

IMPACTS In Situ Observations in the Context of Previous Field Studies and Model Simulations

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Acknowledgements: Funded by NASA grant 80NSSC19K0354. Gary Lackmann (Midwest storm) and Brian Colle/Phillip Yeh (2020/02/07 storm) provided WRF output. Laura Tomkins, Kevin Burris, and Toby Peele provided helpful discussions and feedback on the content of this poster.

Summary

We compared the in-cloud environments for ice growth sampled during IMPACTS 2020 to those sampled by other airborne field studies: PLOWS, ICE-T, and DC3, as well as WRF simulations of a Midwest winter storm and the 2020/02/07 IMPACTS northeast U.S. case.

- In all the environments analyzed, vertical motions were mostly weak (within $\pm 1 \text{ m s}^{-1}$).
- As expected, deep convection has more relative storm volume with updrafts and moist adiabatic conditions than winter storms.
- RH_{ice} clustered around smaller values (just below 100%) for IMPACTS compared to PLOWS (just above 100%). In part, this is likely related to IMPACTS sampling warmer clouds than PLOWS.
- Dry regions ($\text{RH}_{\text{ice}} < 100\%$) with hydrometeors present were found in both the observations and model simulations of winter storms.

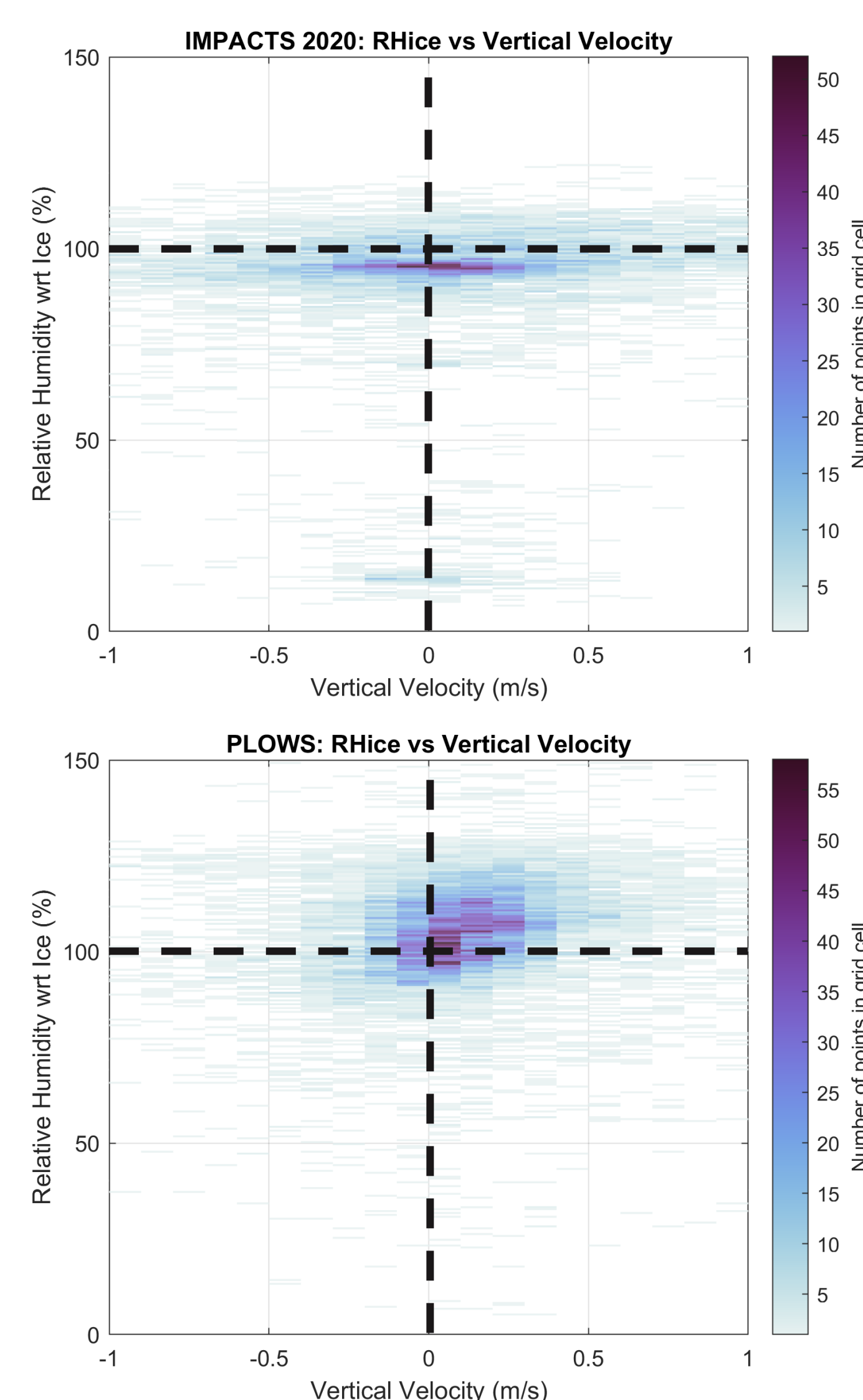
Project	Targeted Weather	Cloud Probe	DOI to Data
IMPACTS	Northeast and Midwest U.S. winter storms	CDP	10.5067/IMPACTS/DATA101
PLOWS	Midwest U.S. winter storms	CDP	10.5065/D6HX1B1V
ICE-T	Tropical oceanic cumulus	2DC	10.5065/D66D5R9Z
DC3	Midlatitude continental deep convection	2DC	10.5065/D6BC3WKB

