Dynamical aspects of convectively coupled diurnal rainfall systems in SPCAM3.5

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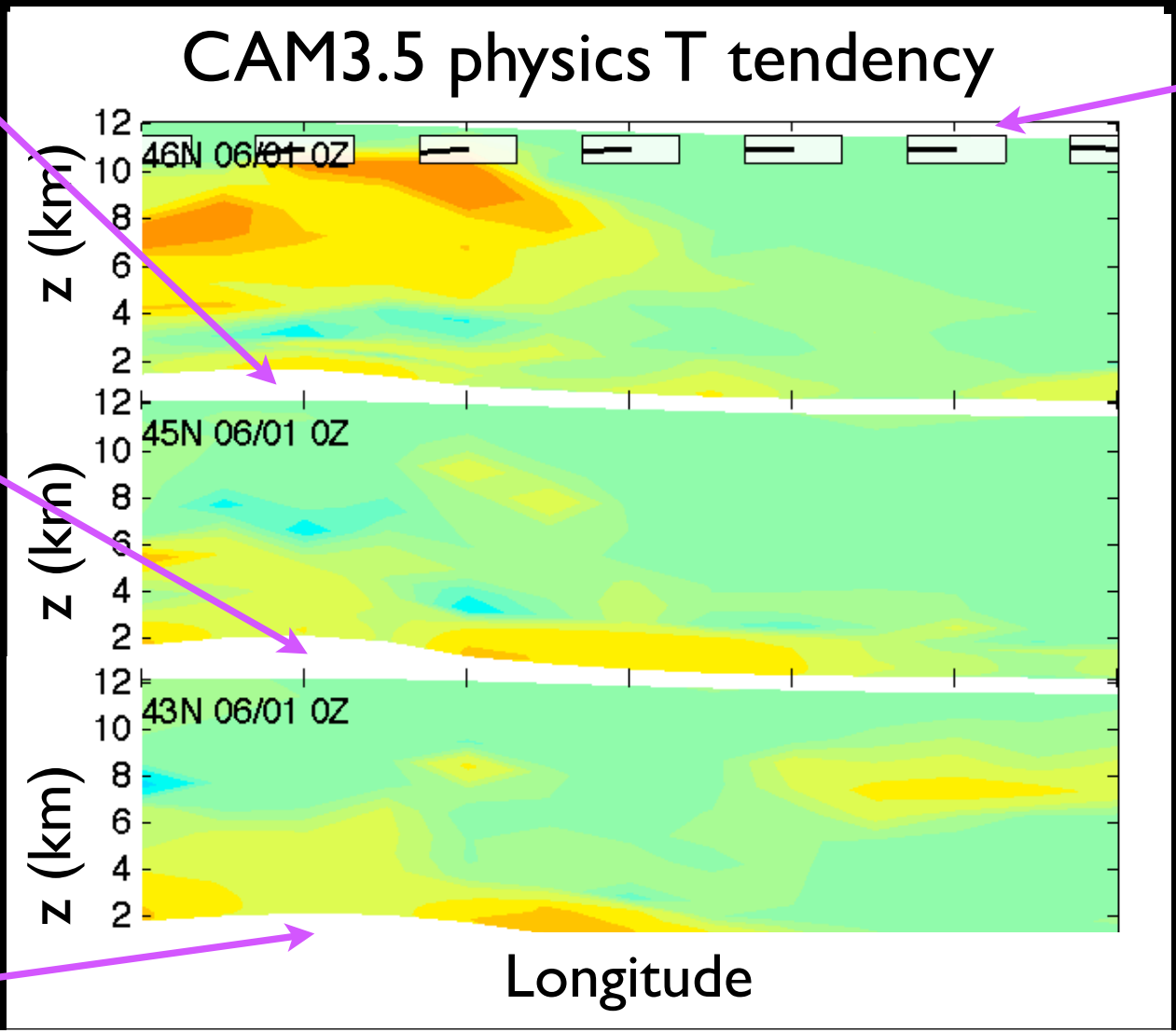
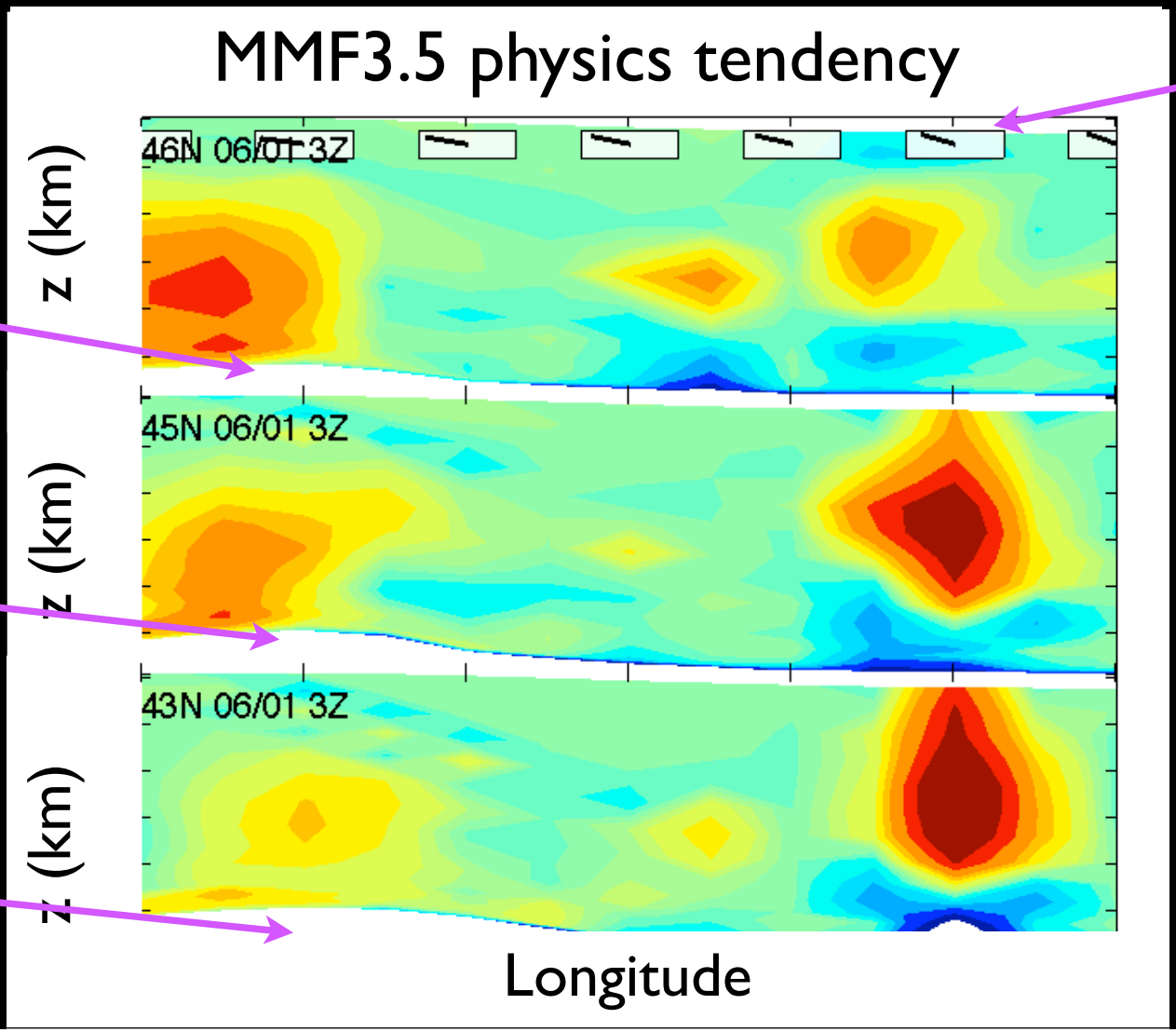
Last time, at the CMMAP team meeting...

