Photo: Budapest, 2-4 November 2011

# Analyses of elevated PM10 concentrations related to drought event in Eastern & Southeastern Europe, November, 2011

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Croatian Civil Aviation Agency

Founded in 1861

National Institute for Public Health and the Environment
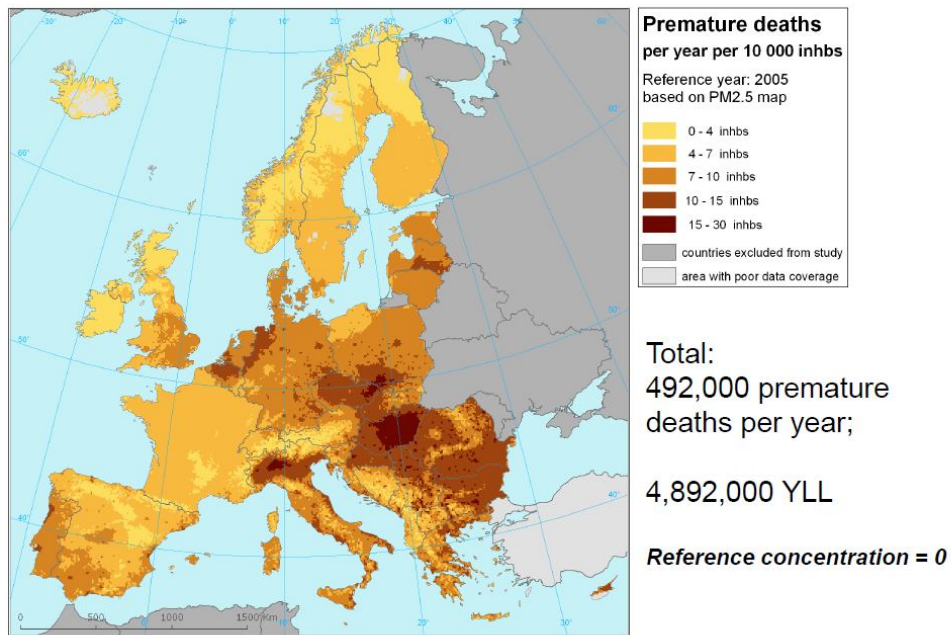Ministry of Health, Welfare and Sport

Meteorological and Hydrological Service

# Why particles?

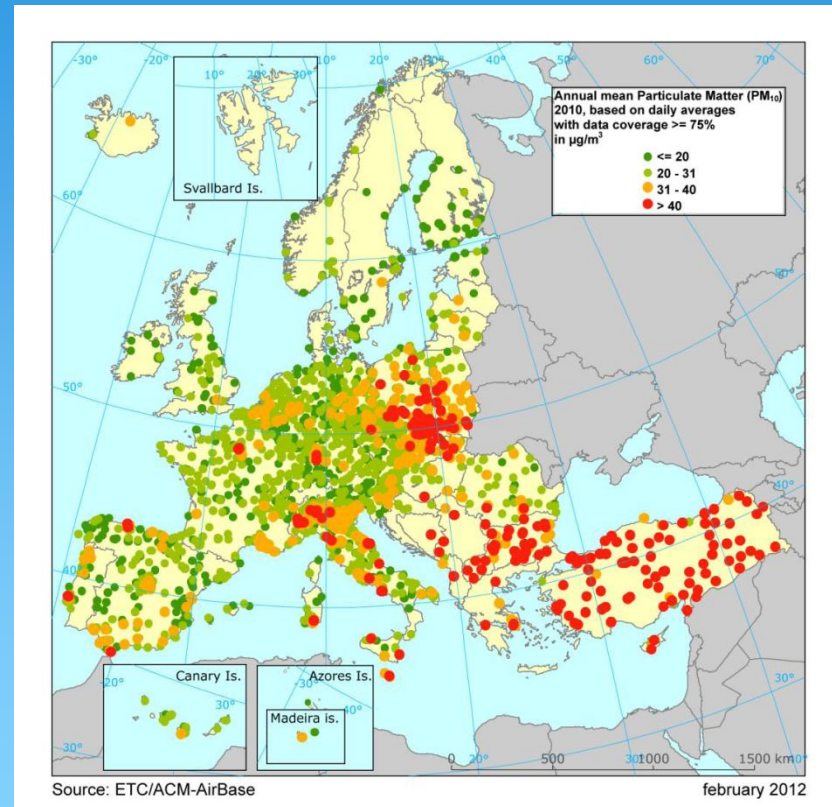**Premature mortality attributable to PM$_{2.5}$ in EU (2005)**



Premature deaths
per year per 10 000 inhbs

Reference year: 2005
based on PM2.5 map

- 0 - 4   inhbs
- 4 - 7   inhbs
- 7 - 10  inhbs
- 10 - 15 inhbs
- 15 - 30 inhbs
- countries excluded from study
- area with poor data coverage

Total:
492,000 premature
deaths per year;

4,892,000 YLL

*Reference concentration = 0*

Source: F. De Leeuw, J. Horalek, ETC/ACC, 2009

- PM – one of major AQ concerns -adverse health effects
- Sources:
  - direct-anthropogenic, natural & Secondary
- Complex mixture:
  - solid and liquid parcels of (organic matter, core elements, SIA, trace metals)
- WHO (January 2013): Review of evidence on health aspects of air pollution – REVIHAAP Project: There is no 'safe' level for PM!

