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Title :

Validation and inter-comparison of CALPUFF regulatory model to eulerian models and measurements. An application over the Greater Athens Area, Greece

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Scope:

To validate and inter-compare, over the Greater Area of Athens (GAA):

- CALPUFF 3-D regulatory dispersion model
- UAM 3-D eulerian photochemical model
- REMSAD 3-D eulerian photochemical model
- Experimental measurements

Acknowledgements : ICAROS NET (Integrated Computational Assessment of Urban Air Quality via Remote Observation Systems Network)

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CALPUFF Modeling System
(U.S.EPA – Earth Tech Inc.)

CALMET
Meteorological Model

→

CALPUFF
Dispersion Model

CALMET Meteorological Model

Main characteristics

- Diagnostic Wind Field generator
- Objective analysis
- Topographical effects
- Divergence minimization procedure
- ABL properties parameterized effects

Input Data

- Surface meteorological data
- Upper air data
- Geophysical (terrain, land use)
- Precipitation / Overwater data
- Input from prognostic models (e.g. MM5)

Output Data
3-D Wind & Temperature
2-D mixing height, dispersion properties and surface characteristics

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CALPUFF Dispersion Model

Main characteristics

- Non-steady –state Lagrangian Gaussian puff model
- Complex terrain effect
- Overwater transport
- Coastal interaction effects
- Dry deposition and Wet removal
- Building downwash
- Simple Chemical transformation (SO_2, NO_x)
- Dispersion + Rise (Calm periods)
- Odor modeling
- Visibility modeling

Input Data

- Met-fields (CALMET or other)
- Sources :
  - point
  - area
  - volume
  - line
  - (constant or variable)

Output Data

3-D concentrations
3-D deposition fluxes

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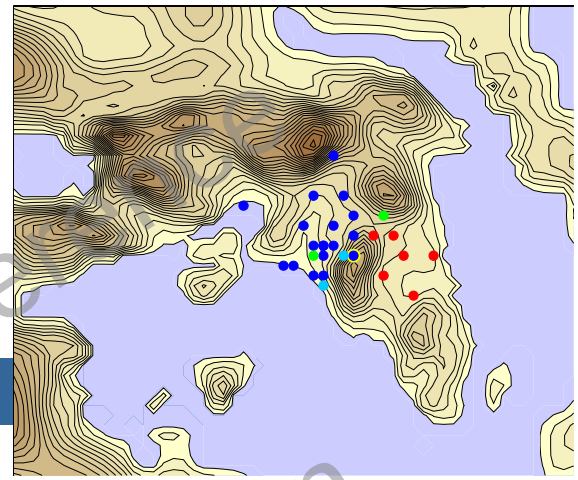

Application

Date

27.09.02

CALMET

Meteorological input data

- 2 Surface meteor. stations of N.O.A. (Thiseio & Penteli)
- 1 Upper air meteor. station of H.M.S (Hellenic Meteor. Society)
- Upper air meteor. data from RASS SODAR of U.O.A

CALPUFF

Dispersion model input data

- Emissions Inventory : 1998
- Temporal resolution: Hourly emissions rates for the significant season
- 2207 Area & 121 Point sources

Input emissions species for the application

NO2, NO, SO2, PM10

Output emissions species for the application

NO2, NO, NO3, HNO3, SO2, SO4, PM10

Concentrations measurements

Concentration measurements at 24 stations :

- PERPA (17),
- U.O.A (1),
- Airport El. Venizelos greater area (6)

