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Studying light-absorbing aerosols properties in Northern France through combined in-situ observations, emission inventory, and individual back-trajectory analyses

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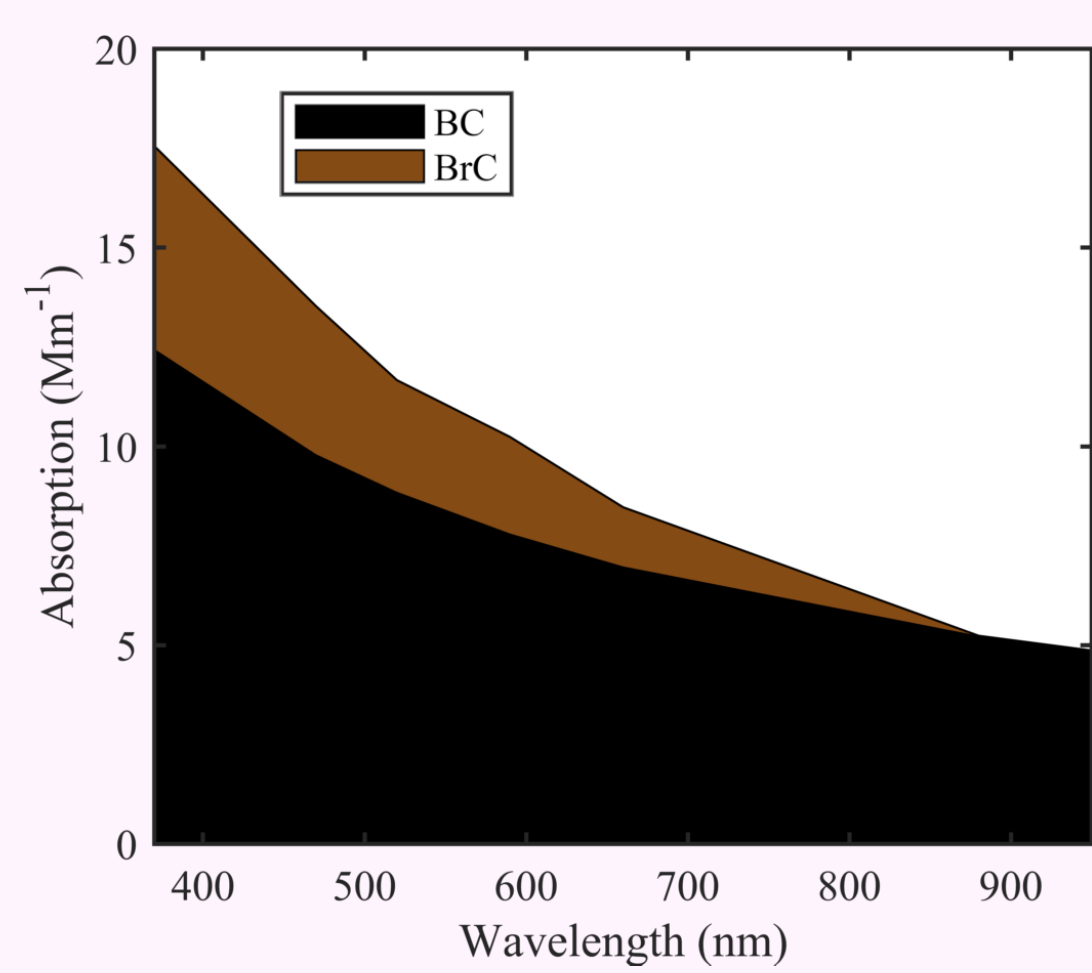
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1. Light-absorbing aerosols (LAAs)

Composed of:

- Black carbon (BC)
- Brown carbon (BrC)



Mineral dust (not frequent in ATOLL site)

Effects:

- Impact on solar radiation and cloud properties
- Reduce snow/ice albedo
- Health effects

From incomplete combustion of:

- Fossil fuels
- Biomass
- Biofuels
- & secondary reactions

The ATOLL site:

Mean Single Scattering Albedo (SSA) at 525 nm of 0.75 → LAAs

5. Optical properties

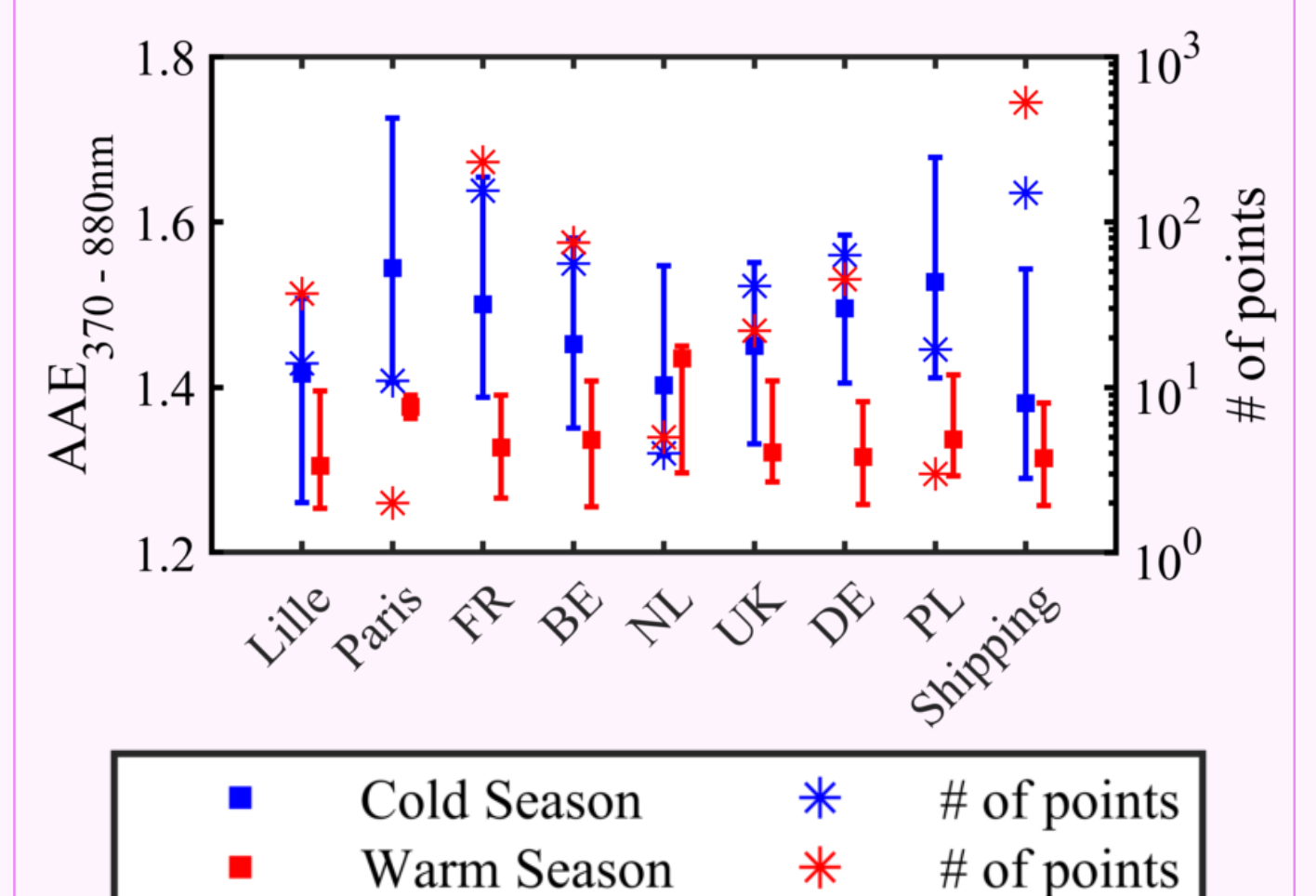
~3 years of in situ observations:

- Absorption Ångström Exponent (AAE) at 370-880nm

Summer (JJA) ~ 1.3
Winter (DJF) ~ 1.6

→ presence of Biomass Burning (BB), mainly related to increases in residential heating emissions during the cold season

INTERPLAY → AAE for air masses from different regions



2. Gaps

We aim to investigate LAAs...

