

› SOURCE ATTRIBUTION OF BLACK CARBON FOR IMPROVED EMISSIONS AND MODELLING

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TNO innovation
for life

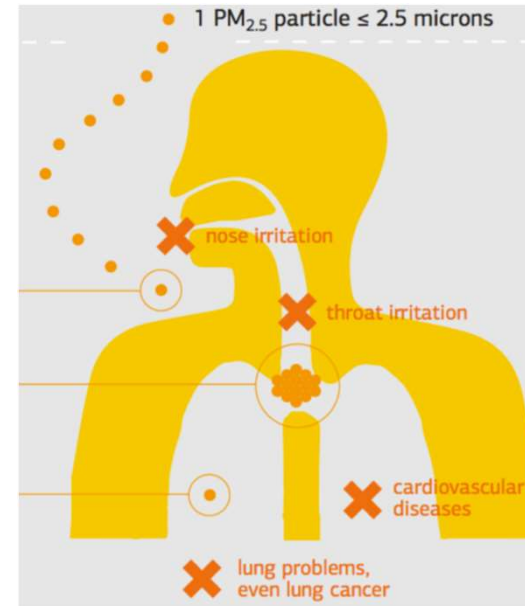
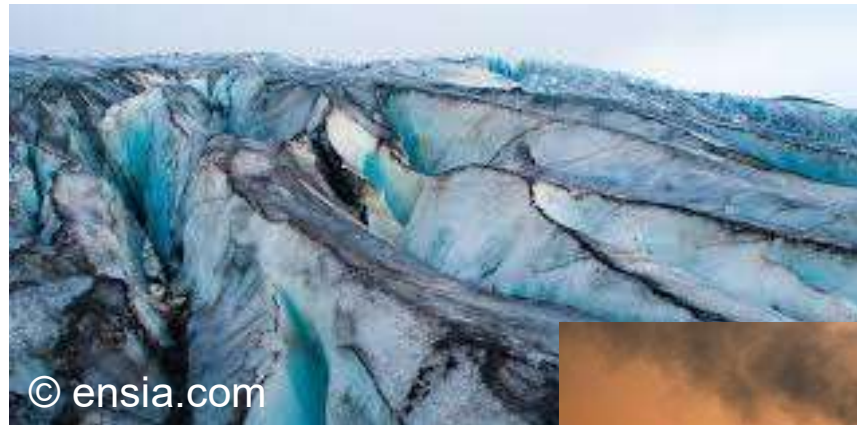


Umwelt 
Bundesamt

RATIONALE

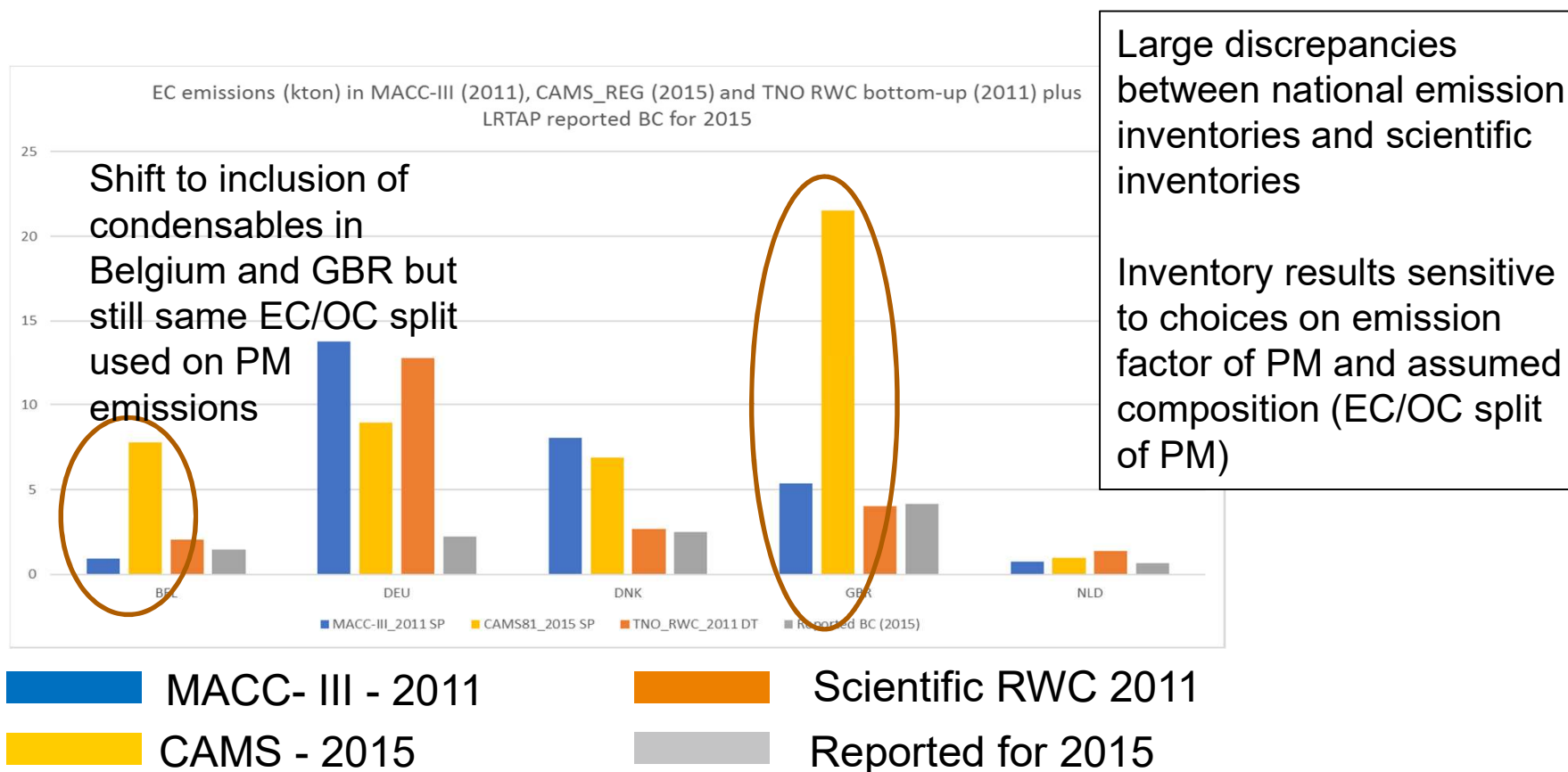
Black carbon contributes to global warming and has adverse health effects

- › reduction in BC gives a win-win
 - › priority substance in NEC Guideline (NEC2016/2284/EU)
- Need for accurate emission and concentration estimates

