

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

COST Action TD1105

## 4<sup>th</sup> International Workshop *EuNetAir* on

### *Innovations and Challenges for Air Quality Control Sensors*

FFG - Austrian Research Promotion Agency - Austrian COST Association

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## The air pollution in the cross-border region Turkey-Bulgaria: model simulations vs. measurements



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# The region

- Cross-border area (10 000 km<sup>2</sup>)  
Protected areas, rich biodiversity
- Low population density ( 53 / km<sup>2</sup>)
- Without big emission sources



# Main goal of the study

- Reveal main AQ problems based on:
  1. Available routine AQ observations
  2. Wet deposition data from field campaigns
  3. Results from the NIMH modeling system (WRF – CMAQ)

The focus today:

- Comparing model results to observations:
  - **O<sub>3</sub>, SO<sub>2</sub>, PM<sub>10</sub>** at 3 AQ stations
  - **sulphur wet deposition** at 2 BG coastal sites.

*The study was supported by a project, funded by EU IPA  
BG – TR cross border Programme CCI No: 2007CB16IPO008*

<http://saap4future.ecobg.org/>

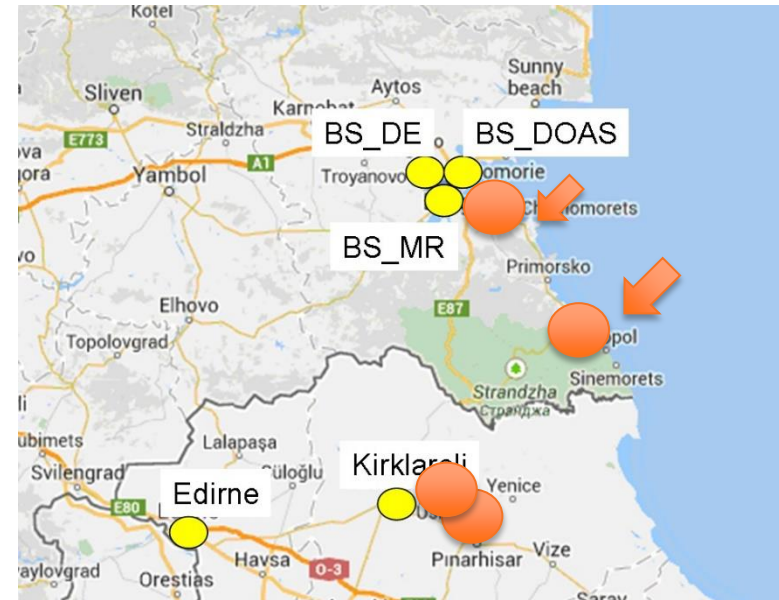
# AQ model at NIMH: WRF-CMAQ

- **3 nested domains** (EU – 81km, Balkan – 27km, Bulgaria – 9km)
- **Meteorological:** WRF v.3.2.1; Driven by NCEP/GFS ( $\Delta x$  1°x1°,  $\Delta t$  - 6h); Analysis nudging on the EU domain
- **Chemical Transport:** CMAQ v. 4.6; CB4 mechanism
- **Emissions:**
  - domain “Bulgaria” – National Emission Inventory for 2010,
  - all other domains - TNO for 2005;
- The system is **operationally running** at NIMH, 72h forecast for  
O<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub>

