

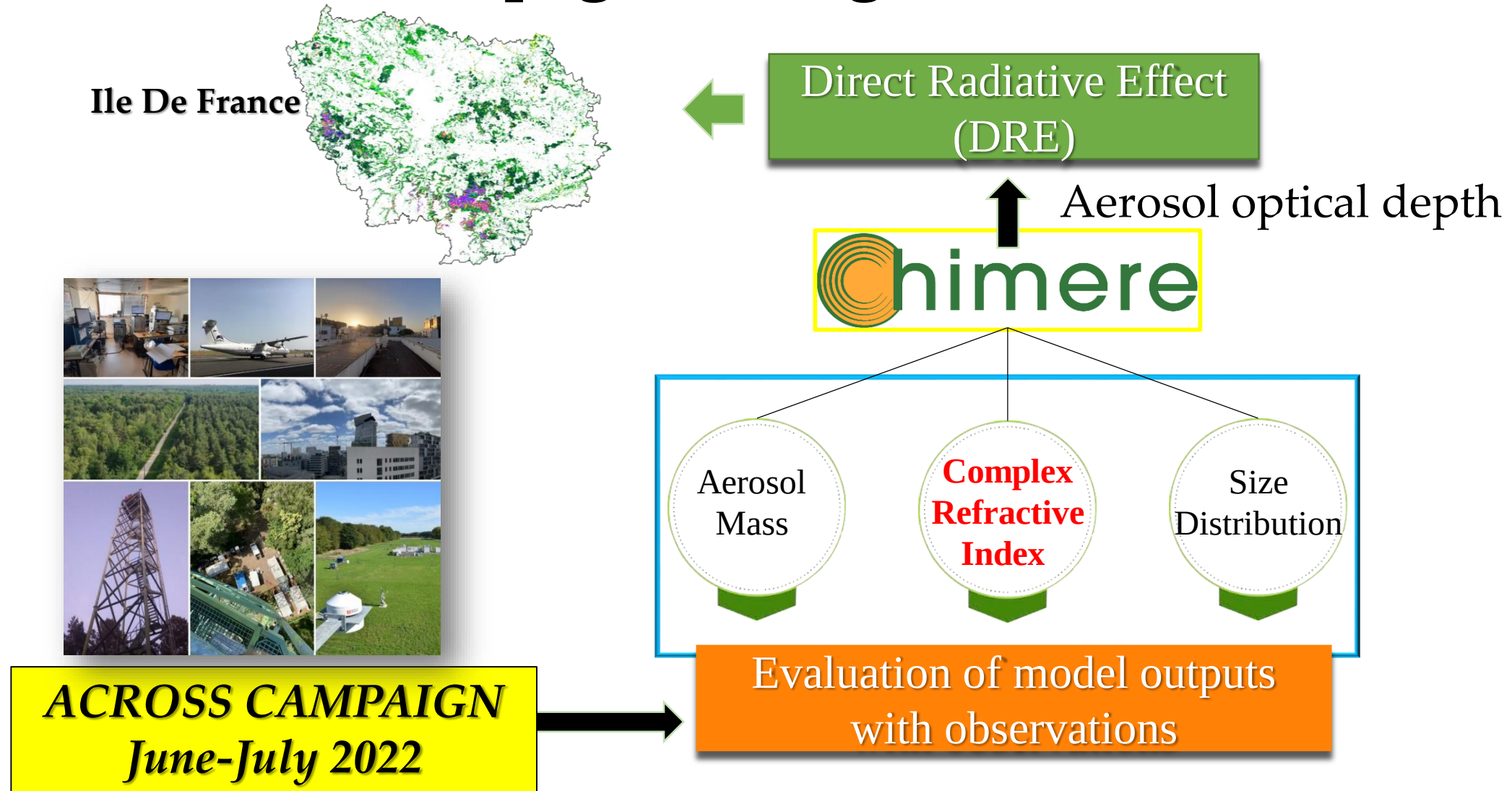


Aerosol spectral optical properties in the Paris urban area and its peri-urban and forested surroundings during summer 2022 from the Atmospheric Chemistry of the Suburban Forest (ACROSS) surface observations

