



APPLICATION OF ADJOINT CMAQ CHEMICAL TRANSPORT MODEL IN THE ATHENS GREATER AREA: SENSITIVITIES STUDY ON OZONE CONCENTRATIONS

Spyros Andronopoulos, Athanasios Sfetsos, Diamando
Vlachogiannis, Andreas Yiotis and Nikolaos Gounaris

Environmental Research Laboratory, Institute of Nuclear Technology and
Radiation Protection, National Centre for Scientific Research
"Demokritos", 15310 Aghia Paraskevi Attikis, Greece

e-mail: sandron@ipta.demokritos.gr



Aim of the paper

- Sensitivities of ground level ozone concentrations (model-calculated) with respect to concentrations and emissions of NO_x , CO , VOCs etc.
- The distribution of the sensitivities in the computational domain for different times, (isosurfaces) delineate influence regions, i.e., areas where perturbations in some concentrations will result in significant changes in the ozone concentrations in the area of interest at the final time.

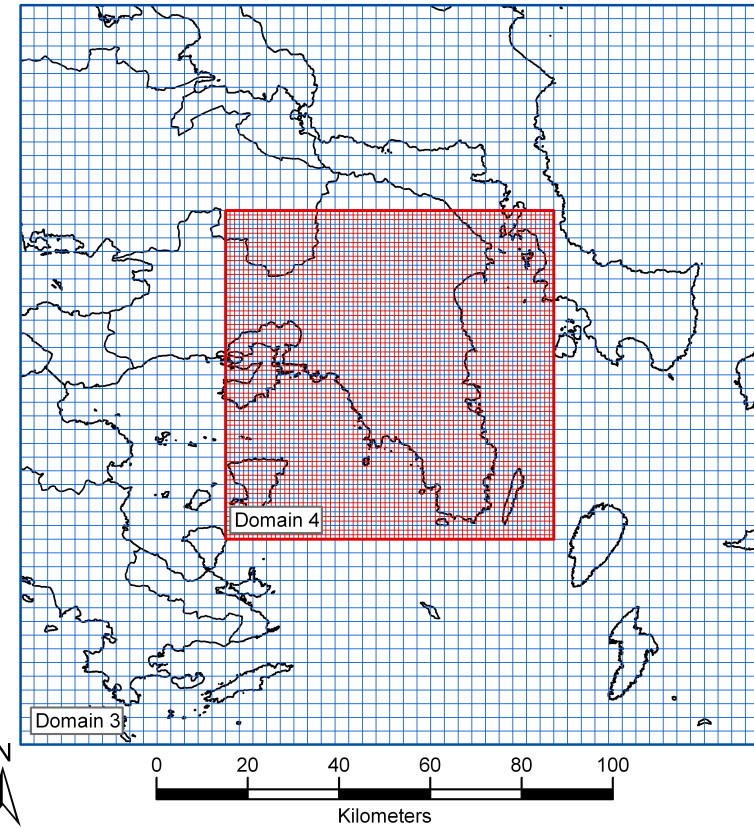
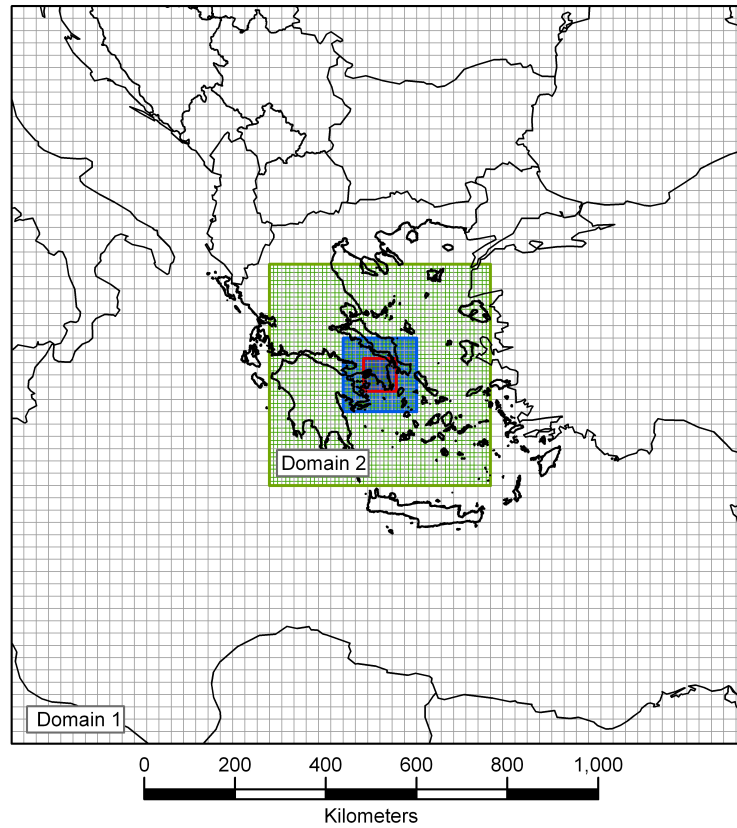


Tools and methods

- Meteorology and Air Quality forecasting system
 - Meteorology: MM5
 - Emissions: EMISLAB
 - Chemistry / dispersion: CMAQ
- System configuration: 4 nested domains centred on the Athens Greater Area
- Adjoint sensitivity analysis at ground level ozone concentrations
 - Adjoint version of the Community Multiscale Air Quality, (CMAQ v.4.5)
 - Input from MM5 and EMISLAB
 - Specific dates of application: 18 - 19 / 7 / 2005



System configuration



	Cells	Cell size(km)
Domain 1	60 x 60	27 x 27
Domain 2	54 x 54	9 x 9
Domain 3	54 x 54	3 x 3
Domain 4	72 x 72	1 x 1



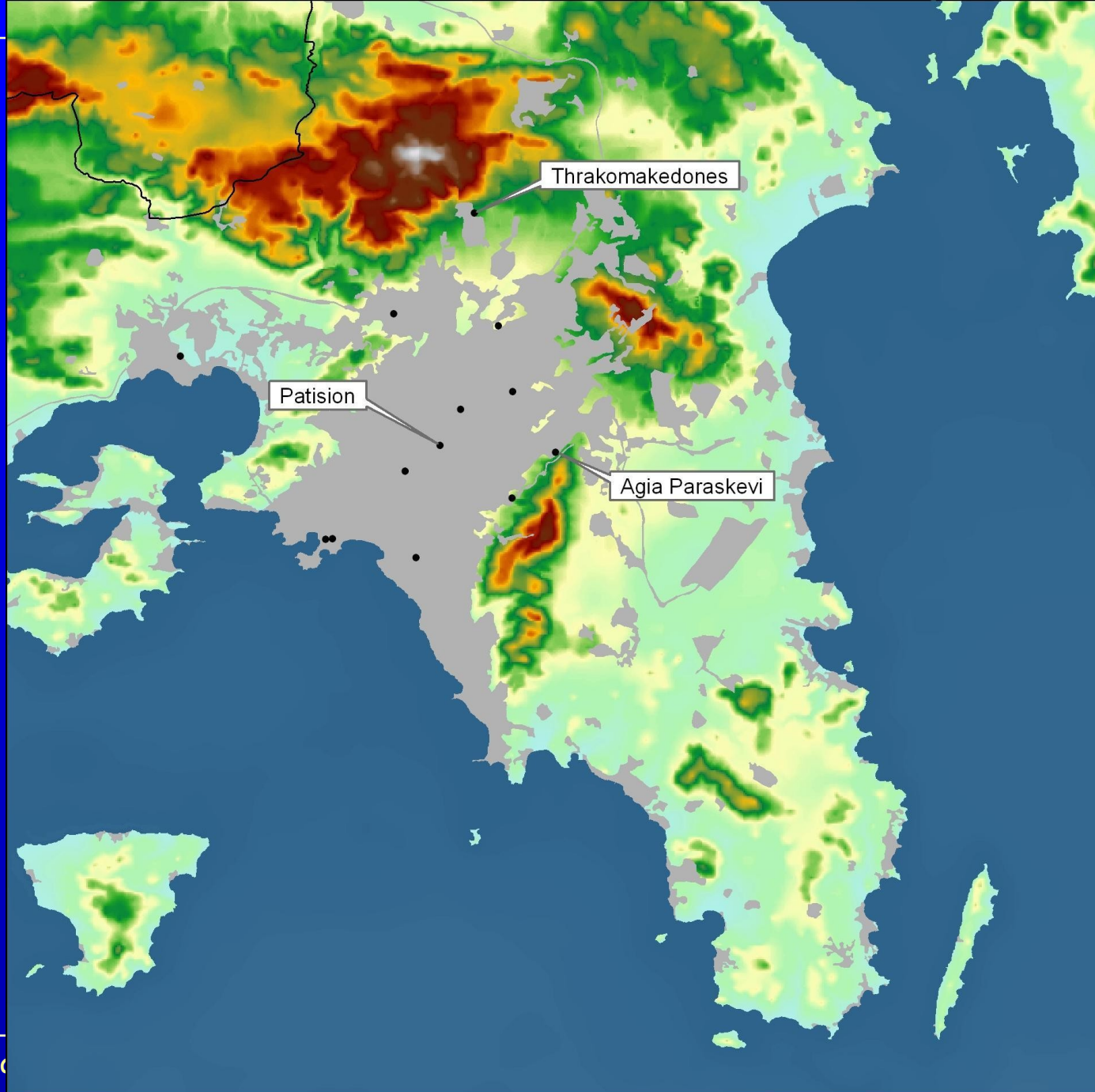
Tools and methods (2)

- Selection of 2 air quality stations in the Greater Athens Area, as receptors measuring O_3 :
 - Thrakomakedones
 - Aghia Paraskevi
 - Sub-urban stations with different characteristics and affecting areas
- "Target" date:
 - 19/7/2005, 15:00 local time (12:00 UTC)
 - Air pollution episode (19/7)
- Model run periods:
 - Forward run: 18/9, 00:00 UTC - 20/9 00:00 UTC
 - Adjoint run: 19/9, 12 hours backwards of the target time (output at 09:00, 06:00, 03:00, 00:00 UTC)



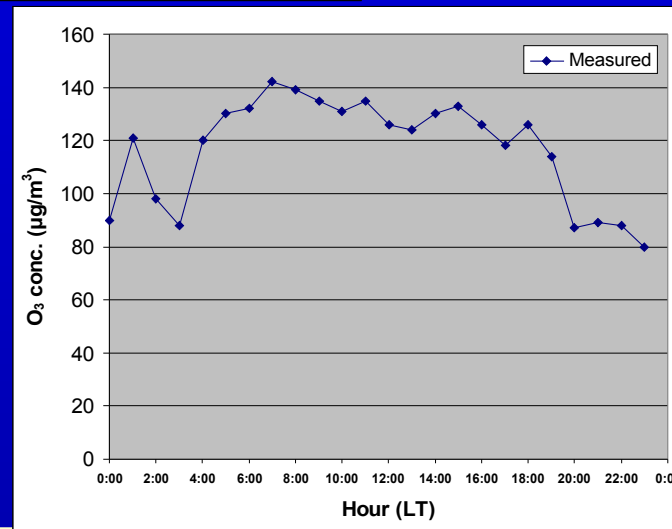
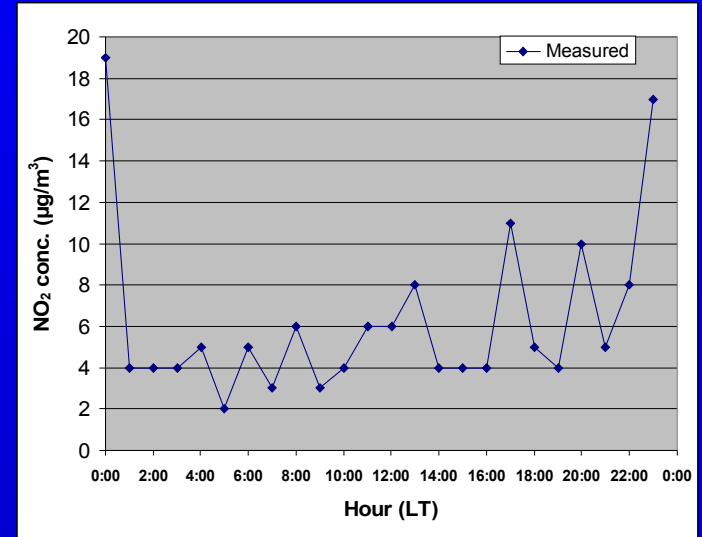
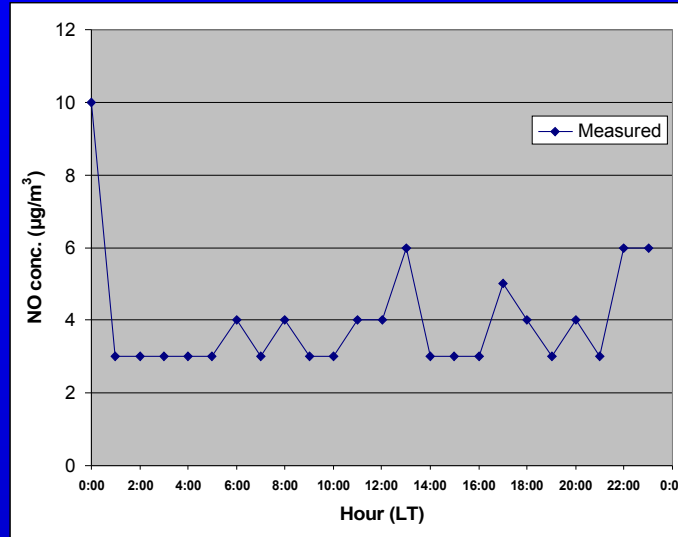
Domain 4:

- Topography
- Urban areas
- Air quality stations



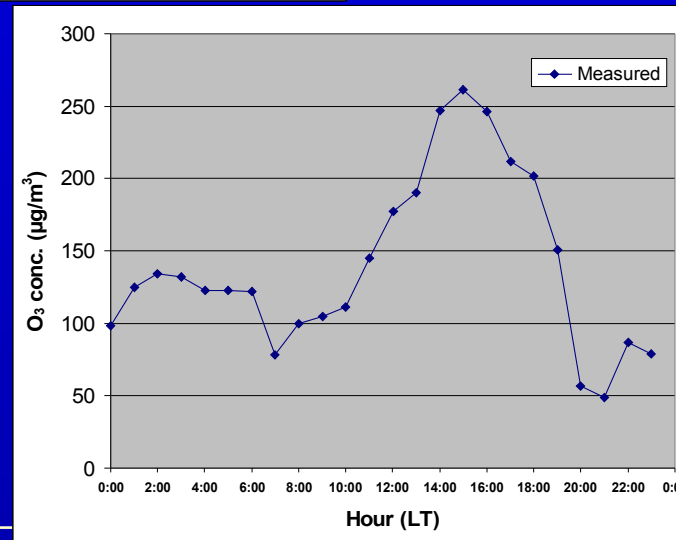
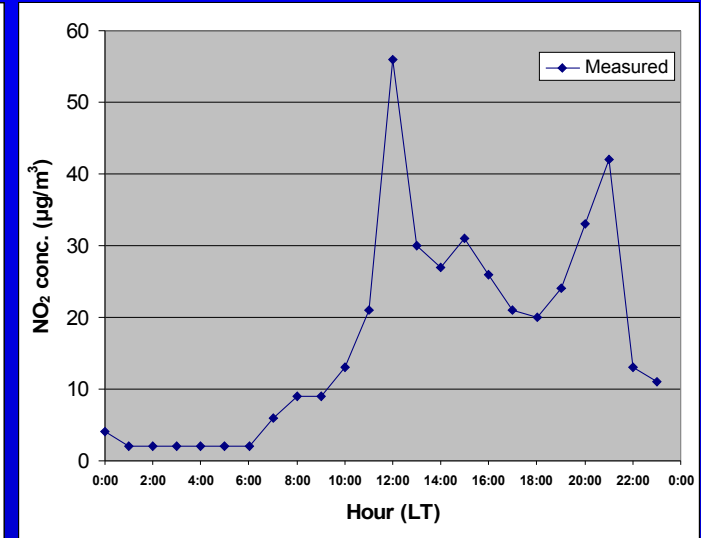
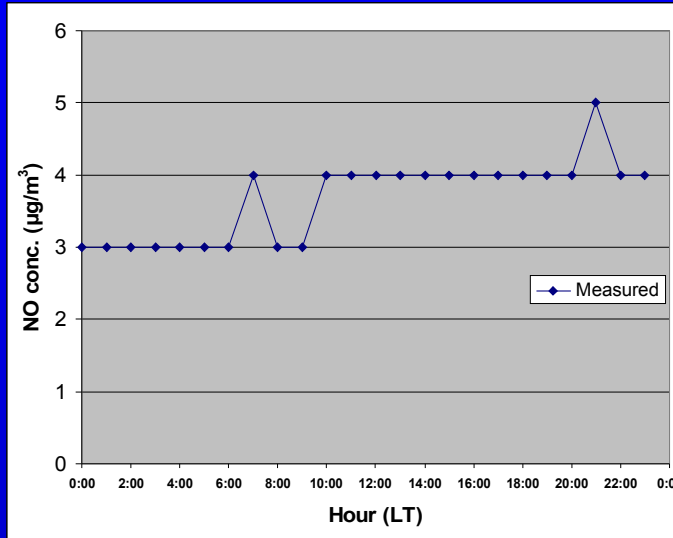


Thrakomakedones, 18/7/2005



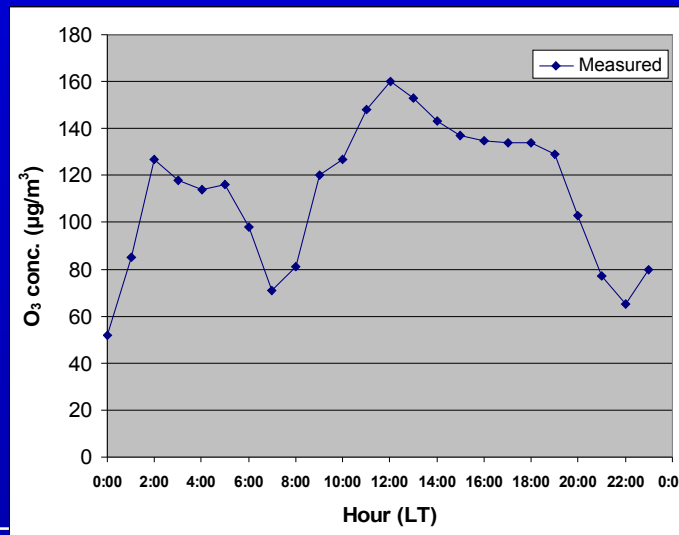
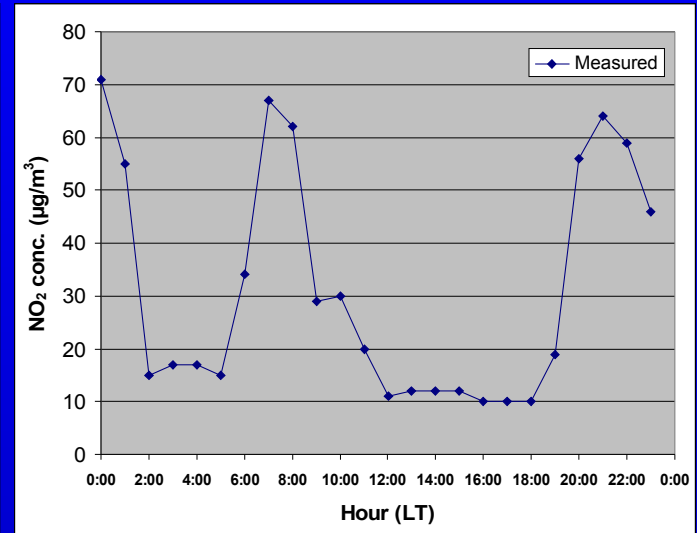
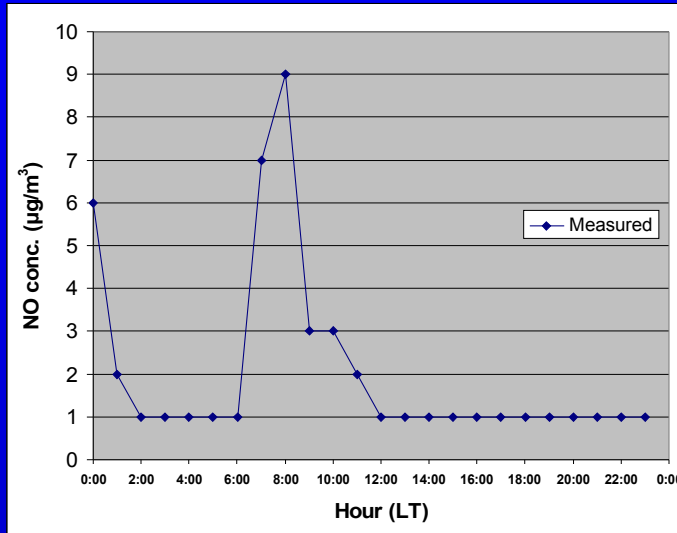


Thrakomakedones, 19/7/2005



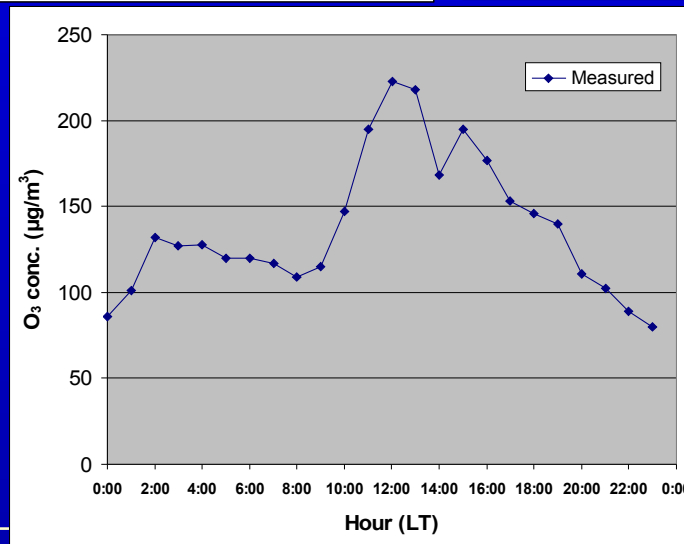
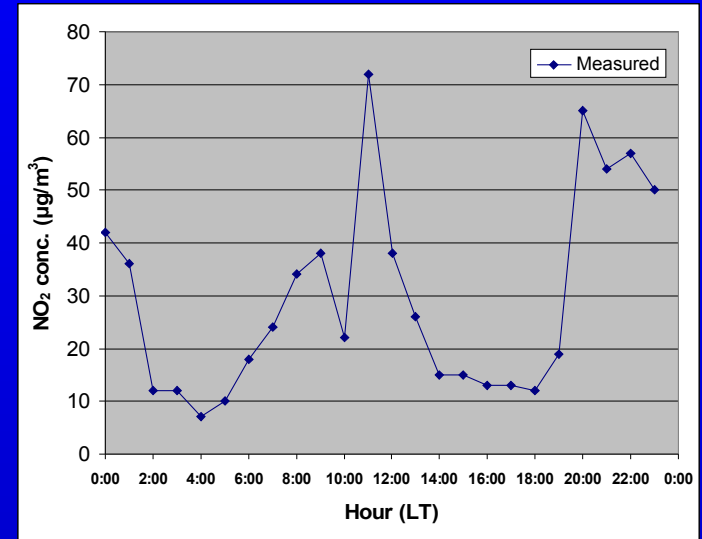
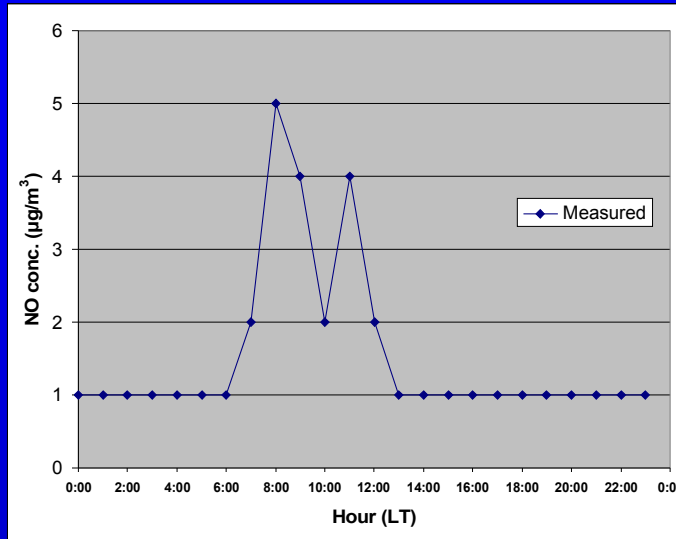


