

REGIONAL AIR QUALITY FORECASTING OVER GREECE WITHIN PROMOTE

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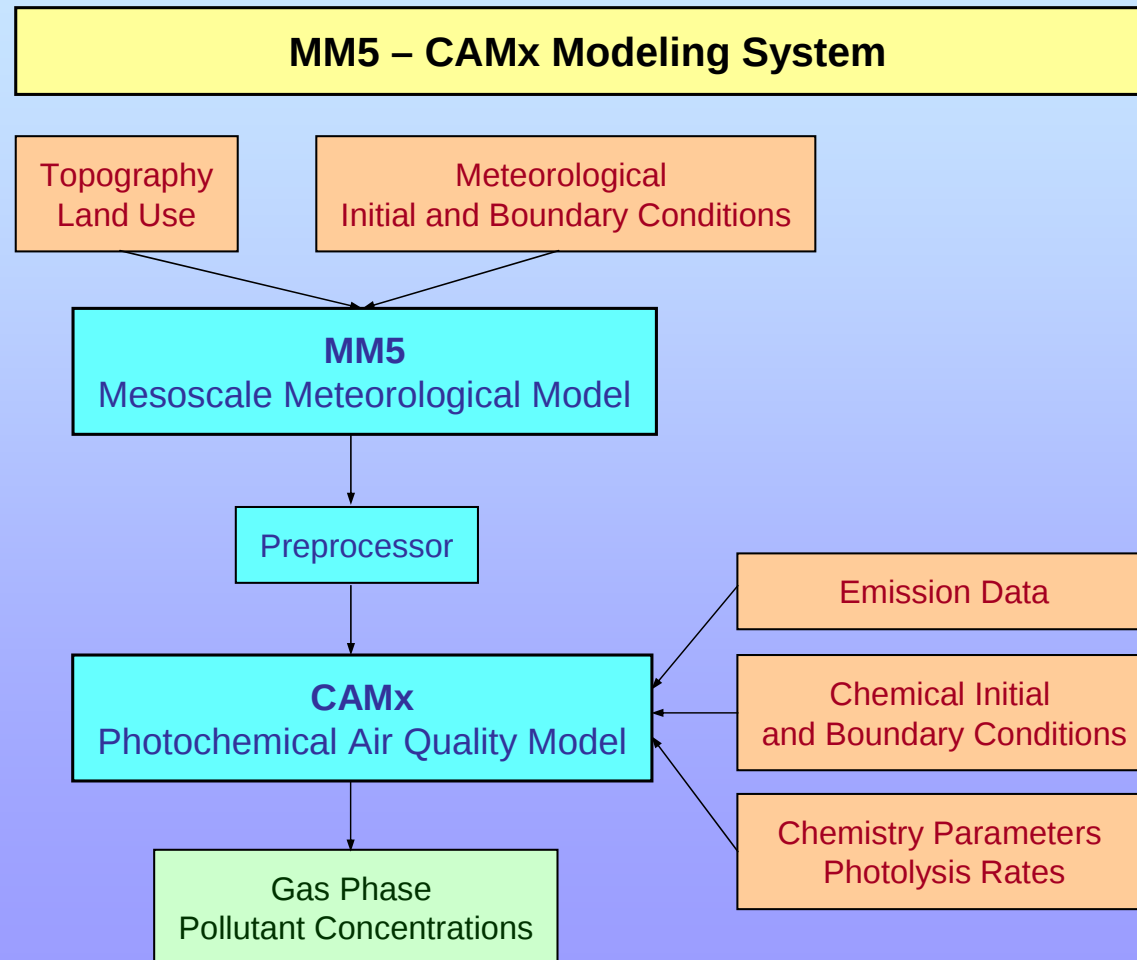
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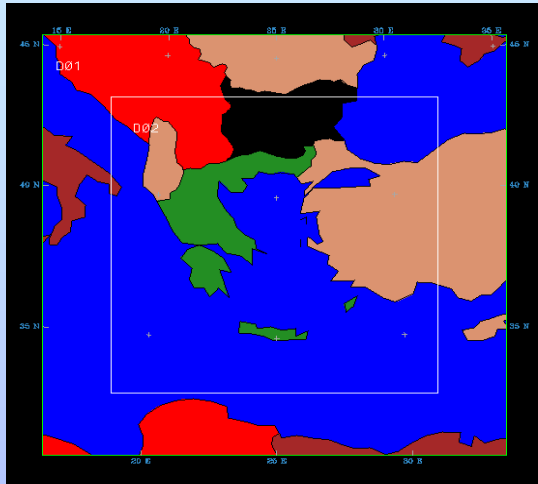
DESCRIPTION OF THE AIR QUALITY FORECAST SYSTEM

