

# Application of Ensemble Sensitivity Analysis to Convective Predictability and Dynamics

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# Overview

- Overarching goal is to understand how errors in model fields at earlier lead times impact subsequent convection forecasts
  - Hypothesis is that reducing the errors in these regions will lead to better convection forecasts
- In turn, this approach could lead to greater insight into what processes govern the predictability of convection

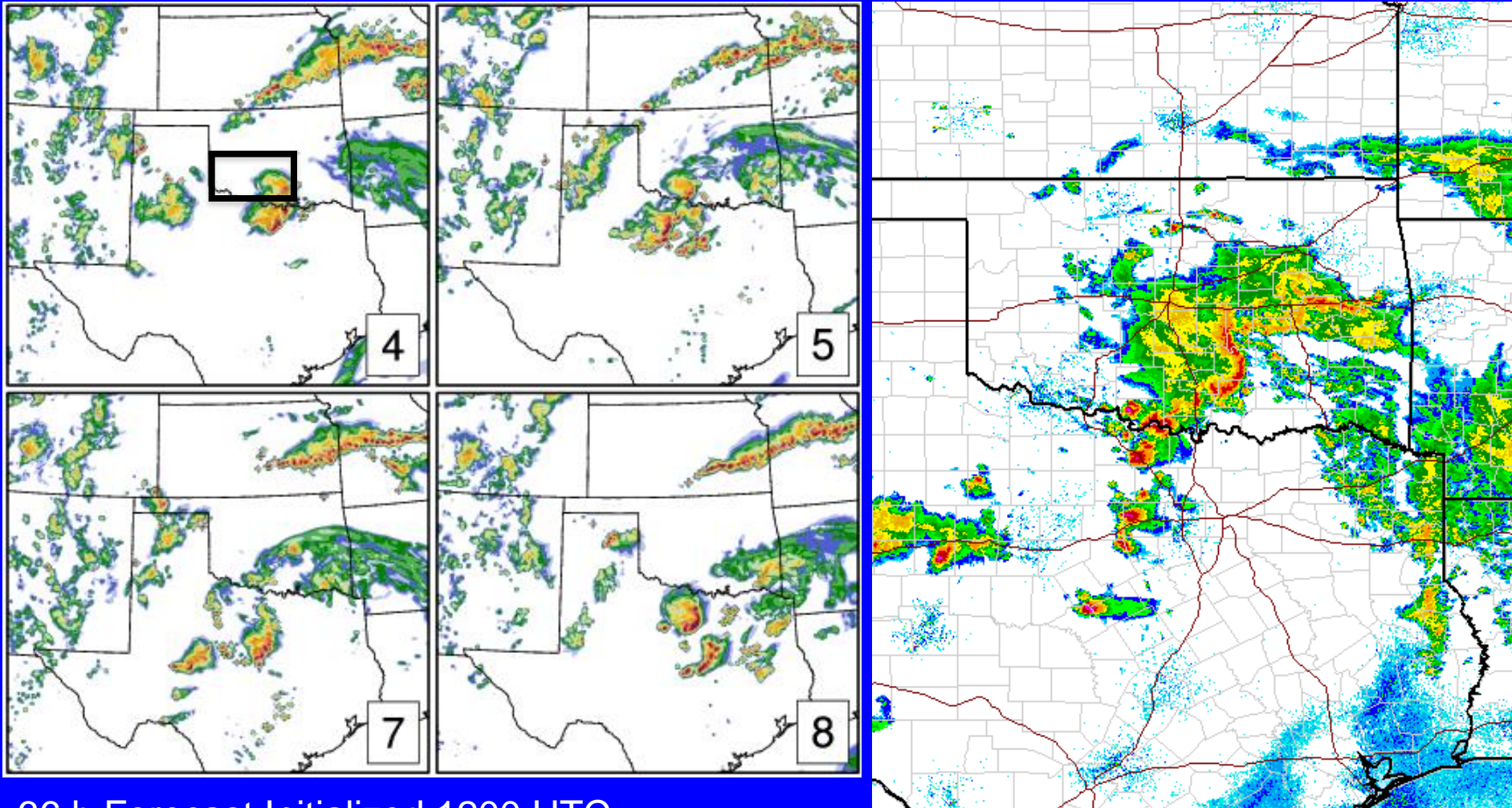
# Methods

- Apply ensemble sensitivity analysis to WRF forecasts produced by Glen
- Forecast metric (J) is 3 h precipitation averaged over a box

$$\frac{\partial J_e}{\partial x_j} \equiv \text{cov}(\delta J, \delta \mathbf{x}_{o,j}) \mathbf{D}_j^{-1} = \frac{\text{cov}(\mathbf{J}, \mathbf{X}_j)}{\text{var}(\mathbf{X}_j)}$$

$$X_{diff} = \frac{\bar{X}_{sub1} - \bar{X}_{sub2}}{\sigma_X}$$

- Question 1: To what extent can assimilating the dropsondes, especially in sensitive regions, improve convection forecasts

