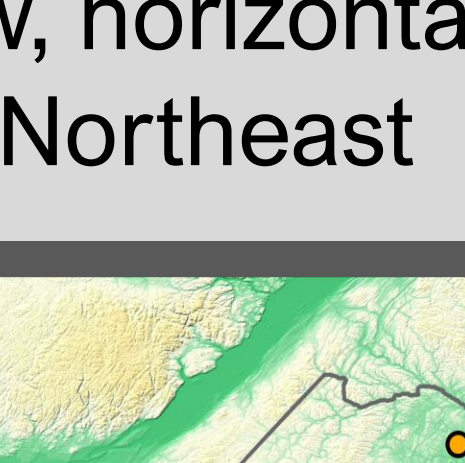
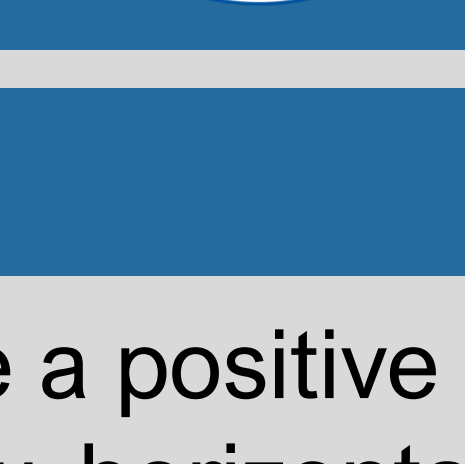
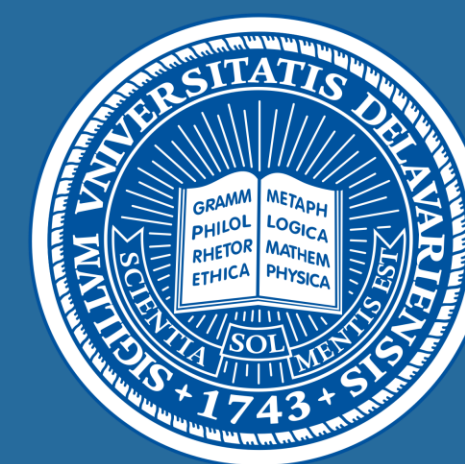




Cool-Season Dew Point Temperature and its Relationship With Atmospheric Rivers and Precipitation in the Northeast U.S.

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I. Introduction

Dew point temperature is a common method to measure atmospheric moisture and has been shown to have a positive correlation with extreme precipitation (Steinschneider and Najibi 2022). Atmospheric rivers (ARs) are narrow, horizontal channels of water vapor that can produce large amounts of precipitation. Dew point varies seasonally in the Northeast U.S., with lower dew points in the cool season. AR frequency tends to be more consistent seasonally, but cool season ARs are more likely to cause precipitation extremes (Slinsky et al. 2020). The goal of this study is to create a dew point climatology for the Northeast U.S. and investigate how dew point impacts ARs and AR-caused precipitation in the cool season.

II. Methodology

Hourly dew point data was collected at seventeen stations across the northeast. Daily precipitation and AR occurrence data was obtained from Glade et al. (2023) for eight stations. All data spanned 1988 - 2017 but was limited to the cool season months of October - March. Daily mean dew point was calculated from hourly data. Stations were separated into eastern seaboard and inland locations (Fig. 1).

III. Cool Season Dew Point Climatology: 1988-2017

- October has the highest frequency of **95th percentile** daily mean dew point temperature values (Fig. 2)

