



Comparative Evaluation of WRF and WRF-Solar for solar irradiance in South Korea

Ji Won Yoon^{1,2}, Hyunsu Kim⁴, Seungyeon Lee^{2,3}, and Seon Ki Park^{1,2,3}

¹Center for Climate/Environment Change Prediction Research, Ewha Womans University, Republic of Korea

²Severe Storm Research Center, Ewha Womans University, Republic of Korea

³Department of Climate and Energy Systems Engineering, Ewha Womans University, Republic of Korea

⁴National Electric Power Control Center, Korea Power Exchange, Republic of Korea

The accurate forecasting of the solar irradiance is crucial for the grid stability, energy management, and maximizing the efficiency of the solar energy systems. The increasing reliance on solar energy as a key element of its renewable energy strategy highlights the need for accurate solar irradiance forecasting not only globally but also in South Korea. However, the variability of solar irradiance greatly influenced by the weather conditions poses challenges to its integration into the energy grid. To address this issue, we simulate two numerical weather prediction models---Weather Research and Forecasting (WRF) and WRF-Solar---during high-demand summer seasons for electricity and then utilize various observational data, such as satellite and in-situ measurements, to investigate the prediction performance of the solar irradiance. The WRF-Solar model was specialized for the solar irradiance prediction and fully integrates cloud-aerosol-radiation feedback to enhance solar irradiance prediction performance. Through the evaluation of these models, we aim to enhance the prediction accuracy of the solar irradiance in South Korea. Preliminary findings indicate that WRF-Solar exhibits better performance compared to the WRF model in South Korea. These results emphasize the potential benefits of integrating the solar radiation physics and specialized algorithms into forecasting models. By doing so, WRF-Solar shows potential in overcoming the challenges associated with solar irradiance forecasting. In the future, we need more research to better understand the abilities and limitations of WRF-Solar, and to improve its forecasting accuracy. With this knowledge, we can make solar irradiance predictions more accurate and help solar energy grow in South Korea.