Aghia Paraskevi, 18/7/2005



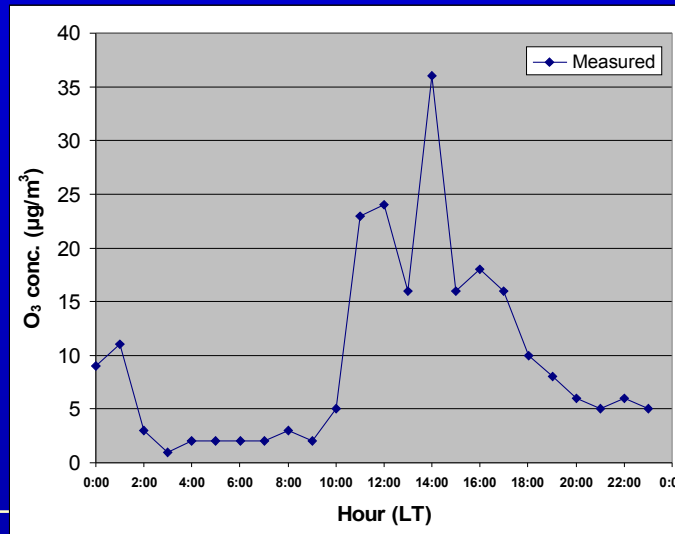
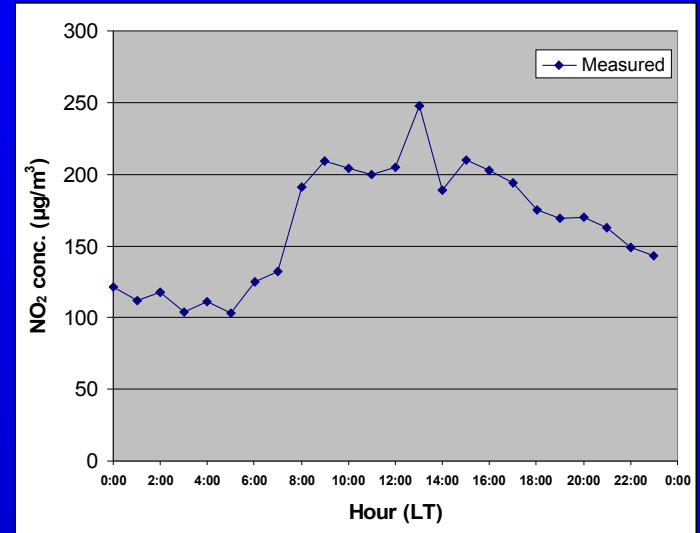
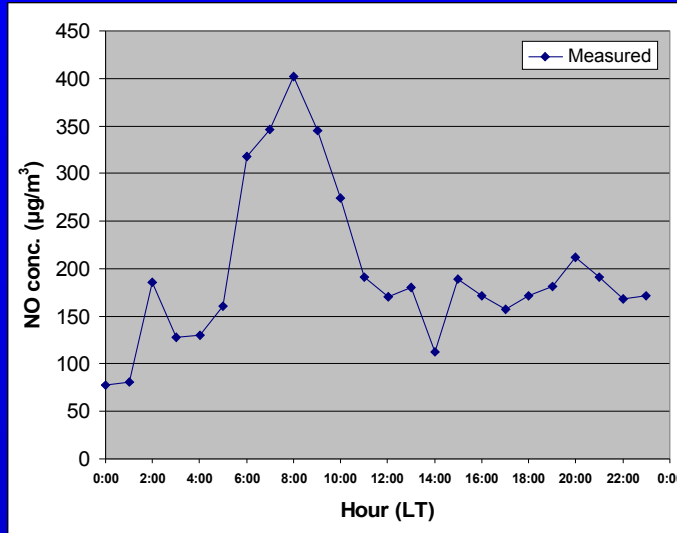


Aghia Paraskevi, 19/7/2005



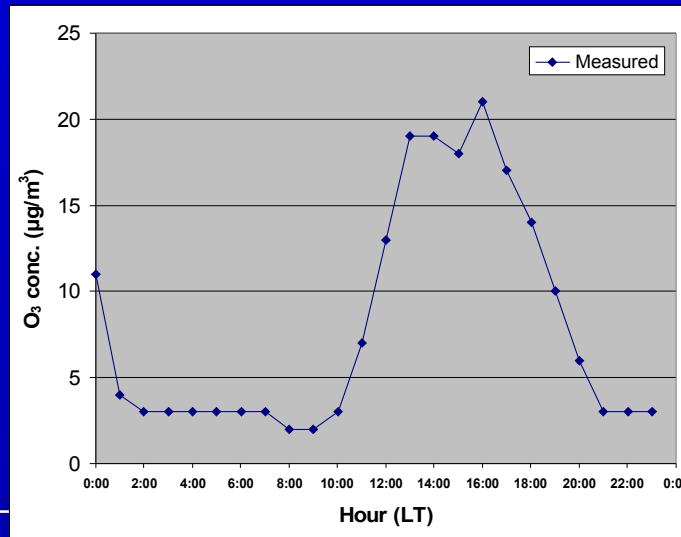
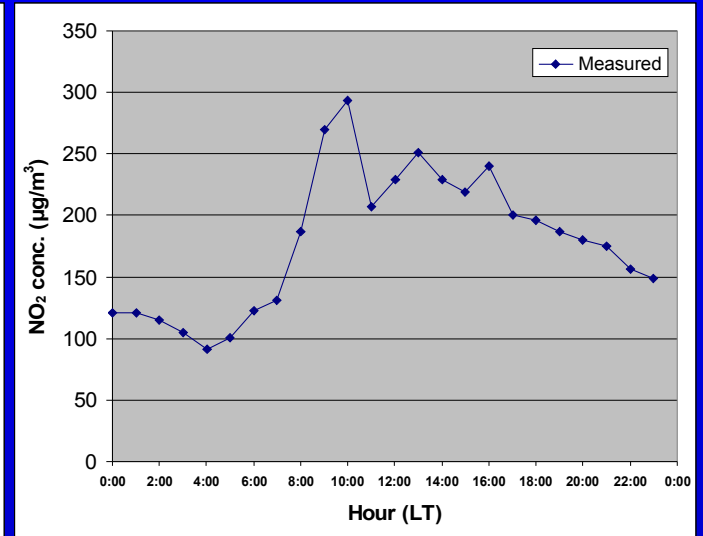
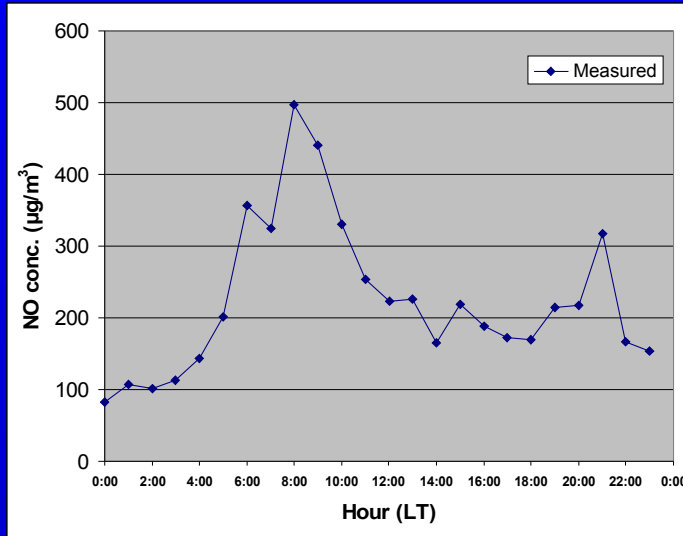


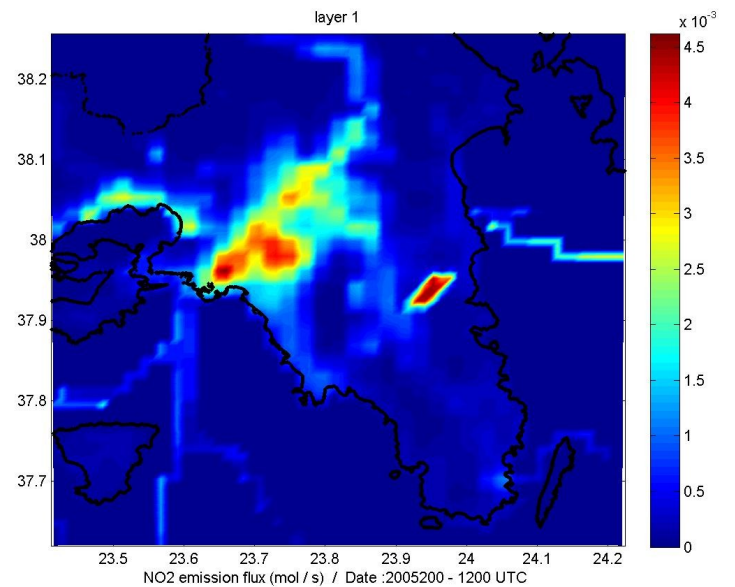
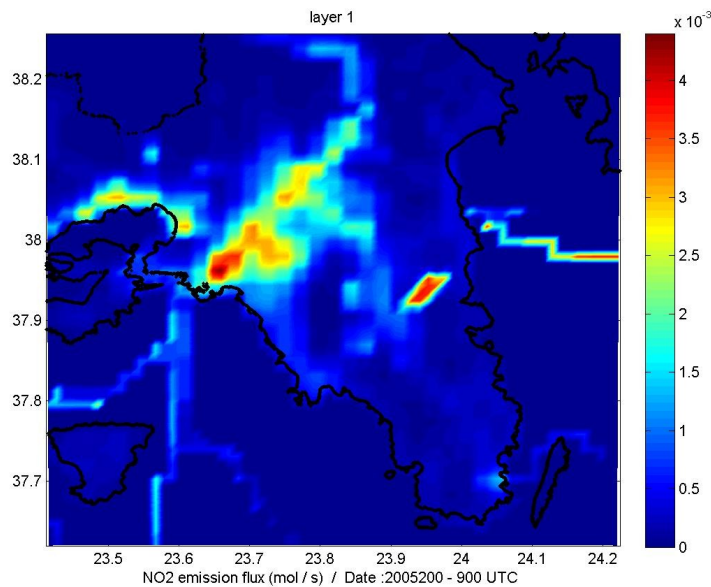
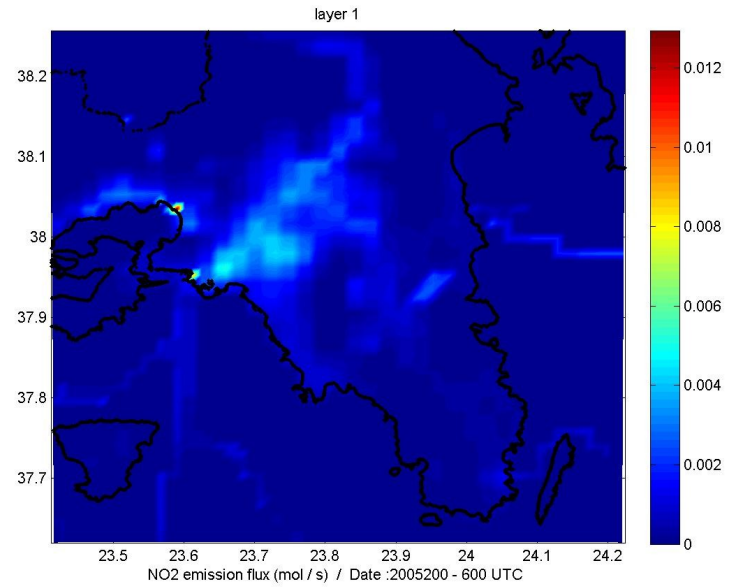
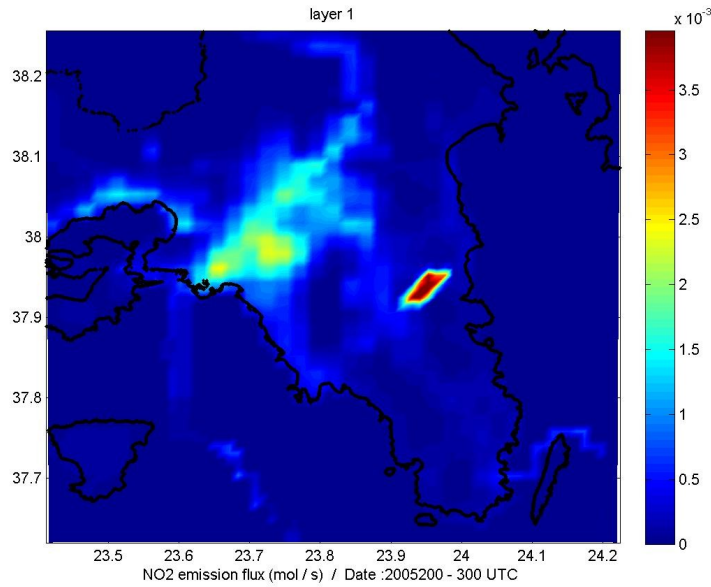
Patision, 18/7/2005



