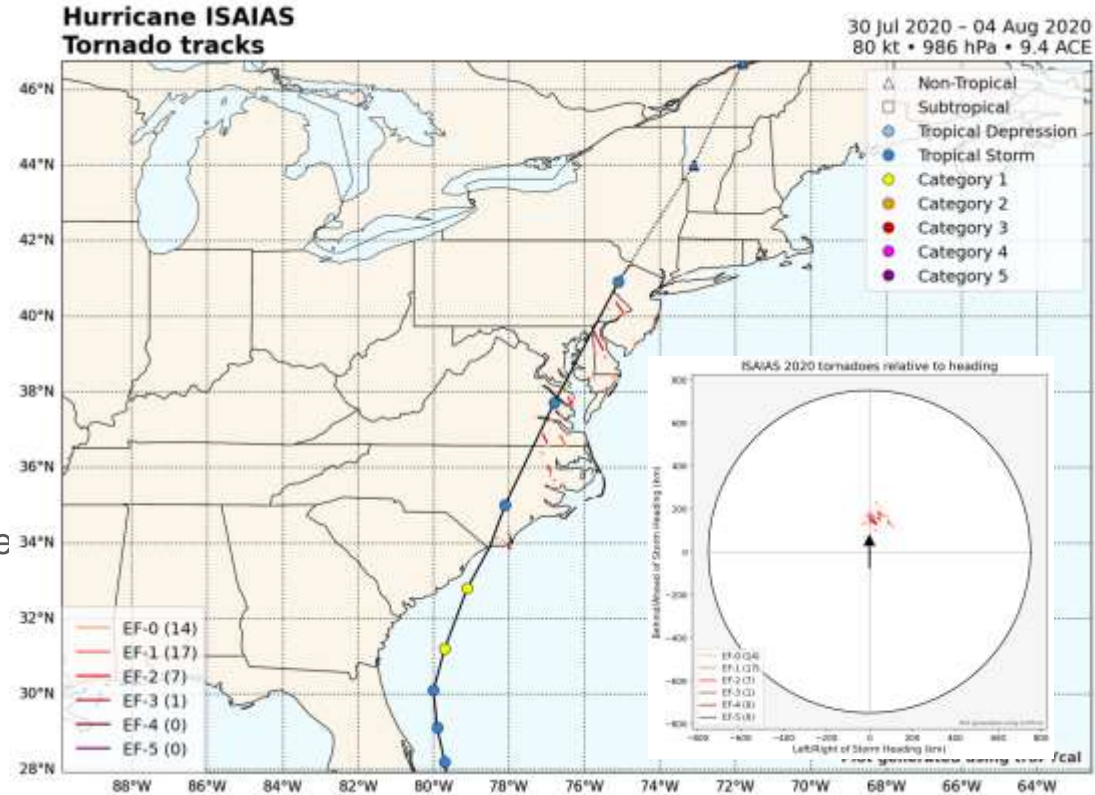


Lightning and Radar Characteristics of Tornadic Cells in Landfalling Tropical Cyclones

Benjamin A. Schenkel, Kristin M. Calhoun, The N. Sandmæl

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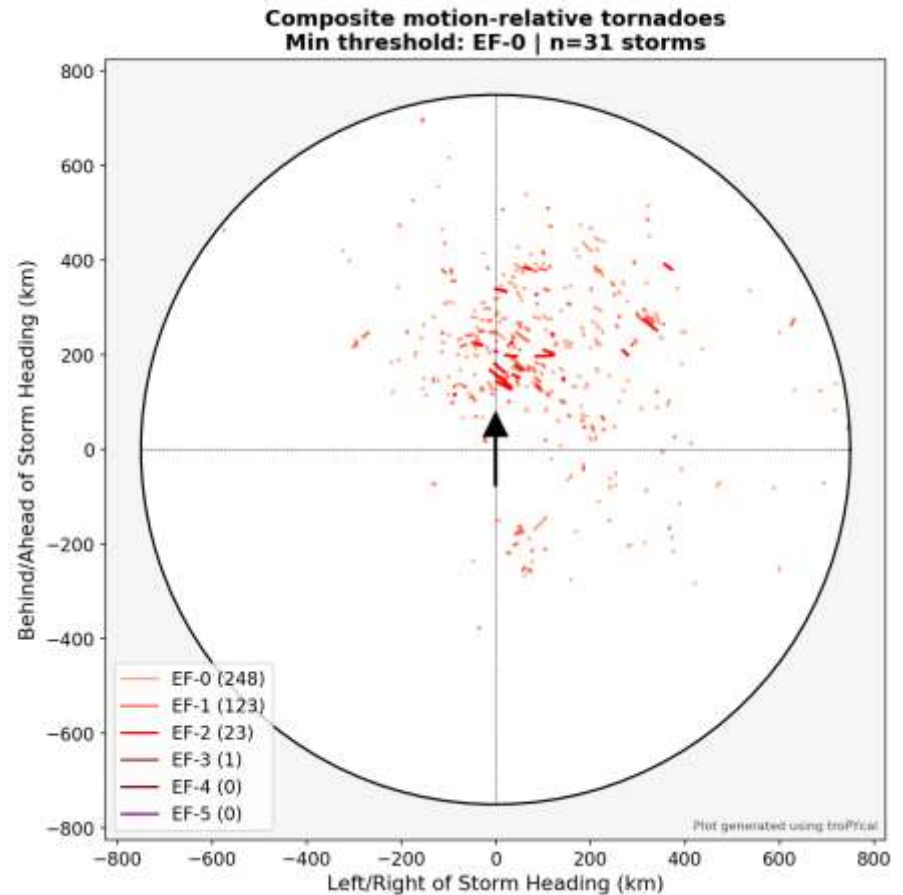


Schenkel, B. A., Calhoun, K. M., Sandmæl, T. N., Fruits, Z. R., Schick, I., Ake, M. C., & Kassel, B. F. (2023). Lightning and radar characteristics of tornadic cells in landfalling tropical cyclones. *Journal of Geophysical Research: Atmospheres*, 128, e2023JD038685. <https://doi.org/10.1029/2023JD038685>

Lightning and Radar Characteristics of Tornadic Cells in Landfalling Tropical Cyclones

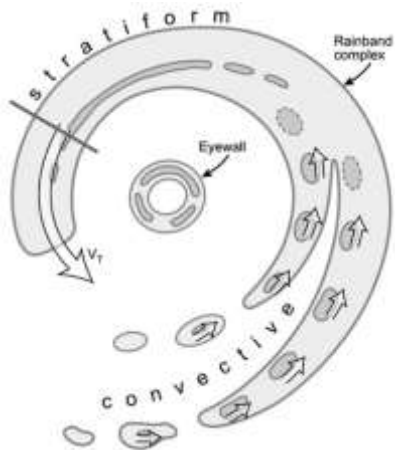
Benjamin A. Schenkel, Kristin M. Calhoun, Thea
N. Sandmæl

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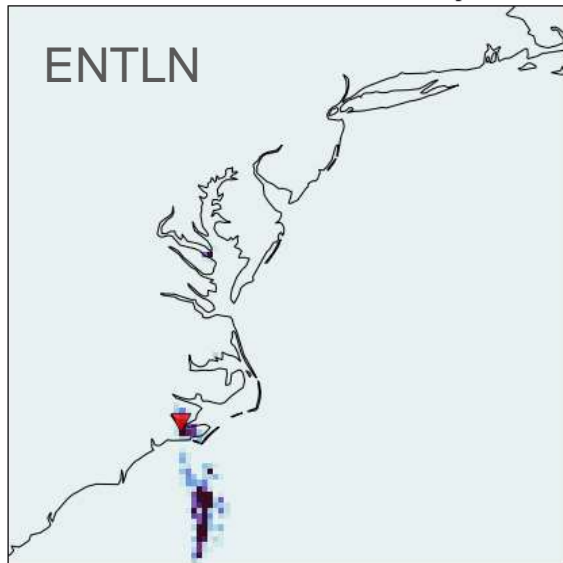


