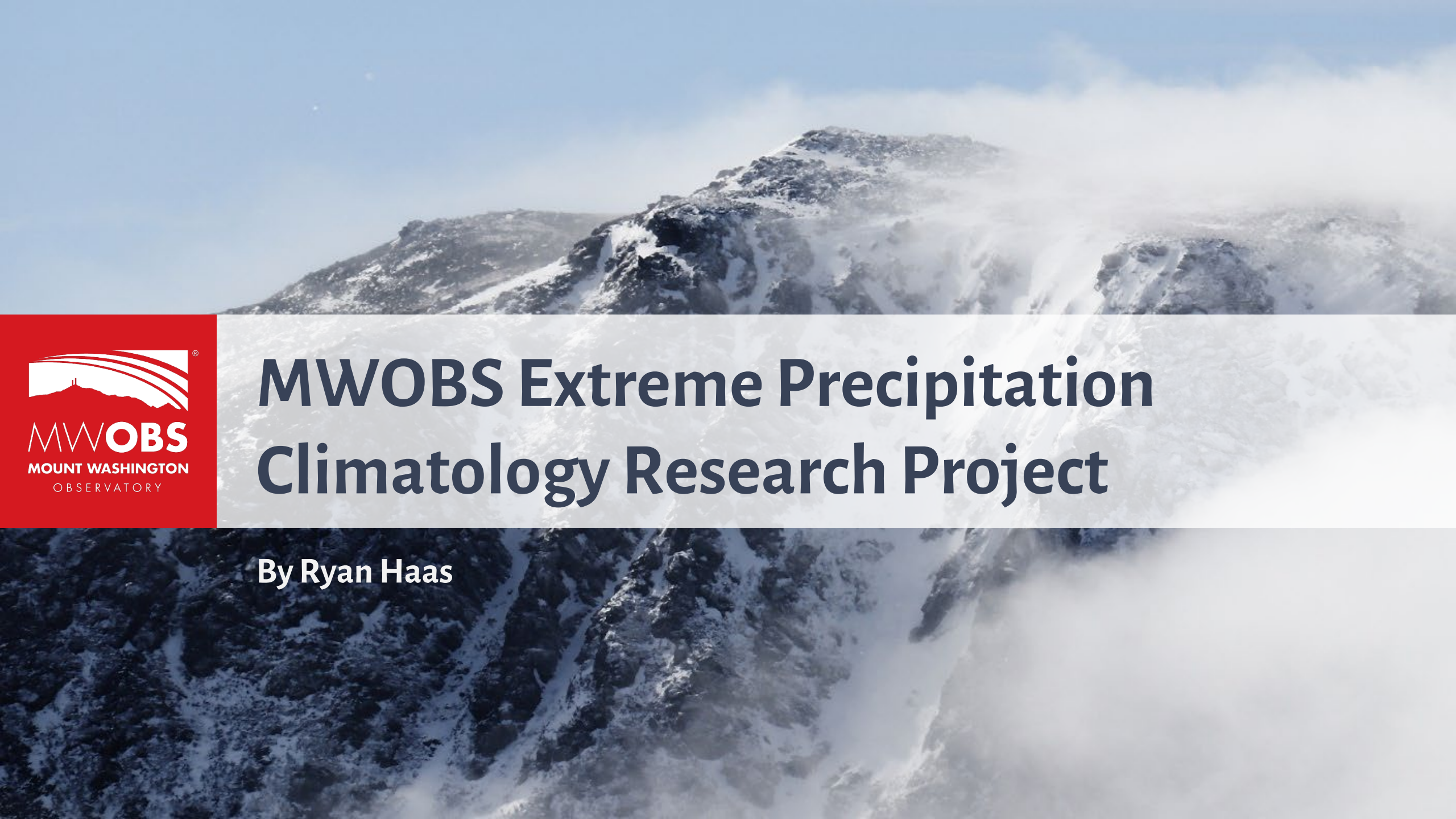

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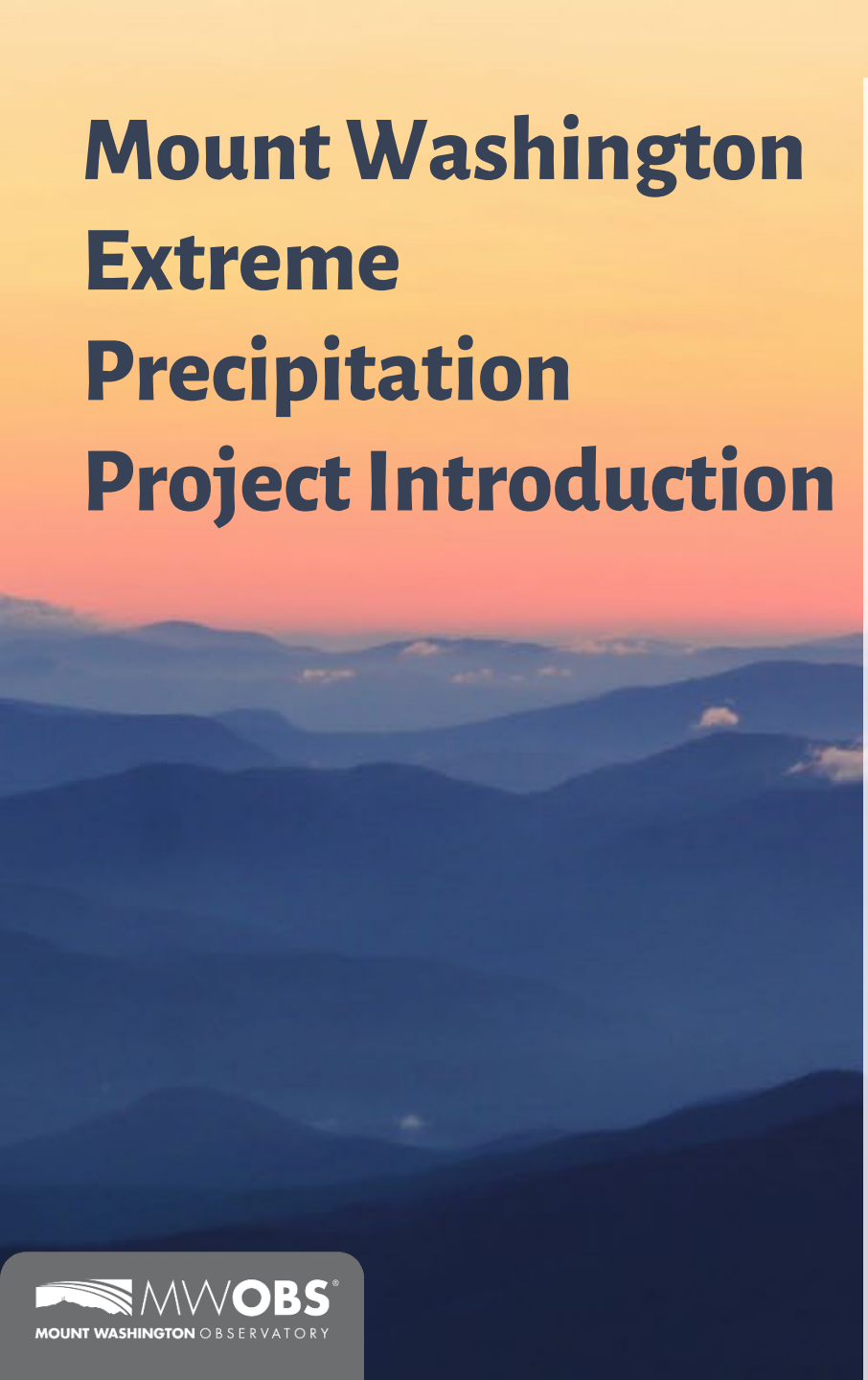
MWOBS Extreme Precipitation Climatology Research Project

By Ryan Haas

Mount Washington Extreme Precipitation Project Introduction



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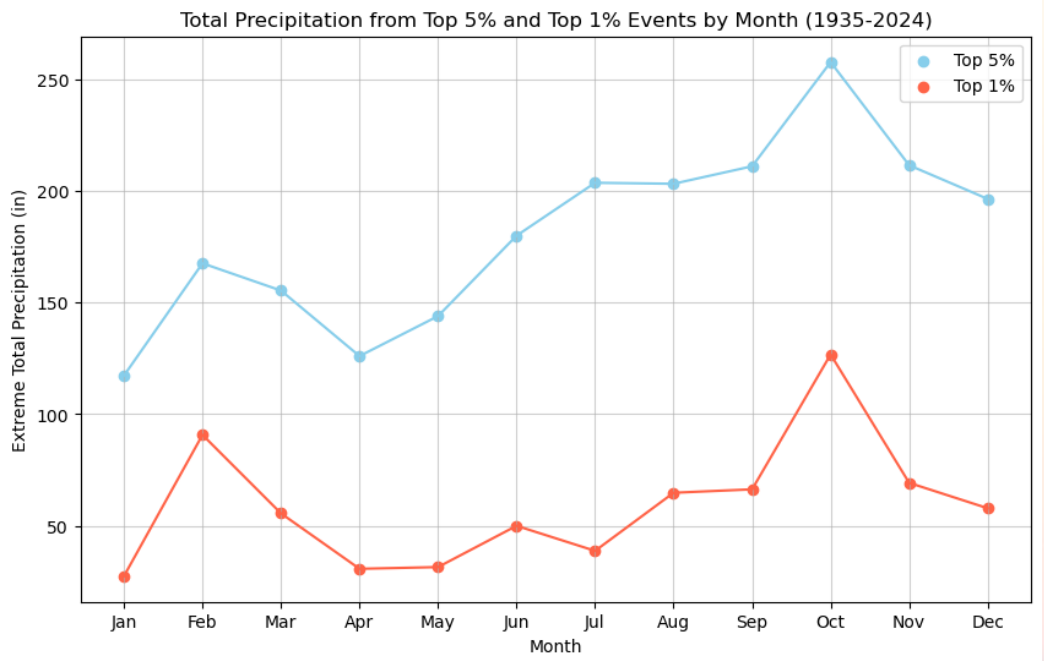