Observed Environments During IMPACTS and Previous Field Studies

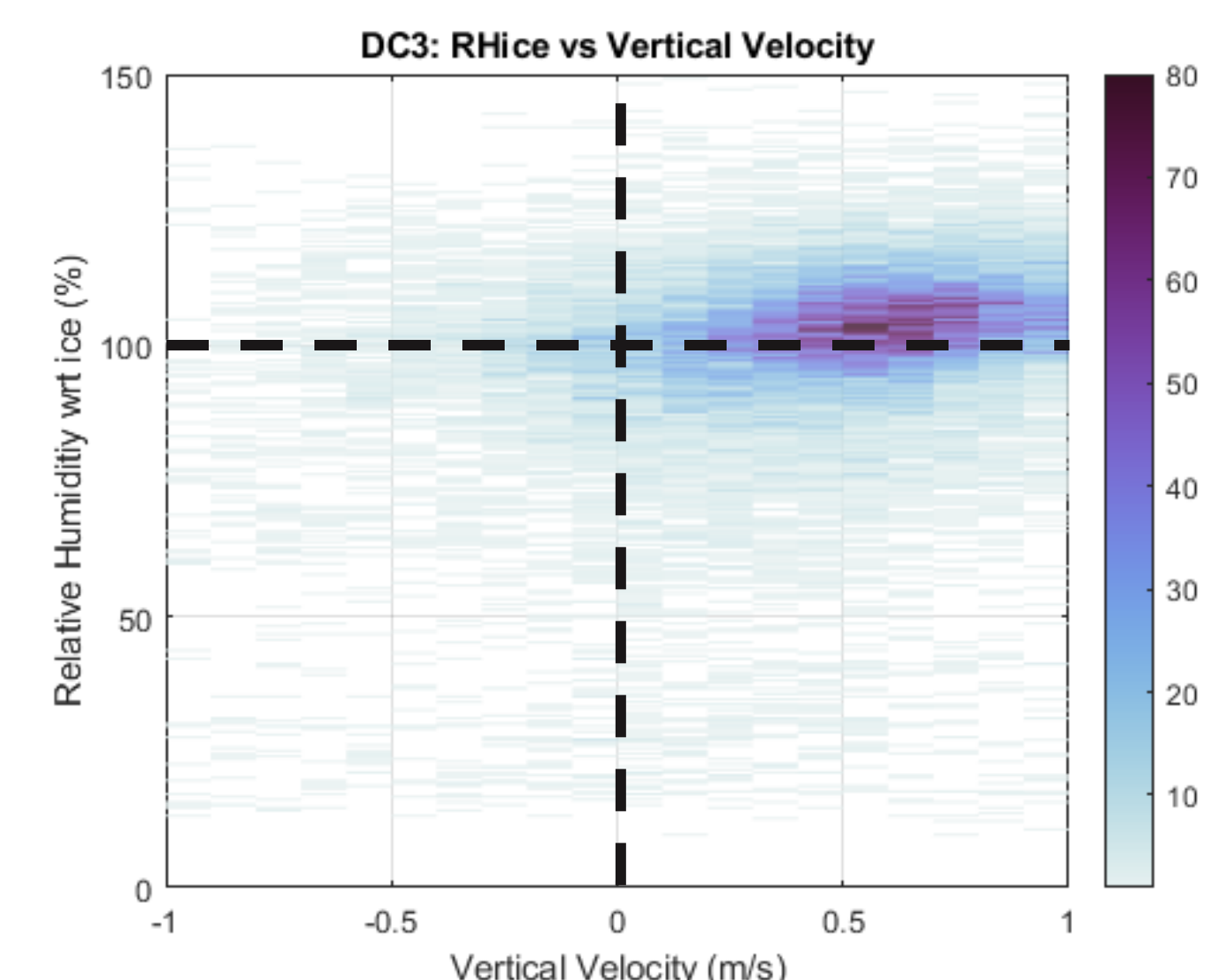
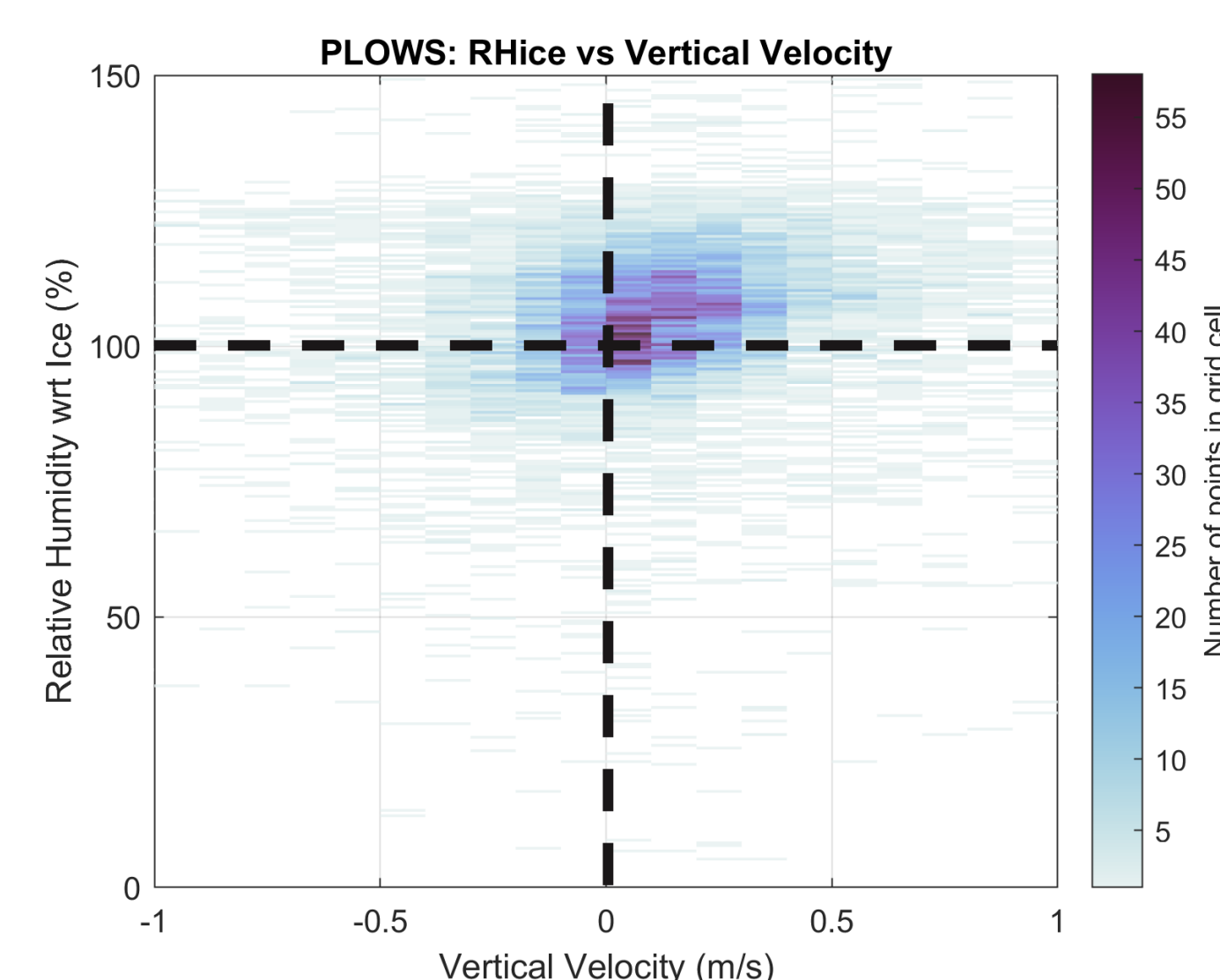
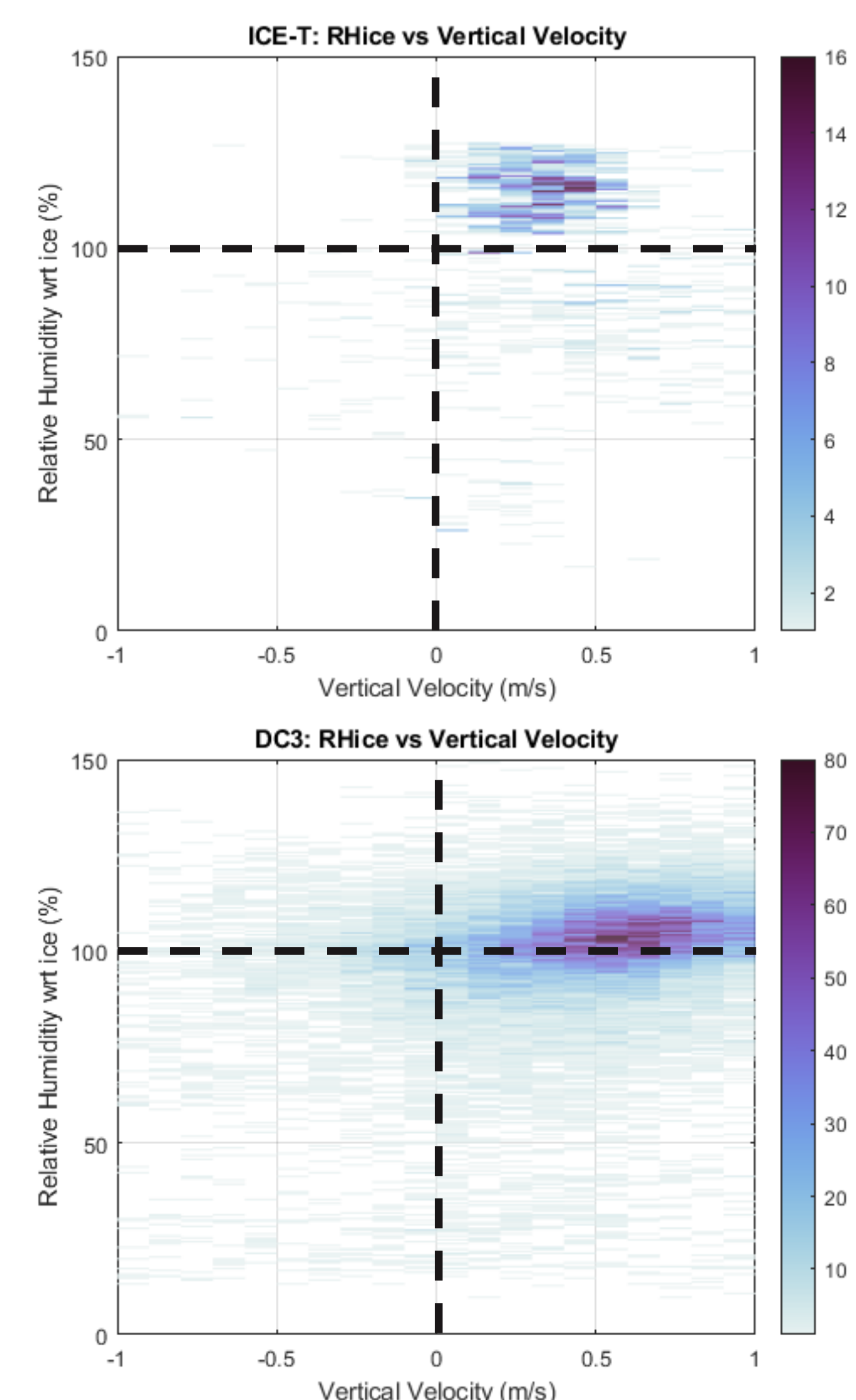
Only in-cloud points, defined by cloud particle number concentrations exceeding 0 cm^{-3} , were included plots of observations. Cloud particle number concentrations were measured using the CDP for IMPACTS and PLOWS and using the 2DC for ICE-T and DC3. Points where the ambient air temperature $\geq 0^\circ\text{C}$ were excluded.

