

# Evaluation of the Operational Ozone Forecast Model of the ZAMG with Measurements of the Austrian Air Quality Network

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Geodynamik



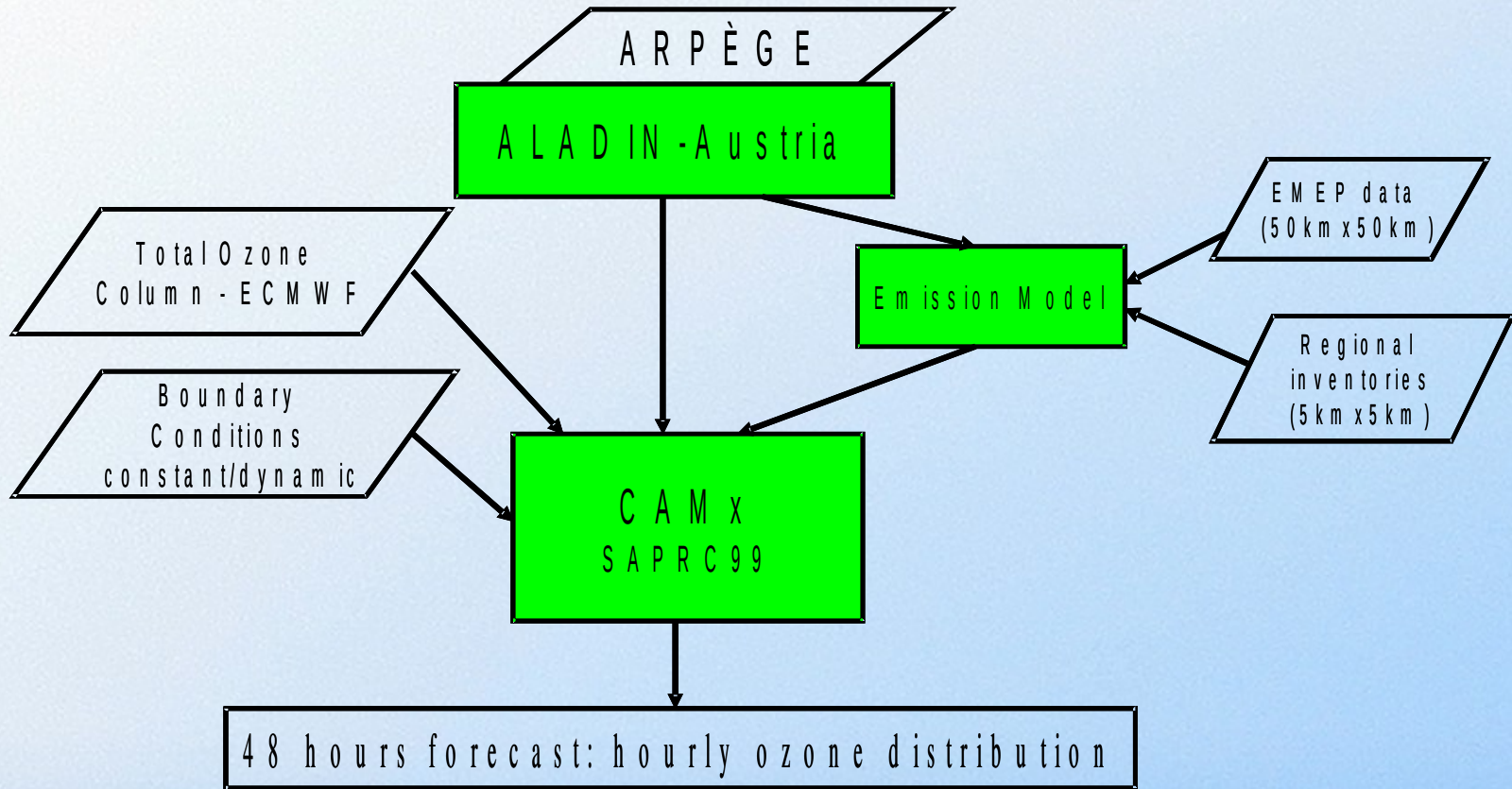
## Overview

- Modeling system and setup
- Operational products
- Evaluation of the operational forecasts
- Case study 2006

## Overview

- National cooperation:
  - Support: federal governments of Vienna, Lower Austria and Burgenland.
  - The daily ozone forecasts are operated since 2005 at the ZAMG in cooperation with the University of Natural Resources and Applied Life Sciences (Vienna, Institute for Meteorology, Dr. Bernd C. Krüger).
- International cooperation:
  - COST728 - „Enhancing Mesoscale Meteorological Modelling Capabilities for Air Pollution and Dispersion Applications”
  - COST ES0602 - „Towards a European Network on Chemical Weather Forecasting and Information Systems” (ENCWF)

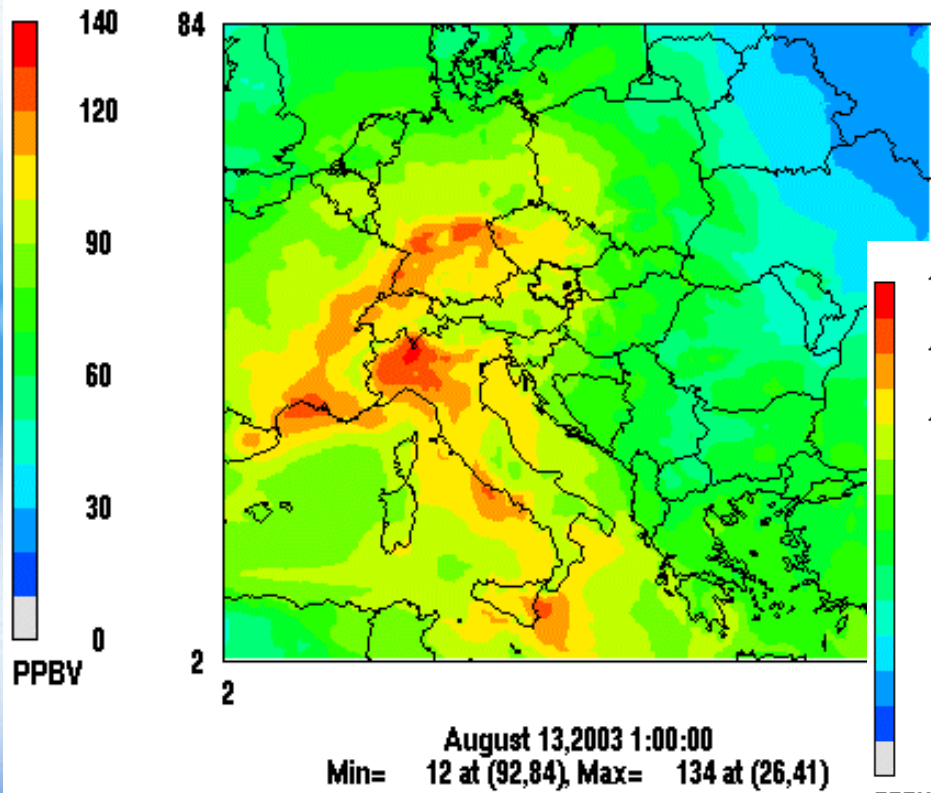
# The Austrian Ozone Forecast Modelling System: Model Components



