Impact study of Martigues' thermal power plant on ozone formation in the PACA region using CTM POLAIR3D

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ESCOMPTE Campaign

- Conducted over southeastern France during Summer 2001 (Including five Intense Observation Periods (IOP))
- An intensive data measurement campaign
  - Meteorological and chemical surface and airborne measurements
  - Aircraft, Radio-sounding, LIDAR,SODAR
  - Operational network (MF, AIRFOBEP,AIRMARAIX)
- A detailed emission inventory
- An international exercise of models intercomparison

Principal tools:

CTM POLAIR3D

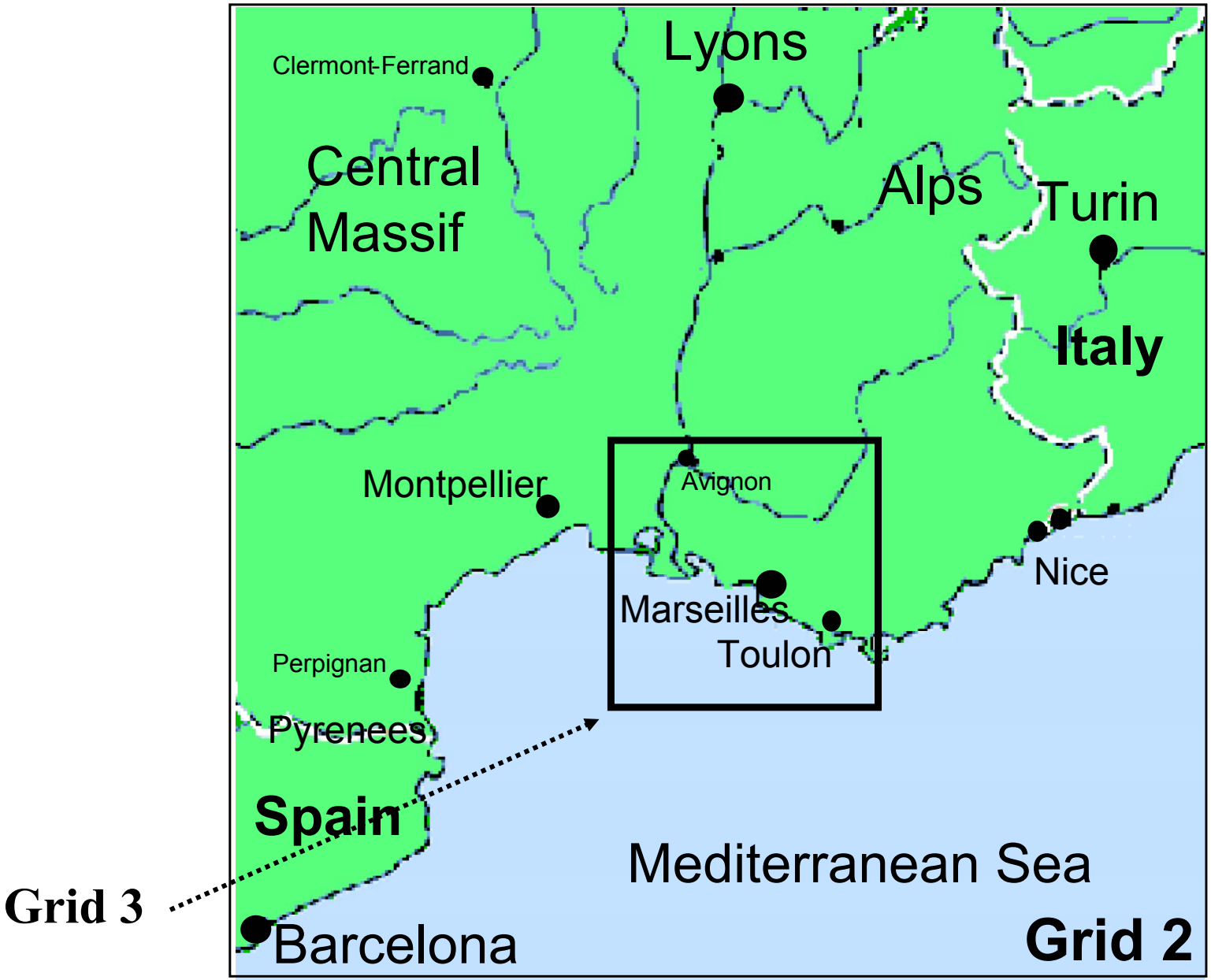
RAMS model

RAMS Model (http://atmet.com)

- Non-hydrostatic eulerian model
- Version 4.3: Parallel code
- 4DDA nudging technique
- Nested grids (two way nesting)
- ECMWF initialization
- Nudging every 6 hours
- Soil-Vegetation model (30 classes)
- Vegetation (USGS; resolution 0.5' or 1km)
- Topography (USGS; resolution 0.5' or 1km)
- Sea Surface temperature (Satellite, OOM)

Modeling configuration

Domain: Grid 1 (65 x 33) ΔX=ΔY= 0.5° (~ 50Km)
Grid 2 (36 x 36) ΔX=ΔY = 15km
Grid 3 (47 x 47) ΔX=ΔY = 3km


Clermont-Ferrand
Lyons
Central
Massif
Alps
Turin
Italy
Montpellier
Avignon
Nice
Marseilles
Toulon
Perpignan
Pyrenees
Spain
Mediterranean Sea
Grid 3
Barcelona
Grid 2


Avignon
Aix-en-provence
Berre pond
Martigues
Marseilles
Thermal power plant
Toulon
Grid 3

