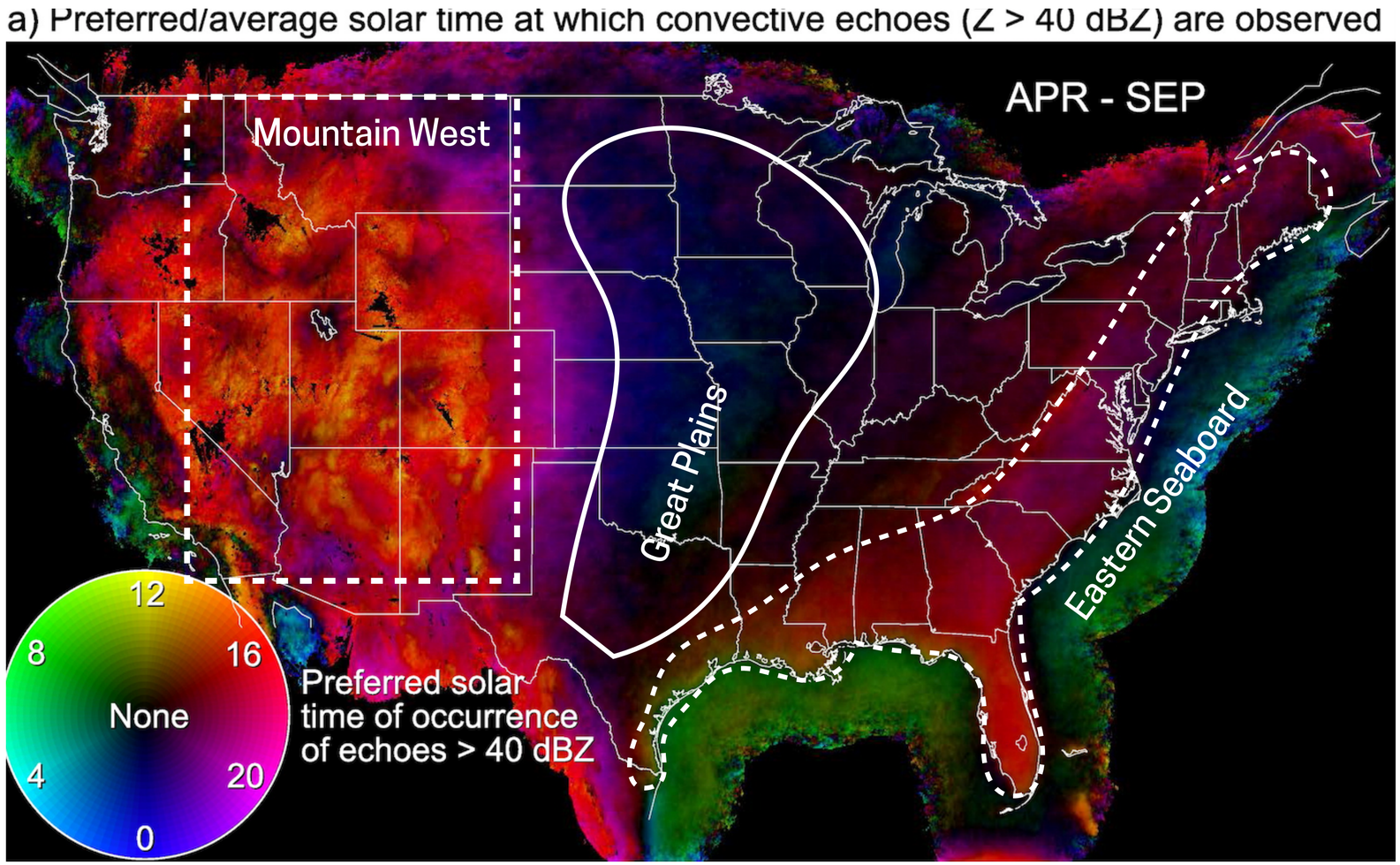
# Where, When, and Why Did It Rain during PECAN?

Tammy M. Weckwerth and Ulrike Romatschke (MWR 2019)

# Goal

- *Identify critical statistical characteristics of rainfall during the PECAN Field Campaign.*
- *Are the PECAN rainfall characteristics consistent with past studies?*
- *Establish the link between synoptic-scale features and the strongest rainfall events during PECAN.*

# Current knowledge base on Great Plains nocturnal precipitation

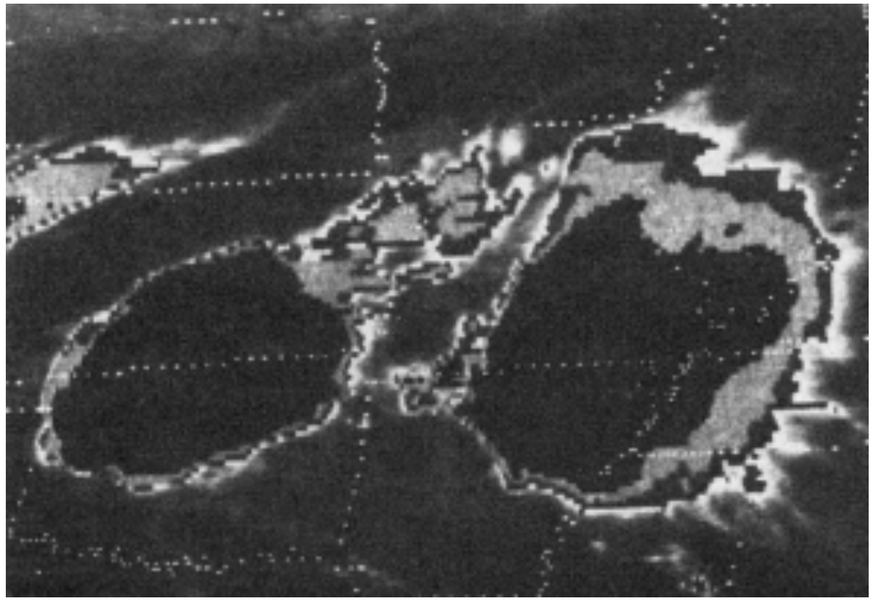



Composite of NEXRAD Radar Mosaic from 1996 to 2015

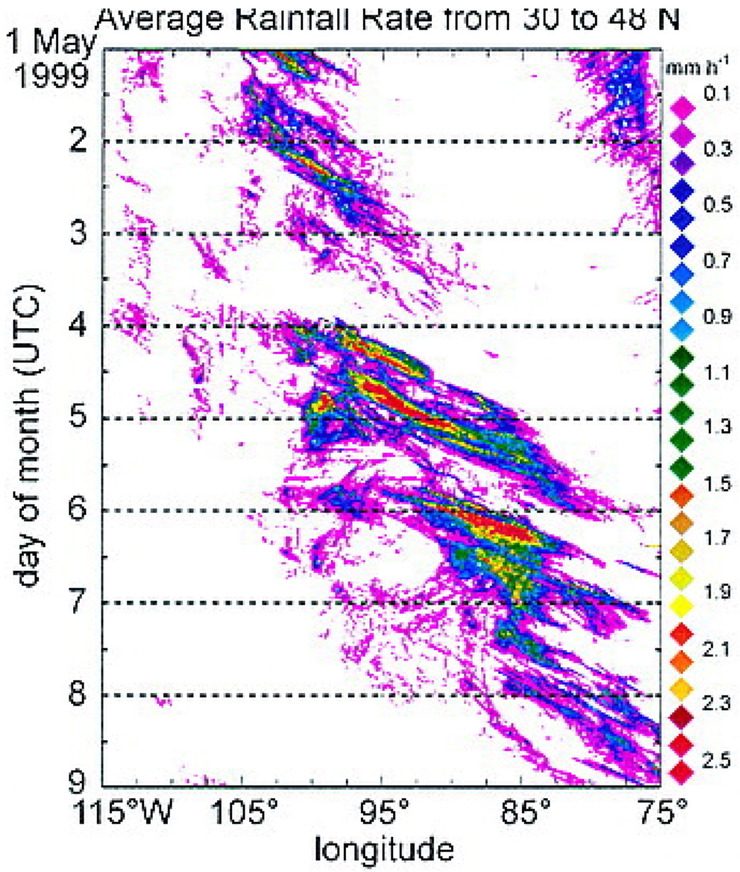
Fabry et al. (2017)

# Current knowledge base on Great Plains nocturnal precipitation

## (1) Propagating component



Maddox et al. (1980)

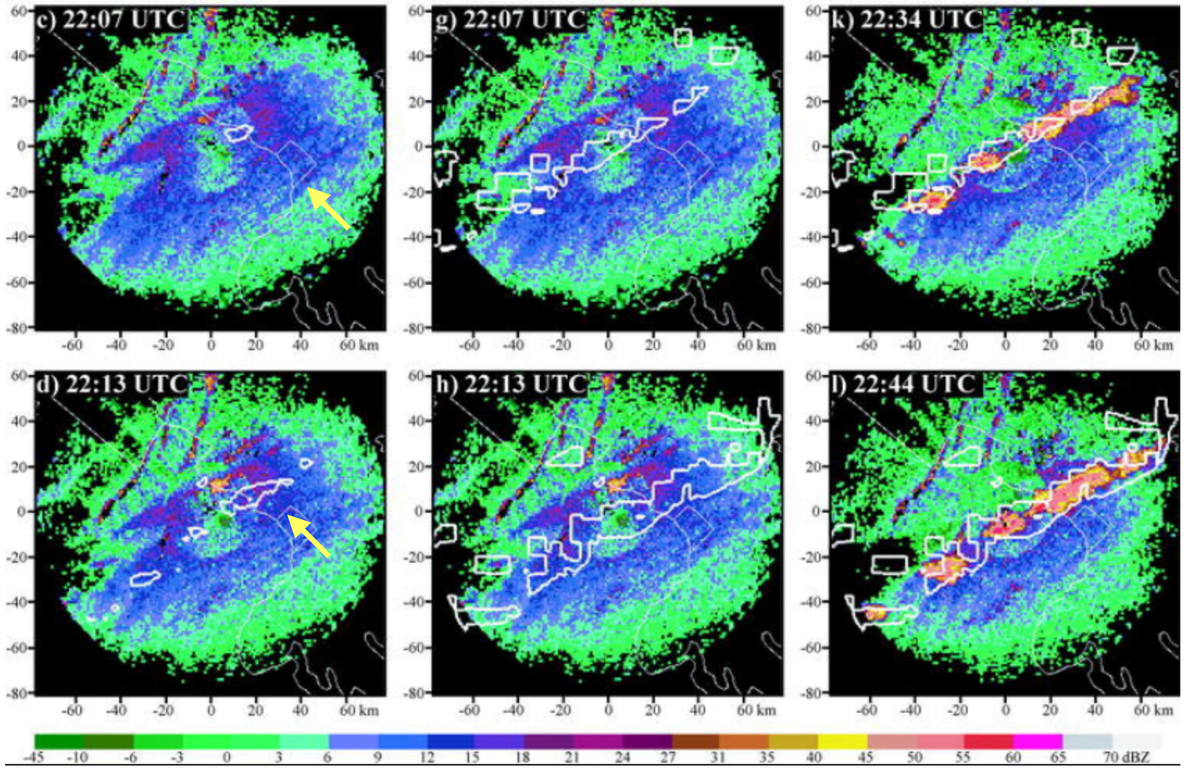



Carbone et al. (2002)

Multi-day precipitation episodes featuring highly organized convective systems with strong eastward propagating tendency. These propagating events contributed **~60%** of total summer rainfall in central U.S. *(Carbone and Tuttle 2008)*

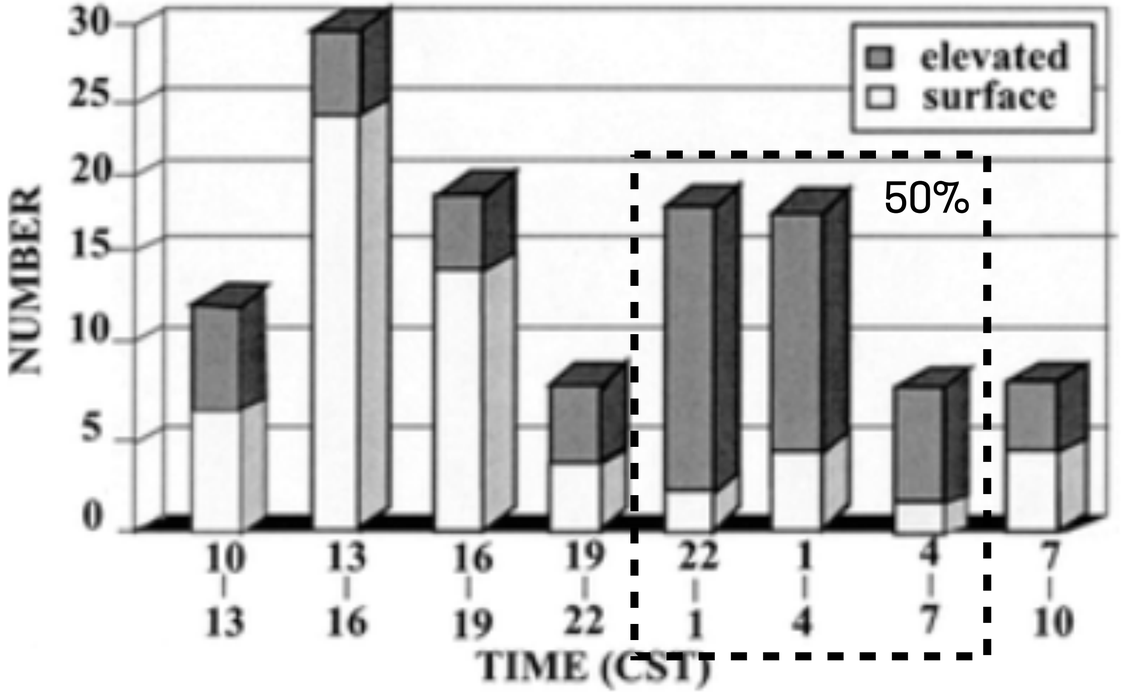
# Current knowledge base on Great Plains nocturnal precipitation

