



European Network on New Sensing Technologies for Air Pollution Control
and Environmental Sustainability - *EuNetAir*
COST Action TD1105

Air Quality Modelling in Slovenia; Understanding and forecasting air pollution episodes

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Univerza v Ljubljani

Fakulteta za *matematiko in fiziko*



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Introduction

- **Air quality modelling at Faculty of mathematics and physics, UL, and Center of Excellence SPACE-SI**
- **Understanding air pollution episodes, investigating abilities and limitations of AQ models (mainly for O₃ and PM episodes)**
- **Regional scales (resolution ~3 km), experiences also with local scales (resolution ~200 m)**
- **Collaboration with Environmental Agency of Slovenia:**
 - ❖ **national monitoring network**
 - ❖ **modelling system for operational air quality forecast**

AirQ stations

(national and supplement network)

National network:

17 stations

O₃, PM₁₀;

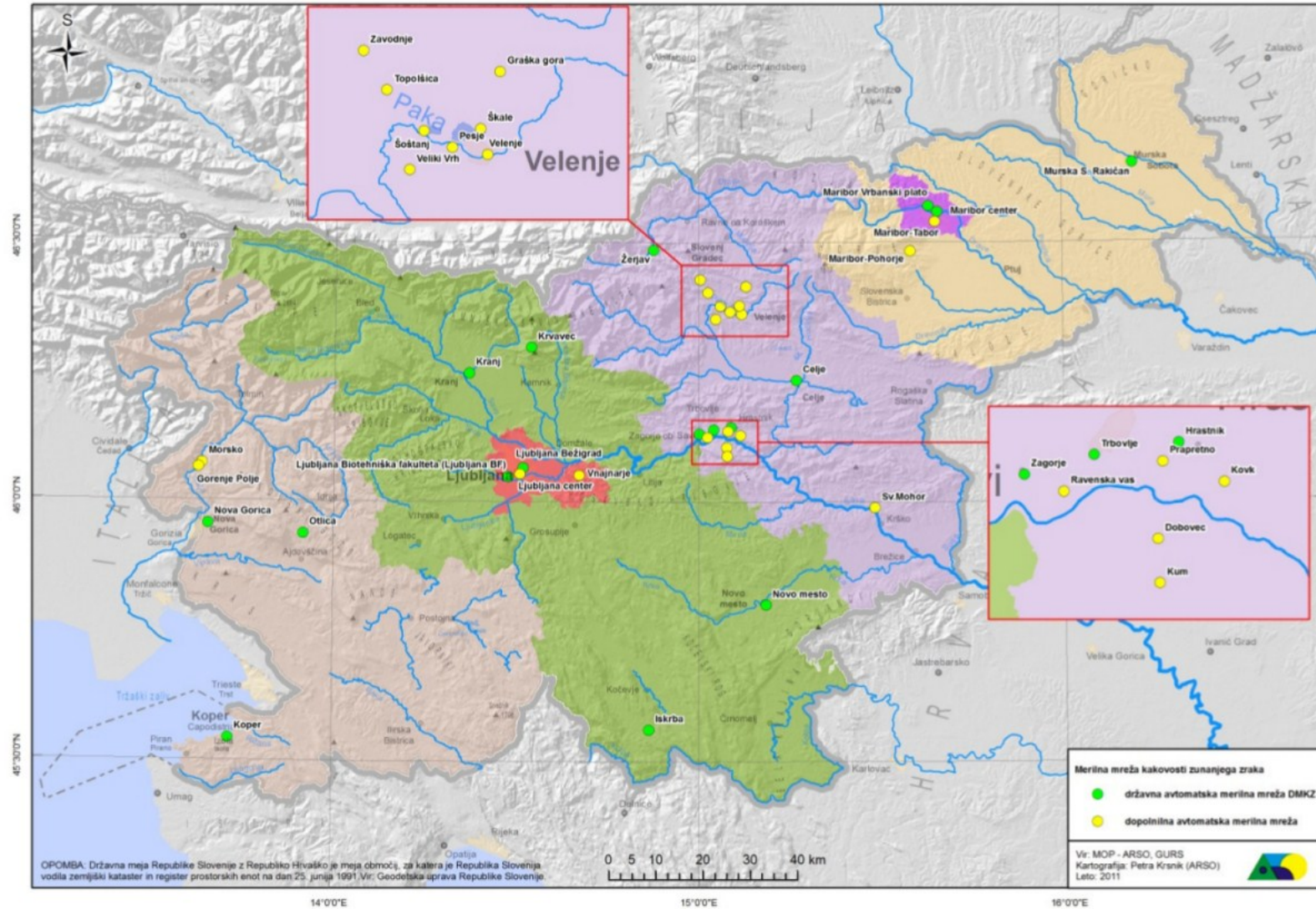
some of them: NO_x, SO₂,
PM₂₅, CO, heavy metals
benzene, benzo(a)pirene