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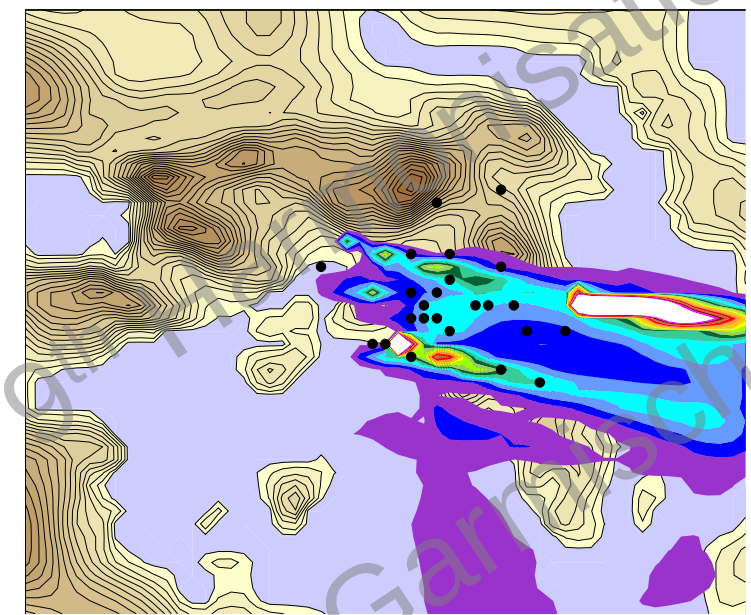
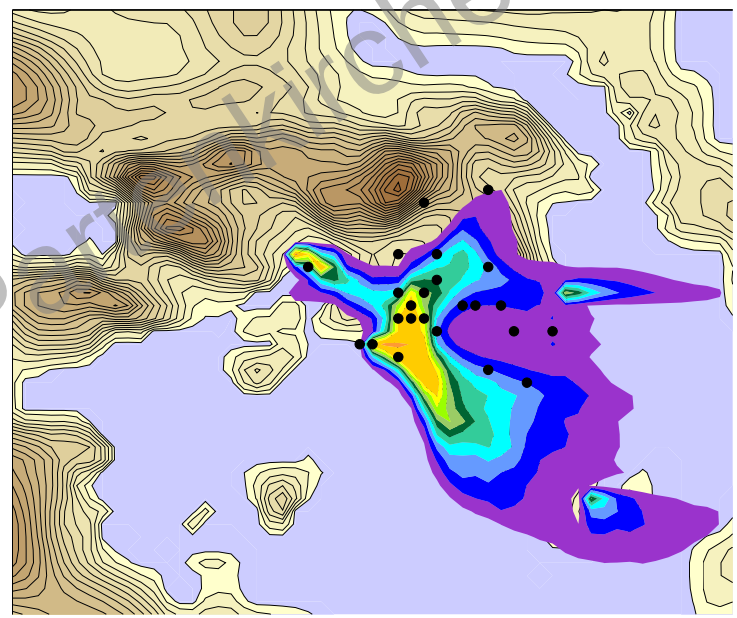
Comparison of **CALPUFF** and **UAM** for 27.09.2002

NO_2 Spatial distribution at 03:00 LST

CALPUFF



UAM



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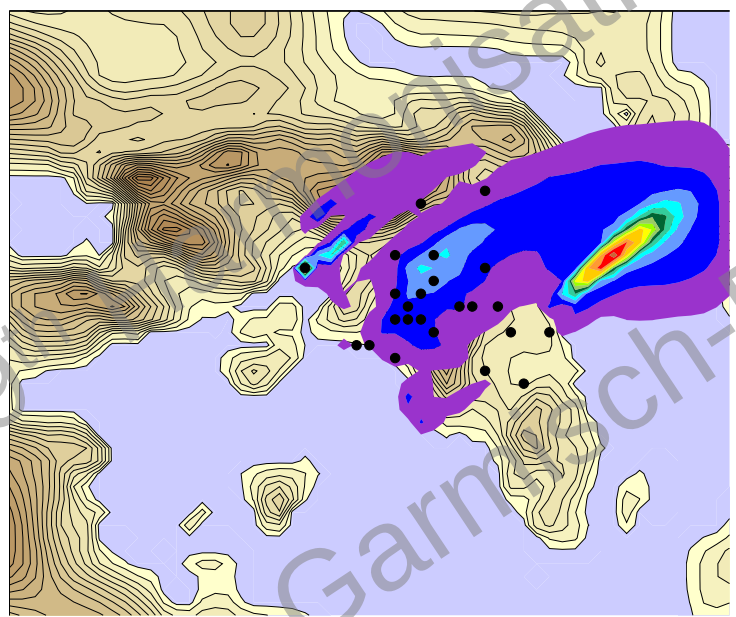
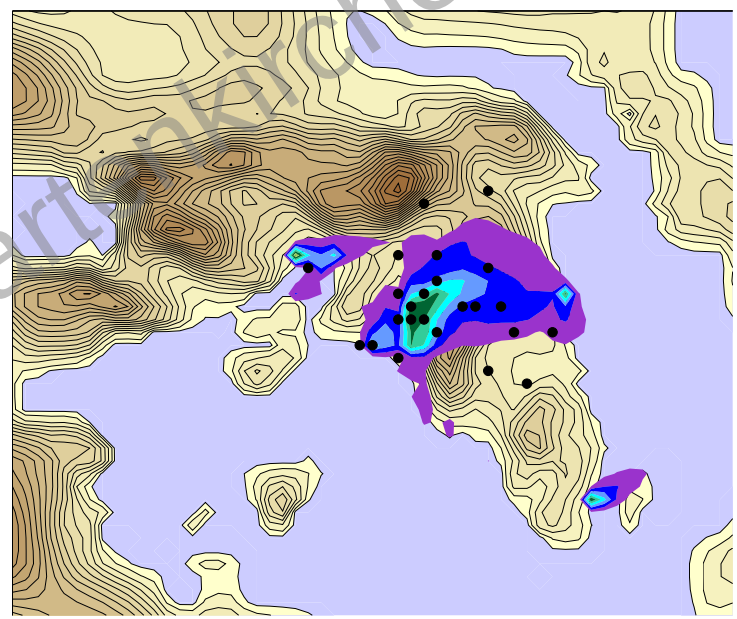
Comparison of **CALPUFF** and **UAM** for 27.09.2002