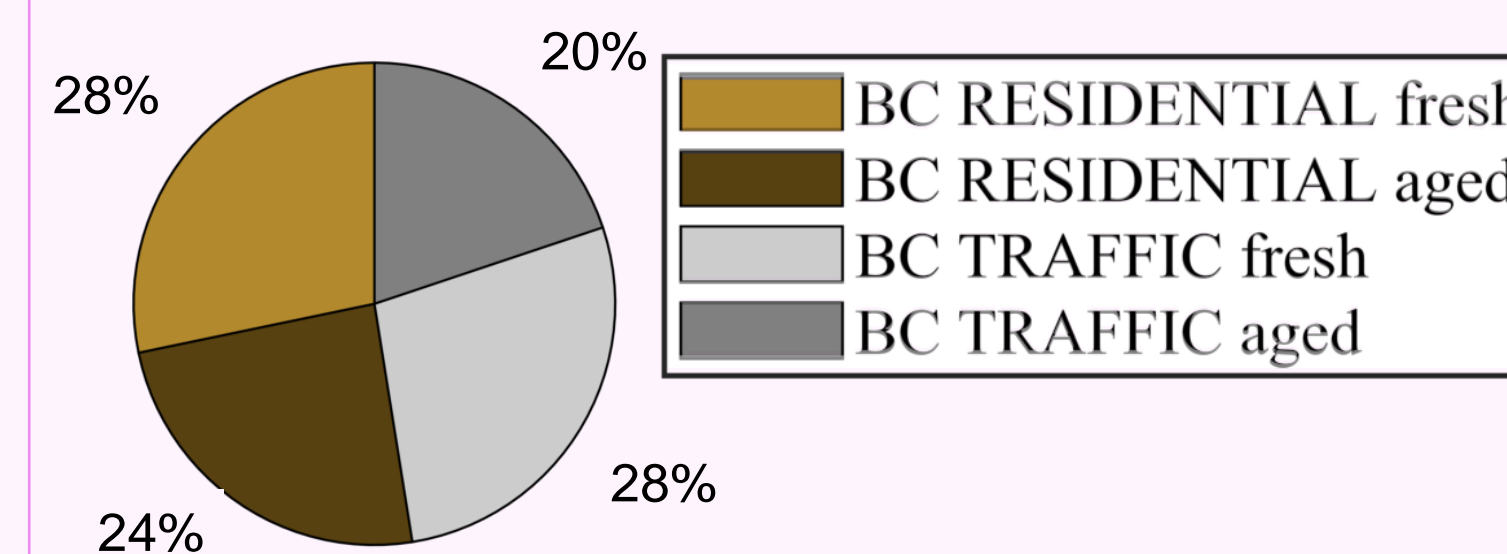
- Sources in Northern France
- Associated optical properties
- BrC origins and lifetime