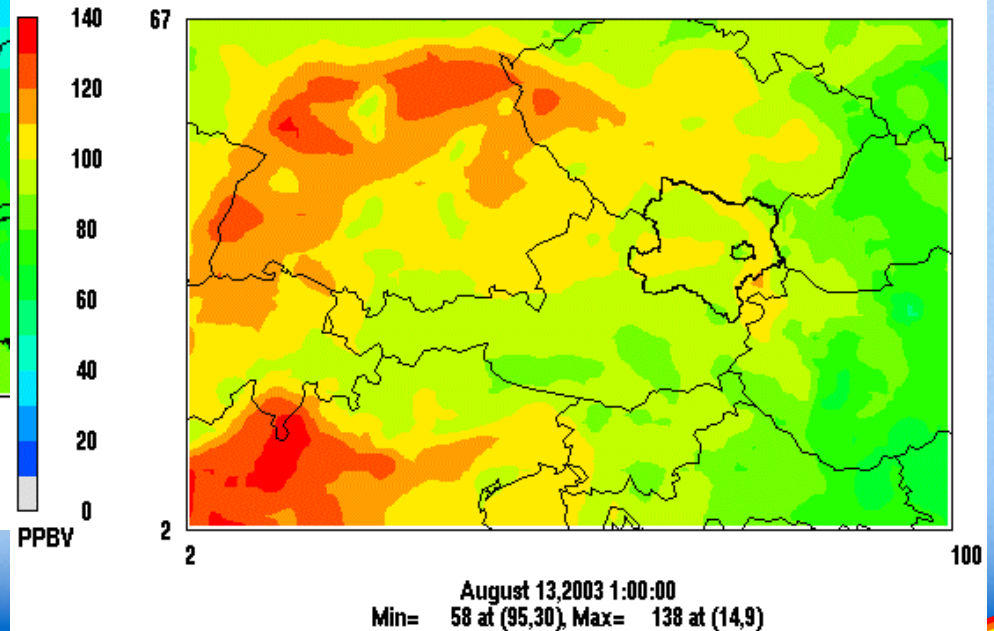


# The Austrian Ozone Forecast Modelling System: Domain

Horizontal resolution:  
 $\Delta x = 27 \text{ km}$



$\Delta x = 9 \text{ km}$

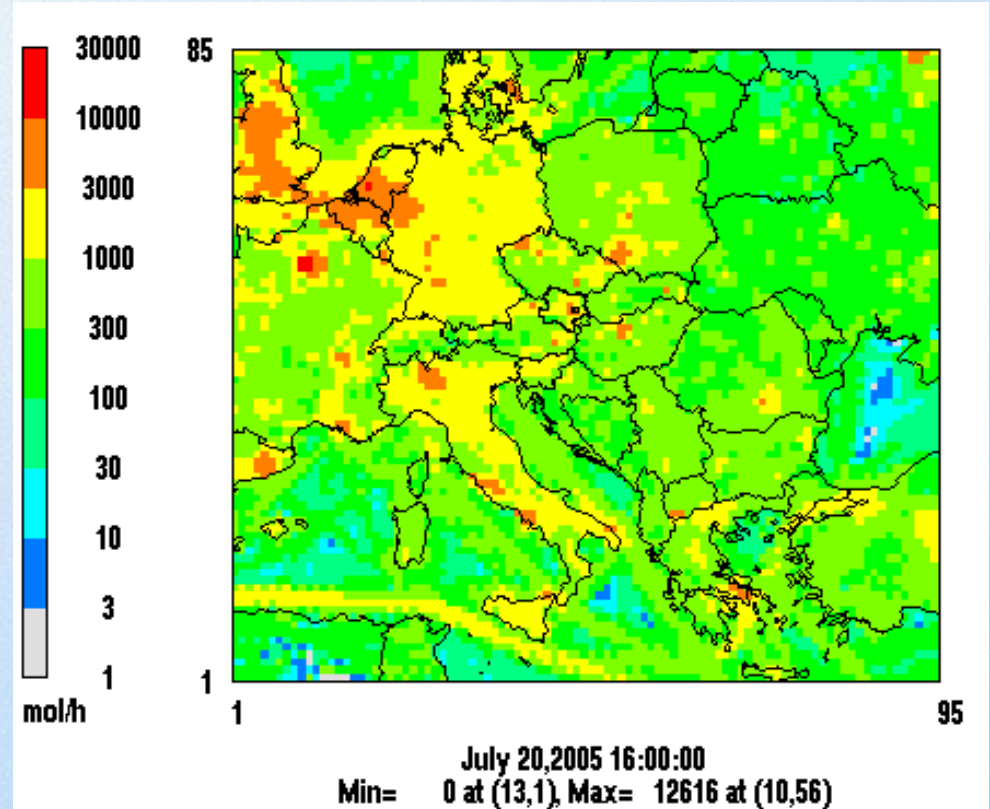


## The Austrian Ozone Forecast Modelling System: Emissions

**EMEP (2005) emissions** are used for Europe.

For Austria, Czech Republic, Slovakia, and Hungary the original 50 km x 50 km data are downscaled to 5 km x 5 km based on an inventory from 1995 (Winiwarter and Zueger, 1996).

In addition, a new highly resolved (up to 100 m x 100m) emission inventory for the City of Vienna (Orthofer et al., 2005) is used for this area.



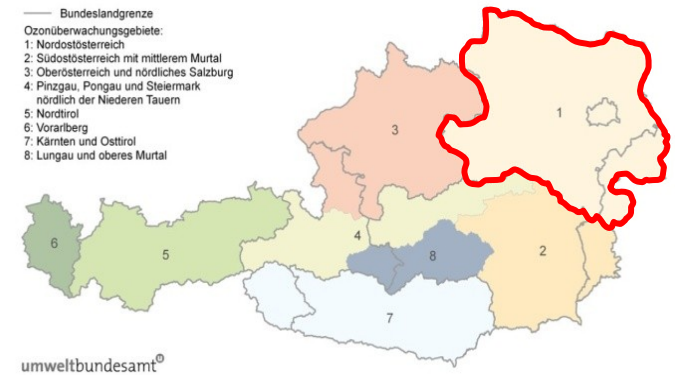
NO2 emissions in the coarse grid (27 km), Wednesday, July 20, 2005, 16:00, unit: mole/gridcell h.