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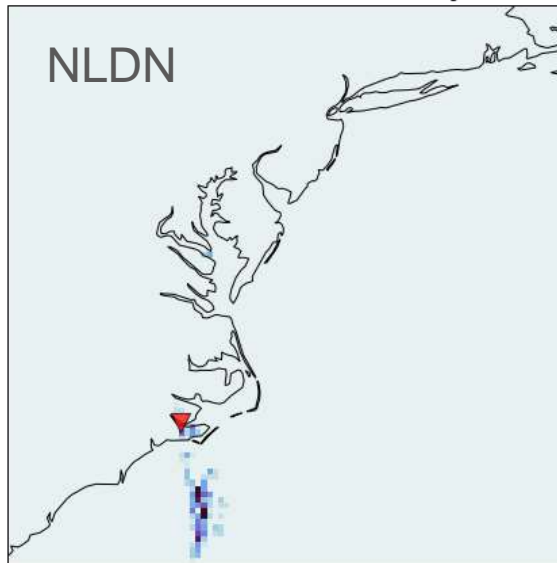
Hurricane Isaias - 4 Aug 2020



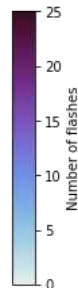
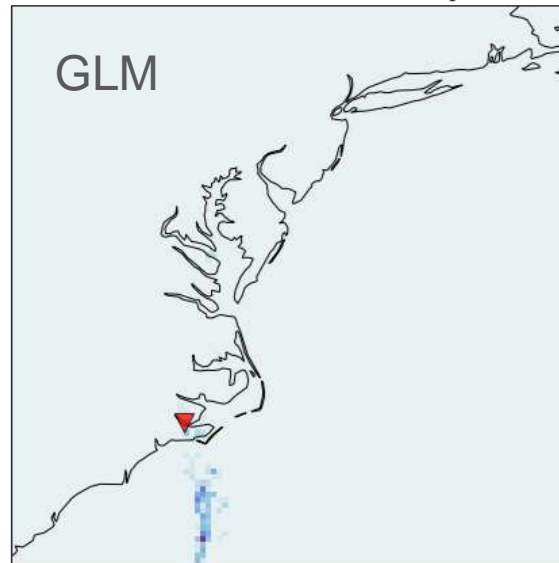
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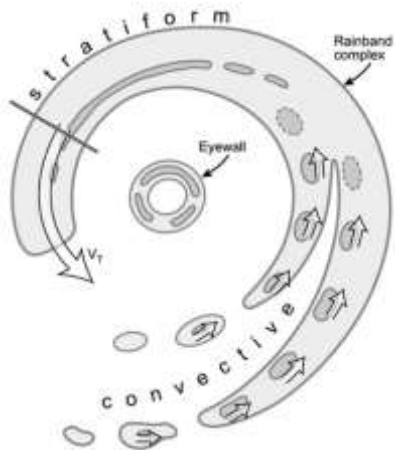
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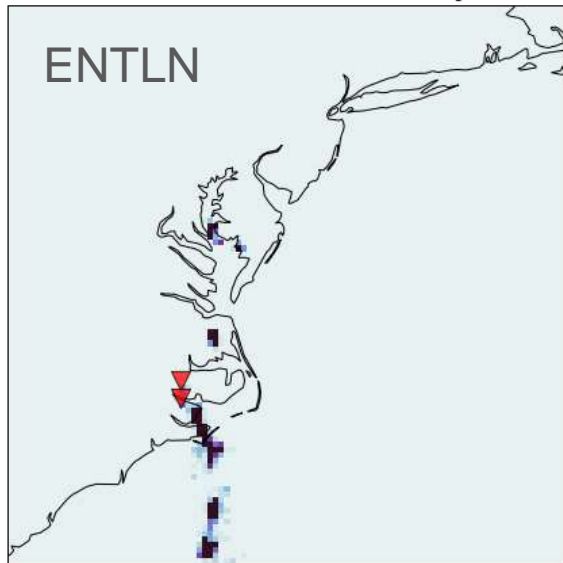
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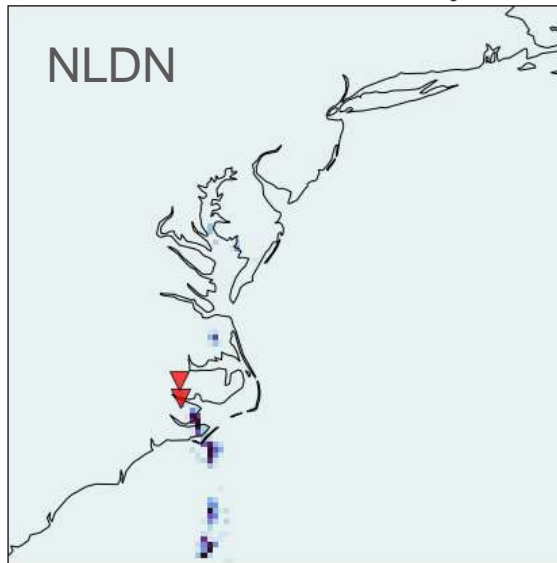
Hurricane Isaias - 4 Aug 2020



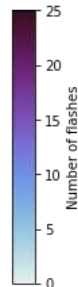
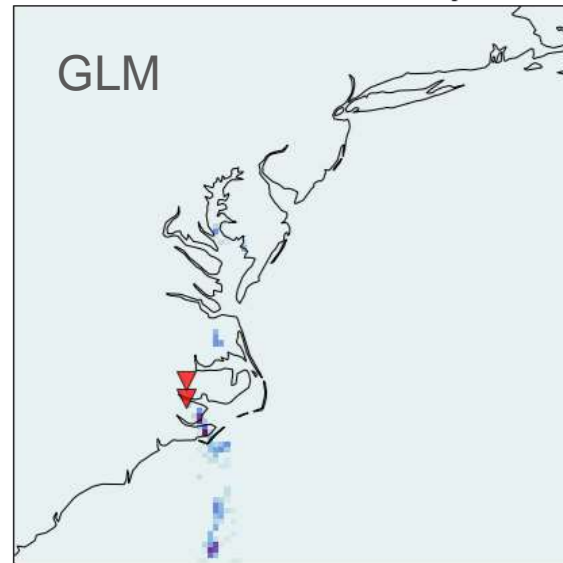
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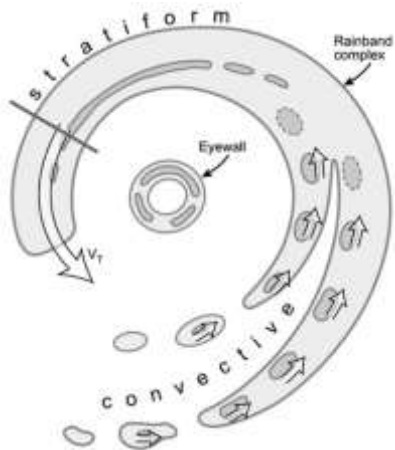
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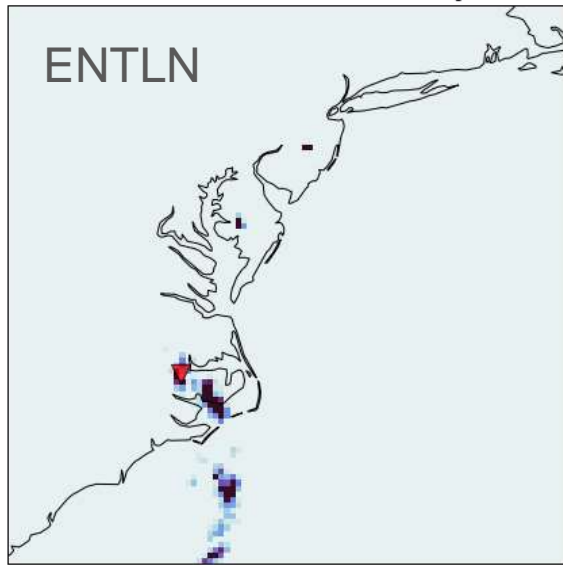
GLM: Hurricane Isaias (2020) - 0400 UTC 4 Aug 2020



