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

Duisburg, Germany, 4 - 6 March 2013

Univerza *v Ljubljani*
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Introduction

- **Air quality modelling at UL, Faculty of mathematics and physics**

- **Understanding air pollution episodes, investigating abilities and limitations of AQ models (mainly O_3 and PM)**

- **Mainly regional scales (resolution ~3 km), experiences also in local scales (resolution ~200 m)**

- **Collaboration with Environmental Agency of Slovenia:**
  - ❖ **national monitoring network**
  - ❖ **set-up modelling system(s) for air quality forecast**

AirQ stations
(national and supplement network)
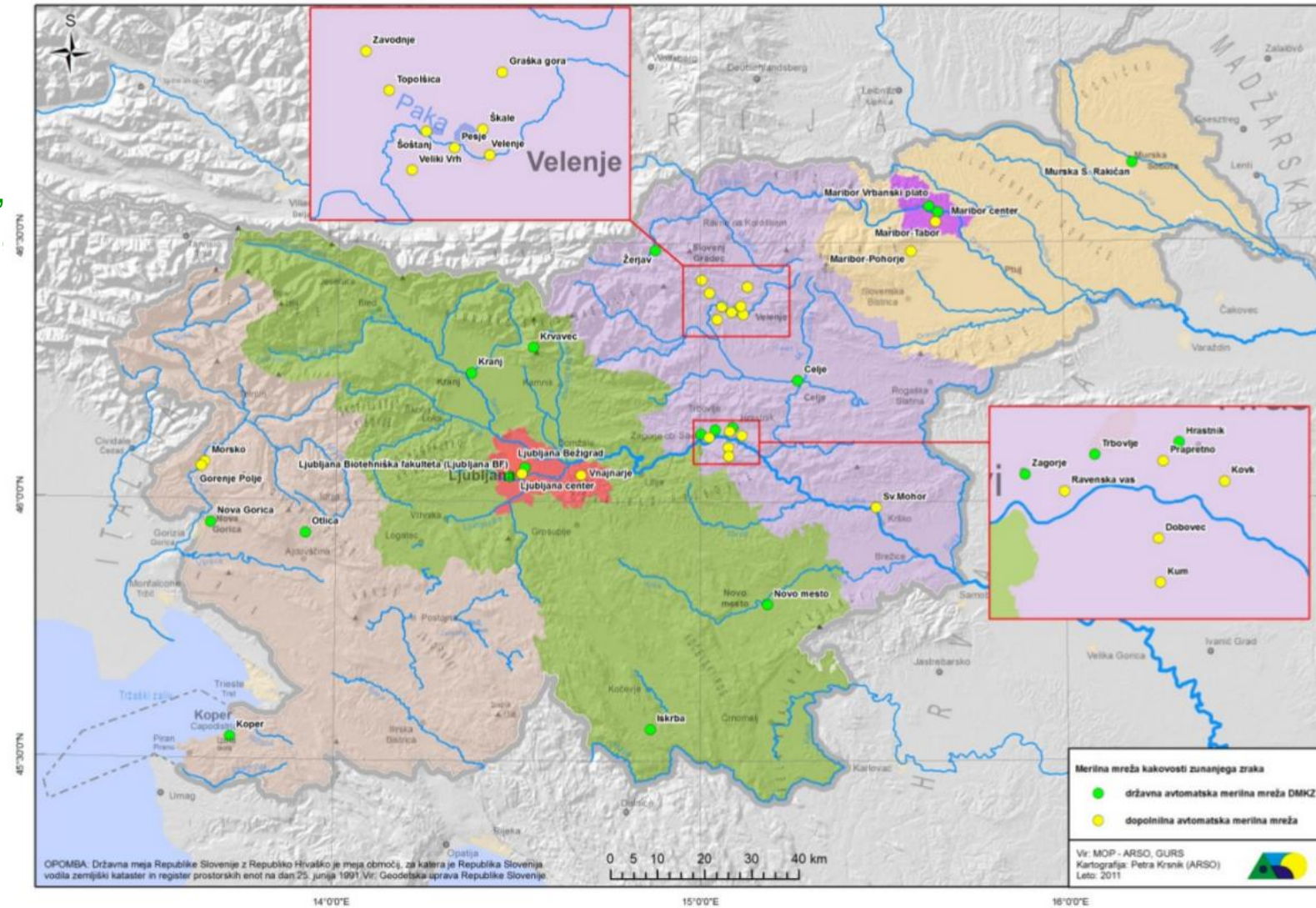
National network:

17 stations

O_3, PM10;

some of them: NOx, SO_2, PM25, CO, heavy metals, benzene, benzo(a)pirene

Supplement network:

19 stations

SO_2;

some of them: O_3, NOx, PM10

Source: Slovenian Environmental Agency

AirQ models

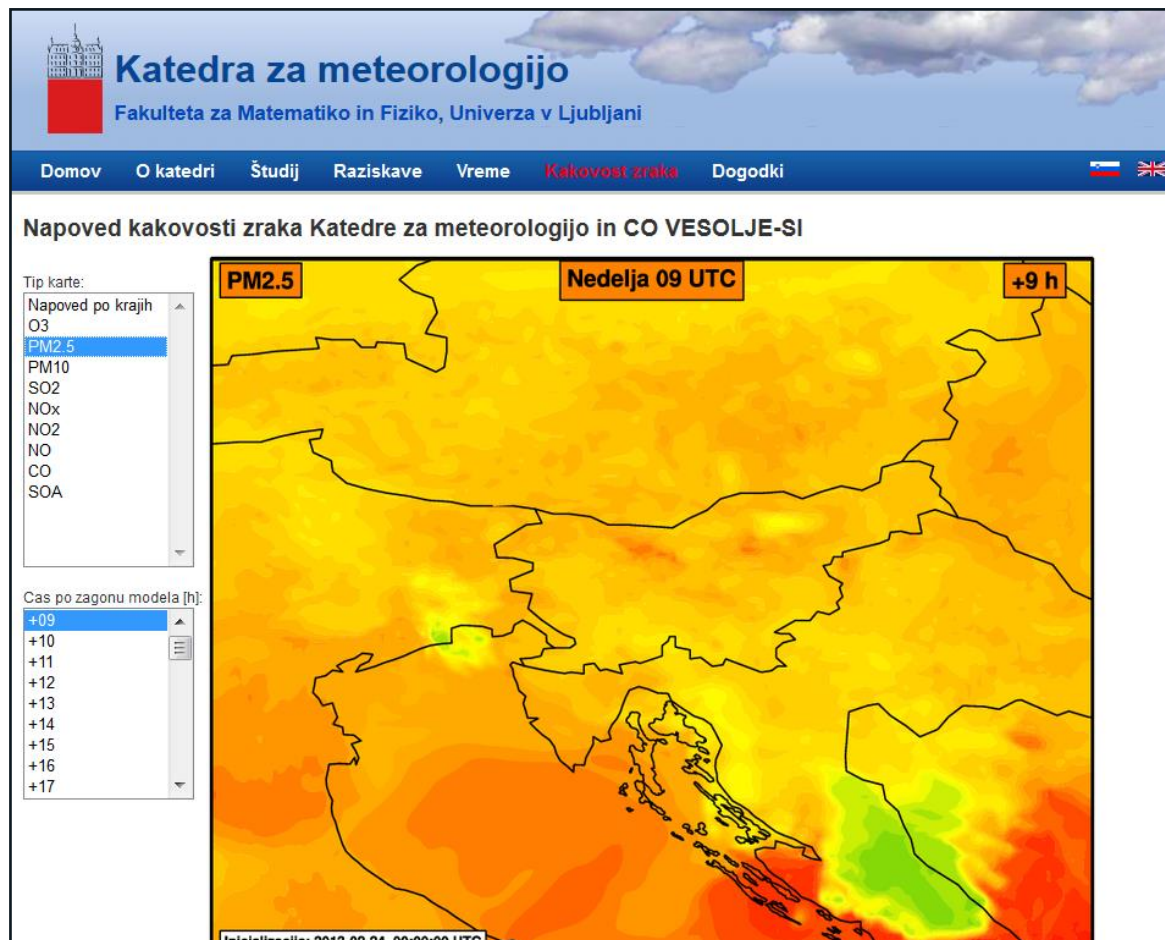## WRF/Chem model (NOAA, NCAR, PNNL, EPA…)