# Operational products

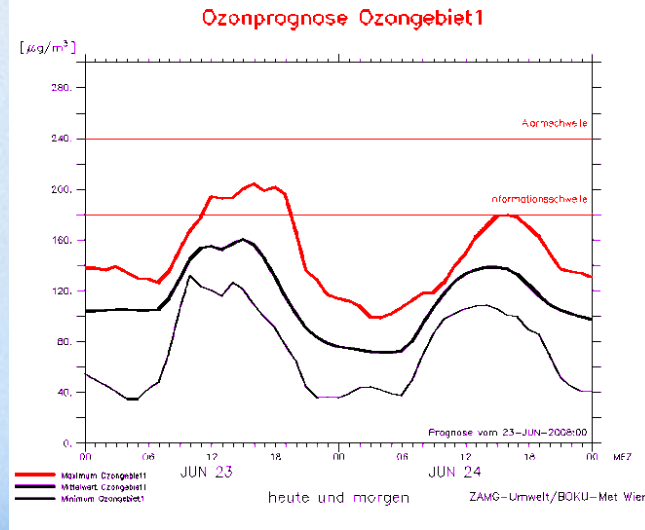
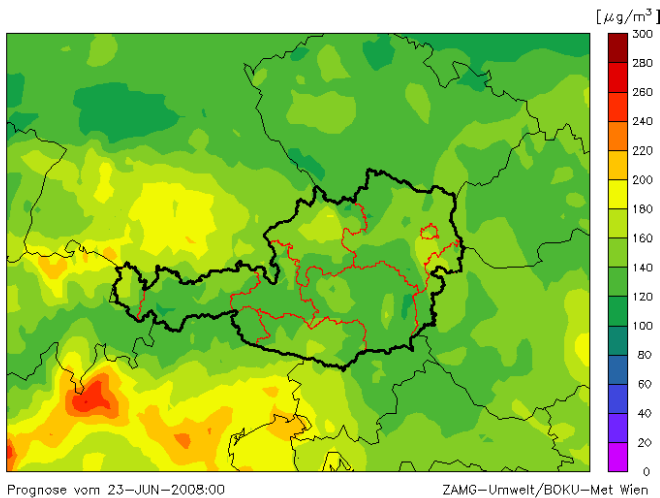
Daily send per mail and available on ftp server:

- 2D ozone levels (max and 13 MEZ) for the fine grid domain
- Time-series for the next 2 days of ozone concentrations for ozone region 1
- Text-messages

Ozonüberwachungsgebiete



Ozonprognose: Tagesmaximum am 24-JUN-2008



\*\*\*\*\* Ozongebiet1

Modellauf (20080623): Ozonprognose Ozongebiet1 fuer den 20080623:

Auf Basis der Modellberechnungen mit ALADIN-Austria/CAMx vom 20080623 wurden fuer den 20080623 fuer das Gebiet Ozongebiet1

\*\*\* Ueberschreitungen \*\*\*

zu folgenden Zeiten (MEZ) vorhergesagt :

- 12 Uhr: 193.7 ug/m3 --- INFORMATIONSSCHWELLE !
- 13 Uhr: 192.4 ug/m3 --- INFORMATIONSSCHWELLE !
- 14 Uhr: 193.5 ug/m3 --- INFORMATIONSSCHWELLE !
- 15 Uhr: 199.8 ug/m3 --- INFORMATIONSSCHWELLE !
- 16 Uhr: 204.0 ug/m3 --- INFORMATIONSSCHWELLE !
- 17 Uhr: 198.8 ug/m3 --- INFORMATIONSSCHWELLE !
- 18 Uhr: 201.3 ug/m3 --- INFORMATIONSSCHWELLE !
- 19 Uhr: 195.9 ug/m3 --- INFORMATIONSSCHWELLE !

Modellauf (20080623): Ozonprognose Ozongebiet1 fuer den 20080624:

Auf Basis der Modellberechnungen mit ALADIN-Austria/CAMx vom 20080623 wurden fuer den 20080624 fuer das Gebiet Ozongebiet1

\* KEINE Ueberschreitungen der Informationsschwelle \* vorhergesagt

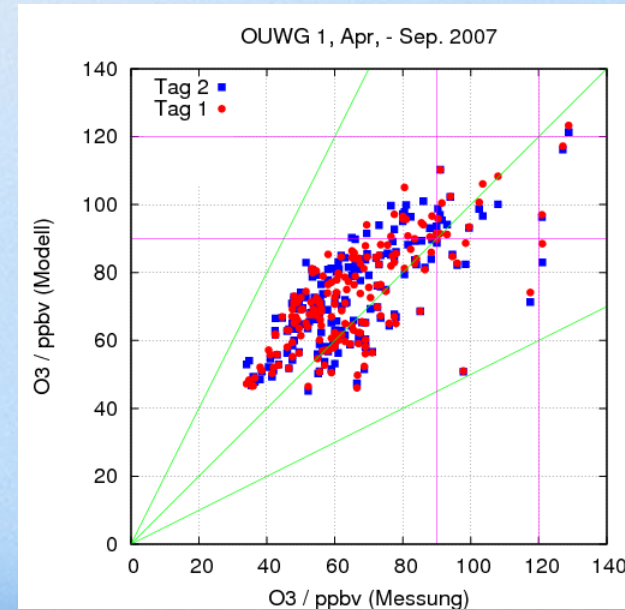
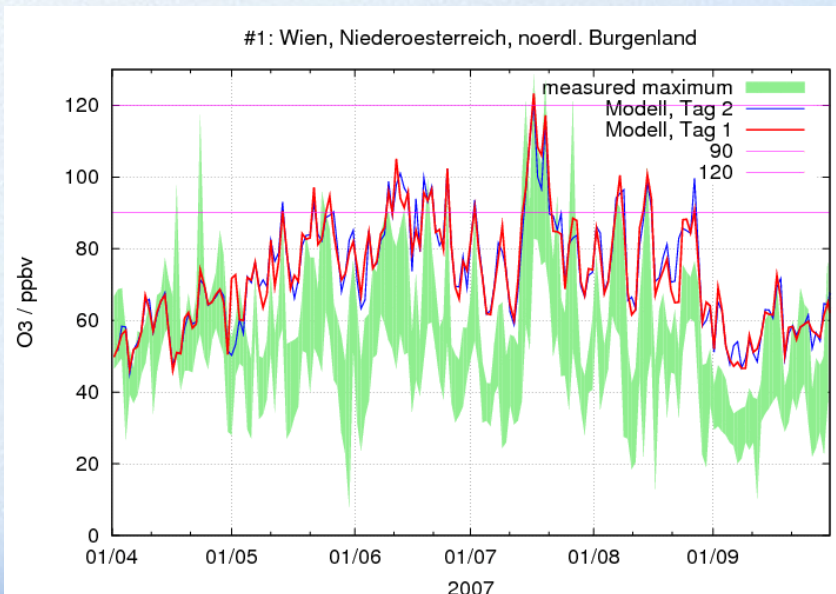
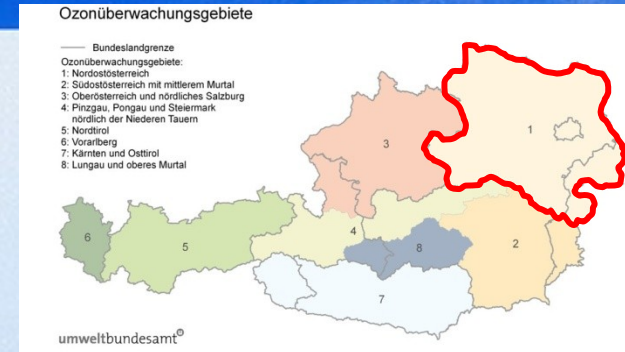