<http://www.meteo.bg/en/cw>

# The AQ monitoring sites

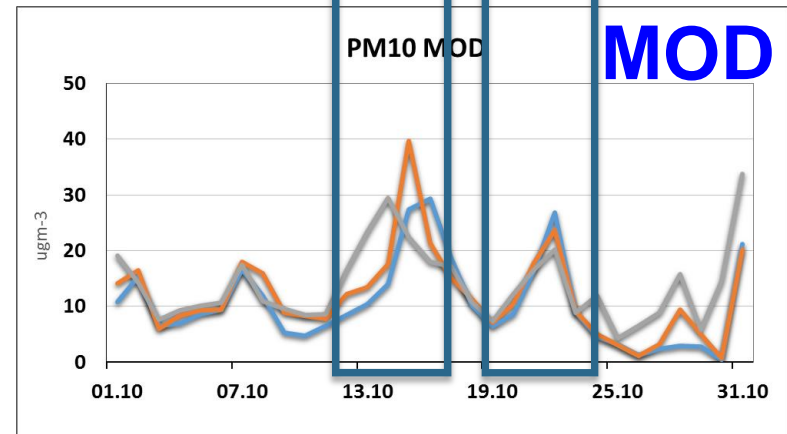
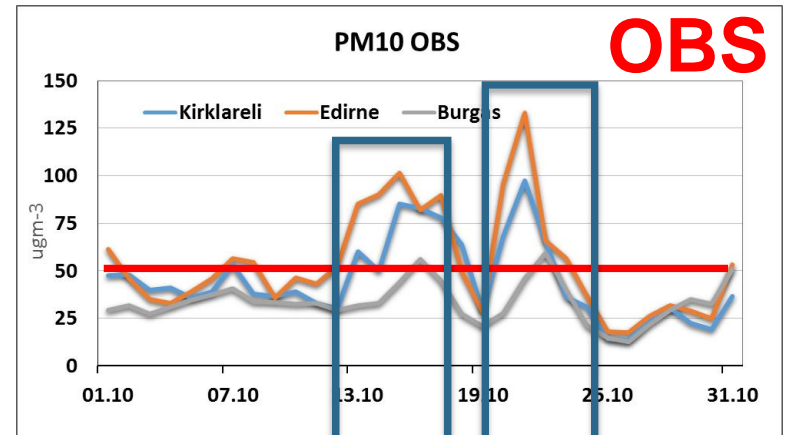
- Routine at 3 urban areas:
  - Burgas (BG)
  - Kirklareli (TR)
  - Edirne (TR)
- **Wet deposition** campaigns (Jun-Nov 2014)
  - **rural Ahtopol (BG)** ↘
  - **urban Burgas (BG)**
  - urban Kirklareli (TR)
  - suburban Kaynarca (TR)



