The Aspire campaign: Assessing the effects of aerosols on solar radiation and energy in SE Europe

Kouklaki, D. [1], Raptis, I.-P. [1,2], Kazadzis, S. [3], Fountoulakis I. [4,5], Papachristopoulou, K. [1,5] and Eleftheratos, K. [1,6]

[1] National and Kapodistrian University of Athens, Department of Geology and Geoenvironment, Athens, Greece
[2] National Observatory of Athens, Institute for Environmental Research and Sustainable Development, Athens, Greece
[3] Physikalisch-Meteorologisches Observatorium Davos, World Radiation Center, Davos Dorf, Switzerland
[4] Research Centre for Atmospheric Physics and Climatology, Academy of Athens, Athens, Greece
[5] Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Greece
[6] Biomedical Research Foundation, Academy of Athens, Greece

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HARMONIA
International network for harmonization of atmospheric aerosol retrievals from ground based photometers

ASPIRE

The ASPIRE project

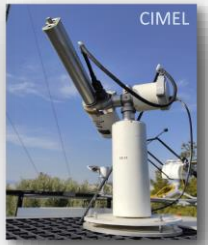
Atmospheric parameters affecting SPectral solar IRradiance and solar Energy

Ozone Clouds Aerosols Water vapor

https://aspire.geol.uoa.gr

- Solar energy
- Health impacts
- Agriculture
- Research

ASNOA



Academy of Athens

December 2020- November 2021

Objectives

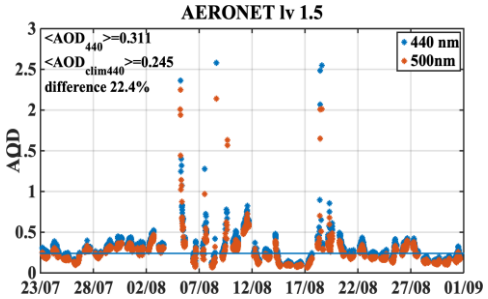
The ASPIRE project has four main objectives:

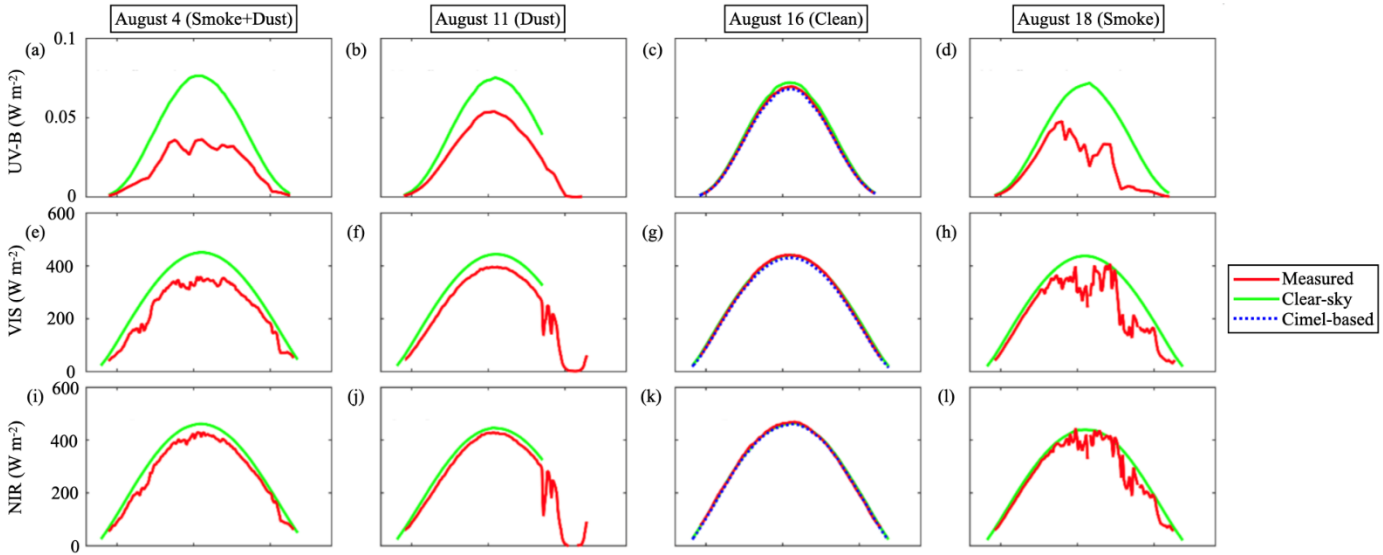
- To investigate the effect of atmospheric composition in different solar spectral regions.
- The impact of atmospheric composition on the **UV index**, **Vitamin-D** and the photosynthetically active radiation (**PAR**).
- To estimate **PV performance** based on spectral solar measurements.
- To evaluate the Solar Energy Nowcasting SystEm (**SENSE**) using ground-based measurements.