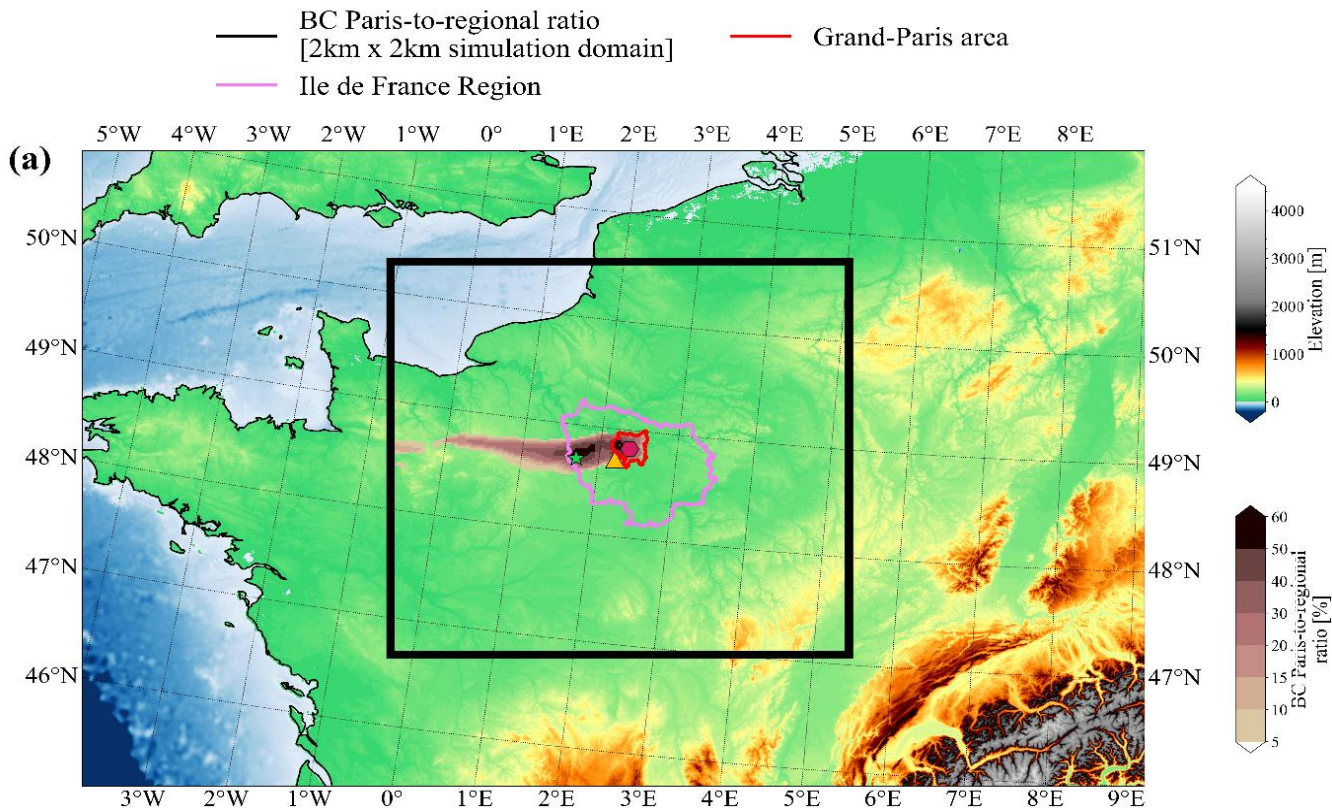
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Aerosol optical properties and direct radiative effect in a mixed anthropogenic-biogenic environment

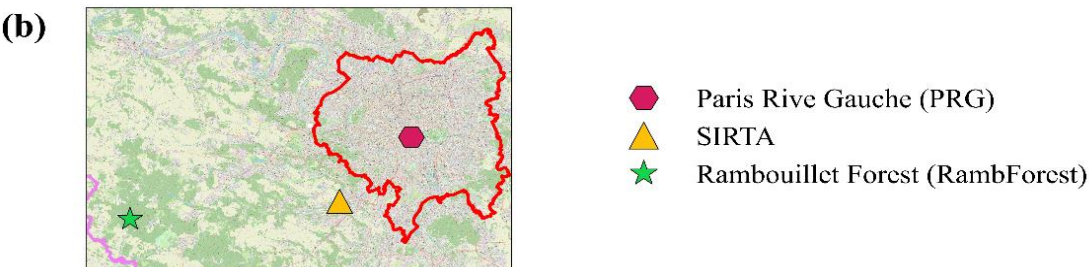


Surface level measurement sites of the ACROSS campaign



Three sites in Ile-de-France region:

- Paris-Rive Gauche **Urban**
- Sirta Observatory **Peri-Urban**
- Rambouillet Forest **Rural**



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Aerosol complex refractive index retrieval algorithm



Absorption coefficient
 $[\beta_{\text{abs}}, Mm^{-1}]$

370nm, 470nm,
520nm, 590nm,
660nm, 880nm,
950nm



Scattering coefficient
 $[\beta_{\text{sca}}, Mm^{-1}]$

450nm-700nm



Particle size distribution
($<1000\text{nm}$)
 $[N, \# / cm^{-3}]$



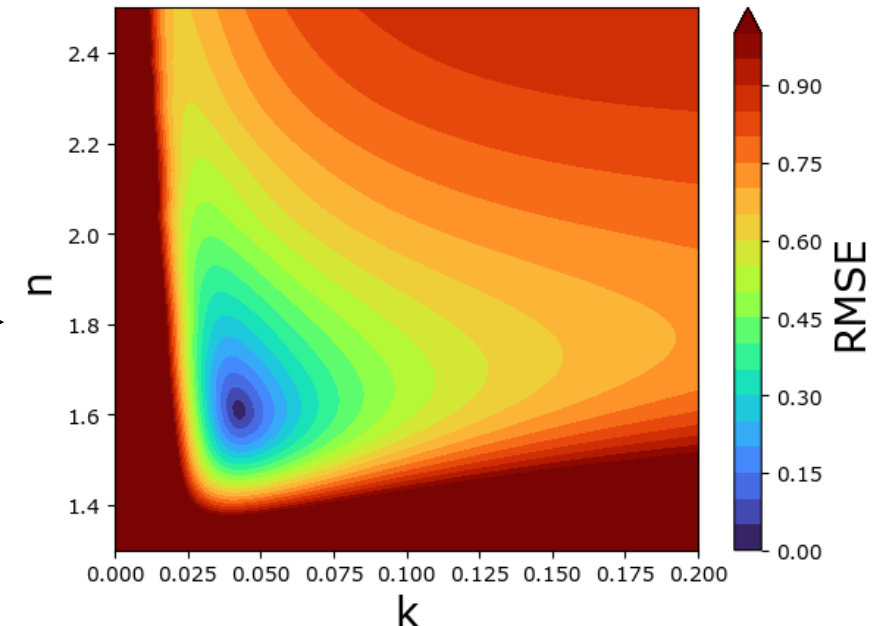
INPUTS

OUTPUT

Complex refractive index ($n+ik$)

