Evaluation of 20CR reanalysis data and model results based on historic (1930-1940) observations from Franz Josef Land

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ABSTRACT

Unique and independent historic observations, carried out in the central Arctic during the early twentieth century warming (ETCW) period, were used to evaluate the older (20CRv2) and newer (20CRv2c) versions of the 20th Century Reanalysis and the HIRHAM5 regional climate model. The latter can reduce several biases compared to the forcing data set (20CRv2) probably due to higher horizontal resolution and a more realistic cloud parameterization. However, low-level temperature and near-surface specific humidity agree best between 20CRv2c and the surface-based observations. This better performance results from more realistic lower boundary conditions for sea ice concentration and sea surface temperature, but it is limited mainly to polar night. Although sea level pressures are very similar, the vertical stratification and baroclinicity change indicating an incorrect coupling between the planetary boundary layer and free troposphere. In addition to surface pressures it is therefore recommended to assimilate available vertical profiles of temperature, humidity and wind speed. This might also reduce the large biases in 10 m wind speed, but the reliability of the sea ice data remains a great unknown.

RESULTS

Temporal usage and resolution of raw data for sea level pressure (SLP), horizontal wind speed (V10m), air temperature (T), specific humidity (SH), and total cloud cover (TCLC).

DATA

Geographic location of the historic station Calm Bay and the nearest-grid neighbor points of the 20th Century Reanalysis (green triangle) and regional climate model HIRHAM5 (blue square), respectively.

Figures show modelled (HIRHAM5; green) and reconstructed (20CRv2c; red) as well as their differences from observations by Walsh et al. 2016 (black). The newer version of 20CR (20CRv2c; red), its older version (20CRv2; blue), and the HIRHAM5 model (green) are used to evaluate the older (20CRv2; blue) and newer (20CRv2c; red) version of the 20th Century Reanalysis, and the HIRHAM5 model. The latter can reduce several biases compared to observed sea level pressure, 10 m wind speed (V10m), air temperature (T), specific humidity (SH), and total cloud cover (TCLC).

LOCATION

Location of the historic meteorological station Calm Bay (red dot) on Hooker Island belonging to Franz Josef Land as well as the nearest-neighbor grid points of the 20th Century Reanalysis (green triangle) and regional climate model HIRHAM5 (blue square), respectively.

REFERENCES

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