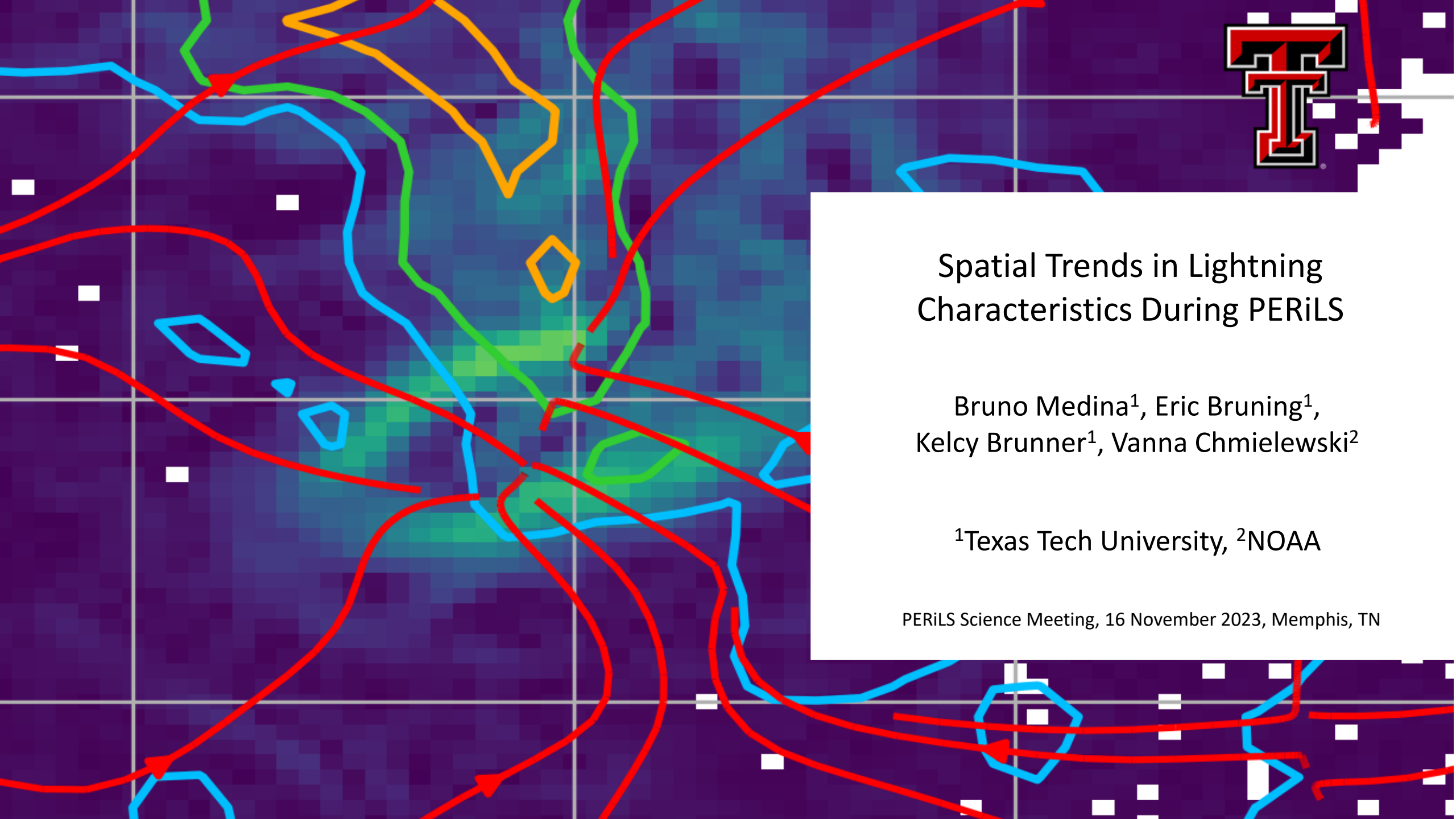

Spatial Trends in Lightning Characteristics During PERiLS

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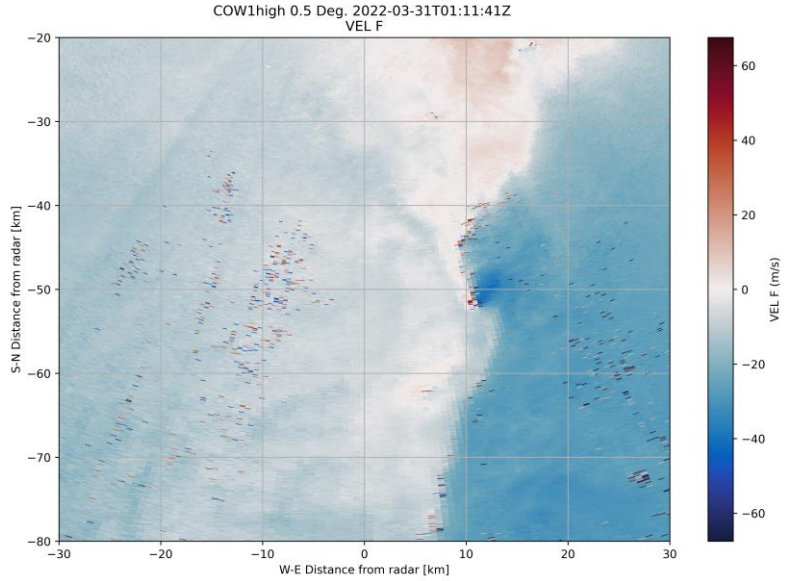
Kelcy Brunner[1], Vanna Chmielewski[2]

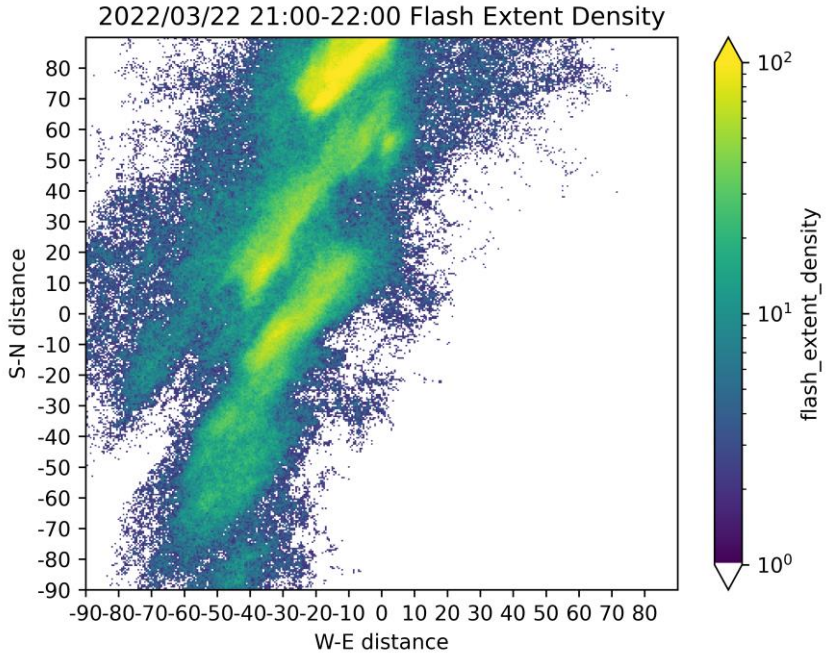
[1]Texas Tech University, [2]NOAA

PERiLS Science Meeting, 16 November 2023, Memphis, TN

Introduction

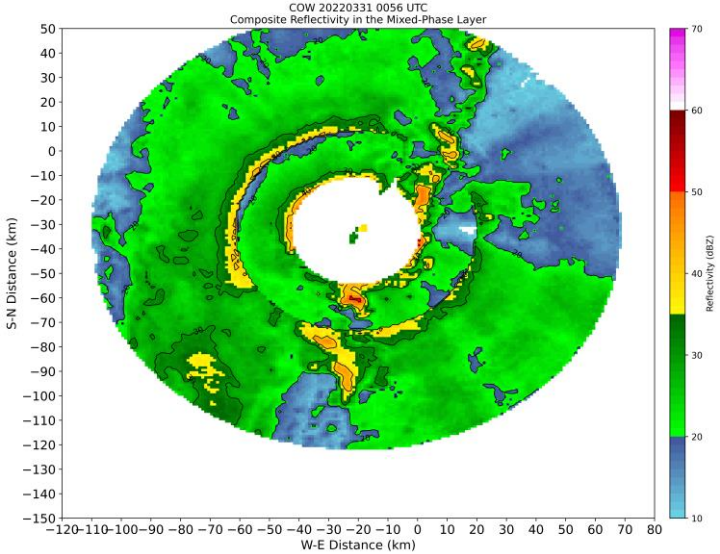
- Lightning occurs as a manifestation of mixed-phase thermodynamics, kinematics, microphysics, and noninductive charging.
- This study will investigate lightning flash rates and sizes and its spatial gradients as an indicator of the potential for mesovortices and tornadoes.
- The high temporal resolution of lightning mapping array data can provide finer details that may be missed by the mixed-phase sampling from radars.