- ✓ The air quality forecast system is set up at the Laboratory of Atmospheric Physics in order to predict air pollutant levels over Greece.
- ✓ It consists of two numerical models:
 1. Prognostic meteorological model PSU/NCAR mesoscale model (MM5 version 3.7)
 - and
 2. Photochemical air quality model Comprehensive Air quality Model with extensions (CAMx version 4.20).
- ✓ The forecast system runs operationally on a daily basis to issue 72-hour forecast of O₃, NO₂ and CO concentrations.
- ✓ The modeling domain has spatial resolution equal to 10km, covers Greece and a part of the neighboring Balkan countries.

FLOW CHART OF THE FORECAST SYSTEM



MM5 MODELING DOMAIN



➤ MM5 is implemented for two nested grids

COARSE GRID

- 55 x 55 grid points.
- 30 km horizontal spatial resolution.
- It covers the greater part of the Balkan Region.

FINE GRID

- 121 x 121 grid points.
- 10km horizontal spatial resolution.
- It zooms in an area that covers Greece and a part of its neighboring countries.

➤ Both grids have the same vertical structure of 33 σ levels.

➤ Model top is 100 mbar.

MM5 INPUT DATA

INITIAL AND BOUNDARY CONDITIONS

- ✓ 12 UTC forecast of the Global Forecast System of NCEP is transferred from an anonymous ftp-server to the local system.
- ✓ GFS forecast is usually available around 16 UTC.
- ✓ Initial and boundary conditions, given in standard-pressure surfaces with a horizontal resolution of 1°, are interpolated onto the regional grid of the forecast system.

TOPOGRAPHY / 25-CATEGORY LAND USE DATA

- ✓ Data Source: USGS Data Center.
- ✓ Horizontal spatial resolution: 2 minutes.

➤ MM5 performs an 84-h forecast.

➤ Model outputs are available around 3 UTC.

CAM_x SET UP



CAM_x MODELING DOMAIN

- It is a part of the MM5 fine grid.
 - 110 x 110 grid points.
 - 10 km horizontal spatial resolution.
 - 5 vertical layers extending up to ~ 2.5 km.
 - First layer height: 50 m.
-
- **Boundary Concentrations:** Forecast of the EURAD-CTM Model.
 - **Photolysis Rates:** TUV radiative transfer and photolysis model of NCAR.
 - **Carbon Bond Mechanism (CB-IV)** employed for solving chemical kinetics.

EMISSION DATA

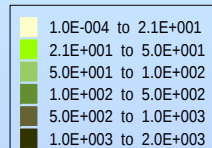
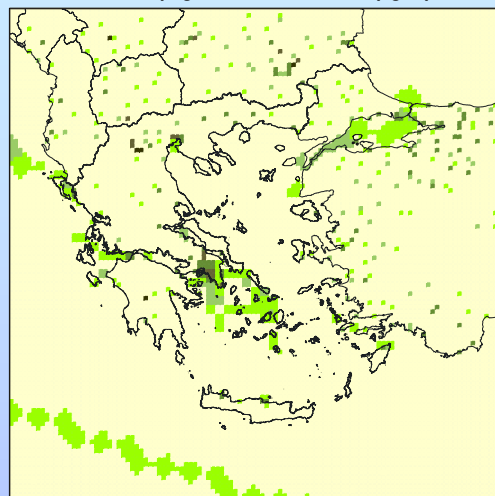
- **Biogenic NMVOCs and anthropogenic NO_x, NMVOCs and CO emission data.**
- **Temporal resolution: Hourly emissions with seasonal variation.**
- **Spatial resolution: 10 km.**