In the CAM3.5, there are only 2 space-time modes of convective heating variability in the lee of the Rockies.



In SPCAM3.5, a new eastward moving diurnal convective mode is triggered by the embedded cloud model.



This raised some questions...

Outline

1. Do the simulated systems in SP-CAM3.5 move at realistic speeds, and *propagate*, as in observations?

2. How are regional diurnal circulations and thermodynamics altered by the embedded CRM approach?

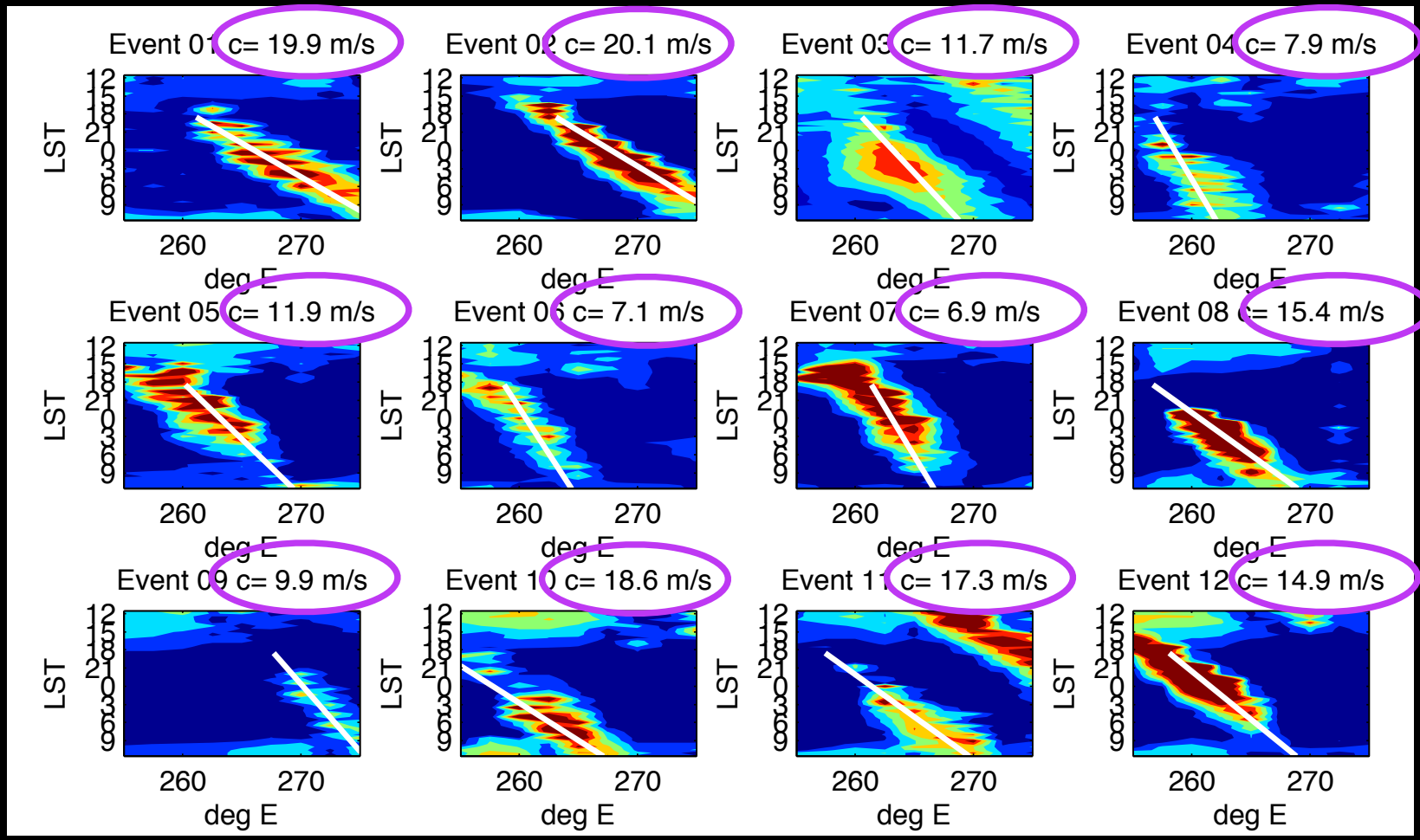
3. Is the chronology of convective genesis in line with established conceptual models?