# Evaluation of the operational forecasts 2007

High ozone values are most frequently encountered in the eastern parts of Austria, where warnings for values above the information or the alarm threshold are launched for ozone region 1 (covering Lower Austria, Vienna and Burgenland).

Exceedances of the information threshold of 90 ppbv occurred from April to August 2007 with the highest concentrations during a hot period in the middle of July. The hitrate for the exceedances of the information threshold was 90.71 % in 2007.

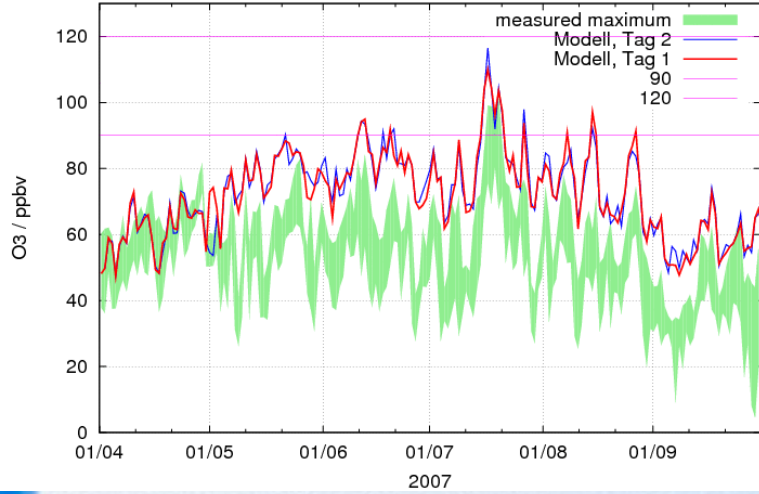


Predicted daily maximum concentrations for ozone region 1 (43 air quality stations).

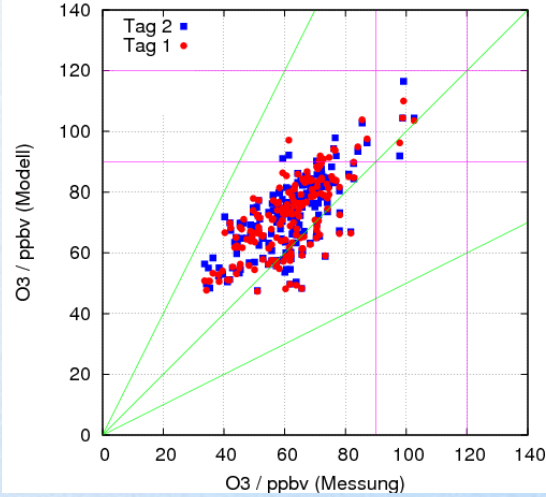


# Evaluation of the operational forecasts 2007

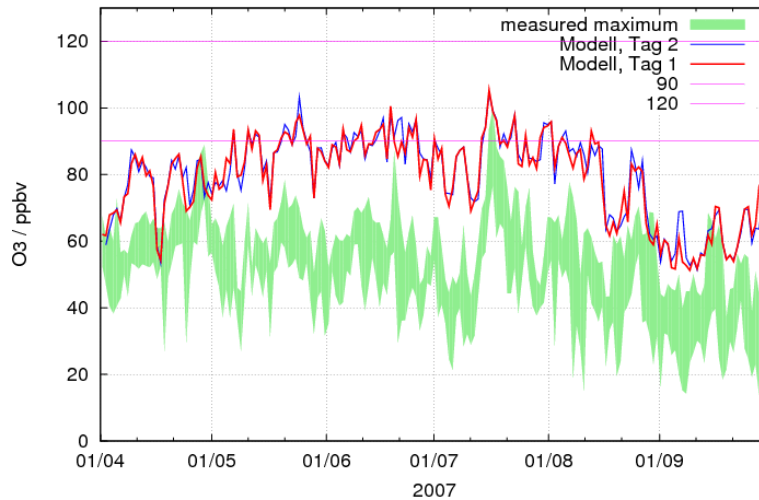
#2: Suedostoesterreich mit mittlerem Murtal



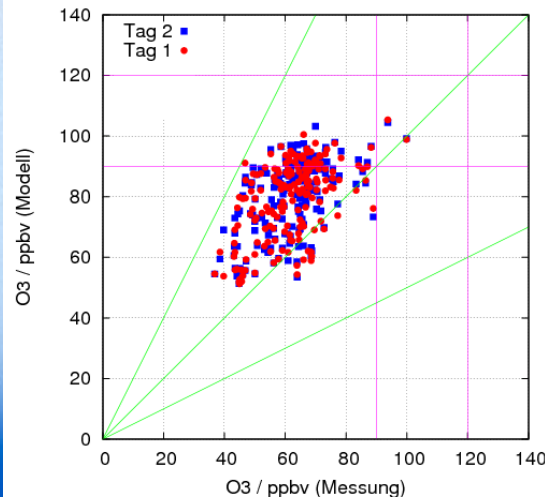
OUWG 2, Apr. - Sep. 2007



#5: Nordtirol



OUWG 5, Apr. - Sep. 2007



Ozonüberwachungsgebiete

- Bundeslandgrenze
- Ozonüberwachungsgebiete:
- 1: Nordostösterreich
- 2: Südstösterreich mit mittlerem Murtal
- 3: Oberösterreich und nördliches Salzburg
- 4: Pinzgau, Pongau und Steiermark nördlich der Neuderen Tauern
- 5: Nordtirol
- 6: Vorarlberg
- 7: Kärnten und Osttirol
- 8: Lungau und oberes Murtal