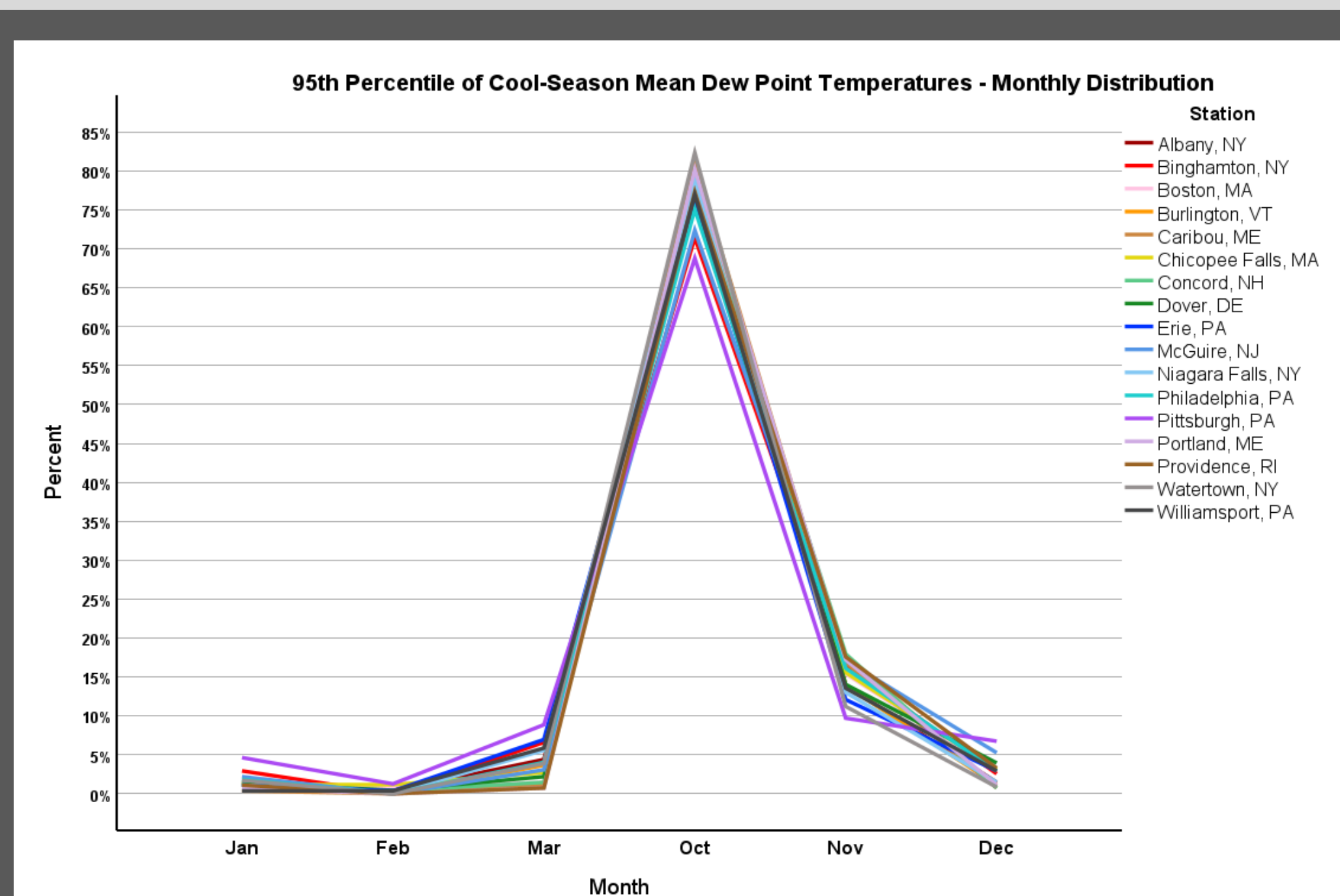


Fig. 2 The percentage of the 95th percentile of daily mean dew points that occur in each cool-season month.

