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TrUmF
Troposphärische Umweltforschung
Institut für Meteorologie
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Urban PM10 Budget

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Motivation

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- PM10 is harmful to human health
- Understanding PM10 origin and composition
- Reveal relevant processes for accumulation and loss of aerosol mass
- Understand discrepancies between observations and simulations
- Help decision makers in emission reduction strategies

Outline

- Measurement Campaign in Berlin (HoVerT 2002)
- Observed PM10 in, around and above Berlin
- CTM-REM_Calgrid
- Process analysis
  - TRANSPORT
  - EMISSIONS / DEPOSITIONS
  - CHEMISTRY
- Discussion

Measurements

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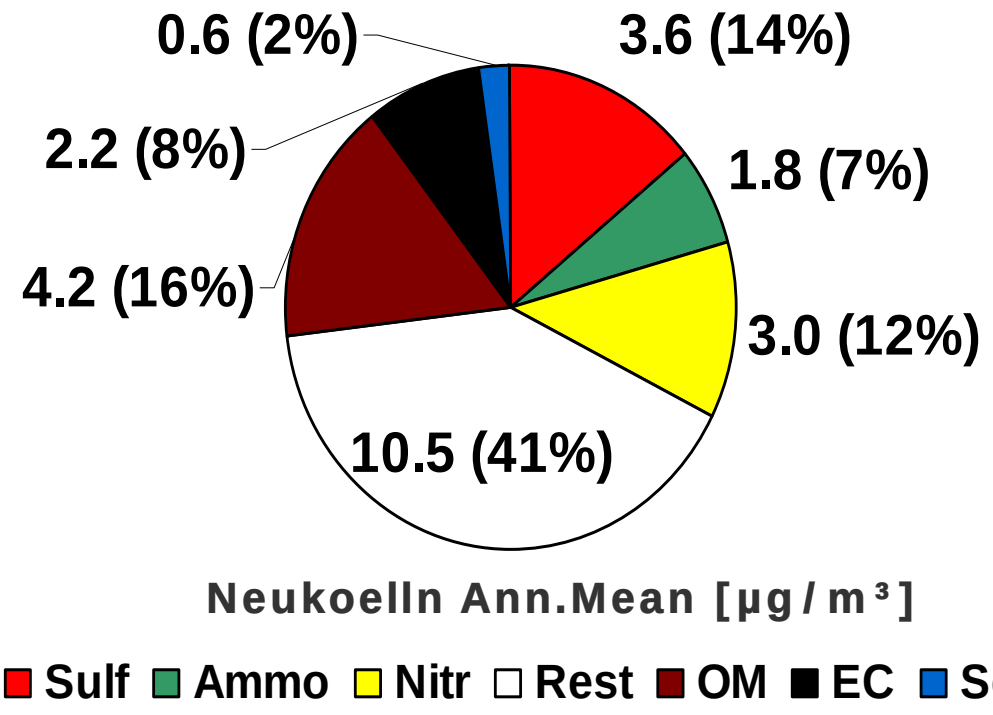
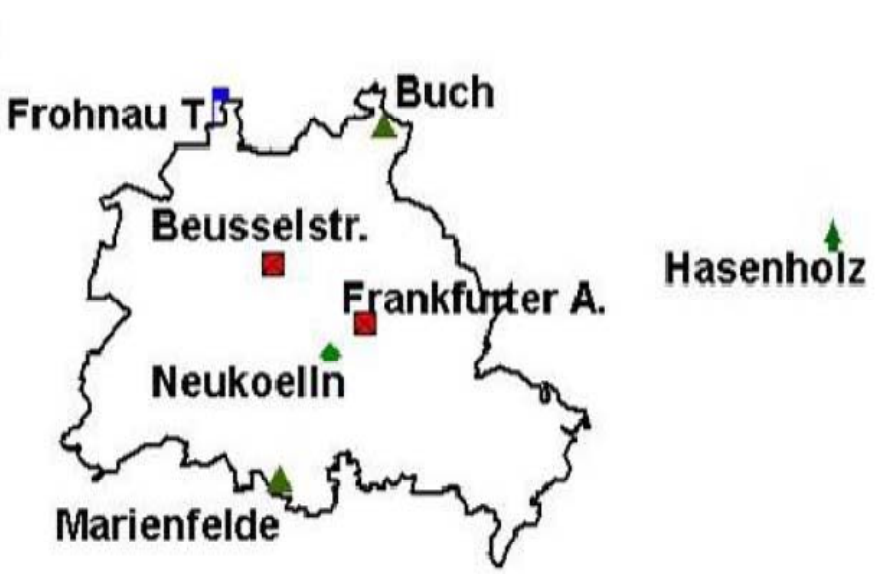
HOVERT





