

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

Marcus Hirtl, Bernd C. Krüger, August Kaiser, Kathrin Baumann-Stanzer, Paul Skomorowski, Helfried Scheifinger

Zentralanstalt für Meteorologie und
Geodynamik



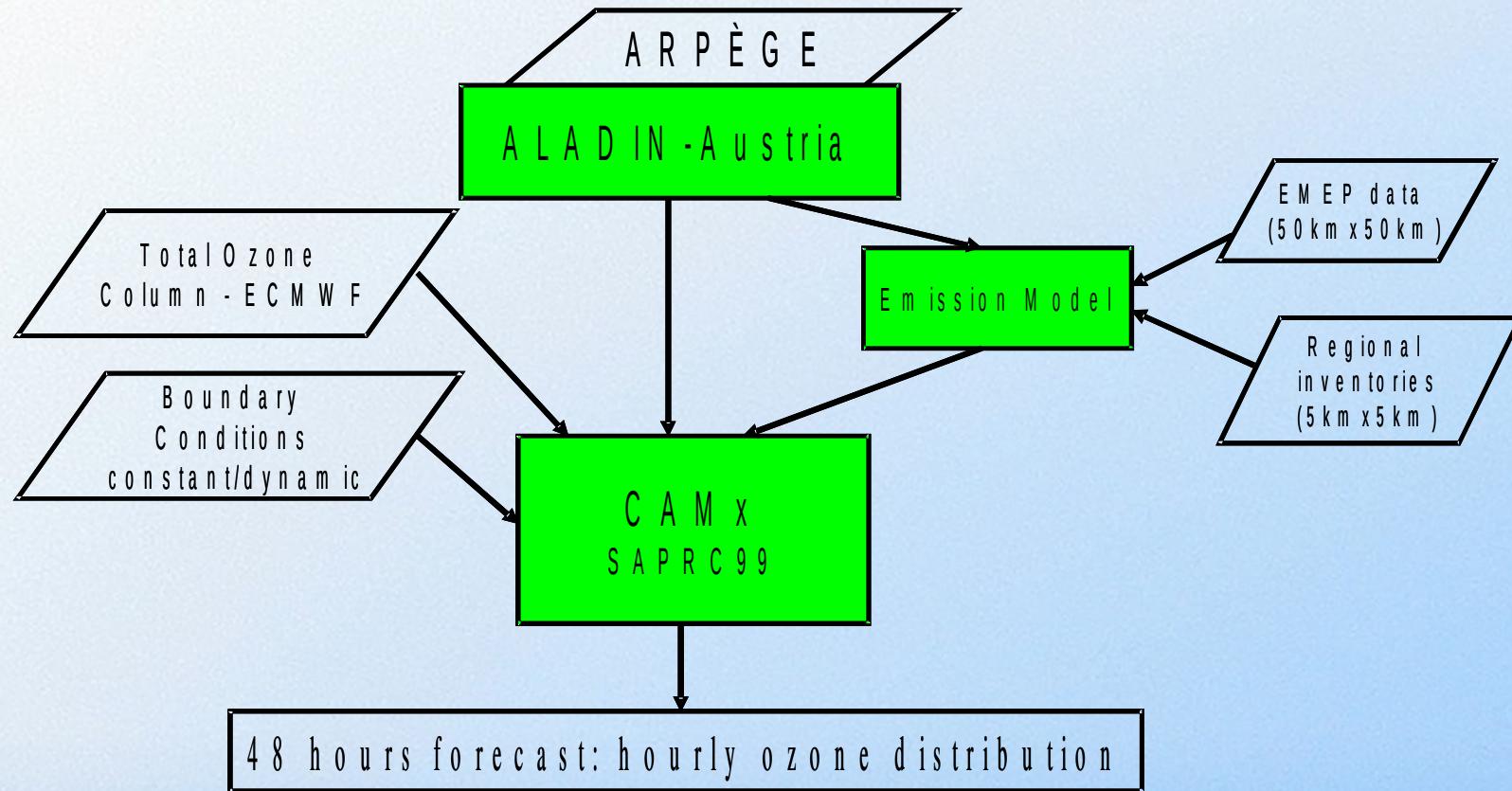
Overview

- 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)

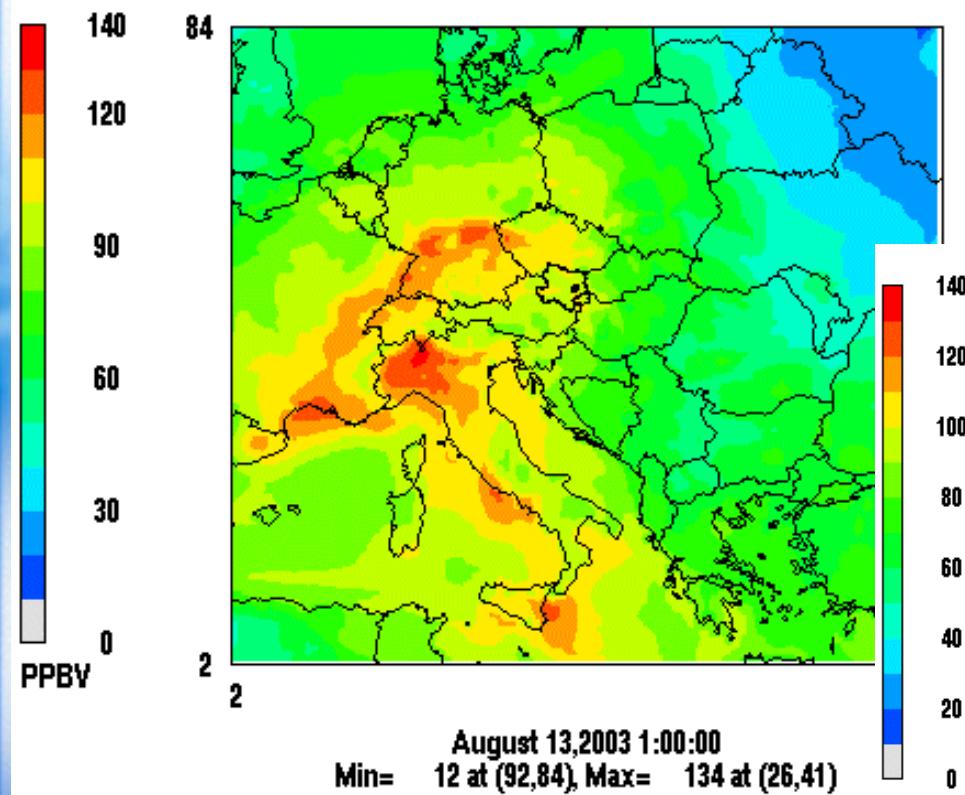
The Austrian Ozone Forecast Modelling System: Model Components



