



# FAIRMODE

Forum for air quality modelling in Europe



## WG3 Source Apportionment

27-29 June 2016

### CAMx - Source Apportionment - Lessons learned

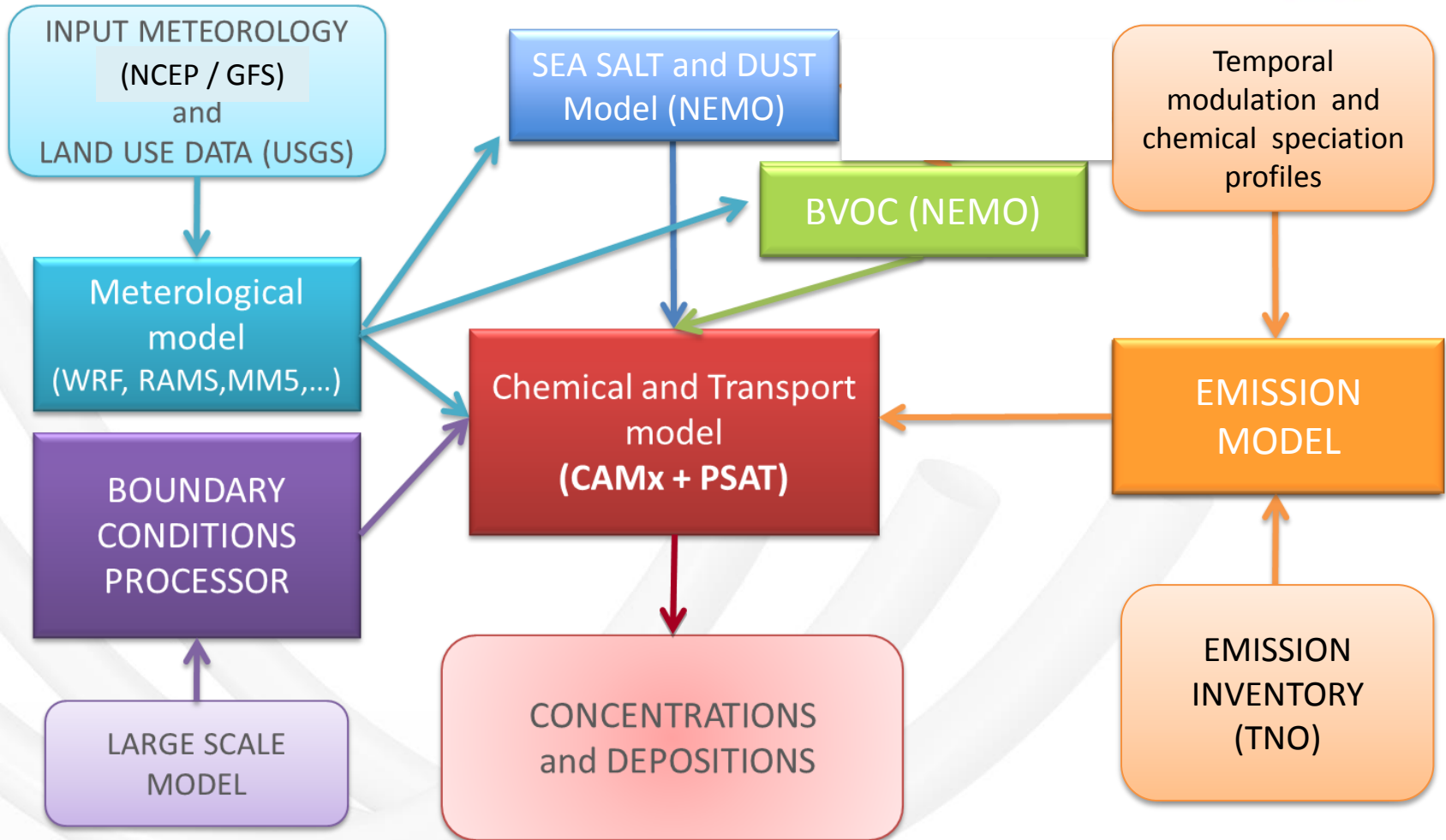
G. Pirovano, P. Brotto, J. Ferreira, Y. Long, C. Emery, G. Yarwood, F. Pradelle,  
S. Pillon, A. Dalla Fontana, A. Poupkou, N. Liora, D. Melas



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# CAMx setup



# CAMx setup - PSAT

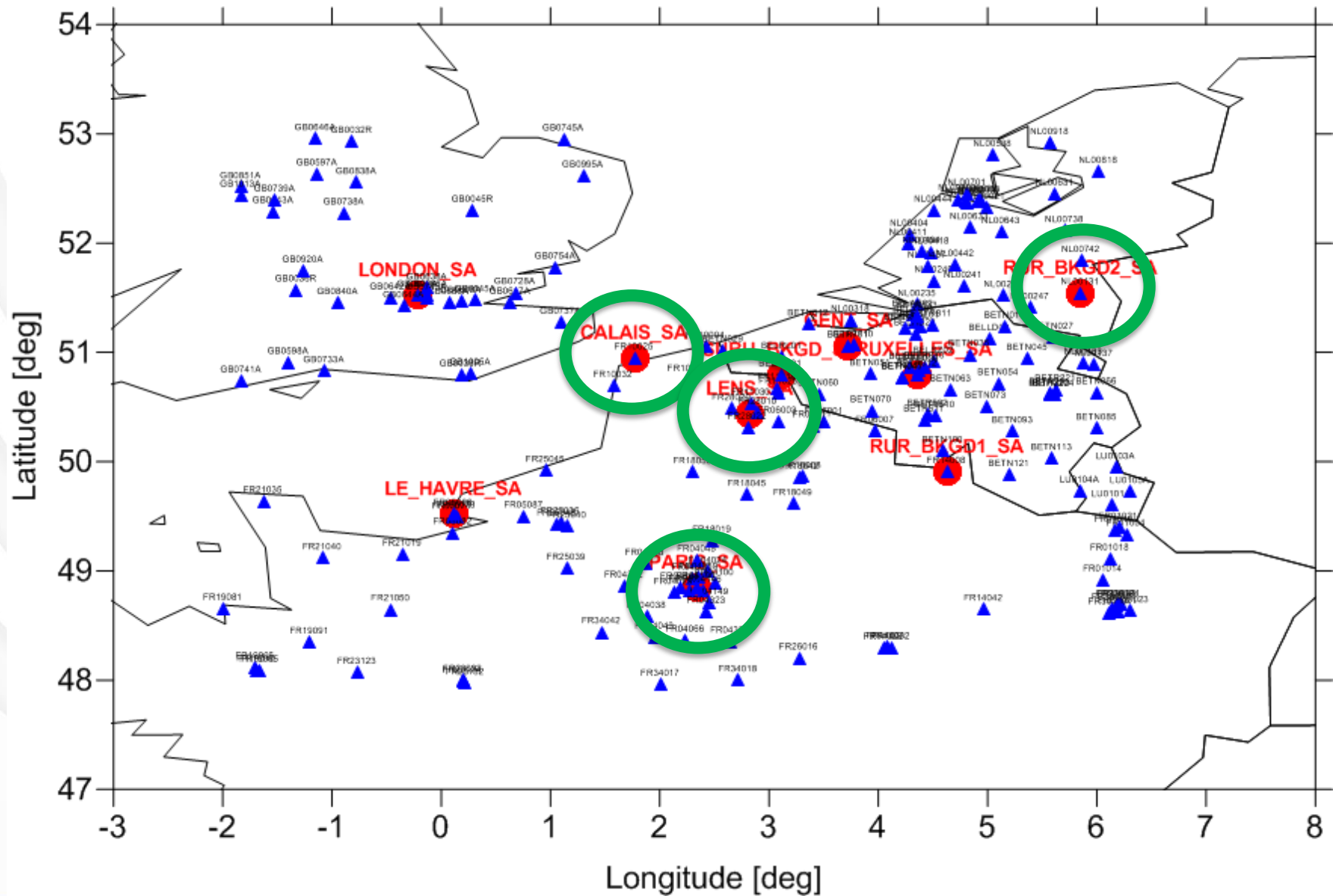
## **PSAT - Particulate Source Apportionment Technology** (Yarwood et al., 2004)

PSAT uses reactive tracers to apportion primary PM, secondary PM and gaseous precursors to secondary PM among different source categories and source regions.

- detect the role played by the different emission sources
- investigate, source by source, the influence of non linear chemical system on the evolution of the PM concentration

**A similar technology has been developed for ozone (OSAT).**

# Domain & sites..



# Emission categories

## Mandatory categories

01 - Electric Energy production

02- BIO - Domestic heating (b. burning)

03-04 - Industrial processes

07 - Transport (all)

08 – Shipping

10 – Agriculture

11 - Dust

99 - Other Anthrop + MS2 other + SSalt + BVOC

## Optional categories

01 - Electric Energy production

02-BIO - Domestic heating (biomass burning)

03-04 - Industrial processes

07-RTR - Transport (others)

71-RTG - Transport (gasoline)

72-RTD - Transport (heavy duty)

75-RTW - Transport (wear)

08 – Shipping

10 – Agriculture

11-DST – Dust

11-SLT – Sea Salt

11-BSO – Biogenic VOC

99 - Other Anthrop

02-OTH - Domestic heating (other)

ALL\_BC - contribution of boundary conditions

# Screening analysis

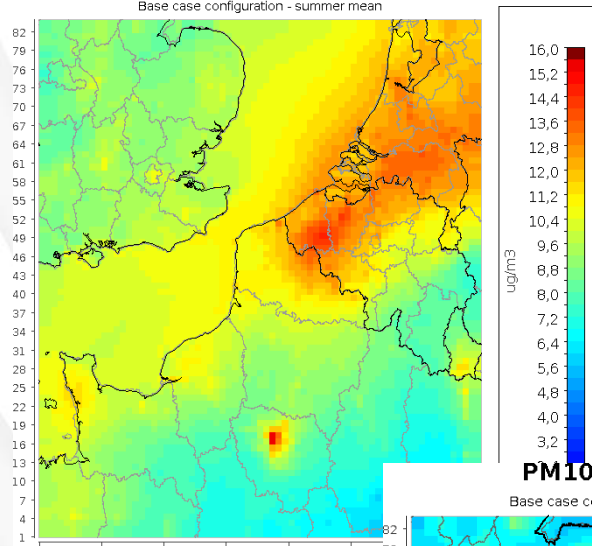
- *Gridded Source Contribution Estimates*
- *Spatial patterns*
- *Seasonal differences*
- *Local vs regional sources*

