Equivalent BC properties during the COVID-19 spring 2020 lockdown period in Brussels, Belgium, compared to non-lockdown periods

A. Mangold, K. De Causmaecker, Q. Laffineur,
G. Joge Ngale, N. Mattielli and A. Delcloo

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Ultrafine Particles Air Quality & Climate 5 July 2022

Outline

- ultra-fine particles in urban atmosphere important for air quality
- relevant part of UFP are light-absorbing particles
- important sources in cities and residential areas are traffic emissions, domestic heating
- relative contributions need to be known in order to be able to apply effective reduction measures
- Covid-19 lockdown / imposed experiment / effect on air quality important to know
- meteorology important factor

Aethalometer
Magee Sci AE31

→ **aerosol light absorption** coefficient
→ **mass concentration of light-absorbing aerosol**
→ **7 wavelengths** UV-A to near–IR

wavelength dependency
→ **information on aerosol type**
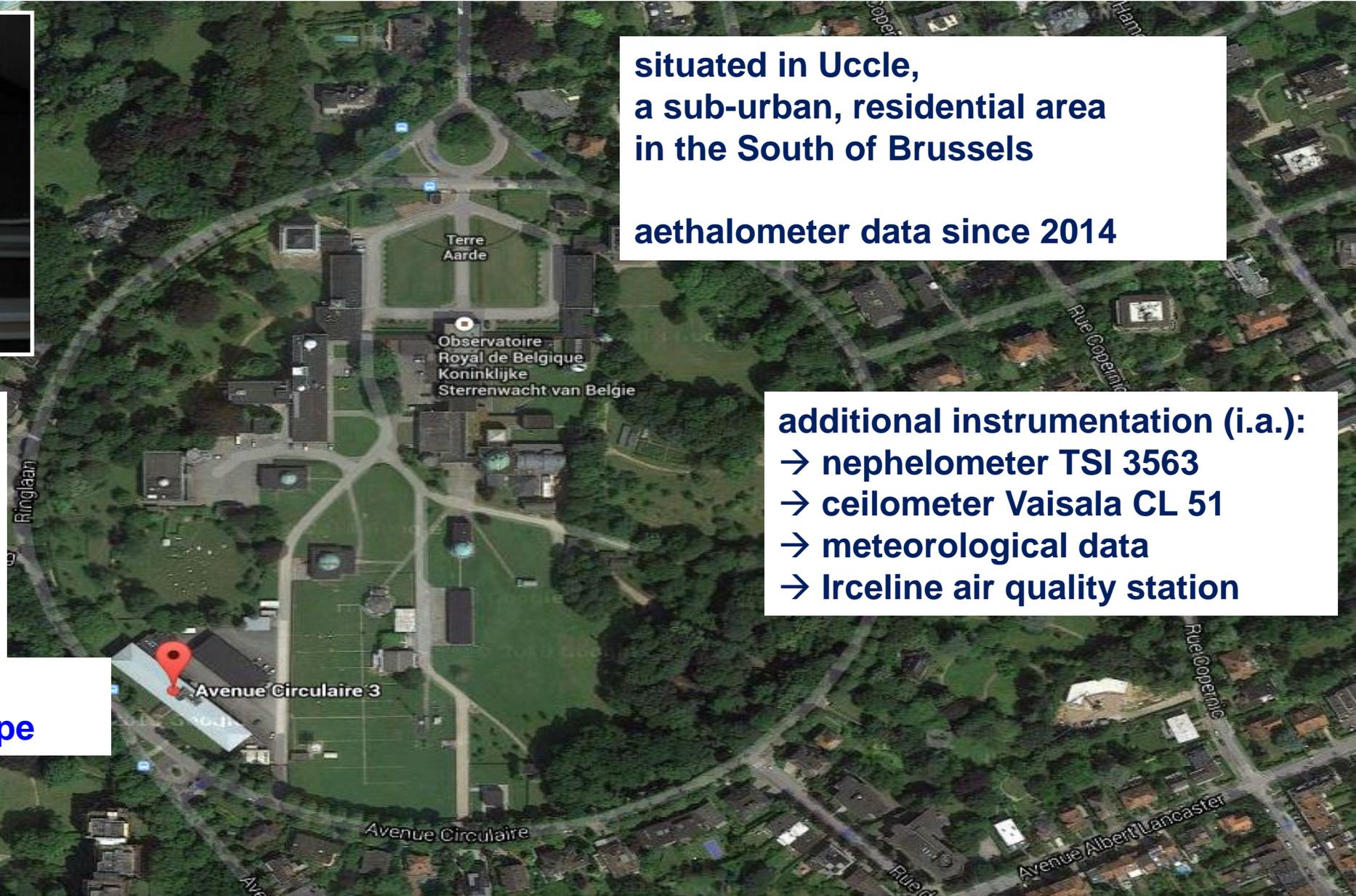
situated in Uccle,
a sub-urban, residential area
in the South of Brussels

aethalometer data since 2014

additional instrumentation (i.a.):
→ nephelometer TSI 3563
→ ceilometer Vaisala CL 51
→ meteorological data
→ Irceline air quality station