$n \rightarrow$ non-absorbing component

$k \rightarrow$ absorbing component



Mie code to simulate the
absorption and scattering
coefficients

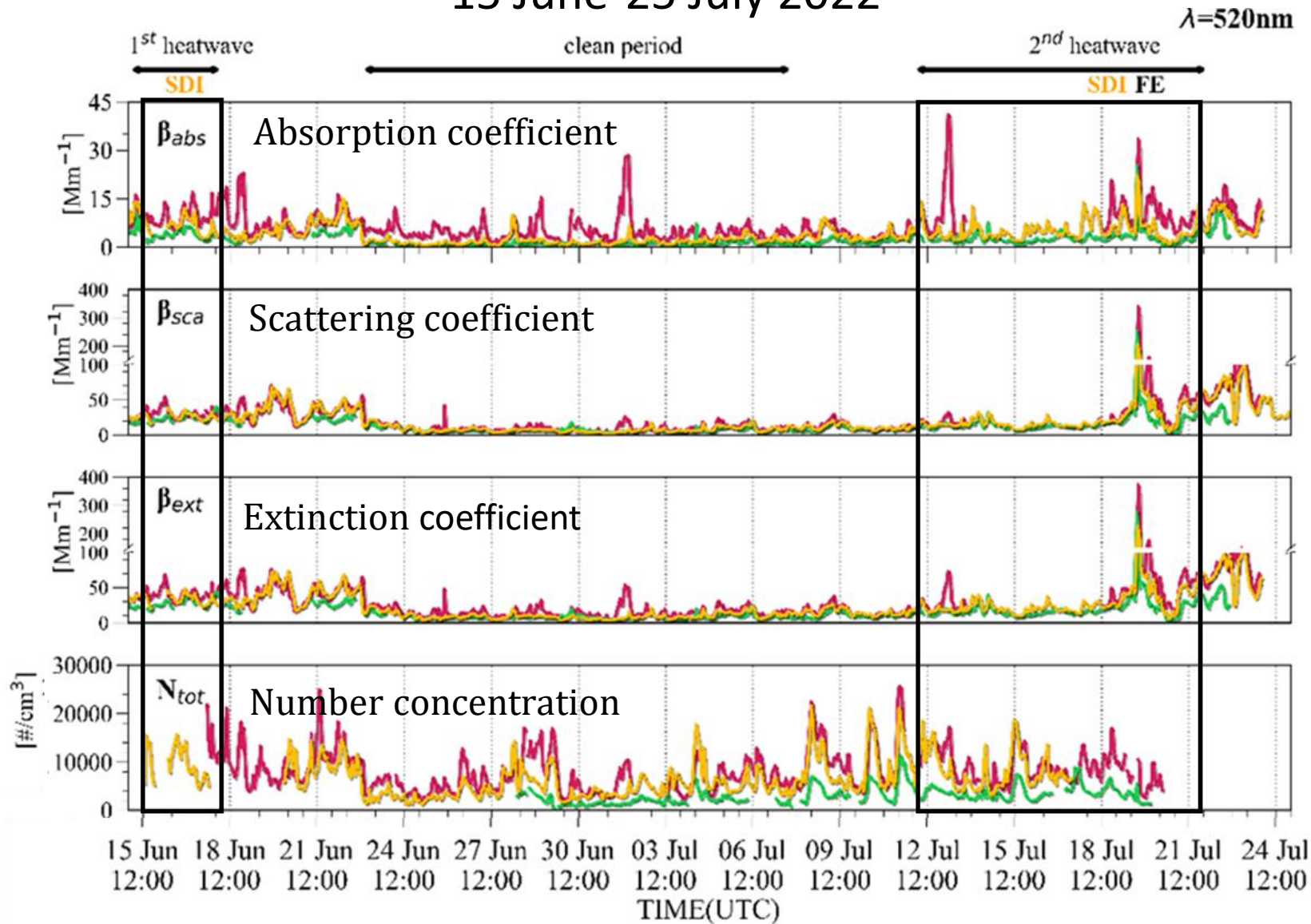
Selection of n, k that
minimize the RMSE
between observations
and modelling

PM_{10} sampling

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Aerosol measurements at the **urban**, **peri-urban** and **rural** sites

