

2021 Weather in Review: Cape Cod National Seashore

Weather and climate play significant roles in driving both physical and ecological processes. For example, the active processes that shape the North Atlantic coastline are largely the result of meteorological events such as wind-driven waves. For research and long-term ecological monitoring, weather and climate data provide the potential for correlations to be made with observed physical and ecological pattern data. This resource brief provides a summary of both historic and current (2021) weather data for Cape Cod National Seashore (CACO), Massachusetts (MA). Because tide levels and wind can be significant for coastal parks, the annual water level and wind data are included.

Temperature

Overall, 2021 was the 3rd warmest year on record with an average temperature of 52.7°F — 3.5 degrees above average (Table 1). 2021 had the 3rd warmest autumn on record. The warmest month was August with an average of 73.5 degrees — 4.8 degrees over the monthly average. Every month had a higher than average temperature, with December recording the highest departure from long-term average temperature — 6.5 degrees above average. Seasonally, spring, summer, and autumn fell within "much above normal" temperatures, while winter fell within "above normal" temperatures (Figure 1).

Table 1. Barnstable County, Massachusetts average monthly, average annual, and departures from long-term average temperatures. Departures from average are based on a comparison of 2021 average temperatures to relevant averages from 1895-2020. Data are available at the NOAA National Centers for Environmental Information, Climate at a Glance: County Time Series website.

Month (2021)	Average temperature (°F)	Departure from long-term average temperature (°F)
January	33.8	+3.9
February	32.8	+3.0
March	39.1	+2.6
April	47.3	+2.4
May	56.6	+2.0
June	67.6	+4.0
July	70.5	+0.6
August	73.5	+4.8
September	67.4	+5.0
October	59.0	+5.9
November	44.7	+1.2
December	40.6	+6.5
Annual	**52.7**	**+3.5**

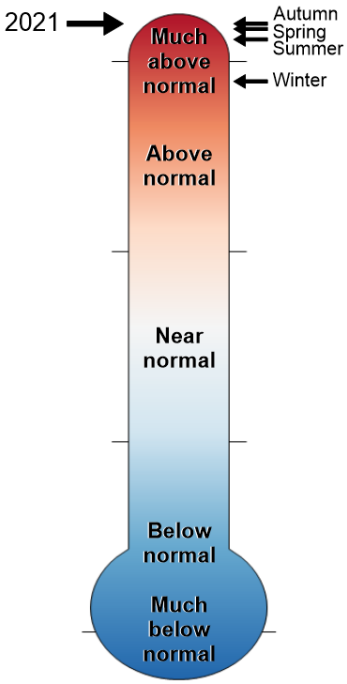


Figure 1. Barnstable County, Massachusetts annual and seasonal temperature rankings from 1895-2021. Of the 127 records, 2021 was the 3rd warmest year. Seasonally, it was the 14th warmest winter, 4th warmest spring, 6th warmest summer, and the 3rd warmest autumn. Data are available at the NOAA National Centers for Environmental Information, Climate at a Glance: County Time Series website.

Precipitation

Overall, 2021 was the 31st wettest year on record with a total level of 48.19 inches of precipitation (Table 2). Seven months had lower than average amounts of precipitation. September had the greatest amount of precipitation due to Hurricane Ida, totalling 10.82 inches — 7.28 inches above average. June had the lowest amount at only 1.70 inches — 1.51 inches below average. Seasonally, winter fell within "below normal" amounts, and autumn and spring fell within "near normal" amounts. Summer fell within "much above normal" amounts (Figure 2).

Table 2. Barnstable County, Massachusetts monthly and annual total precipitation and departures from long-term average totals. Departures from average are based on a comparison of 2021 precipitation levels to relevant averages from 1895-2020. Data are available at the NOAA National Centers for Environmental Information, Climate at a Glance: County Time Series website.