studies on Lockdown impact / examples

EFFECTEN VAN
COVID-19 MAATREGELEN OP DE
LUCHTKWALITEIT IN VLAANDEREN

VLAAMSE
MILIEUMAATSCHAPPIJ   www.vmm.be

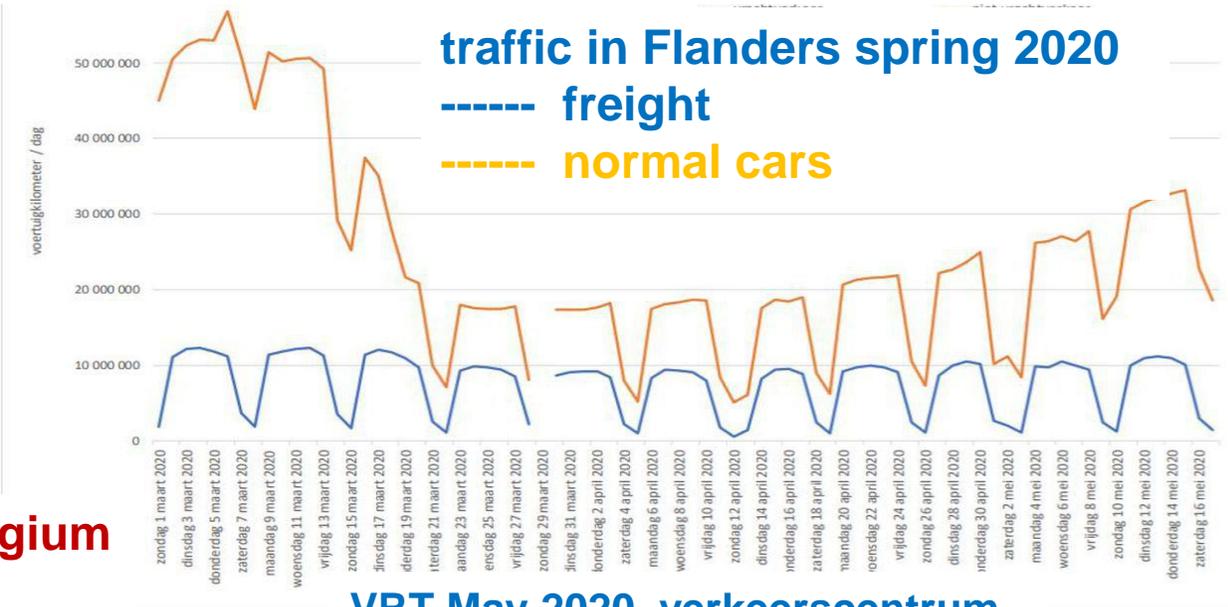**Vlaamse Milieumaatschappij June 2020**

irCELine
Informing you on ambient air quality
in the Belgian Regions

Effet des mesures prises dans le cadre de
la crise sanitaire COVID-19 sur la qualité
de l'air en Belgique :
Evaluation par modélisation « Random Forest »

Random Forest Modelling / Irceline July 2020

traffic in Flanders spring 2020
------ **freight**
------ **normal cars**

lockdown period Belgium
18 March – 04 May

VRT May 2020, verkeerscentrum

Science of the Total Environment 741 (2020) 140426

Contents lists available at ScienceDirect

Science of the Total Environment

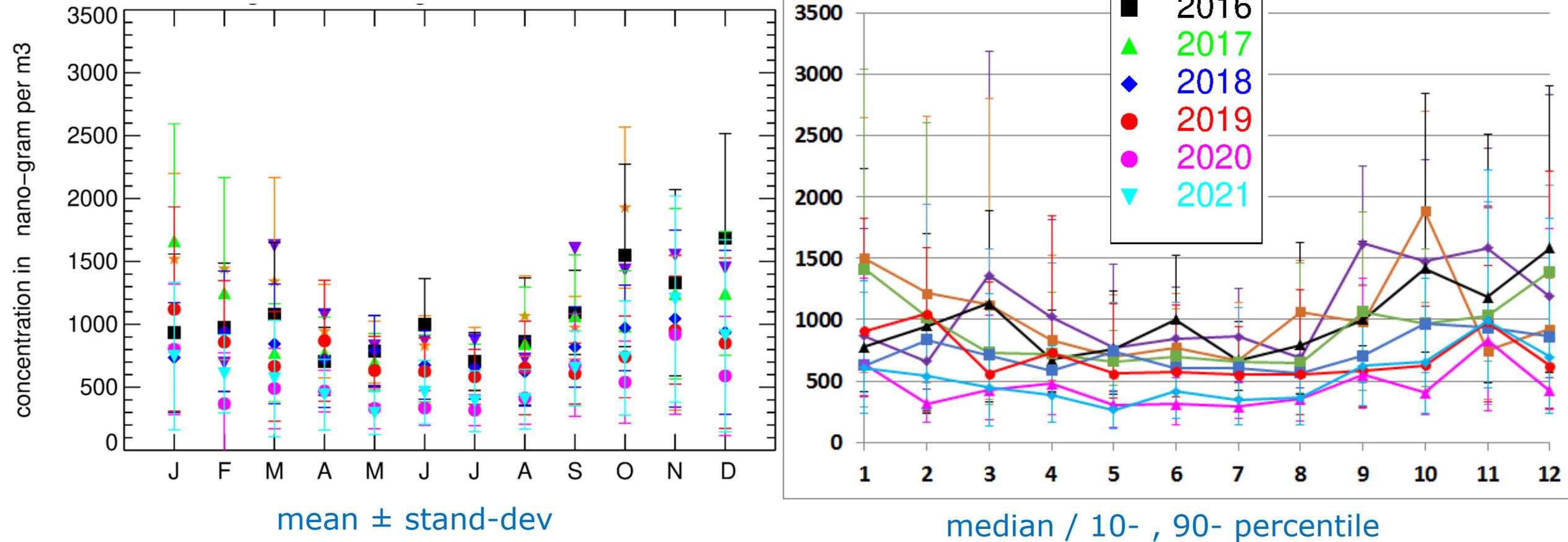ELSEVIER   journal homepage: www.elsevier.com/locate/scitotenv

Chemical Transport Modelling

Impact of lockdown measures to combat Covid-19 on air quality over
western Europe

