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Data Assimilation Within the AIR4EU Project: The Athens Case

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Methodology (1/2)

Data assimilation:

- potentially improves air quality assessments at different scales (local, urban and regional) by combining model results with available observations
- makes both model data and observations more useful by extracting information about conceived underlying true concentrations
- generally reduces uncertainties inherent in model and observational data
- further information about use of data assimilation in air pollution modelling, see Air4EU milestone report at www.air4eu.nl

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Methodology (2/2)

Data assimilation tool applied:

- particle filter: Sequential Importance Resampling
  - ensemble based method
  - no assumption of linearity in model equations
  - no assumption of Gaussian distribution
  - no matrix inversion needed
  - posterior variances can be larger than prior ones
- types of distributions which may be used includes Gaussian, Student's t, log-normal etc.

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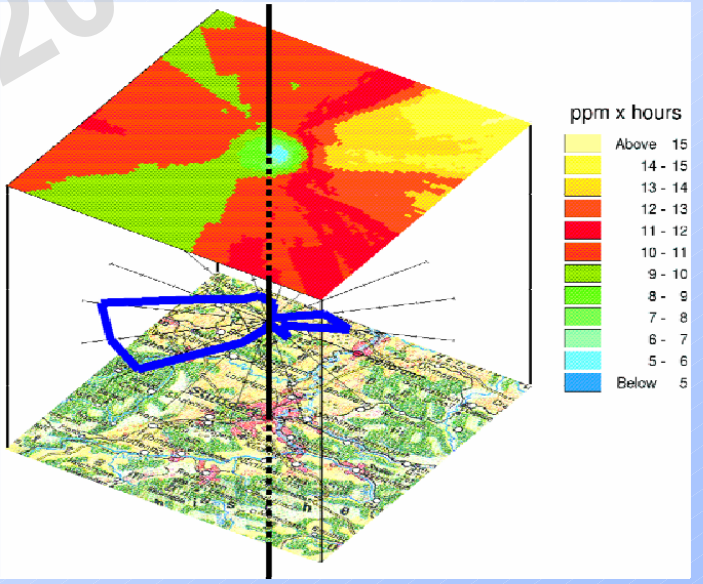
Application (1/4)

The Ozone Fine Structure (OFIS) model - Model concept

The OFIS model was developed in order to

(i) allow authorities to assess urban air quality by means of a fast, simple and still reliable model and

(ii) refine a regional model simulation by estimating the urban subgrid effect on pollution levels



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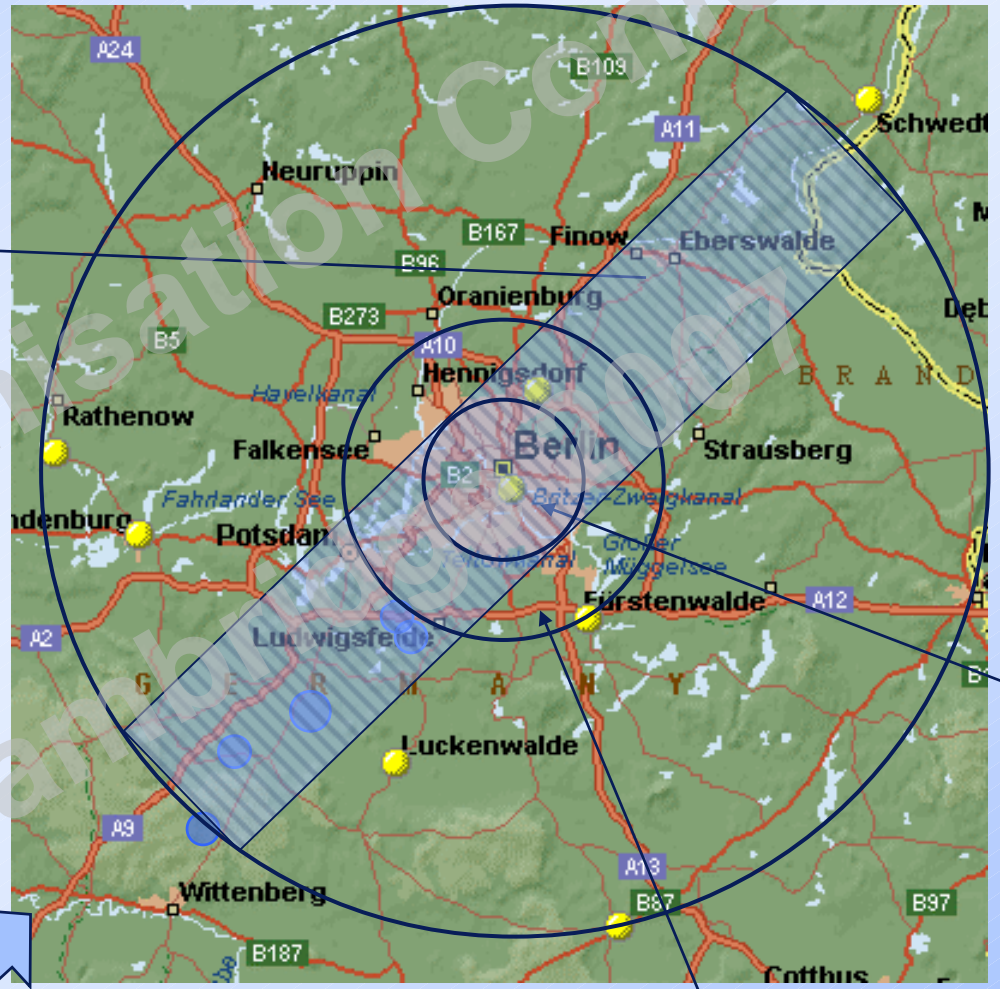
Application (2/4)

OFIS - Sample of horizontal grid layout

(1-2)D multi-box model



urban

Wind direction

suburban

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Application (3/4)

Data requirements:

- Hourly data for the year 2002: measurements and OFIS model results
- Air pollutants: NO, NO_2, O_3, PM_{10}

Monitoring stations:

- Urban stations of the Greater Athens Area:
  - Agia Paraskevi
  - Liosia
  - Lykovrisi
  - Marousi
  - Patision
  - Pireaus
  - Thrakomakedones

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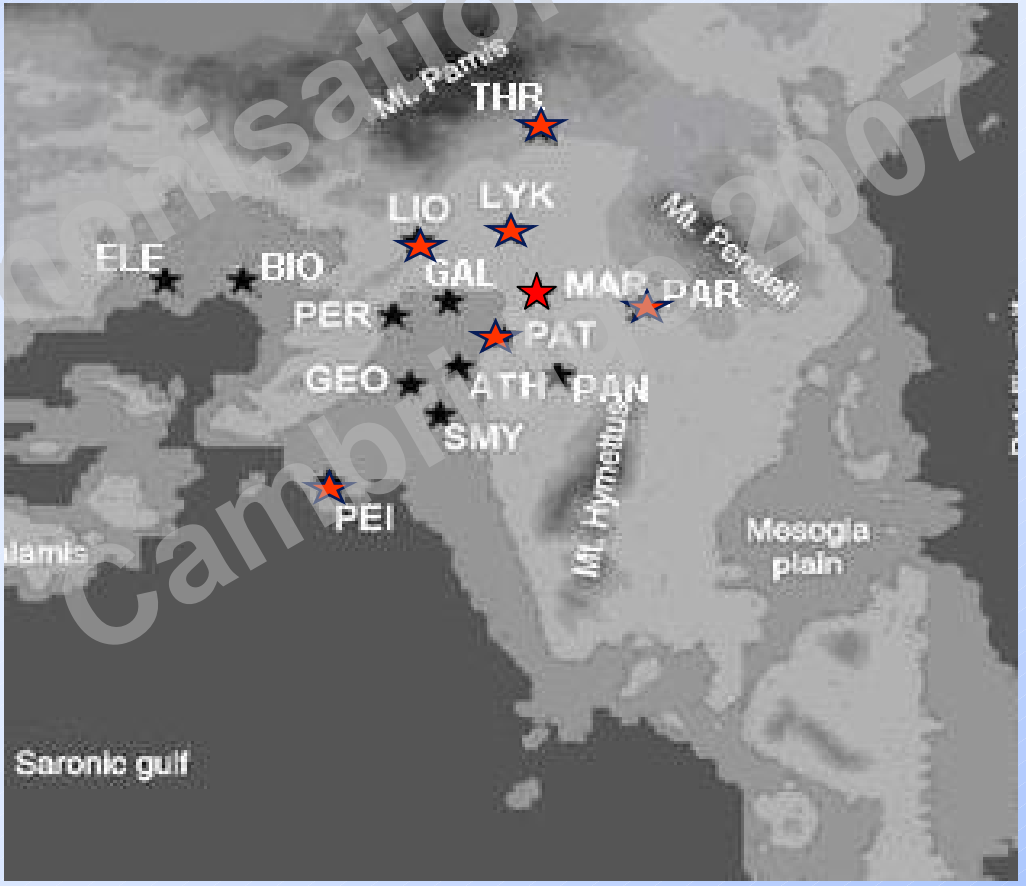
Application (4/4)

Topography of the Greater Athens Area and location of the air quality monitoring stations.
Stations included are indicated in red.



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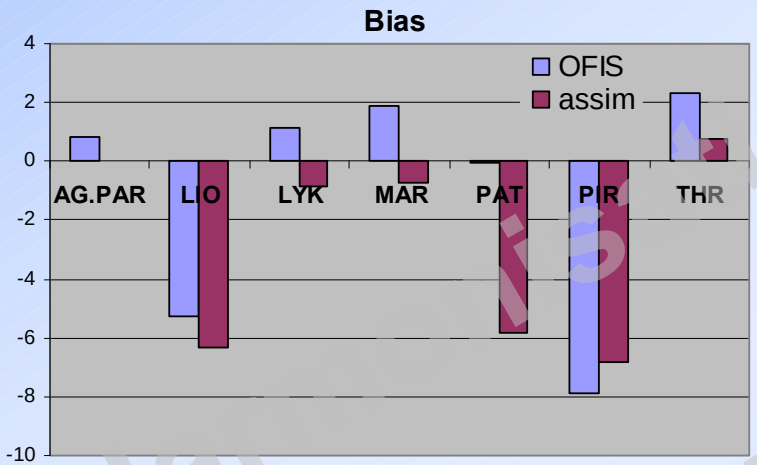
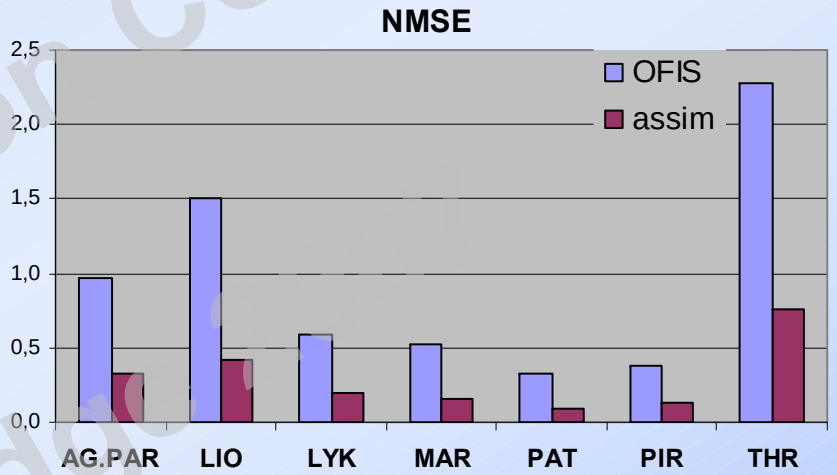
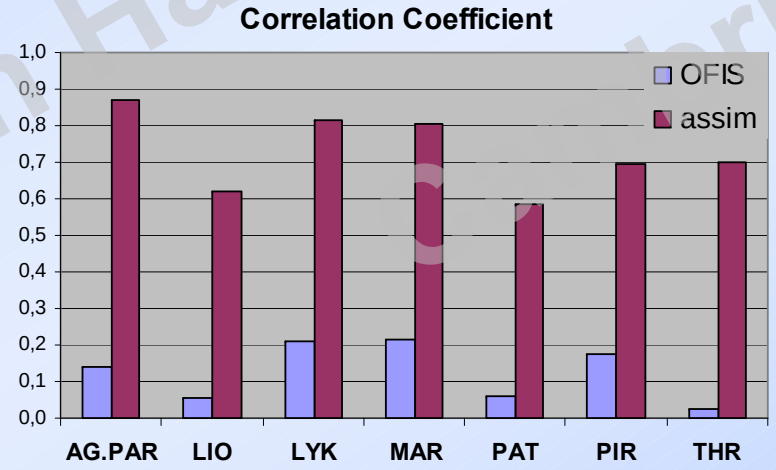
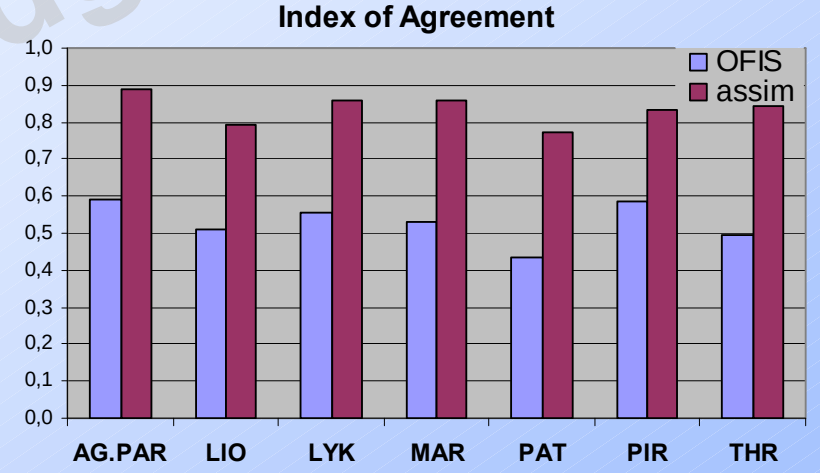
Graphical presentation of results (1/8)