6. BrC origins & lifetime

Traffic and residential sectors

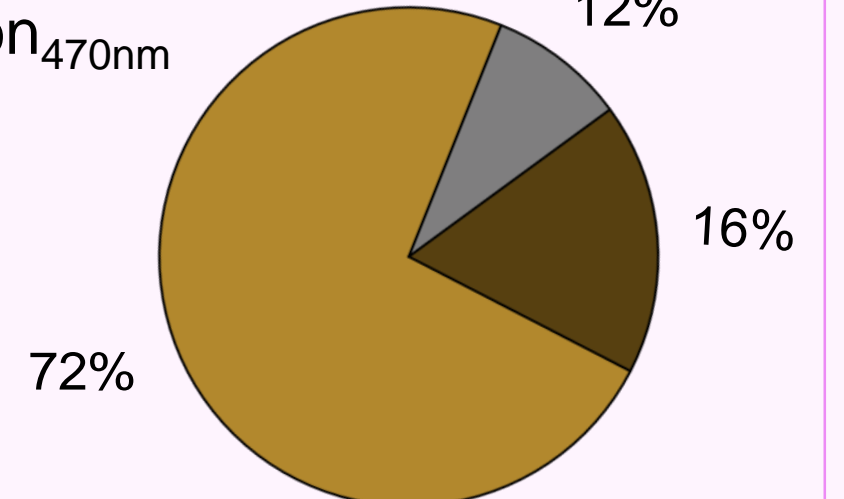
INTERPLAY → fresh & aged aerosols < 24hrs (fresh) & >24hrs (aged)

Relative contribution of sectors to BC mass



In situ → BrC absorption at 470nm
Multiple Linear Regression (MLR) → Mass Absorption Coefficient (MAC)

Relative contribution of sectors to BrC absorption_{470nm}



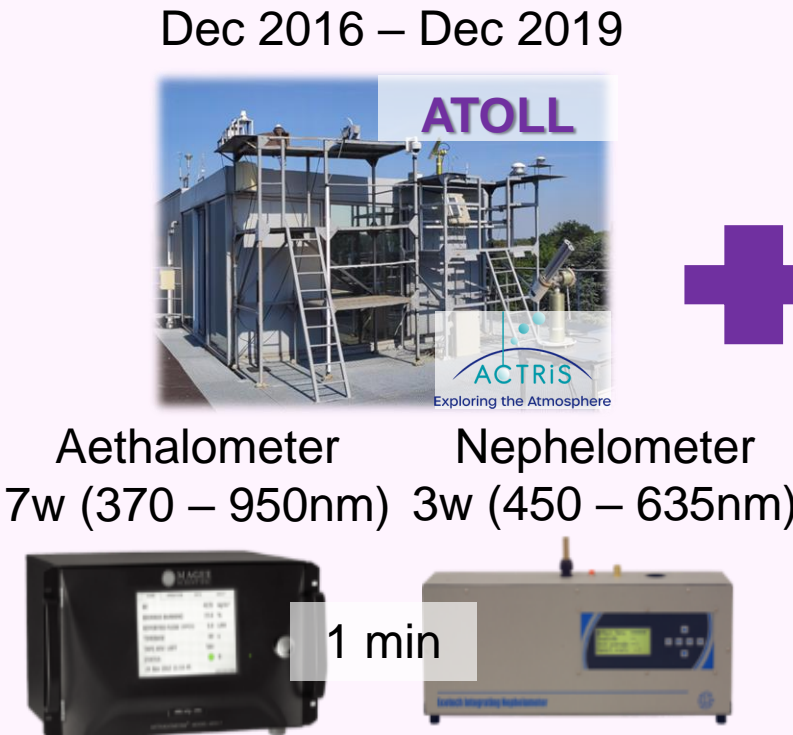
During the cold season (Sep-Apr) residential fresh aerosols contribute to 72% of BrC absorption at 470nm