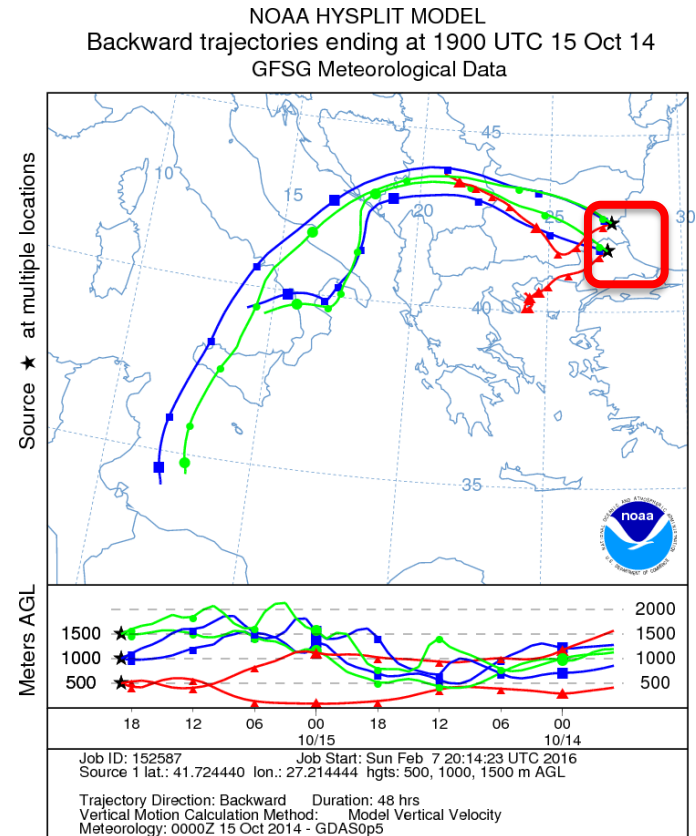
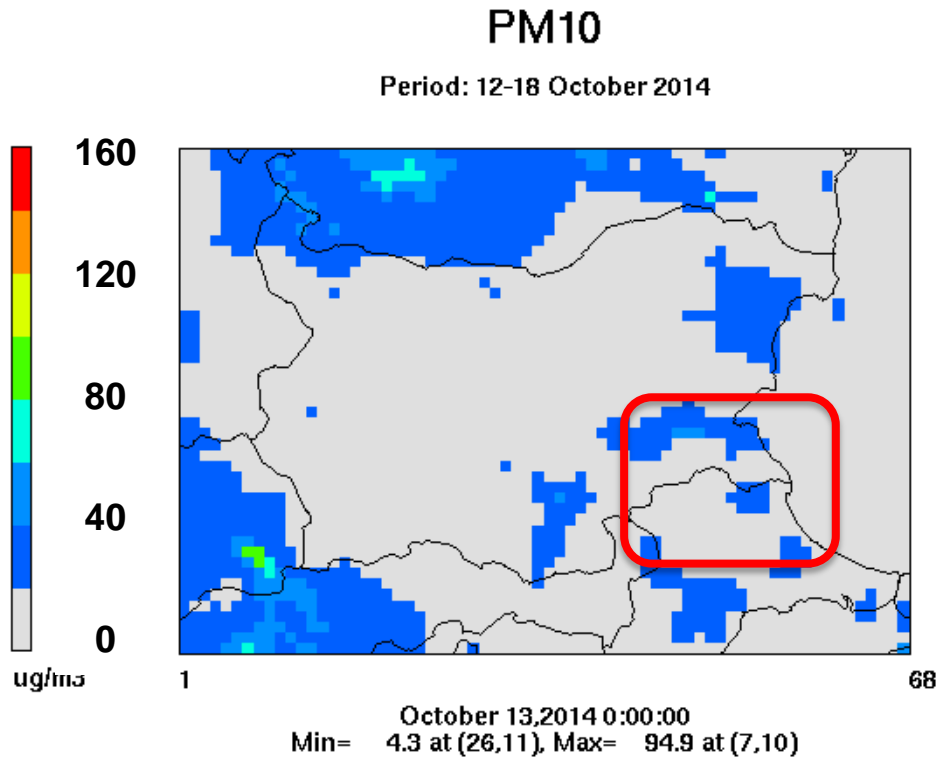
WADOS: Wet and dry only deposition sampler

# PM10 – daily means in October 2014

- Monthly PM10 is underestimated:  
1.5-2 times at BG stations  
3 – 4 times at TR stations
- Exceedances DLV ( $50 \mu\text{g m}^{-3}$ ):  
observed: 26  
modelled: 0
- Correlation: 0.56 – 0.78