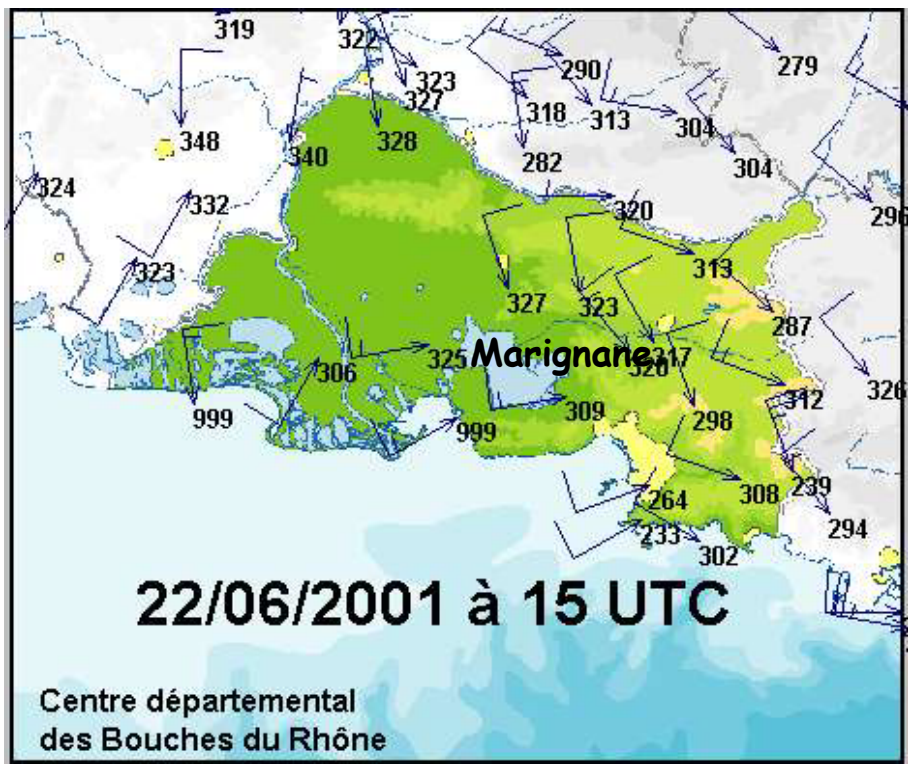
Meteorological fields

continental run : ECMWF

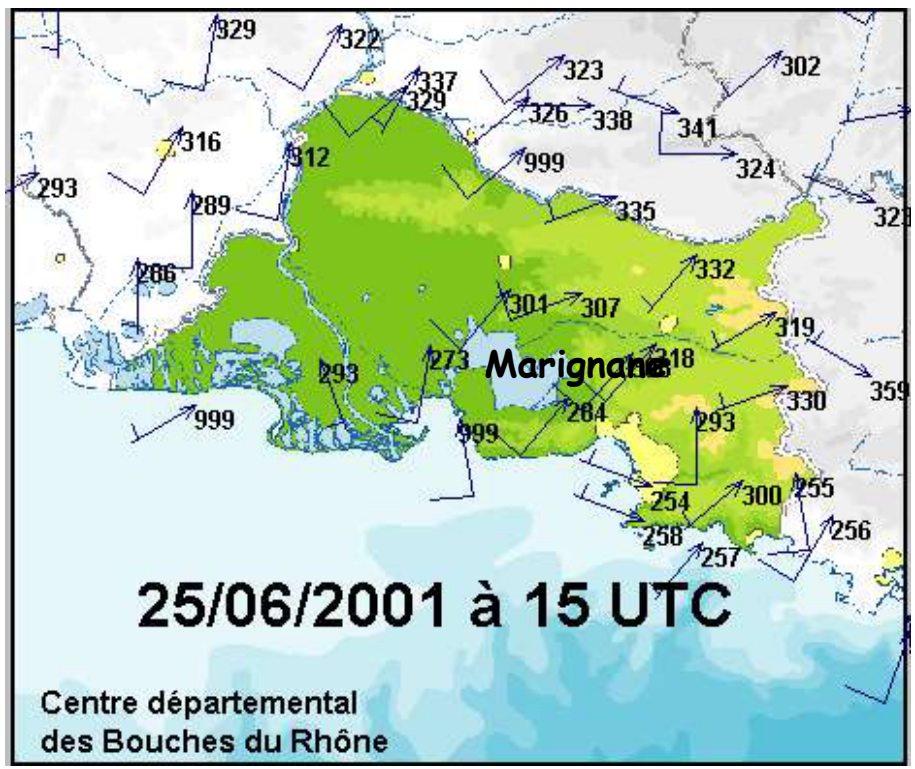
regional run : RAMS

Meteorological conditions

IOP2a : Weak sea breeze



IOP2b : strong sea breeze

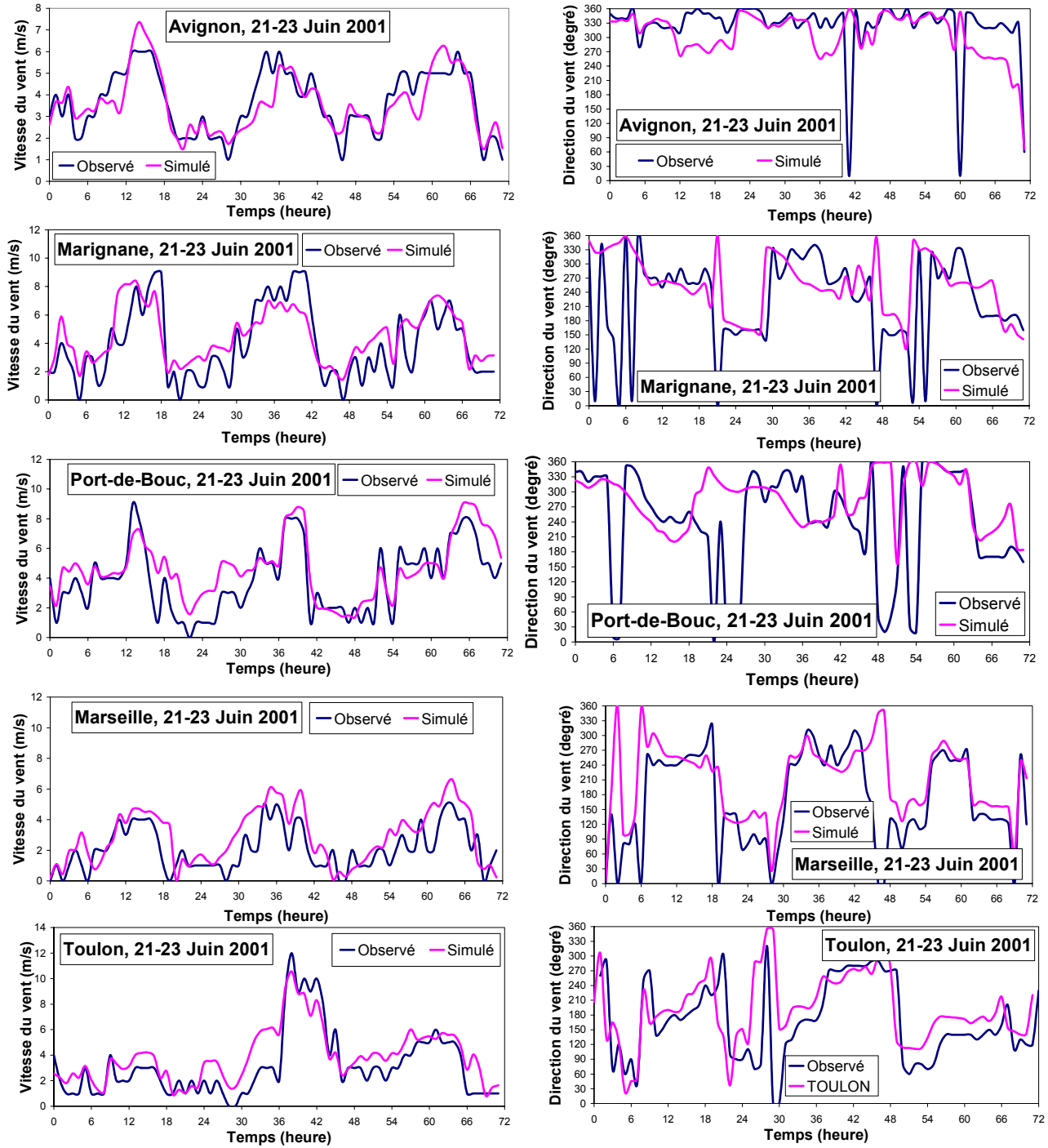


Observed

Modeled

Comparison between modeled and observed of Wind Speed and Wind Direction for 5 measurement stations, Avignon in North of domain, Marignane in center, Port de bouc in industrial area (close to power plant station), Marseilles in urban area, and Toulon in south of domain **(IOP2a)**

(Taghavi et al, 2004)

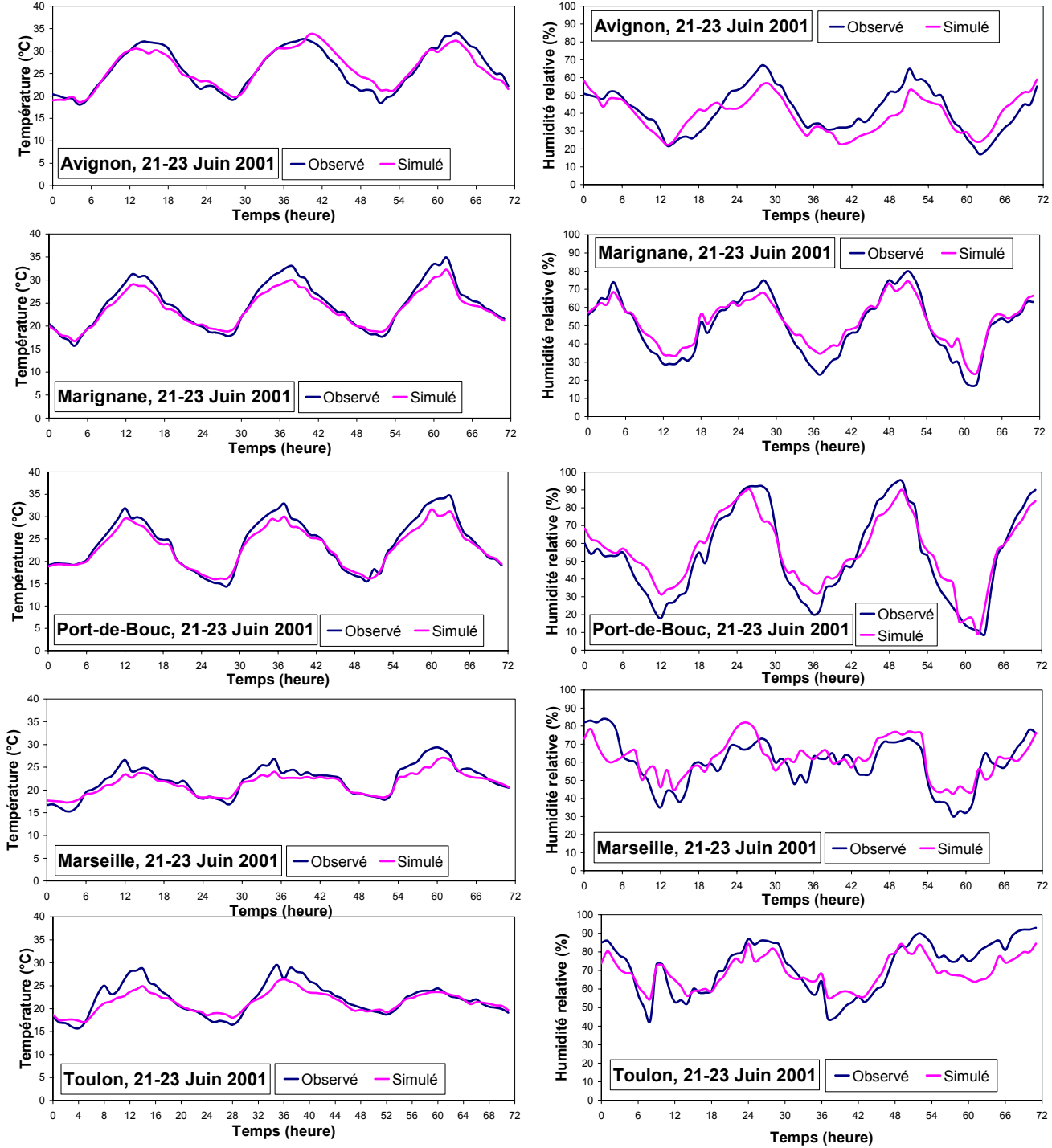


Observed

Modeled

Comparison between modeled and observed of Temperature and Humidity for 5 measurement stations, Avignon in North of domain, Marignane in center, Port de bouc in industrial area (close to power plant station), Marseilles in urban area, and Toulon in south of domain **(IOP2a)**

