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Validation and uncertainty analysis for monthly and extreme precipitation in the ERA-20C reanalysis based on the WZN in-situ measurements

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The proper representation of precipitation, in particular extreme precipitation, in global reanalyses is still challenging. This paper focuses on the potential of the ERA-20C centennial reanalysis to reproduce precipitation events.

The global ERA-20C Reanalysis has been developed within the projects ERA-CLIM and its successor ERA-CLIM2 with the aim of a multi-decadal reanalysis of the global climate system. One of the objectives of ERA-CLIM2 is to provide useful information about the uncertainty of the various parameters. Since precipitation is a prognostic variable, it allows for independent validation by in-situ measurements. For this purpose, the Global Precipitation Climatology Centre (GPCC) operated by the DWD has compared the ERA-20C Reanalysis with the GPCC observational products "Full Data Monthly Version 7" (FDM-V7) and "Full Data Daily Version 1" (FDD-V1).

ERA-20C is based on the ECMWF prediction model IFS version Cy38r1 with a spatial resolution of approximately 125 km and covers the 111 years from 1900 to 2010. The GPCC FDM-V7 raster data product, on the other hand, includes the global land surface in-situ measurements between 1901 and 2013 (Schneider et al., 2014) and the FDD-V1 raster data product covers daily precipitation from 1988 to 2013 with daily resolution. The most suitable resolution of 1° was used to validate ERA-20C. For the spatial and temporal validation of the ERA-20C Reanalysis, global temporal scores were calculated on monthly, seasonal and annual time scales. These include e.g. monthly contingency table scores, correlation or climate change indices (ETCCDI) for precipitation to determine extreme values and their temporal change (Peterson et al., 2001, Appendix A).

Not surprisingly, the regions with the strongest differences are also those with data scarcity, mountain regions with their luv and lee effects or monsoon areas. They all show a strong systematic difference and breaks within the time series. Differences between ERA-20C and FDD-V1 based on ETCCDI diagnoses were detected particularly in regions with large precipitation totals especially in Africa in the ITCZ area and in Indonesia.

The overall comparison reveals geo-spatially heterogeneous results with areas of similar precipitation characteristics, but also areas that still remain challenging for the reanalysis' fidelity to represent the FDM-V7 and FDD-F1 based diagnostics. The results serve good guidance where improvements of the future IFS model versions should be most effective.

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