# European aerosol phenomenology

- EU countries report exceedances of allowed 35 of daily PM LV=50 µg/m$^3$ or yearly average LV=40µg/m$^3$

- Sources need to be determined and regulated

- **Source apportionment methods**: chemical speciation, atmospheric-chemistry models, trajectories, analyses of meteorological parameters related to PM episodes

- Effects of climate change needstto be estimated



Annual mean Particulate Matter (PM$_{10}$) 2010, based on daily averages with data coverage >= 75% in µg/m$^3$

- <= 20
- 20 - 31
- 31 - 40
- > 40

Svalbard Is.

Canary Is.   Azores Is.   Madeira is.

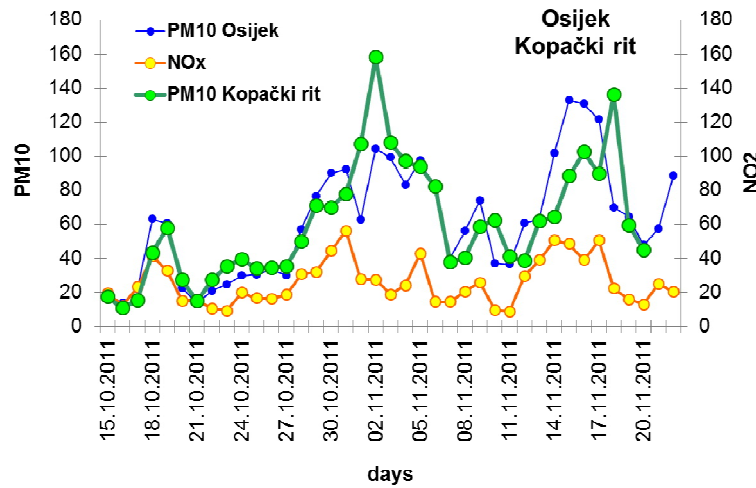Source: ETC/ACM-AirBase          february 2012

# Air pollution episodes

- Two air pollution episodes occurred in November, 2011.

- Unusually high daily PM10 concentrations ~ 140 µg/m$^3$ were observed in Eastern and Southeastern countries

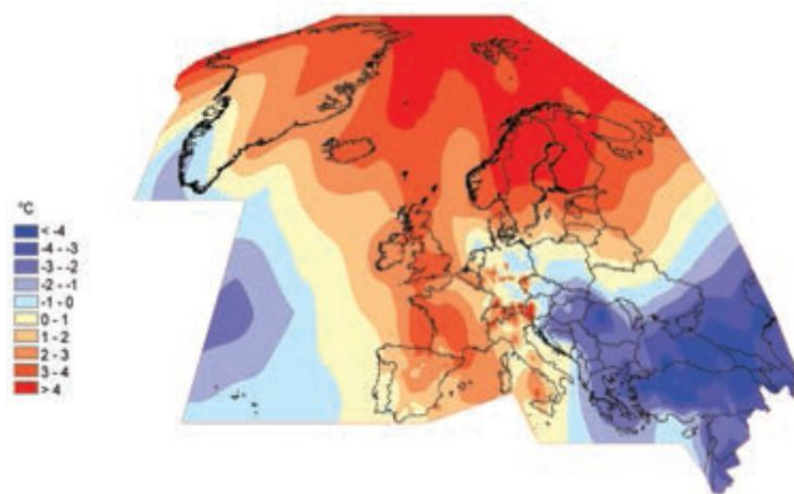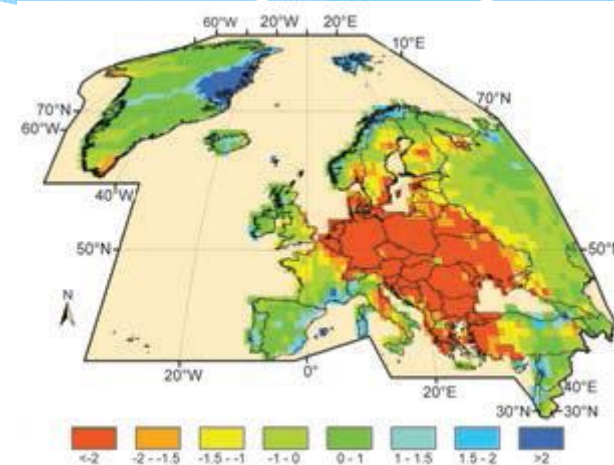  - 1. episode ~ 2. Nov.

