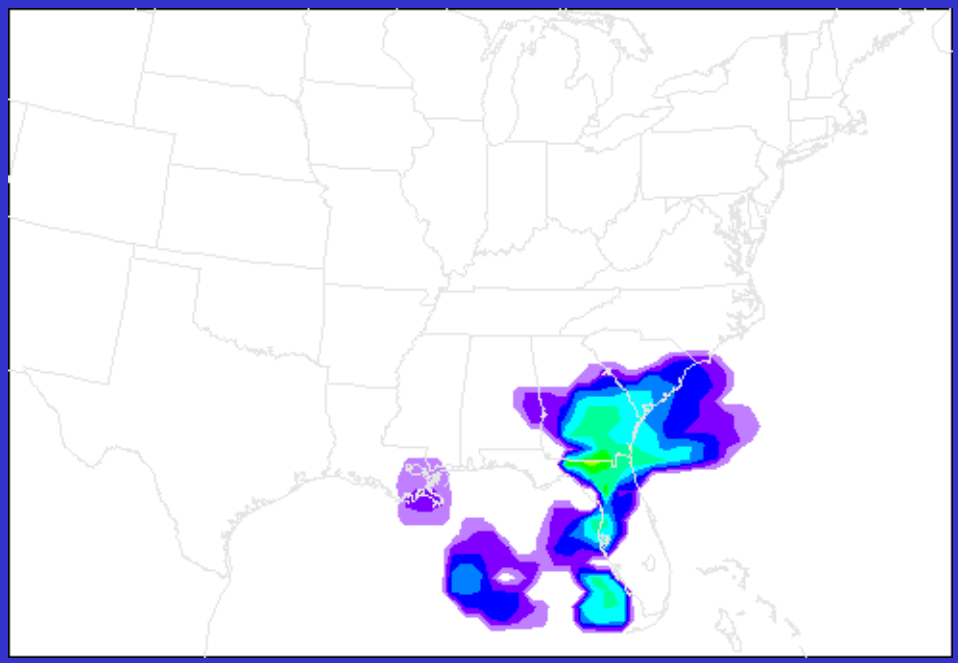
Plotted are spore deposition concentrations at surface

Weekly Spore Dispersal Predictions During July 28 - August 25, 2007

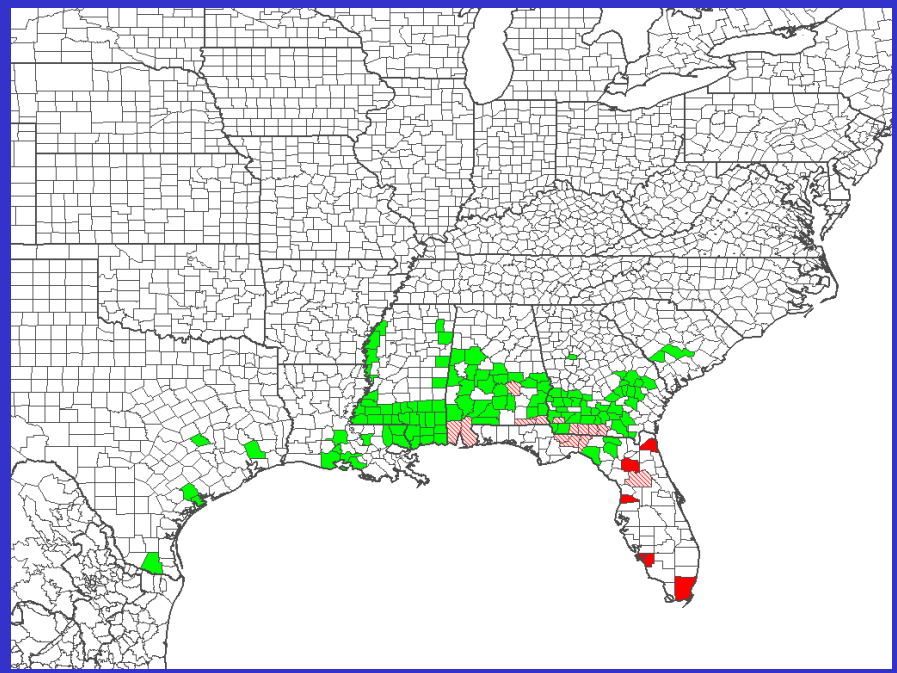


Plotted are spore deposition concentrations at surface

Weekly Time Series of Forecast Spore Dispersion and Disease Detection – Apr. 28 – Nov. 2, 2007



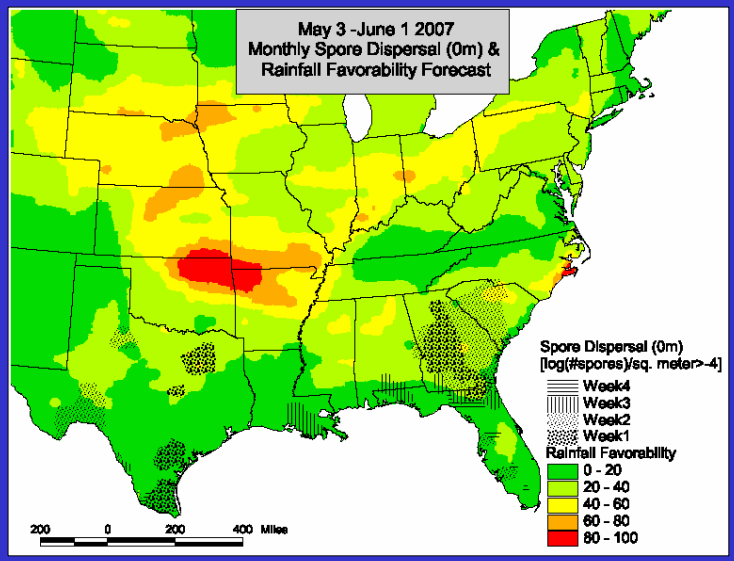
spores



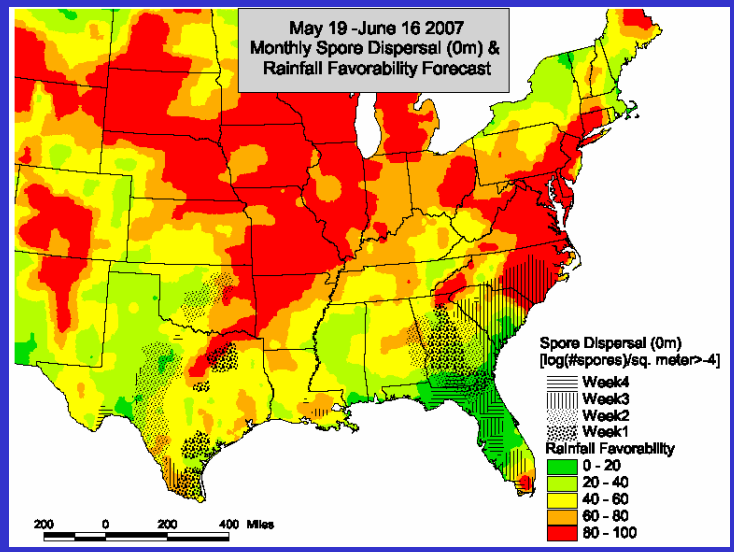
disease

Model predicted Favorability for Epidemics in Different Periods of the Growing Season

