Does Autumn Weather Correlate to Winter Conditions at the Blue Hill Observatory?

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It has often been inferred that weather conditions during autumn provide some predictive indication of weather during the subsequent winter. The highly accurate 125-year climate record of the Blue Hill Observatory provides an ideal context in which to study whether any such correlation exists in southeastern New England. This article focuses on October-November (ON) and December-February (DJF) temperature, precipitation and snowfall for the years 1885-2008 as measured on the summit of Great Blue Hill in Milton, Massachusetts.

Figure 1 shows a scatter plot of ON temperature departure (from the 1891-2000 mean) plotted against the following DJF for each year of the Blue Hill climate record. Data are separated into different multi-year time periods as indicated in Figure 1. The diagonal line indicates where the data points would lie if the ON and DJF temperature departures were identical each year. Although there is a wide degree of spread around the diagonal line, there are many seasons in which temperature departures in ON and the following DJF are of the same sign, that is, when ON is warm the following winter is warm and when ON is cold, the following

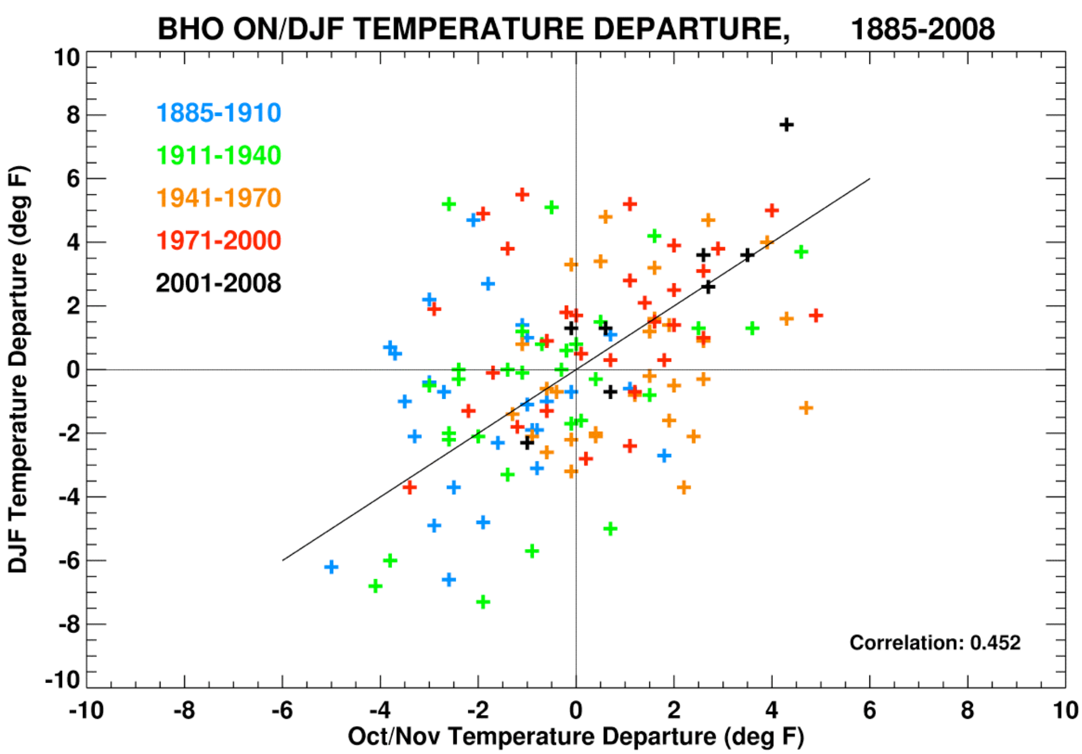

Figure 1. Scatter plot of mean temperature departure for October-November (ON) and the following December-February (DJF) separated into several multi-year time periods. The diagonal line is the line along which the ON and DJF temperature departures would lie if they were identical each year.

winter is cold. The overall temperature departure correlation between ON and DJF for the entire 125 year period is 0.452, which suggests some relation exists between the two seasons (a value of 1.0 is a perfect correlation and a value of 0.0 represents no correlation). Looking at it another way, more than half of the time (64 seasons out of 125) the ON and DJF temperature departures are either both positive and greater than 0.5 deg F (upper right quadrant), or both negative and less than –0.5 deg F (lower left quadrant). The greater number of data points from the latter half of the 20th century in the upper right quadrant and the greater number of data points from the first half of the 20th century in the lower left quadrant reflects the overall upward trend in temperature at Blue Hill over the last 125 years. It is notable that the correlation of temperature between ON and DJF appears to have been higher than usual during the first decade of the 21st century (i.e. the data points lie relatively close to the diagonal line).