# Summer Episode - Mandatory

## Base case configuration - Summer mean

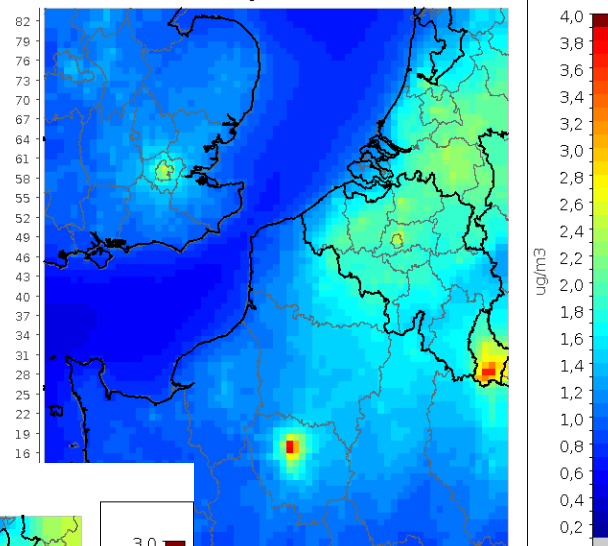
**PM10 - Lens Domain**

Base case configuration - summer mean



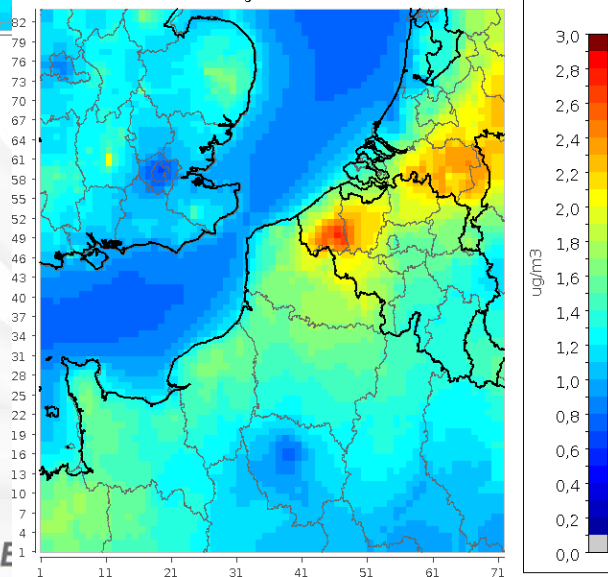
**PM10 - Road Transport**

Base case configuration - summer mean



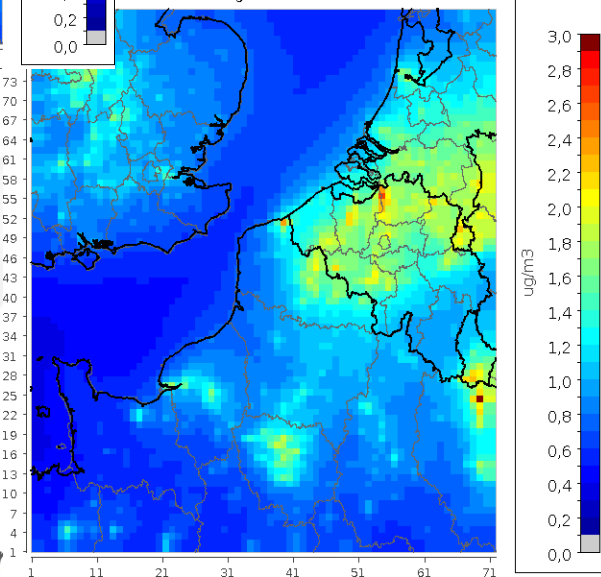
**PM10 - Agriculture**

Base case configuration - summer mean



**PM10 - Industry**

Base case configuration - summer mean



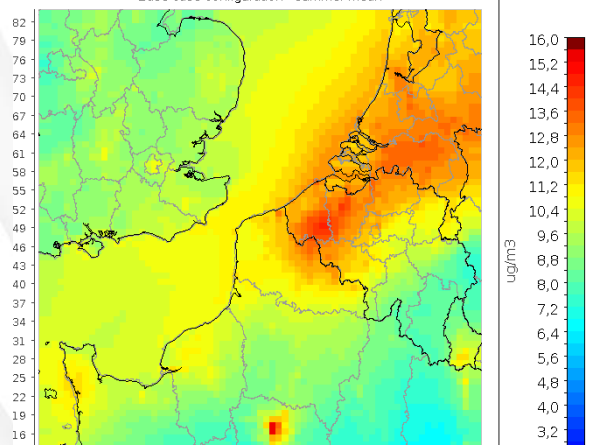


# Summer Episode - Mandatory

## Base case configuration - Summer mean

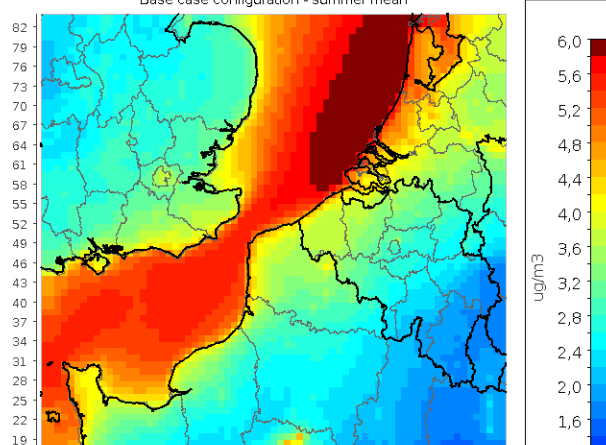
**PM10 - Lens Domain**

Base case configuration - summer mean



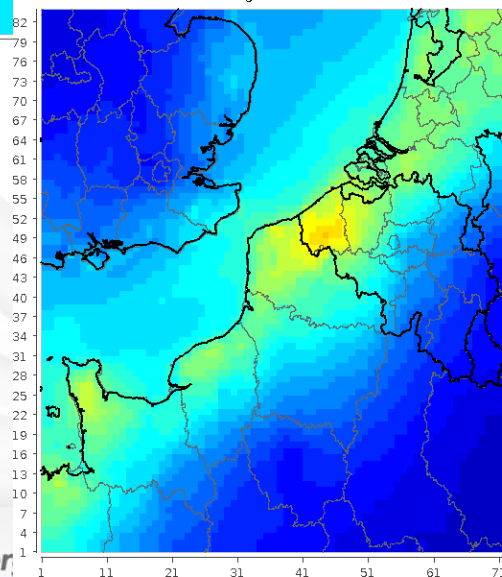
**PM10 - Other PM10**

Base case configuration - summer mean



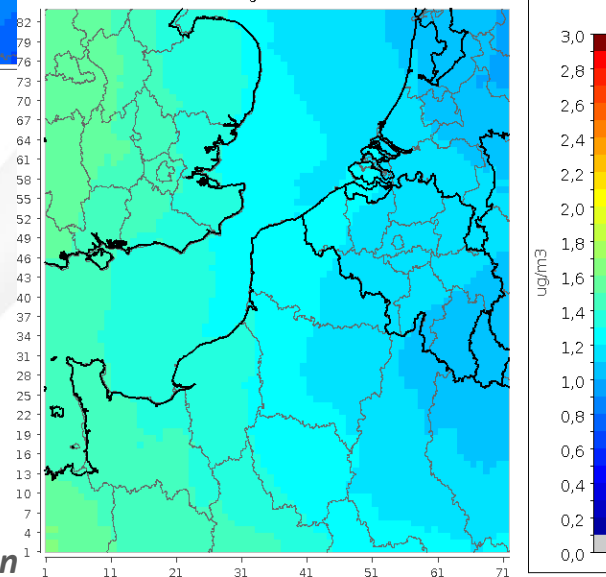
**PM10 - Shipping**

Base case configuration - summer mean



**PM10 - Boundary conditions**

Base case configuration - summer mean



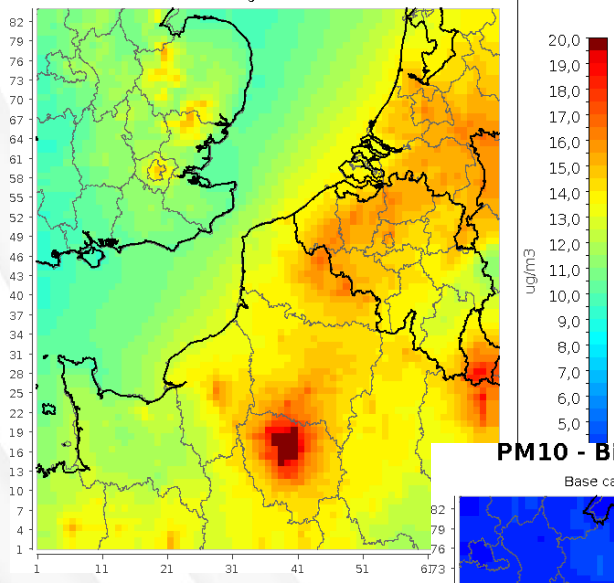


# Winter Episode - Mandatory

## Base case configuration - Winter mean

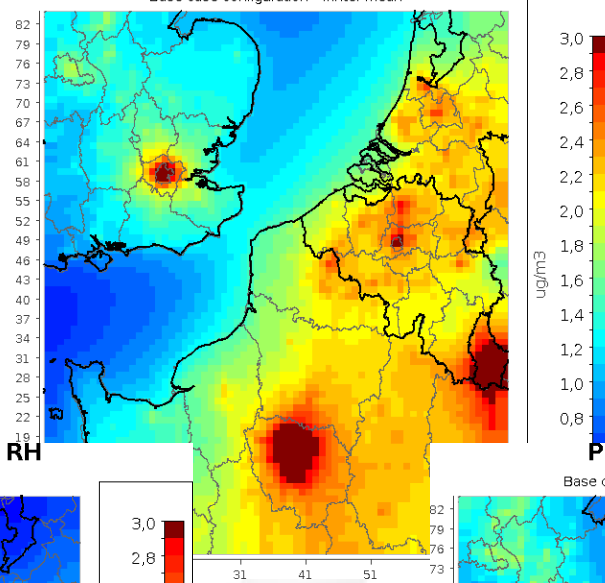
**PM10 - Lens Domain**

Base case configuration - winter mean



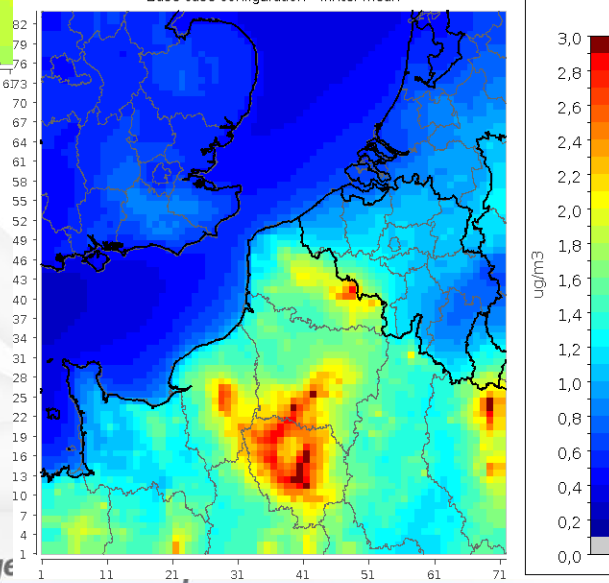
**PM10 - Road Transport**

Base case configuration - winter mean