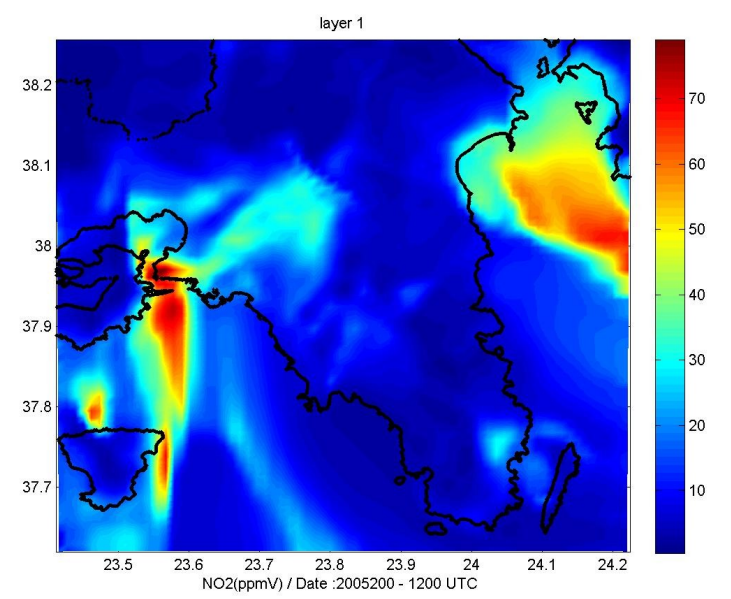
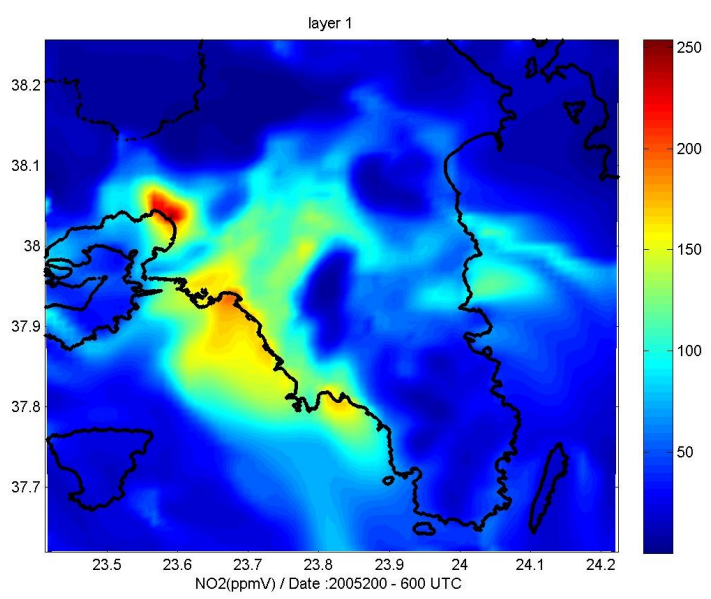
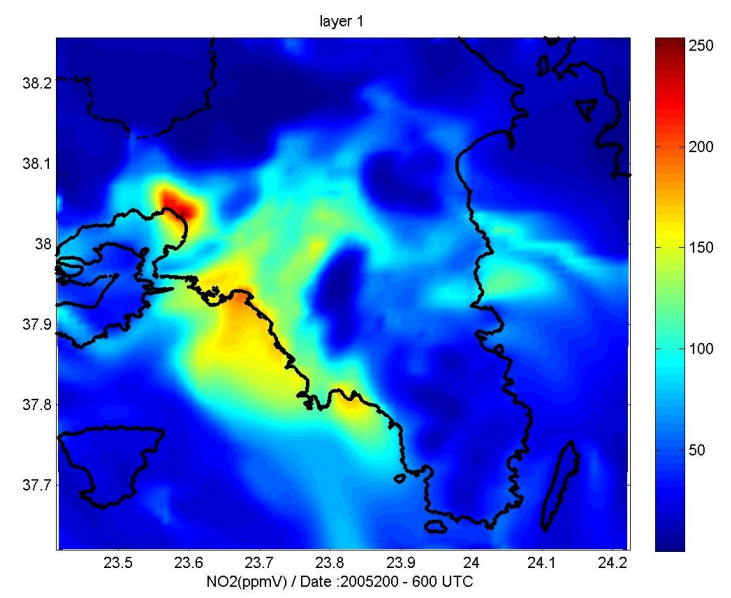
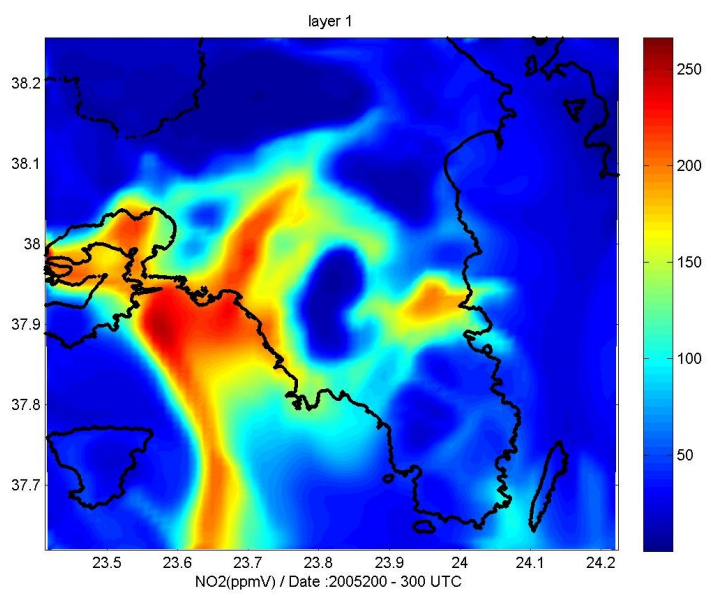


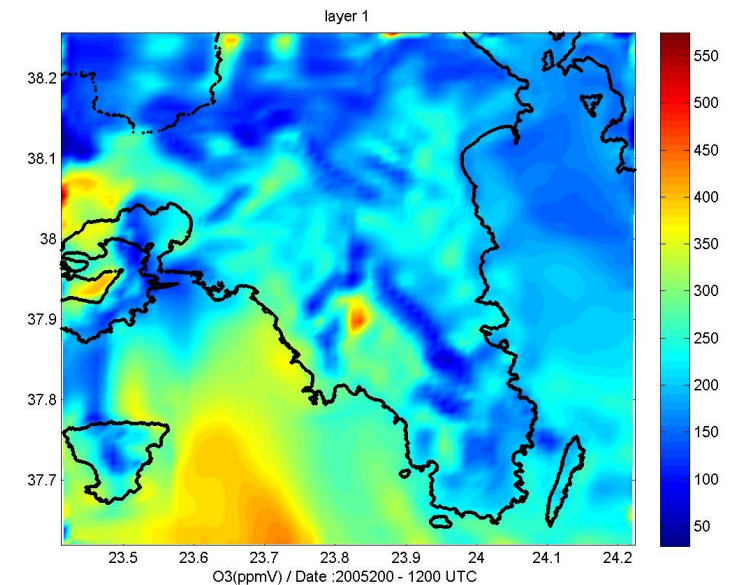
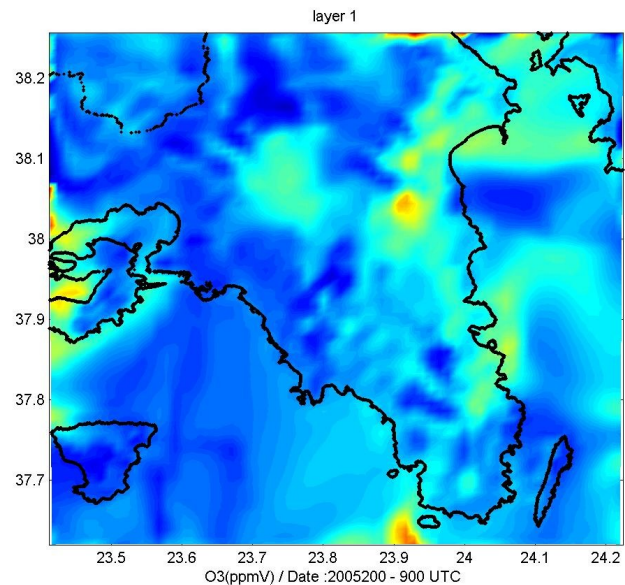
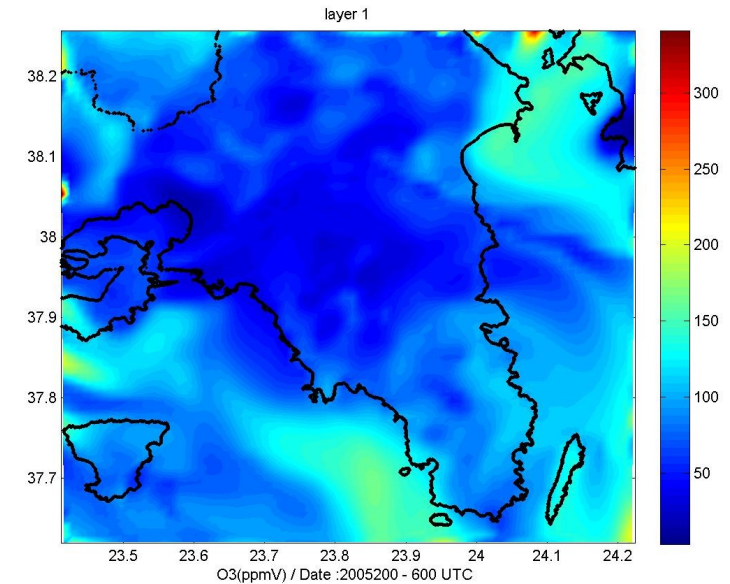
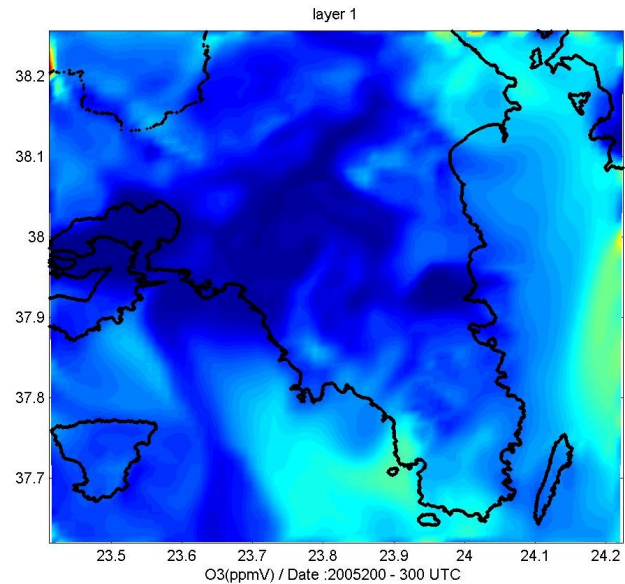
Patision, 19/7/2005