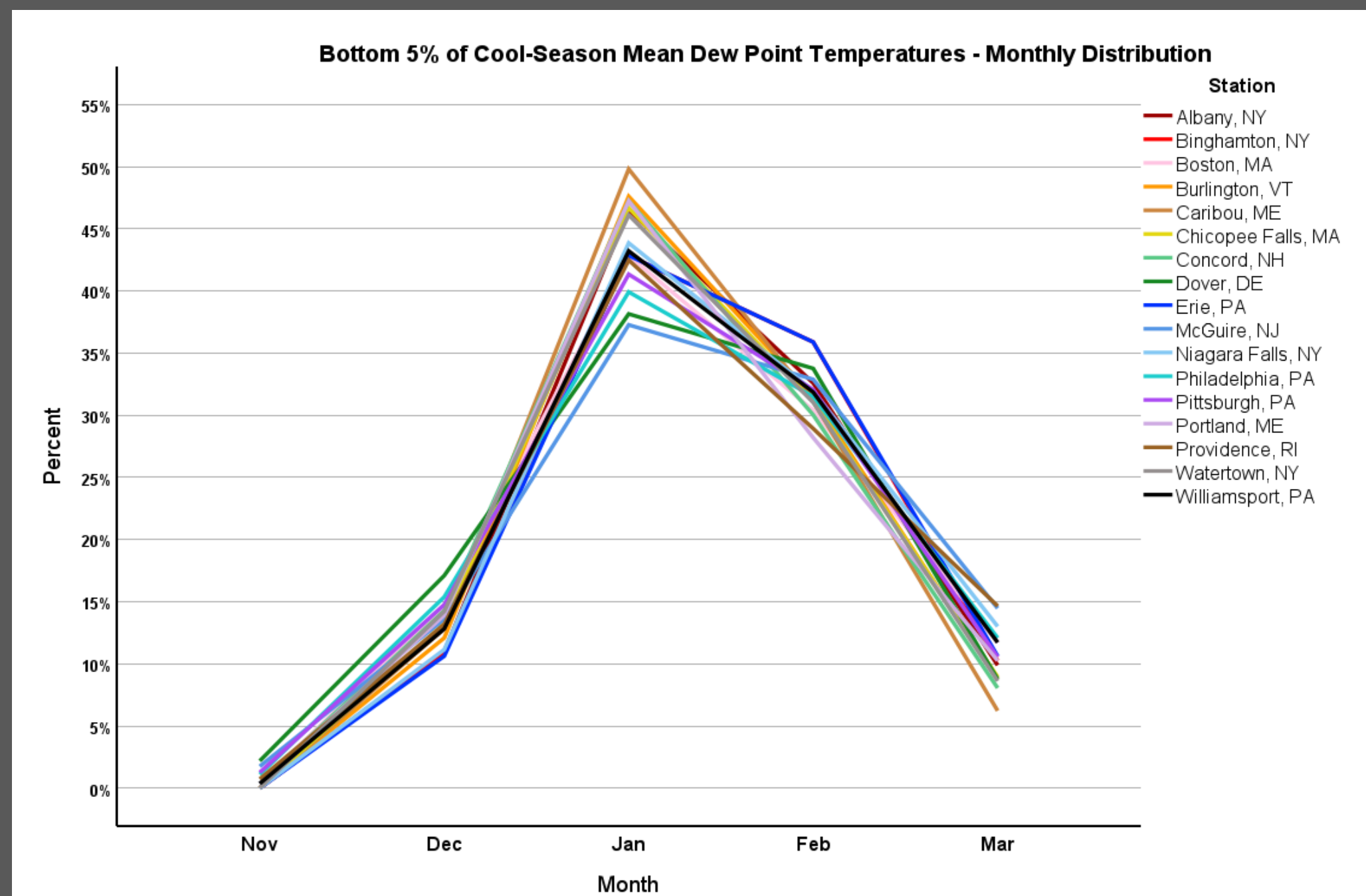


Fig. 3 The percentage of the bottom 5% of daily mean dew points that occur in each cool-season month.

- February has the lowest frequency of **95th percentile** daily dew point temperatures (Fig. 2)
- January has the highest frequency of dew point temperatures in the **bottom 5%** of daily mean values (Fig. 3)
- There are no occurrences of **bottom 5%** daily mean dew point temperatures in the month of October (Fig. 3)
- Dew point temperature *generally* decreases as station latitude increases (Fig. 4)
- The eastern seaboard stations have a *larger* range in dew point temperatures than the inland stations (Fig. 4)

Eastern Seaboard

Range of Maxima:

6.1 °C

Range of Minima:

7.9 °C

Inland

Range of Maxima:

3.6 °C

Range of Minima:

2.3 °C

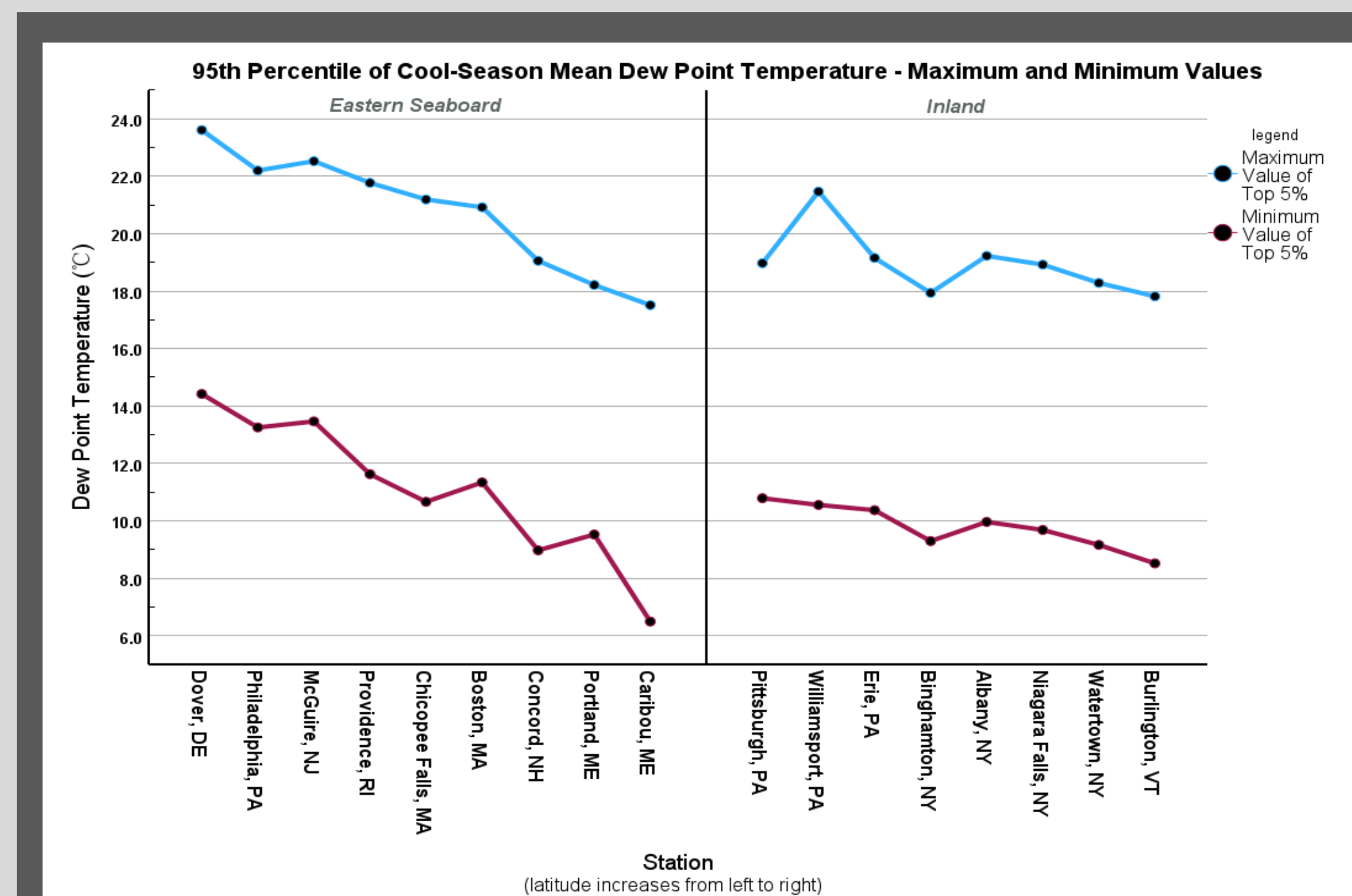


Fig. 4 The maximum and minimum values for the 95th percentile of daily mean dew point temperatures.

