

Towards an Updated Climatology of Overland Tropical Cyclone Maintenance and Intensification Events

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Background

We seek to update the prior climatology of Andersen and Shepherd (2014), who produced a climatology of tropical cyclone events that maintained/intensified overland to better understand the nature of the surface enthalpy fluxes that are believed to support these events.

There are two competing hypotheses on where these overland tropical cyclones gain their enthalpy fluxes:

- Emanuel et al. (2008): sandy soils moistened by rain under the cyclone
- Evans et al. (2011): wet soils under the cyclone's inflowing trajectories

Methods

This climatology uses the global International Best Track Archive for Climate Stewardship (Knapp et al. 2010) dataset to determine candidate cyclones from 1980 to 2021. ERA5 reanalysis data (Hersbach et al. 2020) is used to assess the candidate cyclones' large-scale environments.

Overland tropical cyclone maintenance and intensification events must meet the list of criteria in Fig. 1.

- Tropical in nature refers to classifying the temperature gradients across a tropical cyclone and within their environments.
- Accomplished by evaluating the mean 900-600 hPa thickness in two semicircles with a radius of 500 km across the cyclone's left-of-track and right-of-track halves (Fig. 2).

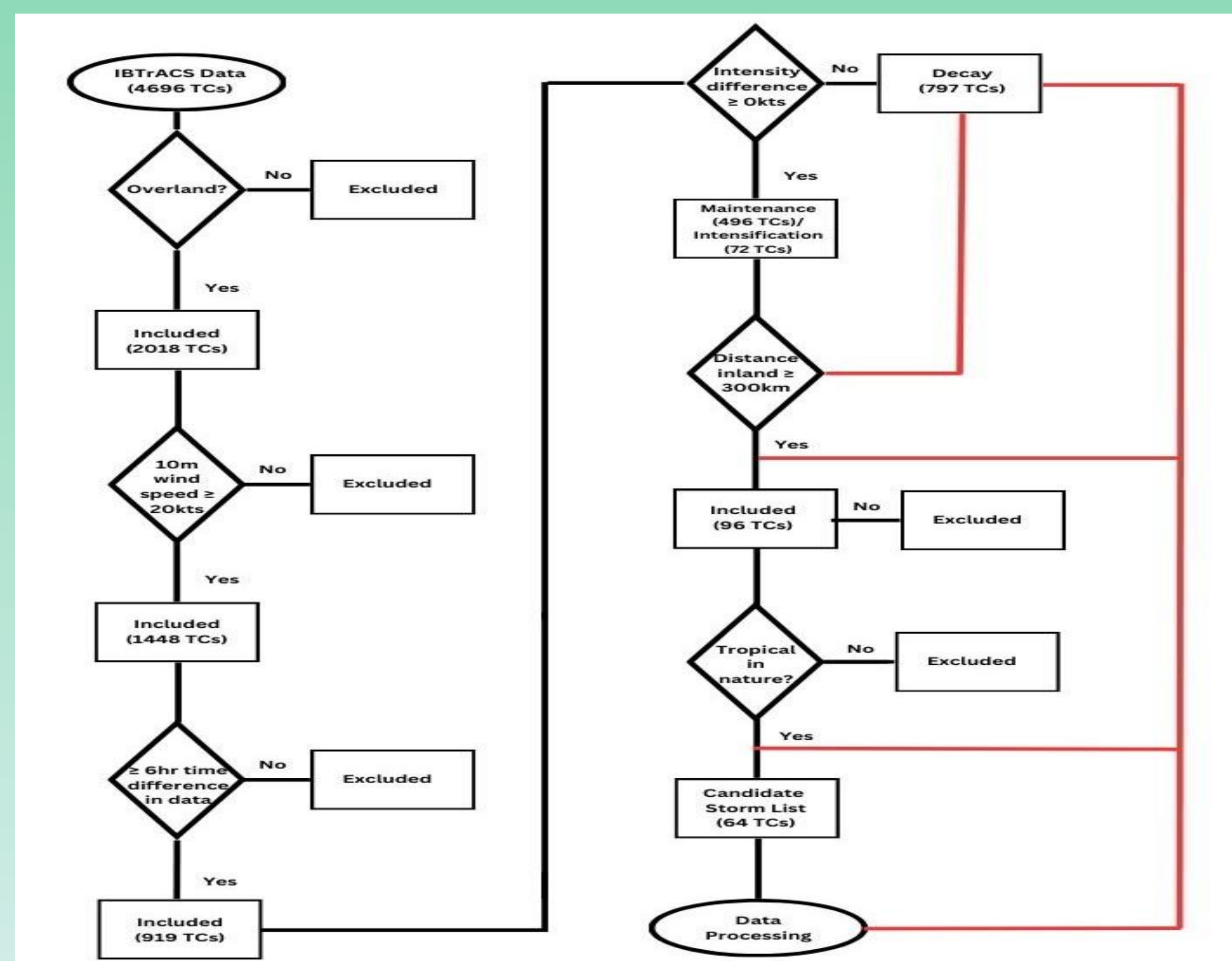


Fig. 1: The decision structure used for determining candidate storms.