15 June-25 July 2022

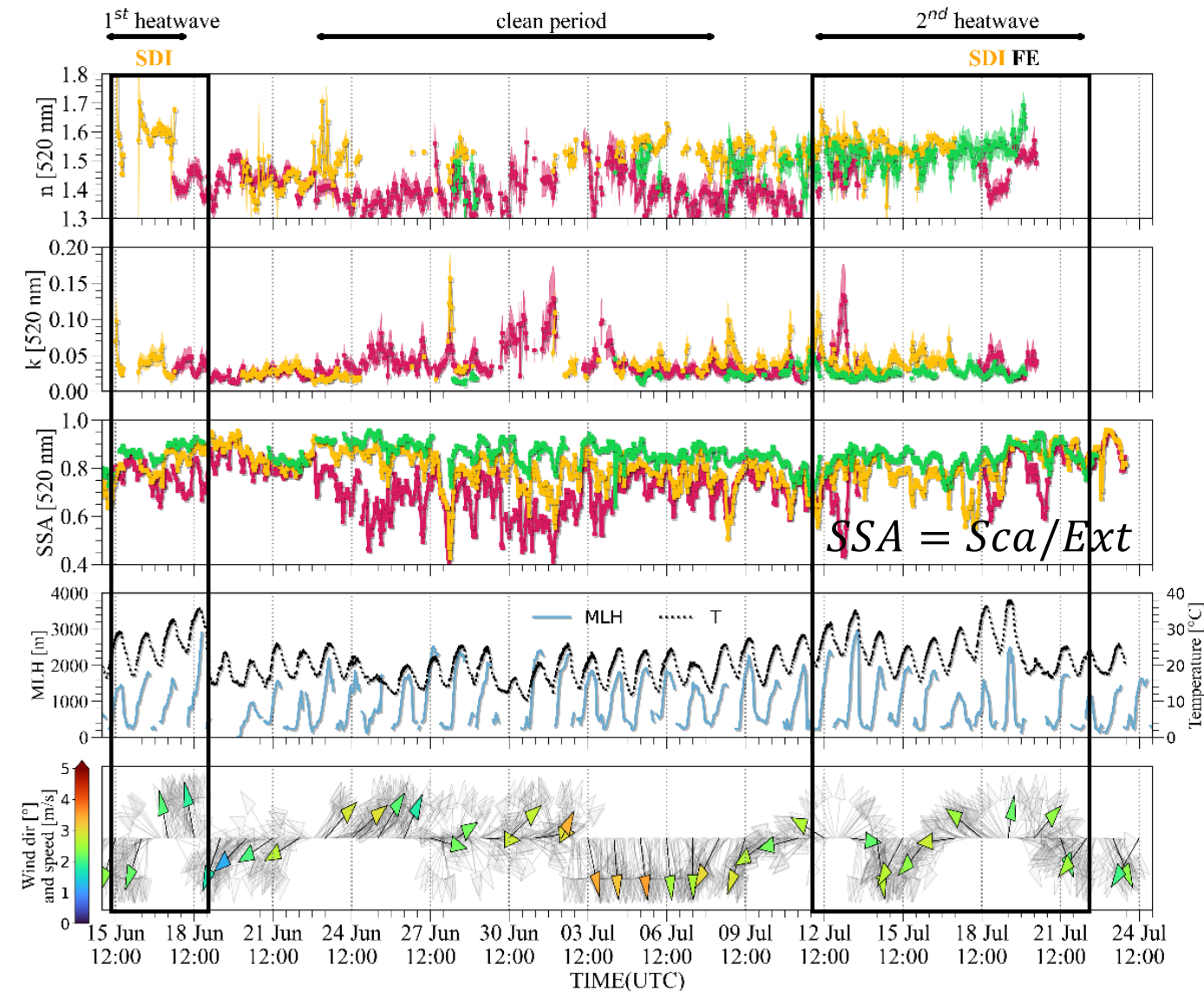


Higher aerosol optical signals during the heatwave periods

Higher abs/sca/ext at the urban Paris site than at the rural site

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CRI and SSA at the **urban**, **peri-urban** and **rural** sites



Full period averages at 520nm
CRI: **1.41-0.037i**, **1.52-0.038i**, **1.50 -0.025i**
SSA: **0.73**, **0.80**, **0.86**

Urban-to-rural gradients in SSA and CRI depending on weather conditions

More spatially homogeneous CRI and SSA under heatwave conditions and NE-E winds (Anticyclonic pressure system over England).

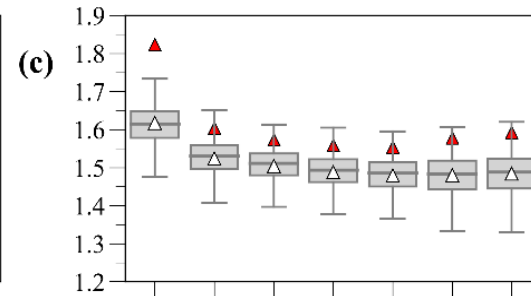
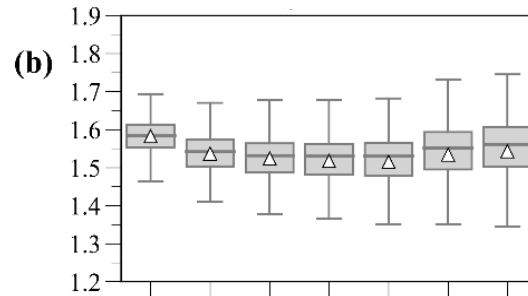
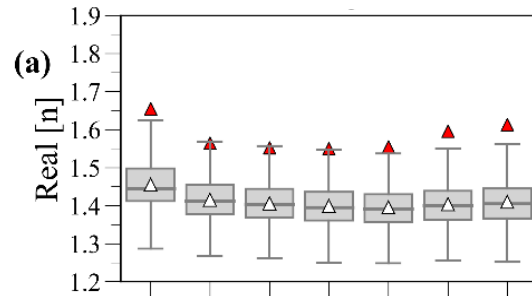
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CRI and SSA at the **urban**, **peri-urban** and **rural** sites

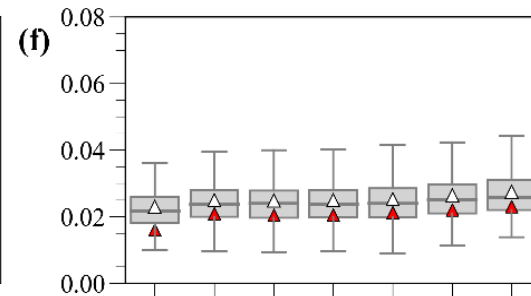
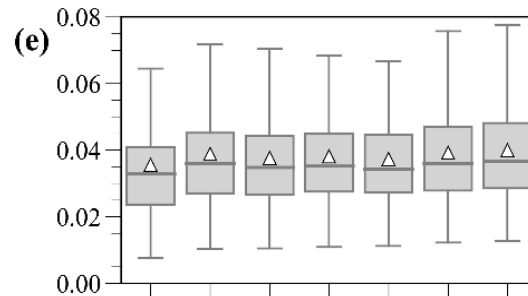
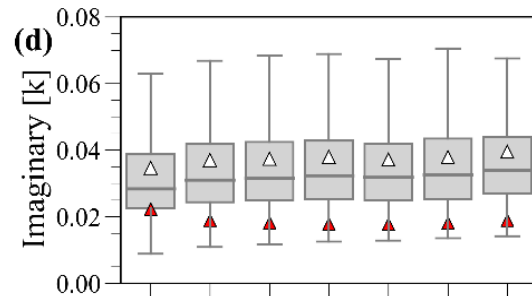
Urban