4. Why is this talk in the K-T breakout, anyways?

1. Do the simulated systems in SP-CAM3.5 move at realistic speeds, or *propagate*, as in observations?

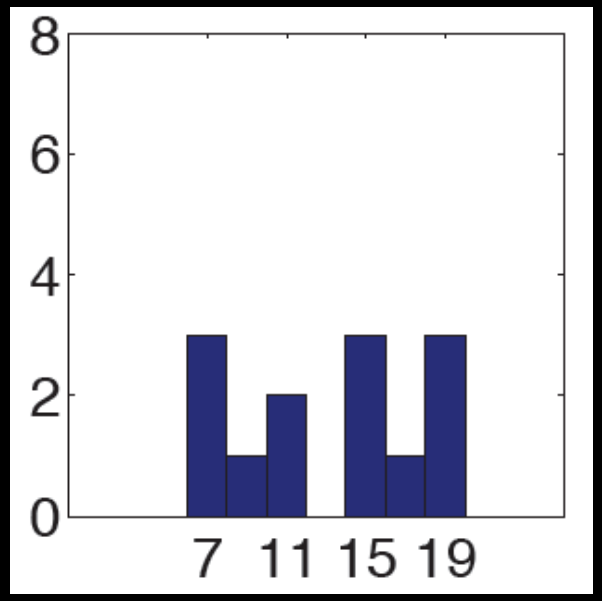
The zonal phase speeds of the organized convective events in SPCAM3.5 are within the observed range.

SPCAM3.5: **7-21 m/s**
NexRAD: **7-30 m/s** (Carbone & Tuttle, *JClim*, 2008)



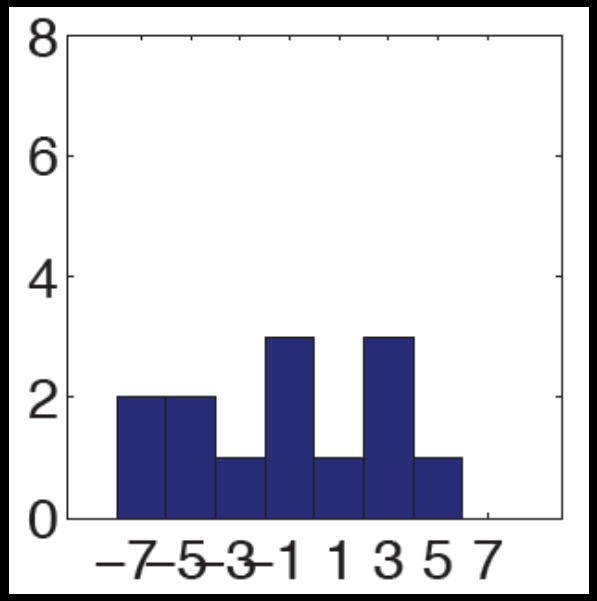
As in nature, the simulated events appear to propagate with respect to the background flow.

Fitted zonal phase speed



m/s

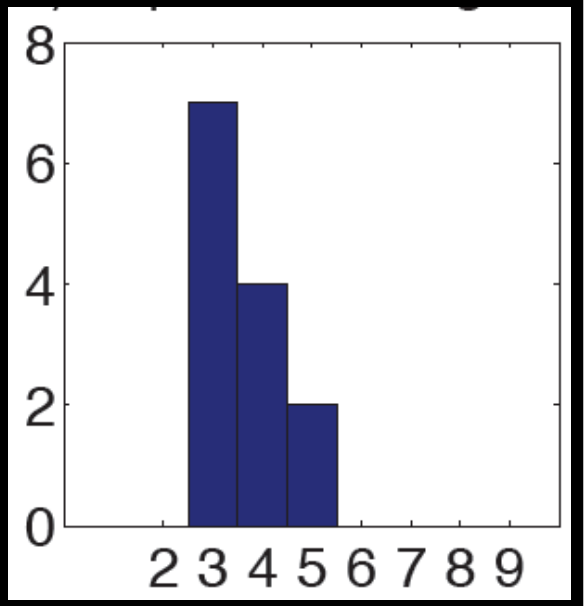
Implied zonal propagation velocity*



m/s

*Fitted zonal phase speed minus the mass- and buoyancy-weighted mean tropospheric zonal wind.

Implied steering level



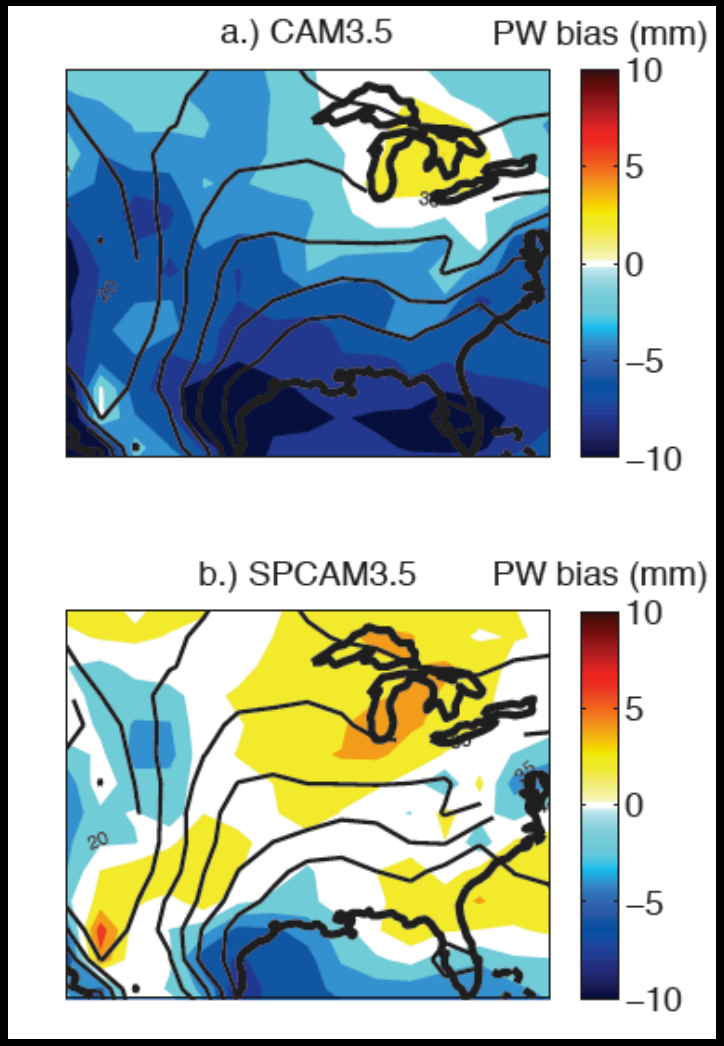
10^4 Pa

events

2. How are Central US thermodynamics and diurnal circulations altered by the embedded CRM approach?

In SP-CAM3.5 there is more moisture available to feed Central US convection.