Hurricane Isaias - 4 Aug 2020



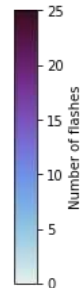
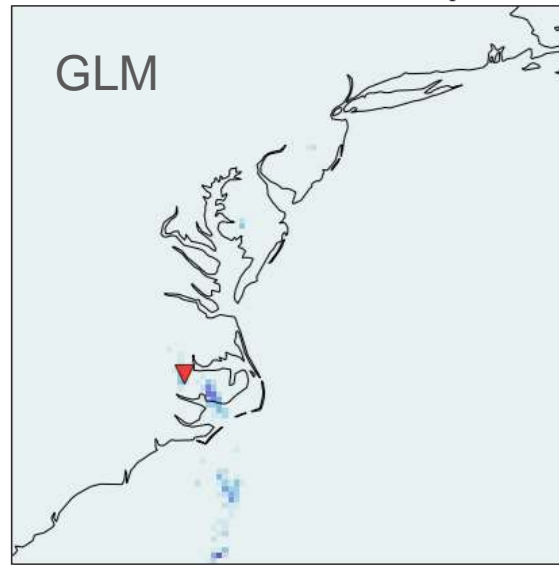
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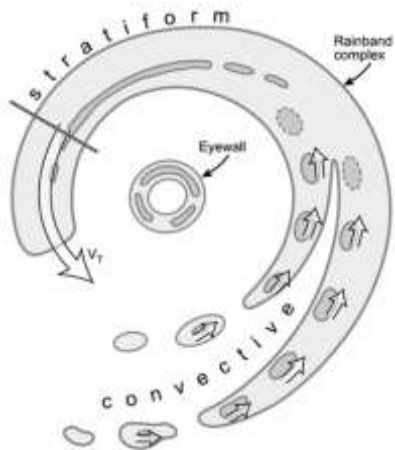
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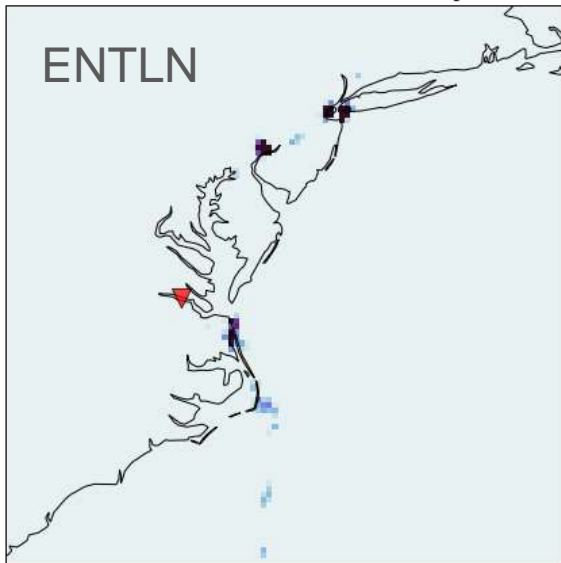
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Hurricane Isaias - 4 Aug 2020



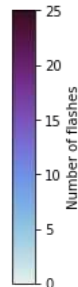
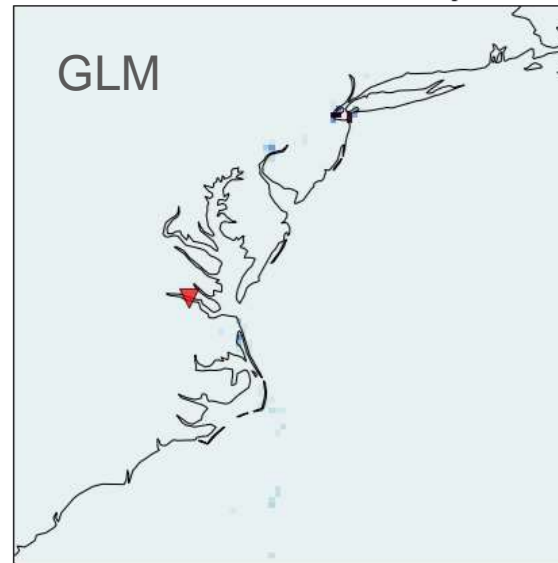
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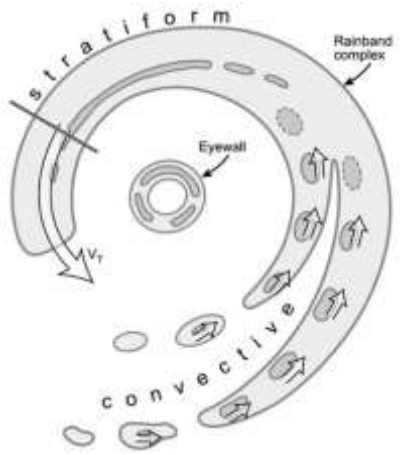
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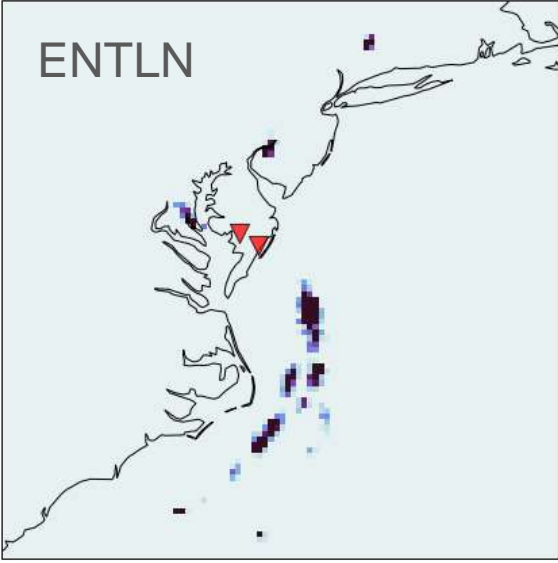
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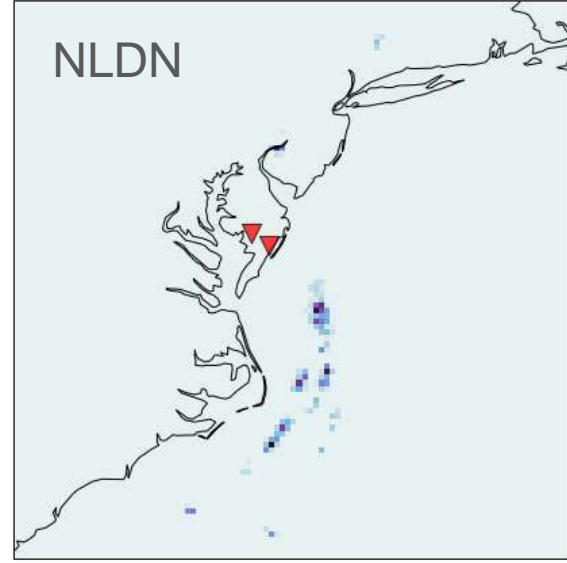
Hurricane Isaias - 4 Aug 2020



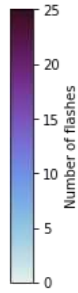
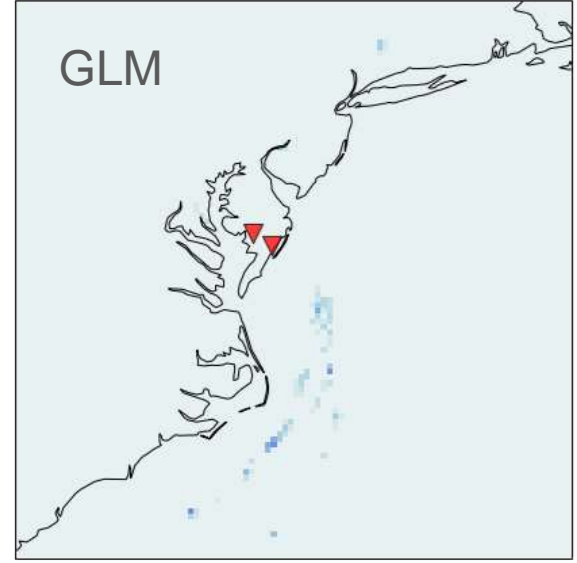
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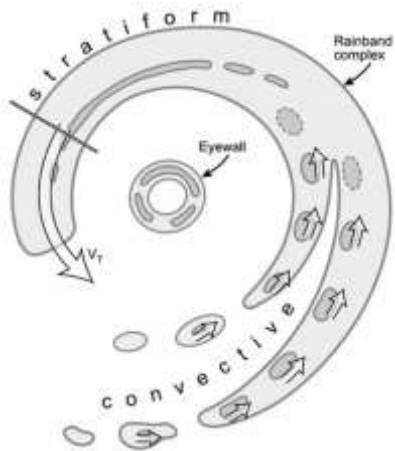
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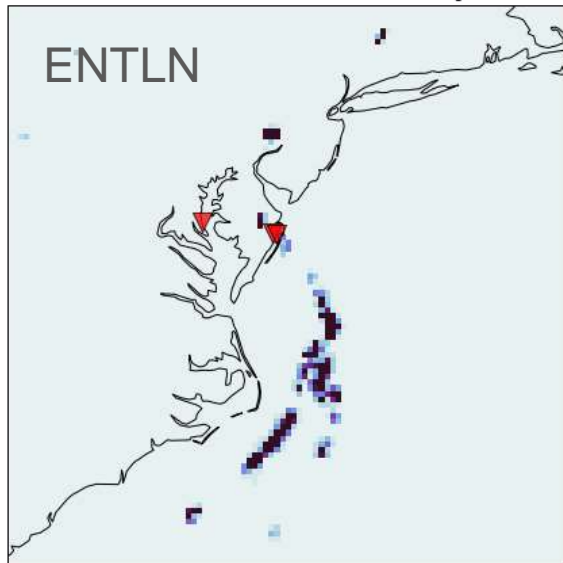
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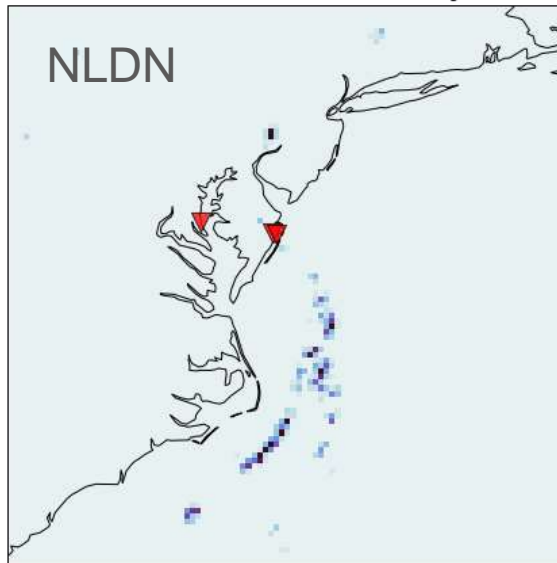
Hurricane Isaias - 4 Aug 2020



