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BC MEASUREMENTS - PANACEA CAMPAIGNS

Atmospheric Pollution and Population Exposure

Assessment of the role of residential biomass burning during wintertime

Campaign	Period
Summer 1 st	Jul. 2019 – Aug. 2019
Winter 1 st	Dec. 2019 – Feb. 2020
Winter 2 nd	Dec. 2021 – Jan. 2022

Emphasis on Ioannina

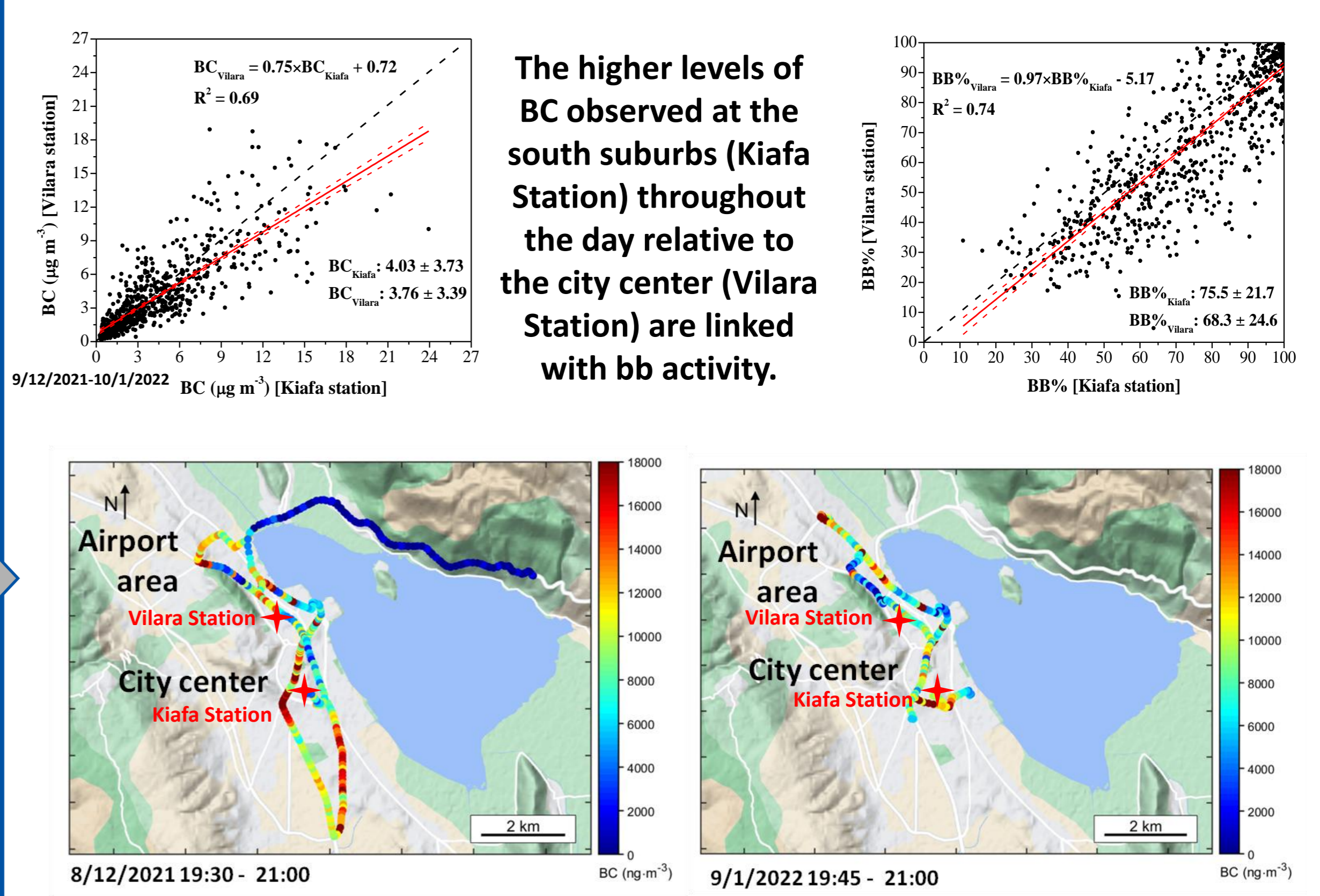
High resolution measurements of Black Carbon (BC) by means of the 7-λ Aethalometers AE33 or AE31 (Magee Scientific, 1 and 5 min resolution, respectively) at three urban centers in Greece (Athens, Thessaloniki & Ioannina) and at the regional background station of Finokalia, Crete. PM_{2.5} sampling also performed on 24-hr basis.



