



SolarPACES 2017

Solar Power & Chemical Energy Systems

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Reflected Solar Irradiance for CSP Plants Simulation: *Impact and Importance for Solar Resource Assessment*

Plan

- **Objectives**
- **Context**
- **Methods for soiling assessment**
- **Results and discussion**



Minimized water consumption
in CSP plants

MinWaterCSP



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654443

Objectives

Perform more accurate simulations of CSP plants expected output based on reflected DNI (on a soiled surface)

Find the most optimal method to assess soiling on operating power plants



Minimized water consumption
in CSP plants

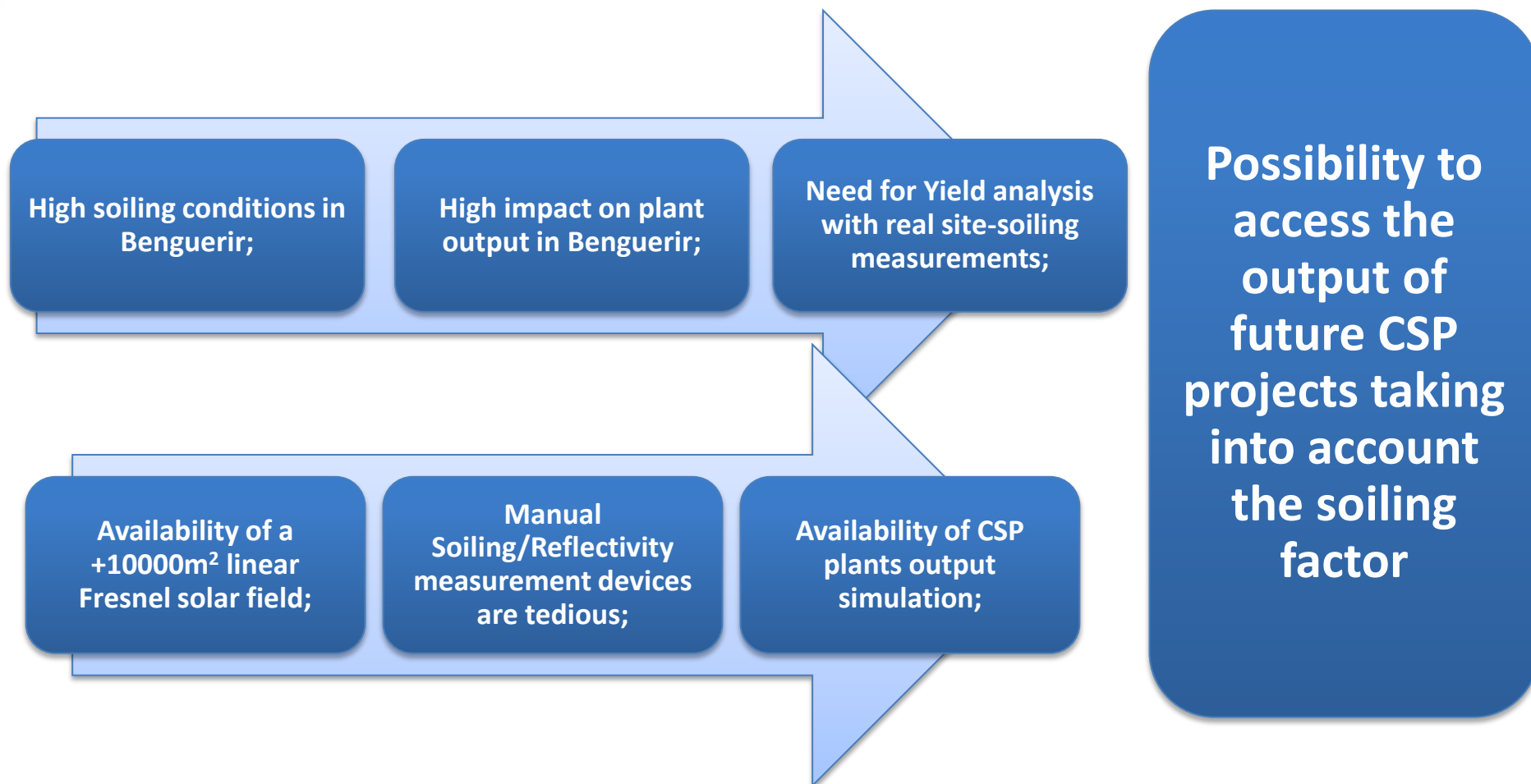
MinWaterCSP



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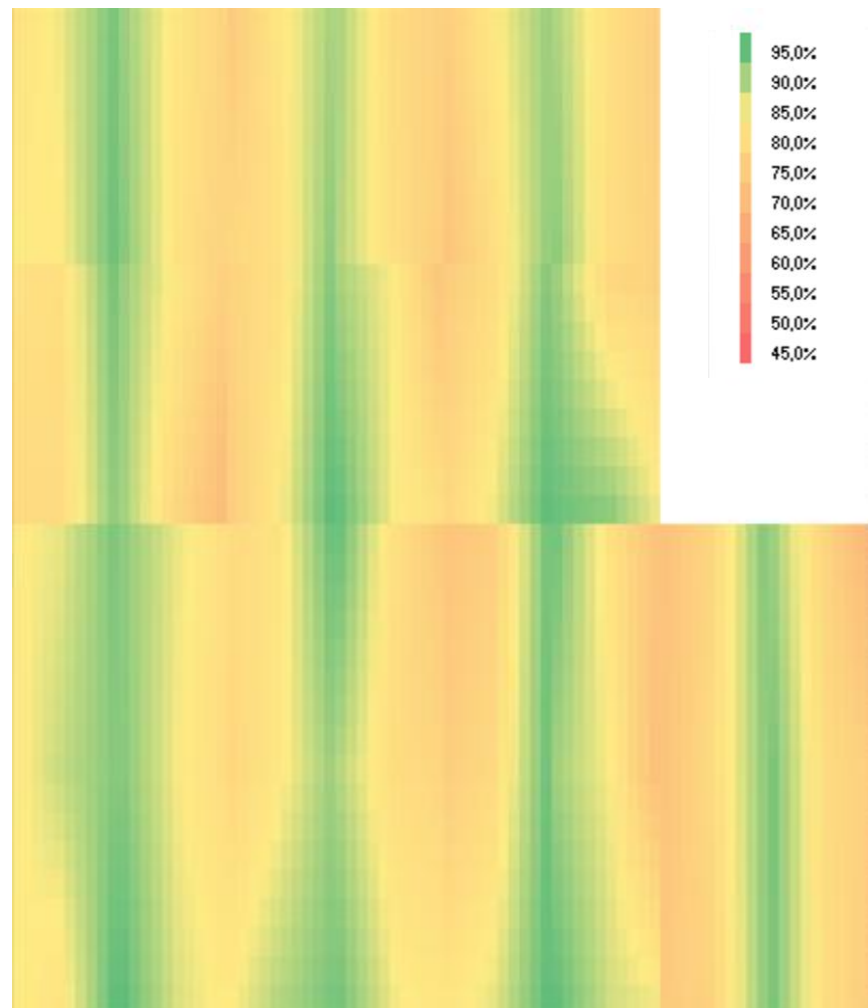
Context