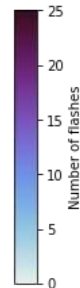
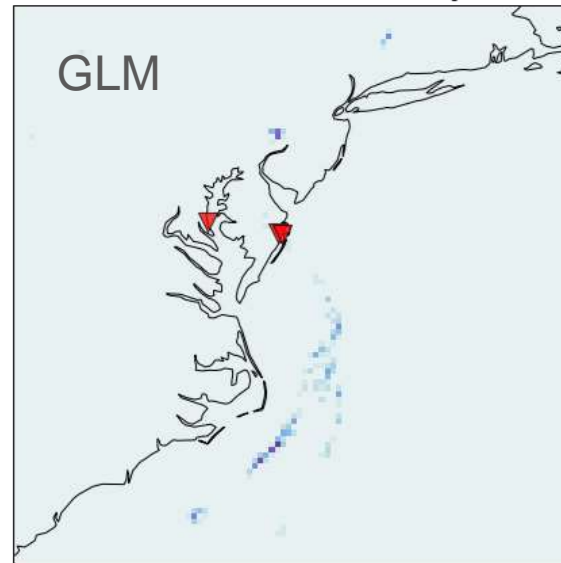
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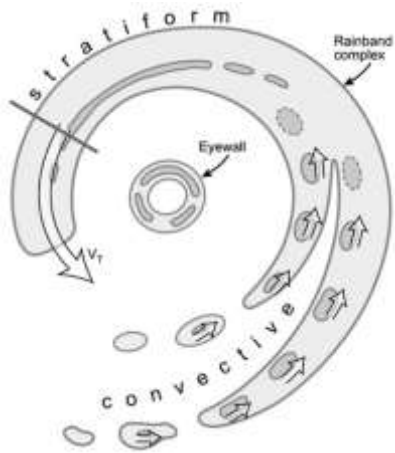
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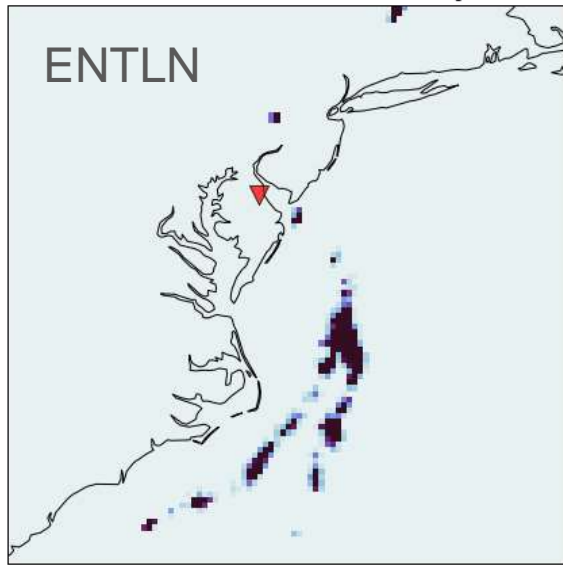
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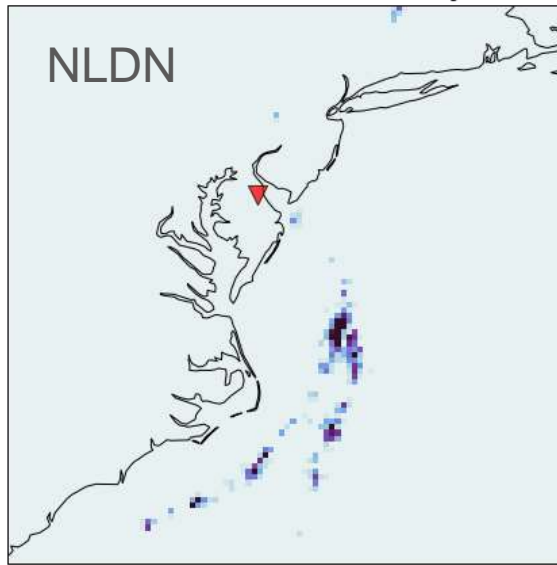
Hurricane Isaias - 4 Aug 2020



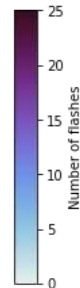
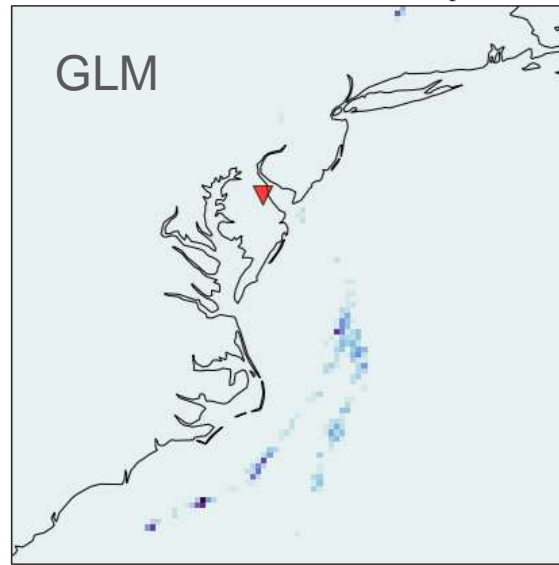
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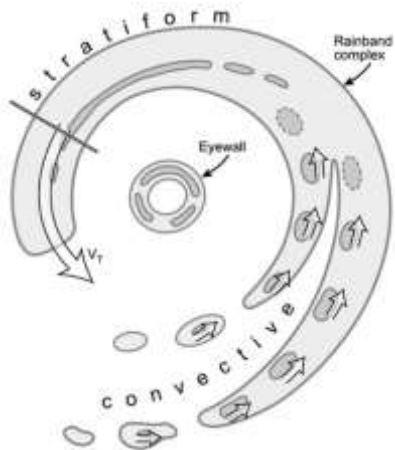
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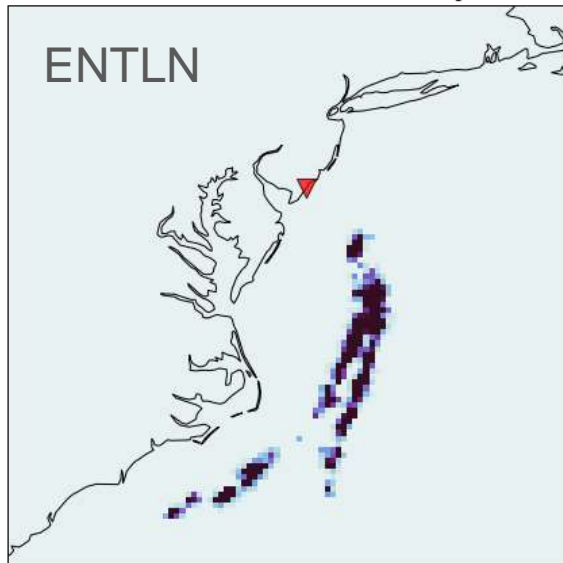
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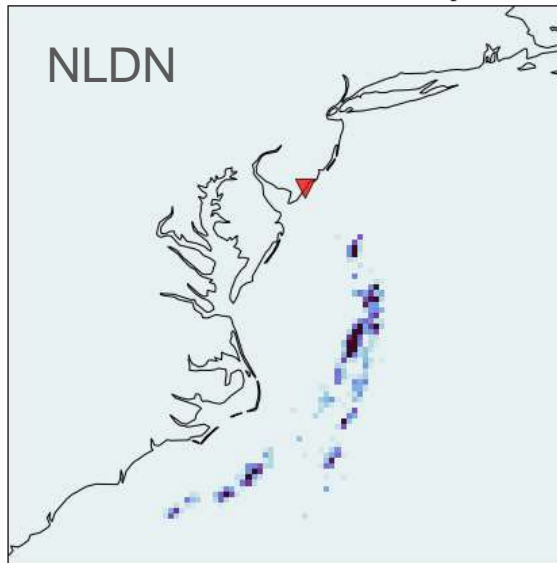
Hurricane Isaias - 4 Aug 2020



