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Measurement campaign for wind power potential in west Greenland

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Experiences and results from a wind resource exploring campaign 2003- in west Greenland.

Like many other countries, Greenland is trying to reduce its dependency of fossil fuel by implementing renewable energy. The main challenge is that the people live on the coast in scattered settlements, without power infrastructure. Based on this a wind power potential project was established in 2002, funded by the Greenlandic government and the Technical University of Denmark. We present results and experiences of the campaign.

1 Field campaign

There were only a few climate stations in or close to settlements and due to their positioning and instrumentation, they were not usable for wind resource estimation. To establish met stations in Arctic areas with complex topography, there are some challenges to face; mast positioning in complex terrain, severe weather conditions, instrumentation, data handling, installation and maintenance budget.

The terrain in the ice free and populated part, mainly consists of mountains of different heights and shapes, separated by deep fjords going from the ice cap to the sea. With a generally low wind resource the focus was on the most exposed positions close to the settlements. Data from the nearest existing climate stations was studied for background estimations of predominant wind directions and extreme wind speeds, and based on that the first 10m masts were erected in 2003.

2 Instruments

The first installations used standard NRG systems with low cost NRG instruments. For most of the sites this low cost setup did a good job, but there were some problems with the first design, including instrument and boom strains. In subsequent years, the systems were updated several times to be able to operate in the extreme conditions. Different types of instruments, data logger and boom systems were tested to get better data quality and reliability. Today 11 stations with heights ranging from 10-50m are installed and equipped according to the IEC standard.

During the first years, the influence of instrument icing was not considered, but recently one of the sites was equipped with an ice rate sensor and a heated ultrasonic anemometer to study the ice influence.

3 Results

The predominant wind direction for most sites is away from the ice cap at the center of the continent, but for some coastal sites it is north or south. The north-south wind pattern is expected from the synoptic patterns and the barrier effect of the ice cap. The sites where the predominant wind direction is away from the inland ice are dominated by katabatic wind systems from the ice cap and form valley systems. These sites also seem to have the highest wind resource and will be studied further. A good example of the influence of katabatic and thermal wind systems can be seen in the measurement data from Sarfannguit and Nanortalik 66 and 60 degrees northern latitude respectively.

In future work, these katabatic flows and their impact on the wind resource will be studied using mesoscale modelling and microscale downscaling.