- Motivations and opportunities for RDNI based simulations



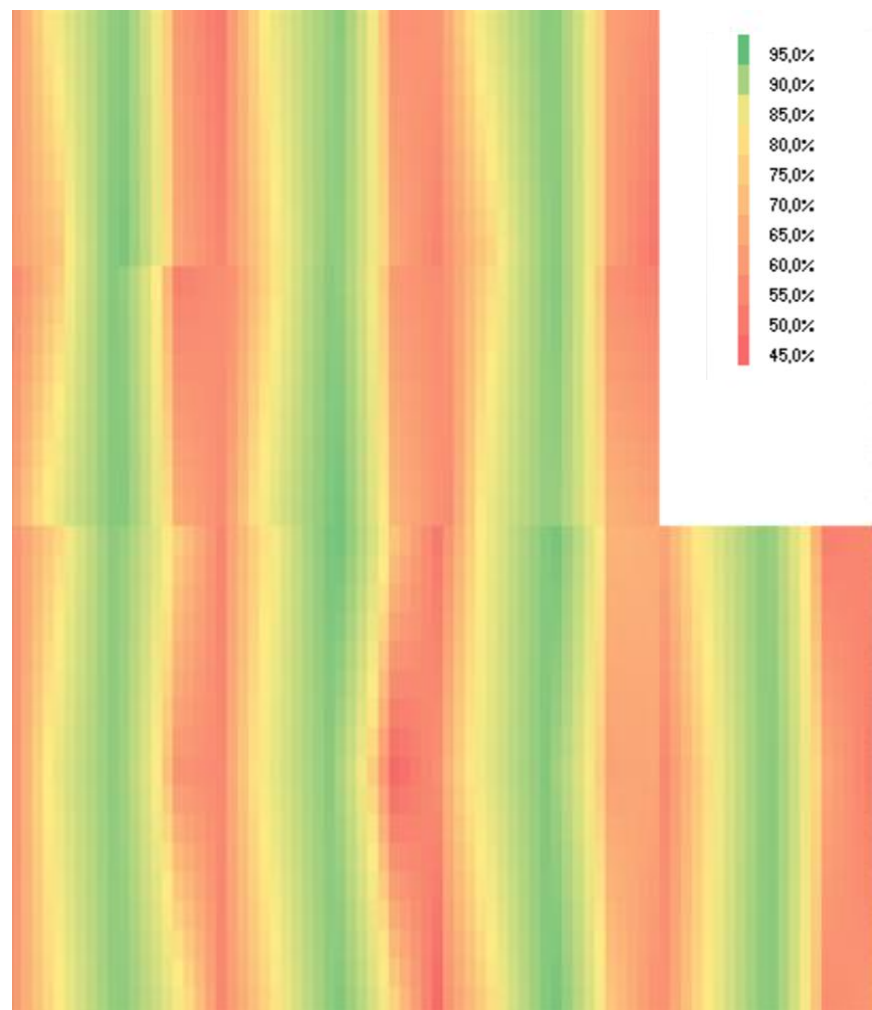
Solar field soiling mapping

- Solar field reflectance mapping one week after cleaning (5th June)
- Average reflectance for the entire solar field 83,7%
- Reflectance peak 95%
- Reflectance pit 68,1%