Performance statistics for NO_2:









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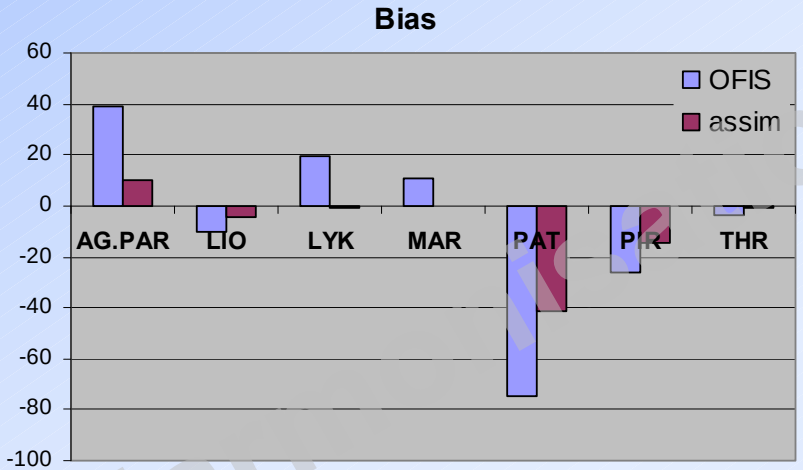
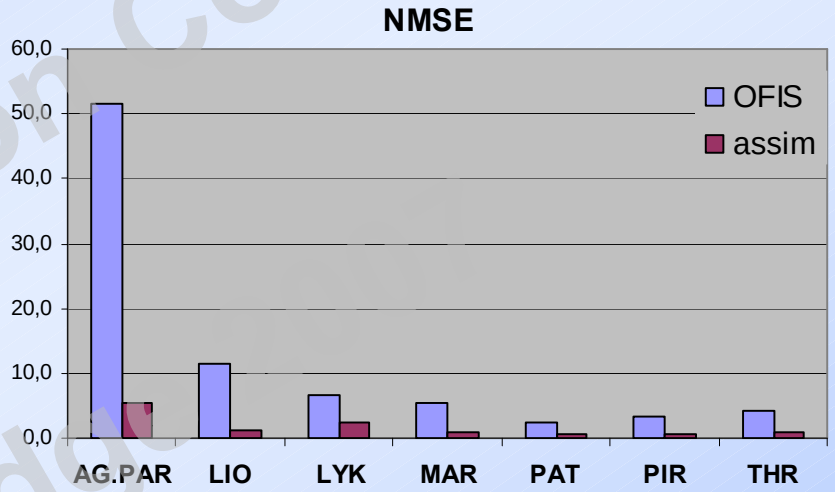
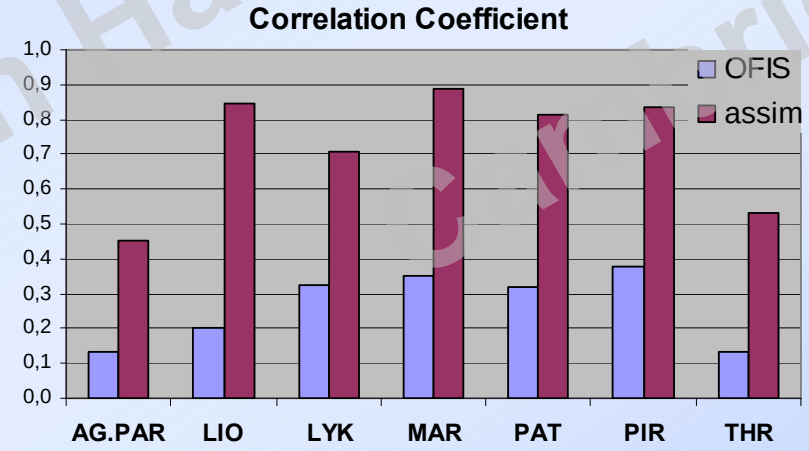
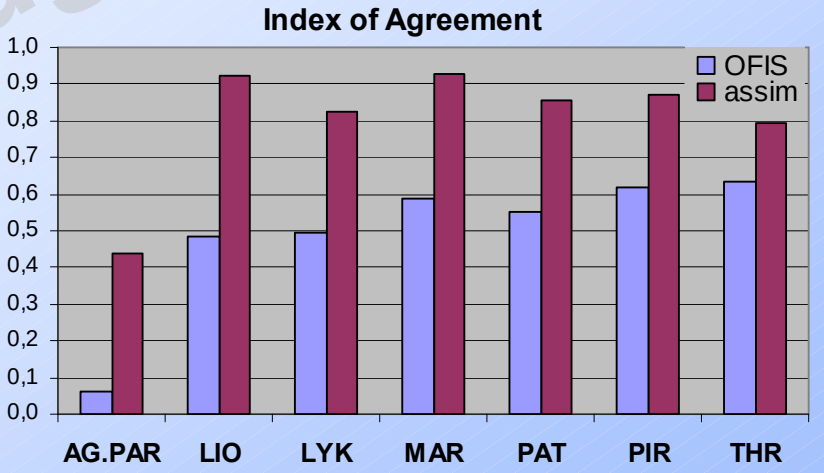
Graphical presentation of results (2/8)