Month (2021)	Total precipitation (in)	Departure from long-term average precipitation (in)
January	2.50	-1.43
February	4.24	+0.77
March	2.76	-1.38
April	3.48	-0.49
May	4.75	+1.43
June	1.70	-1.51
July	2.90	+0.06
August	2.89	-0.85
September	10.82	+7.28
October	8.17	+4.29
November	2.17	-1.97
December	1.81	-2.31
Annual	**48.19**	**+3.88**

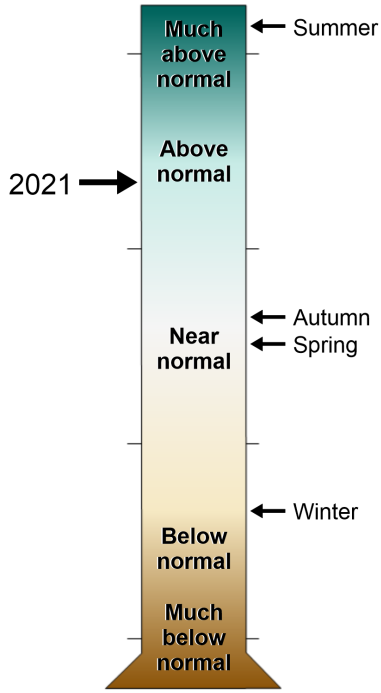


Figure 2. Barnstable County, Massachusetts annual and seasonal precipitation rankings from 1895-2021. Of the 127 records, 2021 was the 34th wettest year on record. Seasonally, it was the 33rd driest winter, 64th wettest spring, 5th wettest summer, and 59th wettest autumn. Data are available at the NOAA National Centers for Environmental Information, Climate at a Glance: County Time Series website.



Temperature and Precipitation Trends (1895–2021)

Temperature and precipitation data are gathered from the U.S. Climate Divisional Database, which stores data from January 1895 to the present, and can be accessed via the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI) website (Figure 3). Users can choose different geographic scales (i.e., global, national, statewide), different temporal scales, and display them in various types of graphical formats. Temperature and precipitation data presented in this brief are for Barnstable County, MA.

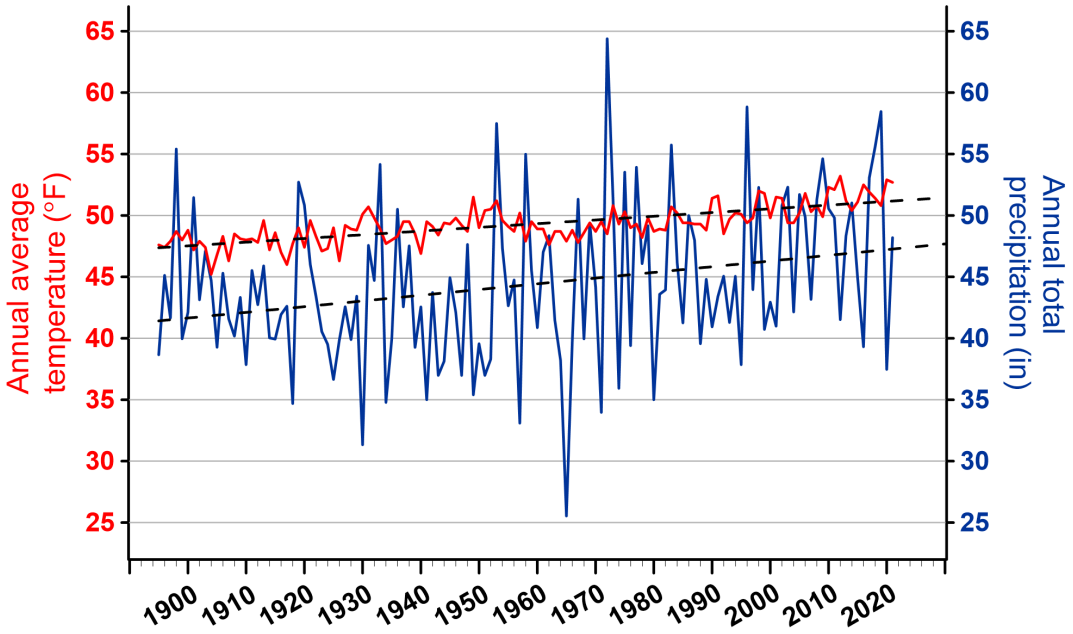


Figure 3. Barnstable County, Massachusetts yearly average temperature and precipitation levels from 1895 to 2021. Dashed lines represent the 1895-2021 trend for each parameter; +0.3°F/decade increase for temperature and +0.46 in/decade increase for precipitation. Data are available at the NOAA National Centers for Environmental Information, Climate at a Glance: County Time Series website.