PANACEA

The overarching goal of PANACEA is the integration of all existing national facilities to create a single harmonized high-class innovative distributed RI to serve and provide access to all academic/research institutions and the private sector in the wide scientific range covered by PANACEA.

BC OBSERVATIONS AT IOANNINA (WINTER 2021-2022)



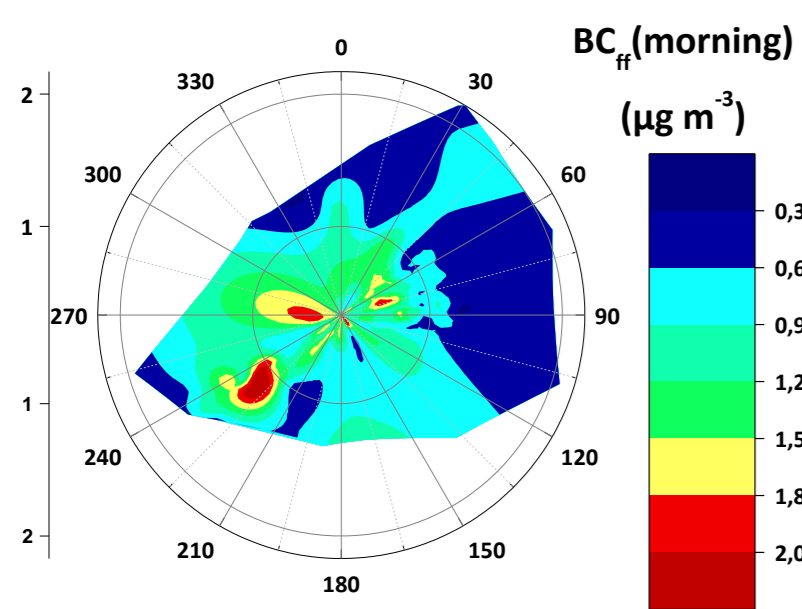
The higher levels of BC observed at the south suburbs (Kiafa Station) throughout the day relative to the city center (Vilara Station) are linked with bb activity.

Increased BC levels close to city center, airport and at the north lakeside area due to traffic. The enhancement at the south suburbs could be linked heating emissions (e.g. fireplaces).

