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SOURCE ATTRIBUTION OF PM FOR BERLIN USING LOTOS-EUROS

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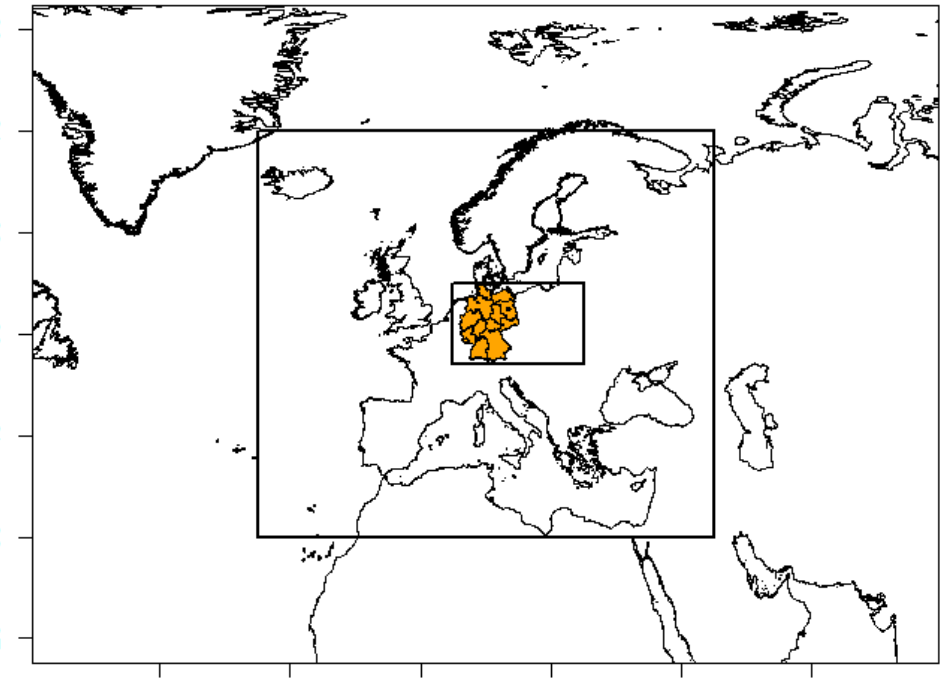
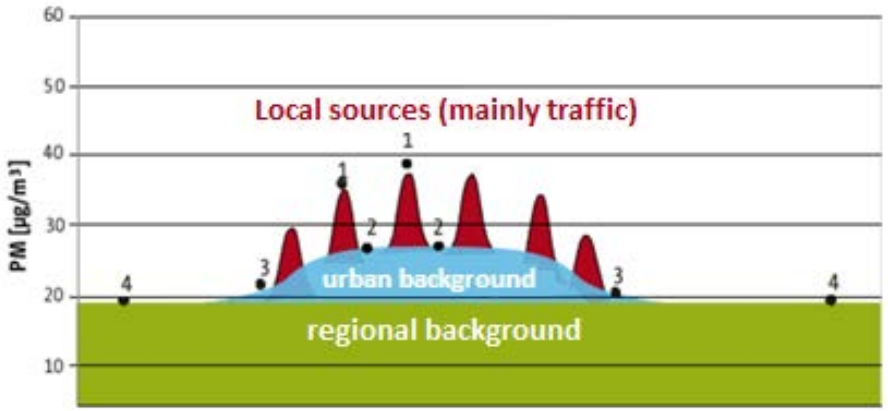
Tropospheric Environmental Research

Introduction

- Particulate Matter (PM) in 2018
  - Air Quality Plan for Berlin
    - ⇨ Strategy to avoid high PM10 concentrations (EU-Limits)
      - Goal: lowering the values
        - ⇨ What are the Origins?
      - Different contributions:
        - Local (Berlin/Brandenburg)
        - National (Germany)
        - Trans-Boundary
          - ⇨ Strategy to avoid Exceedances have to be developed with European Neighbours
  - To resolve the contributions:
    - Observations (Berlin/Brandenburg) for 2018
    - Chemistry-Transport Model for 2018
      - Labeling approach (track the emissions)



Urban Pollution Island



Borrowed on the Berlin Air Quality Plan 2011

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What are the Origins of observed PM in Berlin?

