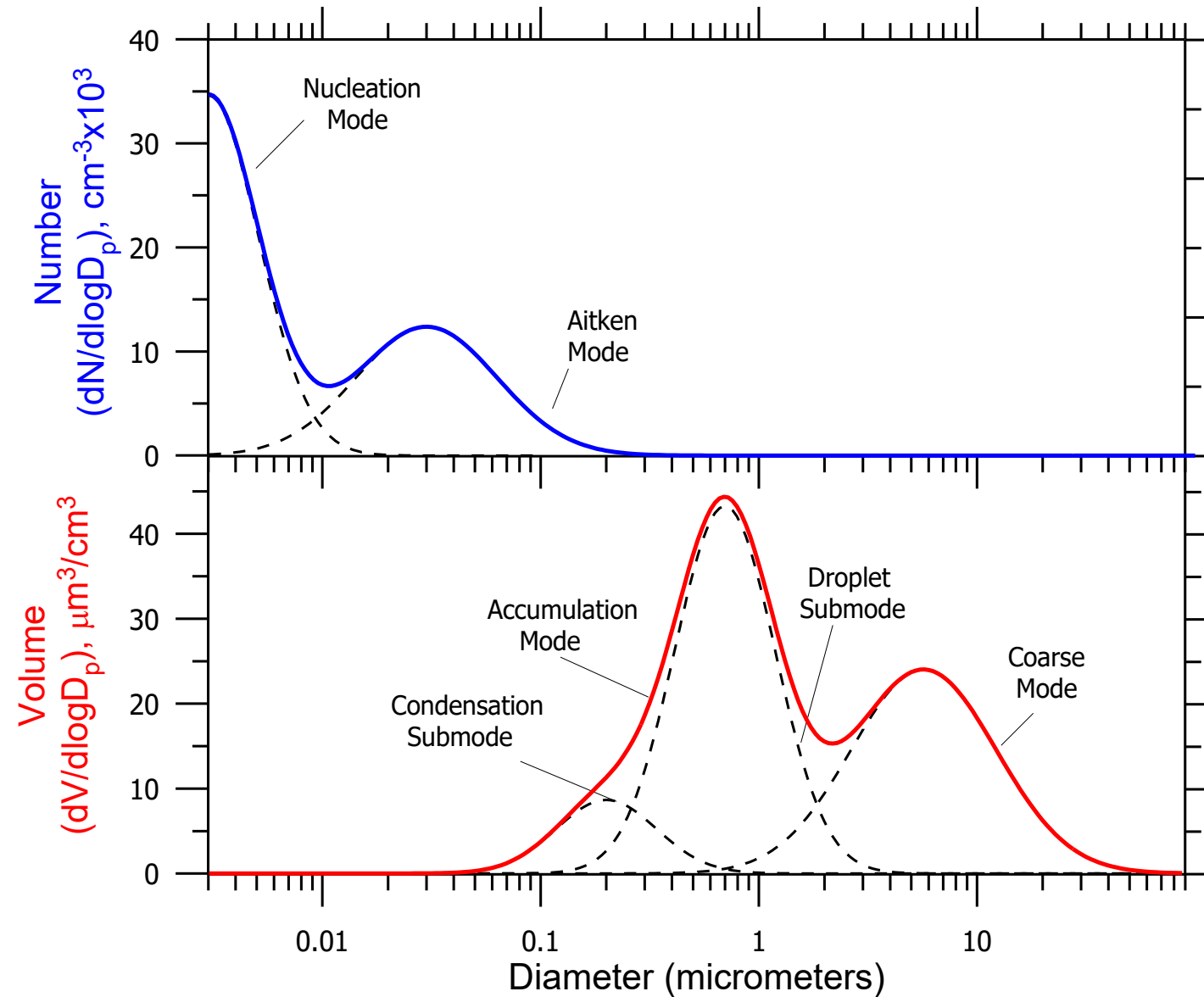


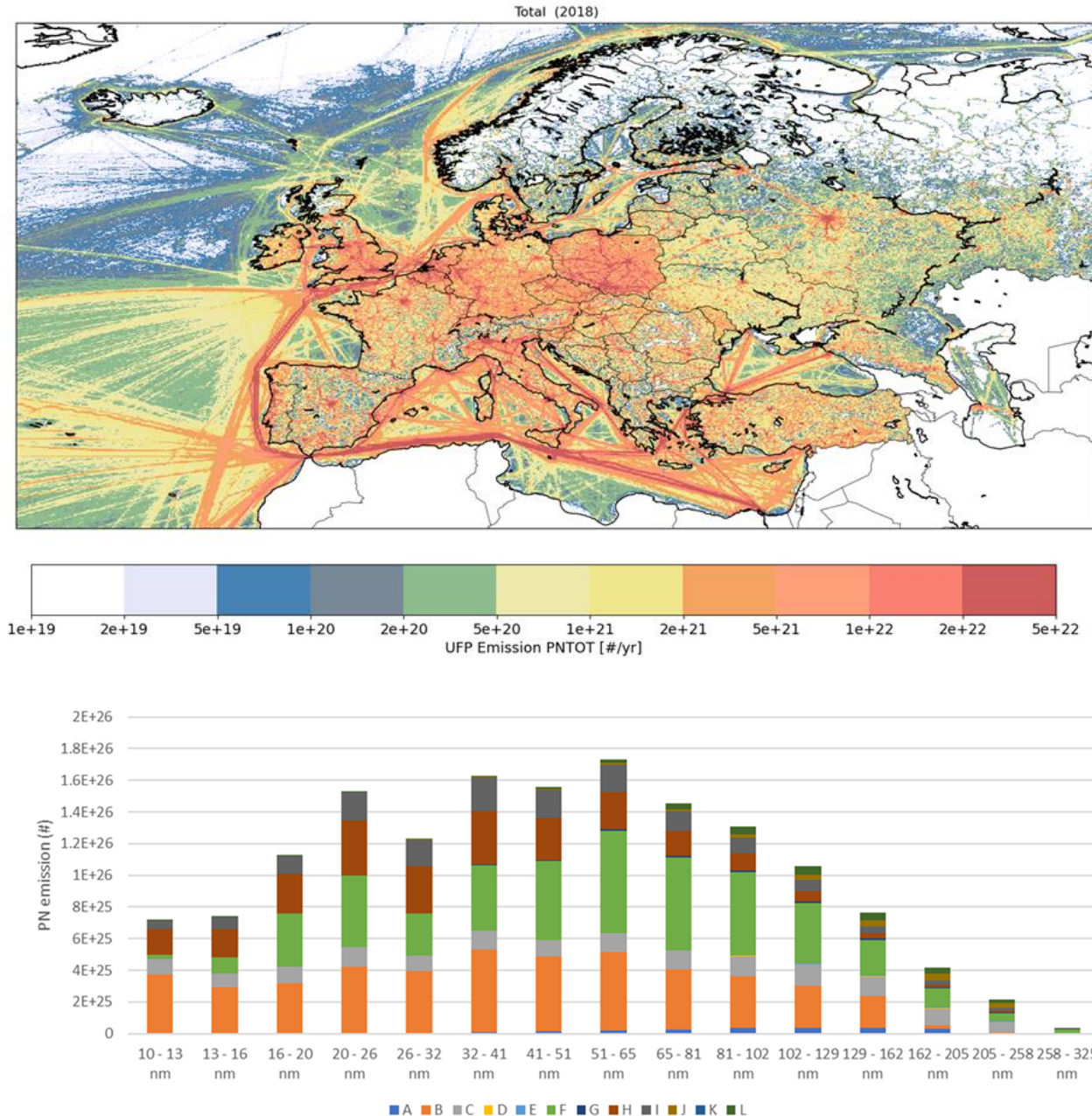
ST16: Multiscale Ultrafine Particle Modeling

Spyros Pandis, Karine Sartelet, and Maria Kanakidou

Atmospheric Aerosol Size Distribution

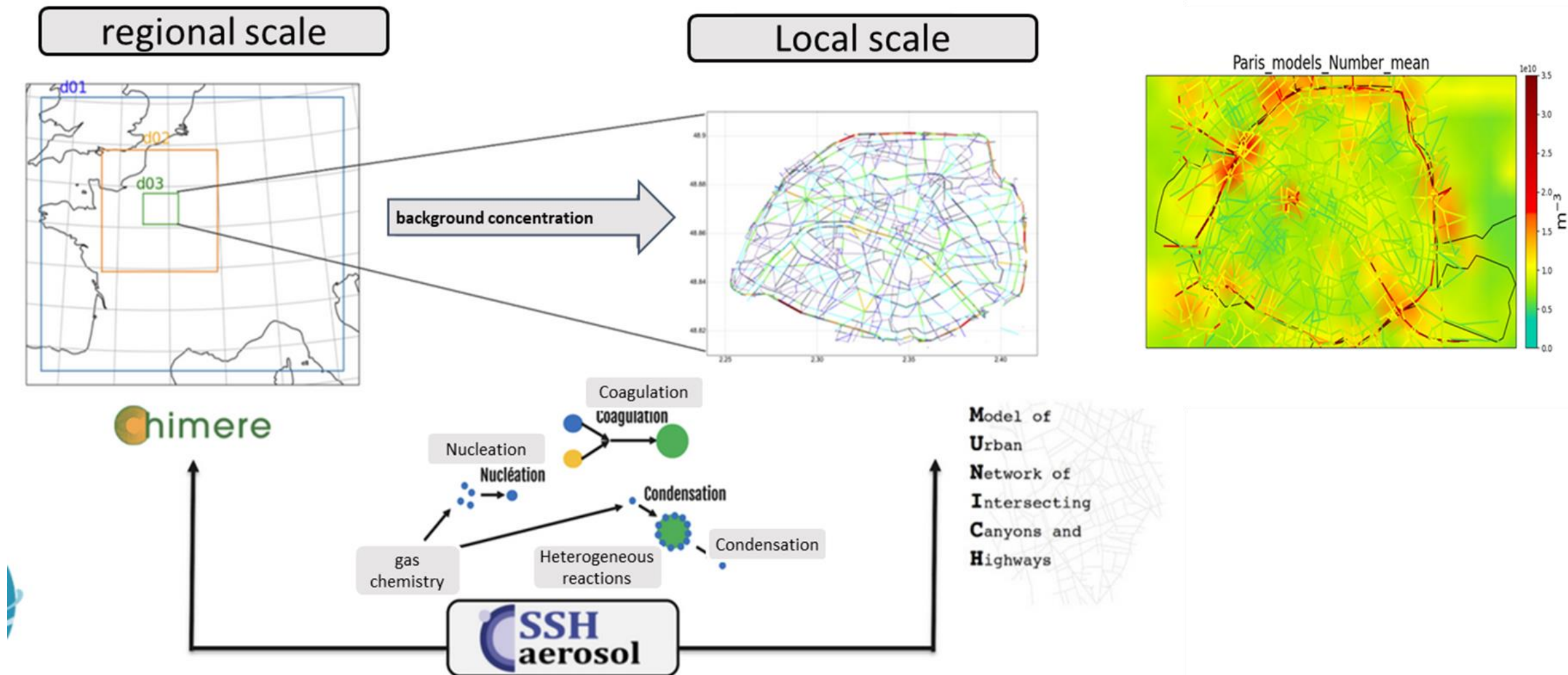


Aerosol Number Emissions in Europe

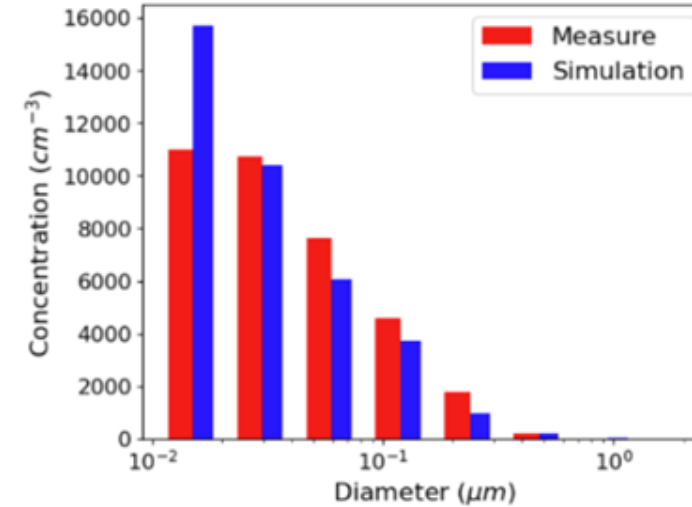
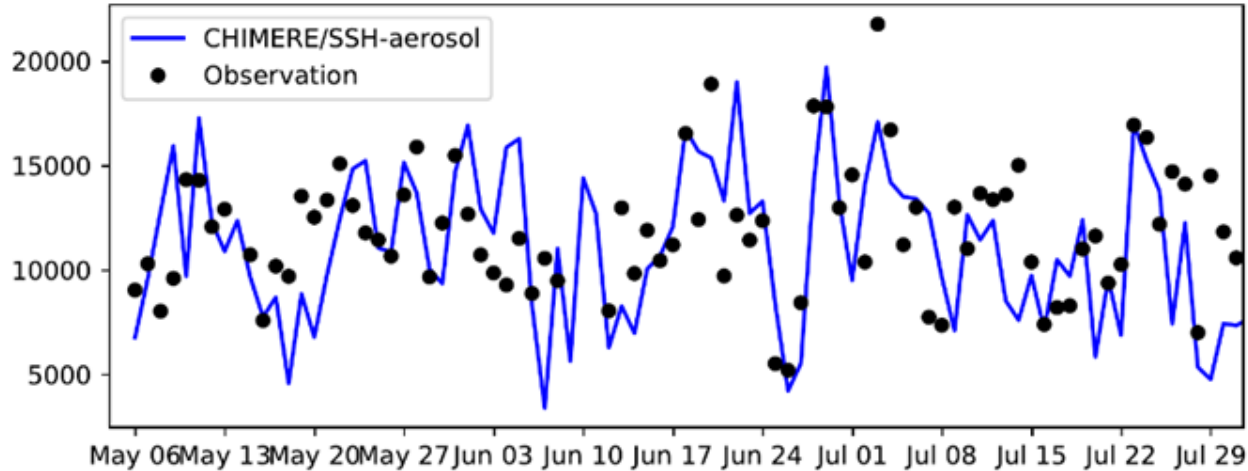


Spatial and temporal resolution but also size, composition, and source resolution

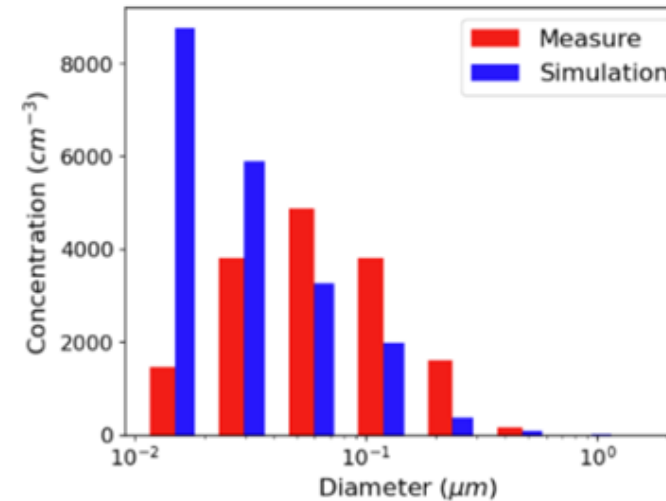
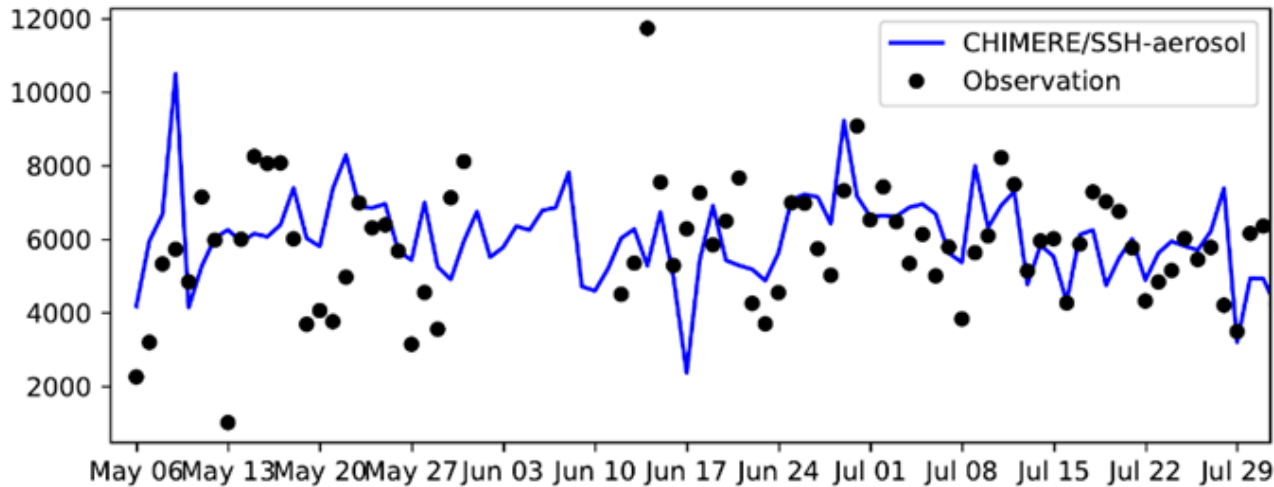
Modelling chain- CHIMERE / MUNICH



