SIMULATION OF AIR POLLUTION IN THE CROSS-BORDER REGION BULGARIA – TURKEY

Dimiter Syrakov[1], Maria Prodanova[1], Valeri Nikolov[1], Ilker Oruc[2], Emilia Georgieva[1], Kiril Slavov

[1]National Institute of Meteorology and Hydrology- Bulgarian Academy of Sciences, Sofia, Bulgaria
[2]Kirklareli University, Vocational College of Technical Sciences, Kirklareli, Turkey

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ABSTRACT

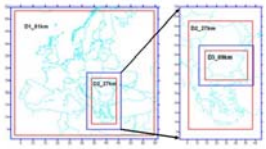
The Bulgarian Chemical Weather Forecast System, based on WRF-CMAQ models is applied with 9km resolution for air pollution simulations in the cross-border region Bulgaria-Turkey, known for its natural parks with rich biodiversity and tourism activities in summer. Model results are compared to observations from 5 surface stations focussing on PM10, O3, NO2 and SO2 in February and June 2014. The preliminary analysis based on evaluation of some main statistics (mean, correlation, temporal variation) reveals that the model system performs well for ozone in summer, while PM10 and NO2 concentrations are underestimated. The results indicate some of the air quality problems of the region – high ozone in summer, high SO2 values in parts of the Turkish territory and high PM10 daily mean concentrations in winter.

SAAP4FUTURE

SAAP4FUTURE (Joint **S**tudy of **A**nthropogenic **A**ir **P**ollution in the Burgas - Kirklareli cross-border area as a step towards **Future** assessments on its impact on the population and the environment") is a collaboration project funded by EU through the Bulgaria-Turkey IPA Cross Border Programme. The overall goal of the project is to raise public awareness on air pollution status and its effect on the ecological, cultural and historical heritage in the region. The main group of activities refer to:

- Numerical modeling of the transport of air pollutants for specific situations;
- Field campaigns for sampling of wet, dry and bulk deposition at four sites in the cross border area;
- Chemical analysis of samples for main anions, cations, and heavy metals.

THE MODEL SYSTEM



The simulations are made with the Bulgarian Multi-domain Chemical Weather Forecast System (Syrakov et al., 2013a,b) based on the models WRF – CMAQ. The forecast period is 3 days and the model domains are 5: Europe, Balkan Peninsula, Bulgaria, Sofia Region and Sofia City. A nesting approach is used with space resolution from 81 km (Europe) to 1 km (Sofia City). The forecasted pollutants are SO2, NO2, O3 and PM10. The WRF model is driven by the US NCEP Global Forecast System data (1° ×1° space and 6 h time resolution). The emission input is from TNO data for the two biggest domains and from Bulgarian environmental authorities emission inventories for the 3 Bulgarian domains. More details on the system can be found on its web-site: http://www.meteo.bg/en/cw, where hourly forecasts for all domains and pollutants are presented. For this study only results with 9 km resolution over Bulgaria are used.

MONITORING DATA

AQ monitoring stations in the region

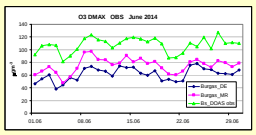
All stations are situated in urban areas - most populated is Burgas (about 200.000 inhabitants), Edirne (about 150.000 inhabitants) and Kirklareli about 100.000 inhabitants. The stations in Burgas are classified as background suburban, the main distance among them is about 7 km. Thus all 3 Burgas station are included in one model grid cell. One of the stations (BS_DE) is situated not far away from the industrial area of "LUKOIL Neftohim Burgas" - the biggest company on the Balkan Peninsula in terms of crude oil processing capacities. The Edirne station is near an international highway.

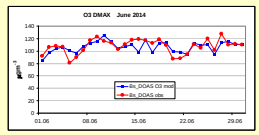
Monitored pollutants and their availability (%) for two months in 2014

STATION	FEBRUARY 2014				JUNE 2014			
	NO2	O3	SO2	PM10	NO2	O3	SO2	PM10
Kirklareli	-	-	72%	92%	-	-	97%	96%
Edirne	-	-	96%	94%	-	-	46%	54%
Burgas_DE	100%	100%	72%	-	99%	99%	-	97%
Burgas_MR	100%	100%	100%	100%	-	100%	100%	95%
Burgas_DOAS	-	-	-	-	94%	98%	98%	-

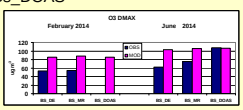
RESULTS

Ozone

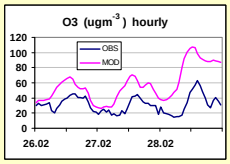


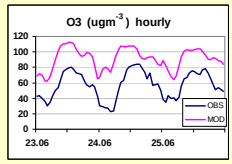


O3 daily max concentrations in June 2014: left - observed at the three Burgas stations; right - observed and modelled at the station Bs_DOAS

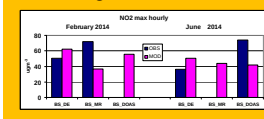


O3 daily max - monthly mean values at the three Burgas stations: left – for February 2014, right – for June 2014



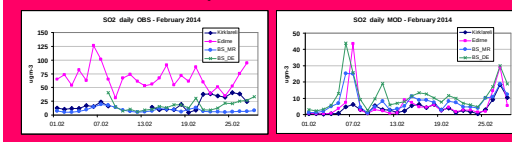


Nitrogen dioxide



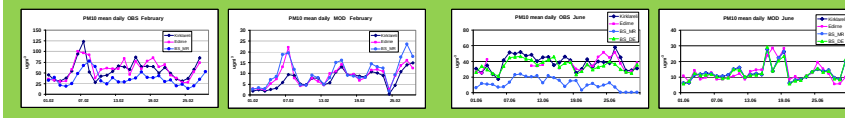
NO2 hourly max concentrations at the three Burgas stations: left – February 2014, right – June 2014

Sulphur dioxide



SO2 daily mean concentrations in February 2014: left - observed; right - modelled at 4 stations

Particulate Matter PM10



PM10 daily mean concentrations in February 2014: left – observed; right - modelled at 3 stations

PM10 daily mean concentrations in June 2014: left – observed; right - modelled at 4 stations

Diurnal variation of O3 daily max at the station BS_MR: left – for 3 days in February 2014; right – for 3 days in June 2014

DISCUSSION AND CONCLUSIONS

The analysis of observations indicates some of the air quality problems of the region – high ozone in summer near the Black Sea coast, high SO2 values in parts of the Turkish territory and high PM10 concentrations in winter. The replica system performs well for ozone in summer, while PM10 and NO2 concentrations are underestimated. The model system underestimates the high SO2 concentrations at Edirne in February, but captures the SO2 peaks in the temporal evolution.

The model shortcomings in simulating NO2 and PM10 is most likely due to representations of local emissions. Further efforts are needed also in input emissions for the Turkish part of the area.
In order to understand model behaviour relative to O3 (overestimation during night-time) more detailed analysis are required involving also meteorological variables.

ACKNOWLEDGEMENT

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http://saap4future.ecobg.org

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