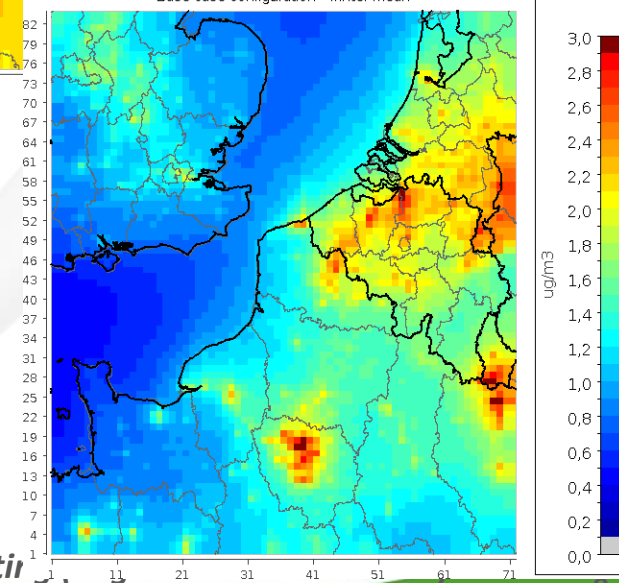
**PM10 - Biomass Burning in RH**

Base case configuration - winter mean



**PM10 - Industry**

Base case configuration - winter mean

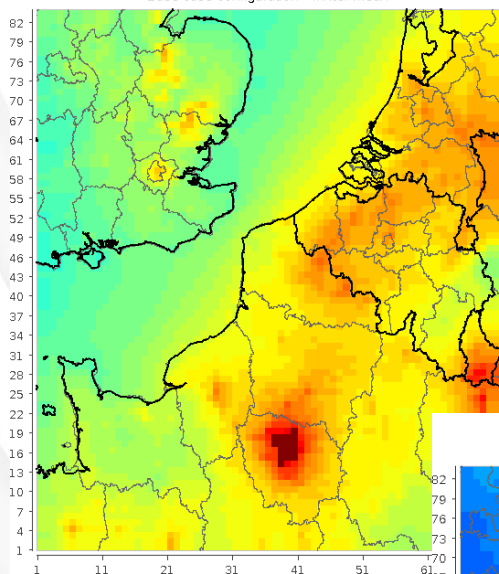


# Winter Episode - Mandatory

## Base case configuration - Winter mean

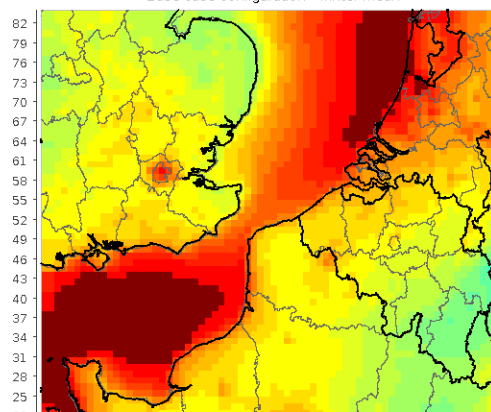
**PM10 - Lens Domain**

Base case configuration - winter mean



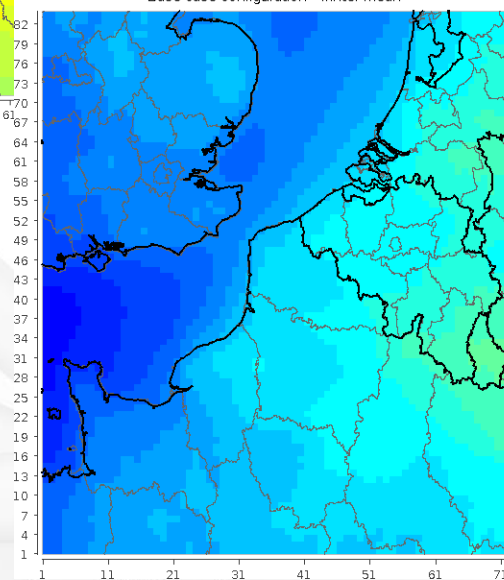
**PM10 - Other Sources**

Base case configuration - winter mean



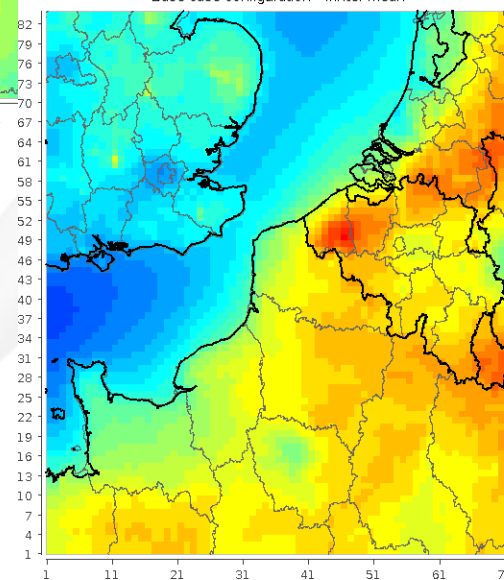
**PM10 - Energy Production**

Base case configuration - winter mean



**PM10 - Agriculture**

Base case configuration - winter mean

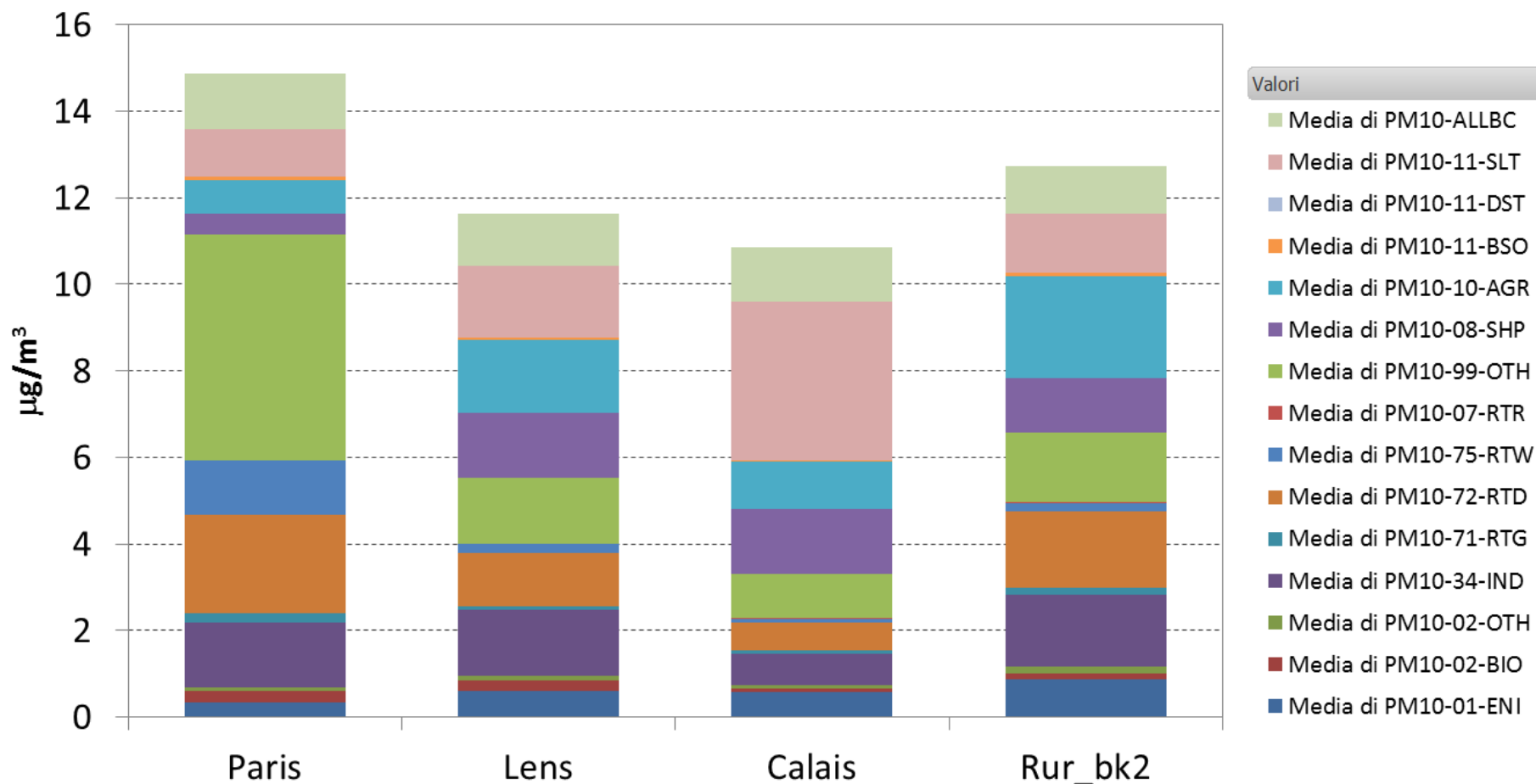


# Average Source Contribution Estimates at receptors

- *Mean Source Contribution Estimates*
- *Comparison with RM estimates*
- *Seasonal differences*
- *Local vs regional sources (first guess)*
- *Secondary PM apportionment*

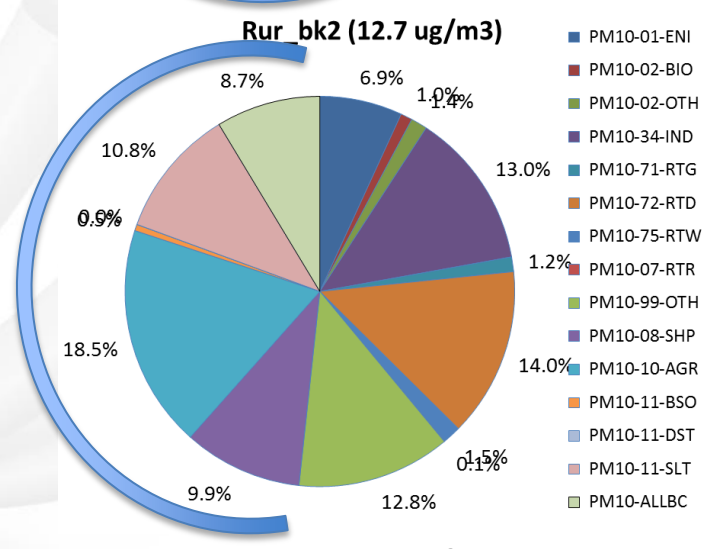
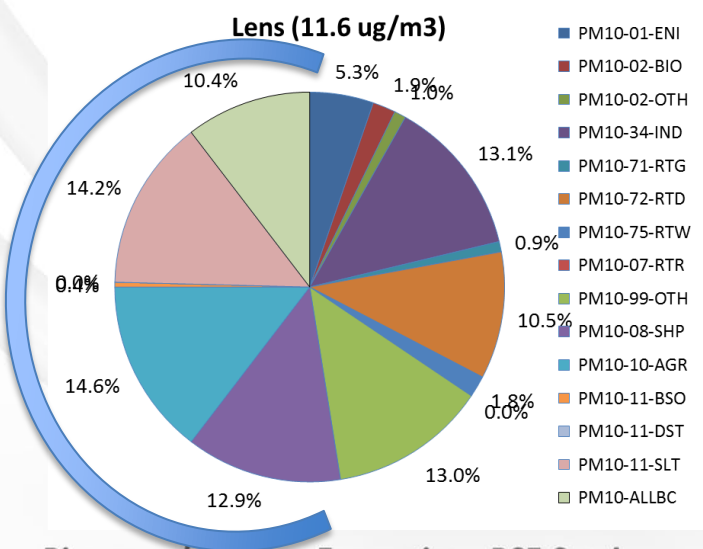
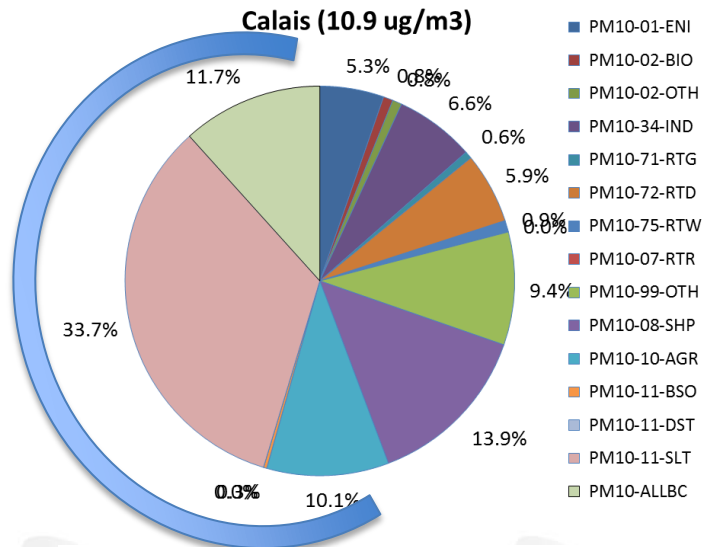
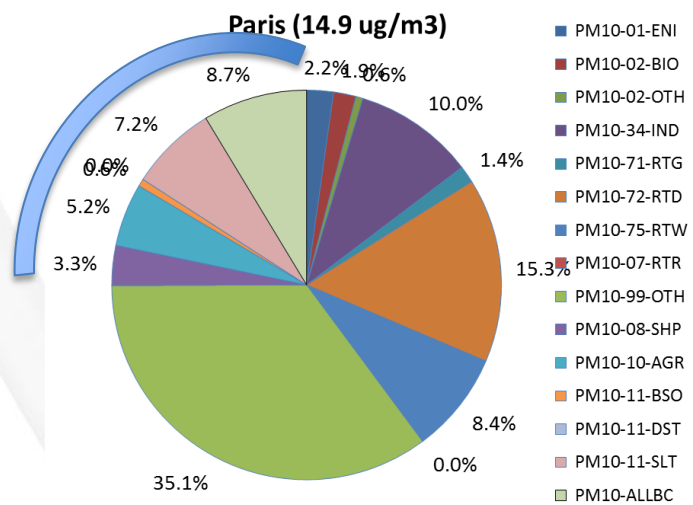
# Summer Episode - Optional - PM<sub>10</sub>

Base case configuration - Summer mean



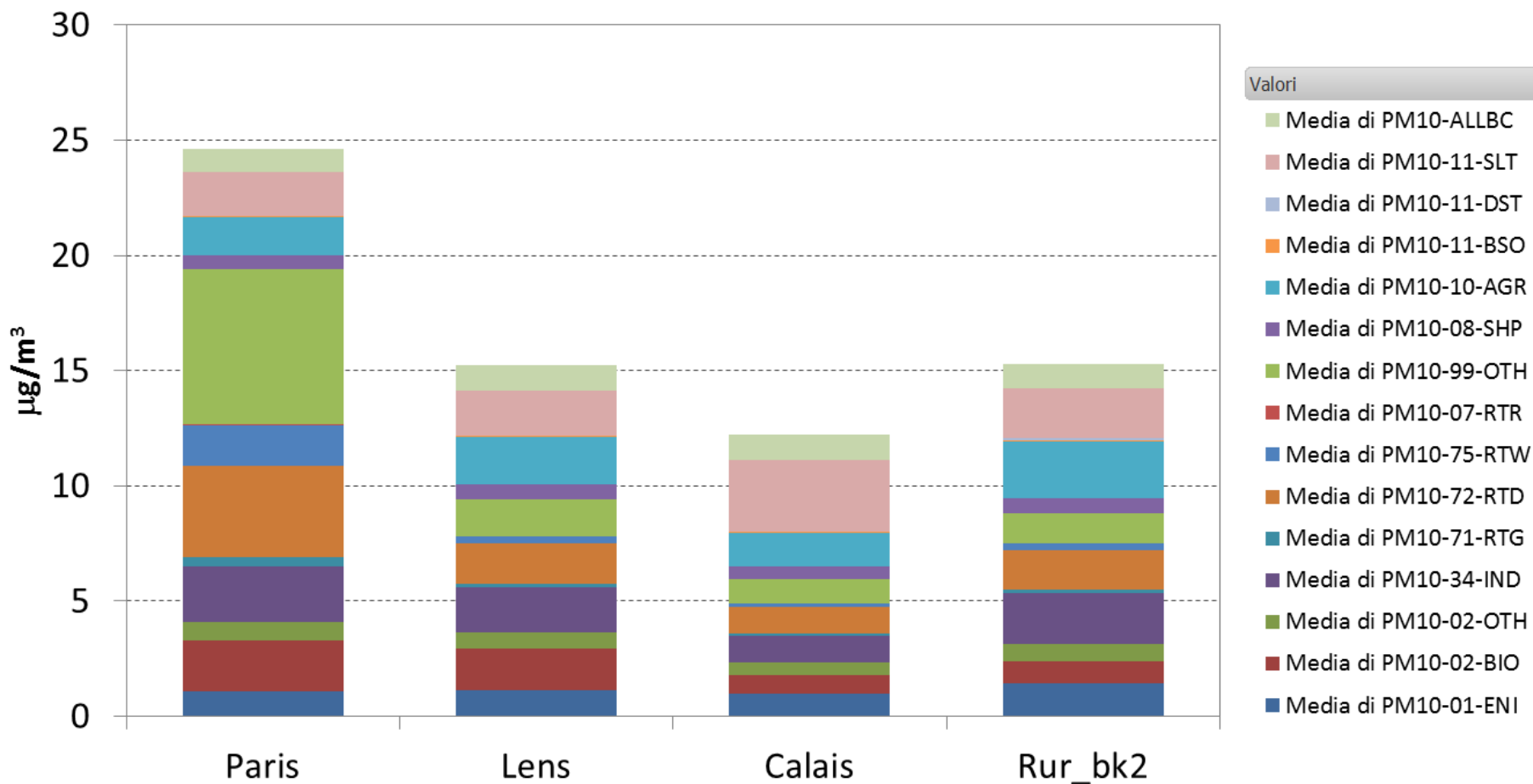
# Summer Episode - Optional - PM<sub>10</sub>