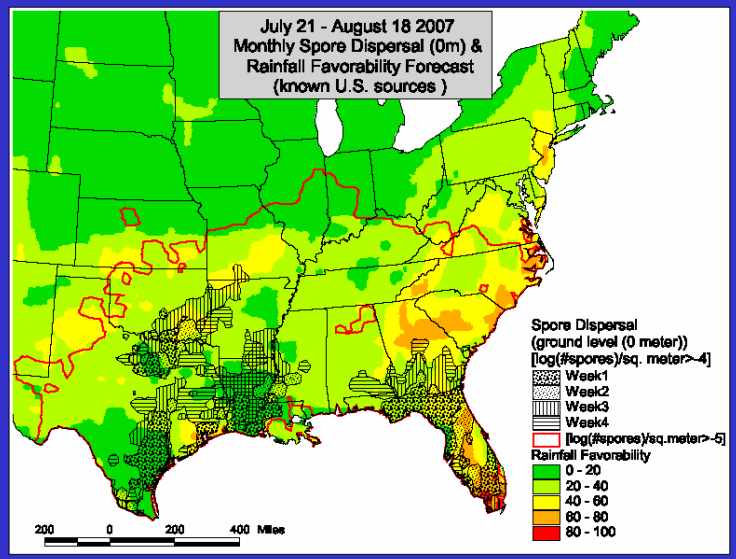
5/3-6/2



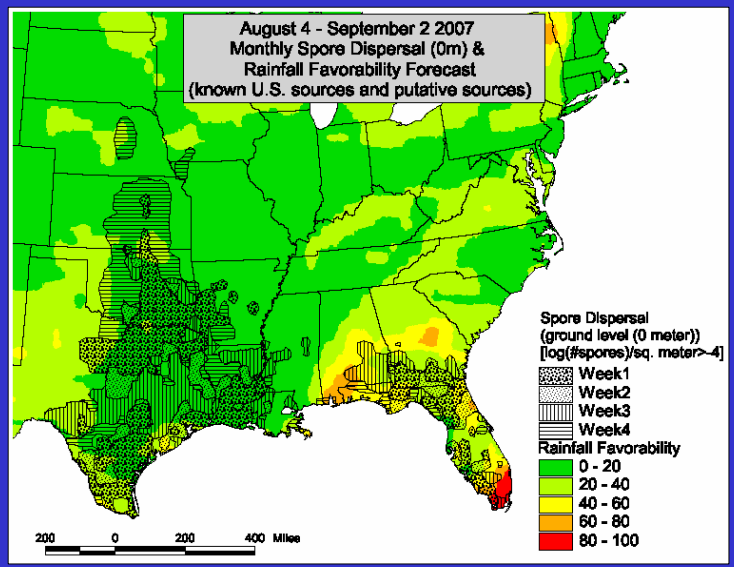
5/19-6/17



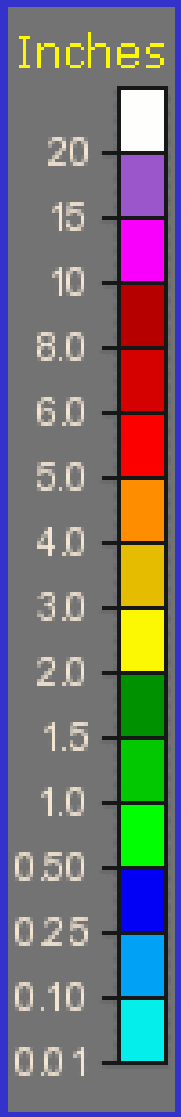
7/21-8/25



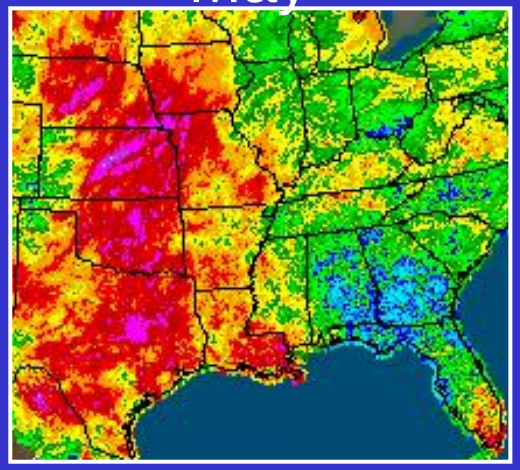
8/4-9/2



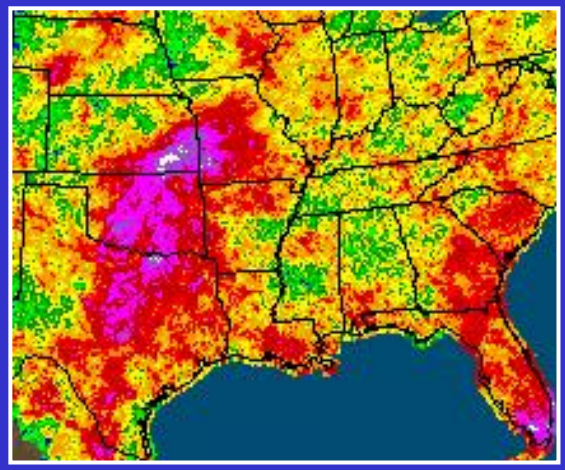
Warm-Season Monthly Rainfall - 2007



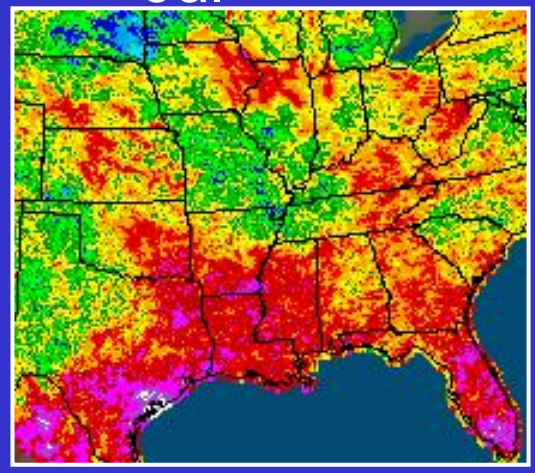
May



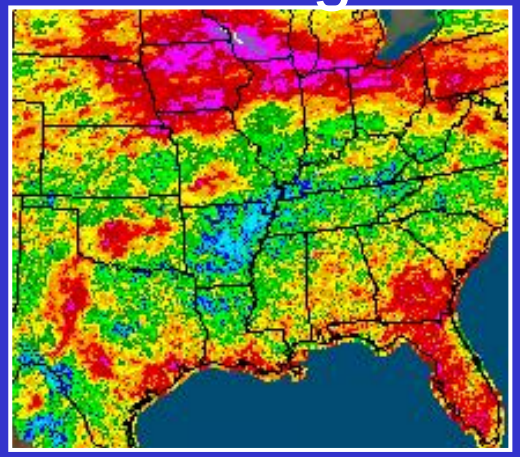
Jun



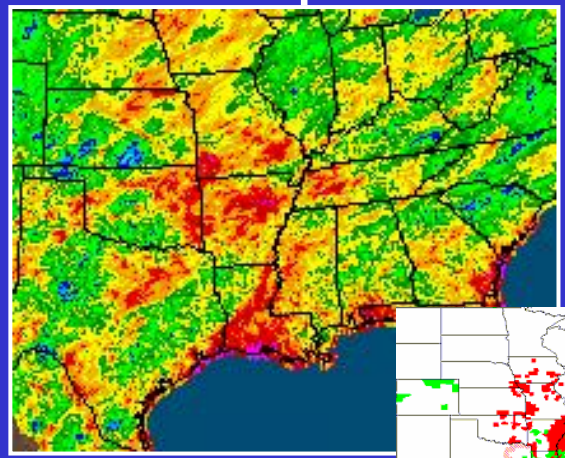
Jul