umweltbundesamt<sup>®</sup>



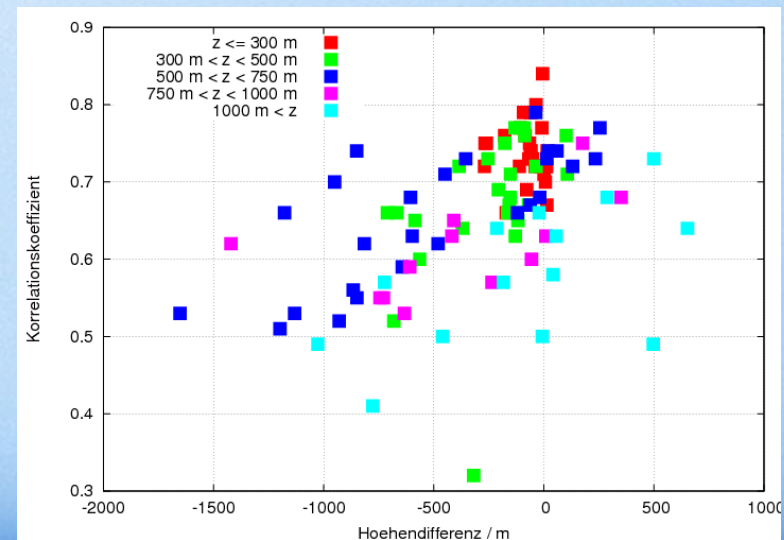
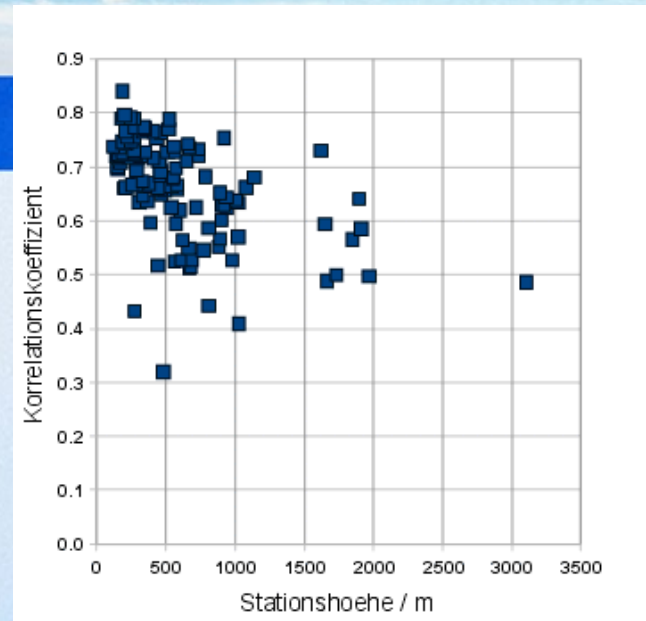
## Evaluation of the operational forecasts 2007

Model performance in different areas:

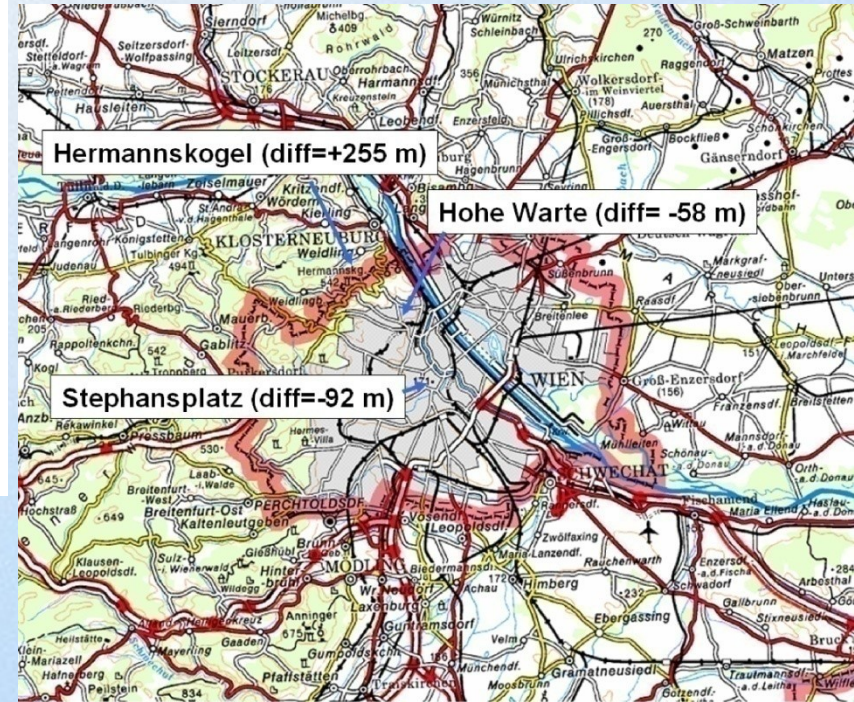
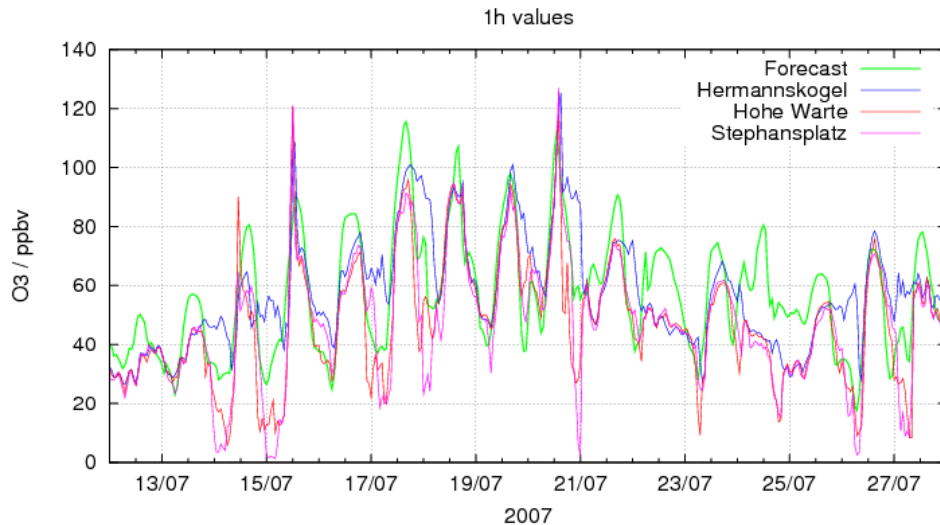
- Stations situated at higher altitudes are less correlated with the model forecasts than stations in flat terrain
- Below 500 m the correlation between model and observation reaches values up to 0.8

diff=station-model

- diff < 0: the station lies below the average grid cell height (most common in alpine regions). Most of these stations are situated in valleys where strong local primary emissions occur.
- diff > 0: the grid cell is lower than the observation (hill stations with only low emissions).