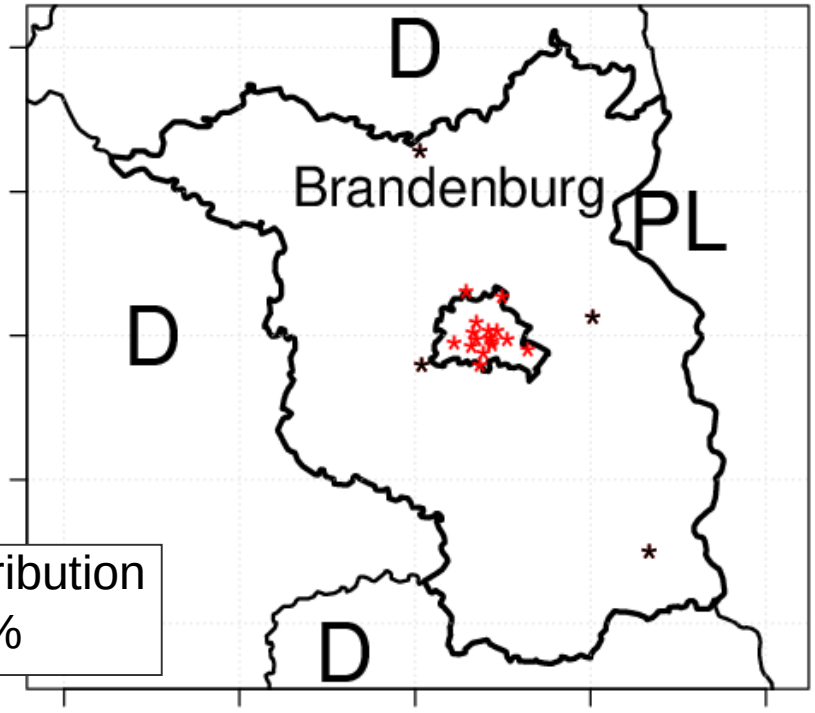
Observations (2018) PM10 & PM2.5

To get the different contributions of

- Local Sources (mainly Traffic)
- Urban Background
- Suburban
- Rural

⇨ What are the typical gradients?

Berliner LUftguete MEssnetz (BLUME)

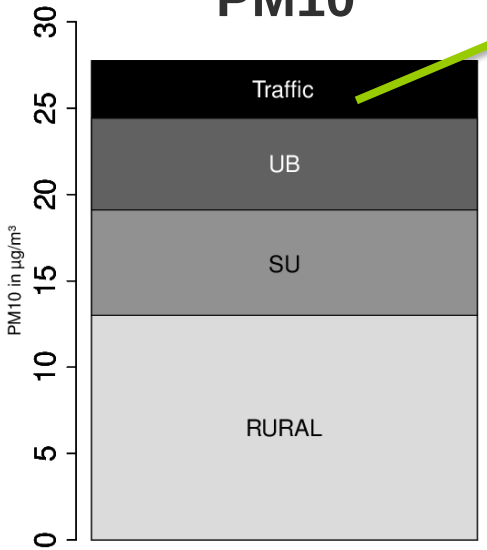


UBA (Umweltbundesamt) Network of Stations in Berlin and Brandenburg

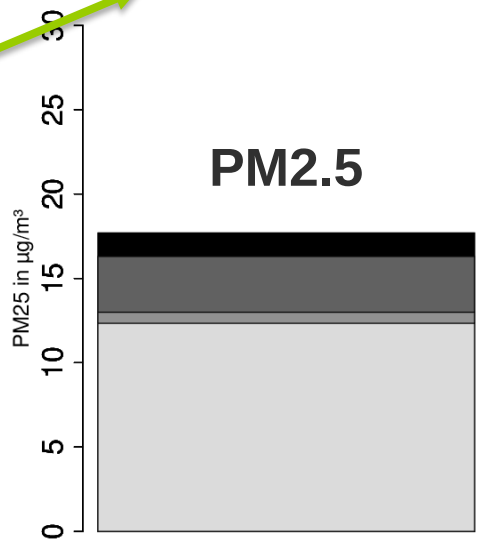
Important local contribution to PM10 ~ 10%

Lenshow-Approach

PM10



PM2.5



- How does LOTOS-EUROS perform?
- Can LOTOS-EUROS reproduce this urban increment?
- What are the main contributors to this?