CHIMERE evaluation



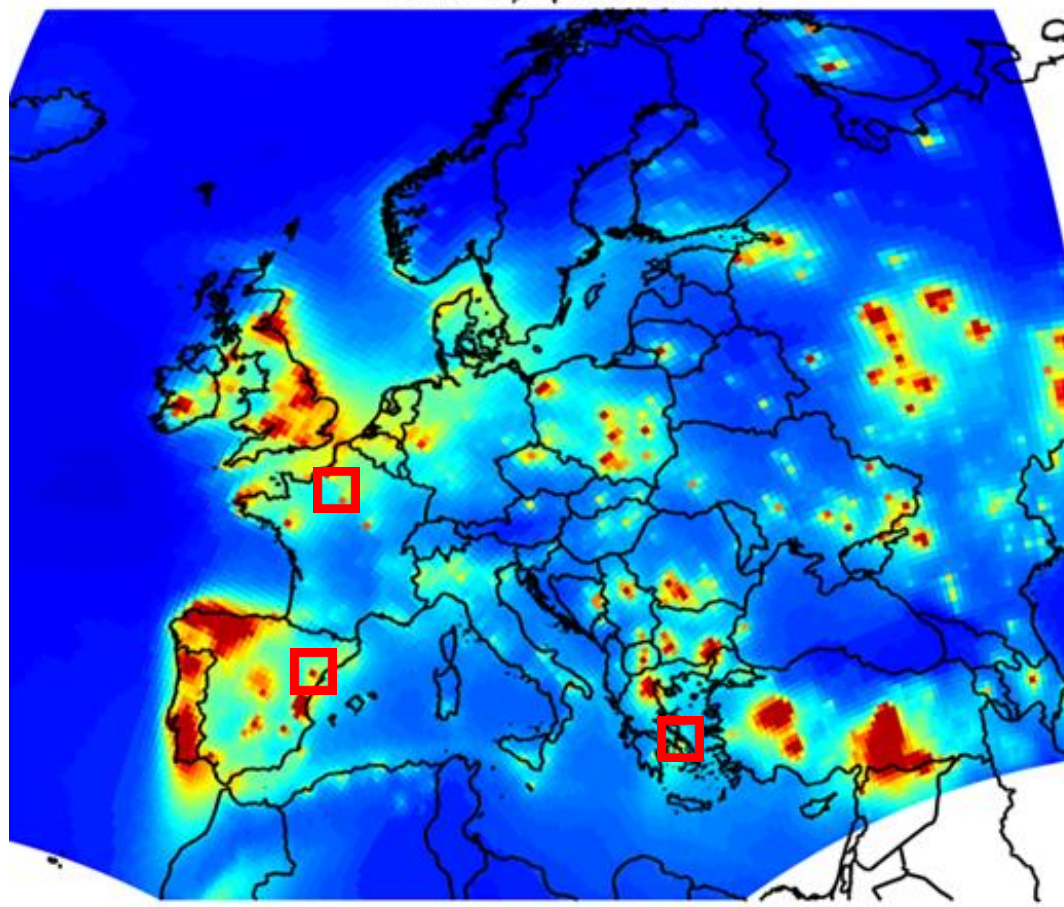
Barcelona



Ispra

PMCAMx-UF High-Resolution Applications

European domain: 36x36 km² resolution

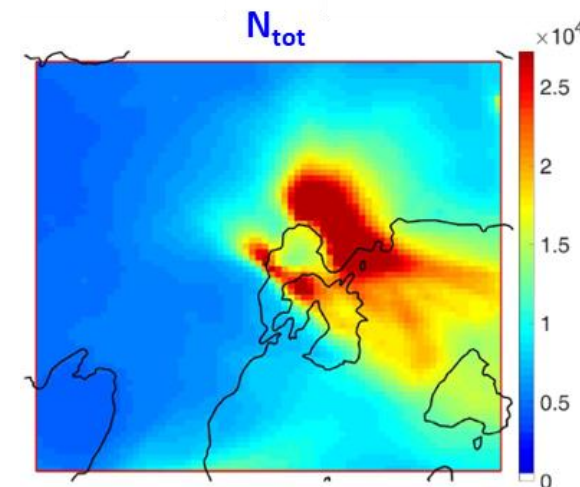


Athens, Barcelona, Paris

Example of zooming over Athens

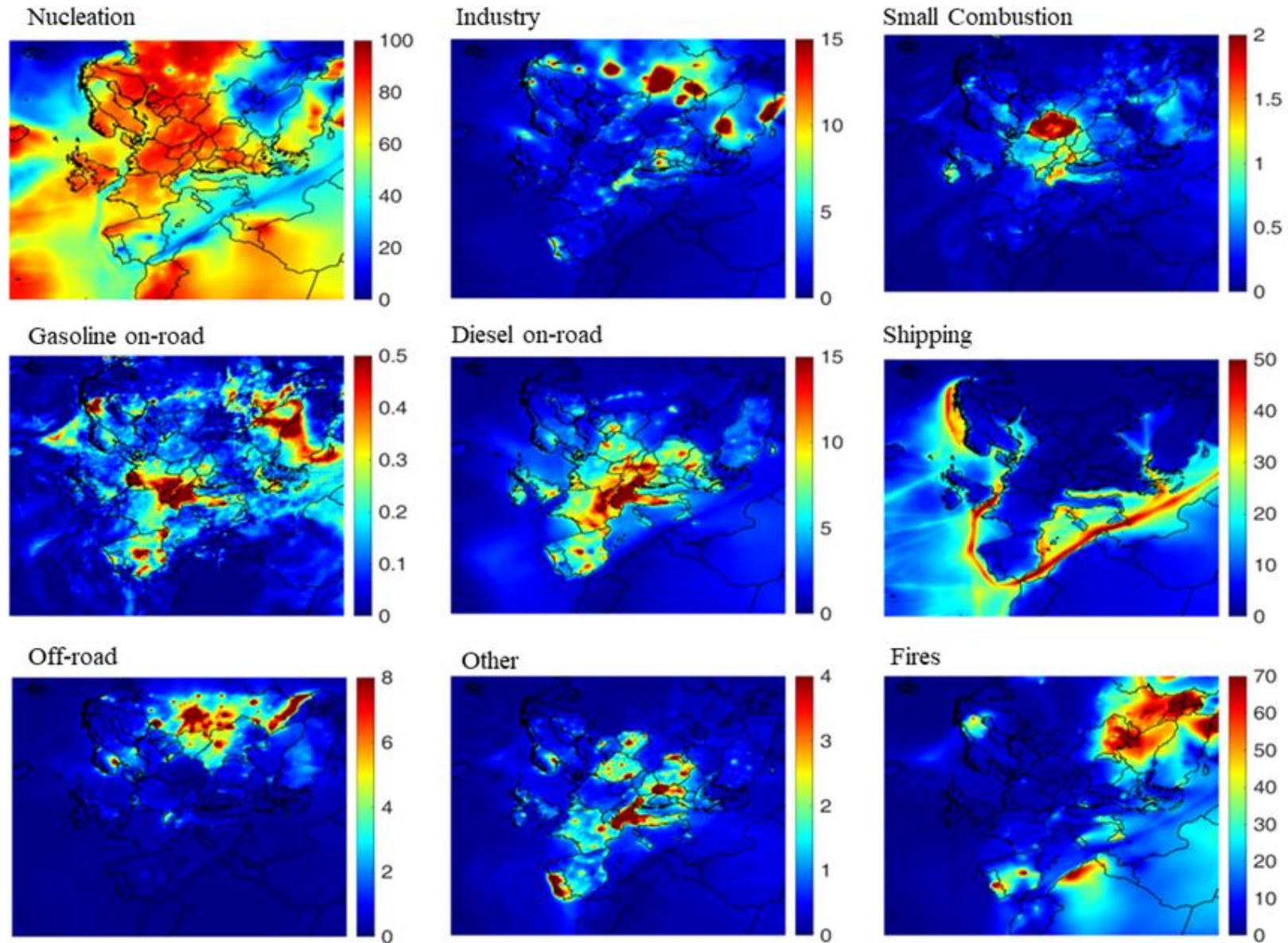


12 km x 12 km
3 km x 3 km
1 km x 1 km

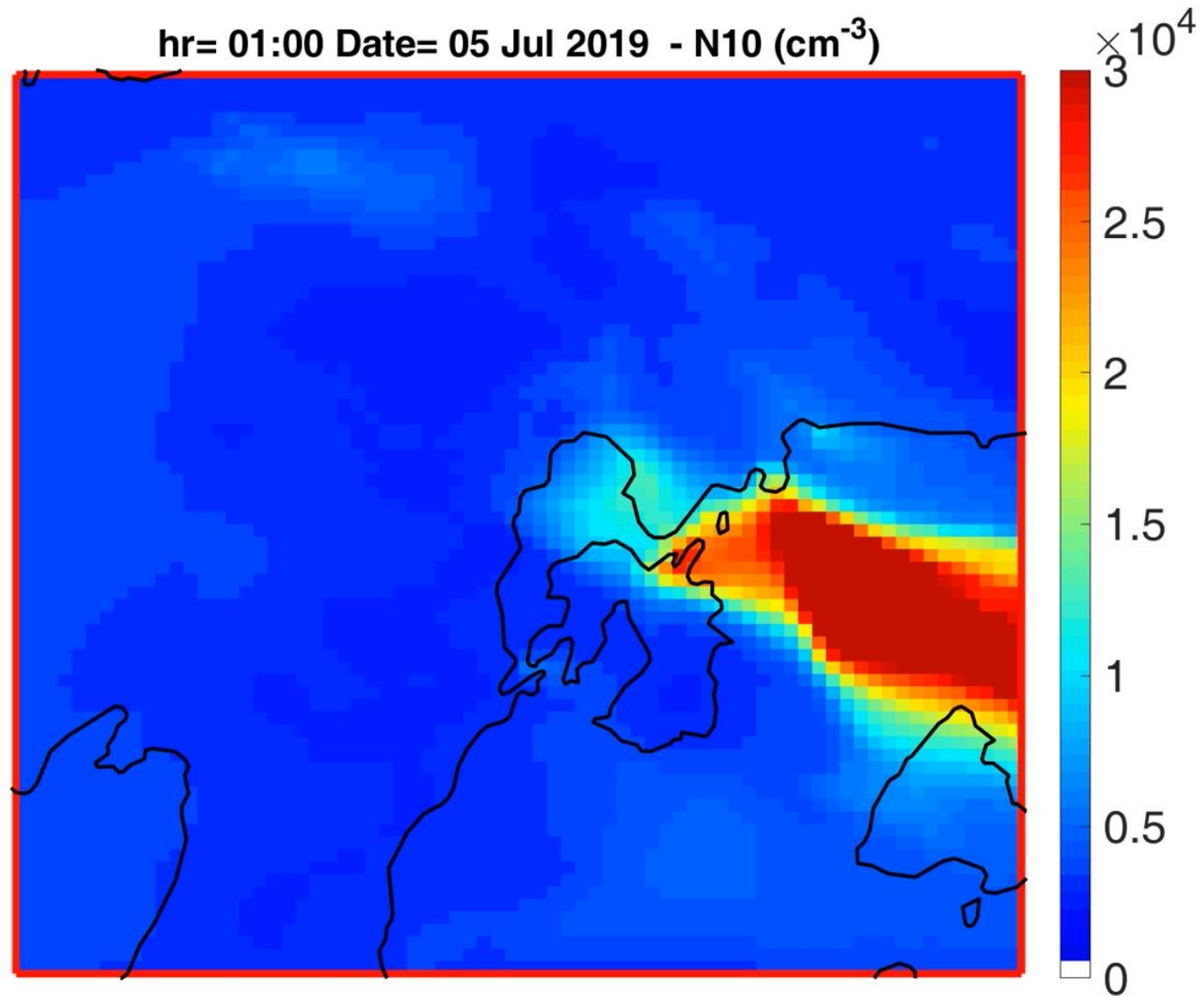


Athens
1 km x 1 km
TNO emissions
NOA downscaling

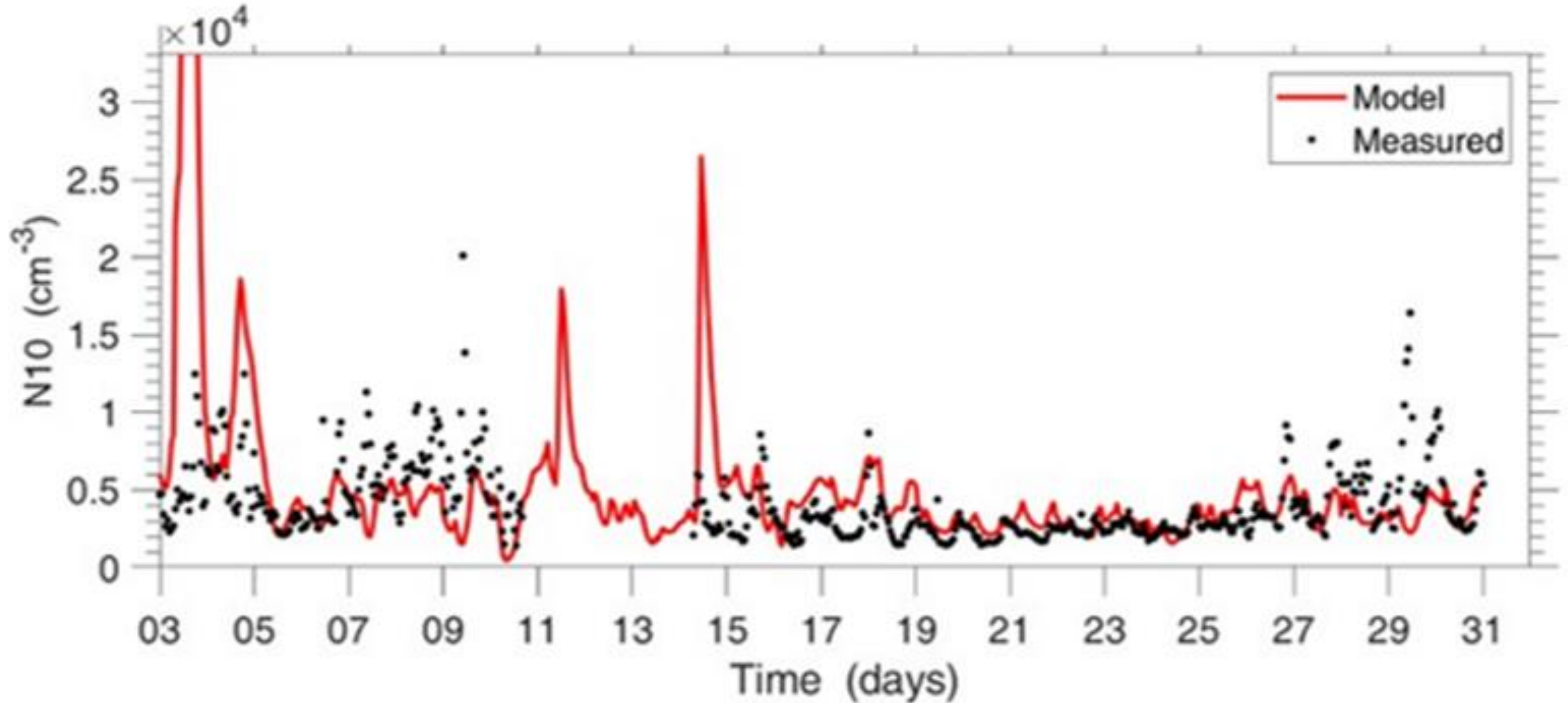
Predicted Source Contributions to N_{10} (Summer)



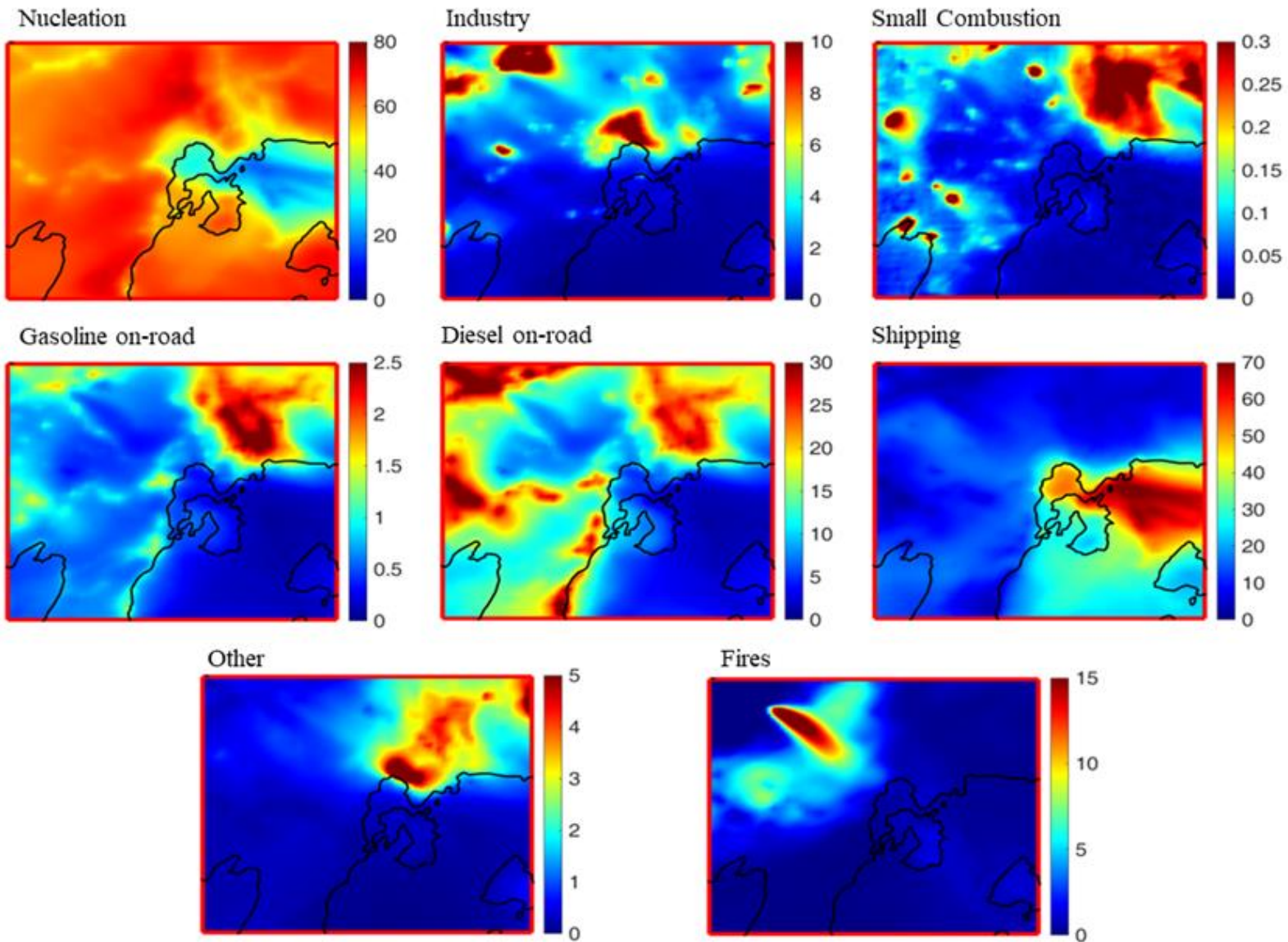
Predicted N_{10} Concentrations (Athens, summer)



Evaluation of PMCAMx-UF at Athens for N_{10} (summer)

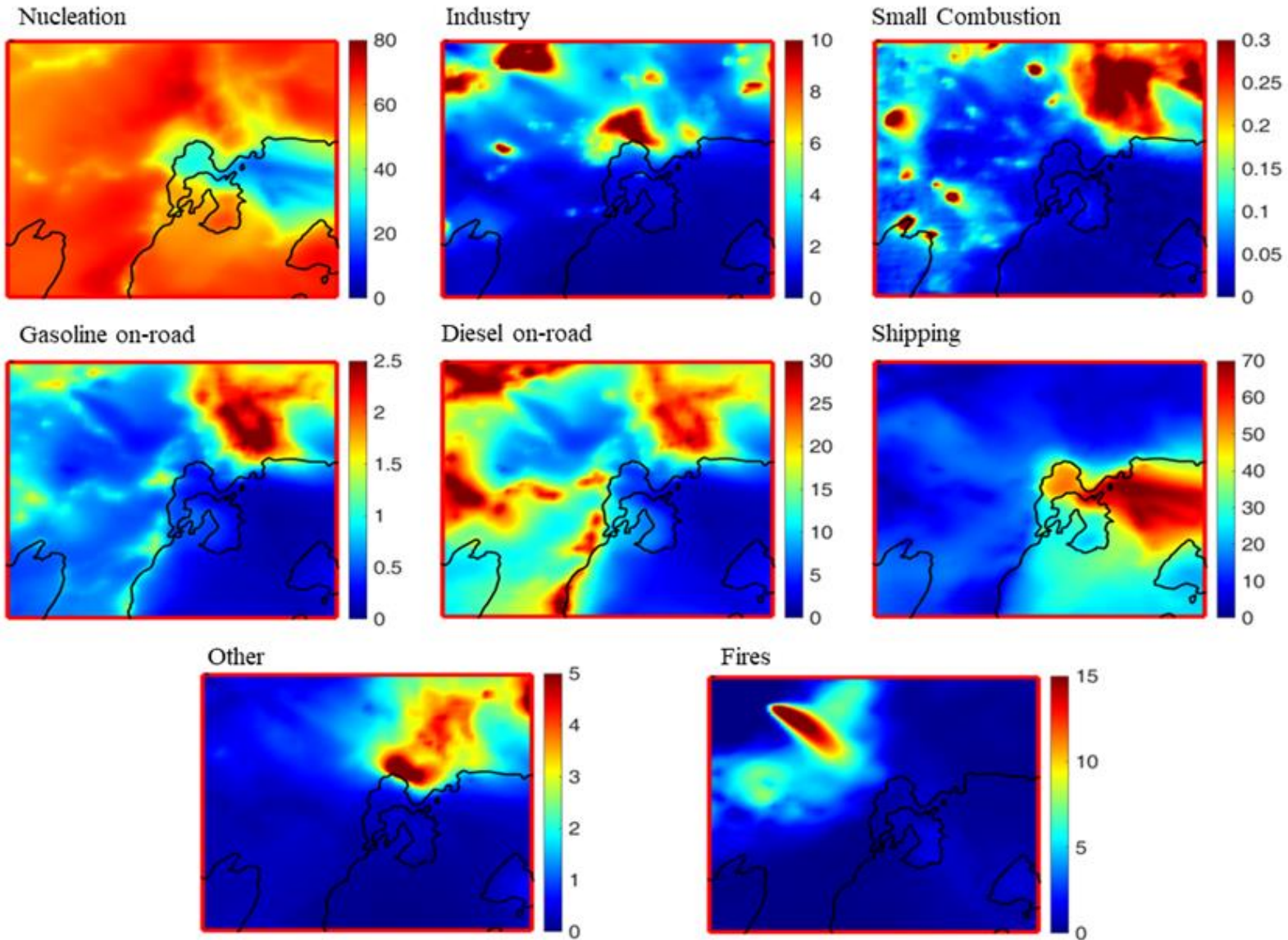


Contribution of sources to N_{10} in Athens during summer



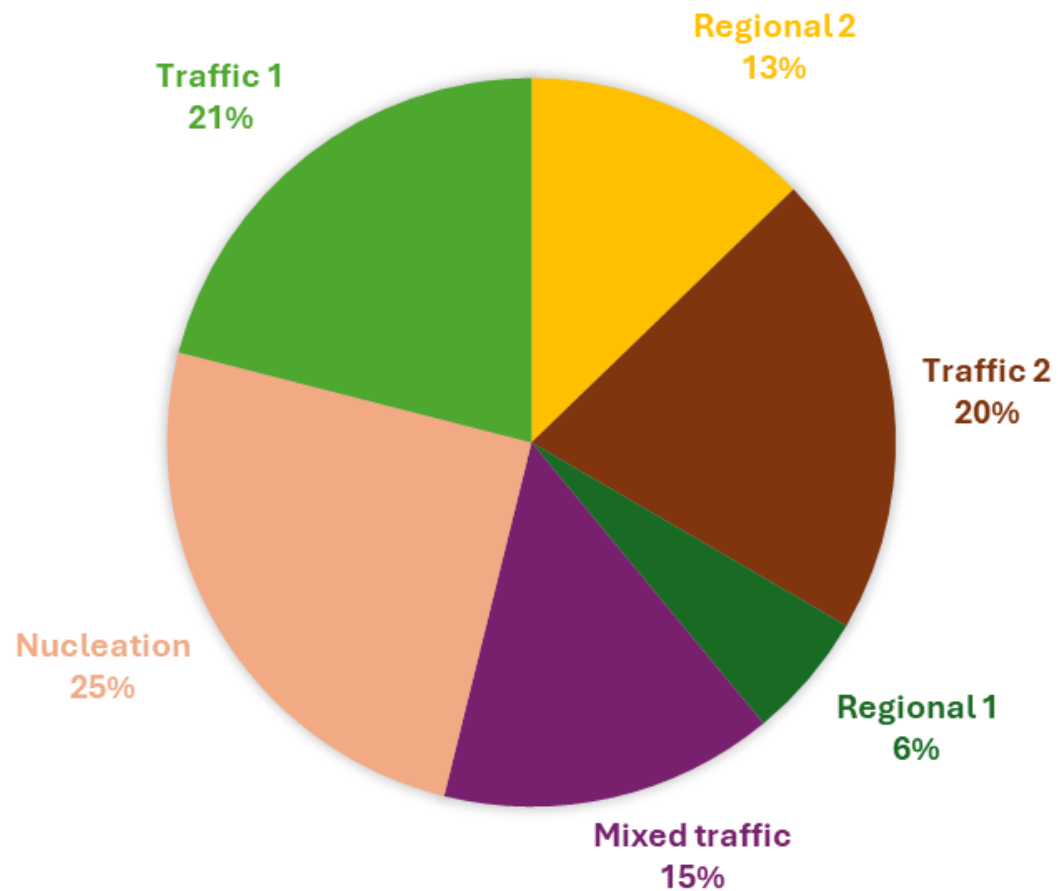
Contribution of sources to N_{10} in Athens during summer

Around 25% based on
the PMF analysis of
SMPS measurements

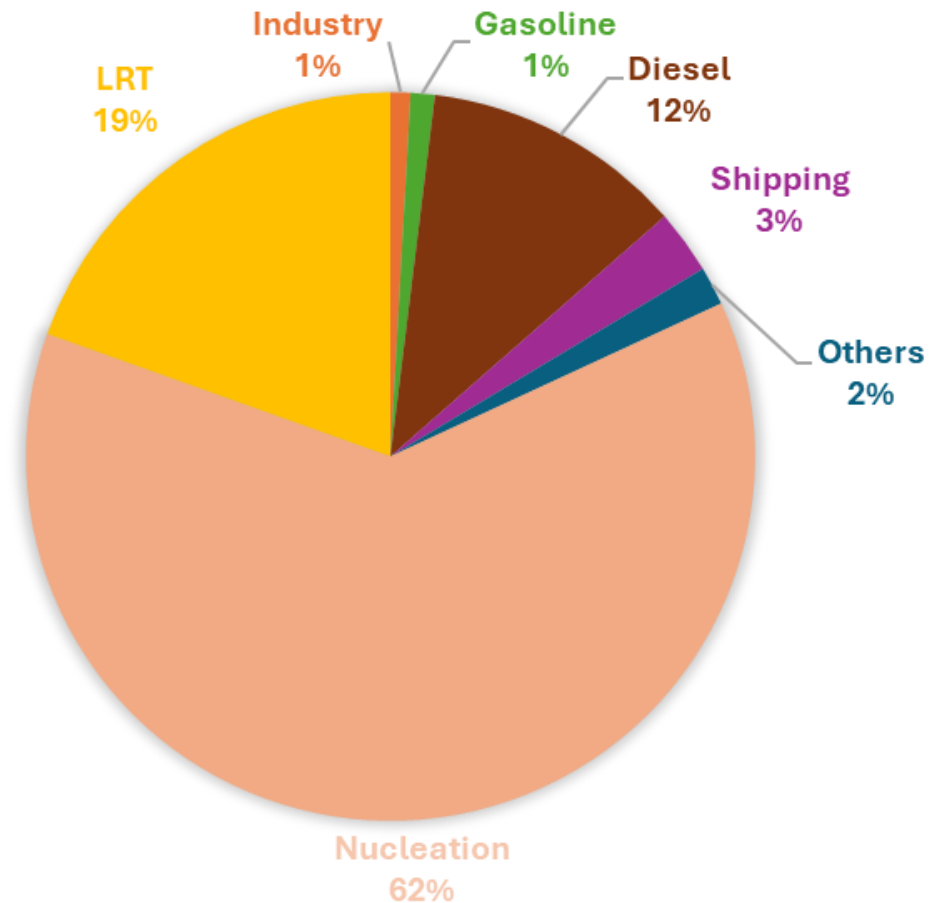


PMF of PMCAMx-UF Predictions versus PMCAMx-UF (summer)

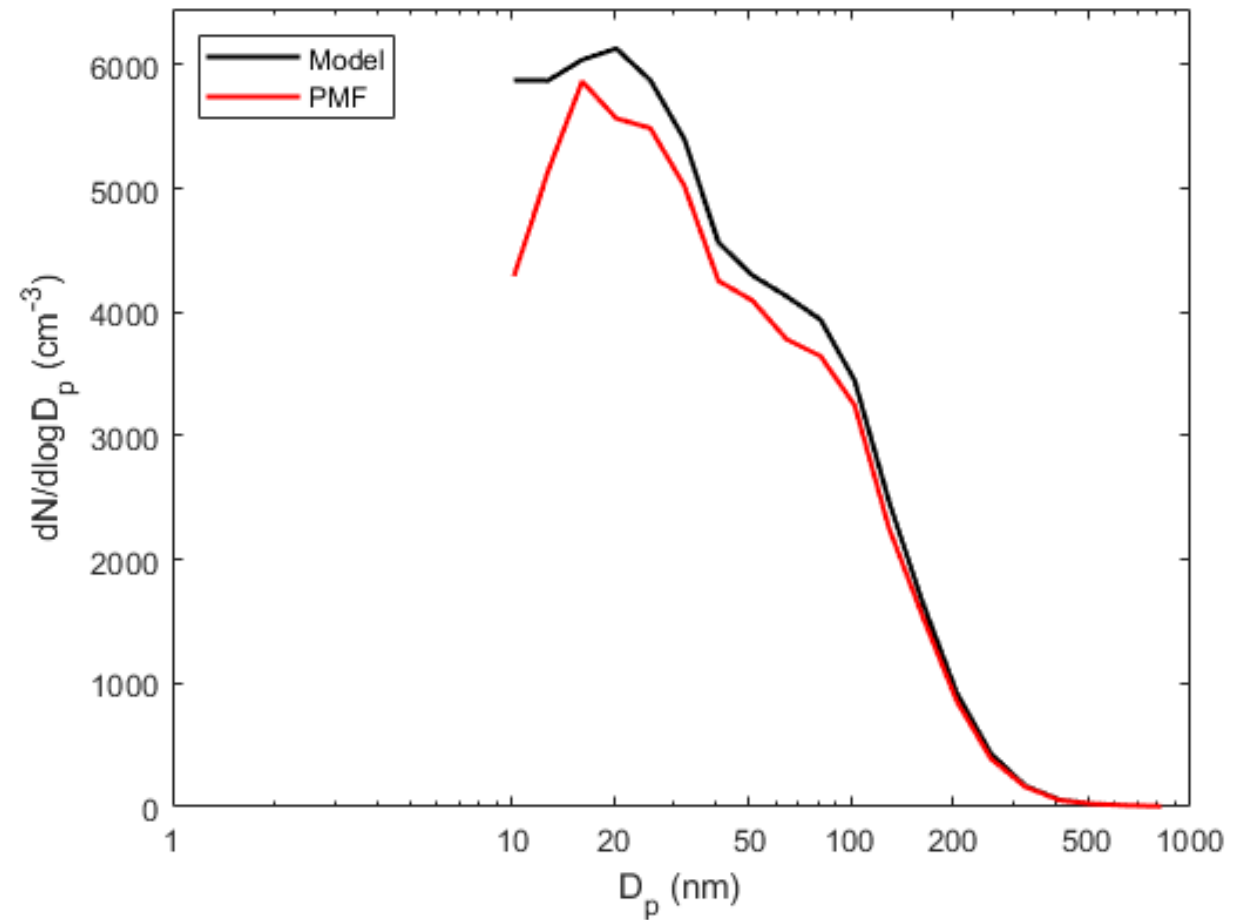
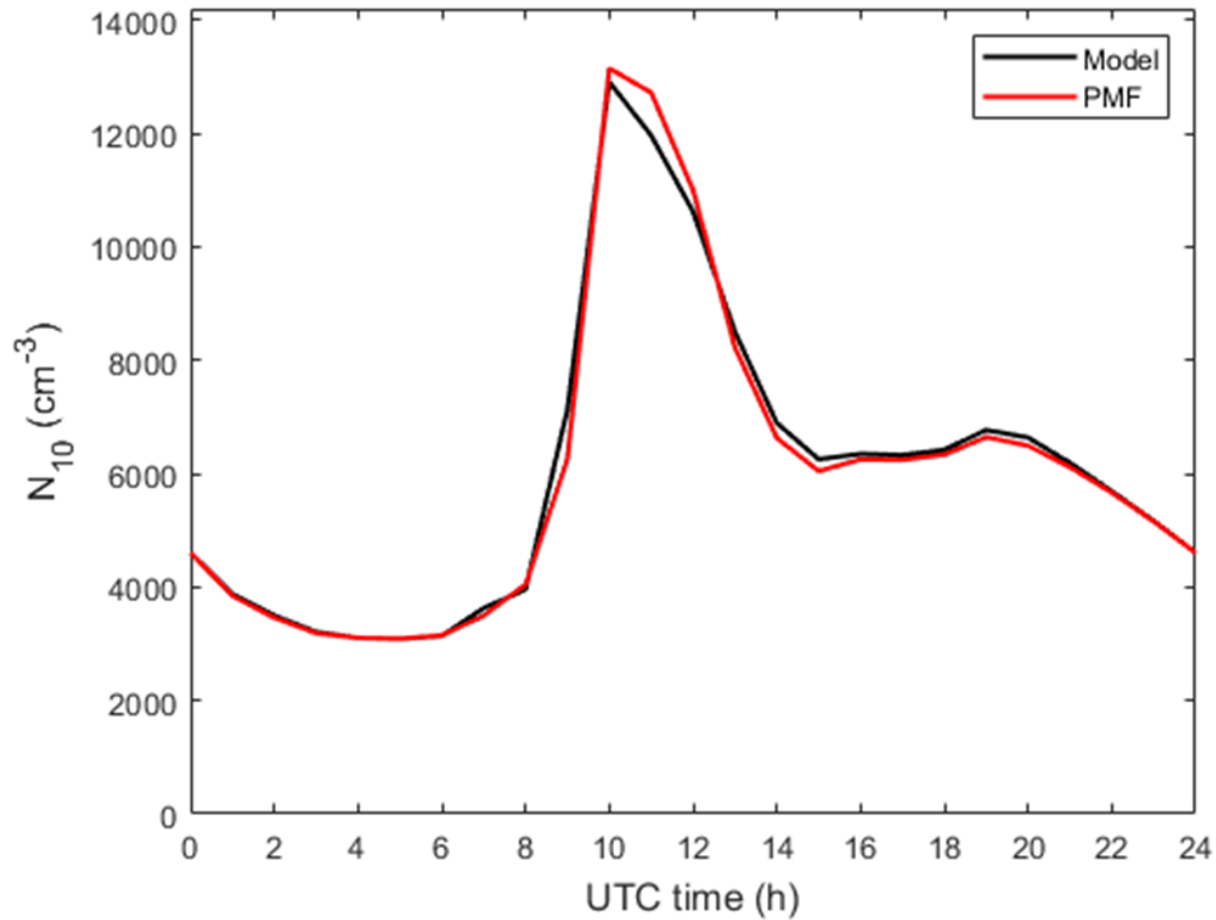
PMF of PMCAMx-UF
predictions