  - 2. episode~ 14.-18. Nov.
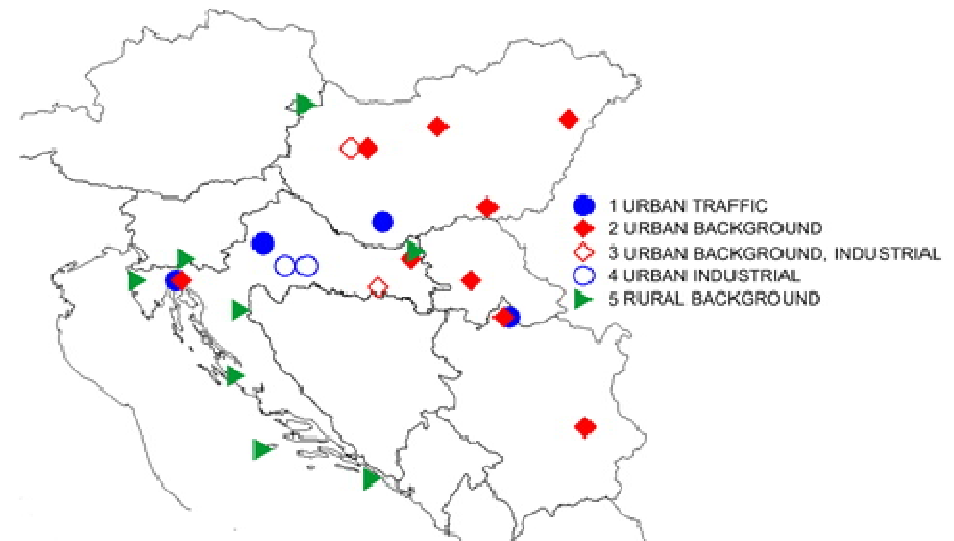
# Observed PM concentrations
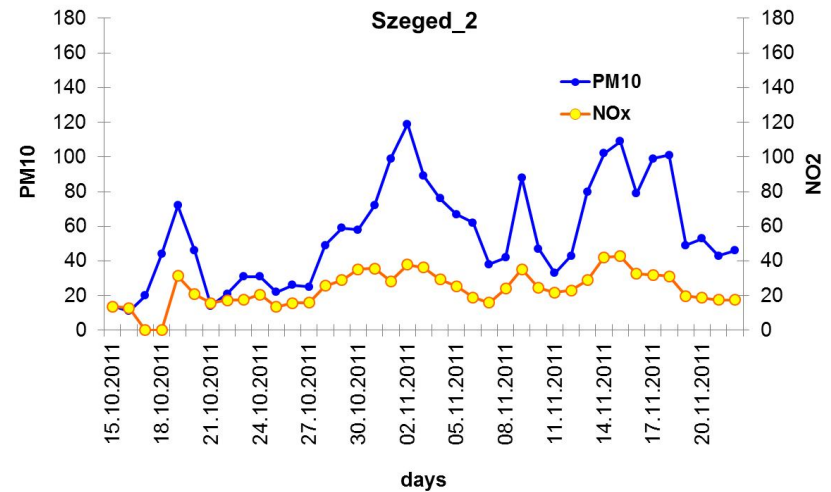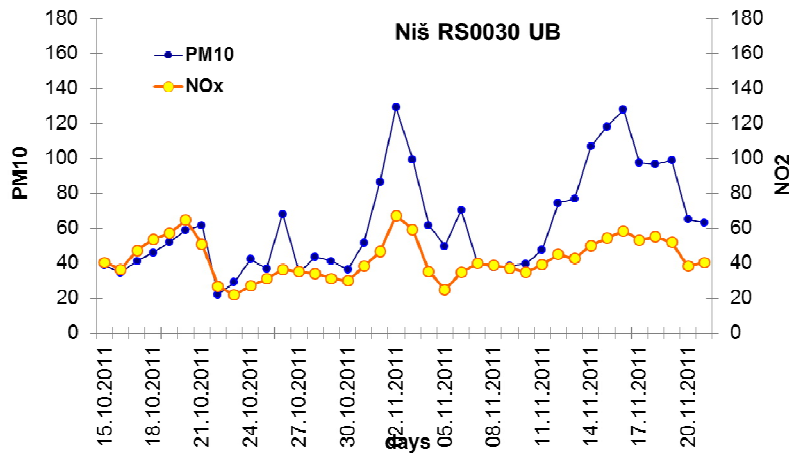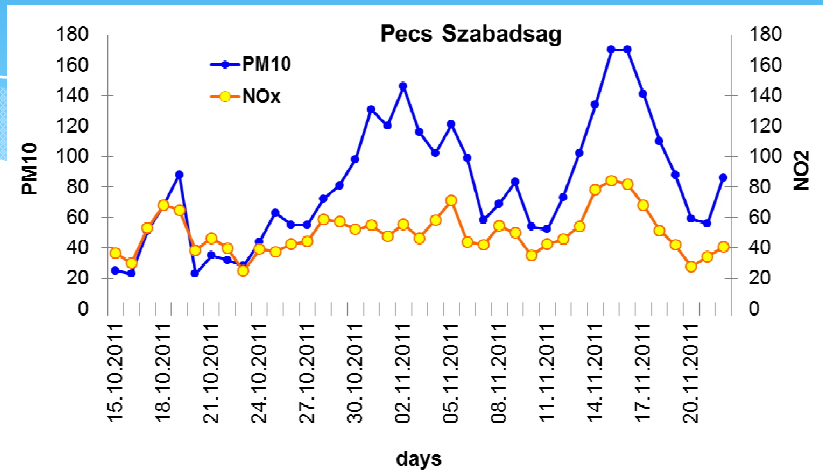
# Weather in November 2011



Mean temperature anomalies in Europe (°C, 1961–90 base period). (Source: Deutscher Wetterdienst)

Standardized Precipitation Index (Pietzsch and Bissolli 2011; departure from 1961–90 base period)