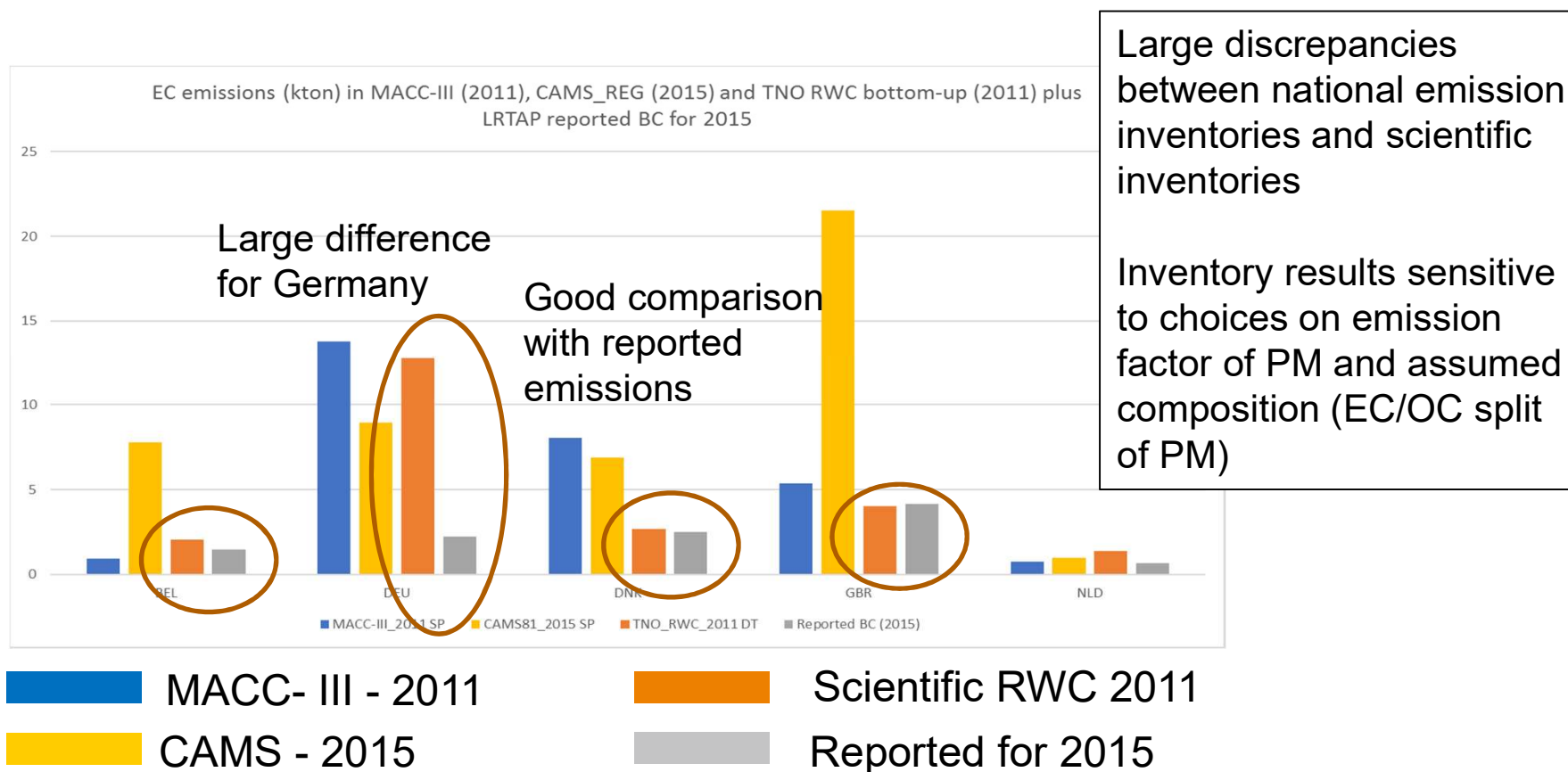


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BC EMISSIONS STILL VERY UNCERTAIN



BC EMISSIONS STILL VERY UNCERTAIN

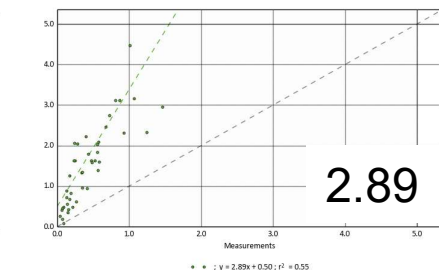
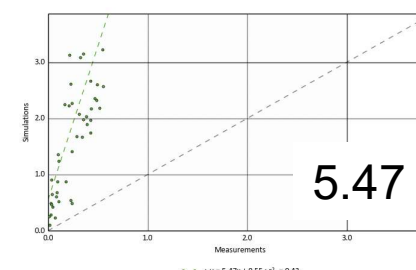
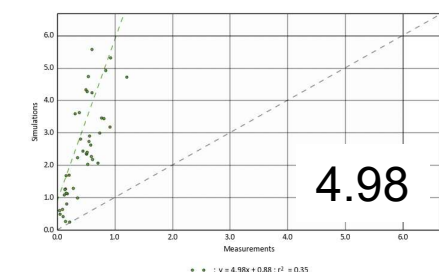
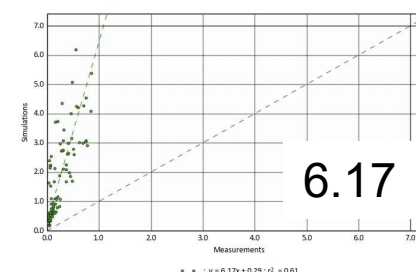
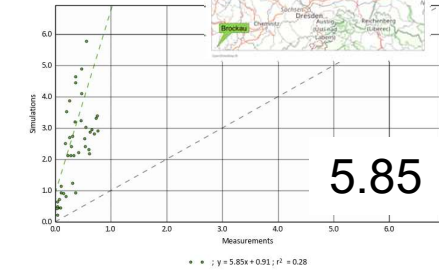
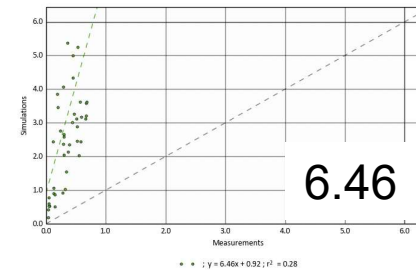
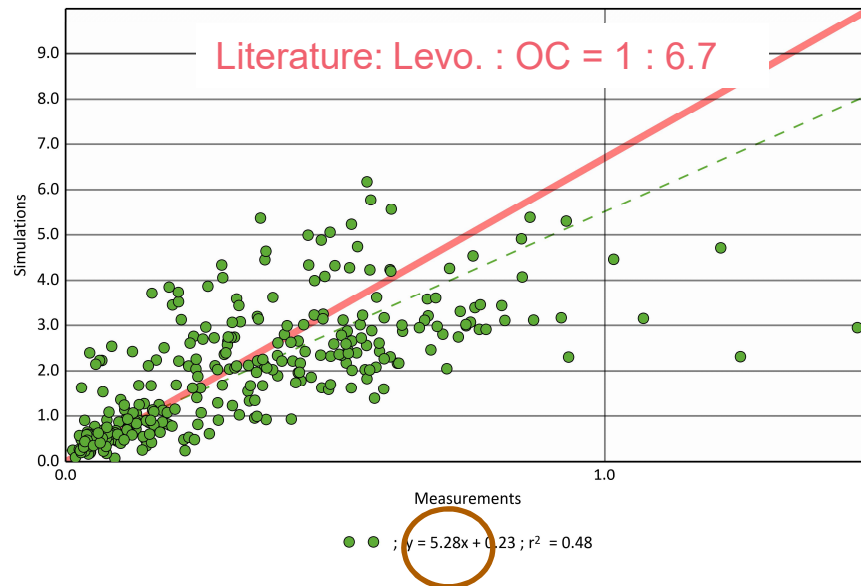