- **Weather Research and Forecast (WRF) model online coupled with chemistry (WRF/Chem)**

- **for episodes**

- **operational forecast:**

   since January 2013

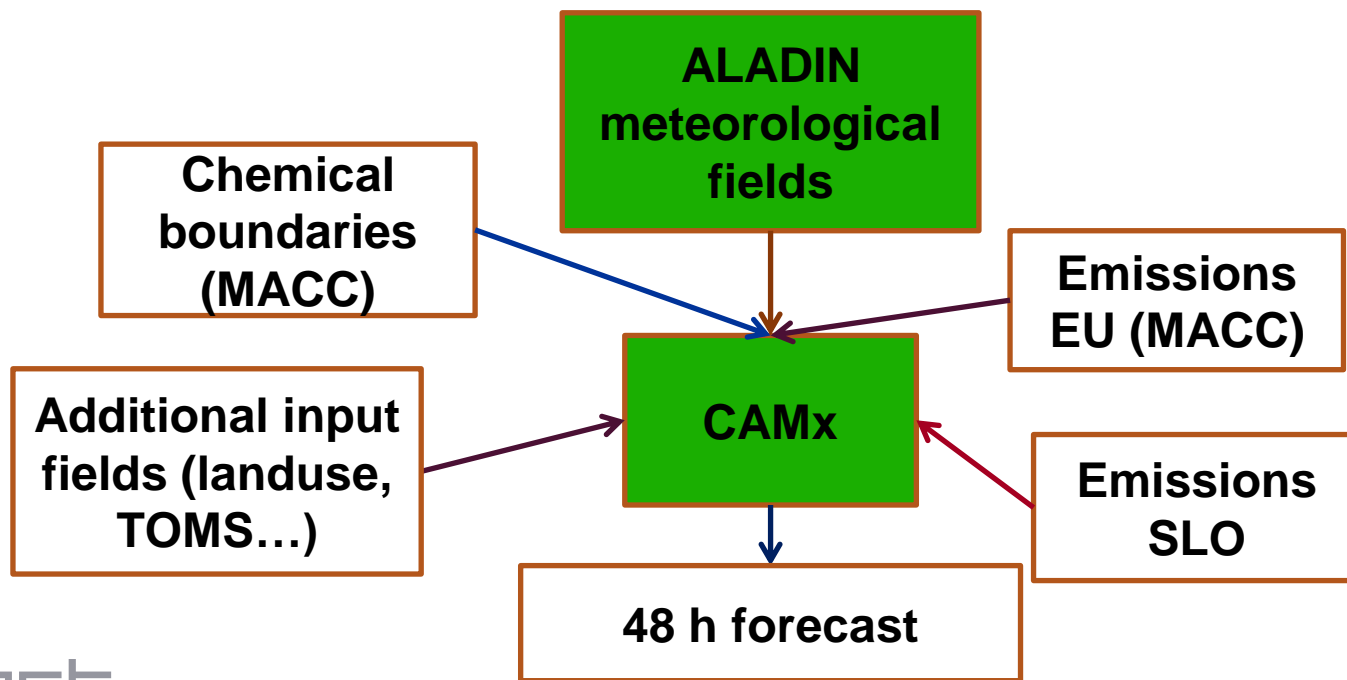**Computer cluster,
Center of Excellence, SPACE SI**