# Evaluation of the operational forecasts 2007



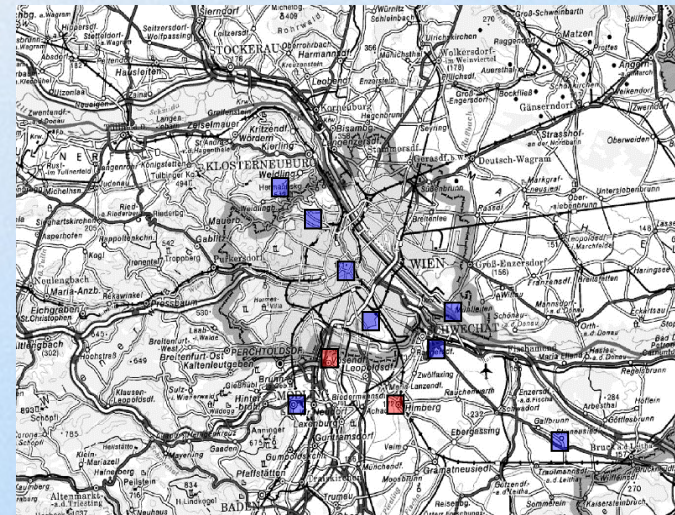
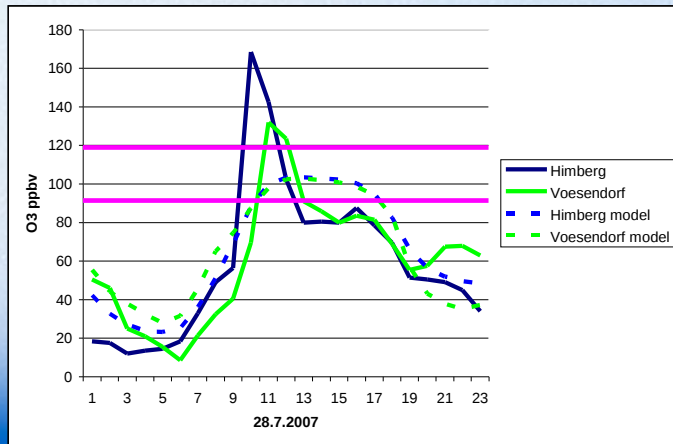
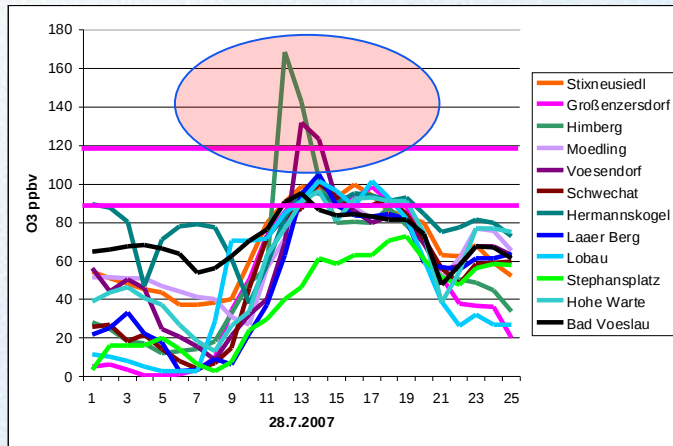
• 3 Air Quality Stations in 1 grid cell (265m):

- Hohe Warte: 207m
- Stephansplatz: 173m
- Hermanskogel: 520m -> elevated station, weak daily pattern

# Case study July 2006

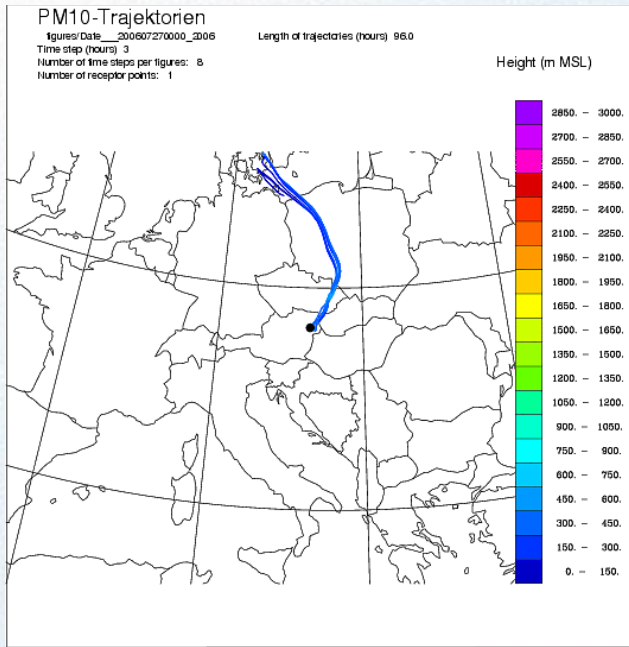
Exceedances of the alarm threshold occurred in the last years in the south of Vienna -> industrial sources?

26 – 28 July 2006: -> Ozone peaks occur only local during for short intervals and in the morning

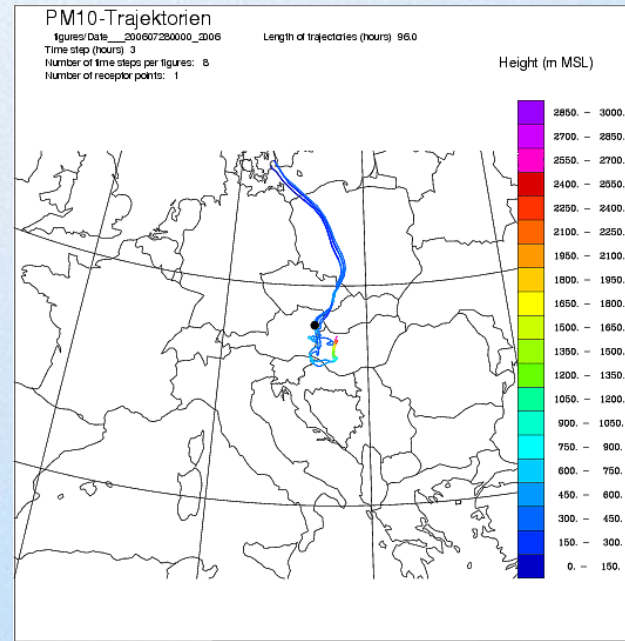


- Are ozone peaks caused by local emissions in combination with low wind conditions?
- Peak emissions by power plants ? The model forecast - which is based on average emission data (with seasonal variations) – does not reproduce these singular events.