SPATIAL ATTRIBUTION UNCERTAIN

OC (co-emitted with EC) from residential wood combustion versus Levoglucosan = tracer for wood combustion



levoglucosan(measured) vs OC-Woodburning (modeled)



PROJECT ON IMPROVED BC EMISSIONS AND MODELLING FOR GERMANY

Umwelt
Bundesamt

The goal of the project is to derive optimized BC emission data

- with regard to area and sector
- through an iterative process in which modelled BC concentrations are contrasted to observations
- by tracing labelled emissions through the model

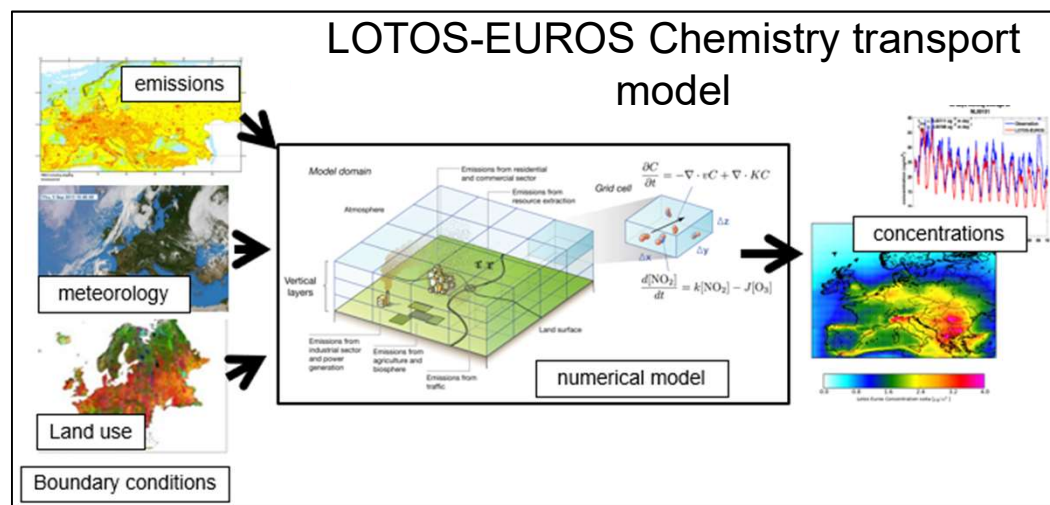
In addition to improved emissions, this will result in improved concentrations.



in cooperation with



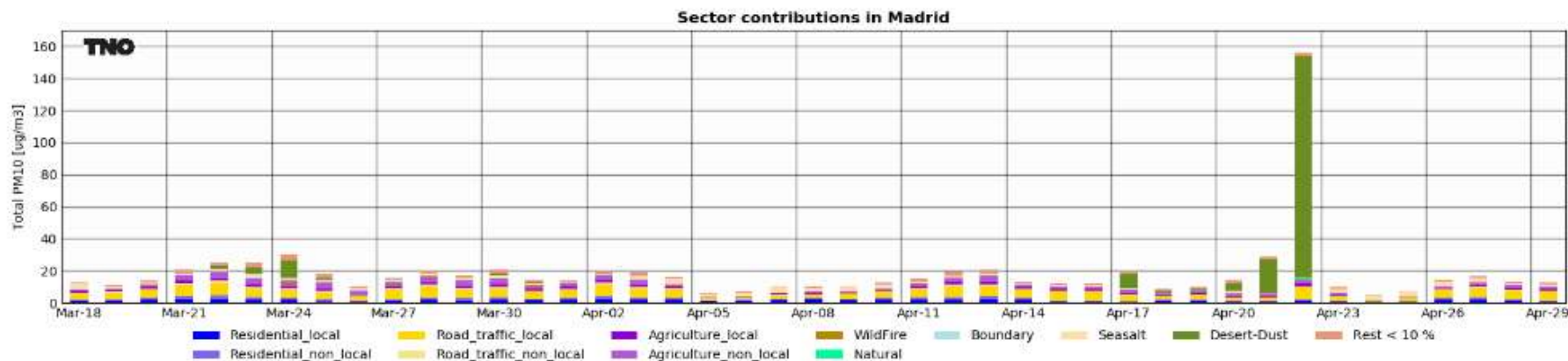
MODELLING APPROACH LOTOS-EUROS



Tagging source apportionment



- Labelling enables the production of scenarios in a very efficient way.
- <https://topas.tno.nl> for PM10 and PM2.5 (past 6 weeks)