The impact of atmospheric composition in different solar spectral regions (UV-B, visible, near-infrared) under different aerosol conditions

The impact of the **Extreme wildfires of August 2021** on air quality and solar irradiance in **Greece**

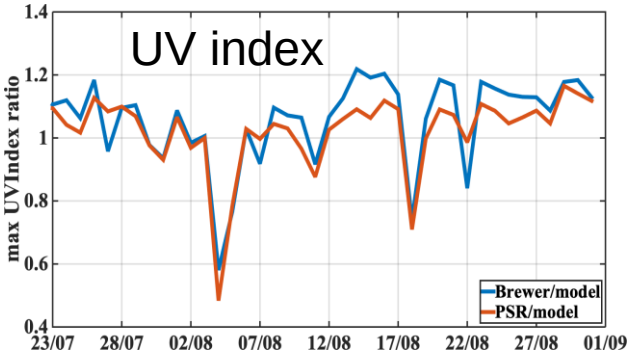
AOD increased up to 12 times and total **NO_2** up to 6 times relative to the climatological averages.

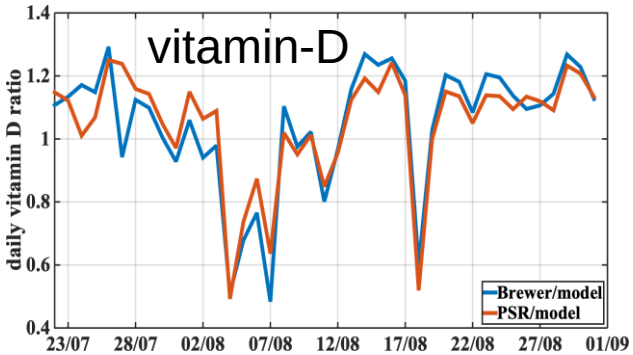




Mansoom et al., 2023 in review

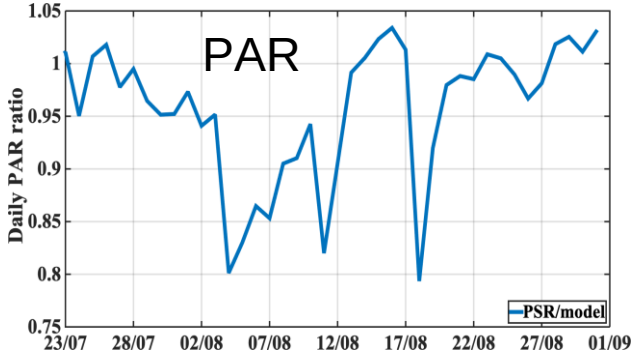
The impact of atmospheric composition on biological effective doses and GHI in Athens, Greece, in August 2021