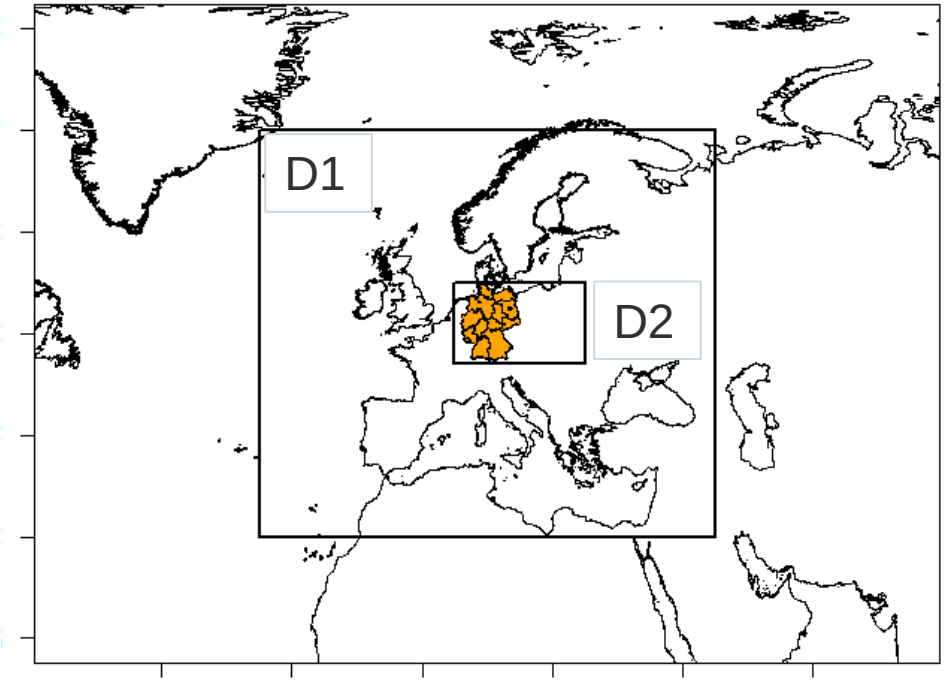
Model Data (LOTOS-EUROS v2.1) for 2018

- **Meteorology** (ECMWF)
- **Emissions**
  - MACC III + Greta (for Germany)
  - Domestic Heating Emission time profiles based on heating demand
- **Labelling** approach:

⇨ Emissions get a label

⇨ track the contributions

COUNTRIES/ REGIONS	SECTORS
Berlin Brandenburg RestGermany Poland Czech Rep.	Traffic Households Industry/Energy Agriculture Rest Natural Boundary
Others	



