# Investigating A Squall Line Interaction with the Southern Appalachians Using High-Resolution Radar Observations


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## 1. Motivation

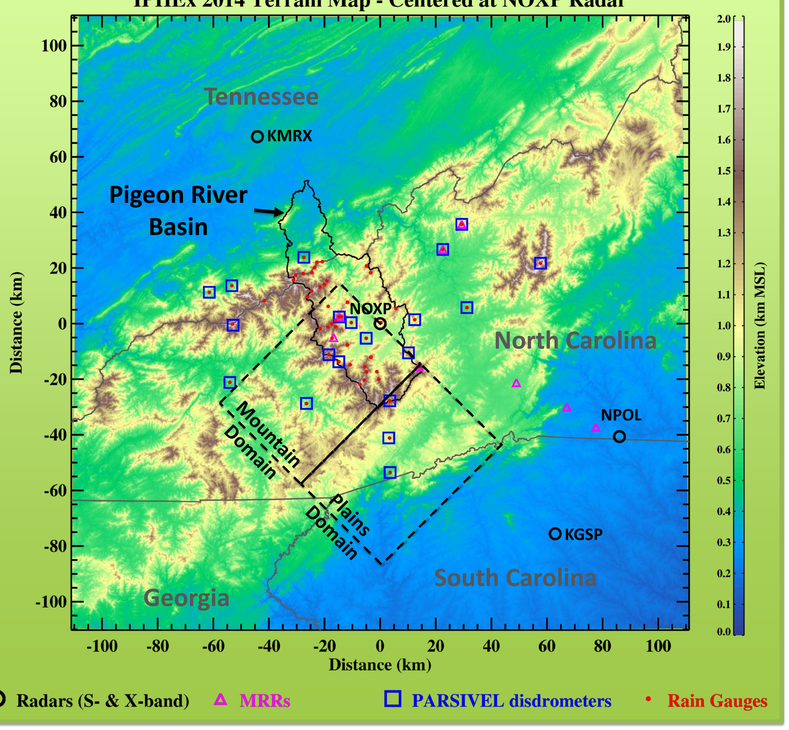
1. Climatology studies indicate that Mesoscale Convective Systems (MCSs) are frequently responsible for extreme precipitation events in the southeastern US (Parker and Ahijevych 2007; Moore et al. 2015; Mahoney et al. 2016), which can lead to flash flooding (Moore et al. 2012) and landslides (Fuhrmann et al. 2008), especially when they encounter the southern Appalachian Mountains
2. Very little research documents the modification of MCSs by terrain using observations (Teng et al. 2000; Keighton et al. 2007)
3. High-resolution radar and in-situ data are available from the IPHEx project in the southern Appalachians, a region less extensively studied compared to US West Coast mountain ranges