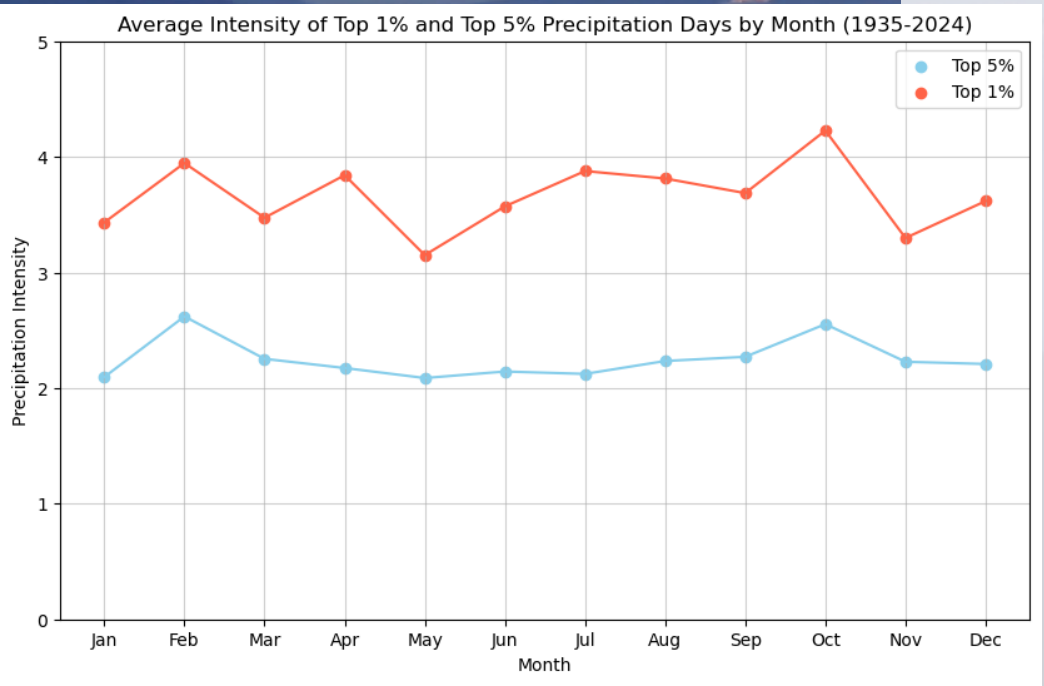
Research Questions: What is the climatology of extreme precipitation on Mount Washington? What types of storms produce the most extreme precipitation days (extratropical cyclones, tropical cyclones) each season? What storm tracks (left or right of the Mountain) yield the most extreme precipitation days?

