Effect of aerosol optical scattering and absorbing particles on the Urban Heat Island Intensity during summertime in Rome

PRIN 2022 project "RESTART"

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Introduction

The Italian project: "uRban hEat and pollution iSlands inTerAction in Rome and possible miTigation strategies" (RESTART) aims to:

- explore the interaction between the Urban Heat Island (UHI) and the Urban Pollution Island (UPI)
- providing mitigation strategies
- Rome (Italy) experienced significant atmospheric warming and intensification of extreme weather events: heat waves (HW) tropical nights, and droughts

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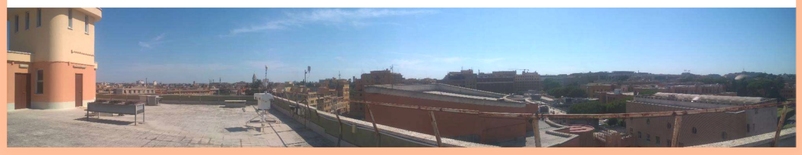
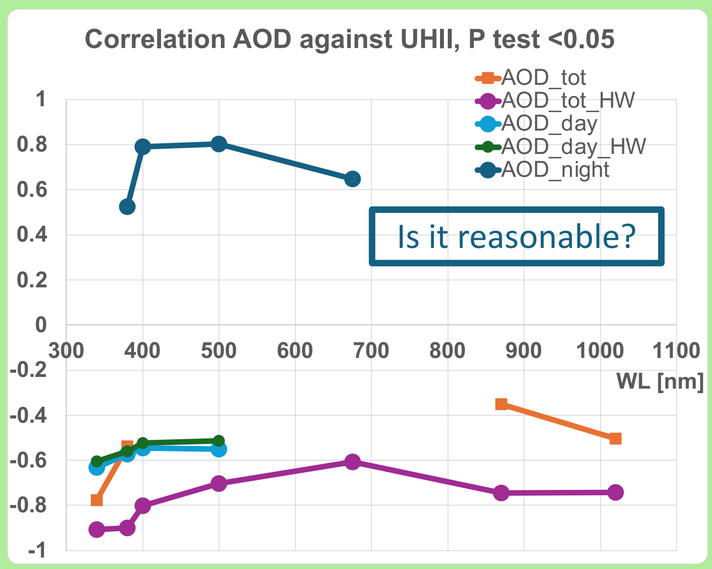


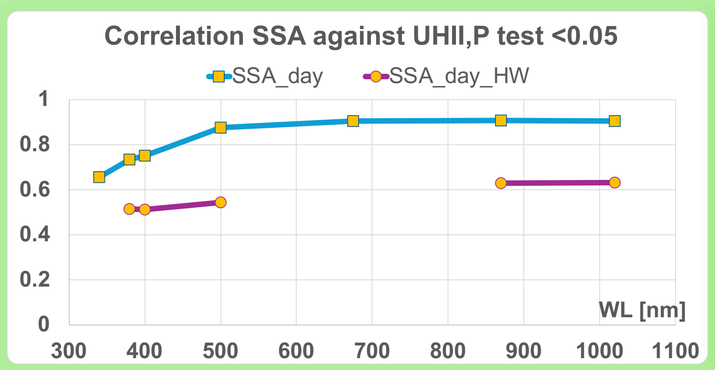
Objective

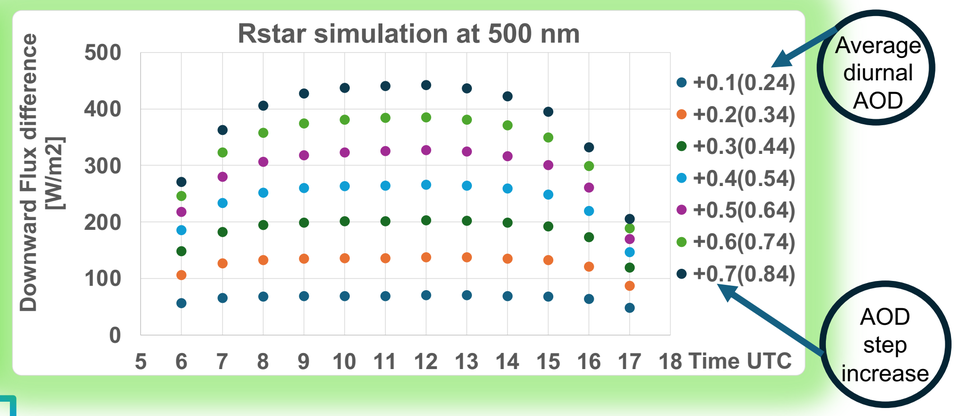
Explore connections between:
Aerosol Optical Depth (AOD) and Single Scattering Albedo (SSA) from SKYNET photometers, and the Urban Heat Island intensities (UHII), within the region 340-1020 nm, during daytime, nighttime and HW events.