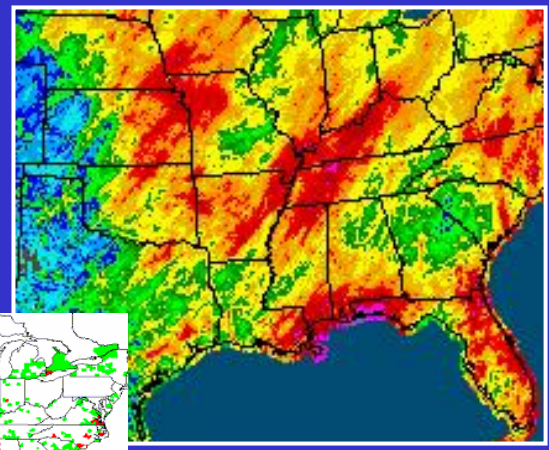
Aug

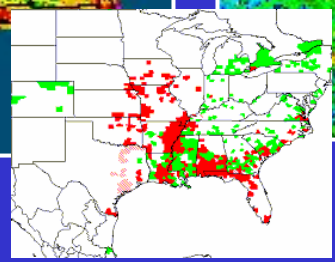


Sep

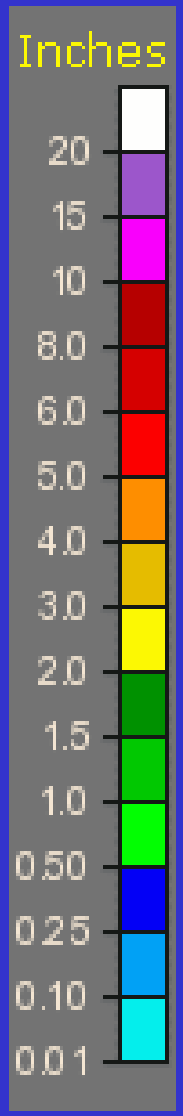


Oct

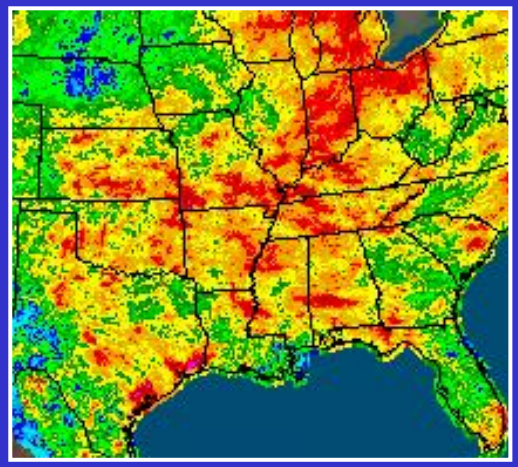




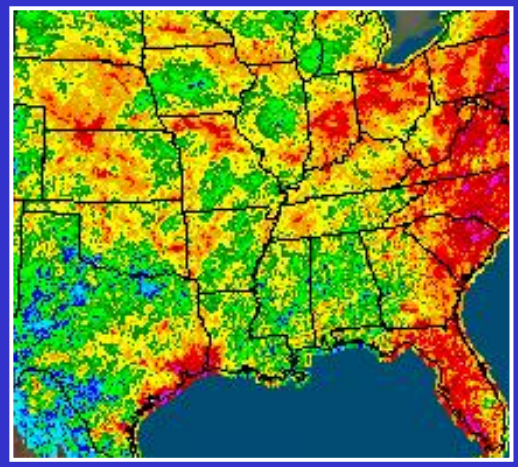
Warm-Season Monthly Rainfall - 2006



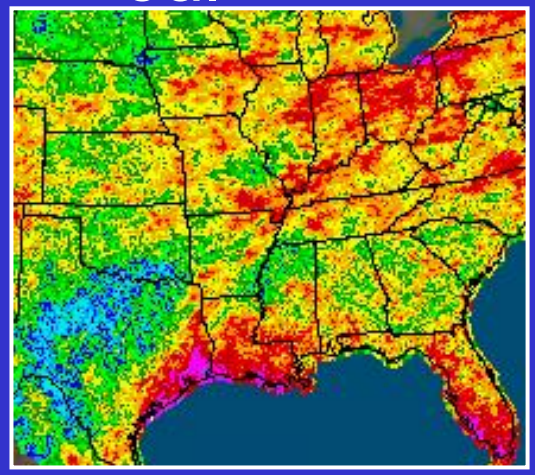
May



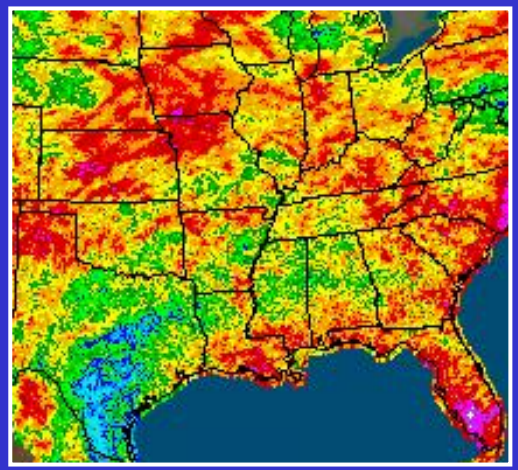
Jun



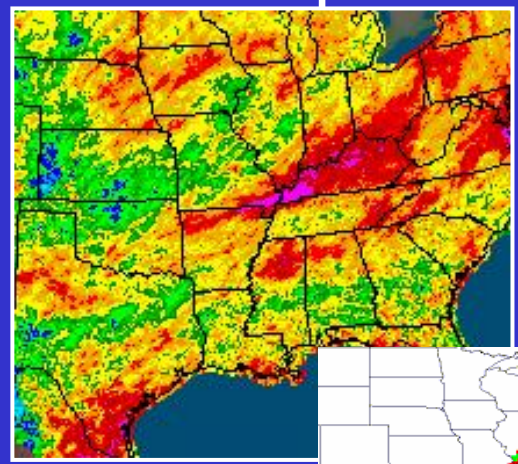
Jul



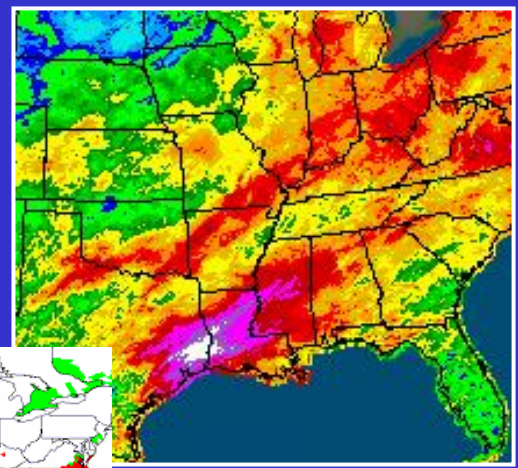
