Examining how complex terrain in the western United States and the diurnal cycle drive deep convection during the North American Monsoon season

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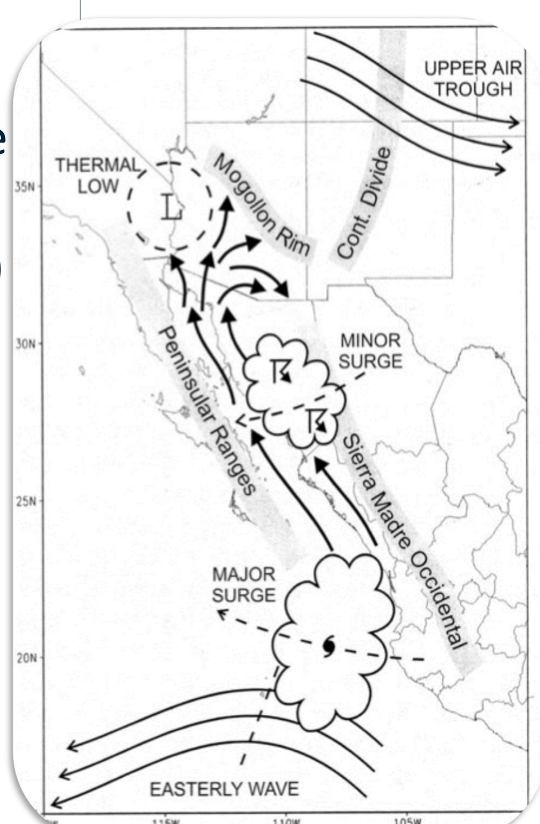
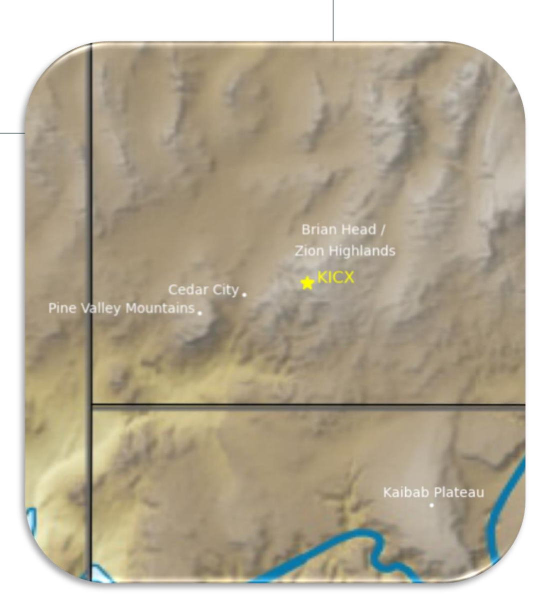
I. Introduction

- The North American Monsoon is defined as a seasonal shift in atmospheric circulation that accounts for a large portion of the rainfall in the southwestern U.S.
- Previous studies (e.g., Adams and Comrie 1997) indicate that:
  - Winds shift from westerly to more southerly during the season
  - Continental heating produces a thermal low over desert areas
  - Mesoscale models show midlatitude upper-level trough
  - Synoptic scale easterly wave enhances moisture surges from the Gulf of California
- The goal of the project is to understand the characteristics of deep convection during the North American Monsoon in SW Utah, including the effects of the complex terrain and diurnal cycle. A secondary goal is to understand the efficiency of the NWS surveillance in complex terrain.



Schematic from Adams and Comrie (1997)