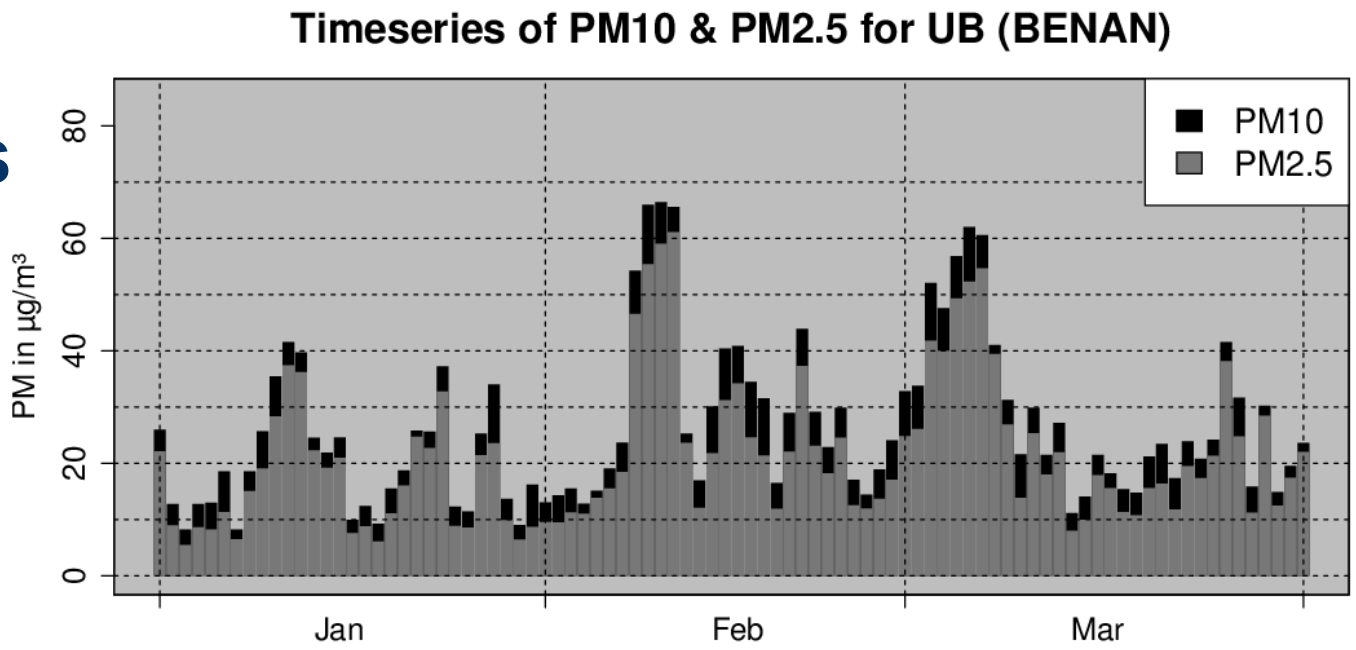
D1: 25 x 25 km²; D2: 7 x 7 km²

Manders et al., 2017, Kranenburg et al., 2013, Schaap et al., 2008

Evaluation Observations 2018

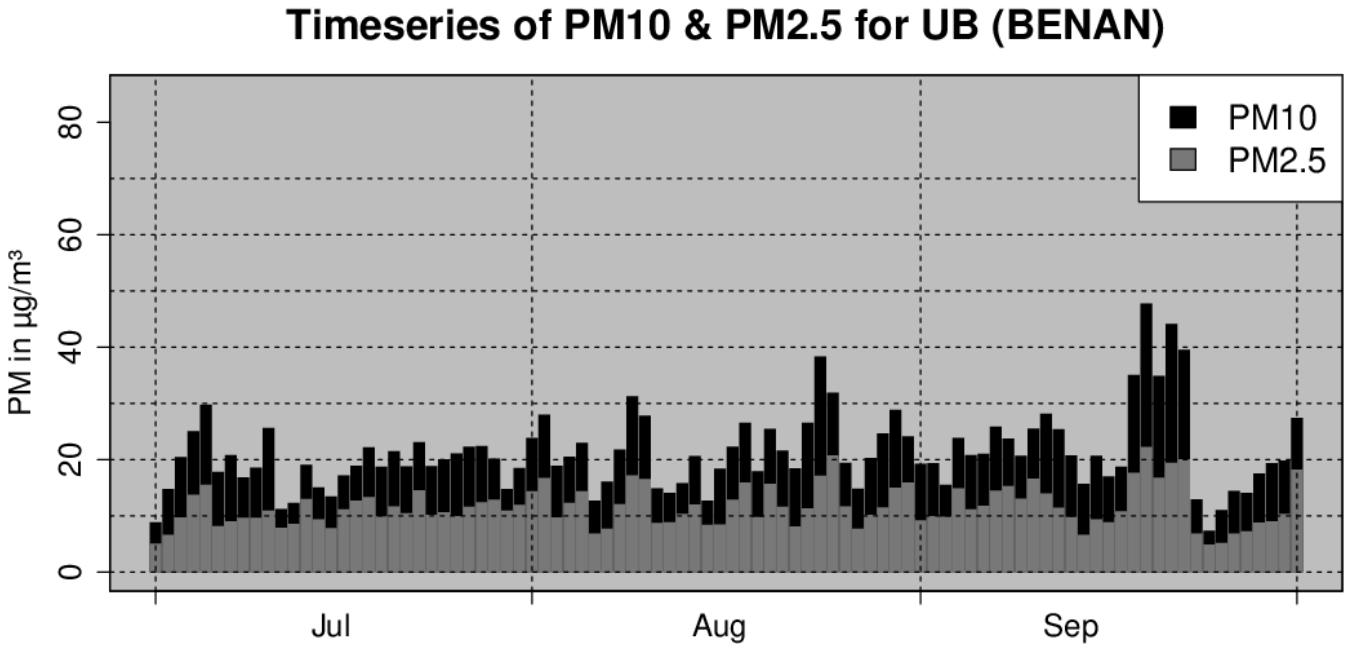
PM in Wintertime:

High fine mode contribution



PM in Summertime:

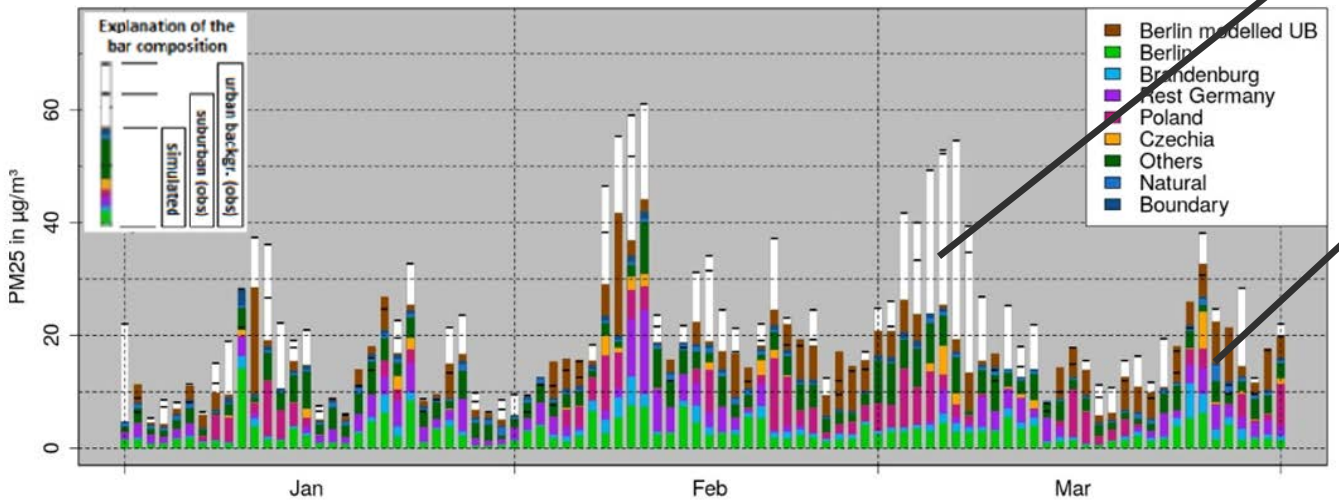
High coarse mode contribution



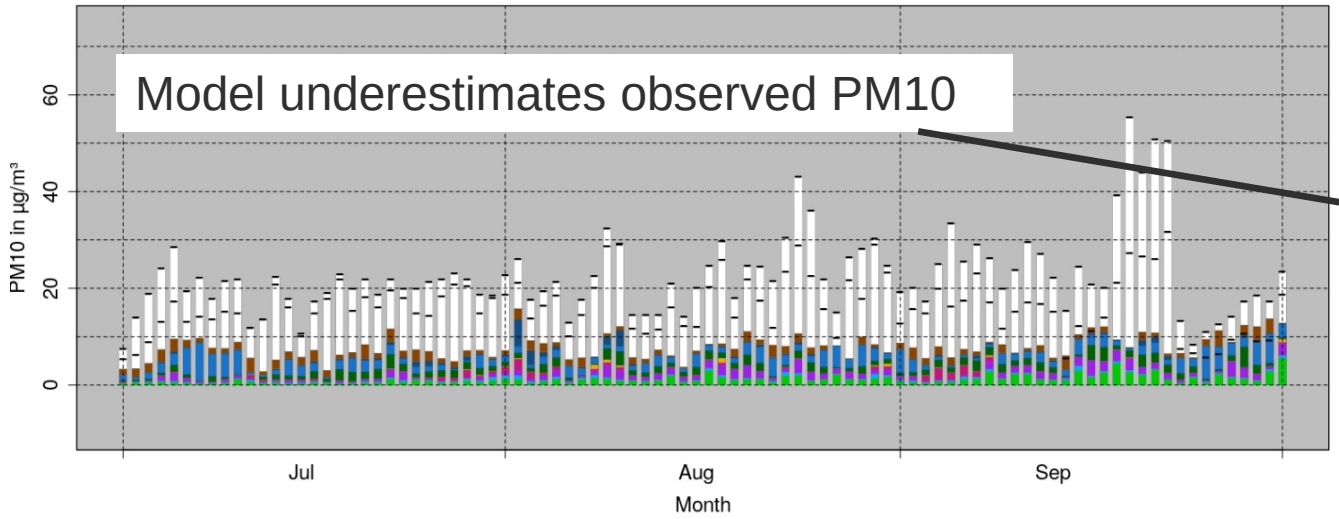
Evaluation (Observations & Model)

PM2.5 Winter

Time series for Urban Background



PM10 Summer



Observations

Simulation

February (PM2.5):

- Dry conditions
- Cold (below 0°C)
  - Enhanced demand of heating