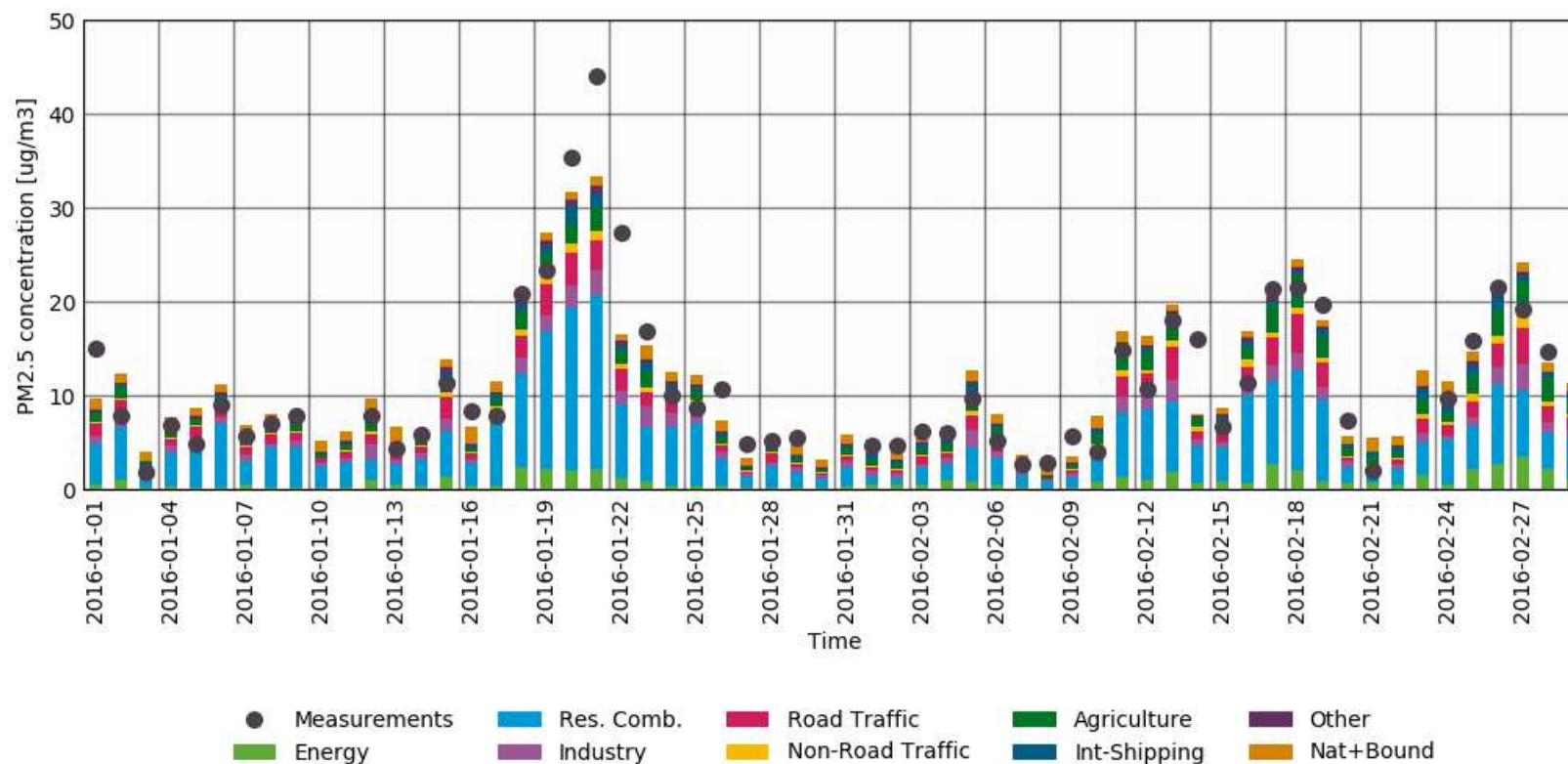
PM2.5/PM10

PM2.5 SOURCE SECTOR CONTRIBUTIONS

Source contribution at: Veldhoven-Europalaan, run domain: NL; tracer: PM2.5 [ug/m3]

Urban
background

Main sector contributions



Scientific RWC emissions



Comparison for PMF combustion biomass

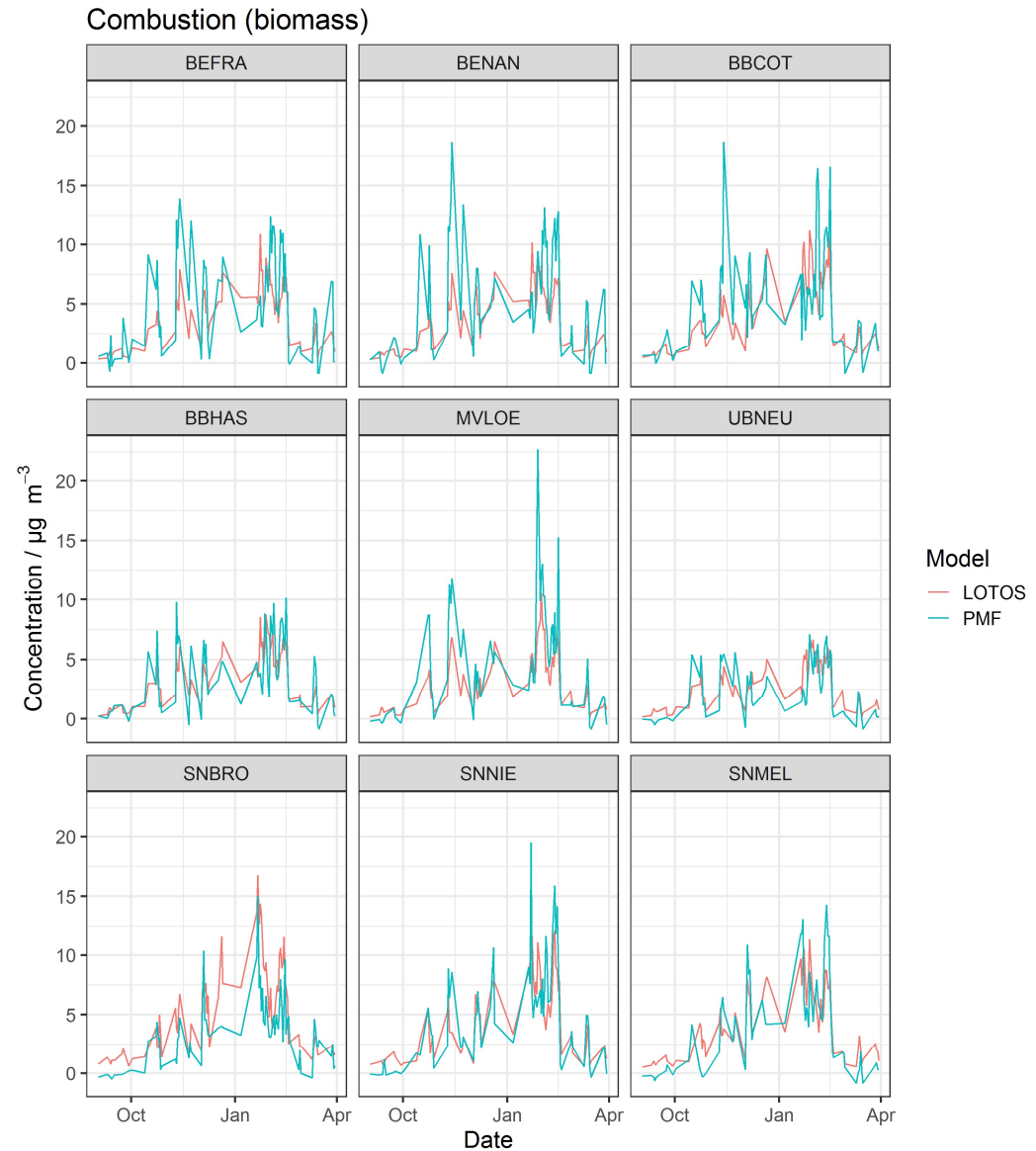
Model PM10 residential combustion biomass