Joint Distributions of RH_{ice} and Vertical Velocity: IMPACTS, PLOWS, ICE-T, and DC3

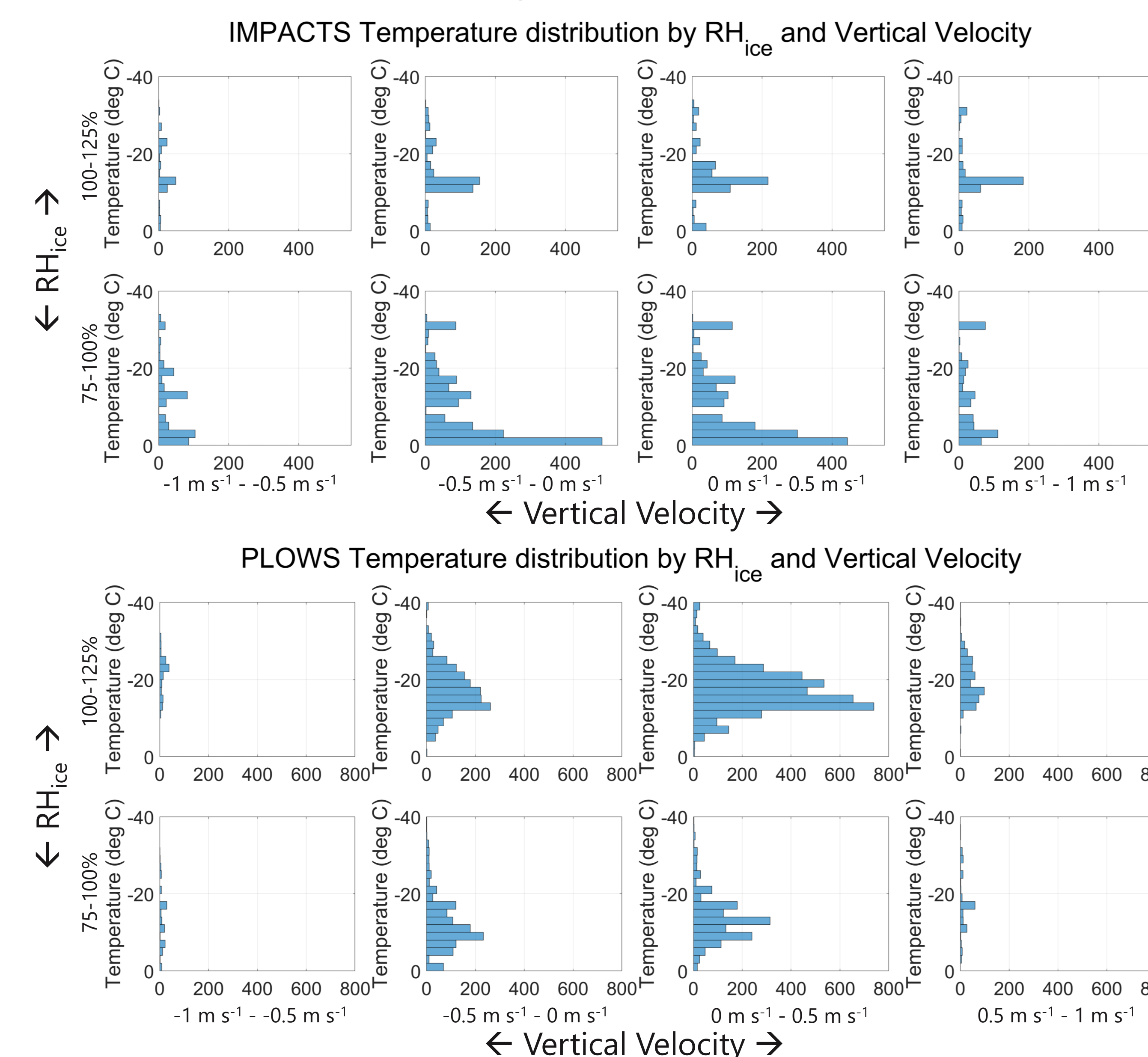
Winter Storms



Summer Convection

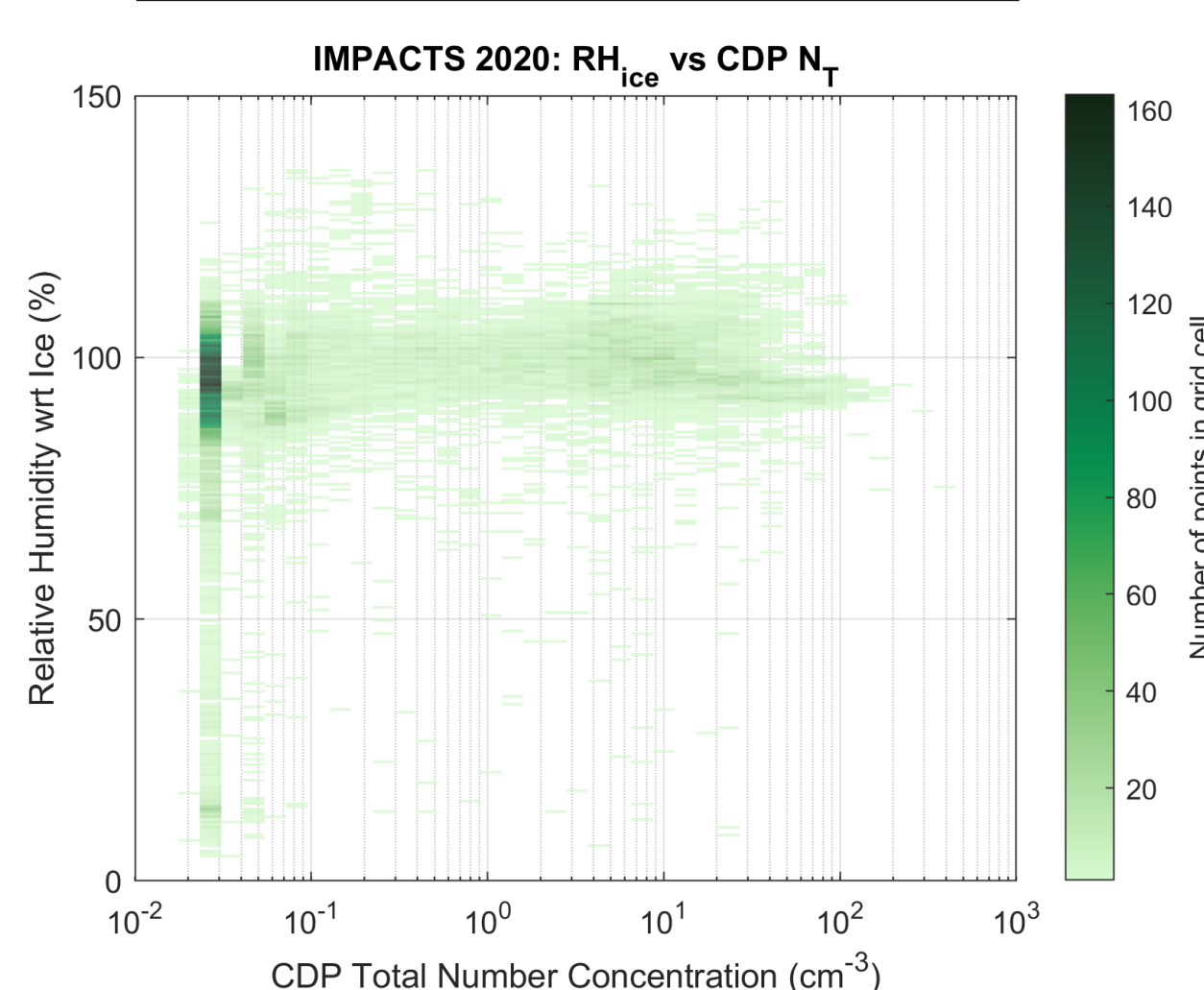