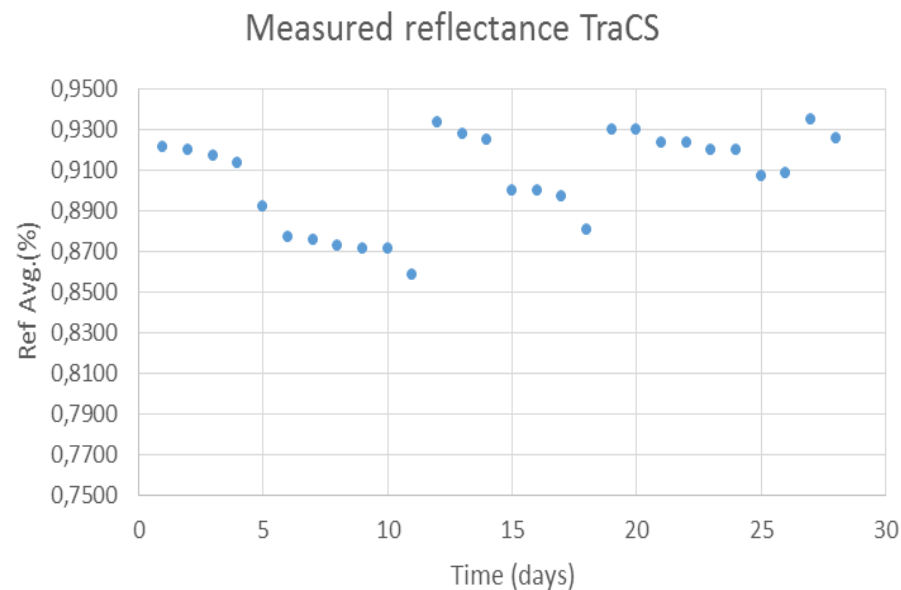
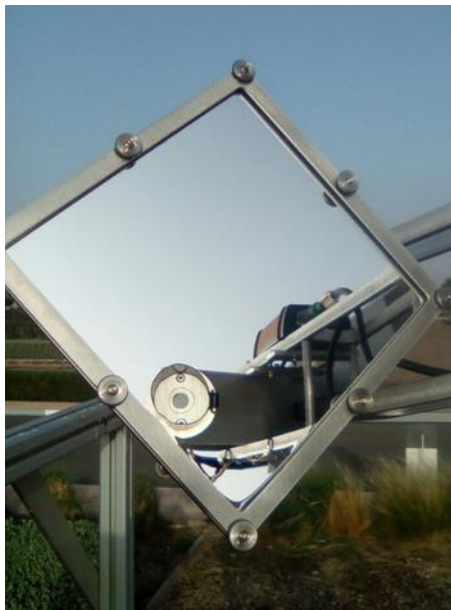
Solar field soiling mapping

- Solar field reflectance mapping five weeks after cleaning (4th July)
- Average reflectance for the entire solar field 66,8%
- Reflectance peak 91,5%
- Reflectance pit 48%



