



Polar lows in the Labrador Sea based on the Moravian historical collection of meteorological data in Labrador and Greenland since the mid-18th century

Michael Matiu (1), Cornelia Lüdecke (2), Dianne Newell (3), Annette Menzel (1,4)

(1) Technische Universität München, Ecoclimatology, Freising, Germany, (2) Center for History of Science and Technology, University of Hamburg, (3) Institute for the Oceans and Fisheries, University of British Columbia, Vancouver, Canada, (4) Institute for Advanced Study, Technical University of Munich, Garching, Germany

Systematically recorded daily instrumental meteorological data from the Moravian Brethern mission stations located on the east coast of Labrador and southwest coast of Greenland during the 18th, 19th and 20th centuries provide a most valuable source of historical climatological data in the Subarctic region. Although the collections of original data themselves are both scattered in physical location and fragmented in their coverage of time and place, and large amounts still need to be digitized, this data provides large potential for studying climate extreme events in this remote region.

In this paper, we study polar lows (PLs). They are high-latitude intense maritime cyclones with only 200 to 1000 km in diameter, a short life-time of only two days, mostly occurring in wintertime, e.g. in the Norwegian, Barents, but also Labrador and Greenland seas. Due to high wind speeds exceeding 30 m s⁻¹, high ocean waves and heavy snow showers, they constitute a major hazard risk difficult to forecast. Published papers indicate that with future climate warming, the frequency of PLs is predicted to decrease; however, climatologies of PLs for the last 7 decades (1948-2009) based on reanalysis data and satellite remote sensing products did not indicate any change in their mean annual frequency.

In our digitized long-term dataset (1846-2015) for one Moravian station at Nain, Labrador, we identified PLs as follows: If there was a drop in air pressure of at least 30hPa during 48 hours, we marked it as a preliminary event. Then, each preliminary event was checked manually to see whether additional changes in air pressure, air temperature, wind direction and wind speed matched the known textbook example. If more than two variables showed the required pattern, the preliminary event was identified as PL. Our analysis revealed an average frequency of 5.6 PLs yr⁻¹ for 1846-1853, 5.2 PLs yr⁻¹(1882-1913), and 4.4 PLs yr⁻¹ (1926-1939), largely confirming long-term averages for the more recent periods 1948-2005 (4.9 PLs yr⁻¹) as well as 1977-1994 (4.4 PLs yr⁻¹) reported in the literature. Once more data from the historical Moravian collection is digitized, it may be checked whether there is a stable tendency of more annual PLs in the mid-19th century compared to recent numbers of this extreme event. With respect of the boundary conditions in which PLs are developing, our data from the mid-19th century cannot confirm recent findings that the occurrence of PLs is mainly associated with NAO+ phases. Due to additional concurrently operating Moravian climate stations at the eastern Labrador and southwestern Greenland coasts, the moving of PLs and PL clusters over the Labrador Sea and southern Davis Strait can be confirmed based on this unique historical subarctic climate data.