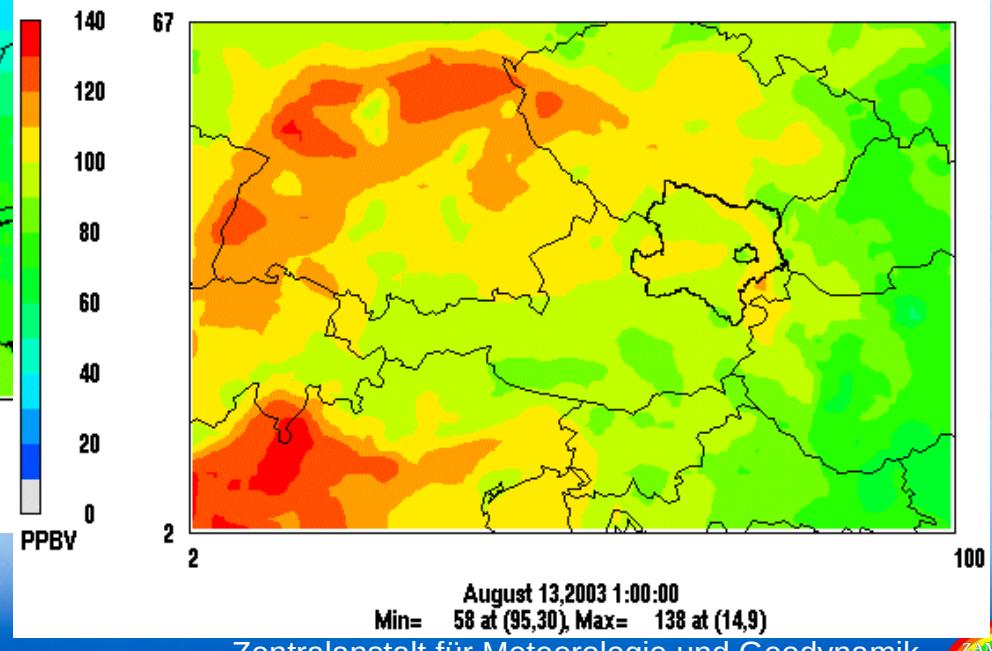


The Austrian Ozone Forecast Modelling System: Domain

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



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

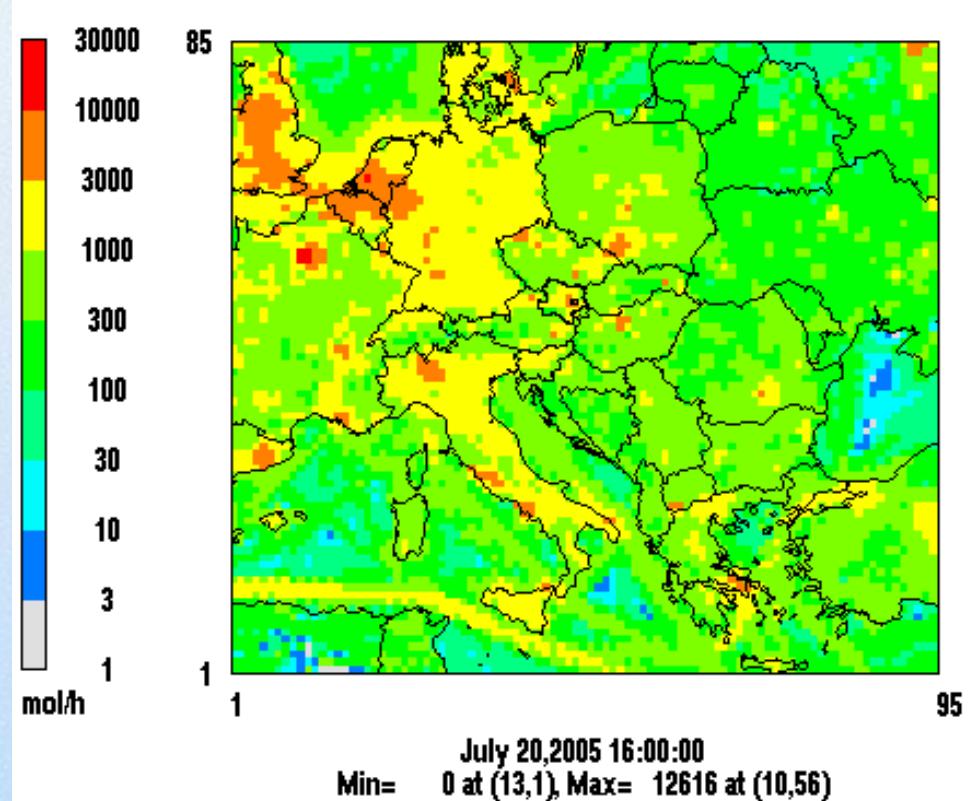


The Austrian Ozone Forecast Modelling System: Emissions

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

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



umweltbundesamt®

***** 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 ***

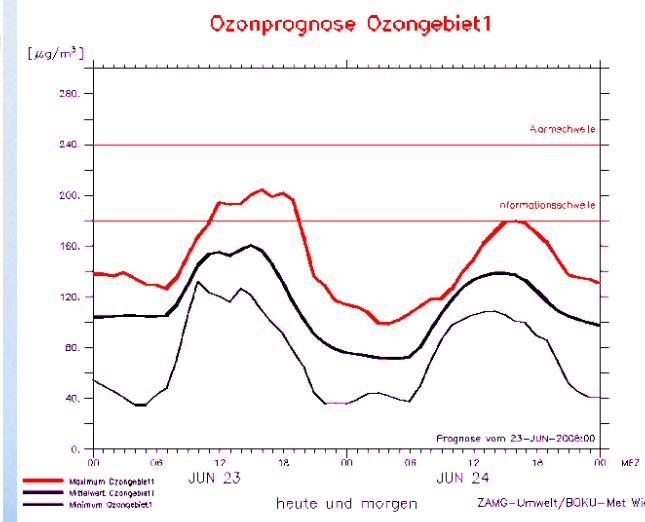
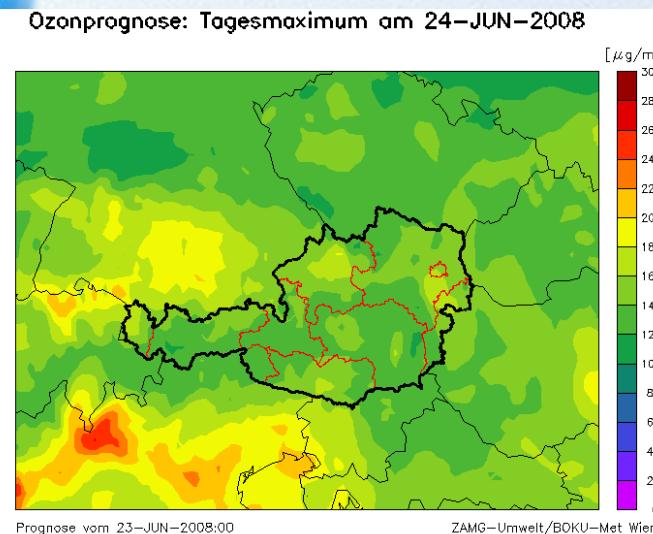
zu folgenden Zeiten (MEZ) vorhergesagt :