Laurent Menut [a,*], Bertrand Bessagnet [a,b], Guillaume Siour [c], Sylvain Mailler [a],
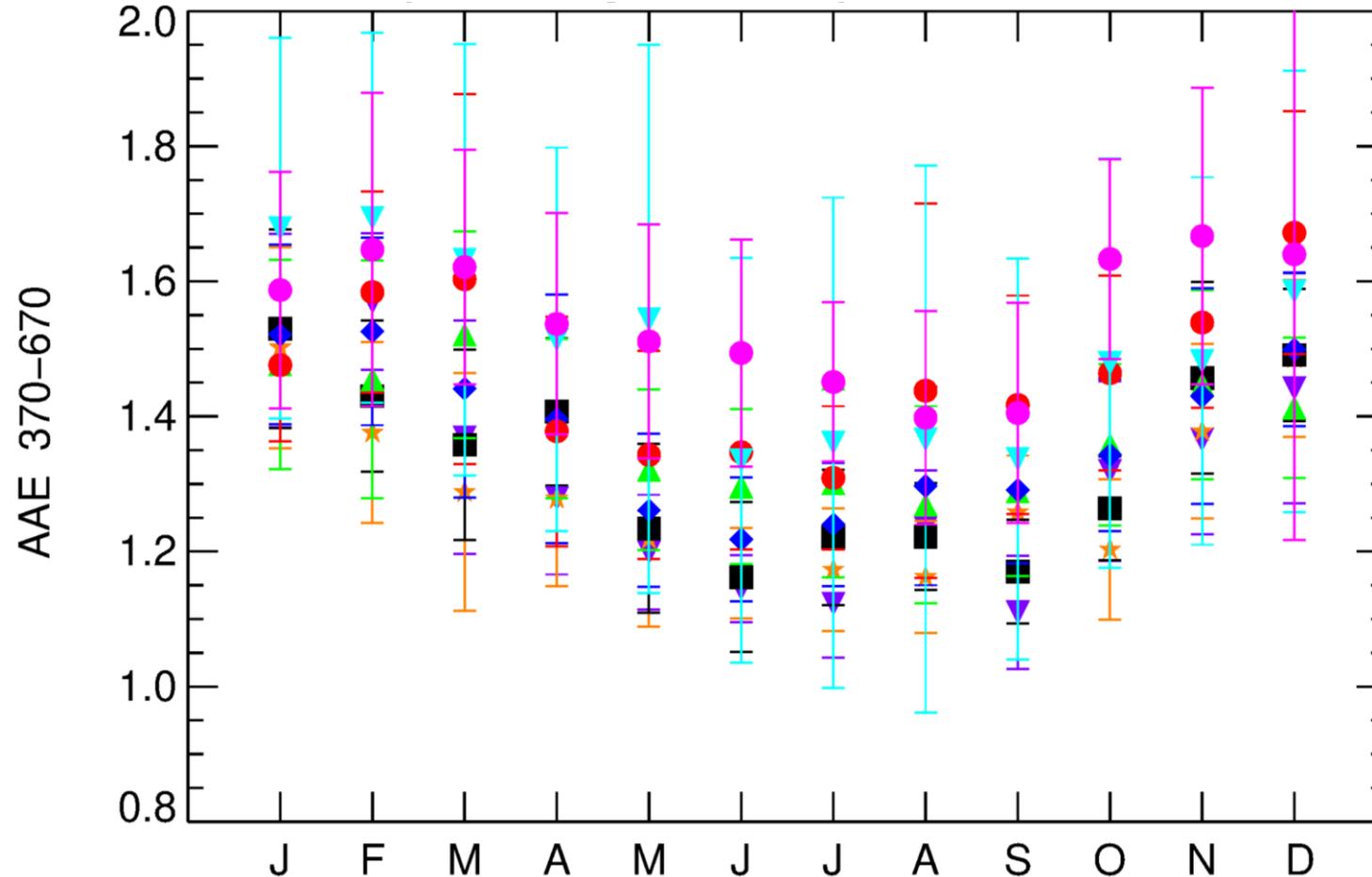Romain Pennel [a], Arineh Cholakian [a]

eq-BC @ 660 nm / ngm^{-3}

mean ± stand-dev

median / 10- , 90- percentile

Absorption Angstrom Exponent calculated between wavelengths 370 and 660 nm
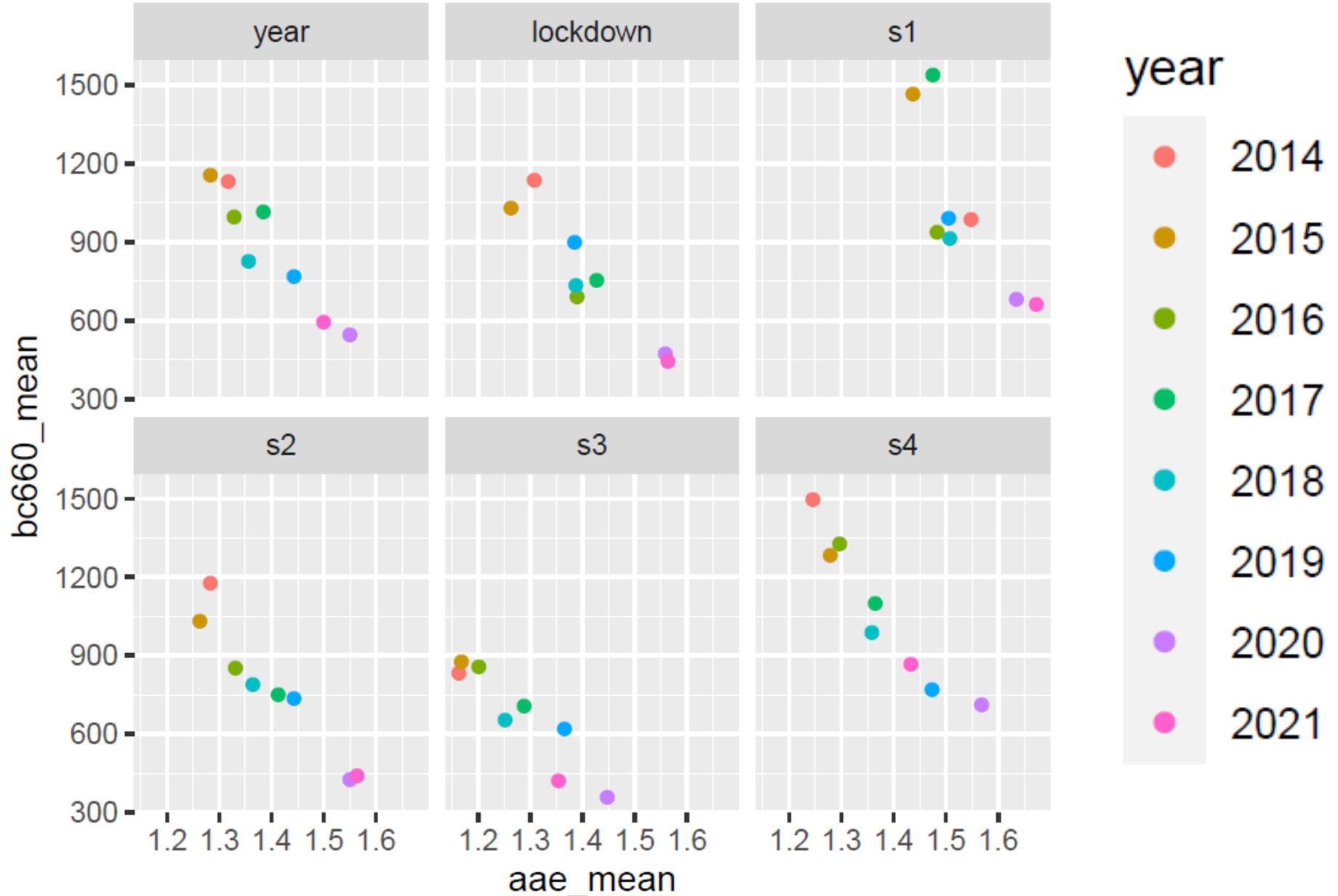