Performance statistics for NO:









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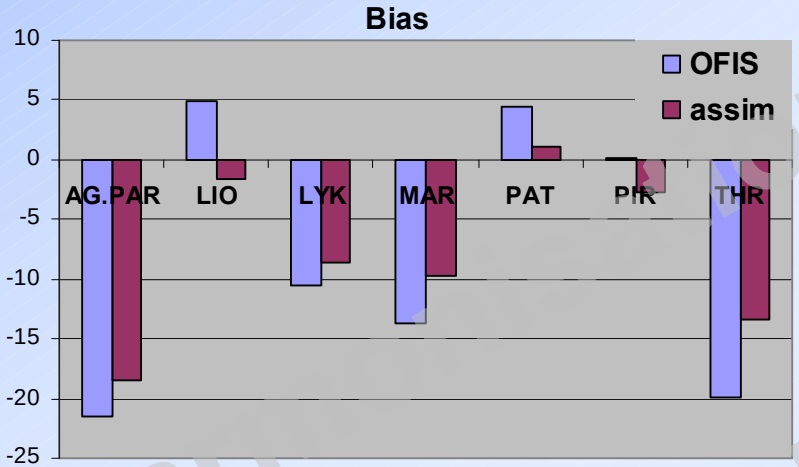
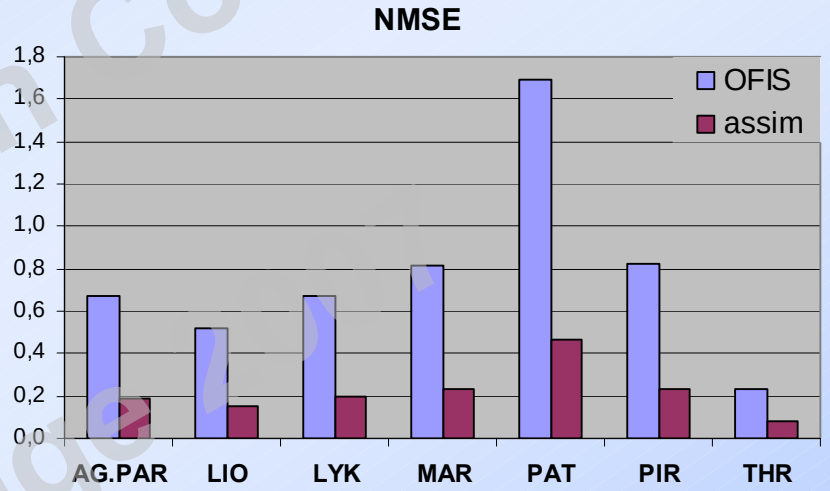
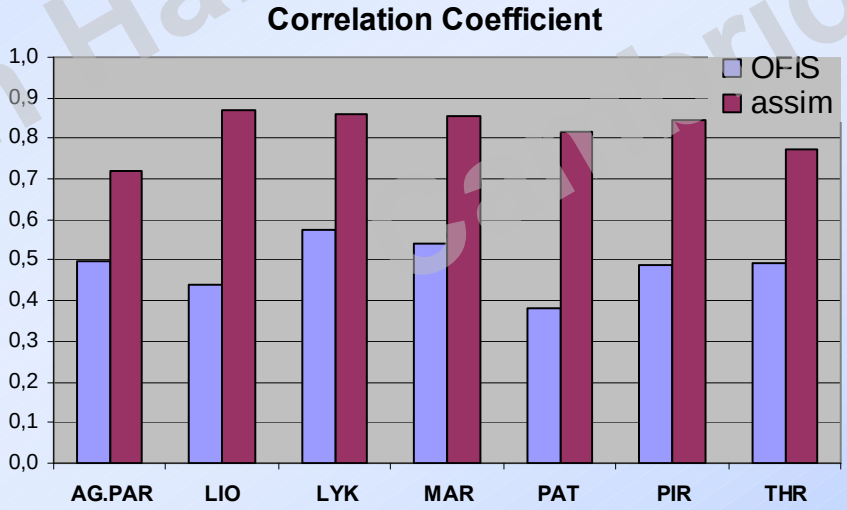
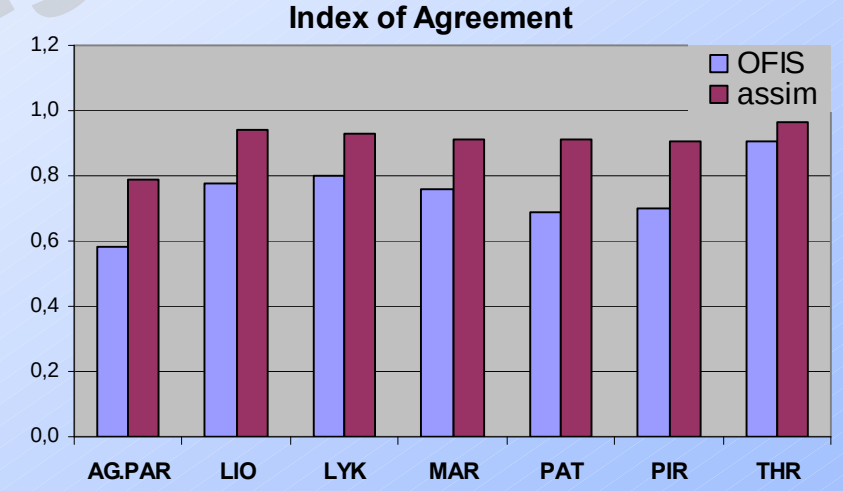
Graphical presentation of results (3/8)