## (2) Locally-initialized component




Radar- and satellite-based 30-min automated nowcasts of daytime CI

Roberts and Rutledge (2003)

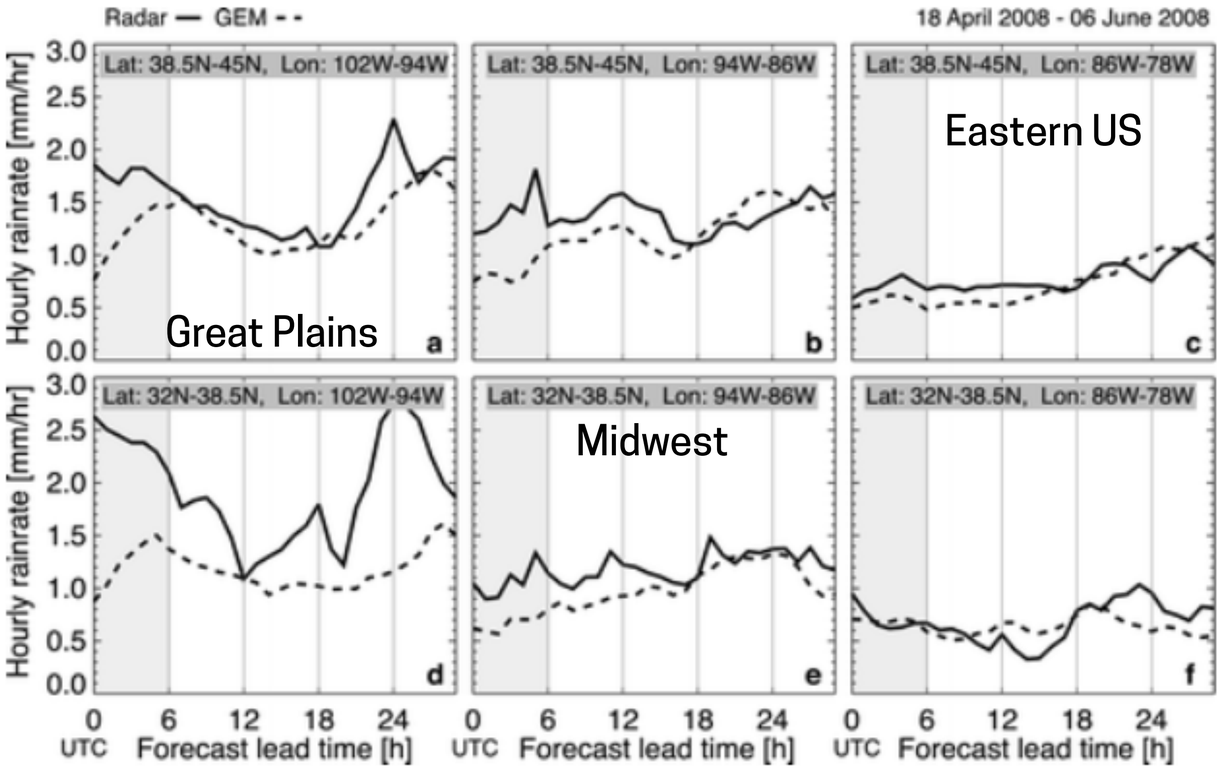



Diurnal Distribution of Convective Initiation Events during IHOP_2002

Wilson and Roberts (2006)

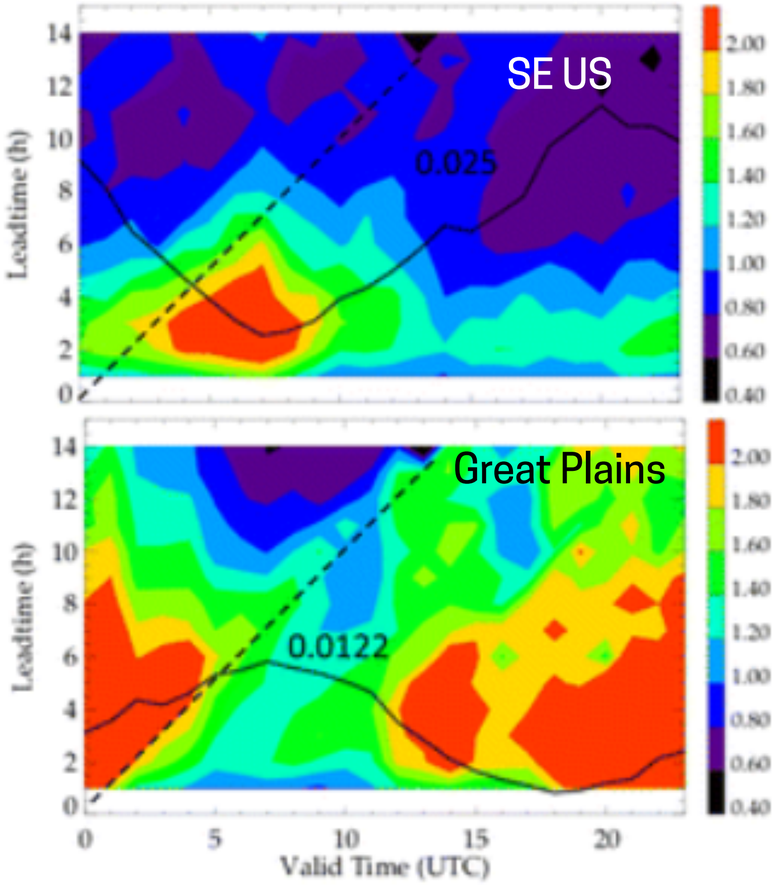
# Current knowledge base on Great Plains nocturnal precipitation

## Limited forecast skills




Comparison of radar-observed rainfall diurnal cycle and rainfall forecasts with Canadian Global Model (GEM)

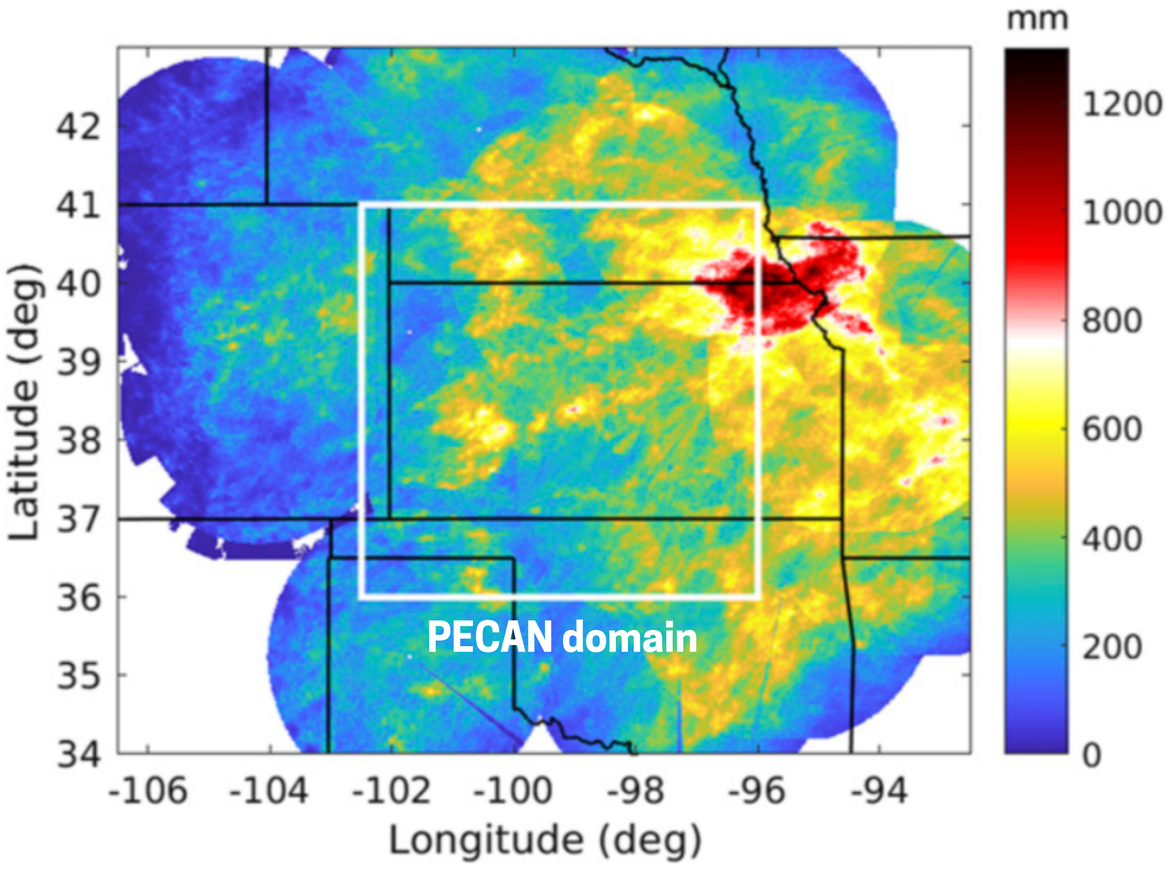
Surcel et al. (2010)



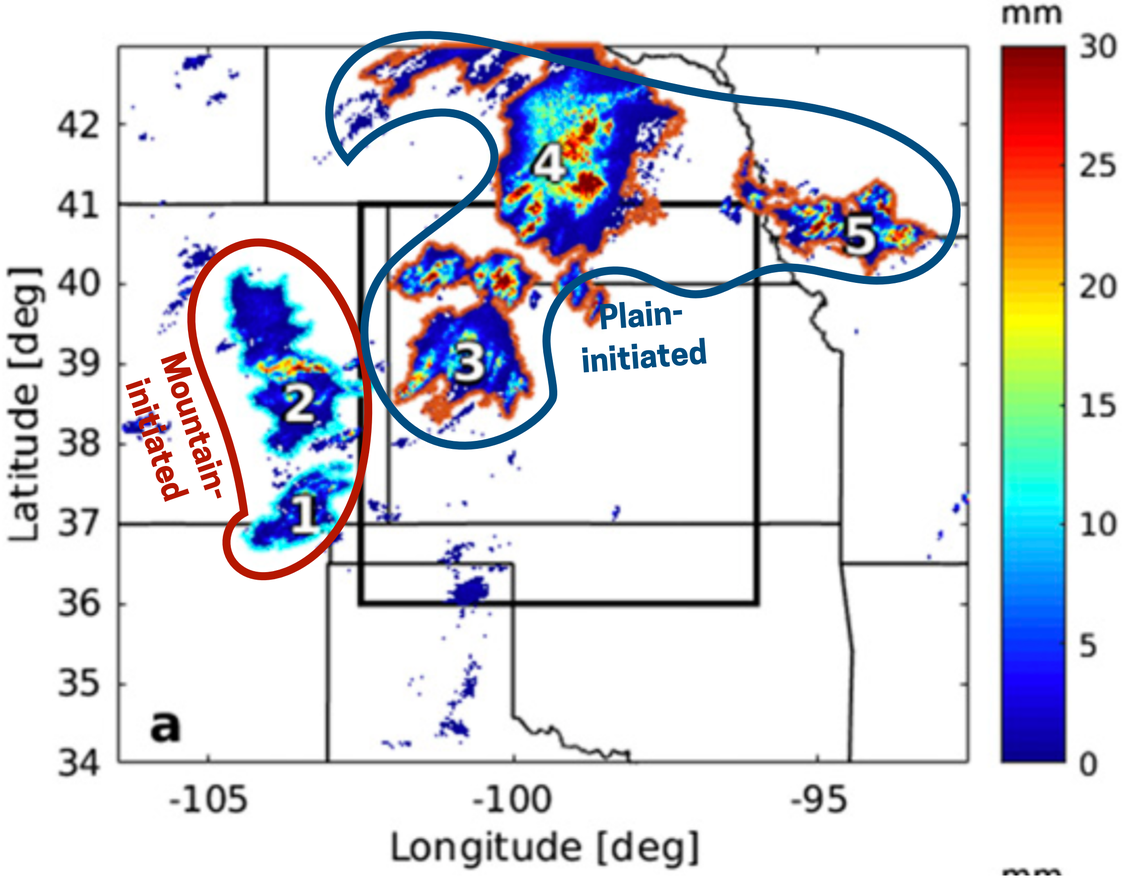

Hourly HRRR model bias as a function of lead time and valid time

Pinto et al. (2015)