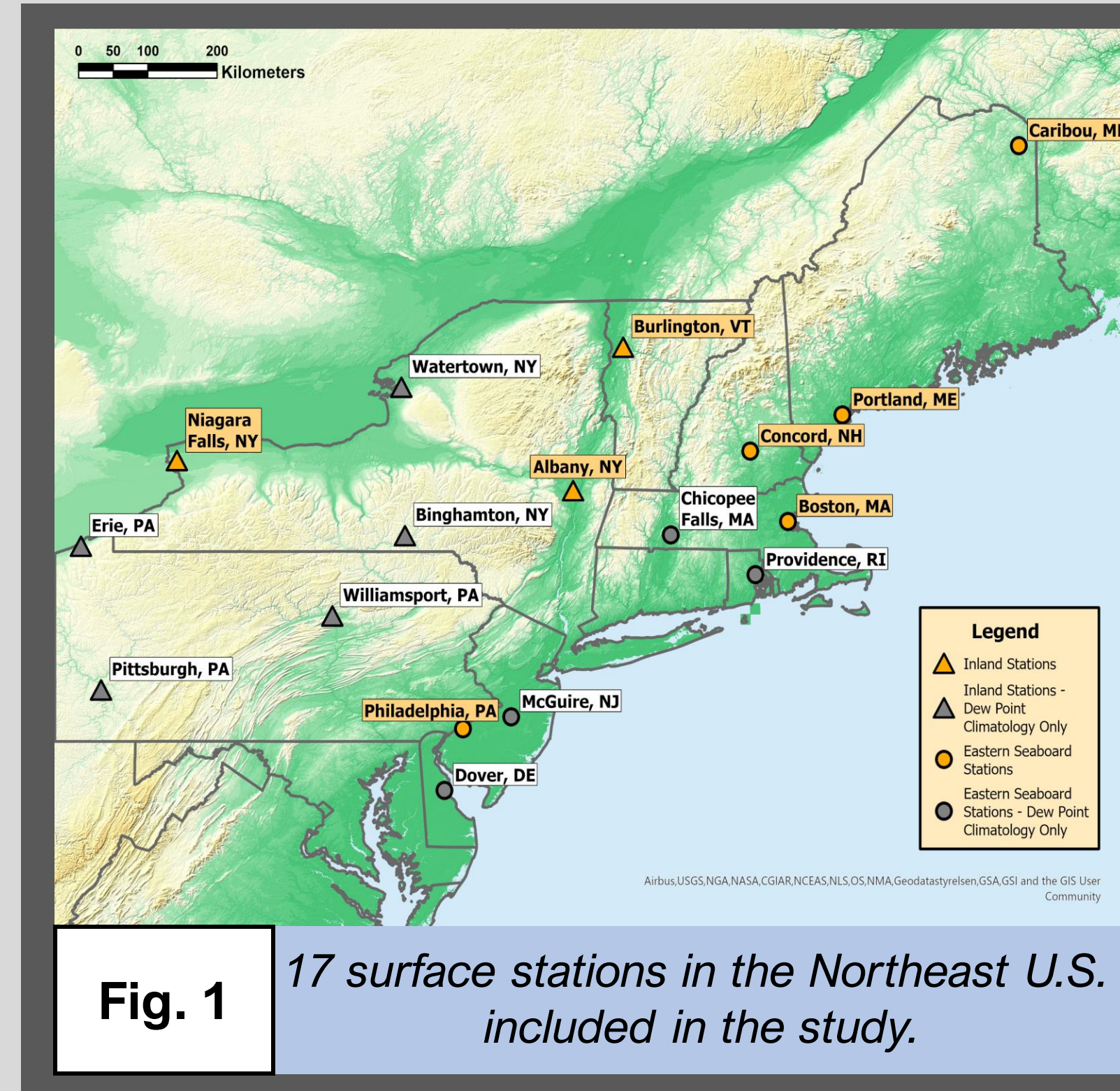


Fig. 1 17 surface stations in the Northeast U.S. included in the study.

IV. Results: Atmospheric River and Precipitation Trends

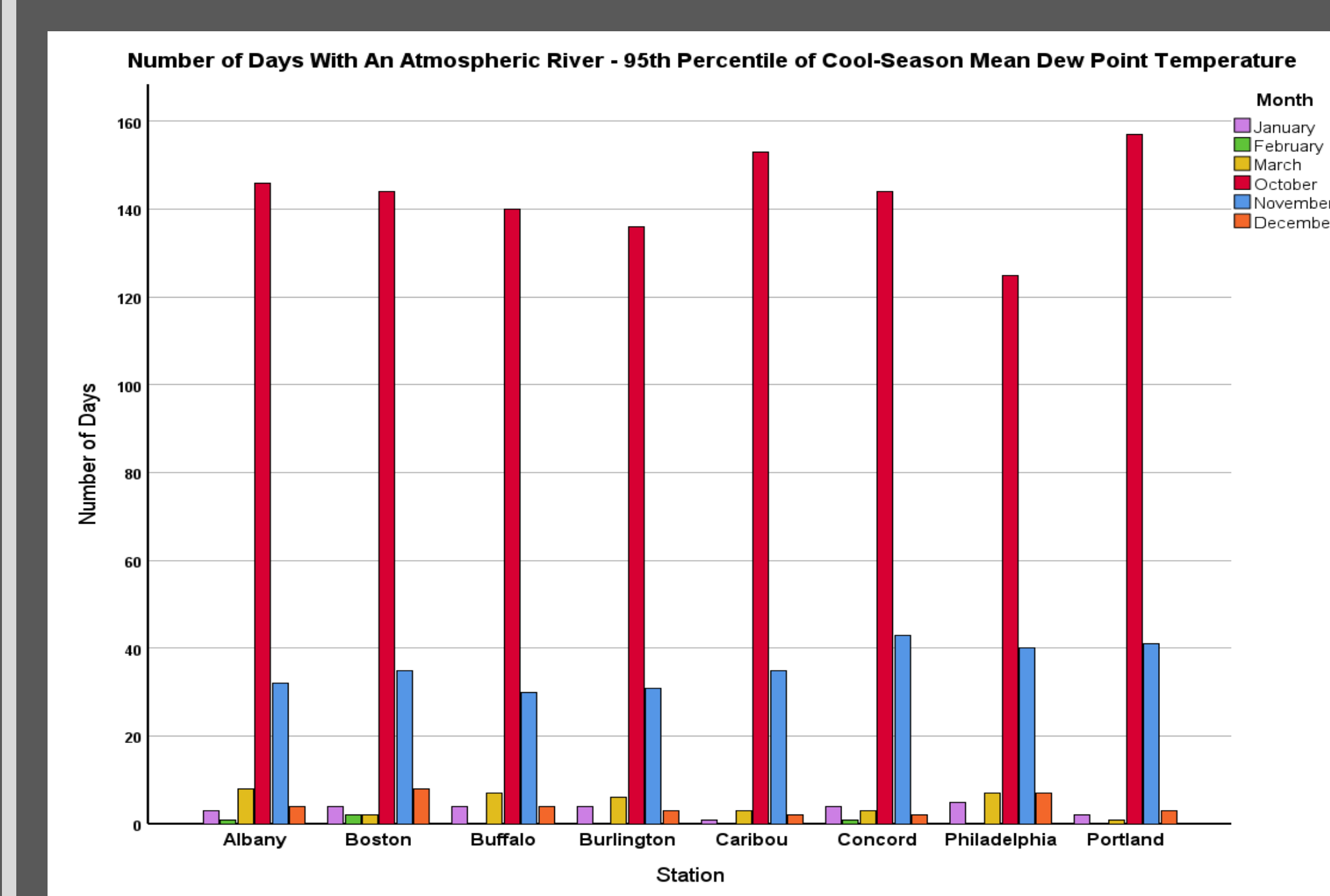


Fig. 5 The number of days with an AR in the 95th percentile of daily mean dew point temperatures for each month.