NO_2 Spatial distribution at 15:00 LST

CALPUFF



UAM



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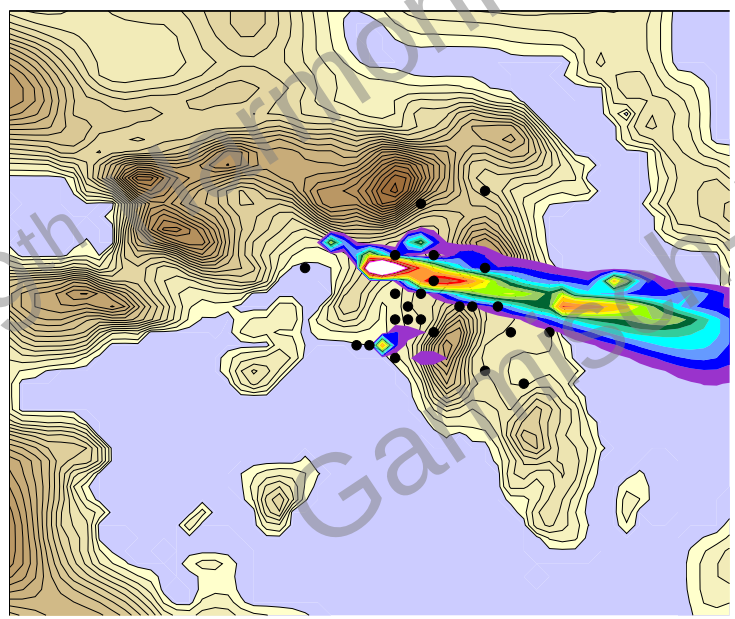
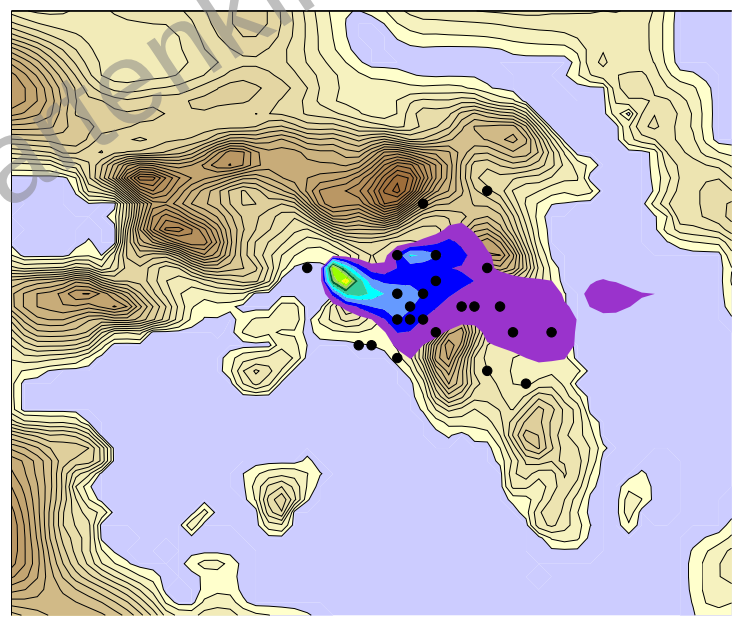
Comparison of **CALPUFF** and **REMSAD** for 27.09.2002