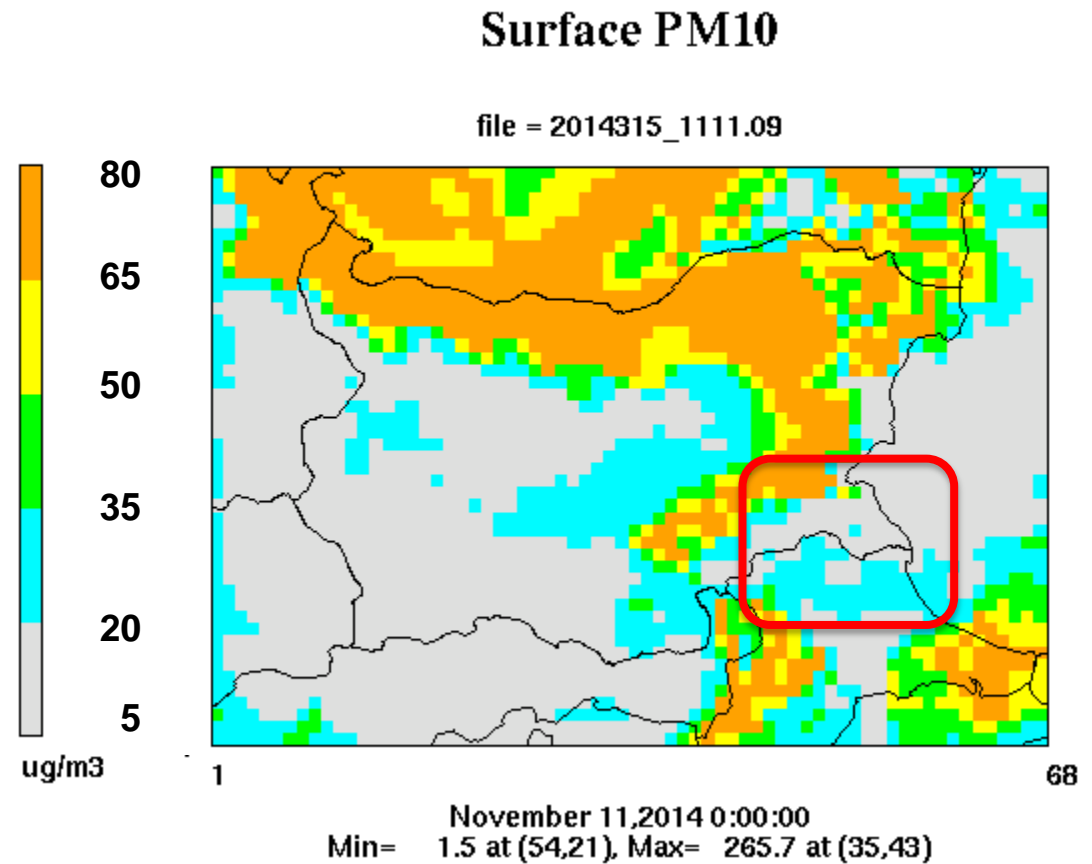
# High pollution episode – 14-16 Oct.2014



- Approaching flow from NW turning in the region from NE and SW

# PM10 : 11- 13 November 2014

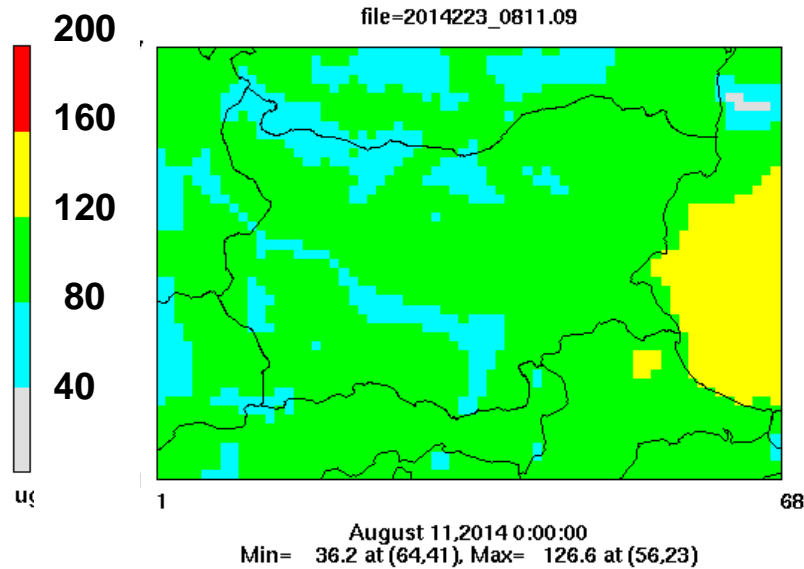
- Example: surface PM10 hourly concentrations
- Anticyclonic conditions and inversions