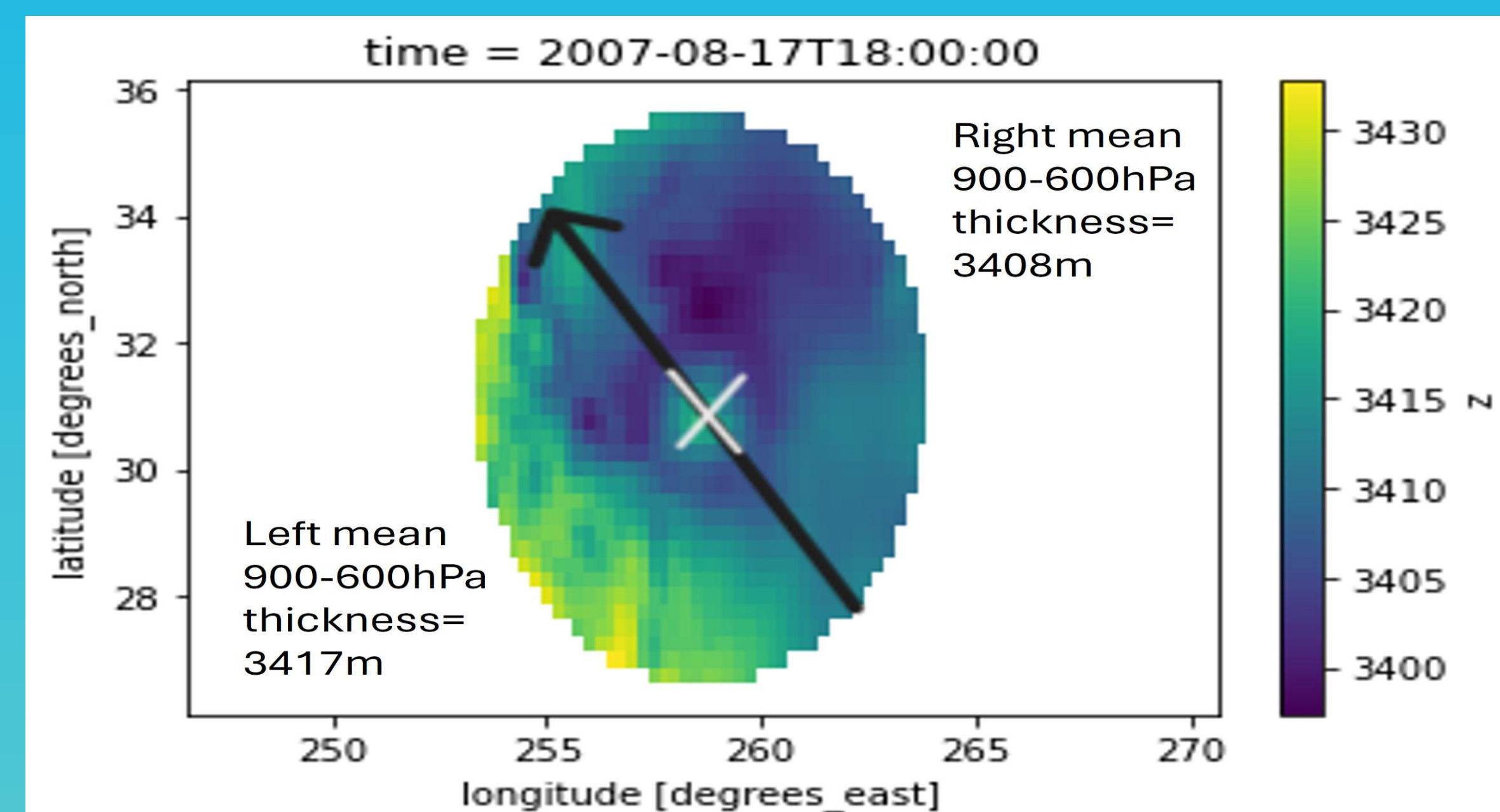


Fig. 2: 900-600 hPa thickness within a 500-km radius of North Atlantic Tropical Cyclone Erin (2007) at 1800 UTC 17 August 2007.