Supplement network:

19 stations

SO₂;

some of them: O₃, NO_x,
PM₁₀



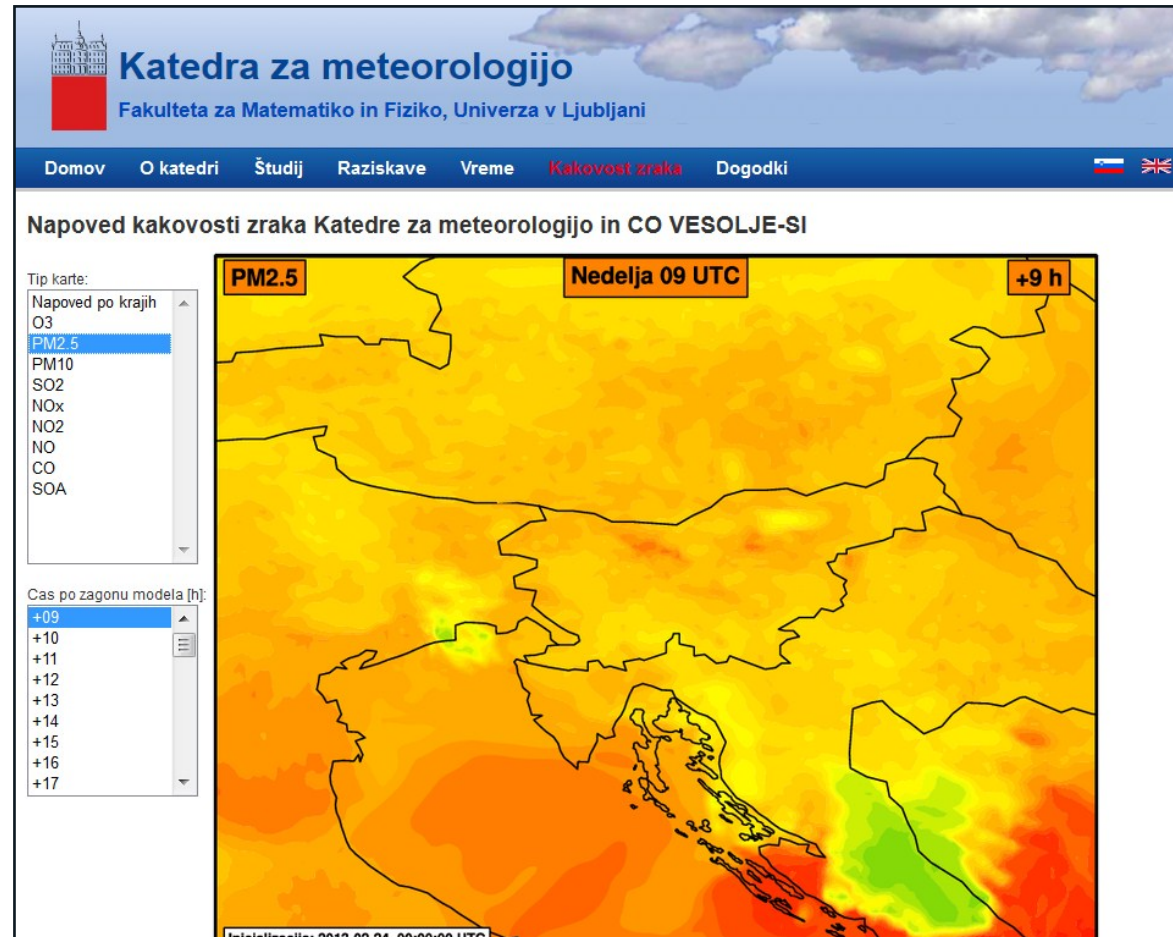
AirQ models

WRF/Chem model (NOAA, NCAR, PNNL, EPA...)