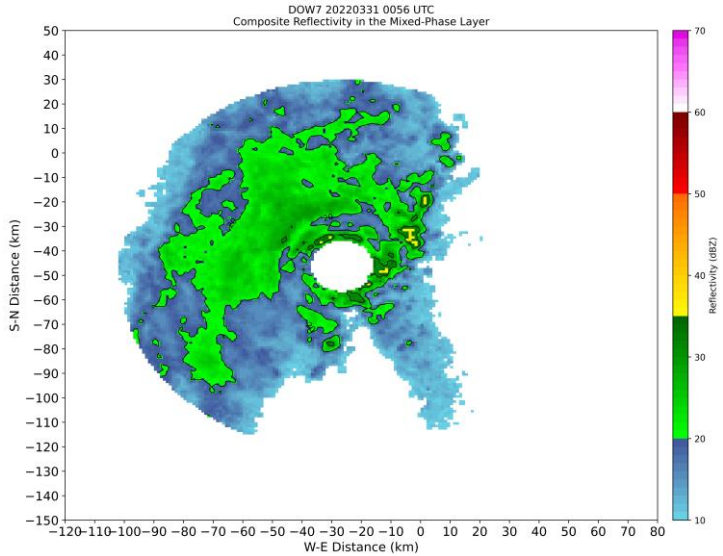


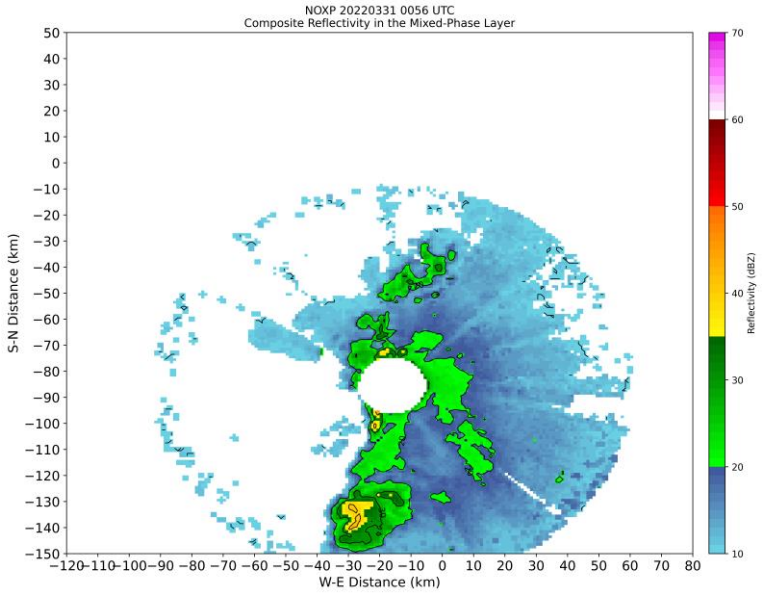


Methods

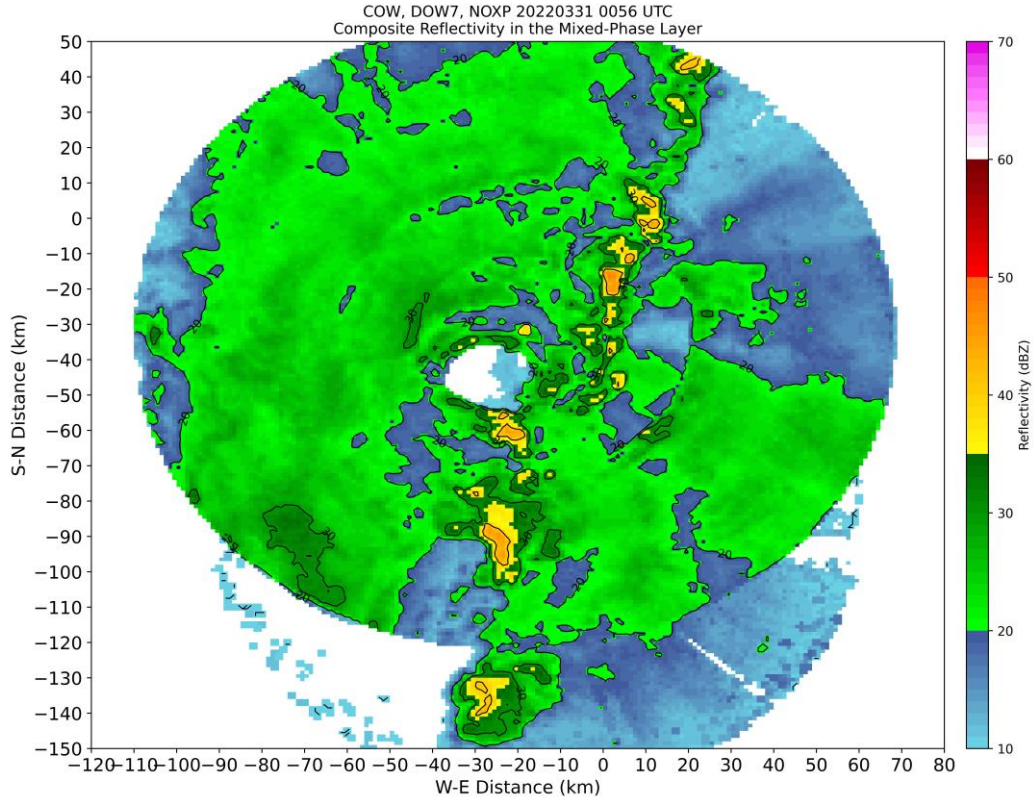
Three mobile radars used: COW, DOW7, and NOXP





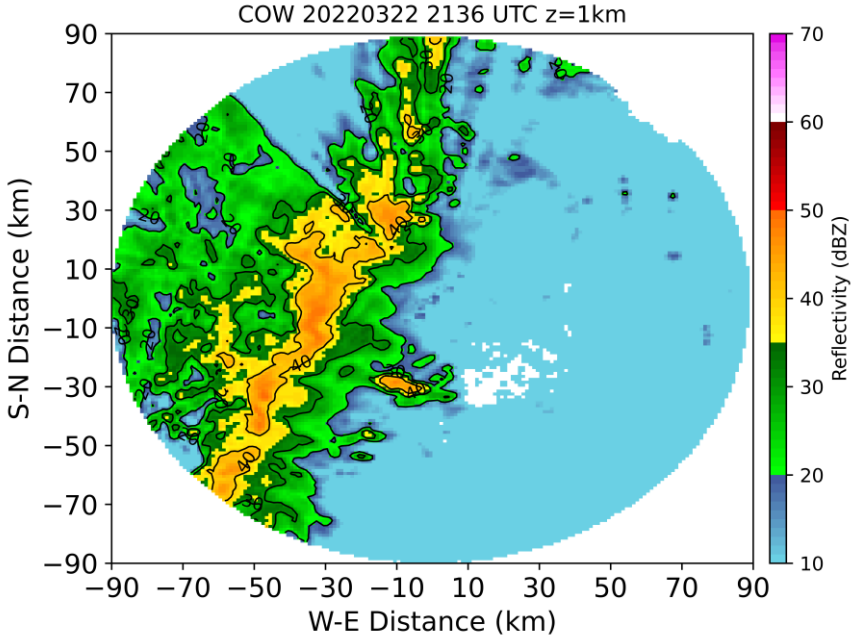


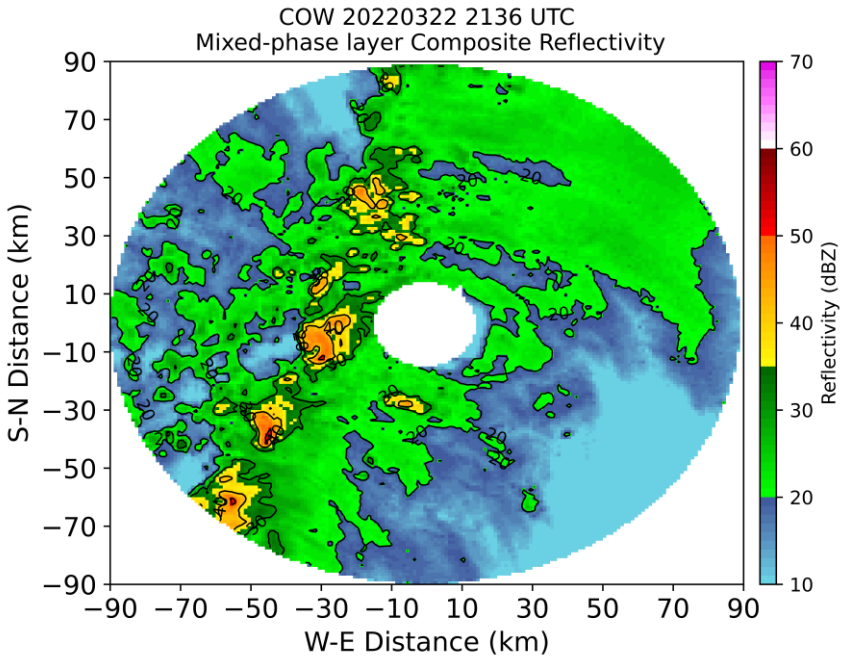
Gridding reflectivity using all 3 mobile radars:

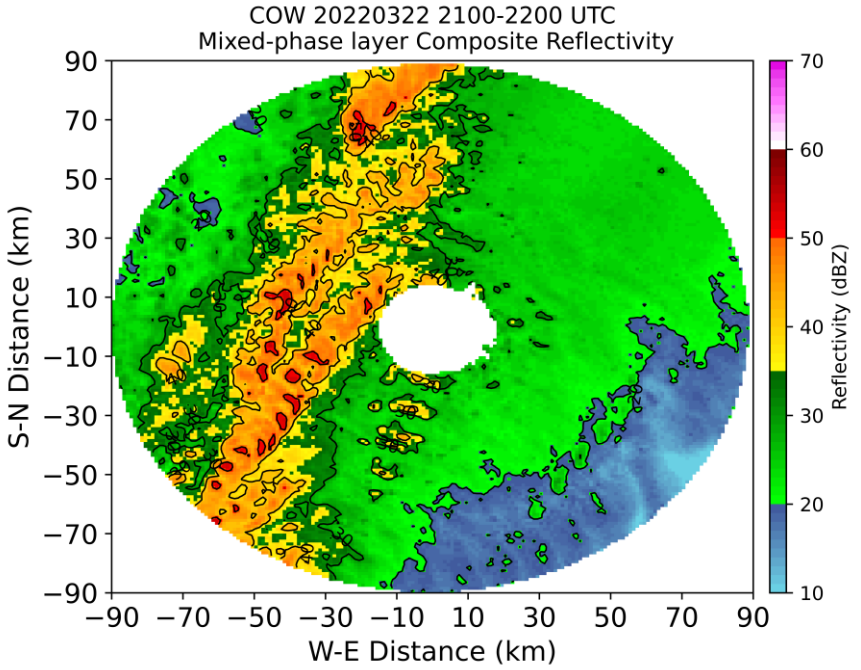


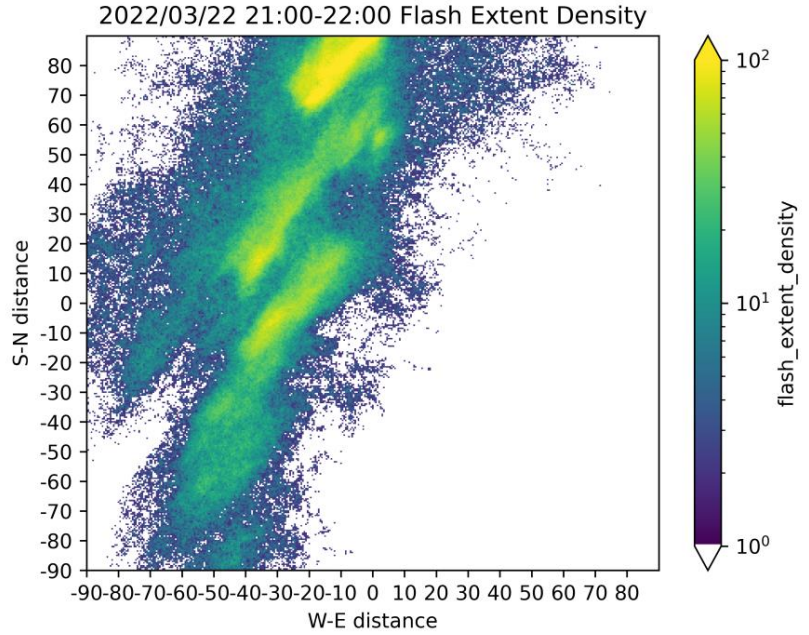
Methods

- Composite reflectivity for the mixed-phase layer
- Correlates with flash extent density