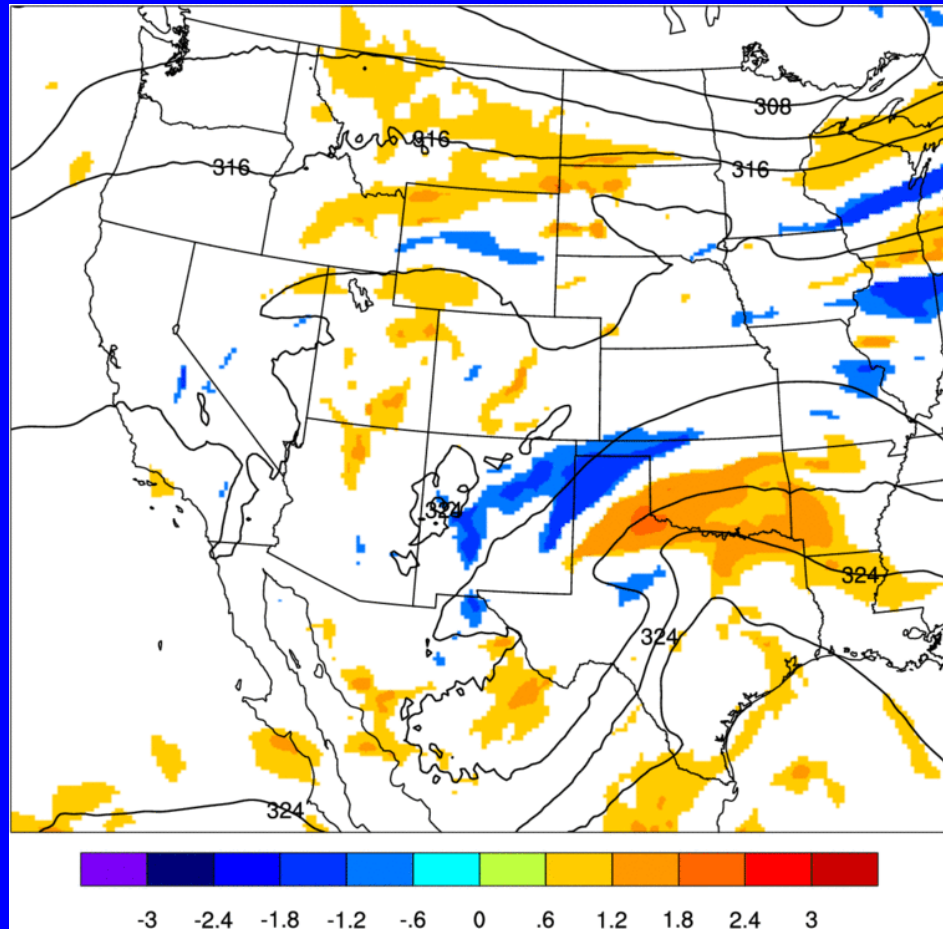
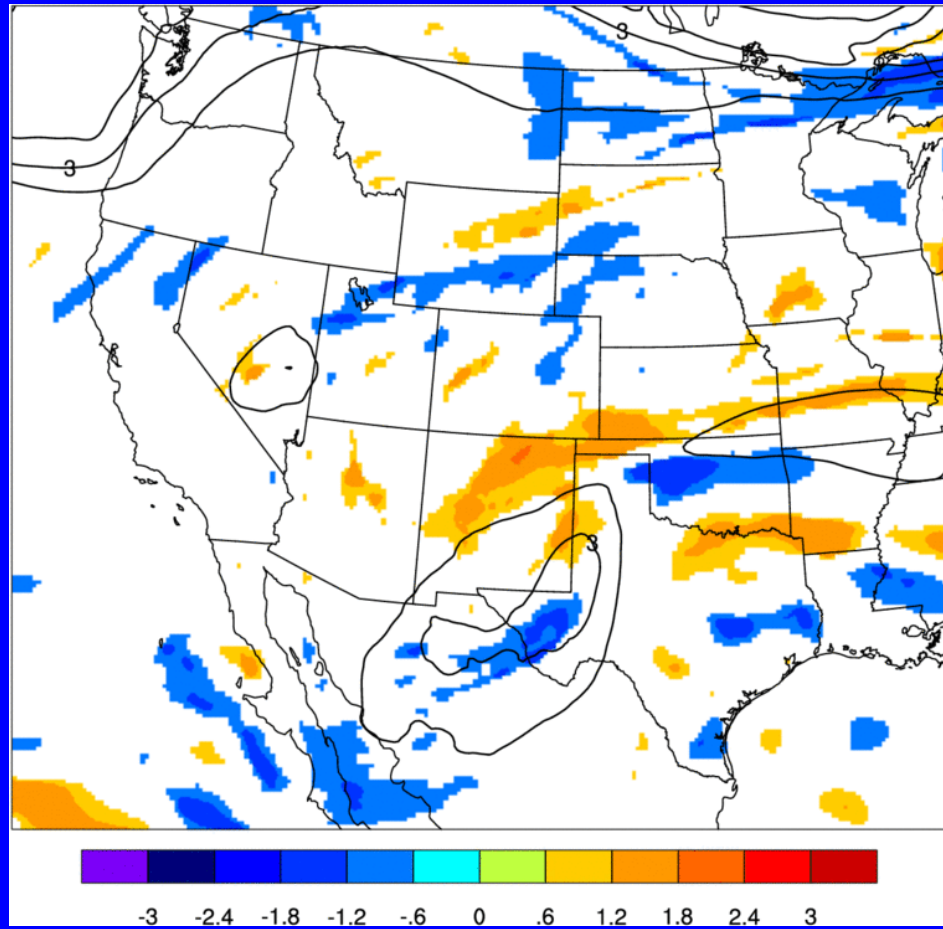


36 h Forecast Initialized 1200 UTC  
14 May (IOP 1)