- Weather Research and Forecast (WRF) model online coupled with chemistry (WRF/Chem)
- for episodes
- operational forecast since January 2013



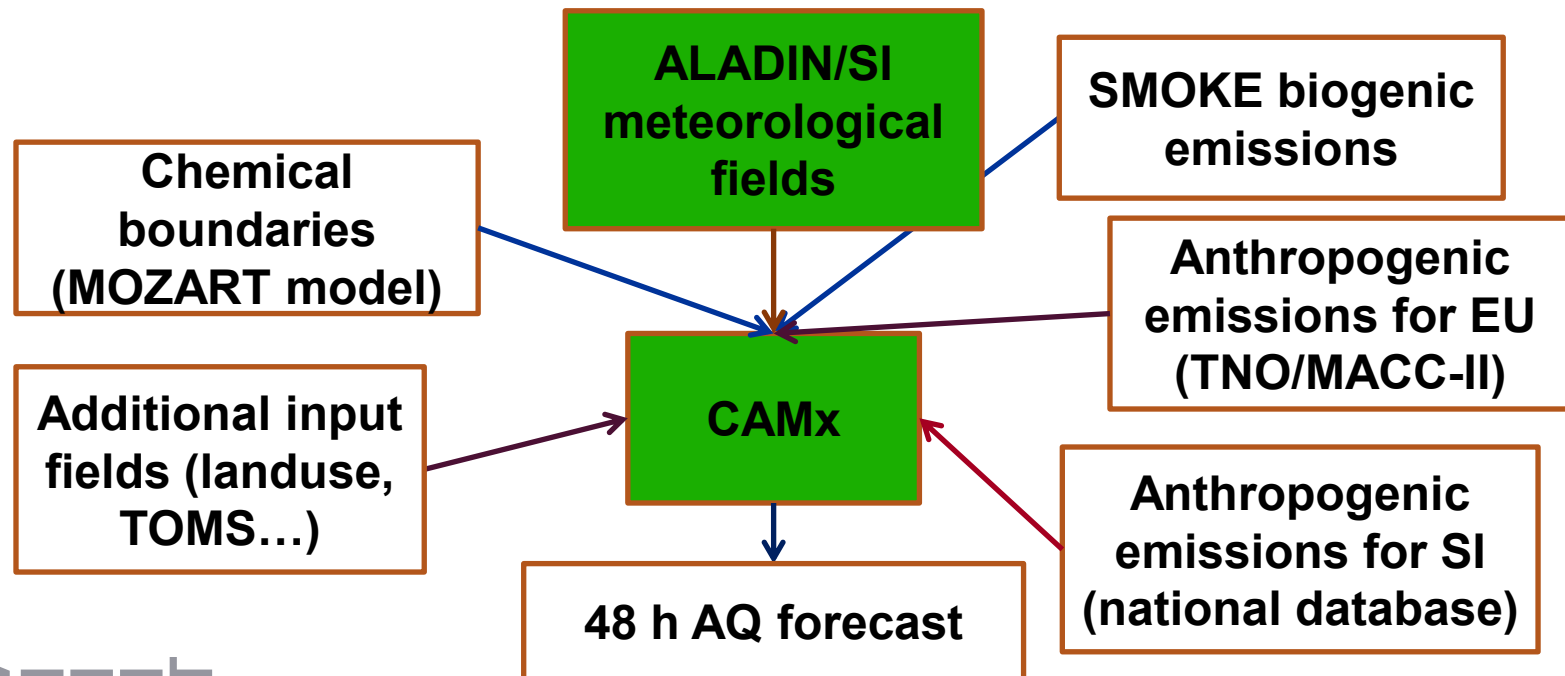
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AirQ models

ALADIN/CAMx modeling system

- offline coupled meteorological ALADIN model and chemical transport CAMx (ENVIRON, 2011) model
- running at Environmental Agency of Slovenia for episodes
- operational forecast since March 2013



High ozone episodes

Information from measurements

Number of days with maximum hourly value above $160 \mu\text{g}/\text{m}^3$ (per year) for different measuring sites:



	NG	KOP	OTL	KRV	LJ	MB	CE	MS	TRB	ZAG	HRA	IS
2010	13	7	13	8	-	-	1	2	2	1	4	-
2011	16	4	15	1	2	-	2	2	2	-	2	1
2012	22	12	12	11	4	-	4	1	2	1	3	2

Mediterranean stations

Elevated site

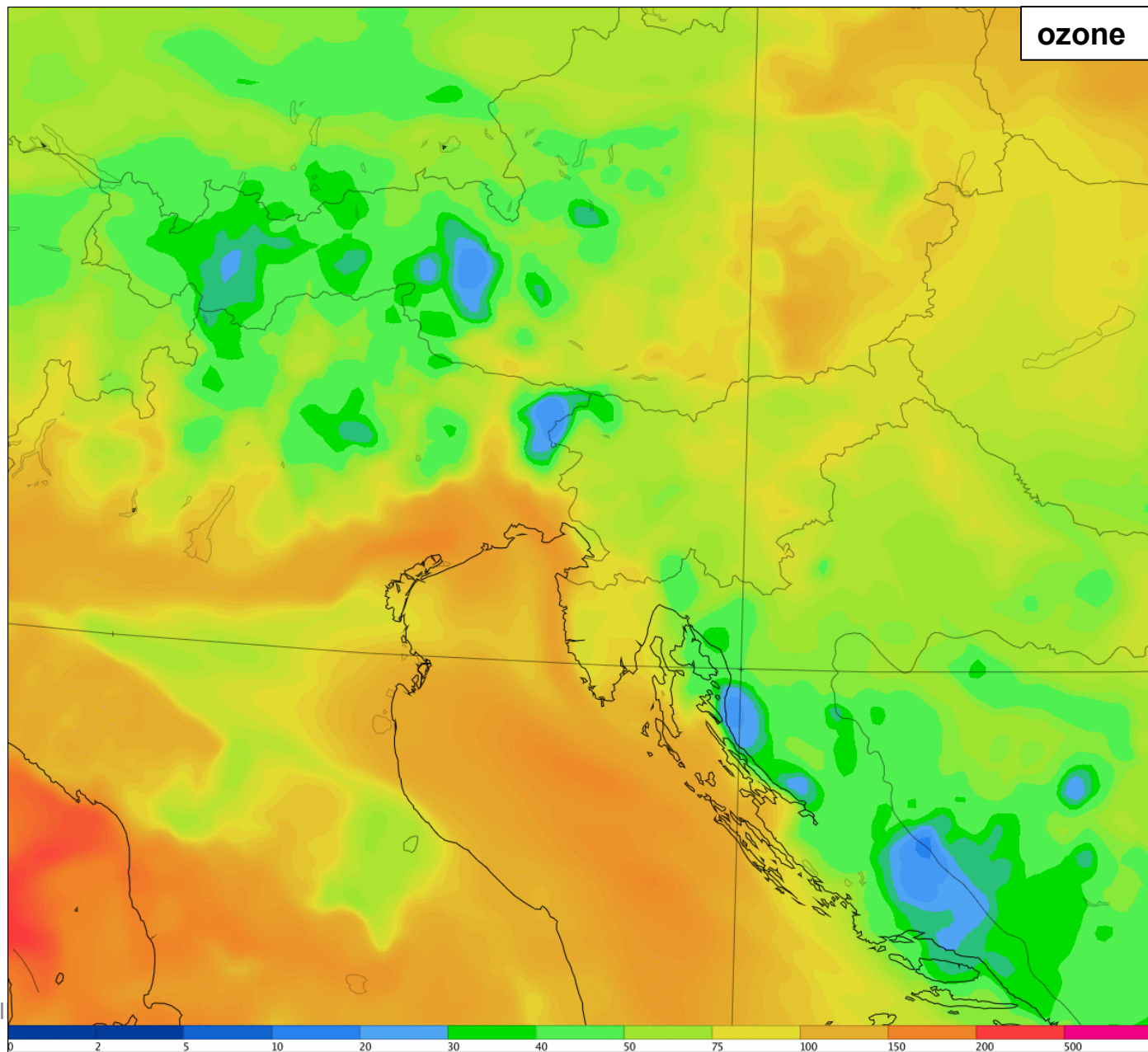
Urban stations

Rural background

High ozone episodes

Model:
ALADIN/CAMx

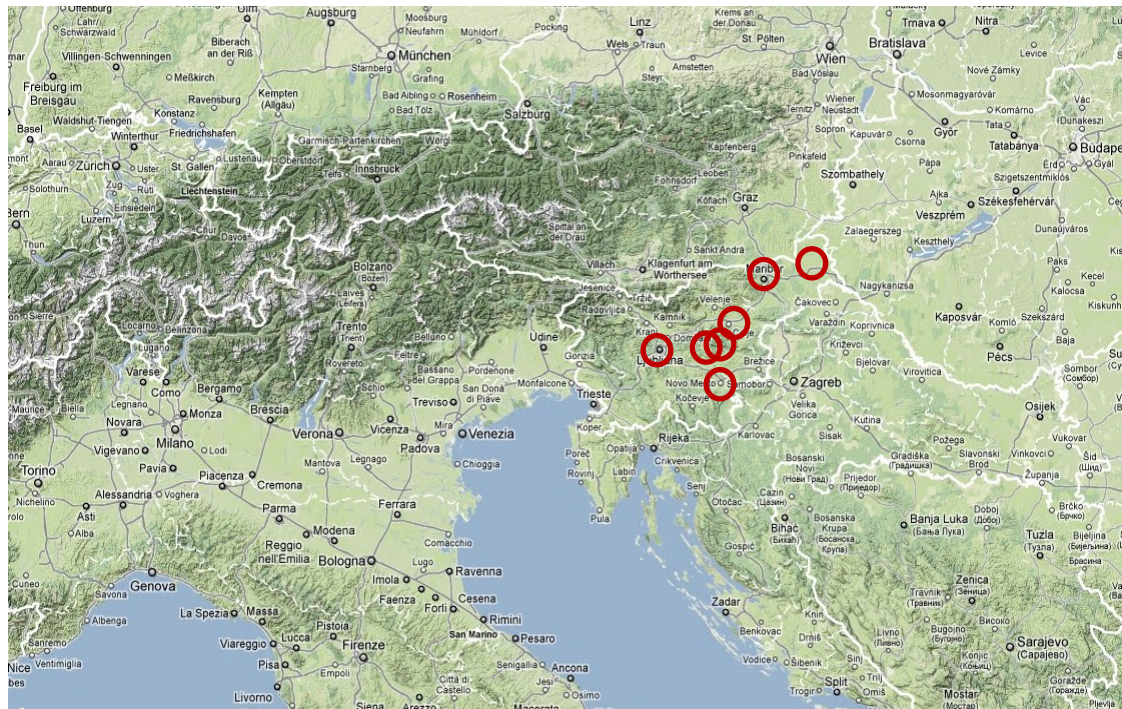
2 days from
August 12 – 24, 2011
episode



High PM10 episodes

Information from measurements

Number of days (per year) with PM10 above 50 $\mu\text{g}/\text{m}^3$ allowed: 35):



	LJ	MB	CE	MS	TRB	ZAG	NG	KOP
2010	44	47	59	53	68	36	27	15
2011	63	70	68	58	70	95	45	18
2012	39	56	45	30	74	69	32	15

1-2 Saharan dust episodes per year

High PM10 episodes

Geographical location of Slovenia in the lee side of Alpine barrier:
blocked predominant westerly flow