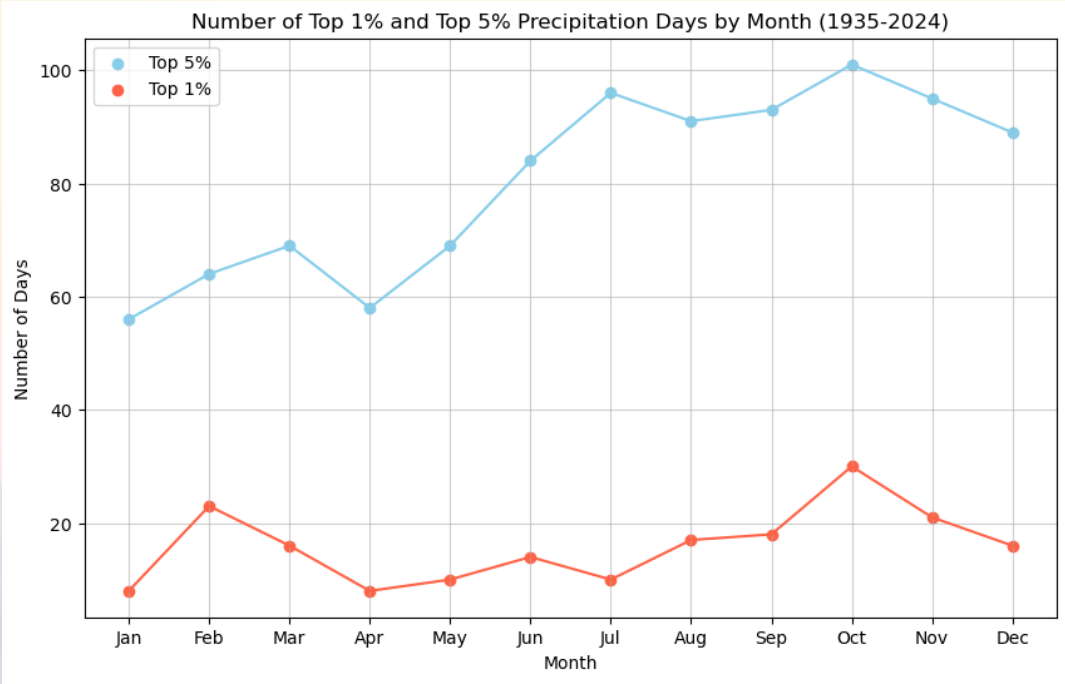
INTRODUCTION:

- Understanding extreme precipitation climatology on Mount Washington, as these events often bring the most disruptive conditions for outdoor enthusiasts (flooding, slippery trails, avalanche danger, etc.).
- For this project, top 1% and top 5% of wet days (>=0.01”) are used to define extreme precipitation days (Peachey, 2023)
- I decided to examine extreme precipitation (liquid equivalent for snow) on daily timescales, as multiday events often see the heaviest rates concentrated within a single day or less (Agel et al., 2015).

Mount Washington Extreme Precipitation Day Climatology







- **Extreme Precipitation Days:** The number of days that produced extreme precipitation totals.
  - Top 1% Threshold: 2.69”/day
  - Top 5% Threshold: 1.46”/day
- **Extreme Precipitation Intensity:** Average amount of precipitation received during an extreme precipitation day.
- **Extreme Precipitation Total:** Total amount of precipitation generated from all extreme precipitation days.