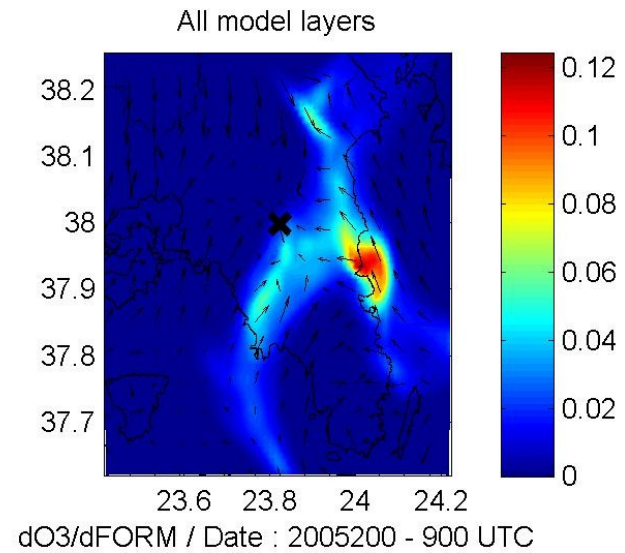
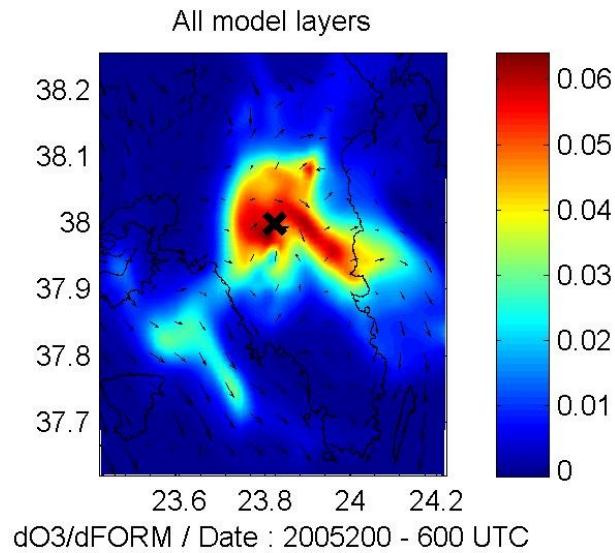
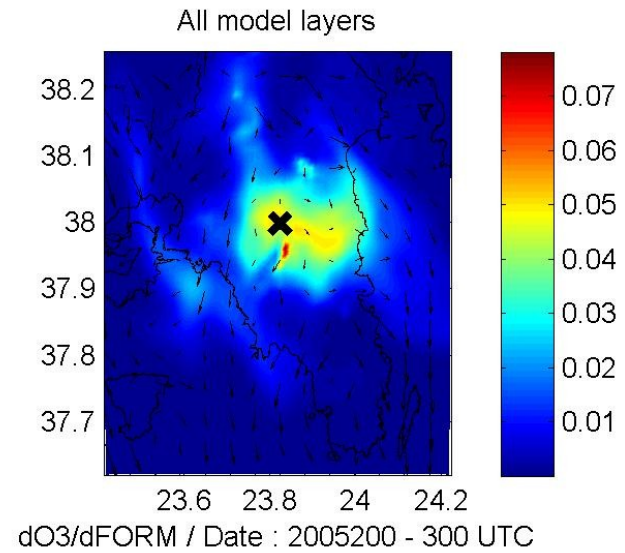
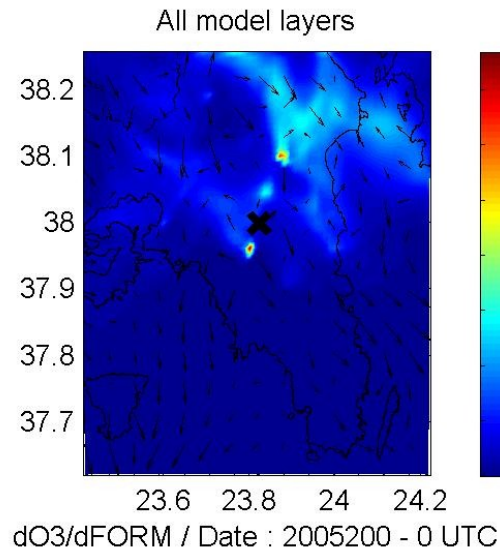


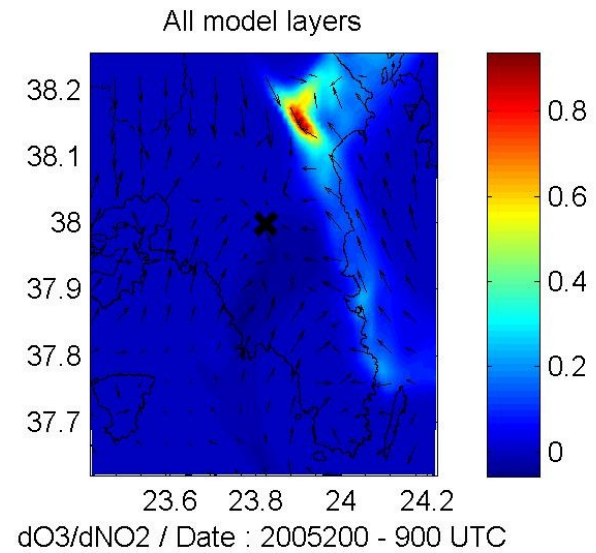
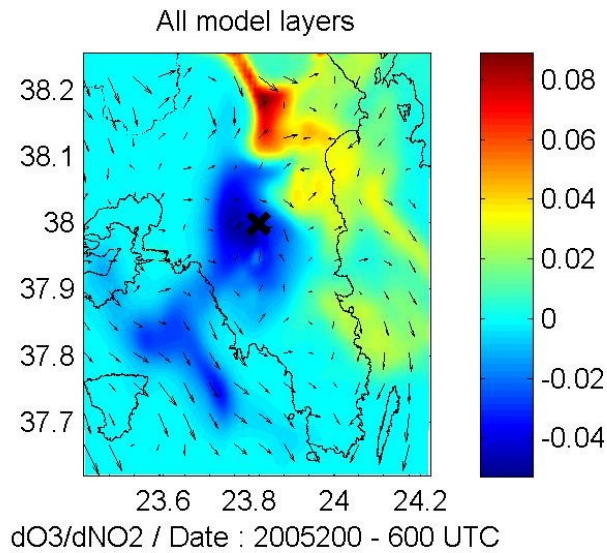
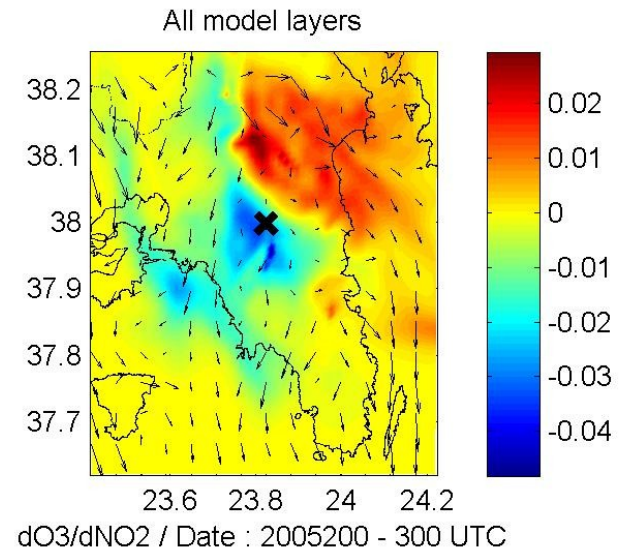
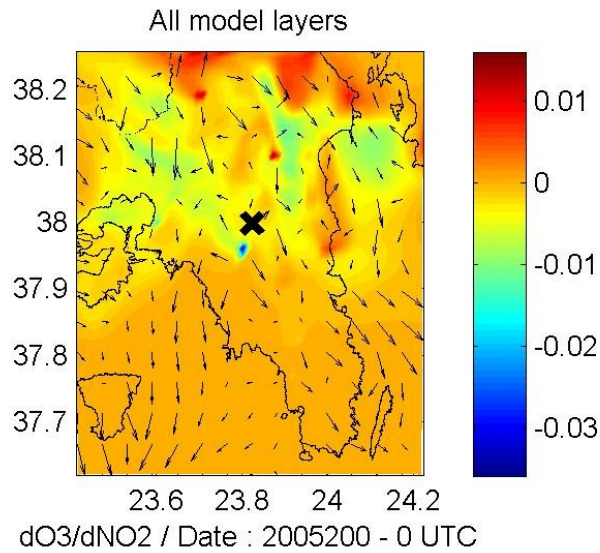


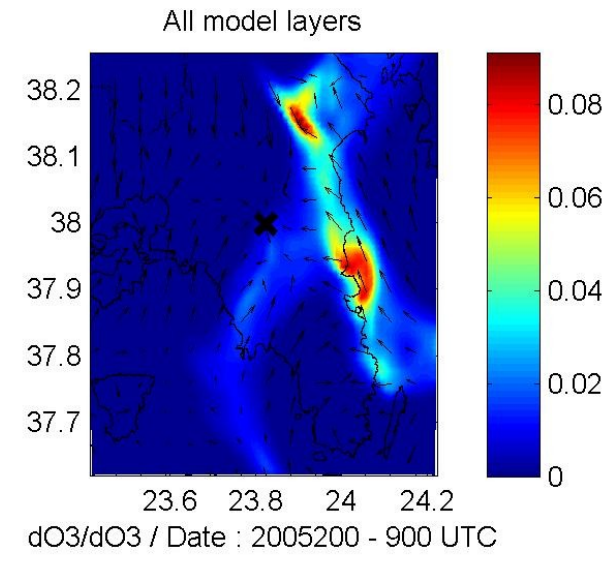
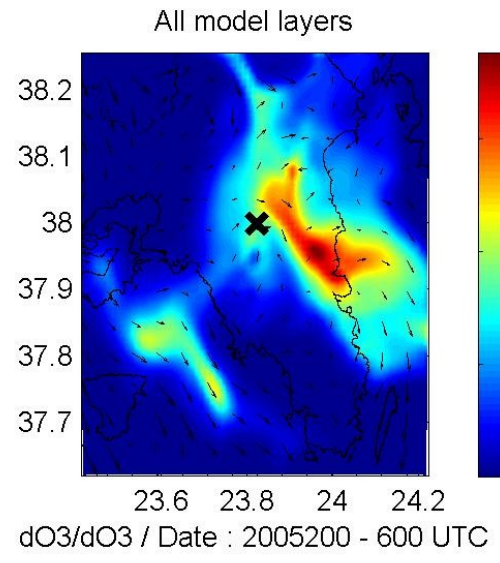
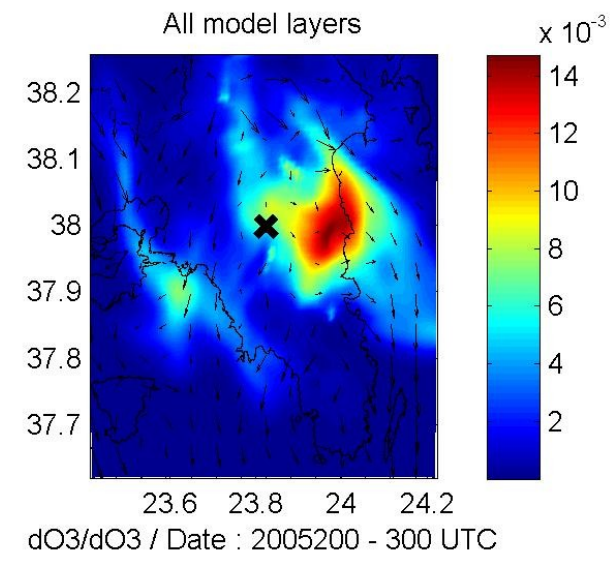
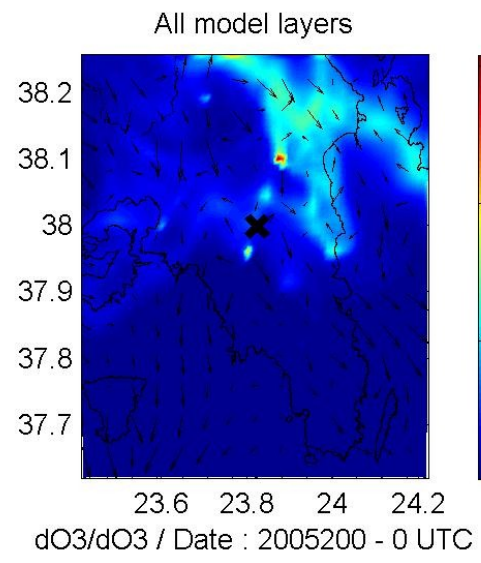
ΔΗΧ
ΚΡΙ
ΤΟΣ