# Sensitivities

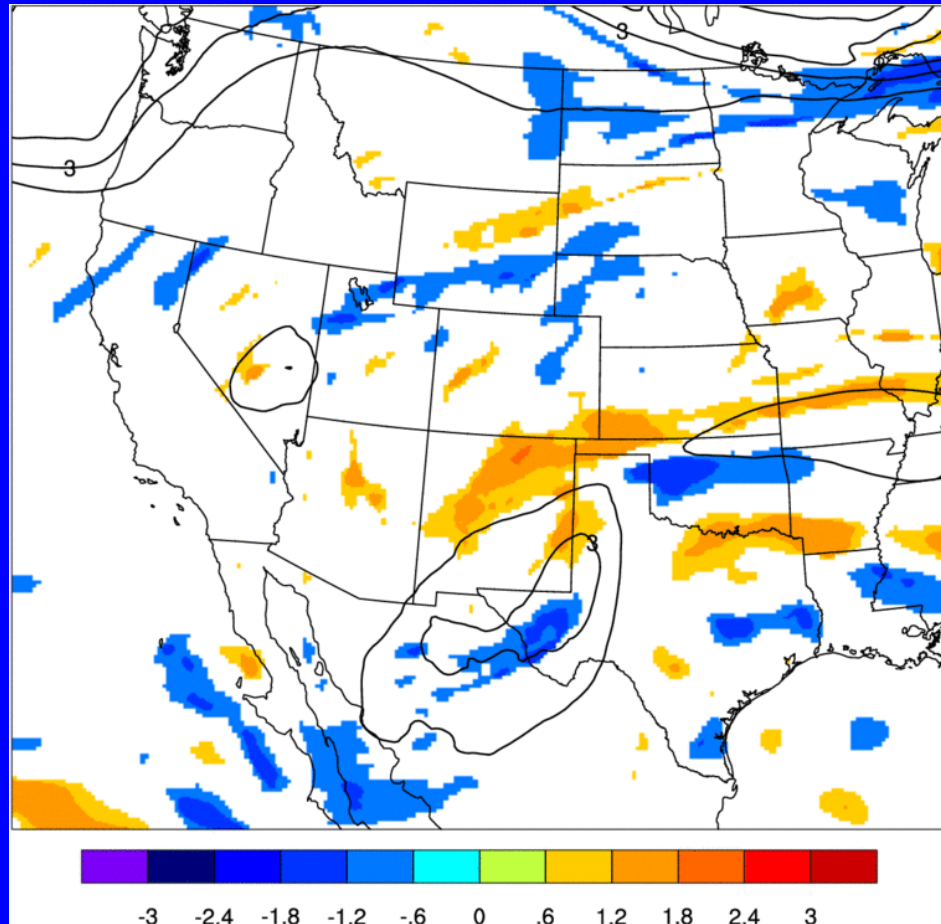
330 K PV

500 hPa MSE

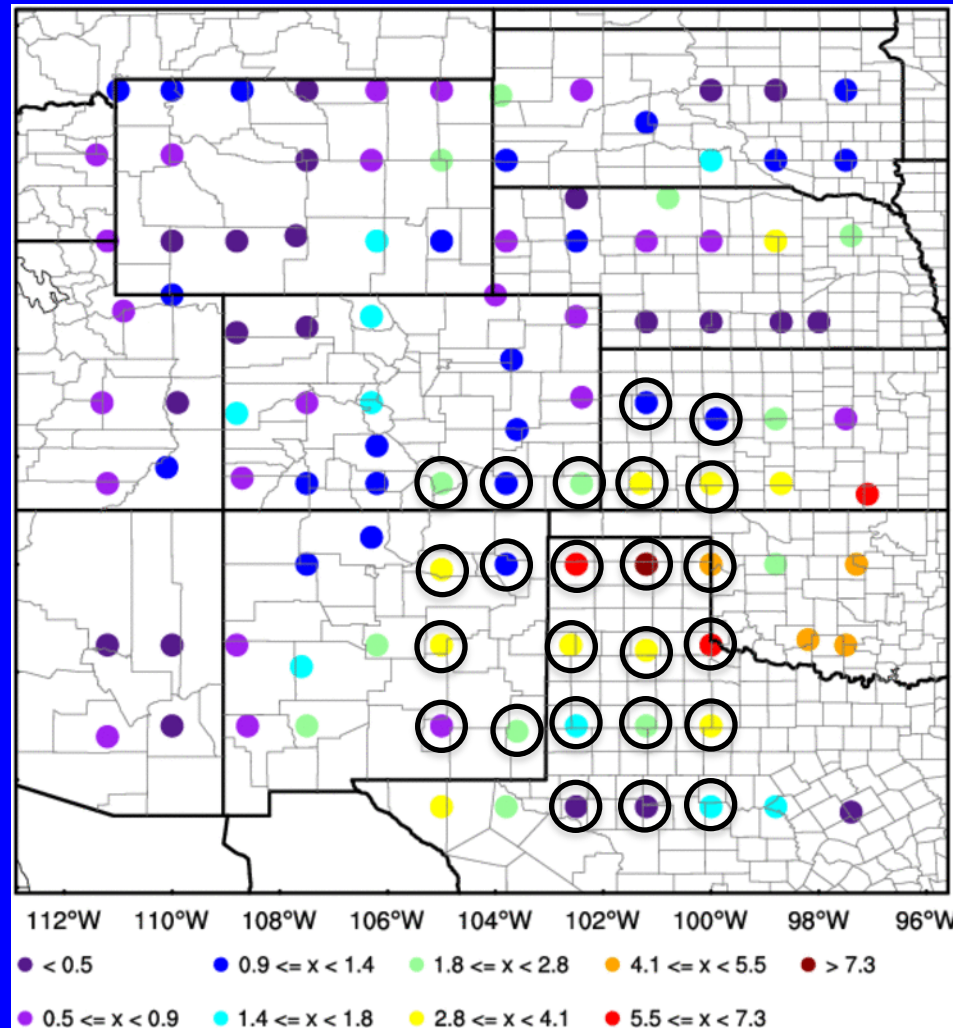


# Sensitivities

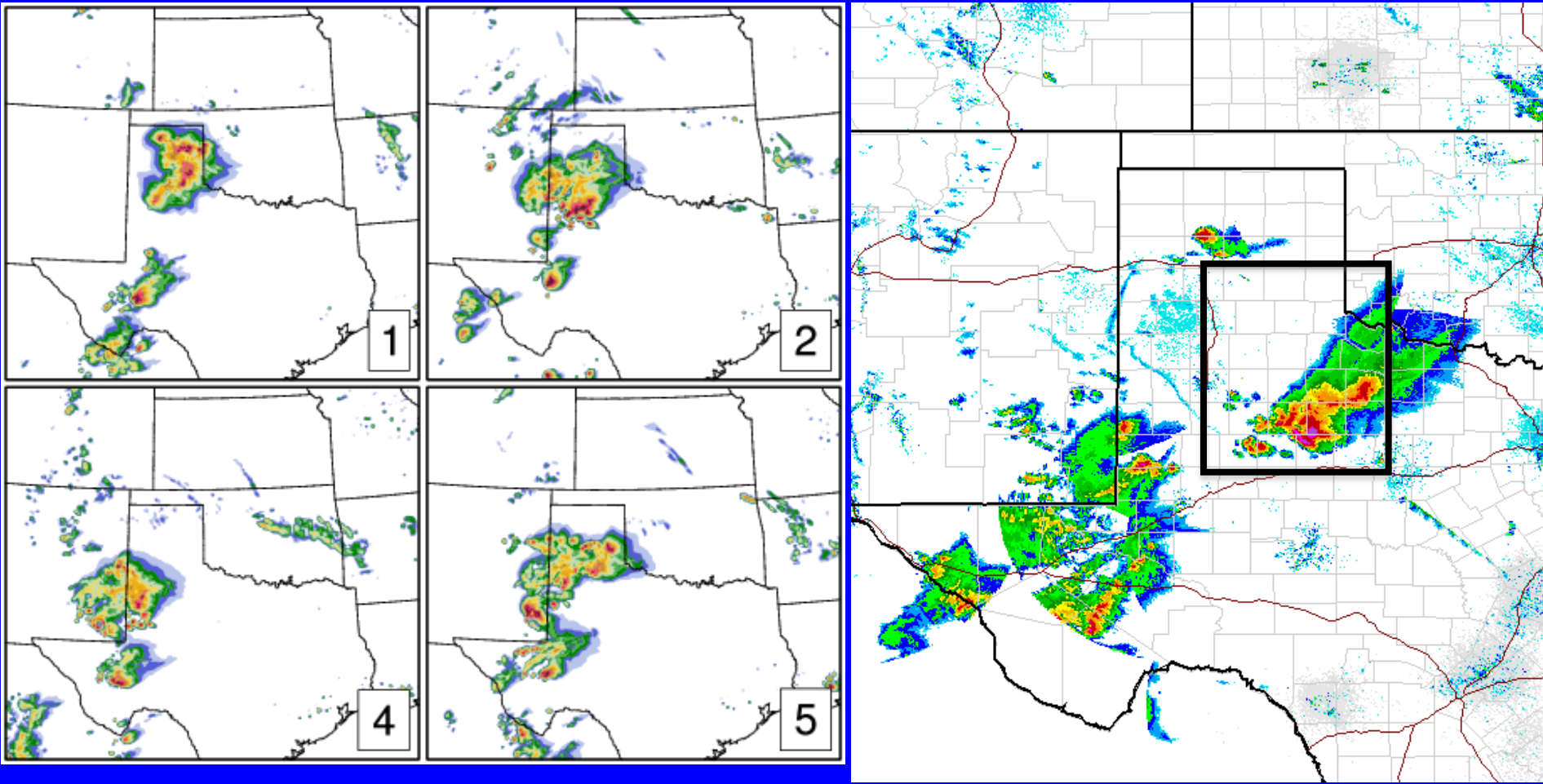
## 330 K PV



## Variance Reduction