## 2. Integrated Precipitation & Hydrology Experiment (IPHEx)

**WHAT: Ground-validation campaign for new GPM satellite**

**WHEN: 1 May - 15 June 2014**

**WHERE: Southern Appalachian Mountains, western North Carolina**




## 3. Instrumentation

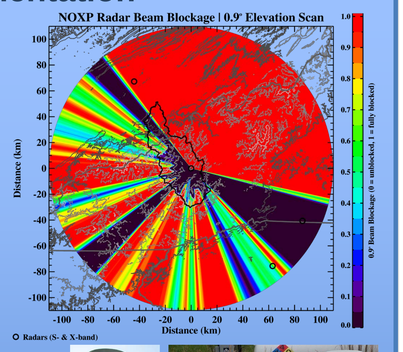
### NOAA X-band Polarimetric Radar

**Frequency (Wavelength) = 9.41 GHz (3.22 cm)**

**PRF = 1350 Hz**

**Range resolution (max range) = 150 m (111km)**

**-3dB Beam Width = 0.9°**


### NASA & Duke Precipitation Gauges

**Type = tipping bucket**

**NASA: 20 dual Met One Model 380 gauges (0.254 mm/tip)**

**Duke: 33 TB03 gauges (0.1 mm/tip & 0.2 mm/tip)**



### PARSIVEL Disdrometers

**Measures precipitation particle sizes & fall velocity**

**Diameter Range = 0 - 25 mm**

**Fall Velocity Range = 0 - 22 m/s**

### Vertically Pointing K-band Micro Rain Radar (MRR)

**Frequency* (Wavelength) = 24.23 GHz (1.24 cm)**

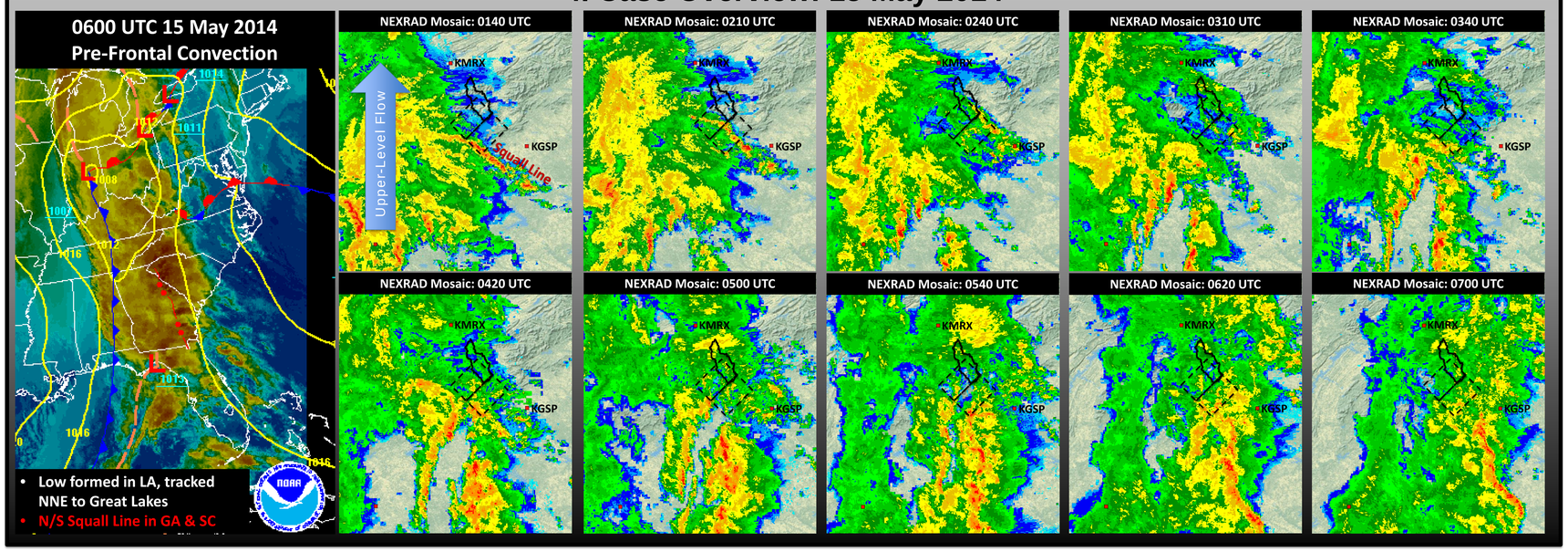
**Beam Width = 1.5°**

**Temporal resolution = 60 s**

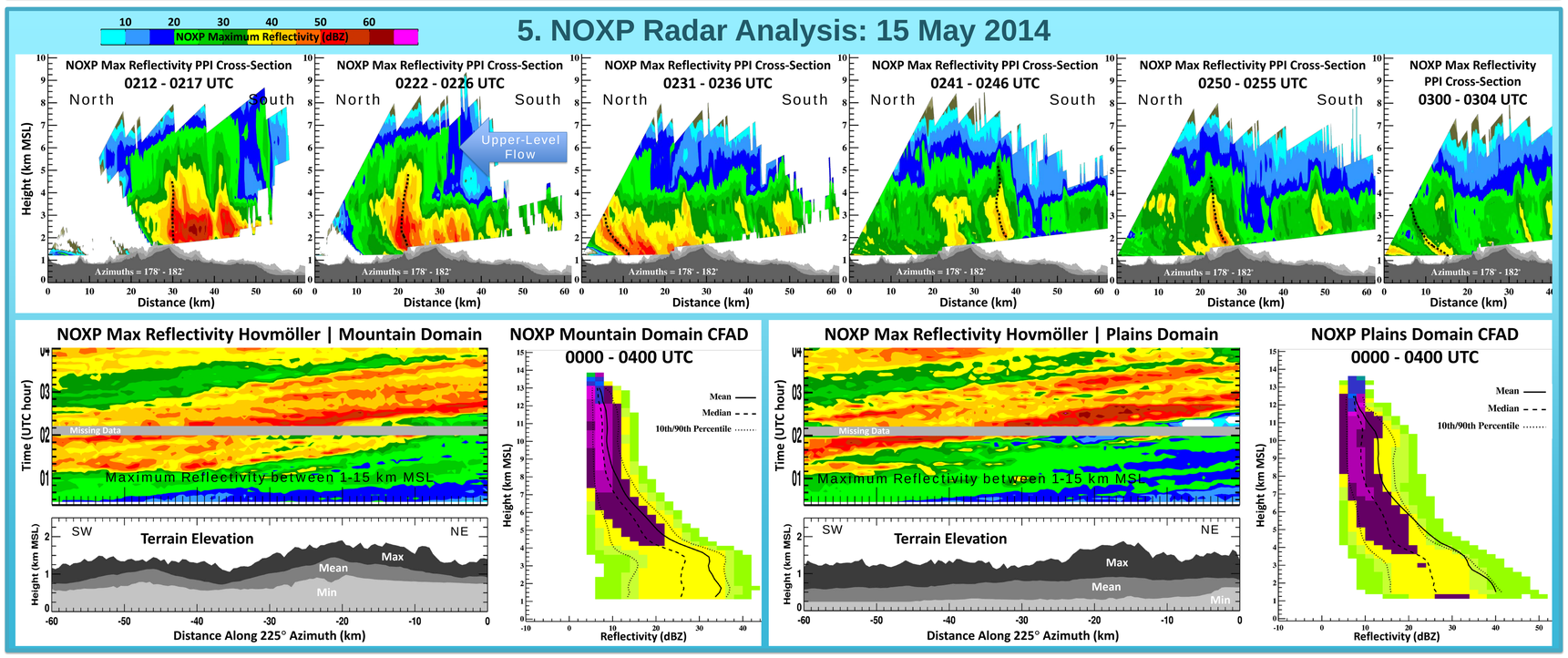
**Vertical resolution (max height) = 35-100 m (1050-3000 m)**

