



## **Long term changes in the wintertime surface Arctic Oscillation, and Northern hemisphere storminess in the ERA20C re-analysis**

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Global atmospheric re-analysis products are a common tool for the validation of climate models, or for studies of long-term climate variability. A number of studies have used century long re-analysis products to investigate decadal variability of meteorological features; however a question remains as to whether any trends seen in these studies are real.

This study finds statistically significant long-term changes in the wintertime surface Arctic Oscillation (AO) calculated for the ECMWF 20th century re-analysis (ERA20C ) which are not seen in two other observational datasets spanning the 20th century. This long-term change in the ERA20C AO index is consistent with changes in mean-sea level pressure during the 20th century. An approximately 6hPa, decreasing trend in mean-sea level pressure is seen in the Polar regions (latitudes greater than 70N) in ERA20C over the course of the century. The long term changes in mean-sea level pressure result in changes in the mean meridional surface pressure gradients in ERA20C. These are consistent with increases in wintertime storminess in Northern Europe and the Polar region. The significant differences in the AO index during the first and second half of the century suggest that ERA20C should be used with caution before 1950.

The long term changes present in ERA20C are also present in the coupled version of the ECMWF 20th century re-analysis (CERA20C), but are not present in the free running model version (ERA20CM). This supports previous studies which suggest that differences throughout the century in ERA20C could be due to increasing numbers of observations used in the data assimilation procedure.