Tide Levels

Water level data is collected from the NOAA National Water Level Observation Network (NWLON) station 8443970. Located in Boston, MA, this station has records dating back to 1921.

The data is graphed to show the difference in the predicted tide level verses what was observed (Figure 4). The offsets in height reflect the effect from storm surge on the normal, astronomically driven tide level.

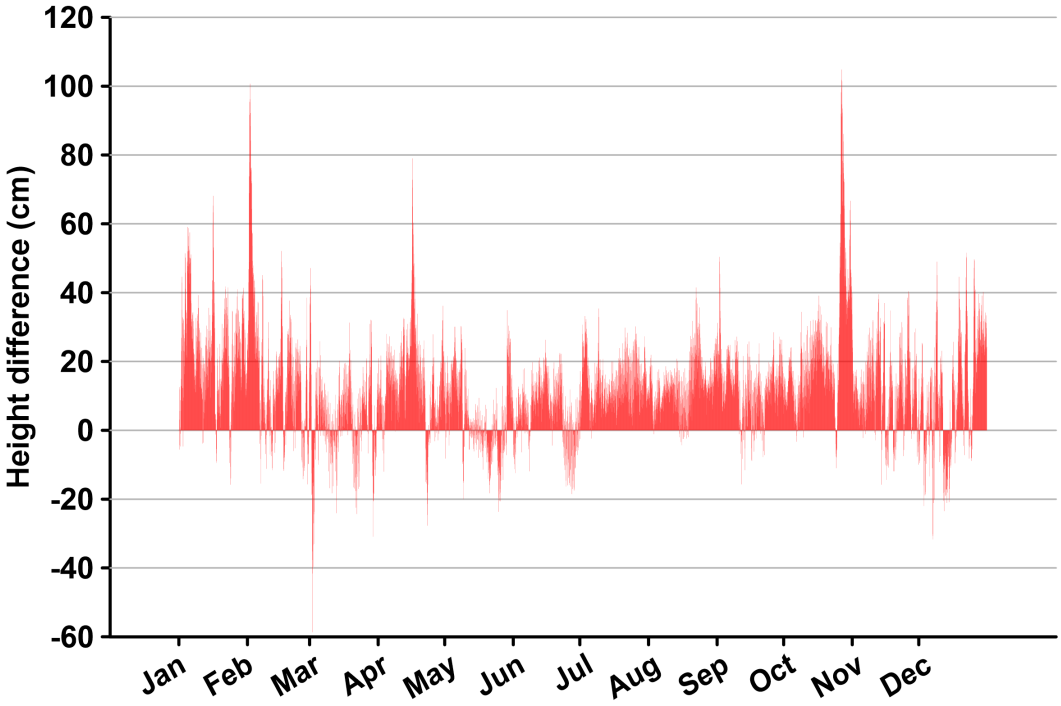


Figure 4. The difference in the predicted and observed tide levels at the NOAA NWLON station 8443970 located in Boston, Massachusetts during 2021. Data are available at the NOAA Tides & Currents website.

Wind

During 2021, wind data (wind speed and direction) was available from the NOAA NWLON station 8447435 in Chatham, MA, and from the Provincetown Municipal Airport located at the northern tip of Cape Cod. Each direction is divided up into categories called bins that are color coated to represent the frequency of a certain wind speed. The length of the bin represents the number of times wind comes from a given direction as well as the speed of the wind. The longer the length of the bin, the more frequent the given speed was recorded (Figure 5 and 6). The difference in appearance of Figure 5 and 6 is due to the Chatham station recording readings every six minutes, while the Provincetown station only records data hourly.