PM_{10} Spatial distribution at 03:00 LST

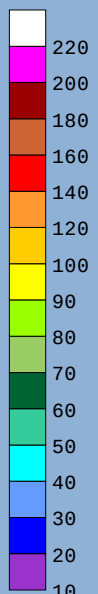
CALPUFF



REMSAD



µgr/m³



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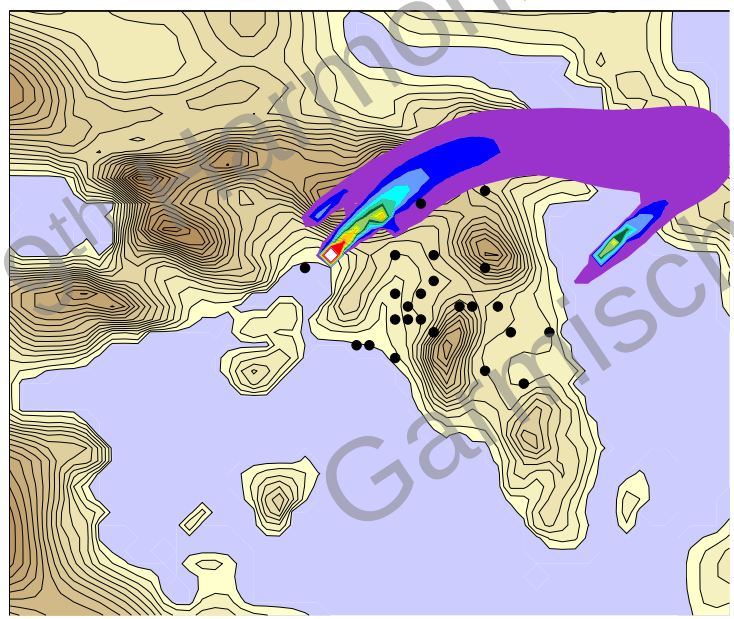
Comparison of **CALPUFF** and **REMSAD** for 27.09.2002

PM_{10} Spatial distribution at 15:00 LST

CALPUFF



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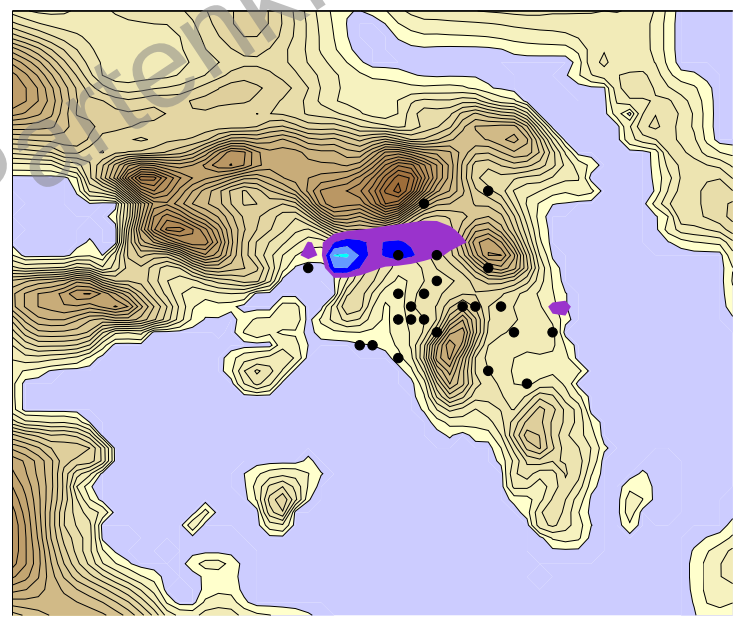