## Base case configuration - Summer mean



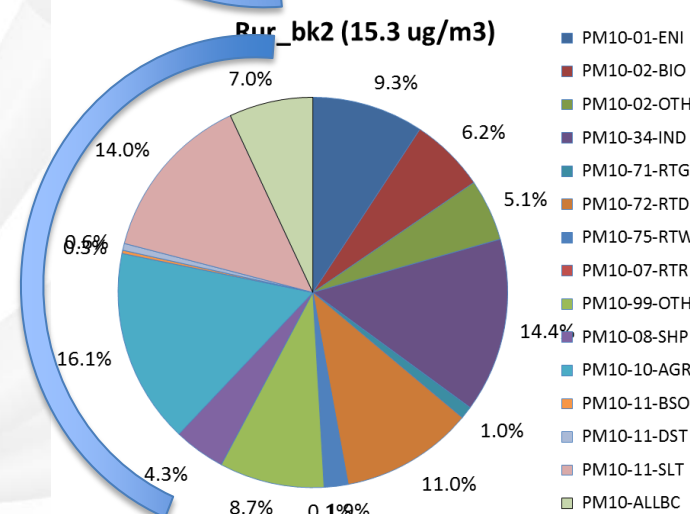
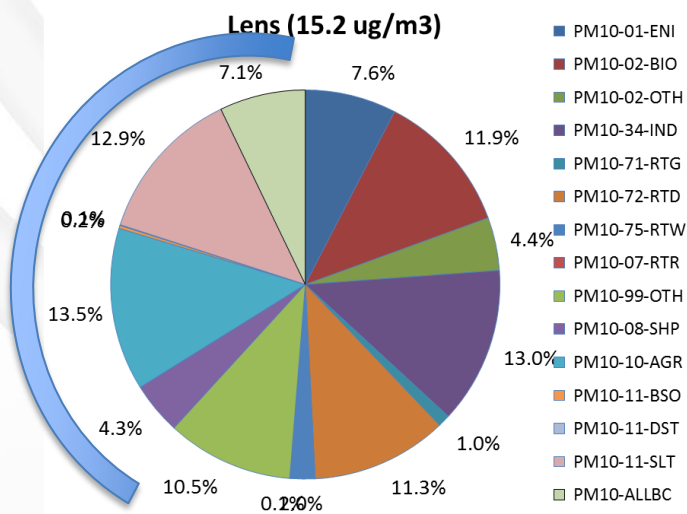
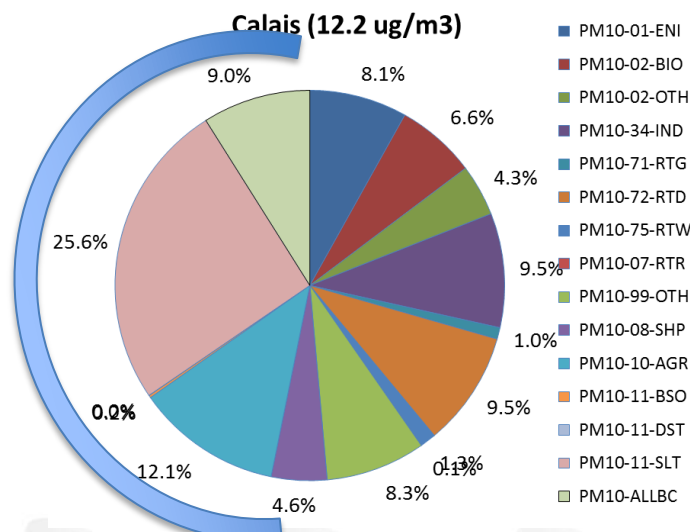
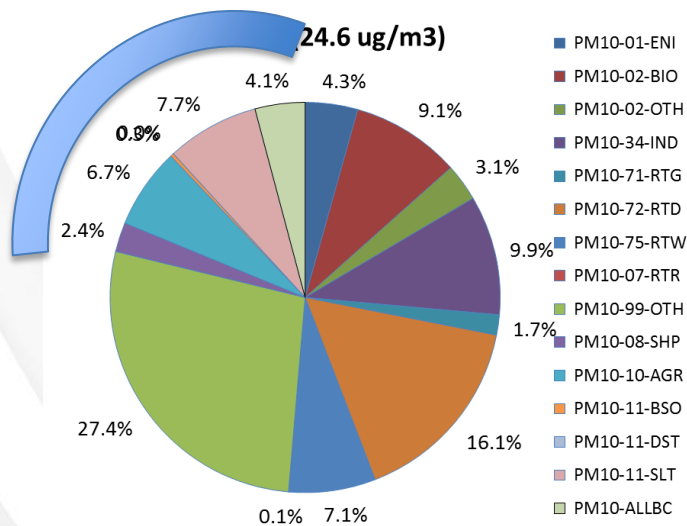
# Winter Episode - Optional - PM<sub>10</sub>

Base case configuration - Winter mean



# Winter Episode - Optional - PM<sub>10</sub>

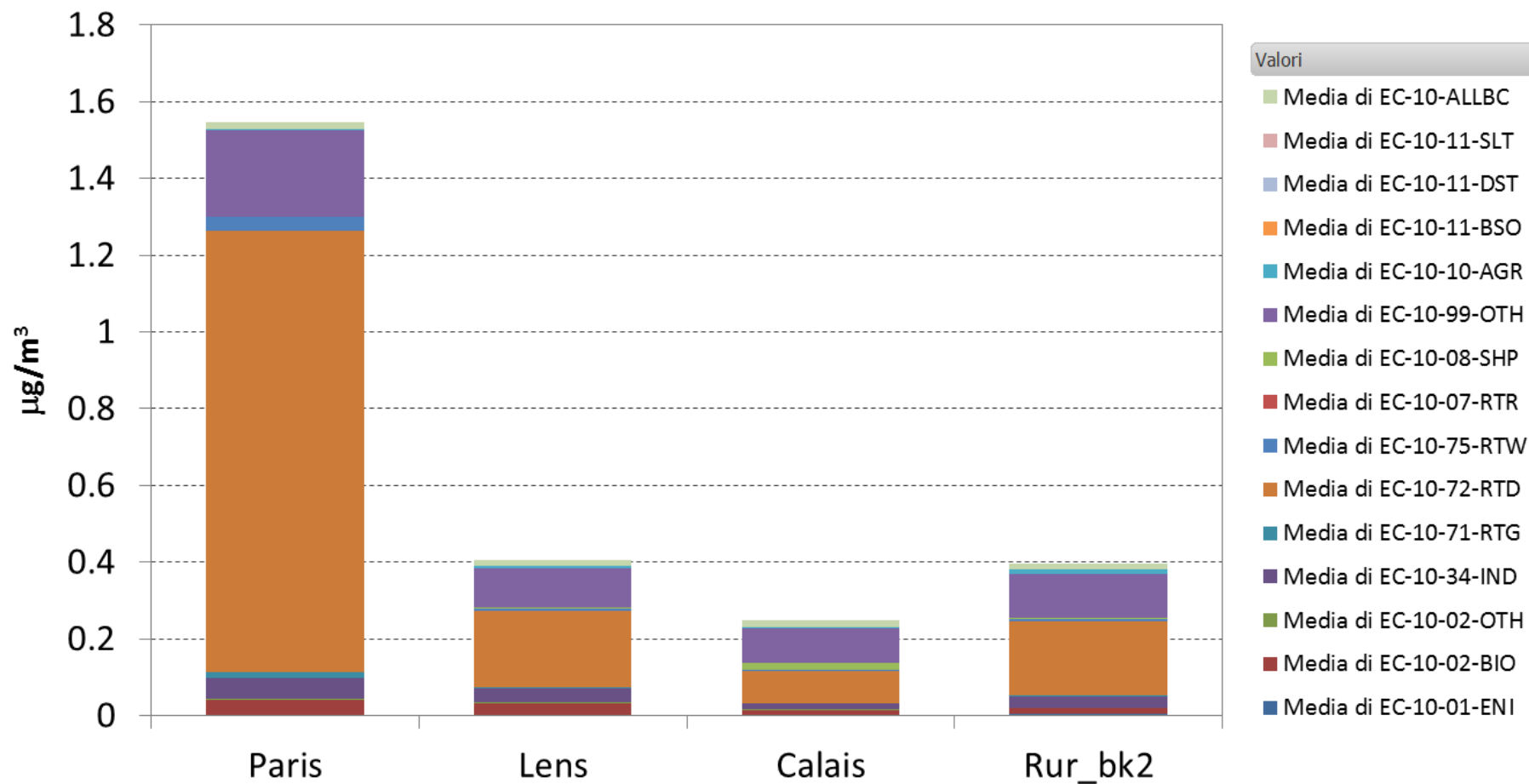
## Base case configuration - Winter mean





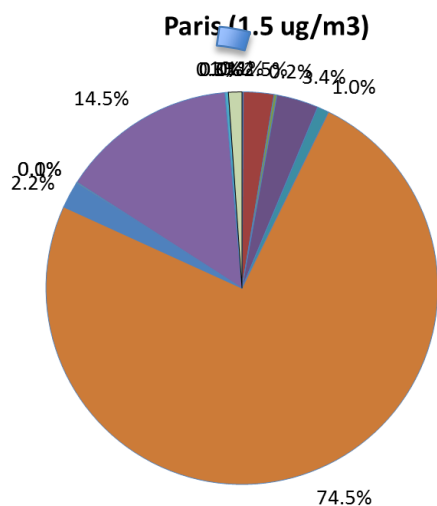
# Summer Episode - Optional - EC

Base case configuration - Summer mean

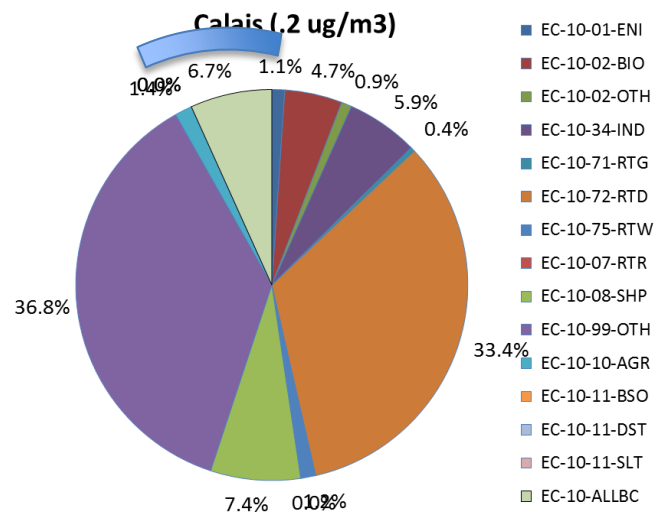


# Summer Episode - Optional - EC

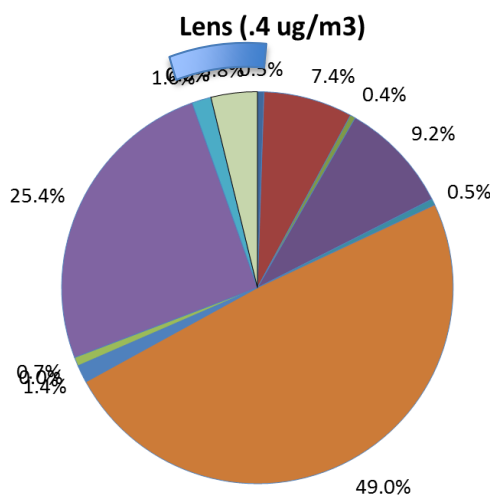
## Base case configuration - Summer mean



