Evaluation of the operational Air-Quality forecast model for Austria ALARO-CAMx

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1. Introduction

The Air-Quality model for Austria (AQA) is operated at ZAMG by order of the regional governments of Vienna, Lower Austria, and Burgenland since 2005. The emphasis of this modeling system is on predicting ozone peaks in the North-east Austrian flatlands. The modeling system is currently a combination of the meteorological model ALARO and the photochemical dispersion model CAMx. Various extensions with external data sources have been conducted in the past to improve the daily forecasts of the model, e.g. data assimilation of O3- and PM10-observations from the Austrian measurement network (with optimum interpolation method technique), MACC-II boundary conditions; combination of high resolved emission inventories for Austria with TNO and EMEP data. The model runs 2 times per day for a period of 48 hours.

ZAMG provides daily forecasts of O3, PM10 and NO2 to the regional governments of Austria. The evaluation of these forecasts is done for January to September 2015, with the main focus on the summer peaks of ozone. The measurements of the Air-Quality stations are compared with the punctual forecasts at the sites of the stations and the area forecasts for every province of Austria.

Several heat waves occurred between June and September 2015 (new temperature records for St. Pölten and Linz). During these periods the information threshold for ozone has been exceeded 19 times, mostly in the Eastern regions of Austria. Values above the alert threshold have been measured at some stations in Lower Austria and Vienna at the beginning of July. For the evaluation, the results for the periods with in Eastern Austria will be discussed in detail.

2. ALARO-CAMx

Model configuration

- Meteorological Model: ALARO, 61 vertical levels
- Photochemical Dispersion Model: CAMx (www.camx.com), 16 vertical levels, SAPRC99-Mechanism (Carter, 2000) with 73 trace gases and 211 chemical reactions
- 2 Model domains: 13,8 km and 4,6 km (Fig. 1)
- 2 Model runs: 00 UTC and 06 UTC. Data assimilation of the Austrian Measurement stations is only used in the 2nd run.

Fig. 1: ALARO-CAMx domains

- Anthropogenic emissions: The emission data is a combination of Austrian inventories, TNO (Visschedijk et al, 2007) and EMEP inventory (http://www.ceip.at/ceip).
- Biogenic emissions of hydrocarbon and nitrogen oxid are calculated by SMOKE (Sparse Matrix Kernel Emissions Modeling System, Houyoux and Vokovic, 1999) based on the actual meteorological data.
- Chemical boundary conditions: The dynamic boundary conditions from ECMWF, developed in the MACC-Project (Monitoring Atmospheric Composition and Climate, www.gmes-atmosphere.eu) are used.
- Data Assimilation: The measurements of PM_{10} and O_3 of all Austrian Air-Quality stations are used to optimize the initial conditions for the Air-Quality model. The optimum interpolation technique (Daley, 1991) is used for data assimilation.

The modeling system is described in several reports and pubilcations (Baumann-Stanzer et al, 2005a, Baumann-Stanzer et al., 2005b, Krüger et al. 2006a, Krüger et al., 2006b, Hirtl et al., 2011).

3. Evaluation of O_3 forecasts of ALARO-CAMx

Figure 2 shows the time series of the highest and lowest measured daily maximum O_3 concentration (shaded grey) for summer 2015 in Eastern Austria (Vienna, Lower Austria and Burgenland). The predicted maximum daily values of ALARO-CAMx are shown in red. A scatter diagram of measured and modeled O3 maximum values is shown in Figure 3.

The model predicts the slight increase of ozone from the winter months to end of spring quite good. First exceedance of the information threshold was measured in Lower Austria at the beginning of July.

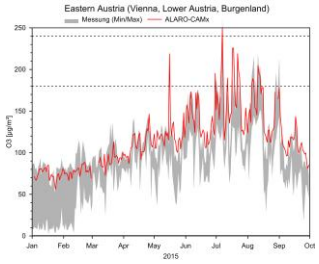

Fig. 2: O_3 daily maximum (summer 2015)

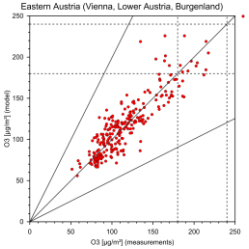

Fig. 3: Scatter diagram of measured and modeled O_3 maximum values

ALARO-CAMx predicts 11 of the 16 measured exceedances (Table 1). The hit rate of the model is over 90 %.

Max./Mod.	April	Mai	Juni	Juli	August	September	gesamt	%
≥ 180 / ≥ 180	30	30	29	21	20	29	159	93,92%
≥ 180 / < 180	0	0	0	5	6	0	11	
< 180 / ≥ 180	0	1	1	4	0	0	6	6,08%
< 180 / < 180	0	0	0	1	3	1	5	

Table 1: Hit rate for O_3 daily max

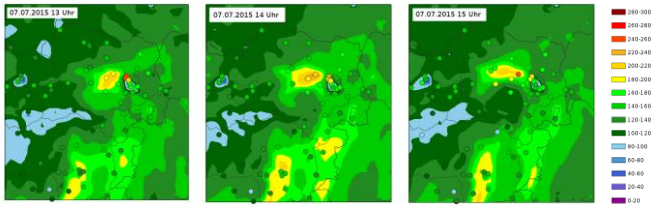

Fig. 4: measured (dots) and modeled (shaded) O_3 values from 2015/07/07 13:00 – 15:00

At 7th July 2015 exceedances of the alert threshold were measured in Austria (Klosterneuburg and Tulln) at 13:00 and in Vienna (Hermannskogel) at 15:00. The model was able to predict these exceedances in the northwest of Vienna (14:00).

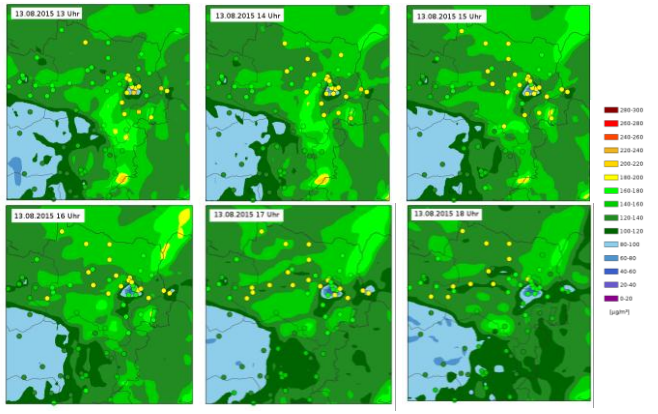

Fig. 5: measured (dots) and modeled (shaded) O_3 values from 2015/08/13 13:00 – 18:00

At 13th August 2015 several exceedances of the information threshold were measured over Eastern Austria. The model predicts exceecances at midday over the south of Burgenland, after 14:00 around Neusiedlersee and over the northeast of Lower Austria but not over all areas where the exceedances were measured.

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