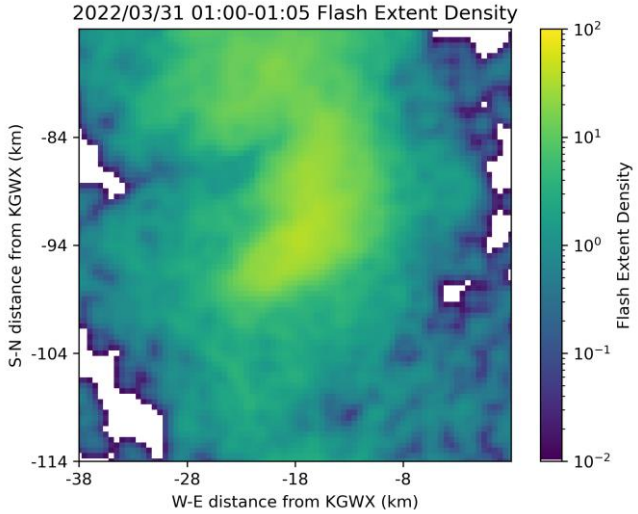


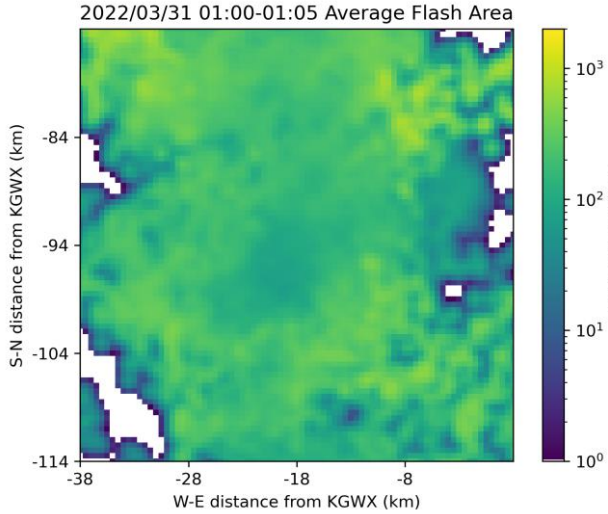


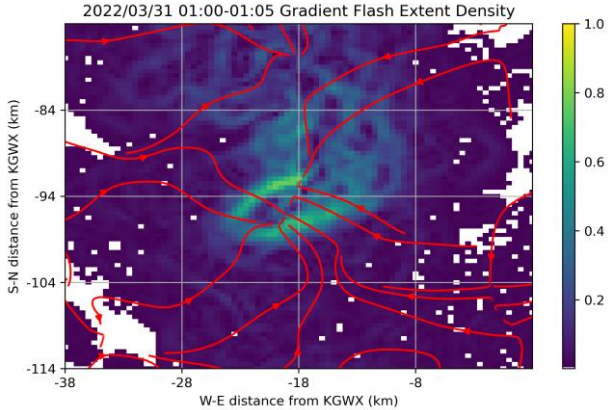
Methods

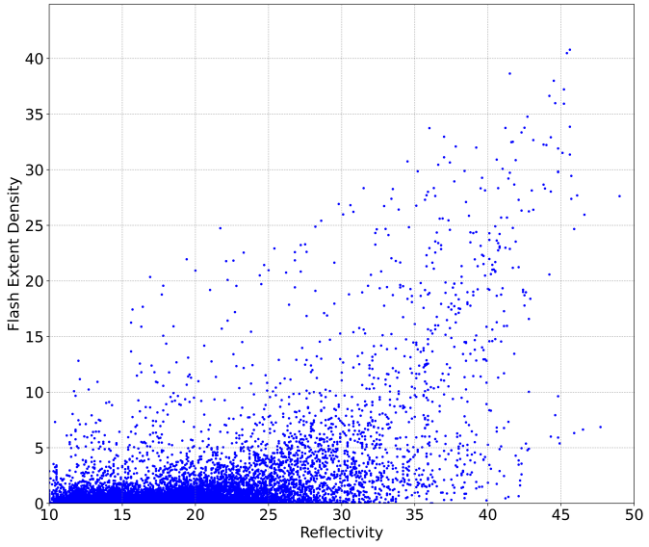
LMA level 3 products:

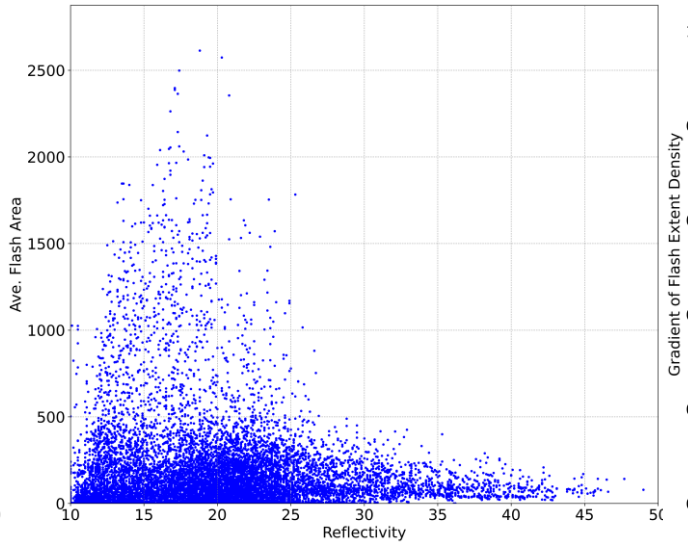
- Gridded fields: flash extent density, average flash area, average flash energy, ...
- Fields smoothed spatially
- Spatial gradients of level 3 fields

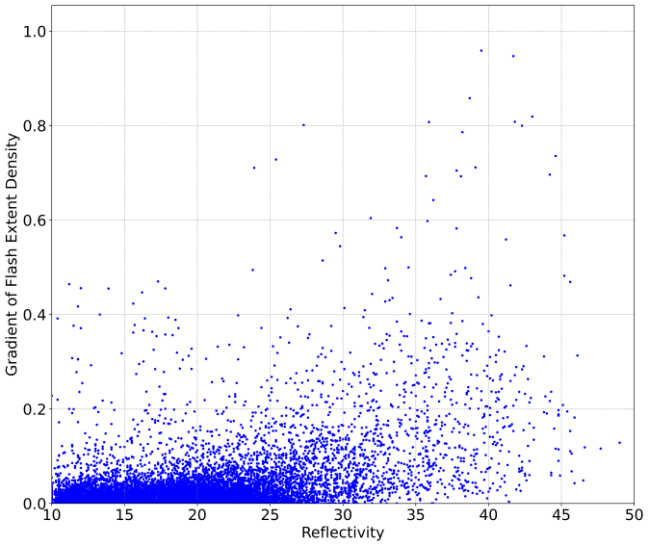






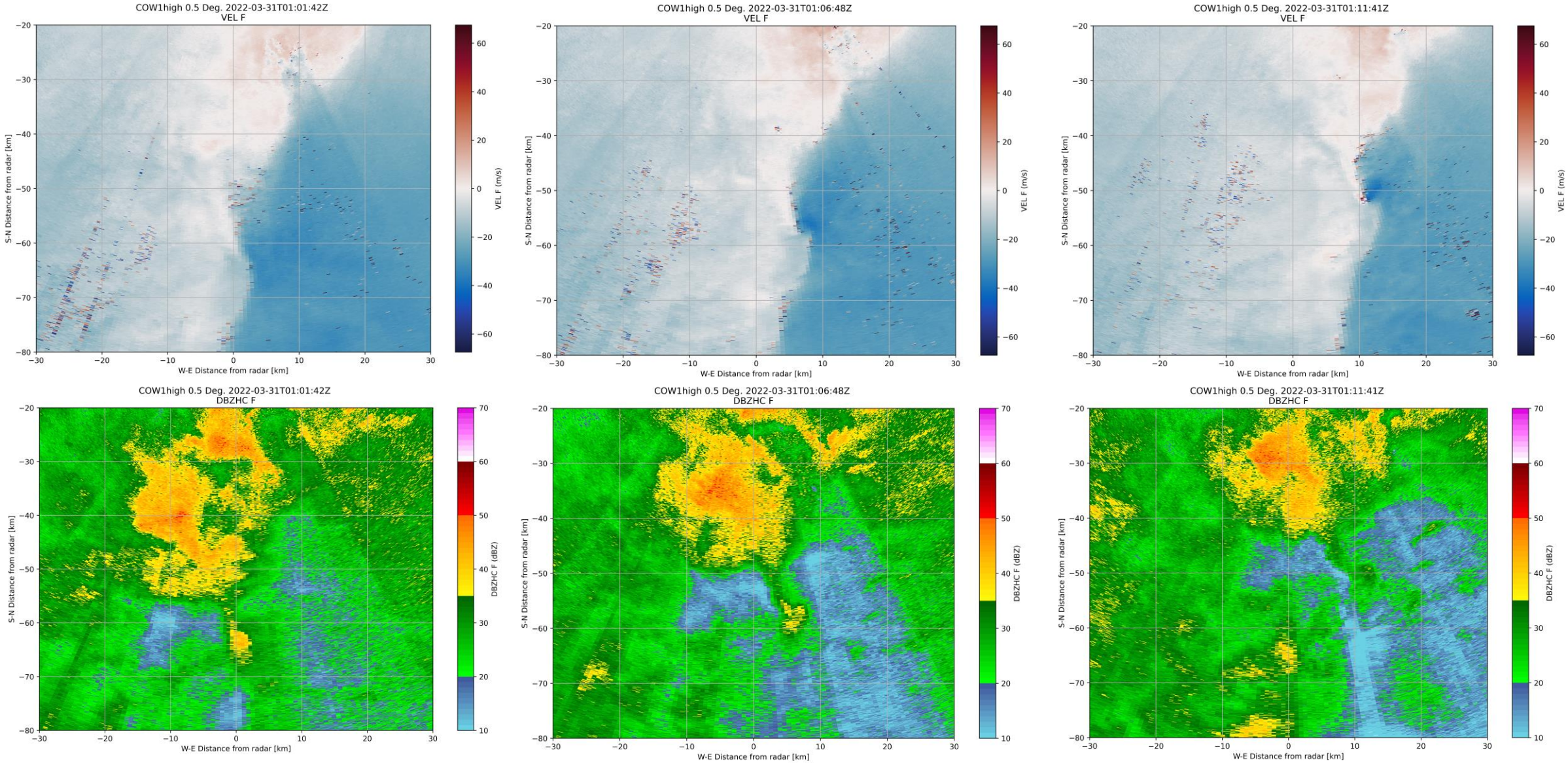






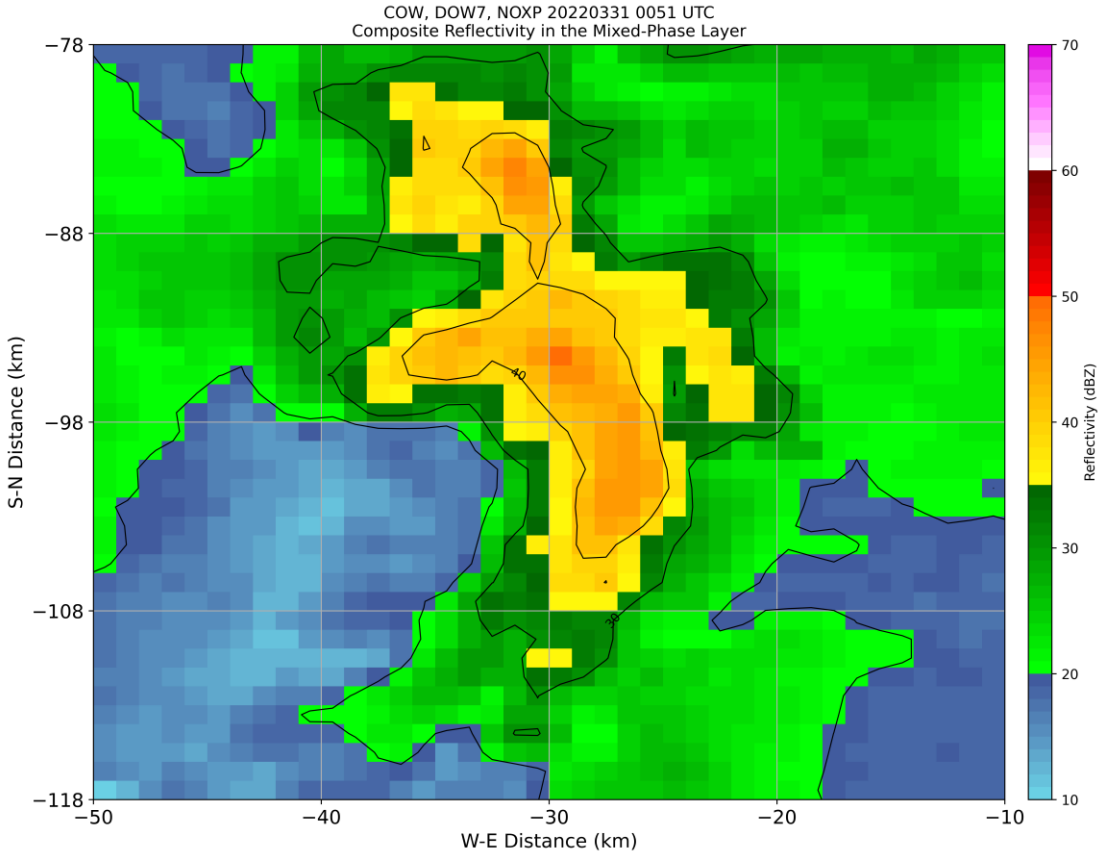
IOP2: Radial velocity and reflectivity in the low-levels