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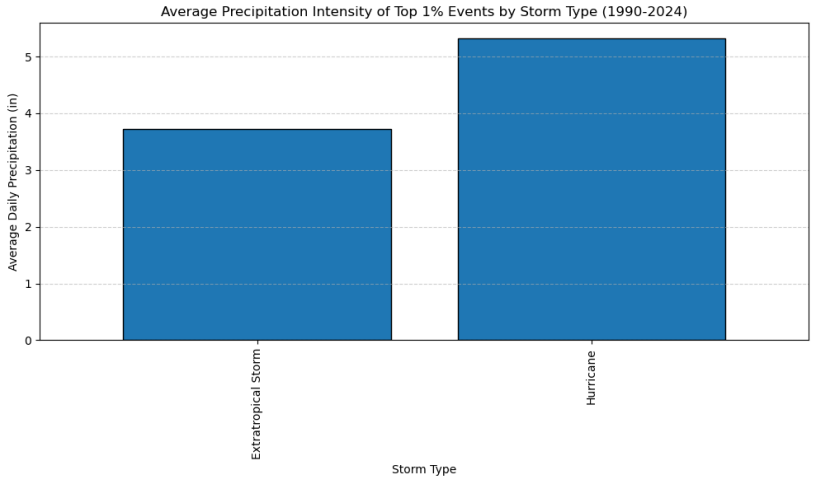
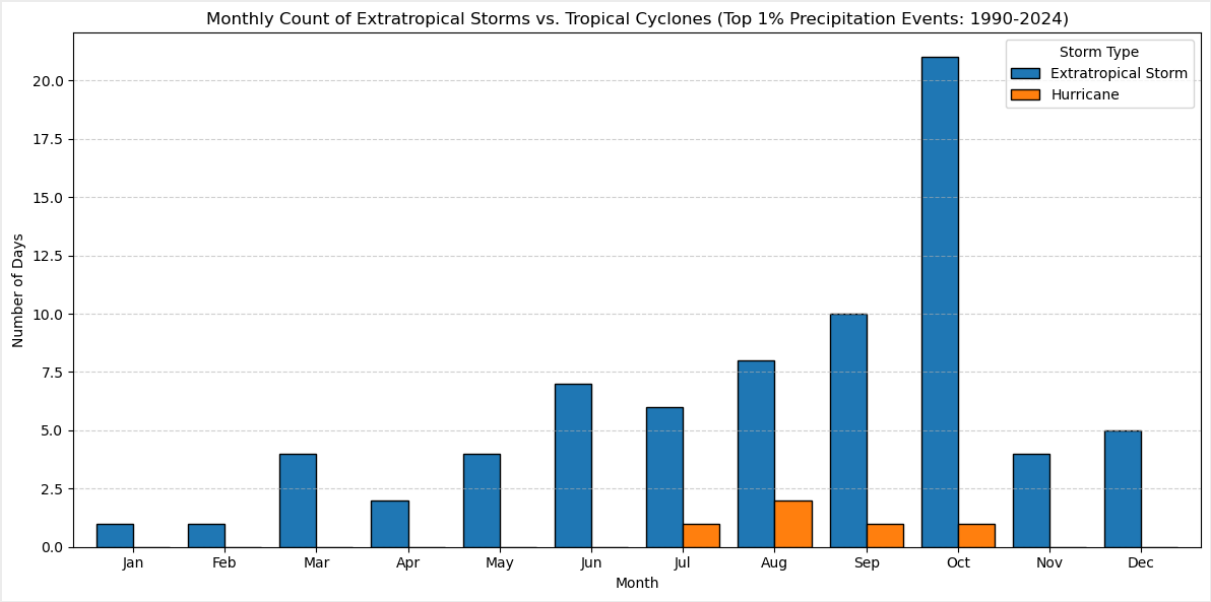
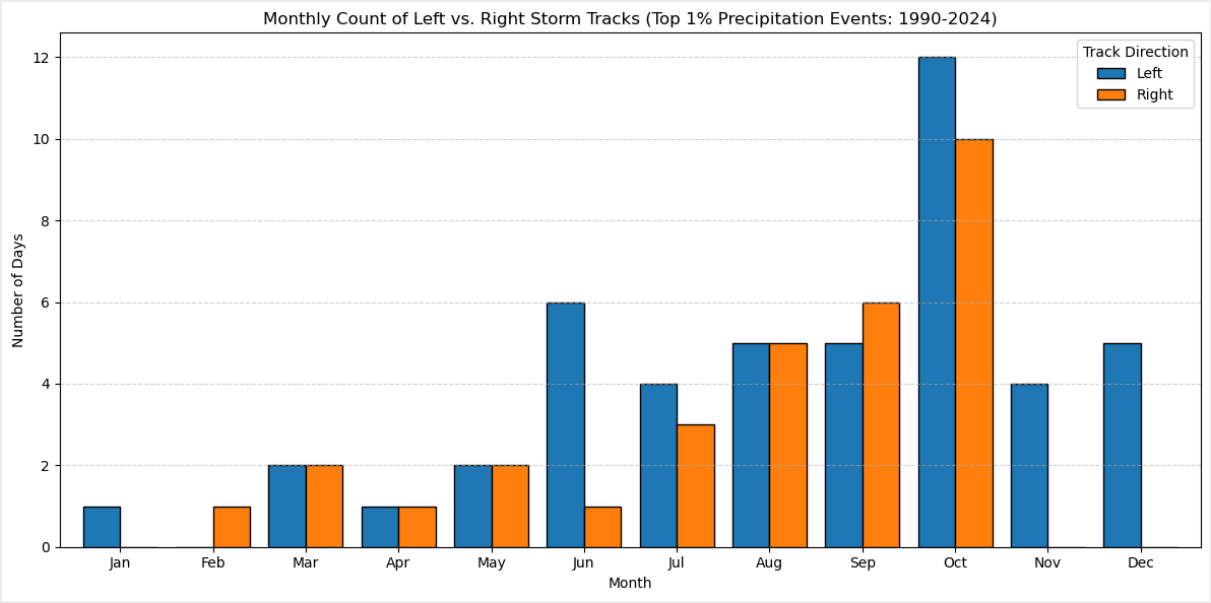
Subjective Extreme Precipitation Storm Track Analysis