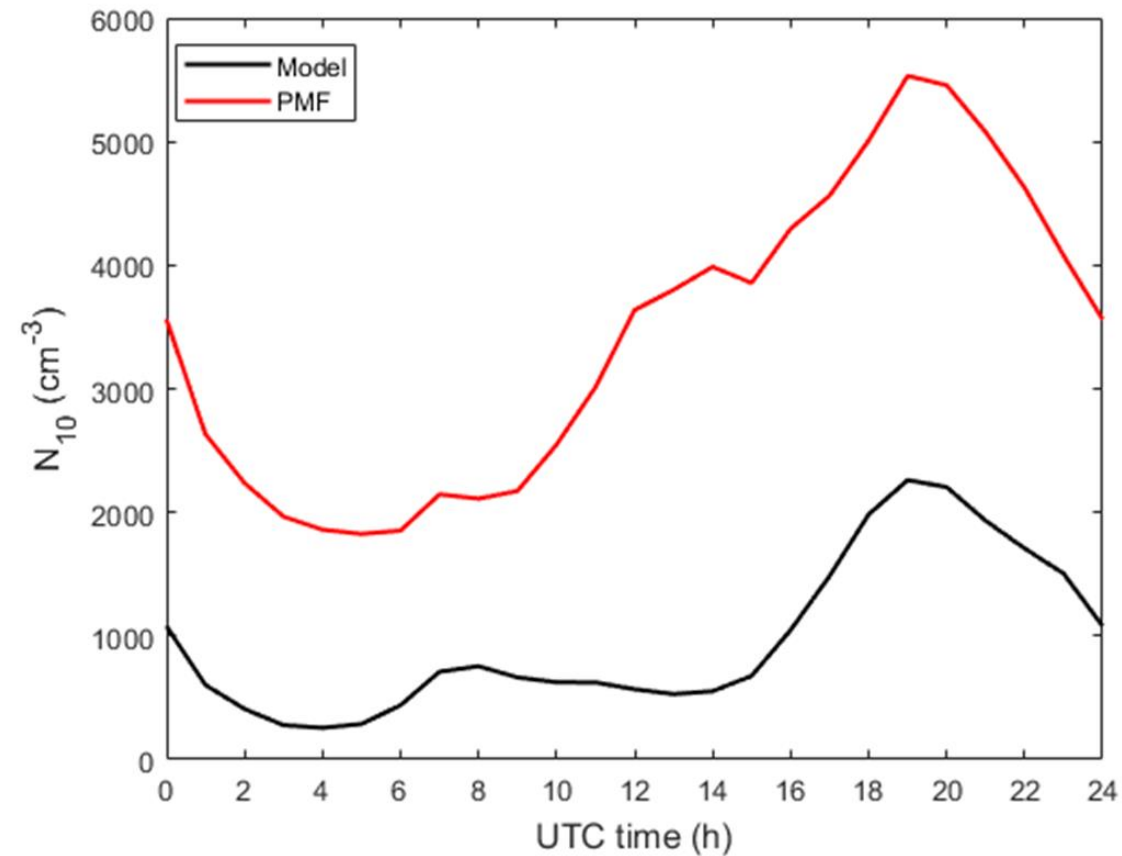
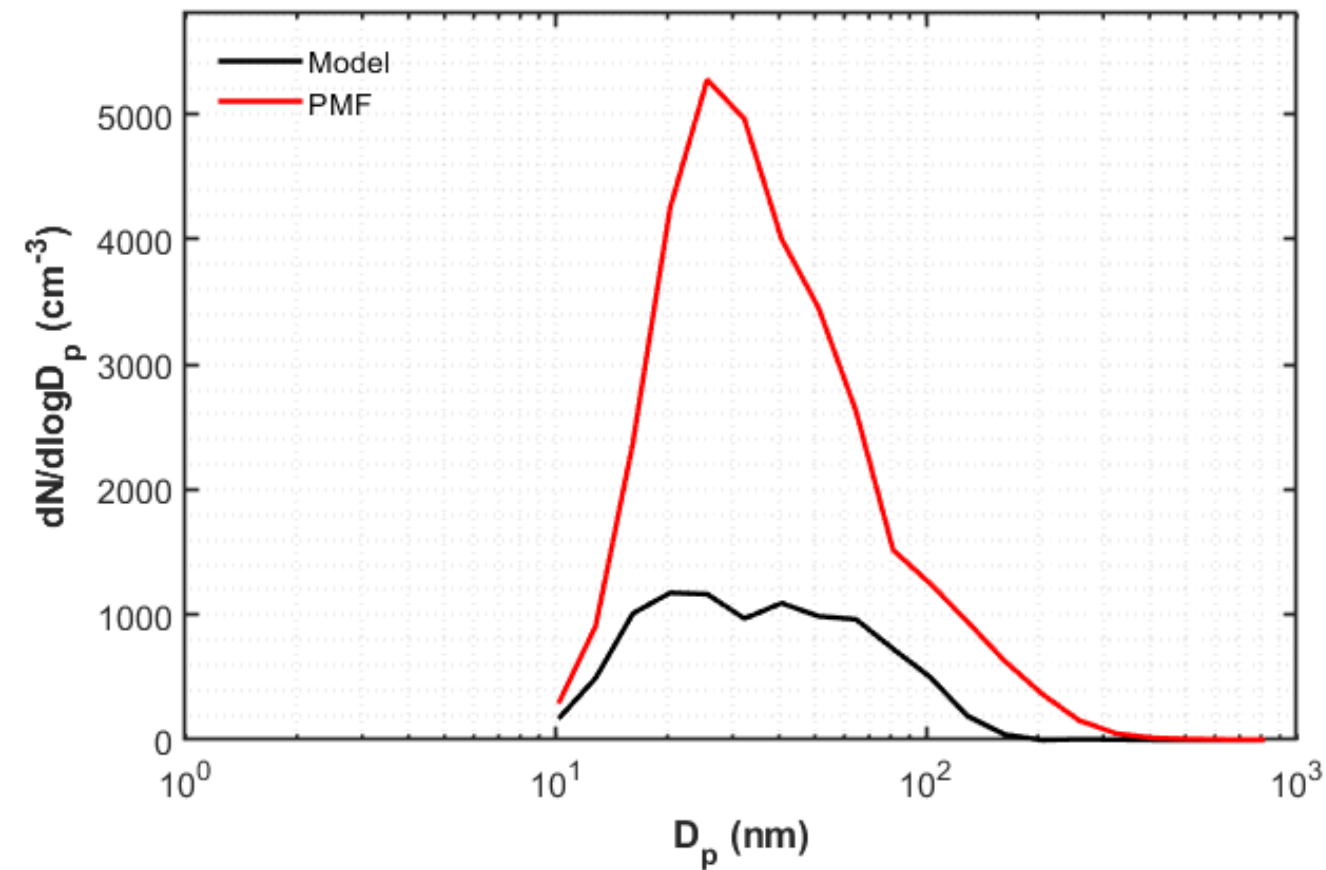
PMCAMx-UF
sources



N_{10} diurnal profile and average size distribution

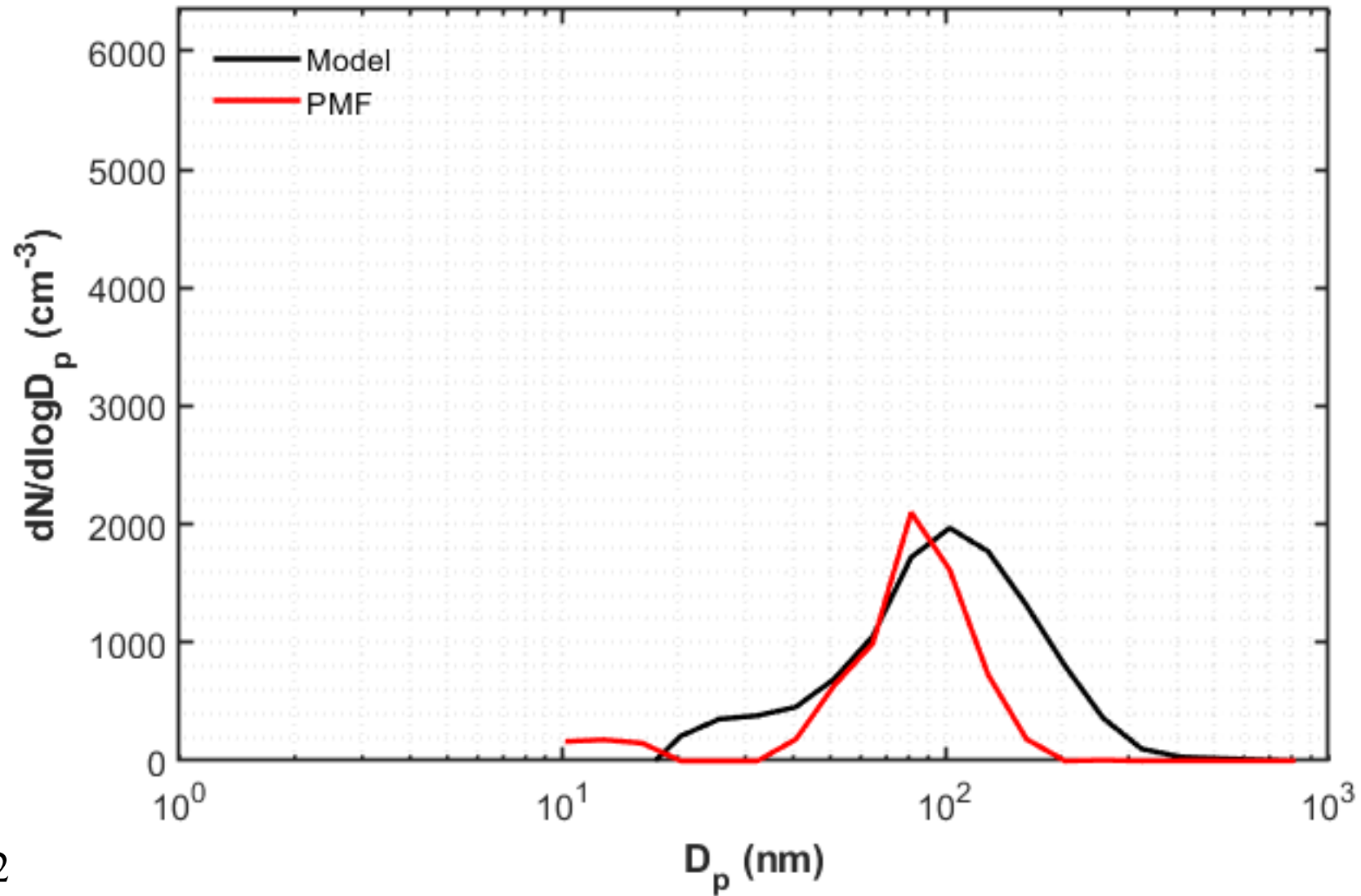


Total traffic (summer)



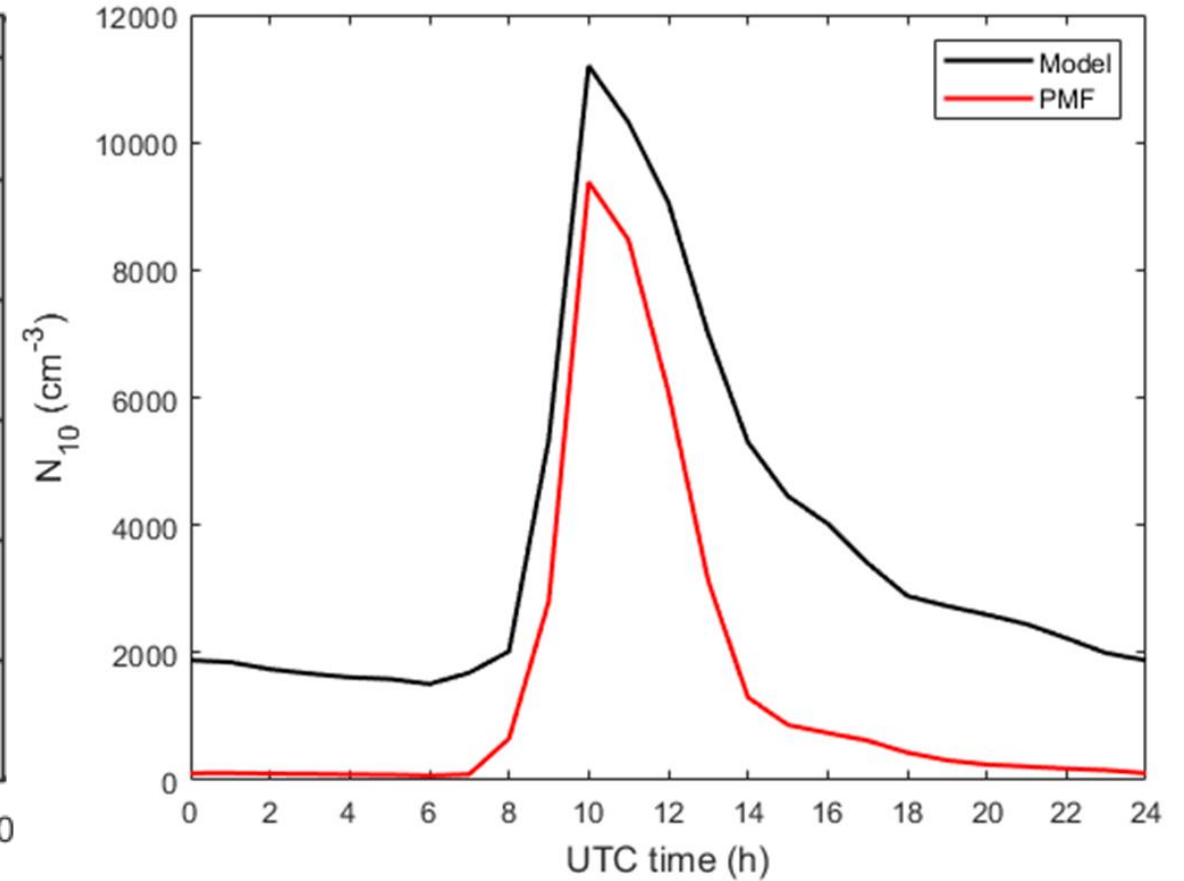
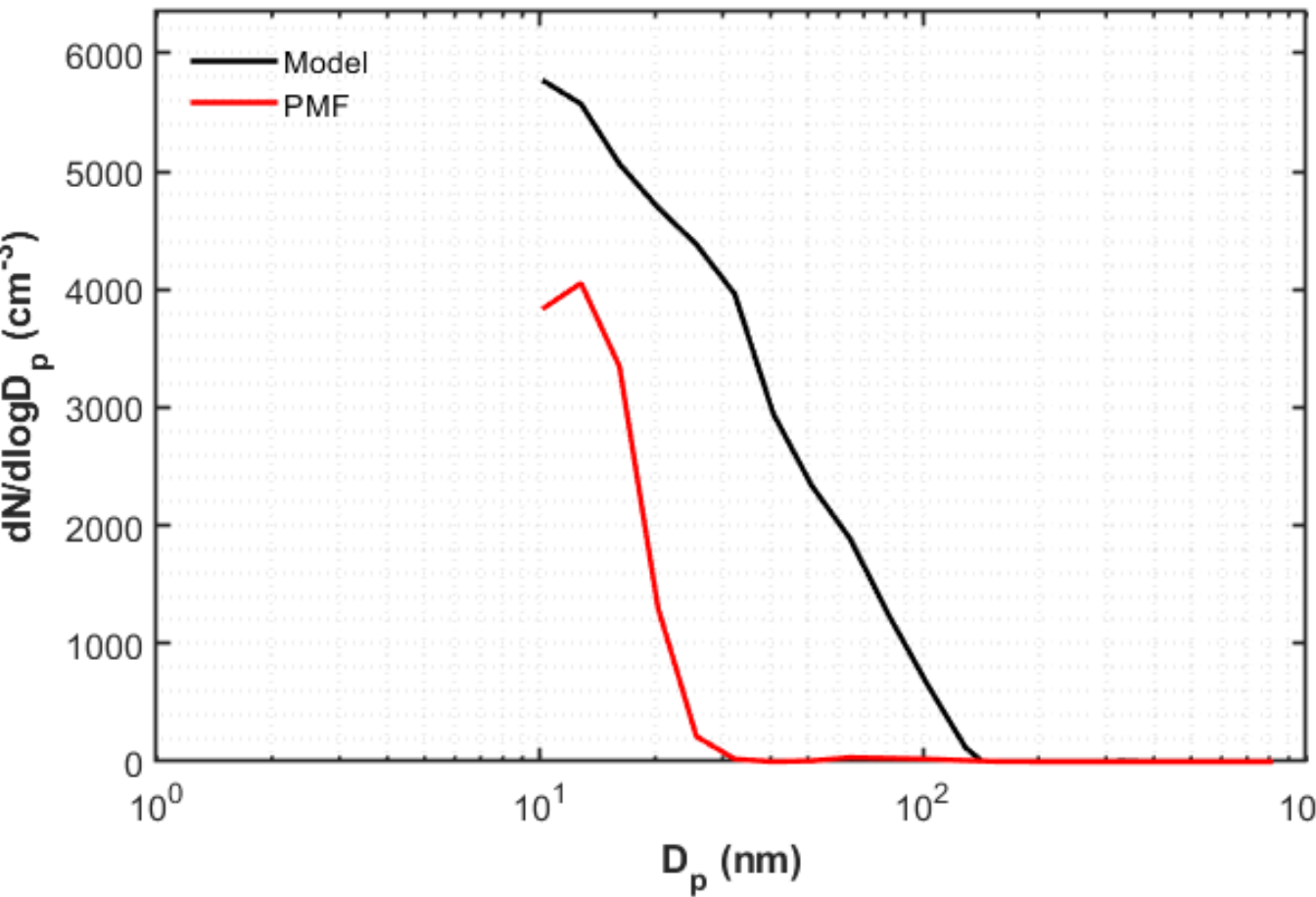
PMF: traffic-1, traffic-2 and mixed traffic
PMCAMx-UF: gasoline, diesel, shipping

Long Range Transport (summer)



PMF: Regional-2
PMCAMx-UF: LRT

Nucleation (summer)

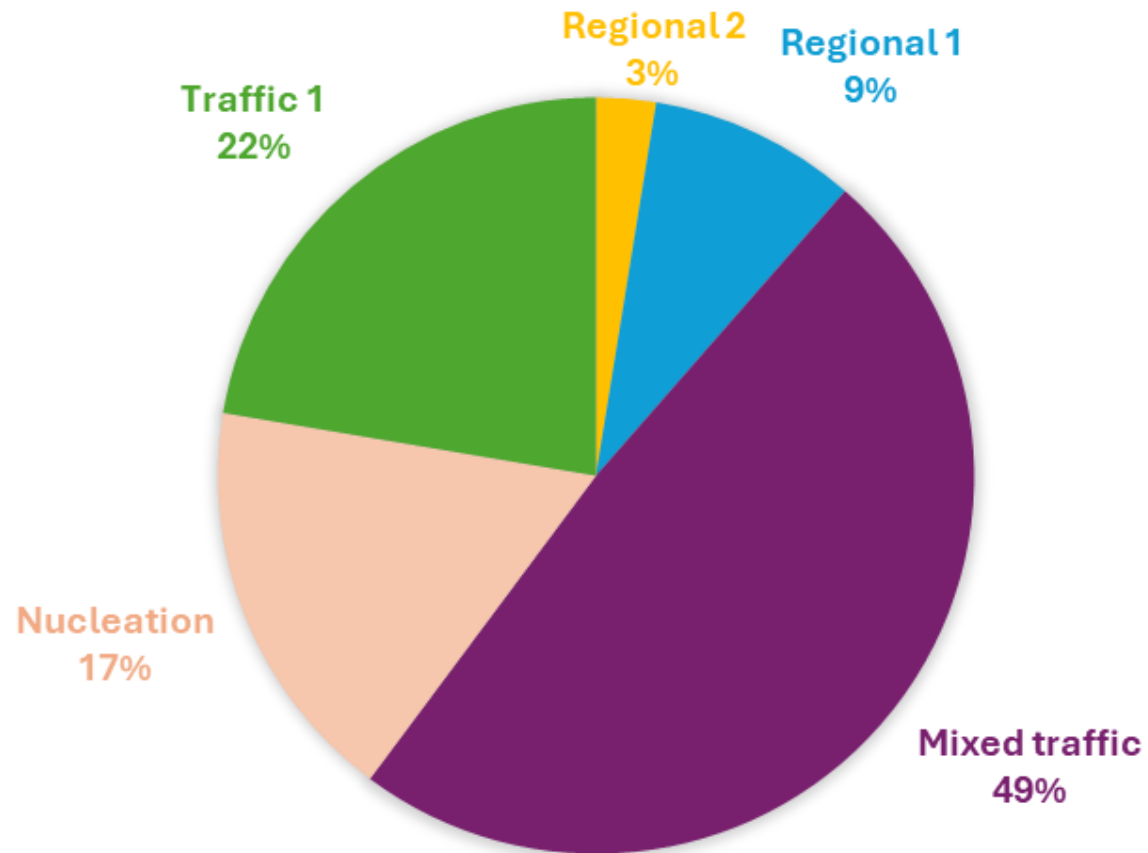


PMF: Nucleation

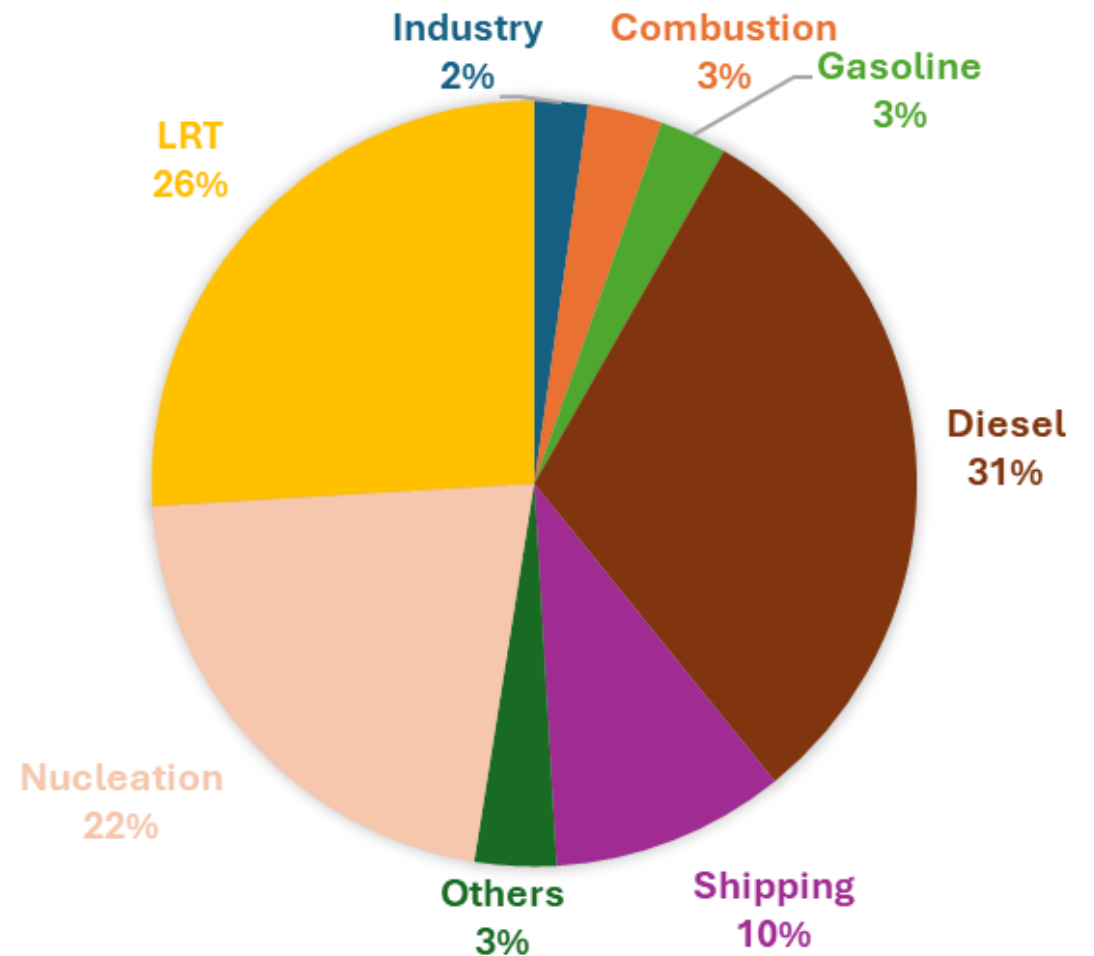
PMCAMx-UF: Nucleation

PMF of PMCAMx-UF Predictions versus PMCAMx-UF (winter)

PMF of PMCAMx-UF
predictions



PMCAMx-UF
sources



Contacts for Service Tool 16

PMCAMx-UF

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CEREA Laboratory

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Lya Lugon: lya.lugon@enpc.fr