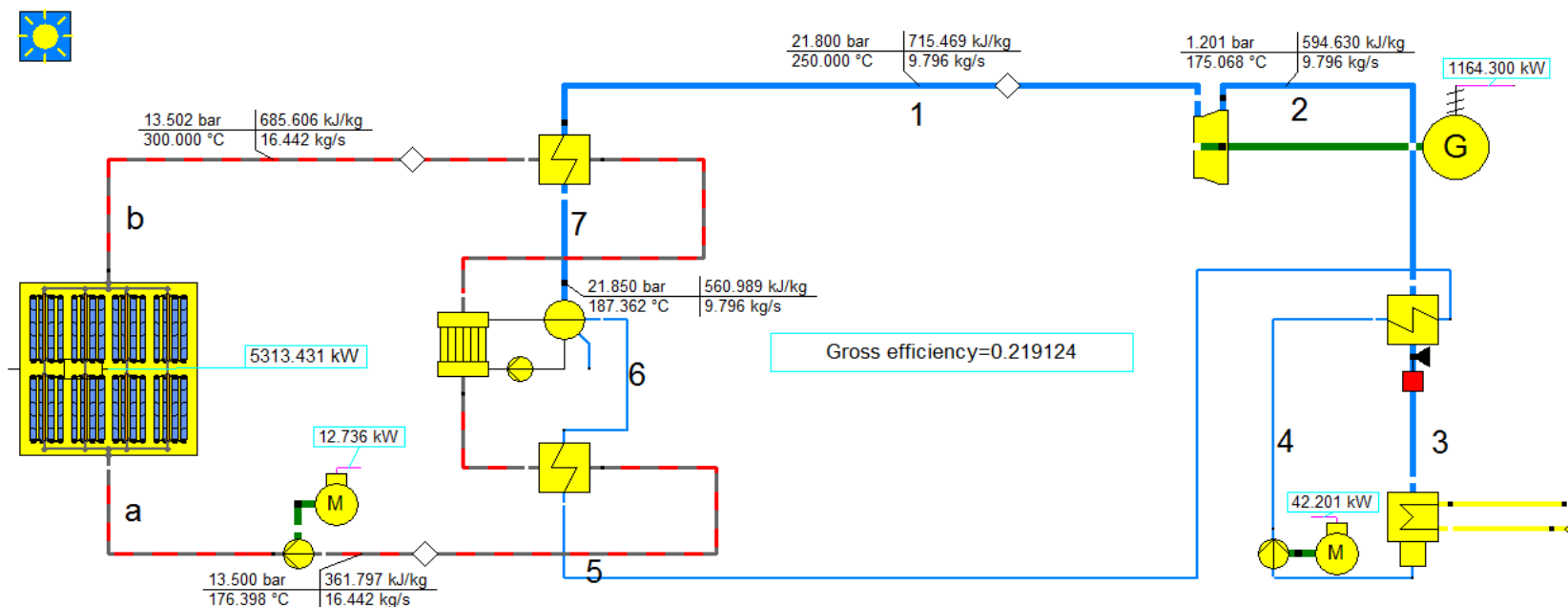
Reflected DNI measurements

- Measurement of reflectance/RDNI done continuously with the traCS
- Cleanings performed on mirror sample every two weeks



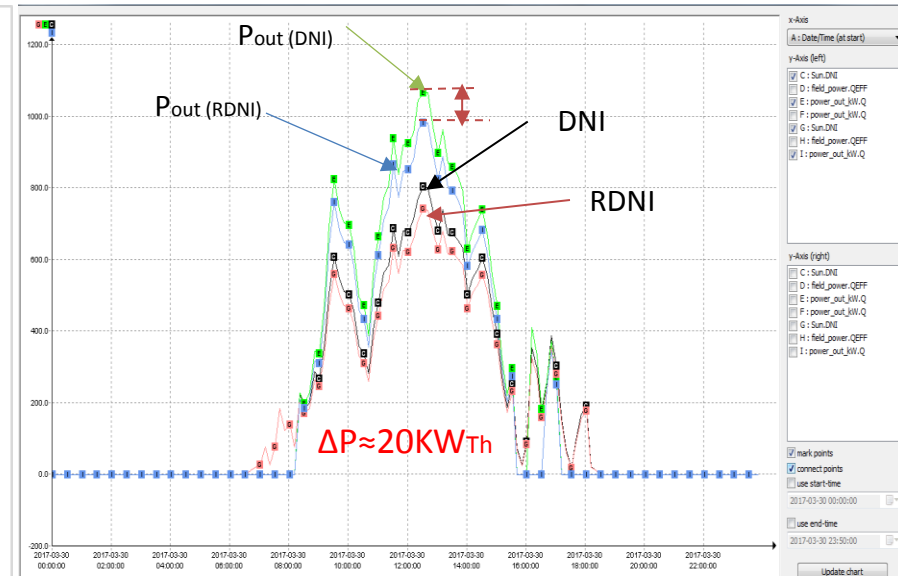
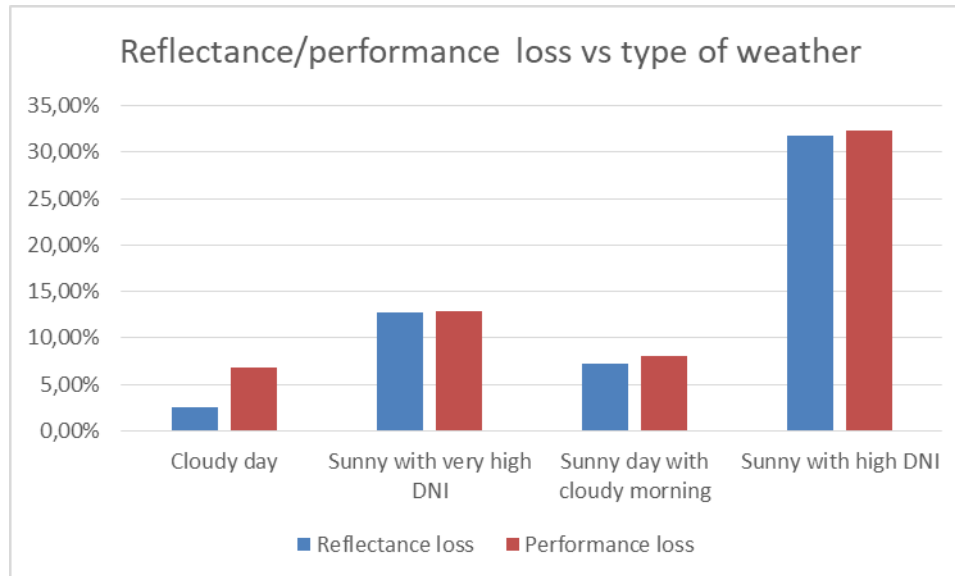
Power plant simulations

