Solar Radiation Forecasting in a desert environment: Impact of explicit treatment of aerosols

Christos Fountoukis[1,*], Luis Martín-Pomares[1], Zeeshaan Shahid[1], Ivan Gladich[1], Daniel Perez-Astudillo[1], Dunia Bachour[1], and Mohammed A. Ayoub[1]

[1] Qatar Environment and Energy Research Institute (QEERI), Hamad Bin Khalifa University, Qatar Foundation, Doha, Qatar

[*]Corresponding author:
Christos Fountoukis
Qatar Environment and Energy Research Institute (QEERI)
Hamad Bin Khalifa University
Doha, Qatar
Email: cfountoukis@hbku.edu.qa
Tel.: +974 4454 0876, Fax: +974 4454 1528

Abstract

The most widely used tool for solar radiation forecasting from 6 hours up to several days ahead is a Numerical Weather Prediction (NWP) model. Traditionally, NWP models either neglect the presence of particles in the atmosphere or (more often) include a simplified aerosol approach (e.g. use of climatological data). The Middle East region has a plethora of solar resources and has recently started adopting plans for renewable energy. However, the fluctuating nature of solar irradiance reaching the surface in this region, caused by elevated aerosol concentrations due to the presence of desert dust, is currently a major challenge in cost-effective management, operation and integration of solar energy into existing electricity supply systems. Global horizontal irradiance (GHI) and Direct Normal Irradiance (DNI) are simulated using a three-dimensional atmospheric meteorology-chemistry model (WRF-Chem) and a triple-nesting configuration over the Middle East with a focus on the hot desert climate of Qatar (Fig. 1). We show that solar radiation forecasting in regions that experience high aerosol loadings can benefit significantly from a detailed and explicit treatment of aerosols and their physicochemical processes. The use of an advanced treatment of aerosols greatly improves the model performance in predicting GHI and DNI.

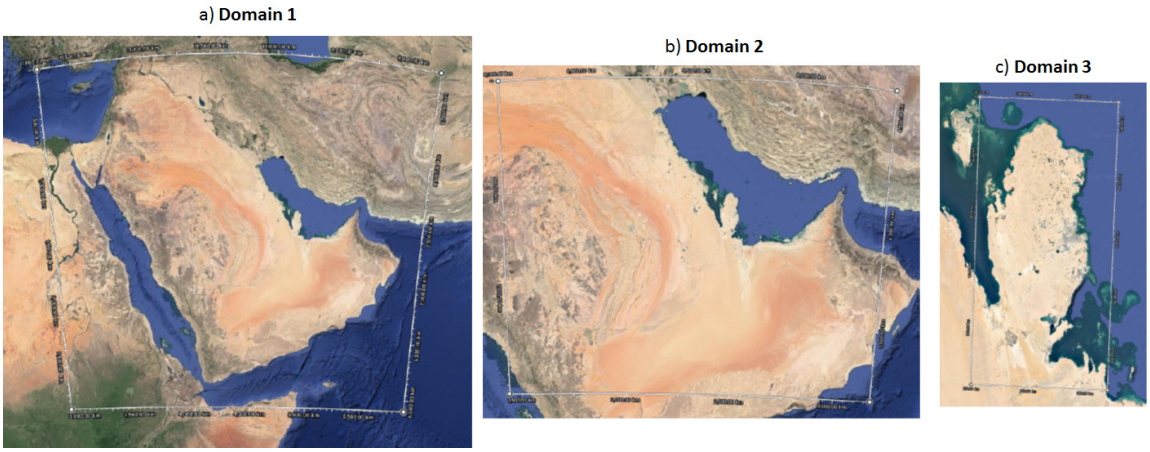

Figure 1. (a) Modeling domains at (1): 50 km × 50 km, (2): 10 km × 10 km and (3): 2 km × 2 km grid spacing.

Keywords: atmospheric dust; NWP model; Middle East; GHI; DNI