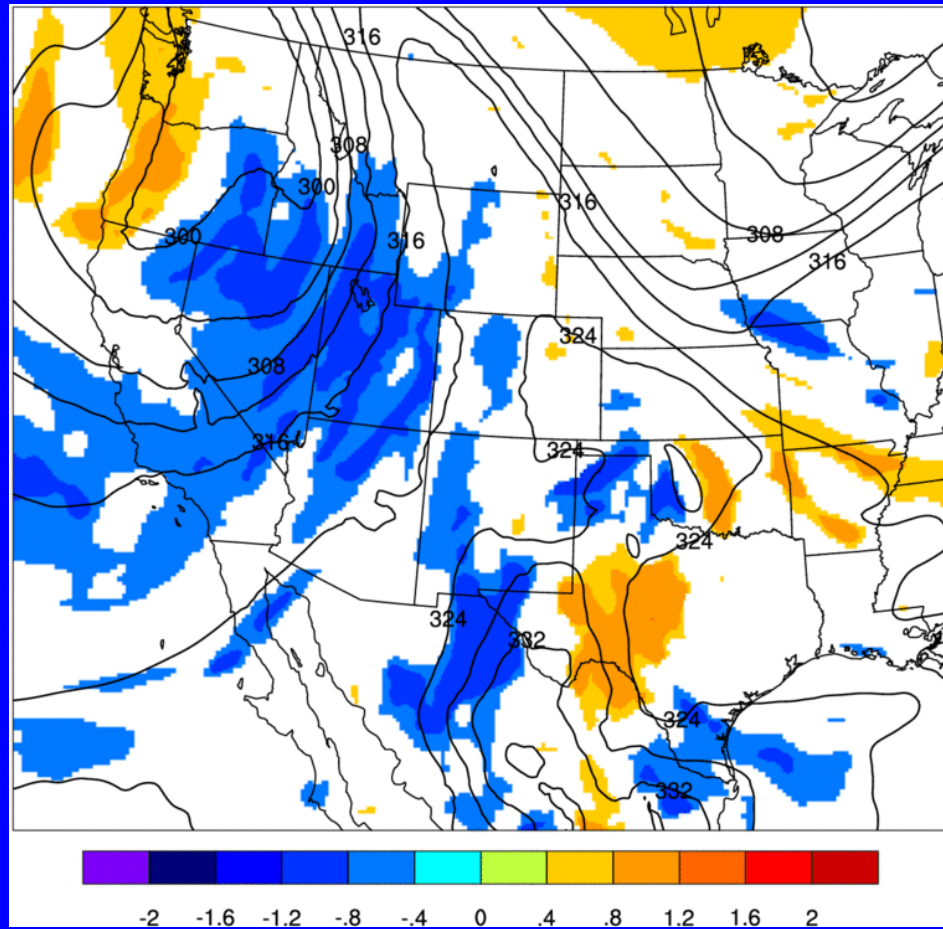
- Question 2: What processes control whether the convection grows upscale?



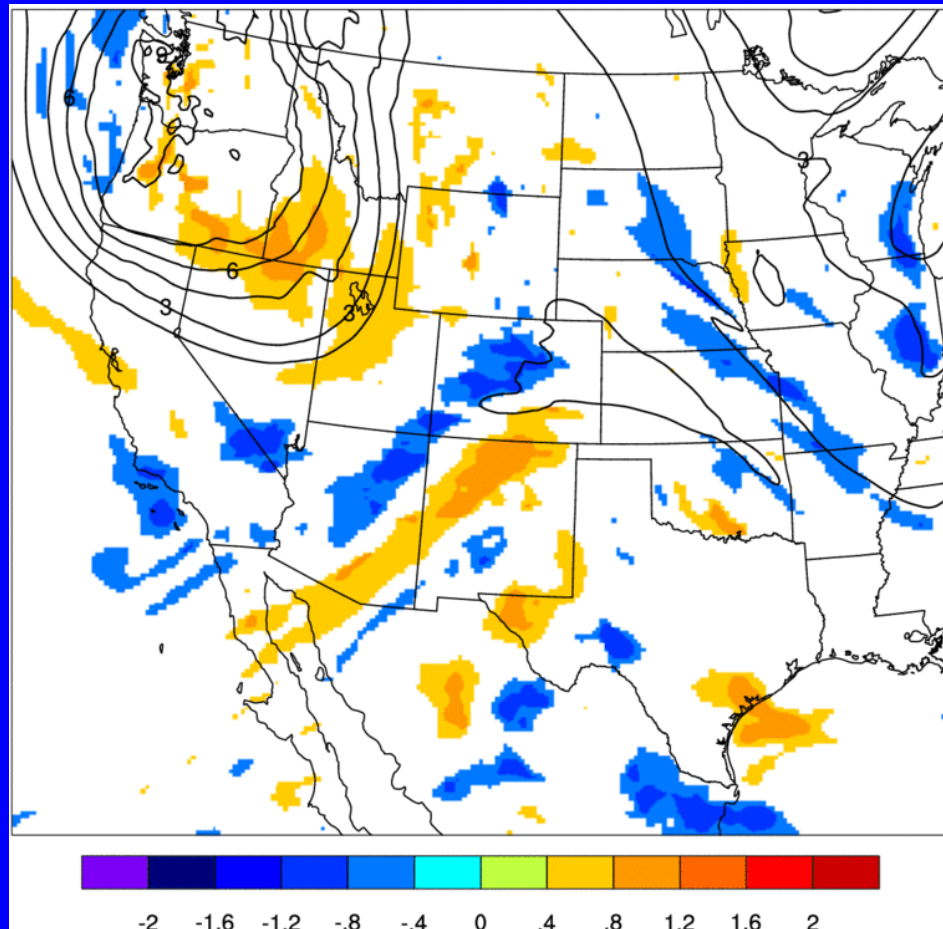
36 h Forecast Initialized  
1200 UTC 22 May (IOP 7)