3. INTERPLAY approach

combining in-situ observations, Hysplit and emissions-inventories

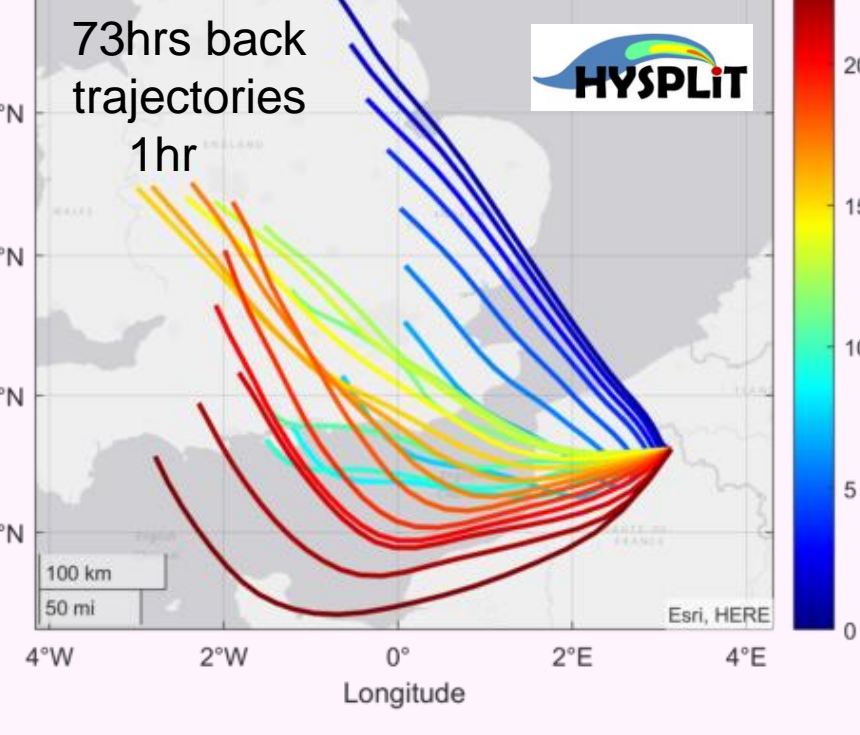
- Integrate BC emissions along individual back-trajectories (BTs) → BC footprint at a receptor site (ATOLL platform)
- Enrich in situ observations → optical properties before & after transport