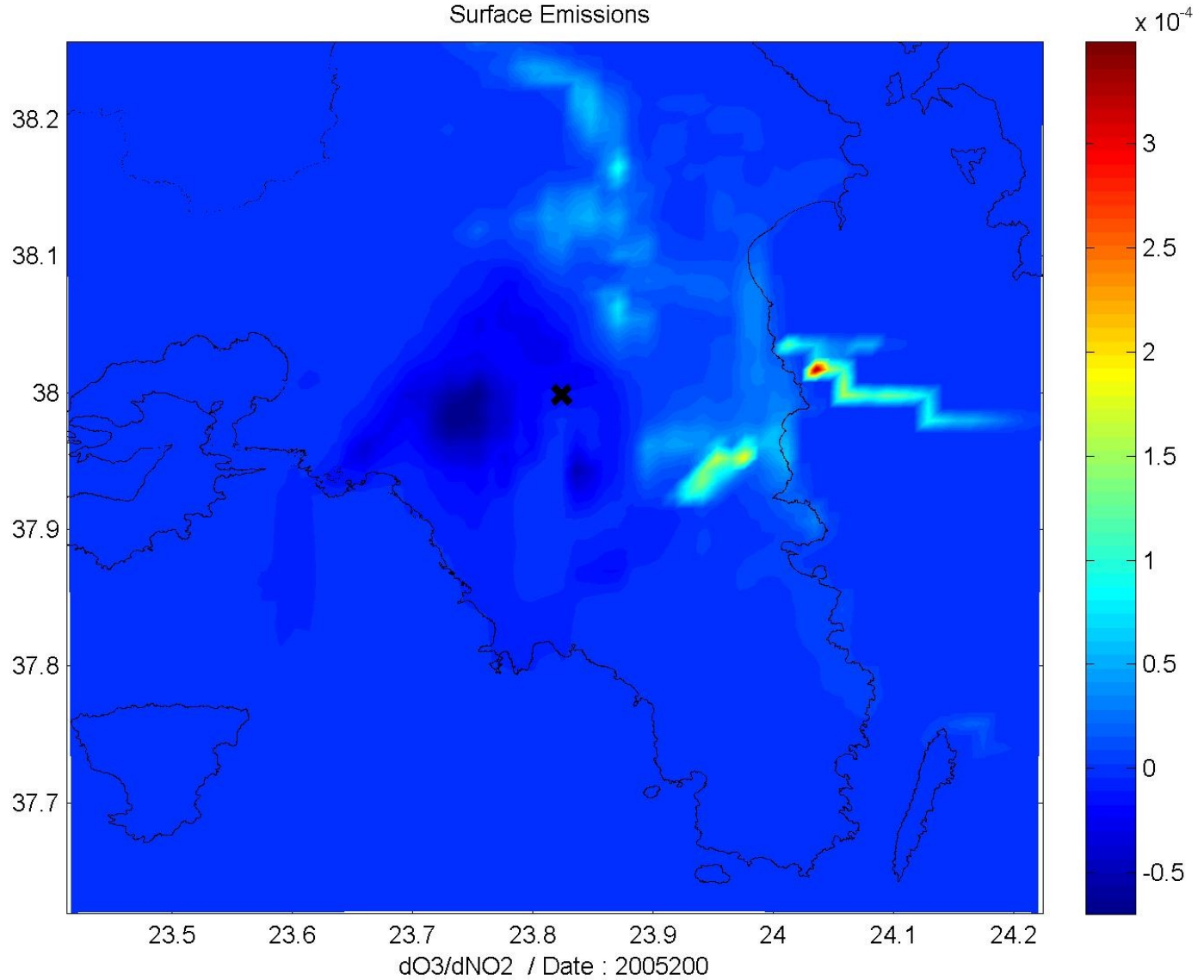






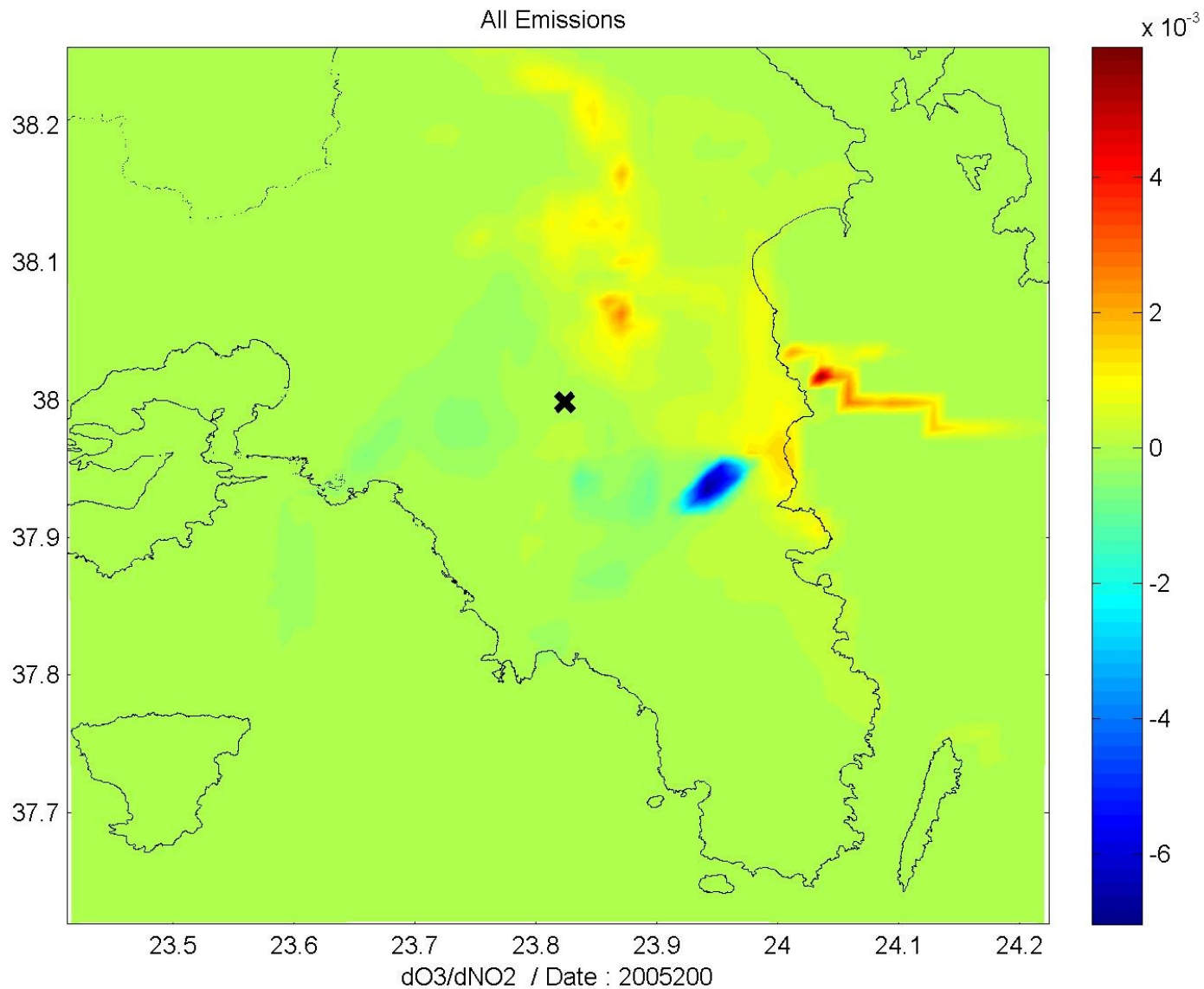


Surface Emissions



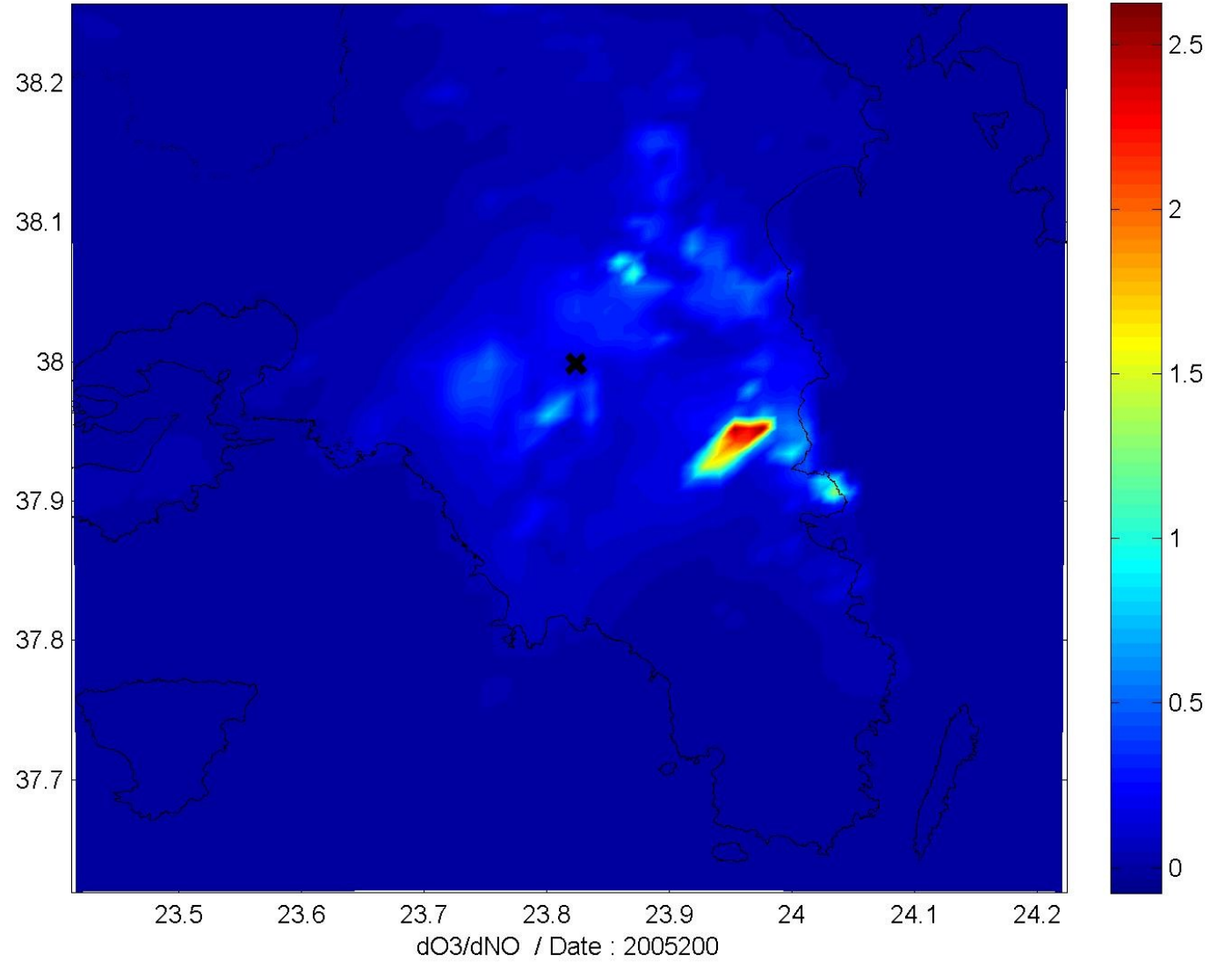


All Emissions



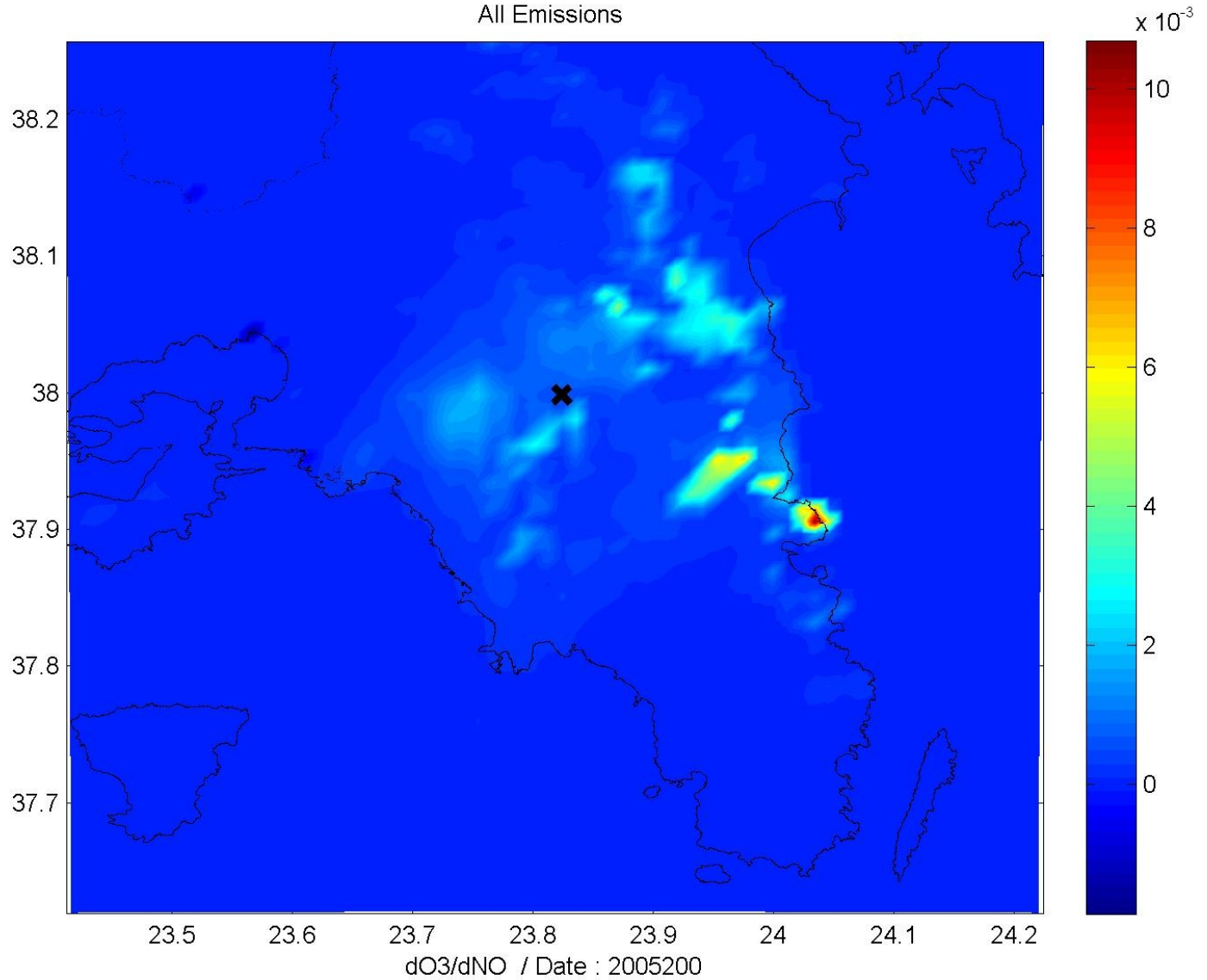


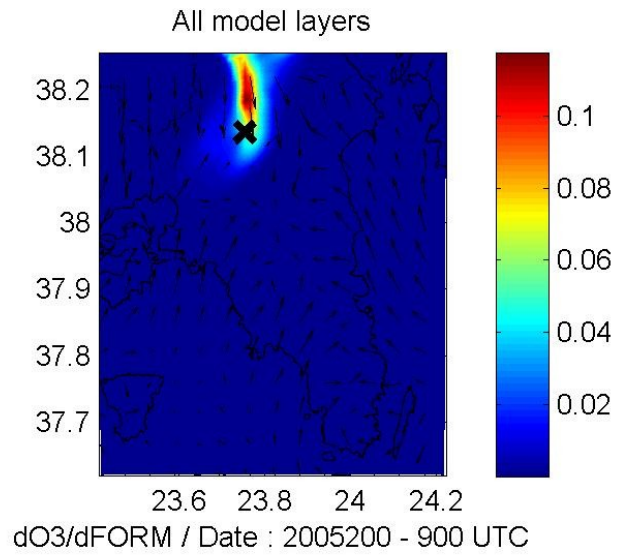
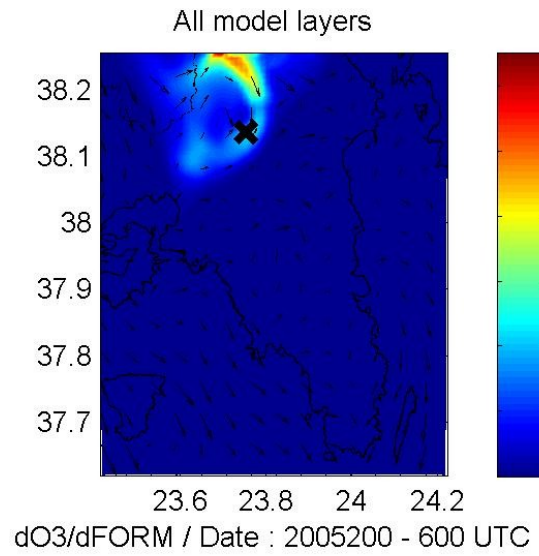