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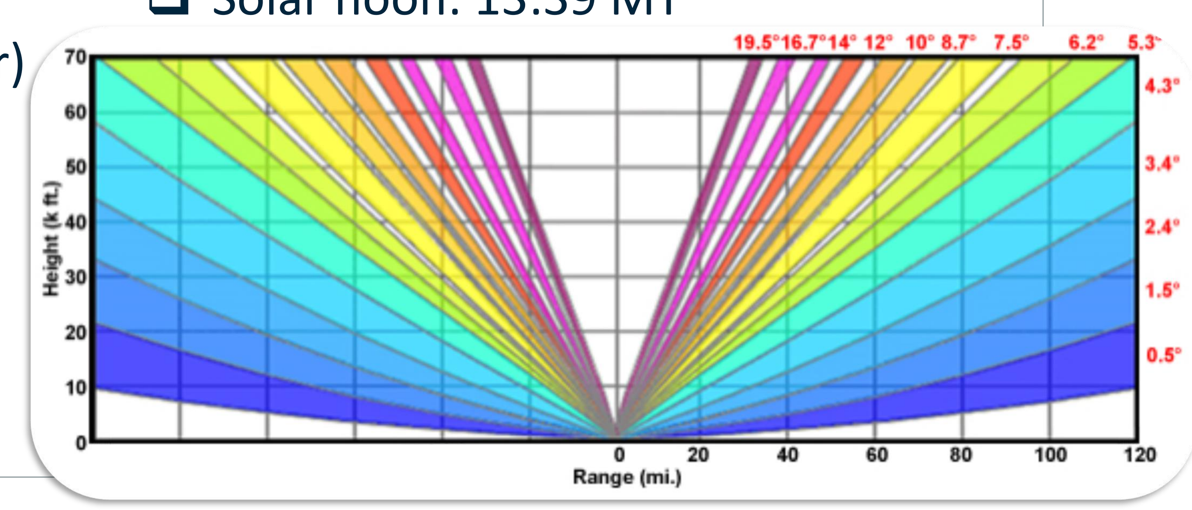
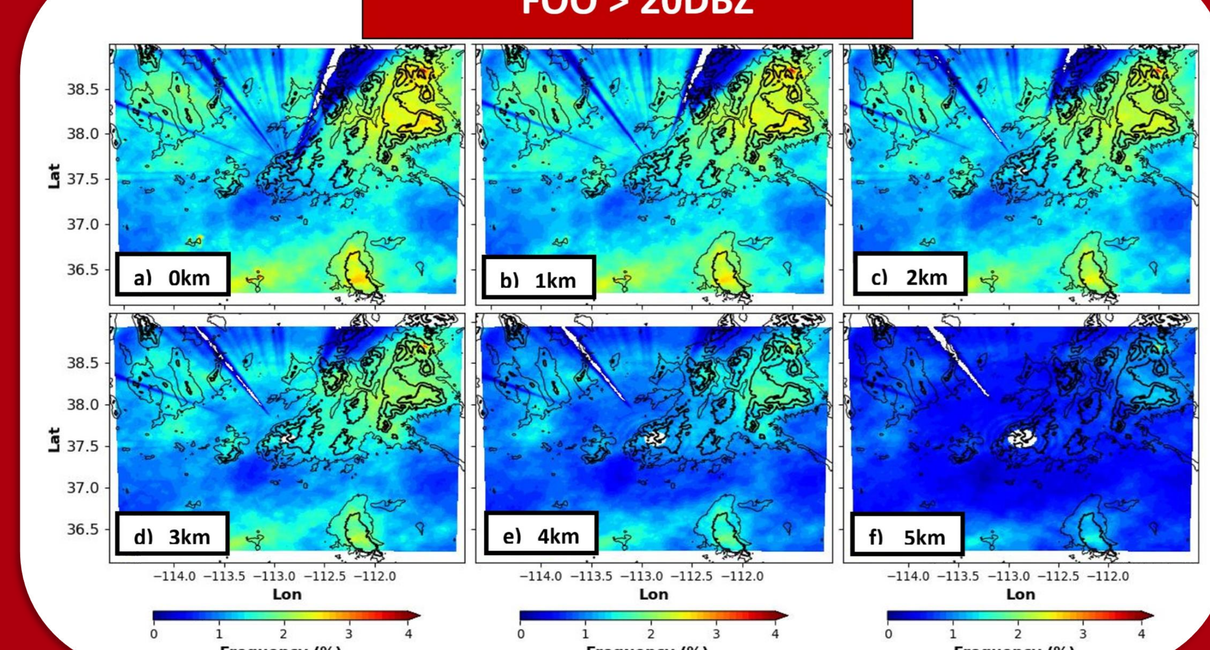
II. Methods