ATOLL in situ observations Dec 2016 – Dec 2019

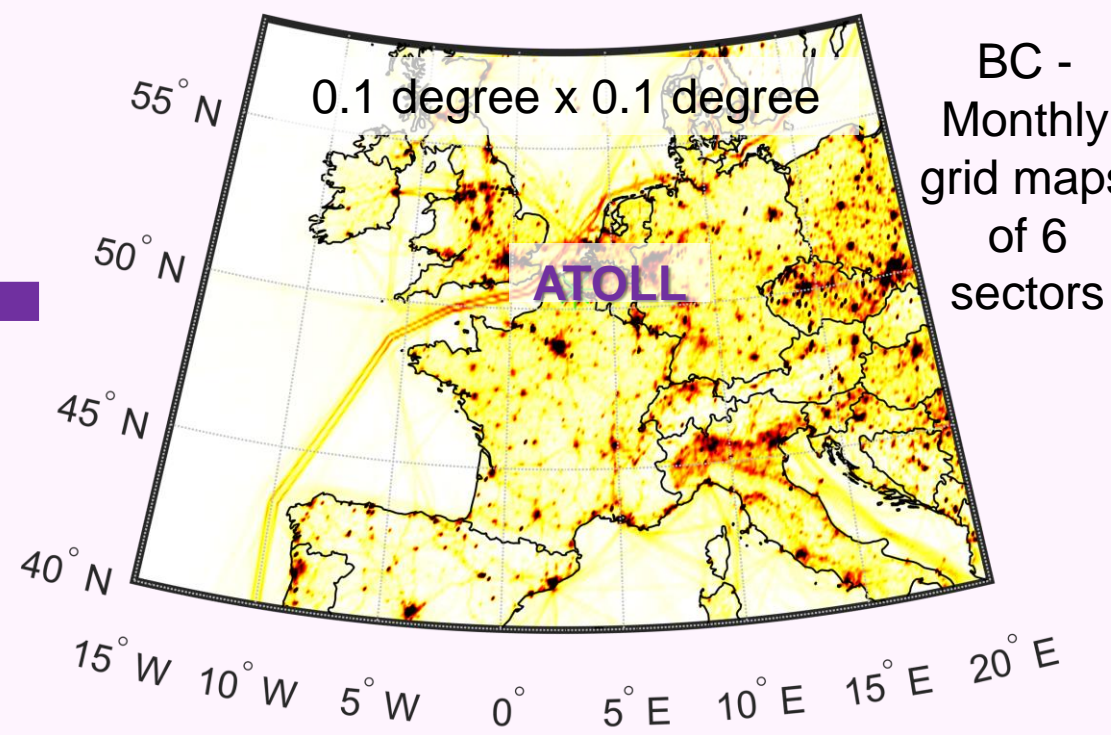


Aethalometer 7w (370 – 950nm)
Nephelometer 3w (450 – 635nm)
1 min

Lille 24h Backtrajectories - 28-Apr-16