Peri-Urban

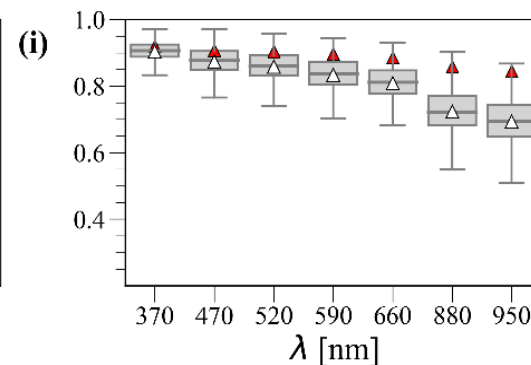
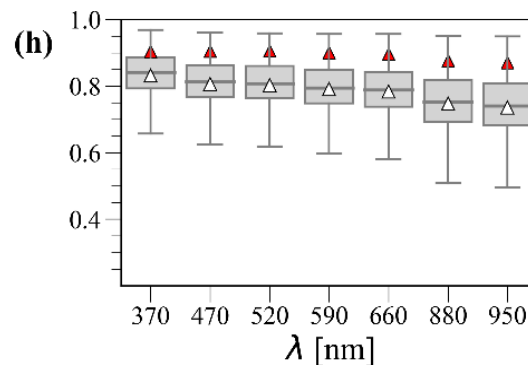
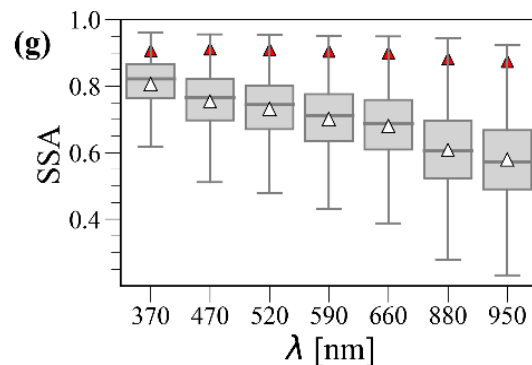
Rural