- Calm weather
- Large contributions of Berlin, Rest-Germany and Poland

⇒ Accumulation of PM

LOTOS-EUROS resuspension-scheme is not connected to meteorological conditions

Results

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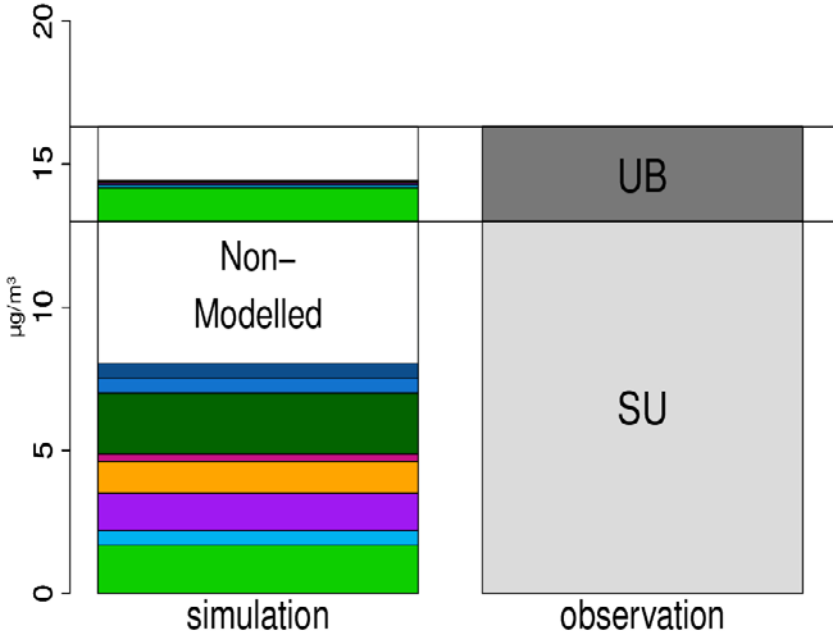
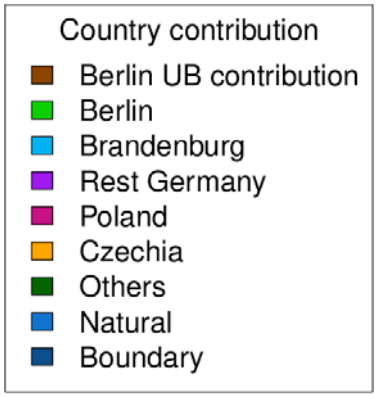
Annual mean PM2.5 concentrations and labels (2018)