Long dry spells result in higher PM concentrations due to decreased wet removal & increased dryness of soils-resuspension
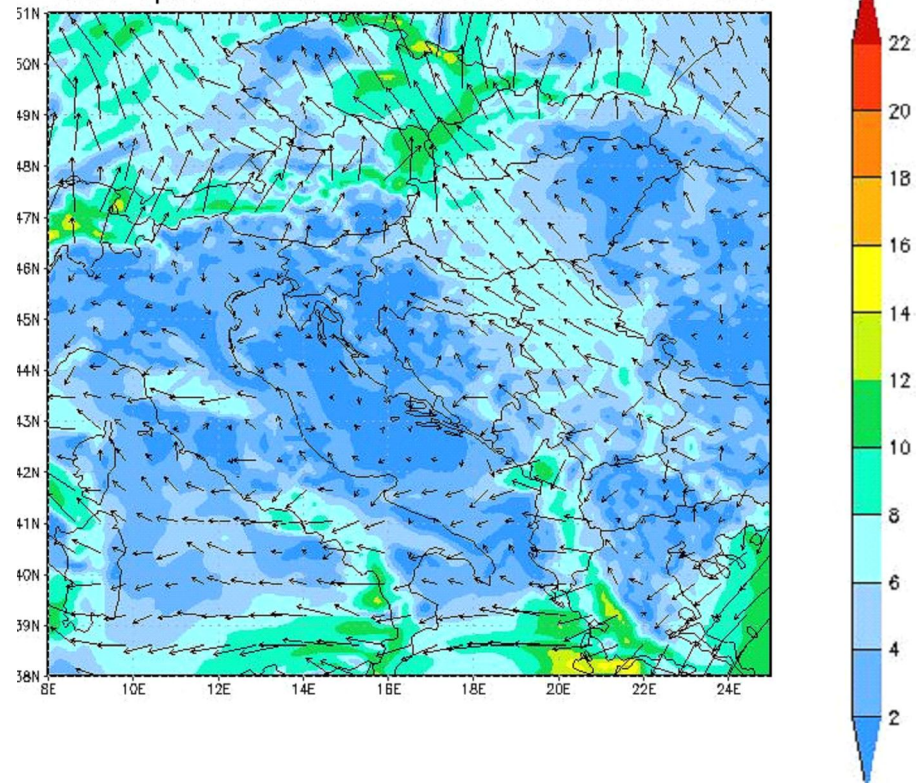
# Synoptic charts-WRF model results

2 November 18 UTC

2 November 2011 00 UTC



Wind speed start 1-11-2011 in 00UTC +42h
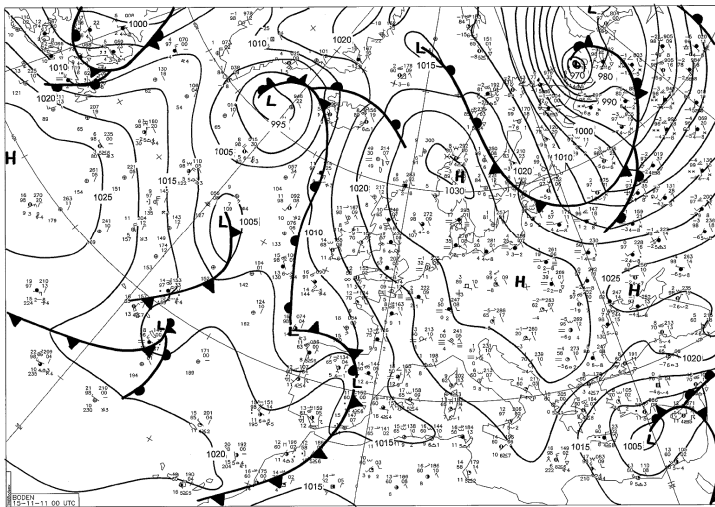
Surface diagnostic charts over Europe (Source: European Meteorological Bulletin)
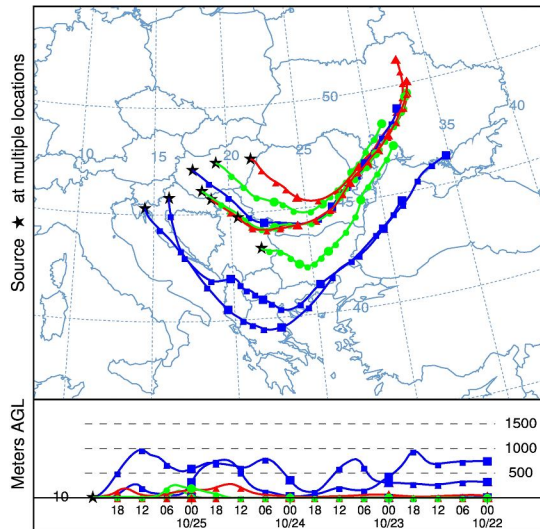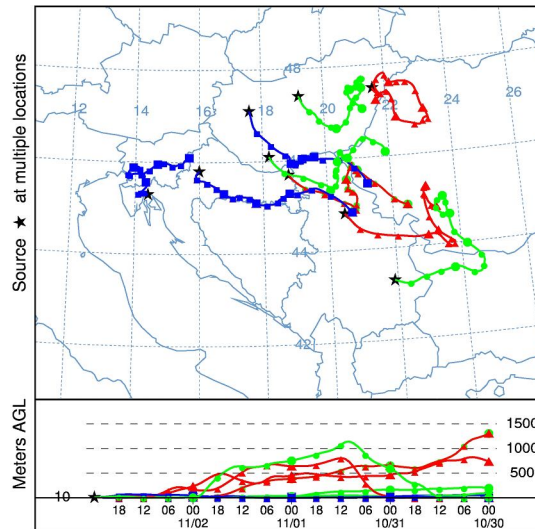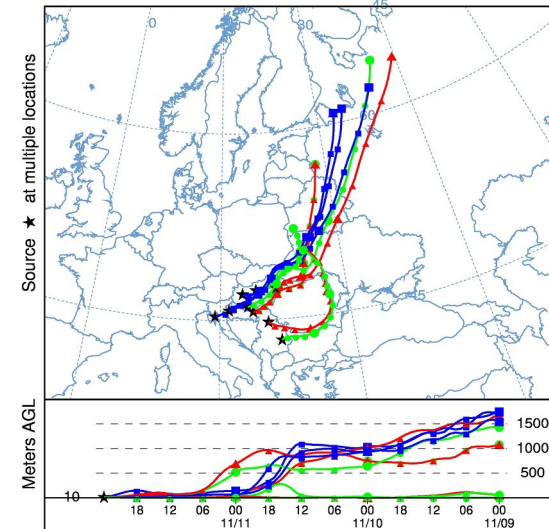
# Trajectories - 1. episode