- Short term simulations performed with EBSILON (single day simulation)
- Long term calculations done with Greenius and an internally developed code

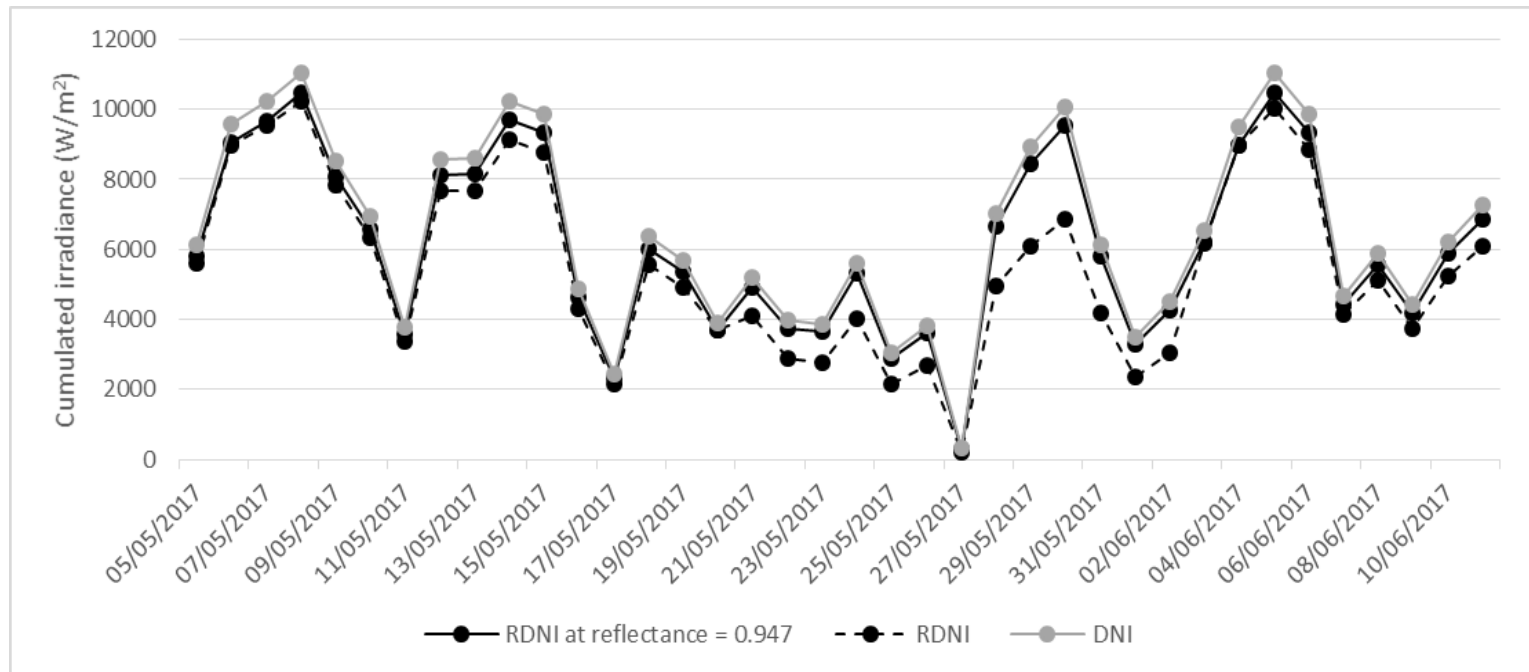


Short terms simulation results

- Performance loss highly linked to weather conditions stiffness
- Higher performance drop with higher irradiance fluctuations
- Lower performance loss with stable weather