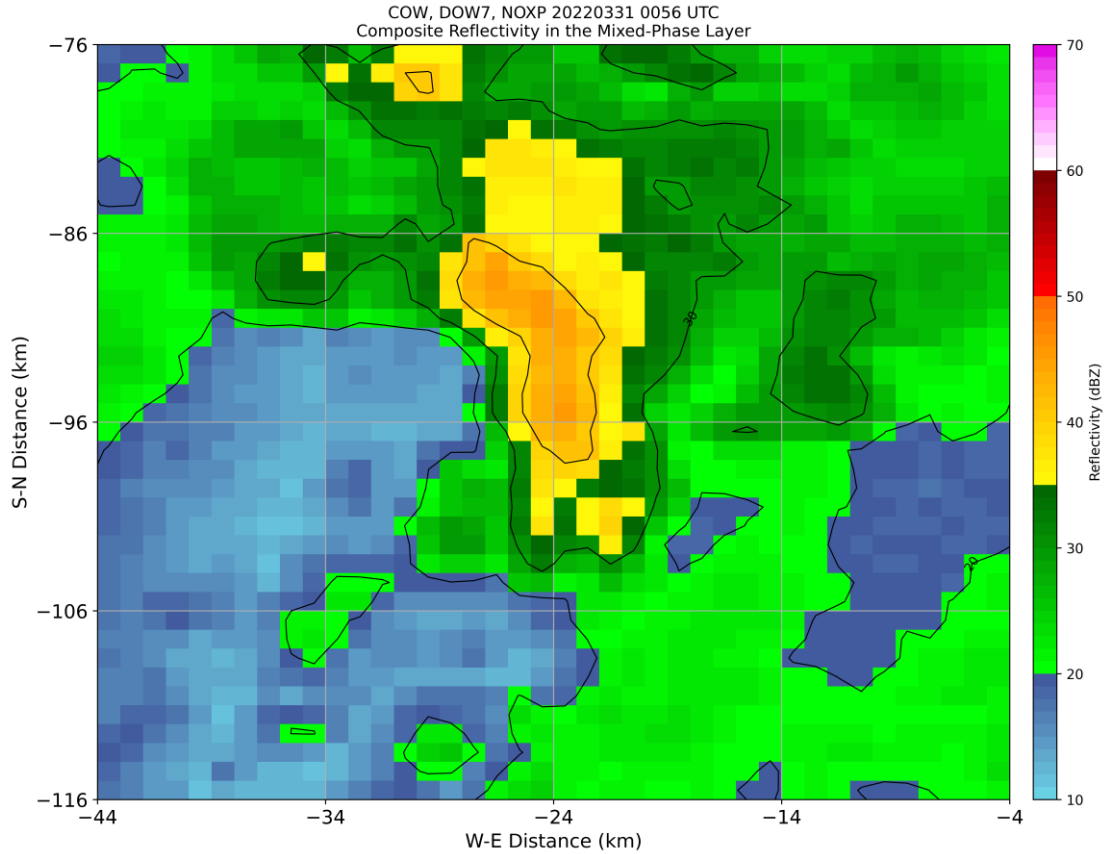
- Prairie Point tornado: 0106-0120 UTC



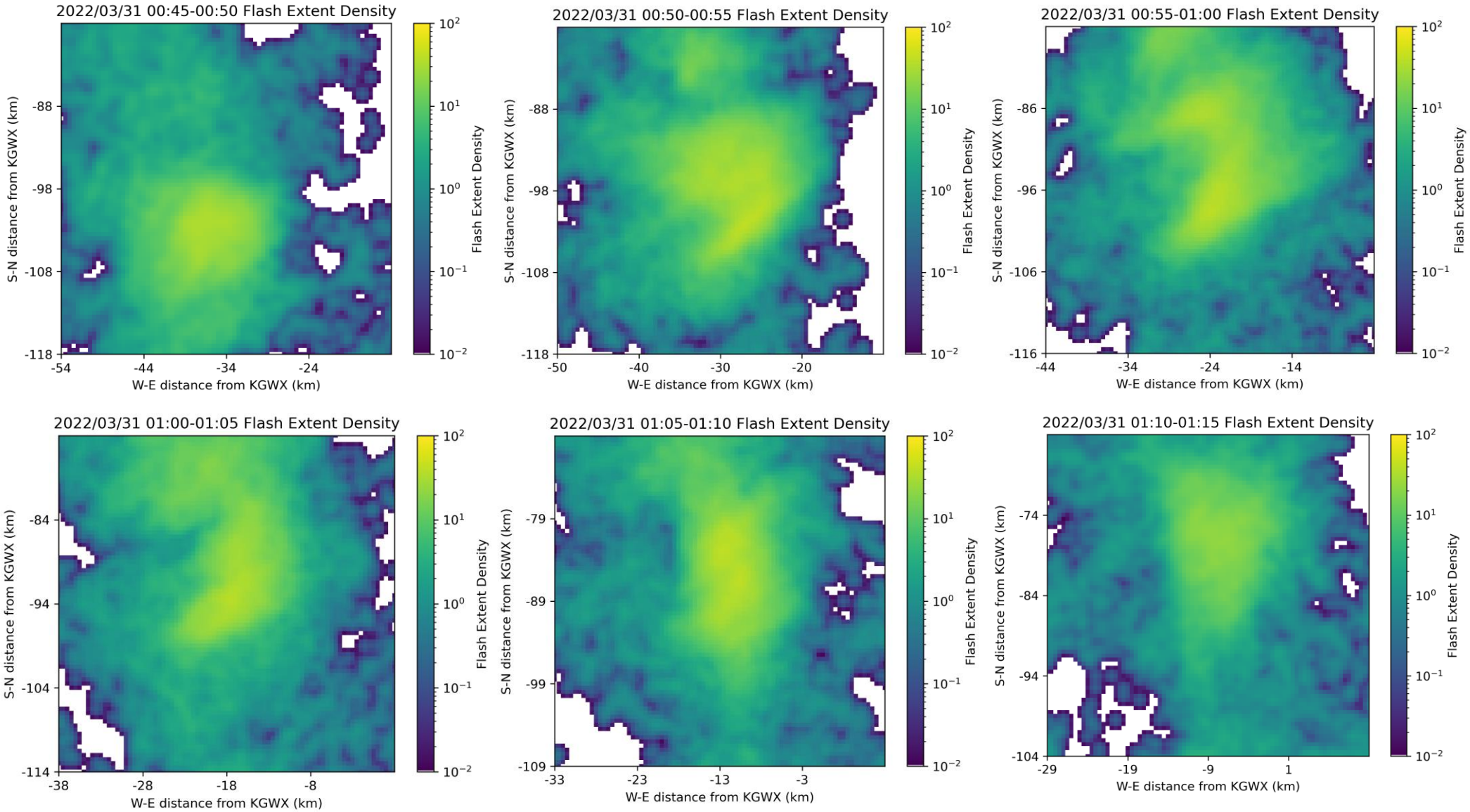
Mixed-phase layer cell was tracked for calculation of spatiotemporal variations (advection correction):