JJA precipitable water bias relative to Rapid Update Cycle

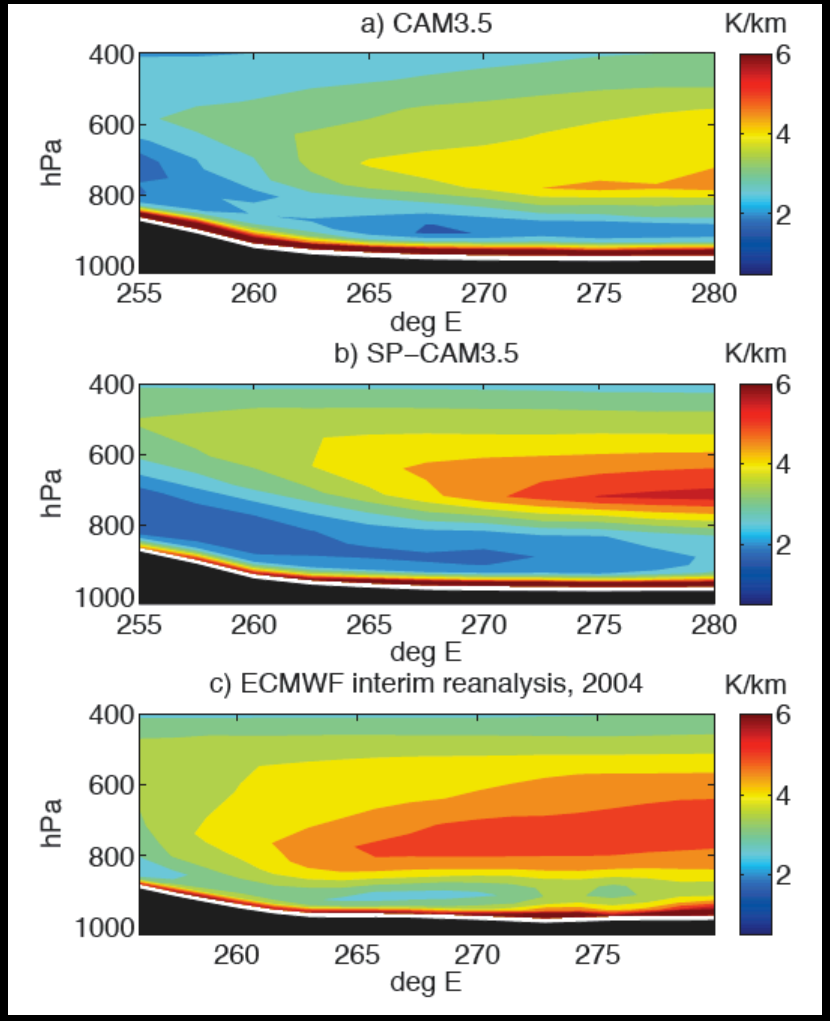


← CAM3.5

← SP-CAM3.5

The Great Plains capping inversion is strengthened by the embedded cloud resolving model approach.

JJA static stability ($d\theta/dz$), 35-45N.



← CAM3.5

← SP-CAM3.5

← ECMWF

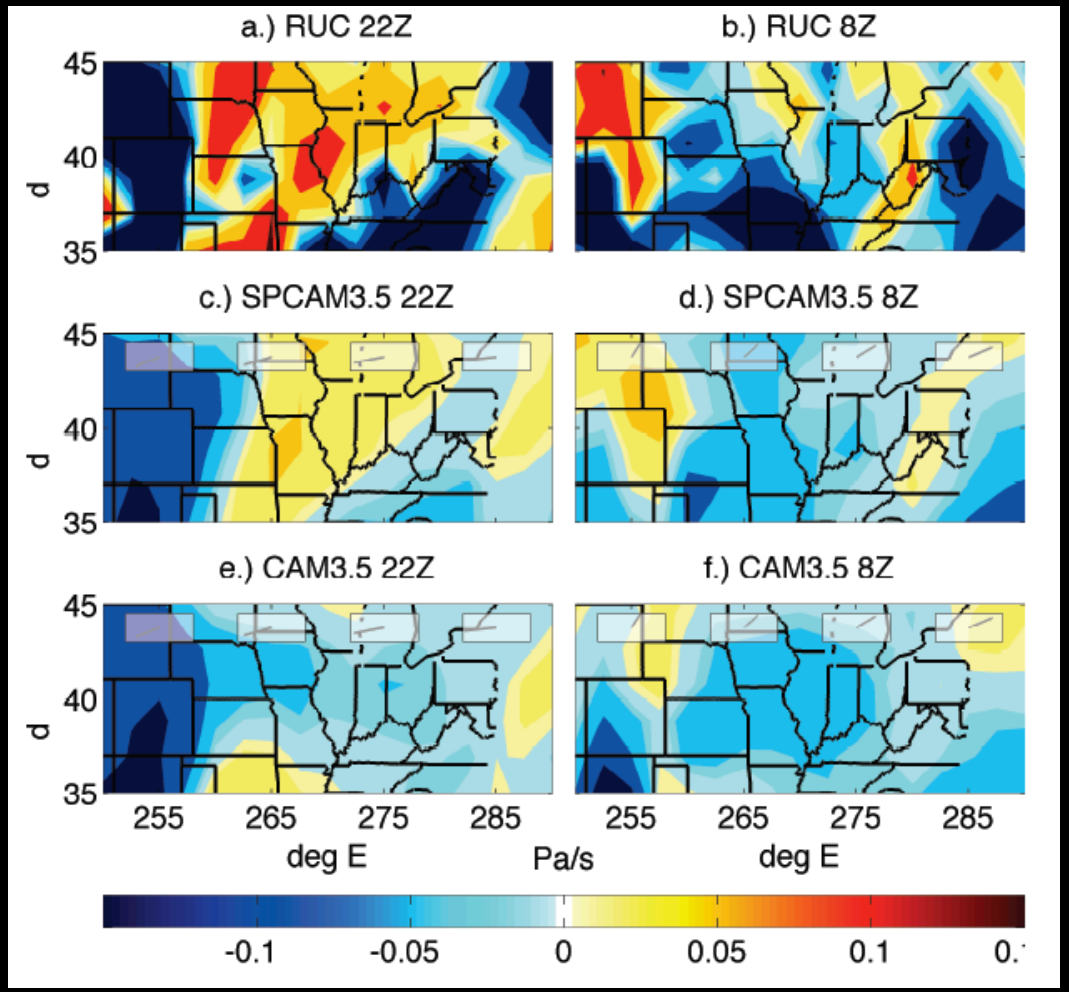
The afternoon descent phase of the mountain-plains solenoid is also improved, consistent with the inversion.

