Development of a longterm climatology of North Atlantic polar lows using a RCM

Matthias Zahn, Hans von Storch

Institute for Coastal Research, GKSS Research Center, Geesthacht, Germany, matthias.zahn@gkss.de

1. Introduction - polar lows

Polar lows are intense mesoscale ground level storms, which occur in the subpolar maritime regions of both hemispheres during the winter seasons. They usually develop in instable atmospheric conditions and are often triggered by convective processes (cf. *Rasmussen and Turner* (2003)). Only since the advent of satellite imagery it became possible to discover a large proportion of these features reliably. However the period covered by such data usually does not allow for any statements on the long-term behavior of polar lows.

For investigations of atmospheric features on timescales of several decades, often so called global reanalysis data are used. These reanalyses contain the past state of the whole atmosphere on a relatively coarse grid, approximately 200 x 200 km. As polar lows are phenomena sized beyond the resolved scales of the reanalyses, we used a RCM for our approach to develop a long-term climatology of polar lows in the North Atlantic.

2. Method - reproducing polar lows with a RCM

This widely used method to gain higher resolved atmospheric fields is called “dynamical downscaling” and post processes reanalysis-data by means of RCMs. However, for a number of applications, it is not clear if the expected additional value of the higher resolved fields justifies this computationally intensive procedure. E.g. *Winterfeldt and Weisse* (2009) show, that an additional value for wind speed statistics in maritime areas in RCMs is only gained in coastal areas, which are influenced by topography.

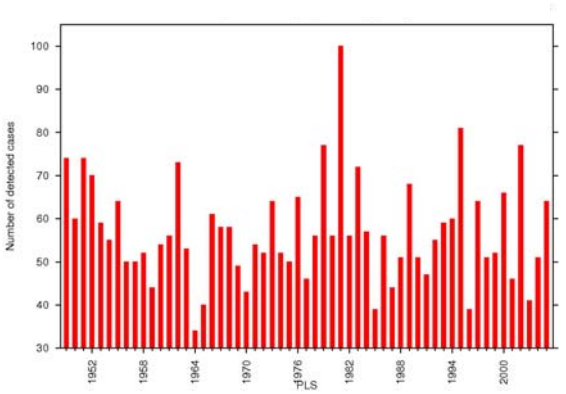
In our talk we show that driving a RCM with global reanalysis-data is a reasonable way for our aim, namely to reproduce polar lows. In RCM simulations polar lows do emerge, whereas in the driving fields, they are not clearly contained. This extends what *Feser et al.* (2009) report on the “added value of limited area model results” on this workshop.

It is further shown, that polar lows can more reliably be reproduced, when a spectral nudging method, which integrates large scale information from the reanalyses into the RCM-simulation, is applied. This holds for an ensemble of case studies as well as for an ensemble of two year long simulations (*Zahn, M. et al.* (2008), *Zahn, M. and H. von Storch* (2008a))

Considering these results we carried out a multidicadal (approx. 60 years) simulation of the atmosphere above the North Atlantic and counted the seasonal numbers of polar lows.

3. Results – the climatology of polar lows

Figure 1 shows the number of counted polar lows per winter season over the investigated period of 60 years. There is large interannual variability in this number, expressed by a standard deviation of about +/- 13 cases, but no long-term changes can be seen (cf. *Zahn, M. and H. von Storch* (2008b)).



Number of detected polar lows per polar low season (PLS). One PLS is defined as the period starting 1 July and ending 30 June the following year.

Further characteristics of the climatology such as regional distribution and the resemblance to limited observational evidence are also presented. Finally, first results for future projections, which assess the behavior of the number of polar lows in presumed changing climate conditions, are discussed.

References

Frauke Feser, Hans von Storch, Jörg Winterfeldt, and Matthias Zahn, Added value of limited area model results, this workshop, 2009

Rasmussen, E. J. Turner, Polar Lows: Mesoscale Weather Systems in the Polar Regions. – Cambridge University Press, Cambridge. 2003

Winterfeldt, J. and R. Weisse, Assessment of value added for surface marine wind obtained from two Regional Climate Models (RCMs), submitted to *Mon. Wea. Rev.*, 2009

Zahn, M., H. von Storch, and S. Bakan, Climate mode simulation of North Atlantic Polar Lows in a limited area model, *Tellus, Ser. A*, 60, pp. 620–631, doi:10.1111/j.1600-0870.2008.00330.x, 2008

Zahn, M. and H. von Storch, Tracking Polar Lows in CLM, Meteorologische Zeitschrift,17(4), 445 - 453, doi:10.1127/0941-2948/2008/0317, 2008a

Zahn, M., and H. von Storch, A long-term climatology of North Atlantic Polar Lows, *Geophys. Res. Lett.*, 35, L22702, doi:10.1029/2008GL035769, 2008b