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

COST Action TD1105

Special Session: *Environmental Case Studies from Mediterranean, Central and Eastern Europe*

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Year: 2012-2013 (*Starting Action*)

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Scientific context and objectives

- **Background / Problem statement:**
  - Air pollution monitoring
    - In background – Hungarian Meteorological Service
    - In cities - Regional Inspectorates for the protection of air, water and nature
  - Air quality modeling (on different time and spatial scale)
    - Long-range transport model – EMEP
    - Decision support models - FLEXPART
    - Regulatory type model – AERMOD (+EDMS)
    - Chemical transport model - CHIMERE

- **Brief reminder of objectives:**
  - Contribution to the WG3 objectives
    - Environmental measurements at laboratory and in field air quality stations
    - Air quality modeling and chemical weather forecasting
  - Contribution to the SIG4 objectives
    - Expert comments for the revision of the Air Quality Directive

Air pollution monitoring

- **What is the aim of this activity?**
  - focus on air quality and environment
  - focus on air quality and human health

- **In the background**
  - identify the impacts of air pollution on ecosystems, human health, materials and climate change
  - detect the long-range transport of air pollutants
- **In the urban areas**
  - follow the concentration levels of toxic pollutants in the urban atmosphere
  - monitor air pollutants relevant to human health (protect the health of human beings)

International regulations of the background monitoring activity

- **EMEP**
  - Monitoring strategy: 2010-2019
  - main objectives: *identify the **impacts of air pollution on ecosystems**, human health, materials and climate change*
  - laboratory intercomparison (air/aerosol an precipitation samples)
  - national data providers
- **WMO - Global Atmosphere Watch (GAW)**
  - Strategic plan: 2008-2015
  - main objectives: *detection of long-term man-made trends in the concentration of greenhouse gases and aerosols related to **climate change***
  - WMO/GAW recommendation for
    - precipitation network (GAW Report No 158 and GAW report No 172)
    - aerosol network (GAW report No. 153)
  - laboratory intercomparison (precipitation samples)
  - national data providers

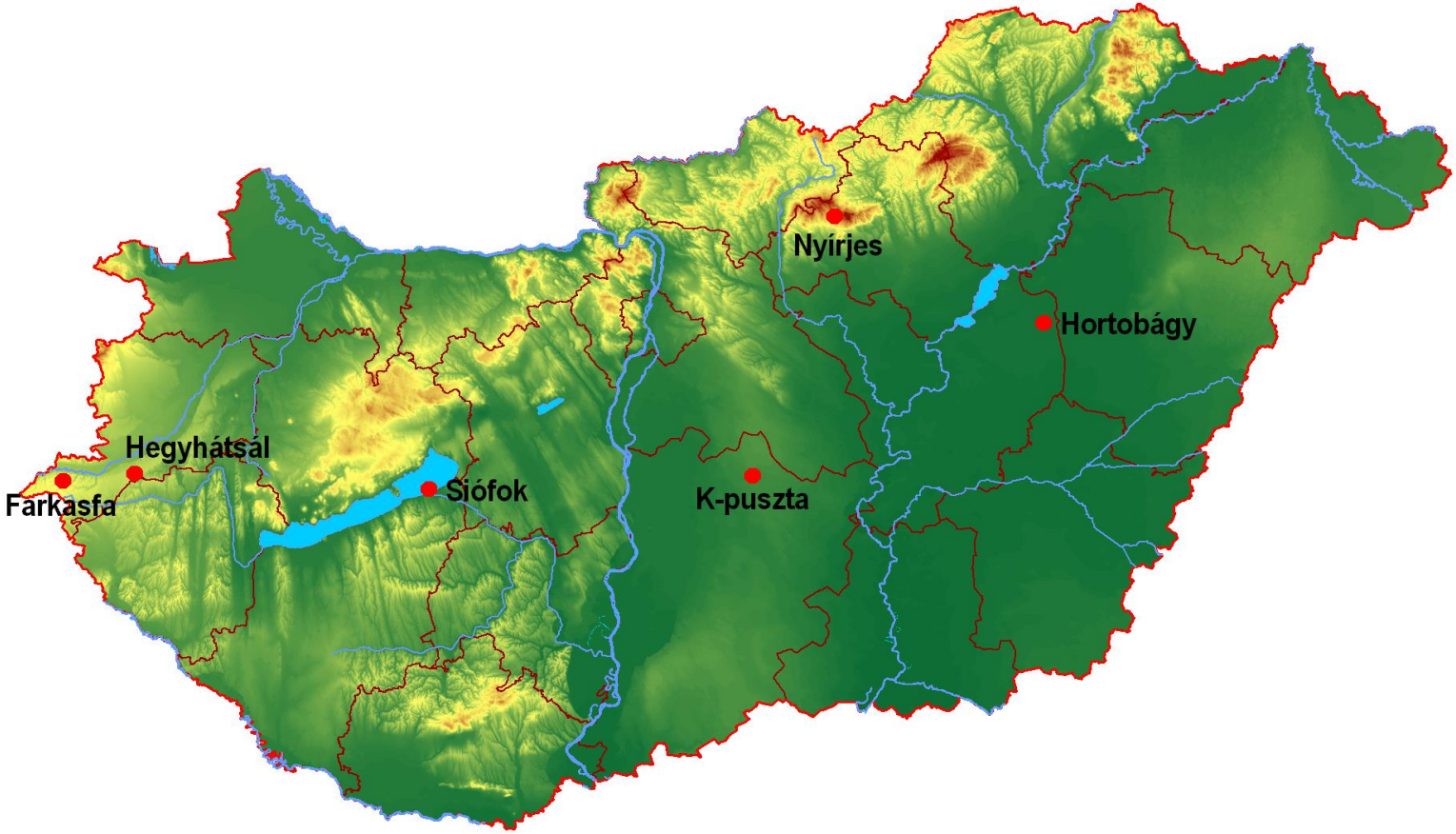
European regulations of urban monitoring activity

- Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive (2008/50/EC)
  - will be updated soon
- European Environment Agency (EEA)
- European Environment Information and Observation Network (Eionet)
- Aquila – Network of National Air Quality Reference Laboratories
  - provide expert judgement
  - promote the harmonization of air quality measurements
  - method development and validation
  - participate in standardization activities

Harmonization of Measurements

- **Inspiration**:
  - Monitoring activity is expensive
  - Do not measure the same components parallel
- **Expectation**:
  - harmonization of urban and background measurements as far as possible
- **Question**:
  - the aim of the monitoring programs are different (how can we harmonize)
  - Different concentration levels of the same pollutants in different conditions
  - Different type of pollutants are in the focus

Background Air Pollution Monitoring Network of Hungary



Monitoring program of K-puszta

- **<u>Trace gases</u>:**
  - SO_2, NO_2, O_3, NH_3, HNO_3
- **<u>Aerosols</u>:**
  - sulfate, nitrate, ammonium, sodium, potassium,
  - calcium, magnesium, heavy metals , PM_{10}, $PM_{2.5}$
- **<u>Inorganic compounds in precipitation</u>:**
  - pH, conductivity, sulfate, nitrate, ammonium, chloride, sodium magnesium, calcium, potassium, heavy metals
- **K-puszta is our reference station, member of the EMEP and WMO/GAW network.**
- **The monitoring program of this station is the widest.**

Monitoring and Modeling, as a tool to study the air quality

- **Air quality monitoring**
  - Accurate, continuous is time, but point-wise in space
  - Monitoring strategy attempts to improve spatial coverage: station sites should represent larger areas
  - expensive
- **Air quality modeling**
  - less accurate, but provide spatial distributions of pollutant concentrations
  - different spatial scales required different approximations
  - cheaper
- **combination the advantages of the two different tools**
  - **Provide more complete assessment of the air quality situation**