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
- from March 2013 operationally

High <u>ozone</u> episodes

Information from measurements

Number of days with maximum hourly value above 160 µg/m³ (per year) for different measuring sites:
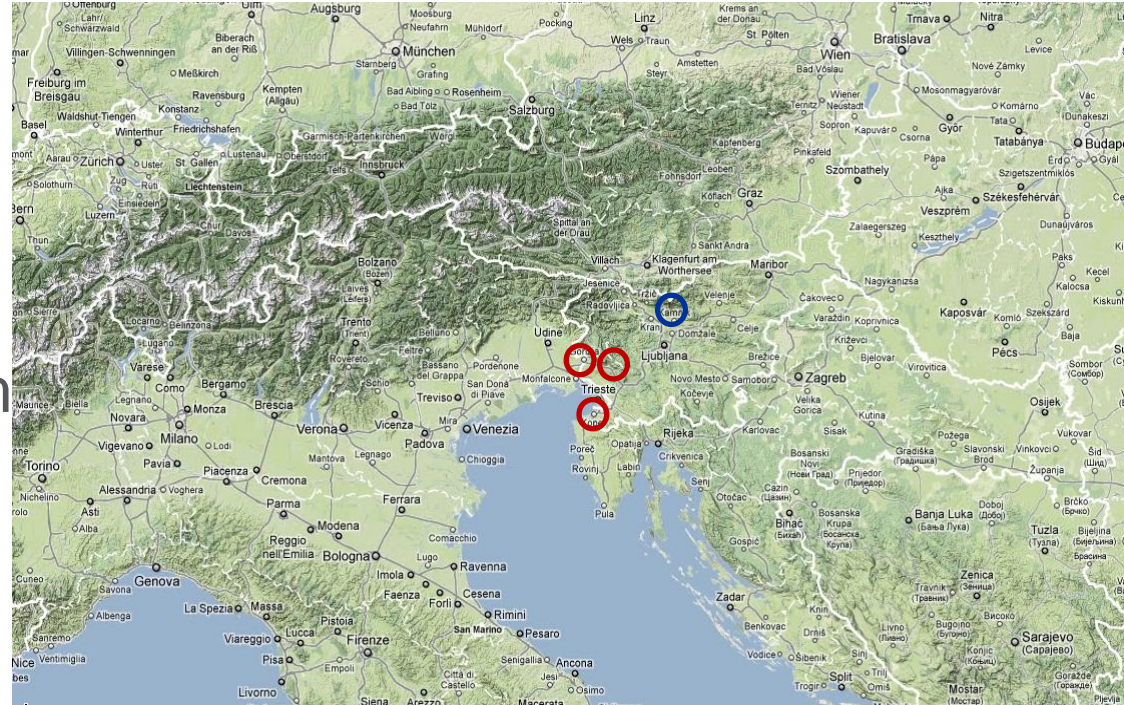
	NG	KOP	OTL	KRV	LJ	MB	CE	MS	TRB	ZAG	HRA	IS
2010	13	7	13	8	-	-	1	2	2	1	4	-
2011	16	4	15	1	2	-	2	2	2	-	2	1
2012	22	12	12	11	4	-	4	1	2	1	3	2

