Ragnhild Bieltvedt Skeie[1], Jón Egill Kristjánsson[1] and Haraldur Ólafsson[2]
1) University of Oslo
2) University of Iceland, Icelandic Meteorological Office and Institute for Meteorological Research

Dynamical processes related to cyclone development near Greenland

A cyclone that led to heavy snowfall and sustained winds exceeding 30 m/s over East Greenland and North Iceland on 21 September 2003 is investigated to determine atmospheric factors contributing to its development. Numerical simulations are conducted to find out what role Greenland's orography did play as well as other factors like latent heat, SST and SST gradients, in determining the position and strength of the low.

This case is run with (CONTROL) and without (NOGREEN) the mountains of Greenland. In the NOGREEN run the height of Greenland is set to 1m, and the model extrapolates the atmospheric conditions from ECMWF reanalysis down to sea level. The case is also run without latent heat release, reduced SST with 5 degrees and without SST gradients in the east-west direction.

The surface low passes over Greenland starting from the north west corner of Greenland. When it moves over the sea on Greenland's east coast, a secondary low south of the original cyclone appears. This secondary cyclone is stronger than the primary low and after 66 hours the primary low is just a trough while the secondary low intensifies. The secondary cyclone does not appear in the run with no mountains. In the NOGREEN run the cyclone has a more direct eastward movement and is not pushed southward to the region between Iceland and Greenland as in the control run. The NOGREEN cyclone deepened more rapidly than in the control run, reaching its mature stage after 66 hours and central pressure 981hPa. The cyclone in the control run gets even deeper when it reaches its mature stage 24 hours later with its central pressure 973hPa. At this stage the cyclone is far east in the North Atlantic and the cold air behind the low is not hampered by Greenland. At upper levels, at 500hPa, the Greenland orography significantly reduces the strength of the low.

The simulations show that the cyclone is strongly affected by the orography of Greenland. Greenland’s orography causes the formation of a lee cyclone off Greenland’s E coast. Due to the orography, the flow of cold air behind the developing low is hampered, weakening the developing low, and delay the most intense stage. At the surface, turning off latent heating weakens the low, but SST gradients and SST in general contribute relatively little to cyclone deepening. The results are considered in the context of previous work on Greenland