versus

PMF PM10 contribution combustion biomass

Observations Sept '16 – Mar. 17
PMOst campaign Eastern
Germany

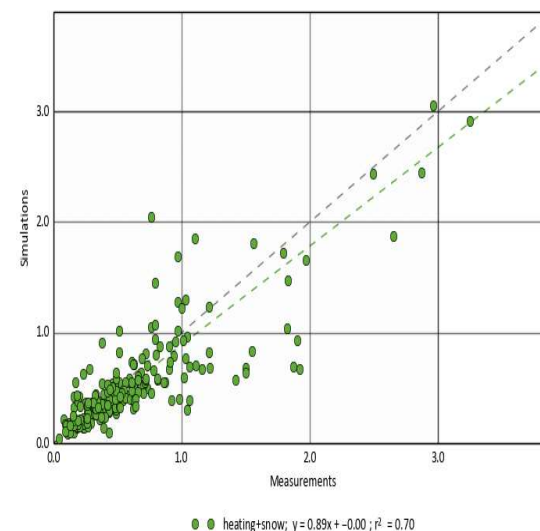
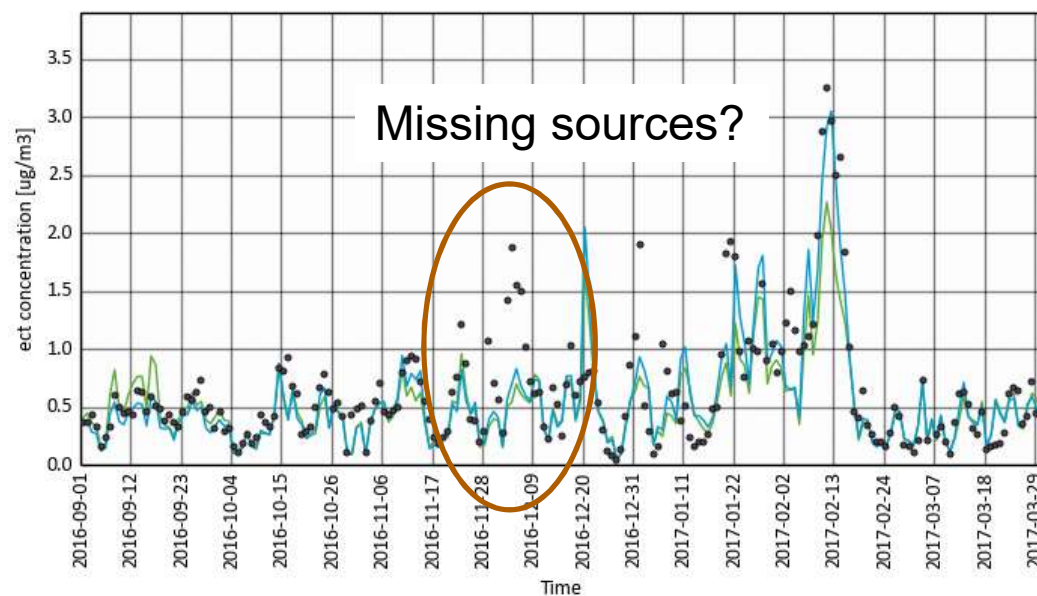
Scientific RWC emissions



BC

MODELLING PERFORMANCE –MELPITZ

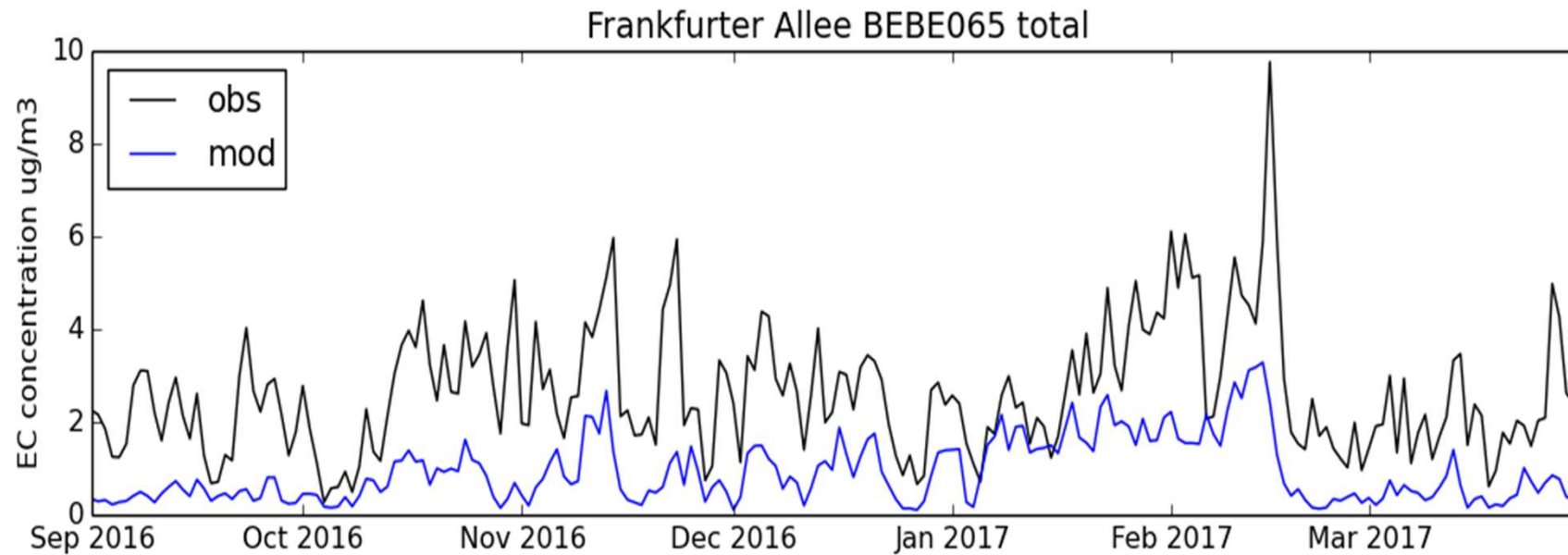
RURAL BACKGROUND STATION - FILTER



- Base run
- using actual temperature instead of standard temporal emission profiles for residential combustion