Air Quality Modeling in Hungary

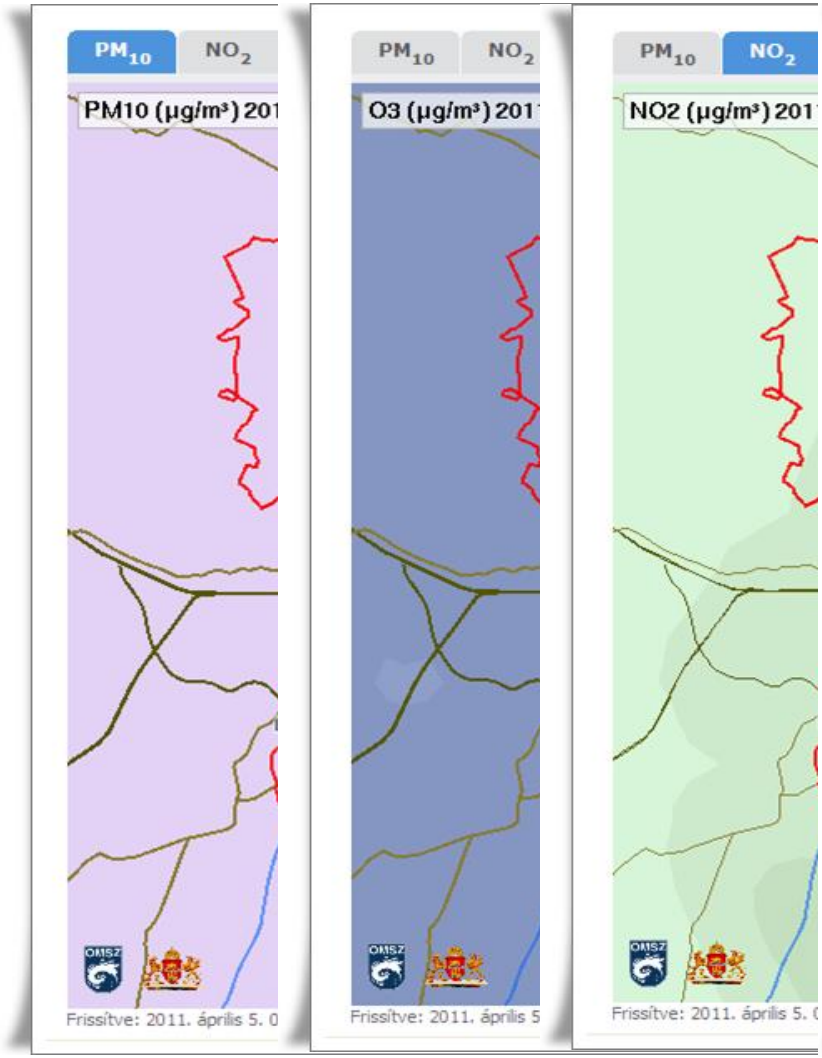
(The models which results we use or which we run)

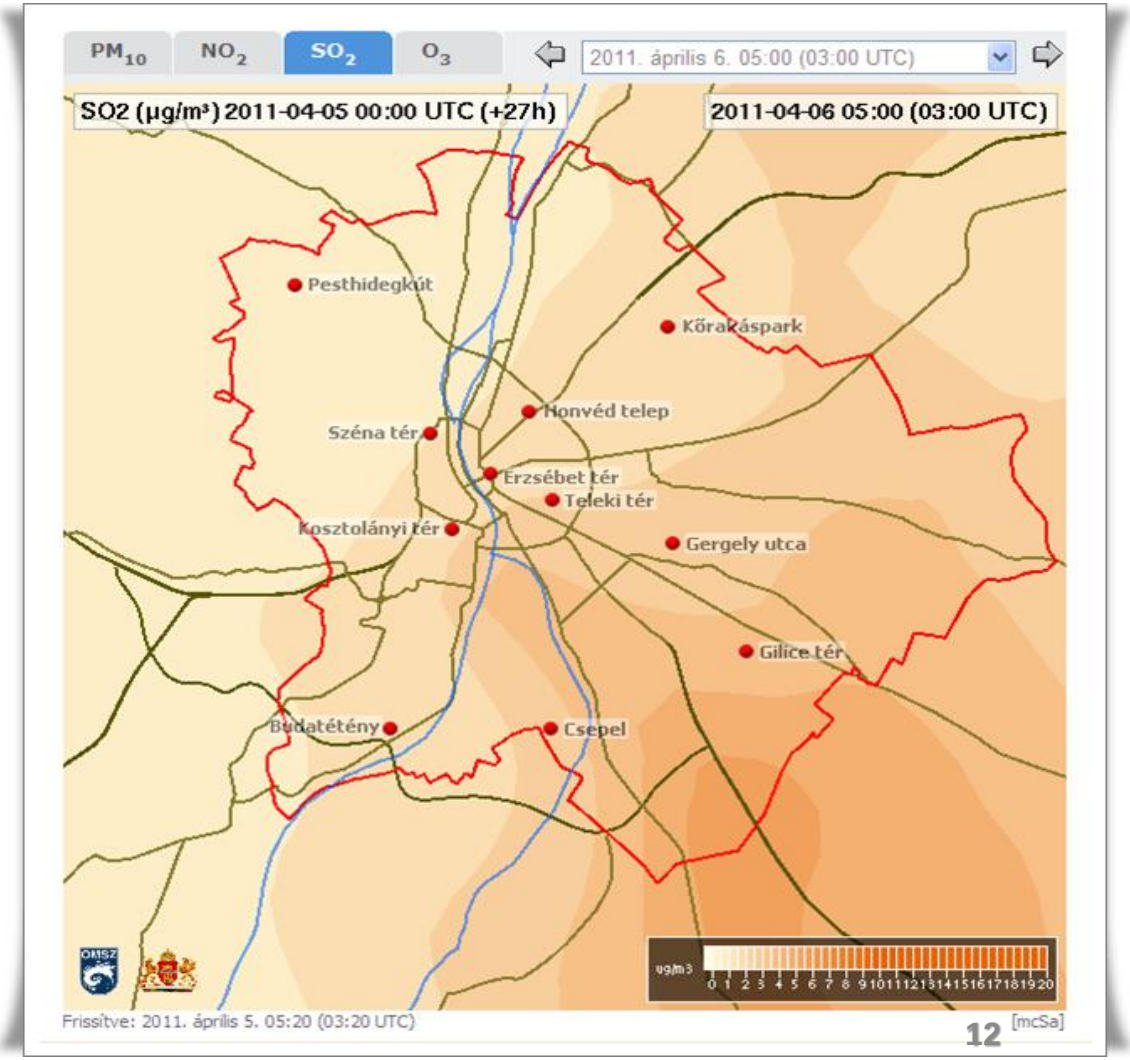
- **Long-range transport model:**
  - EMEP
- **Regulatory model:**
  - AERMOD, (+ EDMS)
- **Lagrangian particle dispersion model (Decision support in case of accident):**
  - FLEXTRA and FLEXPART
- **Chemical weather forecast:**
  - CHIMERE + WRF or. AROME