~4pm ~2am

CAM3.5 →

SP-CAM3.5 →

CAM3.5 →



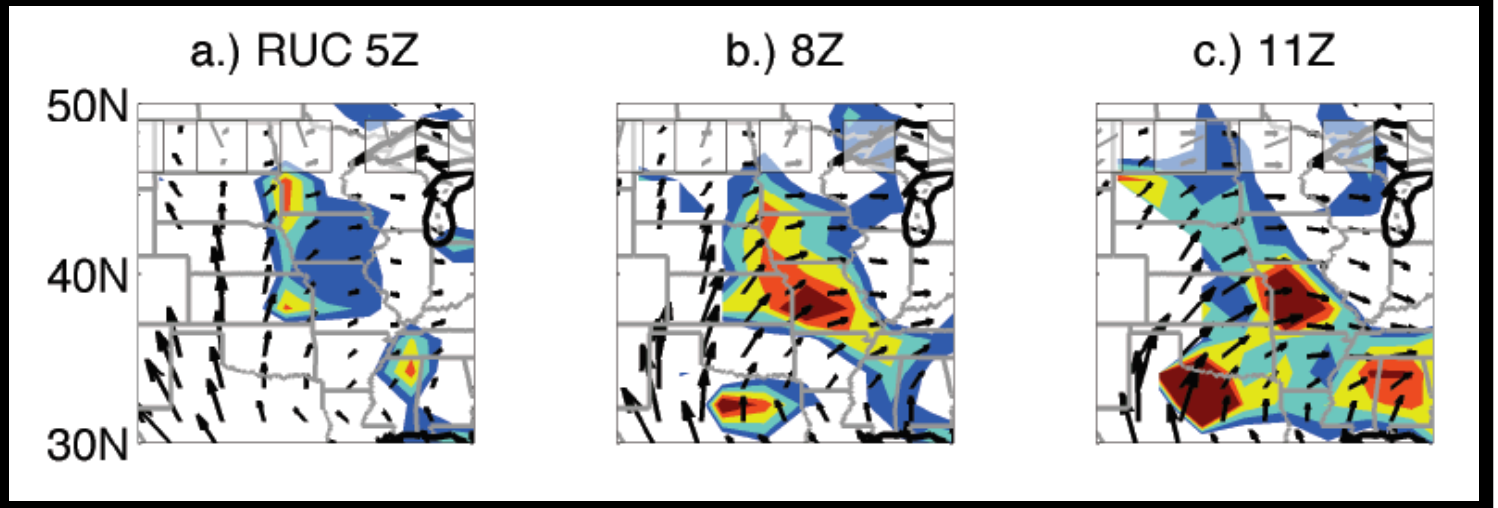
JJA pressure velocity; blue is up red is down

What about the low-level jet?