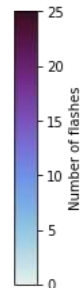
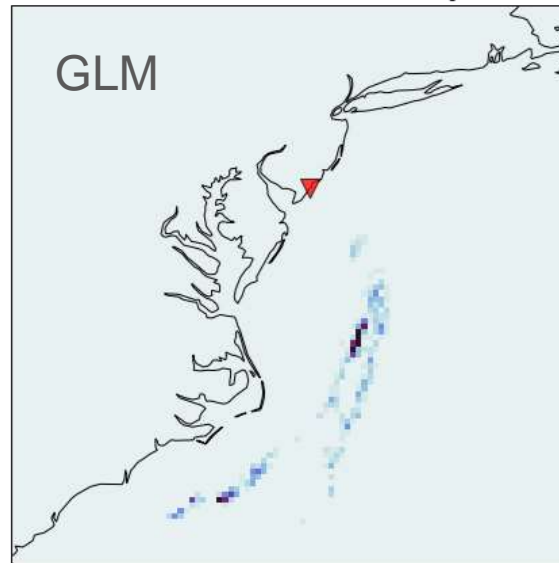
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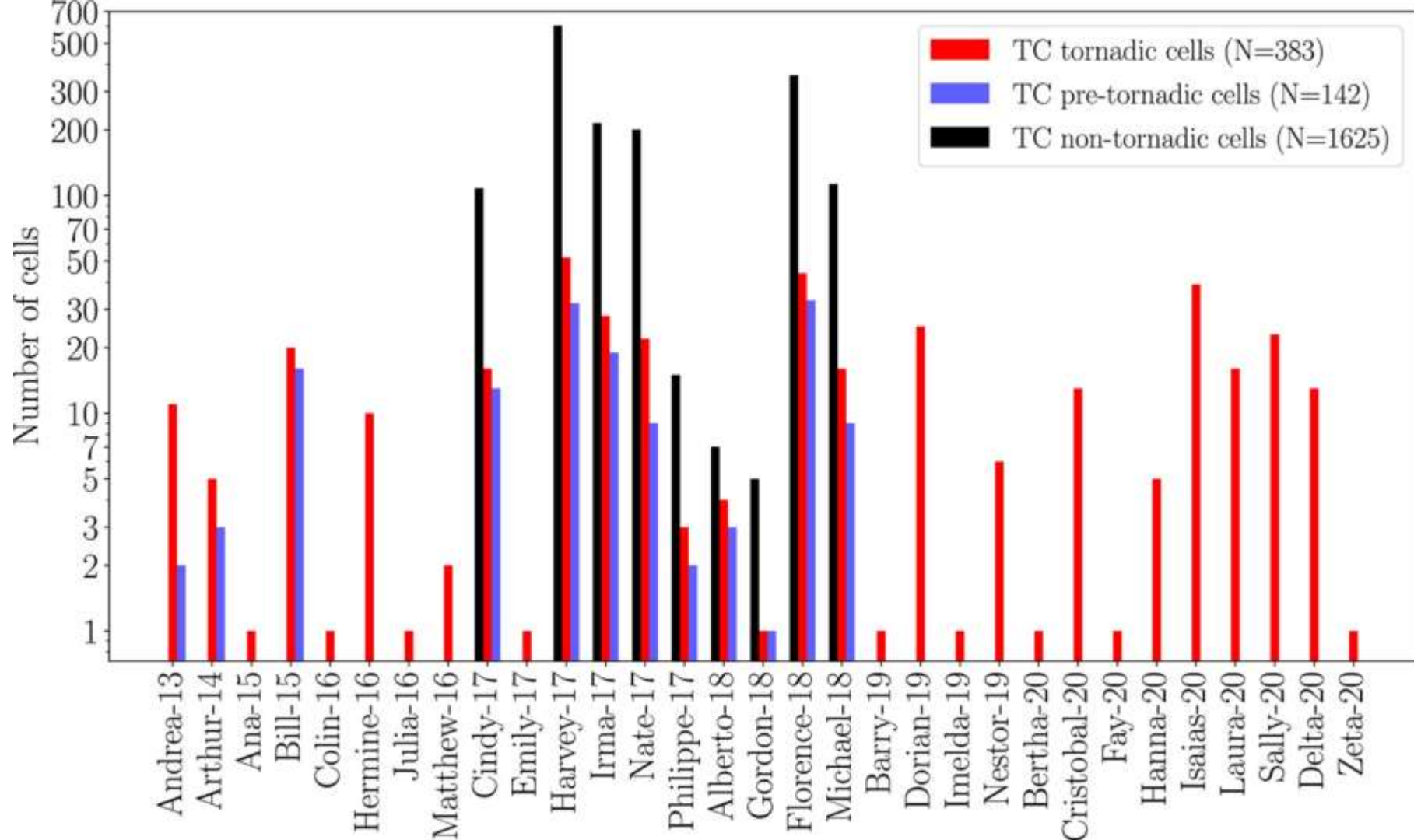