Chemical weather forecast for Budapest

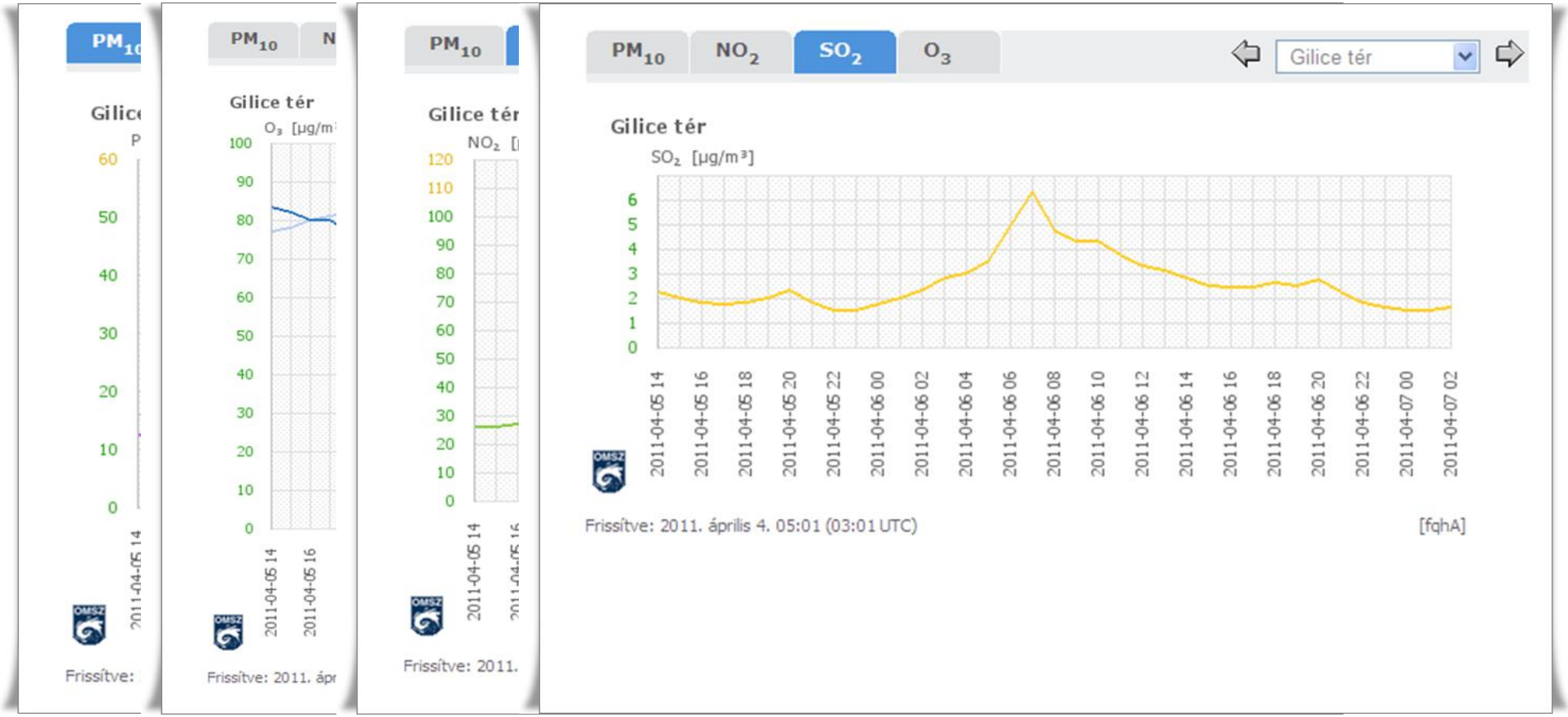
- **To develop a WEB based chemical weather forecasting and information system for Budapest**
- **Chemical transport model – CHIMERE**
- **Emission data**
  - Point sources - power plants
  - Area sources (3 km x 3 km)
    - domestic heating
    - industrial processes
    - traffic - 2004 official traffic count data
- **Meteorological data**
  - WRF (AROME) numerical weather prediction models
- **Visualization – HAWK (Hungarian Advanced WorKstation)**
  - visualization system developed and used by HMS