# Case study July 2006: Trajectories for eastern Austria



27.7.2006



28.7.2006

- Continental air from north
- Trajectories from 28th did not leave Austria for 4 days
  - air flow near the ground -> precursors

-> expected large scale elevated ozone levels

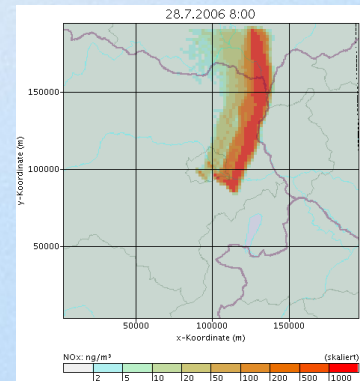
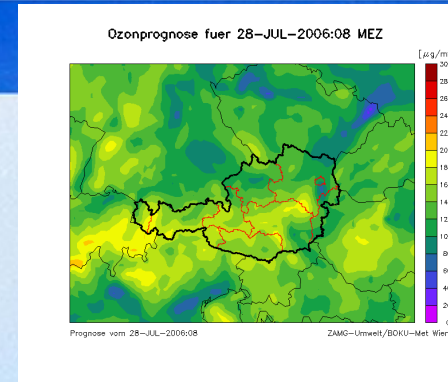
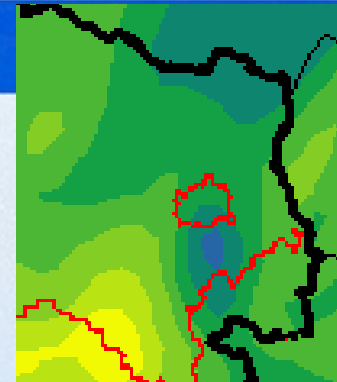
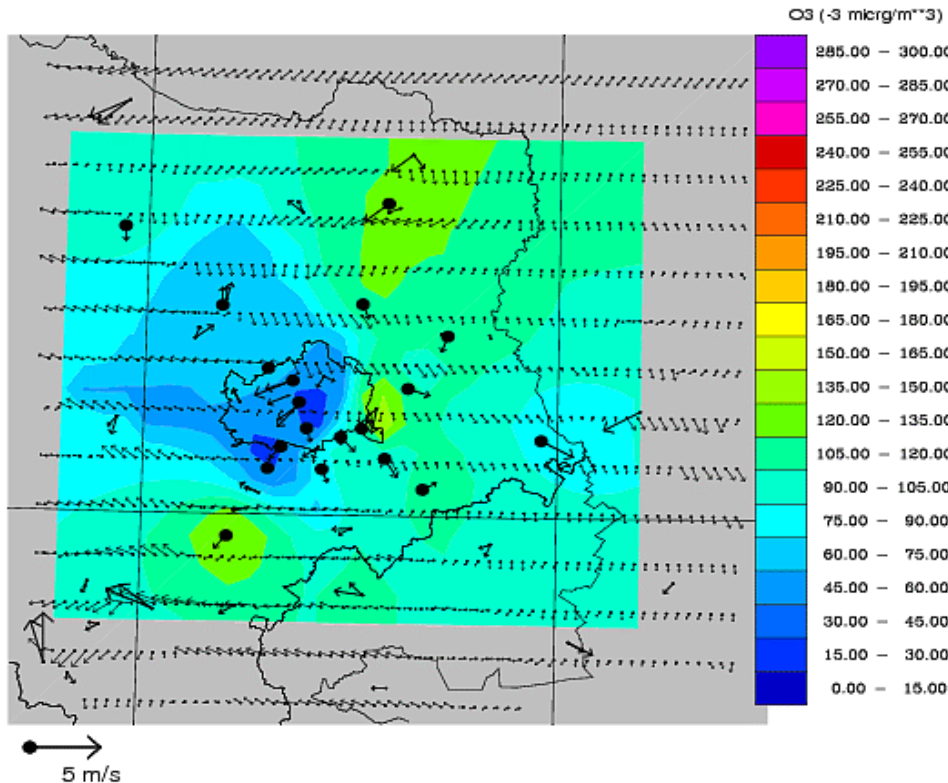
## General weather situation

- high temperature, pressure
- low gradients -> low wind

# Case study July 2006

Wind field and ozone July 2006

200607280800



- Observations:
  - Ozone concentrations interpolated from air quality stations
  - Meteorological stations

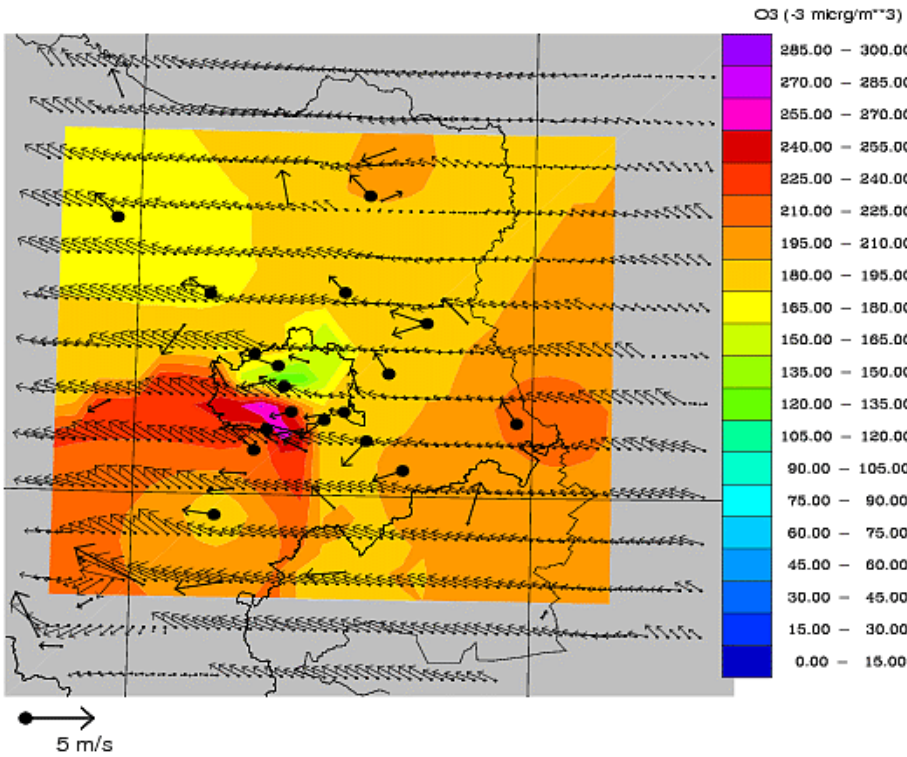
- Lagrangian particle model LASAT:
    - Emissions rates (NO<sub>x</sub> – provided by federal government) from dominant industrial sources in the vicinity of Vienna -> **no extraordinary high emissions**
    - Windmeasurements at Schwechat
- > Dispersion of the plumes