NOAA HYSPLIT MODEL
Backward trajectories ending at 0000 UTC 26 Oct 11
GDAS Meteorological Data

NOAA HYSPLIT MODEL
Backward trajectories ending at 0000 UTC 03 Nov 11
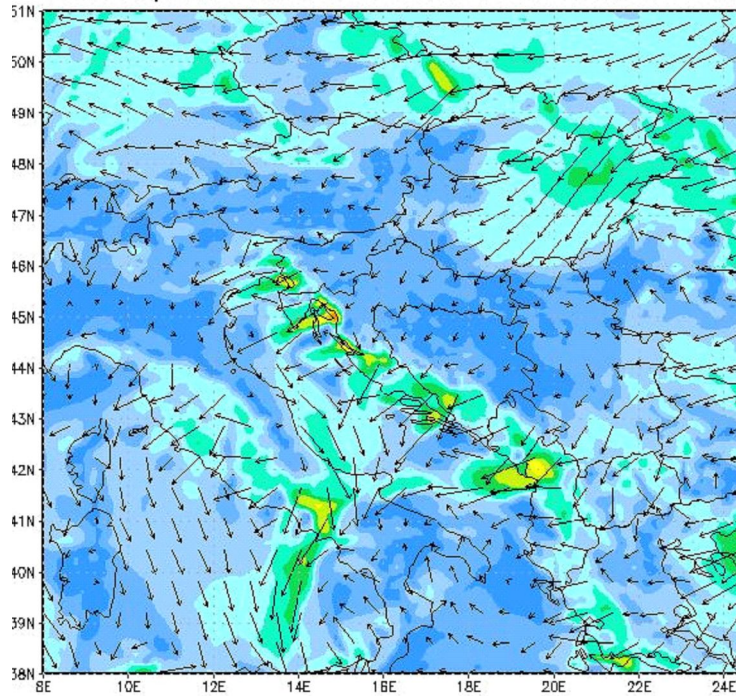GDAS Meteorological Data

NOAA HYSPLIT MODEL
Backward trajectories ending at 0000 UTC 12 Nov 11
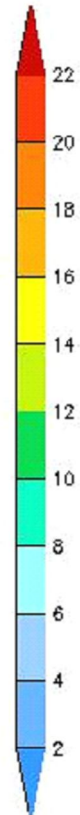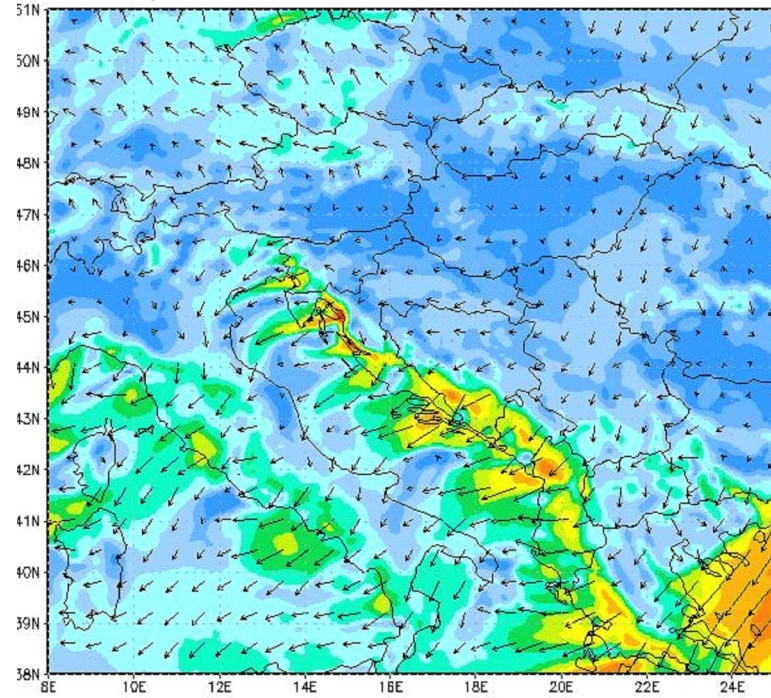GDAS Meteorological Data