The relation of Oct-Nov and winter temperatures through time can be examined by plotting the running 10-year correlation between the ON and DJF temperatures as shown in Figure 2. Each point along the line in Figure 2 is the temperature correlation between the ON and DJF periods over the 10 years ending at that point. Although examining a 10-year correlation will obscure variations from year to year, this plot does suggest that there have been lengthy periods, especially in the early and late 20th century, when ON and DJF temperatures were more highly correlated.

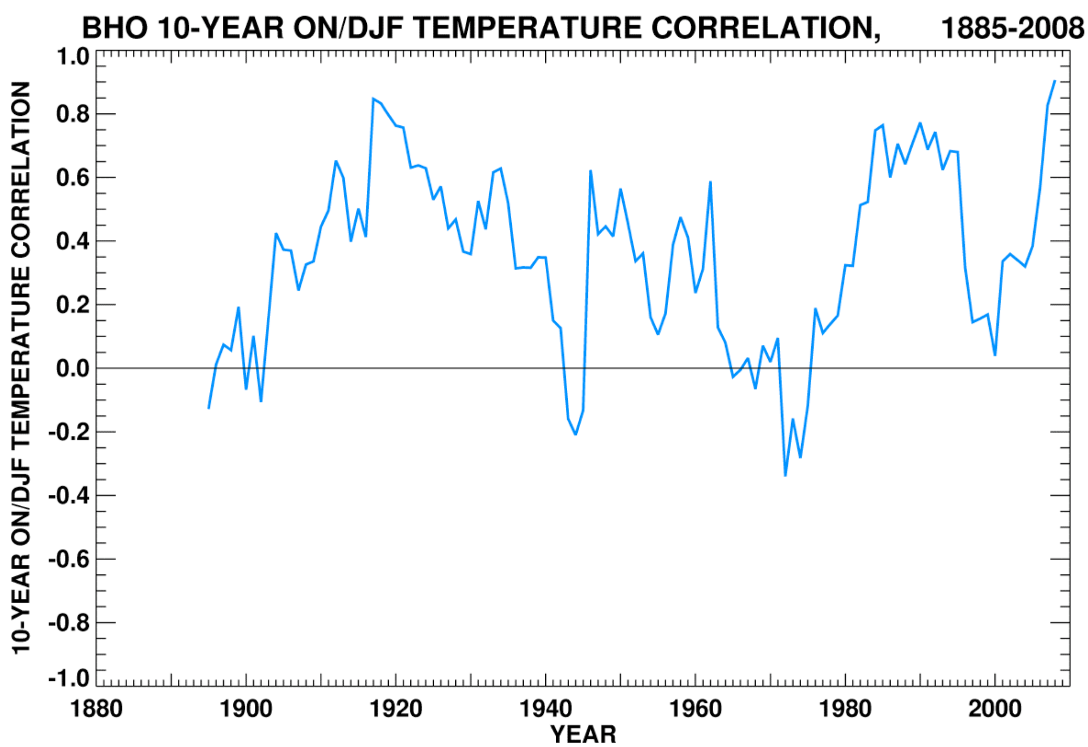

Figure 2. Running 10-year correlation of temperature between October-November (ON) and the following December-February (DJF) for the full period of record at the Blue Hill Observatory.

