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Structure and dynamical Evolution of the Greenland Tip Jet: ERA40 climatology

K. Vaage (1), T. Spengler (2), H.C. Davies (2), and R.S. Pickart (1)

(1) Woods Hole Oceanographic Institution, Woods Hole, MA, USA, (2) Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland

The Greenland tip jet is an intense, narrow and intermittent westerly wind phenomenon southeast of Cape Farewell that often takes place in winter and plays an important role for both the circulation and seasonal evolution of the mixed layer in the Irminger Sea below. The orographically induced winds result from an interaction between a low pressure system and the high topography of Greenland. Using the ERA-40 reanalysis data set and an air-parcel trajectory model, we investigate the wintertime conditions in which tip jets occur and describe their characteristics. A catalog of 586 objectively detected tip jet events for the winters 1957-2002 reveal significant positive correlations of tip jet frequency with both the NAO index and the latitude of the Icelandic Low. Composite tip jet averages expose strong winds with peak velocities and heat fluxes of up to 30 m/s and 600 W/m^2, respectively, sustained for less than one day. Backward trajectories demonstrate a continental origin of the air parcels comprising the tip jet, and confirm that acceleration through deflection around Greenland is a robust feature of most tip jets. A vertical coherence between the lower-level tip jet and upper-level jet stream winds along with strong positive anomalies of cyclone and jet stream residence in the vicinity of Greenland may suggest that tip jets arise due to an interplay between the high topography of Greenland and the presence of a cyclone to the east and the jet stream to the south. We favor an alternative hypothesis that explains the co-location of the tip jet and the jet stream with the tandem propagation of cyclones and the upper-level steering currents in which they are embedded. In this scenario, which is supported by a high variance in jet stream wind speed during tip jets, there is not necessarily a direct dynamical link between the upper- and lower-level winds.