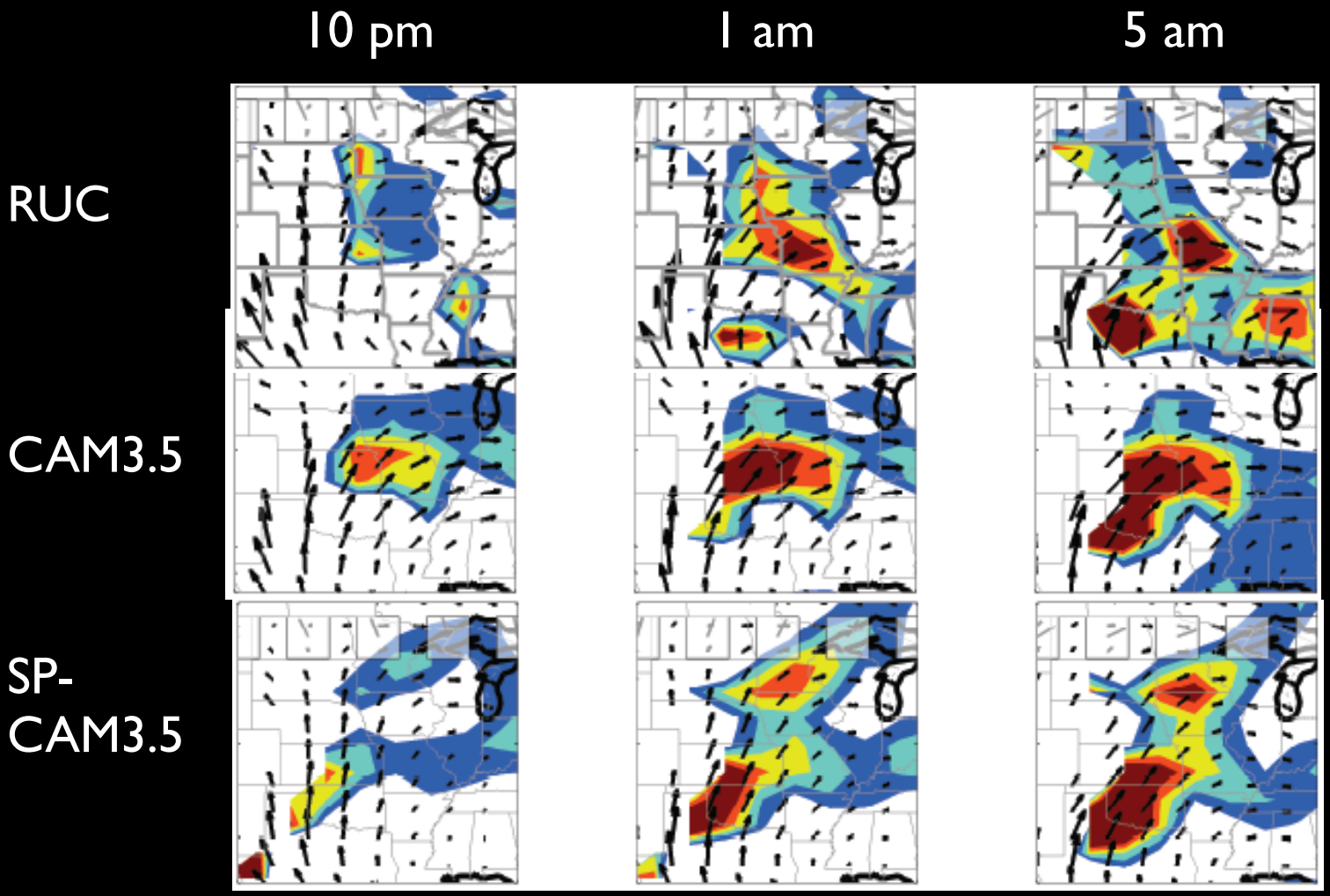
Rapid Uptake Cycle JJA diurnal composite.

10 pm | 1 am | 5 am

850 hPa column vapor transport (vectors) & its convergence (colors)



The nocturnal low level jet's moisture convergence zones were altered by the embedded cloud model approach.



3. Is the chronology of convective genesis in line with established conceptual models?

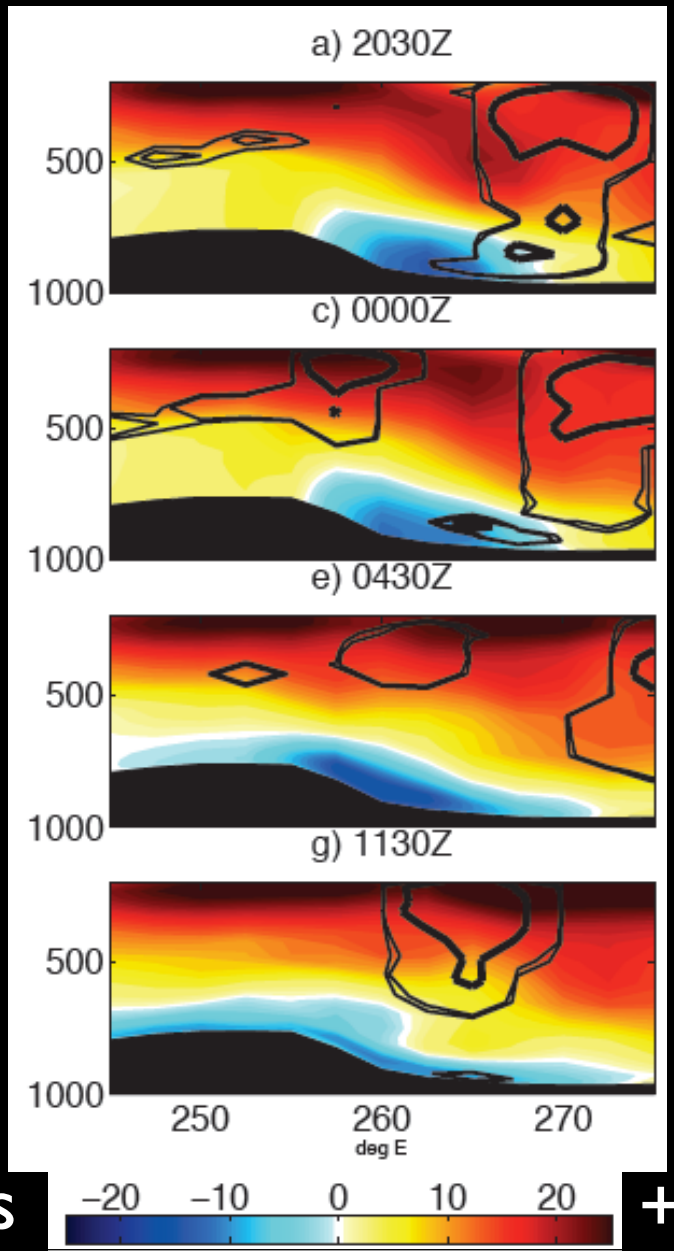
Zonal winds at 40 N as a system is born and matures.