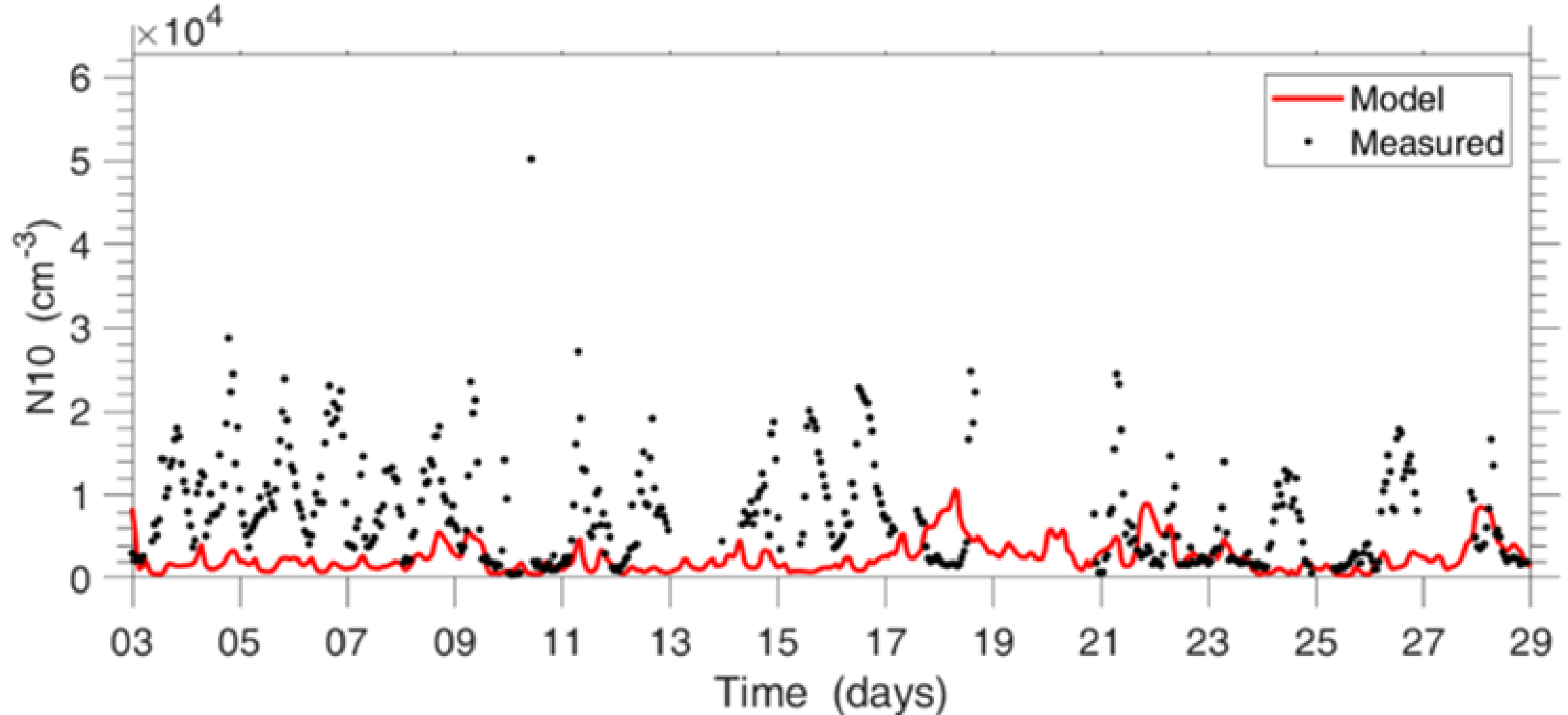
Youngseob Kim: youngseob.kim@enpc.fr

Yelva Roustan: yelva.roustan@enpc.fr

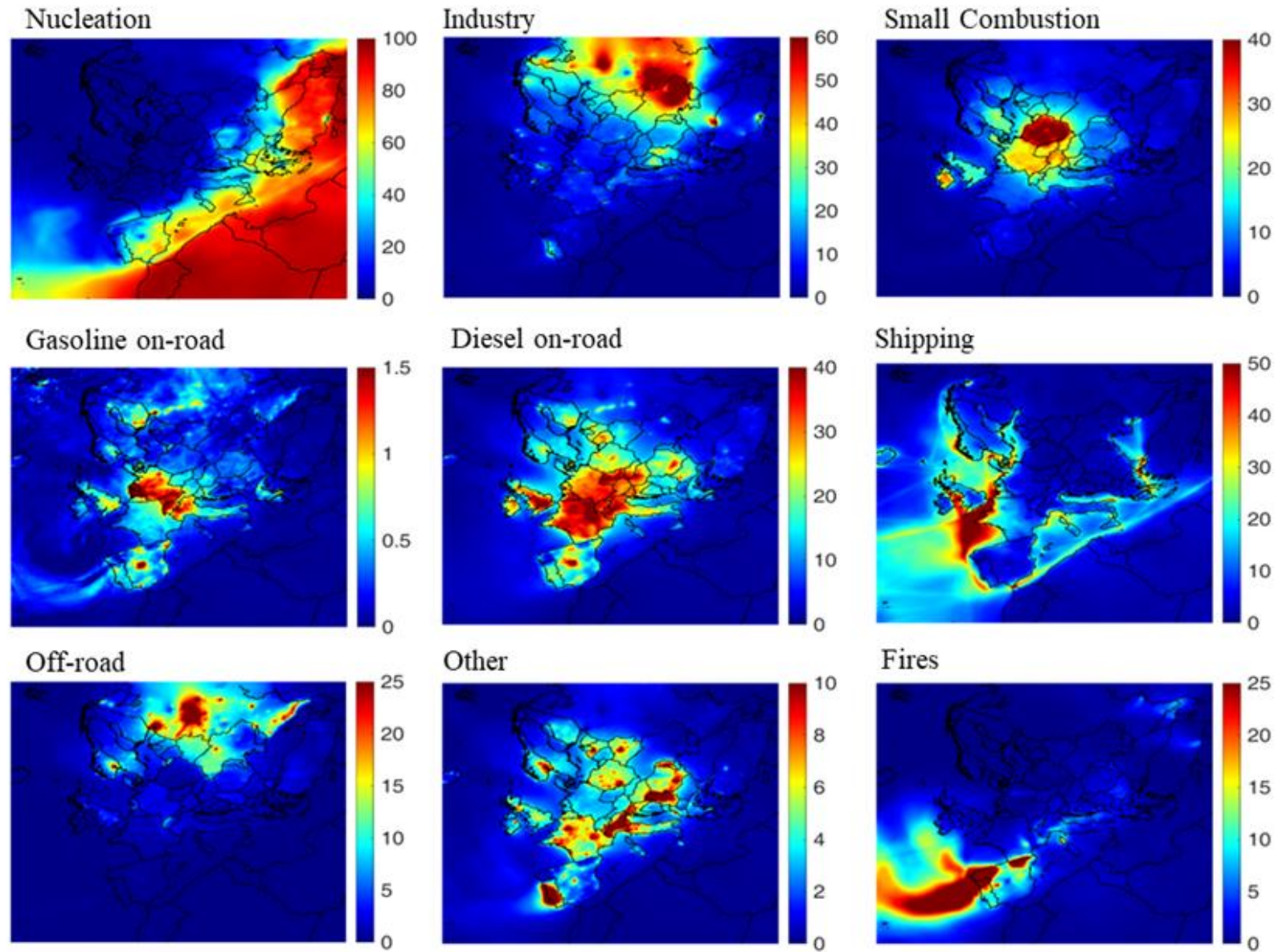
LMD Laboratory

Myrto Valari: myrto.valari@lmd.ipsl.fr

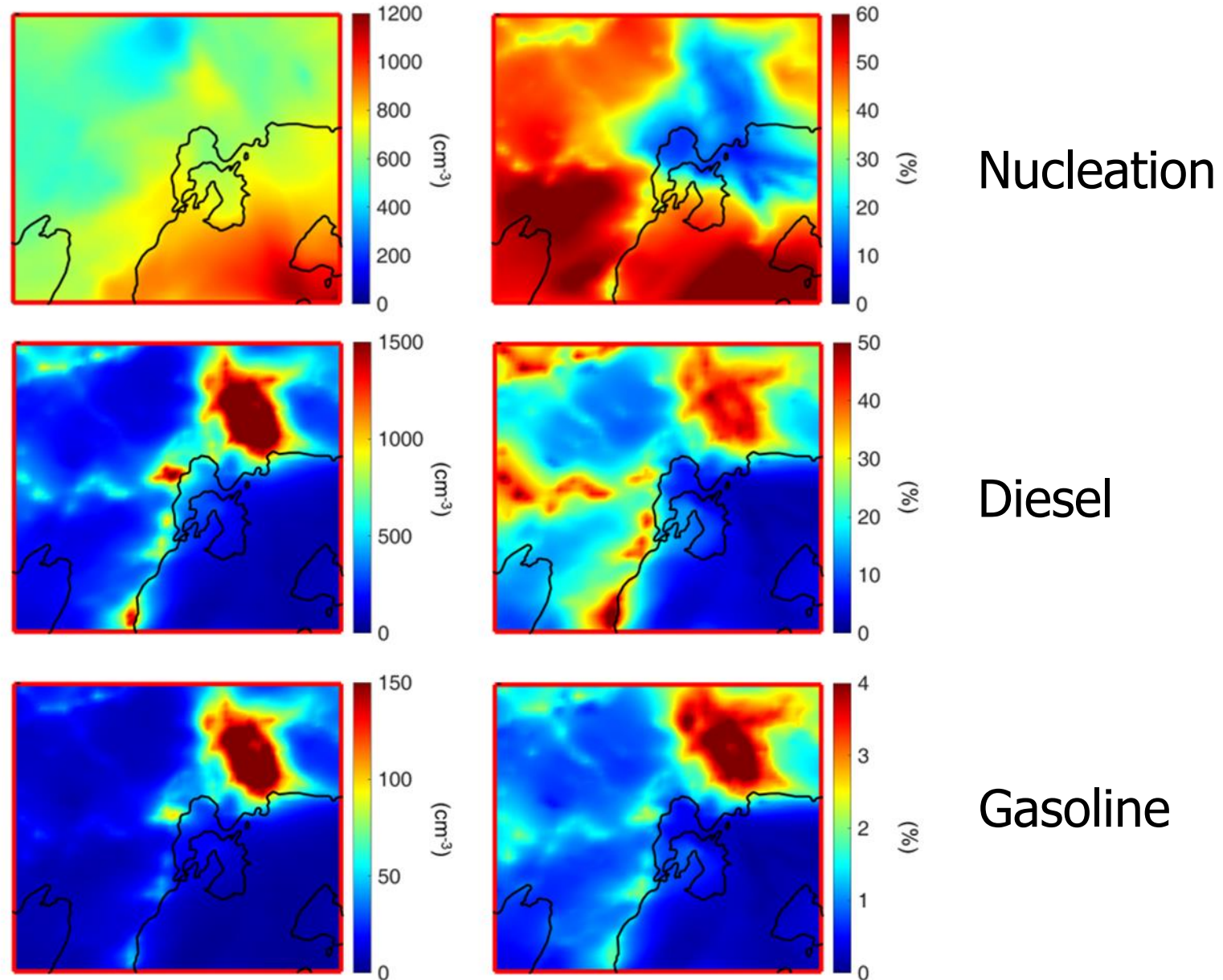
Evaluation of PMCAMx-UF at Athens for N_{10} (winter)



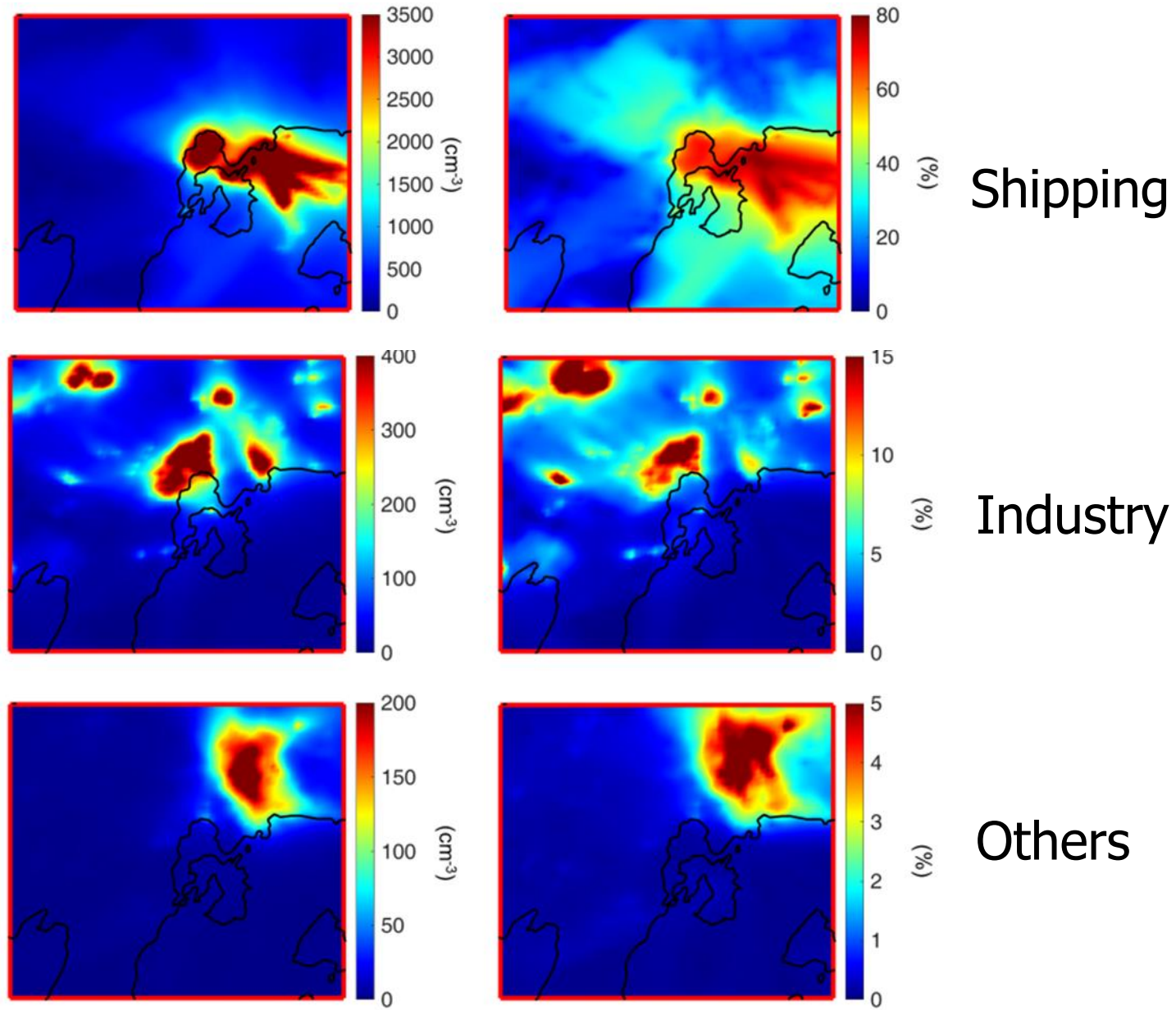
Predicted Source Contributions to N_{10} (Winter)



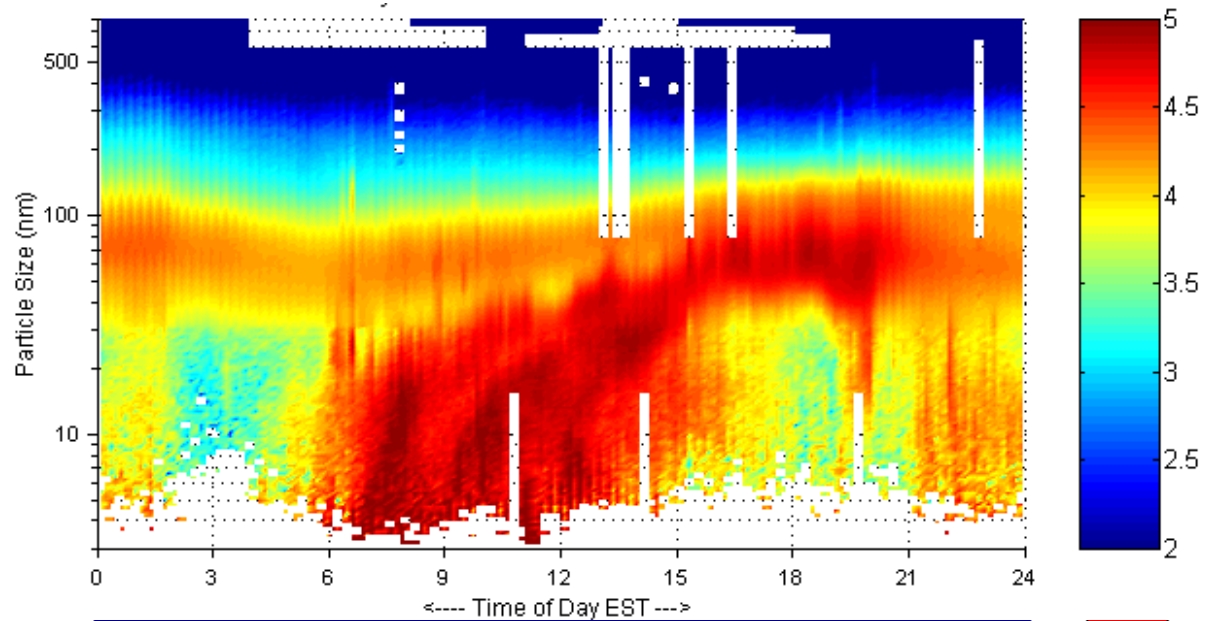
Predicted Sources of N_{10} in Athens (Winter)



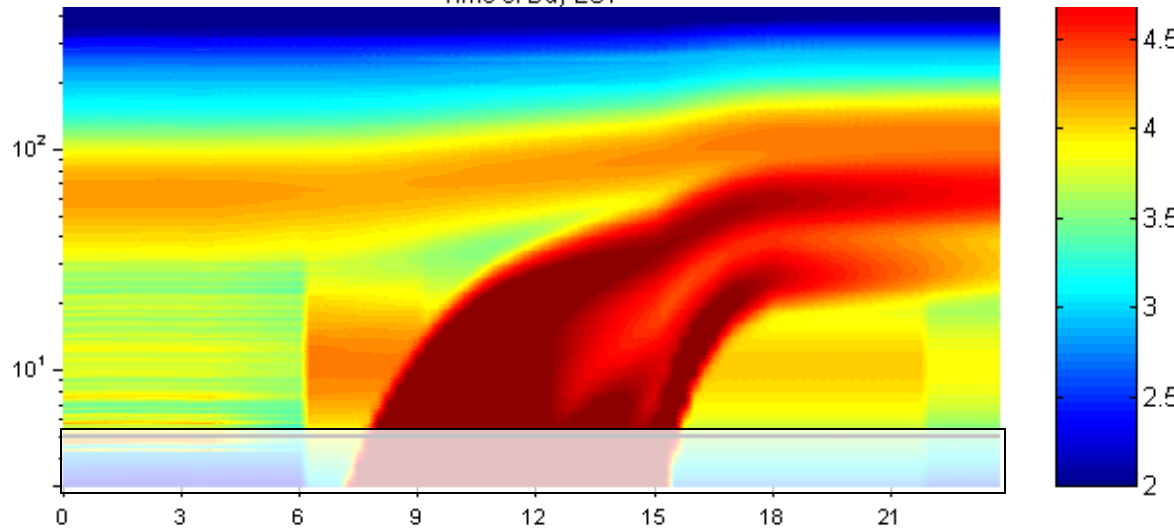
Predicted Sources of N_{10} in Athens (Winter)



UFP Simulation Challenges: Nucleation and Coagulation

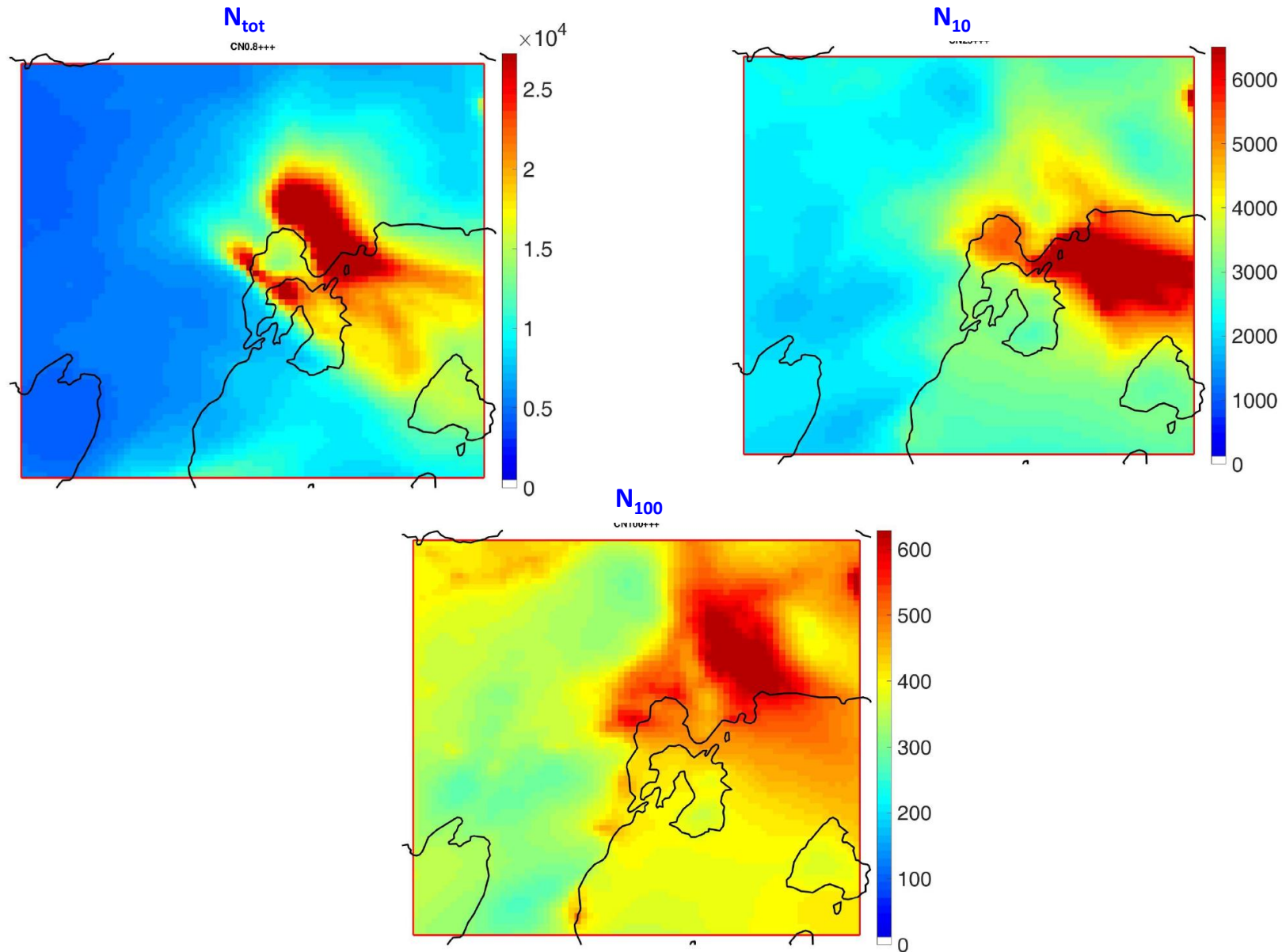


Measured



Predicted

Application of PMCAMx-UF (July 2019)



PMF sources

- **Traffic-1/nucleation growth:** traffic-1 (traffic particles from gasoline or nucleation of particles generated during the dilution of diesel exhaust SVOCs, traffic rush hours) + nucleation growth (photonucleation particles that have grown, higher at midday). Shipping is probably mixed with traffic gasoline.
- **Traffic-2/BB:** traffic-2 (mostly diesel or aged traffic particles, traffic rush hours) + biomass burning (night hours)
- **Mixed traffic:** particles emitted from vehicles with different fuel types, mixed with other urban sources (for example heating), traffic rush hours. During winter it is local combustion.
- **Nucleation:** mostly from photochemically induced new particle formation events, higher at midday and summer. During winter, nucleation has a more local origin so probably they are nucleated particles from traffic (more than shipping or photonucleation).
- **Regional-1:** secondary aerosol associated with nitrates, higher at night and winter. Also, local origin
- **Regional-2:** secondary aerosols associated with sulphates, with a lot of ozone, higher at midday and summer

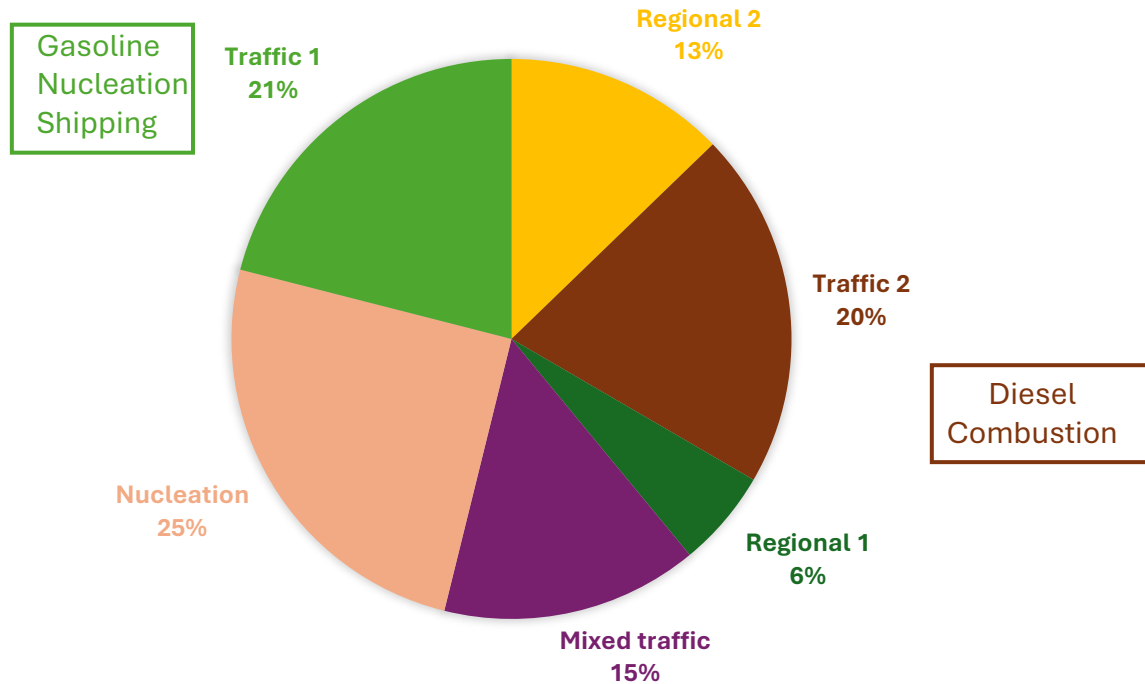
PMF and PMCAMx-UF source apportionment

Thissio

July 2019

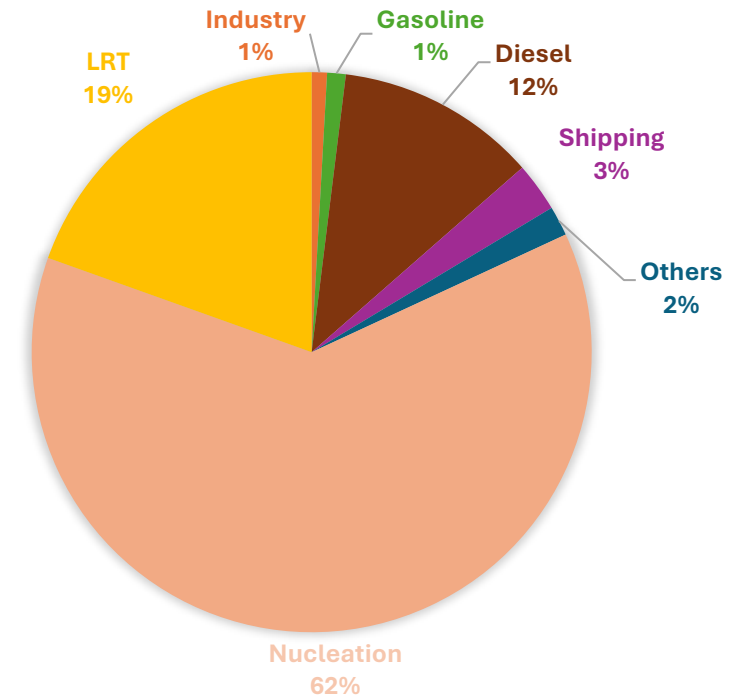
Average source contribution to N_{10} (%) – July 2019

PMF



Source	Average N_{10} cm^{-3}
Regional 2	771
Regional 1	340
Traffic 2	1245
Mixed traffic	896
Nucleation	1517
Traffic 1	1269

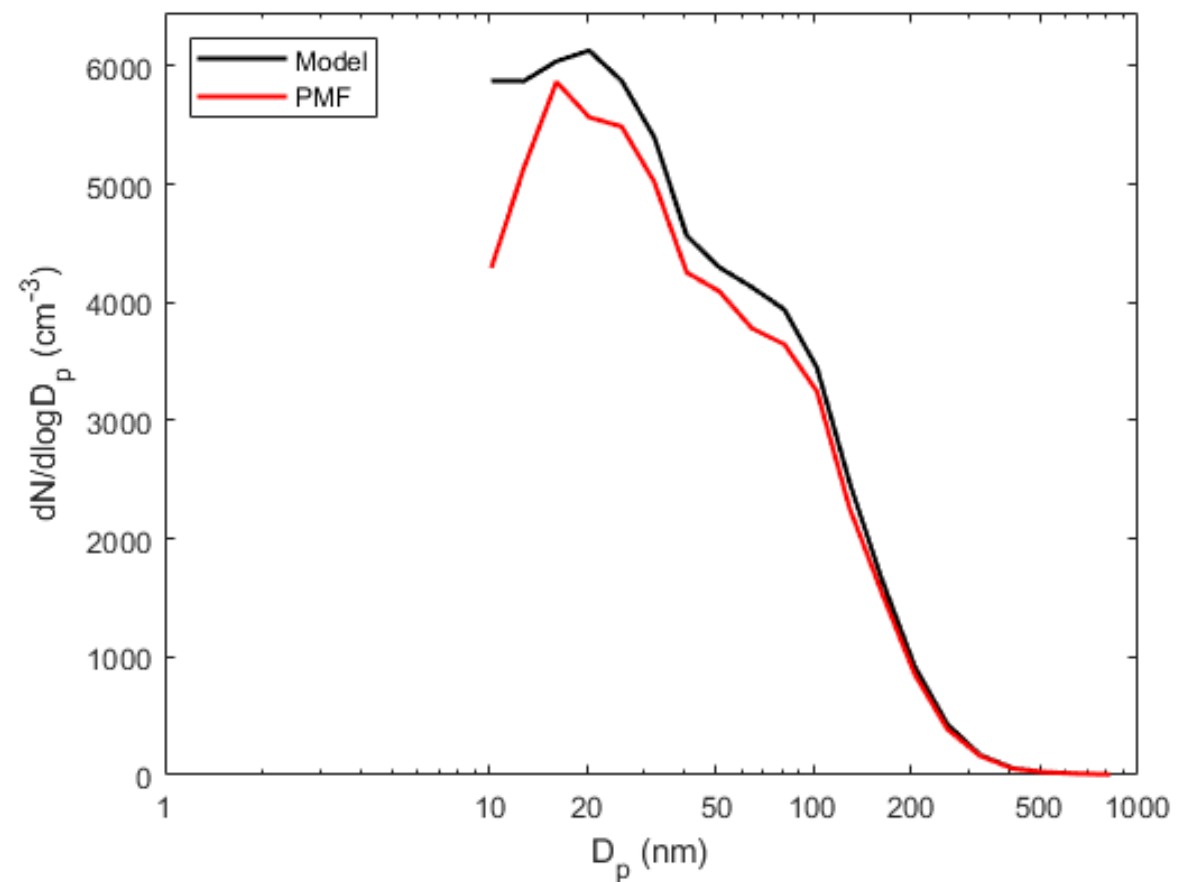
PMCAMx-UF



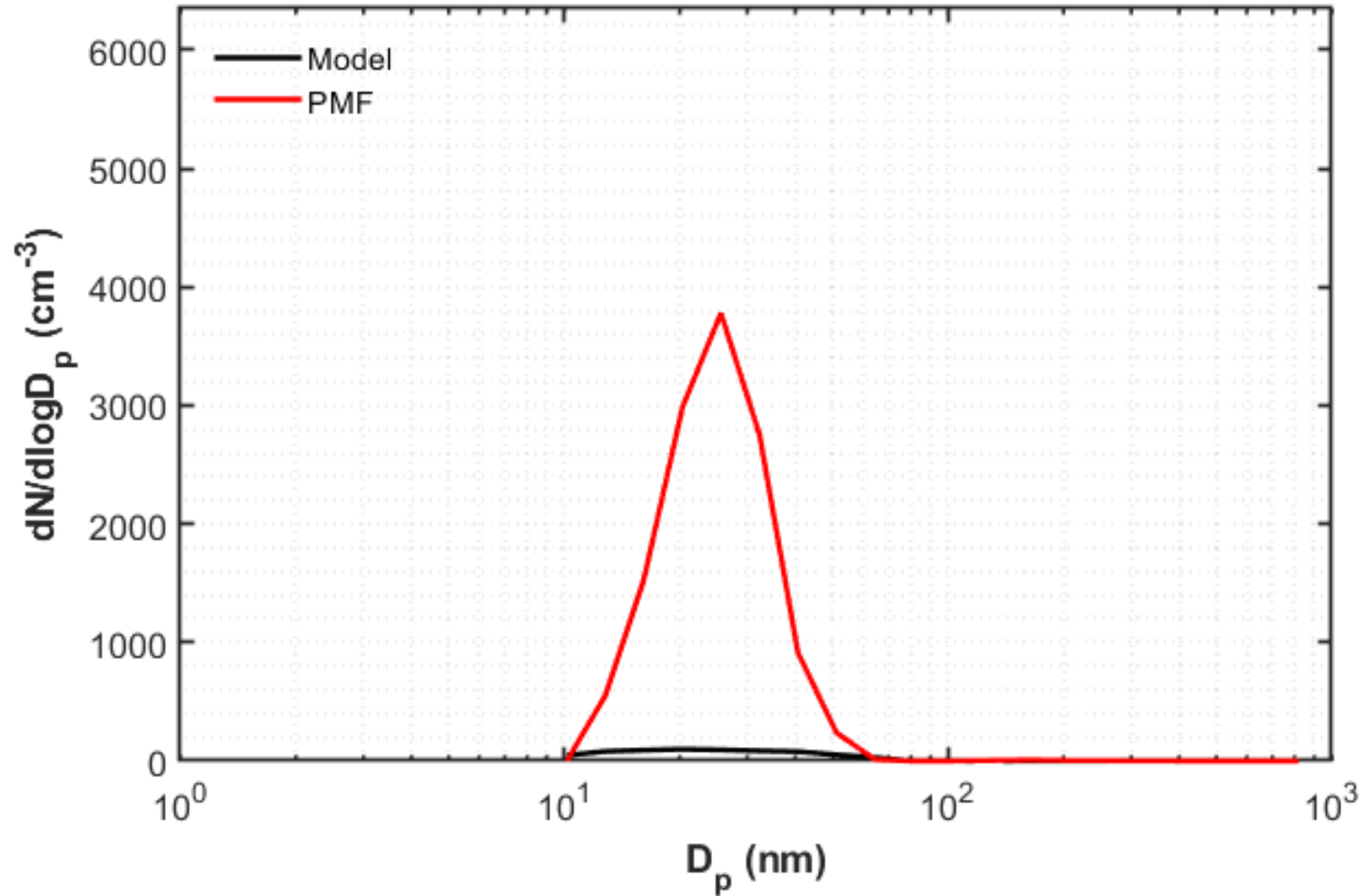
Source	Average N_{10} cm^{-3}
Industry	54
Gasoline	66
Diesel	713
Shipping	174
Others	105
Nucleation	3836
LRT	1201