Aug

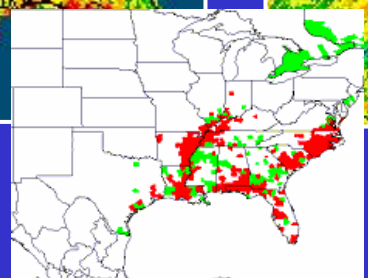


Sep

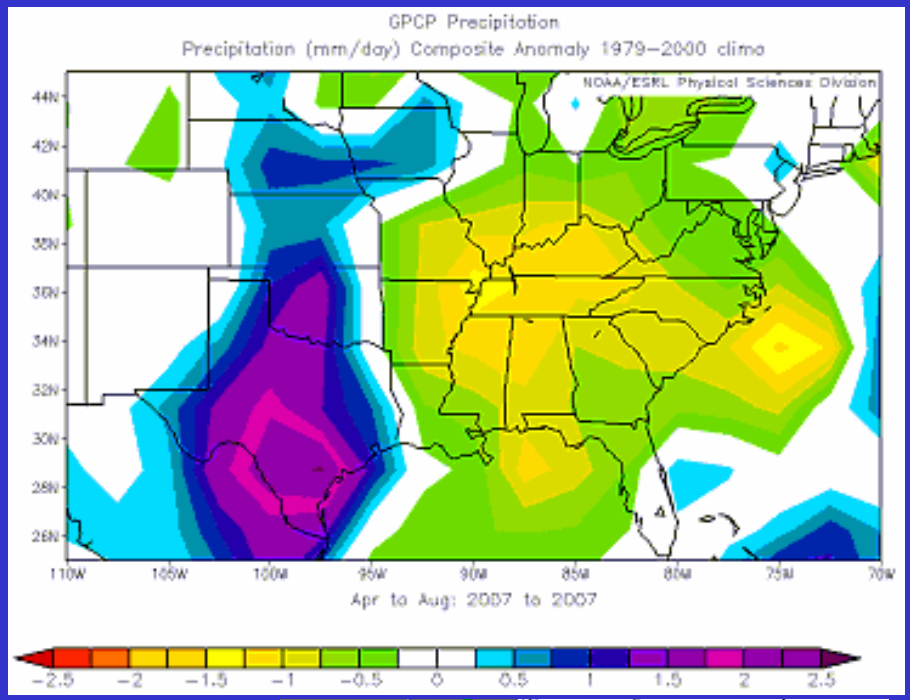


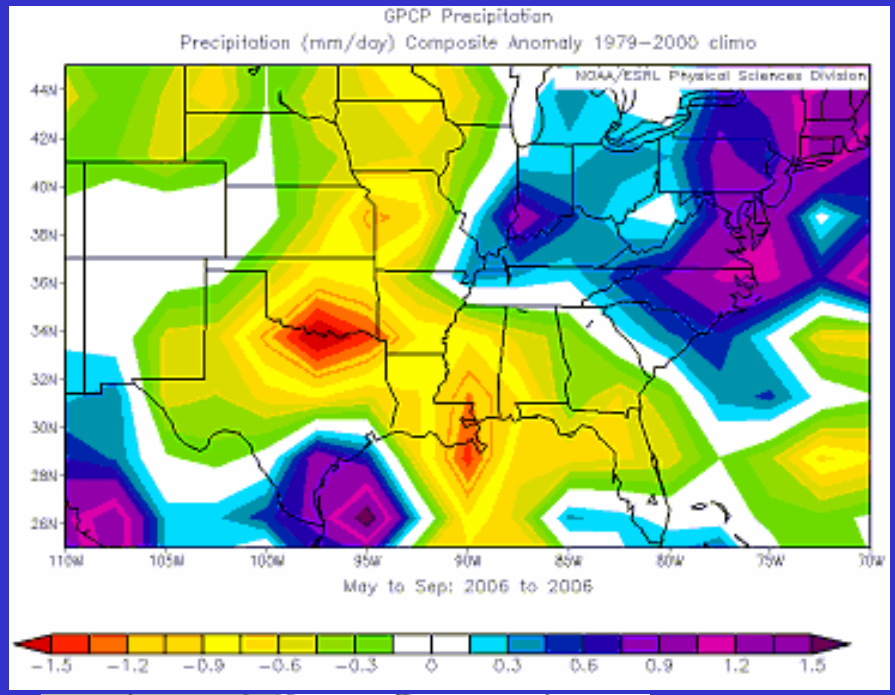
Oct



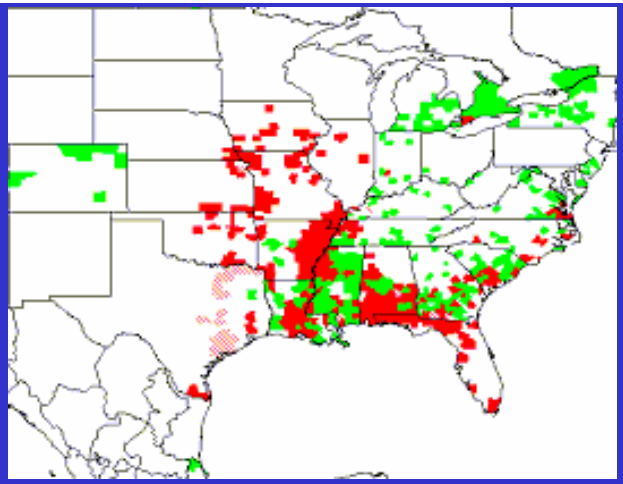


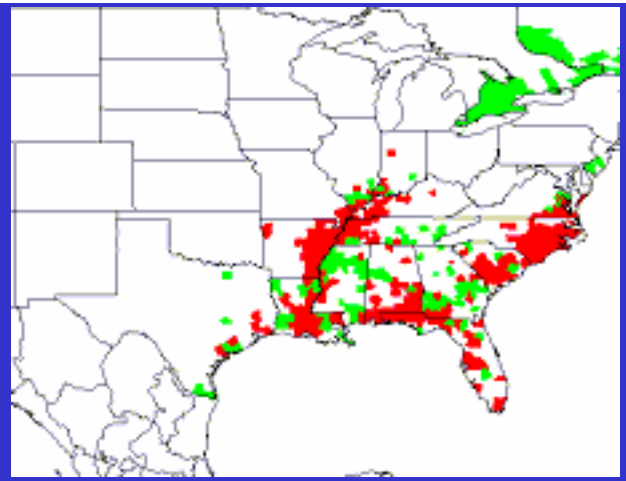
Warm-Season Rainfall: 2007 vs. 2006



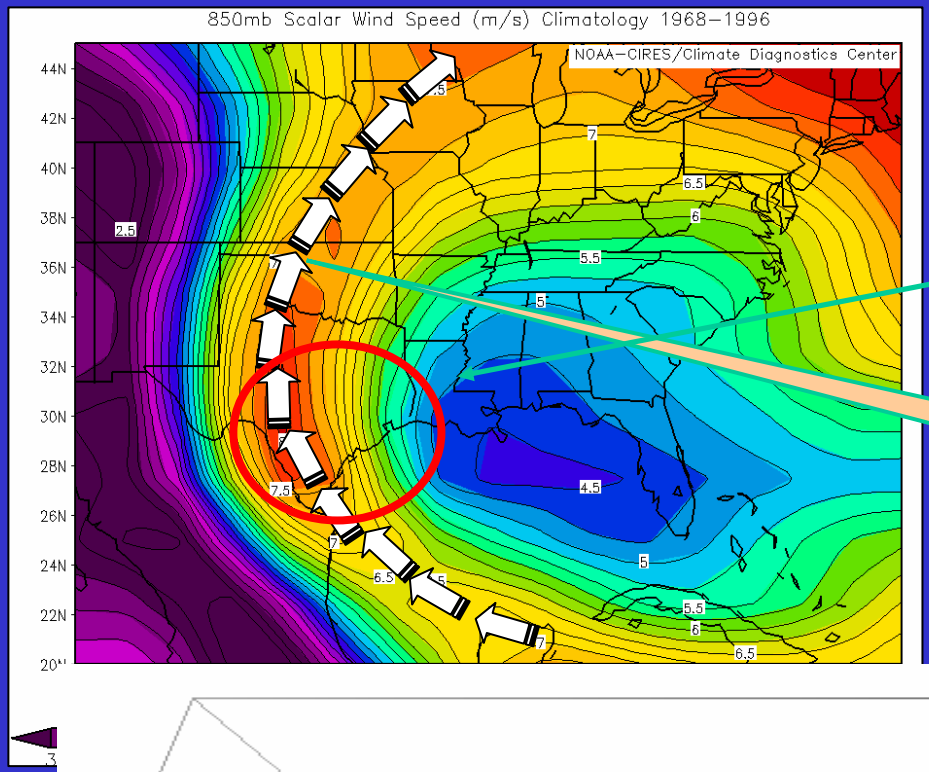


2007





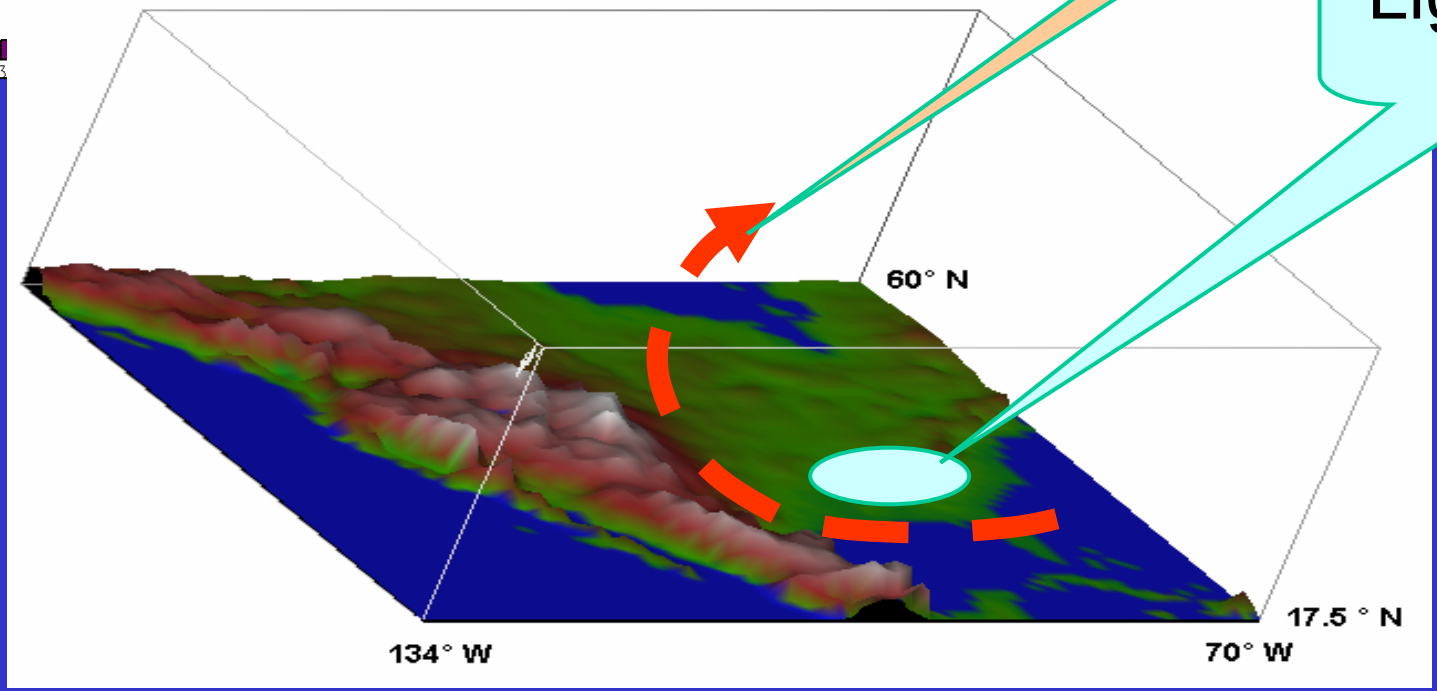
2006



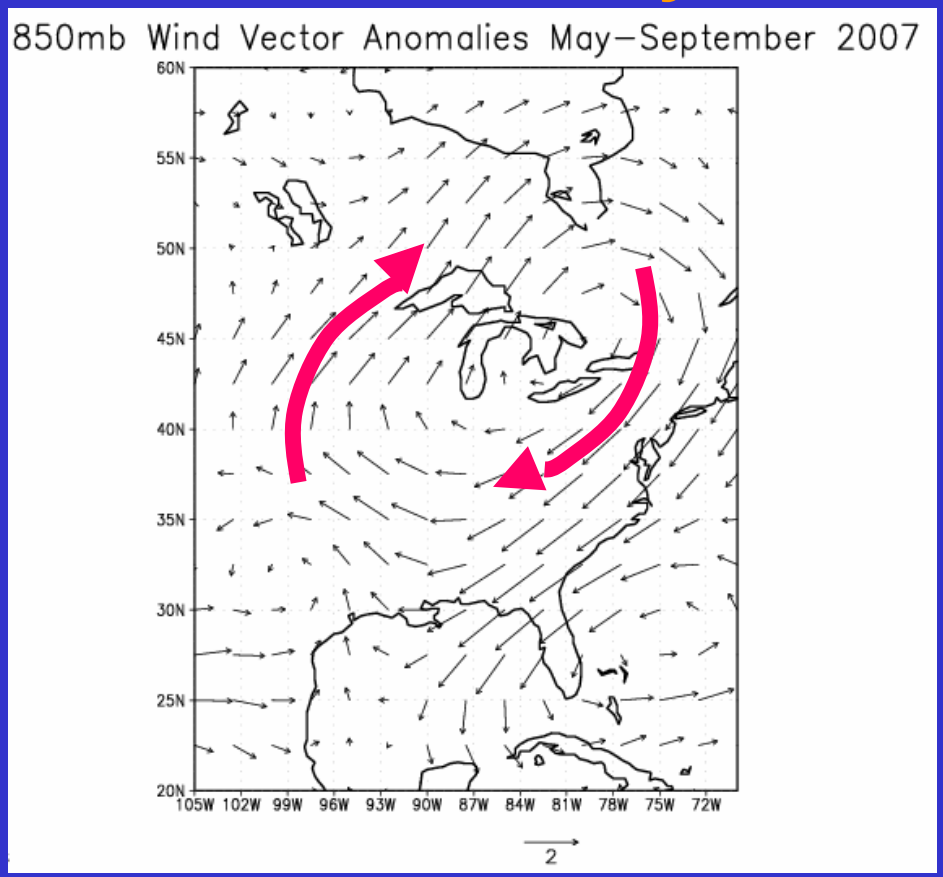
Jet entrance region