Temperature Distribution by RH_{ice} and Vertical Velocity: IMPACTS and PLOWS

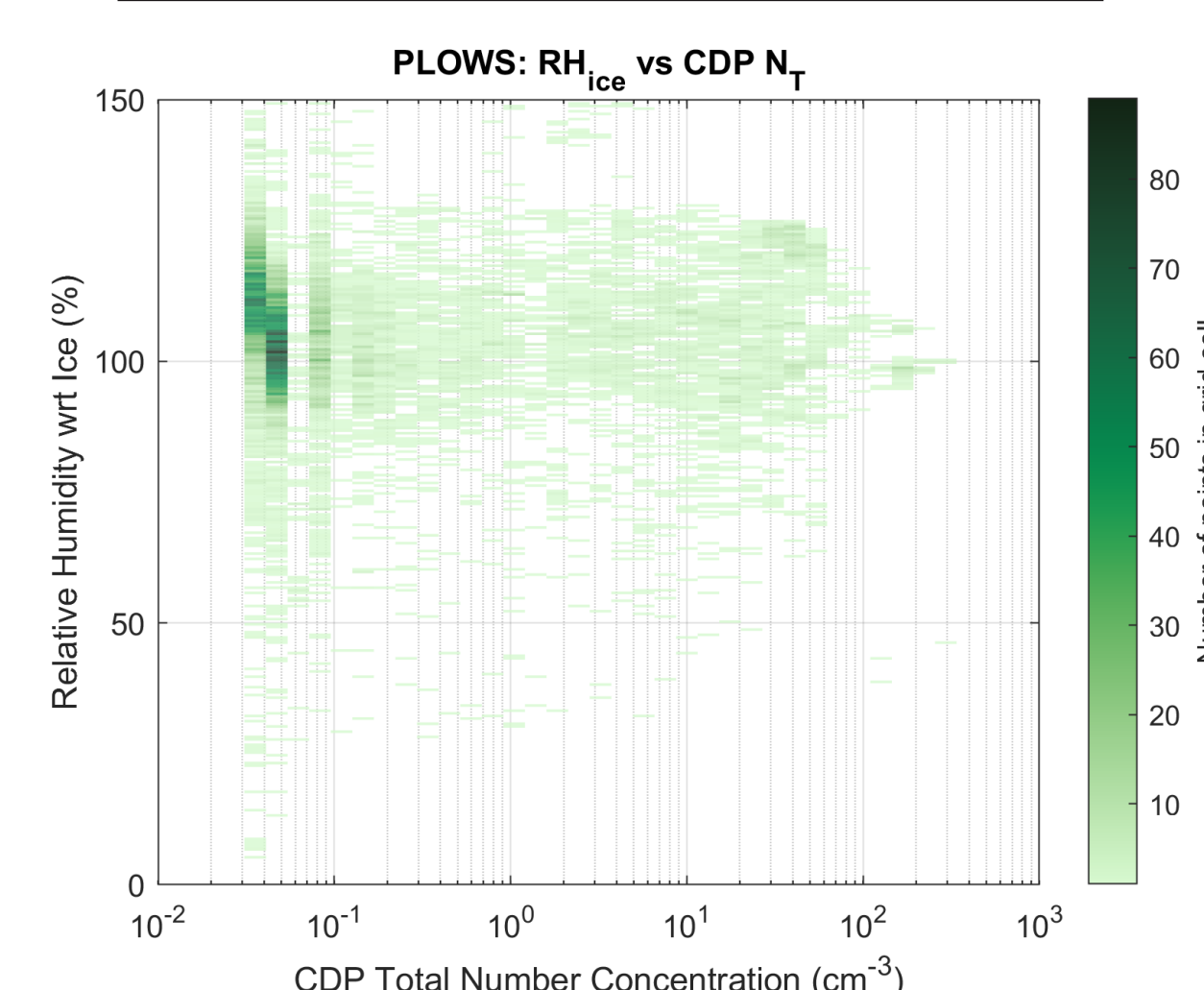


Joint Distributions of RH_{ice} and CDP Total Number Concentration: IMPACTS and PLOWS