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



Operational products: Online Evaluation

file:/// - FAUM: Ozon-Zeitreihen - Mozilla Firefox

Ozon

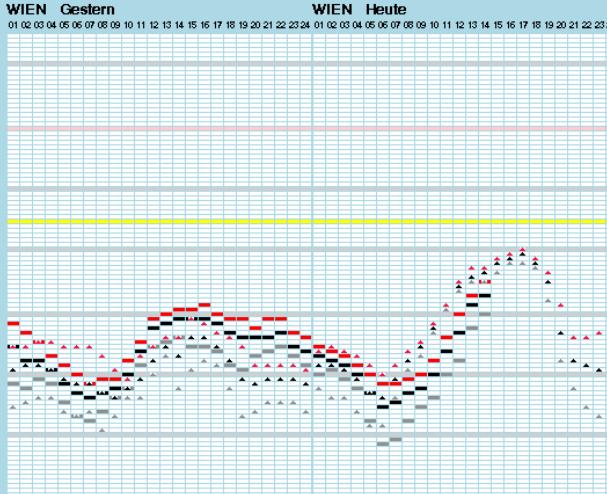
Heute
20070924
WIEN
NOE
BGLD

Gestern
20070923
WIEN
NOE
BGLD

Grafik

WIEN
NOE
BGLD

LEGENDE



ZAMG: Ozon-Zeitreihen - Mozilla Firefox

http://info4.zamg.ac.at/public/umwsys/public/O3MOD/o3_ts.htm

Ozon	NOE 20080929 MEZ:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Heute	Purkersdorf	0	0	0	0	0	1	3	15	36	54	63	-	-	-	-	-	-	-	-	-	-	-	-	-
20080929	Amstetten	2	2	2	2	2	3	5	10	20	27	37	46	-	-	-	-	-	-	-	-	-	-	-	-
WIEN	Kollmitzberg	48	34	30	18	14	17	21	28	25	28	35	47	48	-	-	-	-	-	-	-	-	-	-	-
NOE	St.Valentin/Westaut	2	2	2	2	2	2	2	4	6	16	30	32	-	-	-	-	-	-	-	-	-	-	-	-
BGLD	Bad Vöslau/Gainfarr	43	41	45	41	39	28	26	30	34	42	43	59	64	-	-	-	-	-	-	-	-	-	-	-
Gestern	Forsthof/Schöpfel	65	63	65	63	60	61	54	47	46	53	59	68	72	-	-	-	-	-	-	-	-	-	-	-
20080928	Hainburg	41	37	40	31	25	19	6	14	27	40	48	58	60	-	-	-	-	-	-	-	-	-	-	-
WIEN	Sitzneusiedl	30	29	30	29	29	30	26	22	24	33	48	54	58	-	-	-	-	-	-	-	-	-	-	-
NOE	Gänserndorf	2	0	2	1	0	2	2	6	24	44	47	41	54	-	-	-	-	-	-	-	-	-	-	-
BGLD	Wolkersdorf	53	39	27	30	29	21	24	24	31	32	39	63	74	-	-	-	-	-	-	-	-	-	-	-
Grafik	Großengersdorf/Gili	15	15	11	8	7	4	5	9	28	51	82	67	60	-	-	-	-	-	-	-	-	-	-	-
WIEN	Heidenreichstein	5	4	5	6	5	5	5	7	30	64	80	83	84	-	-	-	-	-	-	-	-	-	-	-
NOE	Klosterteuburg/Frie	21	22	18	13	7	4	5	18	22	43	56	66	72	-	-	-	-	-	-	-	-	-	-	-
BGLD	Hilzingberg	14	14	7	5	4	5	3	9	15	27	37	72	-	-	-	-	-	-	-	-	-	-	-	-
	Ziersdorf	5	5	4	3	4	3	5	10	29	36	41	54	66	-	-	-	-	-	-	-	-	-	-	-
	Imfriz	61	61	68	63	62	59	60	58	63	73	79	83	86	-	-	-	-	-	-	-	-	-	-	-
	Stockerau/West	2	2	2	2	2	2	2	4	7	22	31	48	56	-	-	-	-	-	-	-	-	-	-	-
	Annaberg/Joachimsbe	23	19	19	15	17	17	16	17	18	41	69	83	84	-	-	-	-	-	-	-	-	-	-	-
	Pöchlarn	2	2	2	2	2	2	2	4	8	23	42	55	62	-	-	-	-	-	-	-	-	-	-	-
	Mistelbach	32	32	28	23	18	18	20	30	34	40	57	68	-	-	-	-	-	-	-	-	-	-	-	-
	Mödling	7	6	9	9	4	4	6	6	7	12	50	68	64	-	-	-	-	-	-	-	-	-	-	-
	Vösendorf	27	12	12	11	10	10	10	12	15	24	50	73	82	-	-	-	-	-	-	-	-	-	-	-
	Biedermannsdorf	2	2	2	2	2	2	2	3	7	17	38	63	-	-	-	-	-	-	-	-	-	-	-	-
	Termitz	30	30	30	29	26	16	16	26	32	41	56	66	70	-	-	-	-	-	-	-	-	-	-	-
	Payerbach/Kreuzberg	53	49	46	45	44	43	48	41	37	43	55	69	74	-	-	-	-	-	-	-	-	-	-	-
	Unterbergen/Dunkel	38	38	32	27	31	27	24	36	44	48	47	44	58	-	-	-	-	-	-	-	-	-	-	-
	Tulln/Wilhelmsfrass	3	4	2	2	2	2	2	2	7	18	27	38	53	62	-	-	-	-	-	-	-	-	-	-
	Streithofen im Tull	11	9	10	7	7	7	6	12	24	30	46	55	62	-	-	-	-	-	-	-	-	-	-	-
	Wiesmath	78	74	70	72	74	73	71	69	67	73	71	71	74	-	-	-	-	-	-	-	-	-	-	-
	St.Pölten/Eybnert	18	15	7	4	3	2	2	5	11	19	32	51	62	-	-	-	-	-	-	-	-	-	-	-
	Wiener Neustadt/Neu	17	20	20	17	12	6	8	12	21	30	63	76	78	-	-	-	-	-	-	-	-	-	-	-
	Krems	17	15	17	5	6	3	7	8	20	27	30	45	54	-	-	-	-	-	-	-	-	-	-	-
	Waidhofen/Ybbs-Arbz	17	18	19	18	15	14	12	16	21	23	28	44	50	-	-	-	-	-	-	-	-	-	-	-
	Schwechat/Sportplatz	14	11	8	4	3	2	2	5	12	25	35	72	78	-	-	-	-	-	-	-	-	-	-	-
	Pillersdorf (UBA)	51	51	56	48	39	38	30	34	46	71	86	88	-	-	-	-	-	-	-	-	-	-	-	-
	Maximum	78	74	70	72	74	73	71	69	67	73	82	86	88	-	-	-	-	-	-	-	-	-	-	-
	Mittelwert	24	22	21	19	17	16	15	18	25	35	48	61	66	-	-	-	-	-	-	-	-	-	-	-
	Minimum	0	0	0	0	0	1	2	4	6	16	30	32	-	-	-	-	-	-	-	-	-	-	-	-
	Stationen	35	35	35	35	35	35	35	35	35	35	35	35	32	0	0	0	0	0	0	0	0	0	0	0