# Radar QPE mosaic: Precipitation feature tracking



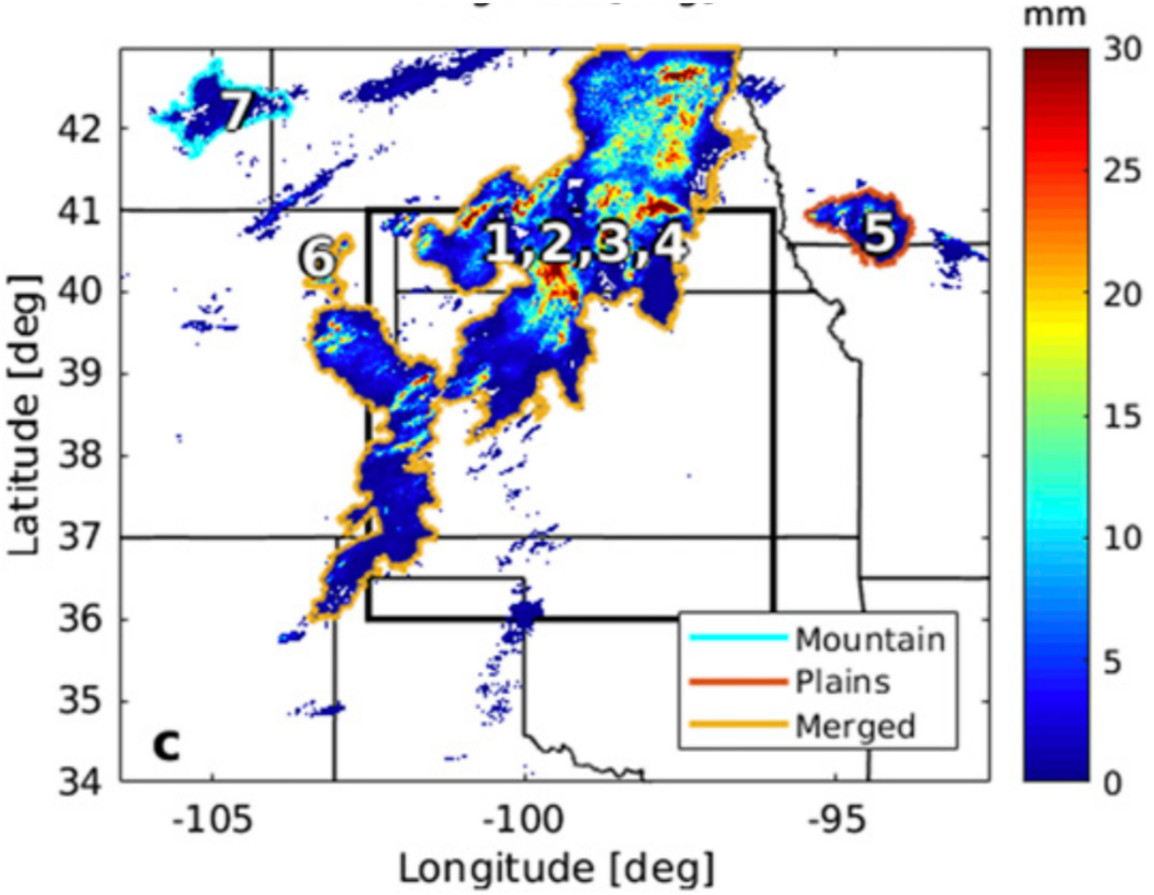

**Radar Domain:** 12 NEXRAD Radars near Hays, KS + SPolKa




**Precipitation feature determination and tracking**

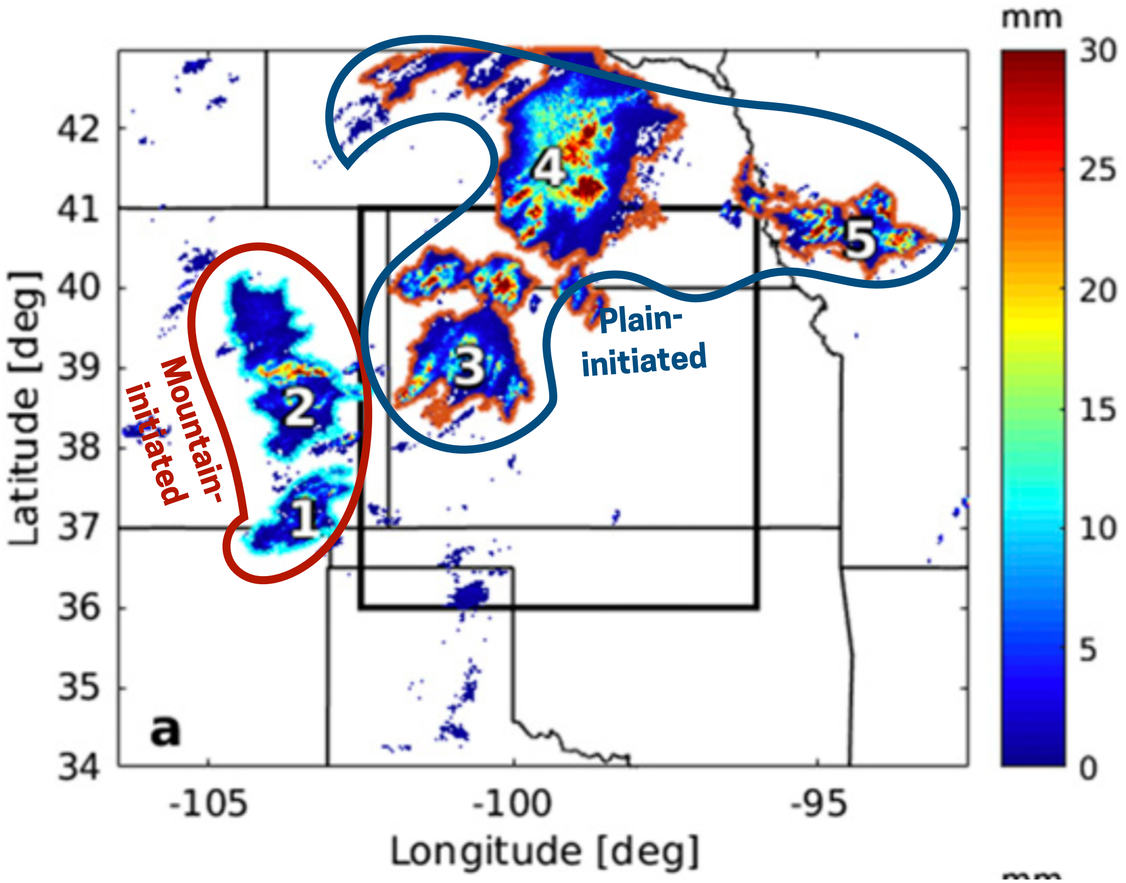
- Exclude features associated with the lowest 5% of total rainfall
- **1026** precipitation features identified

# Radar QPE mosaic: Precipitation feature tracking




**Precipitation feature determination and tracking**

- New cells that formed <100km from established features are classified as “merged"




**Precipitation feature determination and tracking**

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# Potential Utilization of Tracking Results

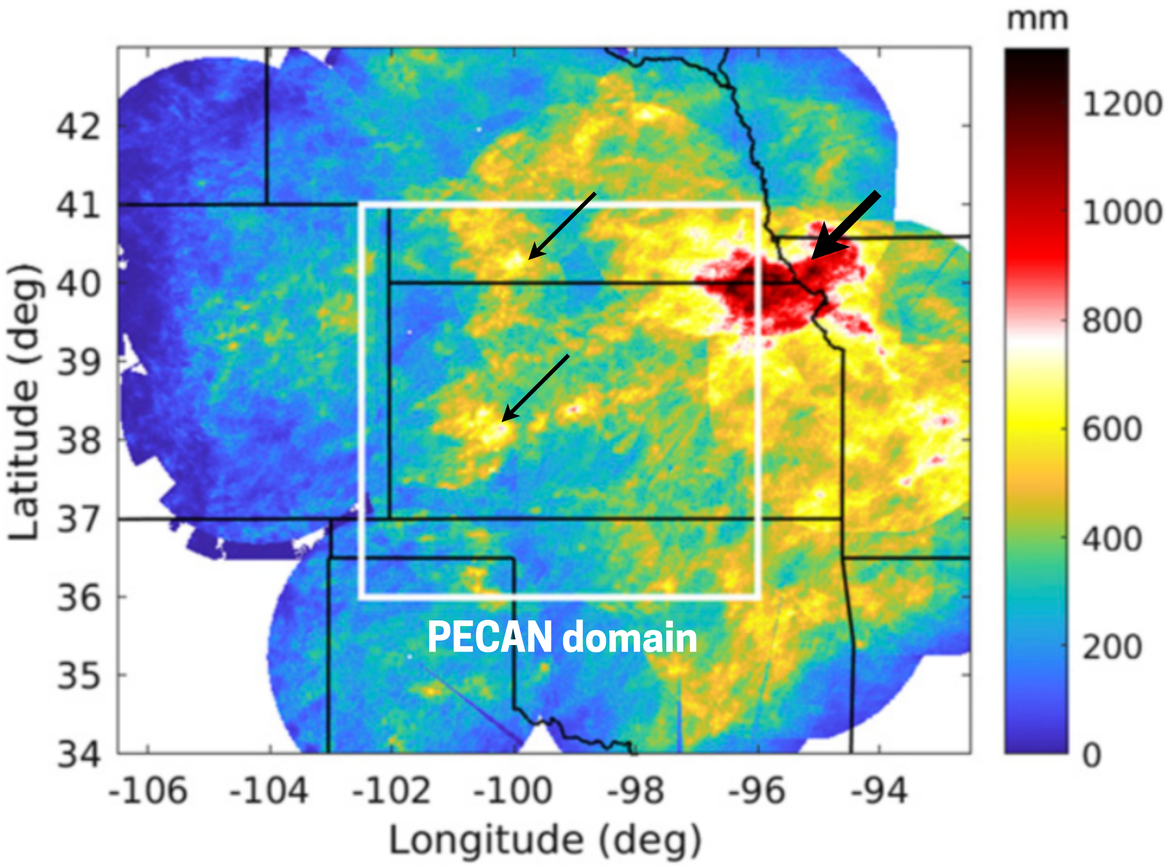
**Spatial Characteristics**

- **Initialization Location:** *Is the strongest PECAN precipitation produced by mountain-induced systems or plain-induced systems?*
- **Dissipating Location:** *Are most PECAN convection transitory and liable to propagate over great distance?*
- **Location of the strongest precipitation**

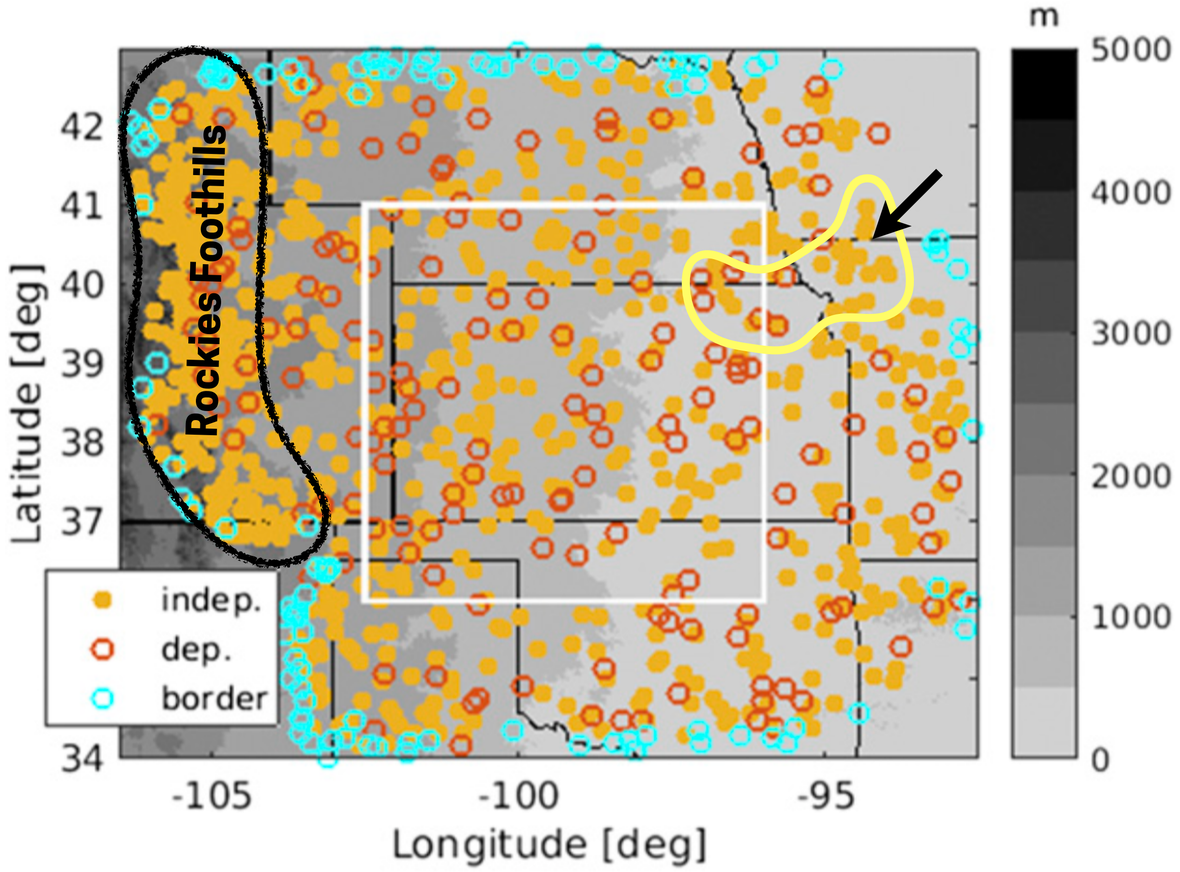
**Temporal Characteristics**

- **Time Series Analysis:** *Frequency of strong rainfall events during PECAN; Contributions from systems of varied origins.*
- **Diurnal Cycle:** *Might there be a transition in preferred CI type from daytime period to nocturnal period?*
- **Longevity of Different PECAN systems:** Is there a positive correlation between the strong rainfall and increased system duration during PECAN?

