Detectability of large forecast error on surface solar radiation using grand ensemble method considering atmospheric circulation patterns

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Forecasting of surface solar radiation (SSR) using numerical weather prediction (NWP) models usually use at several hours to several days forecast. Large forecast errors (forecast busts) for SSR and therefore photovoltaic power generation may lead to either a shortage of power supply or production of excessive surplus power. This study assessed the hit rate and false alarm rate of forecast busts event using lognormal ensemble spread (standard deviation of ensemble forecast). This study used the lognormal ensemble spread on the four NWP centers (Japan Meteorological Agency: JMA, European Centre for Medium-Range Weather Forecasts: ECMWF, National Centers for Environmental Prediction: NCEP, United Kingdom Met Office: UKMO). Also, we evaluated the a multi-center grand ensemble (MCGE), which calculated weighted average of the esemble forecast on 4 NWP center.
The study period is January 2014 to May 2017 in five winter months (January, February, May, November, December), and forecast lead time is from 24 to 144 hour every 24hours. The forecast busts were defined as the top 5, 10, 15, 20 absolute forecast error. The atmospheric circulation patterns are categorized Winter monsoon (WM), Winter Pacific (WP), High Pressure (HP), Low Pressure (LP), Southerly Flow (SF) using 500hPa height. As the results, the proposed method in this study indicate higher detectability of forecast bust than the non-categorized detection (previous study) method. The values of Youden index improved of considering the flow patterns. Moreover, the improvement assessed by the false alarm rate under perfect hit rate (FPR) was indicated in all cases. The FPR is smallest when top 5% forecast busts cases, The FPRs of MCEG in 6 forecast lead time are 0.52, 0.44, 0.50, 0.44, 0.41, 0.53 respectively. The improvement not only the detection method using MCGE but also the method using single NWP center ensemble forecast.

Keywords: Ensemble forecast, Detection of large forecast error, Surface solar radiation, Renewable energy

