Estimation of Solar Energy Potential over Mongolia Based on Satellite Data

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In Mongolia, renewables contribute only about 4.1% of the electricity generation. The National Renewable Energy Program of Mongolia aims to expand this share to 20% by 2020 and to 30% by 2030. To support these goals, a number of new megawatt scale photovoltaic (PV) system projects are being installed in the country.

Due to its climatic characteristics, Mongolia has a large potential for solar energy generation. However, due to lack of sufficient instrumentation, this potential is yet to be mapped. Accurate knowledge of PV generation potential is a key requirement for the renewable energy market, as it provides guidance in choosing the most profitable location for PV projects. Further, such information helps quantify the output of the proposed PV system and its uncertainty.

Over the past few decades, a considerable number of studies have assessed PV potential around the world. Although these assessments are readily available, they do not meet the fine spatial and temporal resolution needed to support PV installation projects in Mongolia. In this study, we propose to meet this requirement using fine resolution satellite data and limited ground measurements. We have implemented a semi-physical model (Otani, 1994) to calculate ground albedo (reflectance) from brightness data provided by Japanese geostationary meteorological satellite Himawari 8/9 (successors of the MTSAT series). After retrieving ground albedo, solar irradiance falling on the earth’ s surface can be estimated, since higher ground albedo leads to low irradiance and vice versa.

The figure below, depicting the solar irradiance map for Mongolia at UTC 4:00 on 2016/06/05, reveals a large PV generation potential in the southern and central parts of Mongolia. The semi-physical model was validated against observations over Choibalsan City (48.065˚ N, 114.515˚ E, 742 m), eastern part of the country, during 2016. We found that the model performed well with mean bias error (MBE) and root mean square error (RMSE) of 109 W/m2 and 230 W/m2, respectively, and a correlation coefficient of 0.87. In future, we are planning to install 3 sets of weather station in southern and central Mongolia. Therefore, validation of the model performance will be extended across the country.

Keywords: Solar Energy , Solar map, Meteorological satellite , Ground measurement, Semi physical model