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Tip jets and barrier winds: A QuikSCAT climatology of high wind speed events around Greenland

G.W.K. Moore (1), I.A. Renfrew (2)

(1) Department of Physics, University of Toronto, Toronto, Canada, (2) School of Environmental Sciences, University of East Anglia, Norwich, U.K.
(moore@atmosp.physics.utoronto.ca / Fax: 416 978 8905 Phone: 416 978 4686)

The high topography of Greenland results in a number of orographically induced high wind speed flows along its coast that are of interest from both a severe weather and climate perspective. Here we use the surface wind field dataset from NASA/JPL's SeaWinds scatterometer on board the QuikSCAT satellite to develop a wintertime climatology of these flows. The high spatial resolution and the twice daily sampling of the SeaWinds instrument allows for a much more detailed view of the surface winds around Greenland than has been possible previously. Three phenomena stand out as the most distinctive features of the surface wind field during the winter months: the previously identified tip jets and reverse tip jets, as well as the hitherto unrecognized barrier flows along its southeast coast in the vicinity of the Denmark Strait. Peak surface wind speeds associated with these phenomena can be as large as 50 m s^{-1} with winds over 25 m s^{-1} occurring approximately 10-15% of the time at each location.

A compositing technique is used to show that each type of flow is the result of an interaction between a synoptic-scale parent cyclone and the high topography of Greenland. In keeping with previous work we argue that tip jets are caused by a combination of conservation of the Bernoulli function during orographic descent and acceleration due to flow splitting as stable air passes around Cape Farewell, while barrier winds are a geostrophic response to stable air being forced against high topography. We propose that reverse tip jets occur when barrier winds reach the end of the topographic barrier and move from a geostrophic to a gradient wind balance, becoming super-geostrophic as a result of their anti-cyclonic curvature.