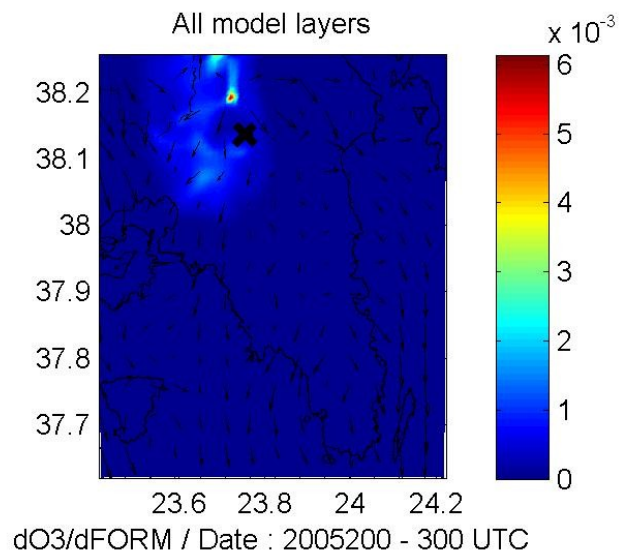
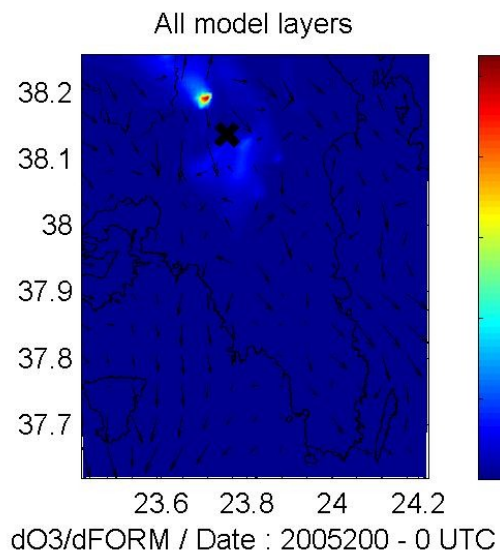
Surface Emissions

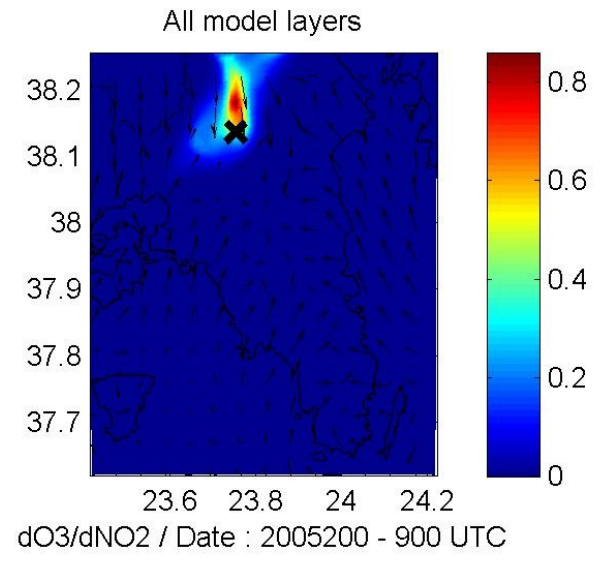
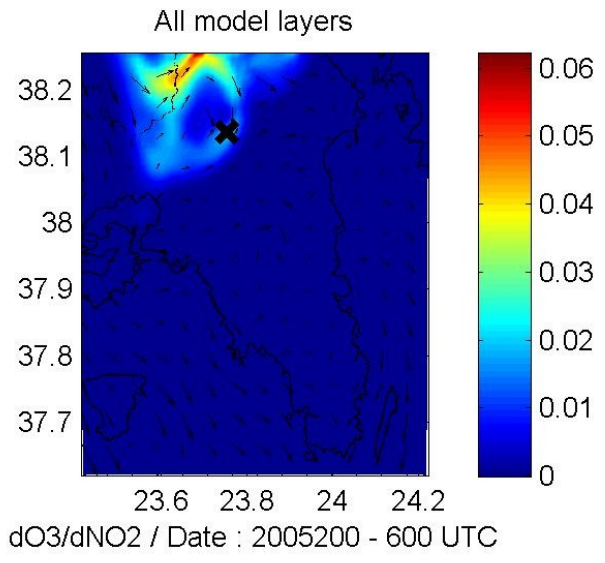
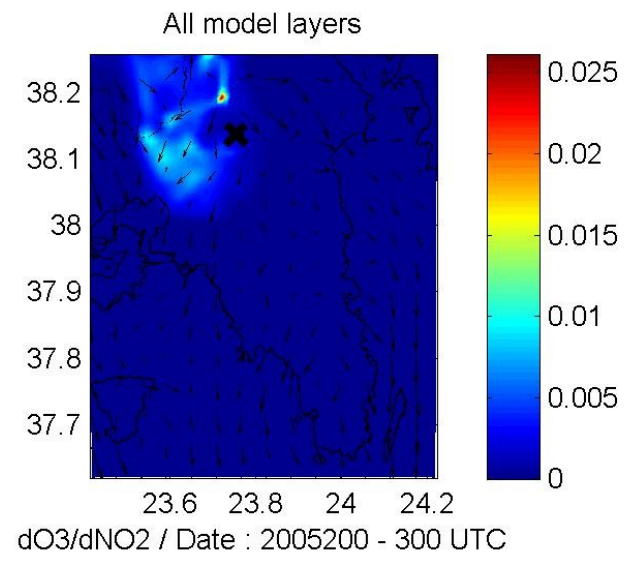
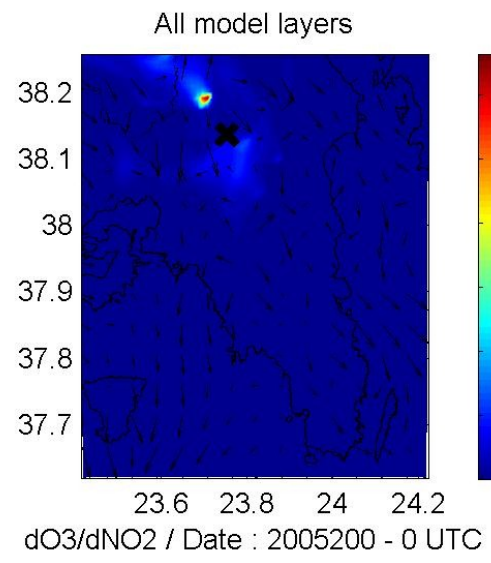