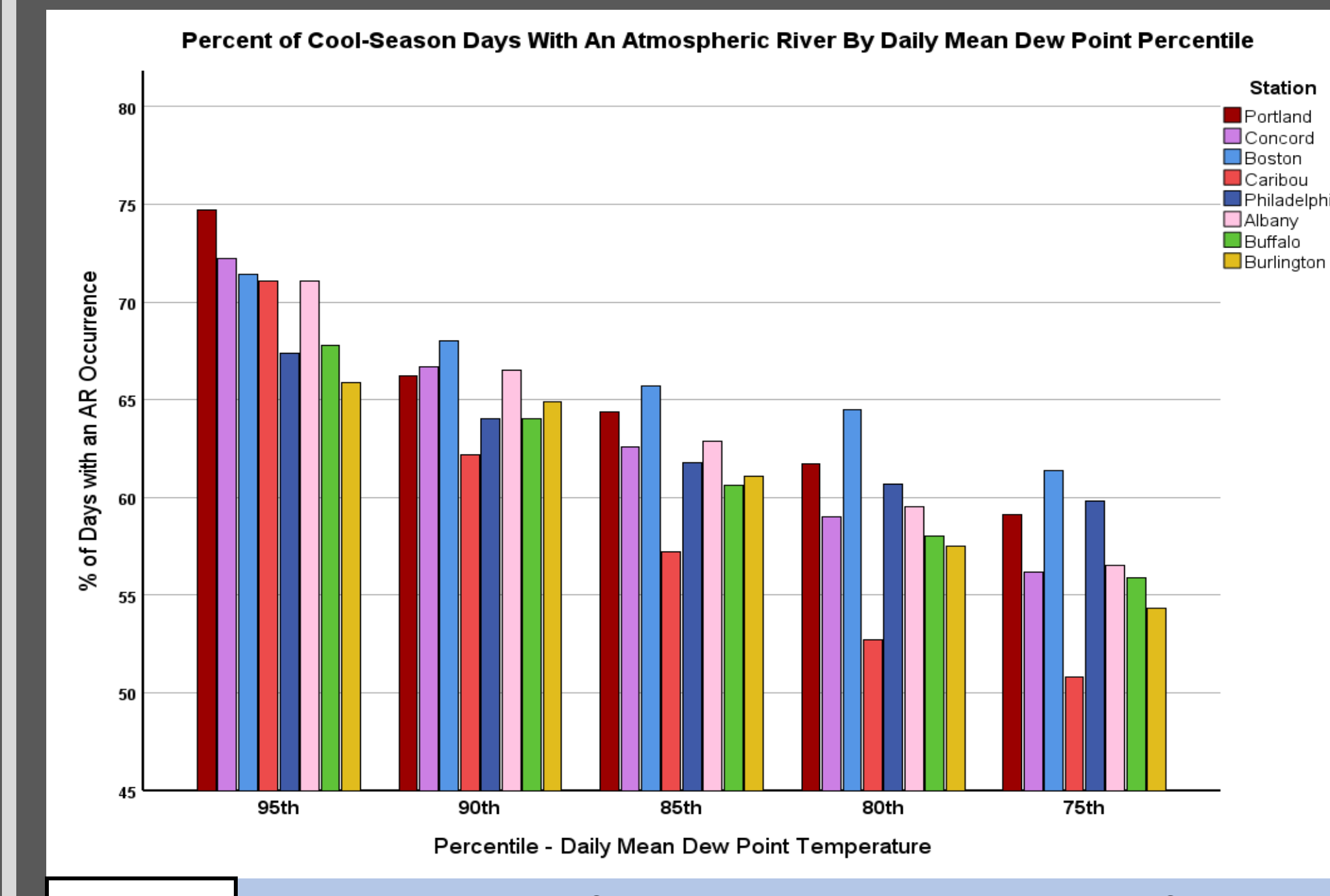


Fig. 6 The percentage of days with an AR occurrence for various percentiles of daily mean dew point temperature.

- October has the **largest** number of AR days, and February has the **smallest** number of AR days (Fig. 5)
 - Aligns closely with the monthly frequency of the 95th percentile of dew point temperatures
- Overall, the percentage of **AR occurrences decreases** as the **dew point percentile expands** (Fig. 6)
- The inland stations *generally have a lower percentage* of AR occurrences compared to the eastern seaboard stations (Fig. 6)
 - The major exception to this trend is Caribou, ME
- The percentage of AR occurrence change with increasing dew point percentile is not consistent at every station (Fig. 6)