# WRF wind fields

10 November 18 UTC

12 November 18 UTC



Wind speed start 8-11-2011 u 00UTC +66



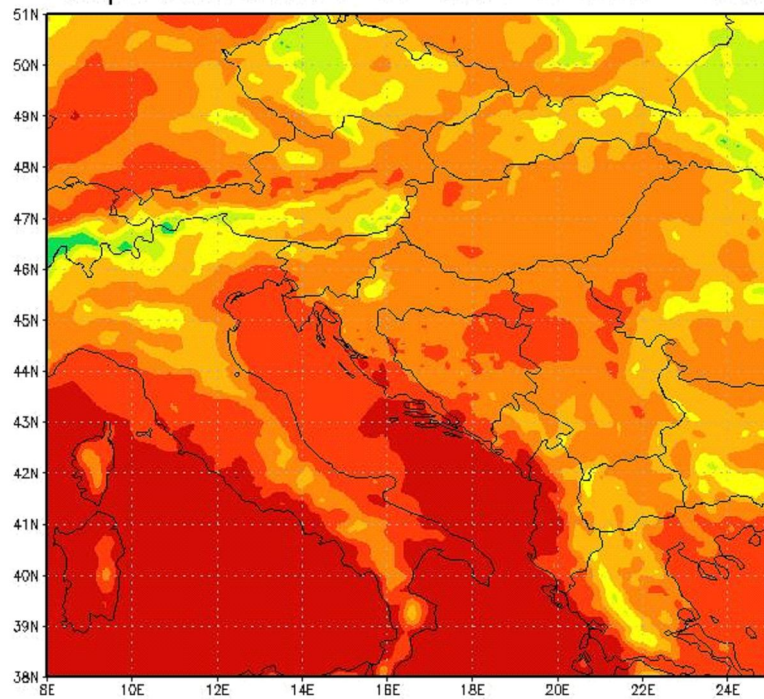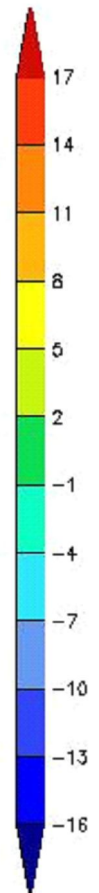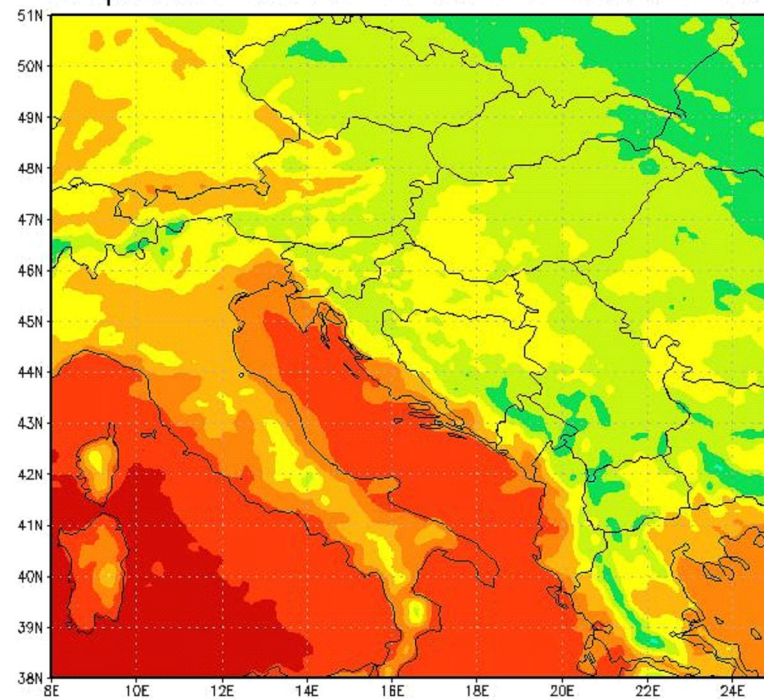Wind speed start 8-11-2011 u 00UTC +114h