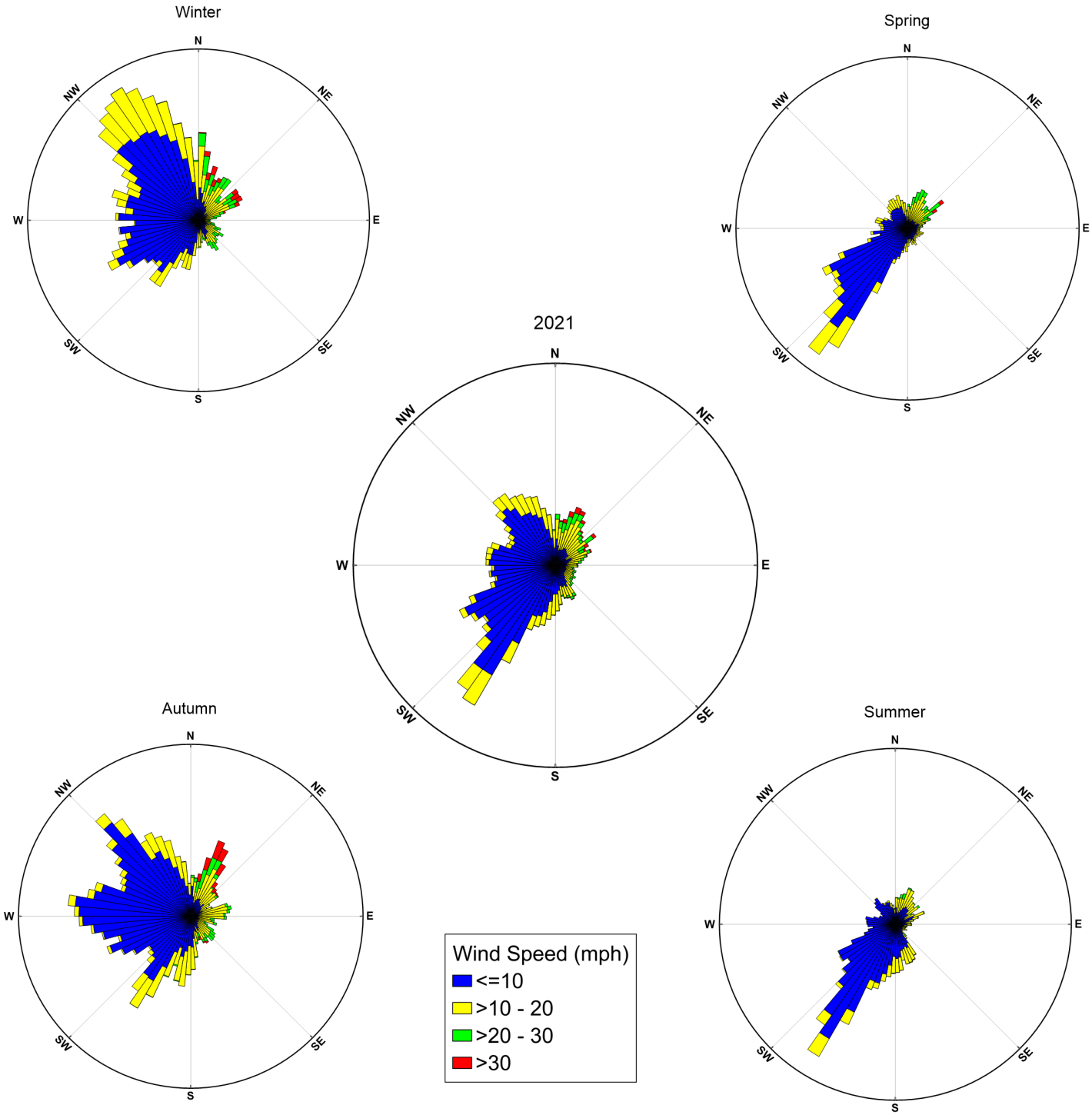


Figure 5. Wind charts reflecting both the seasonal and annual wind direction and speed at the NOAA NWLON station 8447435 located at Chatham, Massachusetts during 2021. Each direction is divided up into categories called bins that are color coated to represent the frequency of a certain wind speed. The length of the bin represents the number of times wind comes from a given direction as well as the speed of the wind. The longer the length of the bin, the more frequent the given speed was recorded. Data are available at the NOAA Tides & Currents website.