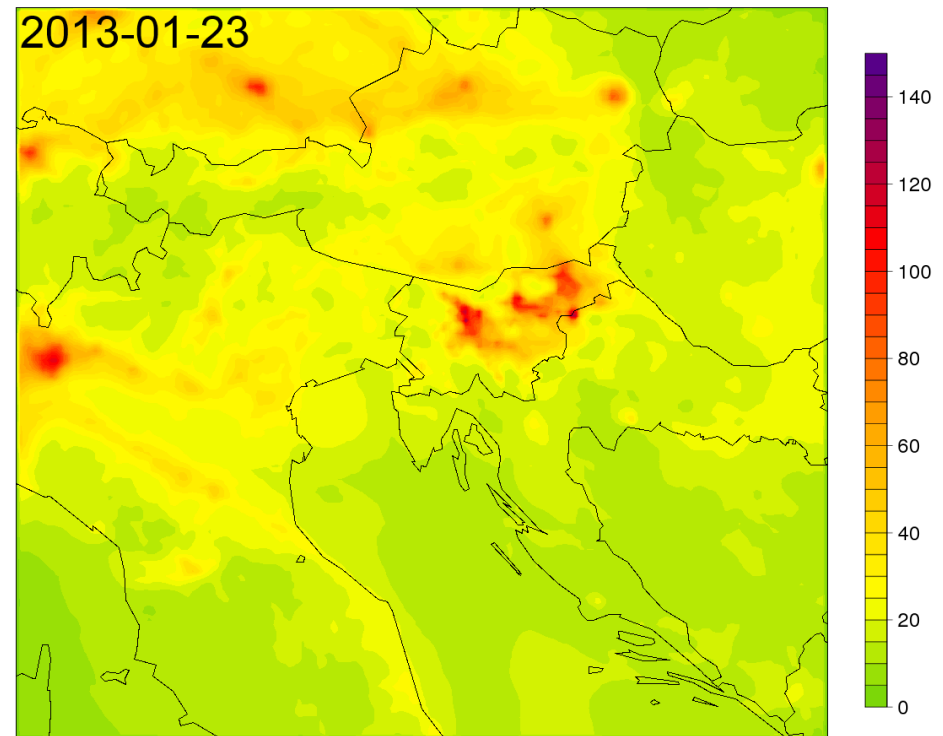
Complex terrain with cities and towns located in basins and valleys:
frequent calm conditions with temperature inversions and suppressed
vertical mixing



Simulation:

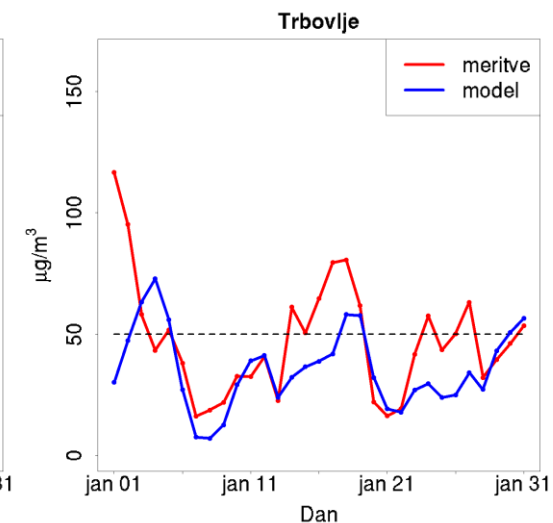
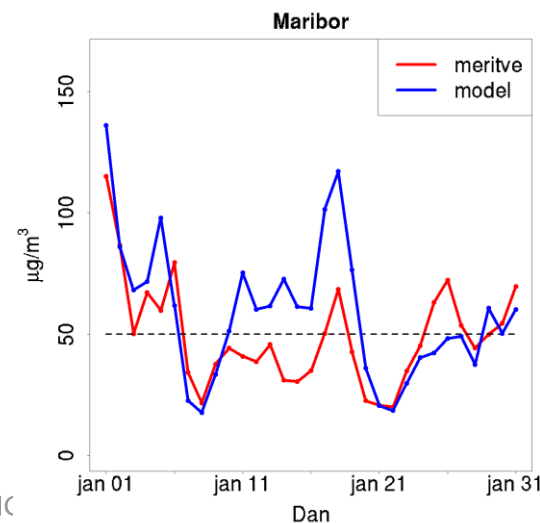
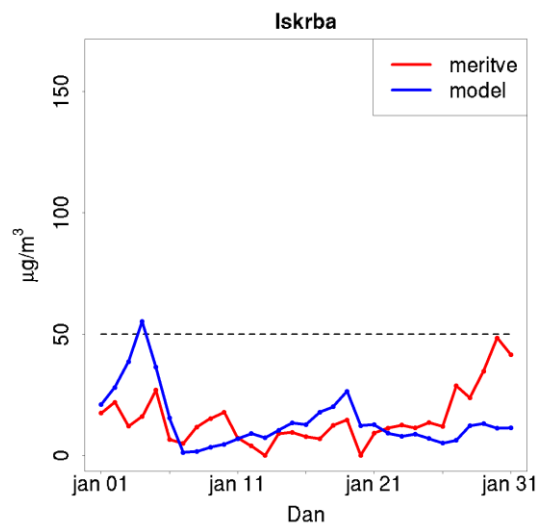
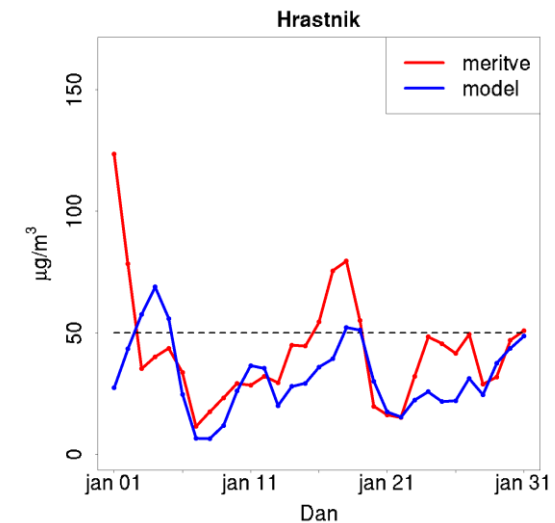
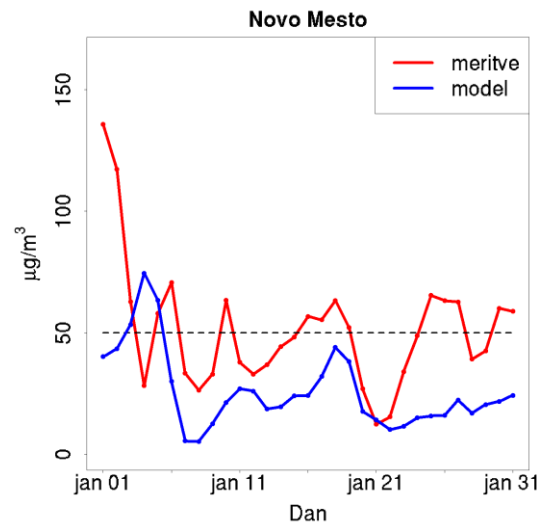
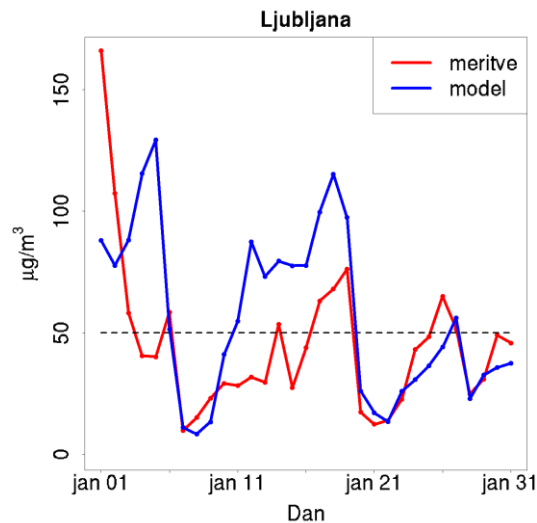
Model: ALADIN/CAMx