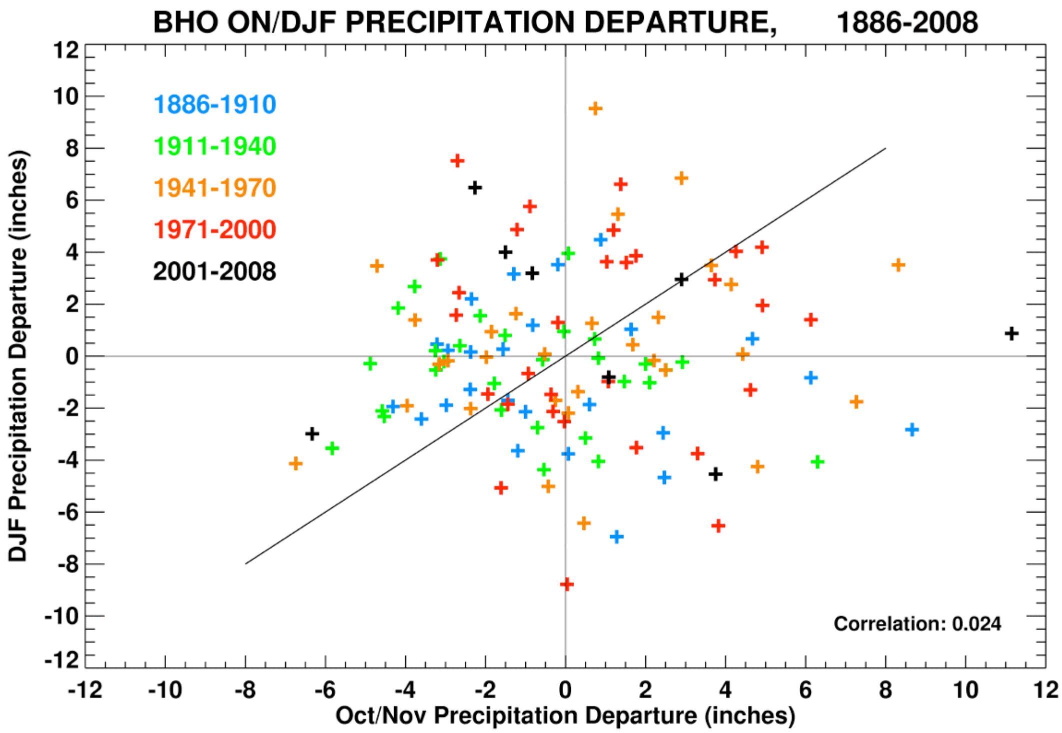

Figure 3. Scatter plot of total precipitation departure for October-November (ON) and the following December-February (DJF) separated into several multi-year time periods. The diagonal line is the line along which the ON and DJF precipitation departures would lie if they were identical each year.