(Taghavi et al, 2004)

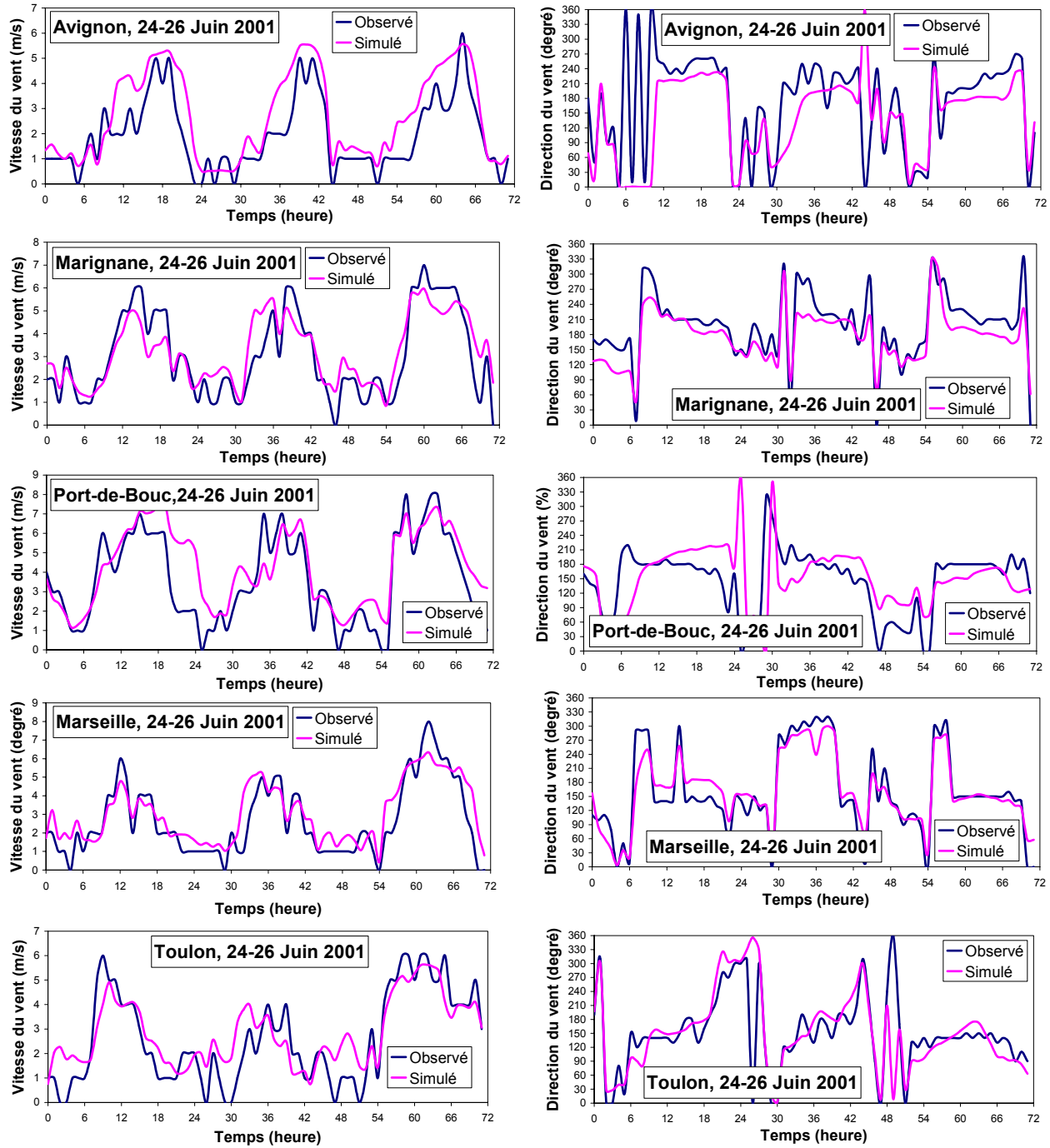


Observed

Modeled

Comparison between modeled and observed of Wind Speed and Wind Direction for 5 measurement stations, Avignon in North of domain, Marignane in center, Port de bouc in industrial area (close to power plant station), Marseilles in urban area, and Toulon in south of domain **(IOP2b)**

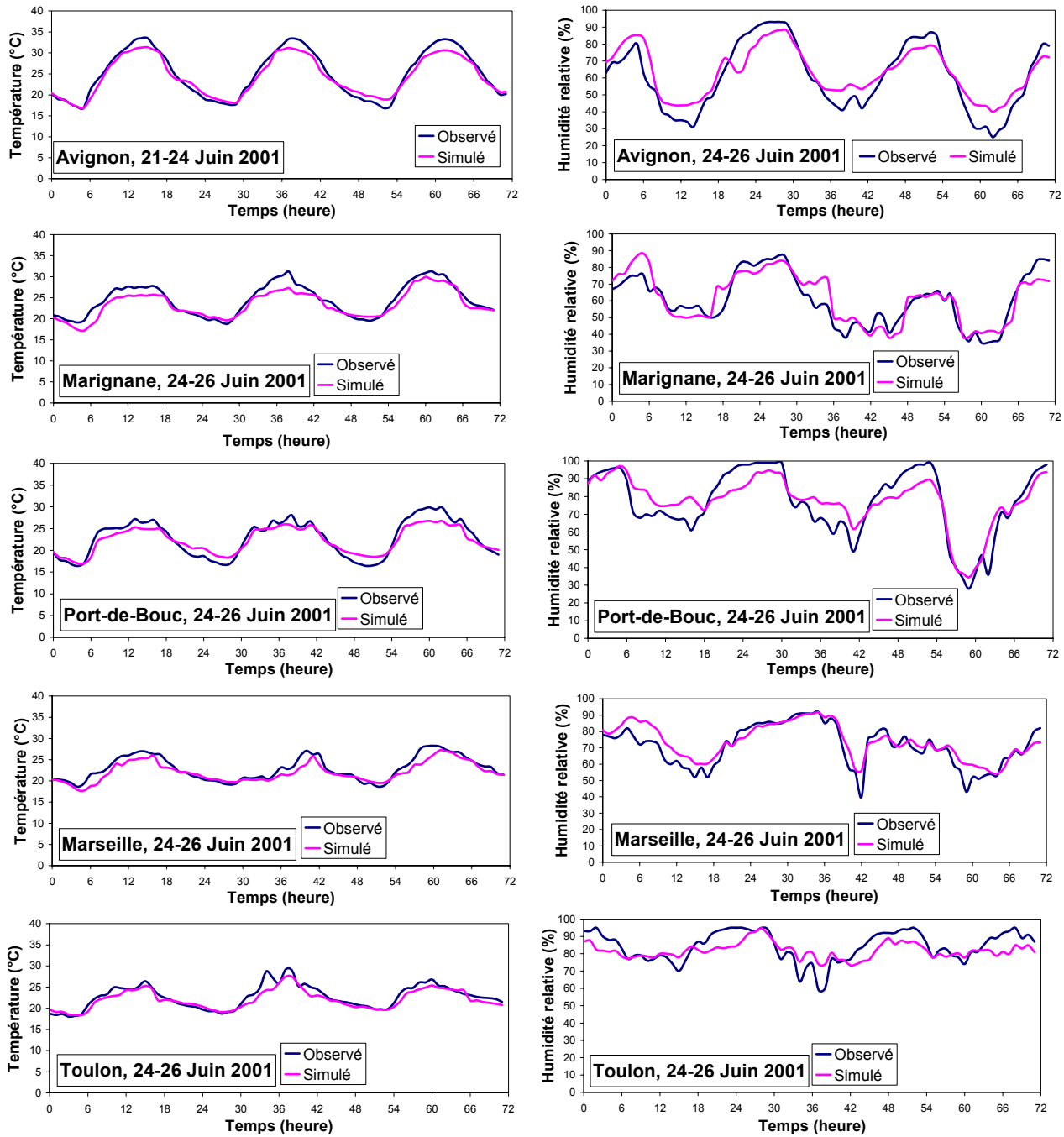
(Taghavi et al, 2004)