EDGAR emission inventory (2018v)



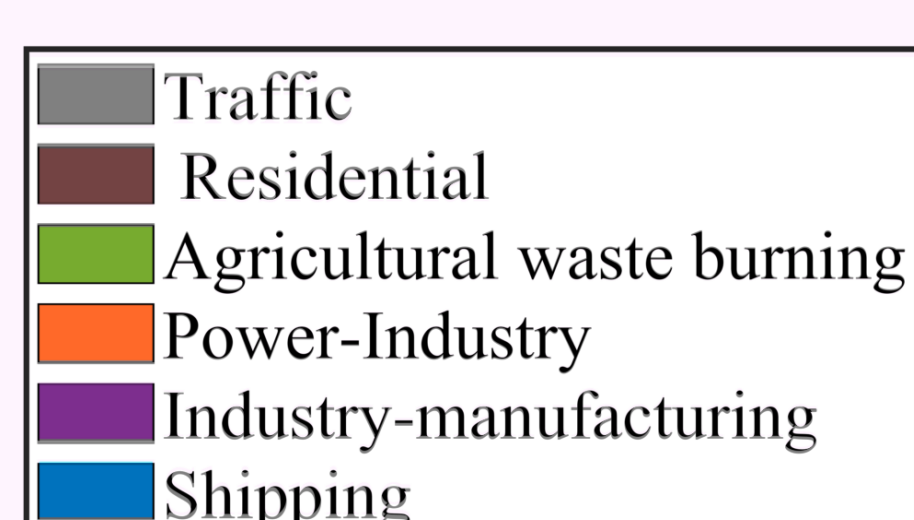
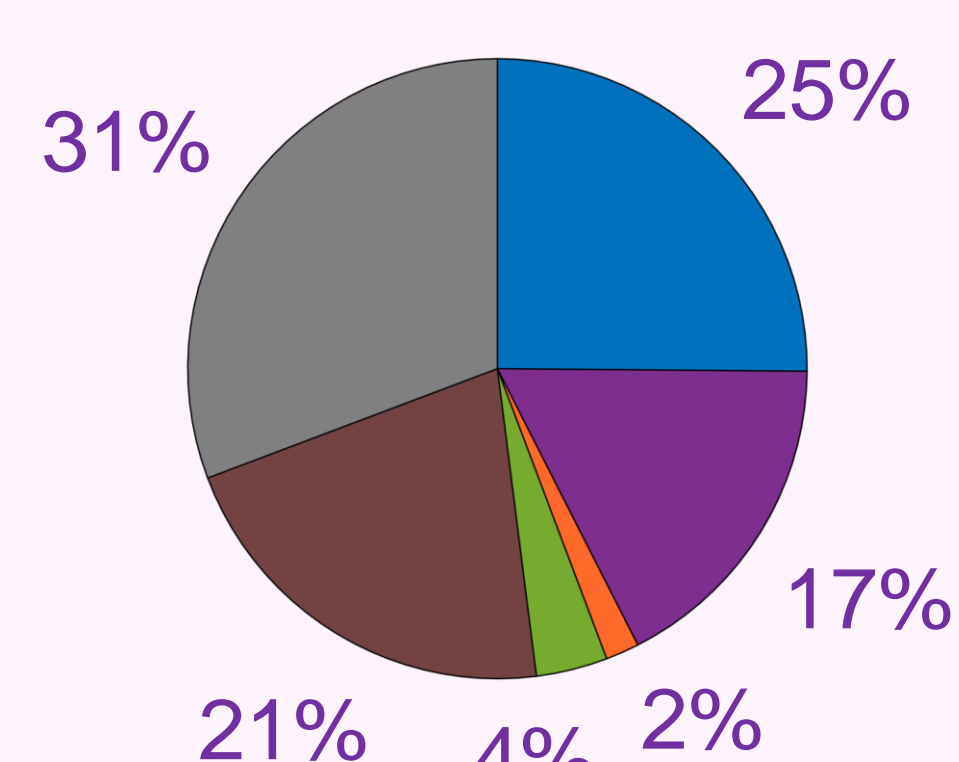
Only in situ observations + Hysplit → limited results