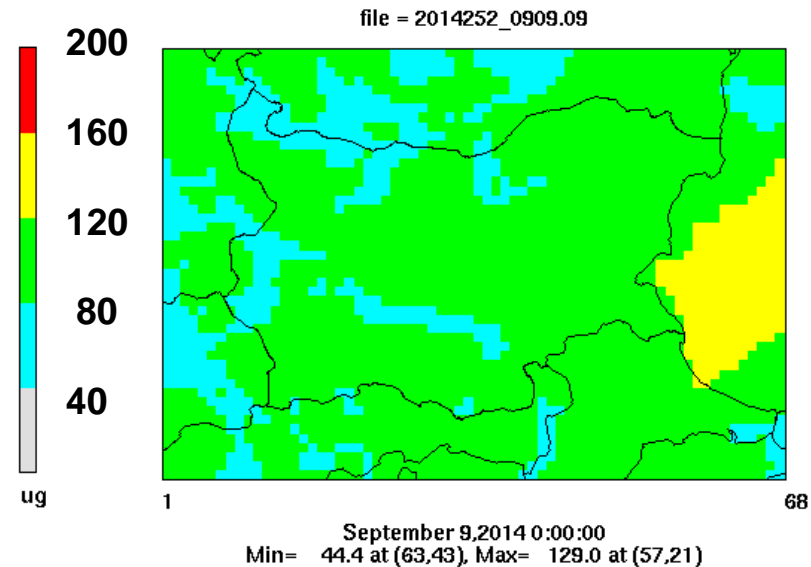


# Ozone – modelled hourly variation

## AUGUST 9-11



## SEPT 9 - 12



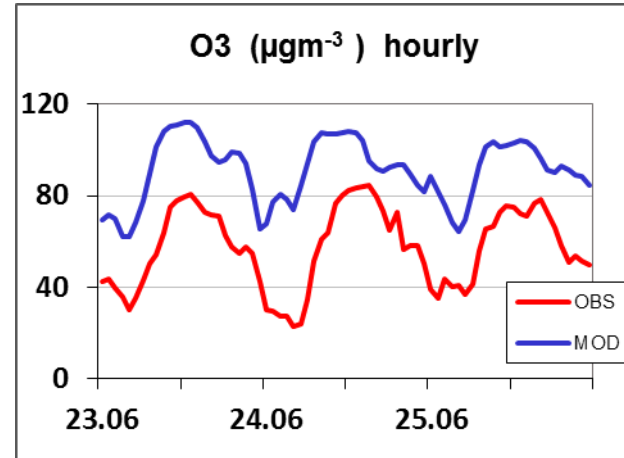
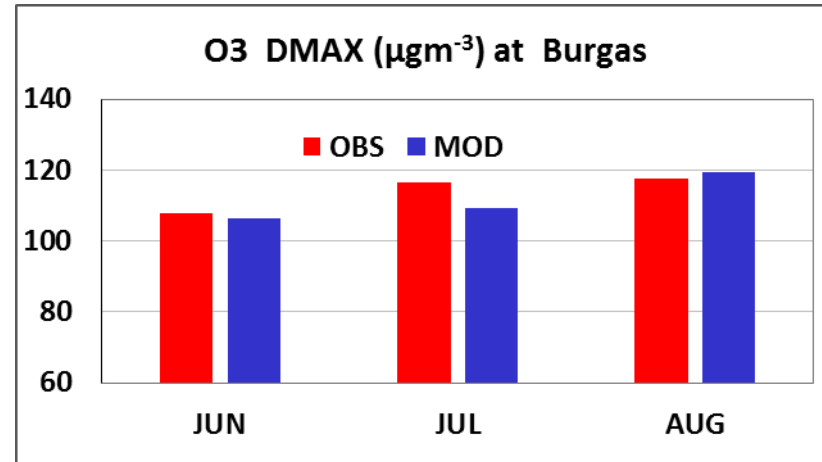
- High ozone levels along the coast, extending sometimes deep inland