Size distributions

All Sources - July 2019

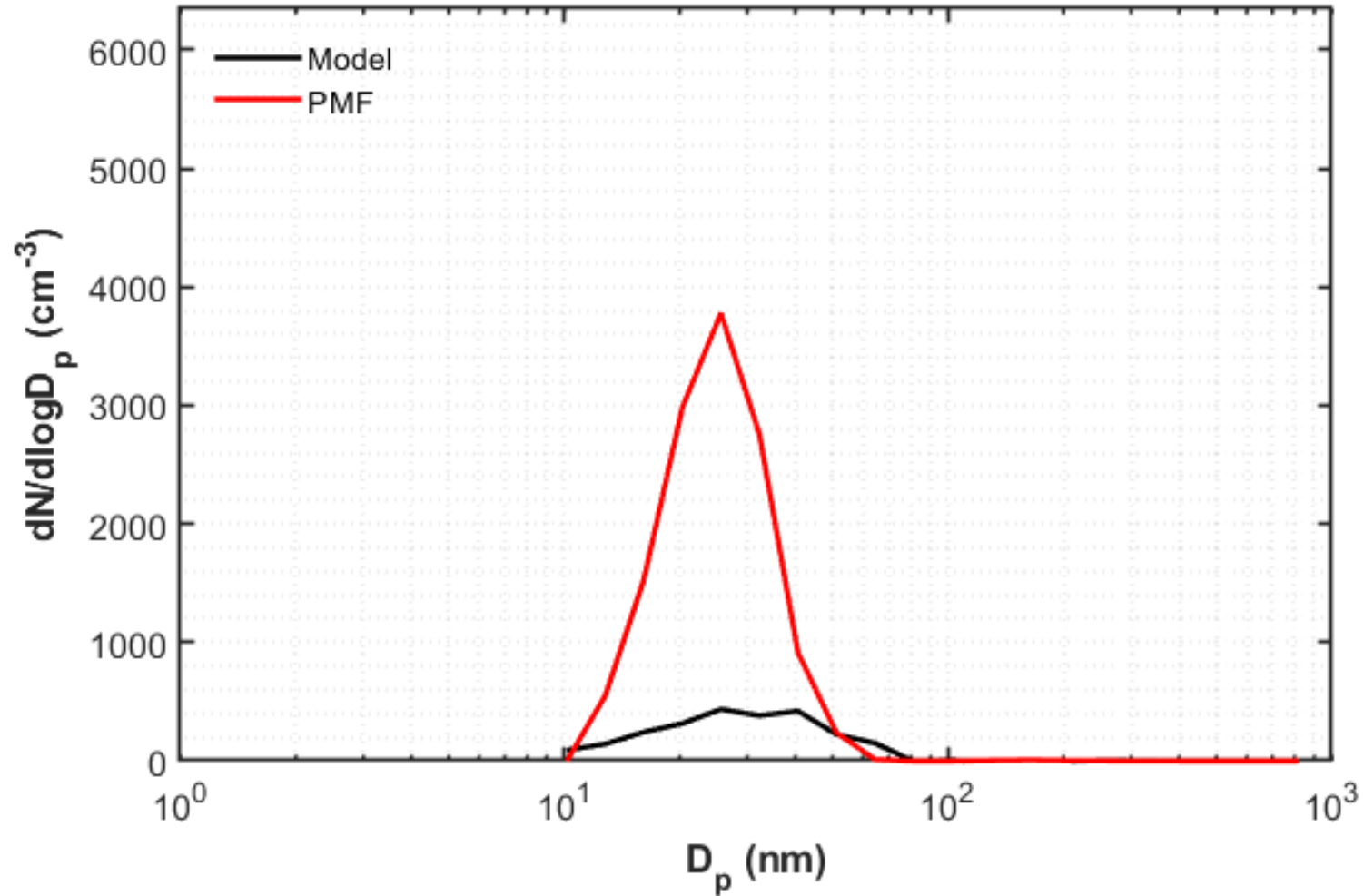


Traffic-1 (gasoline) - July 2019



PMF: Traffic-1/nucleation growth
PMCAMx-UF: gasoline

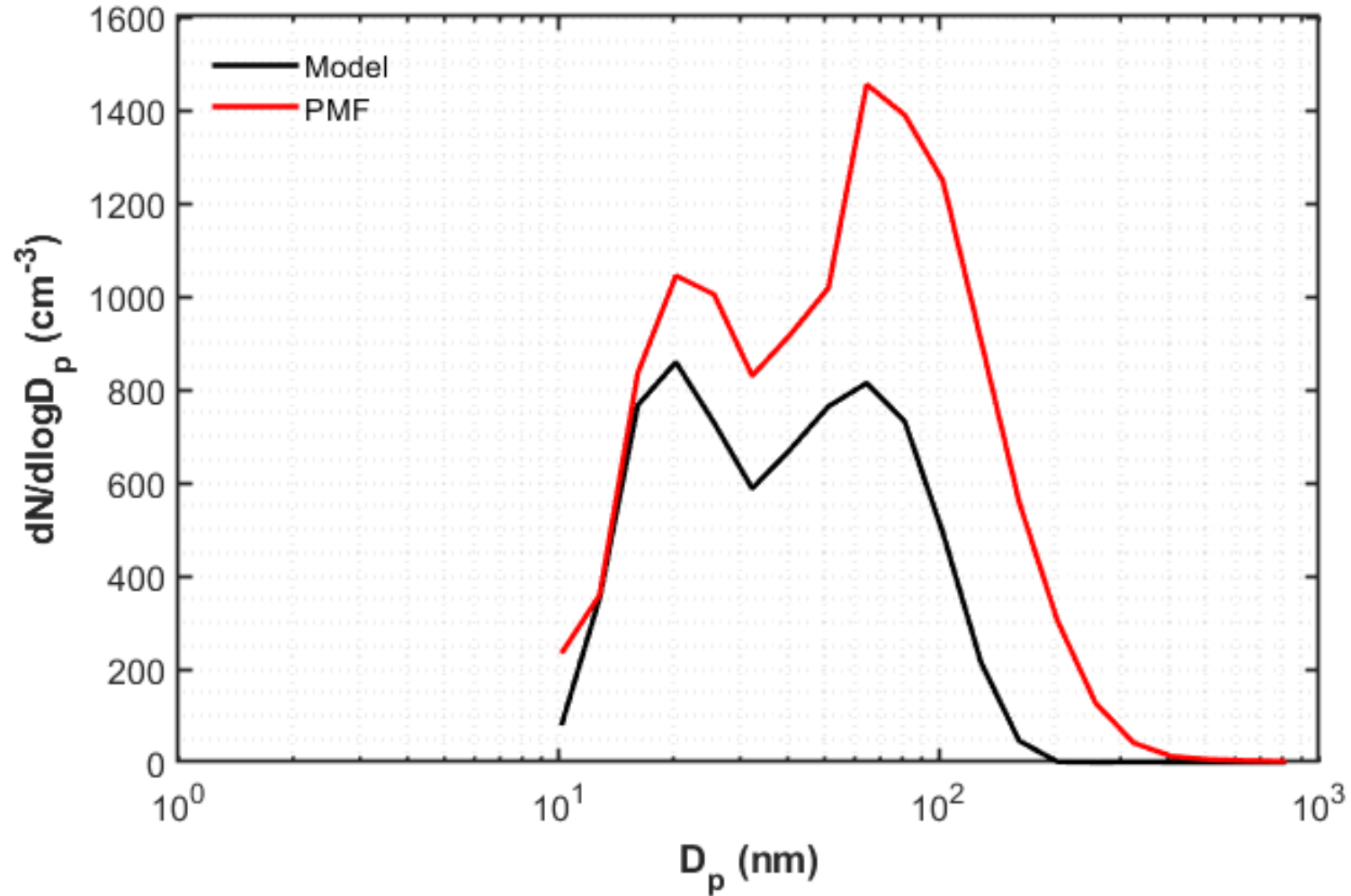
Traffic-1 (gasoline and Shipping) – July 2019



PMF: Traffic-1/nucleation growth

PMCAMx-UF: gasoline and shipping

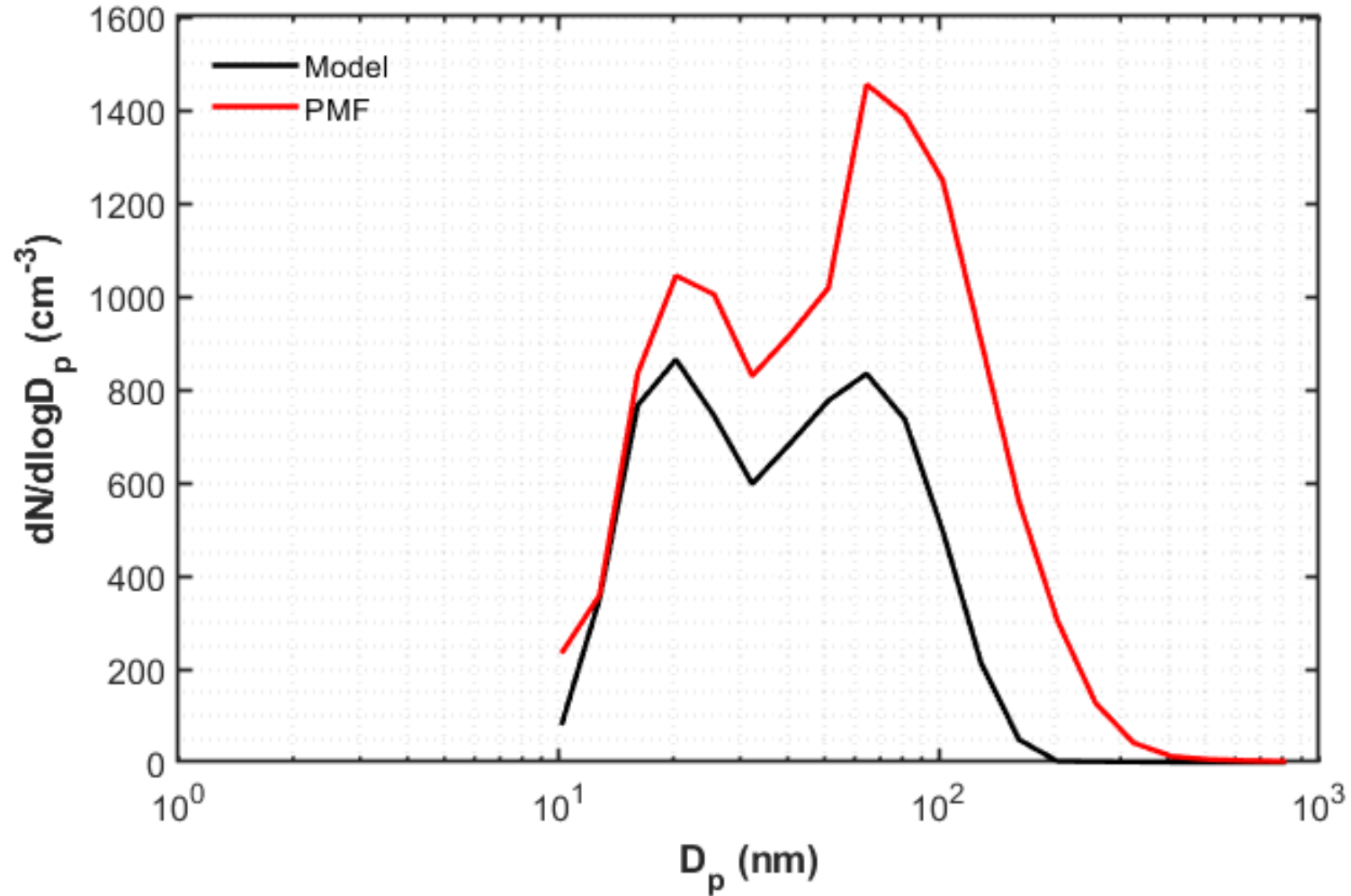
Traffic-2 (diesel) – July 2019



PMF: Traffic-2/BB

PMCAMx-UF: diesel

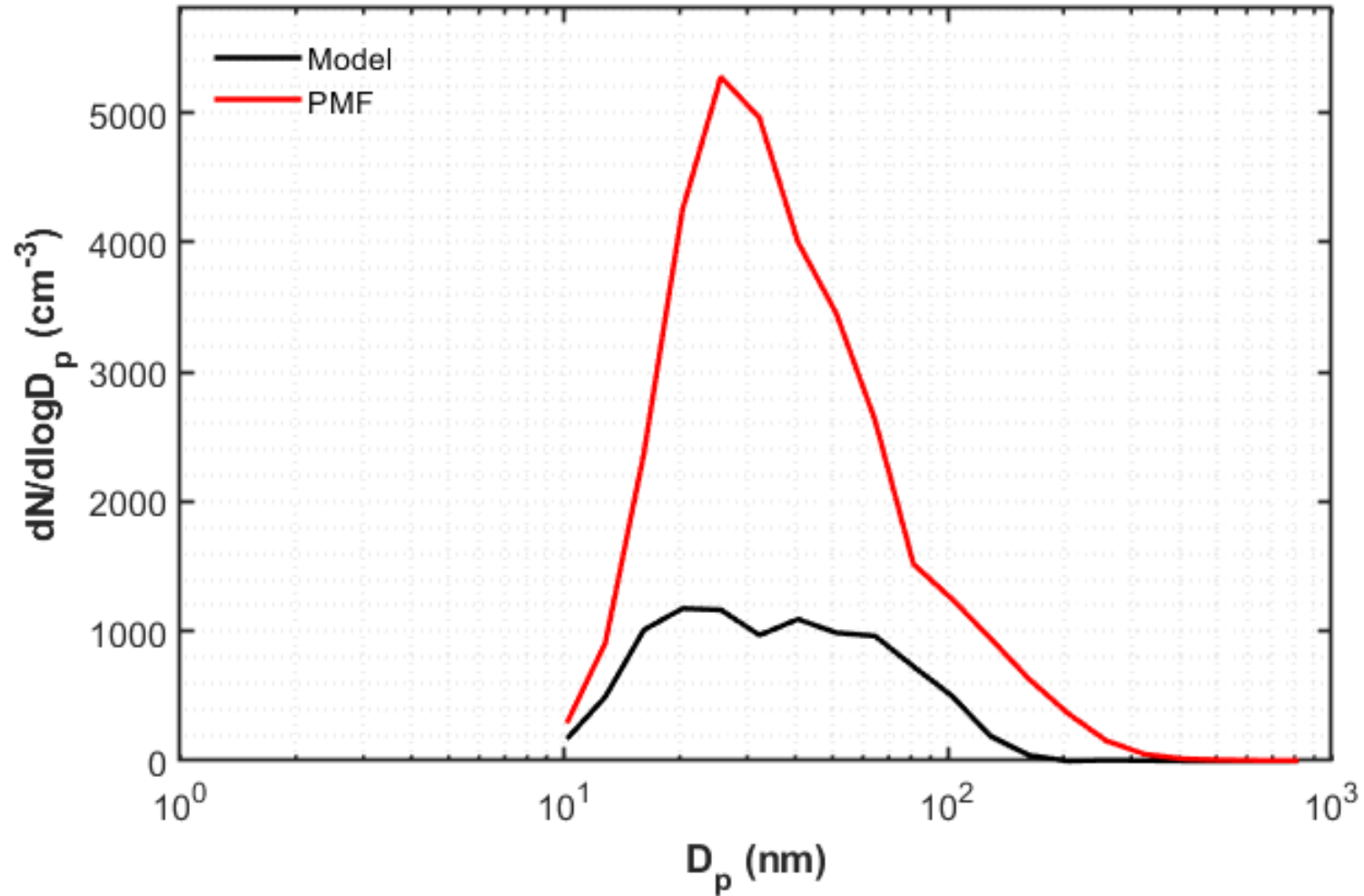
Traffic-2 (diesel and combustion) – July 2019



PMF: Traffic-2/BB

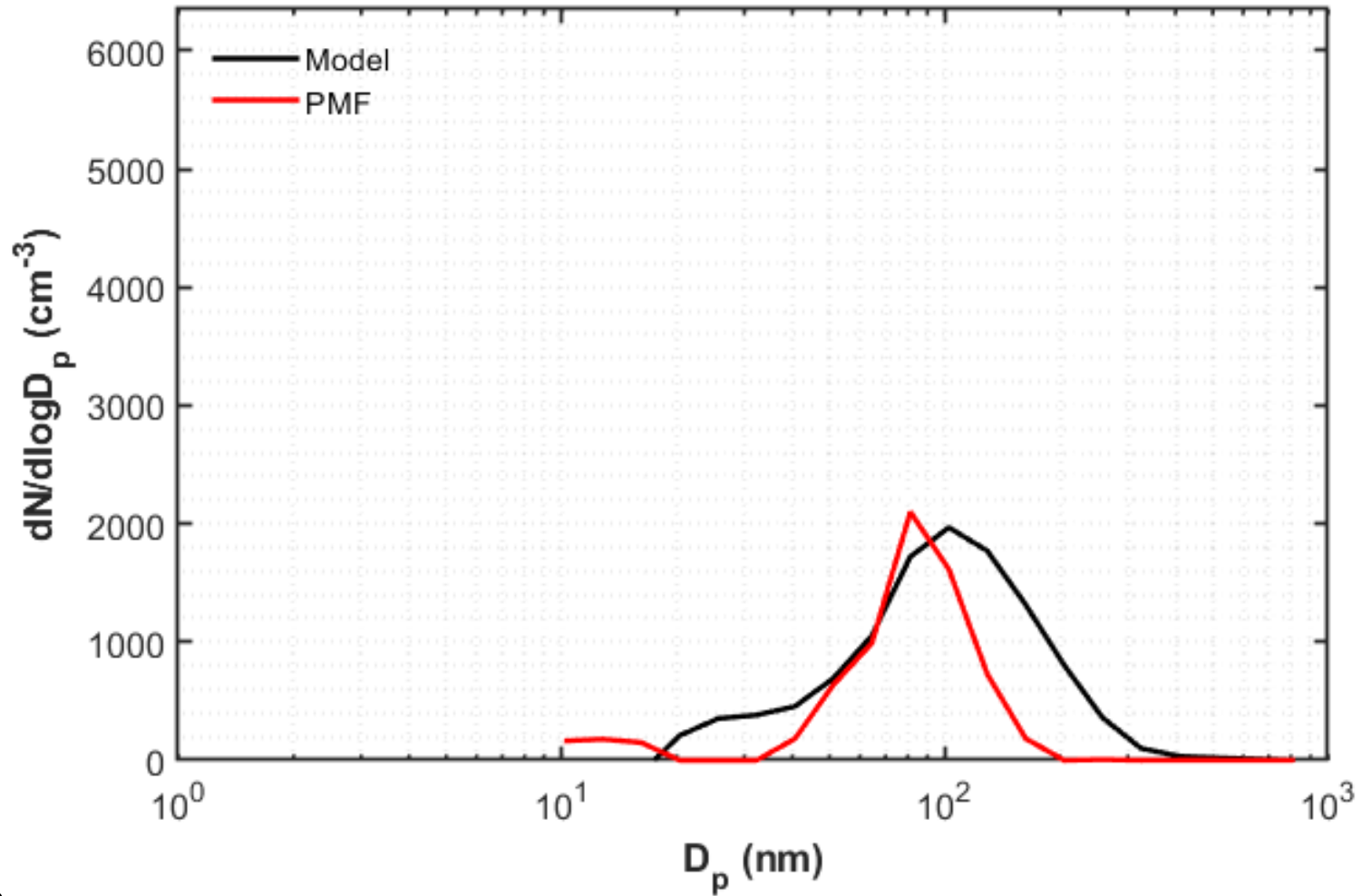
PMCAMx-UF: diesel and combustion

Total traffic – July 2019



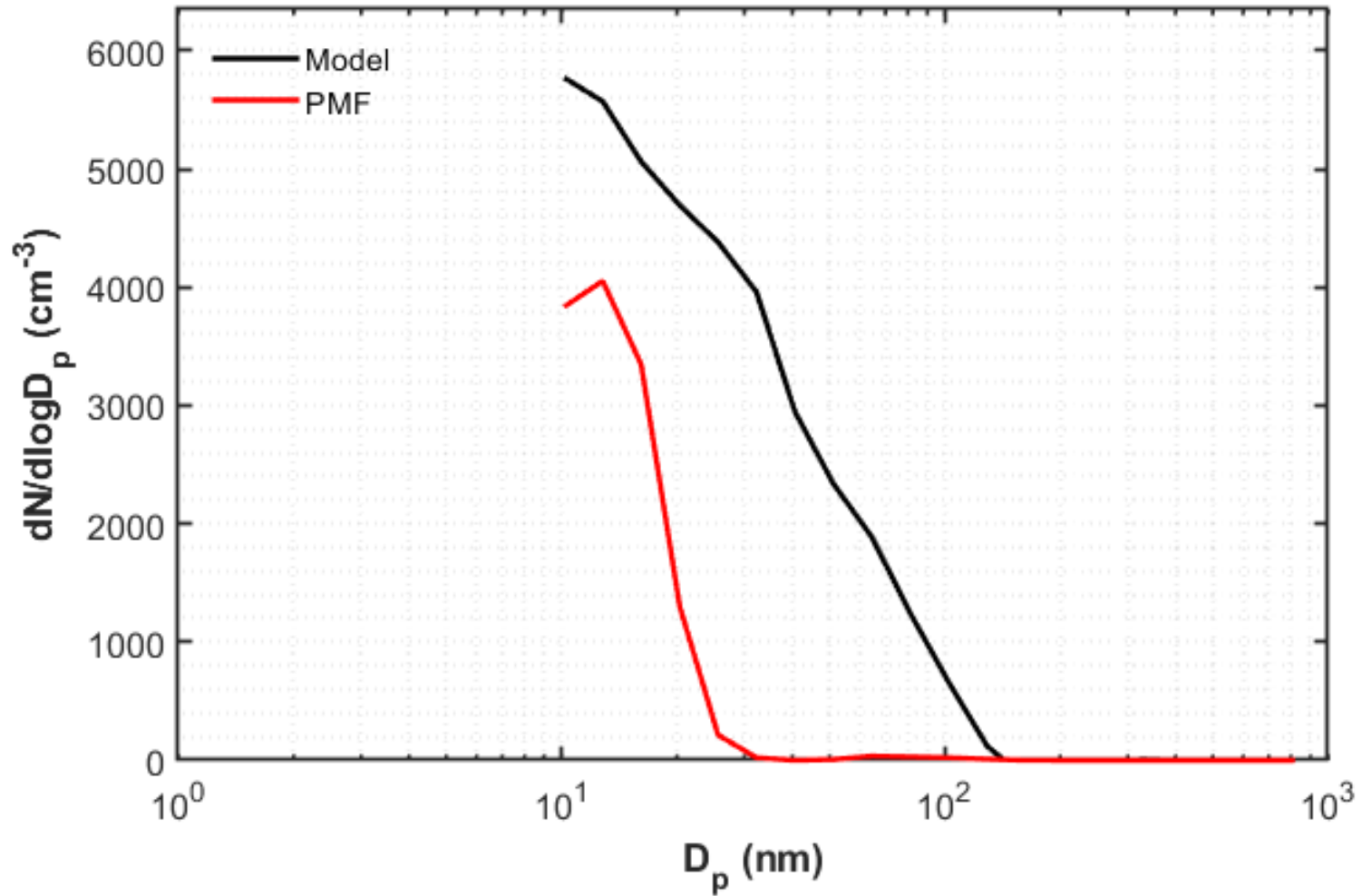
PMF: traffic-1, traffic-2 and mixed traffic
PMCAMx-UF: gasoline, diesel, shipping