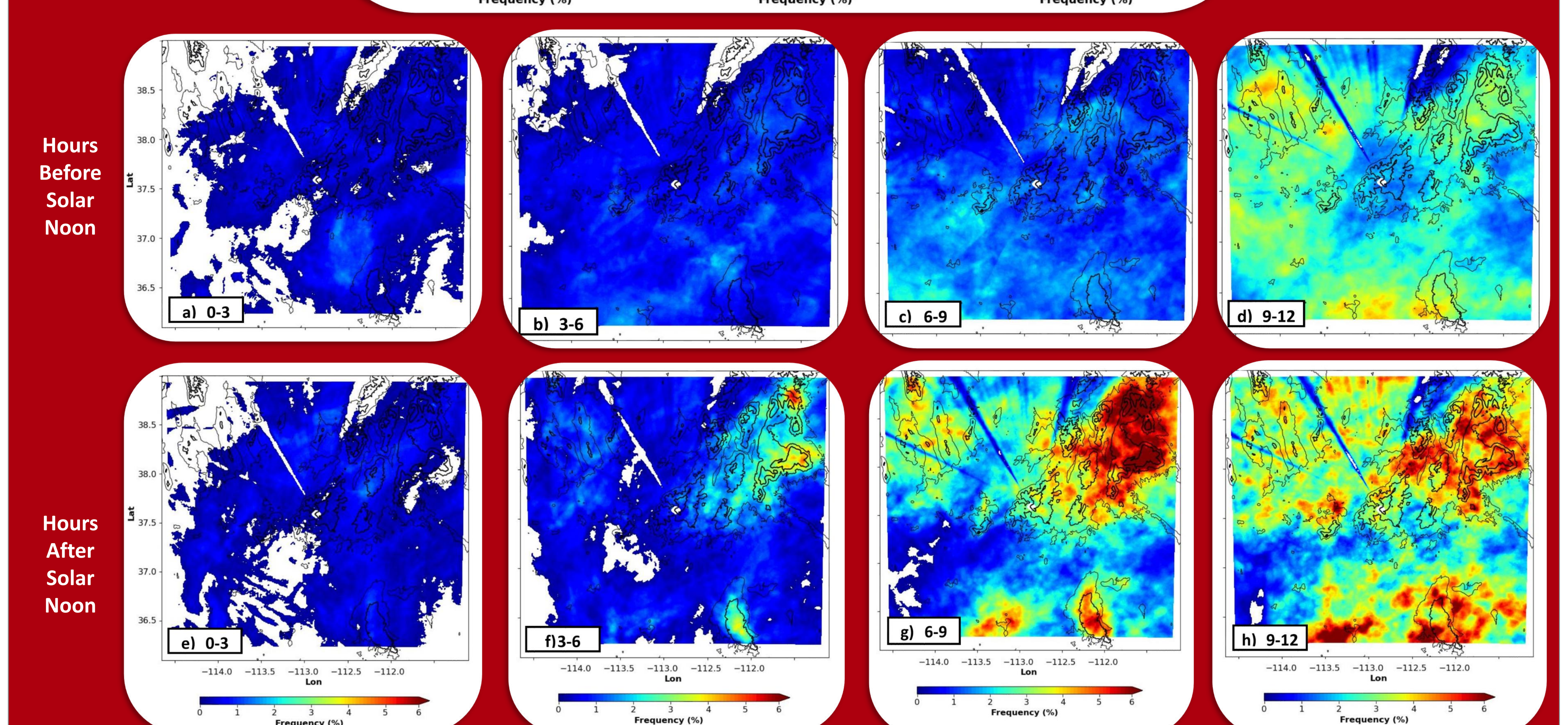
- Obtained KICX station data (3279m above sea level)
- Examined frequency of occurrence (FOO) of reflectivity > 15dBZ, 20dBZ, and 25dBZ during three seasons(01 July – 15 September) from 2018-2021
- Examined FOO at 6 different vertical levels: 0km, 1km, 2km, 3km, 4km, and 5km above the radar
- Examined FOO of reflectivity > 20dBZ at 8 different times relative to solar noon at 2km above the radar (5km above sea-level)
- Solar noon: 13:39 MT



Schematic from The Comet ® Program. Vertical slices of each volume scan at different heights above the radar. "Cone of Silence" is the volume above the highest elevation of the radar scan.

FOO > 20DBZ





III. Results

- Greatest frequency of storms develops over higher terrain, some ranges showing more than other. For example, the 2nd highest range (Pine Valley Mountains), show low values of frequencies relative to the surrounding highlands
- Examining different vertical slices show the depth of convection and radar beam
- Convection starts to develop after solar noon over higher terrain, peaking 9-12 hours after (10:39pm-01:39am MT)
- Moving into the early mornings, storms start to shift to the lower terrain; storms also extend throughout the entire region

IV. Conclusions

- Topography and the diurnal cycle play major roles in the development of deep convection in the southwestern U.S. during the monsoon season. Highlands exhibit the maximal echoes of reflectivity with peak convection in the late evenings. Approaching early mornings, the location of most frequent storms transition from highlands into lowlands.
- Height of a mountain range does not always correlate with the frequency of storms; surface area may be an important contributing factor.

V. References

Adams D.K. and Comrie A.C., 1997: The North American Monsoon. *Bulletin of the American Meteorological Society*, **78**, 2197-2213