METHODOLOGY - DATA SOURCES

- **EMEP/CORINAIR Emission Inventory Guidebook.**
- **CORINAIR European Emission Inventory.**
- **EMEP gridded emission database.**
- **Official national emission inventories (e.g. the transport sector emission inventory for Greece).**
- **Official statistics from national statistical institutes.**

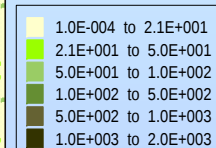
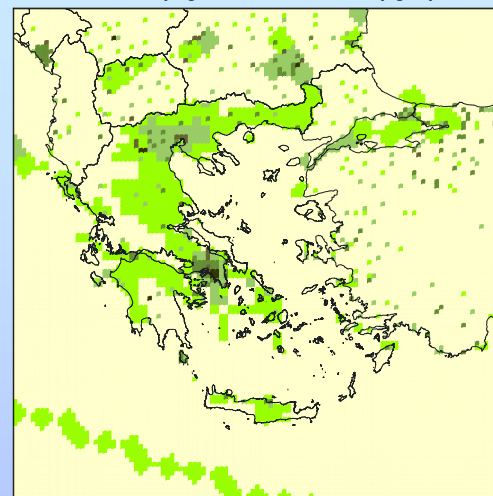
EMISSION MAPS

Anthropogenic NO_x Emissions (kgr/h)



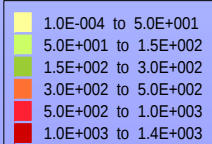
Time period: 00:00 - 01:00 ST Month: June

Anthropogenic NO_x Emissions (kgr/h)



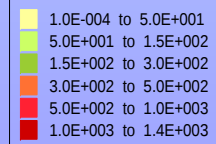
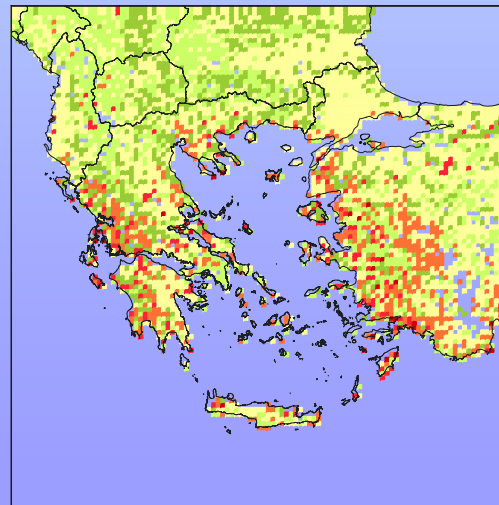
Time period: 12:00 - 13:00 ST Month: June

Biogenic Isoprene Emissions (kgr-C/h)



Time period: 07:00 - 08:00 ST Month: June

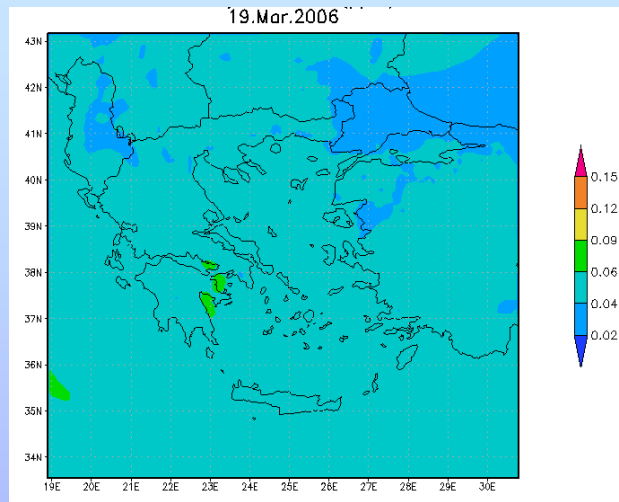
Biogenic Isoprene Emissions (kgr-C/h)