SPATIO-TEMPORAL VARIABILITY OF BC FRACTIONS

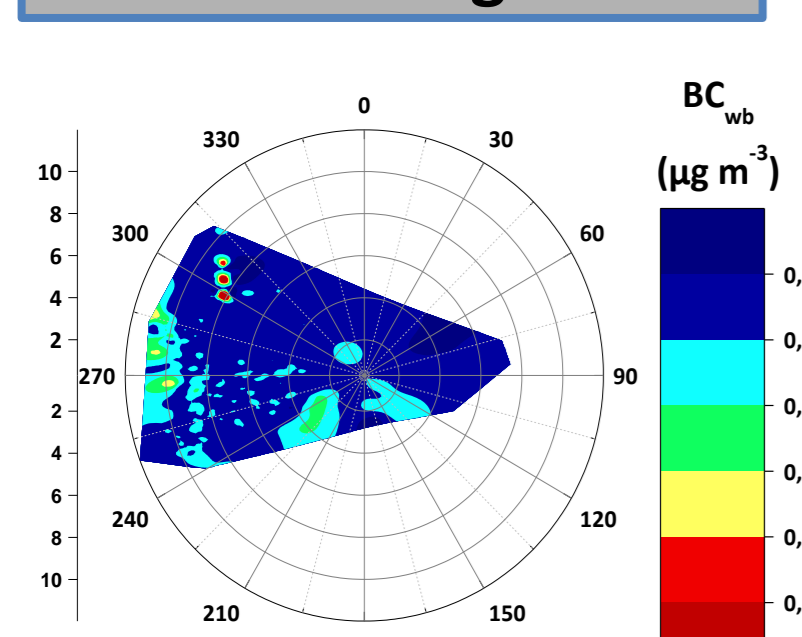
BC (μg m ⁻³)	Finokalia	Athens	Thessaloniki	Ioannina 1 st	Ioannina 2 nd
Winter	0.31 ± 0.23	2.61 ± 3.49	1.37 ± 1.12	4.92 ± 4.69	3.86 ± 3.68
Summer	0.57 ± 0.24	0.66 ± 0.46	0.76 ± 0.45	1.05 ± 0.67	-

Prevalence of local bb emission sources at Ioannina during winter night (>10 