# **Tracking Result:** Spatial Characteristics

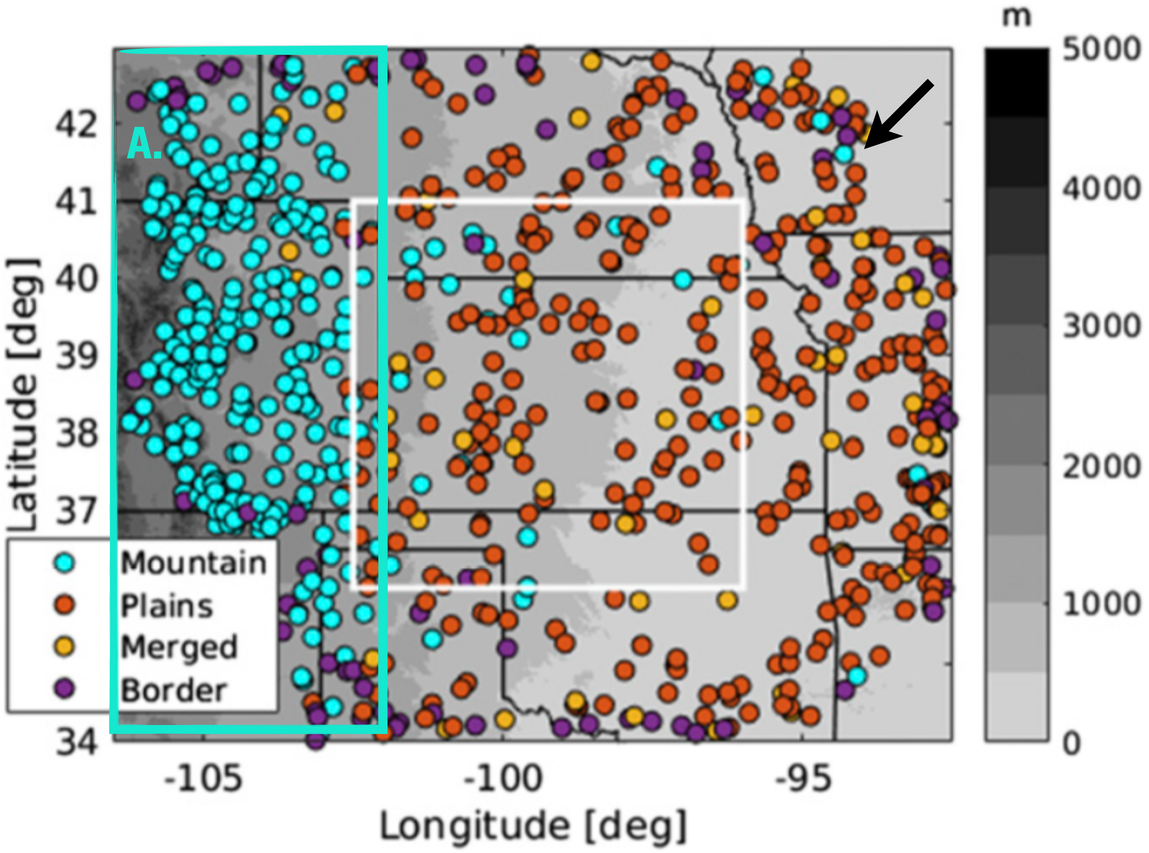



**Total Accumulated Precipitation during PECAN (12 May-22 Jul 2015)**



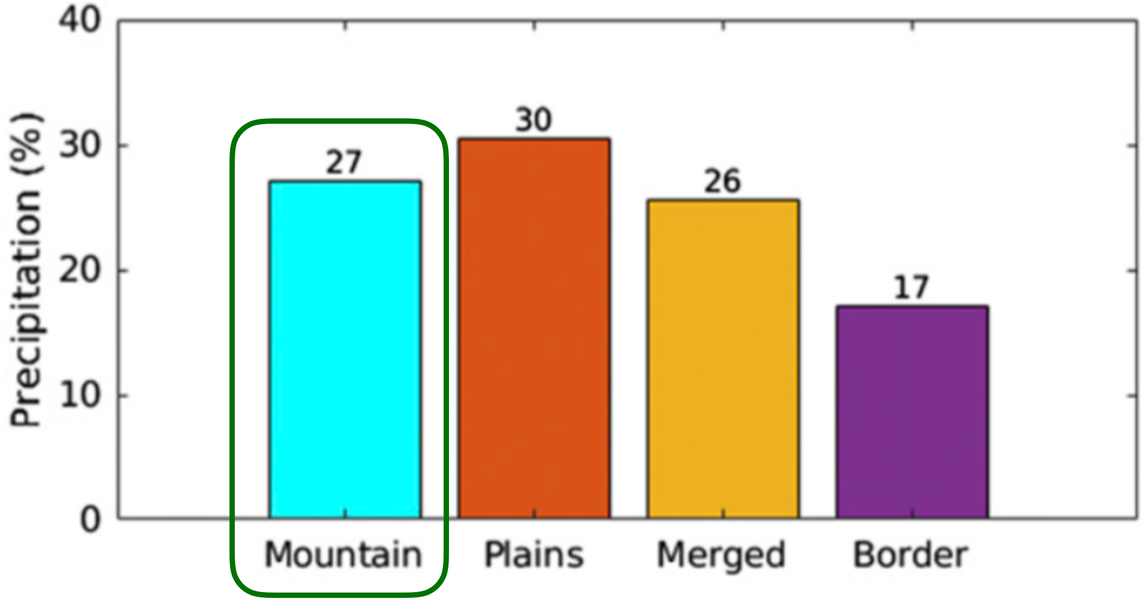

**Centroid of Convective Initiation Events (i.e. CI locations)**

# **Tracking Result:** Longevity of different CI events



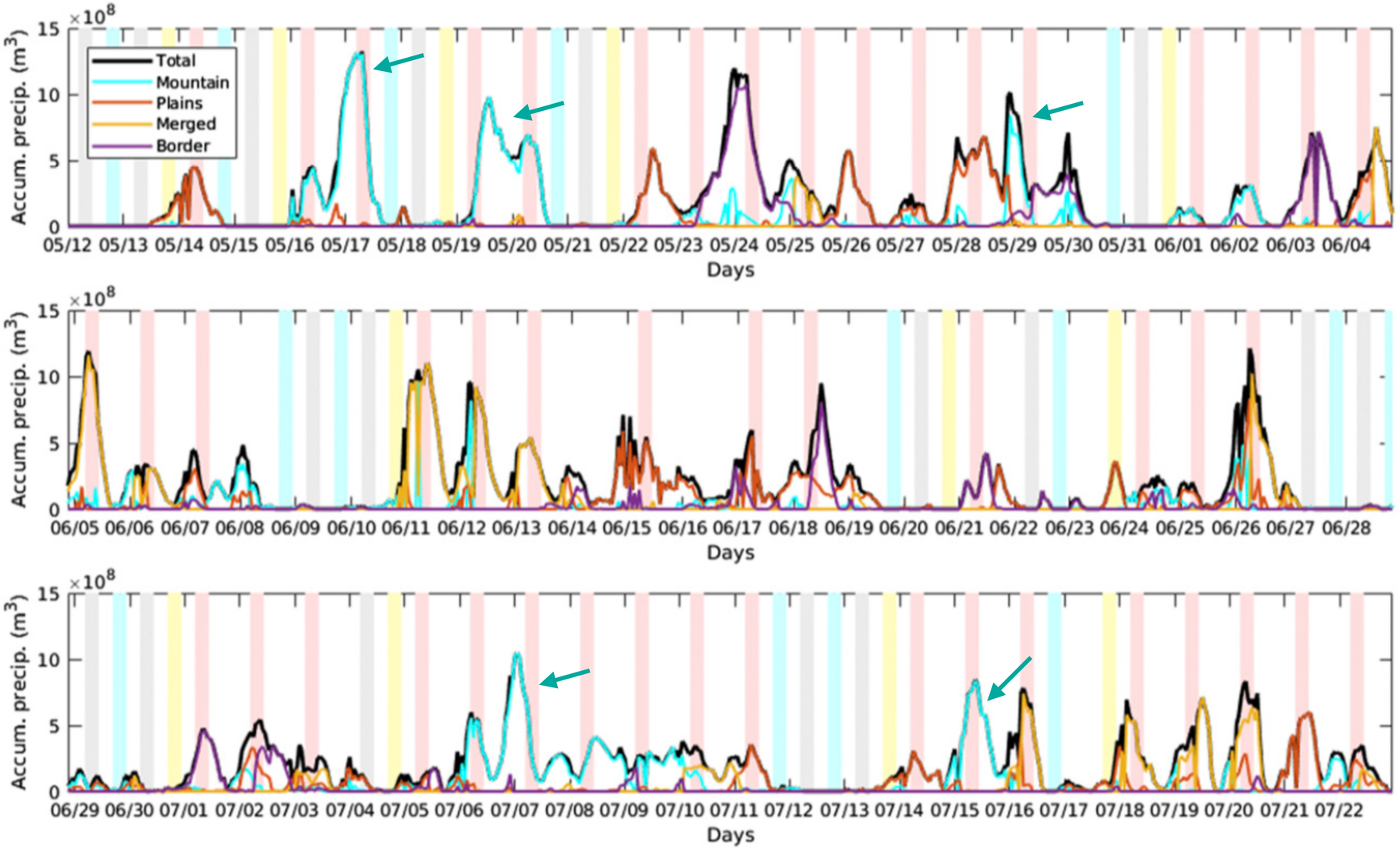

**Dissipation locations of different PECAN systems**

- **91%** of Mountain CI events dissipated before reaching Great Plains (Jim Wilson)

