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An investigation of systematic errors in solar radiation in reanalysis models

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The use of solar photovoltaic (PV) energy in Ireland is growing, leading to more interest in accurate solar radiation climatology. Reanalysis data uses observational data from the past to produce a representation of climatology. The accuracy of reanalysis radiation data can in part be explained by linking it to the cloud amount in reanalysis. In this study, time-series analysis is performed to identify links between errors in radiation and cloud structures at different spatial scales, by making use of satellite imagery and reanalysis cloud data. This study examines two popular reanalysis datasets, MERRA2 from NASA and ERA-Interim from ECMWF, with the aim of establishing the skill of reanalyses when compared to ground measurements to find which is more suitable for solar radiation over Ireland. Reanalysis datasets are compared with a representative selection of Irish pyranometer data for time periods up to 35 years, and standard skill scores (bias, RMSE and Pearson's correlation) are calculated. Scores relative to climate (Anomaly Correlation Coefficient) are also calculated to compare the performance in different seasons.

Skill scores were used to identify individual events with large errors in radiation. These events were analysed to find the prevailing cloud structure which was analysed by both satellite imagery and the cloud data from reanalyses datasets. By linking cloud structure and errors in this way it is found that convective clouds are a source of negative bias in reanalysis radiation, whereas, frontal clouds are a source of positive bias. Solar radiation availability and variability is important at different time scales, from hourly for operational use, up to decadal for planning. Therefore, further analysis is done at different time scales including hours, days and seasons. Knowledge gained from systematic errors in solar radiation in reanalysis models is used to develop novel post processing techniques. This approach reduces systematic errors and produces an improved radiation dataset for Ireland.