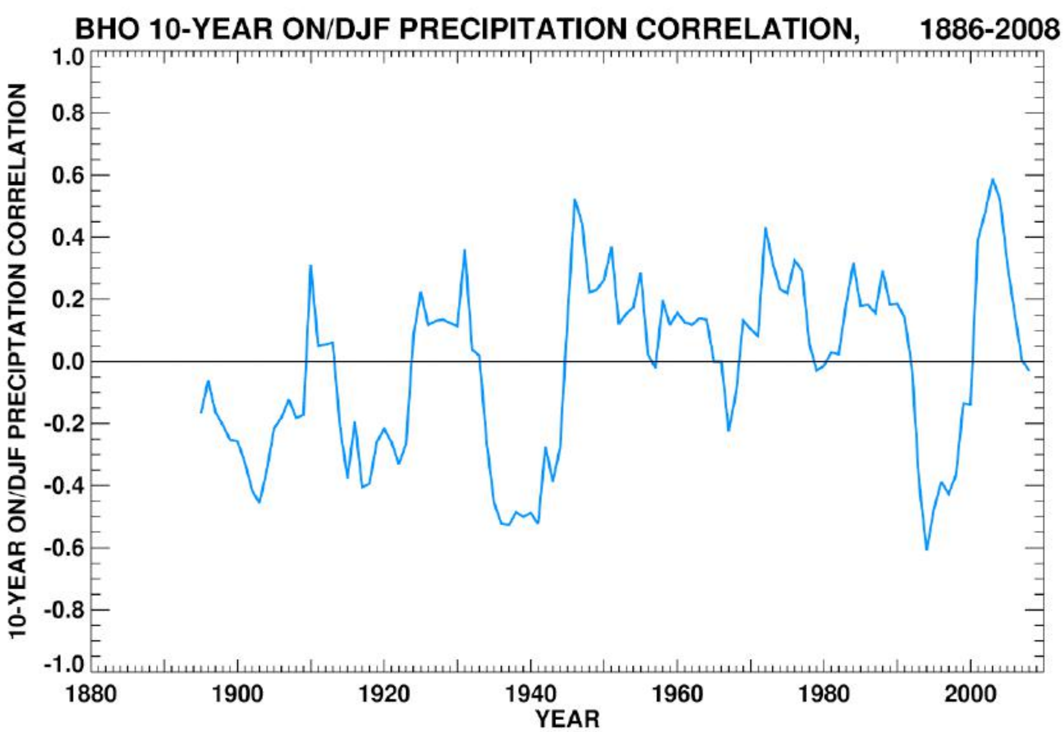

Figure 4. Running 10-year correlation of precipitation between October-November (ON) and the following December-February (DJF) for the full period of record at the Blue Hill Observatory.

Precipitation during ON and DJF is generally uncorrelated relative to temperature due to the highly variable nature of rainfall. Figure 3 shows a scatter plot of ON precipitation departure against the following DJF seasonal departure. The relatively uniform spread of the data suggests that there is little relation between fall and winter precipitation, and this is supported by the overall numerical correlation of 0.024 between ON and DJF precipitation departure for the full period of record. However, the running 10-year correlation between ON and DJF precipitation shown in Figure 4 suggests that precipitation is occasionally weakly correlated or anti-correlated for a few years between these seasons. This analysis does not show whether there is a physical reason for this, or whether this is merely due to random statistical fluctuations.

As with total precipitation departure, total snowfall departure is generally uncorrelated between ON and DJF. Figure 5 shows the scatter plot of ON and DJF snowfall departure. The reason for the sharp left edge to the scatter plot is that in many years no snow is observed during ON, and the departure from average of the total ON snowfall will be –2.9 inches in those years. For those ON time periods that do have measurable snowfall, there is little apparent correlation with the following DJF average snowfall. The overall correlation between ON and DJF average snowfall for the full period of record is 0.109, which indicates essentially no correlation. Figure 6 shows the 10-year running correlation for ON and DJF snowfall, and again there appear to be brief intervals when a correlation is much more apparent, though these are likely the result of random variability.