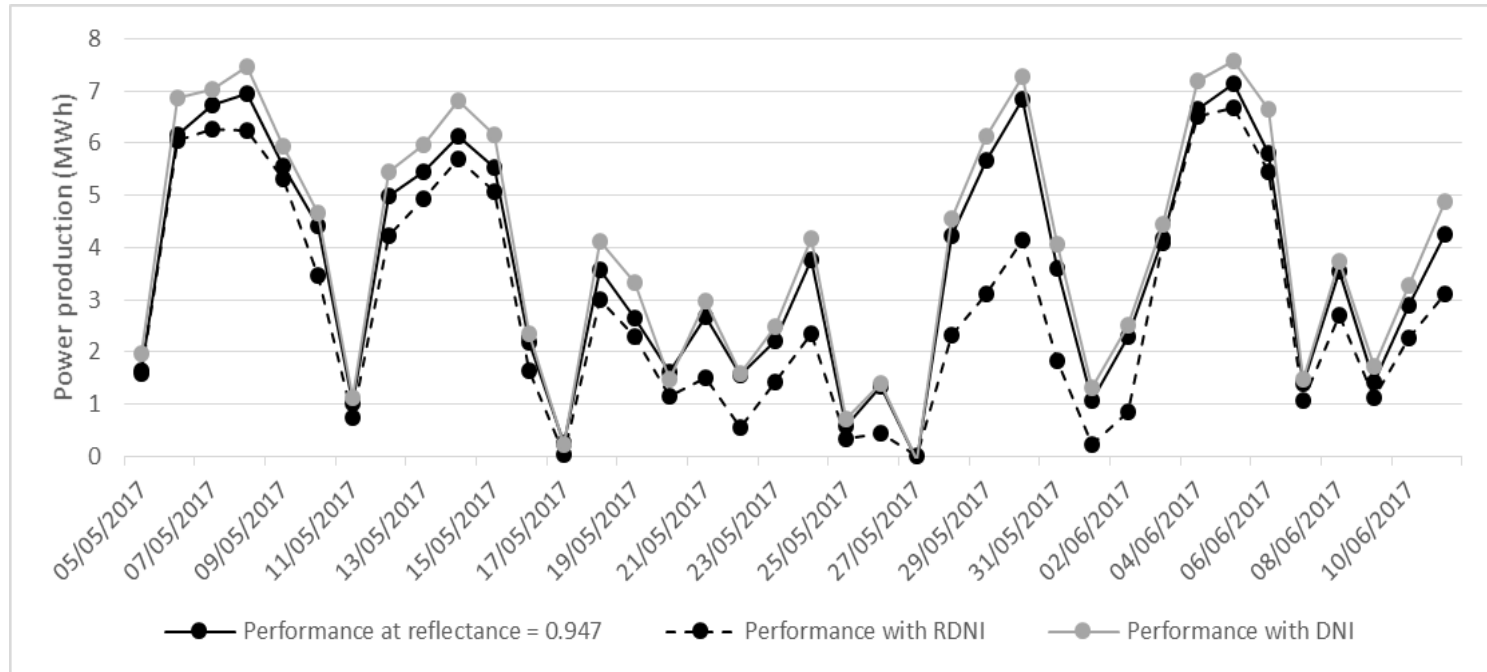


The DNI and RDNI values over the experiment period



- The values of the 3 DNI inputs for simulation over the measurement period. Higher performance drop with higher irradiance fluctuations
- Soiling affect's the DNI value very much and it's in accordance with the Cleanliness values measured by TraCS.