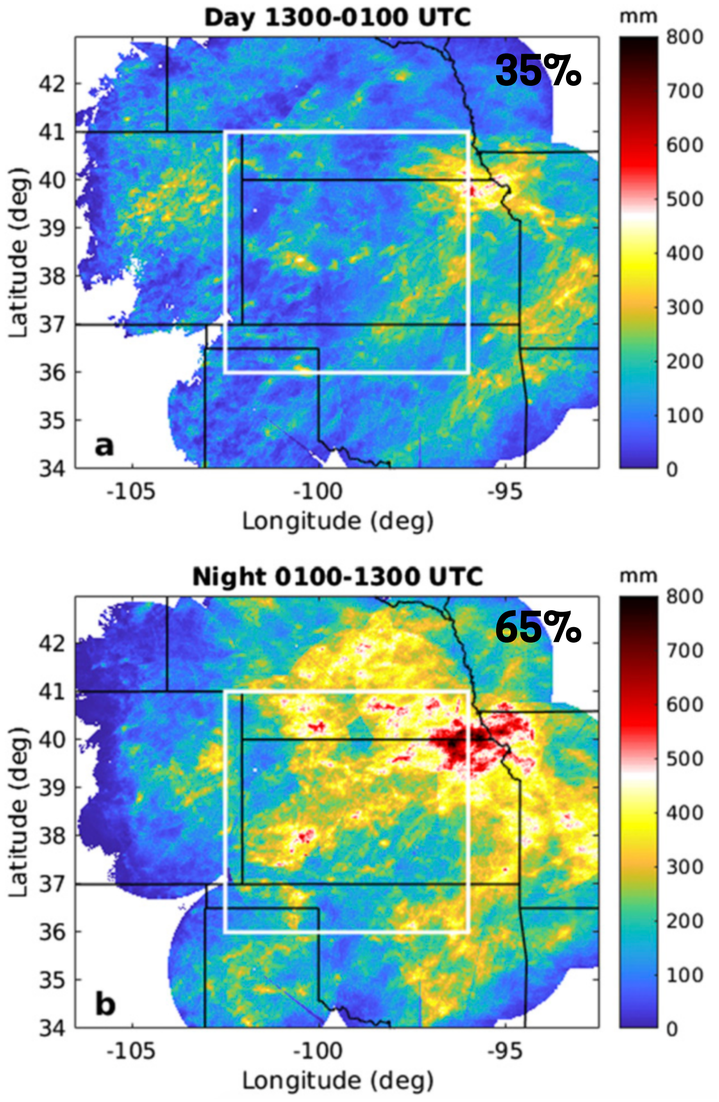


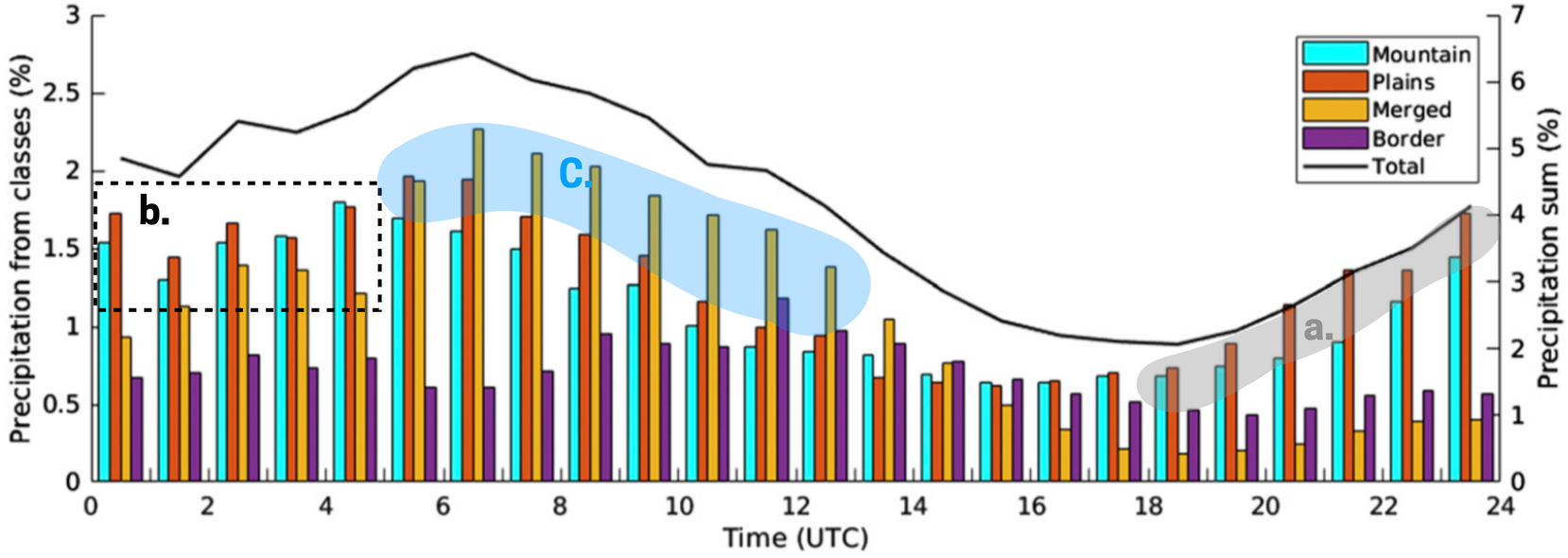

**Percentage of Precipitation East of 102.5W attributed to different system categories**

# **Tracking Result:** Time Series Analysis



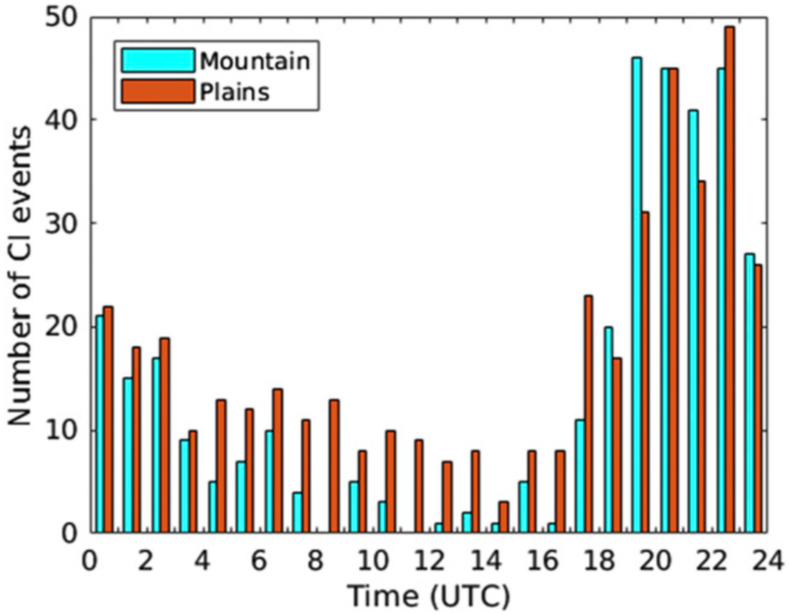
# **Tracking Result:** Precipitation Diurnal Cycle during PECAN



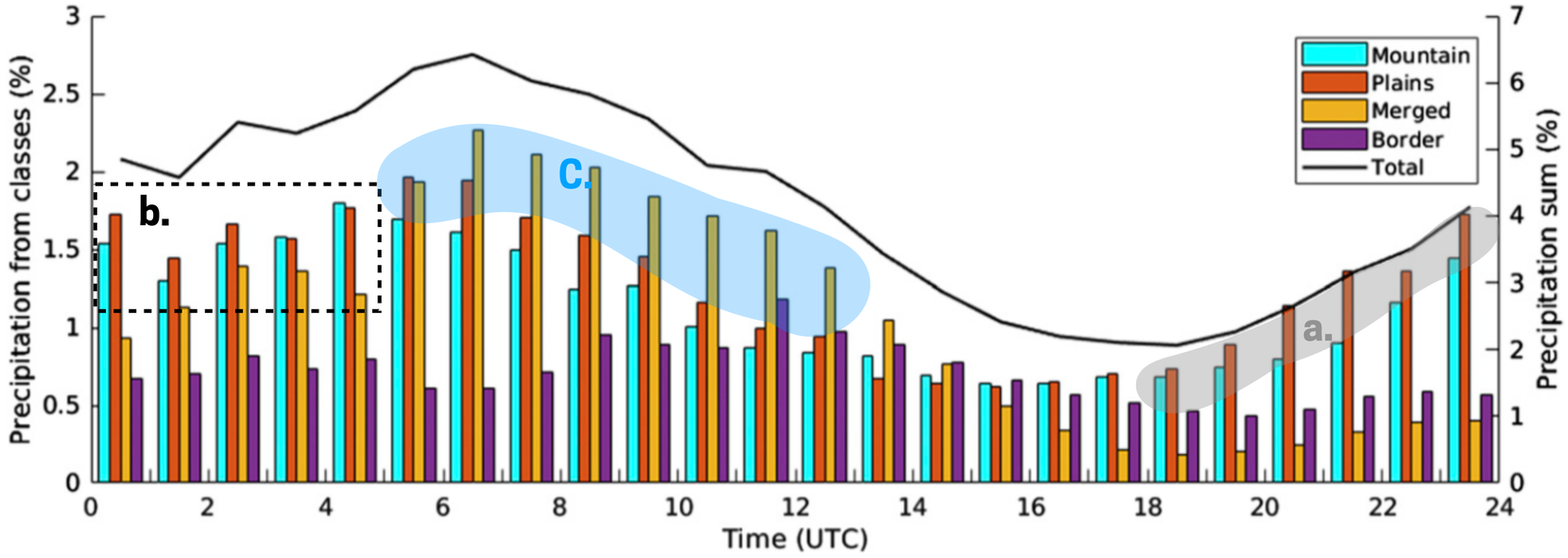




**Histogram of diurnal hourly Great Plains precipitation east of 102.5W**

# **Tracking Result:** Precipitation Diurnal Cycle during PECAN




Diurnal hourly histogram of *CI events*

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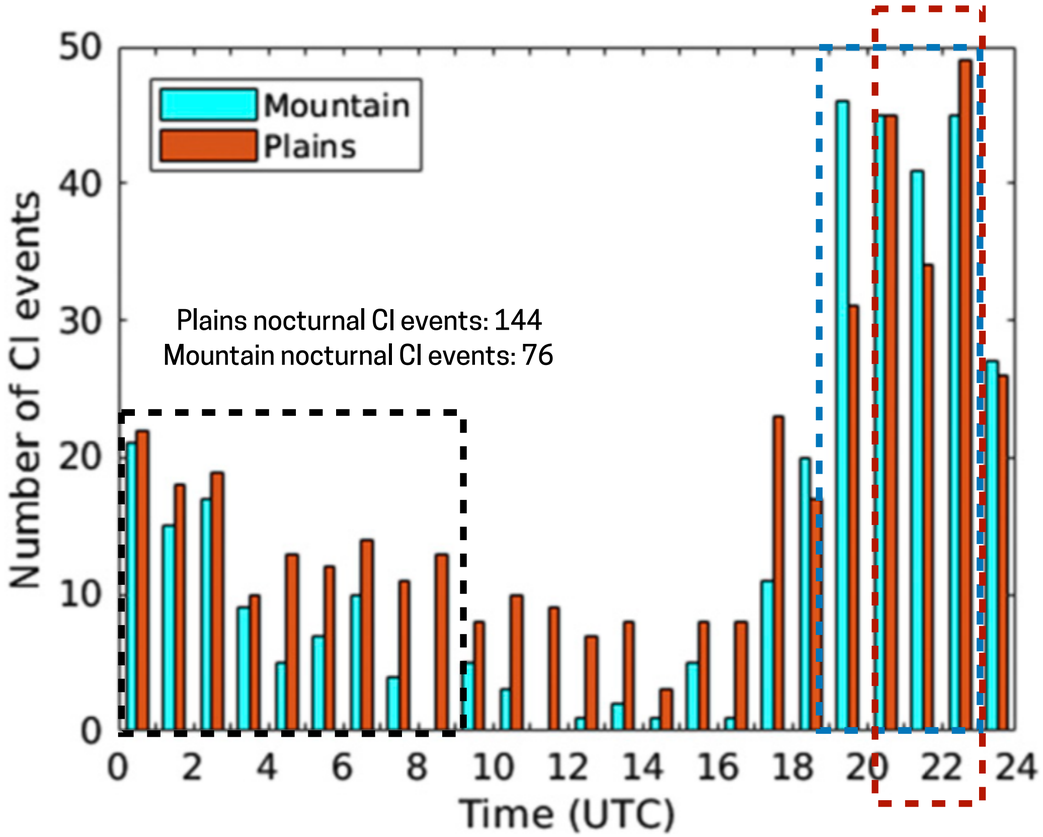
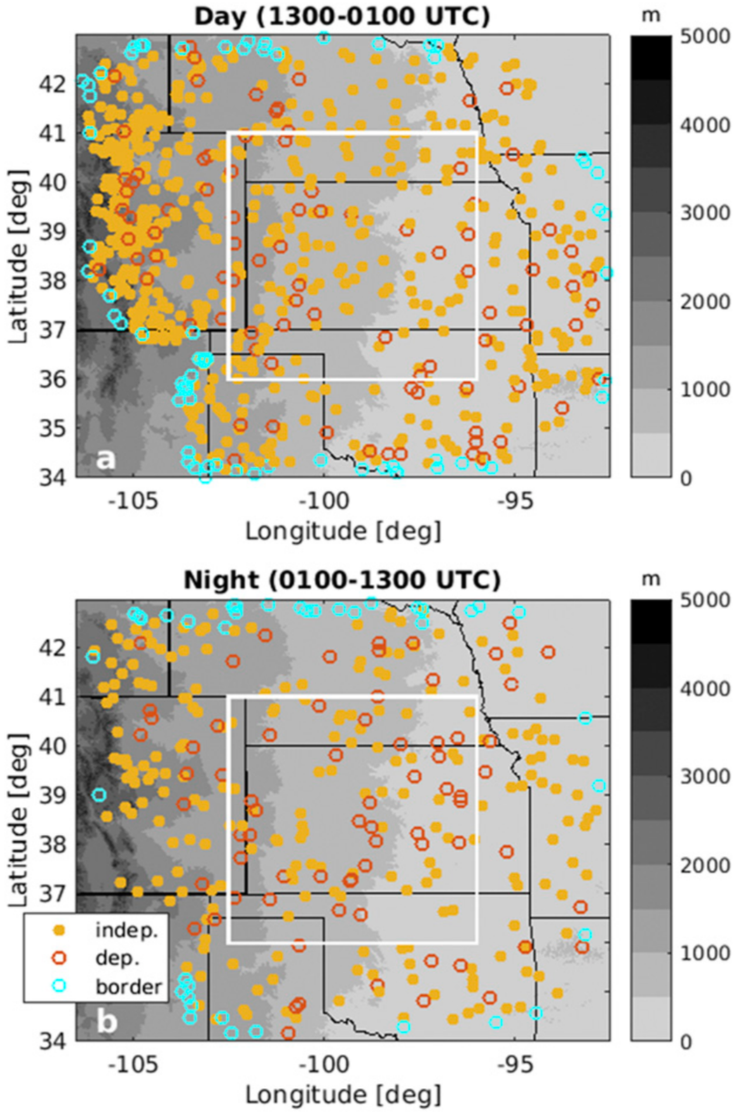
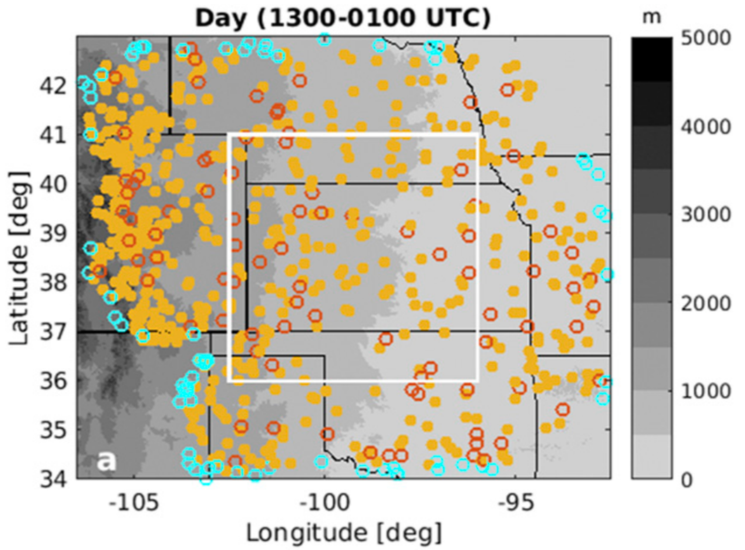