Real CRI



Imaginary CRI

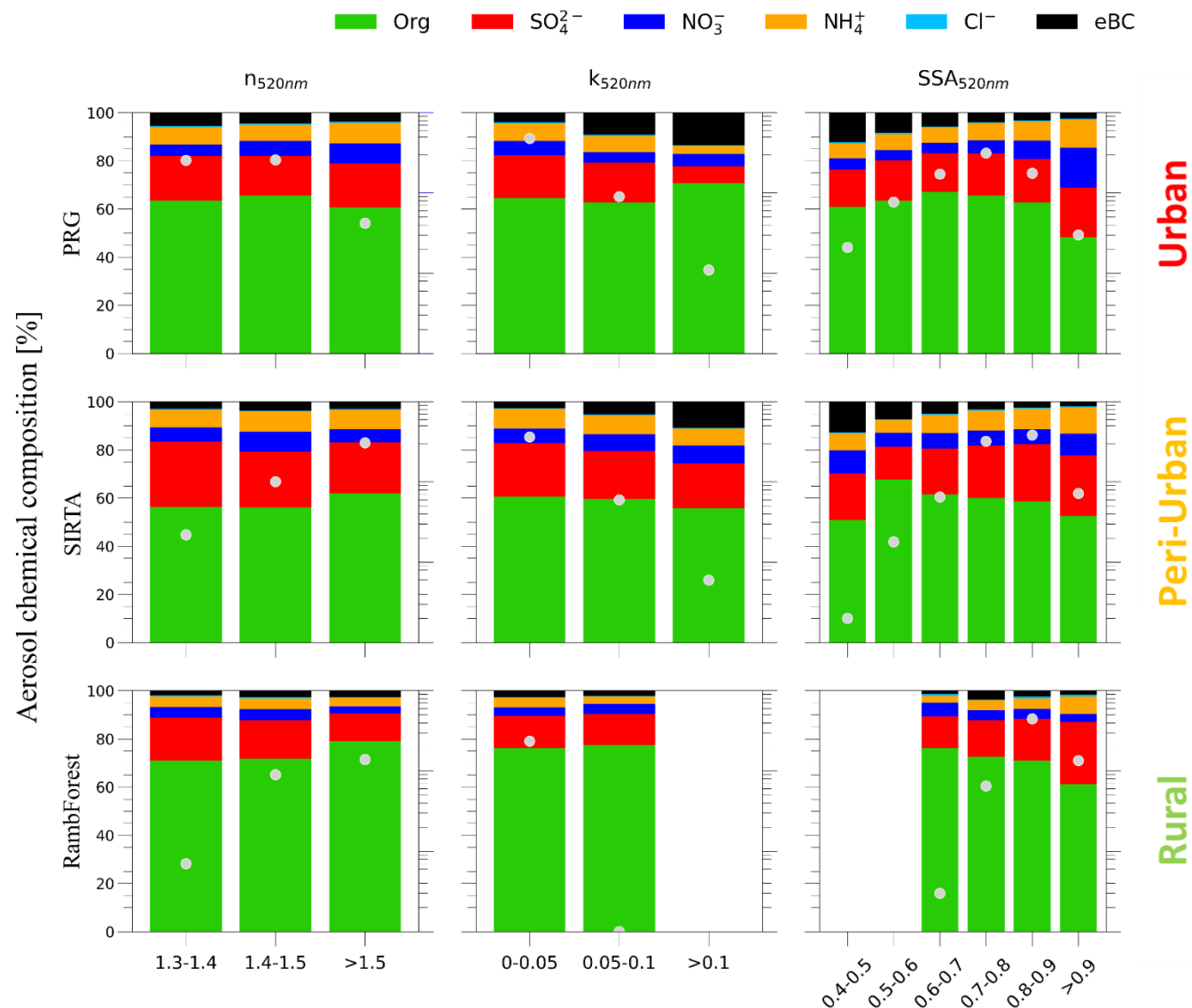


SSA

Red triangles indicate an intense fire episode of the 19 July 2022

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CRI and SSA vs bulk aerosol chemical composition



Organics dominates the PM_{10} composition at all sites

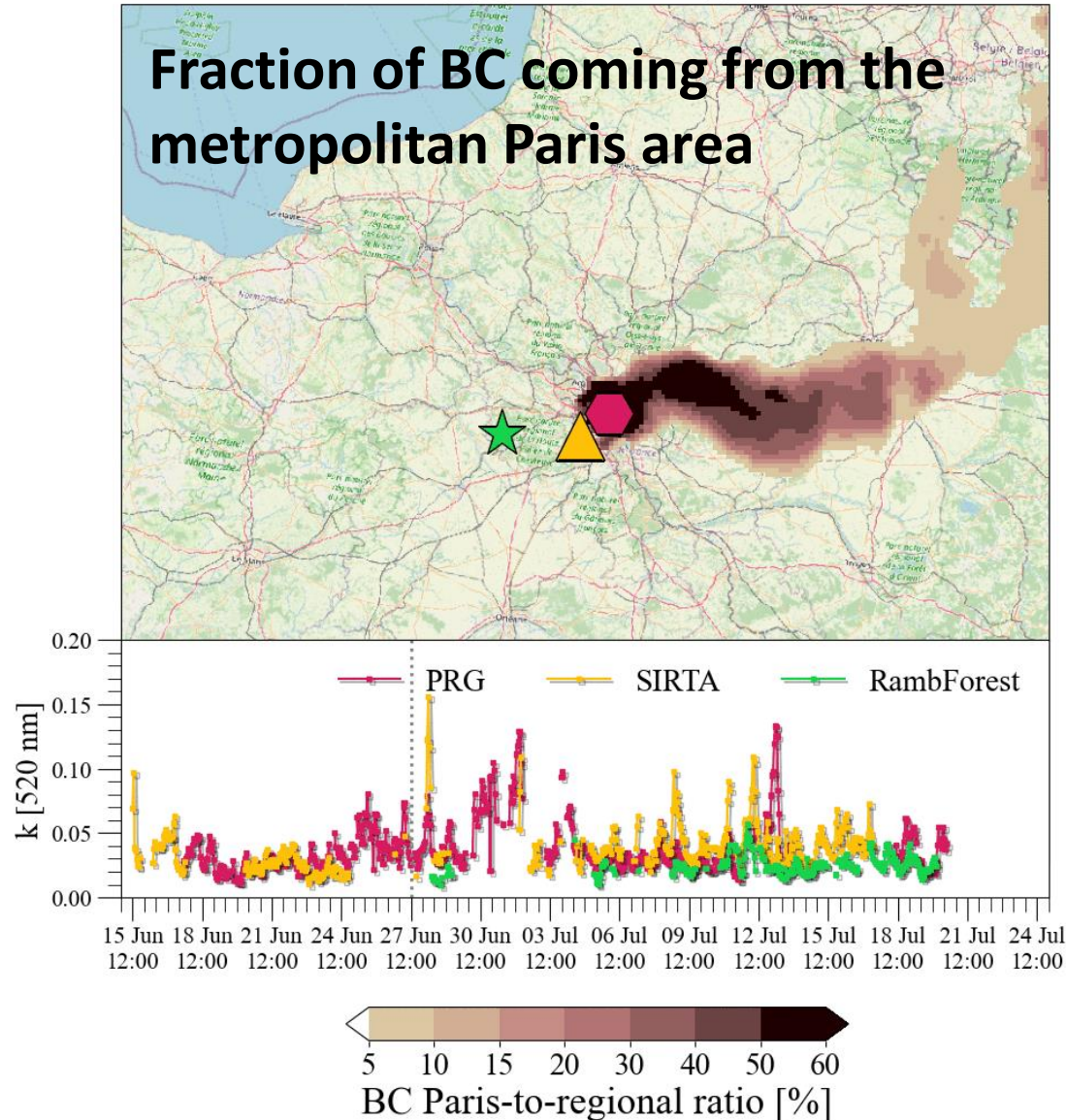
eBC is up to ~15% in mass at the urban and peri-urban sites and associated to highest k and lowest SSA

The lowest k and highest SSA are linked to higher concentrations of sulfates and nitrates

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Influence of the Paris plume on its regional surrounding