AAE = exponential behaviour of absorption between two wavelengths
AAE near 1 marks fresh combustion (traffic) soot
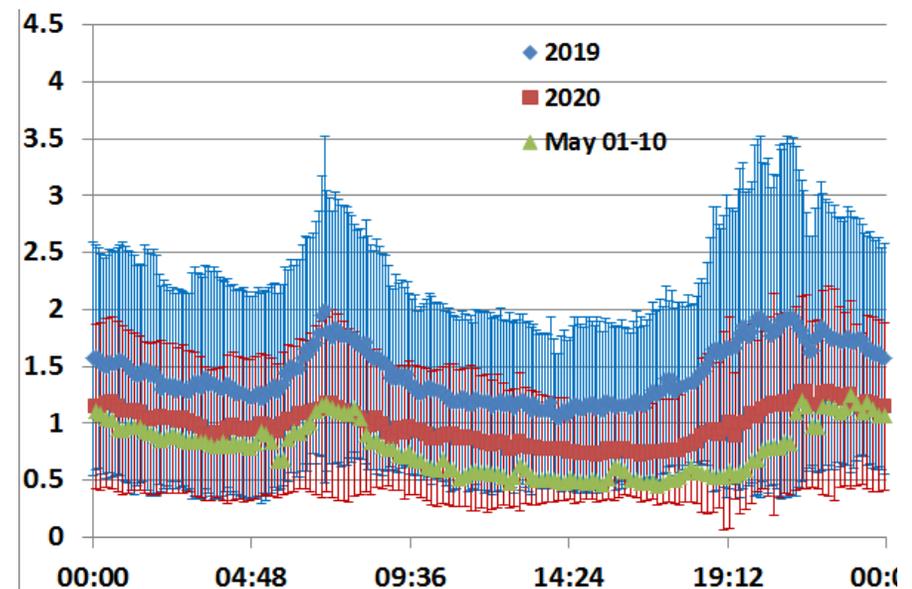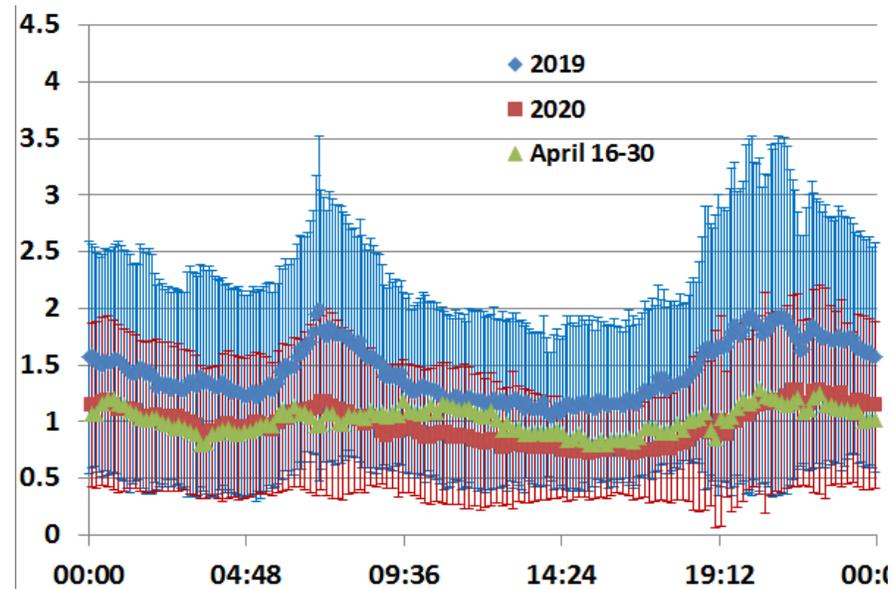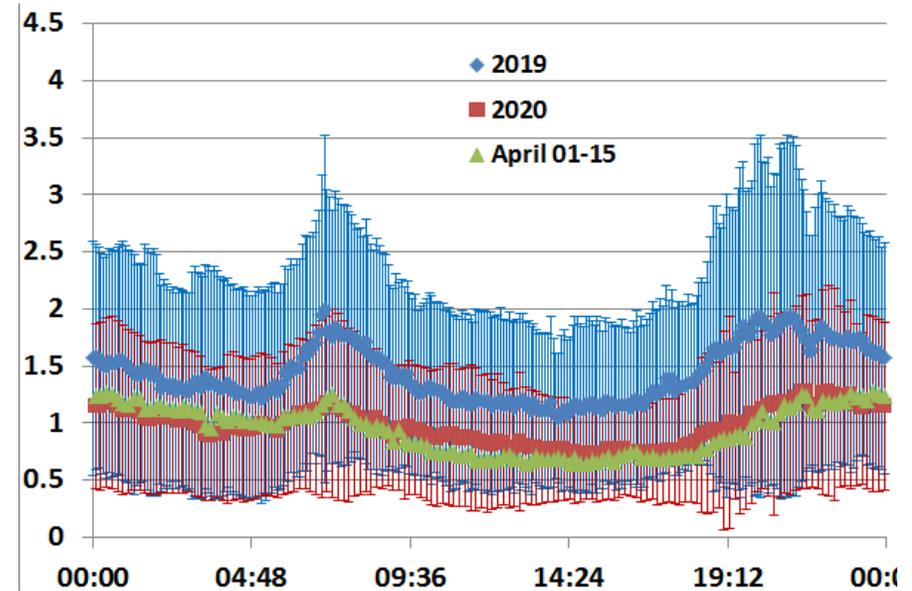**higher AAE → other sources like biomass burning, domestic heating more important**