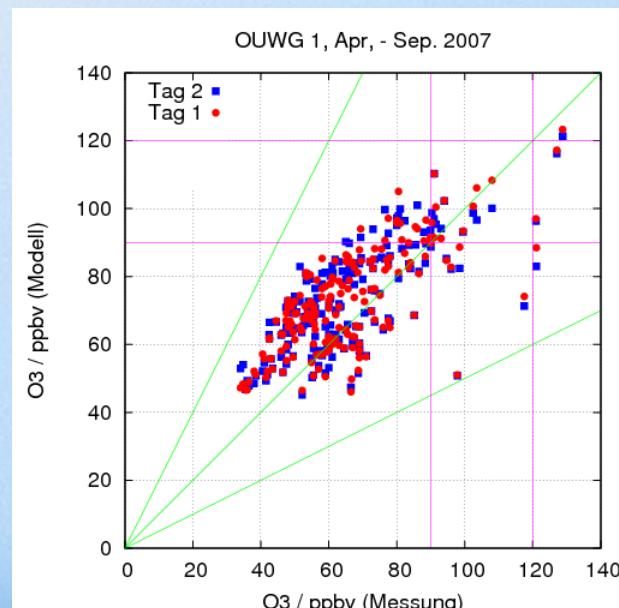
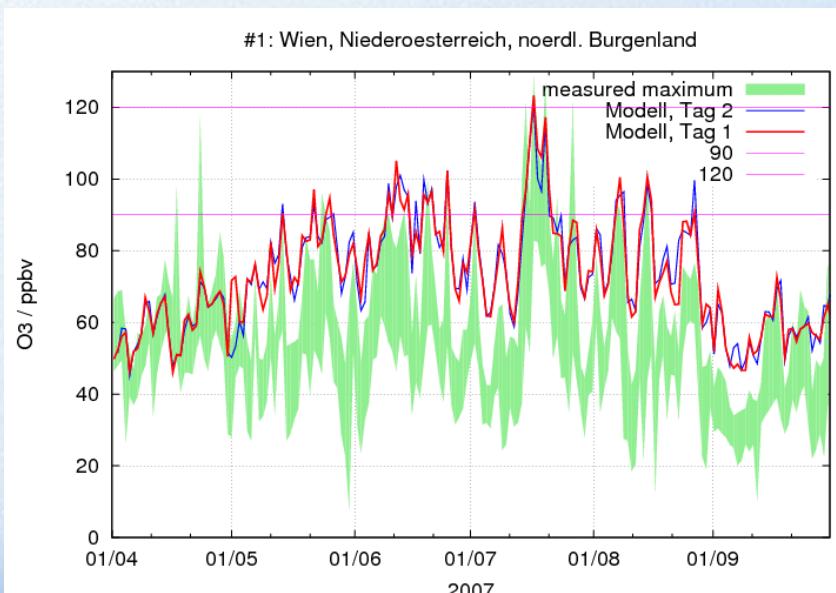
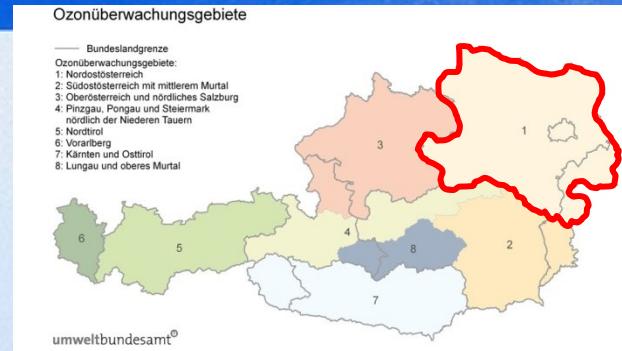
Fertig

Wert.. nur 1 HMW ---- Last update: Mon, 29 Sep 2008 12:34:35 GMT

Evaluation of the operational forecasts 2007

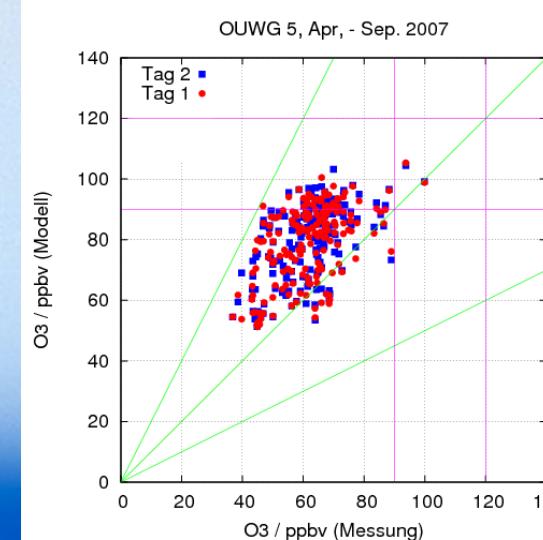
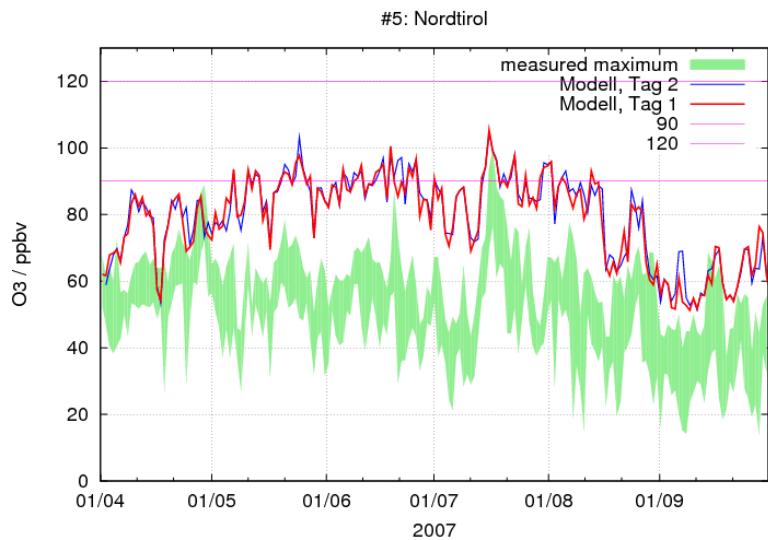
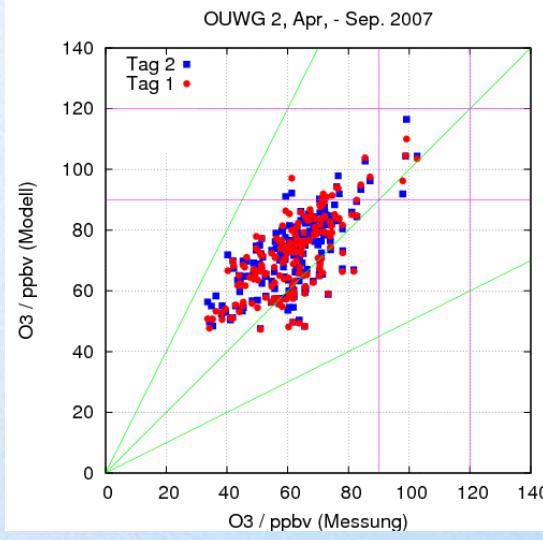
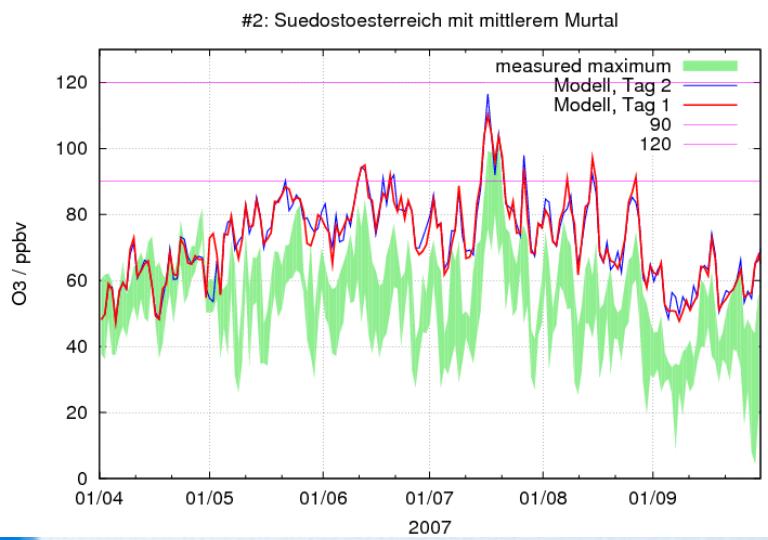
High ozone values are most frequently encountered in the eastern parts of Austria, where warnings for values above the information or the alarm threshold are launched for ozone region 1 (covering Lower Austria, Vienna and Burgenland).

