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Two centuries of observed atmospheric variability and change over the North Sea region

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In the upcoming North Sea Region Climate Change Assessment (NOSCCA), we present a synthesis of current knowledge about past, present and possible future climate change in the North Sea region. A climate change assessment from published scientific work has been conducted as a kind of regional IPCC report, and a book has been produced that will be published by Springer in 2016.

In the framework of the NOSCCA project, we examine past and present studies of variability and changes in atmospheric variables within the North Sea region over the instrumental period, roughly the past 200 years, based on observations and reanalyses. The variables addressed in this presentation are large-scale circulation, pressure and wind, surface air temperature, precipitation and radiative properties (clouds, solar radiation, and sunshine duration). While air temperature over land, not unexpectedly, has increased everywhere in the North Sea region, with strongest trends in spring and in the north of the region, a precipitation increase has been observed in the north and a decrease in the south of the region. This pattern goes along with a north-eastward shift of storm tracks and is in agreement with climate model projections under enhanced greenhouse gas concentrations. For other variables, it is not obvious which part of the observed changes may be due to anthropogenic activities and which is internally forced. It remains also unclear to what extent atmospheric circulation over the North Sea region is influenced by distant factors, in particular Arctic sea-ice decline in recent decades.

There are indications of an increase in the number of deep cyclones (but not in the total number of cyclones), while storminess since the late 19th century shows no robust trends. The persistence of circulation types appears to have increased over the last century, and consequently, there is an indication for ‘more extreme’ extreme events. However, changes in extreme weather events are difficult to assess owing to homogeneity issues resulting for example from changes in instrumentation and station relocations. There is a wealth of as-yet undigitised data available for the North Sea region. Digitisation is a time-intensive process requiring thorough quality control, without which the digitised datasets may be useless or even counterproductive. Quality control requires human input and thus cannot be fully automated. We also compare reanalysis data, which can help detect inhomogeneities in observed time series, but at the same time are prone to biases and/or spurious trends introduced e.g. by changes in the availability and quality of assimilated data. It therefore remains unclear whether surface observation-based reanalysis fields prior to the 1970s are homogeneous.