MODELLING PERFORMANCE – BERLIN

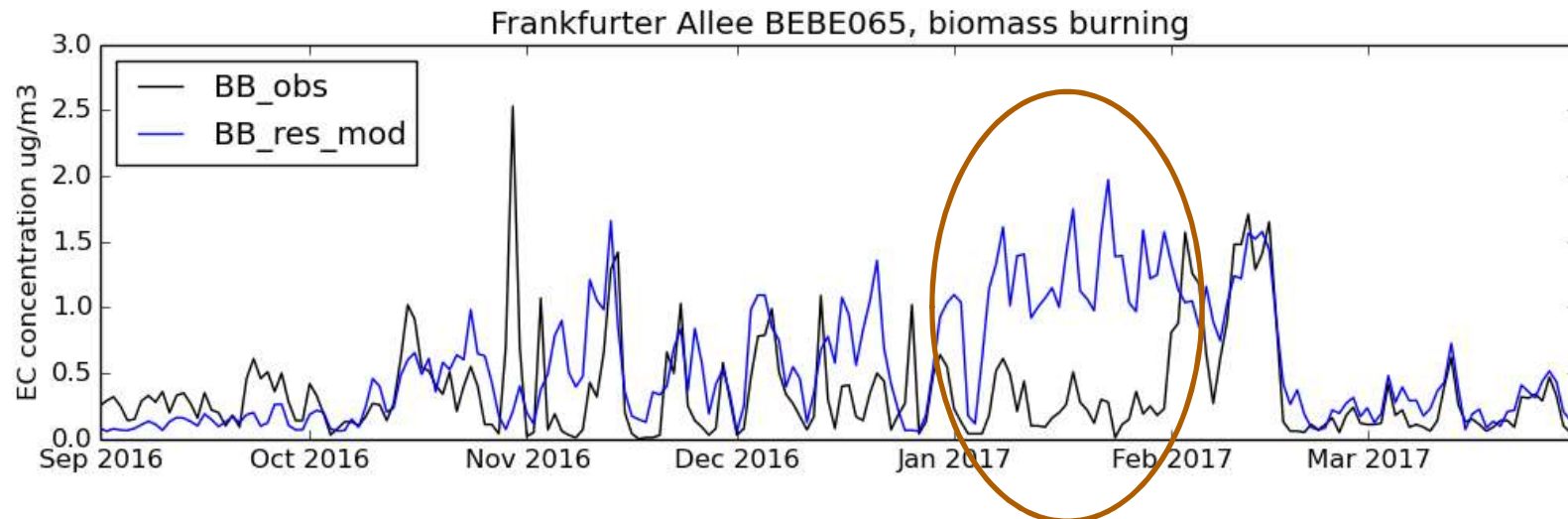
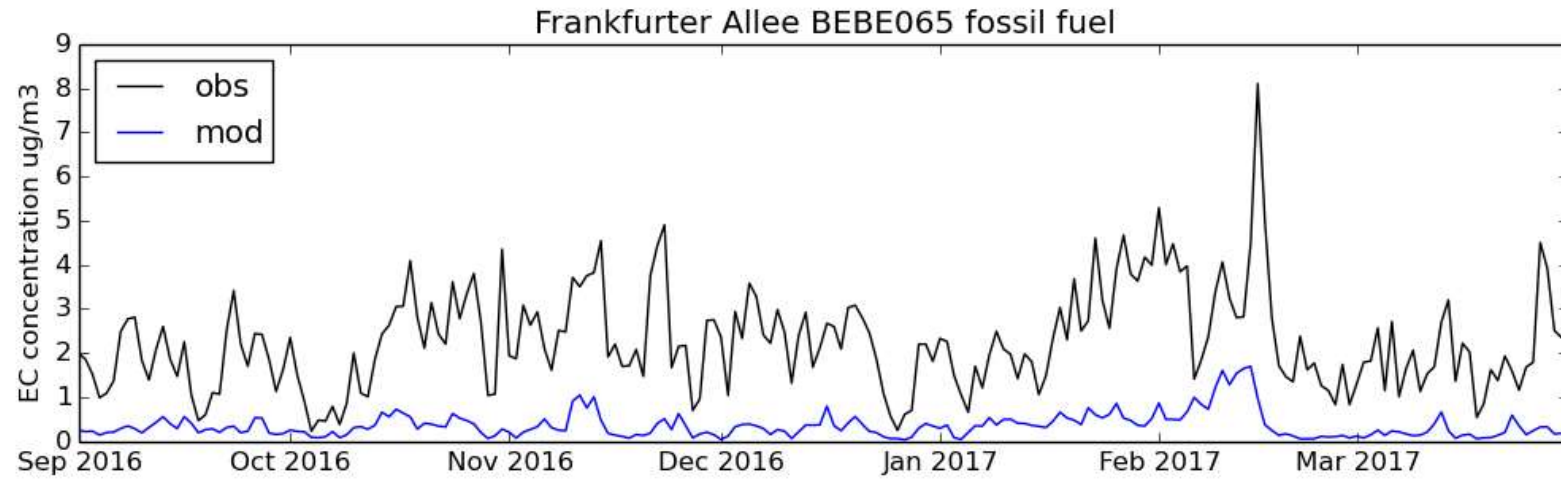
TRAFFIC STATION - AETHALOMETER



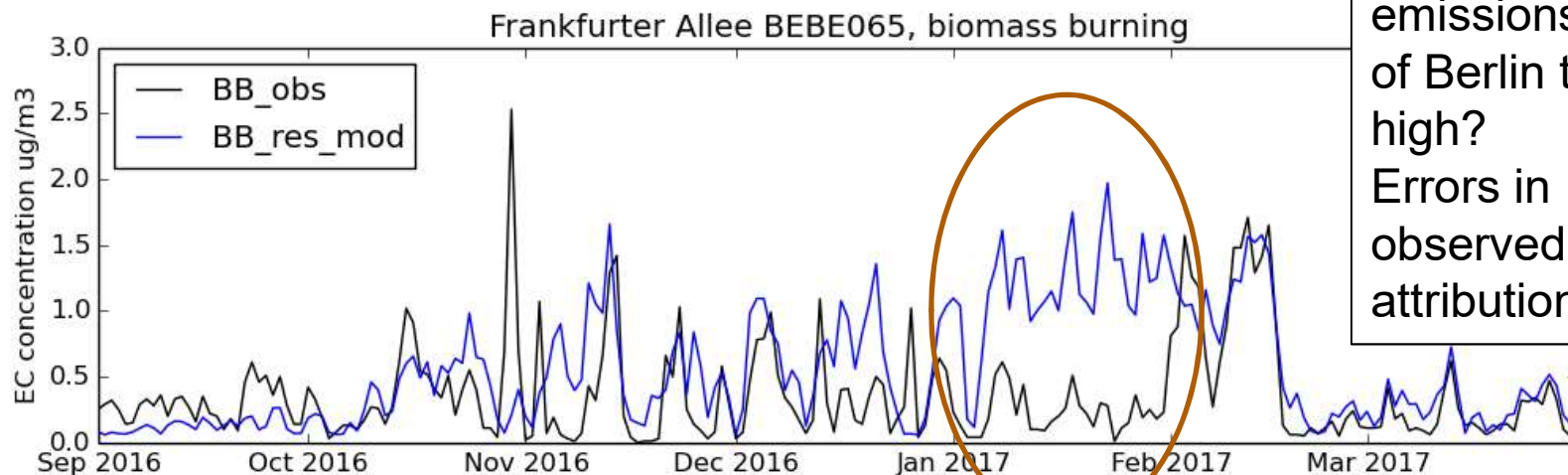
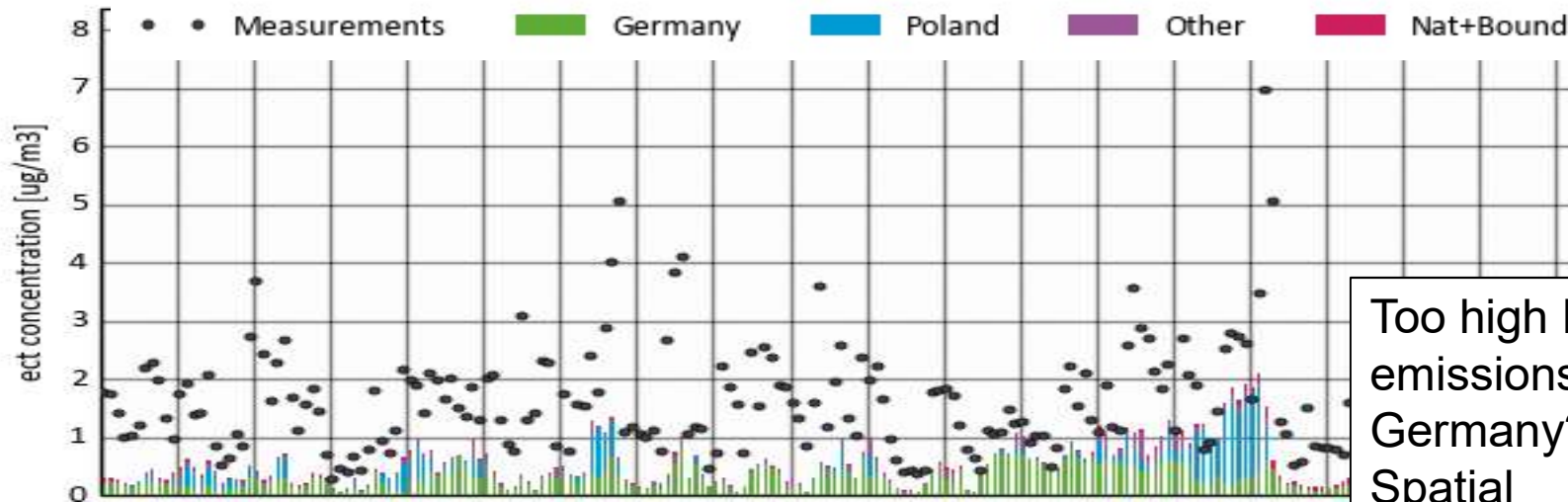
7 x 7 km resolution model run
Scientific RWC emissions