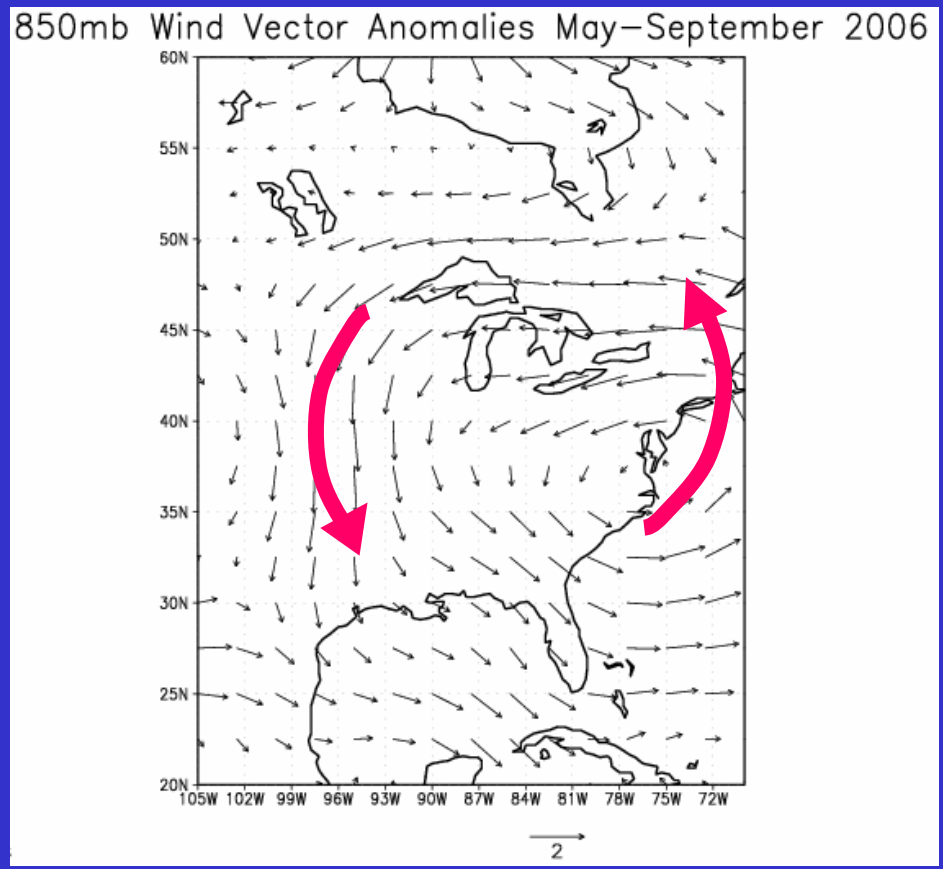
Low-level Jet

Light wind hole

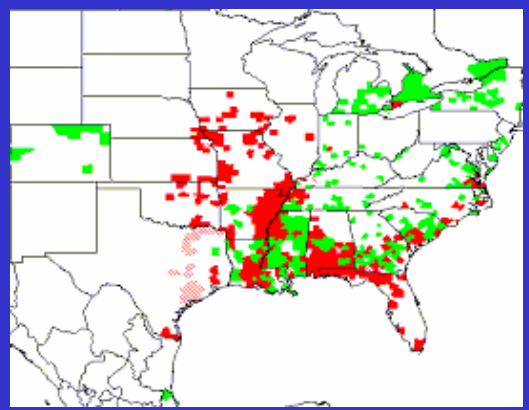


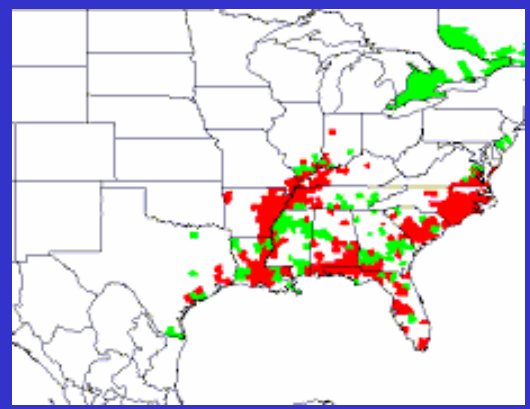
Wind Anomaly - Contrast 2007 with 2006





2007

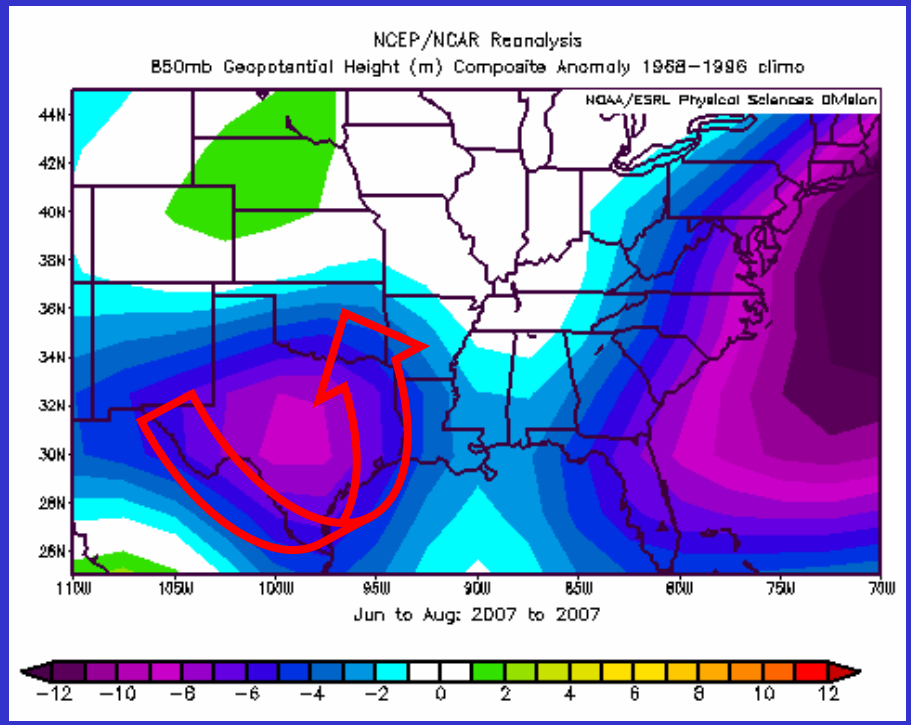




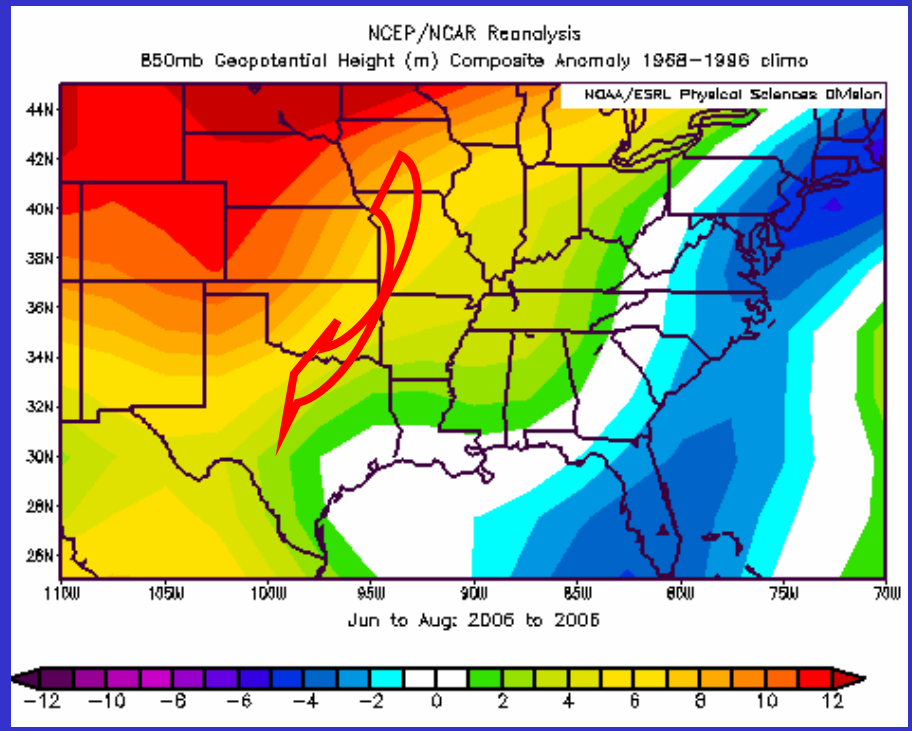
2006

Geopotential Height (Pressure) Anomaly

2007

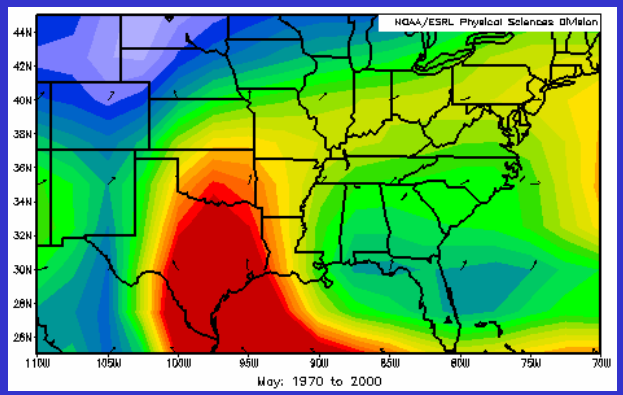


2006

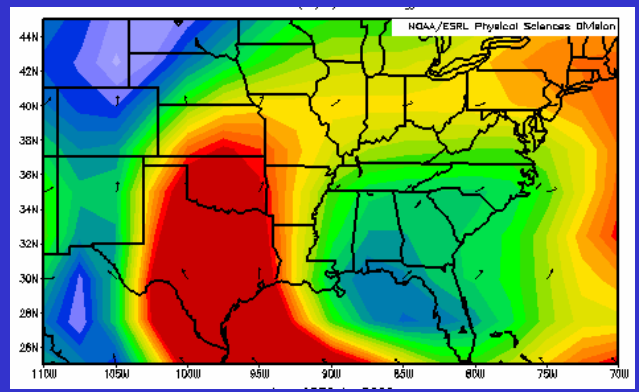