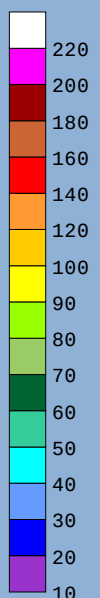

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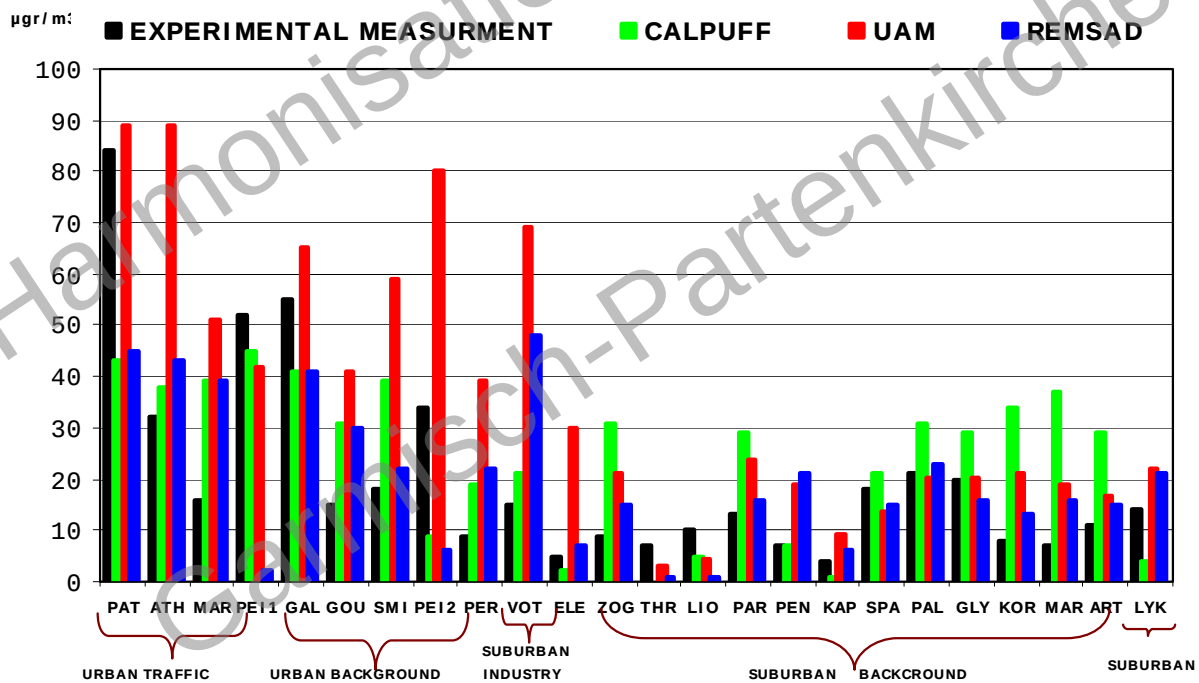
Comparison of **CALPUFF, UAM, REMSAD** results to **experimental measurements** for 27.09.2002