folded BC_{wb} levels relative to BC_{ff}) inline with the findings of the mobile mapping, i.e. high BC levels at both the city center and the suburban residential area.



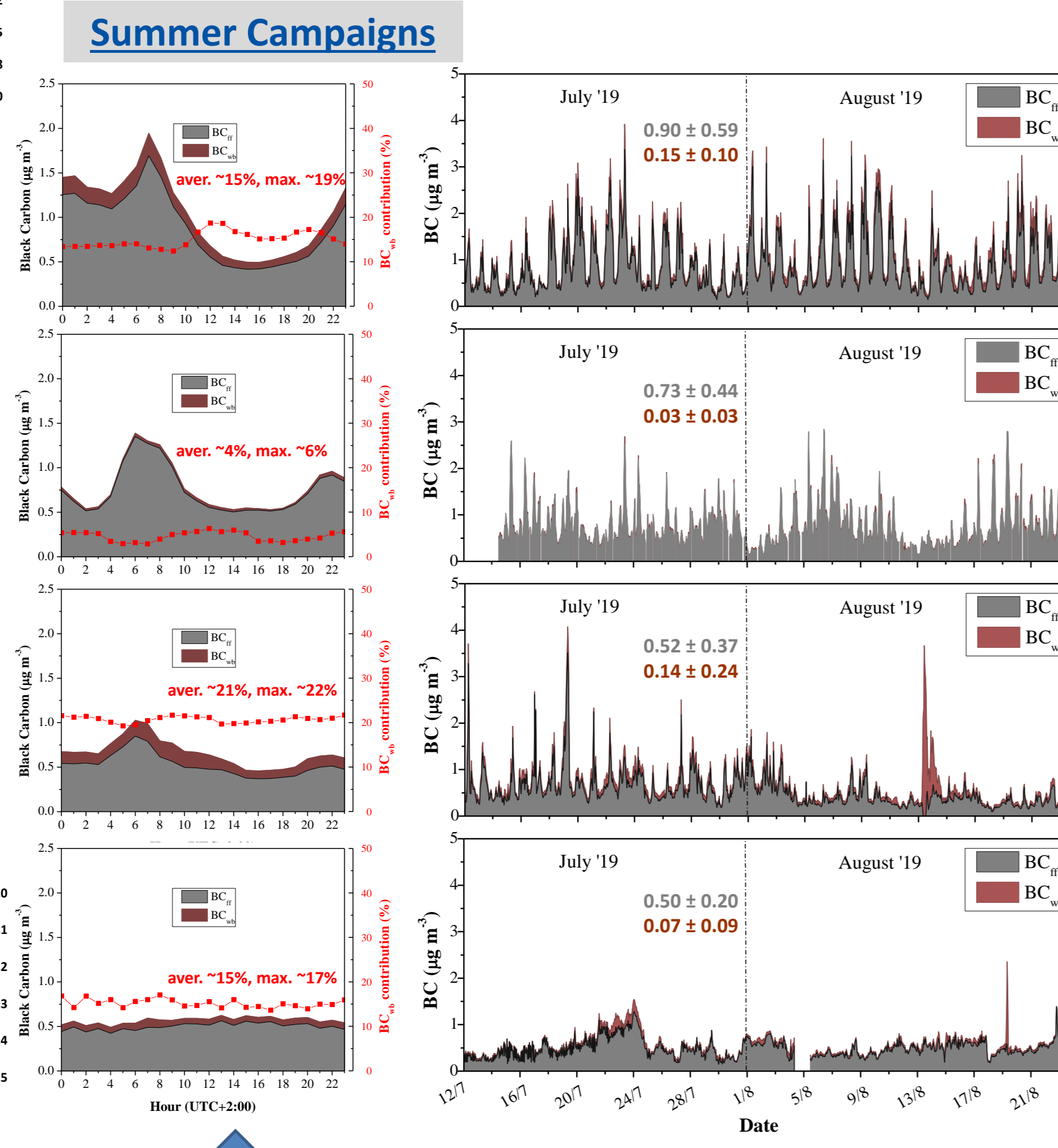
Uniformity of local traffic impact at Ioannina during summer in the morning, with BC_{ff} peaking averagely at about 2 μg m⁻³ as during winter.