# Sensitivities

## 2-6 km Theta-e

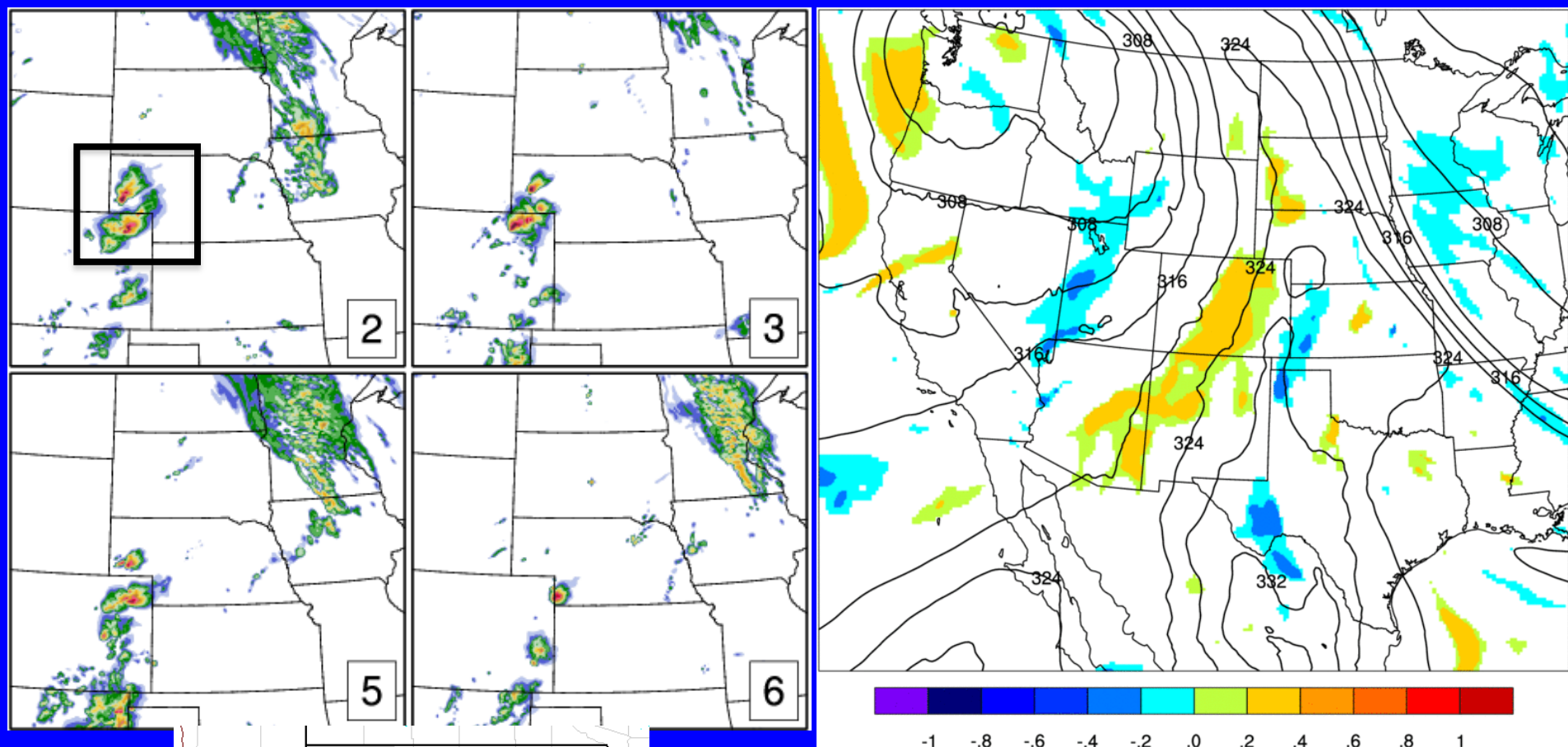


## 330 K PV

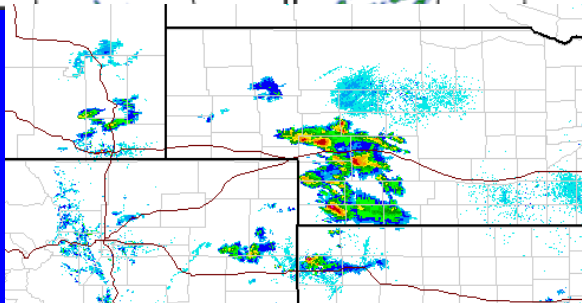




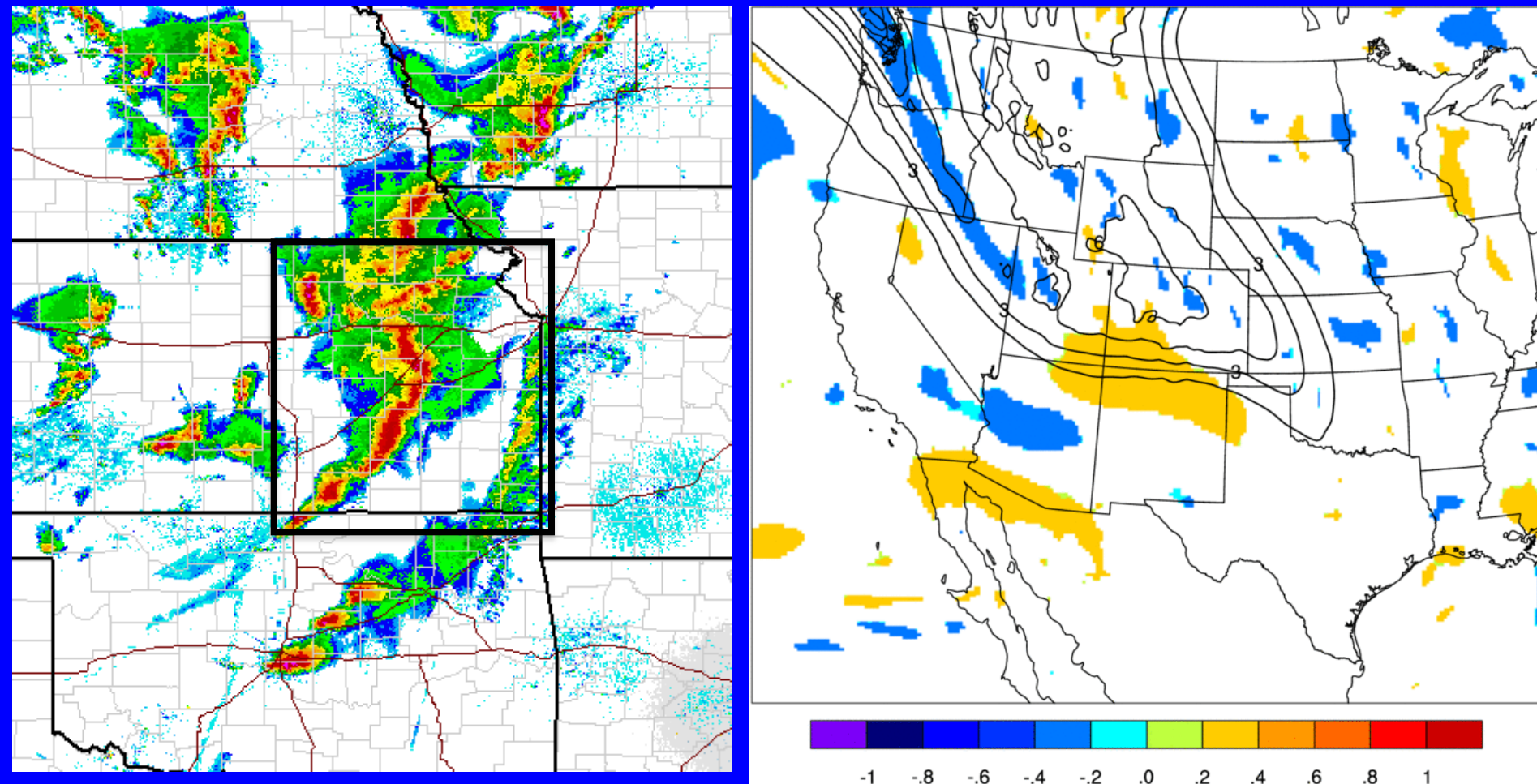
- Question 2: What processes control whether the convection grows upscale?