Measurements

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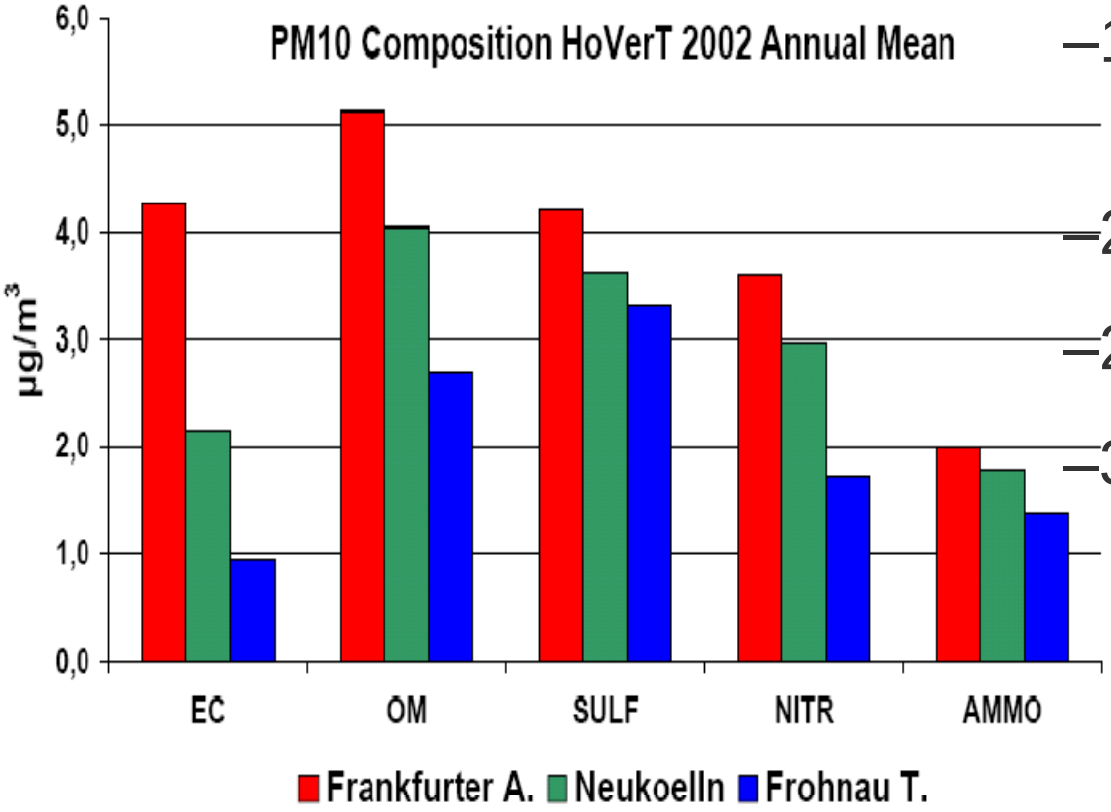
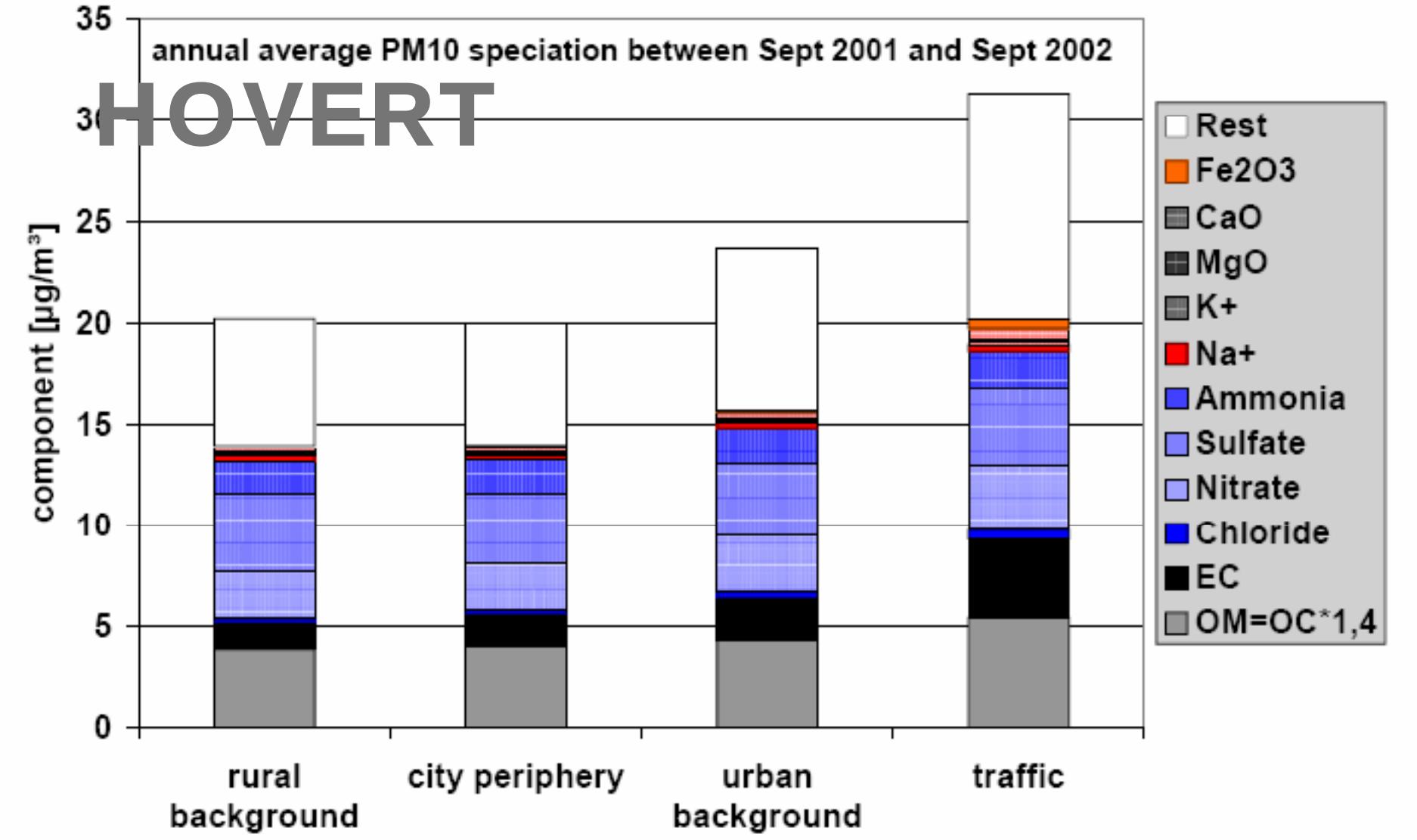
HOVERT



Urban-Rural (PM10):

- 15 µg/m³ free atmosphere (Frohnauer Turm)
- 20 µg/m³ rural background
- 26 µg/m³ urban background
- 34 µg/m³ traffic

Measurements



Measurements

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HOVERT

%	Traffic	Urban	Tower
Inorganic PM10	27	33	43
Carbonaceous PM10	27	25	24
Rest	46	42	33

