Geophysical Research Abstracts
Vol. 15, EGU2013-12749, 2013
EGU General Assembly 2013

Mesoscale modeling of South Greenland

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The WRF model was run for a limited domain over Southern Greenland to investigate thermal and katabatic wind systems and their impact on the wind resource.

Rising fossil fuel prices have motivated Greenland to expand its renewable energy network. Although the main focus has been on hydro power, the large investment costs and lack of hydro resources have led to openings for other energy sources, including wind energy.

Most of Greenland is covered by the large inland ice cap and most of the ice-free coastal part consists of mountainous terrain, split by deep fjords and valleys that run from the sheet edge towards the sea. The mountains are of varying ages, heights and shapes, depending on location. The fjord systems and mountains form a very complex terrain with widely branched channels. The complex terrain, together with relatively large temperature differences between the fjord/sea water and the atmosphere create thermal circulations. The ice cap gives ideal conditions for downslope katabatic winds and has a major influence on the wind climate at the coast. These mixed physical processes and the complex terrain present considerable challenges for wind prediction and wind energy resource mapping. It is essential that any wind resource mapping based on mesoscale or microscale modelling takes into account both the katabatic flows and the impact of flow in the complex terrain.

In this work, the wind conditions for a limited domain over Southern Greenland are studied using the polar version of the Weather Research and Forecasting model [1]. The model is run at a horizontal resolution of 2km for one month test period, and is nested in the recently created Arctic System Reanalysis [2].

The extent to which the thermal and downslope Katabatic winds are captured in high resolution WRF simulations is explored by comparing the mesoscale model output to extensive meteorological mast measurements collected over the period 07.2007 to 08.2012. In particular, the focus for the work is:

- Can the model realistically capture the variability in wind speed and direction over the area?
- Can the model represent the thermal and katabatic processes, which dominate the area?
- How is the terrain represented in the model, and what resolution is necessary to get accurate results?

For accurate wind energy resource mapping, mesoscale model output must be further downscaled using a microscale model such as WAsP. Therefore, future work will focus on microscale modeling based on the mesoscale model results.

[1] Hines, K. M., and D. H. Bromwich (2008), Development and testing of Polar WRF Part I: Greenland ice sheet meteorology, Mon. Weather Rev., 136, 1971–1989.

[2] Bromwich, D. H., Y.]H. Kuo, M. Serreze, J. Walsh, L.]S. Bai, M. Barlage, K. M. Hines, and A. Slater (2010), Arctic System Reanalysis: Call for community involvement, Eos Trans. AGU, 91(2), 13–14.

This work was partially supported by the Danish Council for Independent Research – Technology and Production, under contract number 10-093196.