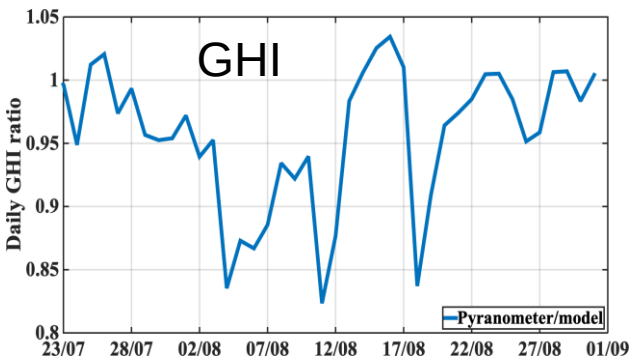




UVI ↓ **53%**

vitamin-D ↓ **50%**



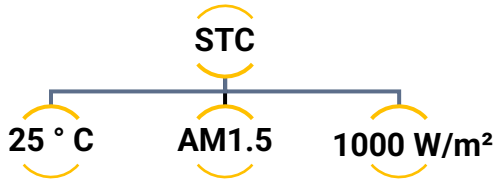


PAR ↓ **21%**

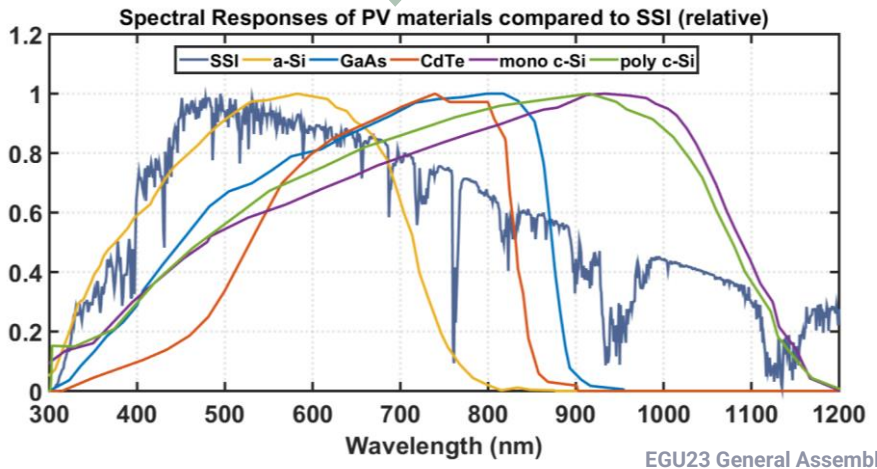
GHI ↓ **17%**

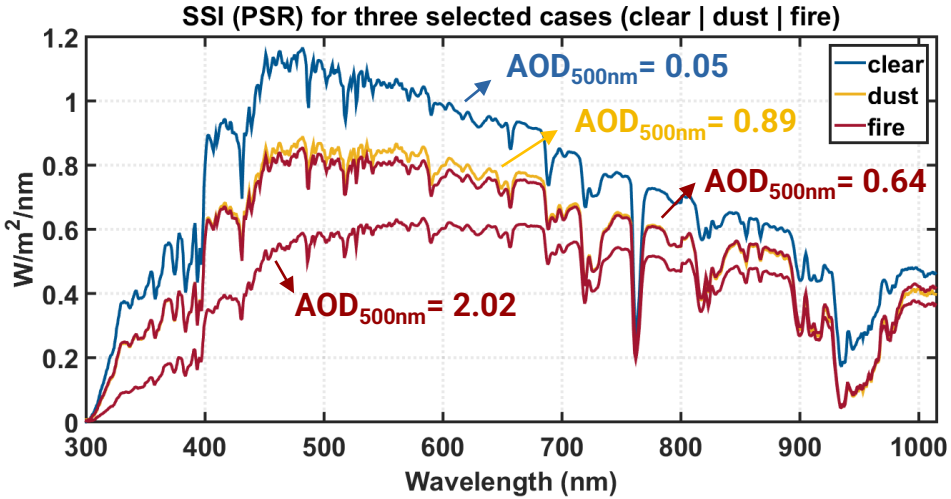
Mansoom et al., 2023 in review

The impact of atmospheric composition on spectral solar irradiance and PV performance (work in progress)