Observed

Modeled

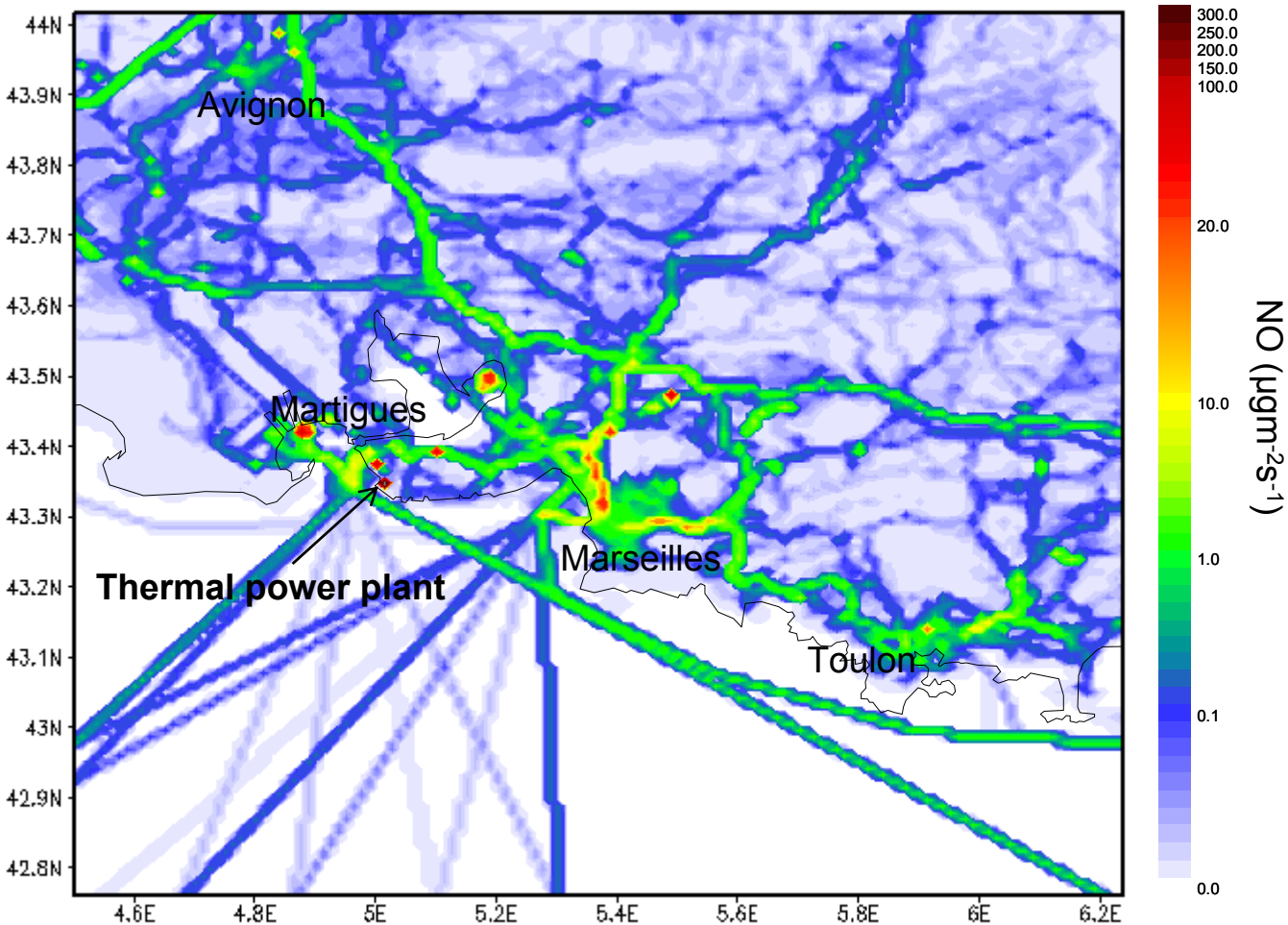
Comparison between modeled and observed of Temperature and Humidity for 5 measurement stations, Avignon in North of domain, Marignane in center, Port de bouc in industrial area (close to power plant station), Marseilles in urban area, and Toulon in south of domain **(IOP2b)**



(Taghavi et al, 2004)