Bimodal diurnal variability in the urban environments regardless the season, followed by enhancement of the bb fraction during winter night.

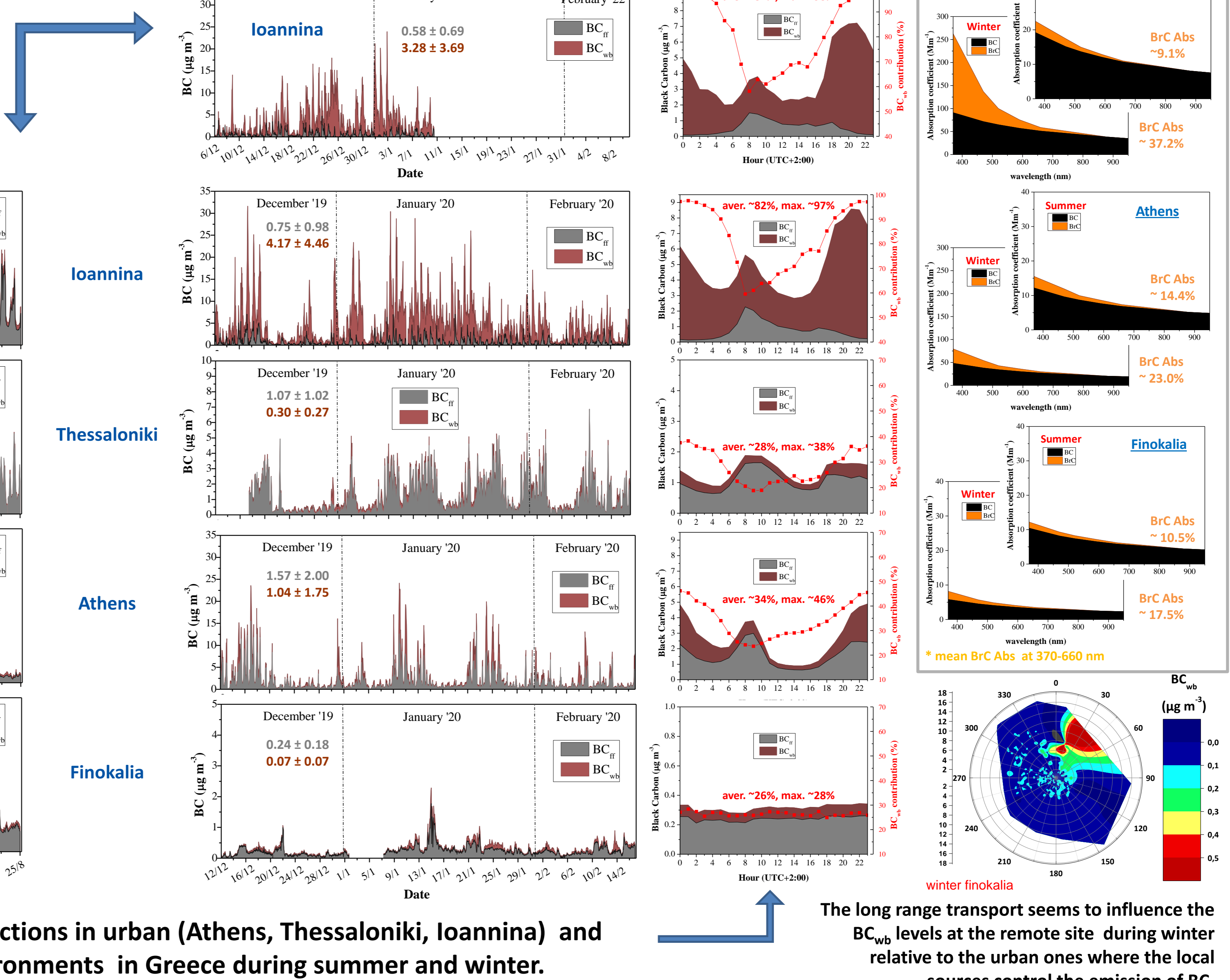


Low spatio-temporal variability of the BC_{wb} levels at the remote site during summer.

Mean hourly variability of BC fractions in urban (Athens, Thessaloniki, Ioannina) and background (Finokalia) environments in Greece during summer and winter.