Mediterranean stations

Elevated site

Urban stations

Rural background

EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY
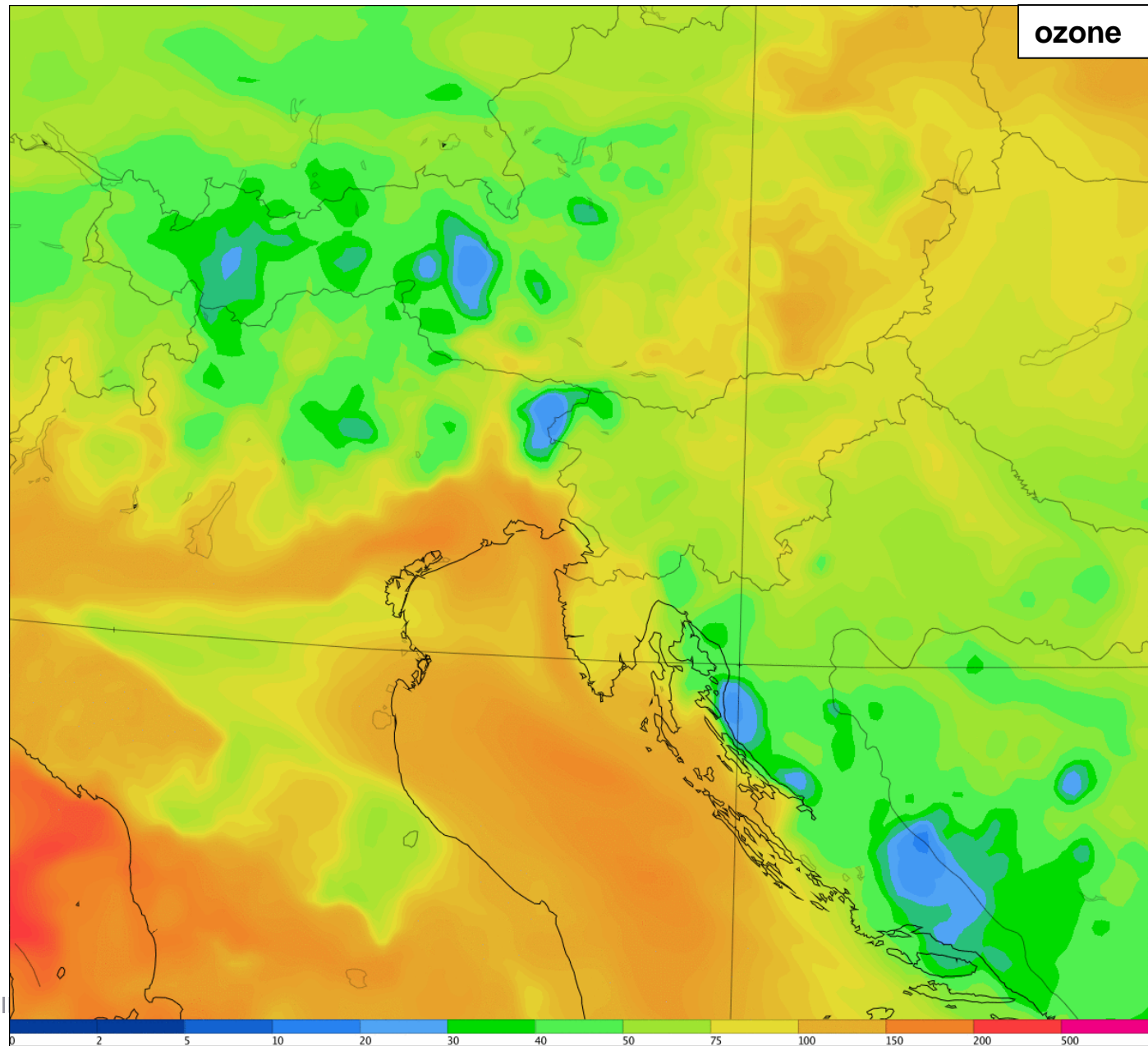
High <u>ozone</u> episodes
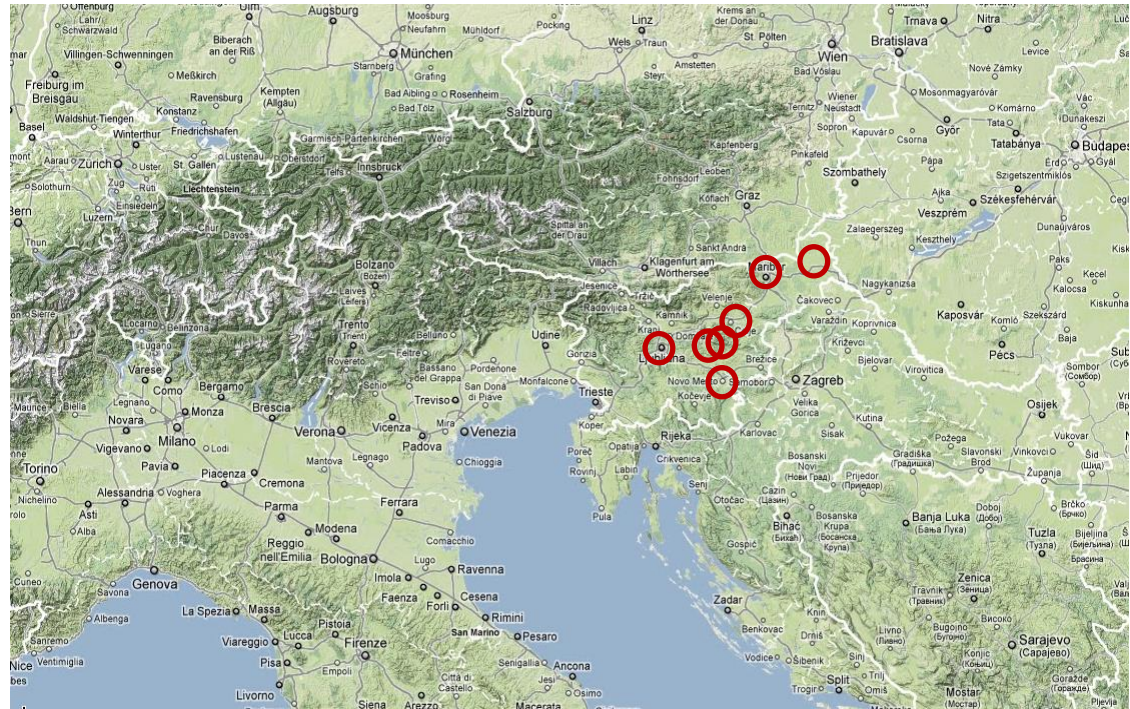
Model: ALADIN/CAMx