POLAIR3D modeling, Validation, and Impact study

NO emission map

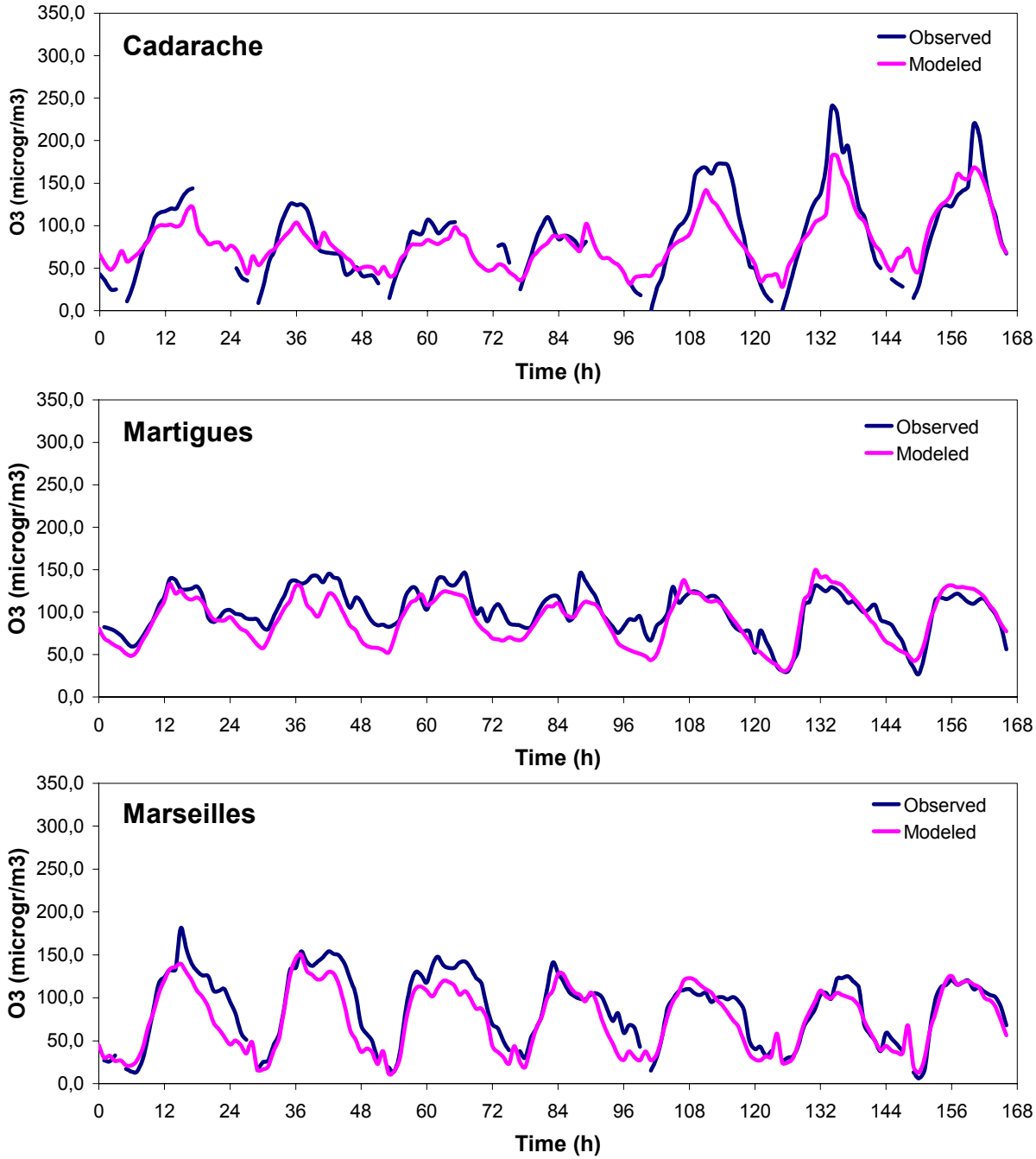


Observed

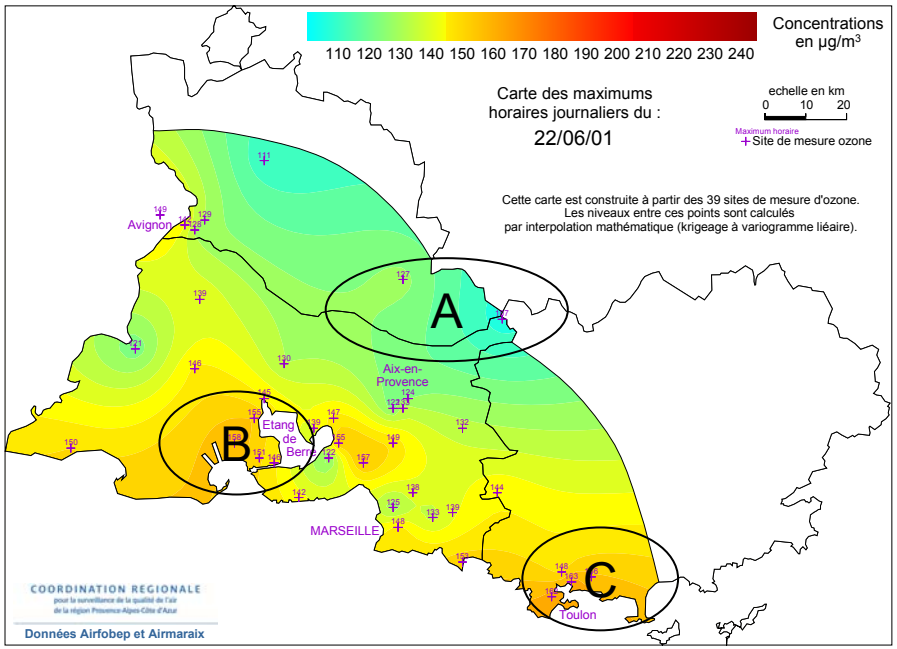
Modeled

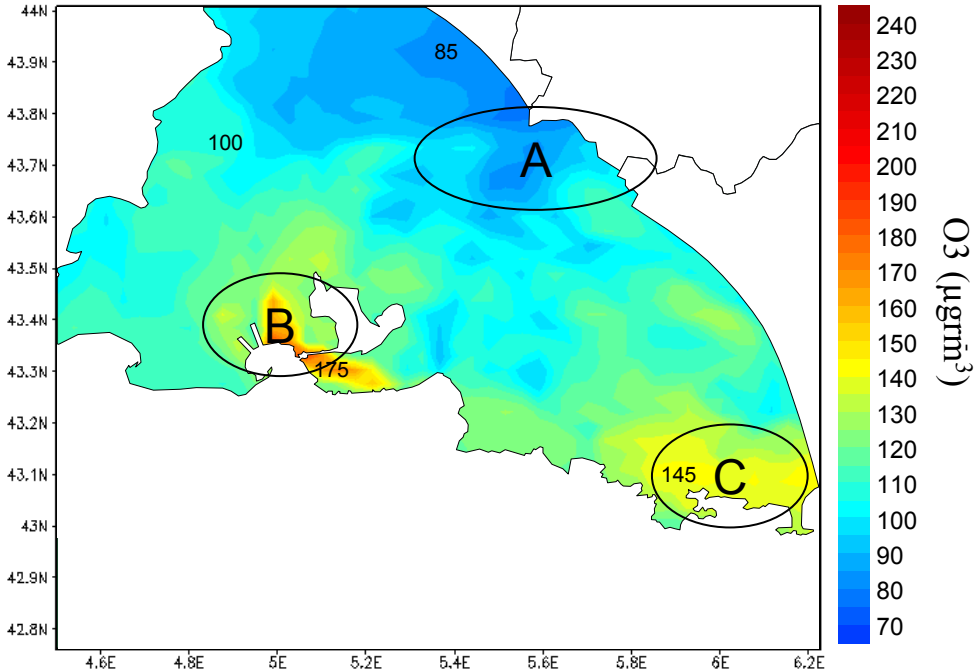
Comparison between modeled and observed values of ozone concentration for three measurement stations, Cadarache in rural area in north of domain, Martigues in industrial area, and Marseilles in urban area

(IOP2a and IOP2b)



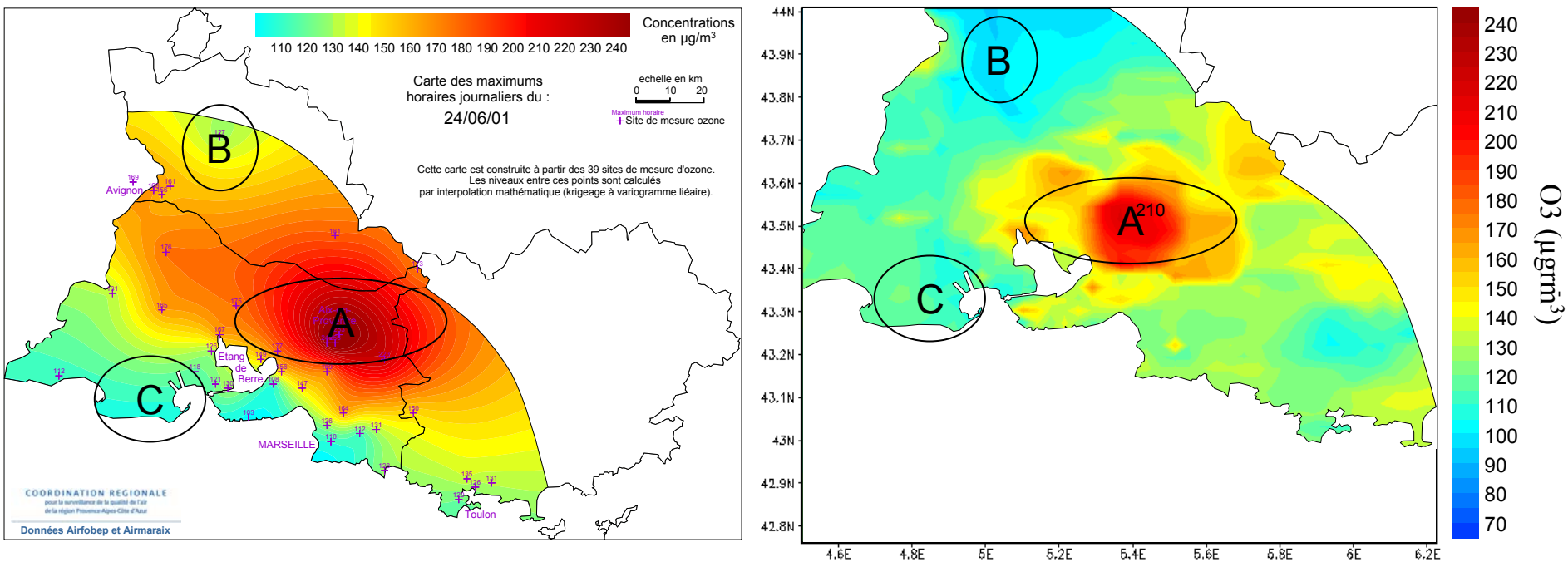
ozone maxima map





Modeled (right) and observed (left) ozone maxima concentration map for June,22 2001 (**IOP2a**)

ozone maxima map



Modeled (right) and observed (left) ozone maxima concentration map for June,24 2001 **(IOP2b)**

Scenarios

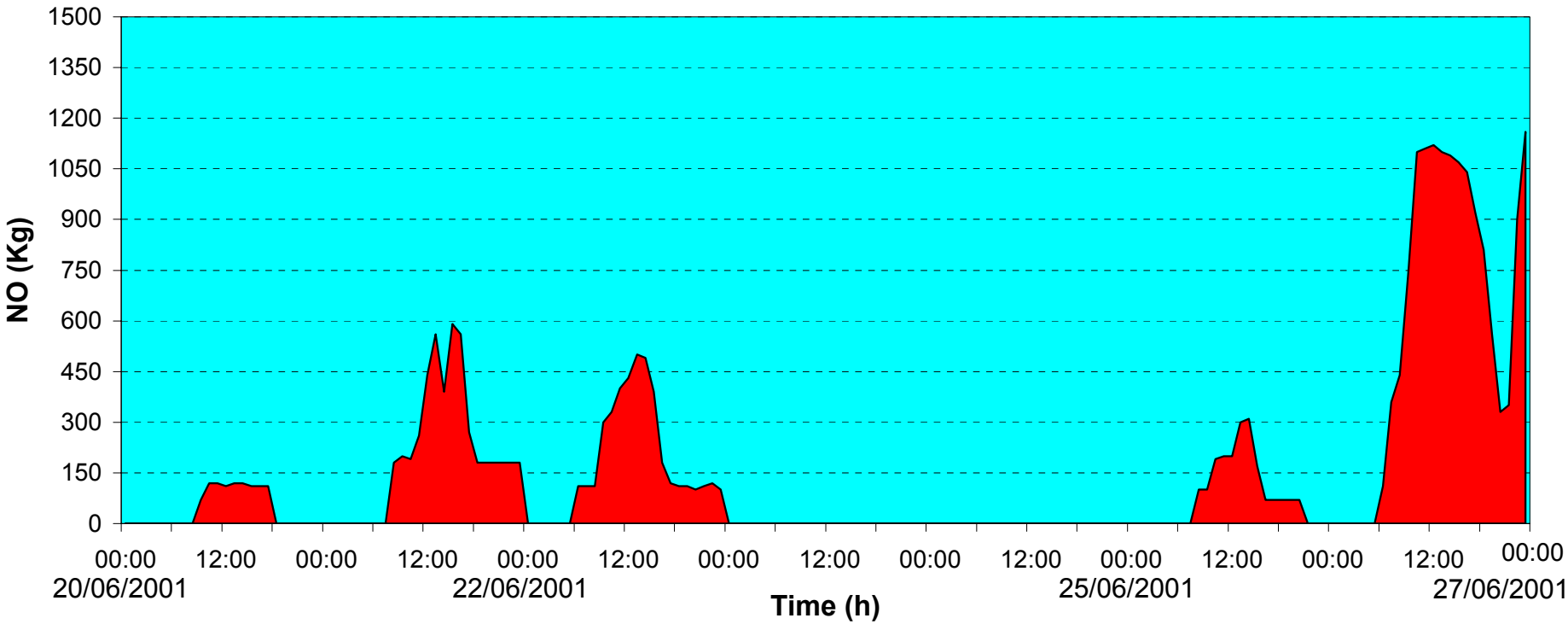
1- Power plant in it' maxima emission and fulltime function