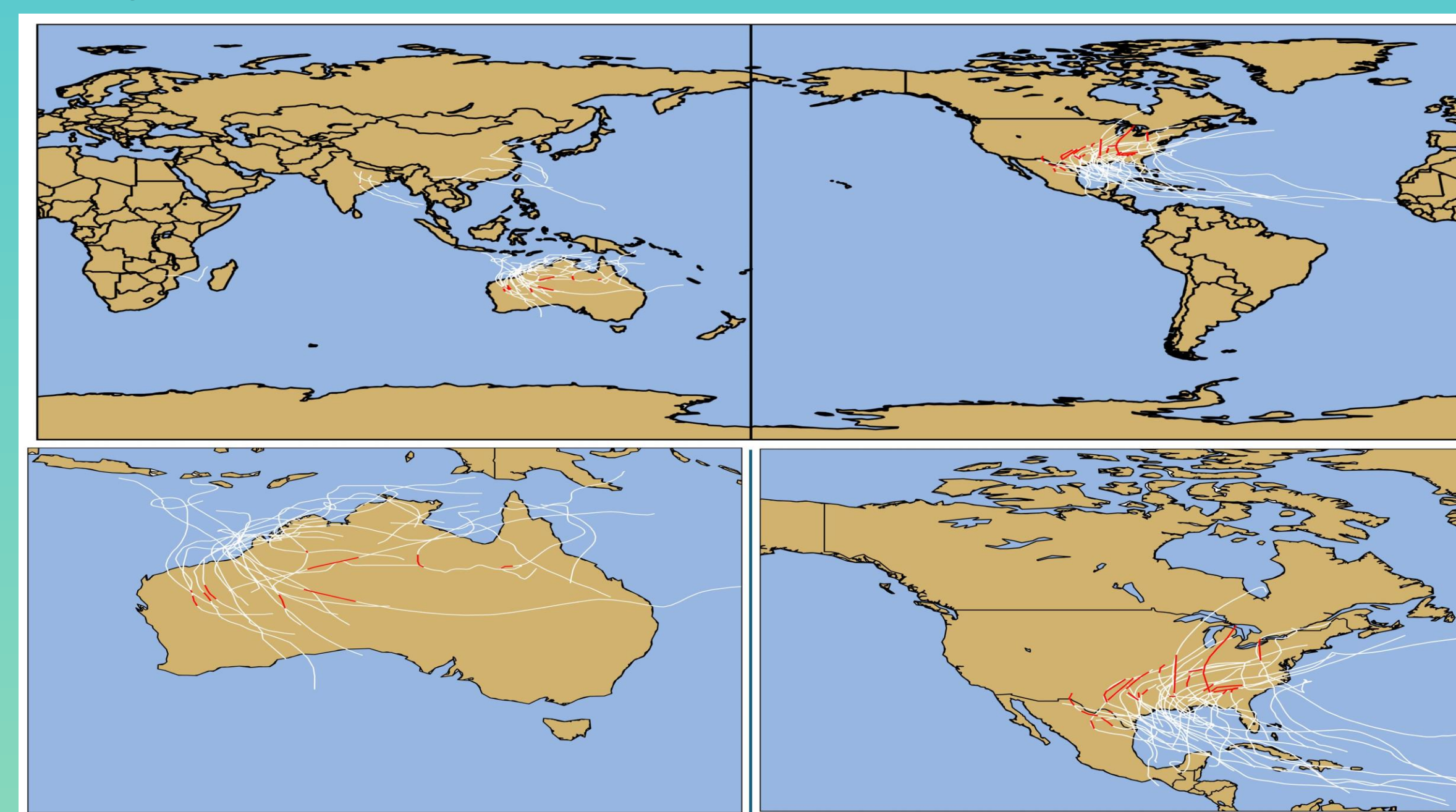


Fig. 3: Global tracks of candidate cyclones (top) and tracks over Australia (bottom left) and North America (bottom right). Red tracks depict maintenance/intensification.

