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Evaluation of the near-surface climate of the Greenland ice sheet as modelled by the climate model MAR and the ERA-Interim, ERA5 and Arctic System reanalyses

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The new reanalysis produced by the ECMWF, ERA5, is currently available over the period 2000-2017. Ultimately, it will cover the period 1950 to the present-time and will replace the ERA-Interim, which is by many considered as one of the best reanalyses over the Greenland ice sheet (GrIS). We first compare the ERA5 reanalysis to ERA-Interim and ASR (Arctic System reanalysis), which is a regional reanalysis specifically developed for the Arctic area at a finer resolution. We evaluate them against a set of near-surface climate observations from the AWS of the PROMICE network covering the GrIS. This observation data set is not assimilated in these reanalyses. We furthermore assess the ability of the state-of-the-art regional climate model (RCM) MAR, forced by the ECMWF reanalyses, ERA-Interim and ERA5, to represent the AWS observations. Finally, we demonstrate the advantages of using MAR compared to the forcing reanalyses alone. ERA5 improves ERA-Interim almost for radiative fluxes, but not significantly. ASR, which is more specific for Arctic region and has a finer spatial resolution, outclasses other reanalyses for wind speed and near-surface temperature. The comparison of results from MAR simulations forced by ERA-Interim and ERA5 reanalysis shows that the near-surface climate variables are closed to each other and then not significantly different according to the forcing used. ERA5 which should replace ERA-Interim after 2018, can be used to force a RCM such as MAR in the same way than ERA-Interim now. Although the reanalyses seem to be sufficient to study the surface climate of Greenland, the RCM MAR has the best representation of the near-surface temperature even without any data assimilation. This is mainly due to a better representation of the snowpack and interactions between surface and atmosphere by MAR, resulting in a better representation of the surface melt and the GrIS surface mass balance (SMB). Near-surface temperature and SMB are both very useful for constraining glacial dynamics models in order to represent the current and future evolution of the ice dynamics of the GrIS.