2- Power plant in 50% of it' maxima emission and fulltime function

3- Real function (emission and temporal)

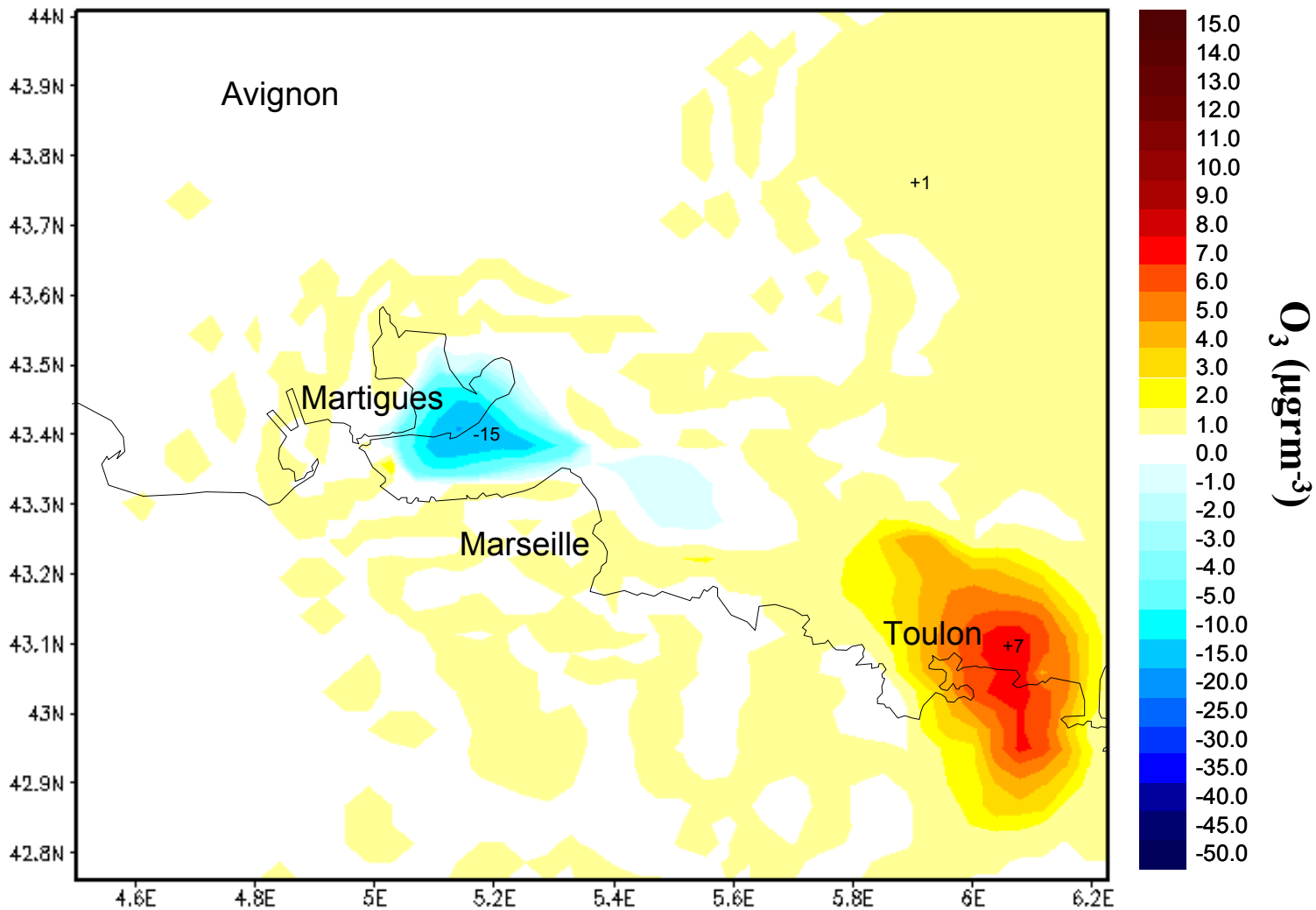
4- Temporal real function with real emission divided by 2

Power plant station' temporal function



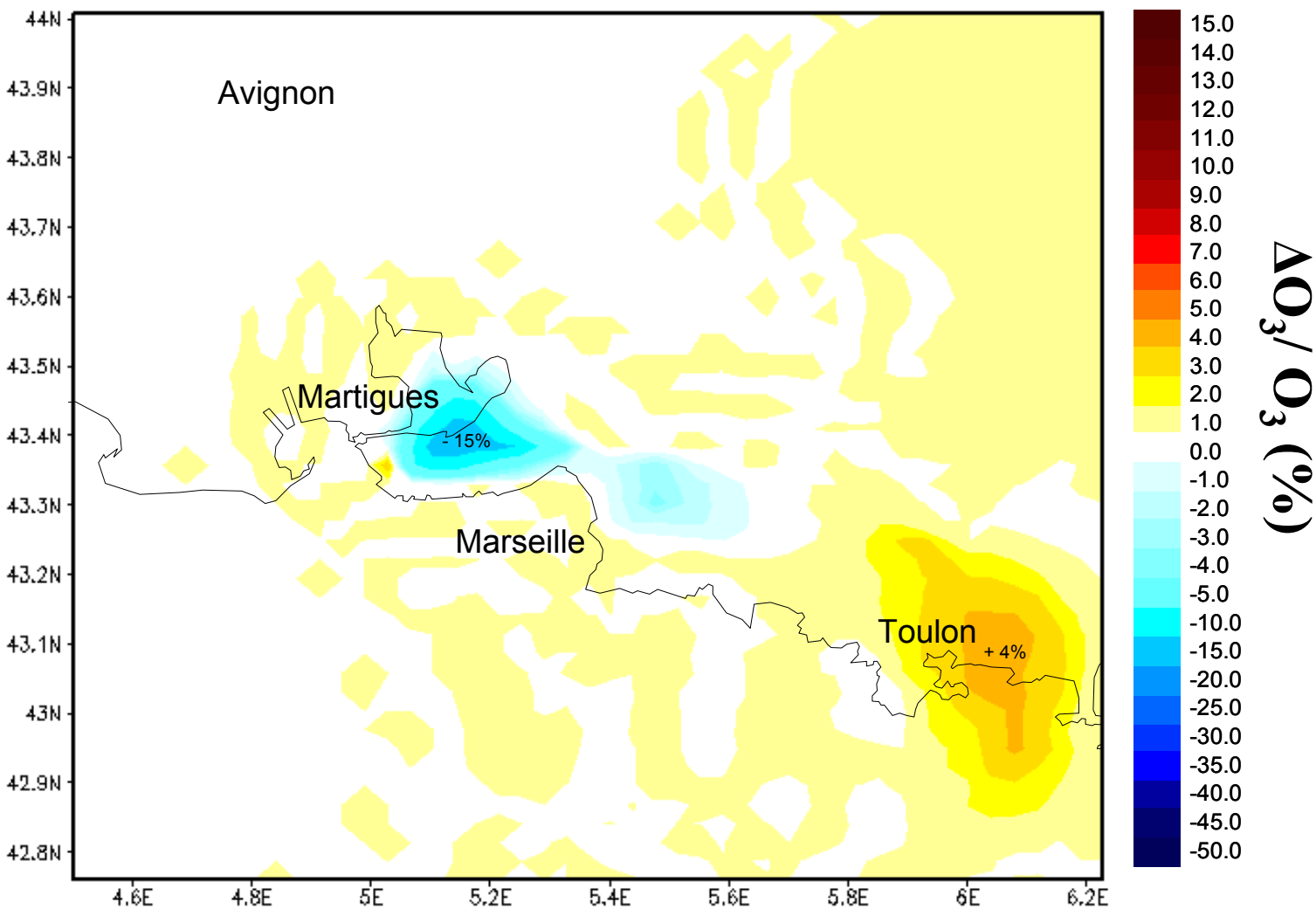
Temporal function of Power plant station during IOP2a and IOP2b

