

14th European Polar Low Working Group meeting
Workshop on ‘Polar lows and mesoscale weather extremes’
5-6 April 2018, Trier, Germany

State and perspectives of the concept of large-scale conditioning of coastal weather extremes for deriving forecasts and statistics of such phenomena

Hans von Storch¹, Matthias Zahn¹, Leone Cavicchia² and Delei Li (李德磊)³

¹Institute of Coastal Research, Helmholtz Center Geesthacht, Germany

²School of Earth Sciences, University of Melbourne, Australia

³Key Laboratory of Ocean Circulation and Waves, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China

Polar Lows, Medicanes, Coastal Low levels Jets and other meso-scale storms phenomena represent significant cases of dangerous weather phenomena. The large-scale atmospheric dynamical state conditions the occurrences and features of such events. They are particularly prevalent and energetic above coastal waters, so that for planning coastal infrastructure as well as offshore activity, knowledge about the statistics, including extreme value statistics, are needed. Because of the large-scale conditioning, such statistics vary in time, reflecting not only decadal variability but also long-term climate change.

Deriving such statistics represents a challenge because of the size of such disturbances, but also because of the changing quality and density of the observational basis. Satellite products provide a good source of data, but working with them is labour-intensive, and statistics based on such data may be compromised by subjective choices and the limited lifetimes of different satellites.

An alternative approach of processing is dynamical downscaling, which extrapolates in the state space from large to smaller scales. A climatology of Polar Lows in the North Atlantic was obtained by implementing this method (Zahn and von Storch, 2008), and later to Polar Lows in the North Pacific (Chen and von Storch, 2013), to Medicanes in the Mediterranean Sea (Cavicchia et al., 2014), and to Coastal Low Level Jets in the Bohai / Yellow sea region (Li et al., 2018). The methodology has matured now and is routinely used in many applications – mainly for deriving states in the past decades but also for constructing consistent scenarios for possible future developments.

We review past developments, address the present state and prospect of such approaches, with

- the challenge of simulating dynamical properties of small scale cyclones like Polar Lows,
- the possible extension of phenomena by increasing resolution which allows the simulation of convective processes (as opposed to parametrized; e.g., Li, 2016)
- the possible added value of constrained limited area models in the analysis of processes (Kolstad et al., 2016),
- the possible added value of constrained limited area models in regional forecasting (Zhao et al., 2016)
- and the option of implementing such methodology in global models (von Storch et al., 2017).

Di Luca, A., Evans, J. P., Pepler, A. S., Alexander, L., & Argüeso, D. (2016). Evaluating the representation of Australian east coast lows in a regional climate model ensemble. *J South Hemisphere Earth Syst Sci*, 66, 108-124.

陈飞 (Chen F.), and H. von Storch, 2013 : Trends and variability of North Pacific Polar Lows, *Advances in Meteorology* 2013, ID 170387, 11 pages, <http://dx.doi.org/10.1155/2013/170387>

Kolstad, E. W., T. J. Bracegirdle, and M. Zahn (2016), Re-examining the roles of surface heat flux and latent heat release in a “hurricane-like” polar low over the Barents Sea, *J. Geophys. Res. Atmos.*, 121, 7853–7867, doi:10.1002/2015JD024633.

李德磊 (Li D.), 2016: Added value of high-resolution regional climate model: selected cases over the Bohai Sea and Yellow Sea areas. *Int. J. Climatol.*, doi:doi: 10.1002/joc.4695.

李德磊 (Li D.), Ph.D.; H. von Storch, Yin B., Xu Z., Donglin Guo D., and Wei W.: Climatology of coastal low level jets over the Bohai Sea and Yellow Sea and the relationship with regional atmospheric circulations, submitted

von Storch, H., F. Feser, B. Geyer, K. Klehmet, 李德磊 (Li D.), B. Rockel, M. Schubert-Frisius, N. Tim, and E. Zorita, 2017: Regional re-analysis without local data - exploiting the downscaling paradigm. *J. Geophys. Res. - Atmospheres*, DOI:10.1002/2016JD026332

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

Zhao Y., Wang D., Liang Z and Xu J., 2016: Improving numerical experiments on persistent severe rainfall events in southern China using spectral nudging and filtering schemes. *Q. J. R. Meteorol. Soc.* DOI:10.1002/qj.2892