27 Jun 2022 12:00



chimere

3D CTM

$$BC_{ratio} = \frac{BC_{paris}}{BC_{paris} + BC_{regional}}$$

The imaginary CRI correlates to the Paris plume direction

Urban
Peri-Urban
Rural

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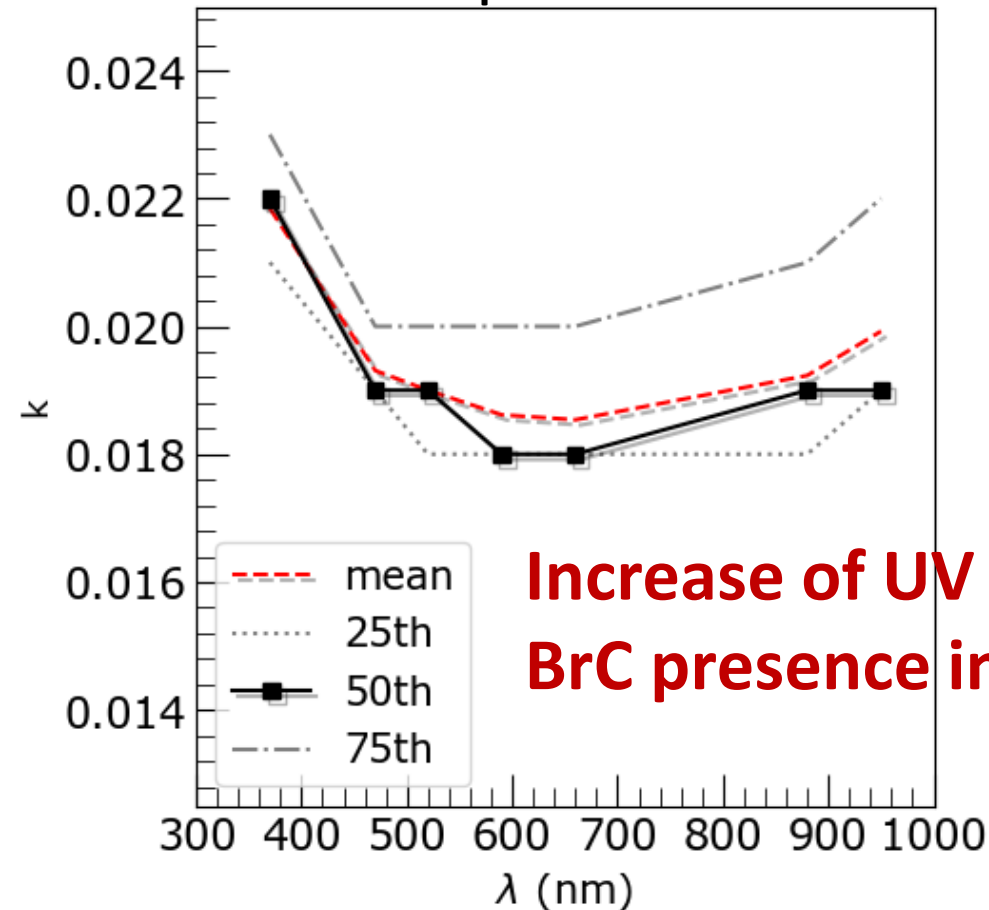
Case study: Fire transport Episode of 19-20 July in Paris from Southern France

Paris before and after the
fire plume arrival



Scattering coefficient up to 500 Mm^{-1}

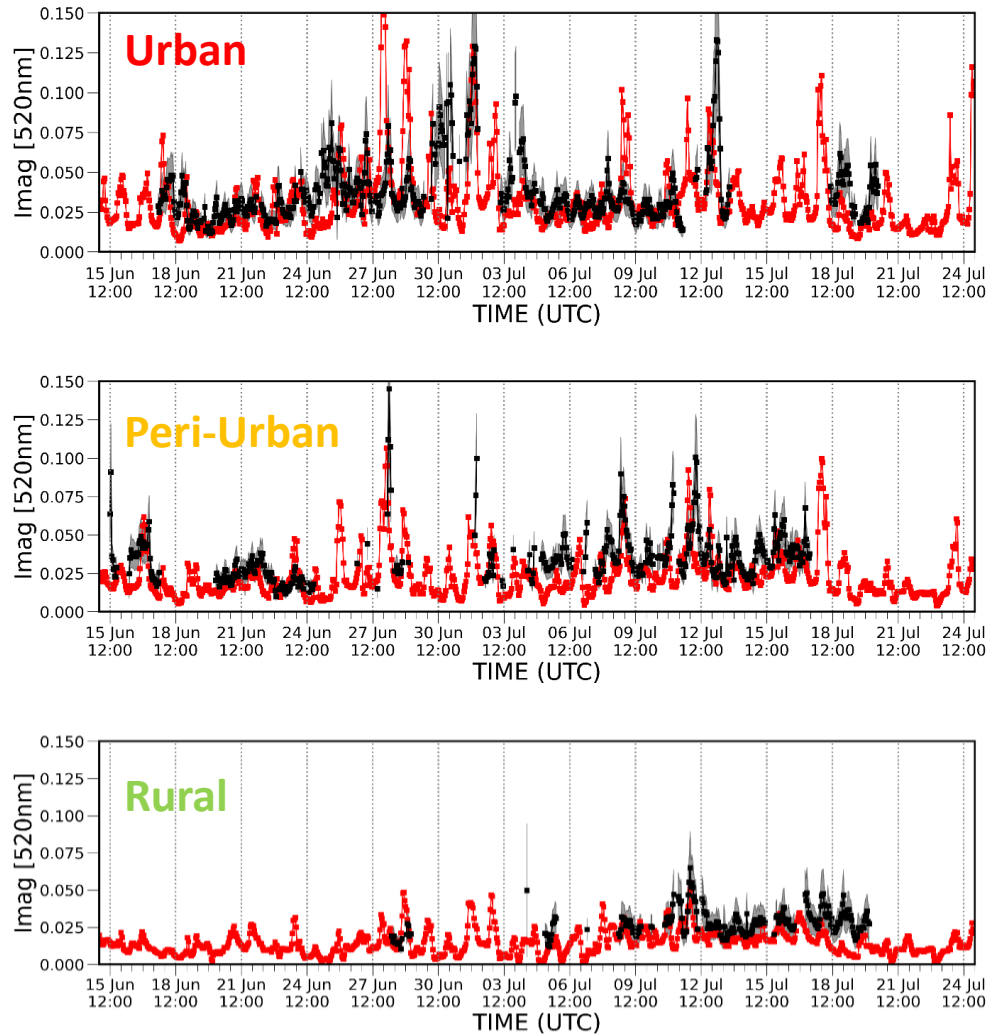
Imaginary CRI average during
the fire episode in Paris