Methodologies

UHII and HW	AOD and SSA	Downward Flux
[Cecilia et al., 2023 https://doi.org/10.1016/j.uclim.2022.101355]. UHII is obtained through Satellite measurements of imperviousness (IMP). UHII is the temperature difference between areas with 100% IMP (dense urban) and 0% IMP (rural).	[Nakajima at al., 2020 https://doi.org/10.5194/amt-13-4195-2020]. AOD and SSA are obtained by SUNRAD and SKYRAD_MRIv2 algorithms, respectively, and downloaded by the SKYNET webpage (https://www.skynet-isdc.org).	RSTAR model, distributed by the OpenCLASTR project (http://157.82.240.167/~clastr/) Urban model (0.56 water soluble, 0.24 dust-like, 0.20 soot) Mid latitude summer







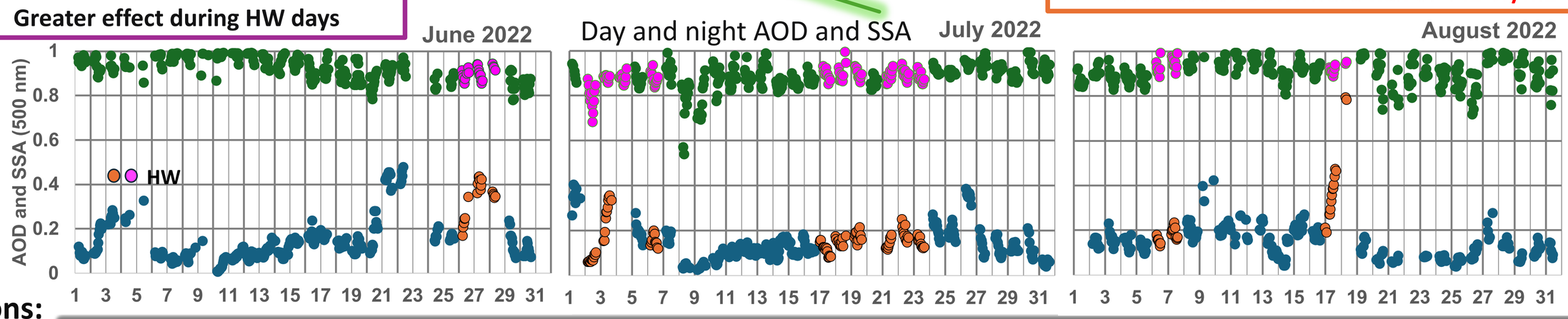
Increasing SSA ↑ (less absorbing aerosol) causes:
surface downward flux ↑
surface temperature ↑ => UHII ↑
Smaller effect during HW days

Zenith angle for each hour of July 15, 2022;
AOD (500 nm) averaged over July hourly bin: mean value 0.14
AOD increased by steps of 0.1 up to the max of summer 2022

Increasing AOD ↑ causes:
surface downward flux ↓
surface temperature ↓ => UHII ↓
Greater effect during HW days

Increase of AOD from 0.14 to 0.24 at 12 UTC => decrease of Downward flux of 137 W/m2
Increase of AOD from 0.14 to 0.84 at 12 UTC => decrease of Downward flux of 442 W/m2

Results



Conclusions: (Next steps)

Run the Radiative transfer model to estimate downward flux at each wavelength and during the night.
Understand the reason of different correlation sign during day and night.
Investigate the impact of meteorological variables (Wind, Relative Humidity, Boundary layer Height) on the UHII and on aerosol optical properties.
Study Relation with in-situ particle sampling to estimate how much the increasing of solar radiation causes more photo-chemical reaction generating more aerosols.
Compare with the aerosol measurements in a rural site close to Rome