- Mesovortex location used as the center of a 40x40 km area

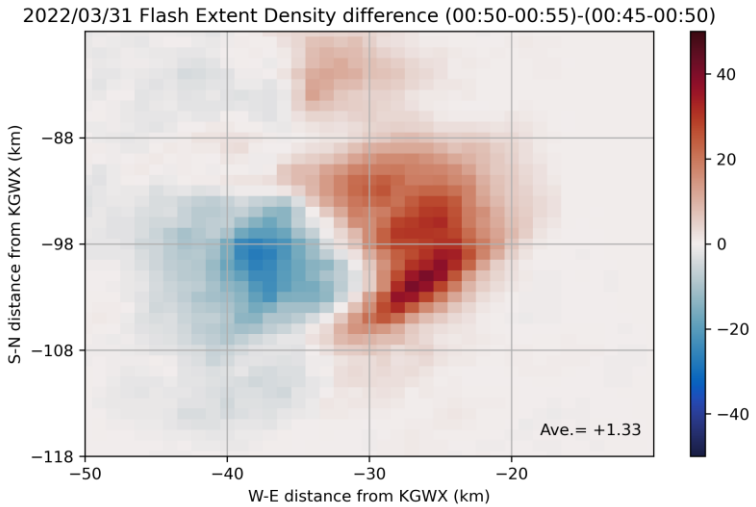


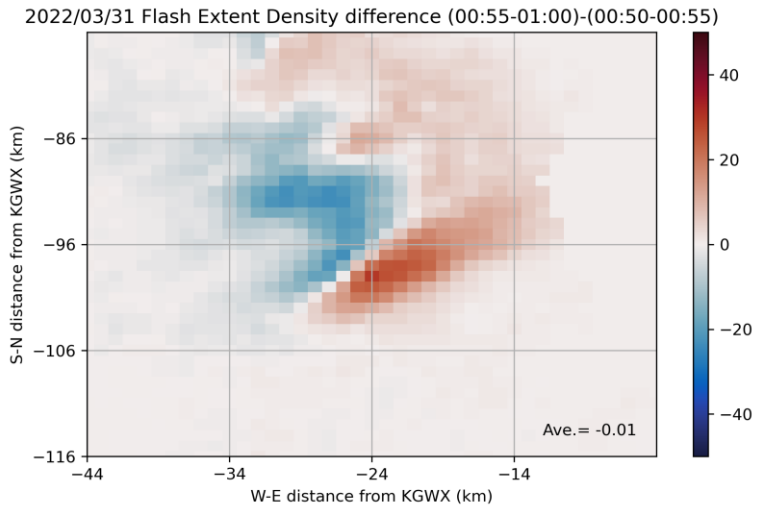


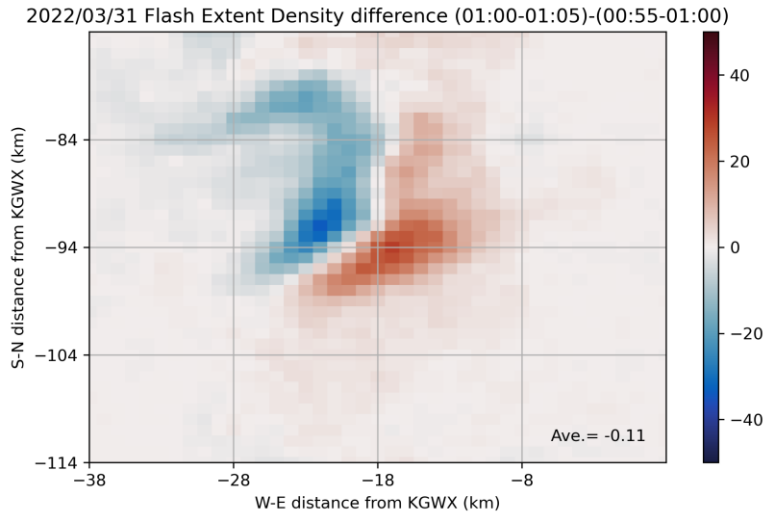
MV-related Flash Extent Density

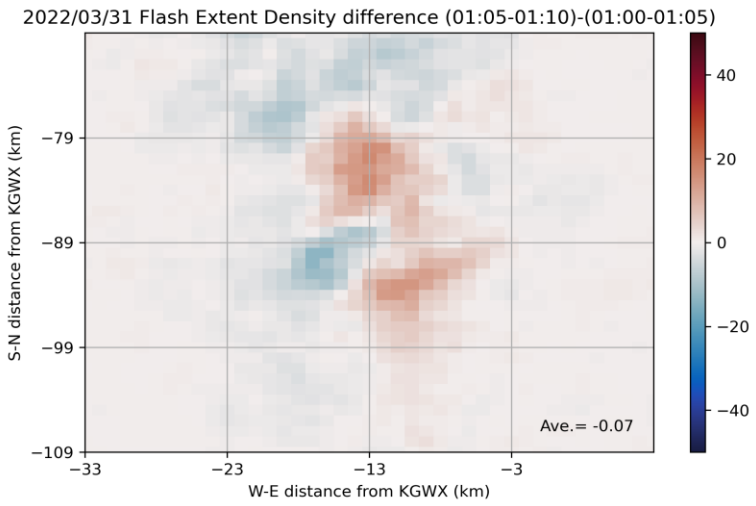


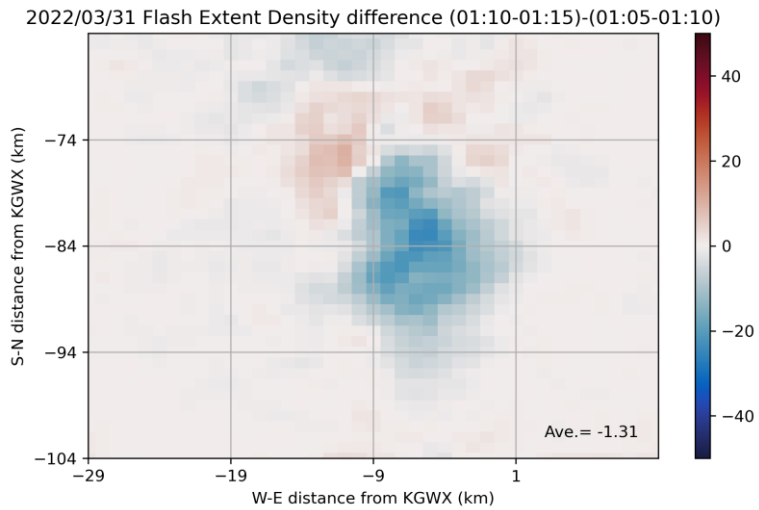
Flash Extent Density: time difference

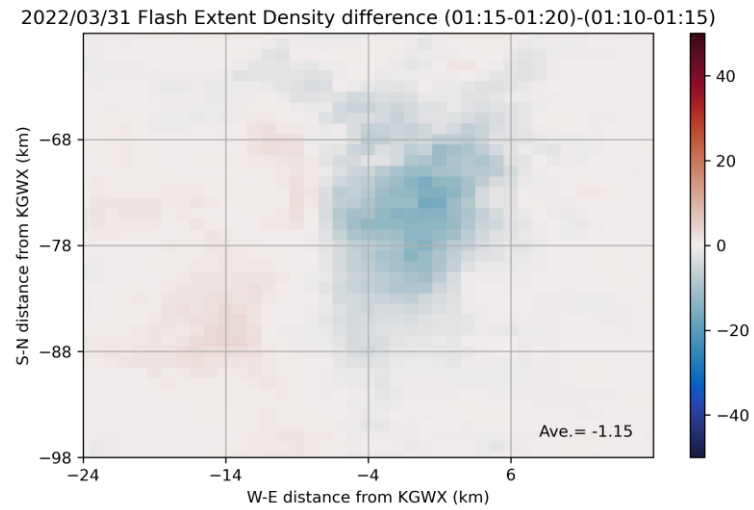




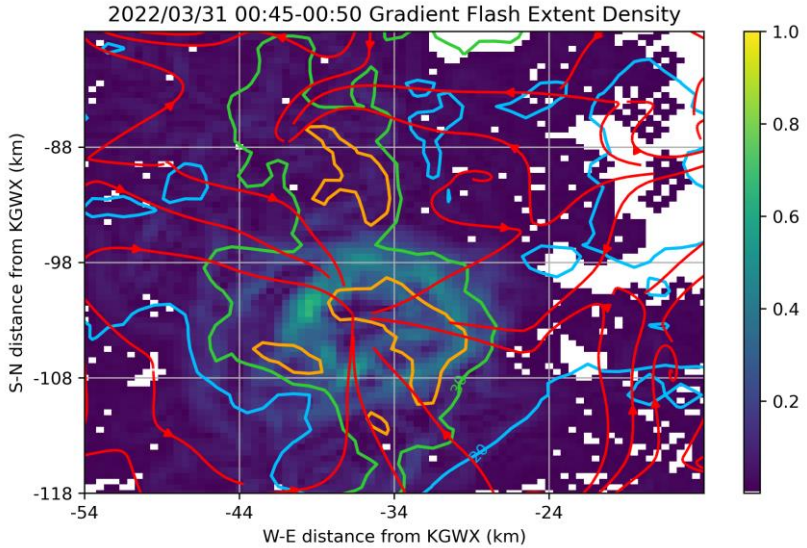


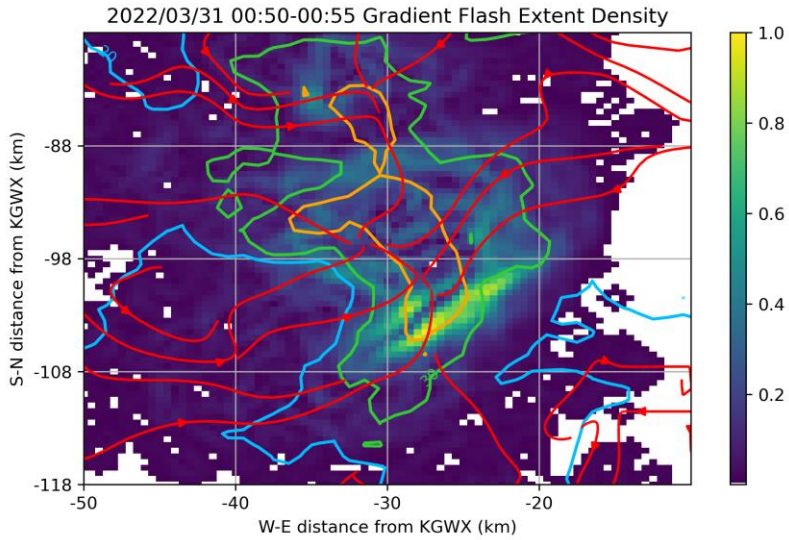


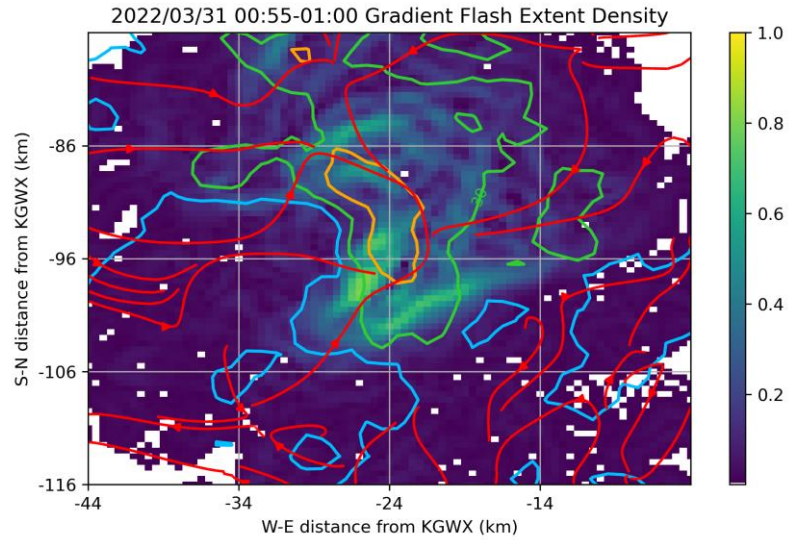


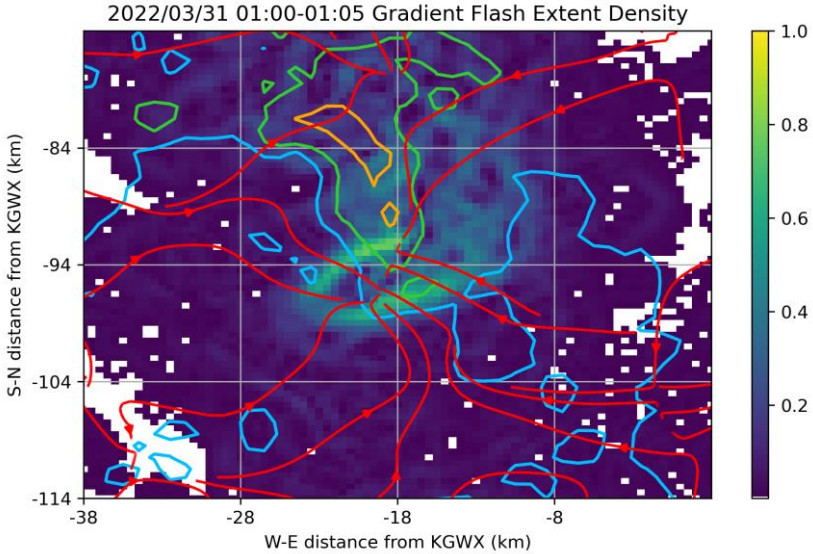


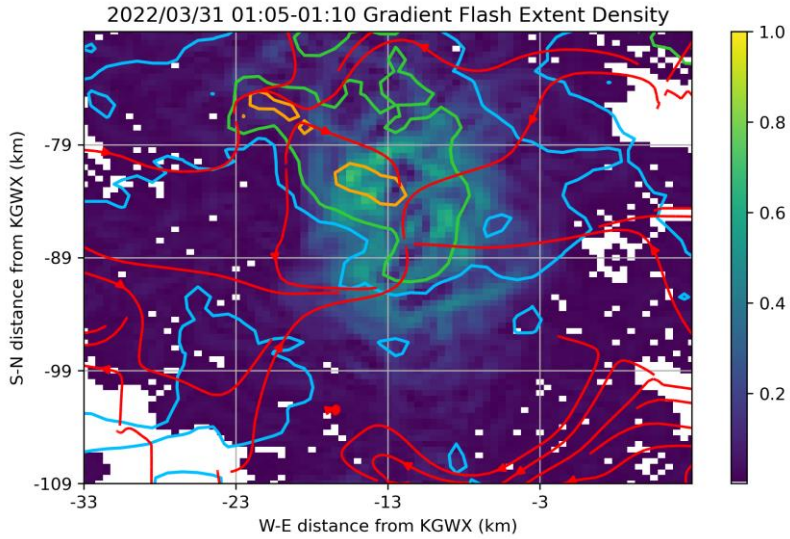
Spatial gradient of FED, direction of gradient (red streamlines), reflectivity (contours)