s1 – winter
s2 – spring
s3 – summer
s4 – autumn

average values absorption coefficient (Mm^{-1}) lockdown period
for 2019
for 2020
2-week periods 2020
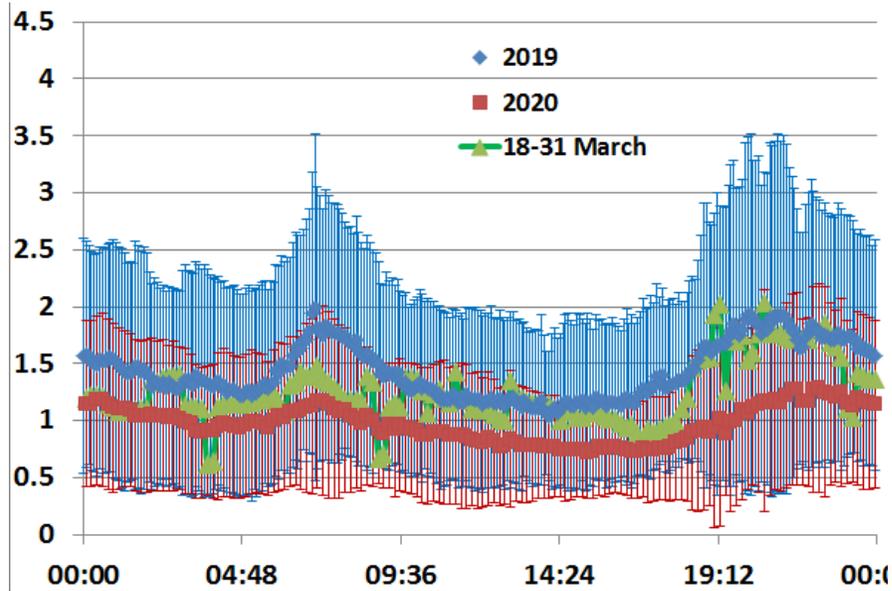
Interpretation

- all four periods show distinctly lower values than 2019 and 2014-18 period

- 2nd half of March 2020 highest values – relatively cold, stable conditions during night and morning

- morning 'rush-hour' peak visible in three of the four periods
  (stable conditions during morning; still traffic, in particular freight)

- lowest values in 1st half of April (incl Easter) and 1st half of May (incl long weekend over 1 May)

→ **clearly lower absorption coefficient during Covid-lockdown compared to former years**

Dispersion model:

Lagrangian particle transport model FLEXPART 9.02 in backward mode
period: 01-Dec-2013 to 30-Nov-2021; 3-hourly

Meteo data input:

3-hourly data with 0.5° grid resolution from ECMWF ERA-5

output:

potential source regions or 'residence time'; relates to the chance that air arrived at sample site
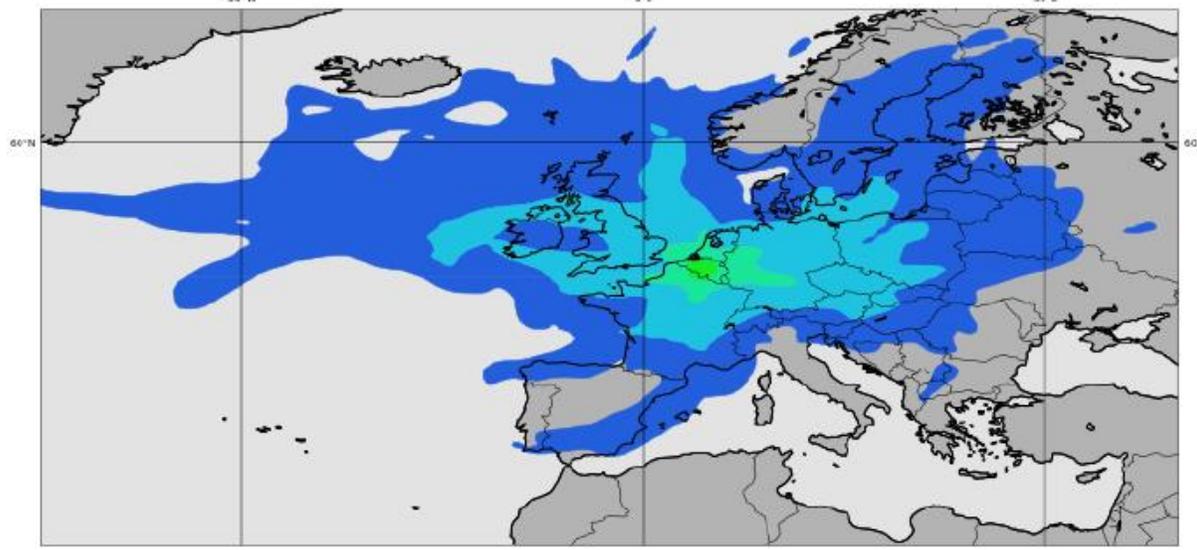at a given day passed over that region