Chemical weather forecast for Budapest maps





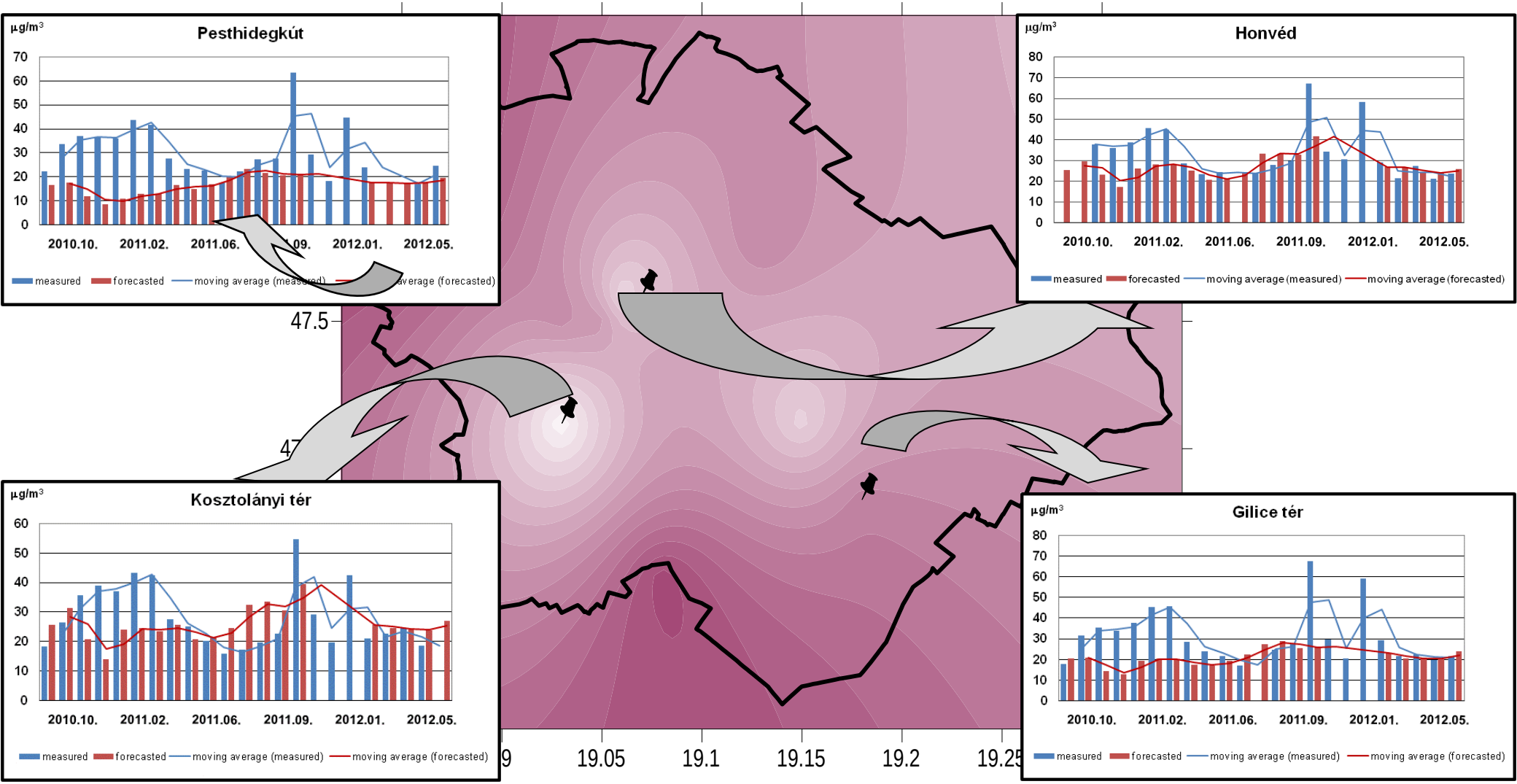
Chemical weather forecast for Budapest diagrams