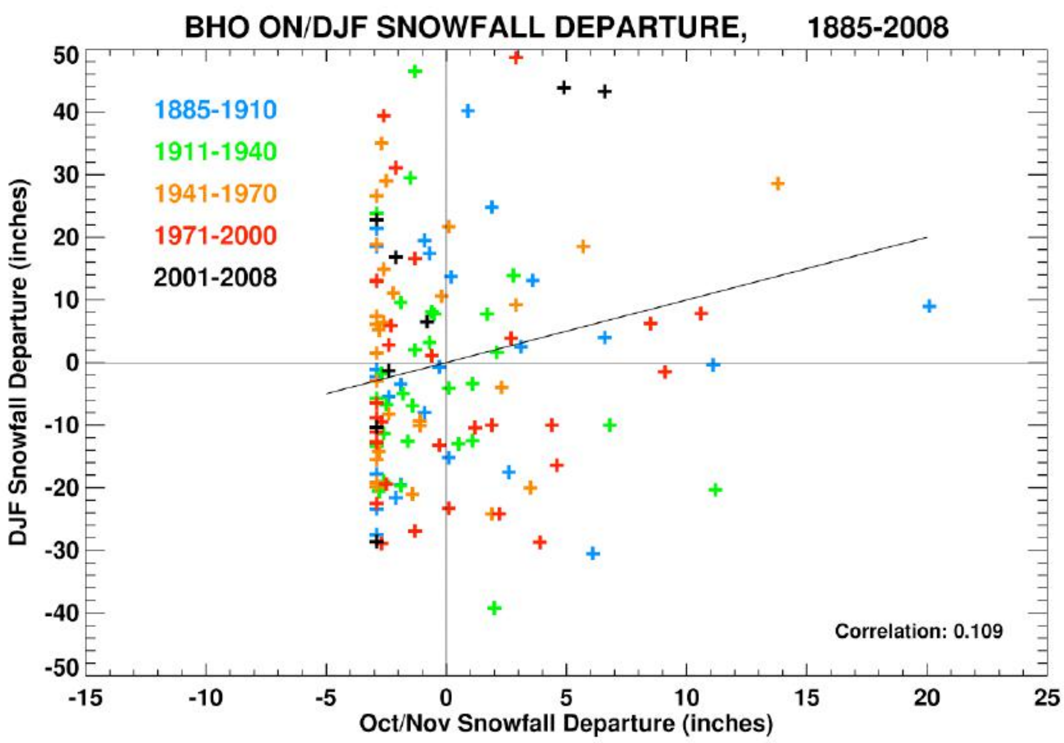

Figure 5. Scatter plot of total snowfall departure for October-November (ON) and the following December-February (DJF) separated into several multi-year time periods. The diagonal line is the line along which the ON and DJF snowfall departures would lie if they were identical each year.

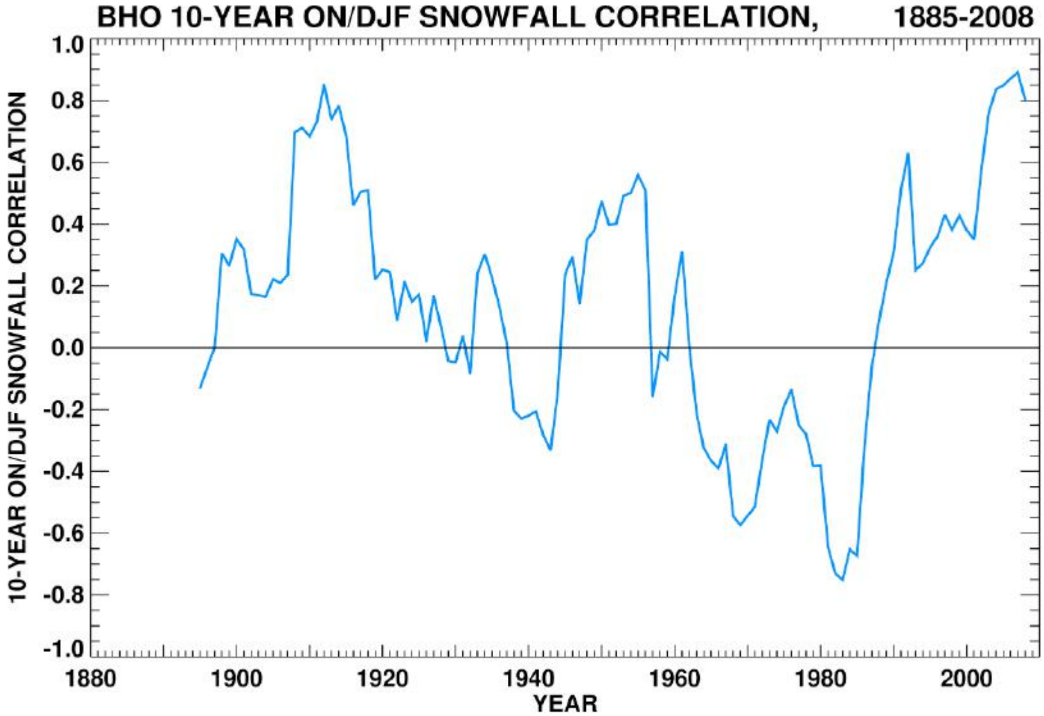

Figure 6. Running 10-year correlation of snowfall between October-November (ON) and the following December-February (DJF) for the full period of record at the Blue Hill Observatory.

In summary, temperature at the Blue Hill Observatory during October-November correlates to some degree to the following winter temperature more than half the time, with an overall correlation of 0.45 and with much higher and much lower correlation over some ten-year periods during the 20th century. Both precipitation and snowfall, which are much more highly variable than temperature, are in general essentially uncorrelated between ON and the following winter, though some correlation is occasionally apparent over some years due to random variations. As a result, ON precipitation and snowfall provide little predictive capability of the subsequent winter precipitation and snowfall. Although ON temperature appears to provide some prognostic information about the following winter temperature, the extent to which the correlation is effective very likely depends on the specific atmospheric dynamical processes than dominate the weather conditions during particular fall and winter seasons.