grouped according to

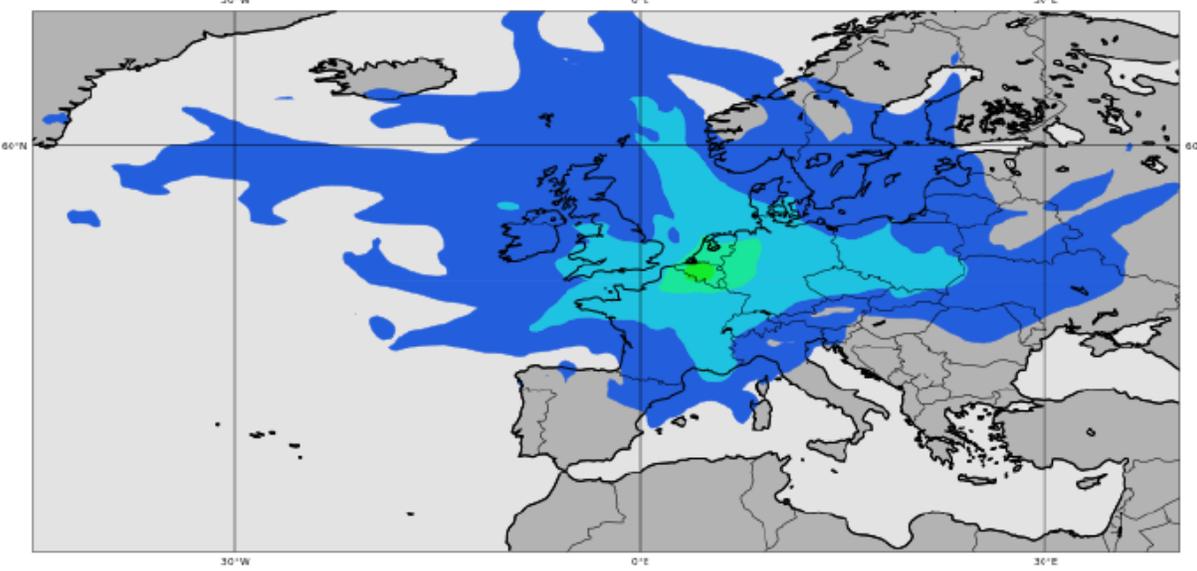year / season / vertical level / lockdown period / 'local radius' around sample site (50 km)

vertical levels (m agl):

l1 = 0 – 100   / l2 = 100 – 200   / l3 = 200 – 500   / l4 = 500 – 1000 / l5 = 1000 – 2000
l6 = 2000 – 5000

2019
vertical level
0-100 m agl

windroses 10 m
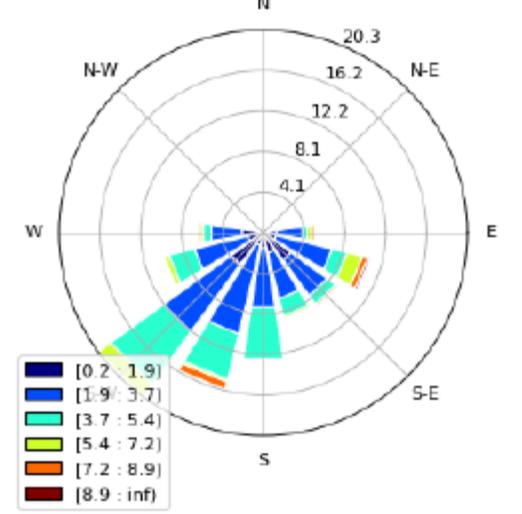
2020
vertical level
0-100 m agl
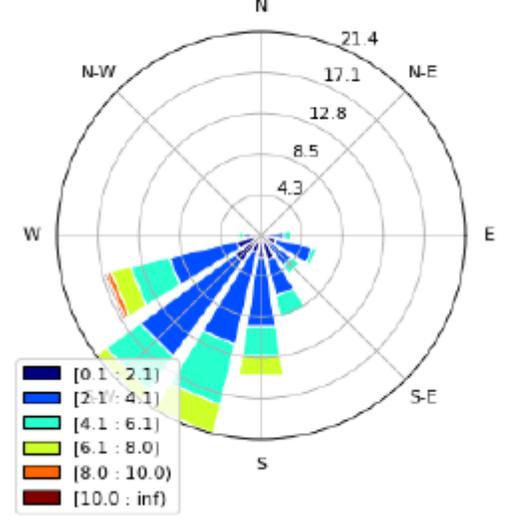
deviation from the average lockdown period