MODELLING PERFORMANCE – BERLIN

TRAFFIC STATION - AETHALOMETER



MODELLING PERFORMANCE – BERLIN

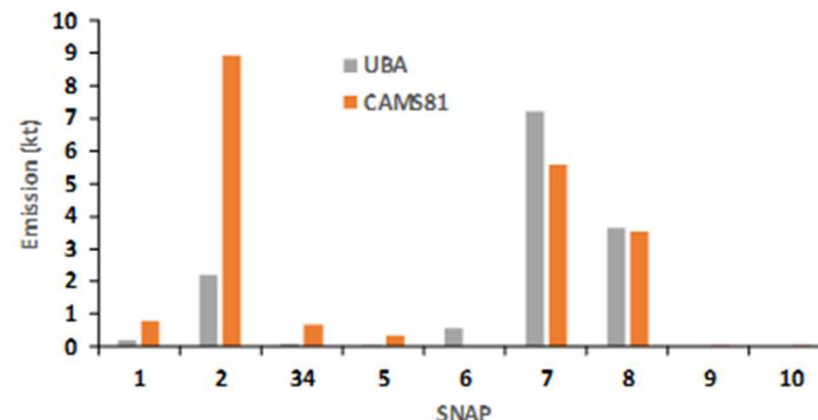


Too high RWC emissions in Germany?
 Spatial attribution of emissions to city of Berlin too high?
 Errors in observed attribution?

FIRST EMISSION UPDATE GERMANY

Baseline:

- › Officially reported BC emissions for Germany (GRETA gridding).
- › Scientific RWC emission database (Denier van der Gon 2015) for other countries, CAMS + bottom-up for residential wood combustion including condensables



Emission adjustments based on review of reported BC emissions for Germany.

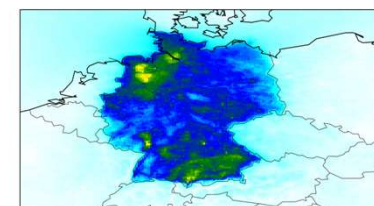
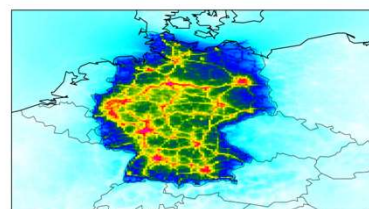
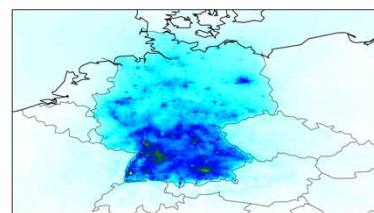
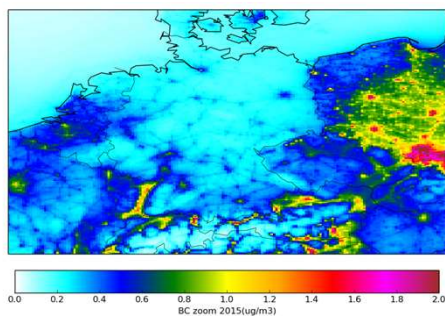
- › Increase in black carbon emission from residential wood combustion
 - ~30% increase in PM emission factor (GRETA assumes very modern stoves)
 - Threefold increase in black carbon fraction (more representative for modern stoves and only solid PM)
- › Reduction of black carbon emissions from tyre and brakewear (most tyre wear not optically active)

Total emissions have increased (not as high as scientific database, there is a clear shift in sector contribution)

IMPACT OF EMISSION ADJUSTMENT

Annual mean concentration and relative sector contributions

baseline

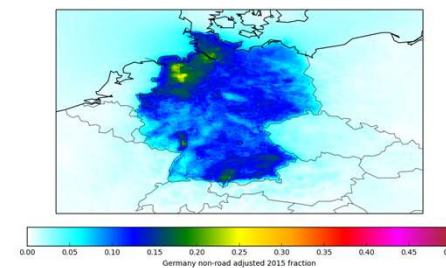
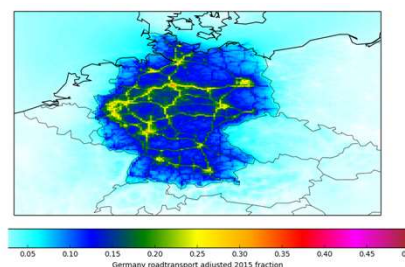
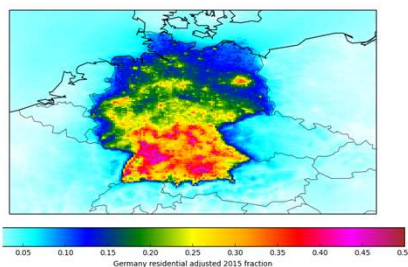
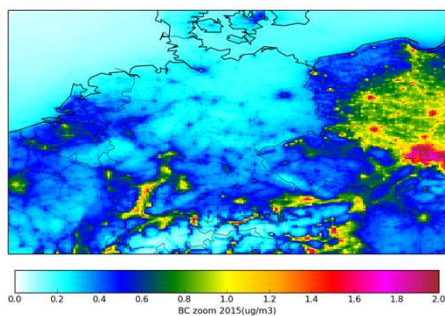