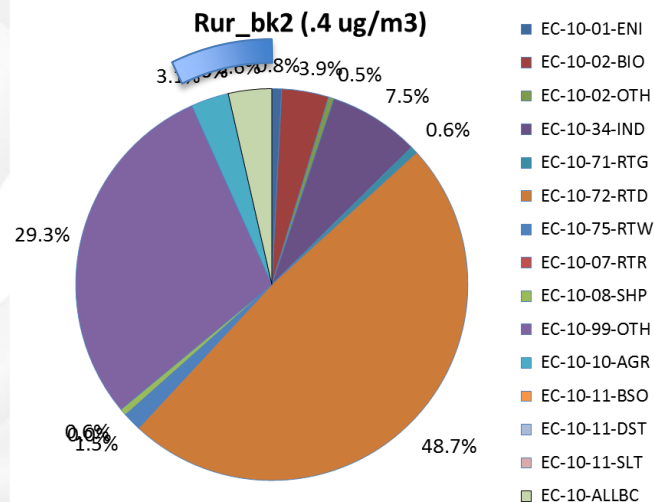
- EC-10-01-ENI
- EC-10-02-BIO
- EC-10-02-OTH
- EC-10-34-IND
- EC-10-71-RTG
- EC-10-72-RTD
- EC-10-75-RTW
- EC-10-07-RTR
- EC-10-08-SHP
- EC-10-99-OTH
- EC-10-10-AGR
- EC-10-11-BSO
- EC-10-11-DST
- EC-10-11-SLT
- EC-10-ALLBC



- EC-10-01-ENI
- EC-10-02-BIO
- EC-10-02-OTH
- EC-10-34-IND
- EC-10-71-RTG
- EC-10-72-RTD
- EC-10-75-RTW
- EC-10-07-RTR
- EC-10-08-SHP
- EC-10-99-OTH
- EC-10-10-AGR
- EC-10-11-BSO
- EC-10-11-DST
- EC-10-11-SLT
- EC-10-ALLBC



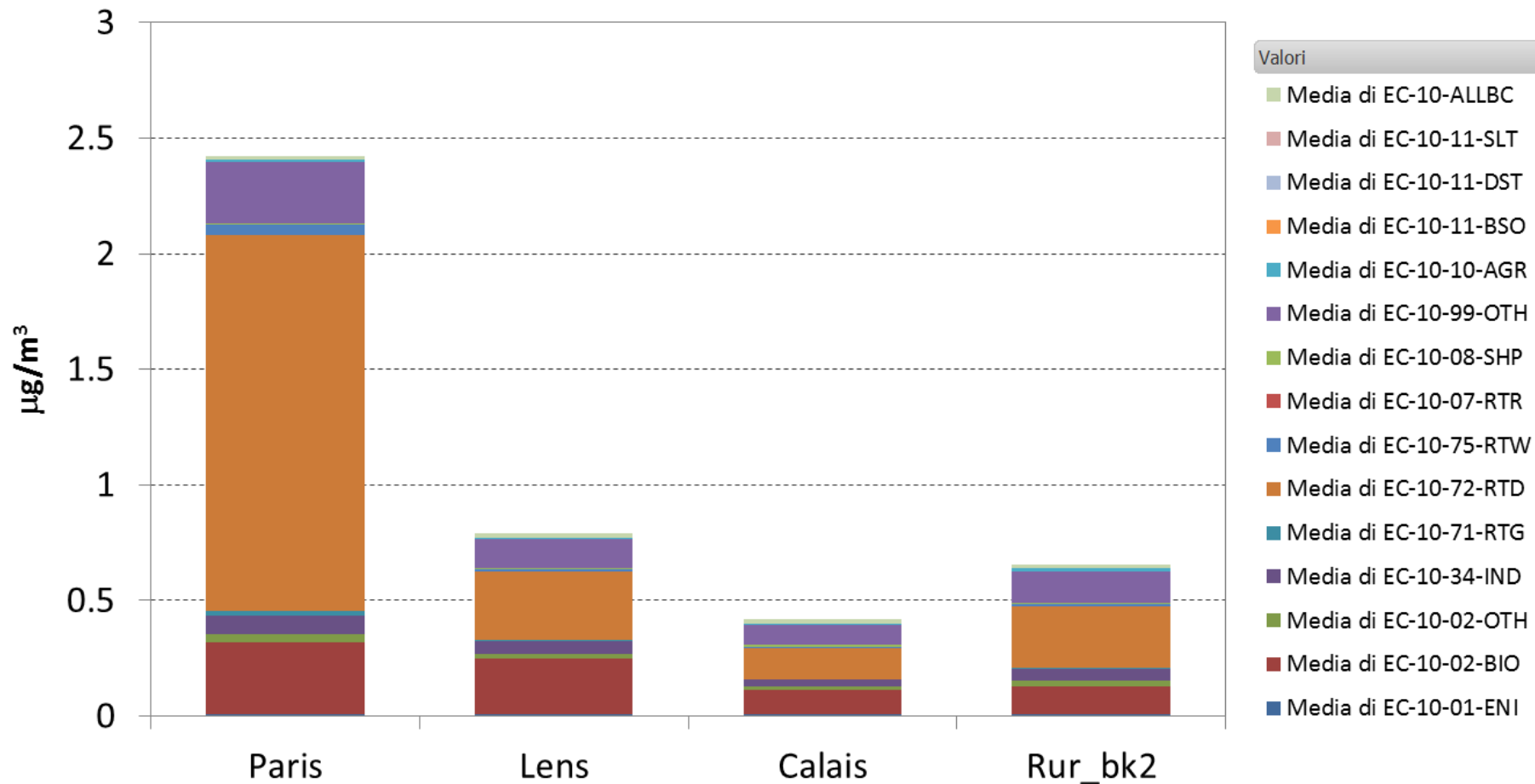
- EC-10-01-ENI
- EC-10-02-BIO
- EC-10-02-OTH
- EC-10-34-IND
- EC-10-71-RTG
- EC-10-72-RTD
- EC-10-75-RTW
- EC-10-07-RTR
- EC-10-08-SHP
- EC-10-99-OTH
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- EC-10-11-DST
- EC-10-11-SLT
- EC-10-ALLBC

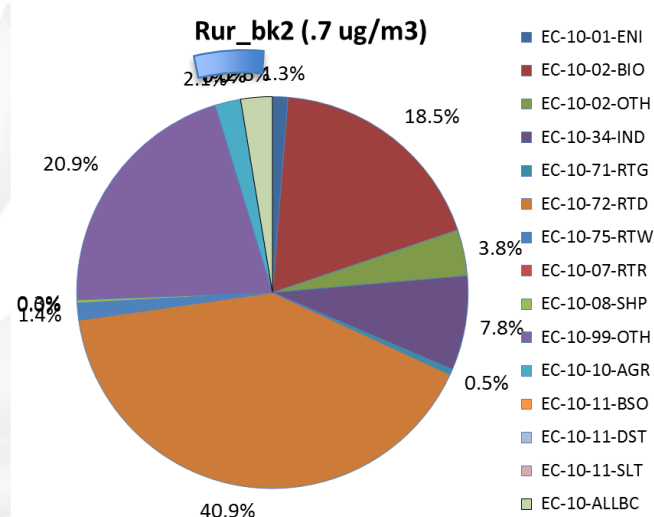
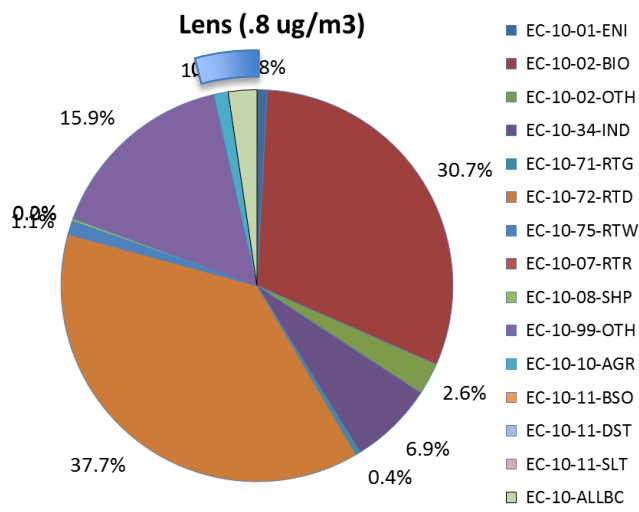
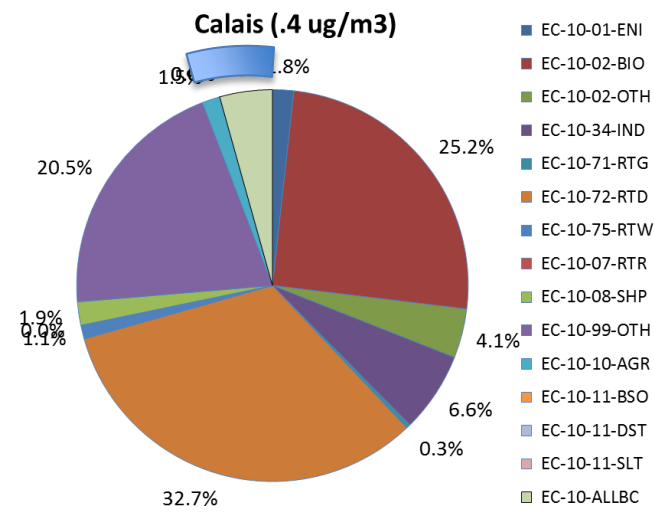
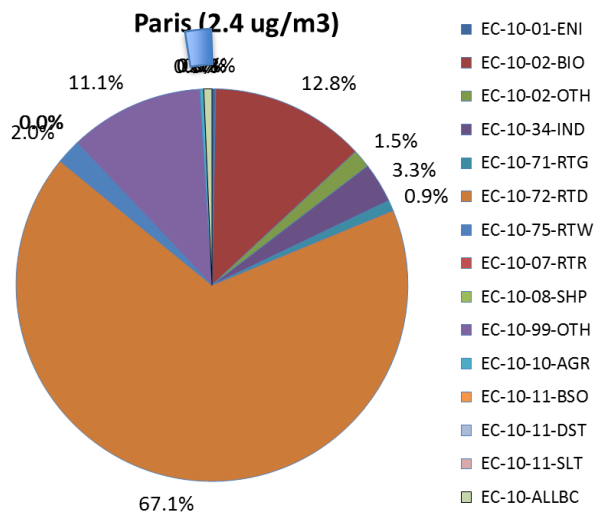
# Winter Episode - Optional - EC