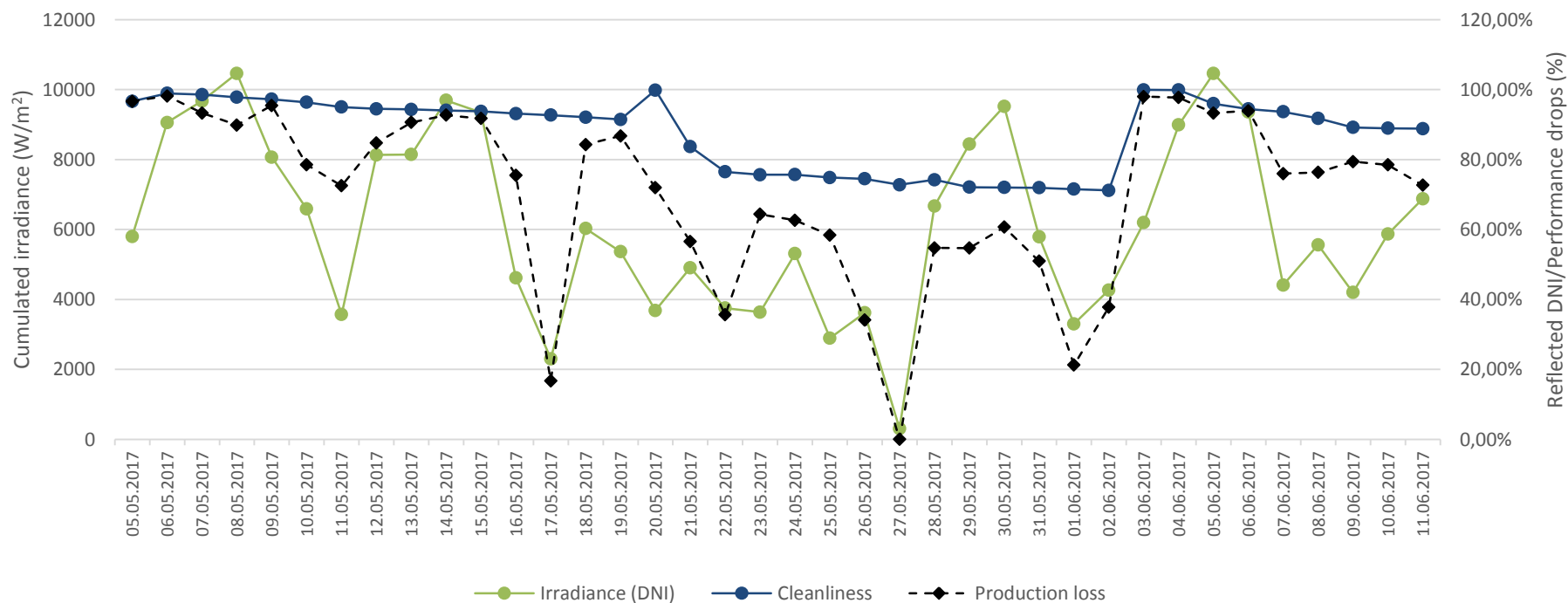
The Power output simulation over the experiment period



- The power output has a similar behaviour with the DNI
- The difference is small with low DNI values.

Long term simulation results

- Over the period of Mai - July
- Average Cleanliness drop 15,8%
- Average performance loss 22%



Conclusions and perspectives

- Higher performance loss due to mirrors soiling may justify the need for accurate soiling measurements before selecting CSP project sites
- Irradiance and performance losses for Benguerir are relatively high, hence more frequent cleanings are necessary (once per week)
- Complete simulation for one year will provide a firm prevision of performance loss for Benguerir

Thanks for your attention!

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Thermal systems

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