Subjective WPC Analysis:

- Analyzed 78 Top 1% Events from 1990-2024
- Counted as an extratropical storm or hurricane if the system was within 1000 km of Mount Washington on the extreme precipitation day (Agel et al., 2015).
- If multiple low centers were within 1000 km, I used the closer and stronger low for my analysis.
- For secondary cyclogenesis, I classified the storm set up (left/right) based on conditions during the heaviest precipitation, as determined by historical radar data.





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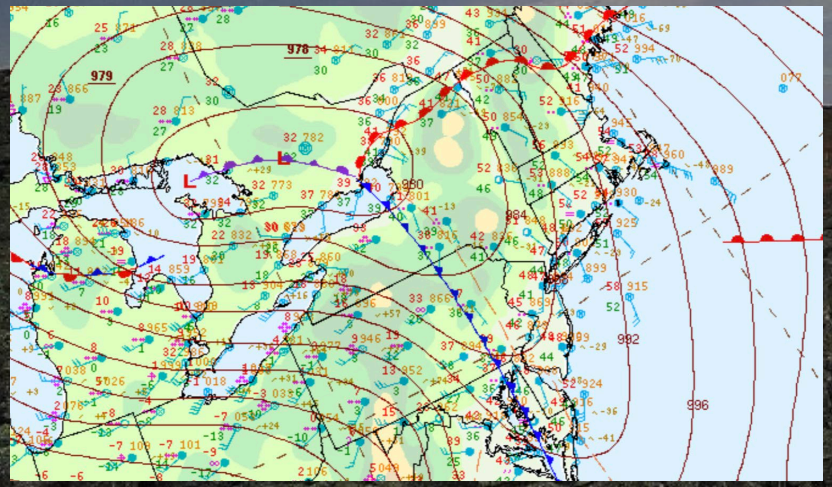
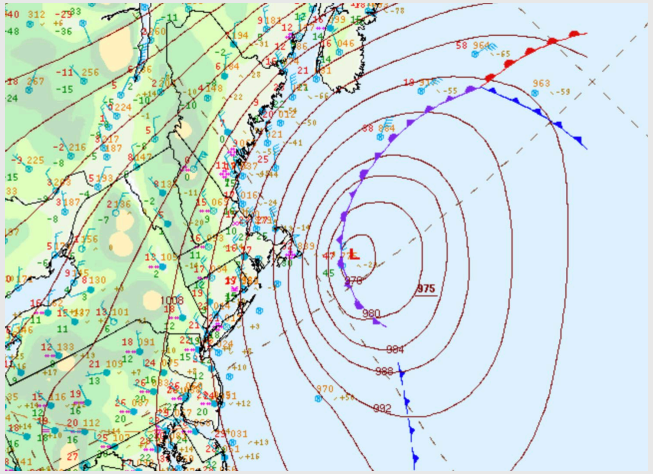
Objective Extreme Precipitation Storm Track Analysis (1935-2024)

- Created wind rose plots using the prevailing wind direction on each extreme precipitation day to show that a majority of top 1% precipitation days feature southeasterly winds, while most top 5% precipitation days have westerly winds.
- Created plots showing whether winds turned clockwise, counterclockwise, or remained neutral during an extreme precipitation day to help objectively determine storm tracks (left/right)
- Wind direction trends found by unwrapping hourly wind direction data (converting to radians, then back to degrees to handle circularity) and performing a linear regression of wind direction vs. time for each extreme precipitation day.
  - Slope <= +1 degree/hour -> Clockwise
  - Slope >= -1 degree/hour -> Counterclockwise
  - -1 degree/hour < Slope < 1 degree/hour -> Neutral
- Clockwise shifts suggest a west/left track, counterclockwise shifts suggest an east/right track, and neutral shifts suggest a north or south track.