Base case configuration - Winter mean



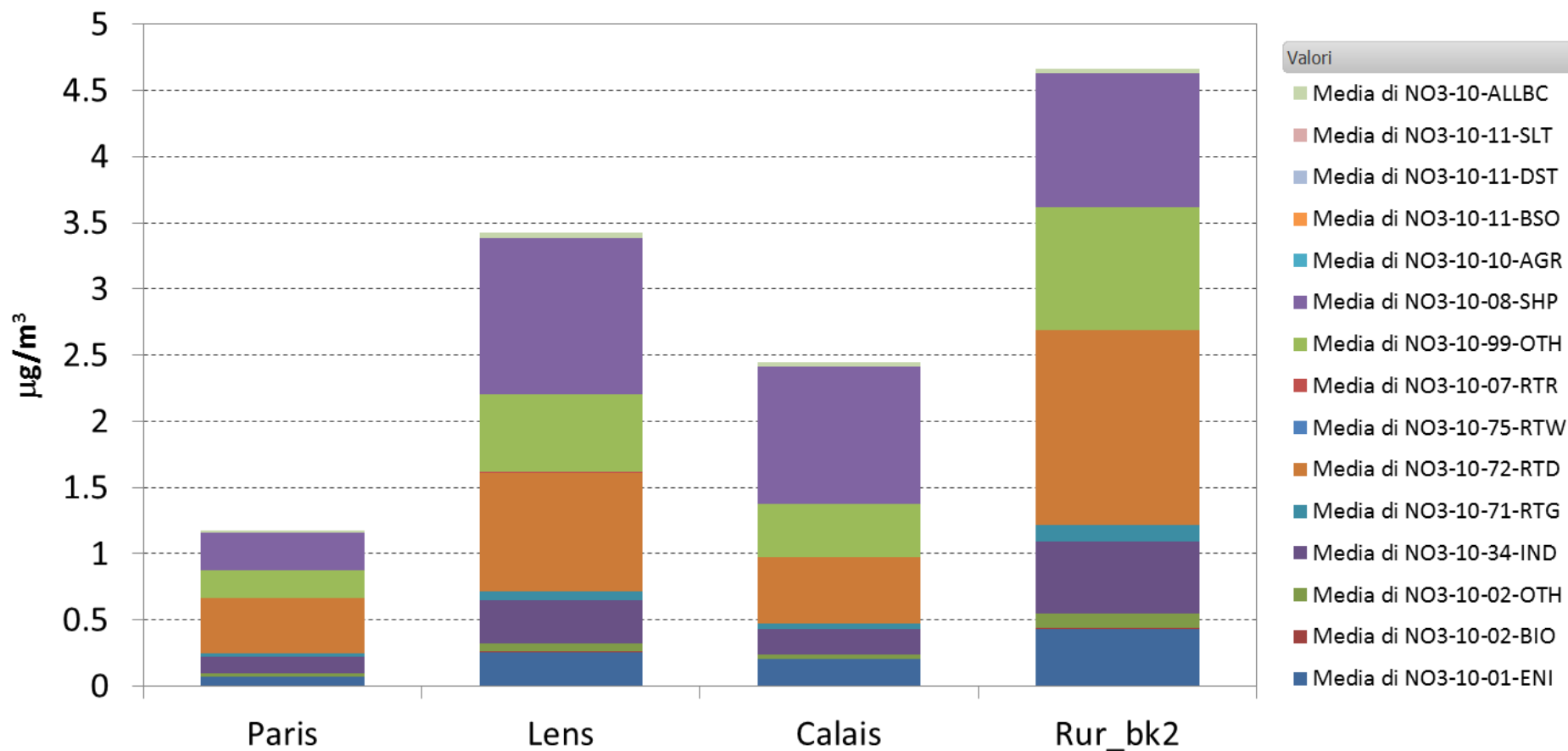
# Winter Episode - Optional - EC

## Base case configuration - Winter mean



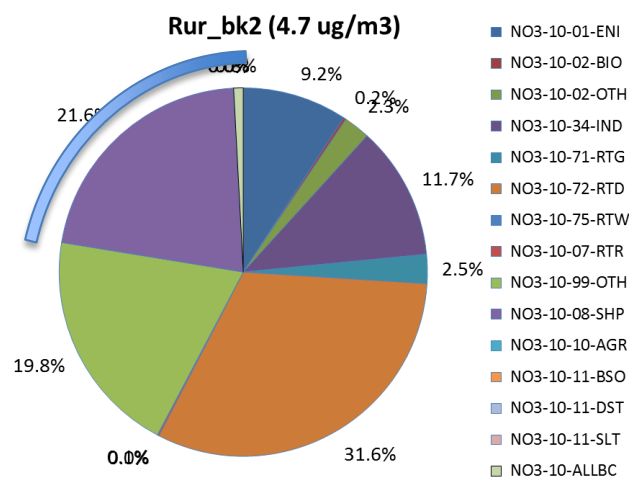
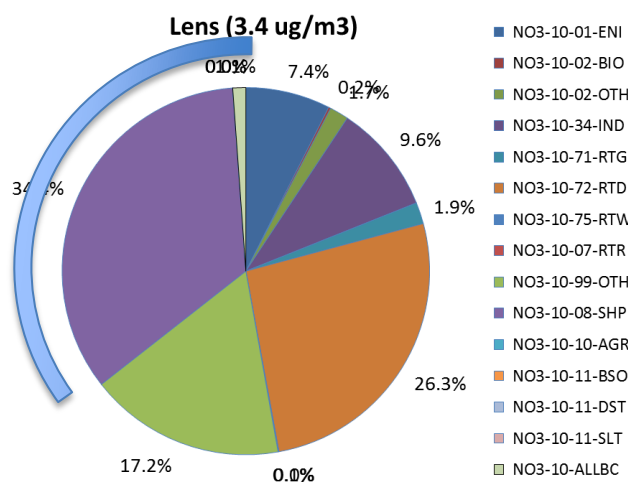
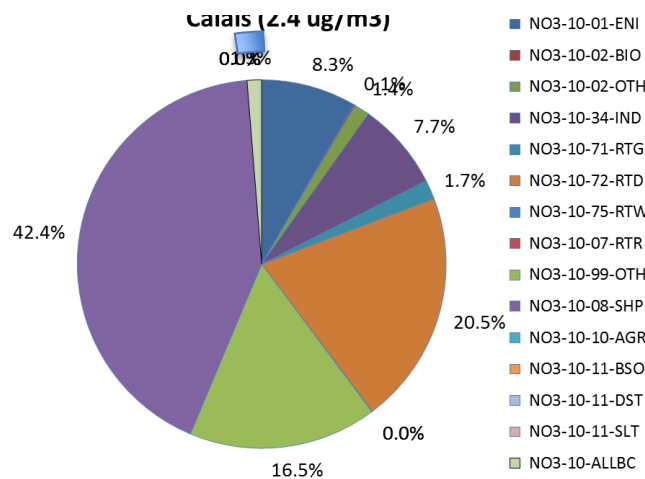
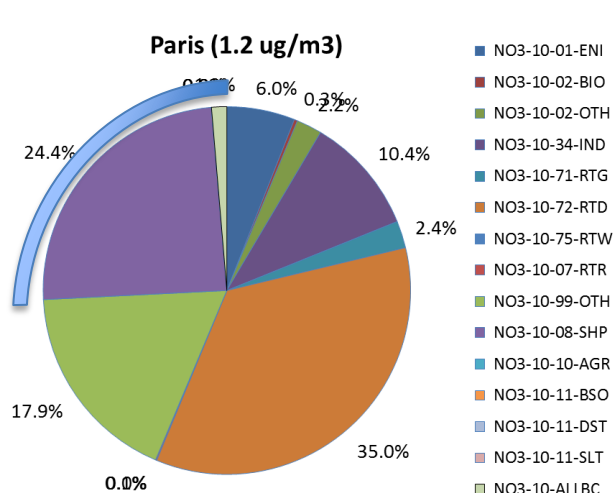
# Summer Episode - Optional - NO<sub>3</sub><sup>-</sup>

Base case configuration - Summer mean



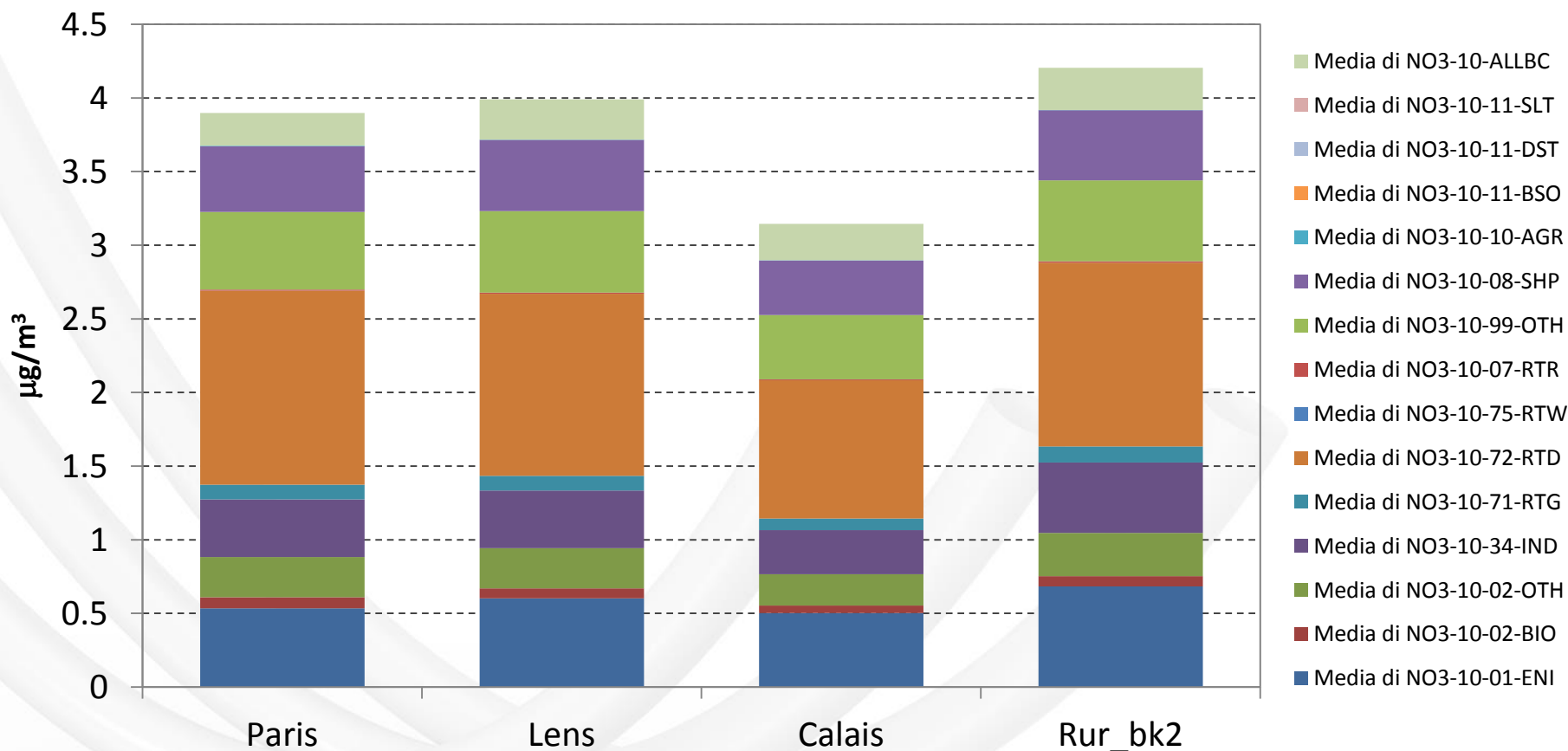
# Summer Episode - Optional - NO<sub>3</sub><sup>-</sup>

## Base case configuration - Summer mean



# Winter Episode - Optional - NO<sub>3</sub><sup>-</sup>

Base case configuration - Winter mean

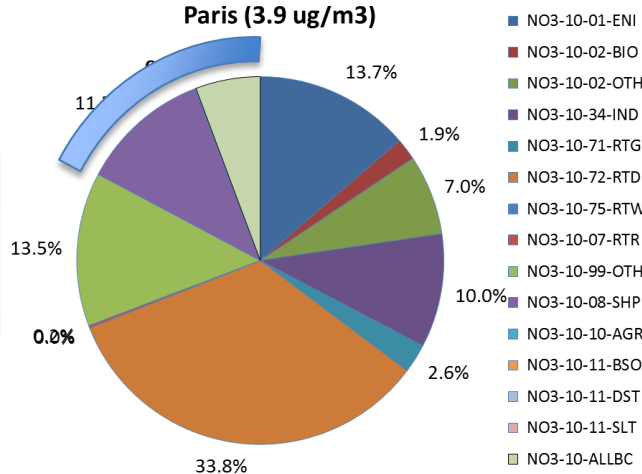




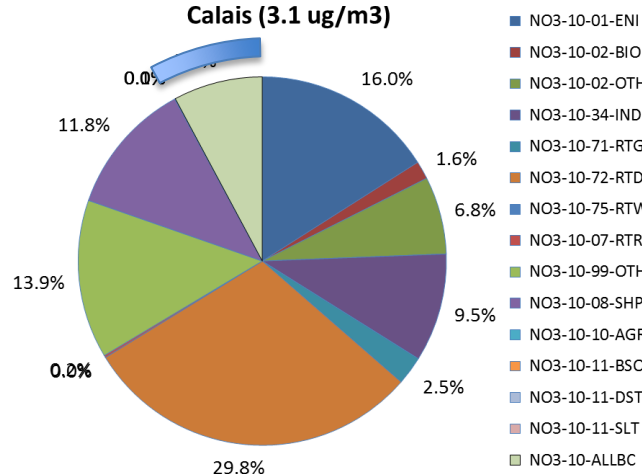
# Winter Episode - Optional - NO<sub>3</sub><sup>-</sup>

## Base case configuration - Winter mean

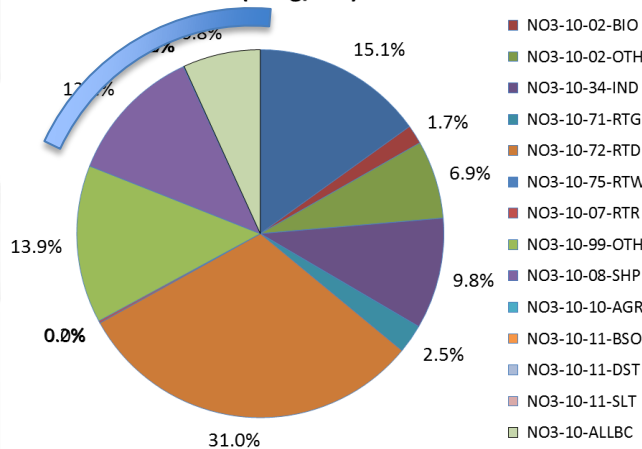
Paris (3.9 ug/m3)