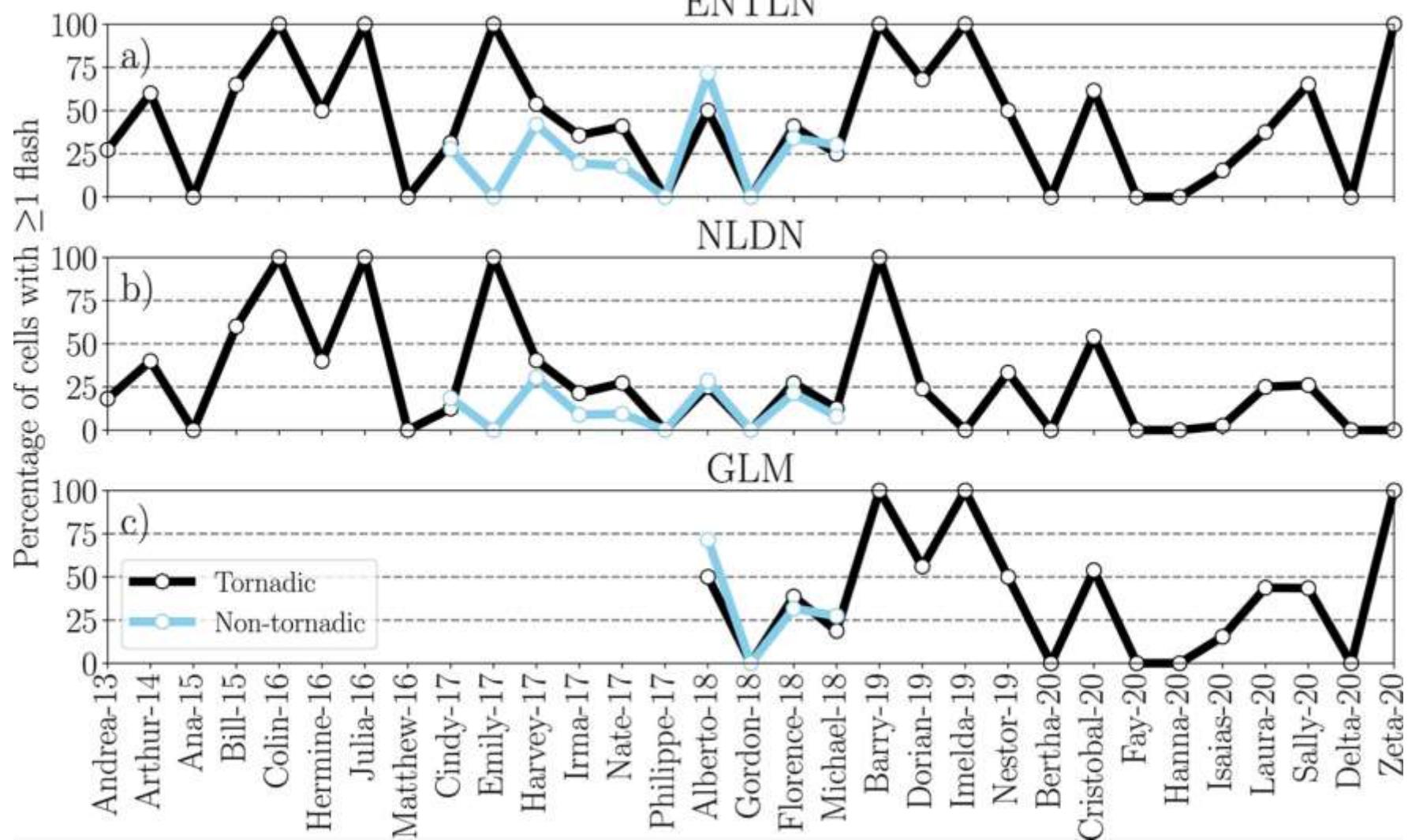
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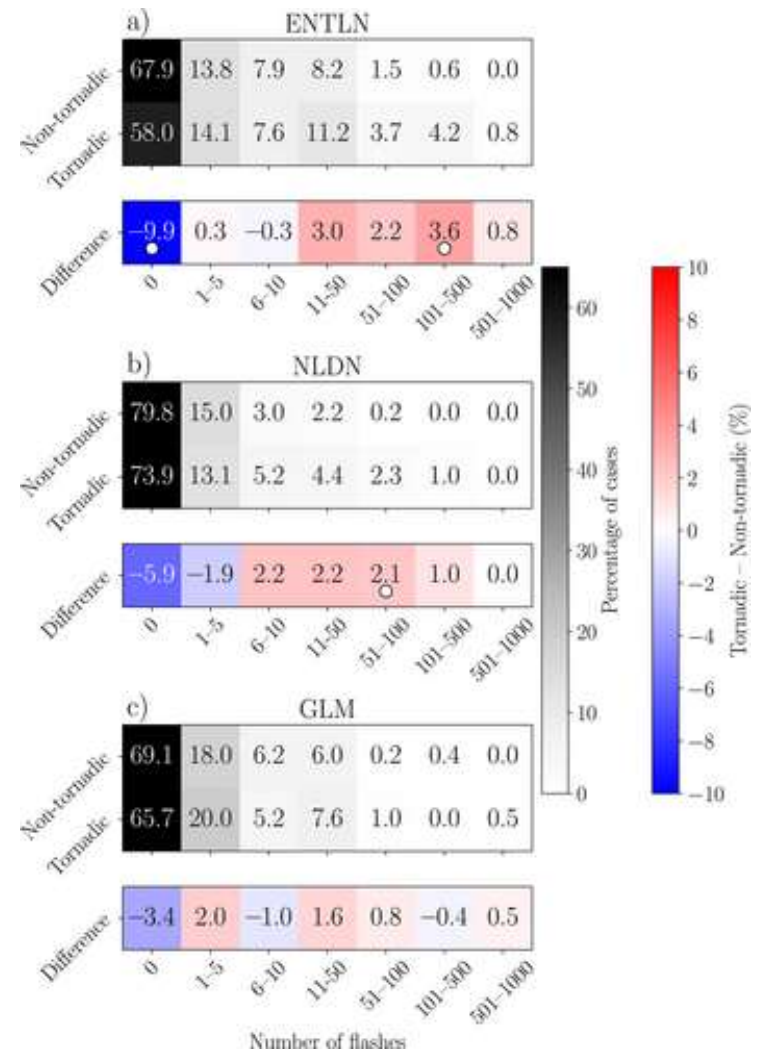


Some bulk stats (spoilers):

Most tropical cyclone tornadic (58%–74%) and non-tornadic (68%–80%) cells have no lightning (from any network).

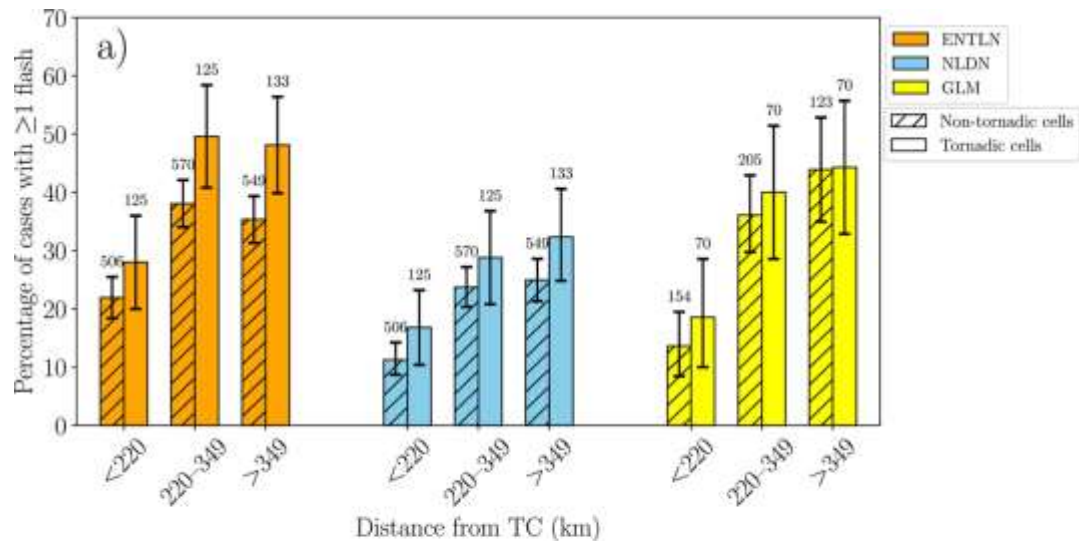
For the minority of tornadic cells with lightning, the ENTLN shows the highest percentage of cases with ≥ 1 flash (42% of cases) followed by the GLM (34%) and the NLDN (26%).

Tornadic cells are associated with more lightning (higher flash rates) more often.



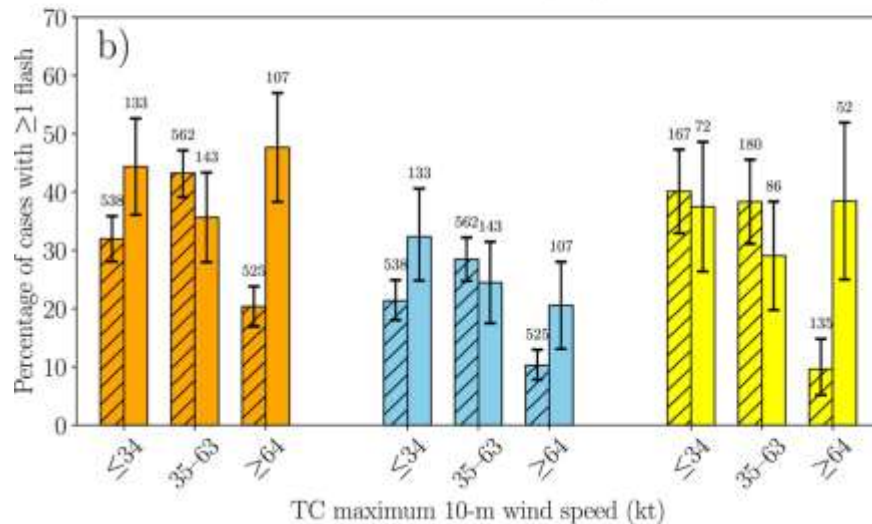
Both tornadic and non-tornadic cells tend to be associated with lightning more frequently as the distance from the TC center increases.