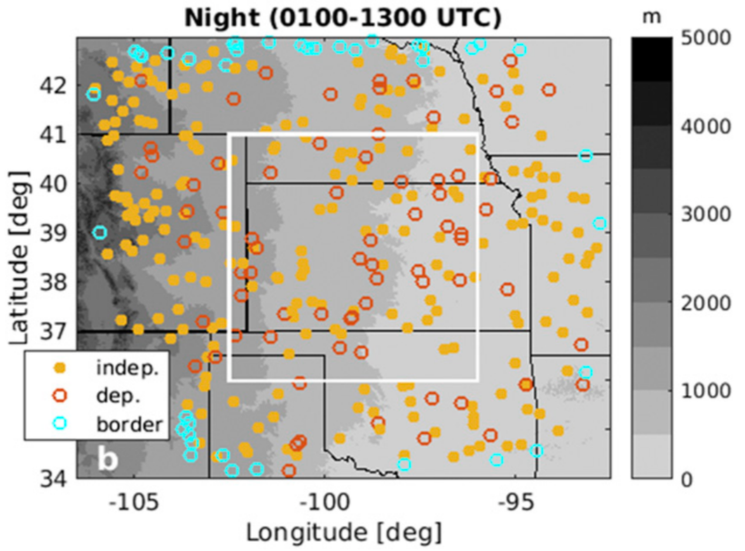

**Diurnal hourly histogram of *CI events***



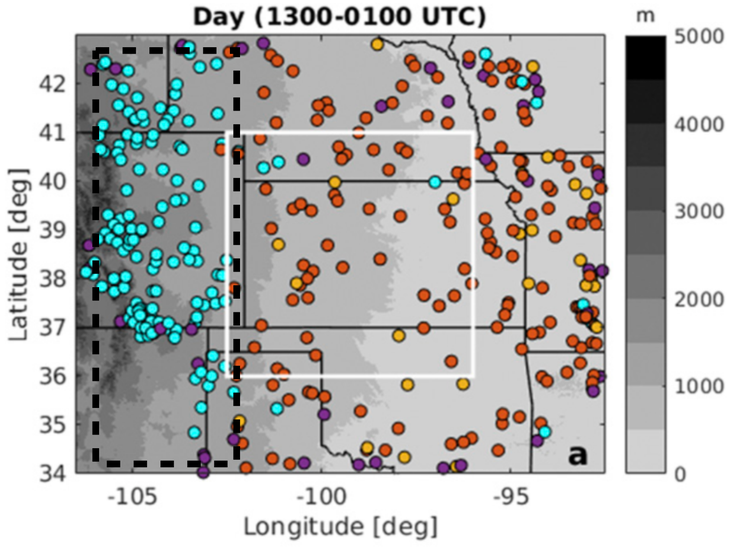
# **Tracking Result:** Inference on convective life cycle during PECAN

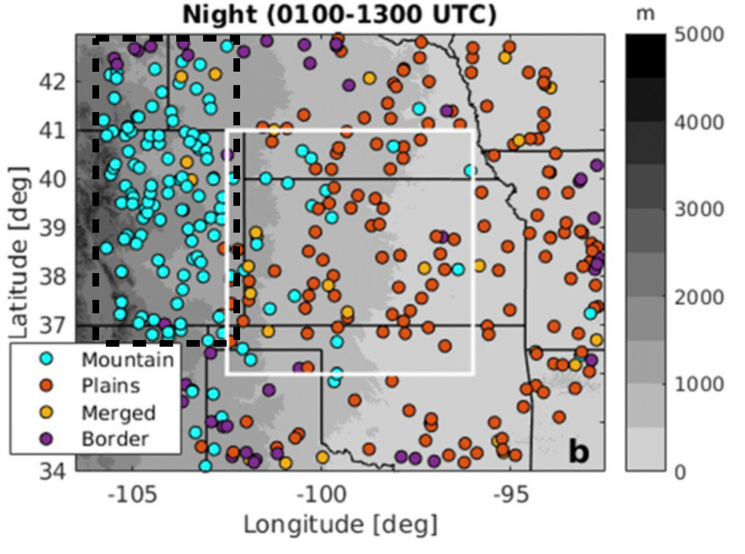
**CI**



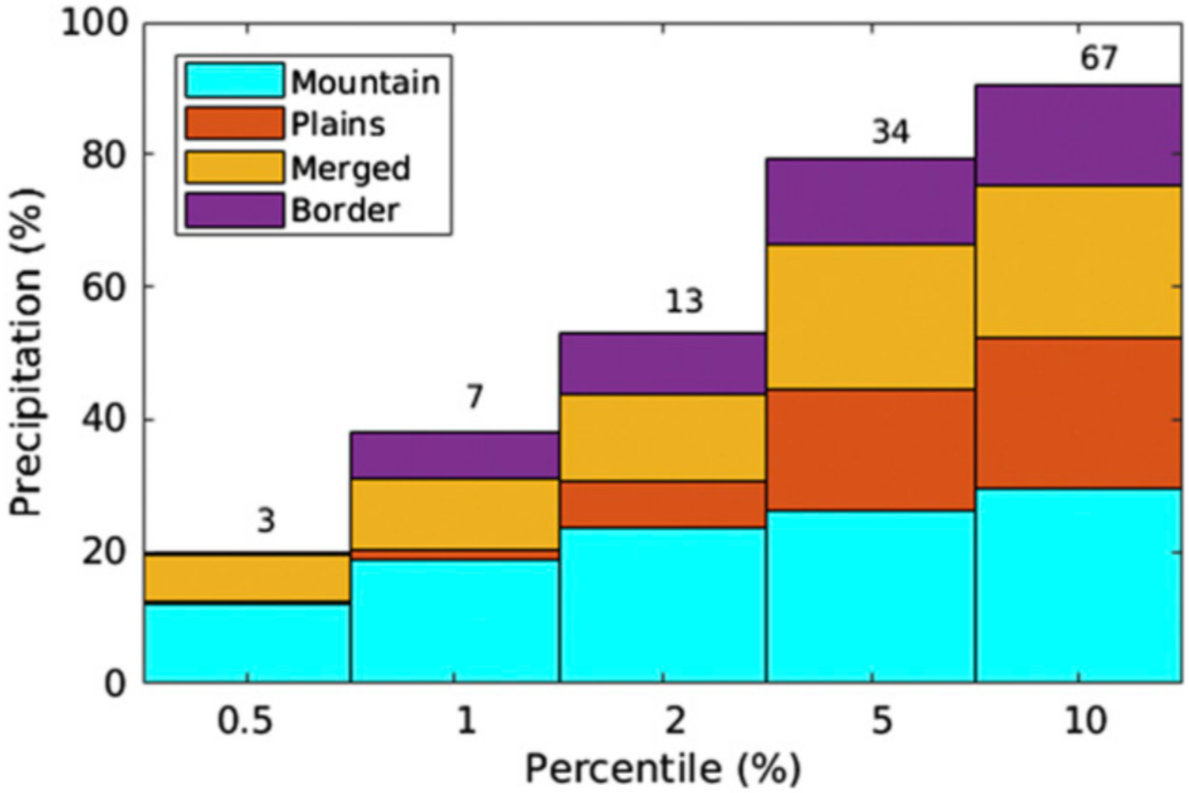




**Dissipation**



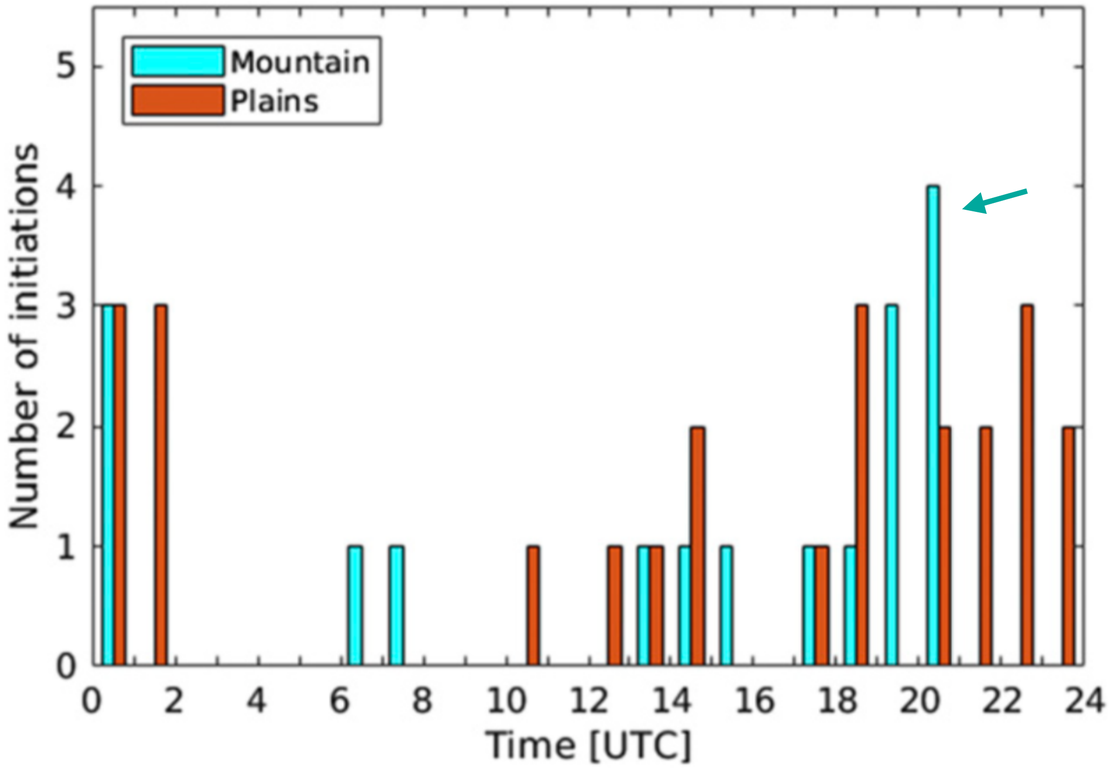



# **Tracking Result:** Statistical characteristics of top rain-producing episodes




**Histogram of top rain-producing episodes**

- **64%** of top 10% rain-producing episodes can be attributed to propagating system types (e.g. mountain, merged etc.)