# WRF -temperatures
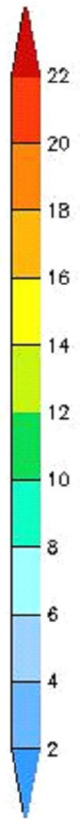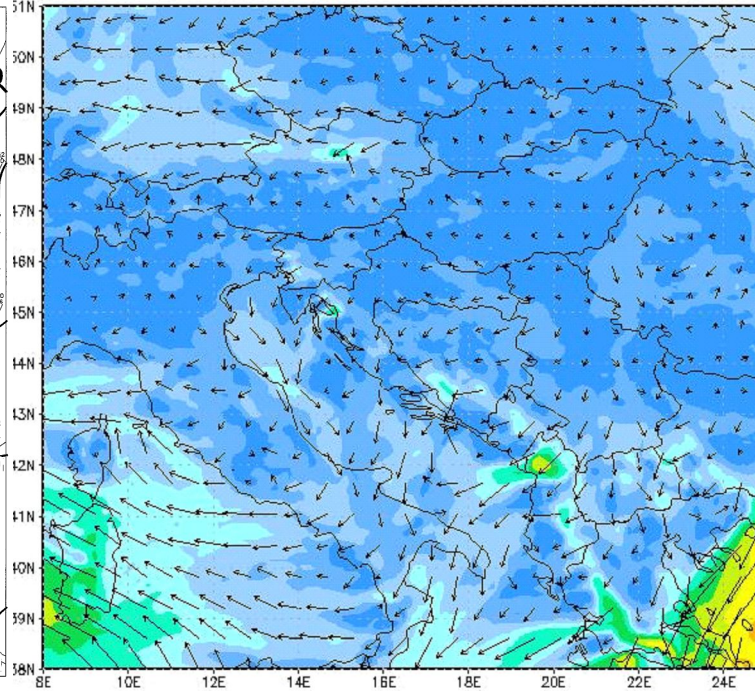


2 November 12 UTC

15 November 12 UTC

# Wrf-wind-cont.

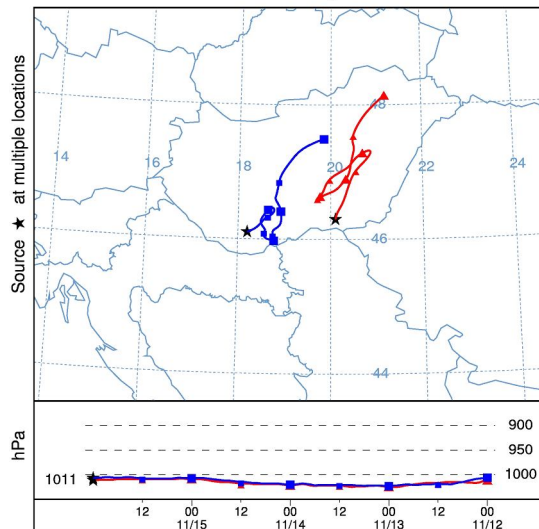14 November 2011 00 UTC
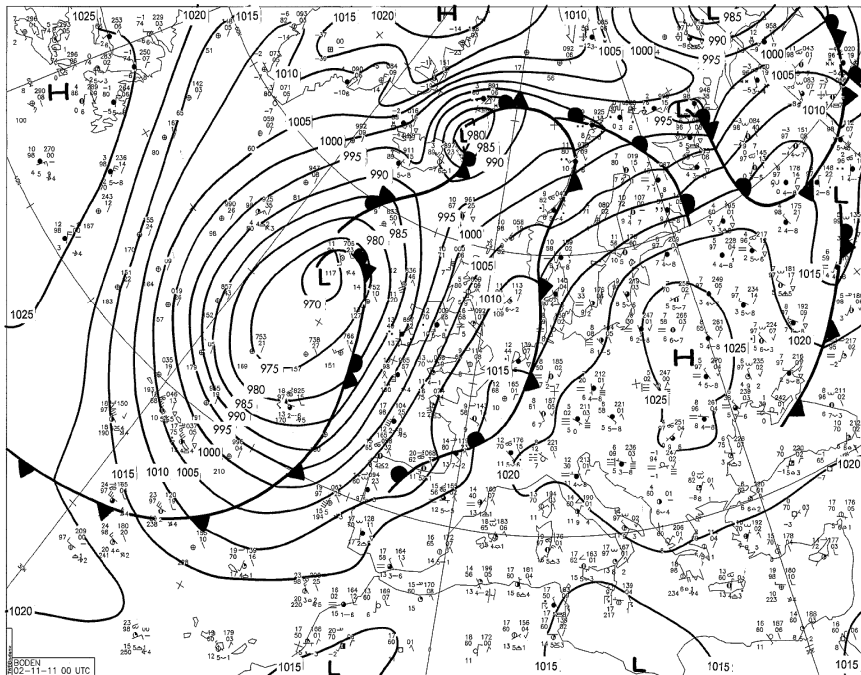
15 November 12 UTC
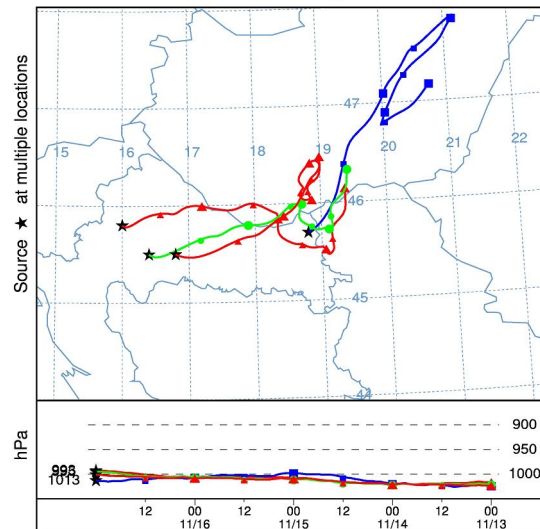


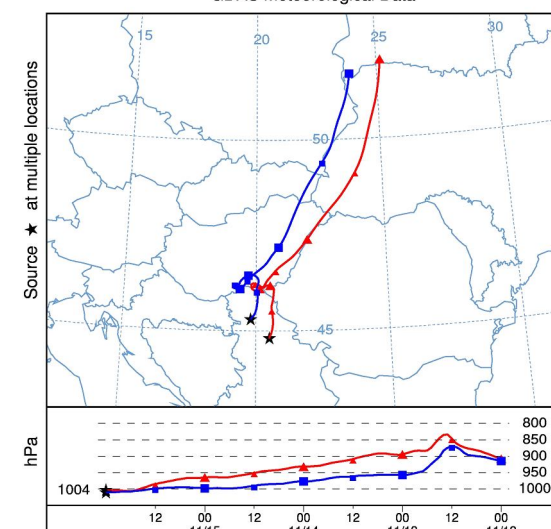Wind speed start 8-11-2011 u 00UTC +180h

# Trajectories-2.episode



NOAA HYSPLIT MODEL
Backward trajectories ending at 0000 UTC 16 Nov 11
GDAS Meteorological Data