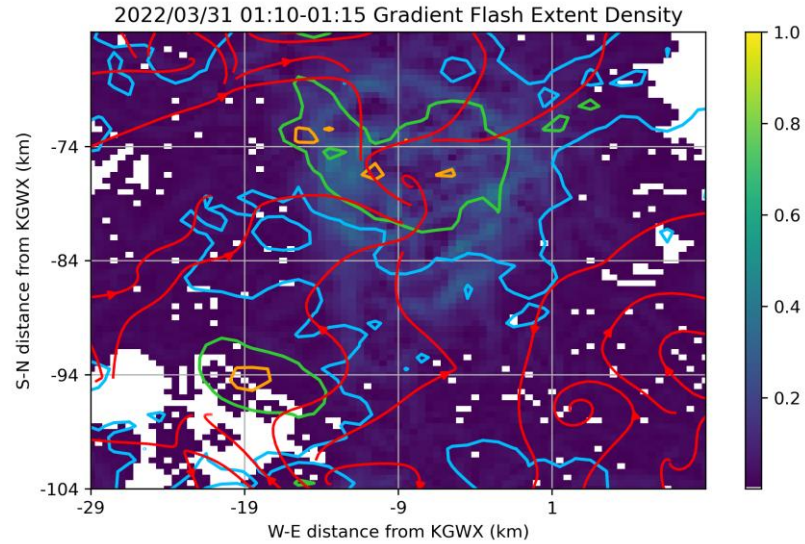




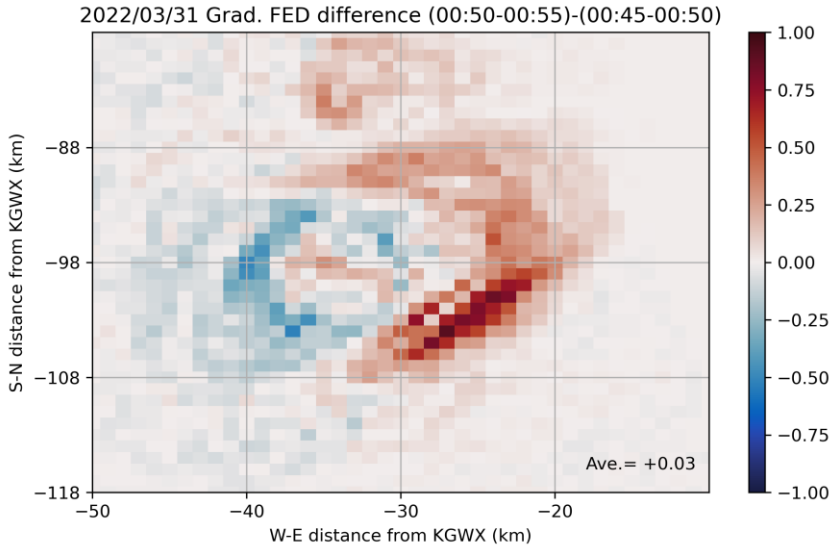


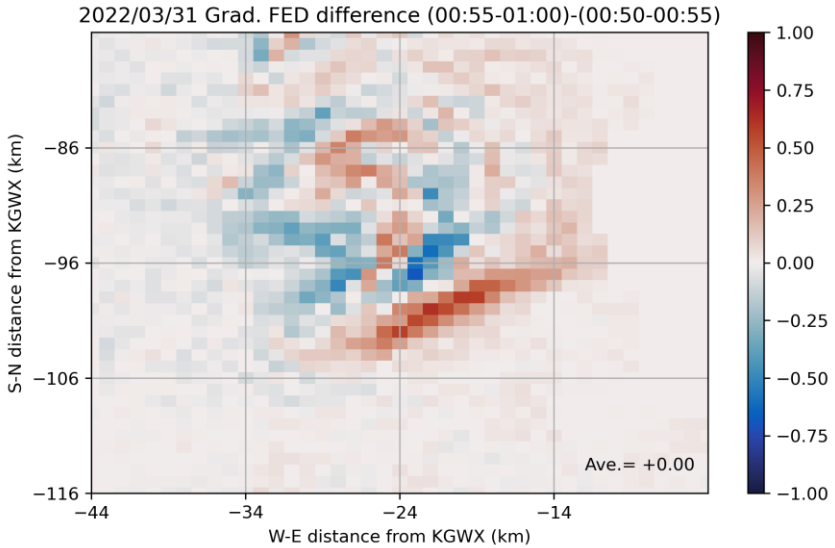


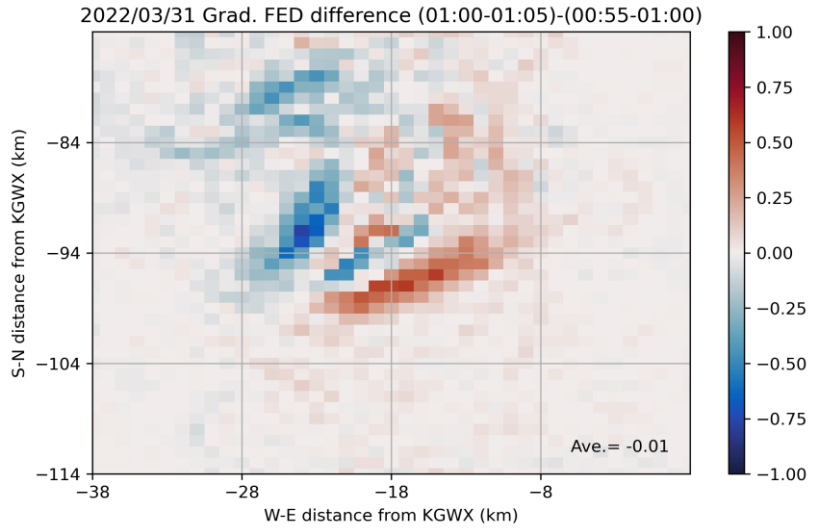


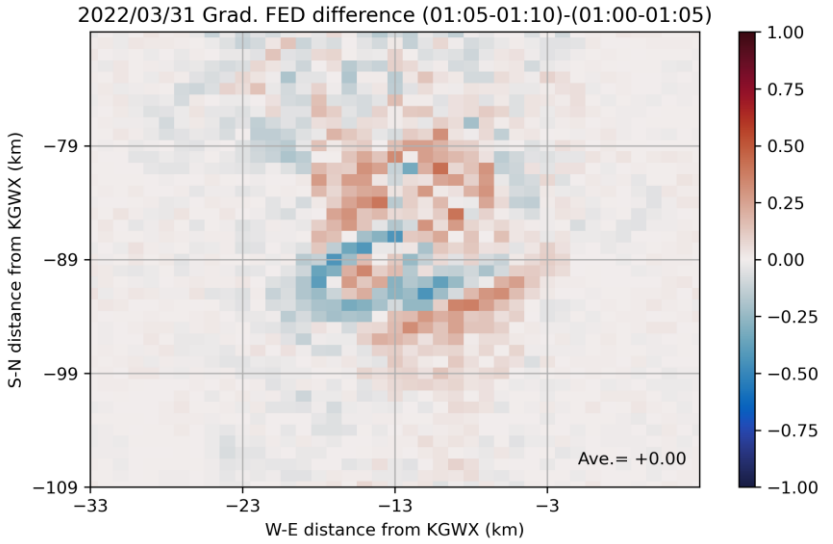


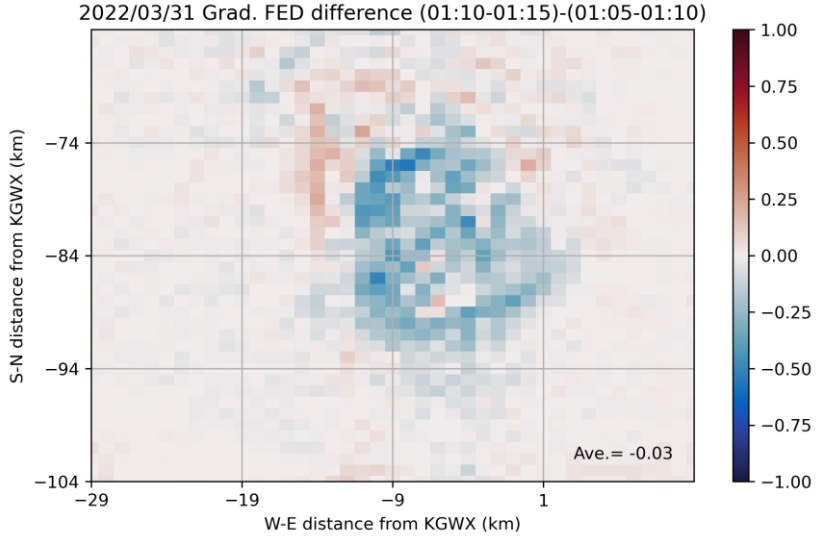
Gradient of FED: time difference

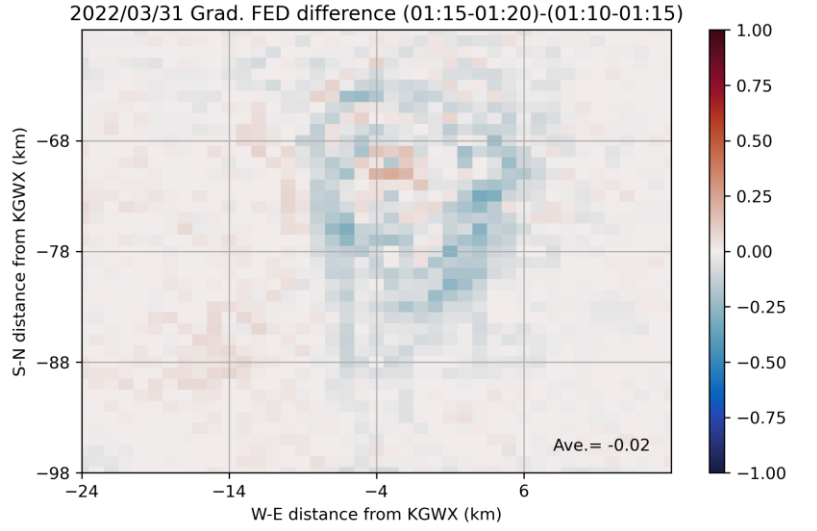




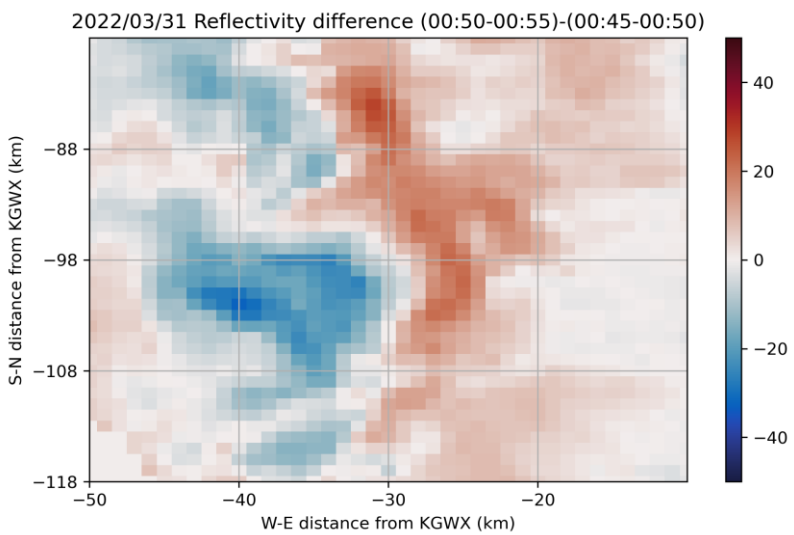


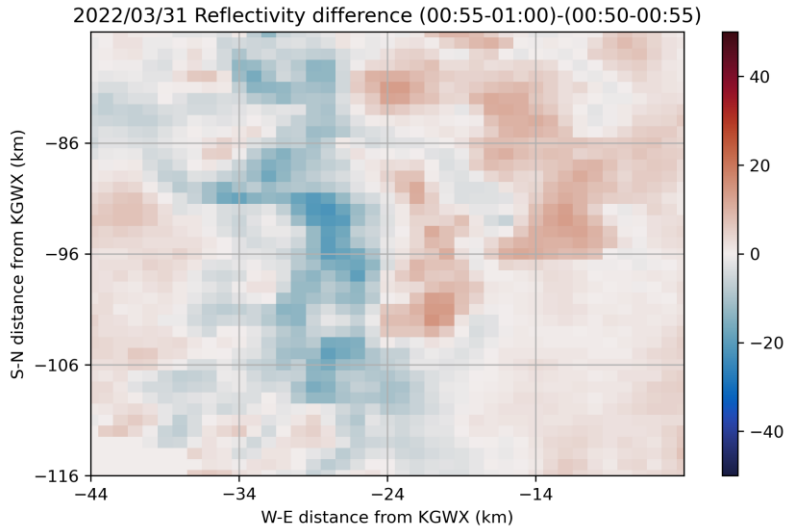


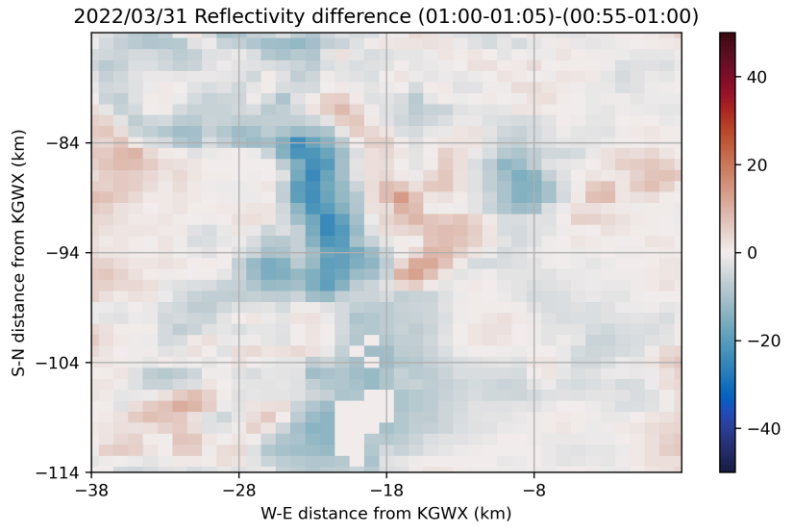


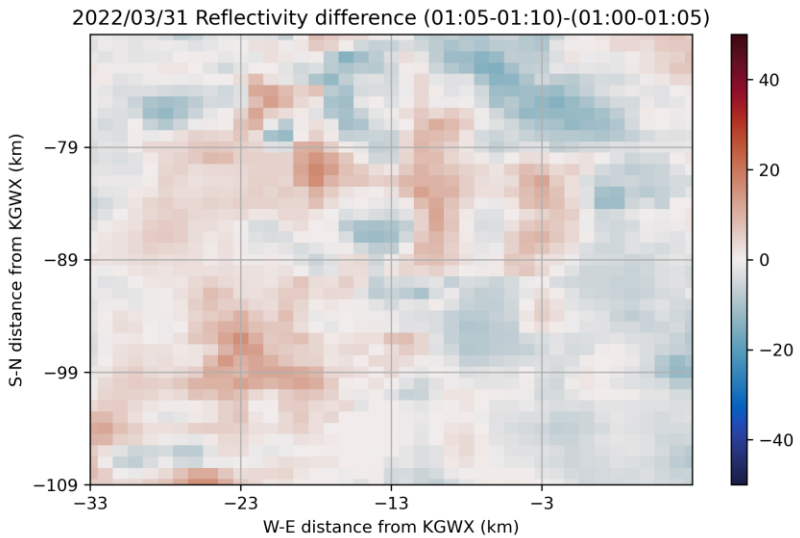


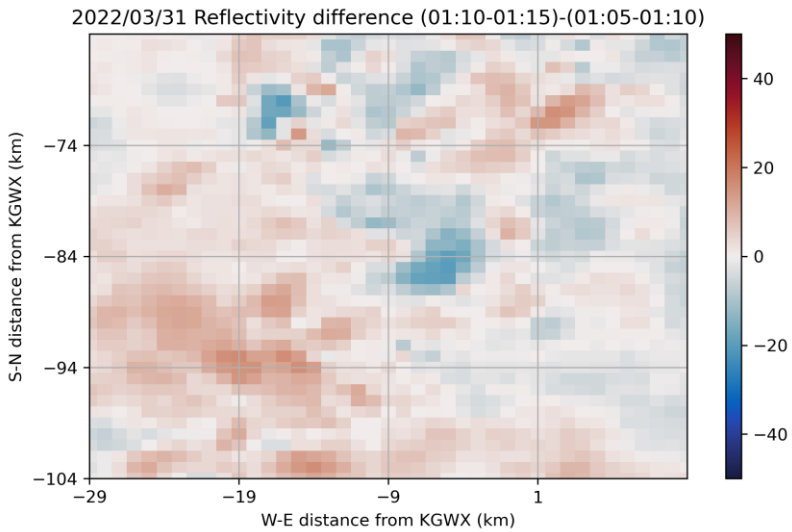
Reflectivity time difference

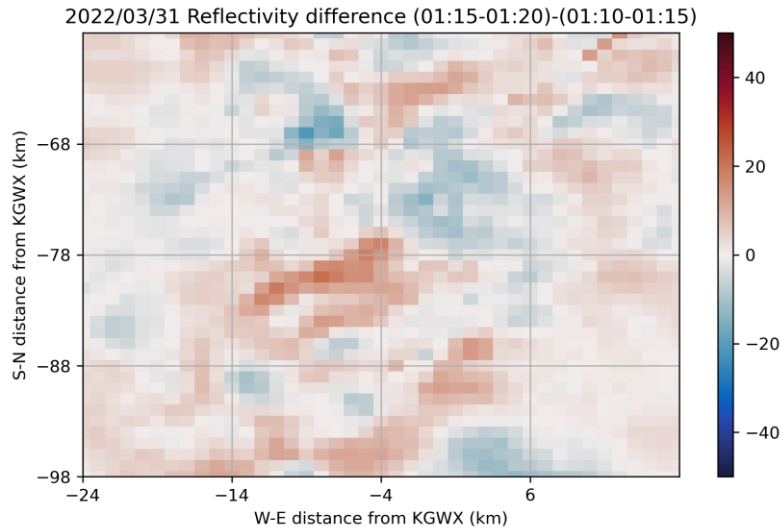