Countries

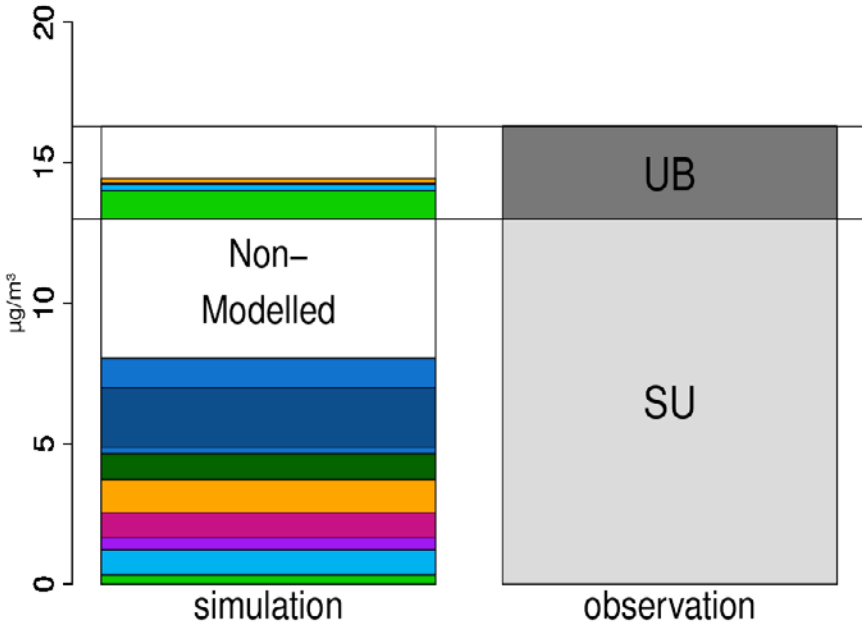


Main Contributors:

- Berlin
- Germany
- Poland &
- Others



Sectors



Main Contributors:

- Berlin Households (& Traffic)
- Households,
- Industry/Energy,
- Agriculture,
- Others &
- Natural/Boundary

Conclusions

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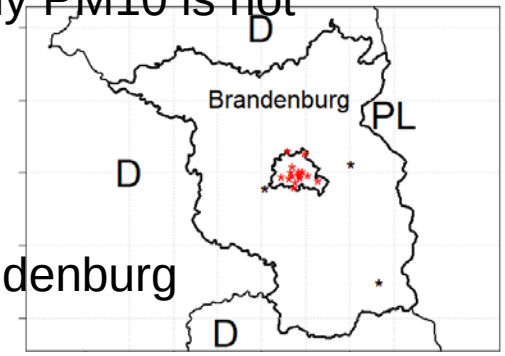
Evaluation

- PM2.5 is much better cought by the model than PM10
  - Model: Urban pollution Island is not caught for coarse mode
  - drought conditions in 2018 might be one reason why PM10 is not well reproduced by the model



Source Apportionment

- Countries - during high concentration episodes:
  - High Berlin, National and Polish contibutions (low Brandenburg contribution)
- Sectors:
  - Residential combustion and agriculture (farm animals) are the most important during wintertime, followed by Industry/Energy and Traffic
  - Households and traffic are the most important local sources

Outlook

- Simulation with increased resolution
- What about the contributions east of Poland?
- Improving spatial time cycles (model vs. measurements)
- Longer time series (2010 – 2018)

Thank you very much