



Mineral dust modeling for optimizing operation and maintenance procedures in concentrated solar power plants

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Concentrated solar power (CSP) plants are being implemented in dusty environments such as the Middle East and North Africa where solar radiation is high. However, these areas are usually dry and typically have scarce water resources. The minimization of soiling-induced losses together with the reduction of cleaning costs is a challenge for operators and project planners. The H2020SOLWATT project targets to significantly reduce the water used by CSP plants.

Within SOLWATT, our goal is to implement an operational soiling rate forecast product for the Middle East, North Africa and Europe. The product will be based on the combination of the MONARCH dust forecast system developed and operated by the Barcelona Supercomputing Center and an empirical soiling model developed by the DLR Institute of Solar Research. The resulting soiling forecast system is expected to help operators optimizing cleaning schedules and to serve as an input to a Dispatch and Operation & Maintenance optimizer.

MONARCH is based on the online coupling of the meteorological Nonhydrostatic Multiscale Model with a full aerosol-chemistry module. The model provides operational regional mineral dust forecasts for the World Meteorological Organization (WMO; <https://dust.aemet.es/>), and participates to the WMO Sand and Dust Storm Warning Advisory and Assessment System for Northern Africa-Middle East-Europe (<http://sds-was.aemet.es/>). The DLR soiling model is a physical model that predicts the soiling rate for a CSP collector from weather parameters like wind speed, particle number concentration, relative humidity and temperature. The model has been optimized and validated using measurement data from two sites in Morocco and Spain.

We evaluate forecasts from MONARCH against the AERONET SDA (Spectral De-Convolution Algorithm) AOD coarse product and deposition measurements in North Africa, Middle East and Spain. We also provide an evaluation of the coupled MONARCH-DLR soiling forecast system for various forecasting horizons with soiling rate data from two CSP operational sites.