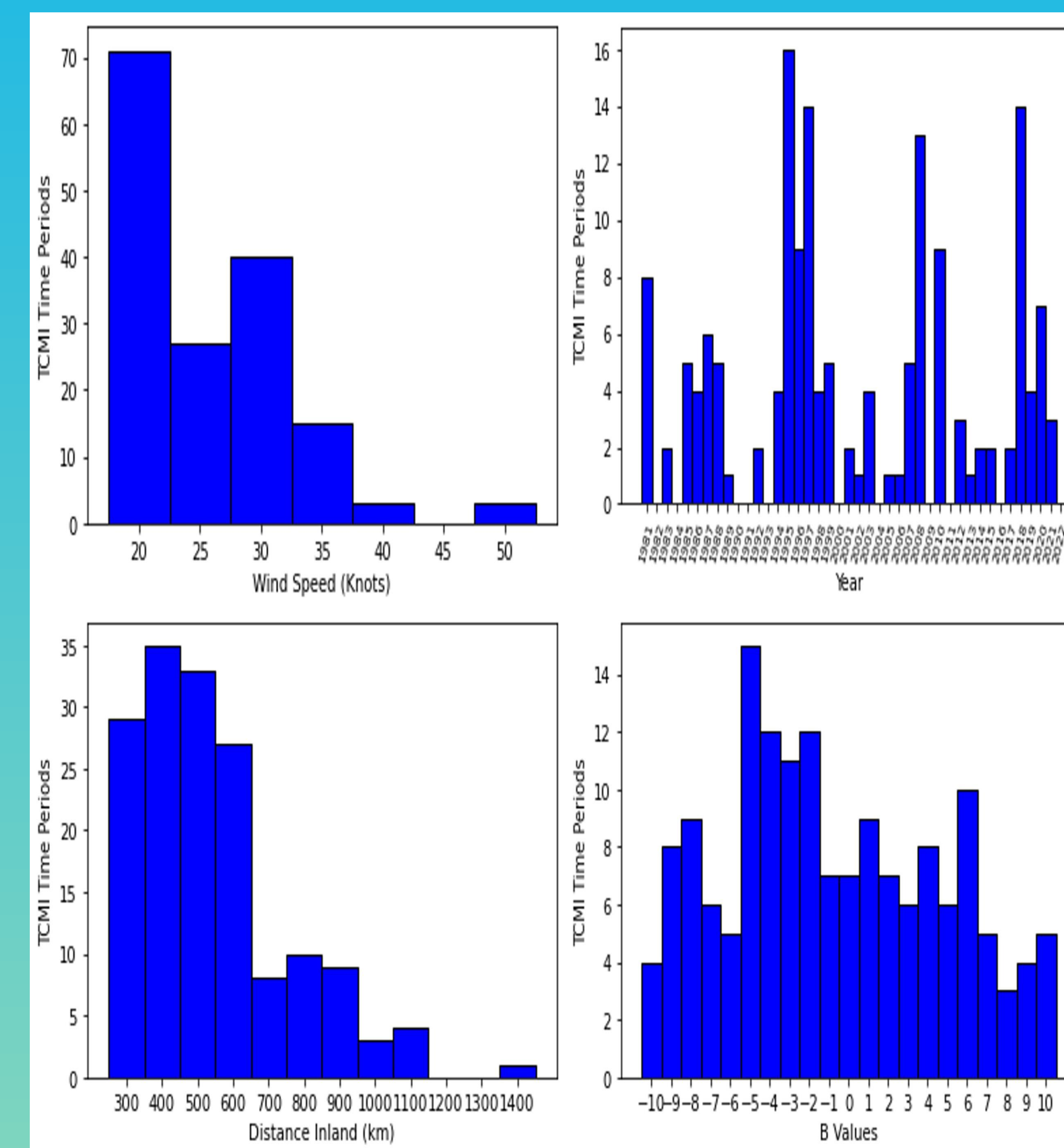


Fig. 4: Histograms depicting candidate cyclones' intensity (top left), years of occurrence (top right), distance inland (bottom left), and large-scale environment (bottom right).

Preliminary Results

Our preliminary results have retained 64 unique tropical cyclones from the original 4696 tropical cyclones in the dataset (Figs. 3-4). These candidate cyclones are characterized by 62 maintenance events and 2 intensification events, a mean intensity of 26 kts, a mean sea-level pressure of 1000 hPa, and a mean distance to the nearest coast of 538 km.

Future Work

We will then document the land-surface properties that control surface enthalpy fluxes such as soil type, soil moisture, and soil temperature in two areas, the region recently wetted by the cyclones' rainfall and the cyclones' inflow region, using:

- ERA5 reanalysis data
- 0.05° MODIS Land Cover Climate Modeling Grid for soil type data (MCD12C1)
- Hybrid Single-Particle Lagrangian Integrated Trajectory Model (HYSPLIT; Stein et al. 2015)

References

- This research was supported by the National Science Foundation under award AGS-1911671
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