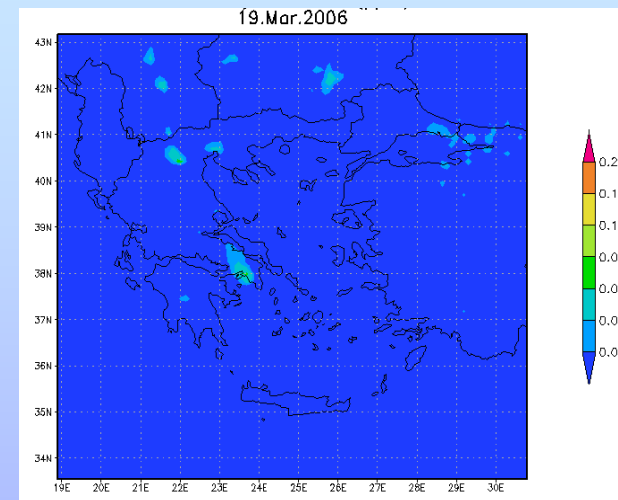
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AIR QUALITY FORECASTING

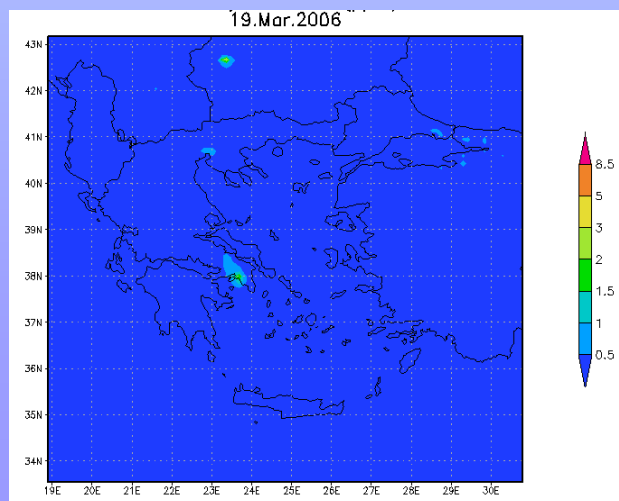
O₃ Daily Maximum (ppm)



NO₂ Daily Maximum (ppm)