per layer !
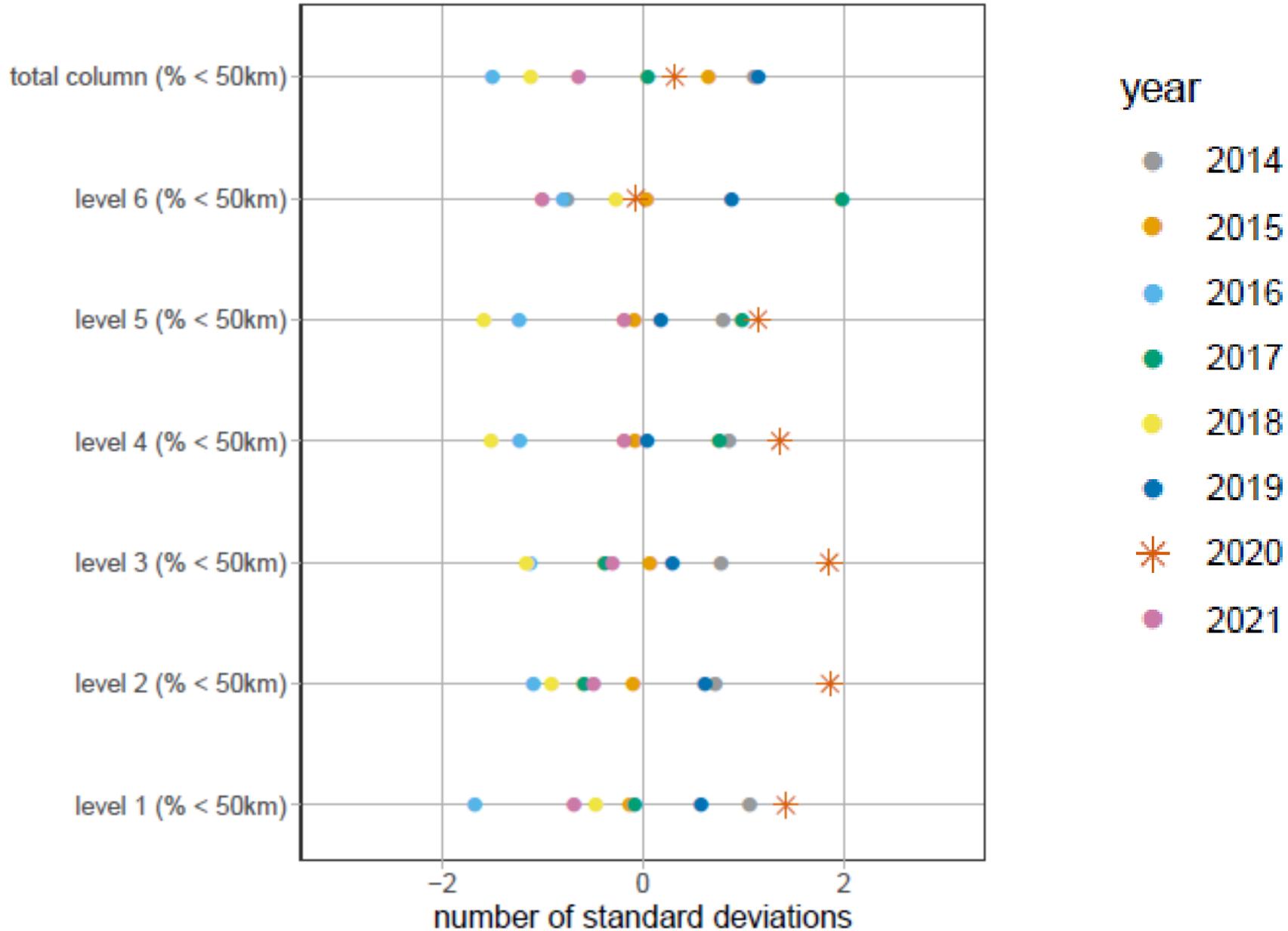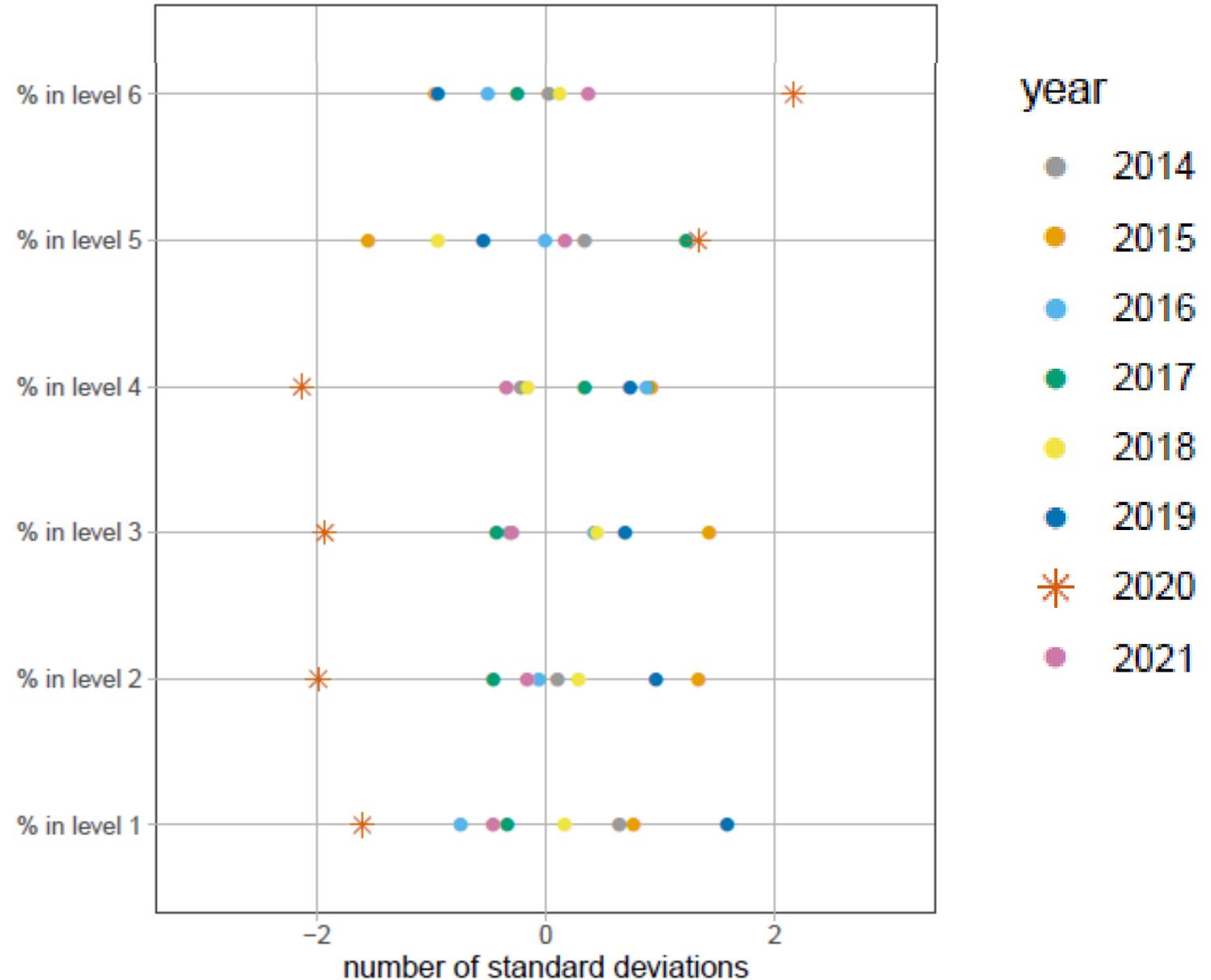
deviation from the average lockdown period