LRT – July 2019



PMF: Regional-2
PMCAMx-UF: LRT

Nucleation – July 2019

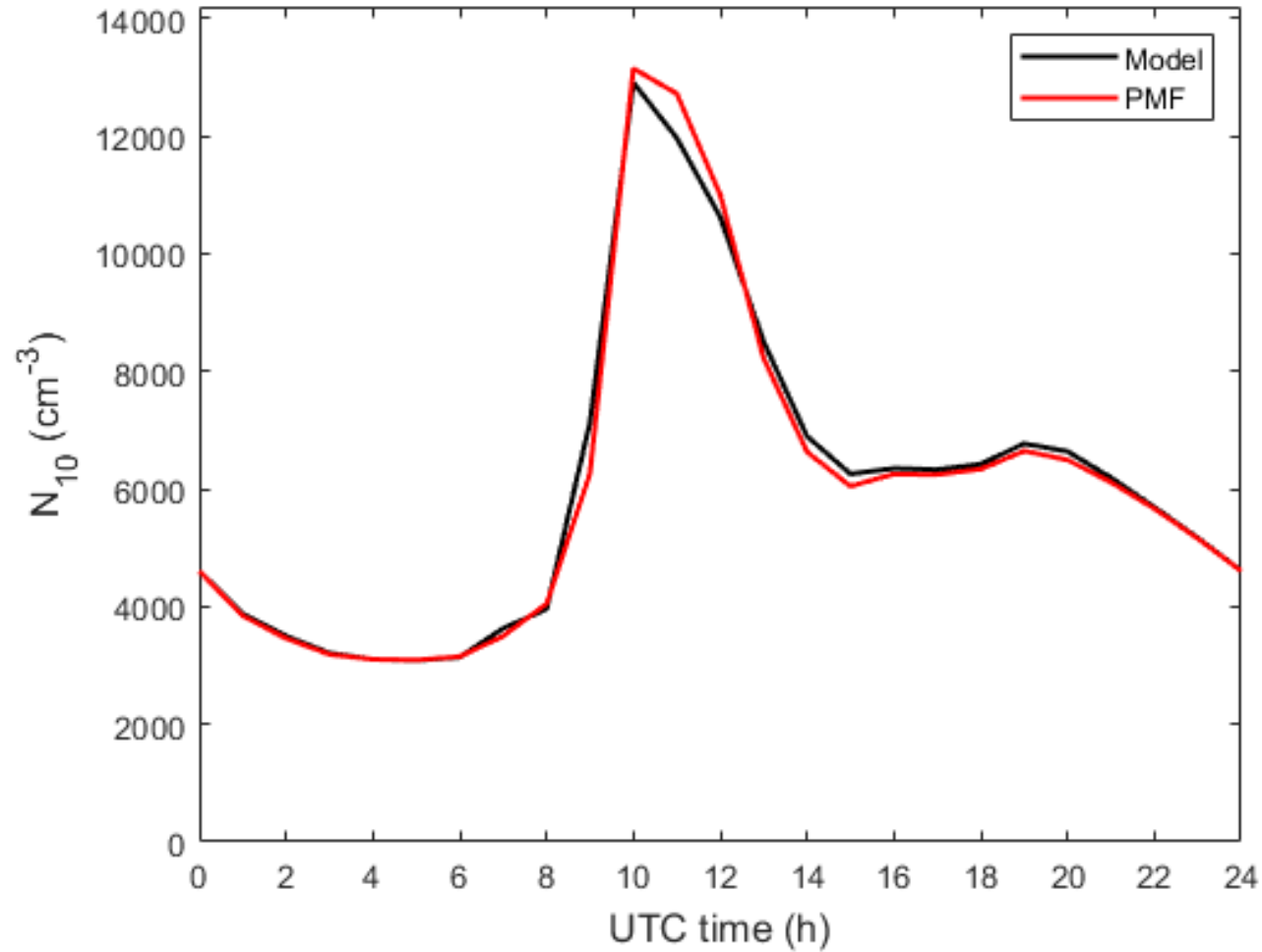


PMF: Nucleation

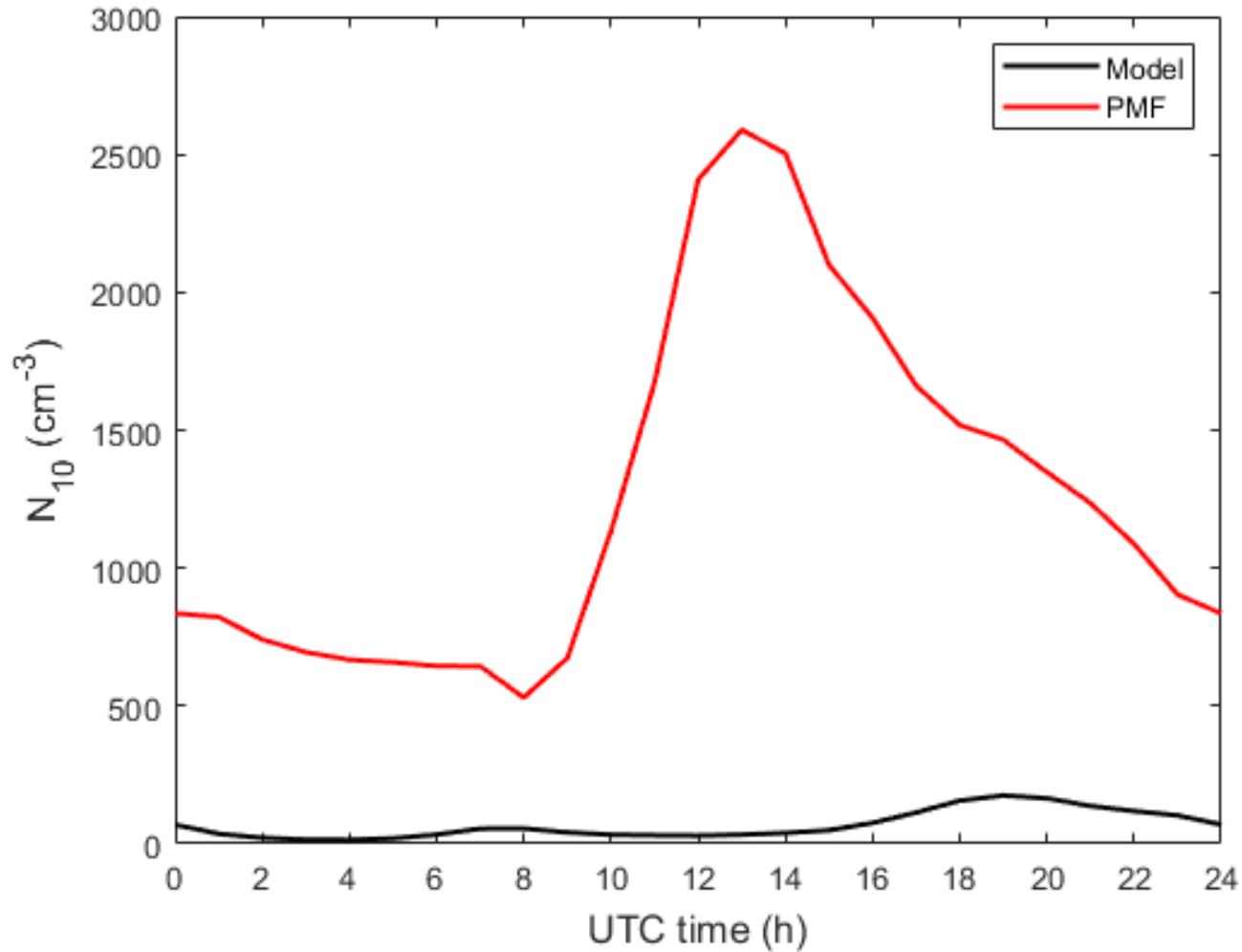
PMCAMx-UF: Nucleation

Average diurnal profiles

Total N_{10} – July 2019

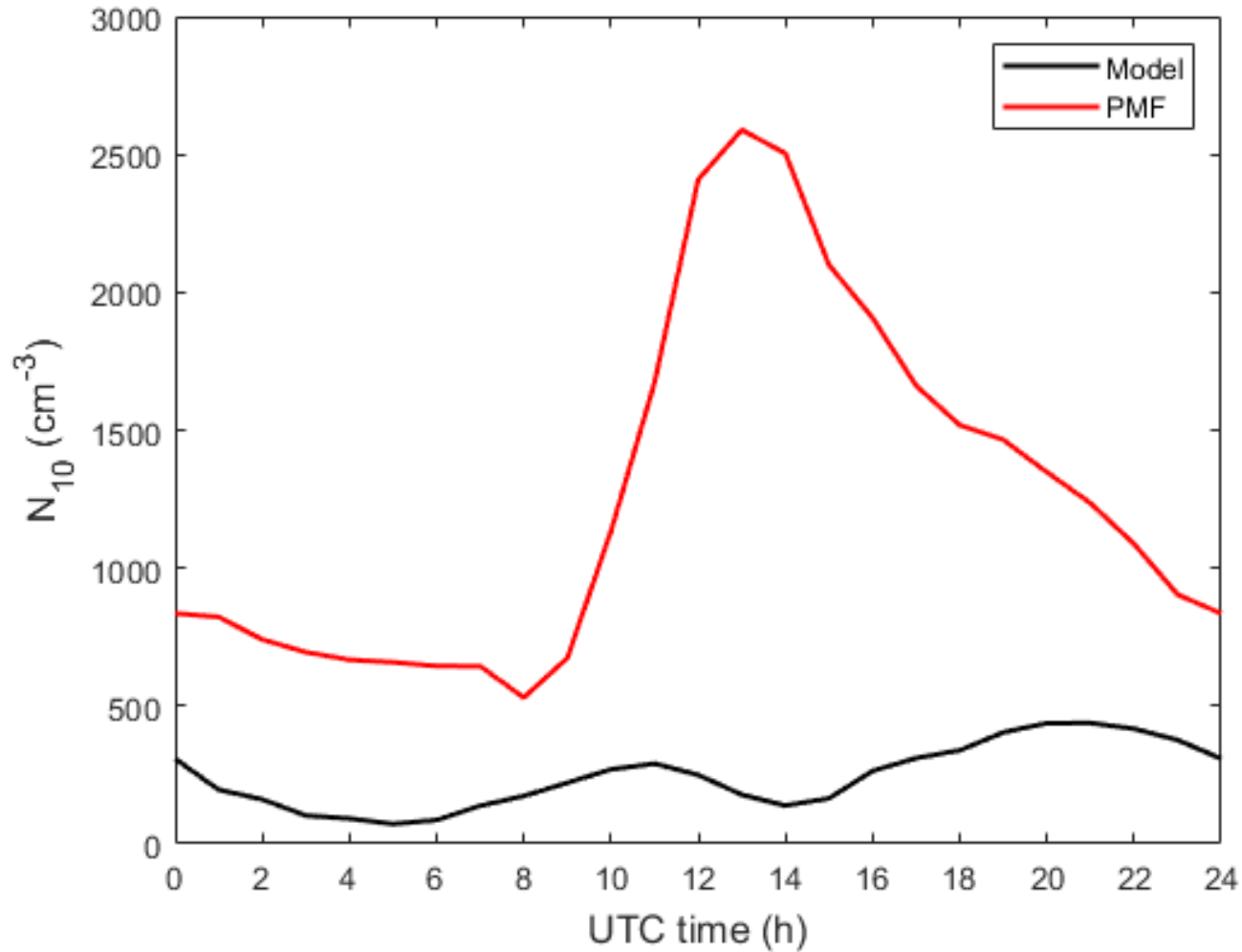


Traffic-1 (gasoline) - July 2019



PMF: Traffic-1/nucleation growth
PMCAMx-UF: gasoline

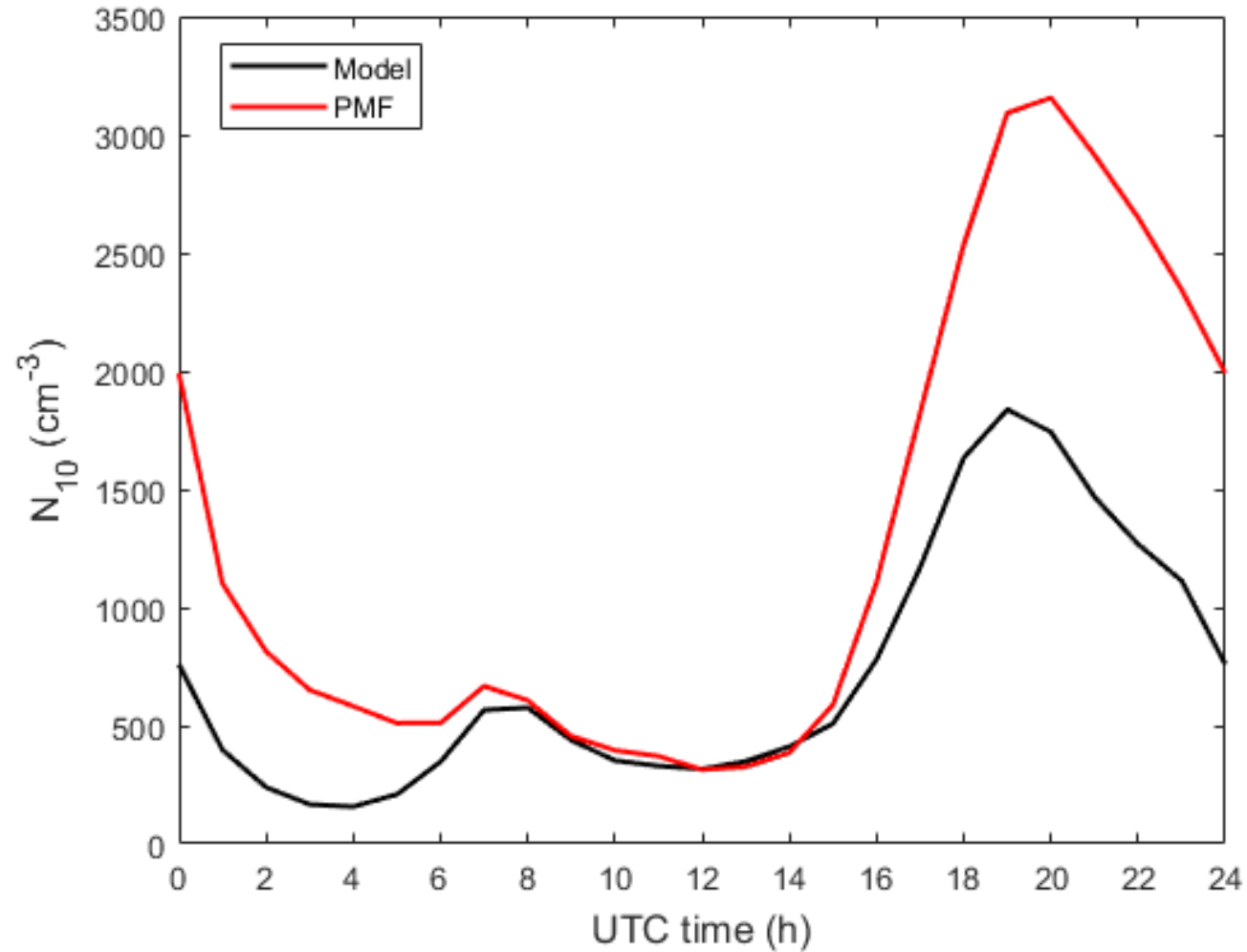
Traffic-1 (gasoline and Shipping) – July 2019



PMF: Traffic-1/nucleation growth

PMCAMx-UF: gasoline and shipping

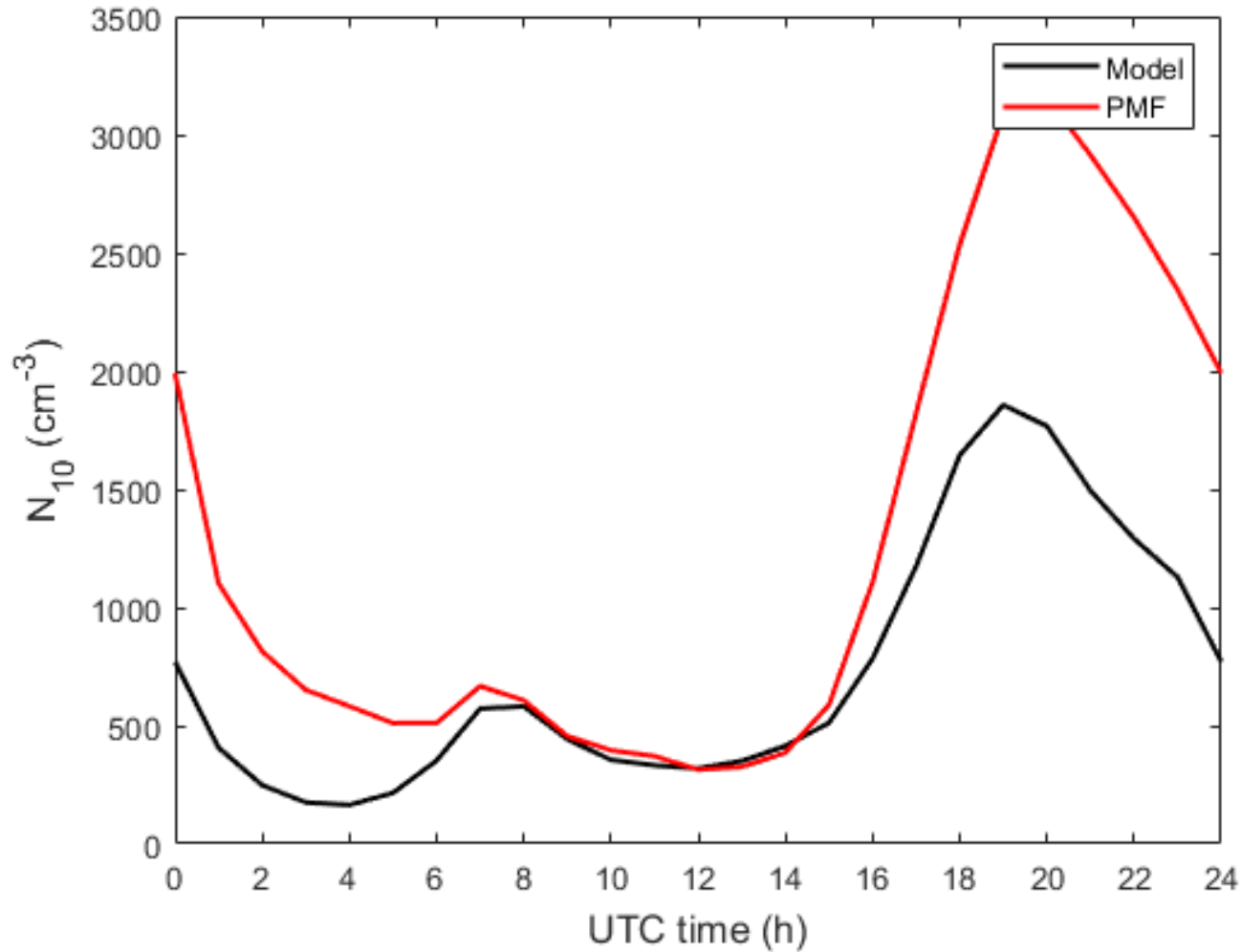
Traffic-2 (diesel) – July 2019



PMF: Traffic-2/BB

PMCAMx-UF: diesel

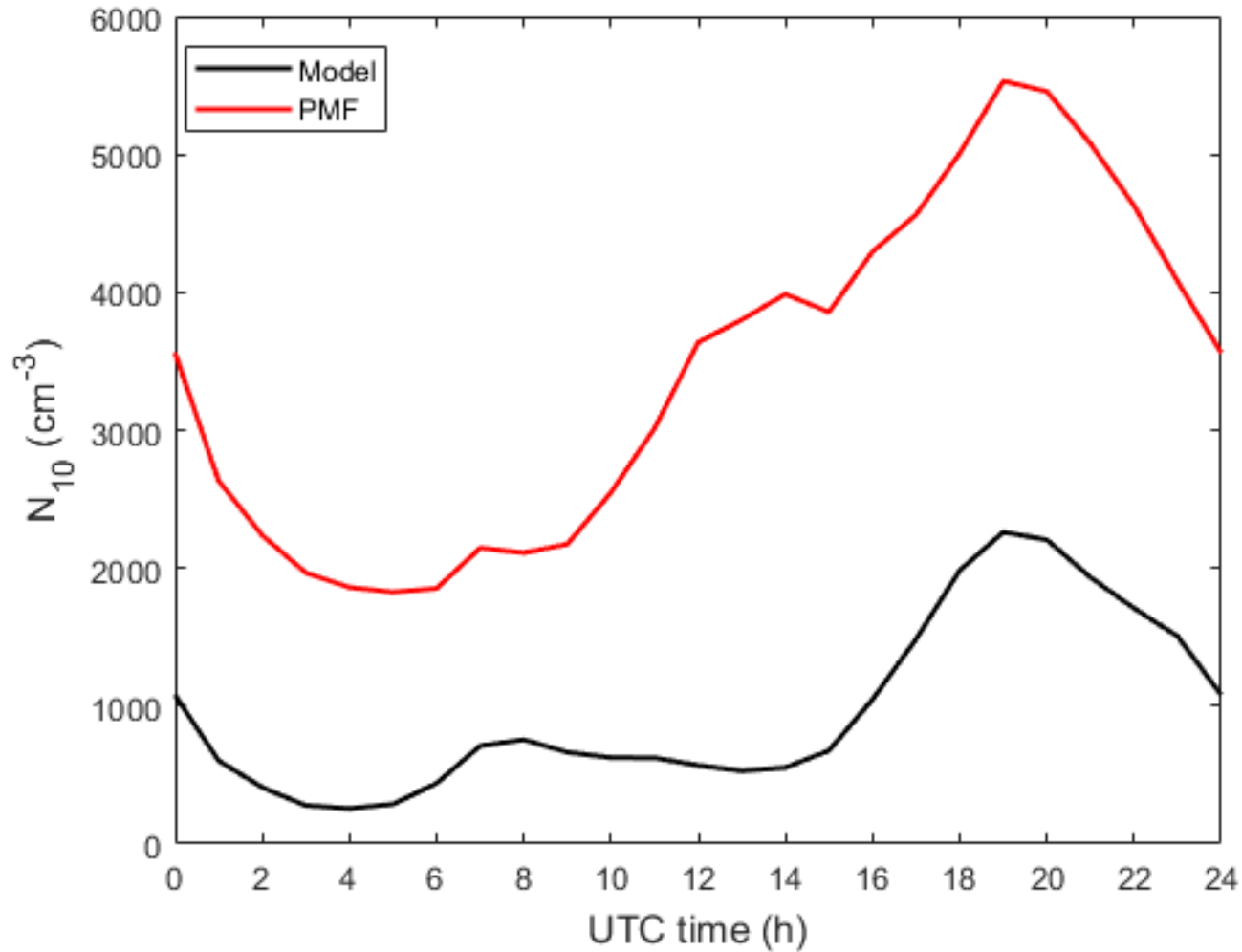
Traffic-2 (diesel and combustion) – July 2019



PMF: Traffic-2/BB

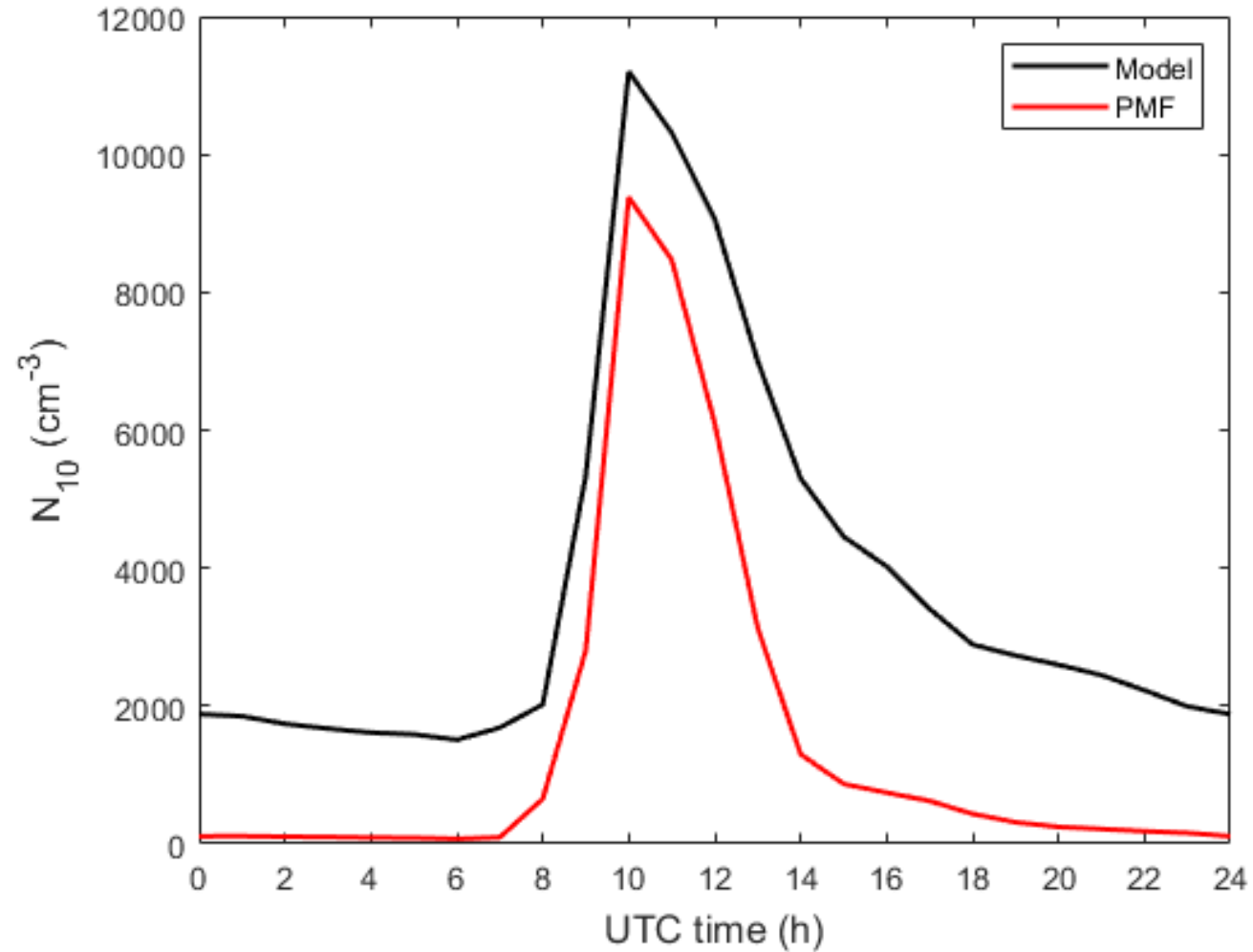
PMCAMx-UF: diesel and combustion

Total traffic – July 2019



PMF: traffic-1, traffic-2 and mixed traffic
PMCAMx-UF: gasoline, diesel, shipping

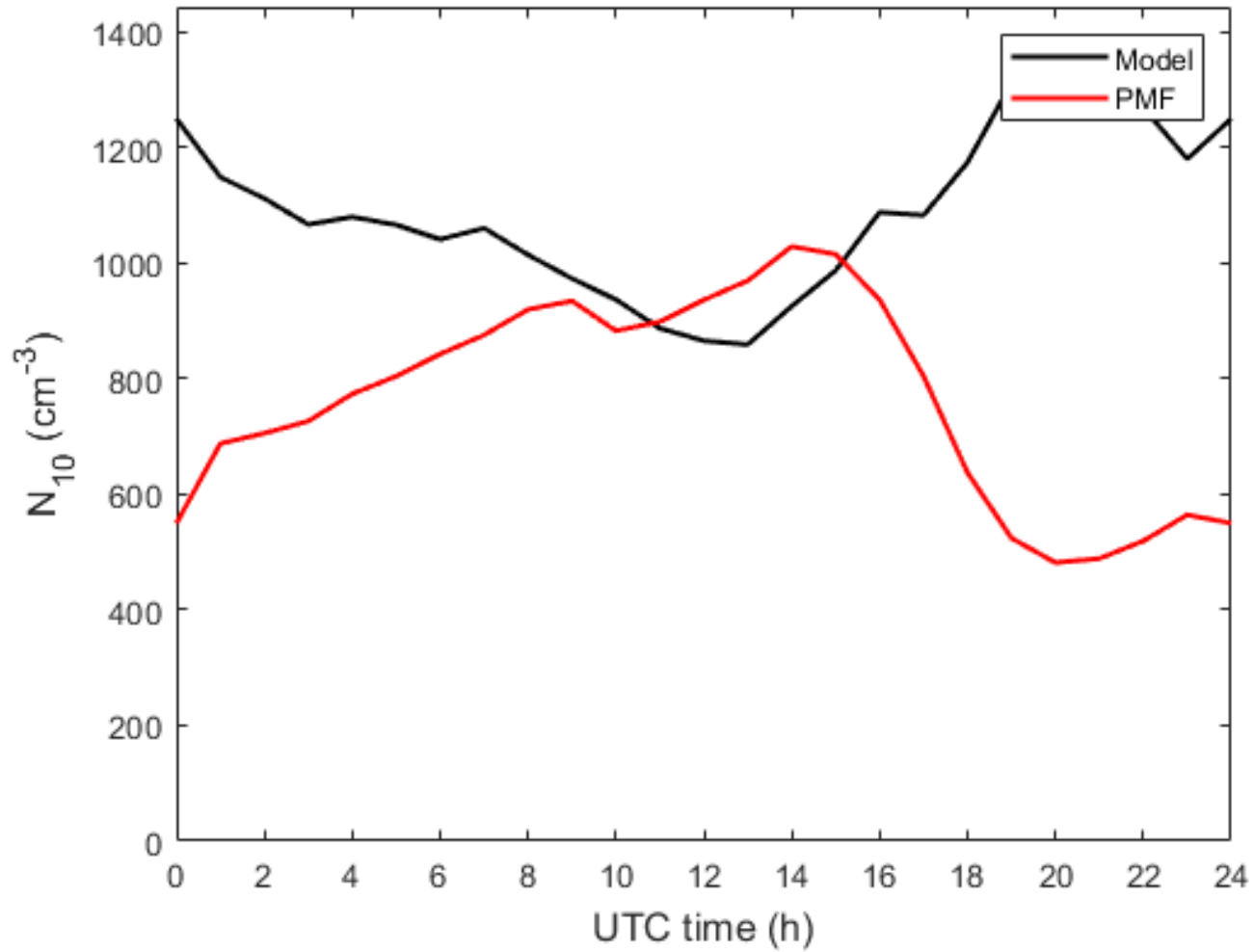
Nucleation – July 2019



PMF: Nucleation

PMCAMx-UF: Nucleation

LRT – July 2019



PMF: Regional -2
PMCAMx-UF: lrt

Conclusions – Summer

- PMF overestimates traffic-related sources, particularly Traffic-1, likely due to its inclusion of nucleation growth and potentially shipping emissions within the same factor. This is evident in both the higher PMF values in the size distribution plots and in the diurnal profiles.
- Diesel-related contributions to N_{10} (Traffic-2) are more consistent between the two methods as seen in the shape of the diurnal profiles, suggesting good agreement for this source category.
- Nucleation is significantly underestimated by PMF, likely attributing it to traffic instead.