(Right: Distance of the tornadic and non-tornadic cells from the center of the tropical cyclone)



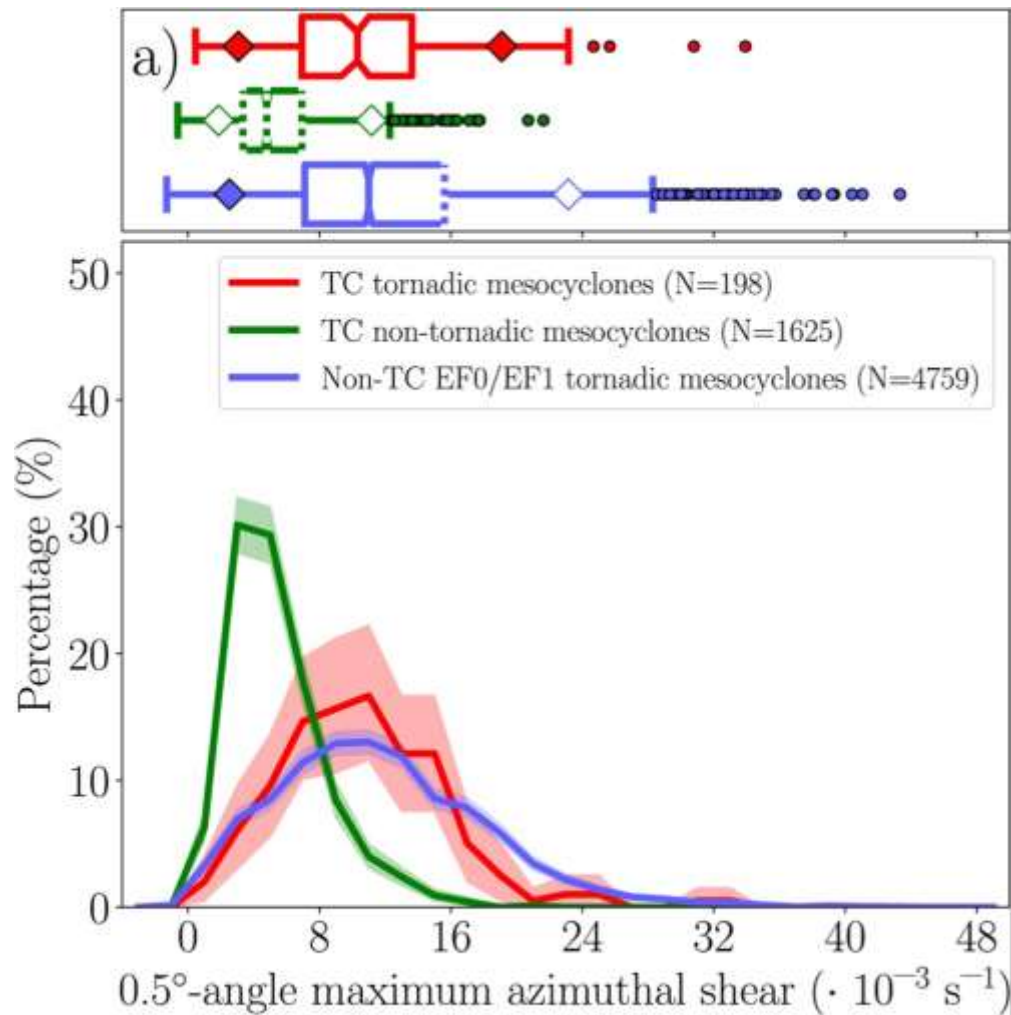
Tornadic cells in hurricane-strength TCs are associated with lightning more often than non-tornadic cells.

(Right, lower: TC intensity (kt) at the time of cell occurrence - tropical depression, tropical storm, and hurricane)



0.5° elev angle max azimuthal shear

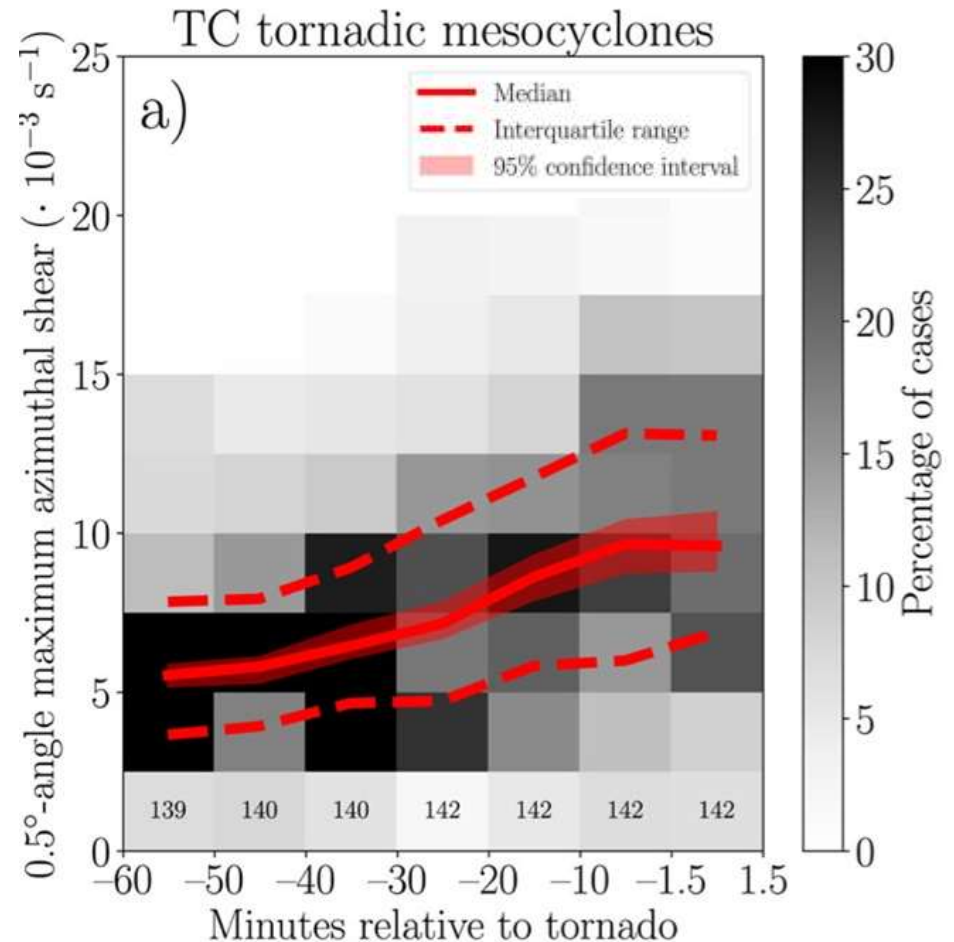
Med values of the maximum azimuthal shear values for TC tornadic mesocyclones > x2 larger compared to TC non-tornadic mesocyclones