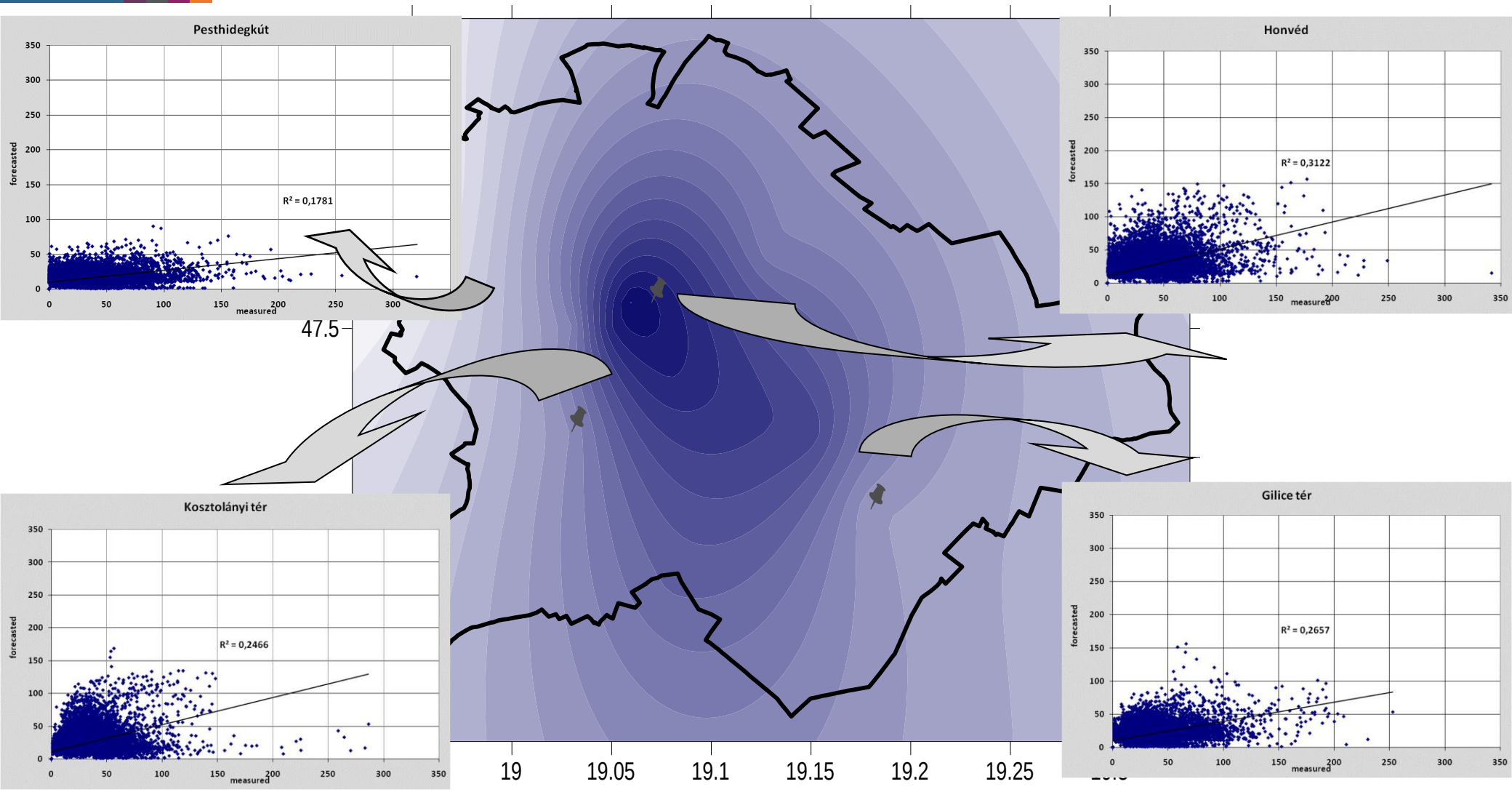
Validation of the system

- 23 months of model run + 11 air quality monitoring stations data
- The O_3 forecast much better than the PM_{10} forecast
- Find the weaknesses of the system
- After the validation we have to make correction on the system
  - improve the meteorological forecast
  - impove the gridded emission data
  - enlarge the calculation area to minimize the effect of boundary conditions