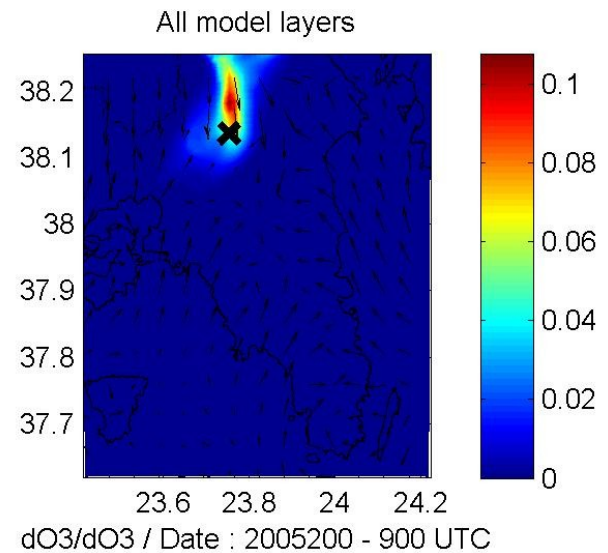
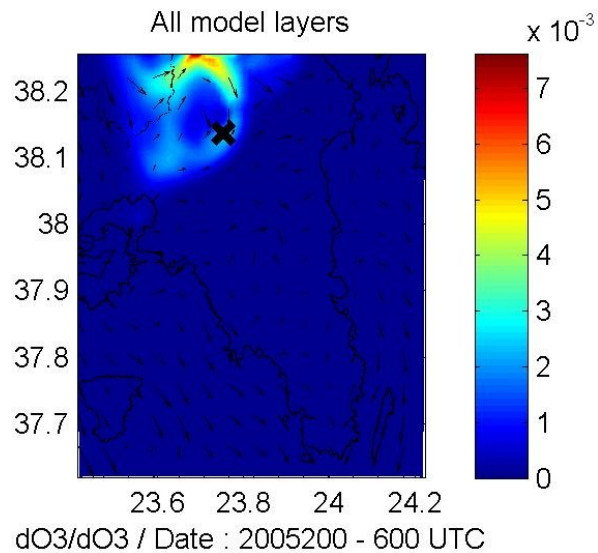
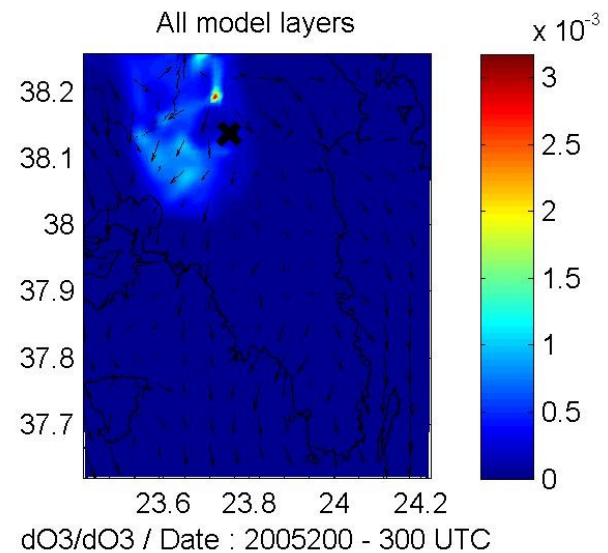
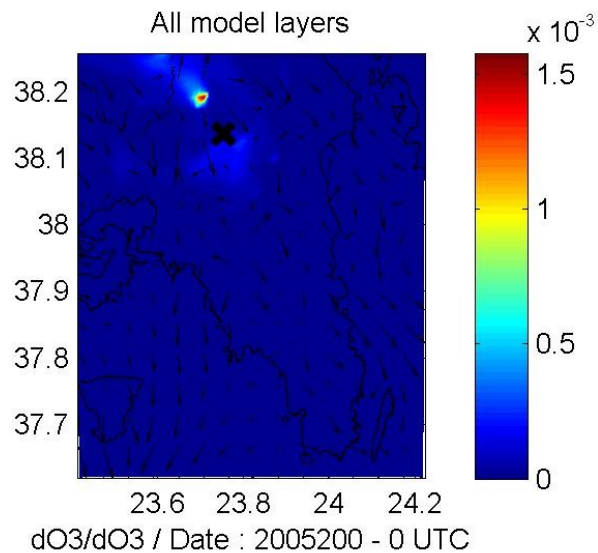


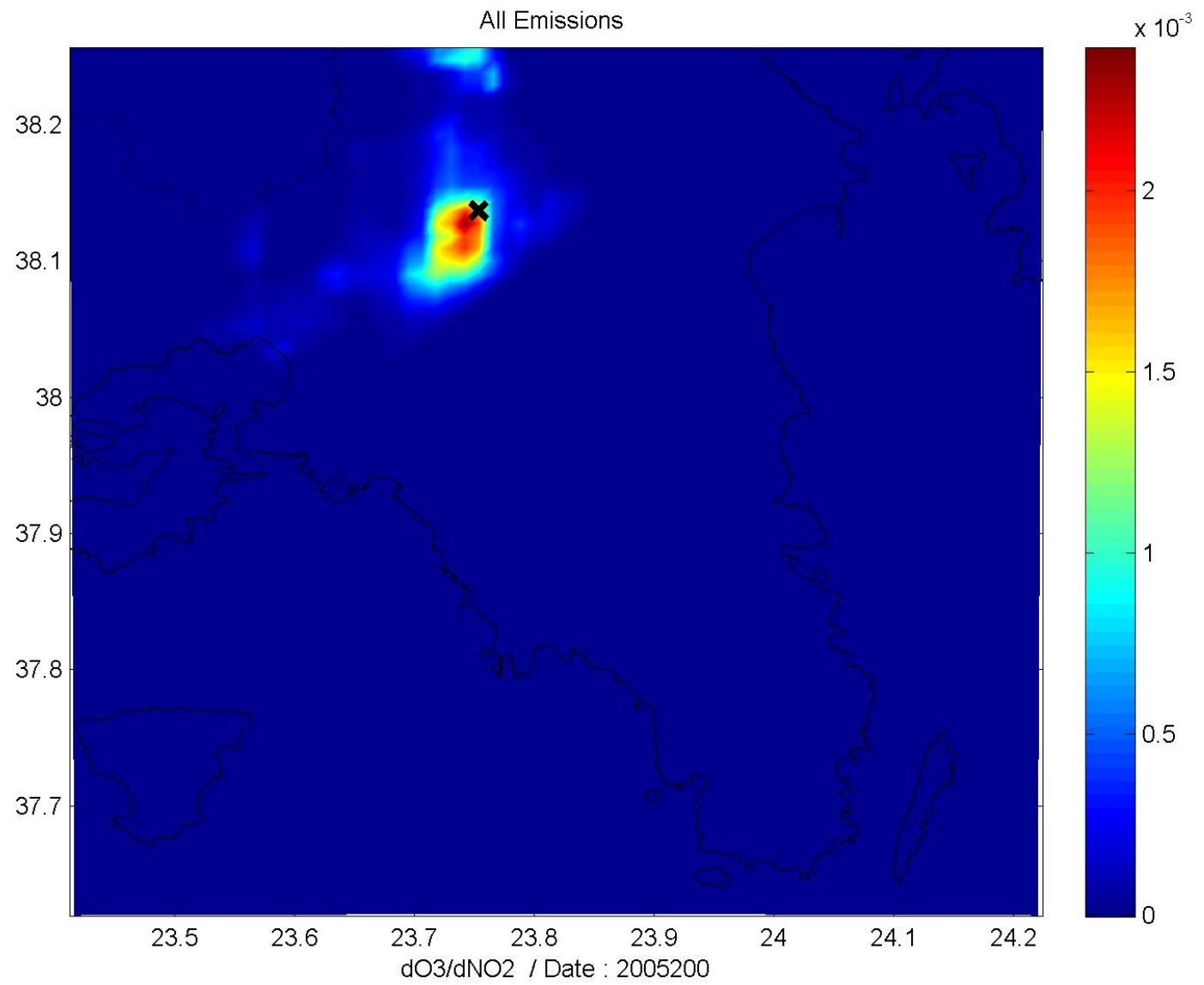
All Emissions

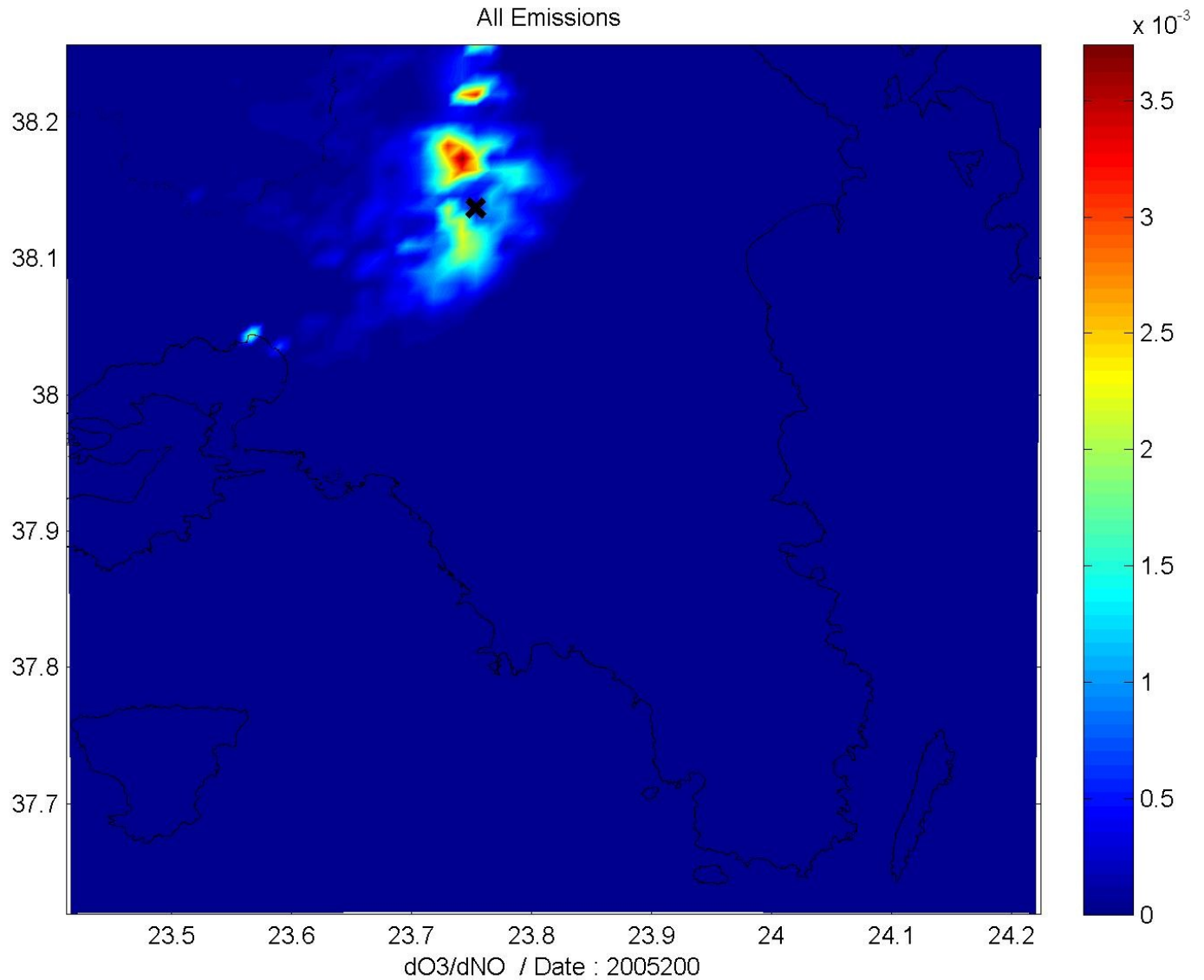














Summary and conclusions

- Adjoint sensitivity analysis: computational tool to assess the areas that have the largest impact on a specific receptor site
- Models used in this study: MM5 - EMISLAB - CMAQ - CMAQ adjoint
- Application area: *Greater Athens Area*
- Target date: 19/7/2007 at 12:00 UTC (15:00 local time) - air pollution episode with sea breeze formation
- Receptor sites: *Aghia Paraskevi, Thrakomakedones*
- Sensitivities of ozone concentrations at the receptors sites have been evaluated, with respect to
 - Concentrations of precursors
 - Emissions of precursors



Summary and conclusions (2)

- Aghia Paraskevi site:
 - Influenced both by the Athens centre area and mainly by the eastern Attiki located sources (airport, harbour).
Transported ozone is also observed
- Thrakomakedones site:
 - Influenced by the industrial area north-east of the Athens basin
- Future plans:
 - Update of the emissions inventory
 - Configuration and performance evaluation of the meteorological model - significant influence of the meteorological data