deviation from the average lockdown period

from RMI-Climato-Dep: less precipitation longer sunshine duration

SUMMARY
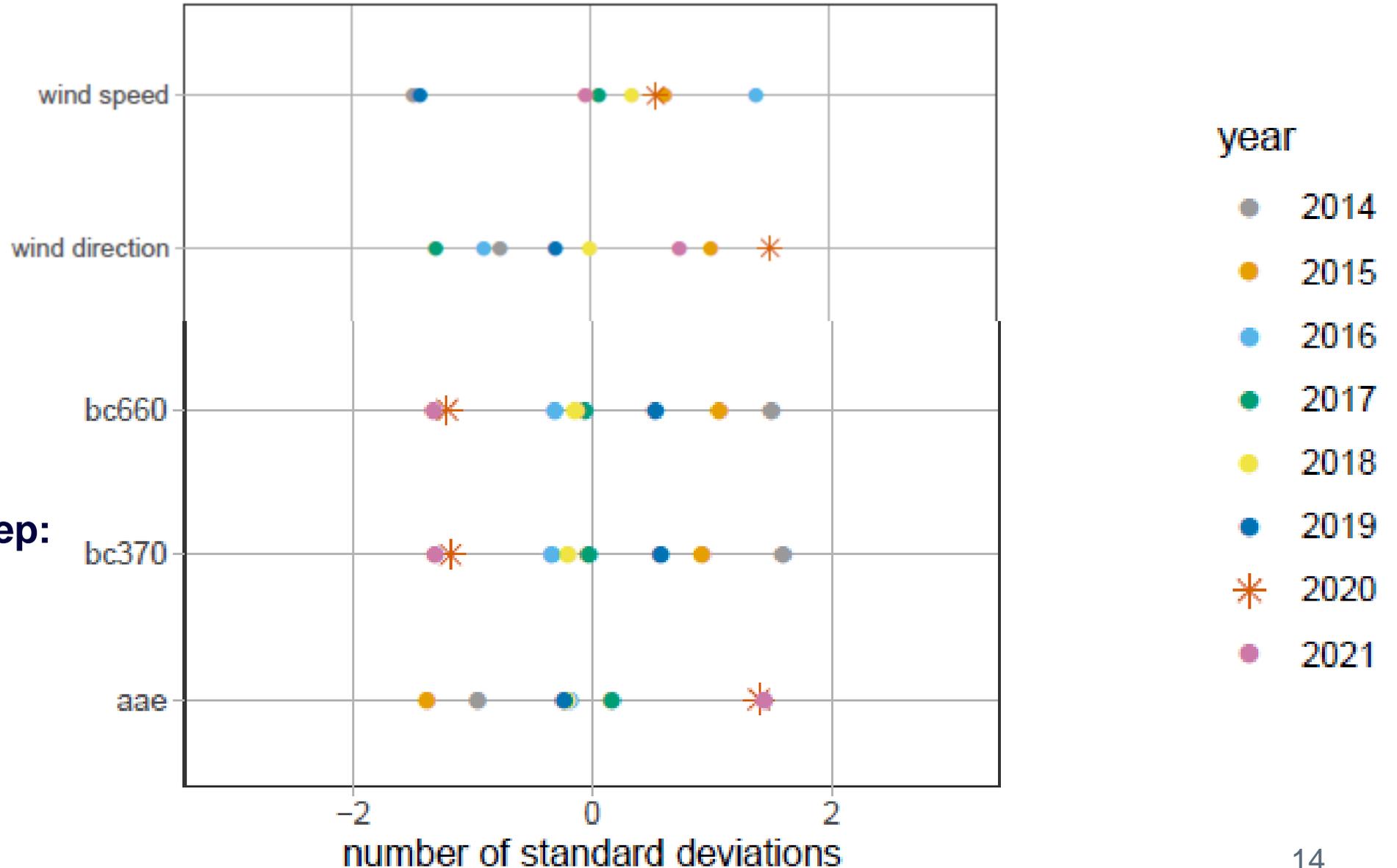
In general, period 2014 – 2021:
- **eq-BC mass concentration decreasing trend – yearly, seasonal**
- **Absorption Angstrom Exponent increasing trend – yearly, seasonal**

Lockdown-period:
- **absorption coefficient distinctly lower**
- **daily cycle of absorption coefficient distinctly less pronounced**
- **AAE distinctly higher values and daily cycle less pronounced**

→ **fresh combustion aerosol (~ traffic soot) decreases**
→ **absorbing aerosol from other sources (most probably heating) more relative weight**
but – 2021 similar values

Disentangling lockdown effect – meteorology
- **meteorology different during lockdown period 2020**
- **wind speed lower /   less precipitation / higher sunshine duration**
- **within lower vertical levels (0 – 1000 m) higher share of 'local' contribution**
- **but higher vertical levels (1000 – 5000 m) higher share of 'local'-total contribution**
→ **more locally and from higher up**
→ **meteo signal ambiguous – not only pointing to better/worse air quality conditions**

Thank you very much