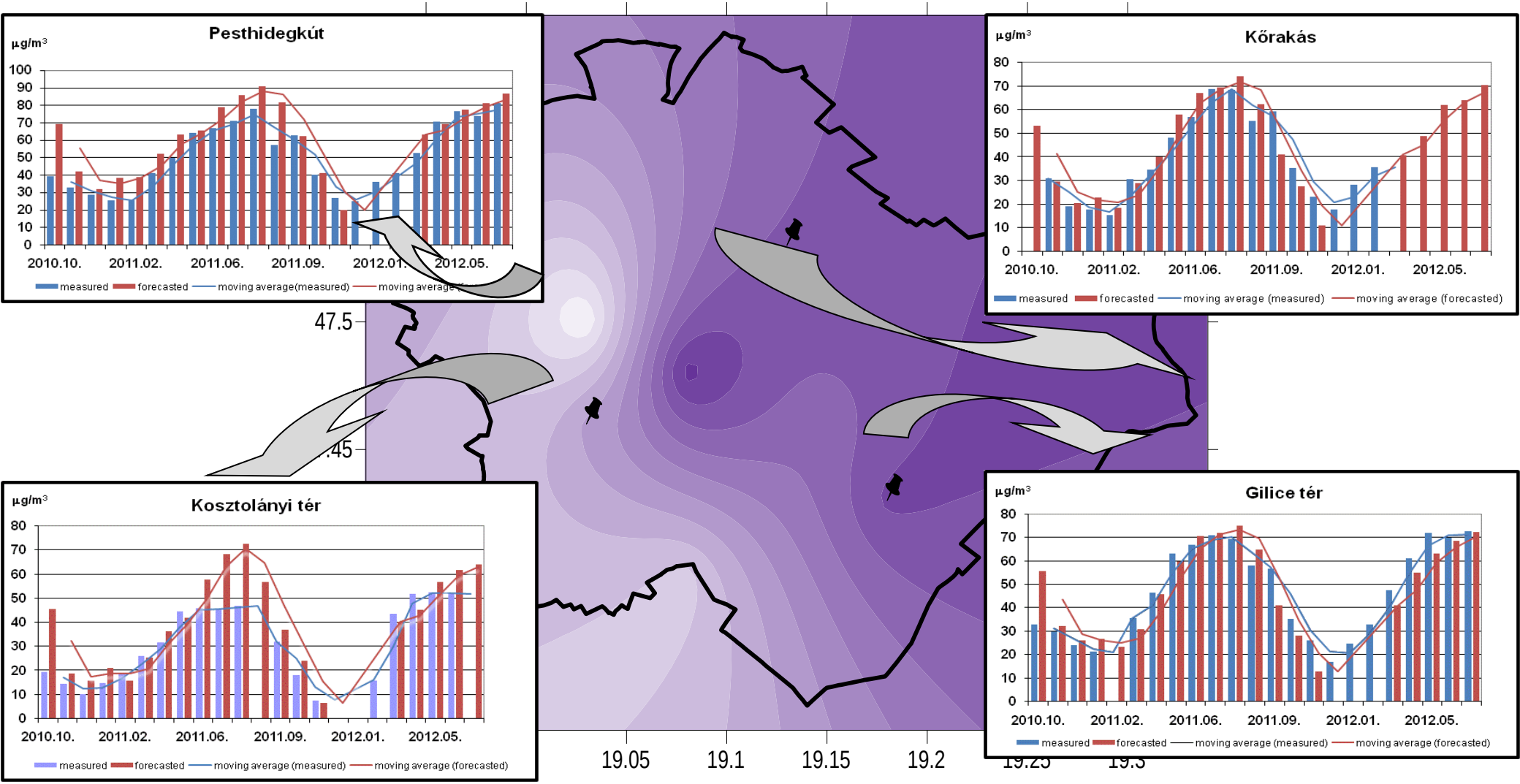
Validation of PM_{10} forecast – rel. BIAS (%)