residential

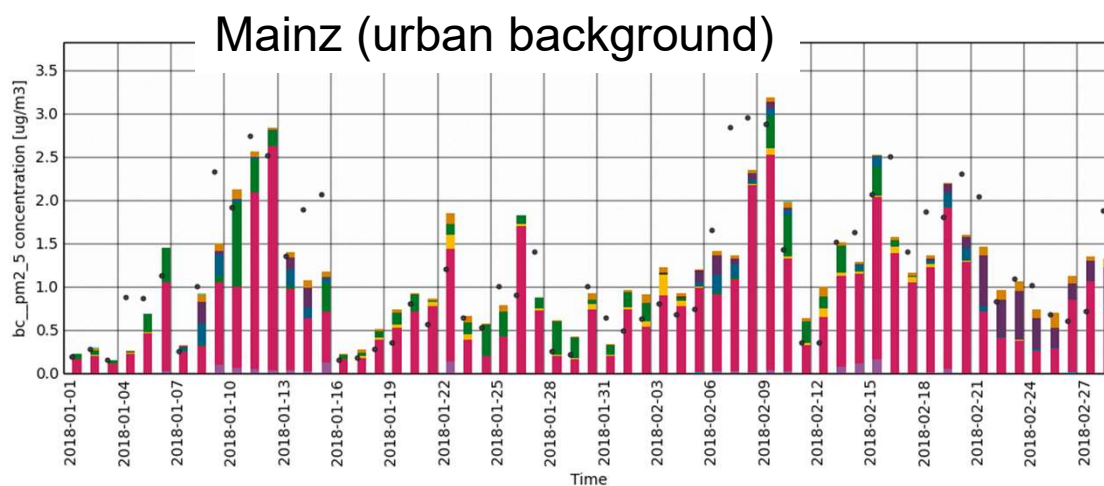
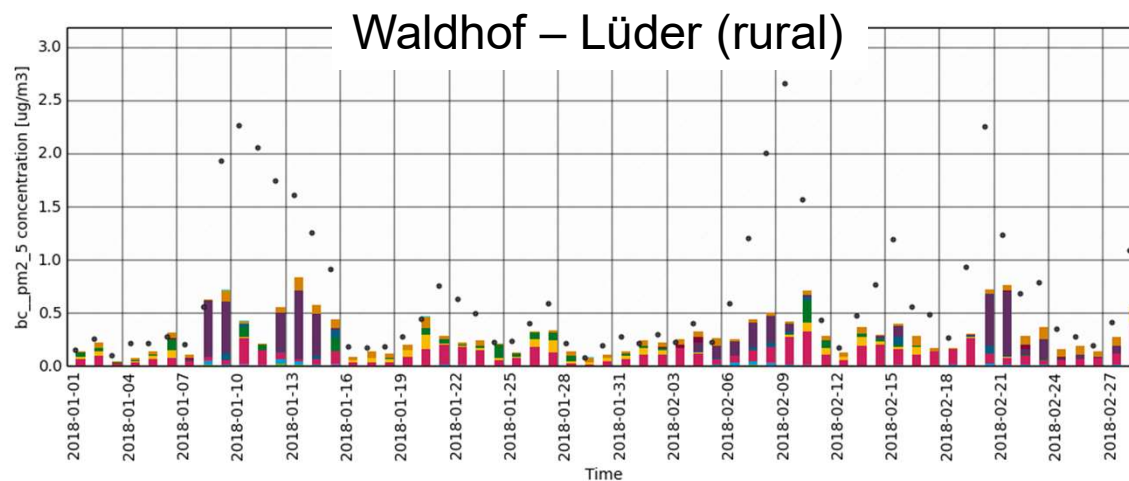
road-traffic

non-road transport

adjusted



VALIDATION WITH OBSERVATIONS



- Measurements
- Brandenburg
- Germany_oth
- France
- Poland
- Other
- Berlin
- Baden-Wuerttemberg
- Benelux
- AlpsCz
- Denmark
- Fire

CONCLUSION

- › LOTOS-EUROS model successfully used with labelling/tagging to calculate black carbon distributions and main contributors (sectors and regions)
- › Comparisons with observations with source attribution prove very valuable
- › Insight in model and emission accuracy and where improvements can be made

OUTLOOK

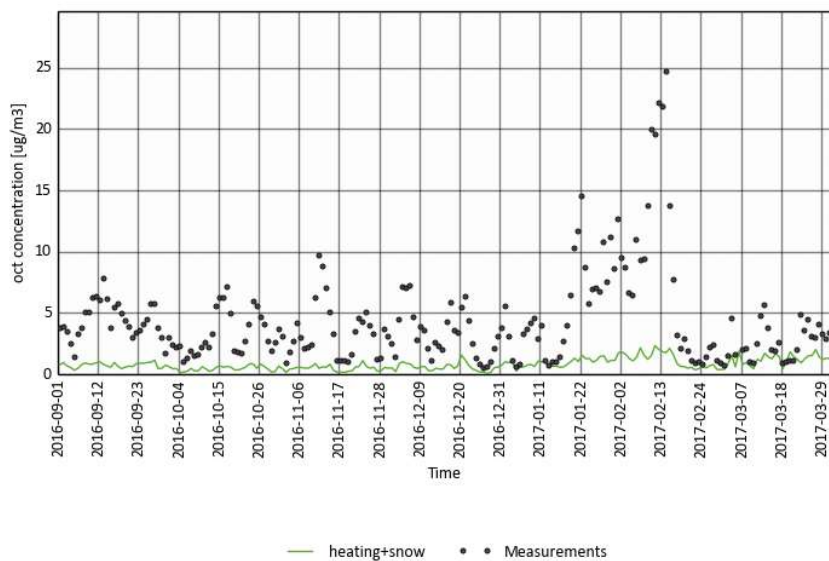
- › Look at seasonal and diurnal profiles of biases
- › Bias as function of meteorological conditions (temperature), sector and regional contributions
- › Comparison to source speciated aethalometer data at stations in Berlin
- › Comparison to source speciated observations from the 2017/2018 winter field campaign -- Eurodelta-Carb intercomparison exercise

EFFECT OF USING SCIENTIFIC RWC DATABASE INCL. CONDENSABLES

OC AT MELPITZ

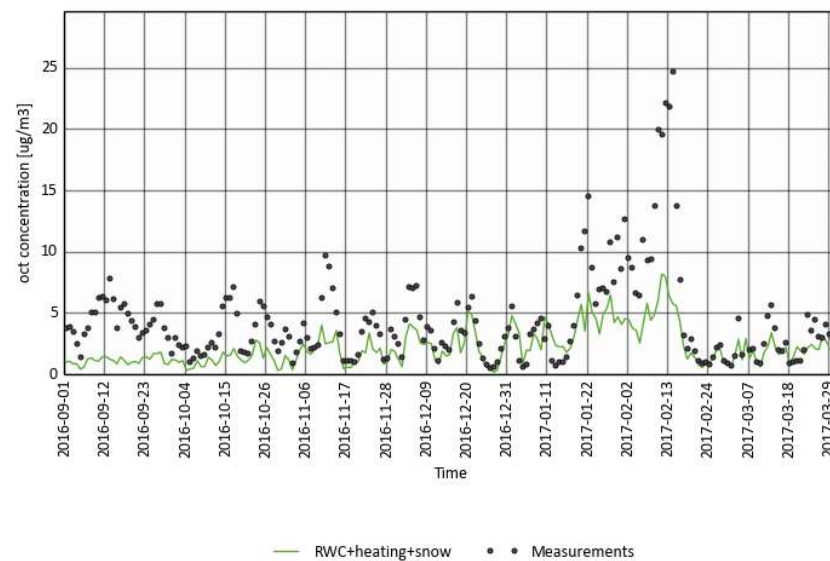
Model performance SNMEL; run domain: D2; tracer: oct [$\mu\text{g}/\text{m}^3$]

Daily measurements vs simulations



Model performance SNMEL; run domain: D2; tracer: oct [$\mu\text{g}/\text{m}^3$]

Daily measurements vs simulations



› **THANK YOU FOR YOUR ATTENTION**

Take a look:
TNO.NL/TNO-INSIGHTS

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