***STC**: Standard Test Conditions*





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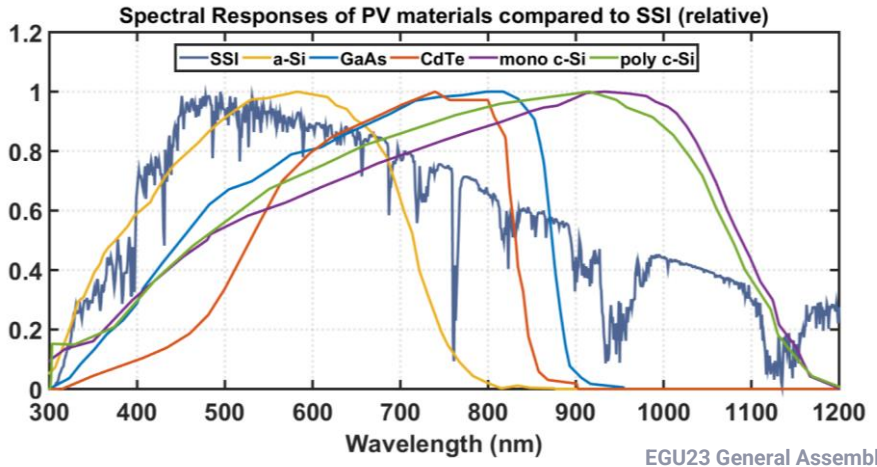
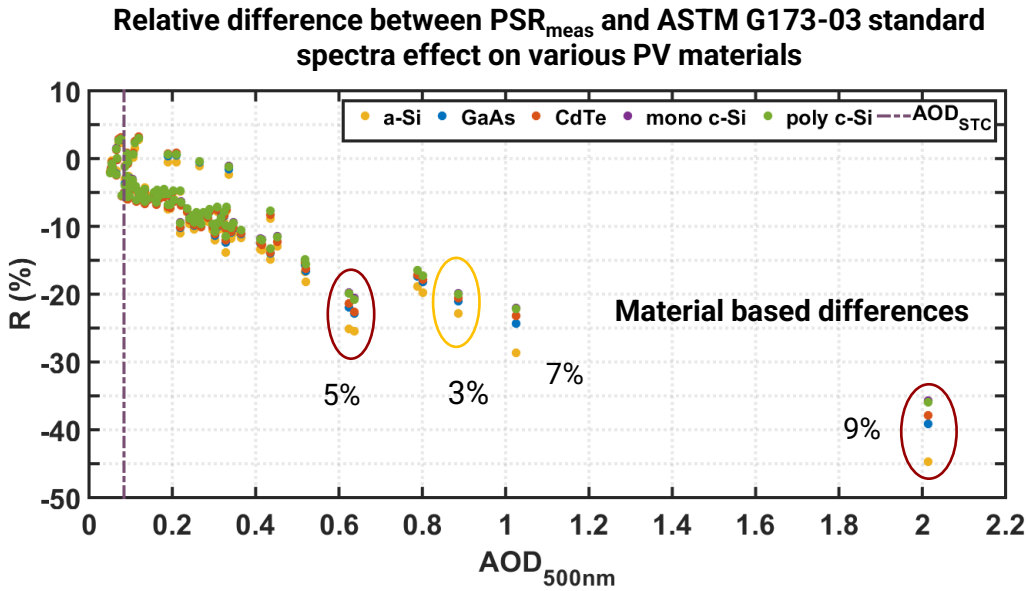
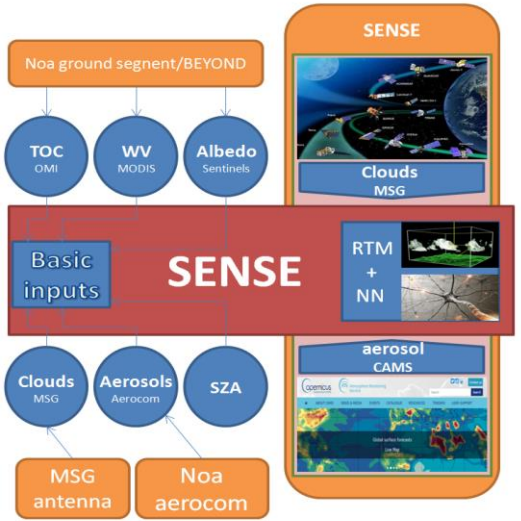