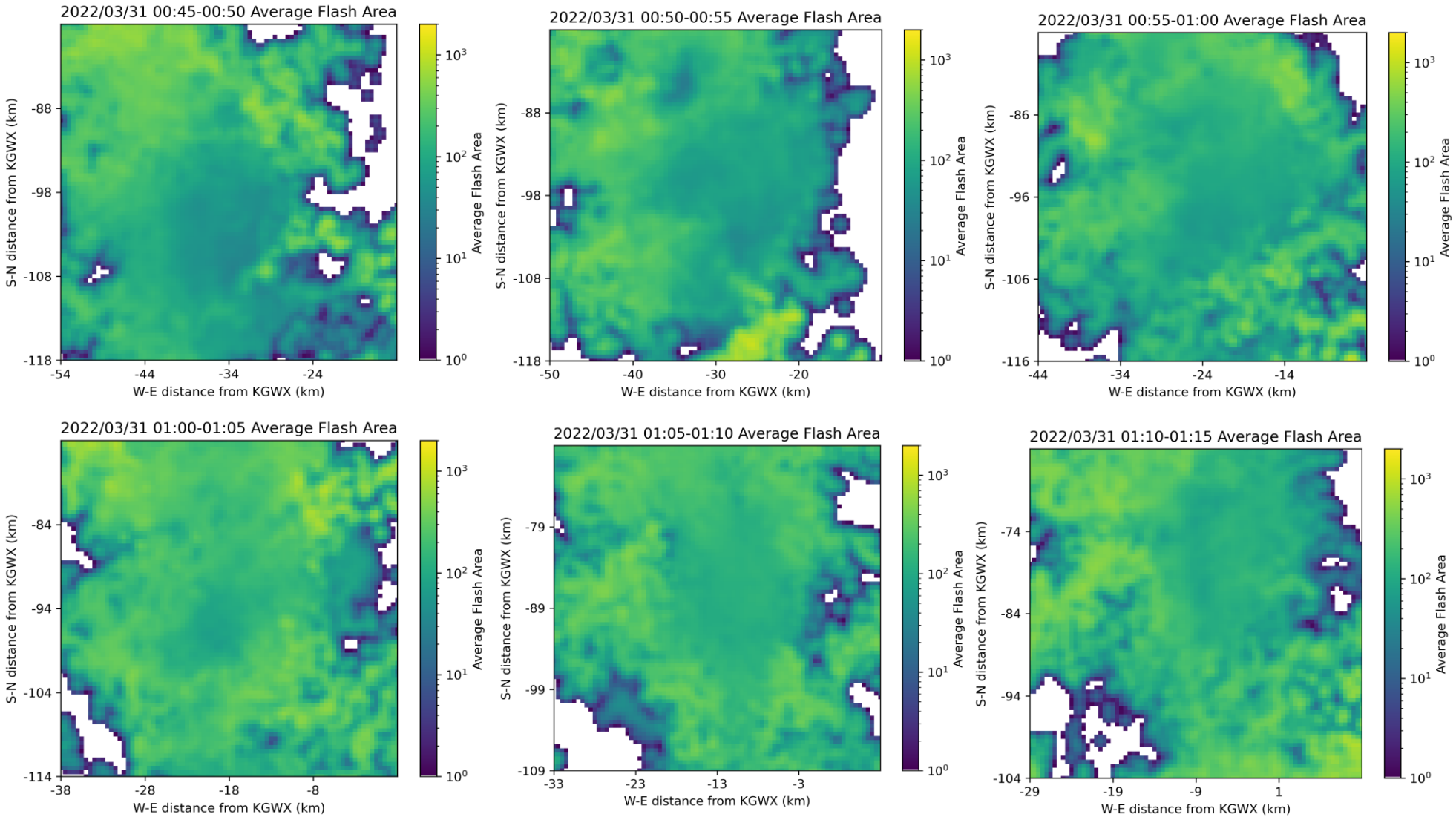


Summary

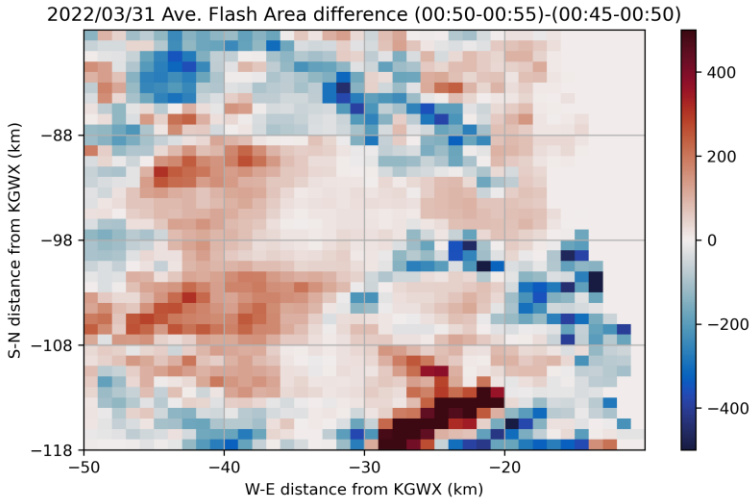
- Composite reflectivity in the mixed-phase layer spatially correlated with flash extent density
- Time difference of flash extent density shows well-defined dipole pattern of increase to the east/southeast prior to MV formation
- General decrease in flash extent density after tornado initiation
- Direction of gradient of FED showed convergence towards the MV location
- Time difference of gradient of FED showed similar patterns to FED, but noisier
- Average flash area showed no clear spatial pattern
- More cases/IOPs will be explored