7. Conclusions

- The ATOLL site has an SSA ~ 0.75 → presence of LAAs
- Hysplit + in situ give limited results → INTERPLAY was created
- The INTERPLAY approach → reproduce BC in situ levels at the ATOLL platform (√r²: 0.60)
- BC major contributor sectors – traffic (31%), shipping (25%), residential-heating (21%)
- Suspicion of bleaching effect using this dataset (AAE decrease with time) → further work is needed

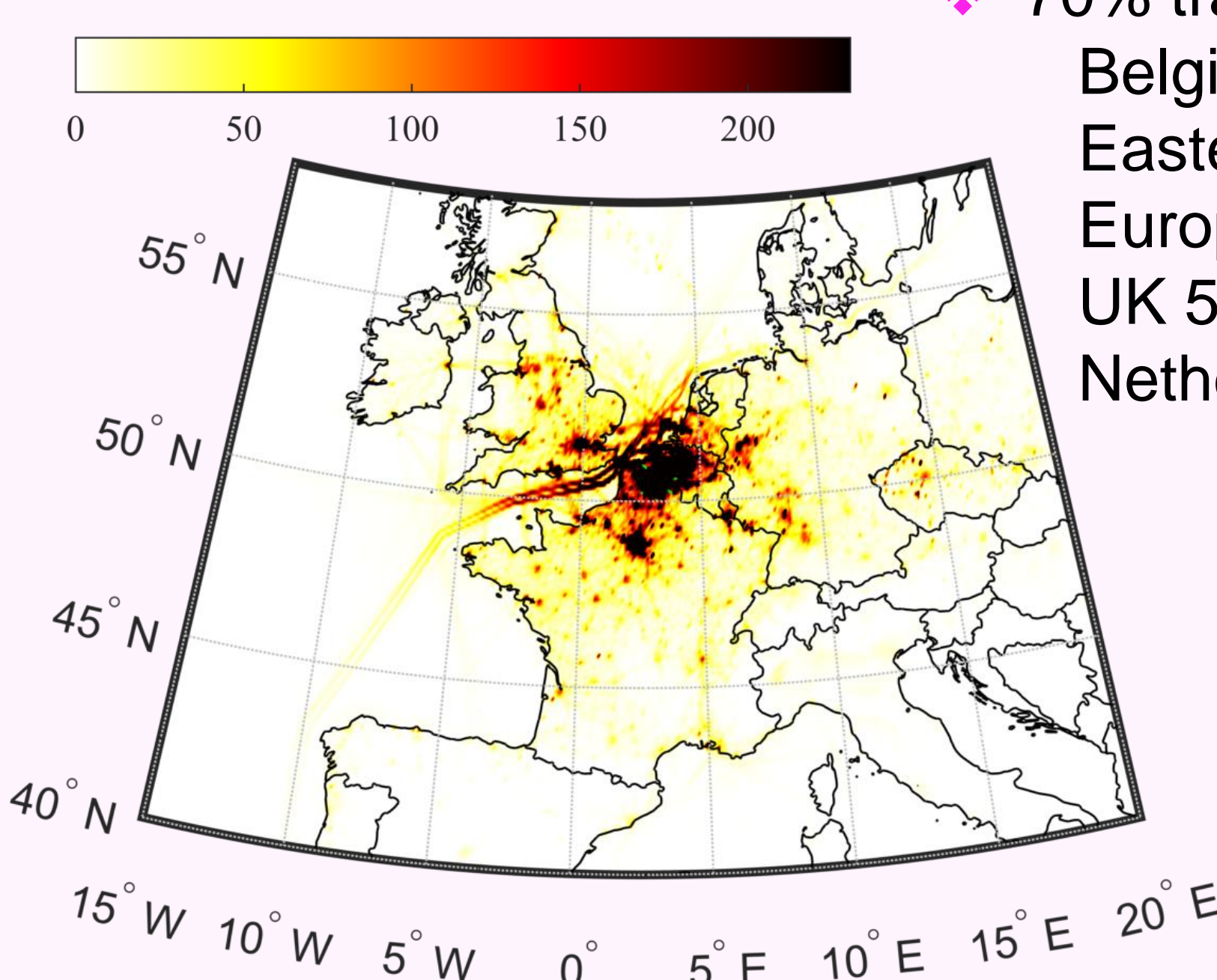
4. BC contribution

Sectors:

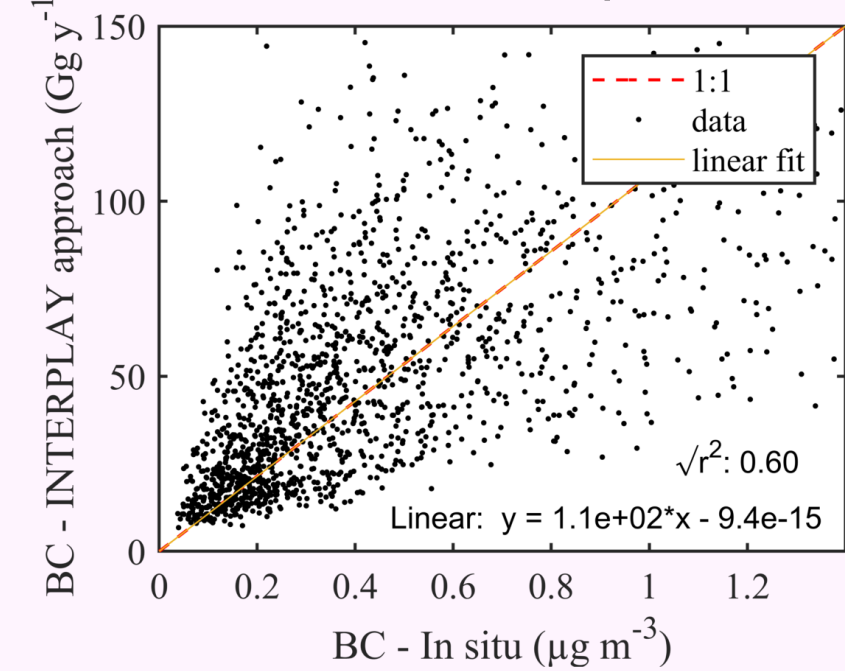


Spatial allocation:

Gg y⁻¹ per cell grid



- 7% Lille area
- 23% rest of country
- 70% transboundary
- Belgium 11%
- Shipping 29%
- Eastern of Europe 9%
- Rest of Europe 14%
- UK 5%
- Netherlands 2%
- BC – INTERPLAY vs BC – In situ (√r²: 0.60)



8. References

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