The Effect of the Atlantic Ocean on Polar Vortex Weakening

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An infamous atmospheric anomaly, Sudden Stratosphere Warming (SSW) alters the circulations of different layers of the atmosphere, affecting the weather of the ionosphere/thermosphere as well as the troposphere. The SSWs typically occur in the Northern winter, but their strength and occurrences are quite dynamic and not predictable so far. Recent studies generalized SSWs to well-defined Polar Vortex Weakenings (PVW) and characterized the strength and occurrences of PVWs in the past 36 years. In my study, the heat energy deposited into the Arctic by the North Atlantic Current (NAC) and the phasing of the Atlantic Meridional Overtuning Circulation (AMOC) are quantified by sea surface temperatures (SST)/ocean air temperatures (OAT) in two certain regions and are correlated with the strength and occurrences of PVWs, respectively. The confidence levels of the correlations (>99.95 %) positively support the hypothesis that the SSWs/PVWs are triggered by the NAC. It is demonstrated that the strength of the PVWs is well correlated with the amount of energy brought into the Arctic by the NAC while the timing of the PVWs is well correlated with the phasing of AMOC, with about a nominal 10-day delay. In particular, the linear correlation establishes that a 1-degree increase in the North Atlantic Subpolar (NASP) Ocean Air Temperature (OAT) translates to a ~12.8-day earlier occurrence of PVW and a 1-degree increase in the NAC OAT leads to a ~5.8 m/s more westward zonal mean zonal wind during PVW. These findings can be directly applied to the prediction of SSWs/PVWs and thus improve the forecast of thermosphere/ionosphere and troposphere weather.

Awards Won:
Third Award of $1,000
Society of Exploration Geophysicists: First Award of $1,000