# Ozone at the coast - Burgas

Monthly mean of O<sub>3</sub>  
DMAX: bias about 5 -  
10%

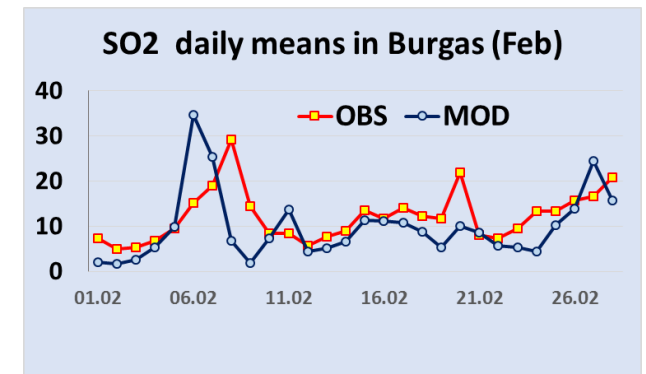
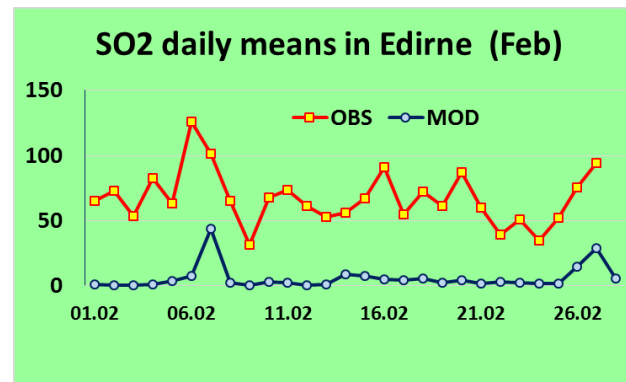
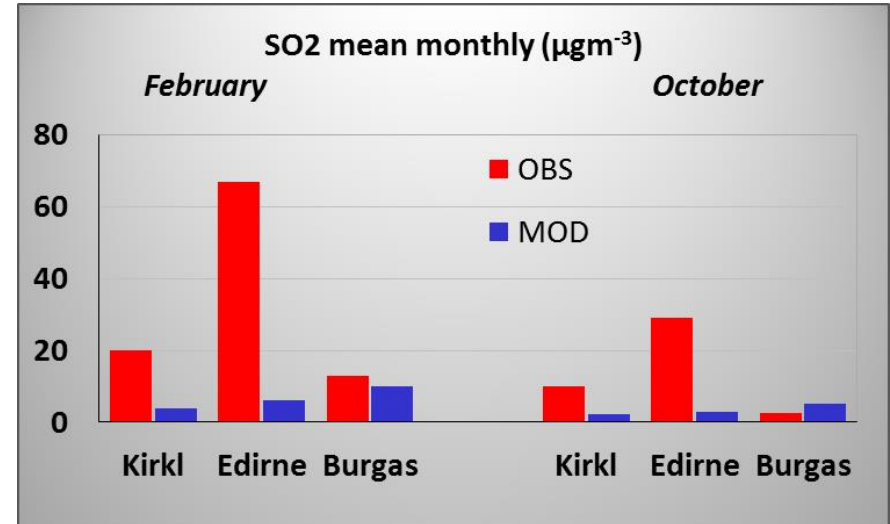
Hourly mean values –  
Overestimation,  
especially at night-

Correlation coefficient  
for June 0.7



# SO<sub>2</sub> – February and October

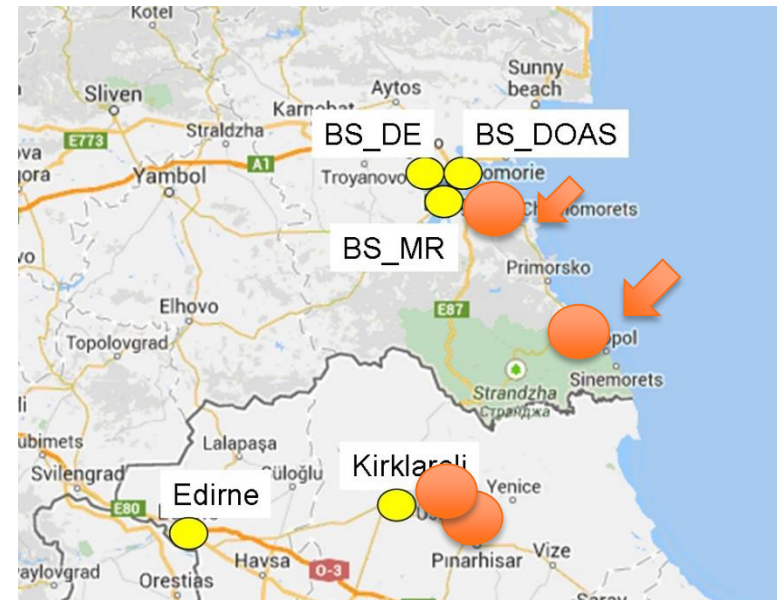
- High SO<sub>2</sub> at Edirne (TR)  
62 µgm<sup>-3</sup> (Feb) 29 µgm<sup>-3</sup> (Oct)
- Model underestimation at TR sites (lack in emissions)
- Correlation  
at TR sites 0.3  
at BG site 0.48