Performance statistics for O_3:









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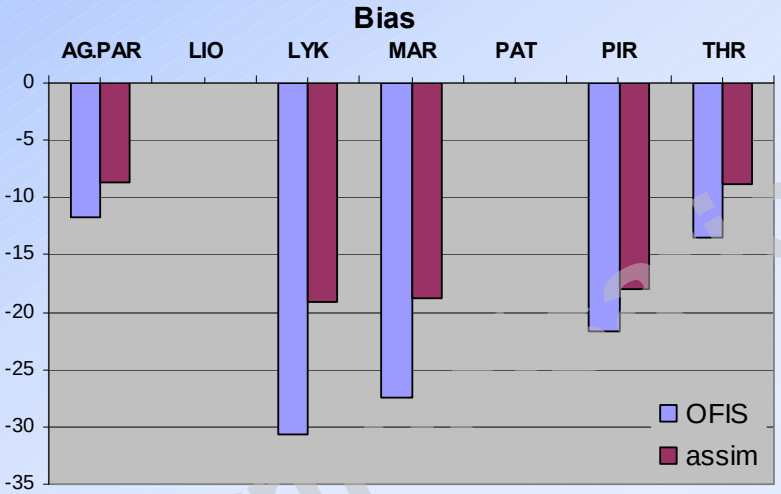
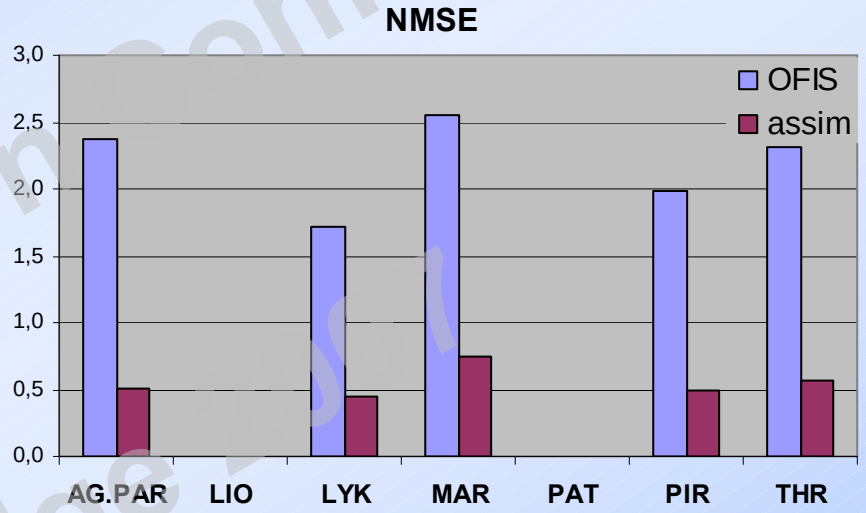
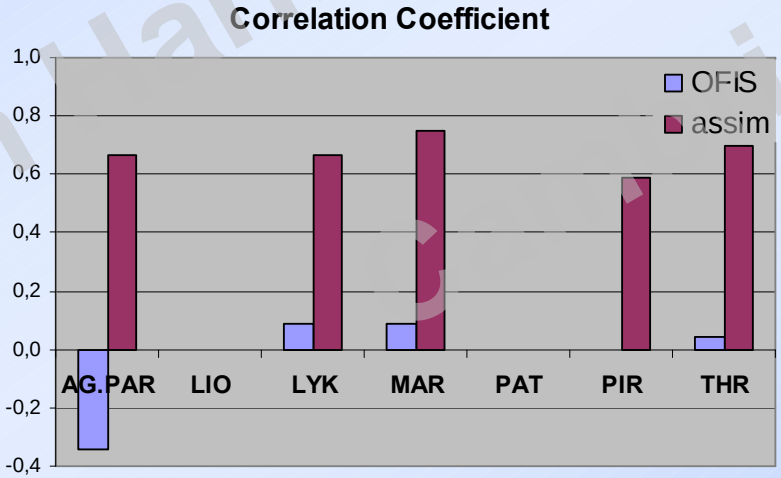
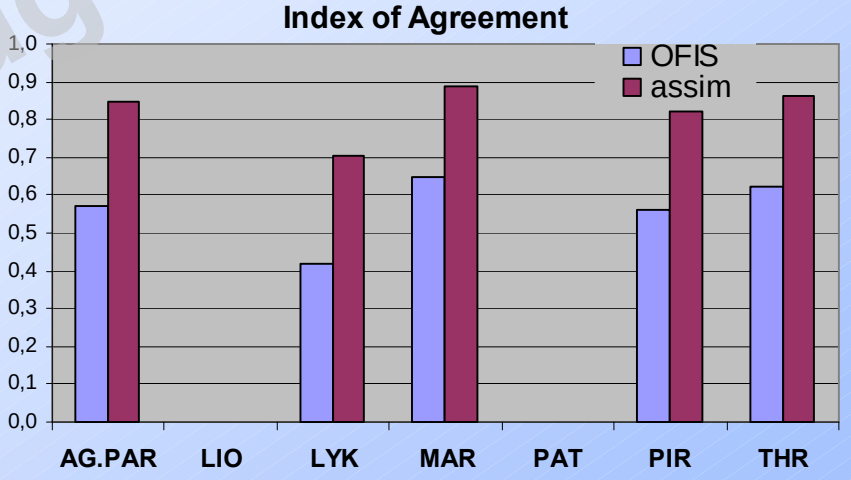
Graphical presentation of results (4/8)