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.



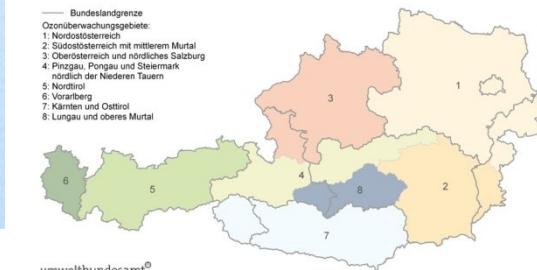
Predicted daily maximum concentrations for ozone region 1 (43 air quality stations).

Evaluation of the operational forecasts 2007



Ozonüberwachungsgebiete

Bundeslandgrenze
Ozonüberwachungsgebiete:
1: Nordoststeiermark
2: Südstoesterreich mit mittlerem Murtal
3: Oberösterreich und nördliches Salzburg
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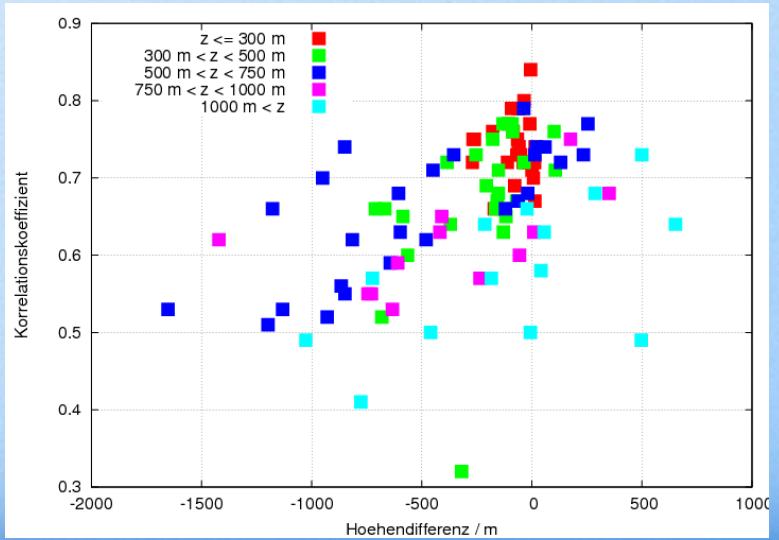
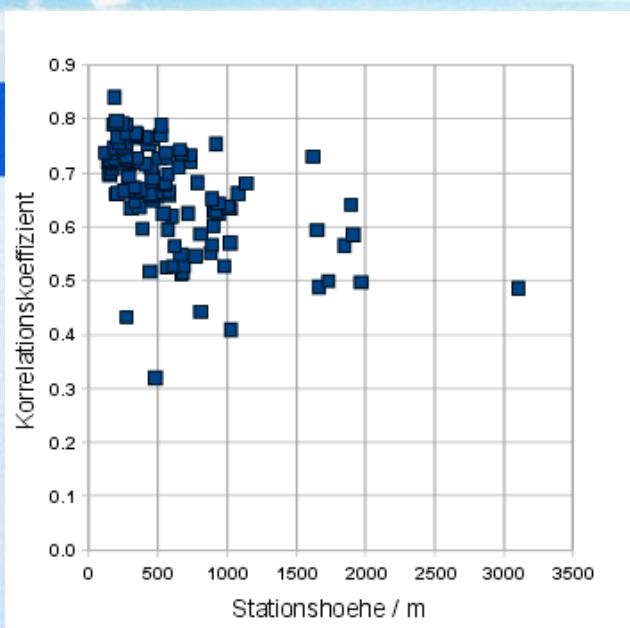
Evaluation of the operational forecasts 2007

Model performance in different areas:

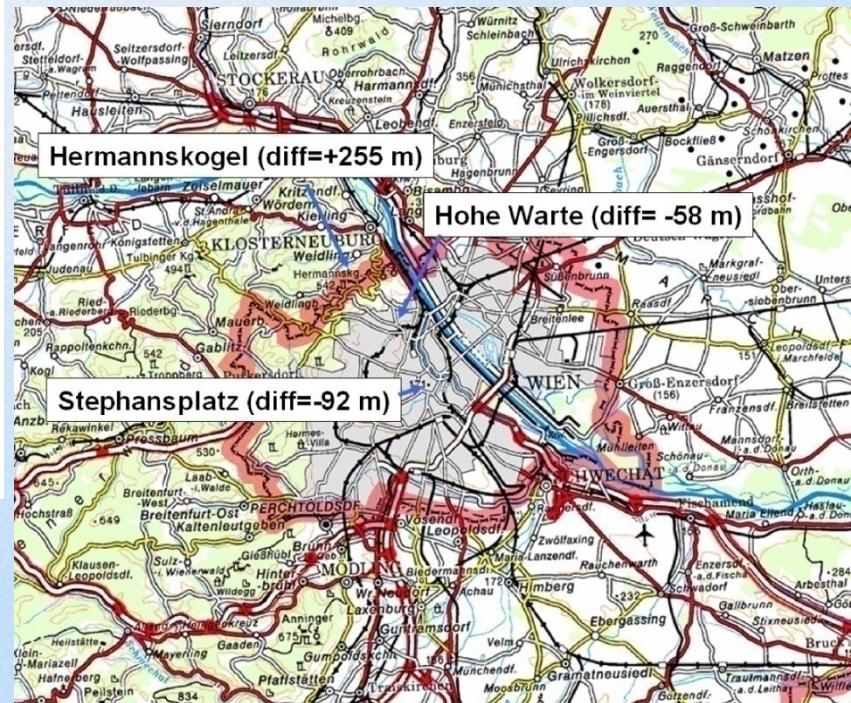
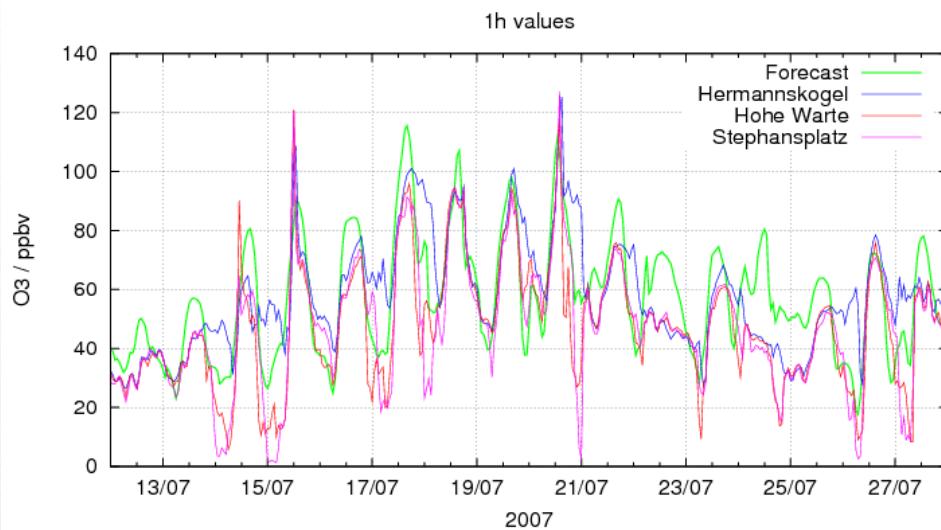
- Stations situated at higher altitudes are less correlated with the model forecasts than stations in flat terrain
- Below 500 m the correlation between model and observation reaches values up to 0.8

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

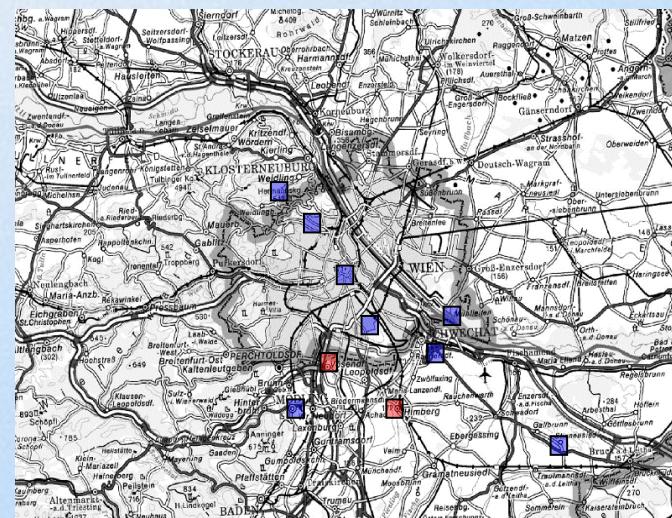
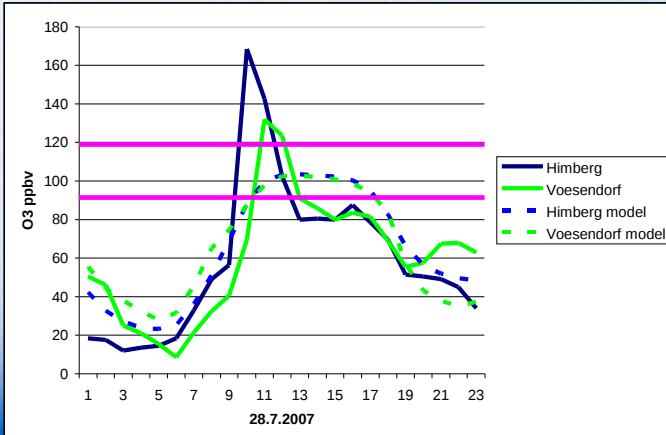
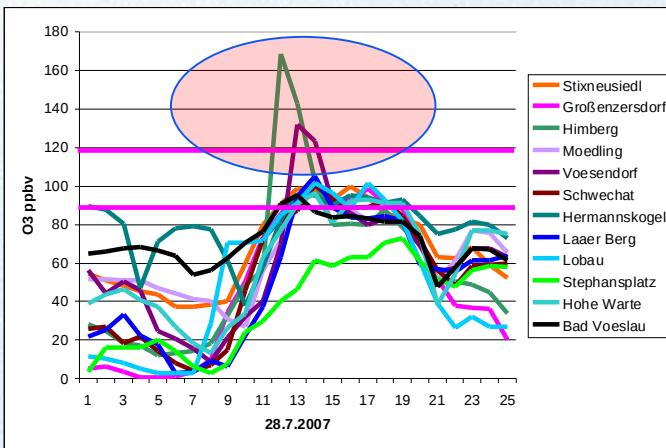


- 3 Air Quality Stations in 1 grid cell (265m):
 - Hohe Warte: 207m
 - Stephansplatz: 173m
 - Hermannskogel: 520m -> elevated station, weak daily pattern

Case study July 2006

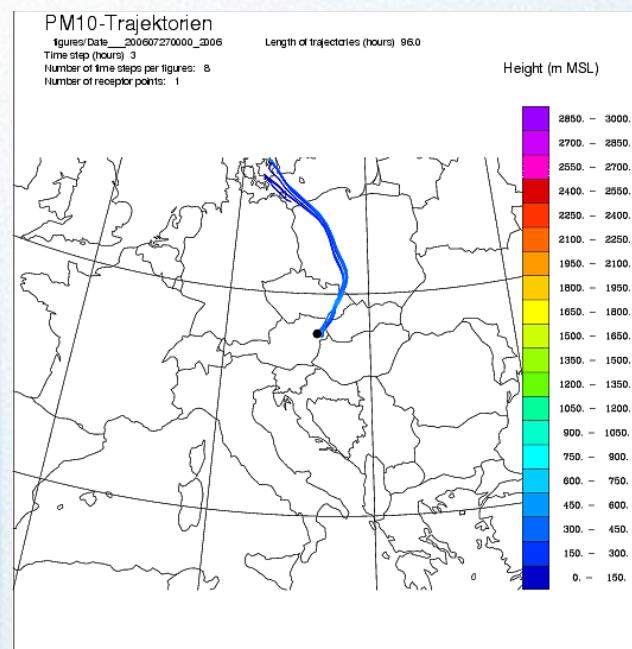
Exceedances of the alarm threshold occurred in the last years in the south of Vienna -> industrial sources?