Episode: January 14 - 31, 2013



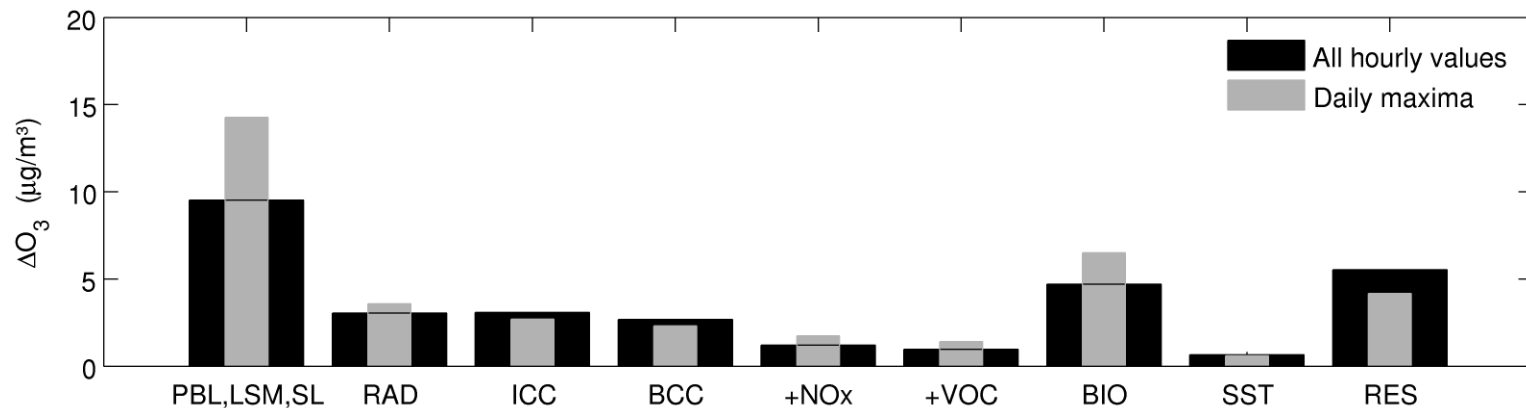
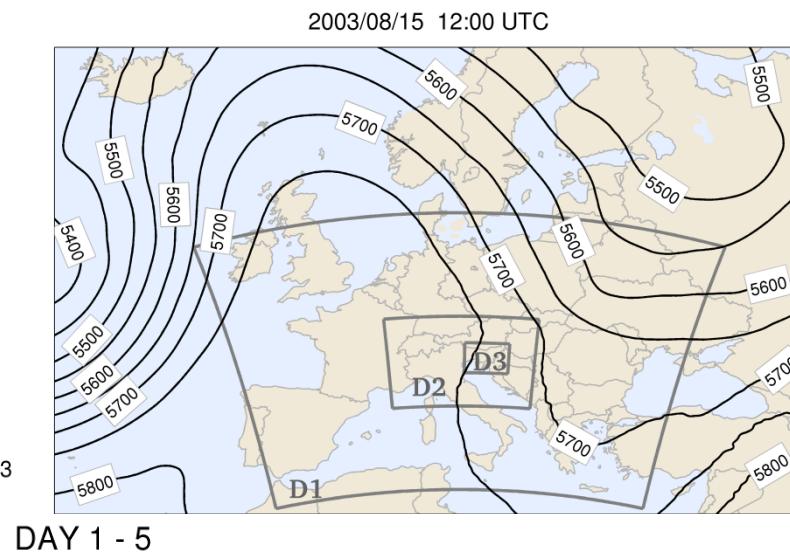
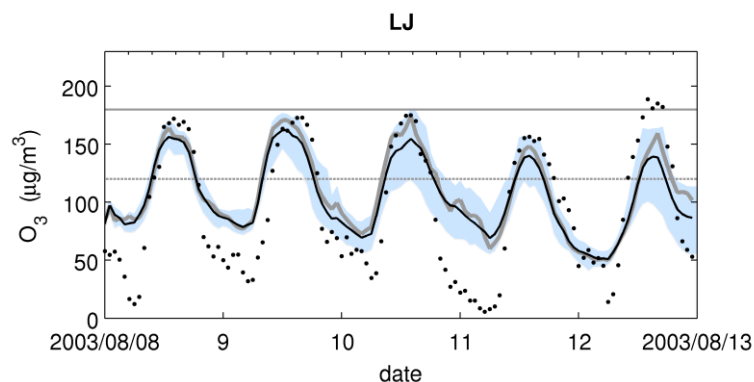
ALADIN/CAMx model evaluation: First results

- PM10, January 2011



Sensitivity study: WRF/Chem

- August 2003 episode, 51 plausible ensemble simulations
- Compared impacts of different sources of model uncertainties on simulated ozone concentrations



Current activities

- **Operational WRF/Chem Air Quality forecast:** model evaluations, sensitivity experiments
- **Operational ALADIN/CAMx Air Quality forecast:** final technical issues, model evaluations, sensitivity experiments (until the end of 2013)
- **COST ES1004** (EuMetChem), **AQMEII phase II** (Air Quality Modelling Evaluation International Initiative, JRC): one of 7 EU WRF/Chem groups

CONCLUSIONS

- Models: WRF/Chem and ALADIN/CAMx
- High ozone levels over Mediterranean Slovenia explained by formation of ozone-rich layer above the area of Northern Adriatic
- High PM10 episodes related to complex terrain, low wind conditions, temperature inversions and increased heating during wintertime
- Main characteristics of selected air pollution episodes well represented and explained by numerical models