Performance statistics for PM_{10}:









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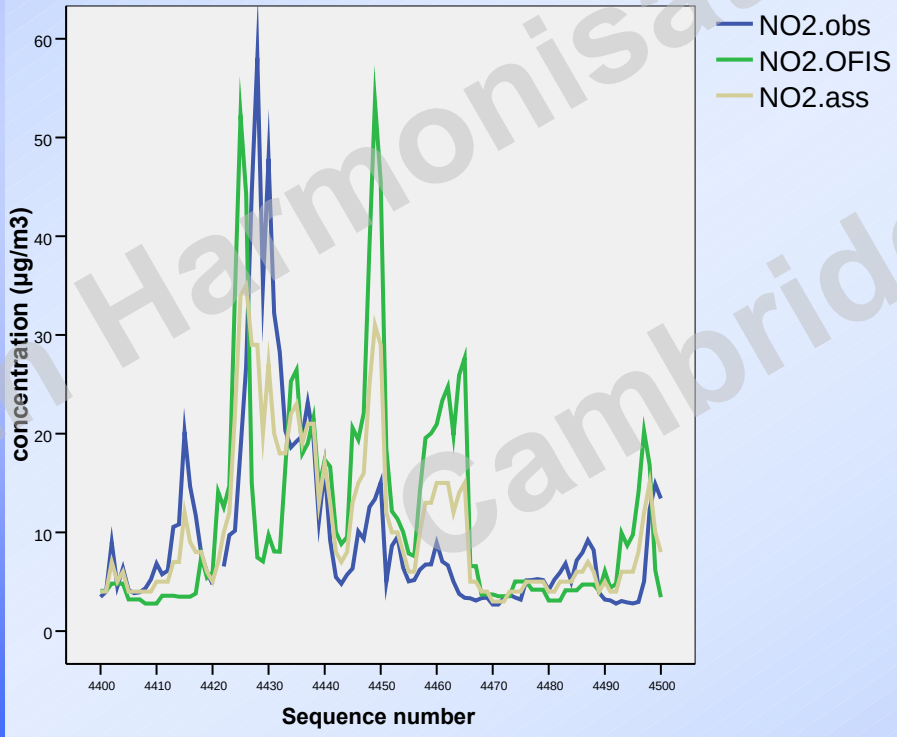
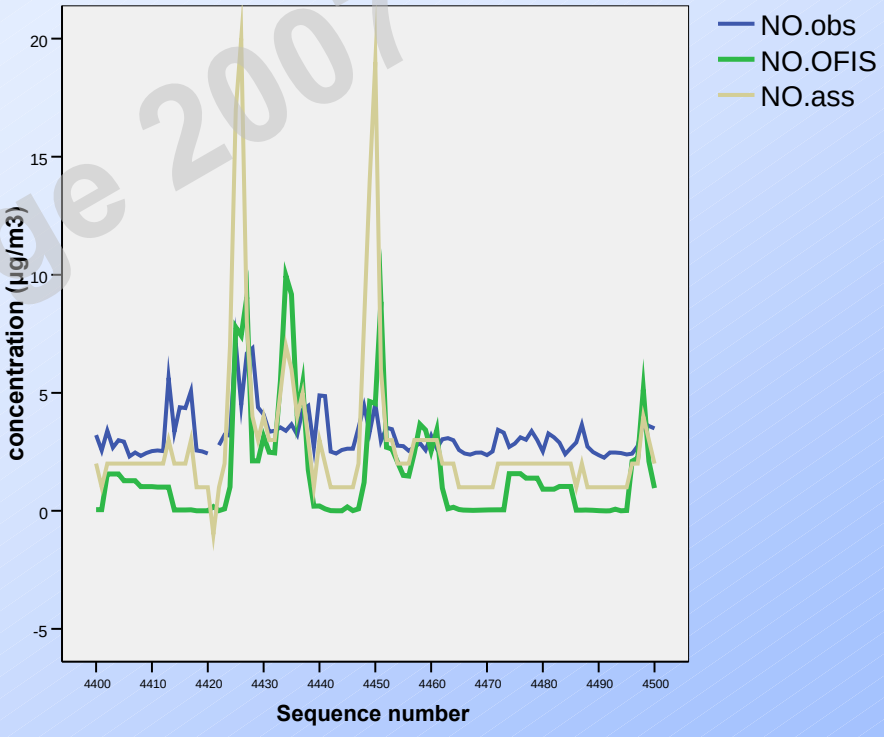
Graphical presentation of results (5/8)

Time series of observed and predicted hourly average concentrations (in μg/m^3) of NO_2 and NO at Thrakomakedones monitoring station