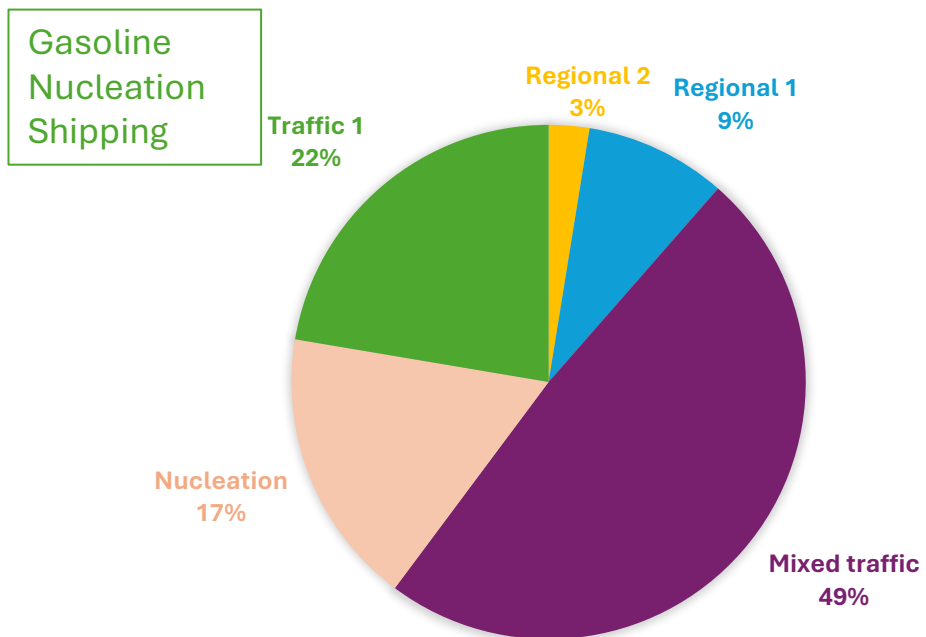
PMF and PMCAMx-UF source apportionment

Thissio

January 2019

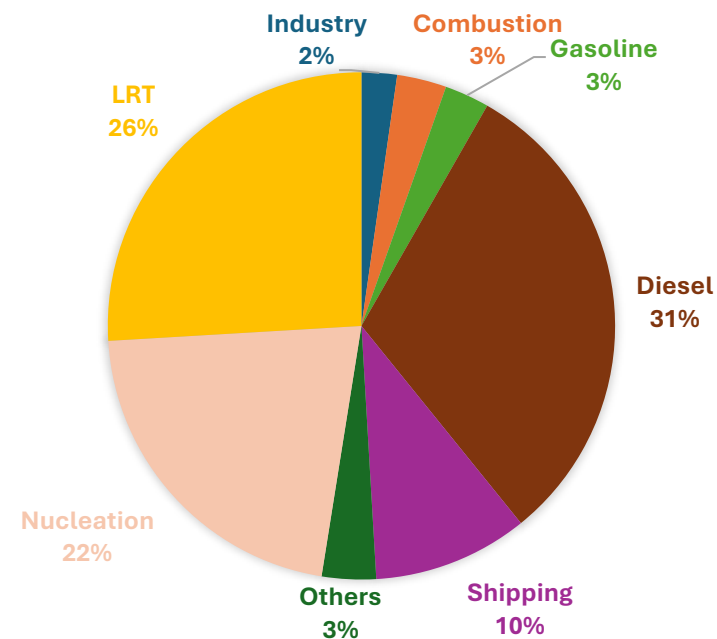
Average source contribution to N_{10} (%) – January 2019

PMF



Source	Average N_{10} cm ⁻³
Regional 2	84
Regional 1	293
Mixed traffic	1606
Nucleation	575
Traffic 1	736

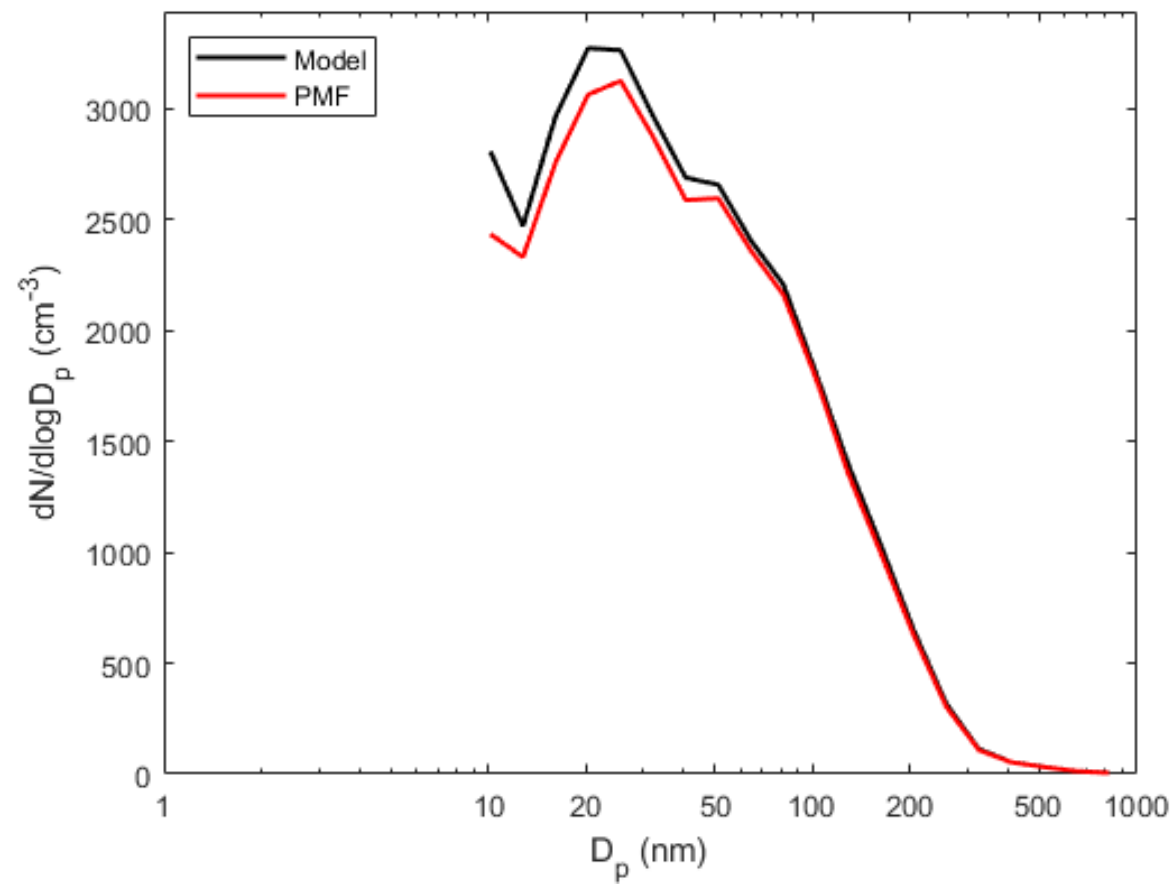
PMCAMx-UF



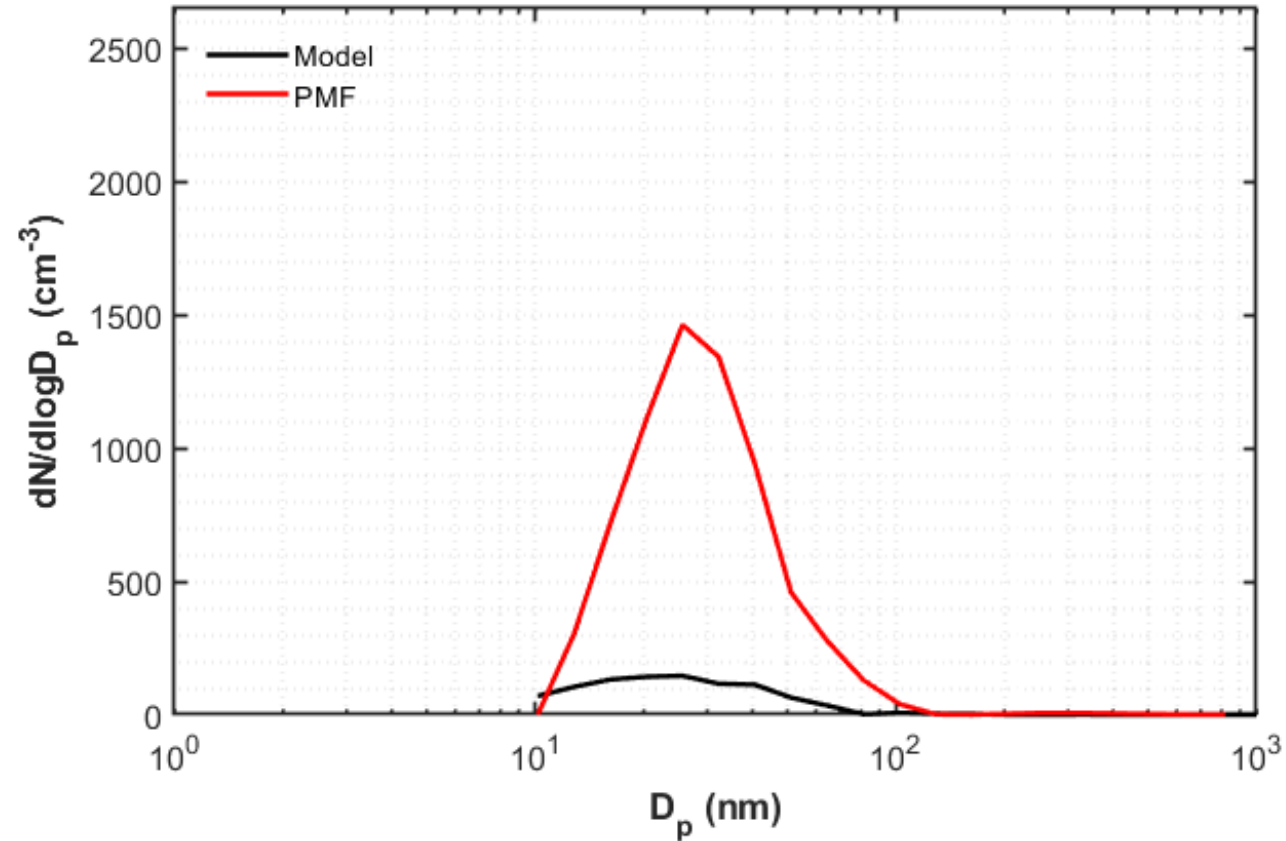
Source	Average N_{10} cm ⁻³
Industry	74
Combustion	104
Gasoline	93
Diesel	1020
Shipping	326
Others	113
Nucleation	711
LRT	856

Size distributions

All Sources - January 2019

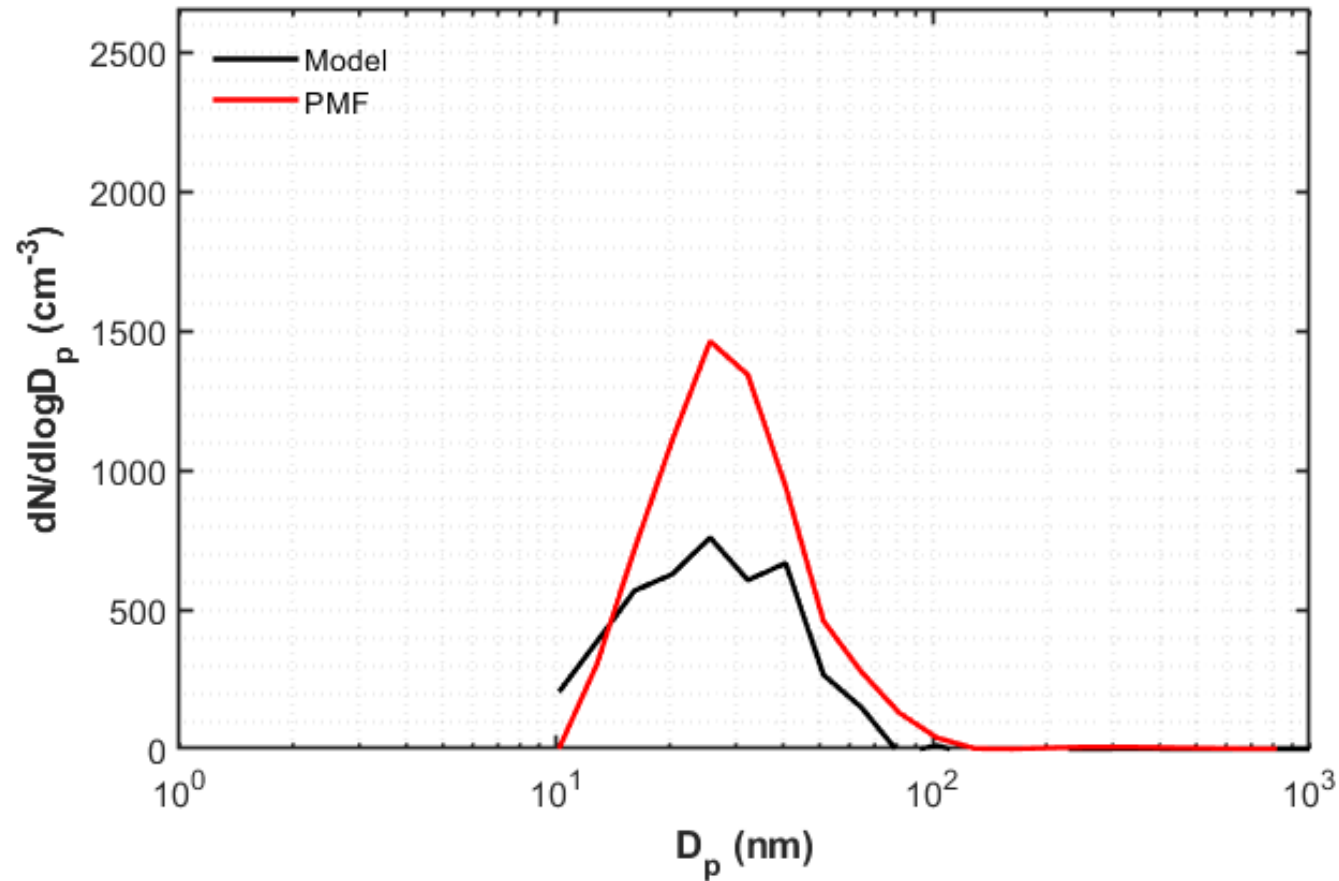


Traffic-1 (gasoline) - January 2019



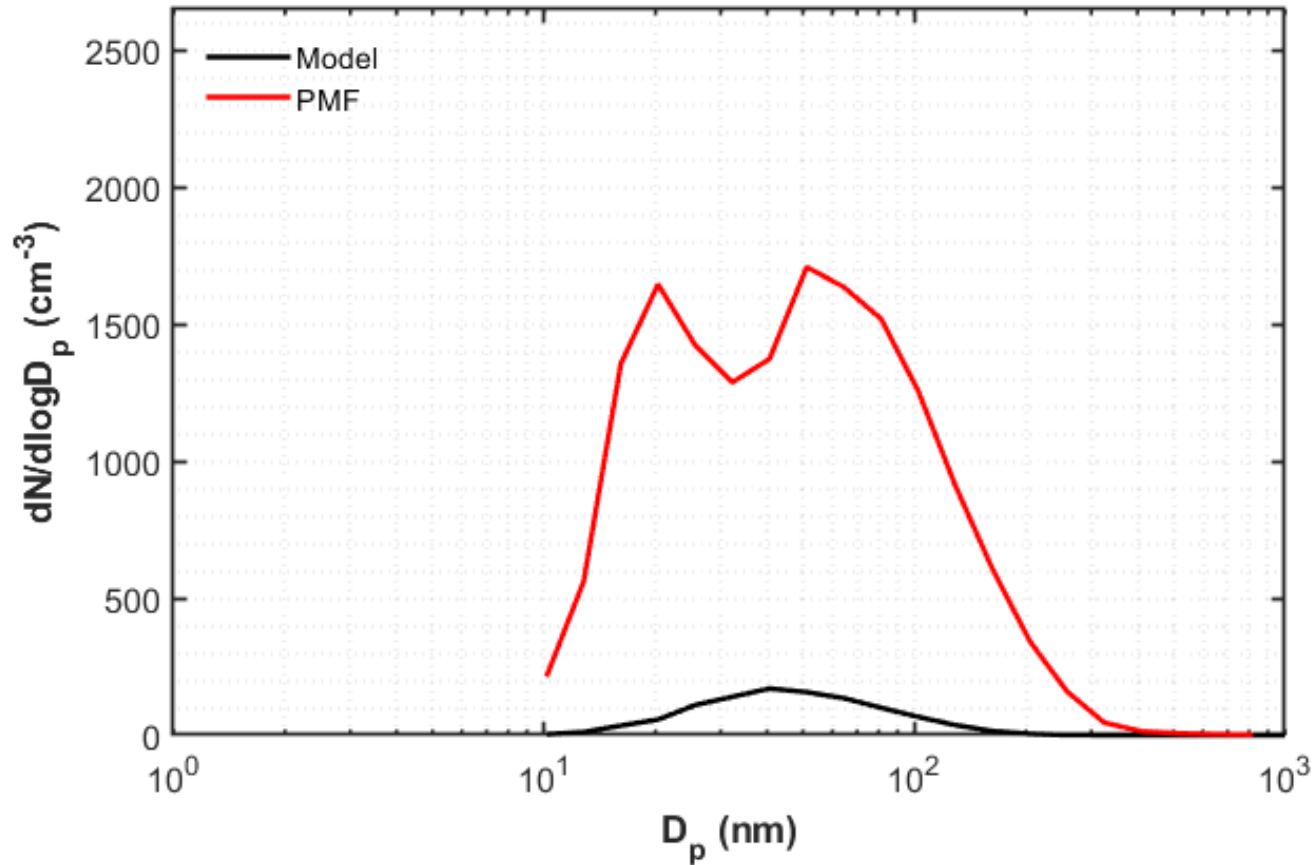
PMF: Traffic-1/nucleation growth
PMCAMx-UF: gasoline

Traffic-1 (gasoline and Shipping) – January 2019



PMF: Traffic-1/nucleation growth
PMCAMx-UF: gasoline + Shipping

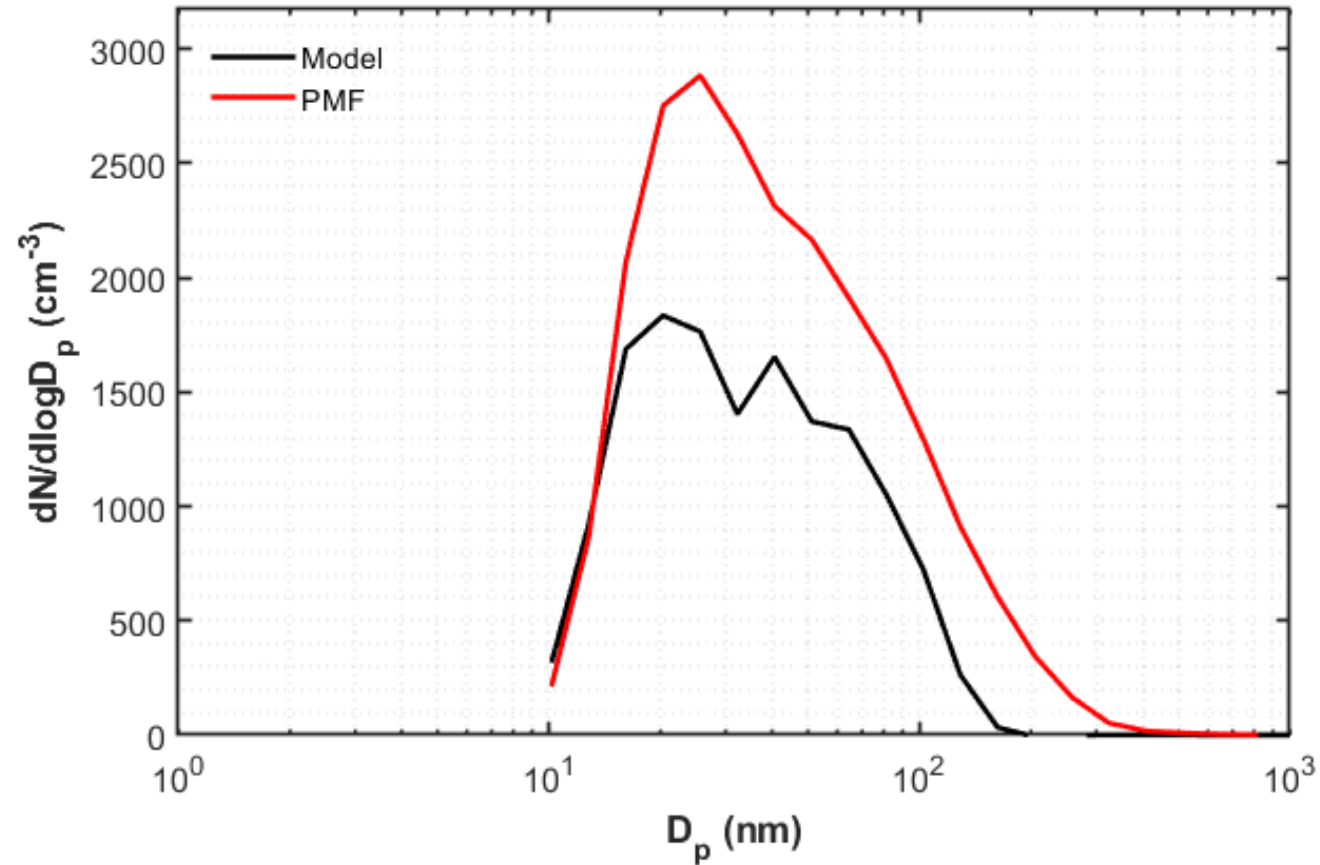
Mixed - Traffic (Combustion) – January 2019



