

# Developing soiling forecasts for optimizing operation and maintenance procedures in CSP plants

Eleni Karnezí<sup>1</sup>, Fabian Wolfertstetter<sup>2</sup>, Natalie Hanrieder<sup>2</sup>, Stefan Wilbert<sup>2</sup>, Sara Basart<sup>1</sup>, Albert Soret<sup>1</sup>, Carlos Perez Garcia-Pando<sup>1</sup>

<sup>1</sup>Department of Earth Sciences, Barcelona Supercomputing Center (BSC-CNS), Barcelona, 08034, Spain  
<sup>2</sup>German Aerospace Center (DLR), Institute of Solar Research, Tabernas, E-04200, Spain

## Introduction

- CSP plants are being implemented in dusty environments such as Middle East and North Africa where solar radiation is high.
- The minimization of soiling-induced losses together with the reduction of cleaning costs is a challenge for operators and project planners.
- H2020SOLWATT** project targets a significant reduction in the water used by CSP plants (by 35% for wet cooled & by 90% for dry cooled). In this way more of **0.5 M€/year** of operational cost for a 50 MW CSP plant will be saved in the future.

## SOLWATT

### Project objectives

The project focuses on the efficiency of innovations on solar field cleaning, power-block **cooling**, water **recycling** system, and plant **operation** strategy. The **social acceptance** of CSP will be increased by detailed analysis of case studies and education of local population to the benefits of solar energy.

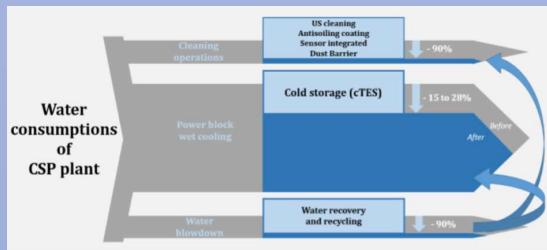


Figure 1: SOLWATT overall objectives

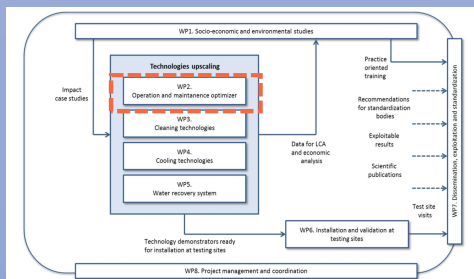
The solutions will be implemented and tested at two CSP operational sites:

- ✓ La Africana, Site location: Posadas, Córdoba, Spain
- ✓ SEDC plant, Site Location: Rotem, Israel

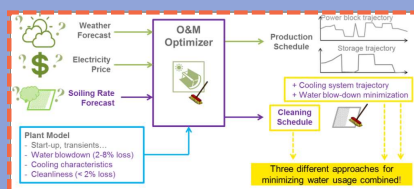


Figure 2: La Africana solar plant

### Project structure



WP2 includes the development of an unique **soiling forecast** product that will be included in the O&M optimizer. This additional input information will assure that innovative water-saving technologies are used in the best way.



**Soiling forecast** model will be developed coupling the outputs of an atmospheric composition model with a soiling model.

## Regional-Global operational dust forecast

Barcelona Supercomputing Center (BSC, [www.bsc.es/ess](http://www.bsc.es/ess)) maintains daily operational dust forecast based on the in-house atmospheric composition model NMMB-MONARCH at global (MONARCH-GLOB) and regional scales at 33km (MONARCH-REG-033) and 10km (MONARCH-REG-010).

The NMMB-MONARCH dust regional daily forecasts contribute to the Regional Center of the WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) dust forecast model intercomparison (<https://sds-was.aemet.es>) and it is the reference model of the operational WMO Barcelona Dust Forecast Center (<https://dust.aemet.es/>).

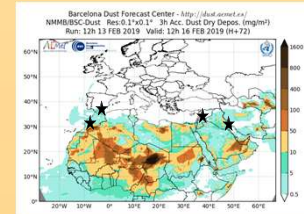


Figure 3: Dust dry Deposition forecast provided by BSC-AEMET.

## Model evaluation results

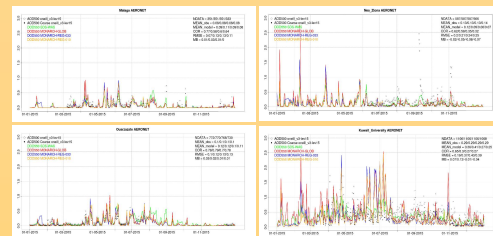


Figure 4: 24-hour forecasts (on 3-hourly basis) of dust aerosol optical depth (DOD) from NMMB-MONARCH daily operational forecasts (MONARCH-GLOB, MONARCH-REG-033 and MONARCH-REG-010) have been validated for the year of 2015 against AERONET SDA AOD-coarse cloud-screened observations over the study region and compare with the SDS-WAS Multi-model Median DOD. The SDS-WAS Multi-model Median DOD is obtained from twelve dust prediction models participating in SDS-WAS Regional Center.

## Soiling model

- The DLR Institute of Solar Research (SF) is the largest research entity in Germany investigating and developing concentrating solar technologies to provide heat, electricity and fuel.
- DLR has developed a soiling model that has been validated for two sites during WASCOP – Water Saving for Concentrated Solar Power (H2020 project).

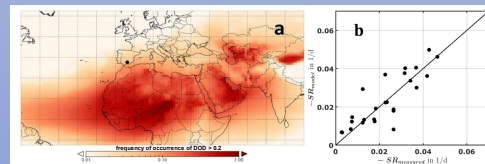


Figure 5: a) Annual average of modelled column-dust optical depth at 550 nm for 2015 based on BSC-DUST b) Soiling rate (SR) determined with the WASCOP empirical model from ground atmospheric measurement data and plotted against the measured soiling rate for PSA. Data in daily resolution from 2.5 years.

## Goal: The Soiling forecasts products Merge of BSC-Dust/ DLR model

- We will couple the dust regional-global NMMB-MONARCH model developed and maintained by BSC and the WASCOP soiling model developed by DLR.
- Both models will exchange several parameters like particle number concentration by size, and other measured weather parameters.
- The resulting soiling forecast rates will be evaluated for the various forecasting horizons over the two CSP operational sites considered in SOLWATT.
- As a result, within SOLWATT we will provide:
  - Operational soiling forecasts: up to 5-days soiling forecasts based on the daily operational dust MONARCH system.
  - A soiling rate map: based on a dust NMMB-MONARCH reanalysis for Northern Africa, Middle East and Europe.

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