CTM REM_Calgrid

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- ONE-WAY NESTED MODEL CHAIN for
  - Regional Scale (Europe, Germany)
  - Urban Scale (Agglomeration area)

- TRANSPORT IN THE LOWER TROPOSPHERE

- PHOTOCHEMICAL TRANSFORMATIONS

- INORGANIC AND ORGANIC AEROSOL FORMATION

- DRY AND WET REMOVAL PROCESSES

- LONG TERM APPLICATIONS

CTM REM_Calgrid

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PM10 Simulation in REM_Calgrid

Coarse (2.5 – 10 µm) **and fine** (< 2,5µm) **fraction**

- **Primary Aerosol – directly emitted:**
  - elemental carbon (EC),
  - Organic carbon (OM)
    (fraction of PM10-emissions)
  - Rest (mainly coarse minerals)
    (wind-blown dust, re-suspension)

- **Secondary Aerosol – chemical transformation:**
  - inorganic Aerosols (SO_4^{2-}, NO_3^-, NH_4^+, Cl^-, Na^+)
  - organic Aerosols (SOA)

CTM REM_Calgrid

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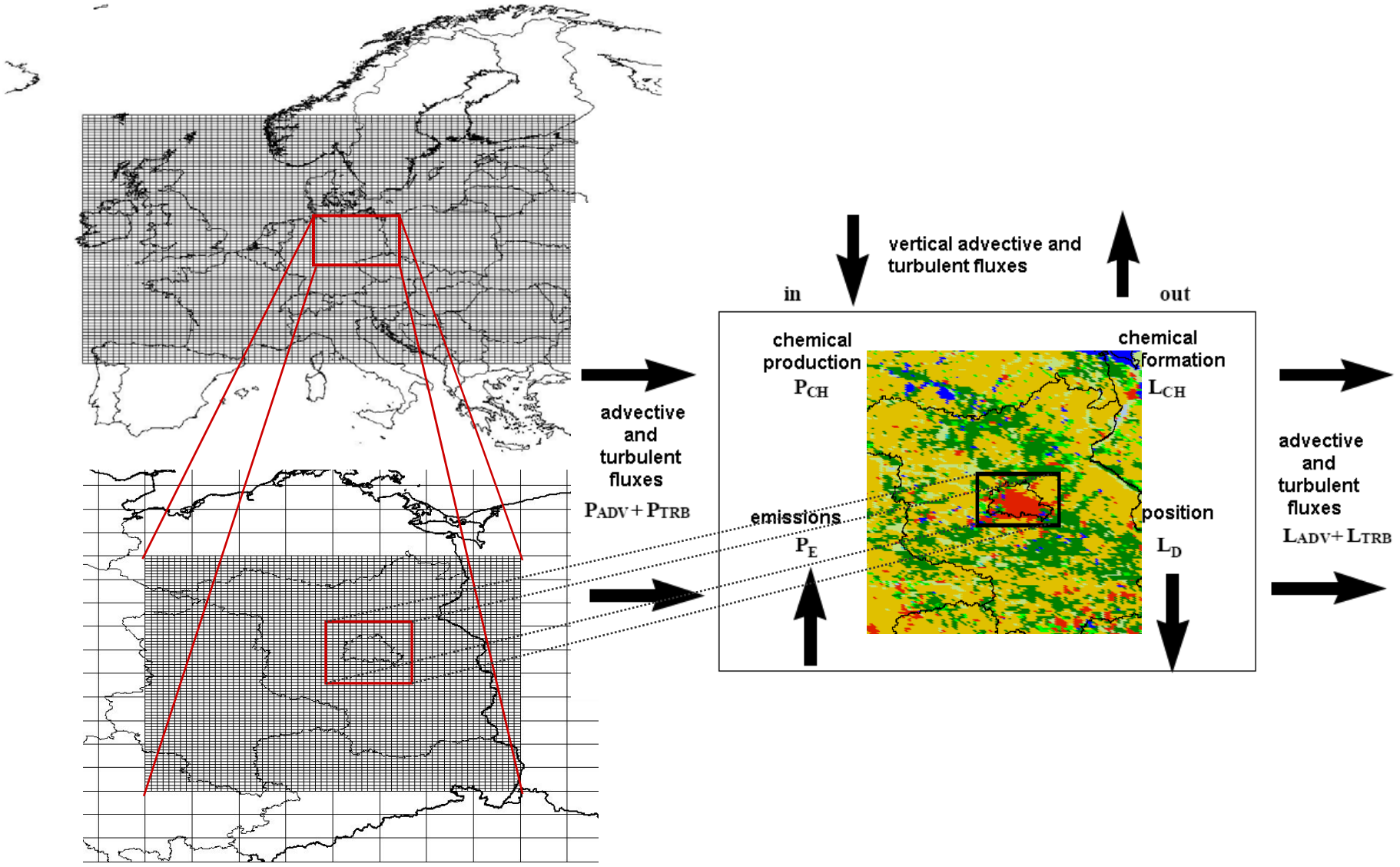
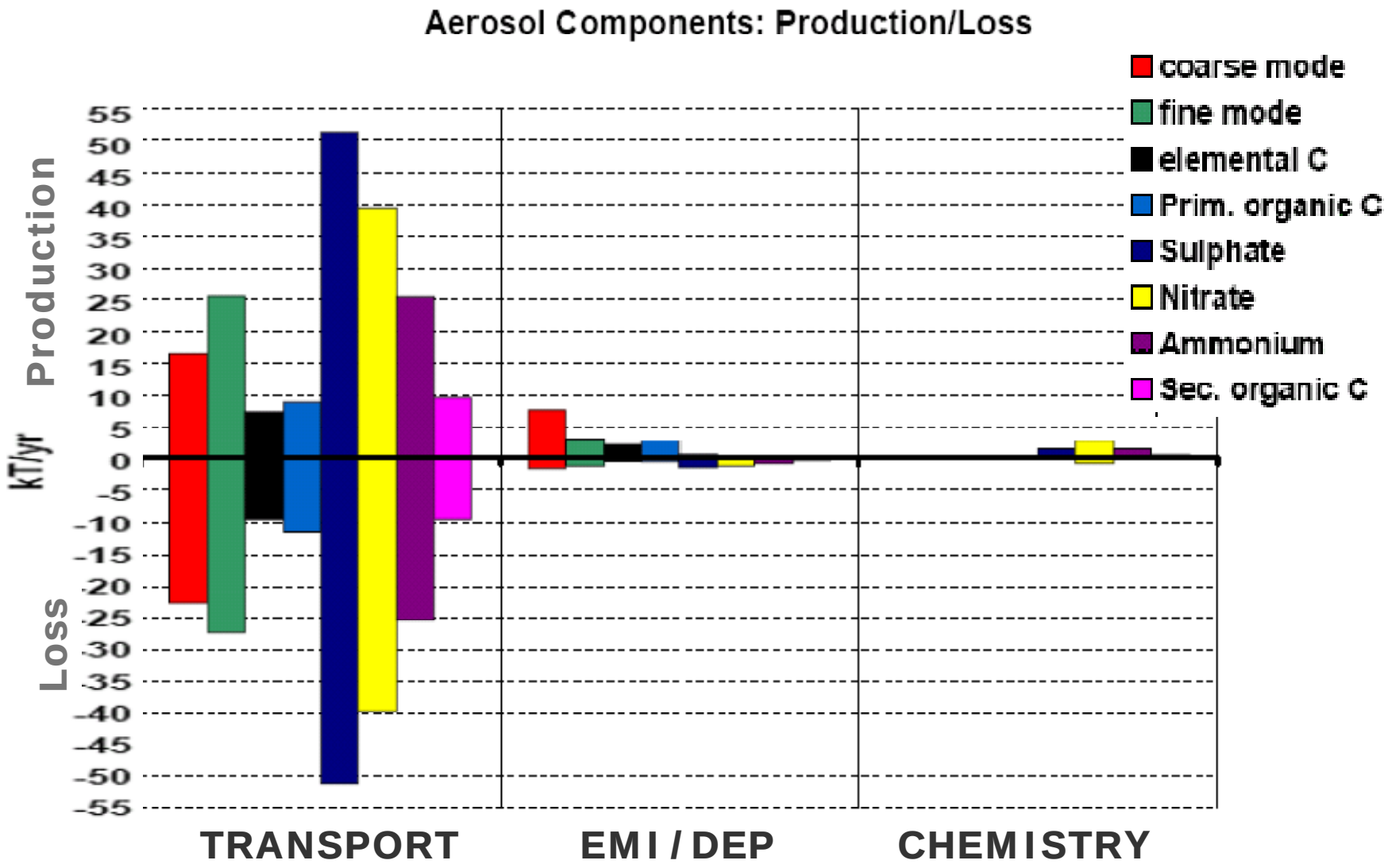
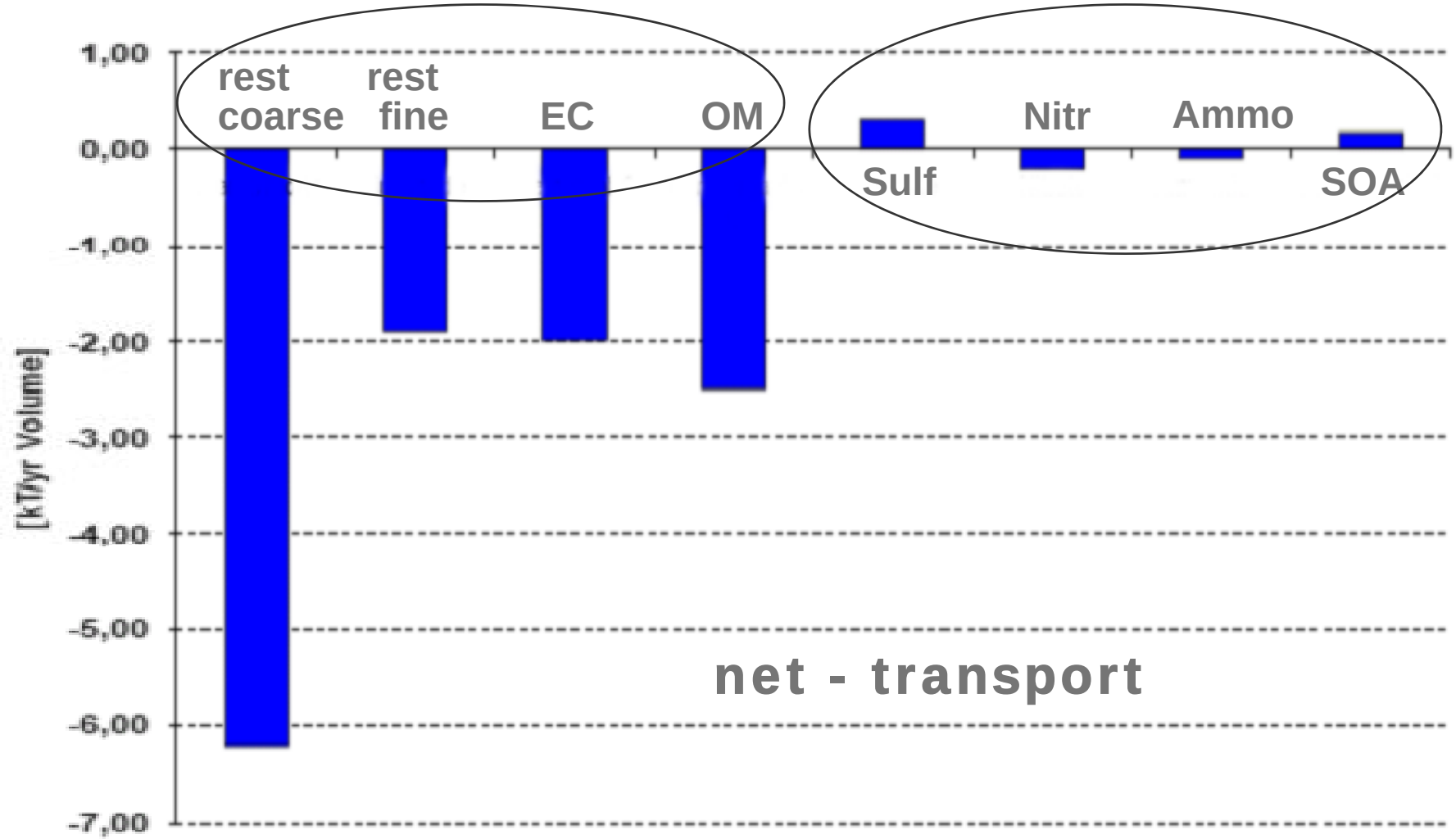