IMPACTS 2020



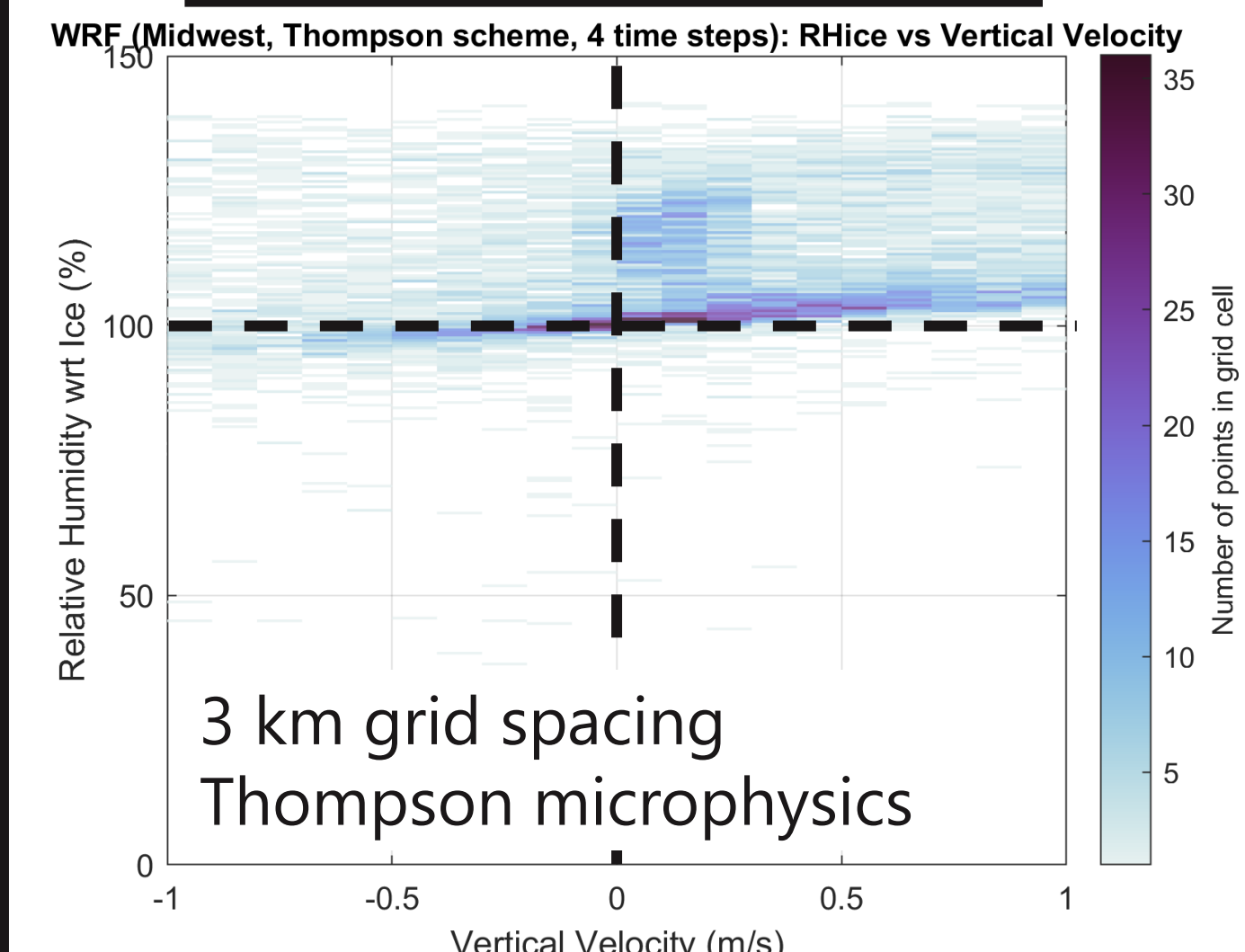
PLOWS 2009-10



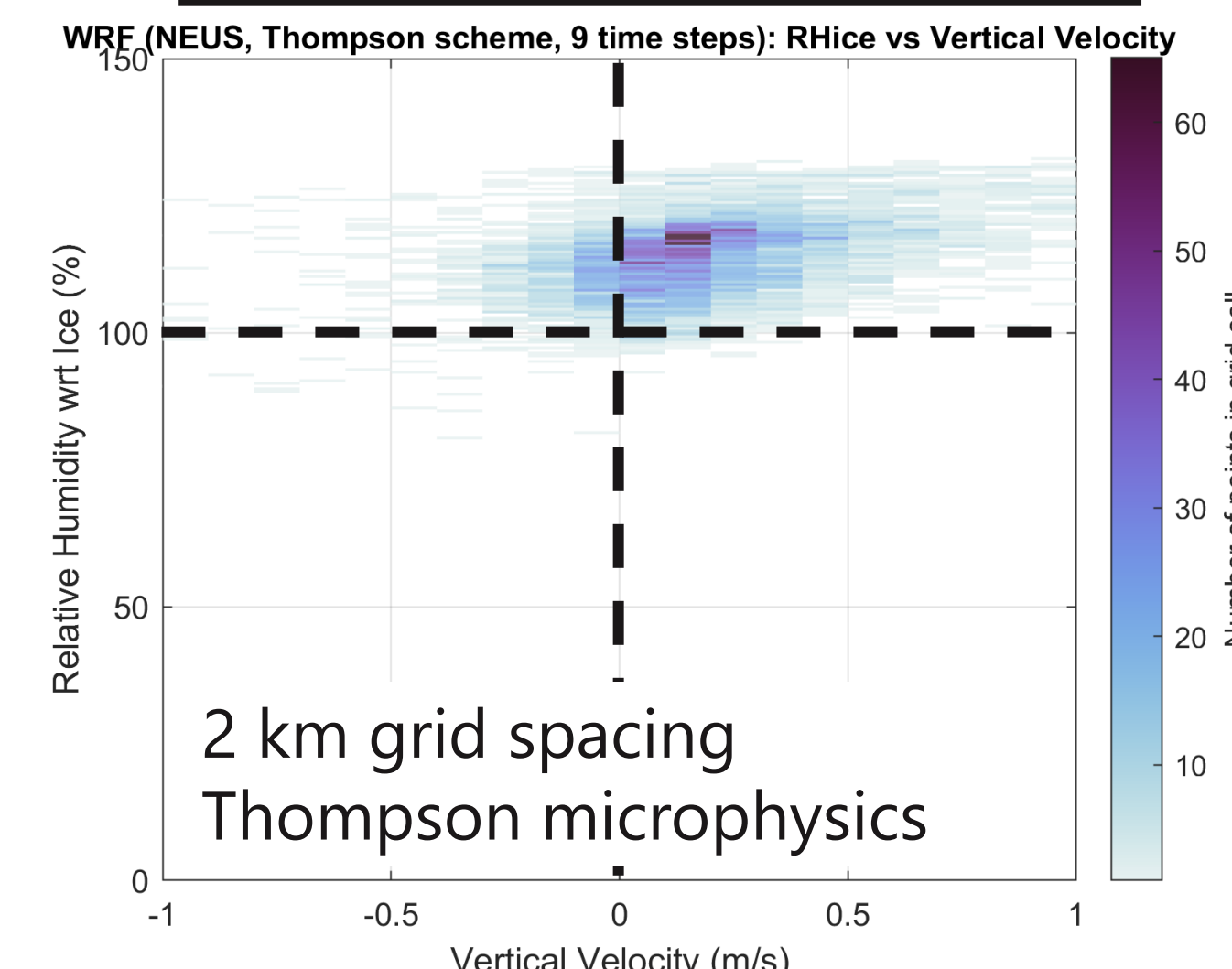
Modeled Winter Storm Environments

Joint Distributions of RH_{ice} and Vertical Velocity: Winter Storm WRF Simulations