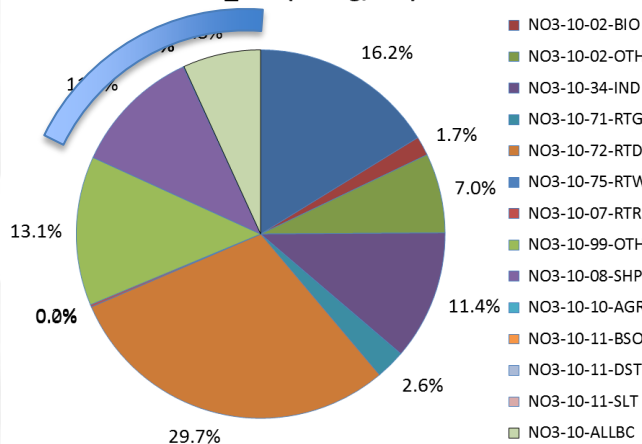
Calais (3.1 ug/m3)



Lens (4. ug/m3)



Rur\_bk2 (4.2 ug/m3)

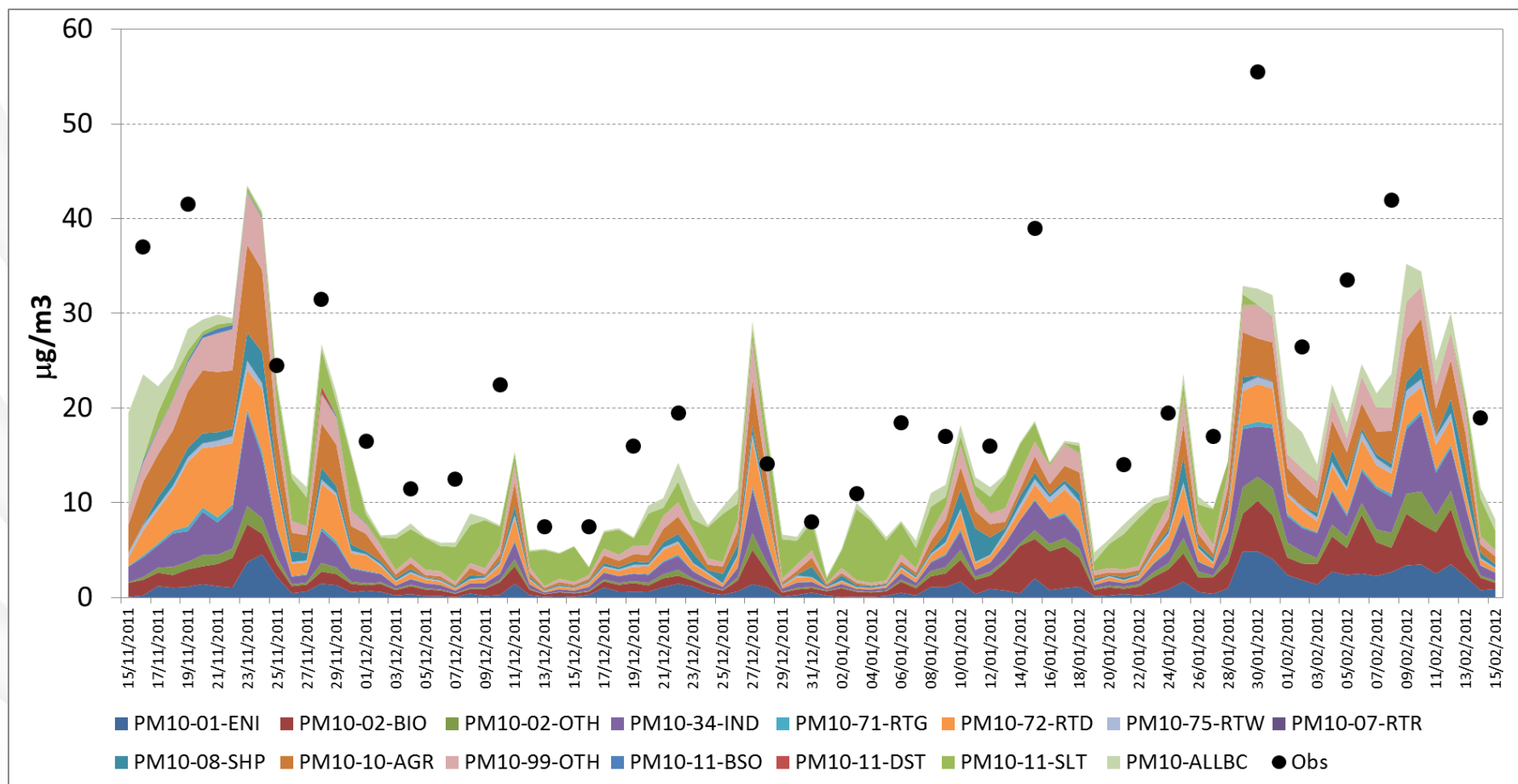


# SCEs time series and comparison with observations

- *Temporal evolution of SCEs*
- *Relationship between SCEs and meteorology*
- *SCEs and Model Performance*
- *Local vs regional sources (first guess)*
- *Secondary PM apportionment*

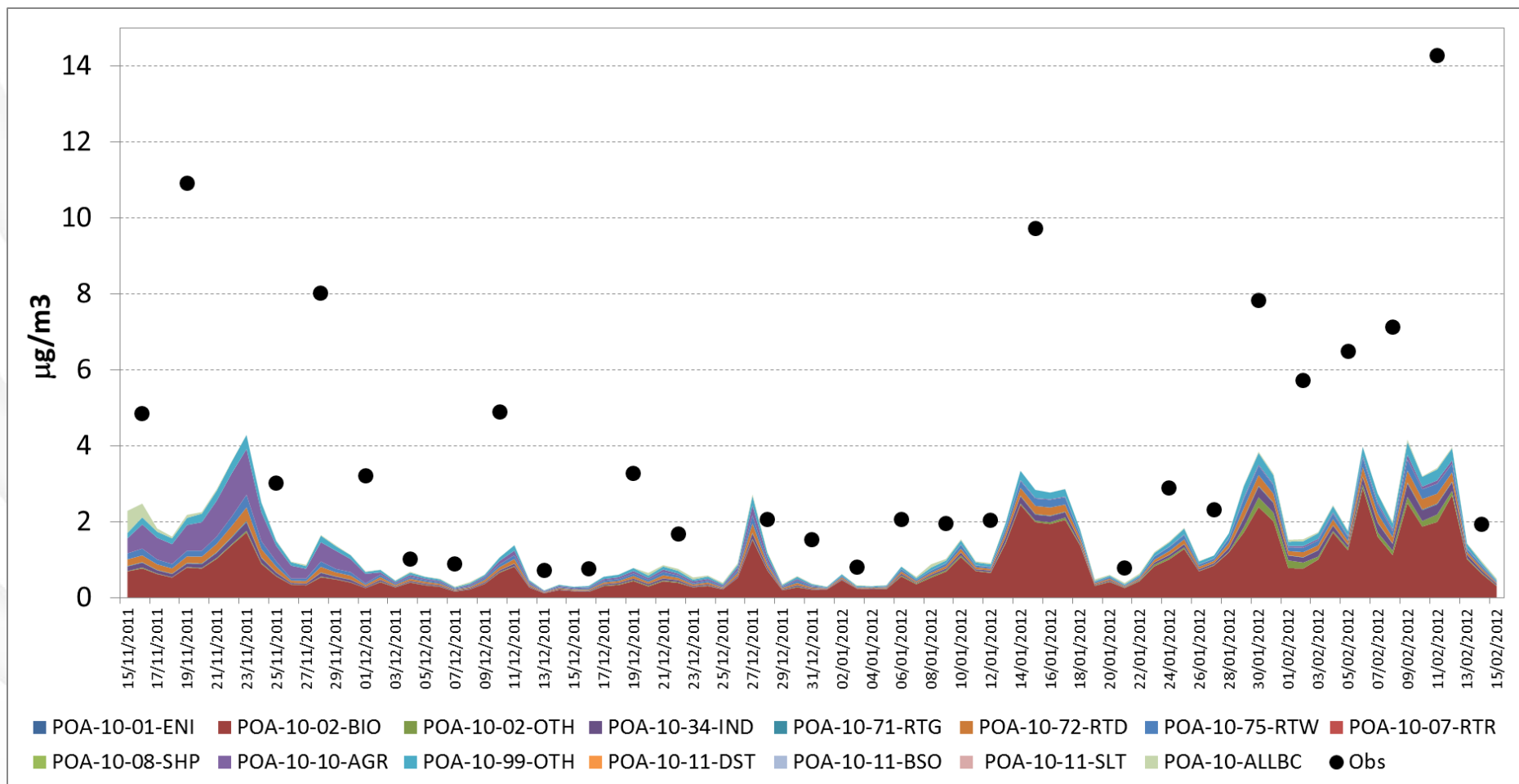
# Winter Episode - Optional - PM<sub>10</sub>