# Wet deposition of sulphur ( $\text{kg ha}^{-1}$ )

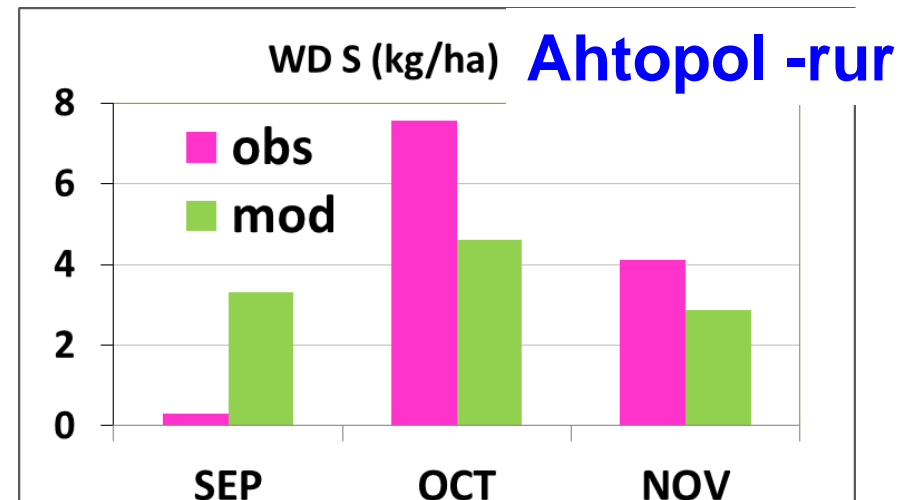
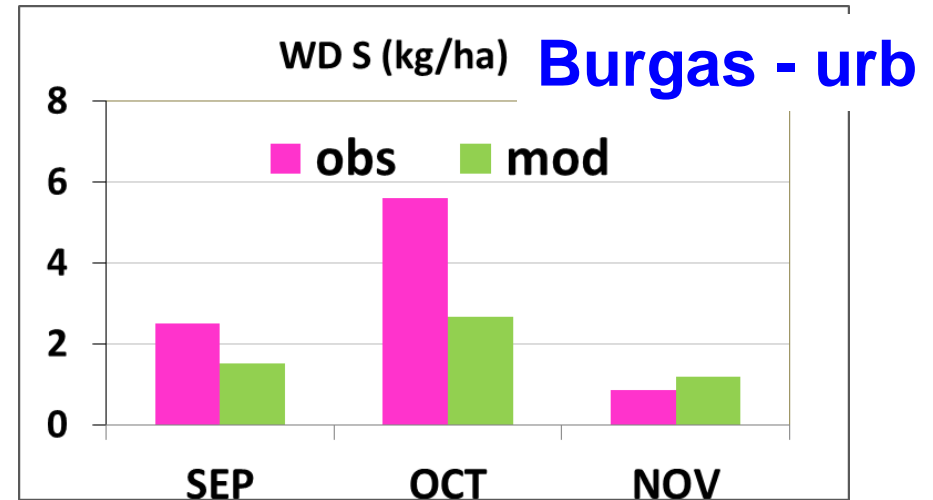
- Monthly means  
SEP, OCT , NOV 2014

at the BG coastal sites  
Burgas (urb) and  
Ahtopol (rur)



# Wet deposition of sulphur ( kg $\text{ha}^{-1}$ )

- Bias: 30%- 50%
- Rain is underestimated especially in October
- The model indicates **higher values at the rural site Ahtopol** (as observations)