2 pm

5 pm

10 pm

5 am



2500 km

12 large scale grid points

-20 m/s

+20 m/s

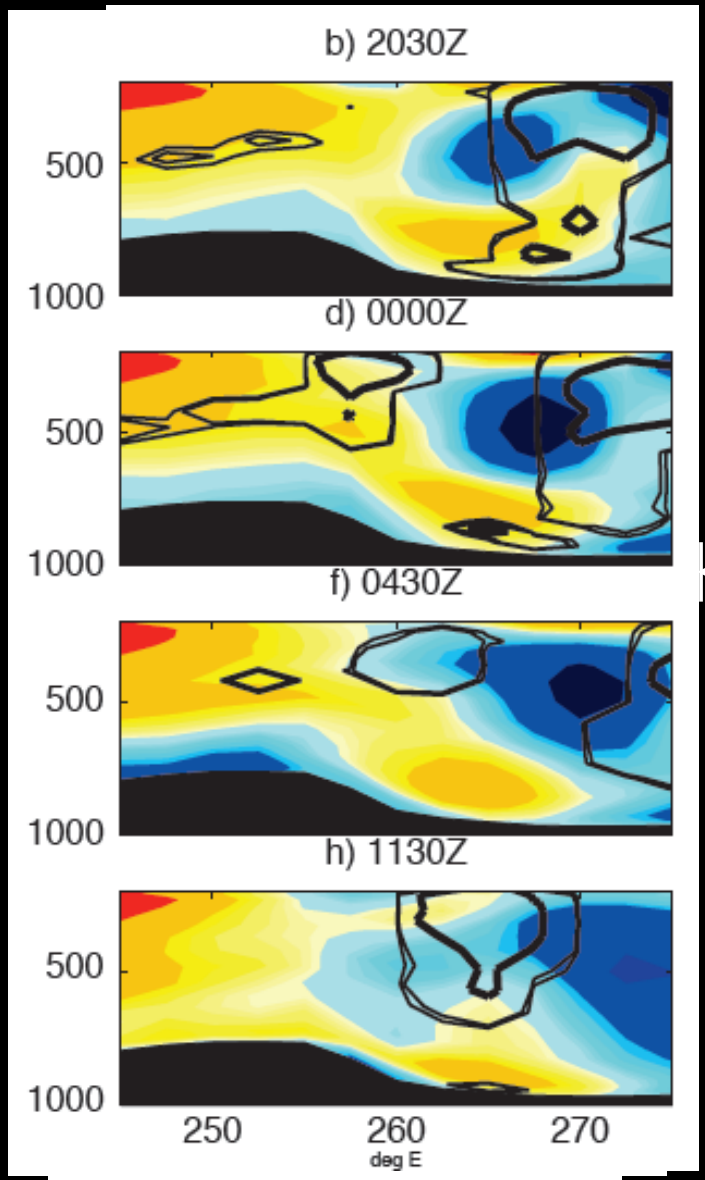
Meridional winds.

2 pm

5 pm

10 pm

5 am



2500 km

12 large scale grid points

-15 m/s

+15 m/s

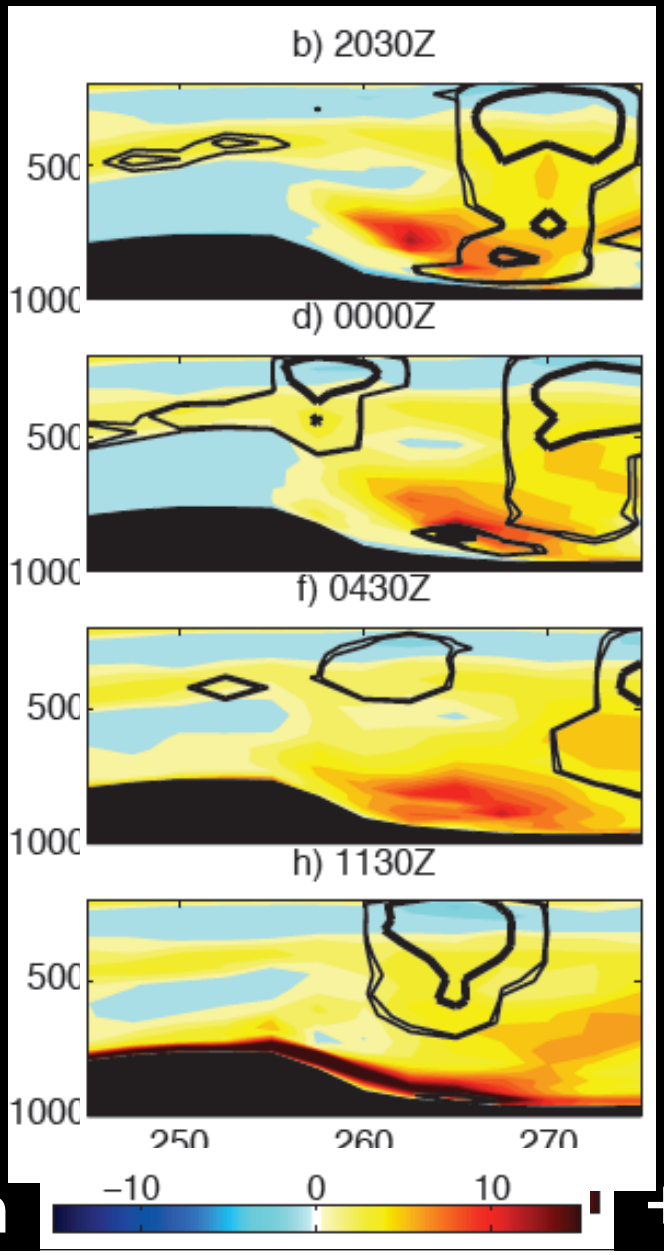
Static stability, dΘ/dz.

2 pm

5 pm

10 pm

5 am



2500 km

12 large scale grid points

(unstable) -15 K/km

+15 K/km (stable)