# Case study July 2006

Wind field and ozone July 2006

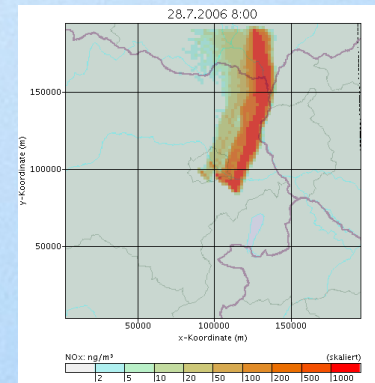
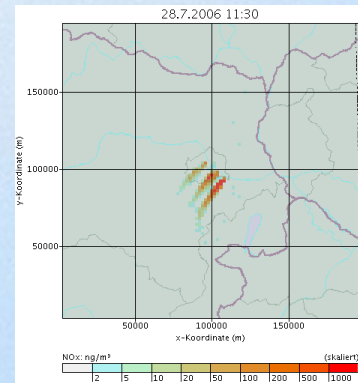
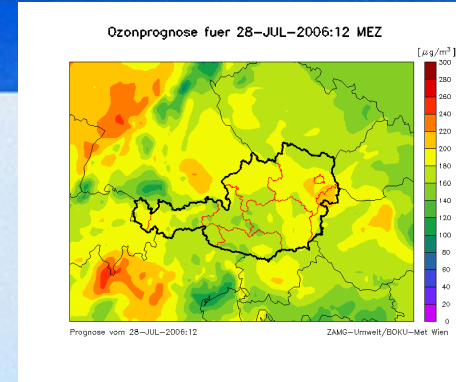
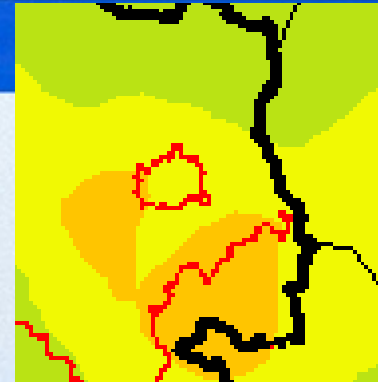
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Windturn from south-west to east

Wind-speed: low

Wind-direction: inhomogeneous



Precursors are transported to the south-east and make an additional contribution to the actual emissions



# Case study July 2006

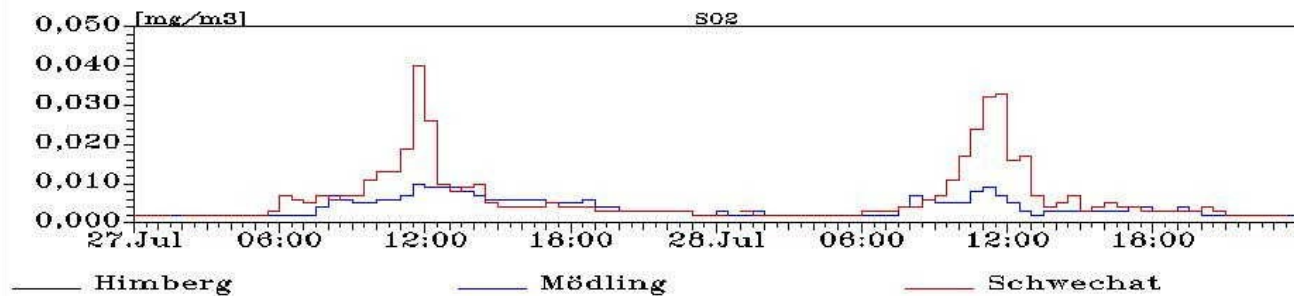
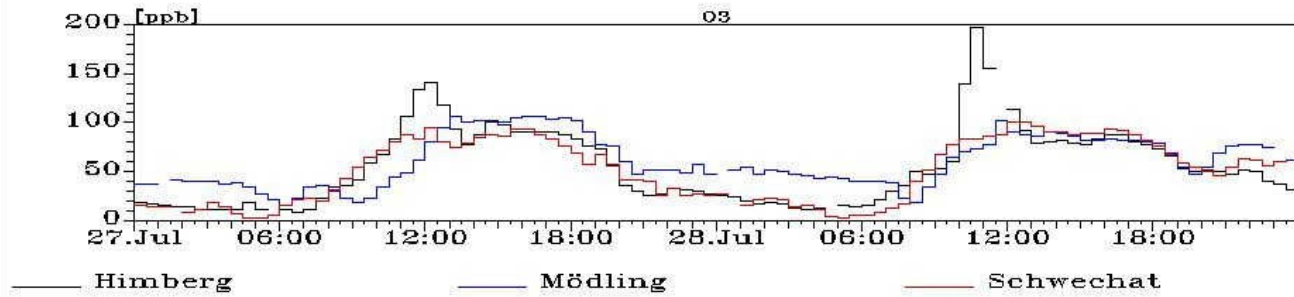
Amt der NÖ Landesregierung, Abt. BD4, NOEL

Grafik 3 Diagramme

Zeitraum : 27.07.2006 00:30 bis 28.07.2006 24:00

Wertebasis: HMW

Darstellung: Messwerte in Wertebasis



kontrollierte Daten

O3 and SO2 time series at Schwechat

- indication that peaks are caused by industry not by traffic?

Ozone

SO2

# Conclusions

- **Operational forecasts:**
  - Model predicts exceedance of thresholds
  - High concentrations can also be predicted in complex terrain, low concentrations are over-predicted
- **AQ Model weak points:**
  - inhomogeneous wind direction in low wind conditions
  - current resolution (~10 km) too coarse to resolve local peaks
    - Finer emission-inventories are available (100m – 5km)
  - Local studies - particle models -> no complex chemistry
- **Further improvements:**
  - New Emission Model SMOKE
  - Aerosol chemistry
  - Evaluation
    - Operational runs
    - COST 728 and COST ES0602
    - EURAD
  - New products online evaluation
  - Up to date emission inventories and model versions