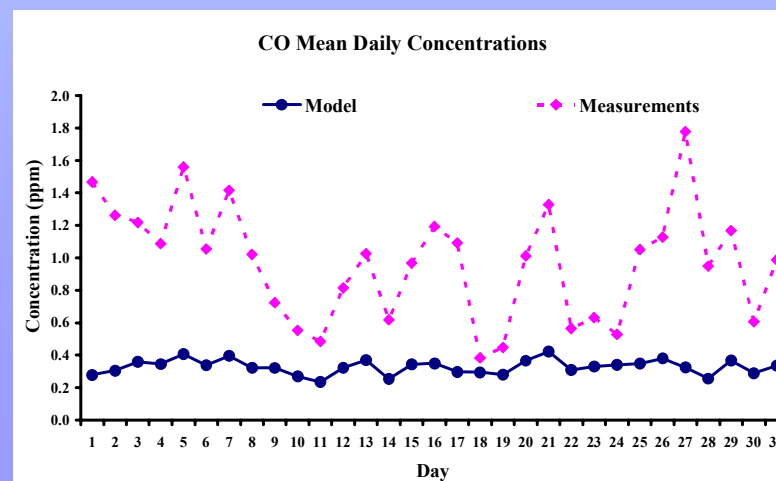
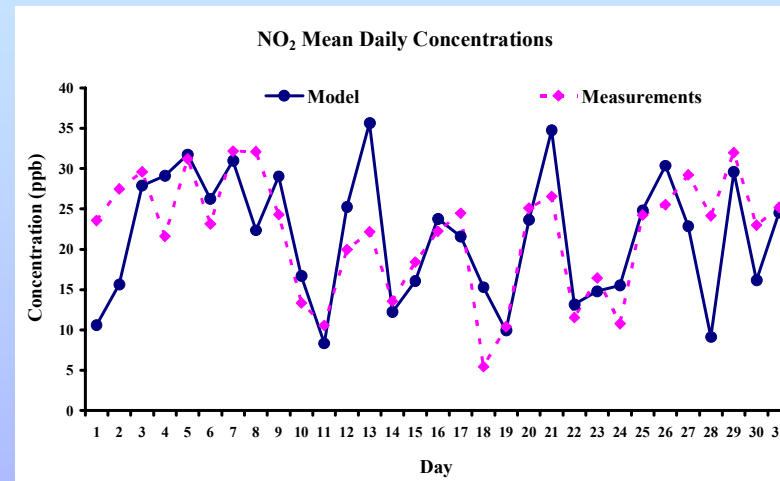
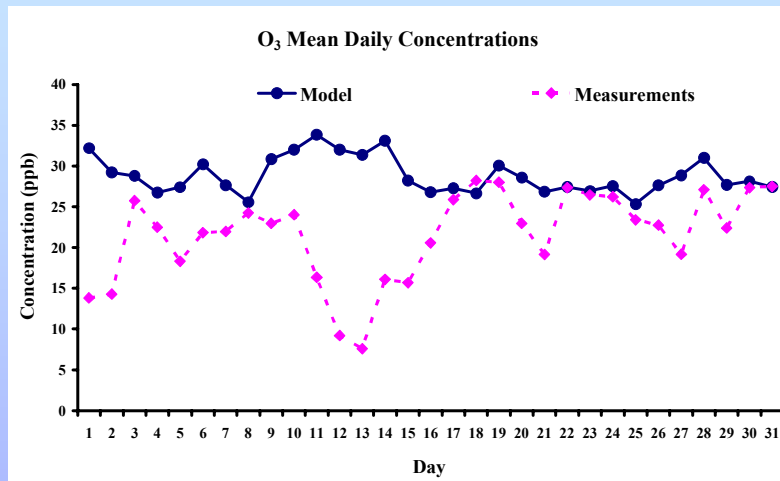
CO Daily 8h-Average Maximum (ppm)



- 72-h air quality forecast completed ~ 4 UTC.
- Air quality maps available on the web ~ 5 UTC.