NO_2 at stations 03:00 LST



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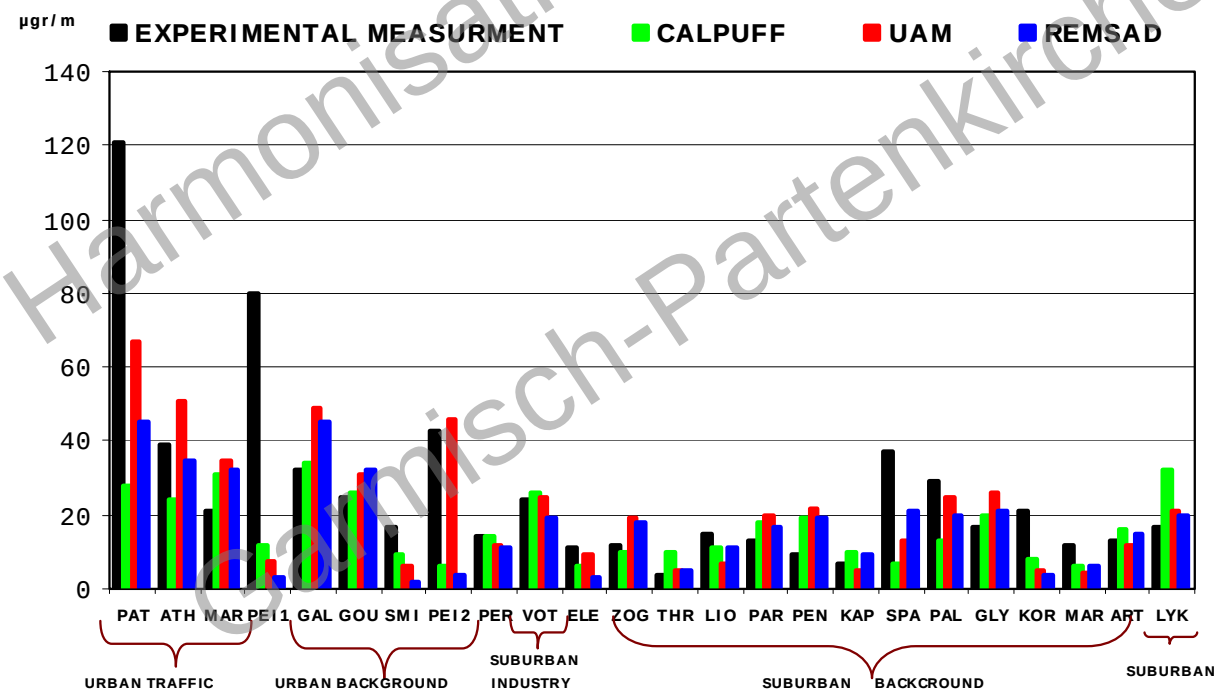
Comparison of **CALPUFF, UAM, REMSAD** results to **experimental measurements** for 27.09.2002

NO_2 at stations 15:00 LST



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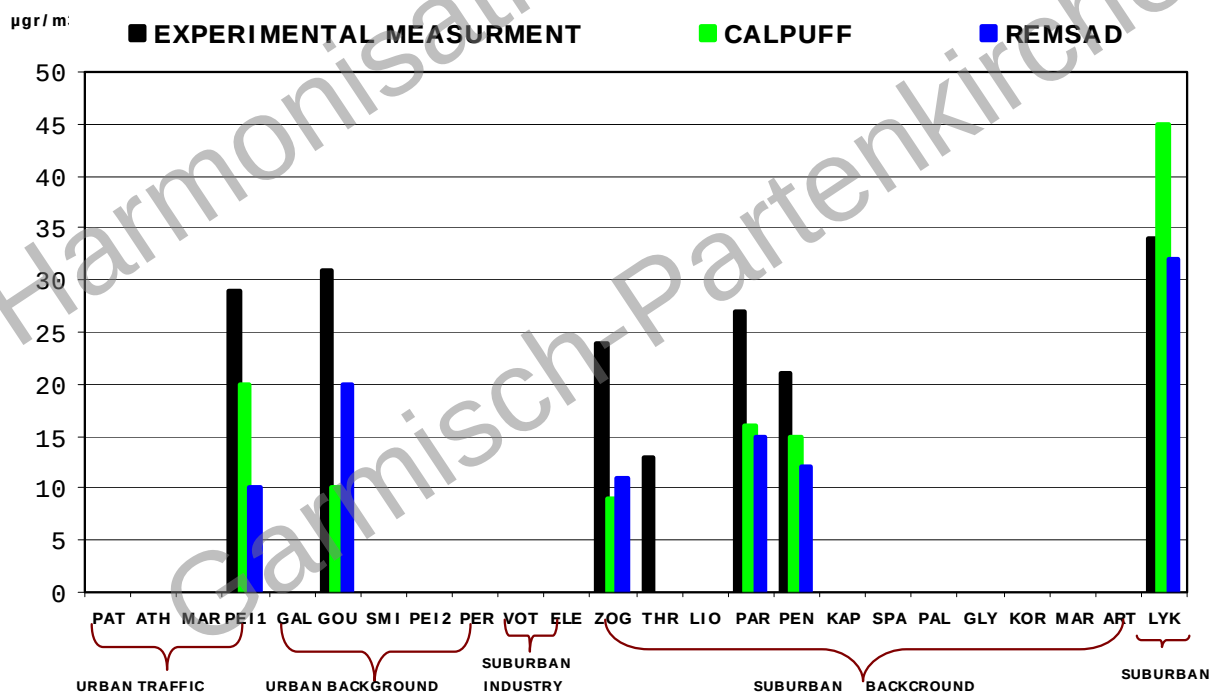
PM_{10} at stations 03:00 LST