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



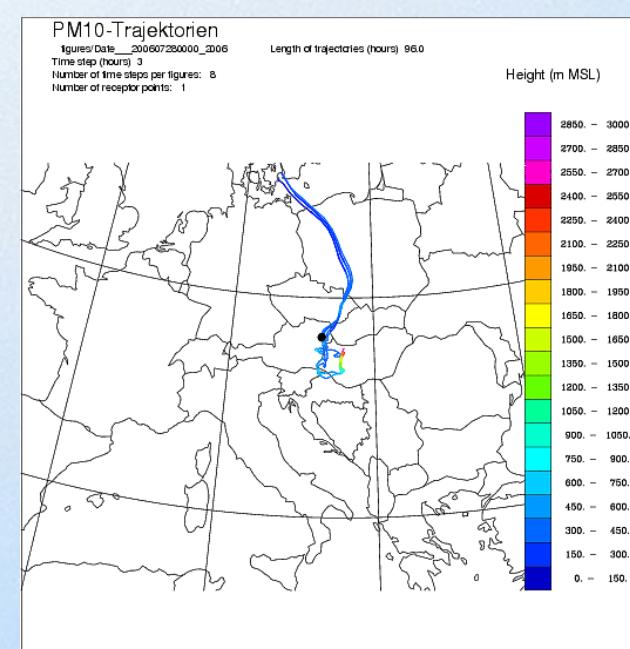
- Are ozone peaks caused by local emissions in combination with low wind conditions?
- Peak emissions by power plants ? The model forecast - which is based on average emission data (with seasonal variations) – does not reproduce these singular events.

Case study July 2006: Trajectories for eastern Austria



27.7.2006

- 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



28.7.2006

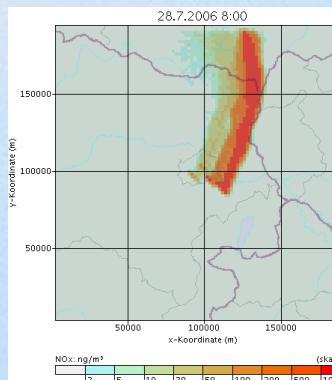
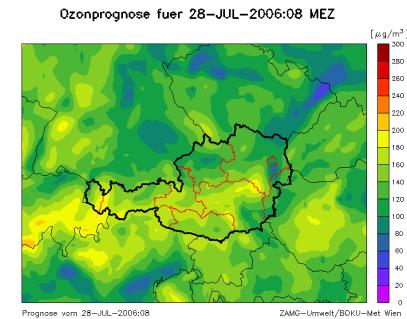
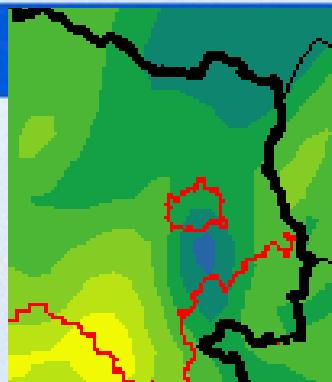
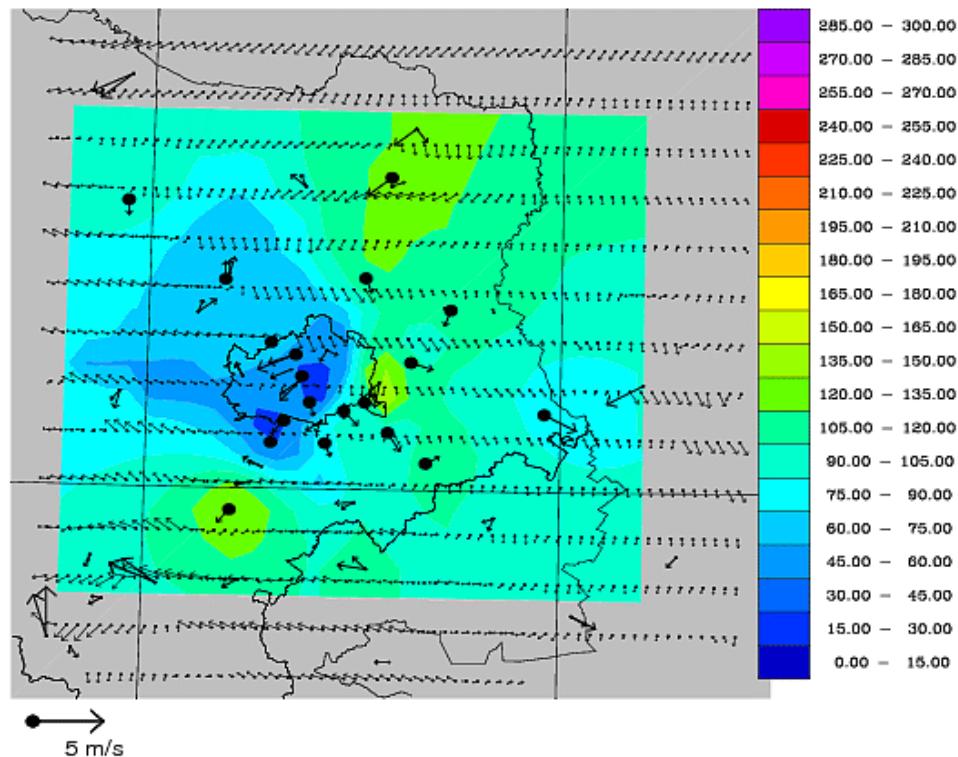
- General weather situation**
- high temperature, pressure
 - low gradients -> low wind

Air Quality Model forecasts: ALADIN-CAMx

Case study July 2006

Wind field and ozone July 2006

200607280800

O3 (-3 micrg/m³)

• Lagrangian particle model LASAT:

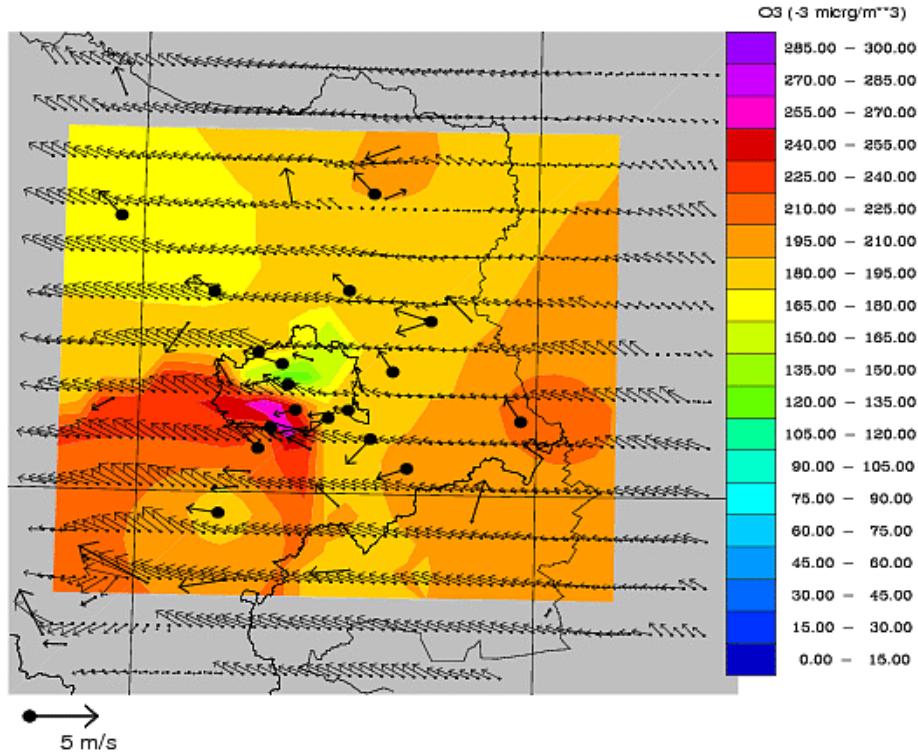
- Emissions rates (NOx – provided by federal government) from dominant industrial sources in the vicinity of Vienna → **no extraordinary high emissions**
- Windmeasurements at Schwechat
→ Dispersion of the plumes

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

Case study July 2006

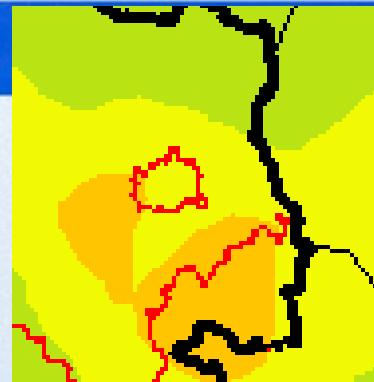
Wind field and ozone July 2006

200607281130

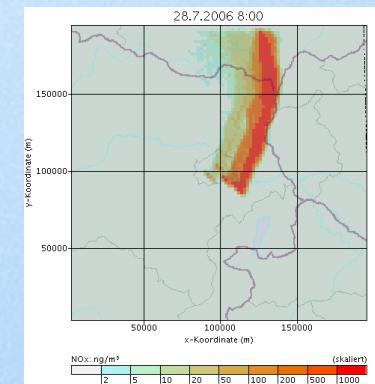
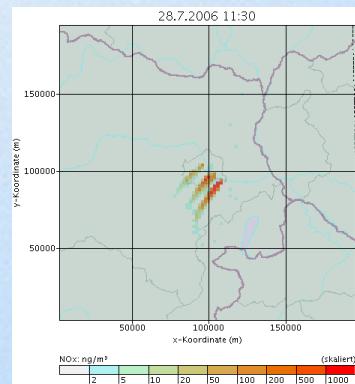
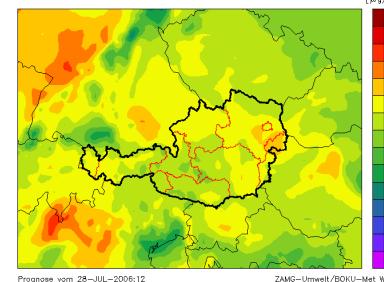


Wind-speed: low

Wind-direction: inhomogeneous



Ozonprognose fuer 28-JUL-2006:12 MEZ



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

Case study July 2006

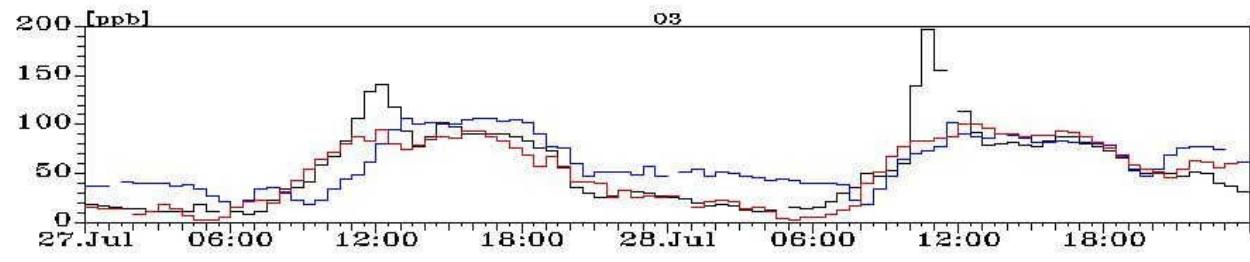
Amt der NÖ Landesregierung, Abt. BD4, NOEL

Grafik 3 Diagramme

Zeitraum : 27.07.2006 00:30 bis 28.07.2006 24:00

Wertebasis: HMW

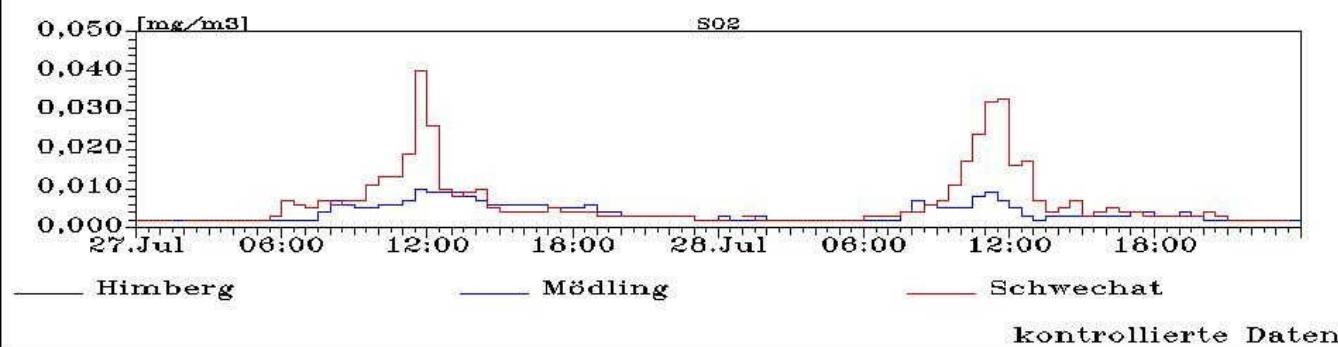
Darstellung: Messwerte in Wertebasis



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