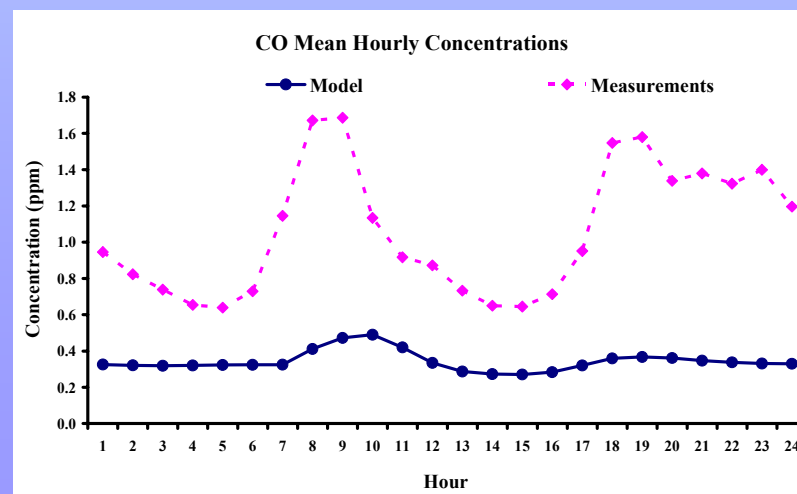
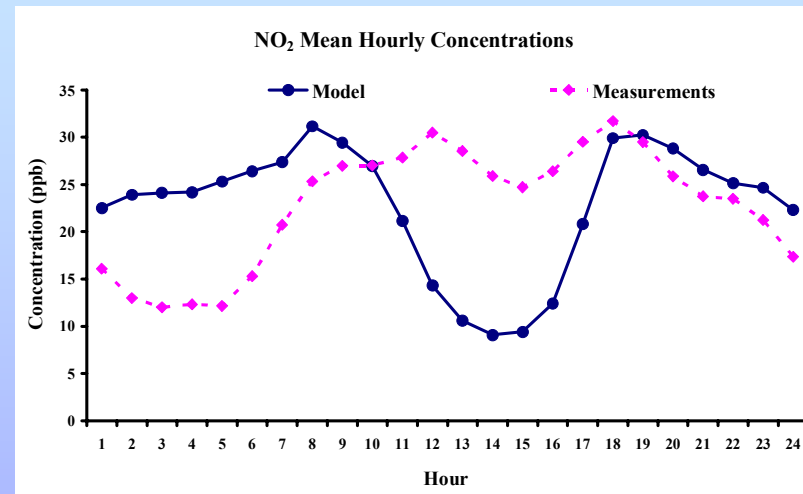
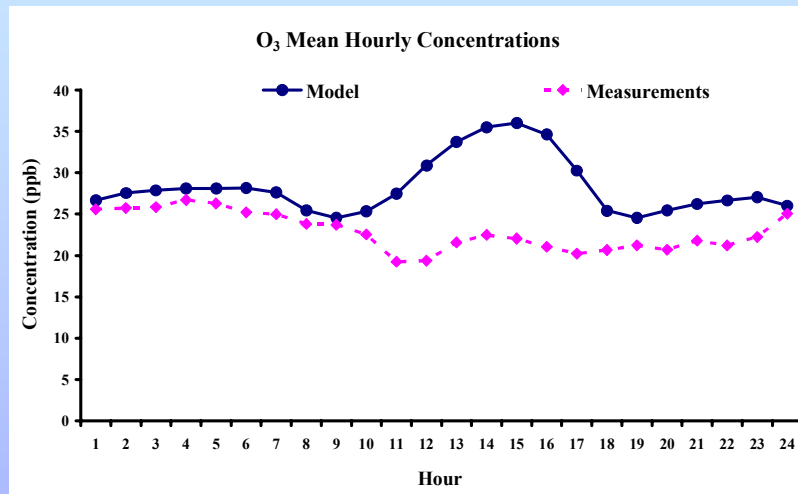
EVALUATION OF THE FORECAST SYSTEM (1)

Greek authority responsible for the evaluation: Region of Central Macedonia



EVALUATION OF THE FORECAST SYSTEM (2)

Diurnal variations calculated excluding modeled and observed data for days of rainy weather.



CONCLUSIONS

- ✓ **An operational air quality forecast system is set up in order to issue 72-hour forecast of near surface air pollutant levels over Greece.**
- ✓ **The forecast system produces maps of daily maximum concentrations of O₃ and NO₂ and daily maximum 8h-average concentrations of CO.**
- ✓ **Evaluation of the forecast system has been performed by Greek authorities.**
- ✓ **The forecast system is capable of reproducing the main features of air quality over the area where measurements were performed.**
- ✓ **The forecast system performance is better regarding O₃ and NO₂ while CO concentrations are systematically underestimated.**
- ✓ **More reliable is the forecast issued during days when it is not raining.**

FUTURE WORK

- **Future forecasting activities would greatly benefit from:**
 - 1. An updated emission inventory.**
 - 2. Finer modeling resolution (mainly over the areas where large urban centers and emission sources are located).**
- **On going work involves comparison of tropospheric NO₂ column derived from satellite data with model results.**