Evaluation of the performance of the Solar Energy Nowcasting System (SENSE) using real solar spectra (work in progress)



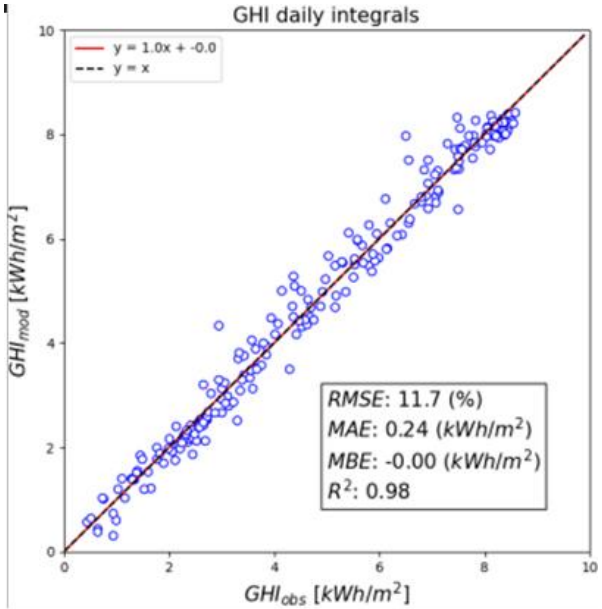
Solar radiation/energy products

Spectral irradiance / weighted

Spatial: ~5Km^2

Temporal: real time

Solar energy: GHI, DNI , tilted surface



GHI per 15min : MRE 13%

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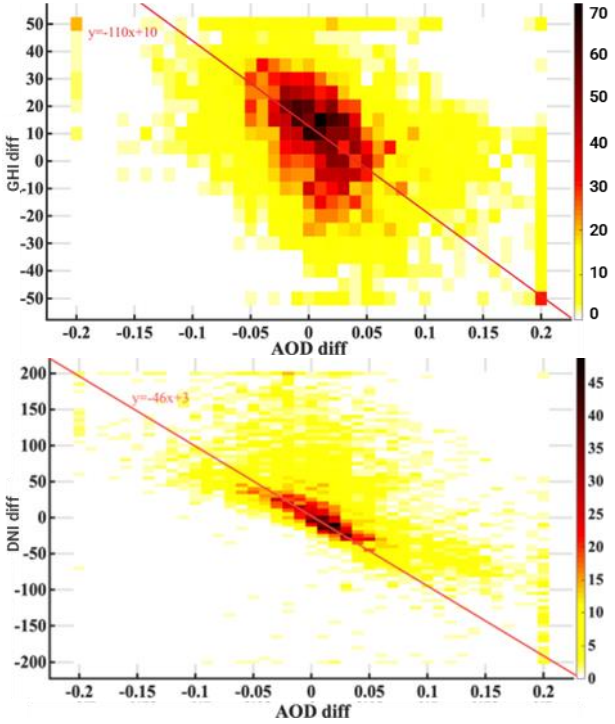
Evaluation of the performance of the Solar Energy Nowcasting System (SENSE) using real solar spectra (work in progress)