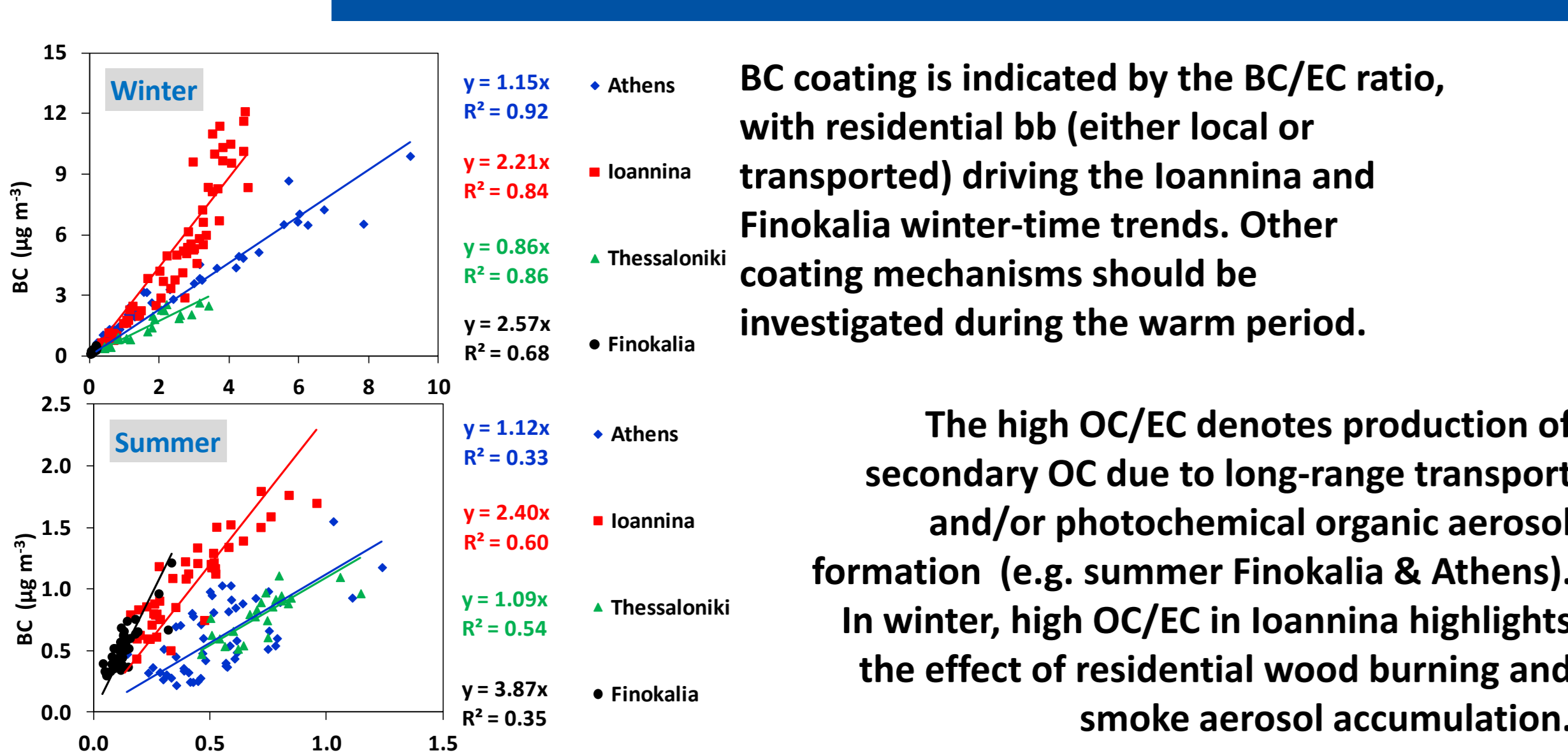
Mean diurnal variability of BC fractions in urban (Athens, Thessaloniki, Ioannina) and background (Finokalia) environments in Greece during summer and winter.



Remarkable variability on the seasonally averaged spectral b_{abs} during winter in Ioannina related to increased wood burning compared to Athens and Finokalia, with the later presenting the lower contribution of BrC absorption.

The long range transport seems to influence the BC_{wb} levels at the remote site during winter relative to the urban ones where the local sources control the emission of BC.

BC-RELATED INDICATIONS ON DOMINANT ATMOSPHERIC PROCESSES



BC coating is indicated by the BC/EC ratio, with residential bb (either local or transported) driving the Ioannina and Finokalia winter-time trends. Other coating mechanisms should be investigated during the warm period.

The high OC/EC denotes production of secondary OC due to long-range transport and/or photochemical organic aerosol formation (e.g. summer Finokalia & Athens). In winter, high OC/EC in Ioannina highlights the effect of residential wood burning and smoke aerosol accumulation.

CONCLUSIONS

- The study delineates the BC characteristics in contrasted environments in Greece over distinct bb conditions, revealing tremendous differences in the levels and in the day-to-day variability.
- The lower mean BC levels were encountered during winter at the background site of Finokalia, Crete and higher at Ioannina by up to one order of magnitude (0.31 μg m⁻³ vs 3.86-4.92 μg m⁻³) whereas Athens and Thessaloniki lie in between.
- During summer, high regional BC levels were observed whereas the city contribution was rather small compared to winter.
- The higher bb impact was encountered in Ioannina with BC_{wb} exceeding frequently the 10 μg m⁻³ in hourly scale and a remarkable mean nighttime contribution of >90% against the other urban sites of lower than 50%. Both the Ioannina city center and the suburbs were impacted due to heating practices and the intensity of the primary combustion processes was also depicted on the BrC absorption contributions compared to the other sites.
- The enhanced levels of carbonaceous aerosol during winter could be linked with combustion emissions under typical low mixing heights, providing insights of atmospheric transformations.