Midwest Storm

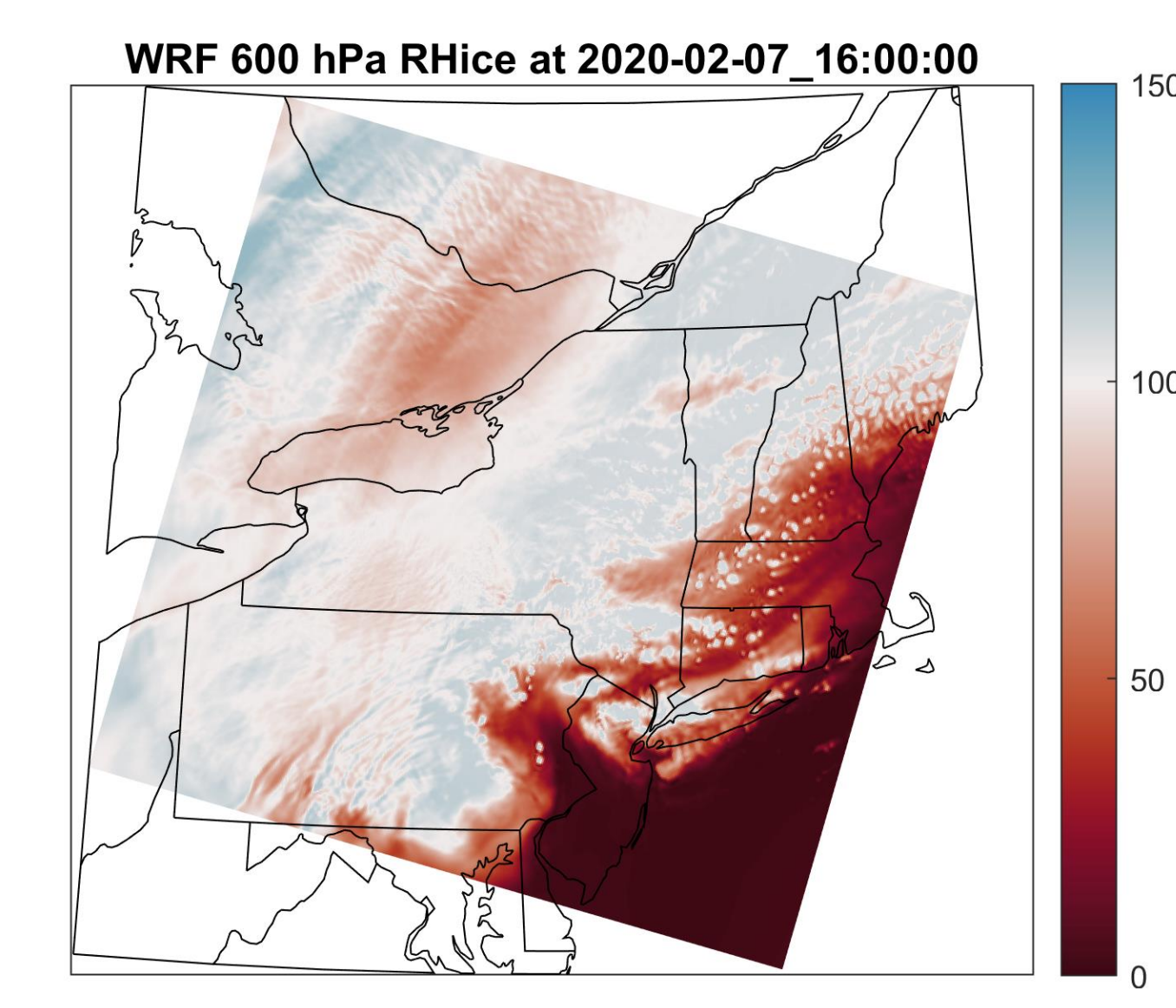
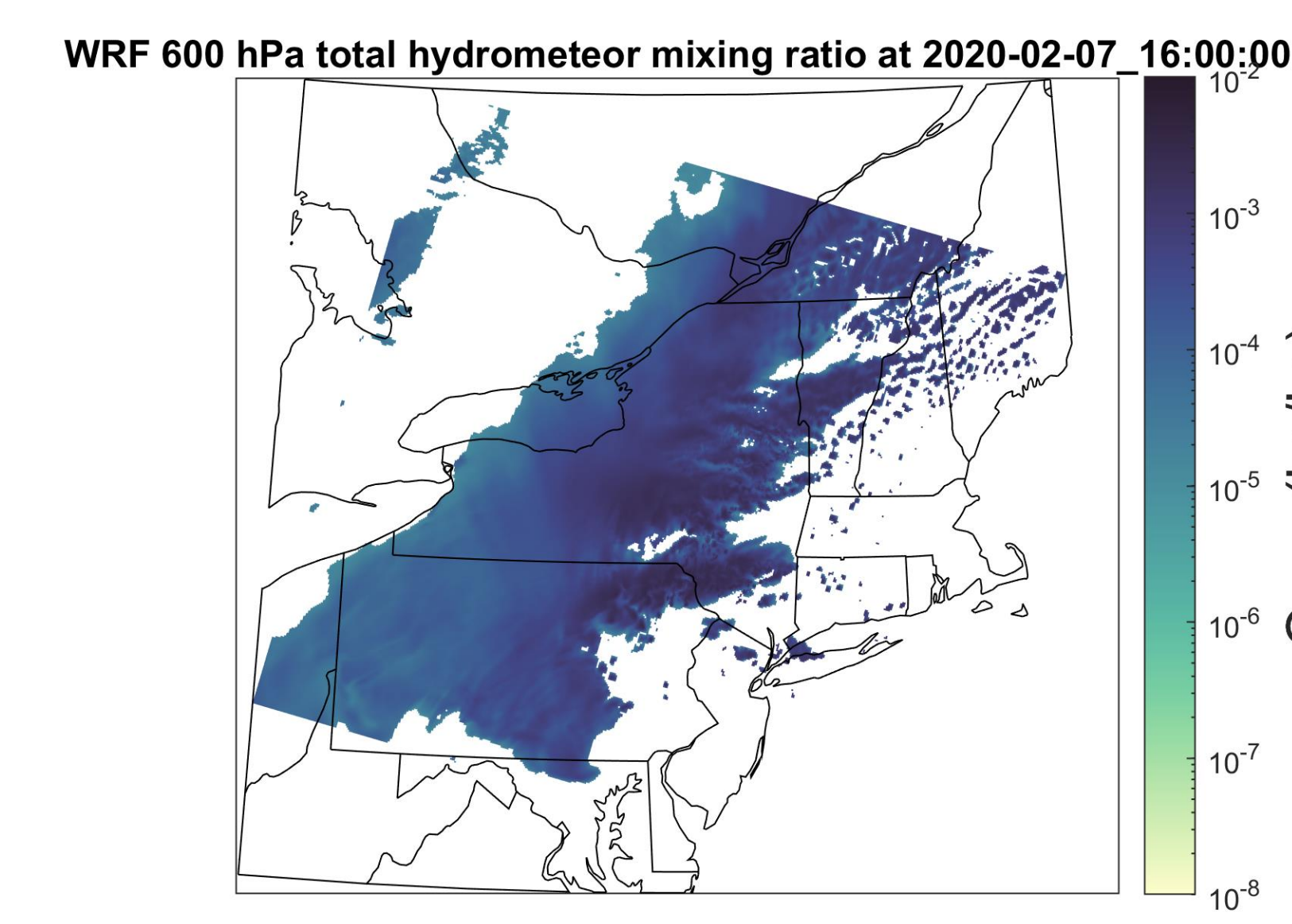


Northeast Storm



The two plots above only include points where $-35^\circ\text{C} < T < 0^\circ\text{C}$ and the cloud ice mixing ratio exceeds 0.01 g kg^{-1} .

600 hPa Total Hydrometeor Mixing Ratio and RH_{ice} : 2020/02/07 IMPACTS Case WRF Simulation



2 km grid spacing
Thompson microphysics