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The North Atlantic variability structure, storm tracks, and precipitation depending on the polar vortex strength

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Abstract. Motivated by the strong evidence that the state of the northern hemisphere vortex in boreal winter influences tropospheric variability, teleconnection patterns over the North Atlantic are defined separately for winter episodes where the zonal wind at 50hPa and 65° N is above or below the critical velocity for vertical propagation of zonal planetary wave 1. We argue that the teleconnection structure in the middle and upper troposphere differs considerably between the two regimes of the polar vortex, while this is not the case at sea level. If the polar vortex is strong, there exists one meridional dipole structure of geopotential height in the upper and middle troposphere, which is situated in the central North Atlantic. If the polar vortex is weak, there exist two such dipoles, one over the western and one over the eastern North Atlantic. Storm tracks (and precipitation related with these) are determined by mid and upper tropospheric conditions and we find significant differences of these parameters between the stratospheric regimes. For the strong polar vortex regime, in case of a negative upper tropospheric "NAO" index we find a blocking height situation over the Northeast Atlantic and the strongest storm track of all. It is reaching far north into the Arctic Ocean and has a secondary maximum over the Denmark Strait. Such storm track is not found in composites based on a classic NAO defined by surface pressure differences between the Icelandic Low and the Azores High. Our results suggest that it is important to include the state of the polar vortex strength in any study of the variability over the North Atlantic.

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