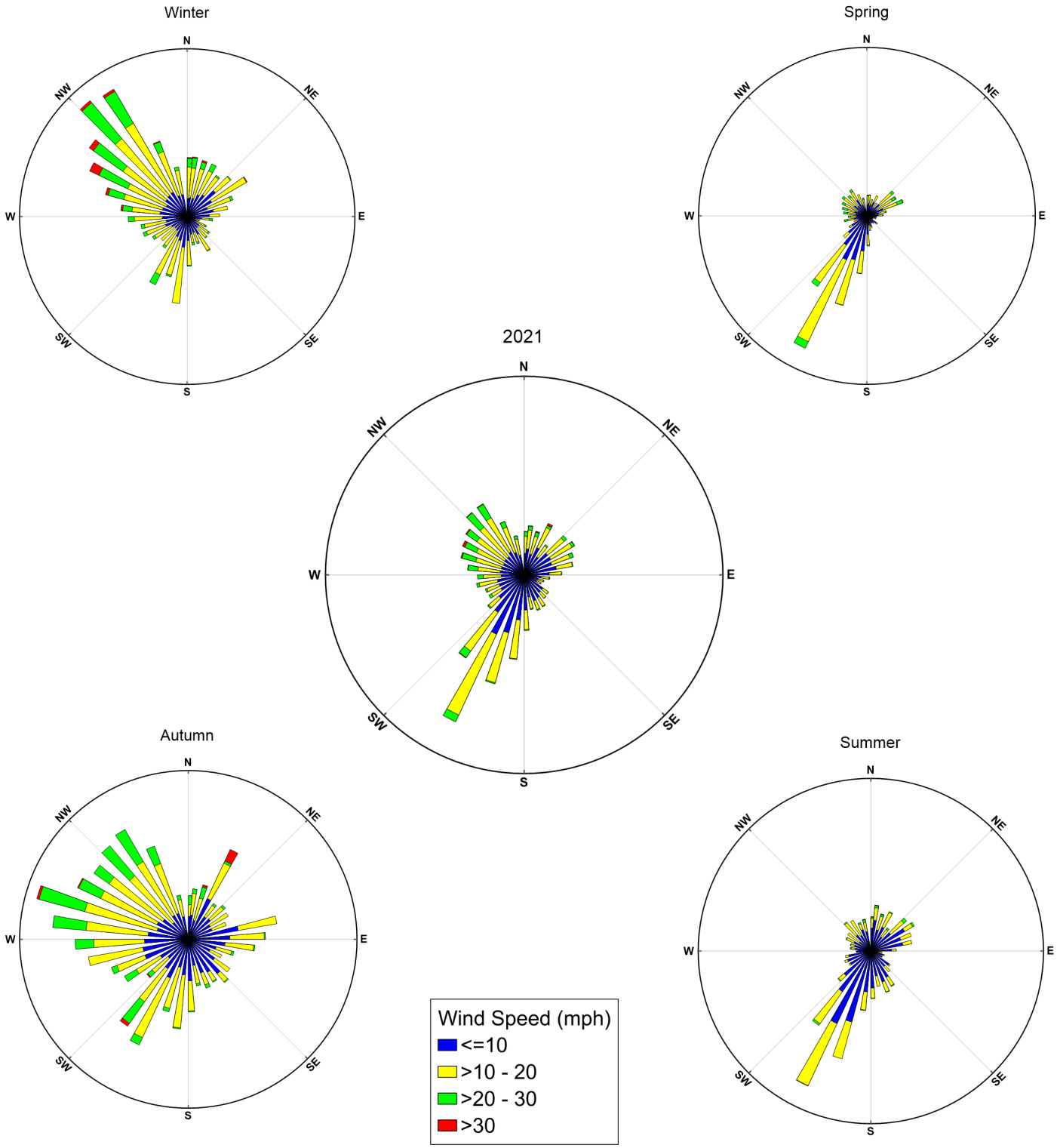


Figure 6. Wind charts reflecting both the seasonal and annual wind direction and speed at Provincetown Municipal Airport, Massachusetts during 2021. Each direction is divided up into categories called bins that are color coated to represent the frequency of a certain wind speed. The length of the bin represents the number of times wind comes from a given direction as well as the speed of the wind. The longer the length of the bin, the more frequent the given speed was recorded Data available at the NOAA National Centers for Environmental Information, Climate Data Online website.

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https://www.nps.gov/im/ncbn/index.htm