Impact study



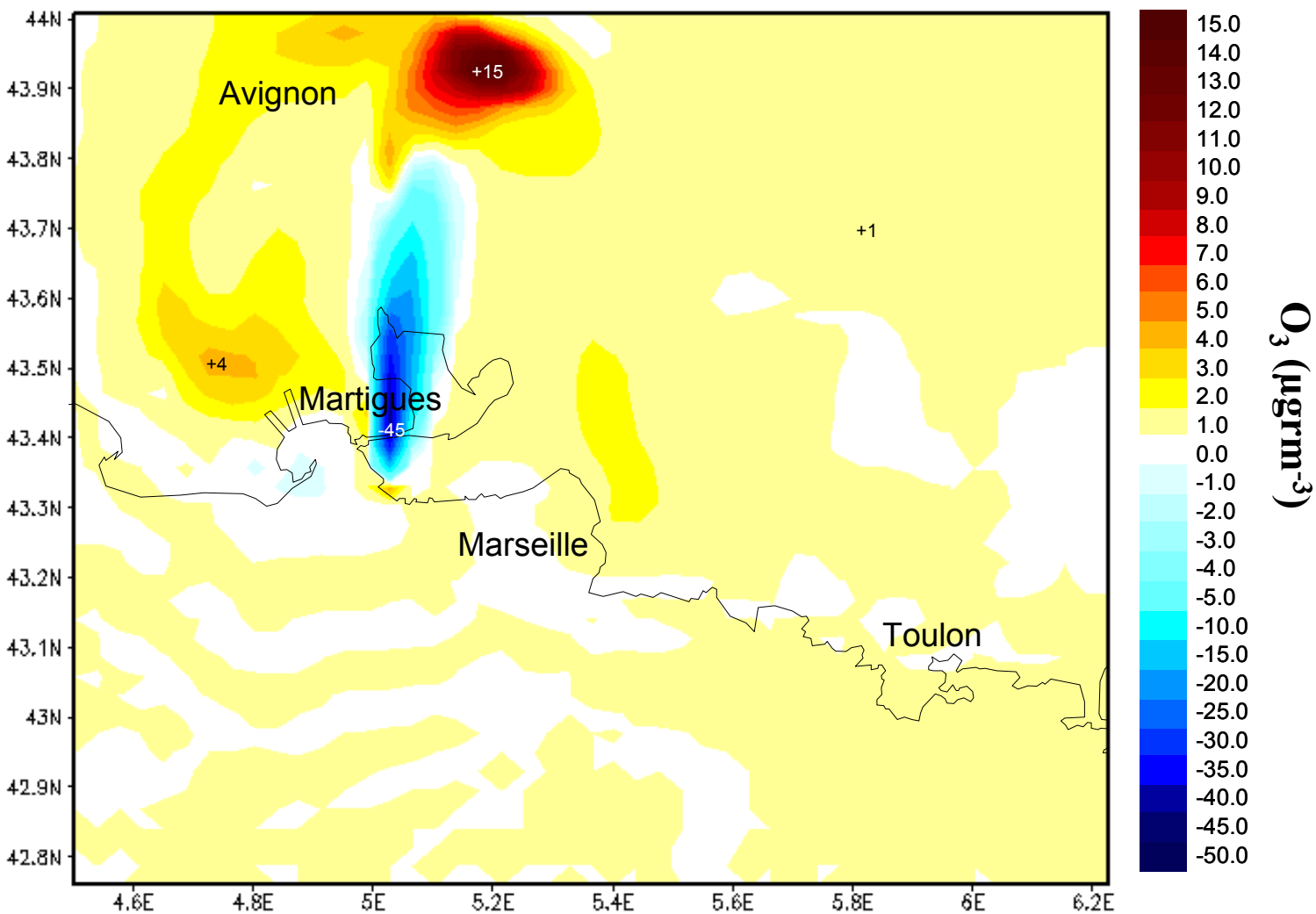
O3 concentration differences between with and without Marigues' emission for scenario I (21/06/04 at 13:00; IOP2a)

Impact study



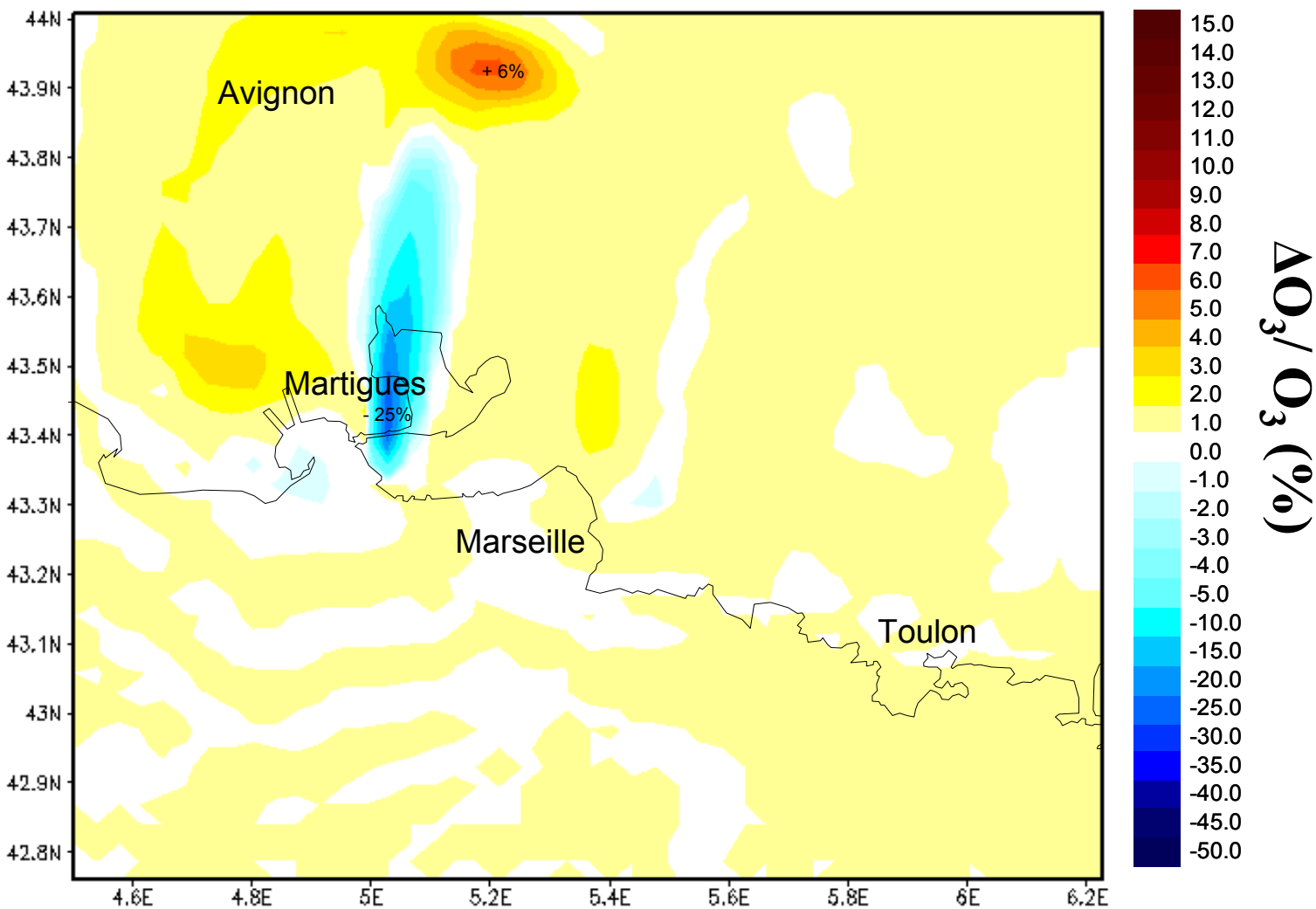
Relative O3 concentration increasing/decreasing for scenario I (21/06/04 at 13:00; IOP2a)