PMF: mixed traffic

PMCAMx-UF: combustion

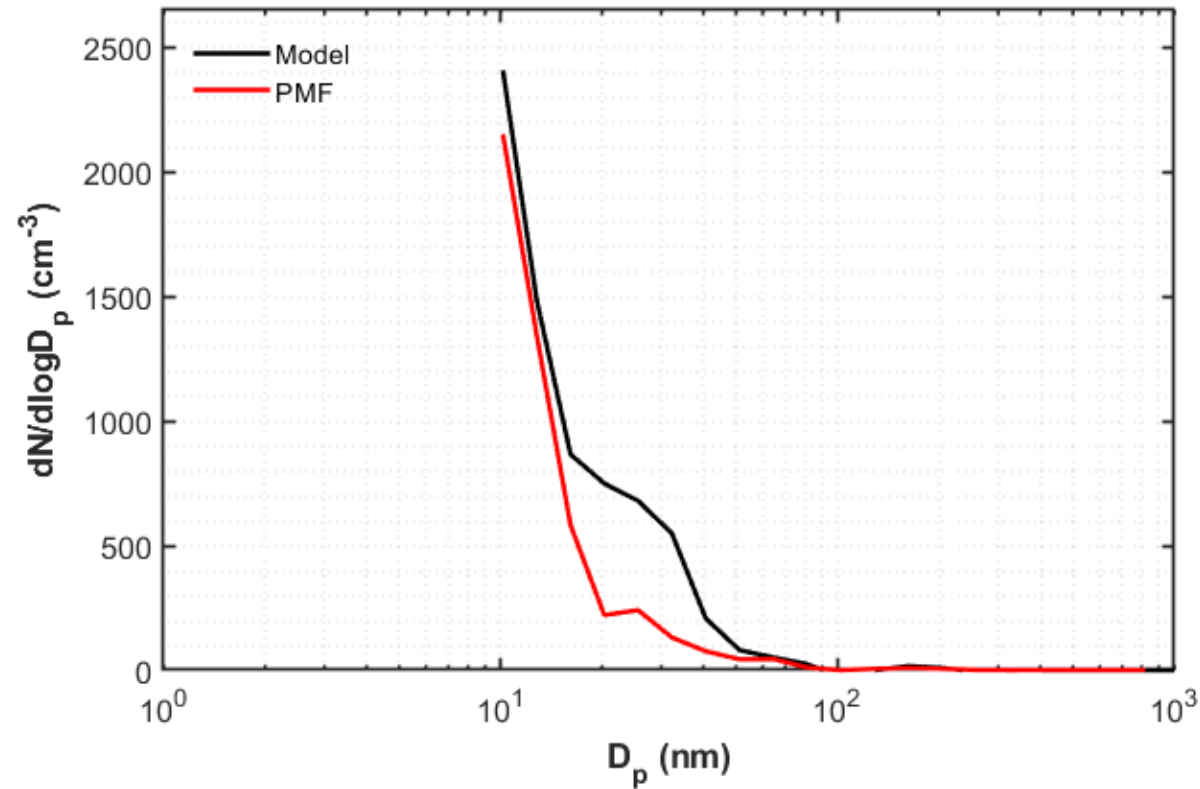
Total Traffic – January 2019



PMF: Traffic-1 + mixed traffic

PMCAMx-UF: gasoline, diesel, shipping

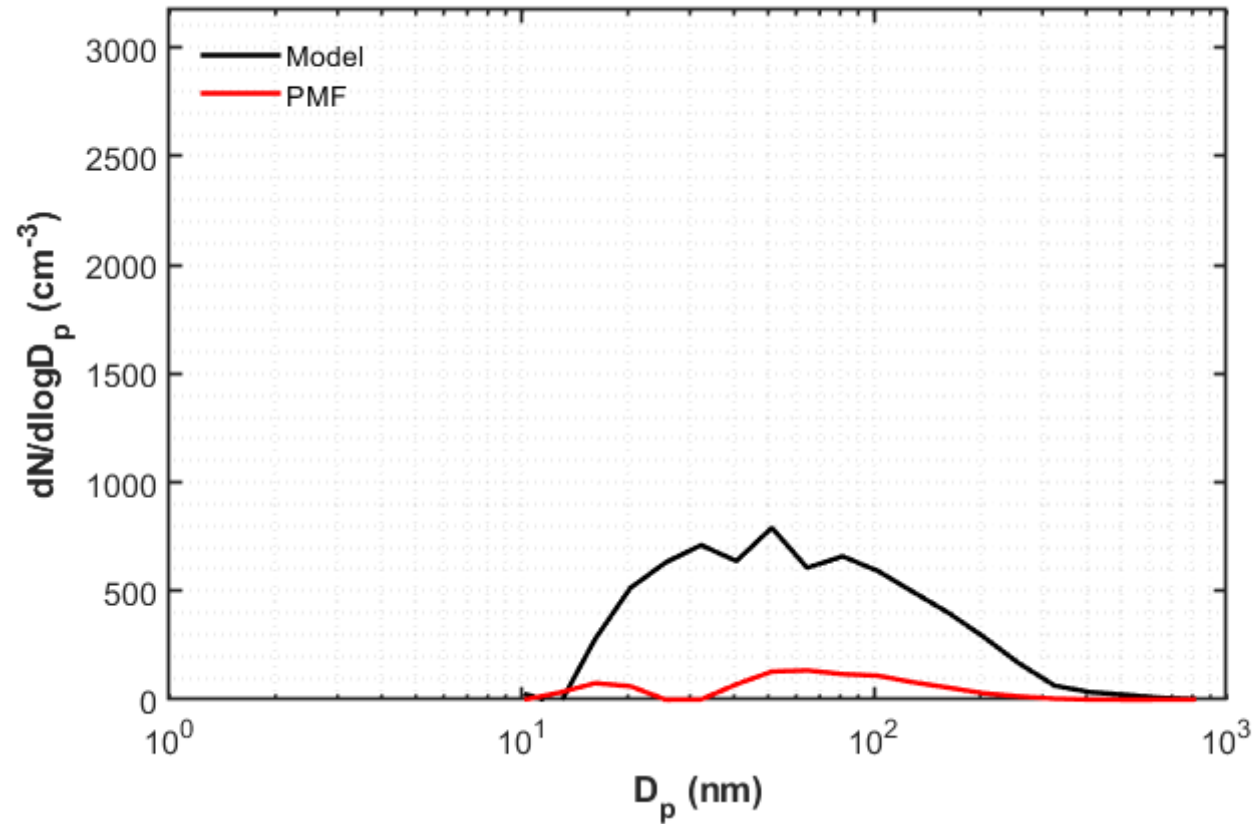
Nucleation – January 2019



PMF: Nucleation

PMCAMx-UF: Nucleation

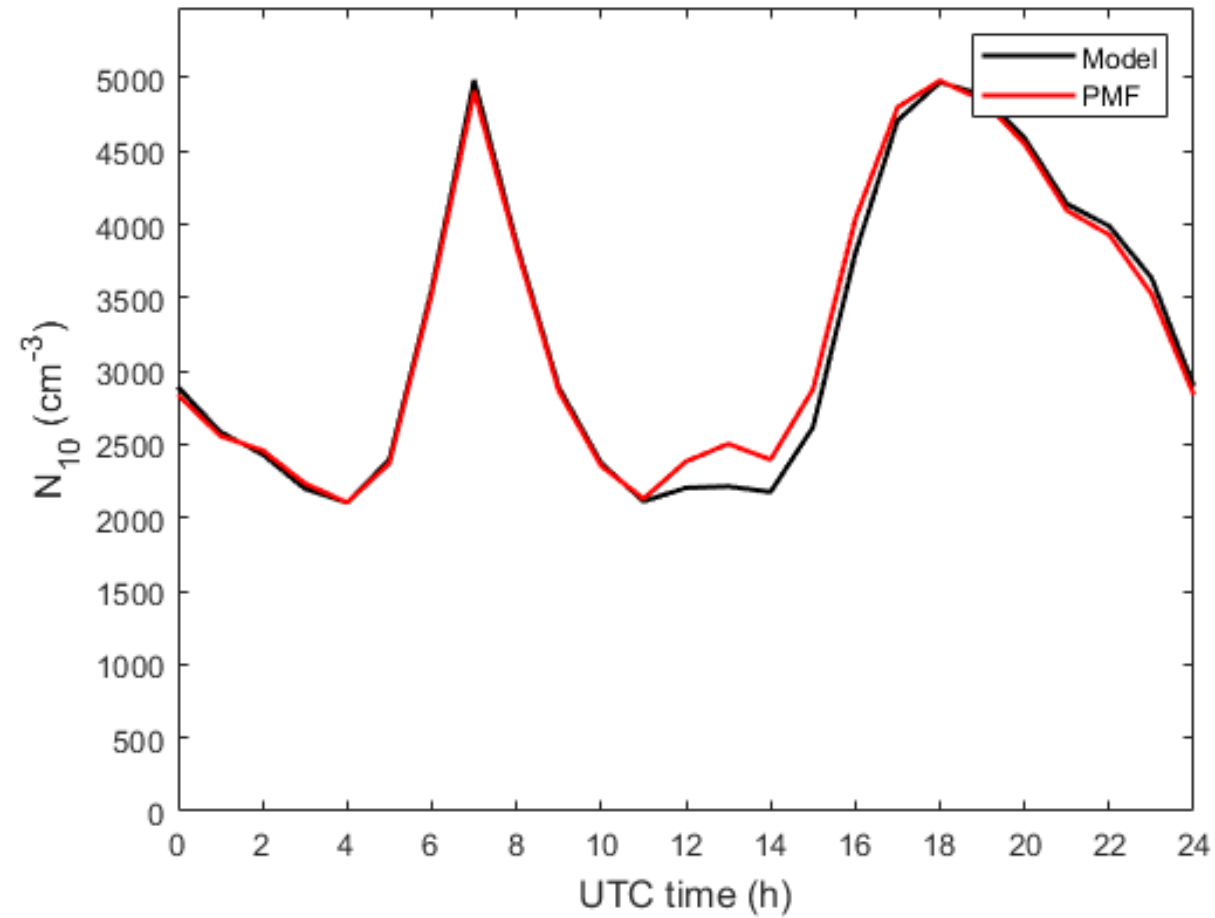
LRT – January 2019



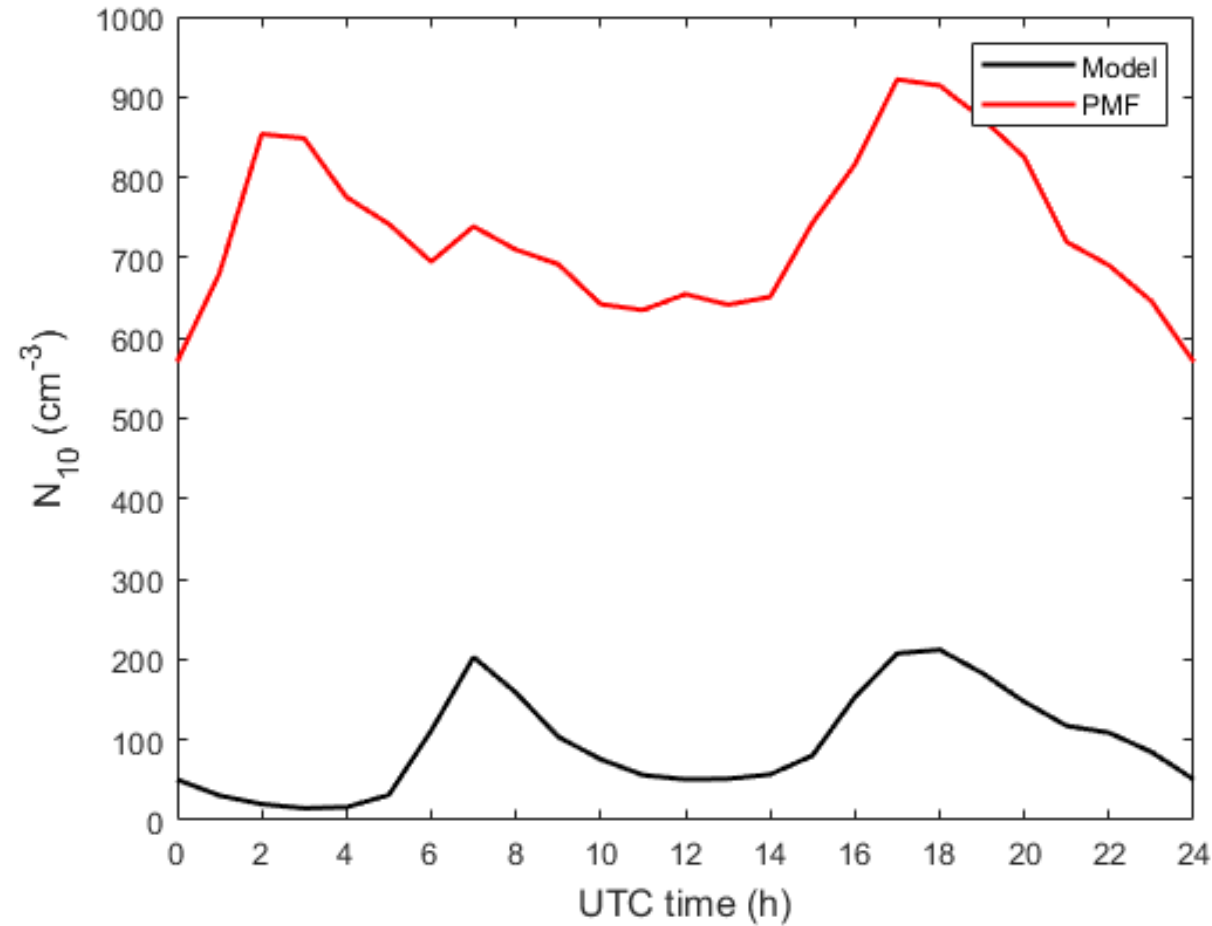
PMF: Regional-2
PMCAMx-UF: LRT

Average diurnal profiles

Total N_{10} – January 2019

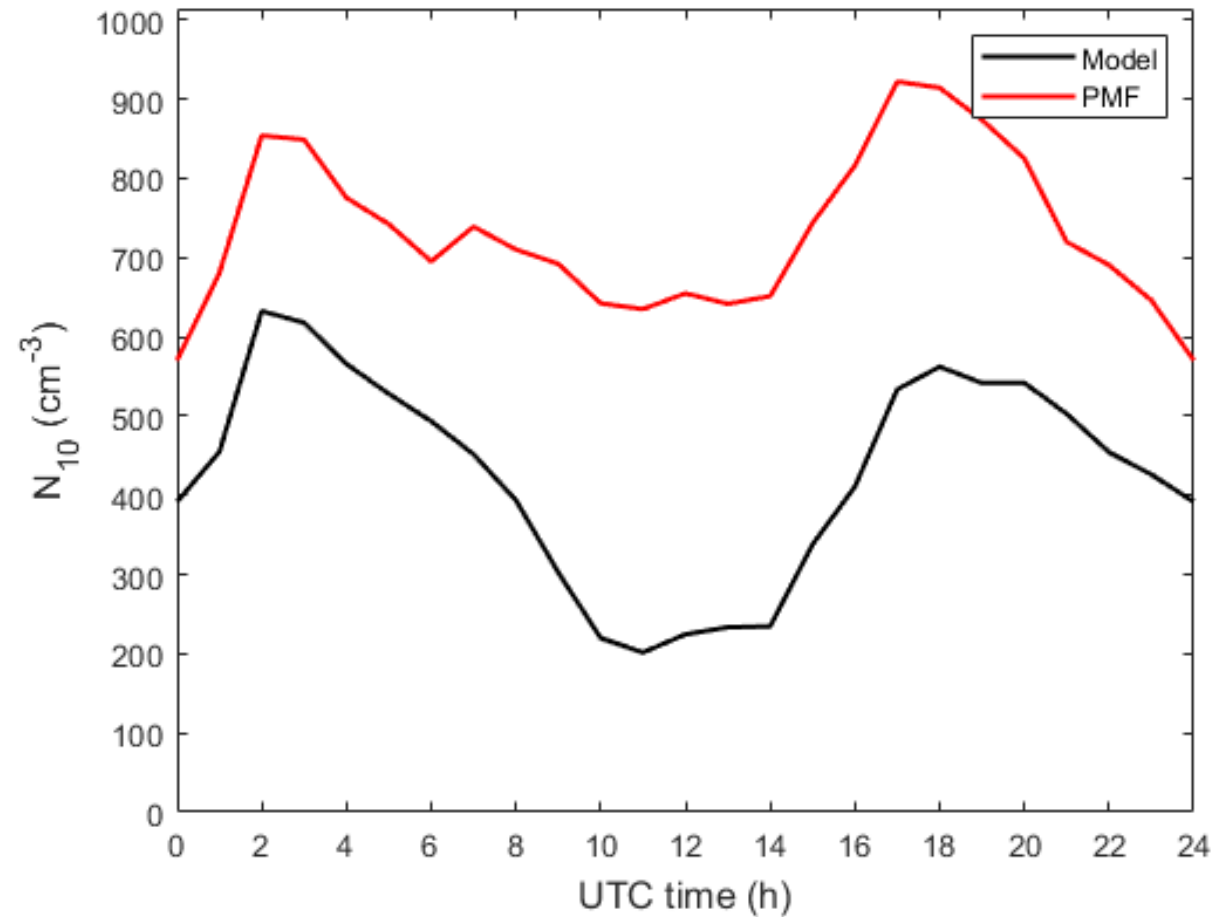


Traffic-1 (Gasoline) – January 2019



PMF: Traffic-1/nucleation growth
PMCAMx-UF: gasoline

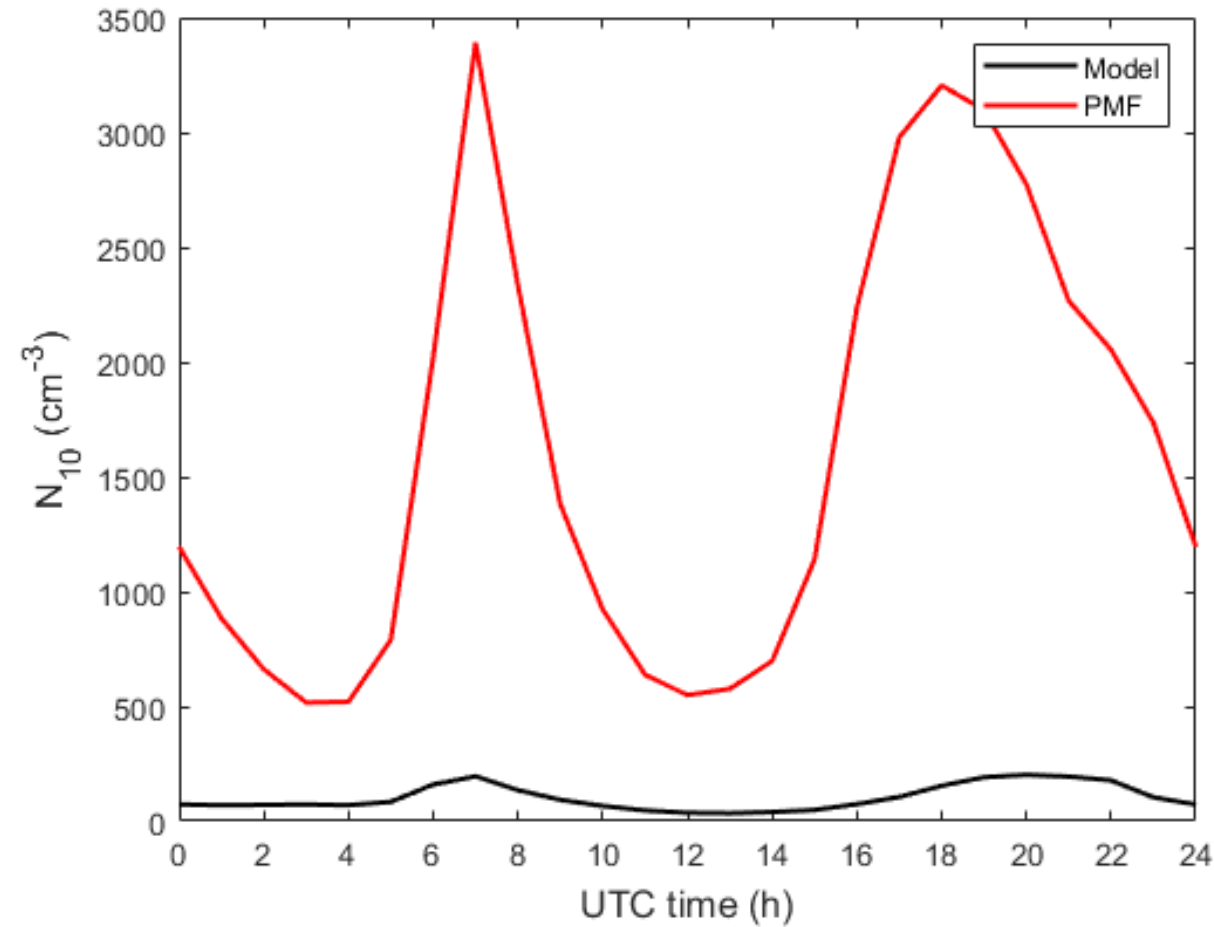
Traffic-1(gasoline & Shipping) – January 2019



PMF: Traffic-1/nucleation growth

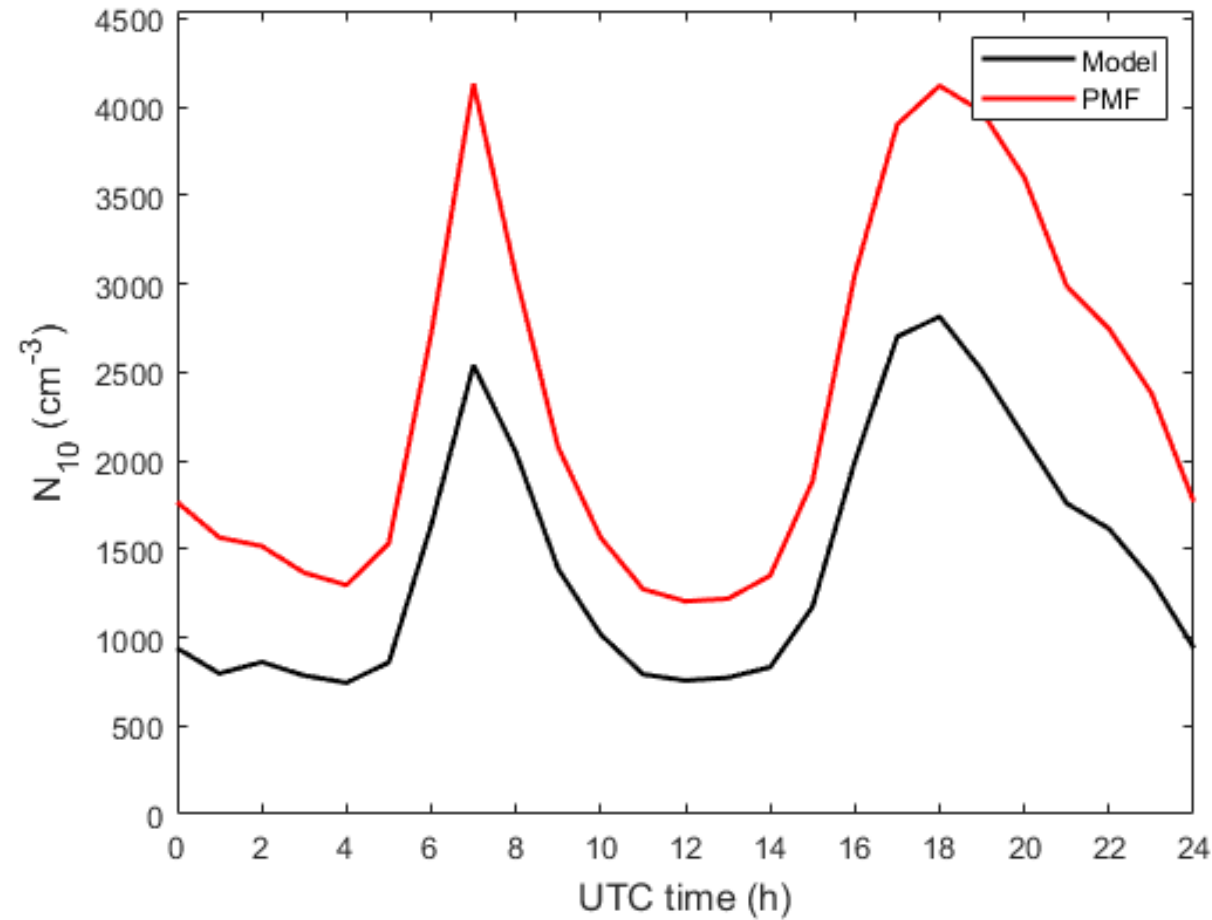
PMCAMx-UF: gasoline and shipping

Mixed Traffic (Combustion) – January 2019



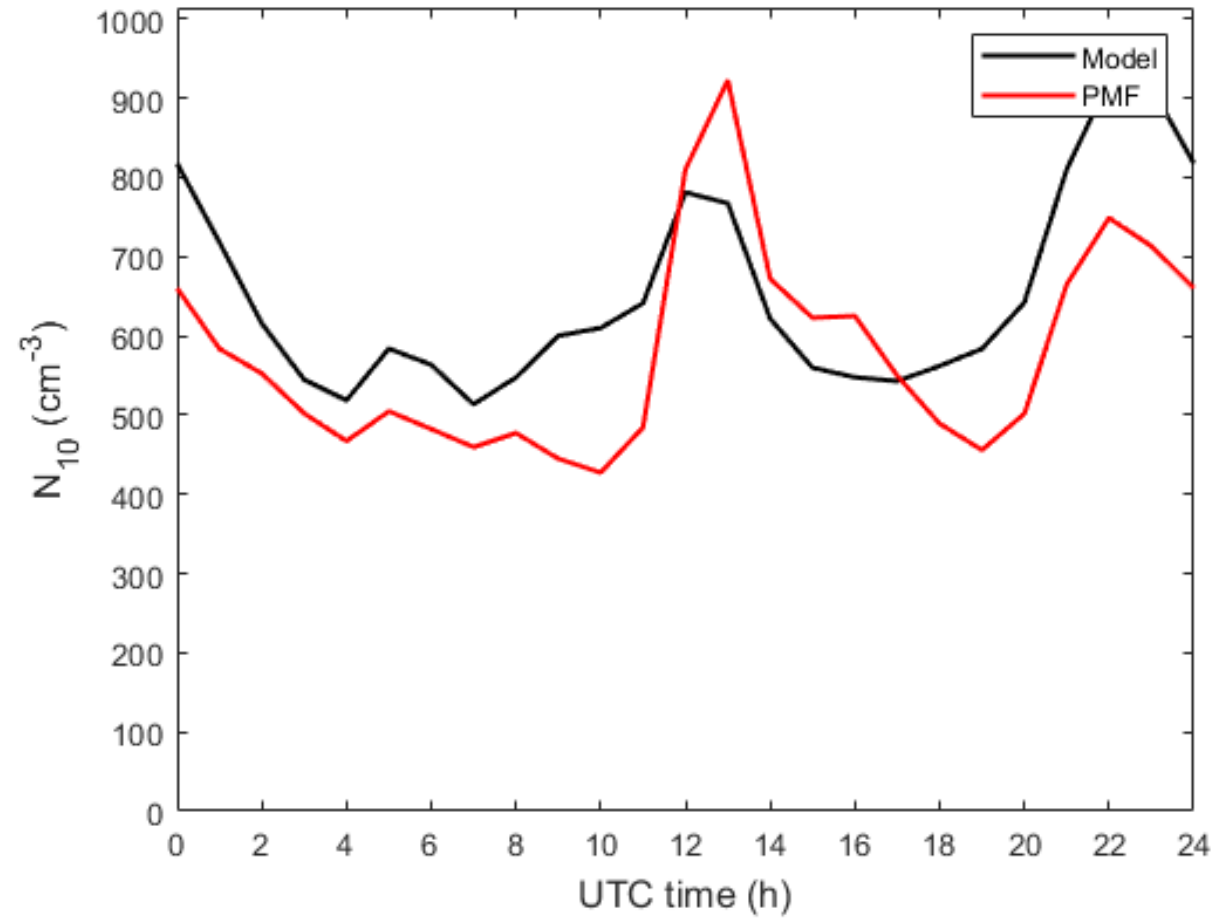
PMF: Mixed-Traffic (Combustion)
PMCAMx-UF: Combustion

Total Traffic – January 2019



PMF: Traffic-1 , Mixed-Traffic (Combustion)
PMCAMx-UF : gasoline, diesel, shipping

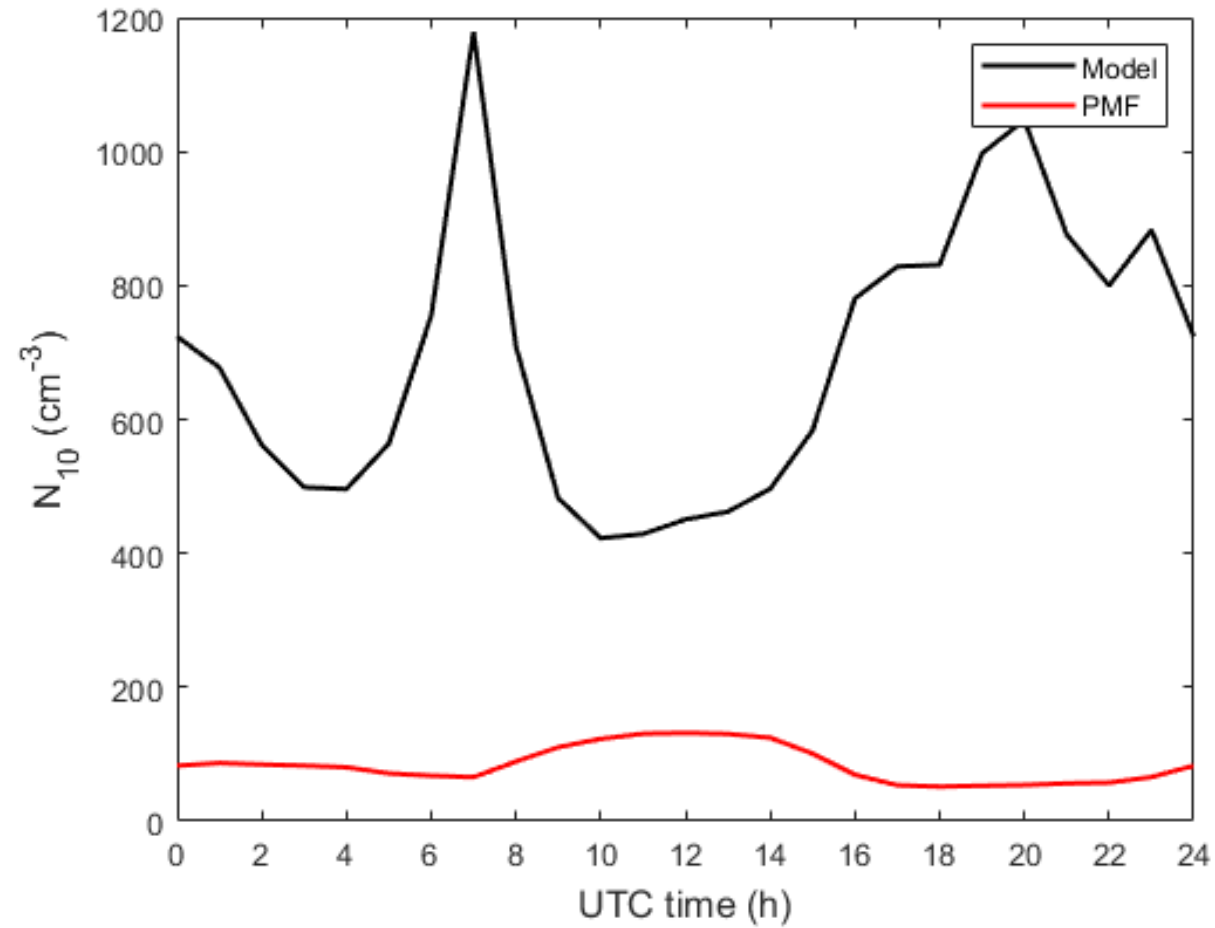
Nucleation – January 2019



PMF: Nucleation

PMCAMx-UF :Nucleation

LRT – January 2019



PMF:Regional 2
PMCAMx-UF :lrt

Conclusions - Winter

- No distinct diesel factor is resolved in PMF.
- PMF again overestimates Traffic-1 (gasoline), possibly because it absorbs other sources like shipping and nucleation, which are better separated in PMCAMx-UF. This is evident in the size distributions and diurnal profiles of Traffic-1 in PMF.
- PMF overestimates the total traffic (traffic-1 and mixed traffic) contribution to N_{10} .