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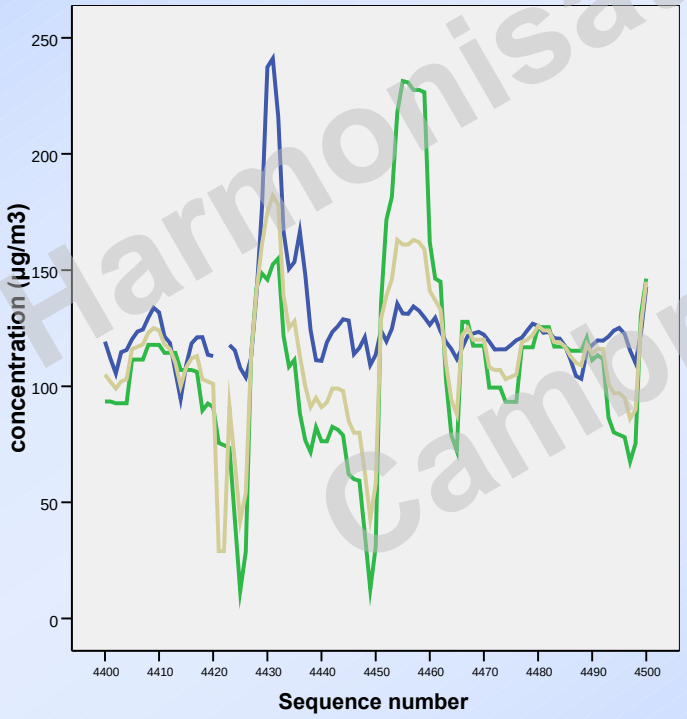
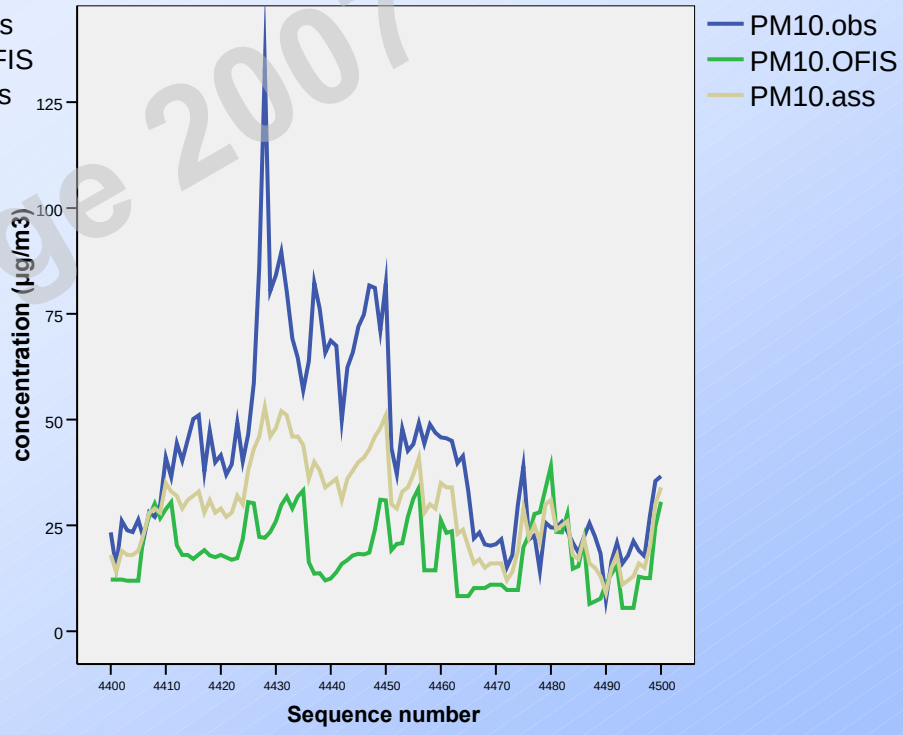
Graphical presentation of results (6/8)

Time series of observed and predicted hourly average concentrations (in μg/m^3) of O_3 and PM_{10} at Thrakomakedones monitoring station





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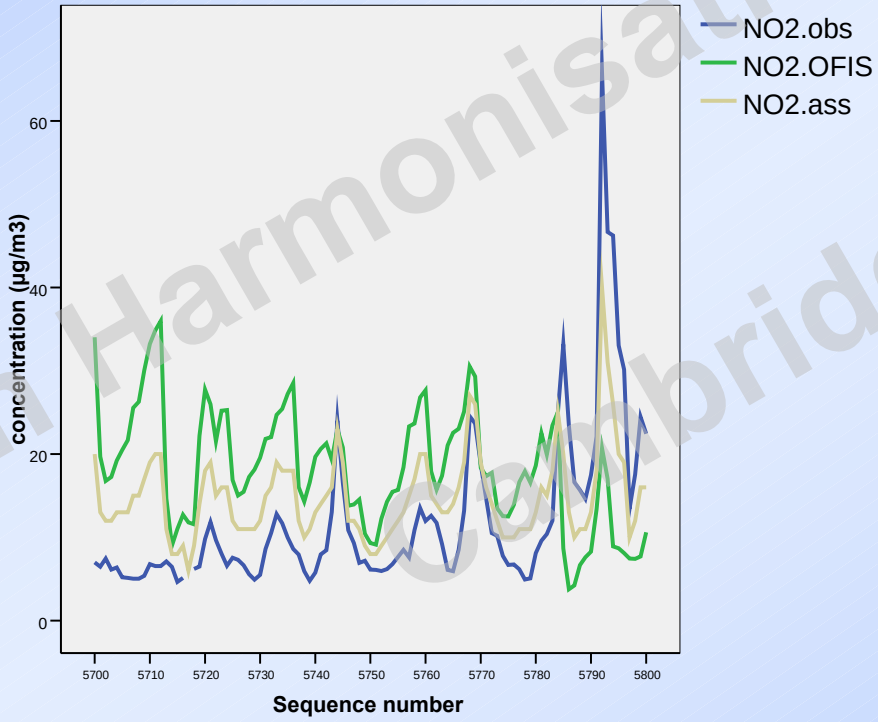
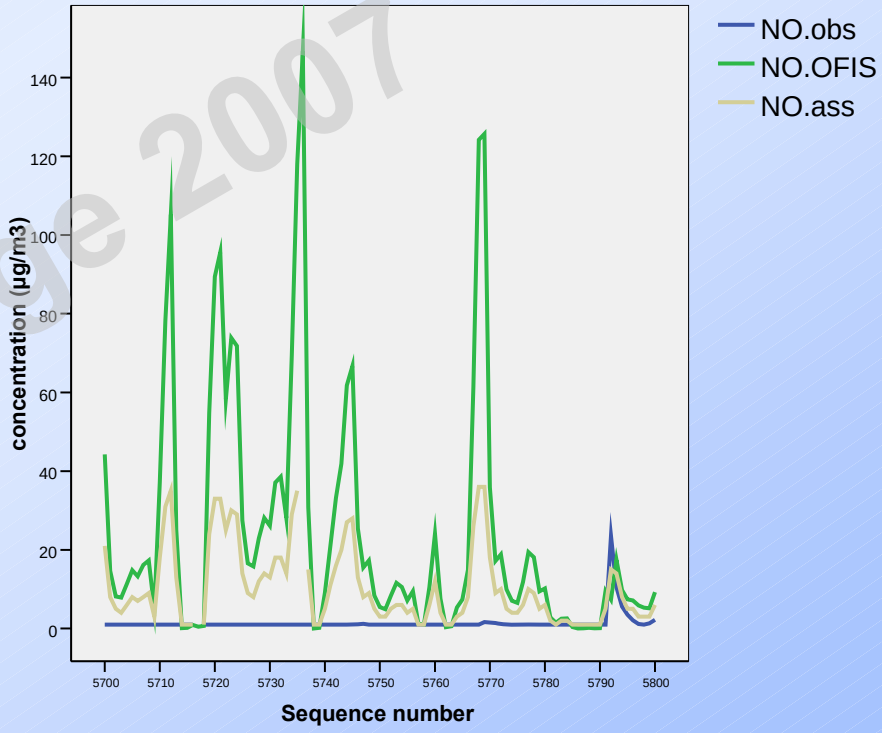
Graphical presentation of results (7/8)