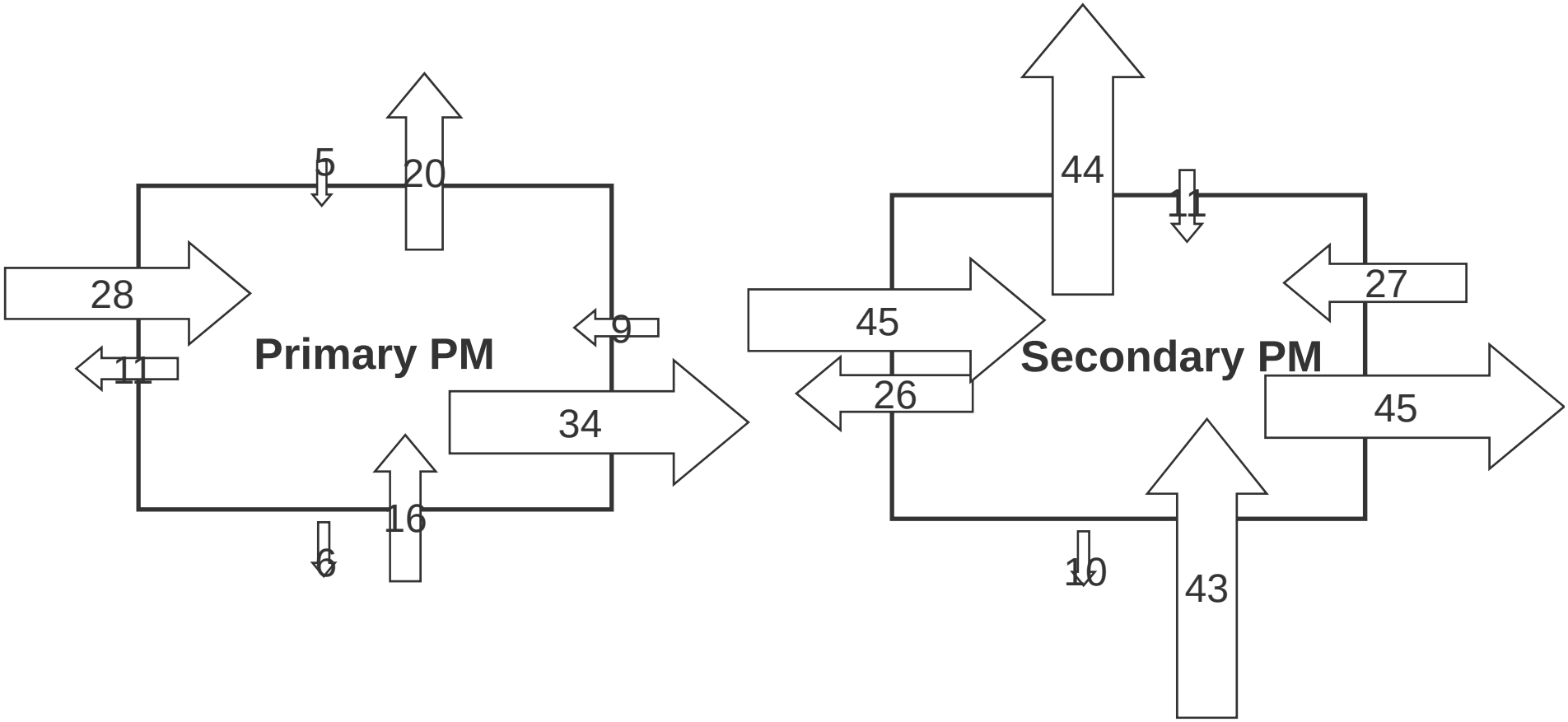
Process Analysis



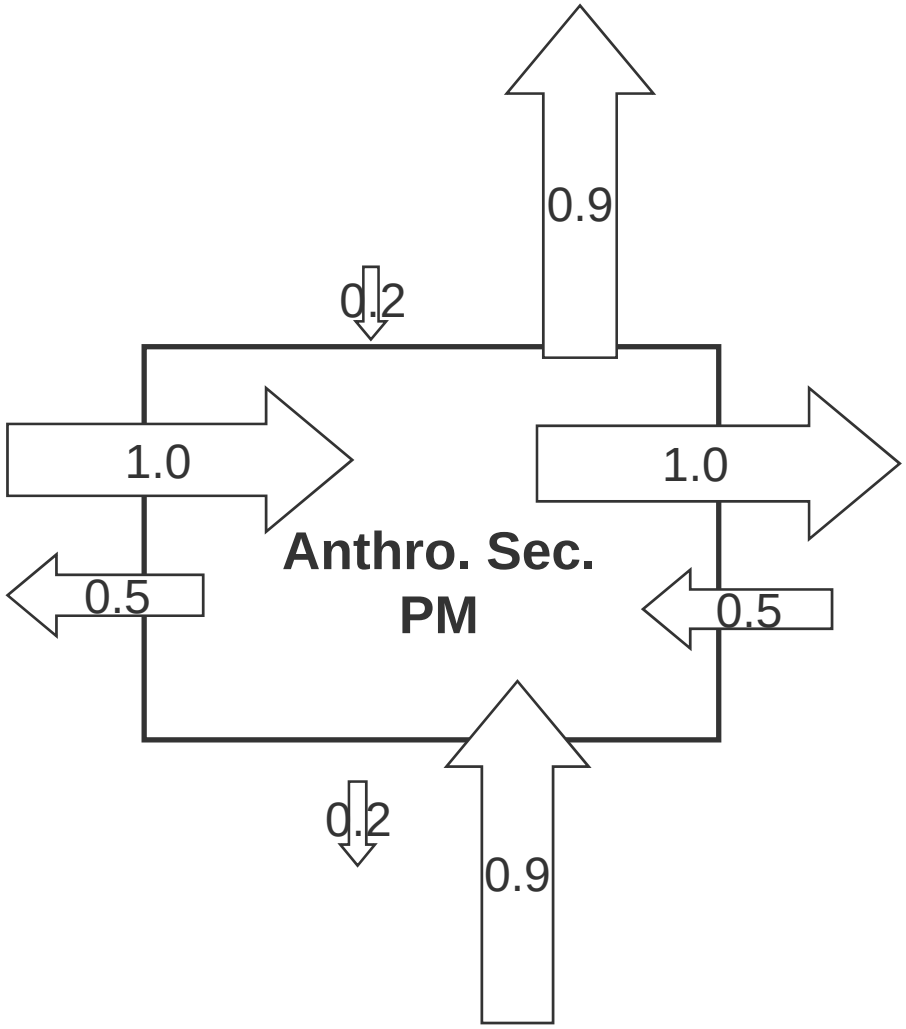
Transport

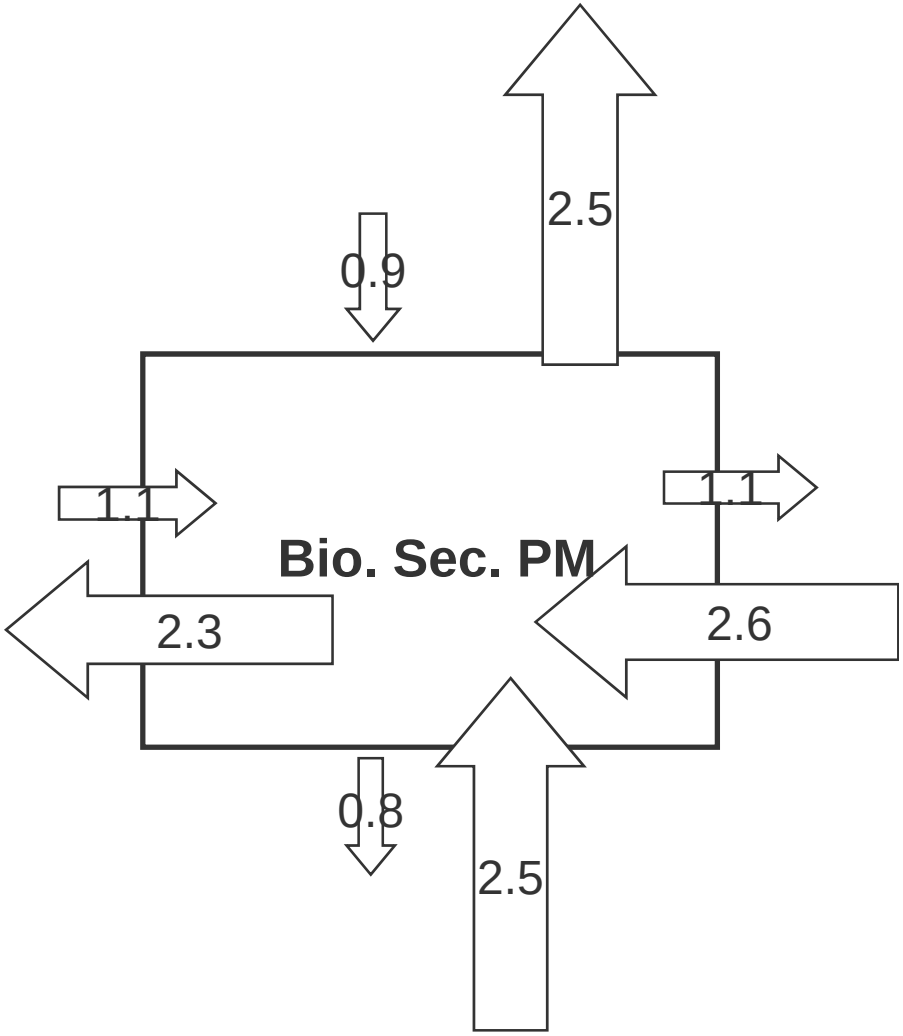

rest coarse
rest fine
EC
OM
Sulf
Nitr
Ammo
SOA
1,00
0,00
-1,00
-2,00
-3,00
-4,00
-5,00
-6,00
-7,00
[kT/yr Volume]
net - transport