Largest decrease across percentiles:
Caribou, ME:
21%

Smallest decrease across percentiles:
Philadelphia, PA:
7%

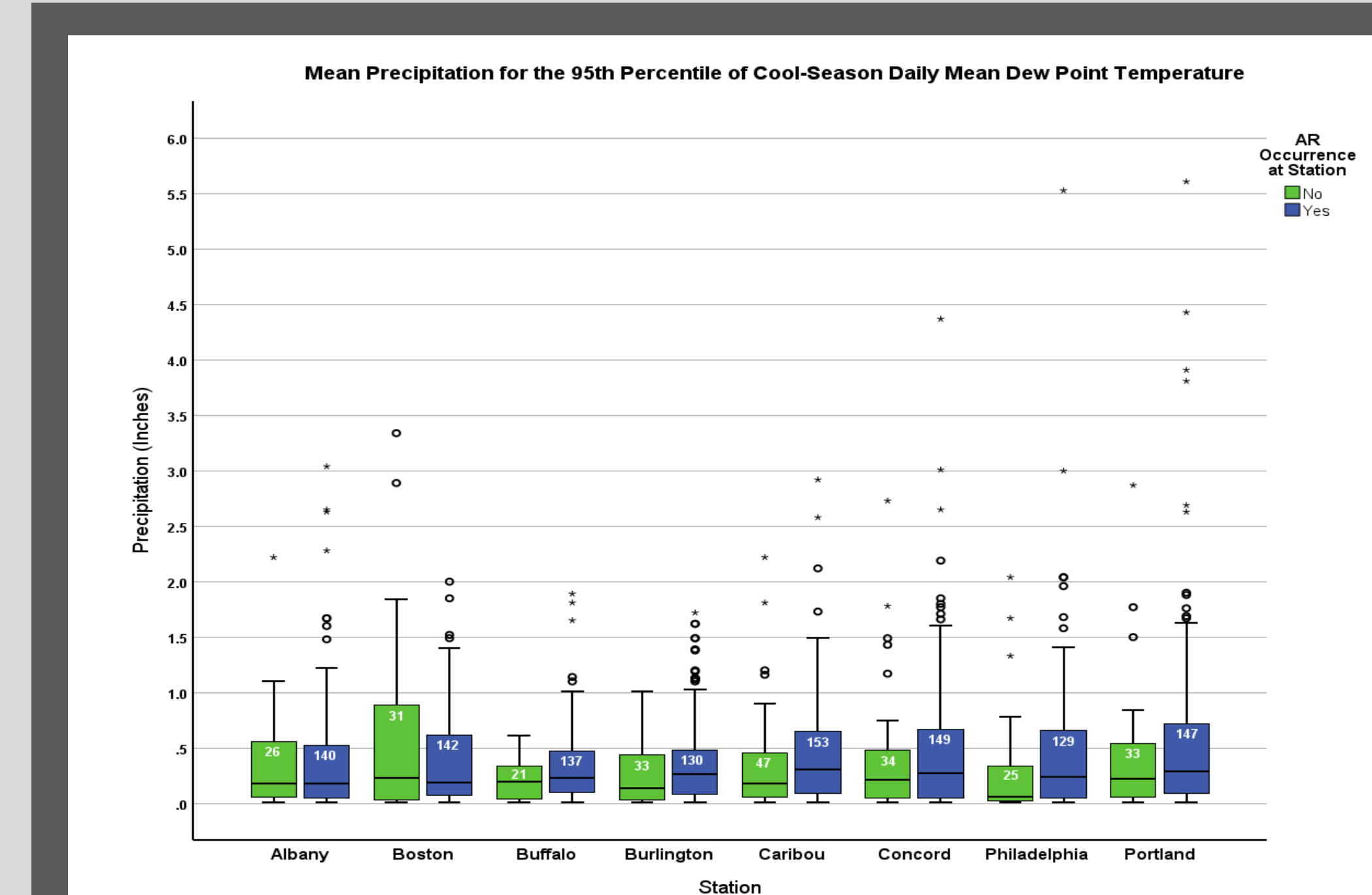


Fig. 7 Boxplot of precipitation on days with dew point in the 95th percentile. The number of days is shown in each box.

- Most stations have **similar median precipitation** amounts both with and without an AR occurrence (Fig. 7)
- The interquartile range of precipitation values is **less** when there is **not an AR** occurrence at the station (Fig. 7)
 - The only station which is an exception is Boston, MA
- There are more outlier/extreme precipitation values when there is an AR present (Fig. 7)
- Average dew point temperatures were typically **lower for days without an AR** compared to days that did have an AR present (Fig. 8)

