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High-resolution long-term atmospheric hindcast for the North Atlantic: mesoscale dynamics and extreme events

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The majority of state of the art climate studies are based on the atmospheric reanalyses. Horizontal resolution of the modern reanalyses is around 0.5º which is sufficient for resolving synoptic-scale dynamics but does not allow for resolving mesoscale processes. This precludes the analysis of still poorly understood role of mesoscale dynamics in climate variability. Many case studies demonstrated the importance of mesoscale features in forming extreme events.

To analyze the role of mesoscale processes onto climate variability we developed a high-resolution long-term atmospheric hindcast based on the non-hydrostatic WRF-ARW atmospheric model forced by ERA-Interim reanalysis. The computational domain covers the North Atlantic from 0N to 80N and has horizontal grid resolution of 1/8° and 50 vertical levels with the lowest level at roughly 10 m high over the ocean. Currently the hindcast spans the period of 22 years (1979—2000) and is continuing onwards to 2017. Since the characteristics the surface atmosphere are crucial for our study, the Planetary Boundary Layer and the Surface Layer parameterization schemes in the model set-up were extensively tested using several satellite data sources (surface wind) and NDBC buoys (surface wind, temperature and humidity).

In order to assess the value of non-hydrostatic high resolution formulation we also additionally developed a coarse resolution hindcast for the same domain. This was performed with the same model configuration but at horizontal resolution reduced to 0.7°. Comparative assessment of the two simulations allows us to provide a comprehensive analysis of the North Atlantic mesoscale dynamics, including mesoscale extreme events.

Developed dataset shows good agreement with observations (surface wind and precipitation) and could be used in the North Atlantic mesoscale studies, specifically as a forcing function for ocean general circulation and wave models. This work was supported by the Russian Science Foundation grant 14-50-00095.