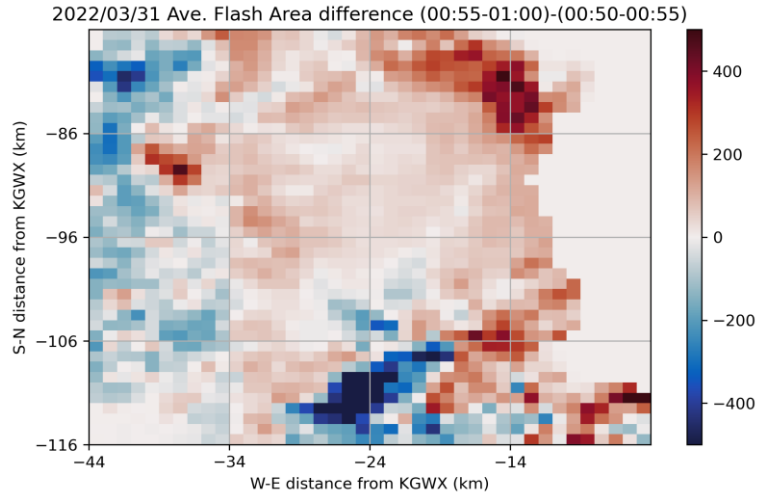
Contact:
bruno.medina@ttu.edu

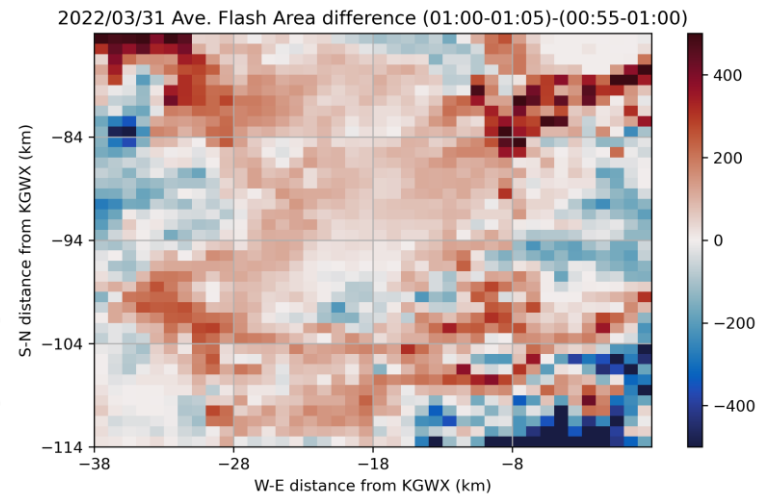
Average Flash Area

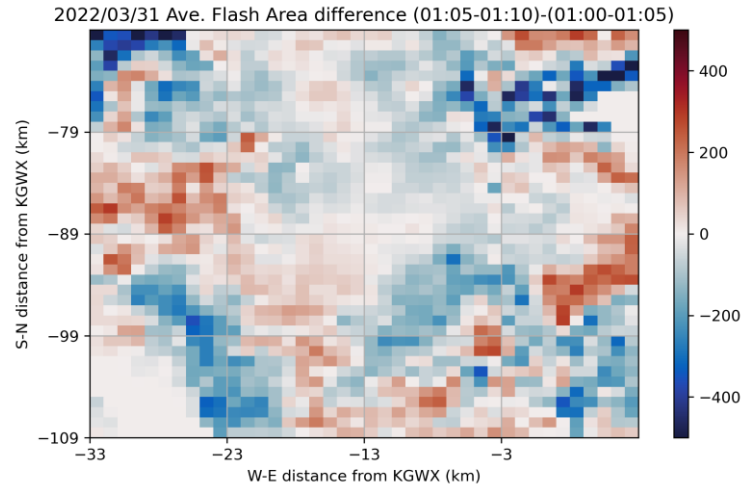


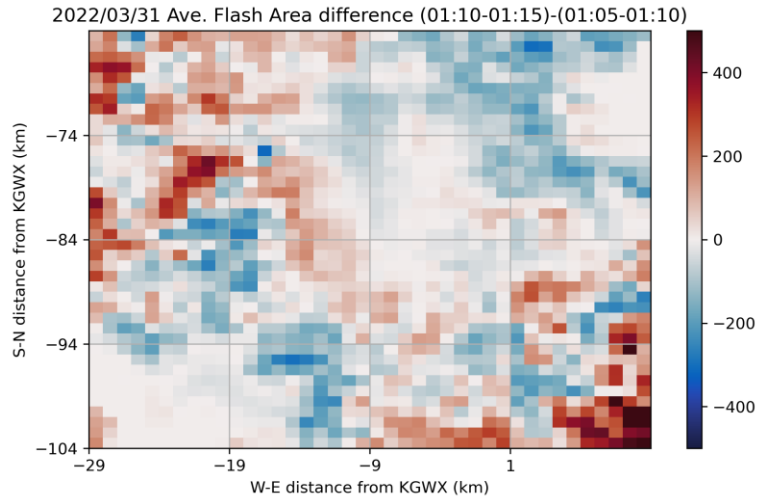
Difference AFA

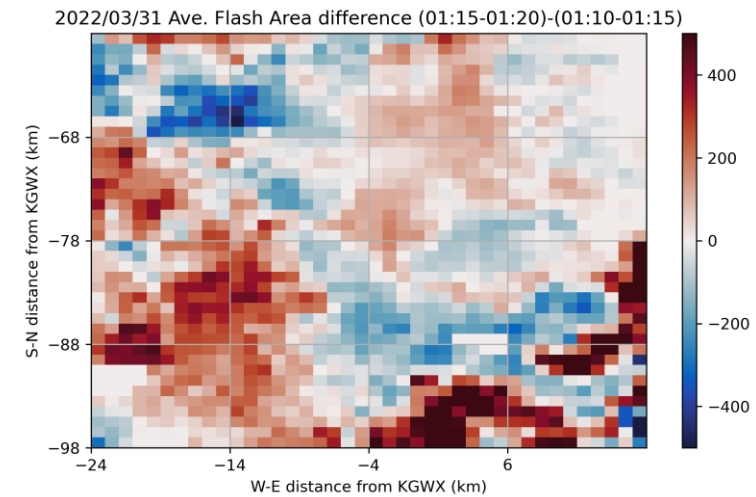




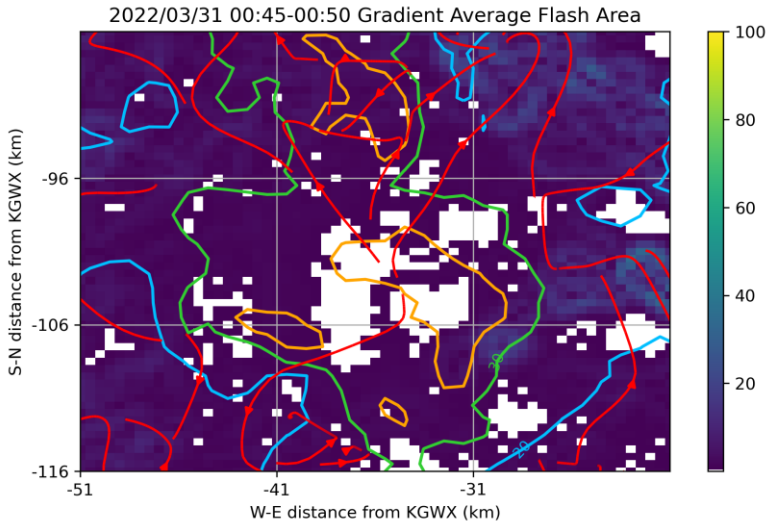


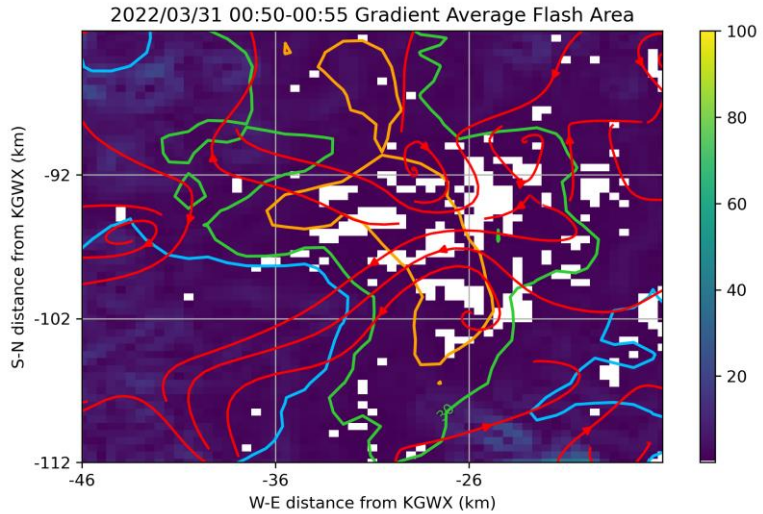


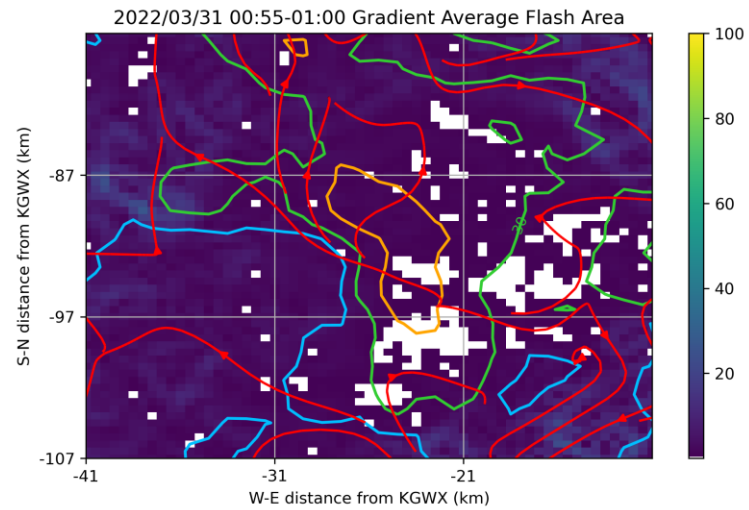


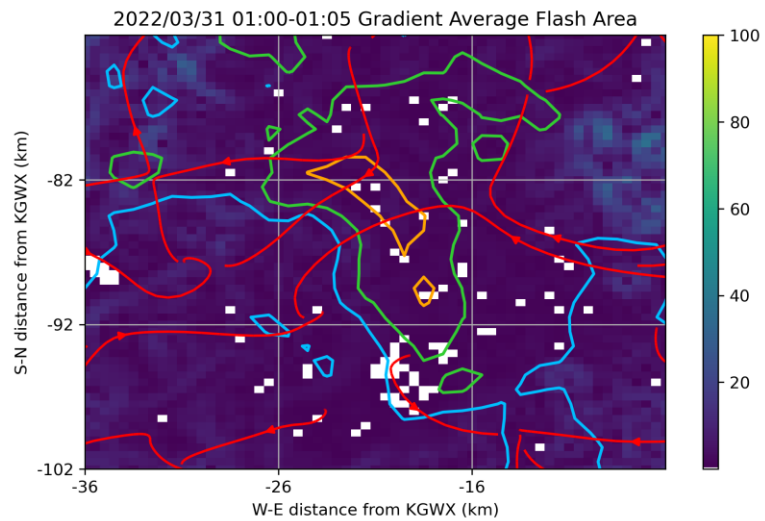


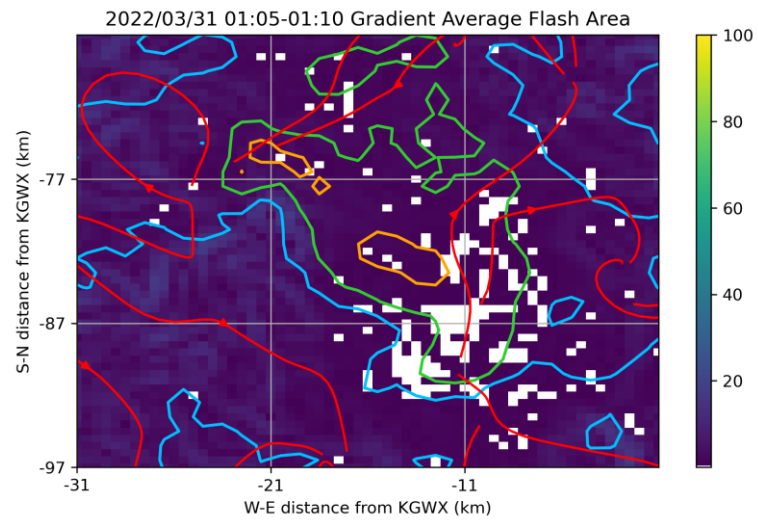
Gradient of Average Flash Area

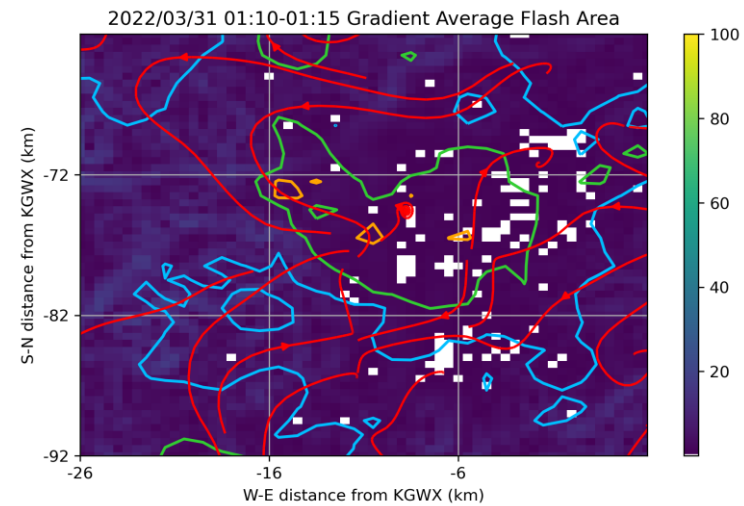












Gradient of AFA time difference