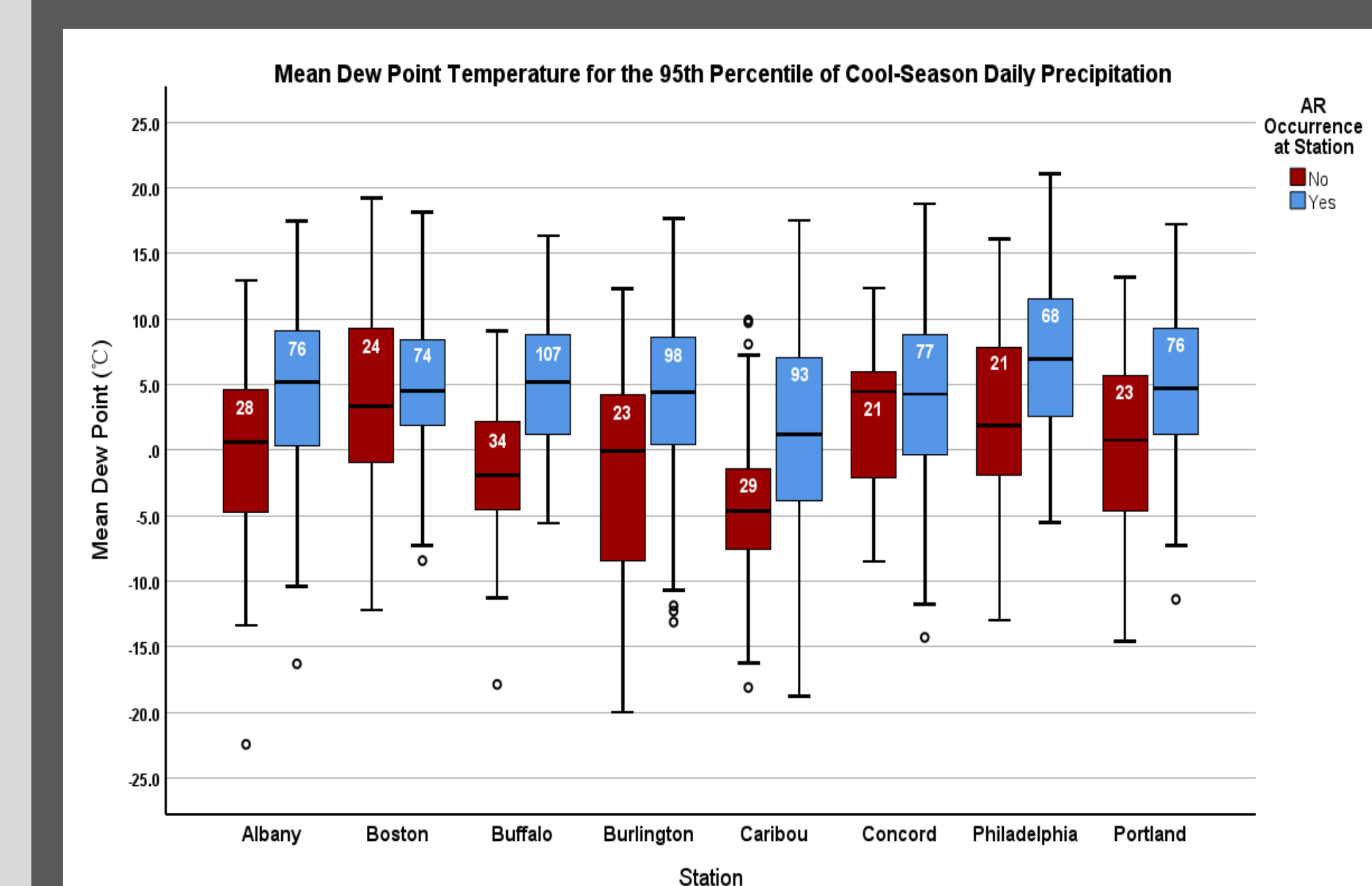


Fig. 8 Boxplot of dew point for days with precipitation in the 95th percentile. The number of days is shown in each box.

V. Conclusion

This study examines the relationship between dew point temperature, ARs, and AR-related precipitation in the cool season. Cool-season ARs are more likely to occur on days with extreme high dew point temperatures. This is indicated by a higher number of AR occurrences within the top dew point temperature percentiles (Fig. 6), as well as a sharp decrease in AR occurrences at locations with lower mean dew point temperature (Figs. 4 & 6). ARs are seen to occur in the months that have more frequent extreme dew point temperatures (Fig. 5). Dew point temperatures tend to be higher on days of extreme precipitation that do have an AR occurrence when compared to days that do not have an AR occurrence (Fig. 8). Precipitation values are generally higher on extreme dew point days that do have an AR occurrence (Fig. 7).

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References: Slinsky, E. A., P. C. Loikith, D. E. Waliser, B. Guan, and A. Martin. 2020. A climatology of atmospheric rivers and associated precipitation for the seven U.S. national climate assessment regions. *J. Hydrometeorol.*, 21, 2439-2456. <https://doi.org/10.1175/JHM-D-20-0039.1>. Steinschneider, S., and Najibi, N., 2022. Observed and projected scaling of daily extreme precipitation with dew point temperature at annual and seasonal scales across the Northeast United States. *J. Hydrometeorol.*, 23, 403-419. <https://doi.org/10.1175/JHM-D-21-0183.1>.

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