***Frequency Modulated Continuous Wave mode**

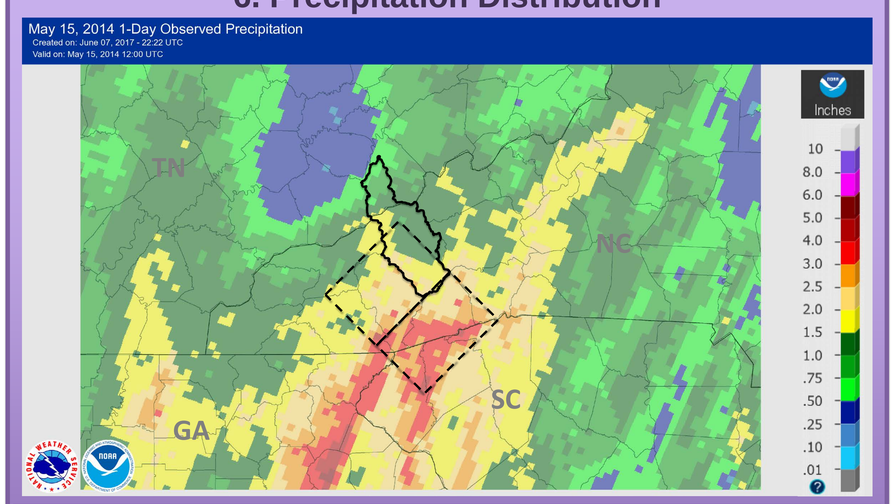

## 4. Case Overview: 15 May 2014

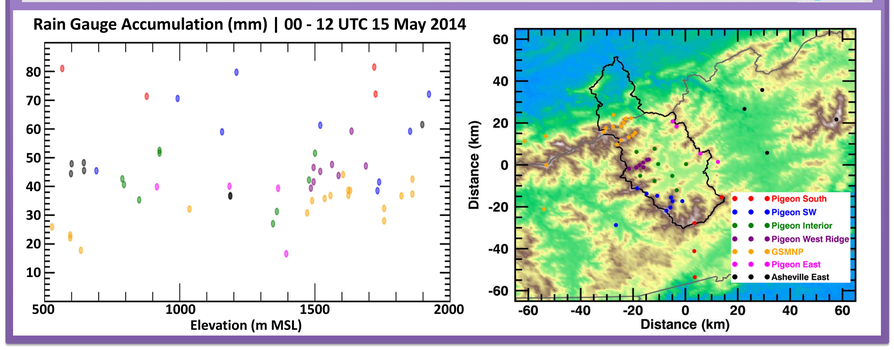



## 5. NOXP Radar Analysis: 15 May 2014




## 6. Precipitation Distribution




## 7. Summary

- Squall line impinged on southern boundary of Pigeon River Basin creating heavy rainfall (30-80 mm accumulation) with high spatial variability, highest rainfall on south end and lowest on north end of Pigeon River Basin
- Convective cells tilted downwind as they cross mountain ridge to south, indicating low-level flow was impeded by mountains
- Higher NOXP reflectivity over Plains to southeast compared to Mountains, indicating squall line convection maintained strength better over Plains
- Squall line convection was NOT able to cross southern Appalachians

## 8. Future Work

- Incorporate NASA NPOL and NWS NEXRAD radar data into 3D grid to fill in data where NOXP beam blockage occurs and document squall line modification from SW to NE
- Assess drop size distribution changes from SW to NE using PARSIVEL disdrometer
- Document changes in MRR profiles from SW to NE to better document low-level changes


### References

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