Impact study



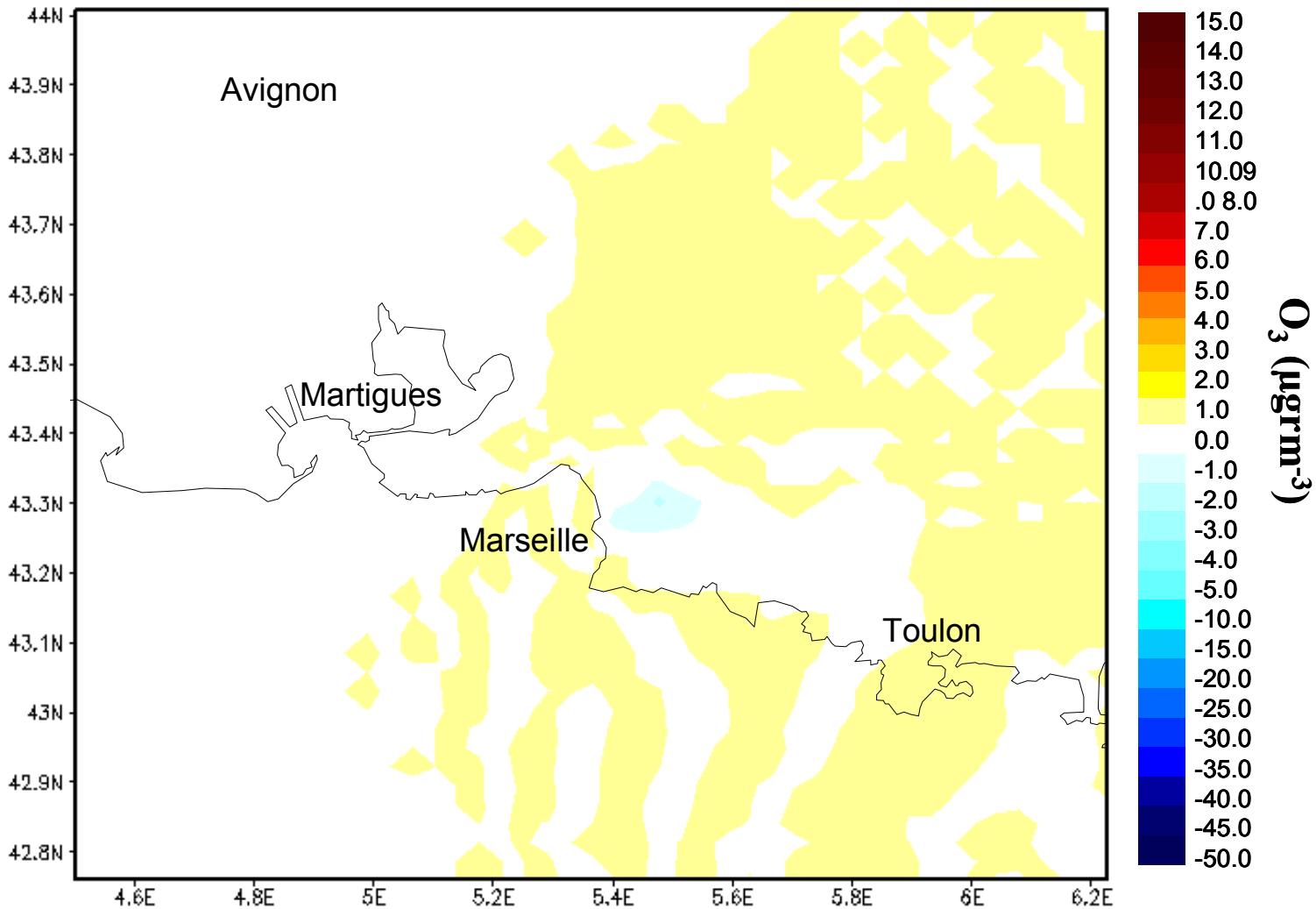
O3 concentration differences between with and without Marigues' emission for scenario I (25/06/04 at 14:00; IOP2b)

Impact study

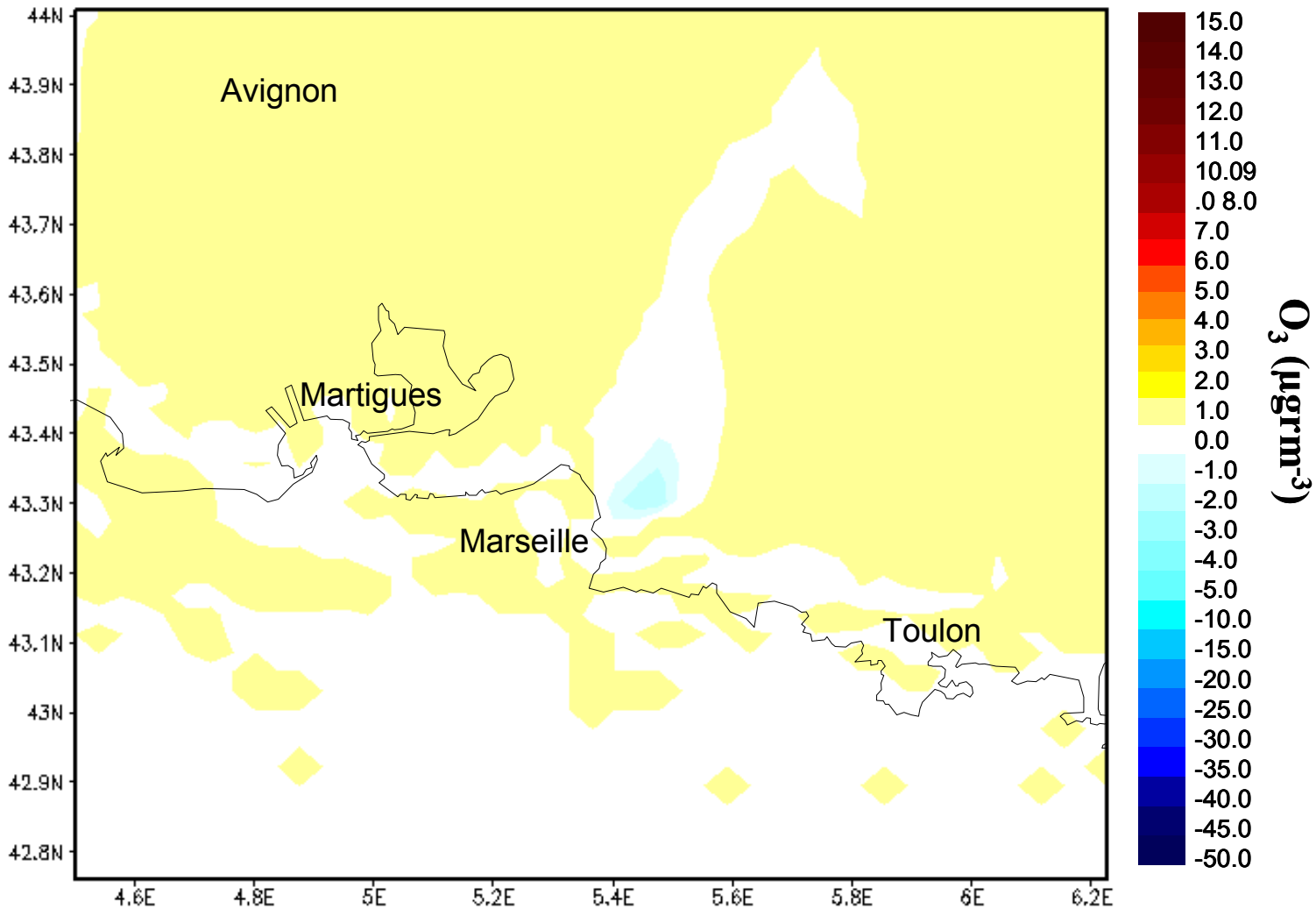


Relative O3 concentration increasing/decreasing for scenario I (25/06/04 at 14:00; IOP2b)

Marseille (POI2a)



Marseille (POI2b)



Conclusions

- **The CTM POLAIR3D provides a good estimation of ozone concentration.**
- **Dynamical processes are very important to retrieve the pollutants maxima and they have an important impact on pollutants redistribution and in subsequent ozone production.**
- **In the polluted zone, ozone formation is a nonlinear function of VOCs-NOx concentrations.**
- **In the case of VOC limited regime, a decrease in NOx emissions leads to an increase in ozone concentration.**
- **Area which includes the thermal power plant of Martigues is usually dominated by a VOC limited regime in sea breeze or Mistral dynamical situation.**
- **Emissions reduction of the thermal power plant of Martigues leads to a decrease in ozone concentration in the vicinity and an increase for the remote area.**

Perspectives

The aerosol size/composition distribution in south-eastern France and the impact of particles emitted by the thermal power plant will be investigated with the aerosol version of POLAIR3D, based on the size resolved aerosol model SIREAM developed at CEREA.