West/Left Example



East/Right Example



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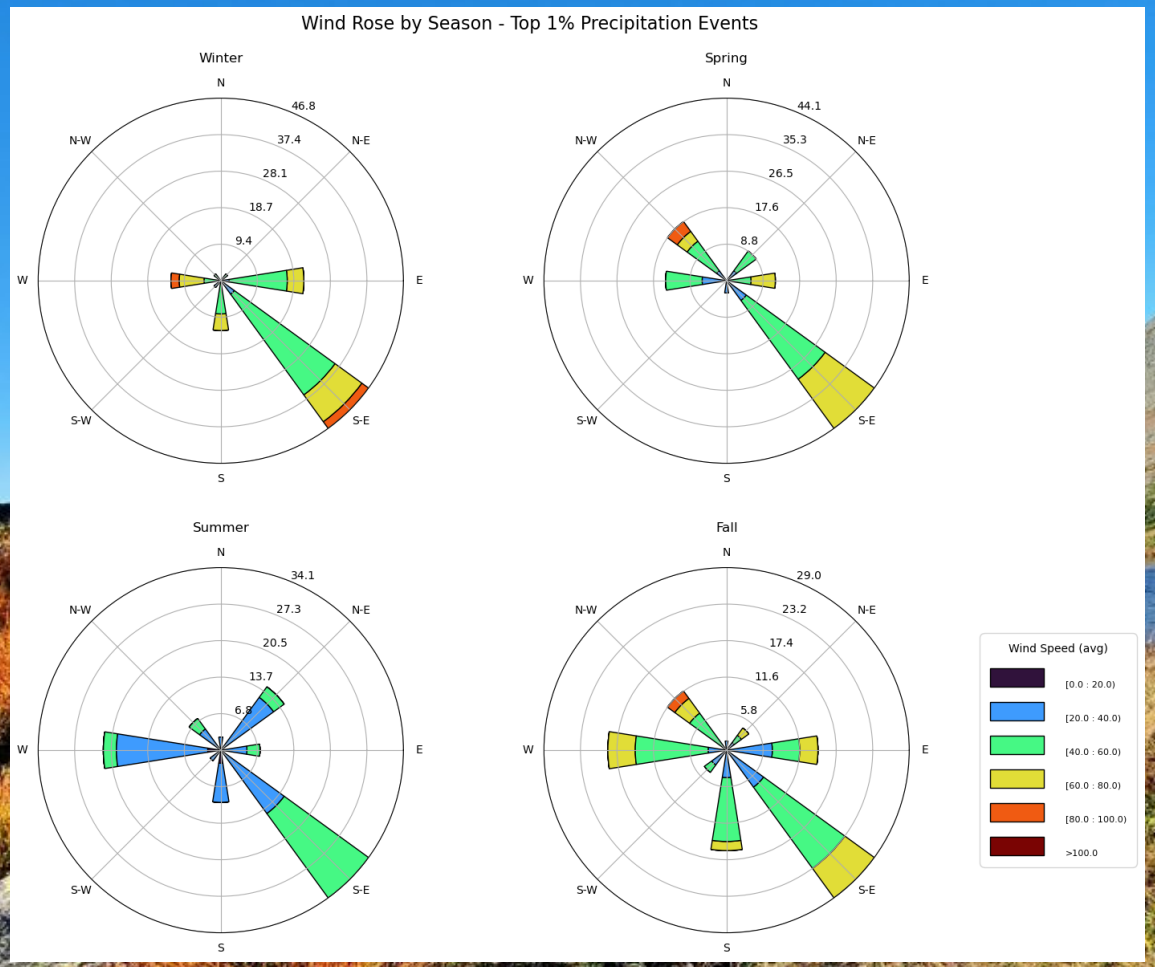
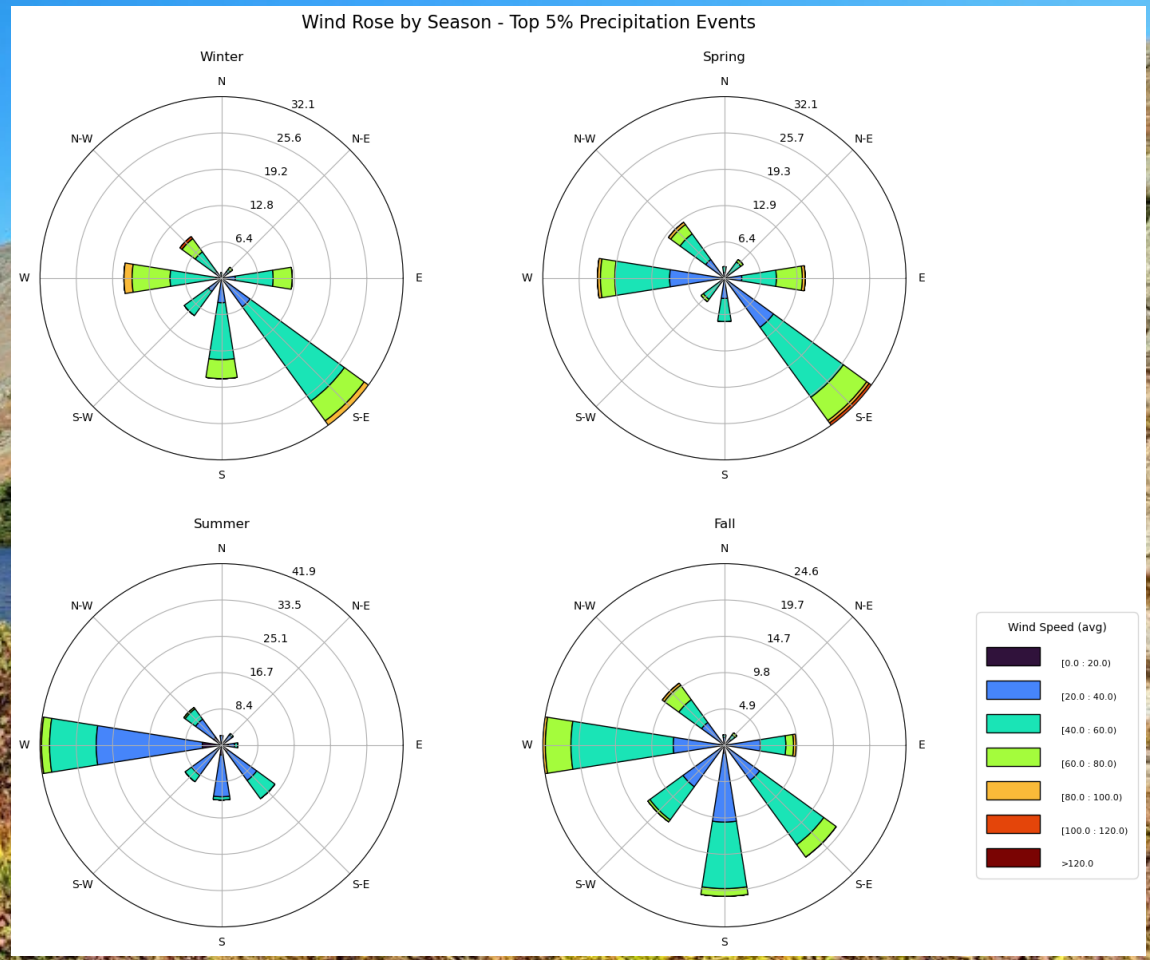
Objective Analysis: Wind Rose Plots (1935-2024)