36 h forecast initialized 1200 UTC 23  
May

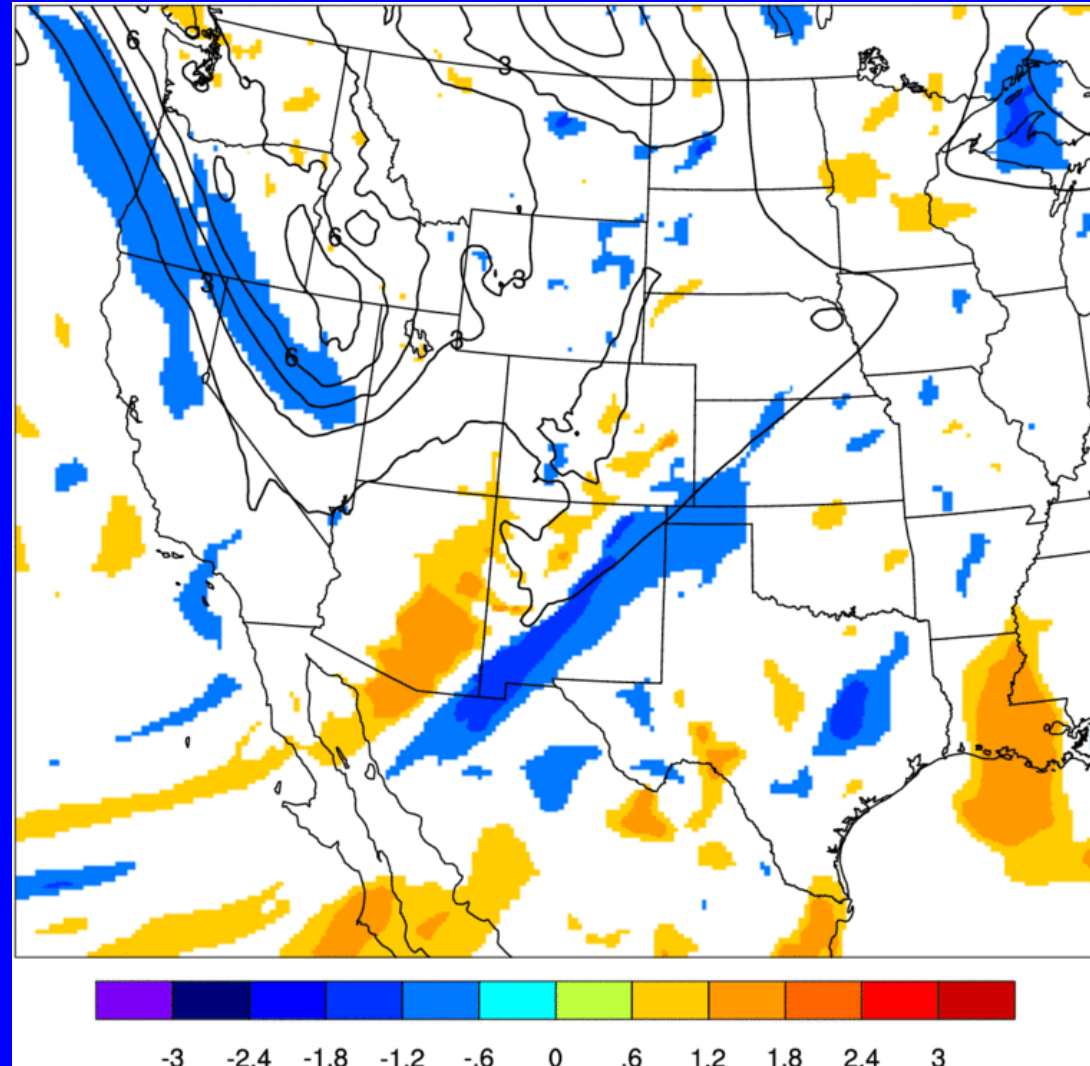
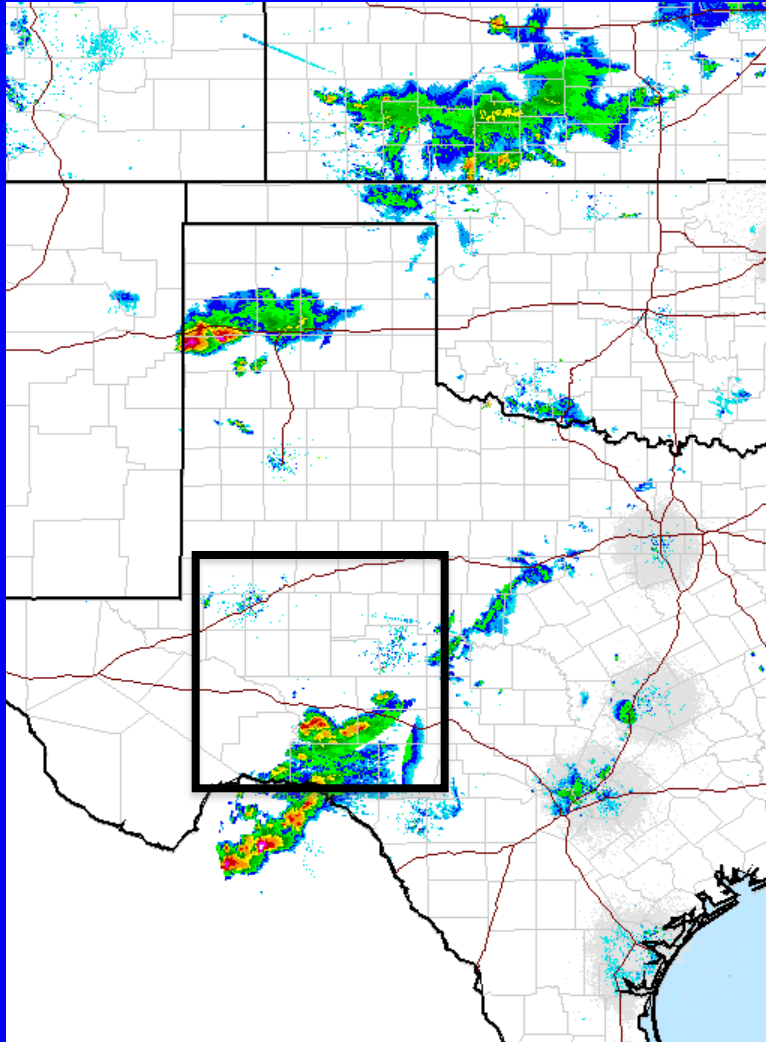


- Question 3: How does uncertainty in large-scale forcing influence convection?