Wind Speed Climatology

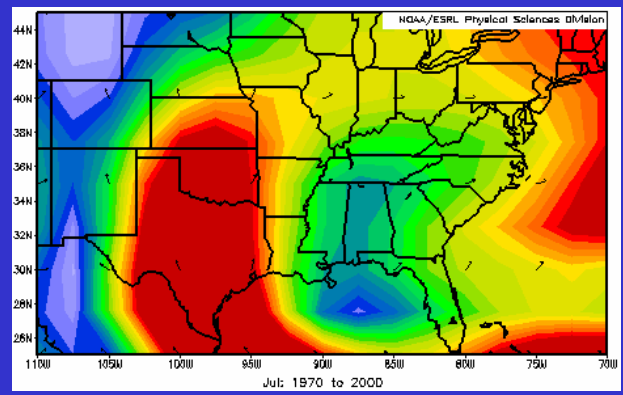
May



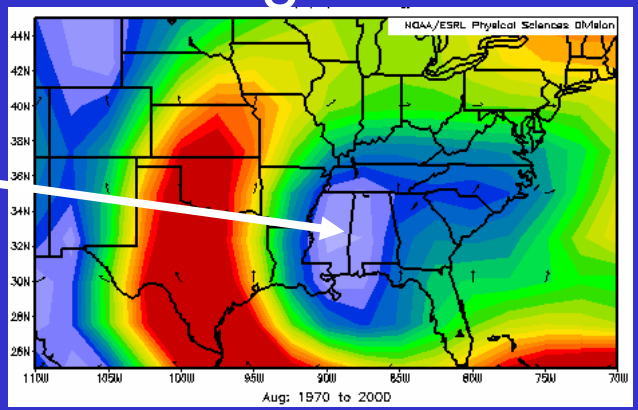
Jun



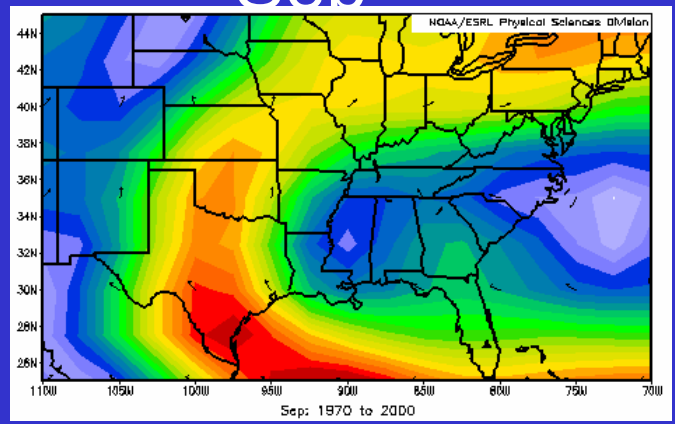
Jul



Aug



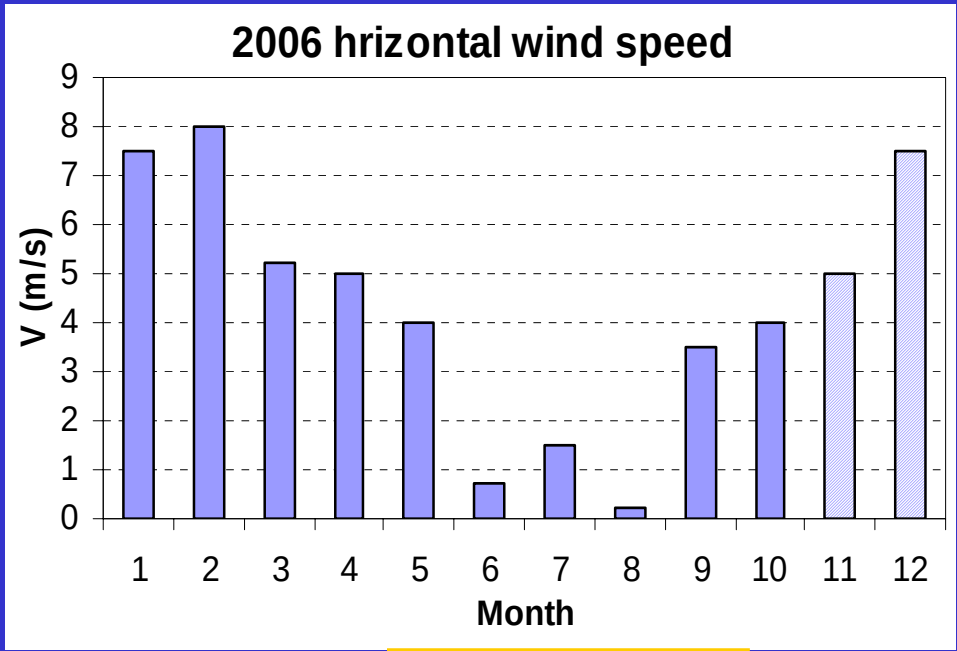
Sep



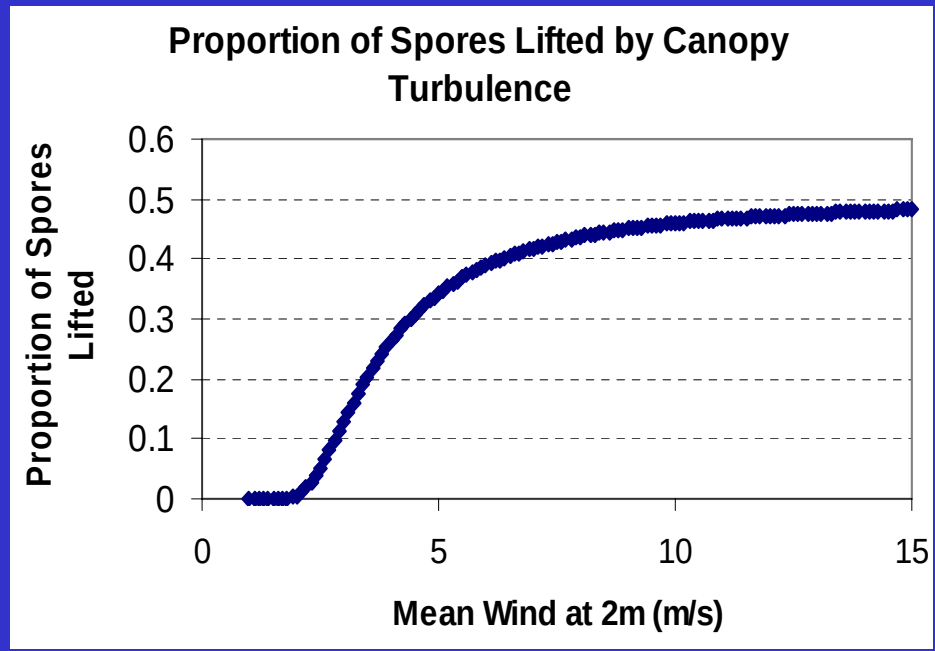
Wind hole

Wind Effects on Spore Escape by Turbulence

Monthly surface mean wind velocity near LA-MS border



Dependence of spore escape on wind speeds



Summary and Discussion

- The coupled spore dispersion-rust development model seemed to be able to predict the general within-season dispersal patterns from known inoculum sources.
- Circulation in eastern U.S. had a anticyclonic anomaly in 2007, which enhanced southerly winds in central U.S. and suppresed southerly winds in the East Coast.
  - 2006 had a cyclonic circulation.

Summary and Discussion – Con't

- The heavy rainfall in TX during early summer may have prompted spore production at the entrance of the low-level jet.
- Both enhanced southerly winds and ample rainfall can partly explain the wider spread of the rust toward the north this year.

Future Work

- Determine when, where, and how often winds enhance or suppress northerly transport.
- Quantity spatial-temporal correlation between climate conditions and rust spread, while more spore and disease data accumulates.