Time series of observed and predicted hourly average concentrations (in μg/m³) of NO_2 and NO at Ag. Paraskevi monitoring station





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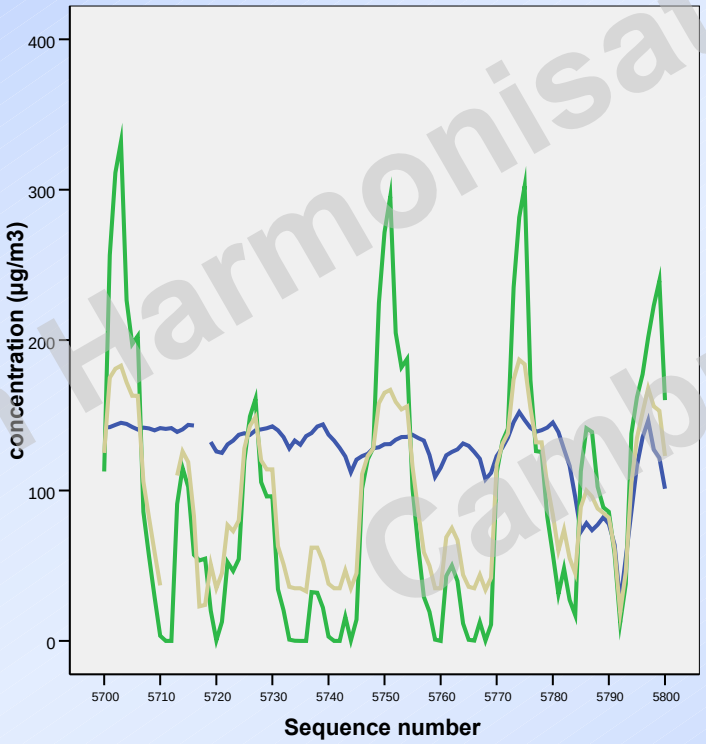
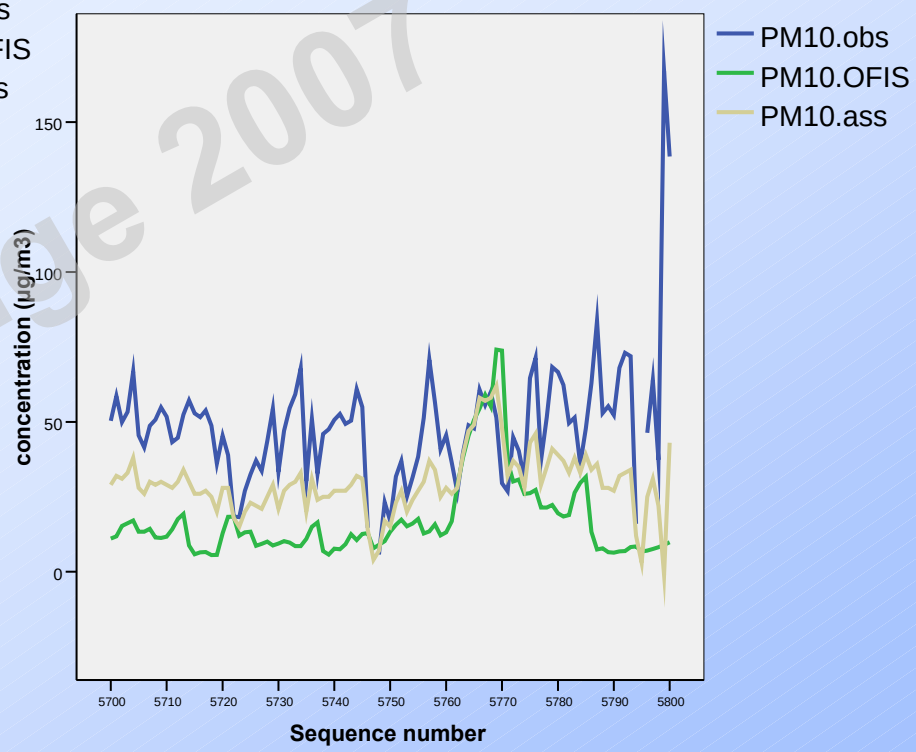
Graphical presentation of results (8/8)

Time series of observed and predicted hourly average concentrations (in μg/m^3) of O_3 and PM_{10} at Ag. Paraskevi monitoring station





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Conclusions

- Use of data assimilation generally results in significant improvements of the OFIS model results

- However, it works less satisfactory when:

  - uncontrolled factors are present in the dispersion, or there are huge variabilities, e.g. during extreme (unstable) meteorological conditions

  - pollutants are extremely high reflecting abnormal situations and distinct episodes