(54-240329-C) **Prediction of Solar Variability by Cloud Type and Cloud Cover at ARM and SURFRAD Sites**

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The solar irradiance reaching the surface varies considerably both spatially and temporally with modulations in part due to changes in cloud amount and cloud characteristics. Increased knowledge on observed solar variability could help to inform day-ahead solar variability predictability for renewable energy purposes. Riihimaki et al. (2021) developed a machine learning model that predicts surface solar irradiance variability from observed cloud type and cloud cover based on five years of observations at the Atmospheric Radiation Measurement Program (ARM) Southern Great Plains (SGP) site located in Lamont, Oklahoma, United States. This study follows on to test the generality of the Riihimaki et al. (2021) results by evaluating the model's performance of solar variability prediction at other sites with different climates. The additional sites considered include several other ARM sites across the globe including the Tropical Western Pacific (TWP), Eastern North Atlantic (ENA), and other shorter term ARM sites where cloud type observations are available. In addition, the model performance is evaluated against observed solar irradiance, cloud type, and cloud cover at the National Oceanic and Atmospheric Administration (NOAA) Surface Radiation Network (SURFRAD) sites located in different climate regions across the United States. Furthermore, the time period considered for the ARM SGP site is extended to 25 years of observations for further evaluation. The model performance evaluation in terms of the predicted solar variability will be presented by site and cloud type.

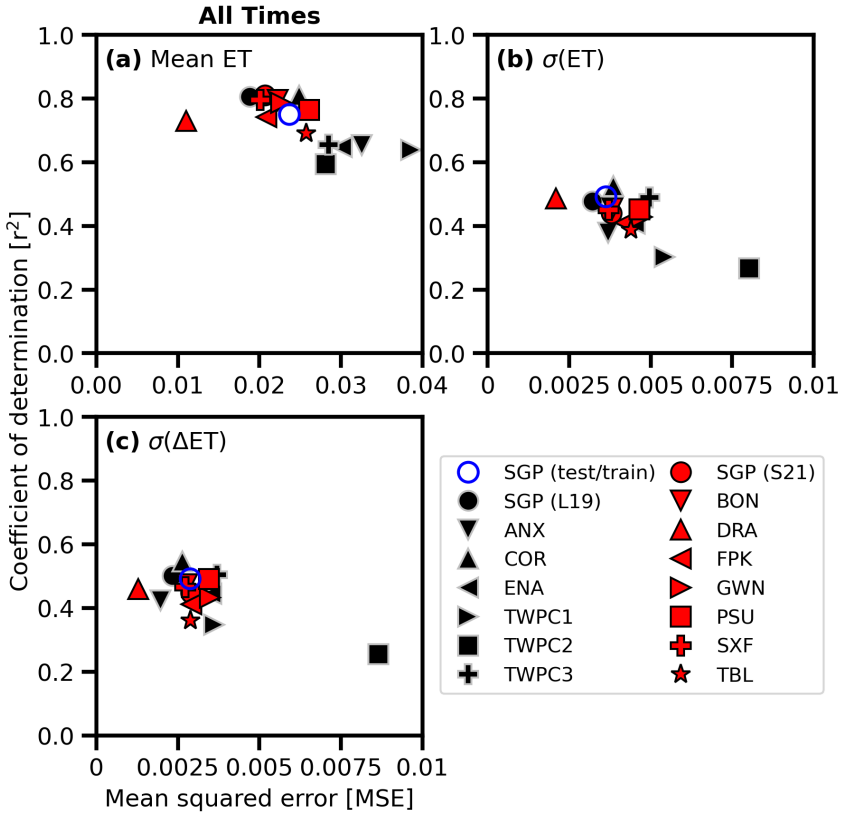

Figure 1. The solar variability predictiability results by site for ARM (black) and SURFRAD (red) sites. The results are shown as the mean squared error (MSE) and coefficient of determination (r^2) for the predicted solar variability compared to the observed 15-minute solar variability. The results are separated by solar variability metric: (a) mean effective transmissivity (ET), (b) the standard deviation of ET, and (c) the standard deviation of the minute-to-minute change in ET.