2 days from August 12 – 24, 2011 episode

High **PM10** episodes

Information from measurements

Number of days (per year) with PM10 above 50 $\mu g/m^3$ 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

Urban stations

Mediterranean stations

1-2 Saharan dust episodes per year

High **PM10** episodes

Geographical location of Slovenia in the lee side of Alpine barrier: blocked predominat westerly flow
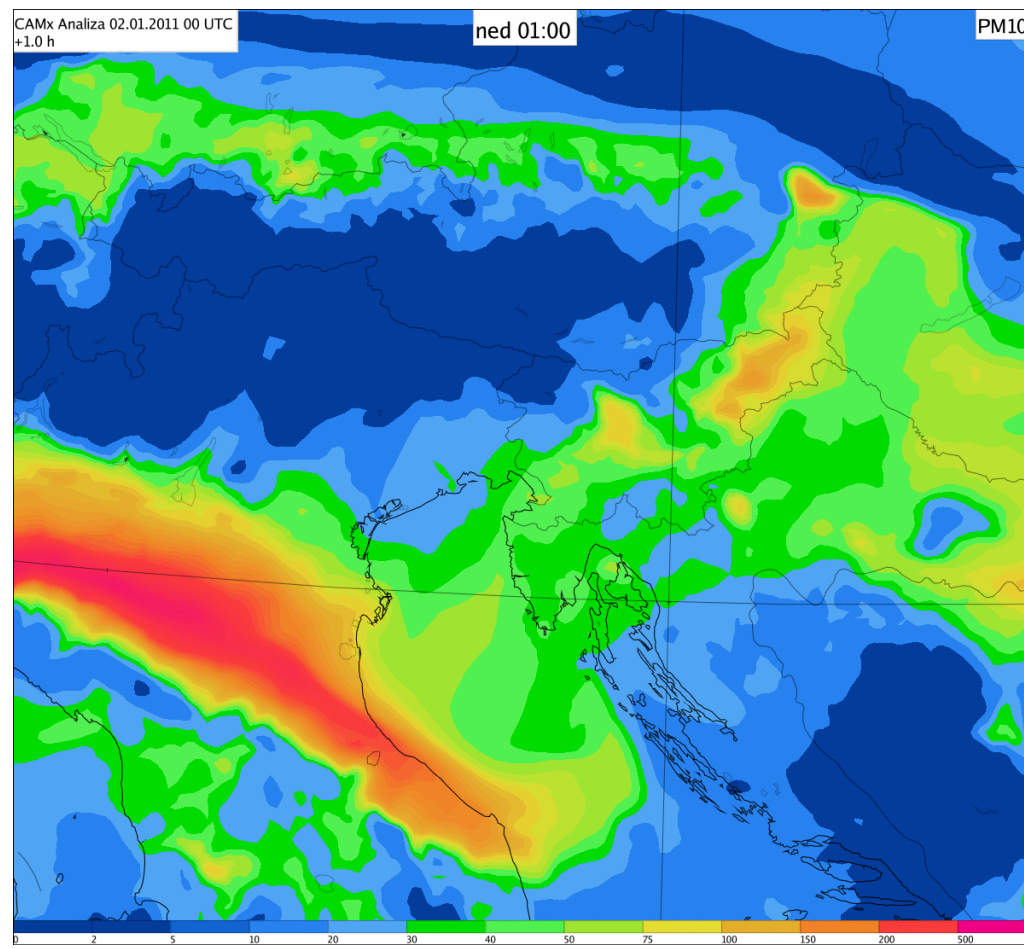
Complex terrain with cities and towns located in basins and valleys: frequent calm conditions with temperature inversions and surpressed vertical mixing

Simulation:

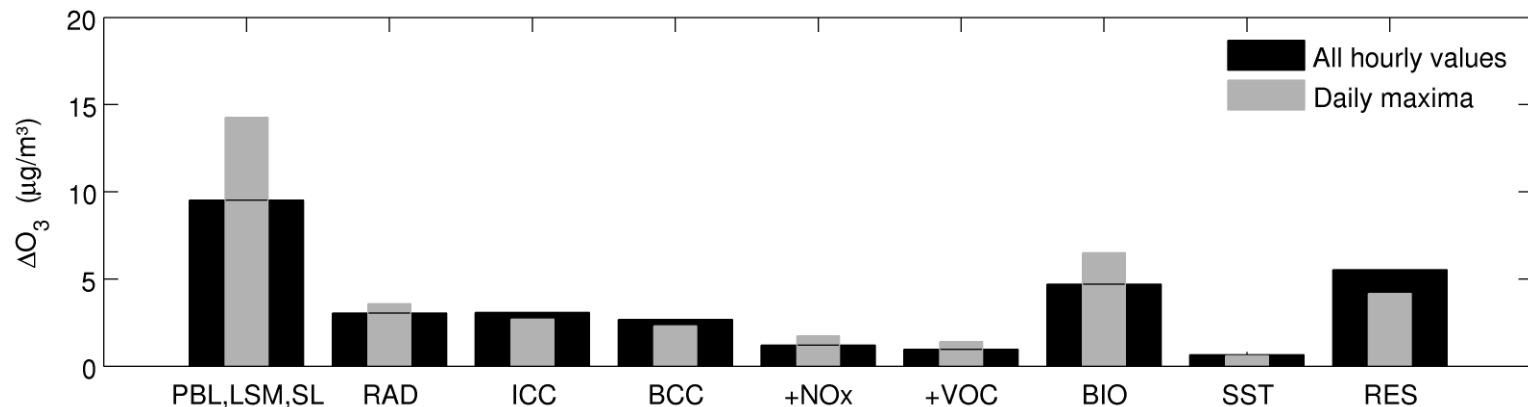Model: ALADIN/CAMx
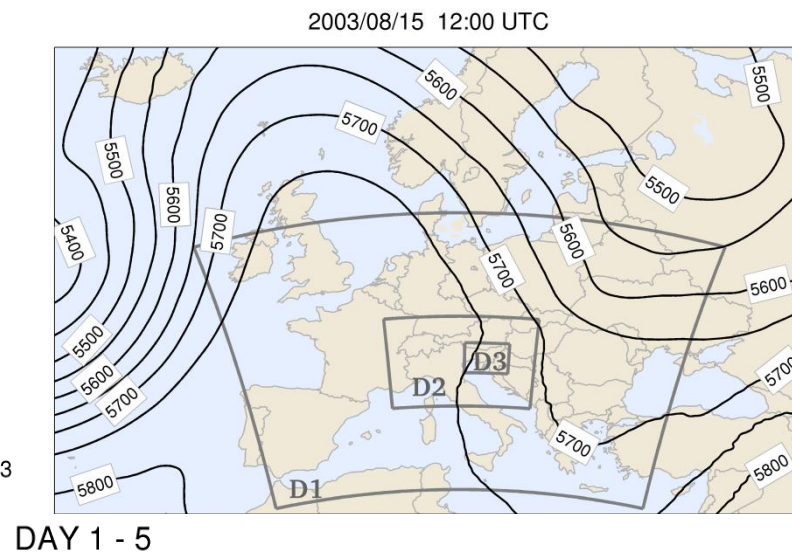
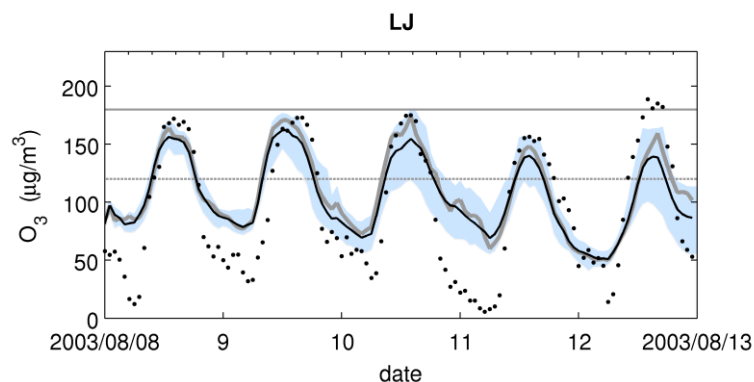Episode: January 2 - 4, 2011

Model evaluation: ALADIN/CAMx

- January 2011 PM10 episode

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, additional 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 groups who participate with WRF/Chem model

Future plans

- **ESA PECS project:** Multivariate relationships between the aerosols, moisture and winds in four dimensional data assimilation for the global monitoring for environment and security (starting January 2014)

- **Modelling impact of aerosols on fog formation** (with the purpose to a) understand the impact, b) potentialy improve the model forecast)

- **Studing and including Saharan dust** impact in operational AQ forecast

- **AQ forecast with chemical data assimilation…**

CONCLUSIONS

- Main modelling systems: WRF/Chem and ALADIN/CAMx

- High ozone levels over Mediterranean Slovenia are explained by formation of ozone-rich layer above the area of Northern Adriatic

- High PM10 episodes are related to complex terrain, low wind conditions, temperature inversions and increased heating during wintertime

- Main qualitative characteristics of selected air pollution episodes can be well represented by numerical models

- For better quantitative agreement improvements in input data, different model parameterizations, initial and boundary conditions, are needed (statistical model better than numerical) - additional measurements needed