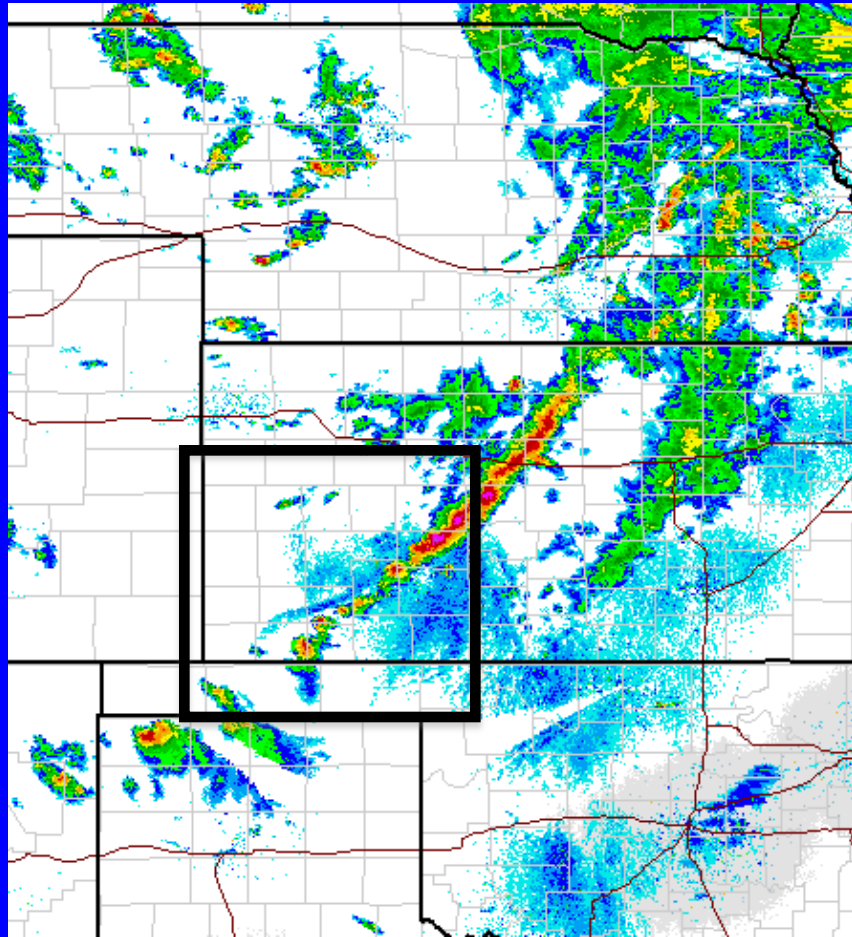
36 h forecast initialized 1200 UTC 18 May (IOP 4)

- Question 3: How does uncertainty in large-scale forcing influence convection?

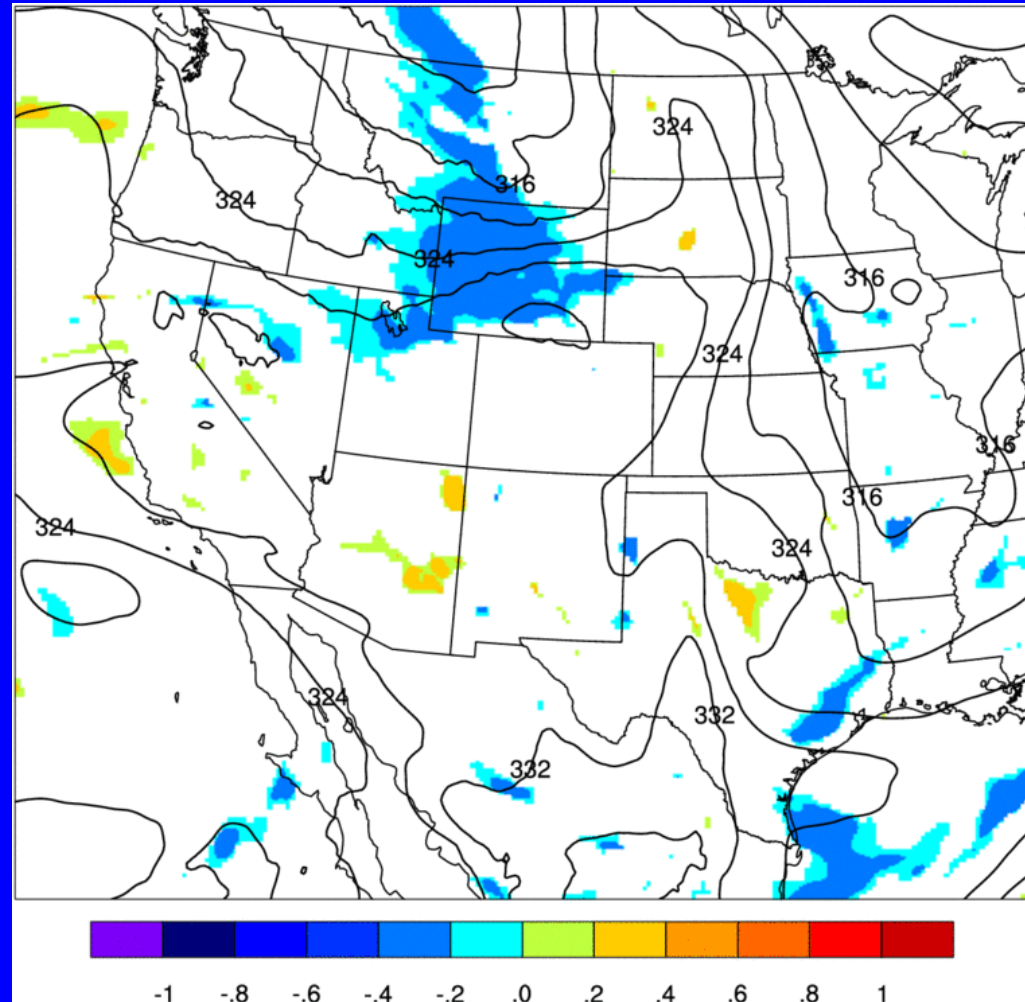


36 h forecast initialized 1200 UTC  
28 May (IOP 9)