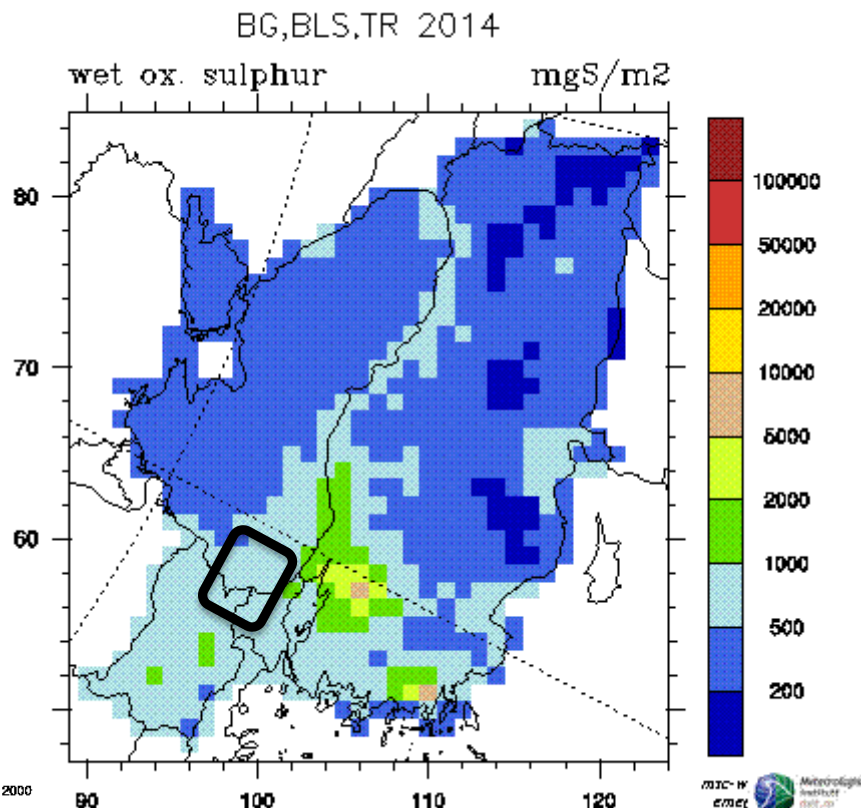
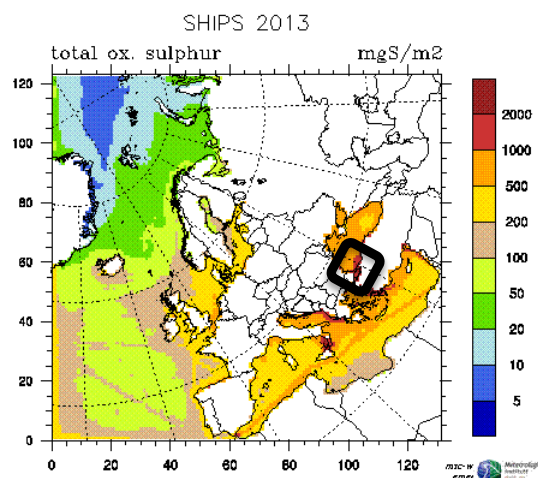
Sep – Nov 2014	Ahtopol	Burgas
OBS (S kg/h)	12	9
MOD (S kg/h)	11	5

# Wet deposition of oxidised S – EMEP model

- EMEP model (50 x 50 km)
- Yearly values 2014  
5 - 10 kg/ha
- Ships contribution might be significant, since Black Sea is non in the “Sulphur Emission Control Areas”



Total ox. sulphur from ships, 2013



Source: <http://webdab.emep.int>

# CONCLUSIONS

- **Main problems in the CBR BG – TR: PM<sub>10</sub> in winter, SO<sub>2</sub> in the TR part, O<sub>3</sub> in summer along the coast**
- **The region is impacted by regional & long range air pollution transport**
- **Some open questions:**
  - deficit in model emissions and regional emission inventories;
  - limited number of observations outside big urban areas;
  - lack of source apportionment measurements
  - relation ship emissions and sulphur wet deposition;
  - effects on ecosystems

**Thank you for your kind attention !**