Transport

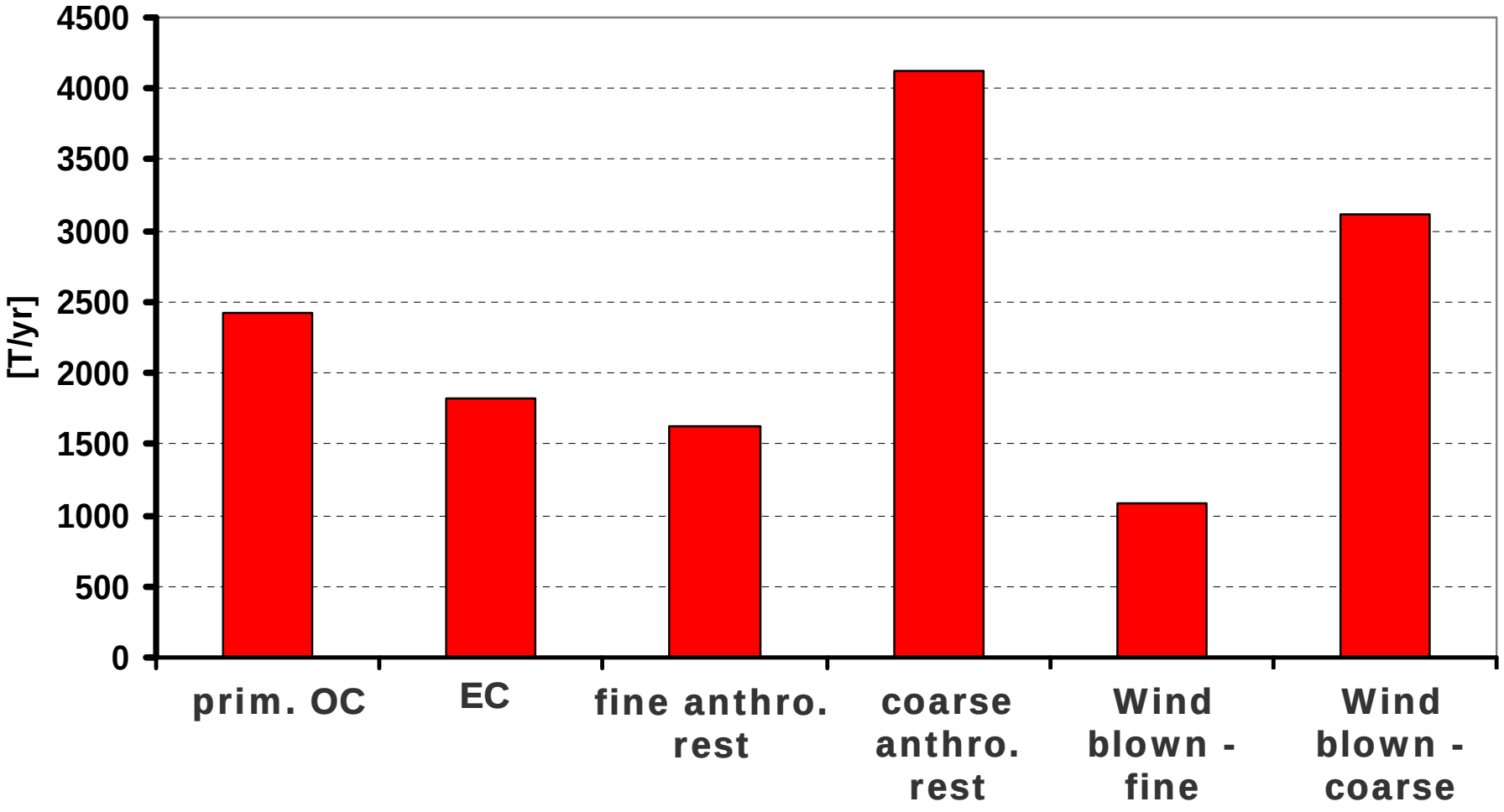


Transport

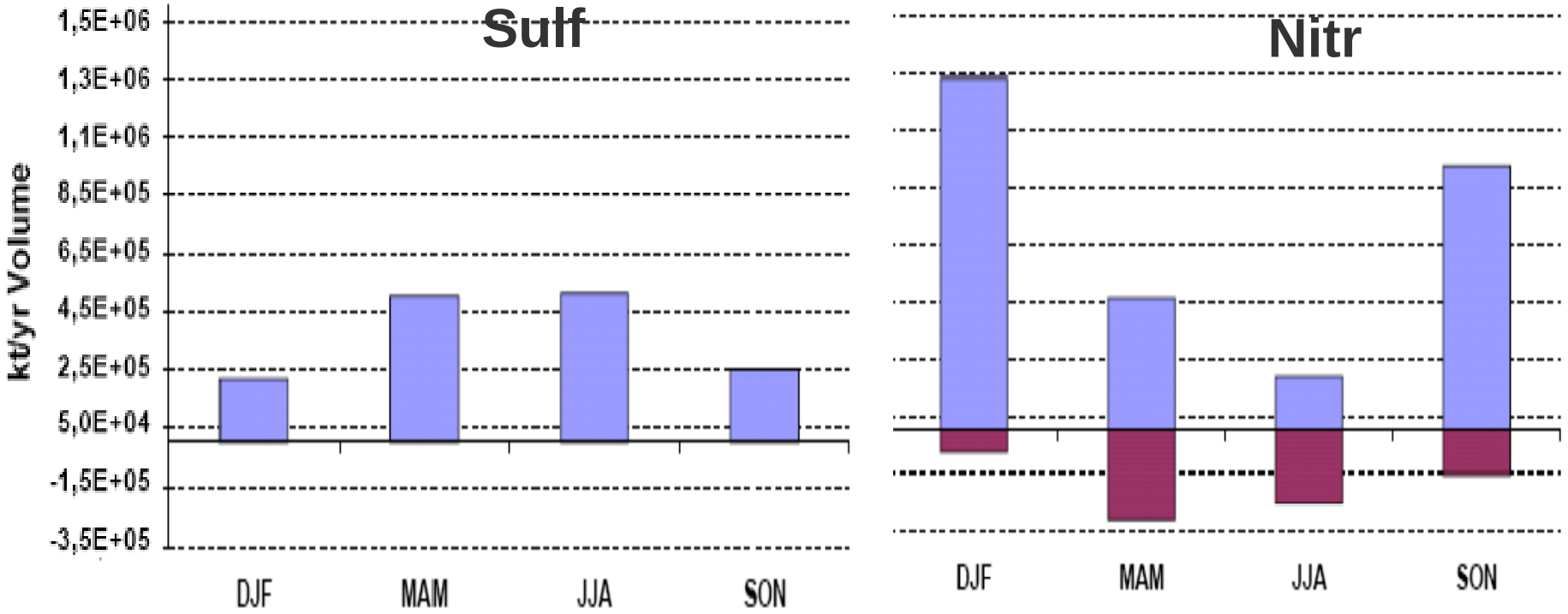

0.9
0.2
1.0
1.0
Anthro. Sec.
PM
0.5
0.5
0.2
0.9


2.5
0.9
1.1
1.1
Bio. Sec. PM
2.3
2.6
0.8
2.5

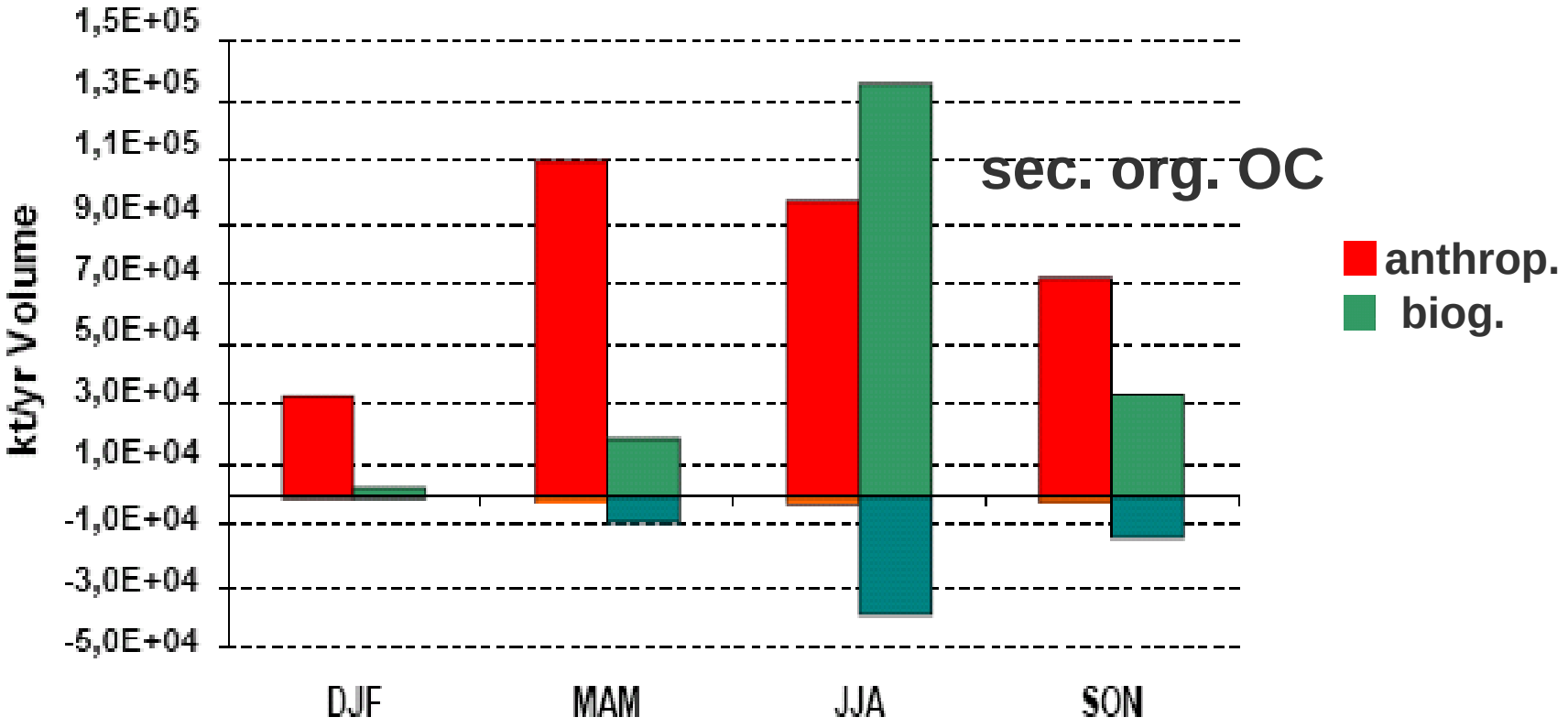
Emissions


4500
4000
3500
3000
2500
2000
1500
1000
500
0
[T/yr]
prim. OC
EC
fine anthro. rest
coarse anthro. rest
Wind blown - fine
Wind blown - coarse

Chemistry


Sulf
1,5E+06
1,3E+06
1,1E+06
8,5E+05
6,5E+05
4,5E+05
2,5E+05
5,0E+04
-1,5E+05
-3,5E+05
kt/yr Volume
DJF
MAM
JJA
SON
Nitr
DJF
MAM
JJA
SON

Chemistry


sec. org. OC
kt/yr Volume
1,5E+05
1,3E+05
1,1E+05
9,0E+04
7,0E+04
5,0E+04
3,0E+04
1,0E+04
-1,0E+04
-3,0E+04
-5,0E+04
DJF
MAM
JJA
SON
anthrop.
biog.

Discussion

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Discrepancies REM_Calgrid - Observations

40% not analysed PM10-Fraction
- Wind-blown dust
- Re-Suspension

EC, OM: RCG - Urban-Rural-Gradient overestimated!
- PM10-Emissions to close to traffic
- Missing emissions in the countryside

NO_3^-: RCG - Urban-Rural-Gradient underestimated!
- NO_3^- long-range transport overestimated
- Chemical loss underestimated

Summary

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Transport of **secondary** aerosol is essentially **blown through Berlin**, while primary coarse mode PM is polluting Brandenburg.

Wind-blown dust is contributing strongly to PM-**accumulation** and to polluting outskirts. This process is not evident in the measurements during HOVERT (**40% unknown part**)

Primary PM comes from the **west**, while **biogenic** and **sulfate** secondary PM comes from the **East**

Chemistry: **Winter** is dominated by **NO3 production**, **Summer** by **SO4 production** and NO3-Loss. Anthropogenic Secondary Organic Aerosol-production highest during spring.

Berlin is a **source** of **primary** AND **nitrate**, **anthr. SOA**

Thank you for your attention