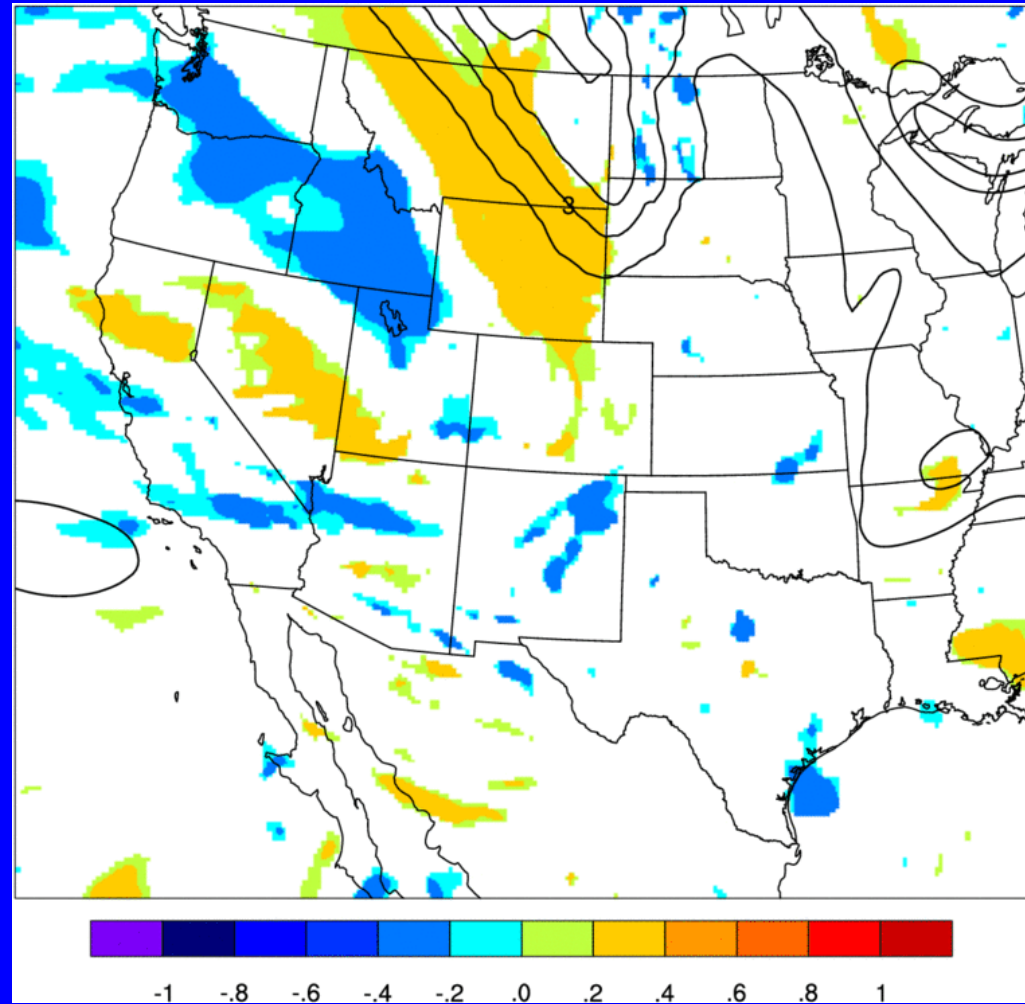
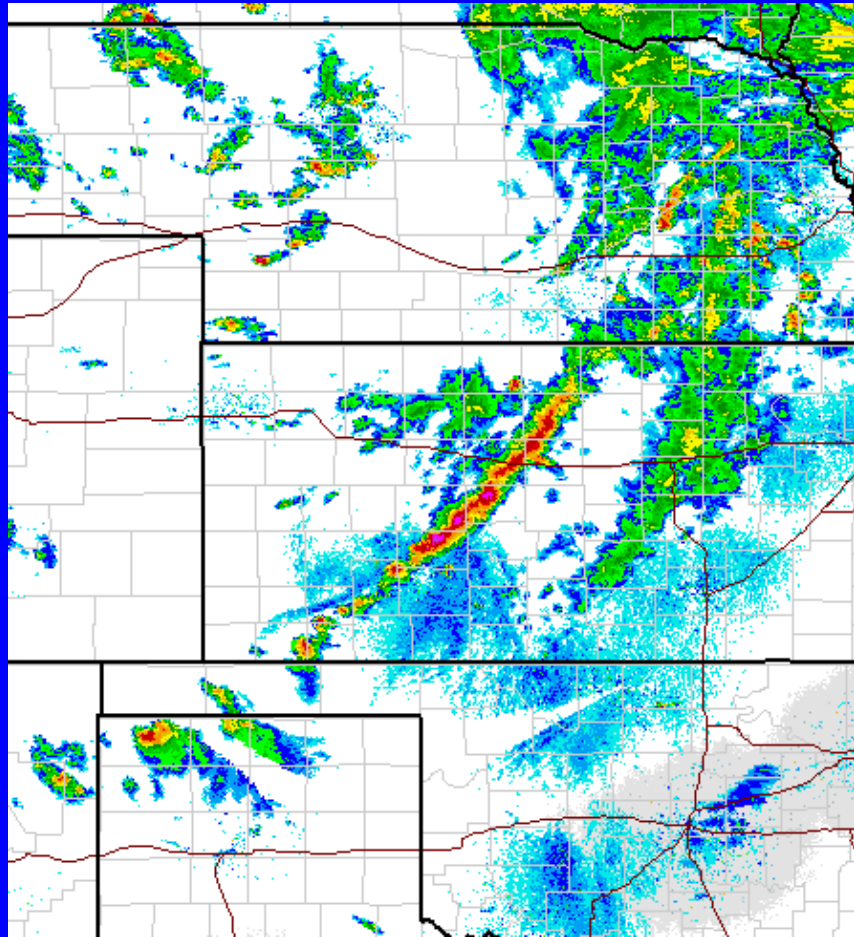
- Question 4: How do uncertainties in northwesterly flow events influence convective predictability?



33 h Forecast initialized 7 June 2012  
(IOP 15)



- Question 4: How do uncertainties in northwesterly flow events influence convective predictability?



# Future Plans

- Revised forecast metric areas and types
  - precipitation EOFs
  - vertical kinetic energy averaged over box
- Compute sensitivity to more specific fields
- Increased ensemble members for cases of interest, helps decrease the noise in the calculation
- Other collaborations based on topics of mutual interest????