NOAA HYSPLIT MODEL
Backward trajectories ending at 0000 UTC 17 Nov 11
GDAS Meteorological Data

NOAA HYSPLIT MODEL
Backward trajectories ending at 0000 UTC 16 Nov 11
GDAS Meteorological Data

# Conclusions

* Extreme weather events (drought) affects air quality
* Stable met. cond. over Eastern Europe under infl. of large HP system enabled the acumulation of PM which led to high regional concentrations over 2 periods in November 2011.
* Back trajectories from all stations with peaks in PM10 concentrations were under the influence of the same air masses, southeastern for the first episode and north eastern for the second episode.
* Elevated PM10 concentrations in the second episode are combination of local anthropogenic emissions, regional transport as well as the resuspension over the bare natural and agricultural surfaces in Hungary, Serbia and Croatia driven by the strong wind.
* Future:
    * Chemical analyses of the core elements
    * Frequency of HP system occurence and 'bad' air quality

# Natural source
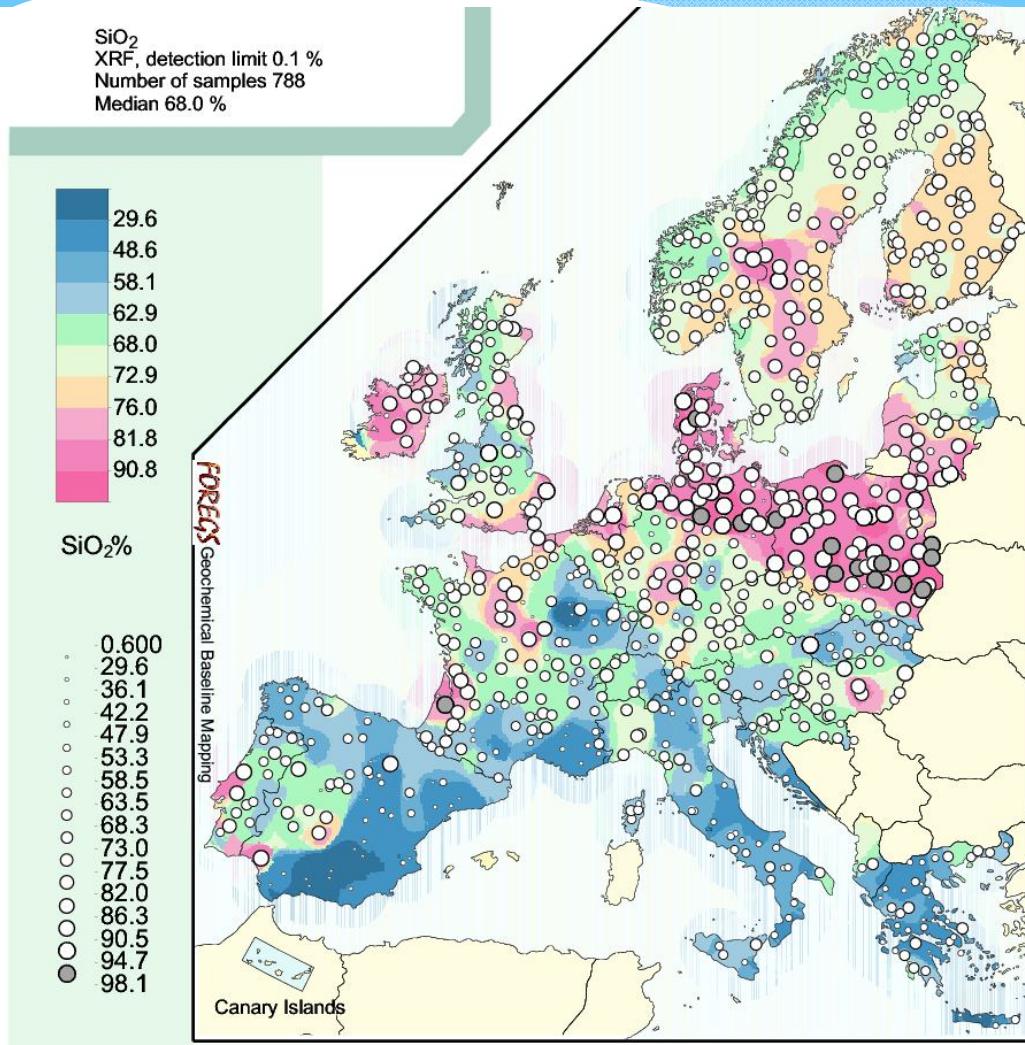


* Trajectories that conects high conentrations with air mases from area that represent natural source (Sahara, desert, bare land).

* High wind speeds that acts as a trigger for resuspension processess

# Satelite data

Global MODIS vegetation indices are designed to provide consistent spatial and temporal comparisons of vegetation conditions.

Global MOD13Q1 data are provided every 16 days at 250-meter spatial resolution as a gridded level-3 product in the Sinusoidal projection.

The enhanced vegetation index (EVI) is an 'optimized' index designed to enhance the vegetation signal with improved sensitivity in high biomass regions and improved vegetation monitoring through a de-coupling of the canopy background signal and a reduction in atmosphere influences.