**Lens** - Base case configuration - Daily time series



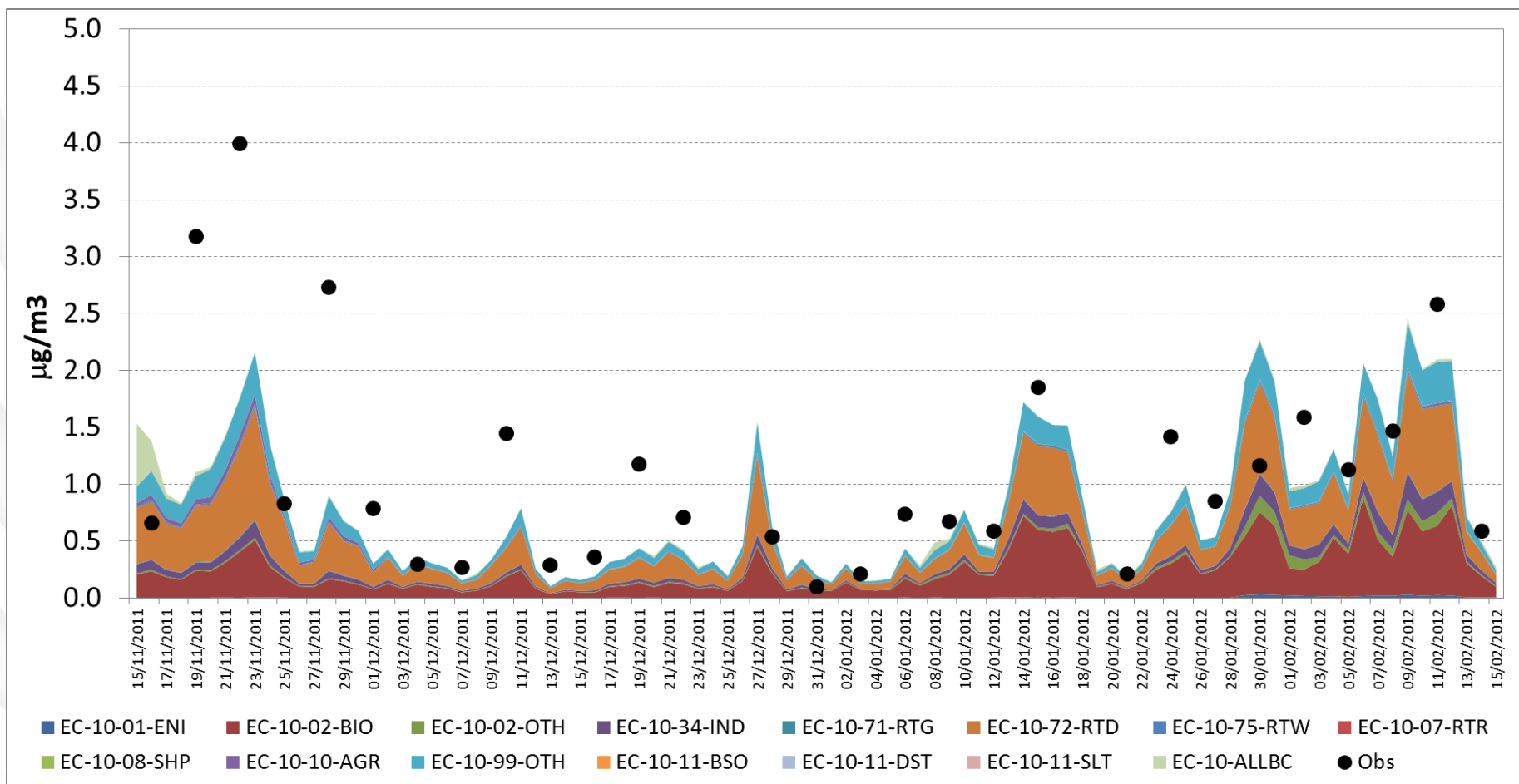
# Winter Episode - Optional - OM

**Lens** - Base case configuration - Daily time series



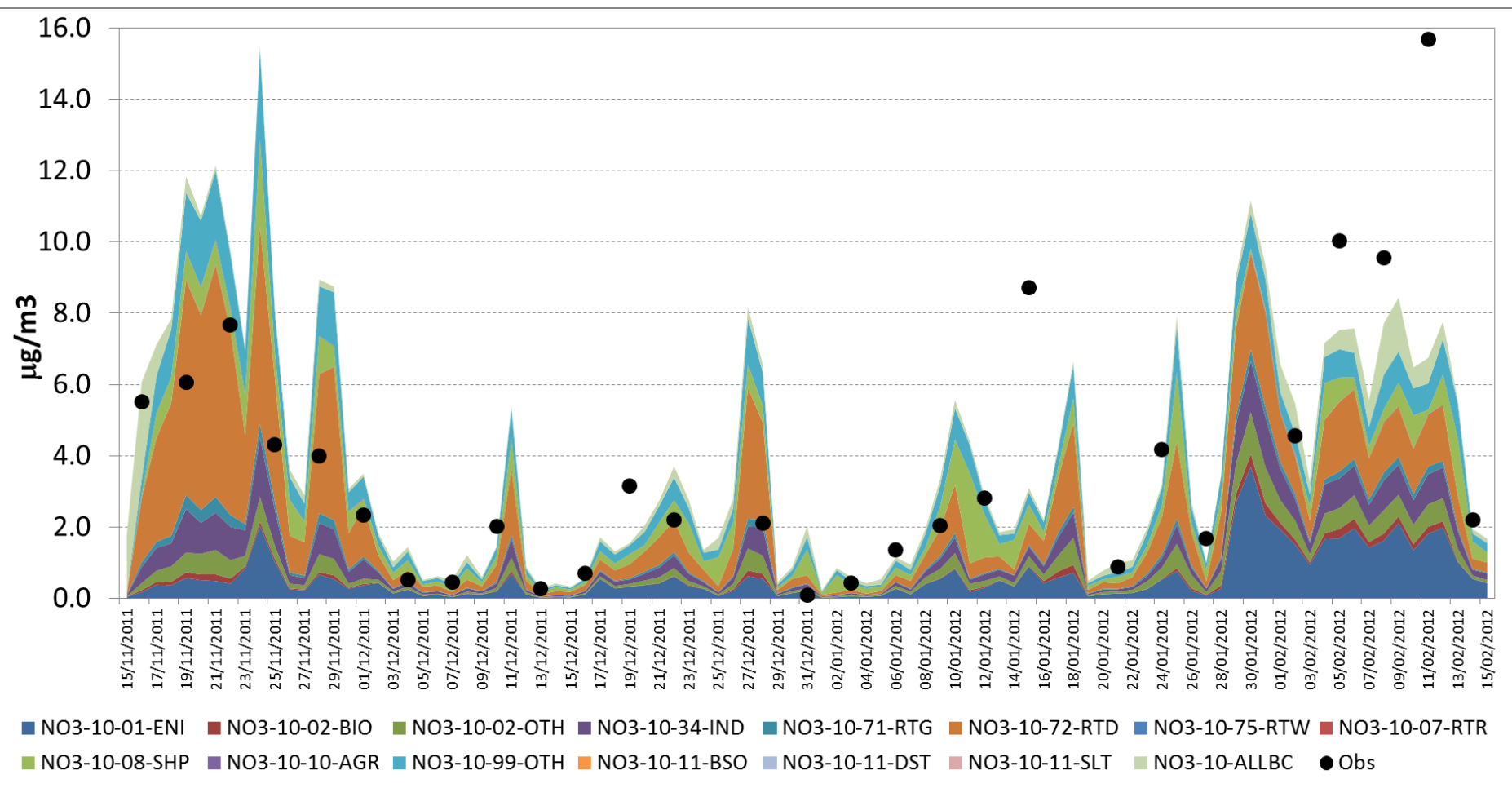
# Winter Episode - Optional - EC

**Lens** - Base case configuration - Daily time series



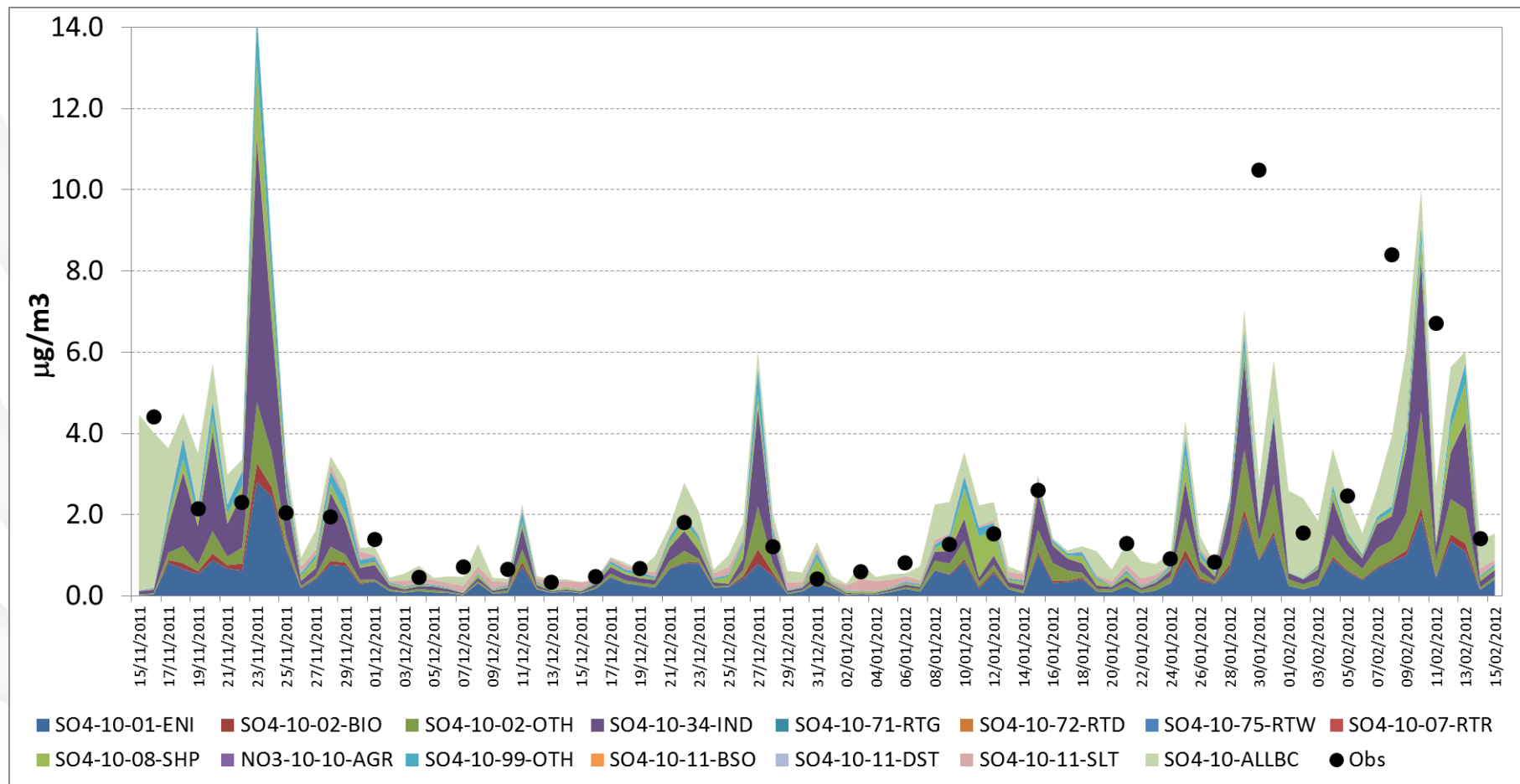
# Winter Episode - Optional - NO<sub>3</sub><sup>-</sup>

**Lens** - Base case configuration - Daily time series



# Winter Episode - Optional - $SO_4^{=}$

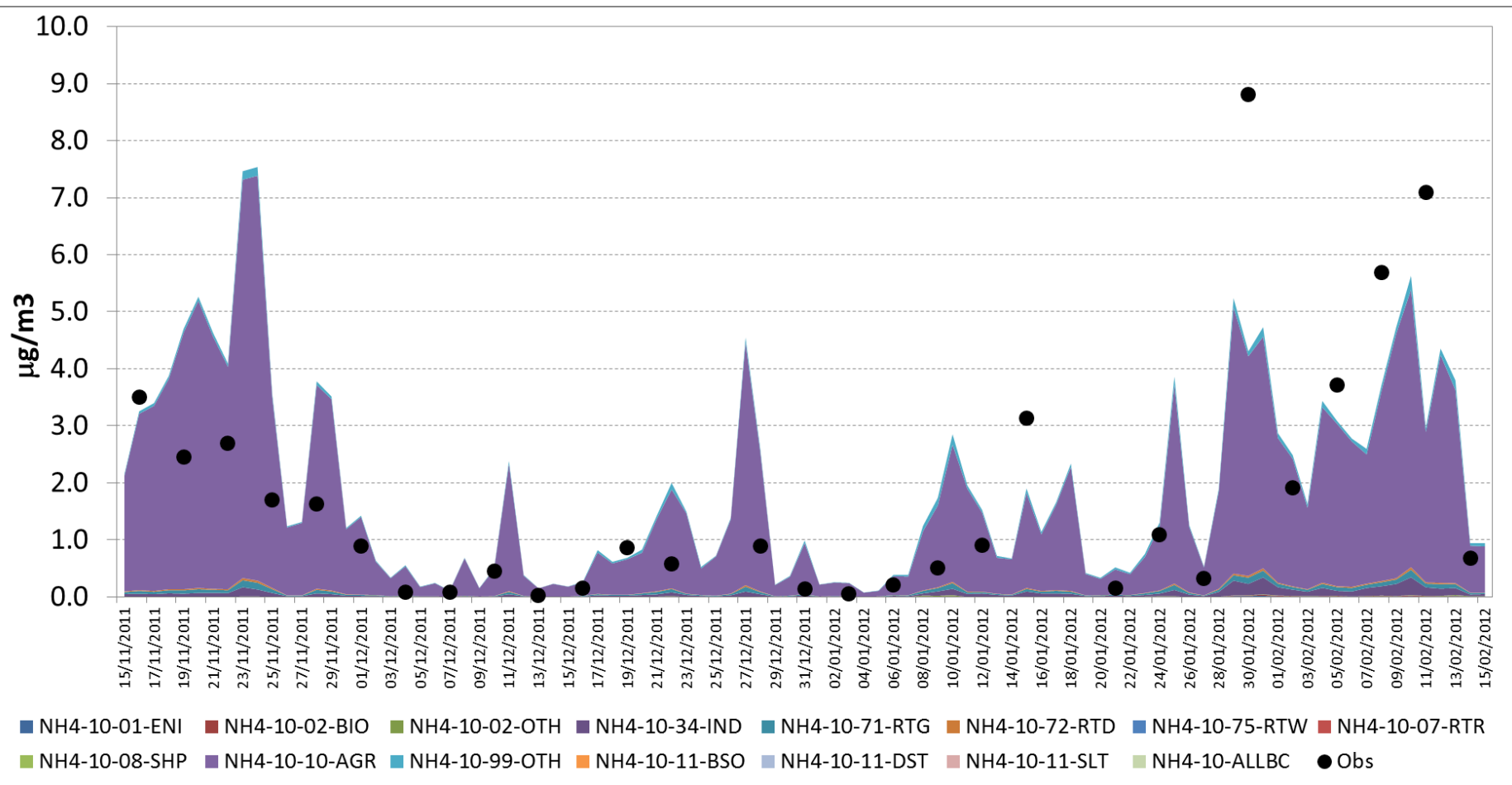
**Lens** - Base case configuration - Daily time series





# Winter Episode - Optional - NH<sub>4</sub><sup>+</sup>

**Lens** - Base case configuration - Daily time series



# PSAT Sensitivity analysis

- *CAMx MPE and SCEs were not very sensitive to differences in input setup*
- *Changes in dispersion efficiency reduce absolute concentrations but are less effective on relative contributions*
- *Changes in grid resolution have different impact on local and regional sources, influencing the corresponding source contribution, particularly at urban sites.*

# Further analysis

- *Evaluation of both source categories and regions (urban, regional, etc...)*
- *Tracers?*
- *Improving Organic Aerosol modelling*

# Open issues

- *Are there systematic differences between tagged approaches and brute force methods?*
- *Is there an influence of OC underestimation on SCEs?*
- *Is there an influence of (likely) underestimation of PMcoarse on SCEs?*
- *How can RMs results improve CTMs MPE and SA? Use of organic tracers?...*
- *How can we combine RMs and CTMs results to provide more reliable and thorough SCEs?*