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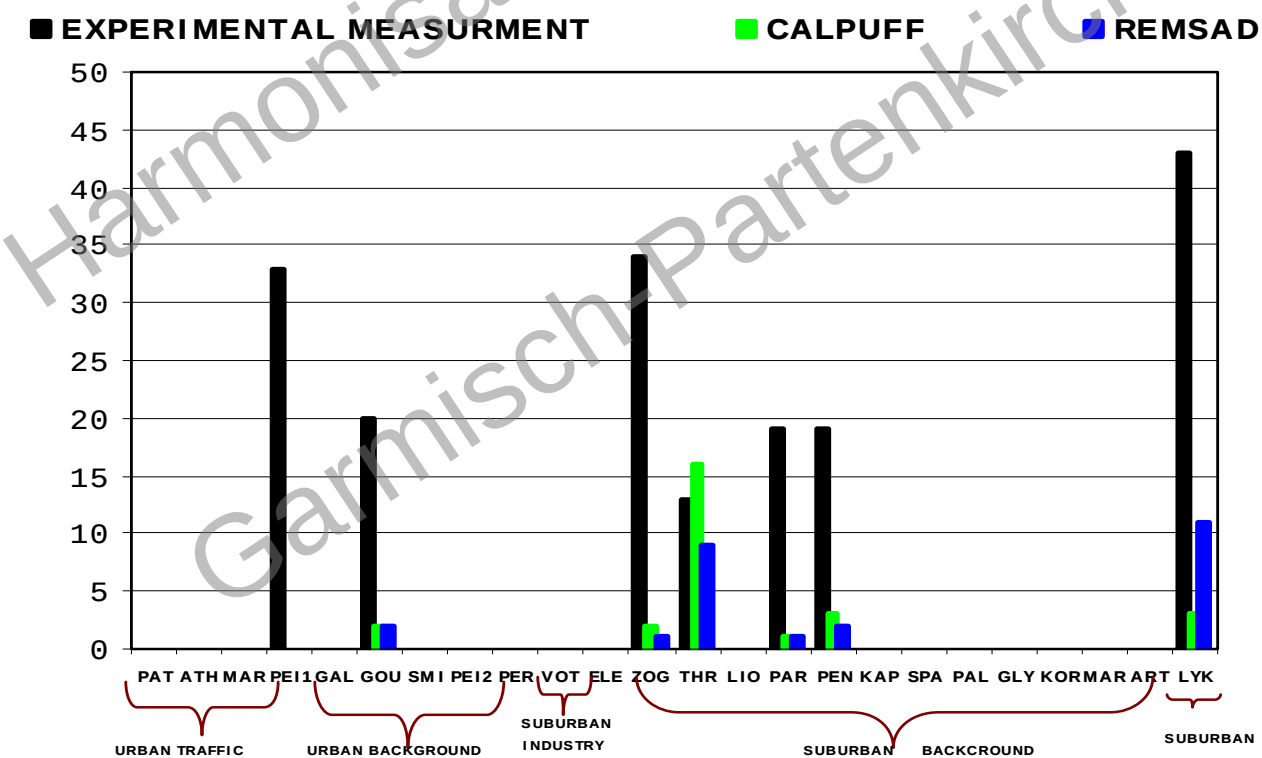
PM_{10} at stations 15:00 LST



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Conclusions and remarks

- For NO_2, a better comparison between calculations and measurements was found during unstable atmospheric conditions, where strong vertical movements prevail. In contrast, there were large discrepancies during stable conditions where the subgrid scale processes (physical and chemical) are significant.
- This picture was reversed in the case of PM_{10}, with larger differences during the daytime.
- Calmet model contributes to a rather homogenous wind field in comparison with the wind field derived by the MM5.
- The results were improved with the inclusion of additional surface stations and soundings from MM5.
- A more realistic emission inventory (including re-suspension), for PM10, will provide better estimates.