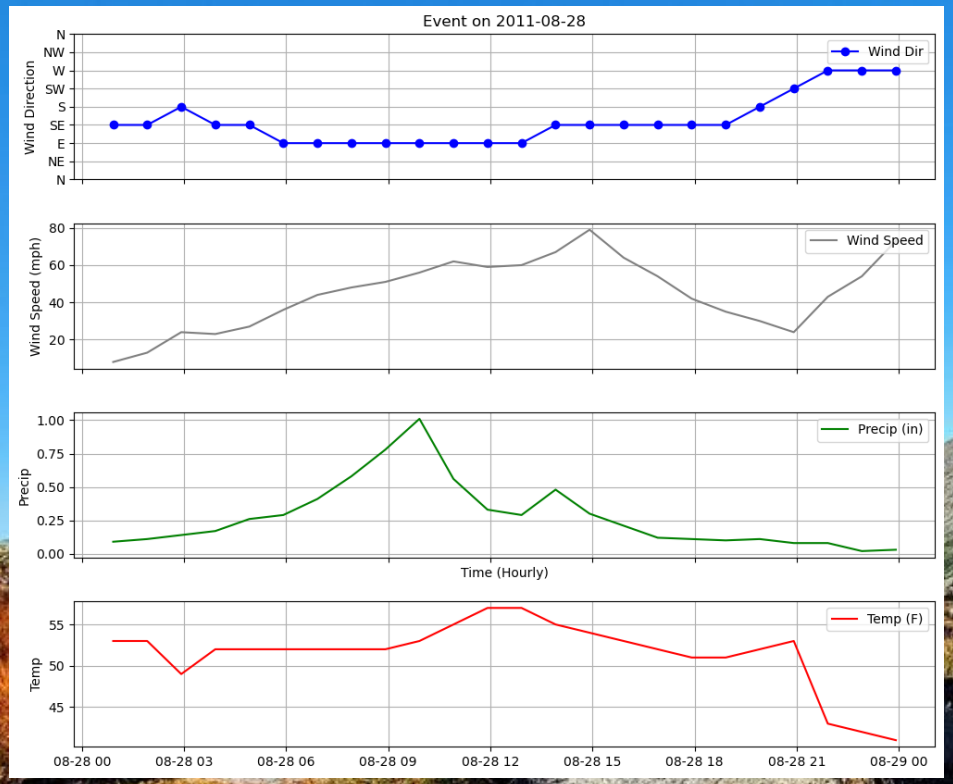


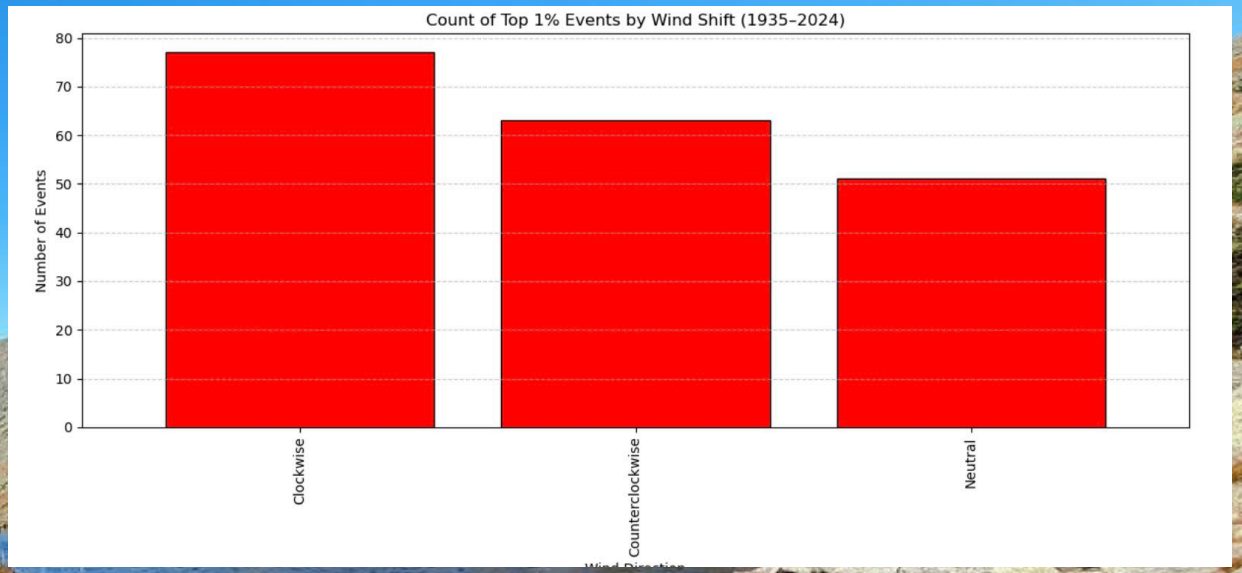


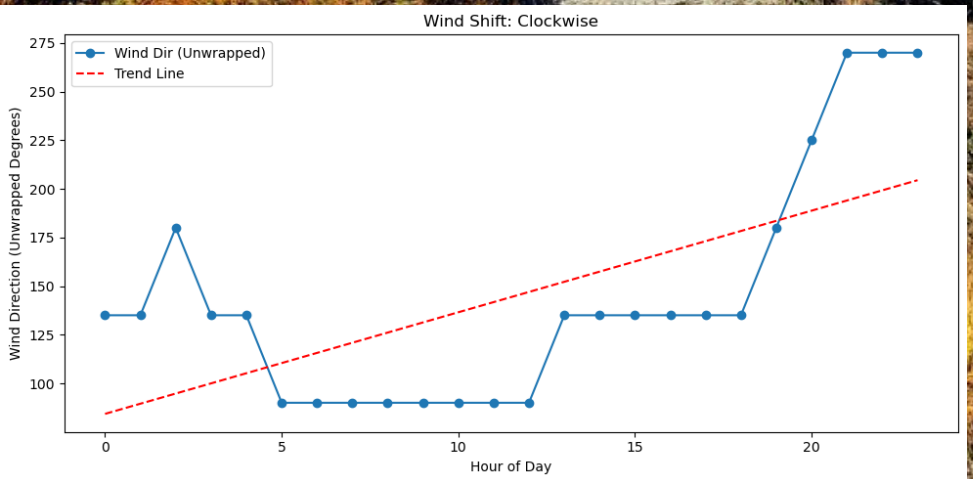
Top 1% Count: 2 N, 13 NE, 27 E, 71 SE, 22 S, 5 SW, 33 W, 18 NW

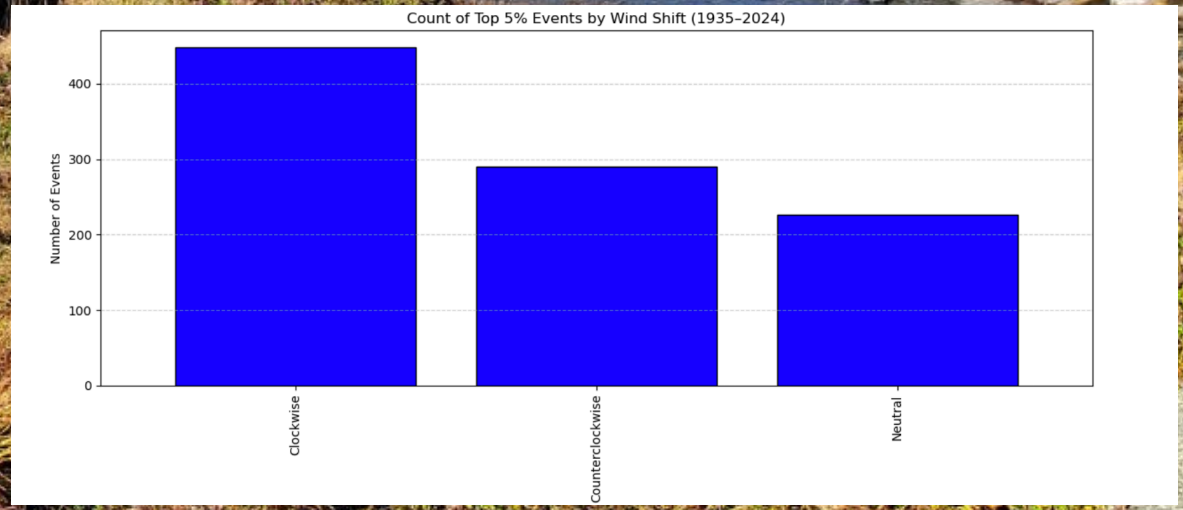
Top 5% Count: 16 N, 28 NE, 92 E, 224 SE, 145 S, 91 SW, 264 W, 102 NW

Objective Analysis: Wind Direction Shift During Extreme Precipitation Days









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Agel, L., M. Barlow, J. Qian, F. Colby, E. Douglas, and T. Eichler, 2015: Climatology of Daily Precipitation and Extreme Precipitation Events in the Northeast United States. *J. Hydrometeor.*, **16**, 2537–2557, https://doi.org/10.1175/JHM-D-14-0147.1.

Peachey, C., 2023: A 25 Year Climatological Analysis of Extreme Precipitation Along the Coast of Maine.

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Thank You!