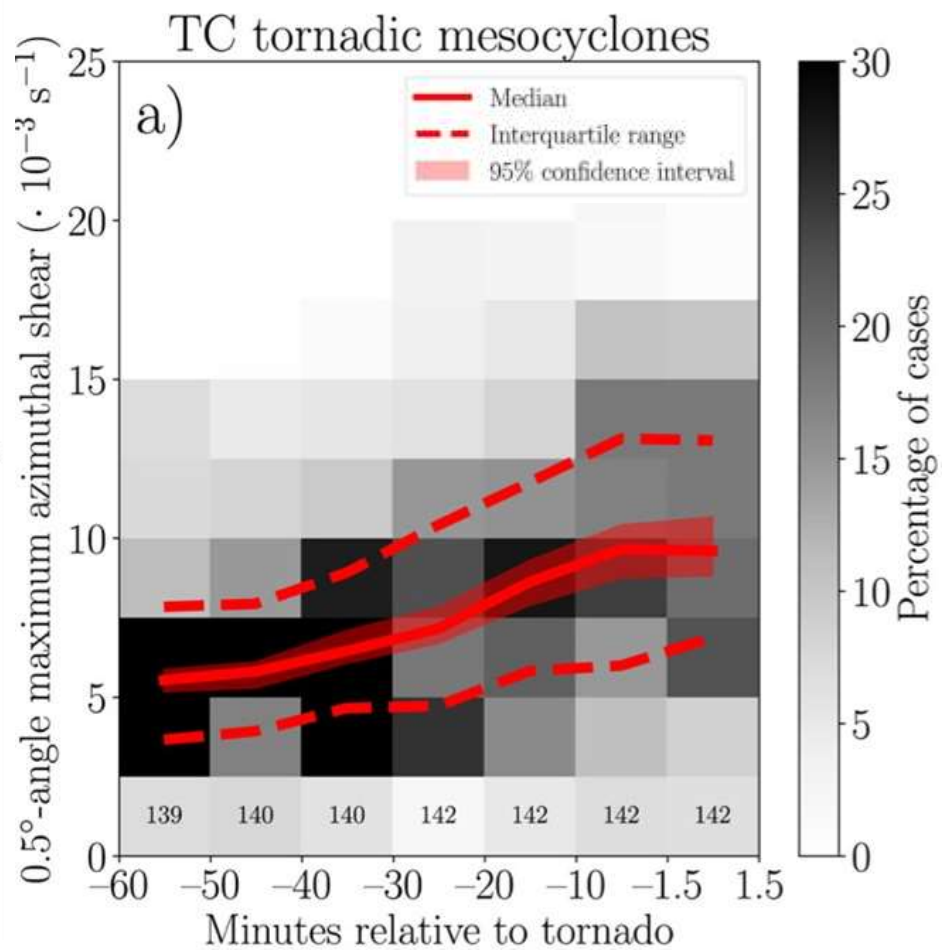
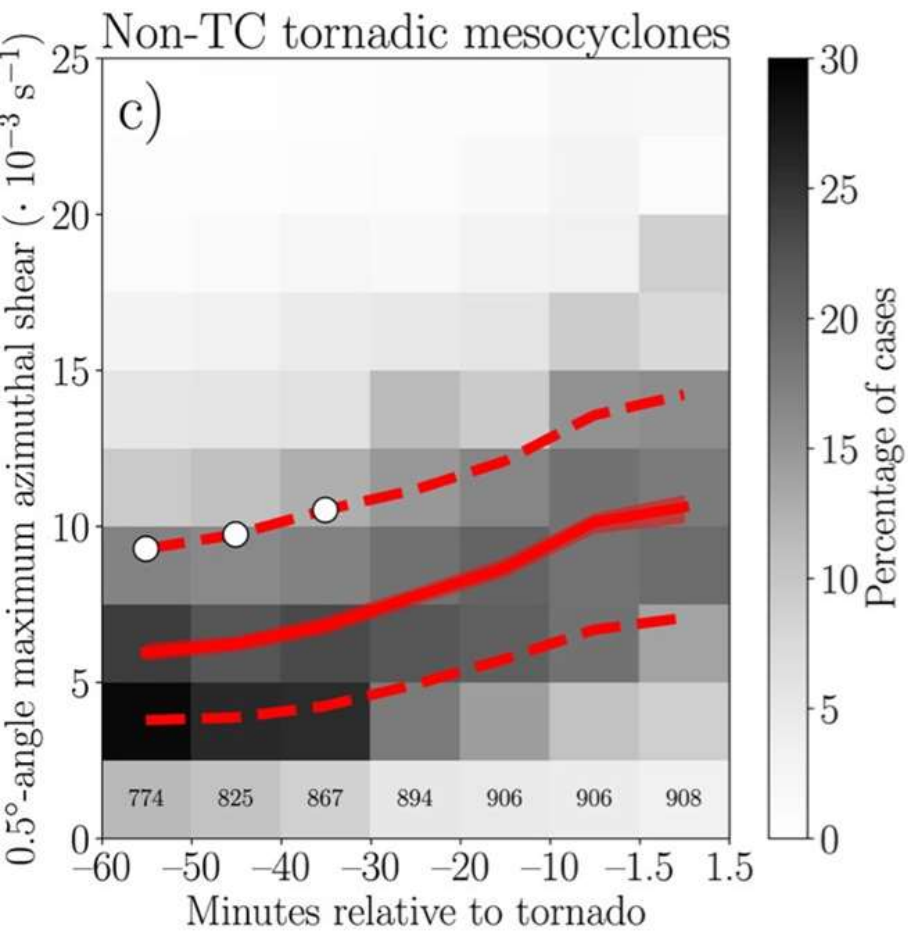


0.5° elev angle max azimuthal shear

Increasing az shear values for 30 min prior to tornado occurrence.

Slightly faster slope in this period compared to overall sample of similarly strong non-TC mesocyclones.

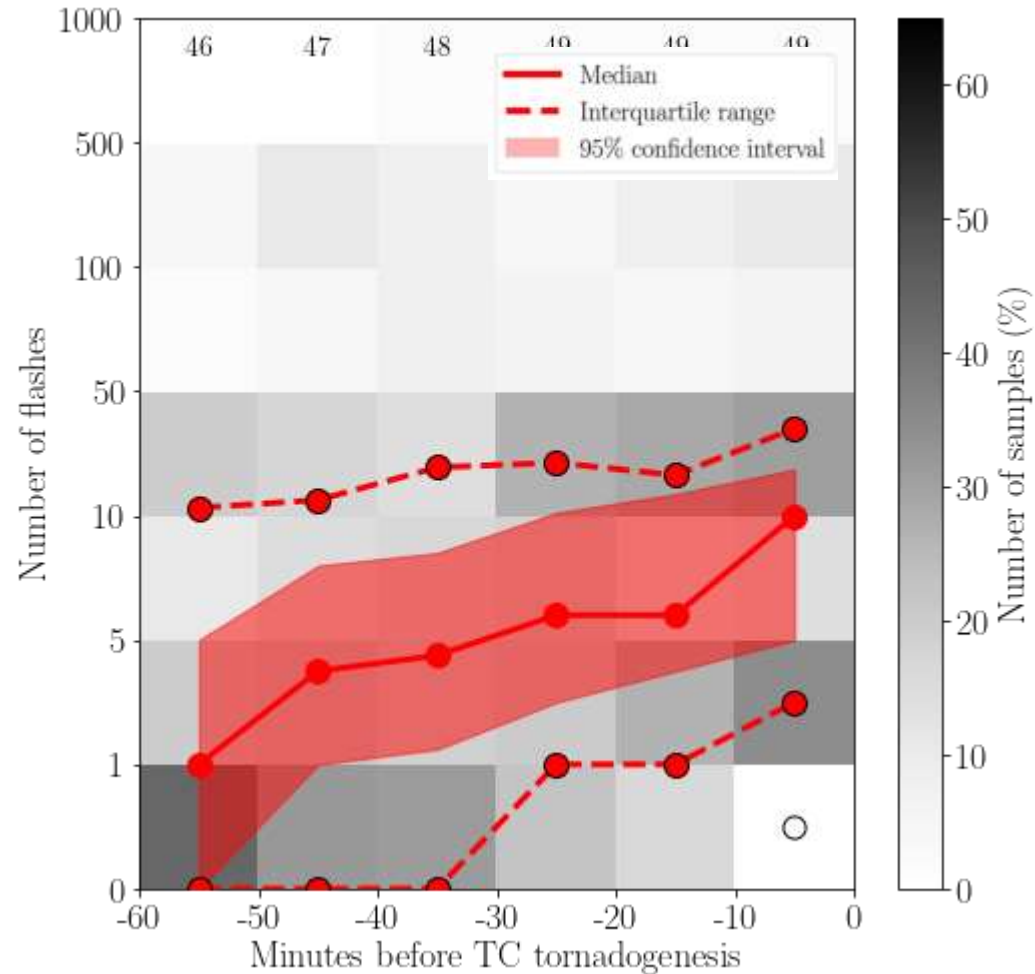




Lightning rates relative to tornadogenesis

For cells that produce at least 1 flash in the hour prior to tornadogenesis:

Weakly trending up, but lower % of storms than in AzShear trends



Conclusions

1. TC tornadic cells are not typically associated with lightning. However, TC tornadic cases are associated with lightning more frequently than non-tornadic convection.

Variability associated with distance from the TC center, TC size, and TC intensity.

1. When lightning is present, location of flashes differs: lightning concentrated to the NE area of tornadic cells, whereas lightning is distributed more symmetrically around non-tornadic cells.

TC tornadic cells are more likely associated with ≥ 1 flash, especially ≥ 100 flashes, in the 10 min before tornado occurrence that are more strongly concentrated to the northeast of the cell.

1. TC tornadic mesocyclones are typified by stronger 0.5° -elevation angle maximum azimuthal shear (than non-tornadic mesocyclones) that increases close to tornadogenesis

Tornadic mesocyclones in TCs tend to have slightly weaker low-level rotation and convergence followed by more rapid increases during the hour before the tornado