Validation of PM_{10} forecast - correlation

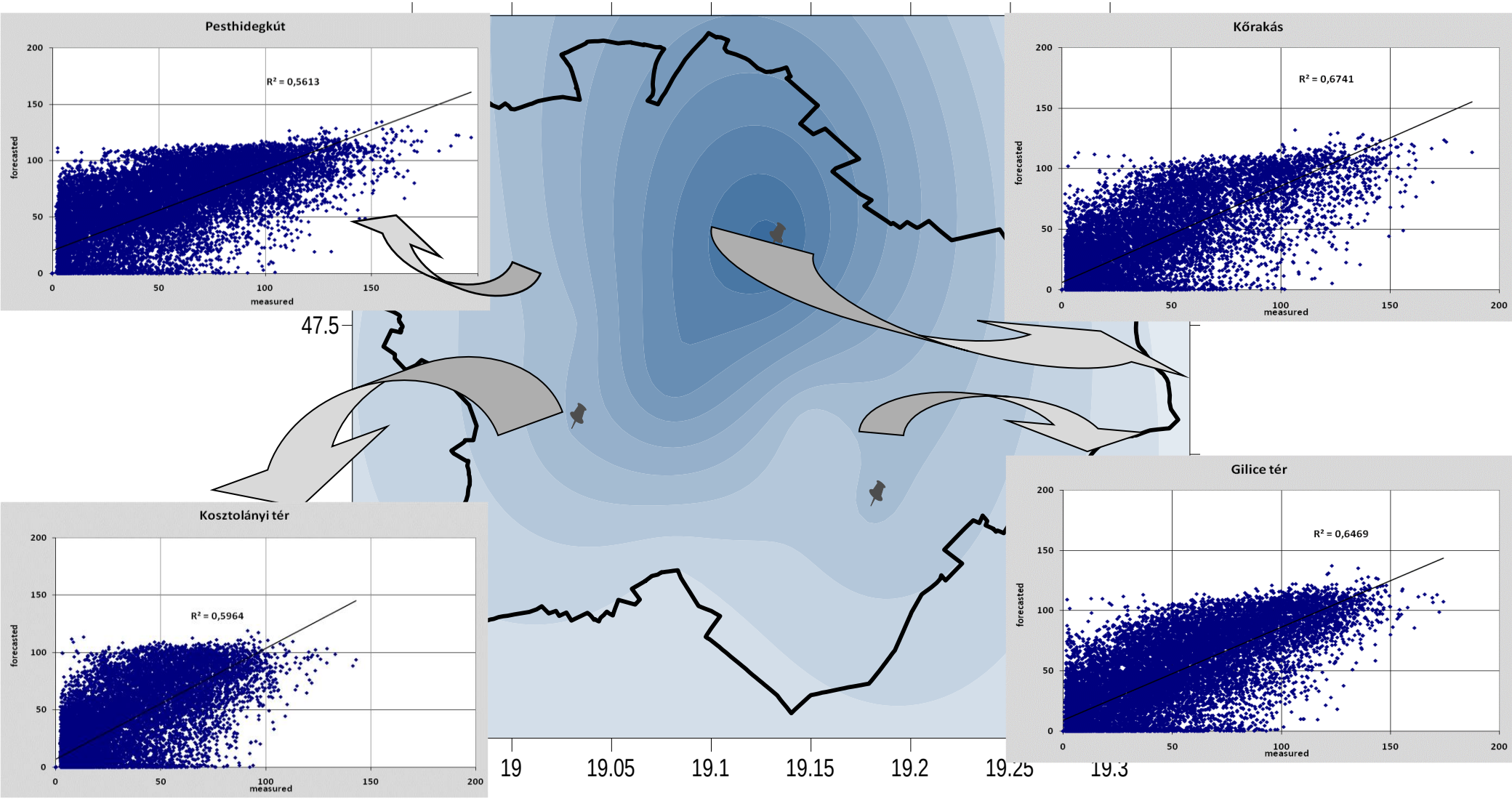


Validation of O_3 forecast – rel. BIAS (%)



Rel. BIAS (%)

Validation of O_3 forecast - correlation



Conclusions and future plans

- **Air pollution monitoring :**
  - We measure the background air pollution in Hungary under the regulations of EMEP and GAW
  - K-puszta: EMEP – „*1 level monitoring station*”, GAW – „*regional station*”
  - *laboratory analysis* of the air, aerosol and precipitation samples
  - Monitors: O_3 and $PM_{10}/PM_{2.5}$
  - Plan to improve the measurements of $PM_{10}/PM_{2.5}$
    - new $PM_{2.5}$ High-Volume Sampler (only daily samples)

- **Air quality modeling:**
  - human resource shortage
    - 1 staff in this field
    - PhD students should involved into the research activity
  - Short-term Research Plan:
    - Predictability analysis of PM_{10} concentration
      - ✓ Determine the most important meteorological parameters affecting PM_{10} concentration
    - Improve the chemical weather forecast system

Thank you for your attention!