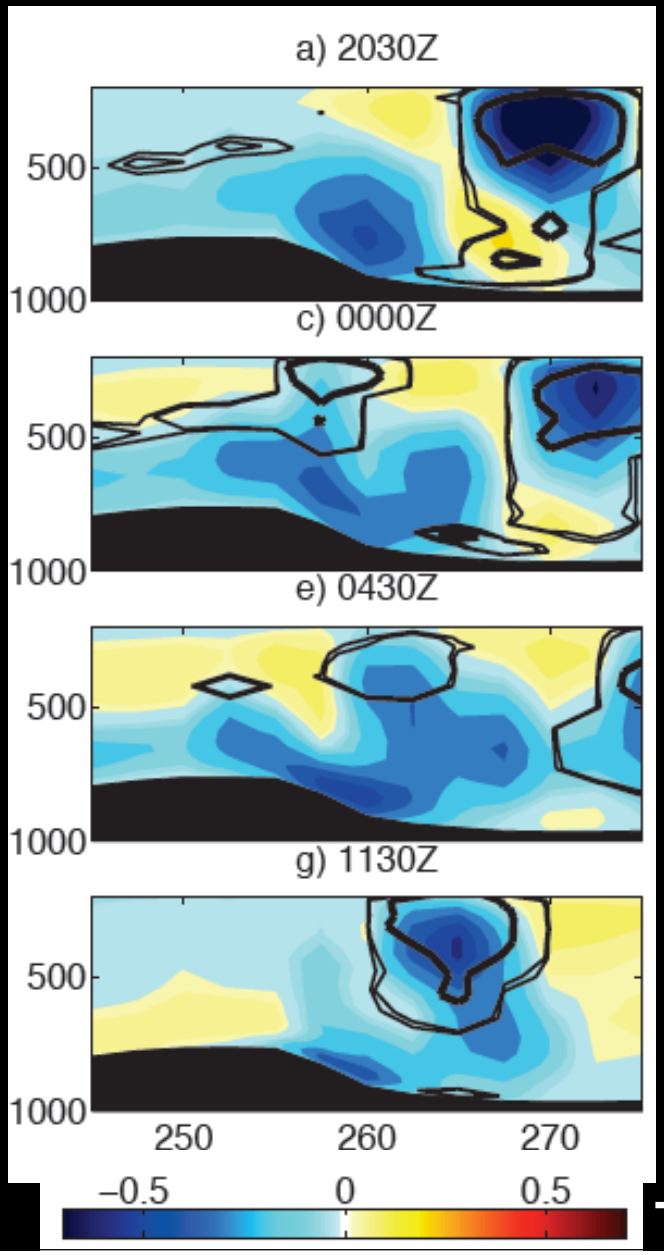
Vertical pressure velocity.

2 pm

5 pm

10 pm

5 am

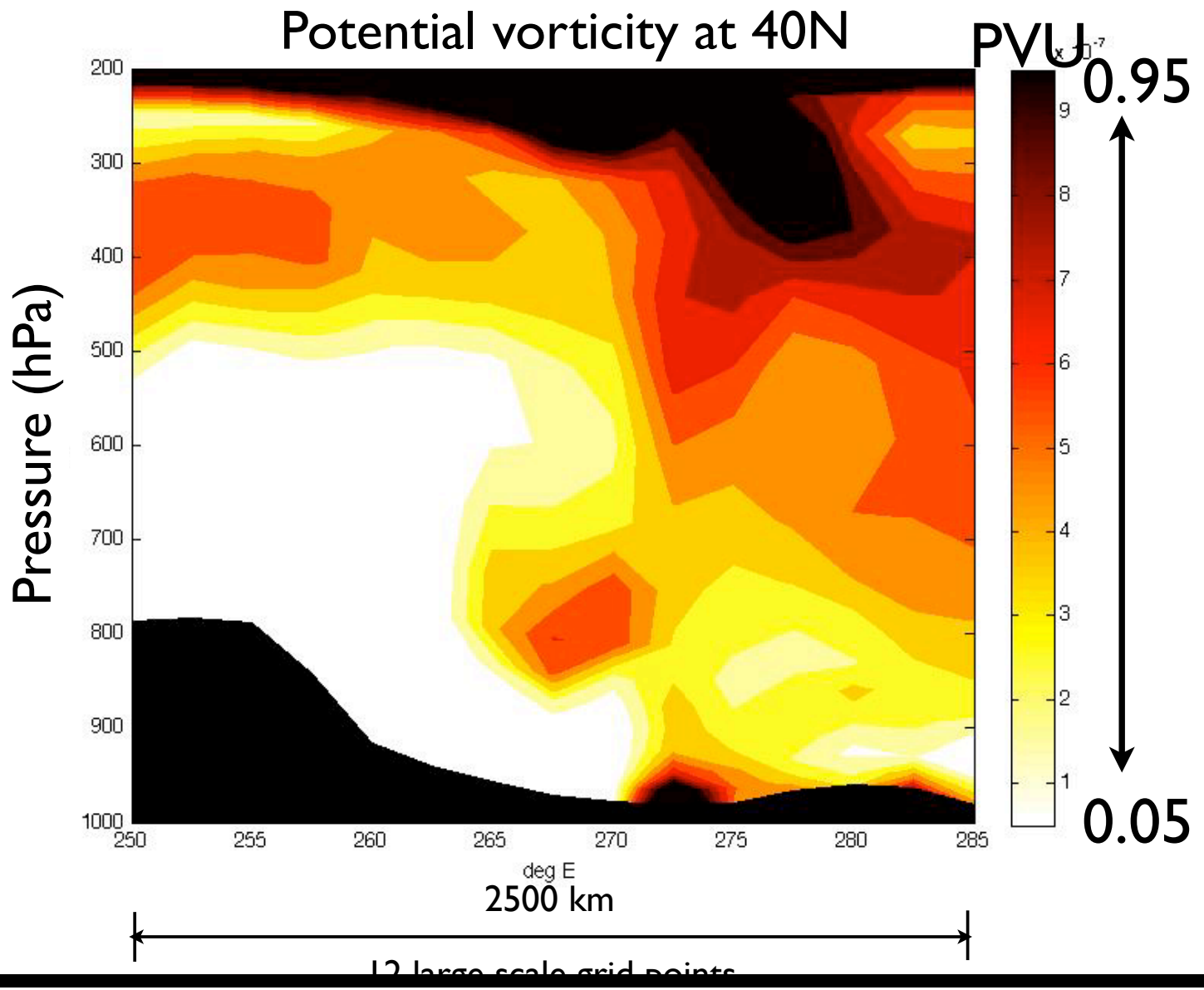


2500 km

12 large scale grid points

(up) -0.6 Pa/s +0.6 Pa/s (down)

Are CRM-generated PV anomalies a "glue" that holds the simulated systems together?...



Summary

1. Reduction of a dry bias and enhancement of the daytime Plains subsidence inversion creates an environment that is more favorable for upscale development of convection in the lee of the Rockies.

2. The genesis mechanism and propagation haracteristics of diurnally generated convective systems in SP-CAM3.5 appear to be consistent with established conceptual model.

3. This concrete weather-climate interface problem is a knowledge-transfer opportunity.