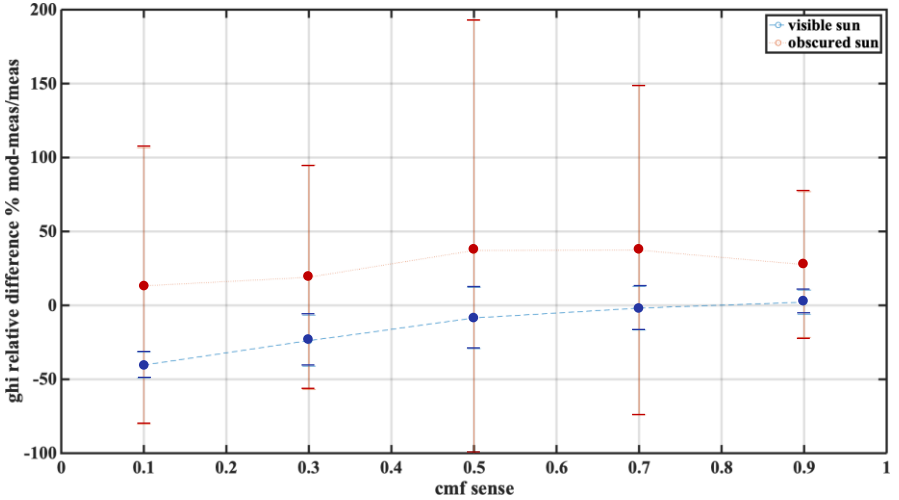
Aerosol effect (clear-sky)



CAMS- AERONET Differences

0.02±0.06

Cloud effect



Systematic overestimation under obscured sun conditions (>50%)

Underestimation of SENSE in low cloud fractions (15-30%)

Conclusions

We have assessed the impact of aerosols on solar irradiance and solar energy in Athens, Greece. Main findings can be summarized as follows:

- Combined smoke and dust events significantly affect air quality and solar irradiance in Greece.
- Biological doses (e.g., UV index, vitamin-D, PAR) are significantly affected by high amounts of aerosol even in sun-rich countries like Greece even in the summer months.
- PV efficiency estimation shows strong dependence on aerosol amounts in high populated cities like Athens – highest dependence is found for a-Si PV materials.
- Solar energy in Greece can be computed with high accuracy – major uncertainties come from incorrect representations of cloud cover.

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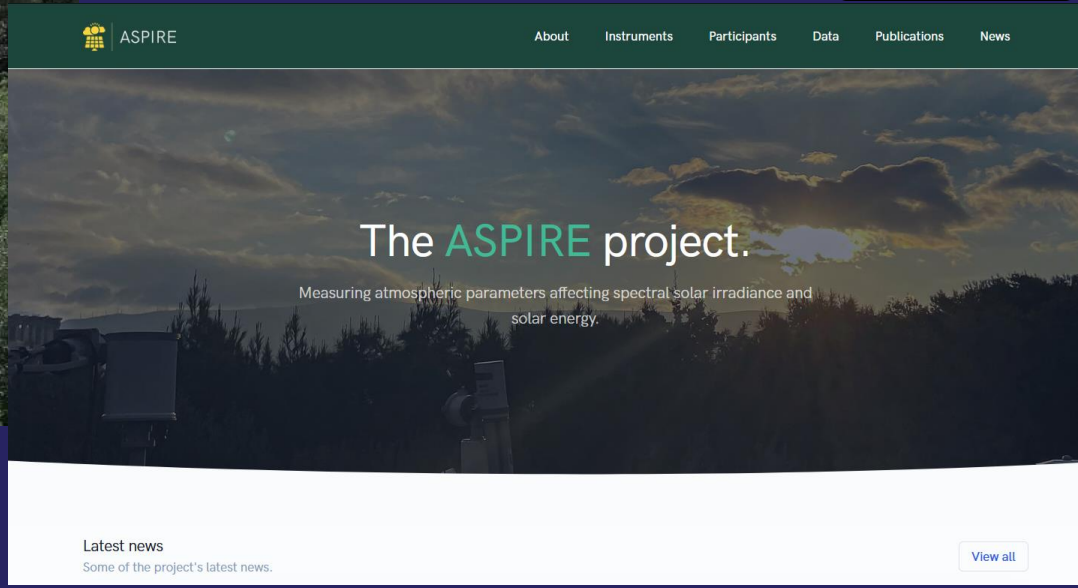
ASPIRE website



Presentation Abstract

Thank you for your attention!

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