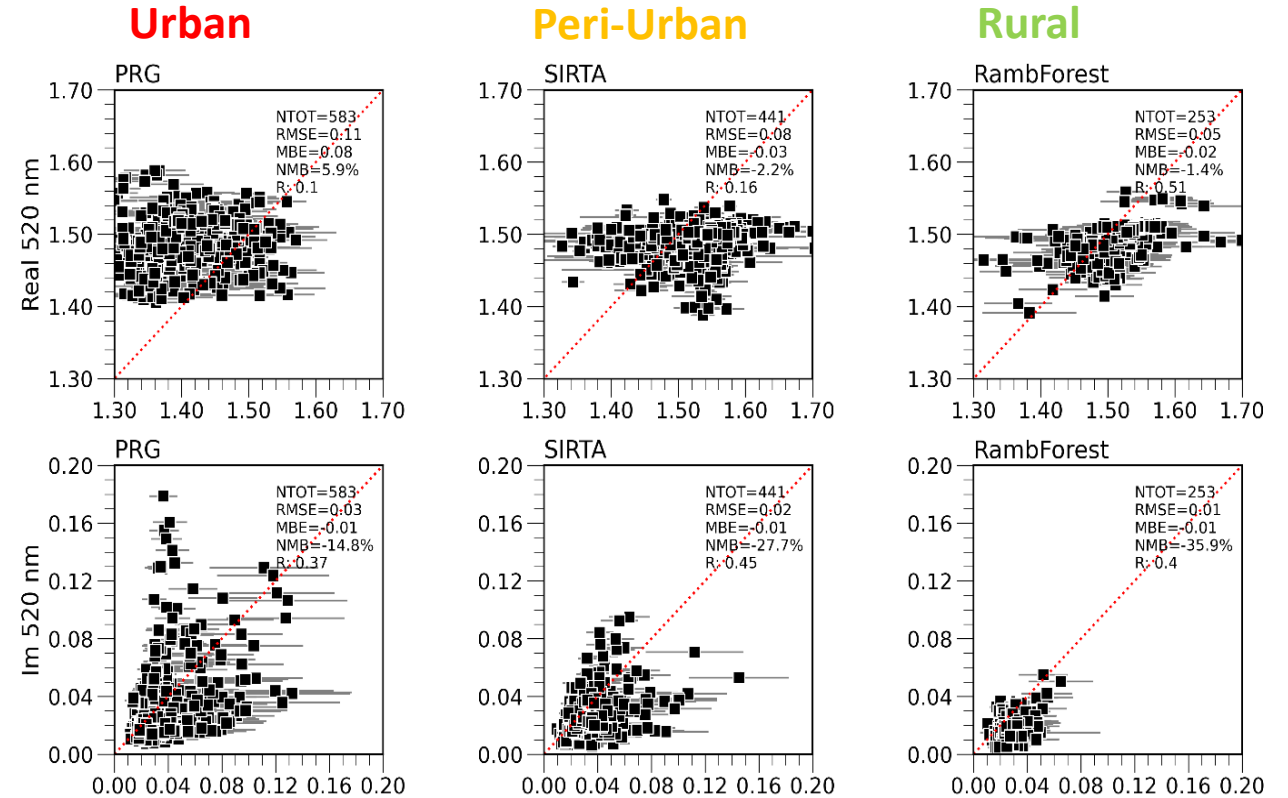
**Increase of UV absorption,
BrC presence in the plume**

CRI data used to evaluate 3D WRF-CHIMERE simulation

Imaginary at 520 nm



Real and Imaginary at 520 nm



the model is capable of reproducing the k temporal variability, but that it tends to underestimate the absorption
 -> higher SSA

Conclusions and perspectives

The spectral complex refractive index (CRI) and single scattering albedo has been retrieved under highly diversified weather conditions of summer 2022 and to characterize three different sites (*urban*, *peri-urban*, *rural*) within the Ile de France region during the of the ACROSS campaign 2022.

Average CRI of *1.41-0.037i*, *1.52-0.038i*, *1.50 -0.025i* and SSA of *0.73* , *0.80* , *0.86*

→ urban-to-rural gradient depending on the weather conditions

Lowest SSA (highest k) -> strongly correlated with the eBC fractions

Highest SSA (lowest k) -> correlated to the increase of sulfate and nitrate and a decrease in the organic and eBC fractions.

The BC tracer analysis shows -> the Paris emissions influence the spectral optical properties at the surrounding sites

Data available at <https://across.aeris-data.fr/>

THANKS FOR YOUR ATTENTION!!!