**CI time for top rain-producing episodes**

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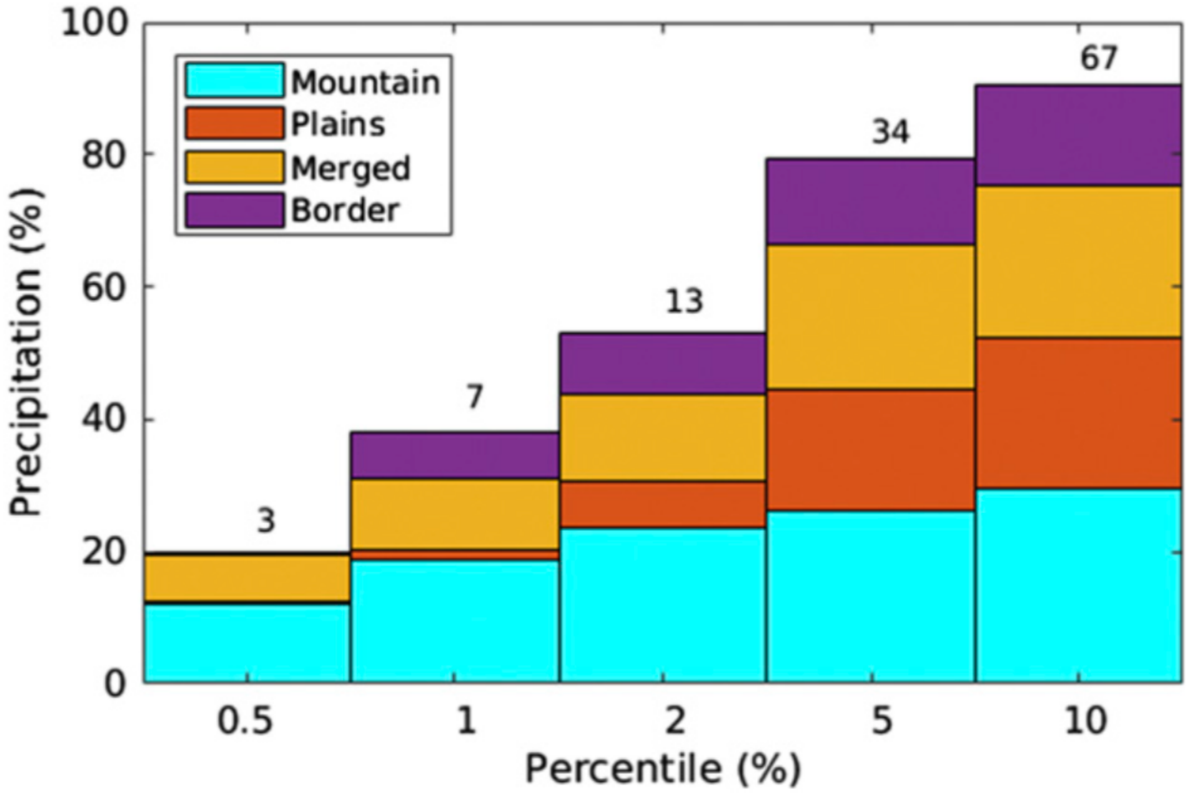


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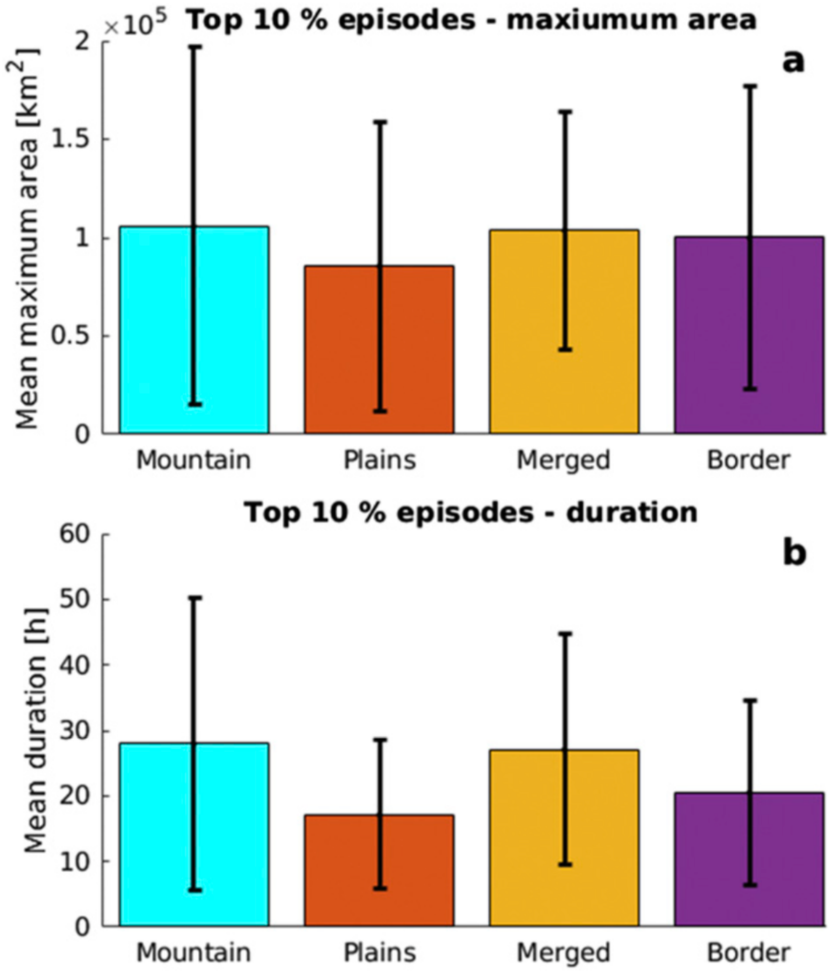
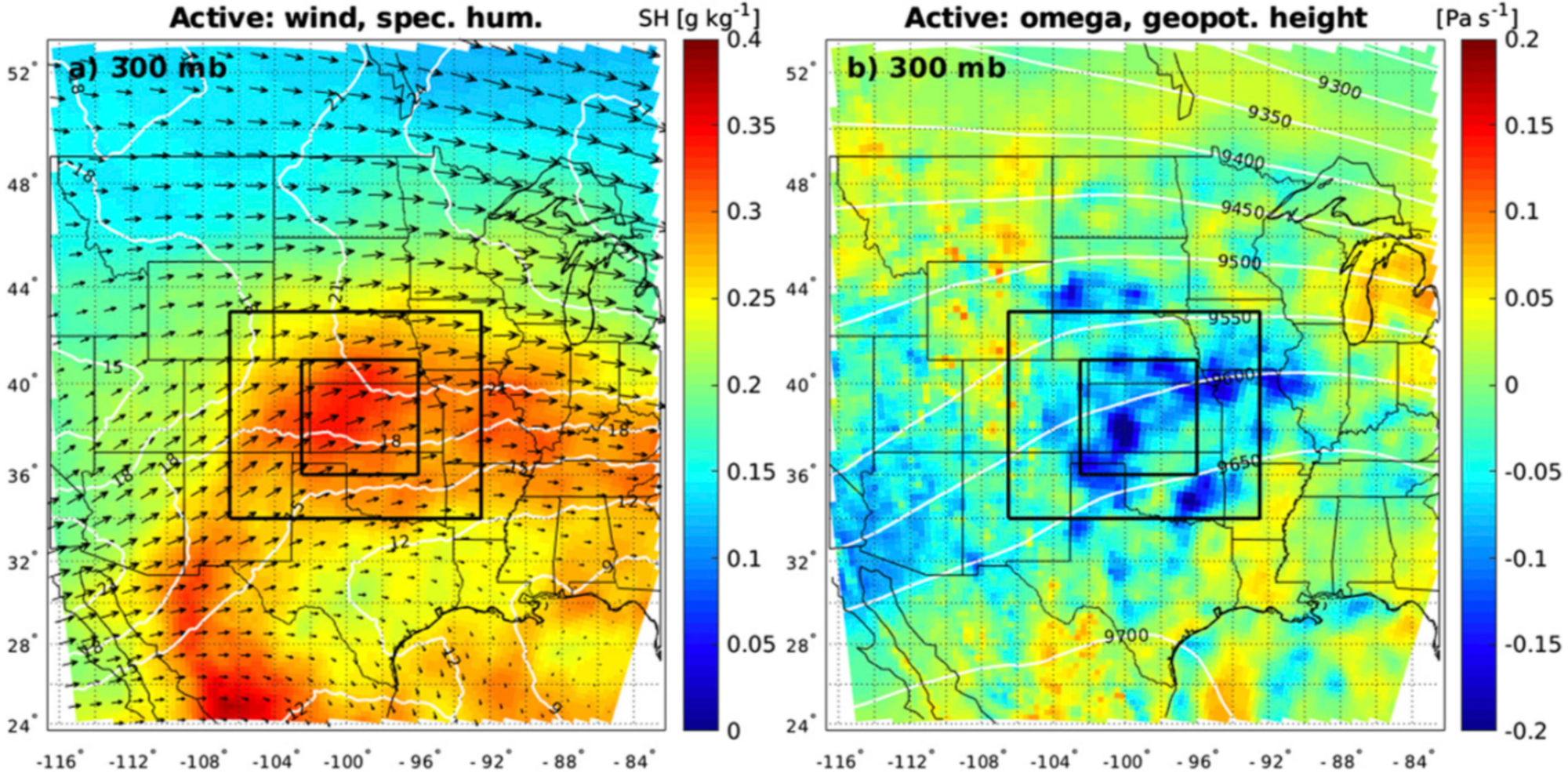
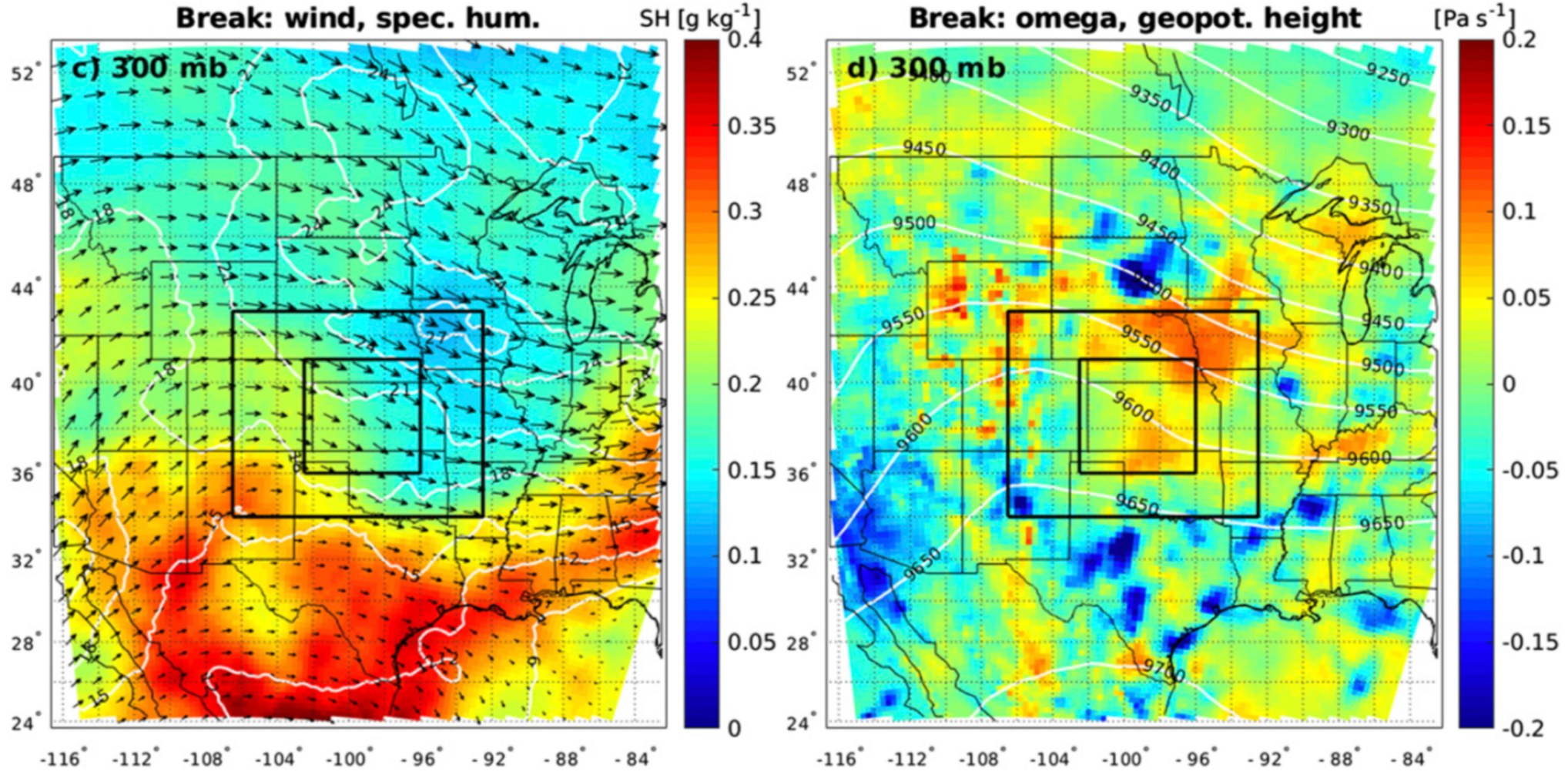



**Size and Duration of top rain-producing episodes, divided by CI types**

# Synoptic analysis for top rain-producing events



# Synoptic analysis for break events



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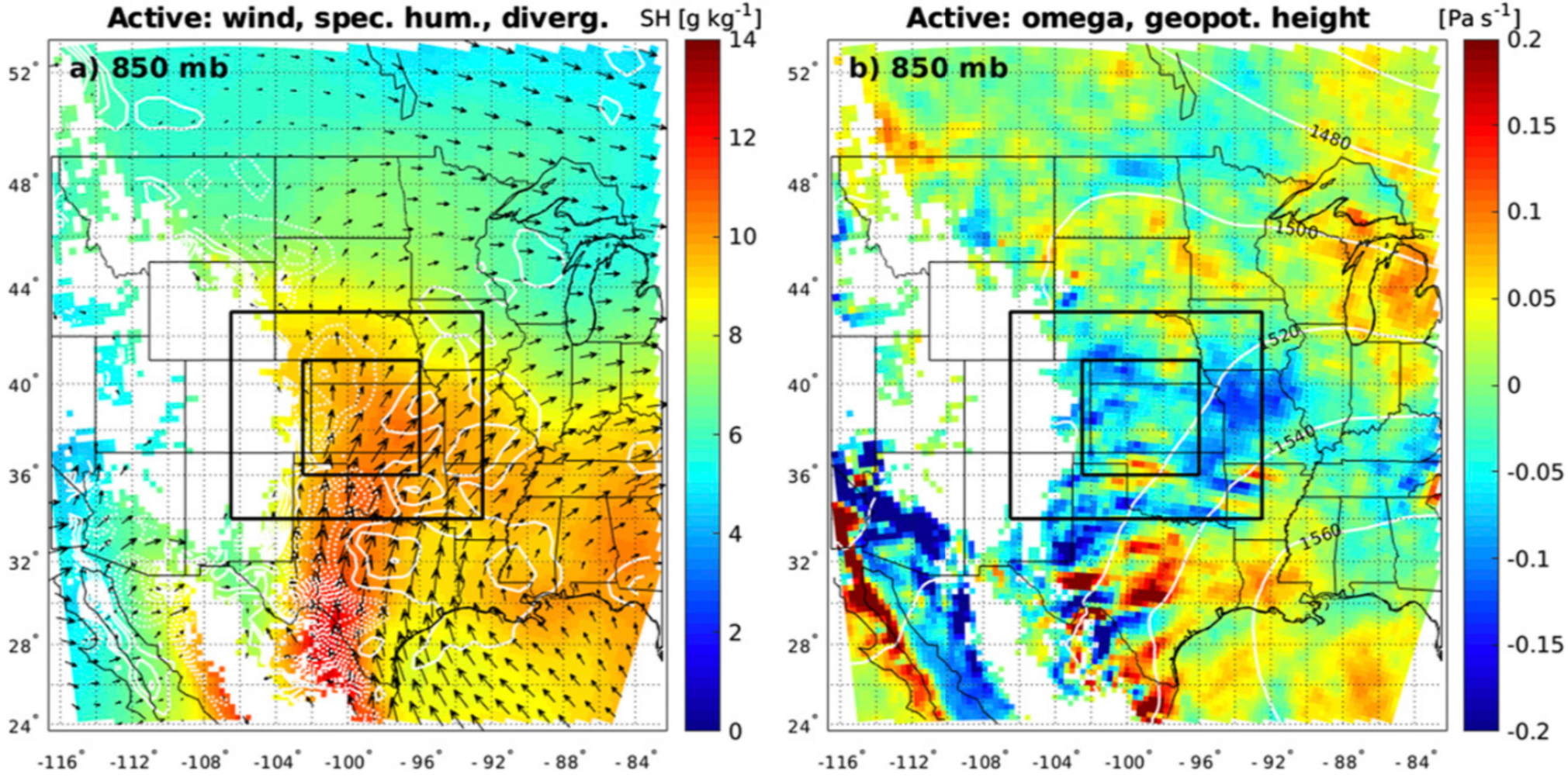

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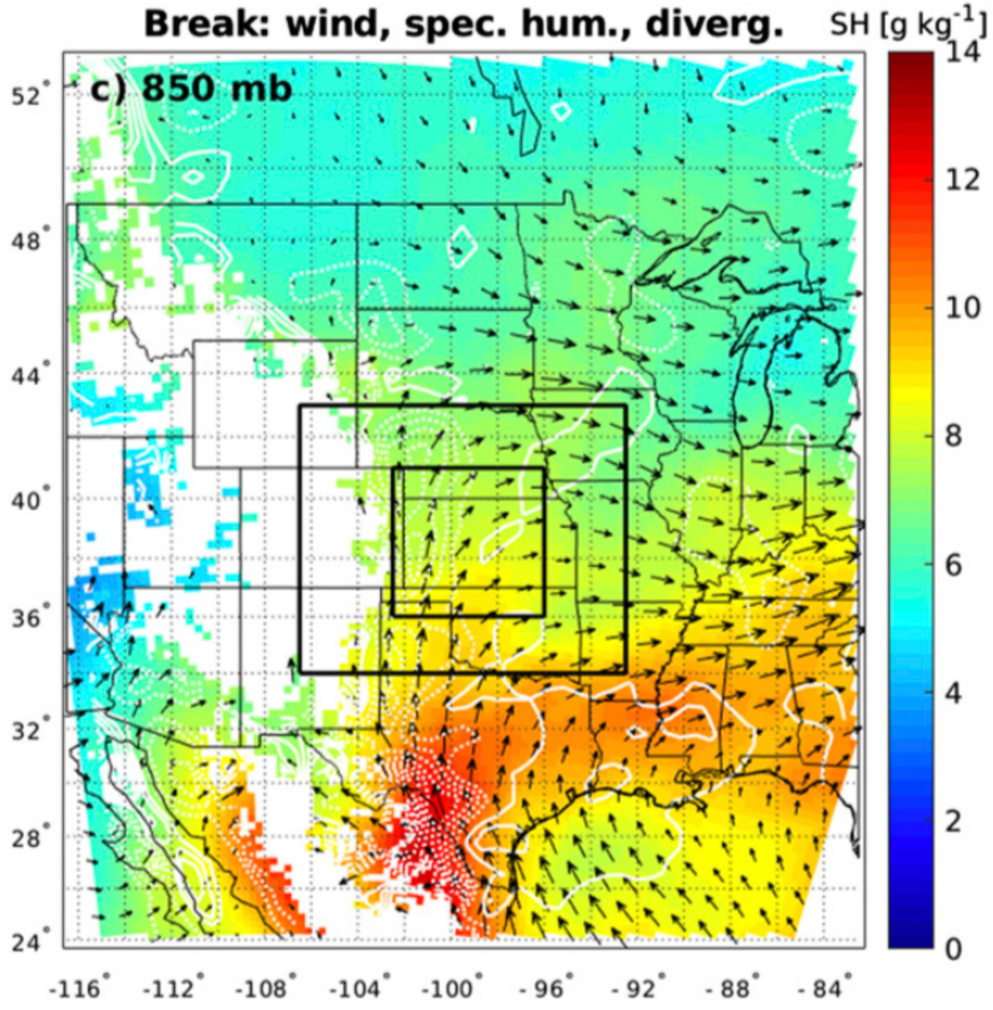
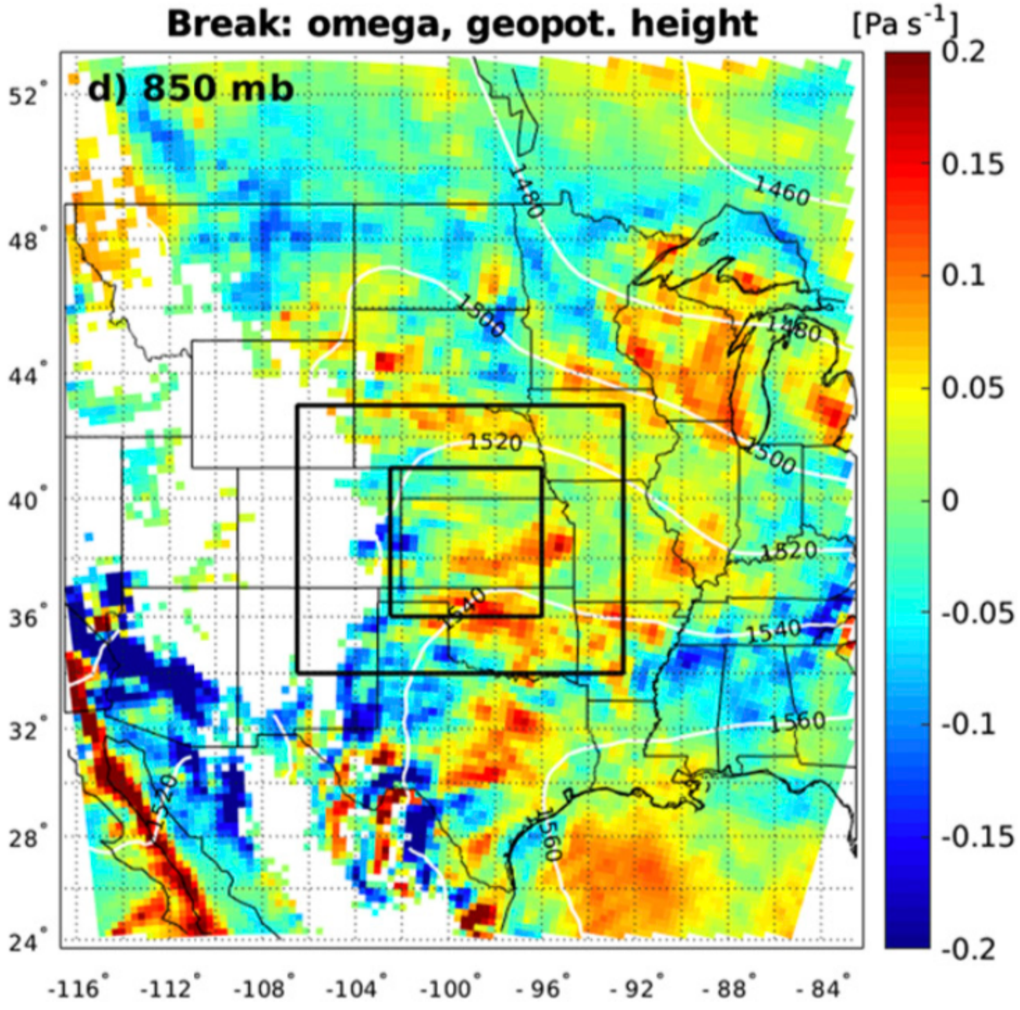
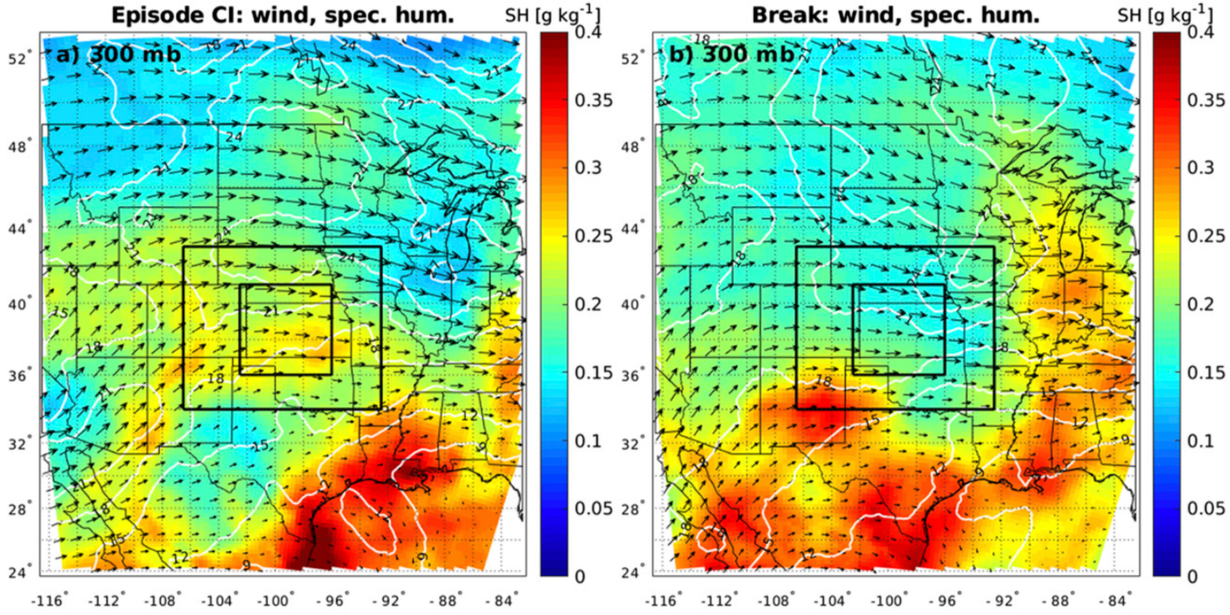


# Synoptic analysis for daytime environments



# Summary

- *A substantial amount of PECAN precipitation could be attributed to propagating systems.*
- *Most mountain convection dissipated early, but those that sustained are often heavy rain producers.*
- *Local systems: more numerous but weaker and short-lived; Propagating systems: fewer in between but stronger and long-lived -> comparable contribution to the average PECAN accumulated precipitation*
- *The top rain-producing episodes during PECAN are located in favorable synoptic environment*