- 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*
- Duisburg, Germany, 4 - 6 March 2013
- Action Start date: 01/07/2012 - Action End date: 30/06/2016
- Year: 2012-2013 (*Starting Action*)

- Partner's Logo

- Presenter's Name: prof. Dimiter Syrakov
- Function in the Action: **WG3.2 member**
- National Institute of Meteorology and Hydrology
- 66, Tzarigradsko shaussee Bulvd.
- Sofia 1784, BULGARIA

COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

Scientific context and objectives in the Action

Background / Problem statement:

New sensing technologies such as cost-effective micro-sensors based on gas-sensitive nanomaterials is critical for improving the monitoring of ambient air in urban, rural or remote sites, in traffic on road network. This improvement is important for validation of dispersion models of air-pollutants and evaluation of exposure of population. The model verification and data assimilation techniques applications are expected to improve AQ modeling and Chemical Weather forecast.

Brief reminder of MoU objectives:

To monitor real-world environmental conditions with experimental campaigns to assess composition of indoor air (buildings: house and office) and outdoor air (urban areas and industrial sites) and to investigate how such data can be utilized in air pollution modeling;

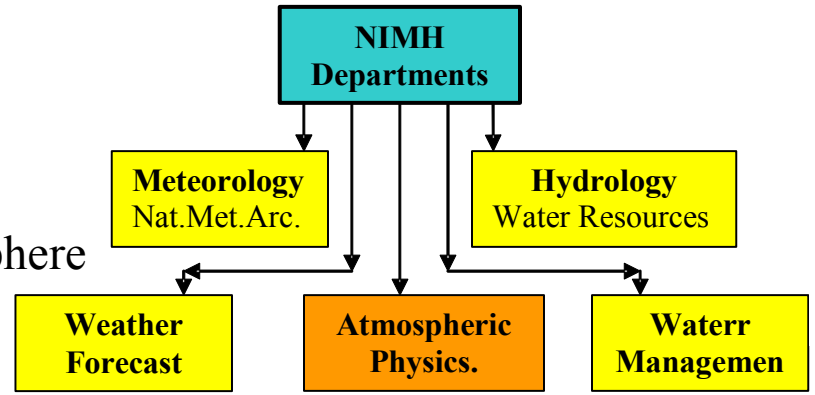
Involvement:

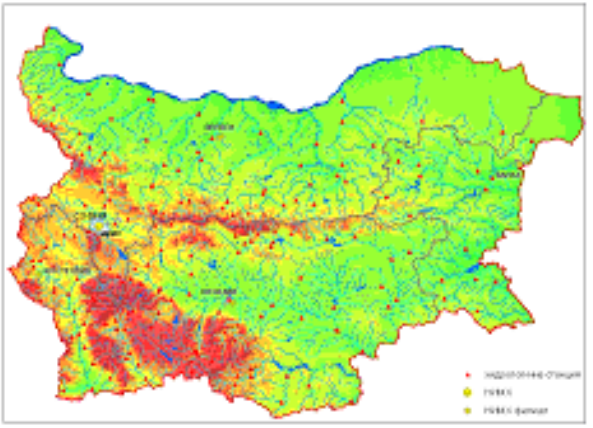
WG3.2: Air-quality modeling and chemical weather forecasting
SIG4: Expert comments for the Revision of the Air Quality EU Directive

Current activities of the Partner (1/2)

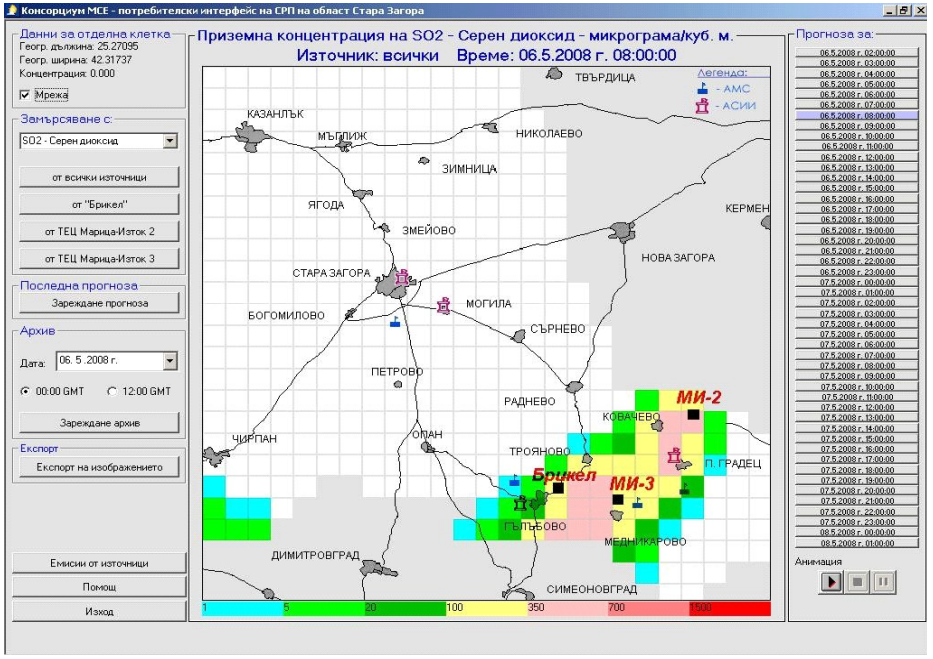
Current research topics at NIMH-BAS:

- Weather forecast
- Remote sensing
- Emergency response
- Climate, ecology
- Physics of the atmosphere
- Hydrological cycle
- Water management





NIMH's Measurement Network



Current activities of the Partner (1/2)

- **EuNetAir related ongoing research topics:**

(Performed in the AQ Modeling group of AF Department)

- Creation and management of Early Warning System in Case of Nuclear Accident
- Climate Change Impact Assessment on Air Quality
- Chemical Weather Forecast – creation, managing, improvement and validation of CWFSystems
- Participation in AQMEII Phase 2 Exercise
- Studding and modeling of the Atmospheric Boundary Layer

Research Facilities available for the Partner (2/2)

Research Facilities:

The Nuclear Emergency Response and Chemical Weather Forecast group works mainly with computational facilities – computers, printers, plotters, scanners. All necessary data is provided by other parties – meteorological centers (including Bulgarian one), European structures like EEA, EMEP, TNO; American NCEP, US EPA; Bulgarian Ministry of Environment and Waters.

List the main facilities

- A 48-core cluster (Infiniband link)
- Two 8-core workstations
- Three 2-core workstations
- Two powerful PCs
- Printers, scanner, notebooks

Achieved RESULTS and future activities

Two applications (services) based on AQ Modeling:

1. Bulgarian Emergency Response System (nuclear accident)
2. Bulgarian Chemical Weather Forecast System (BgCWFS), v.2

Bulgarian Emergency Response System (BERS)

OPERATIONAL PART
(automatic run every 12h)

Meteorological information
(EU, NH)

Archives
(EU, NH)

Trajectory calculations
(EU, NH)

Visualization:
maps with trajectories
from specified NPPs
www.meteo.bg/bnsa/

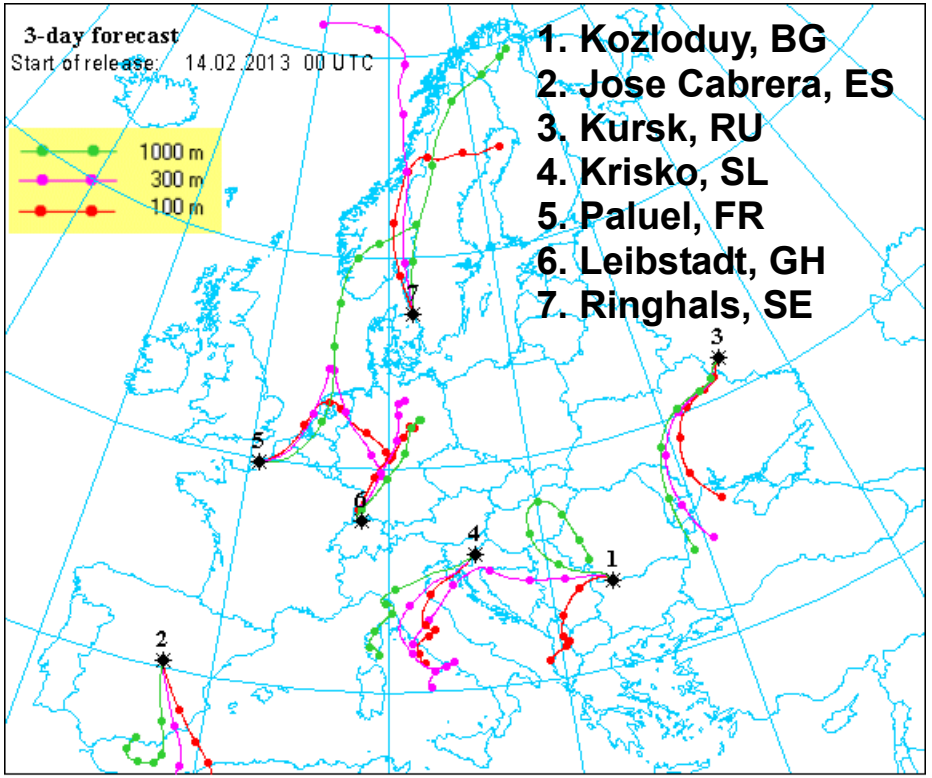
ACCIDENTAL PART
(run by operator)

Source Term
Scenarios Data base

Dispersion Model
EMAP
(EU, NH)

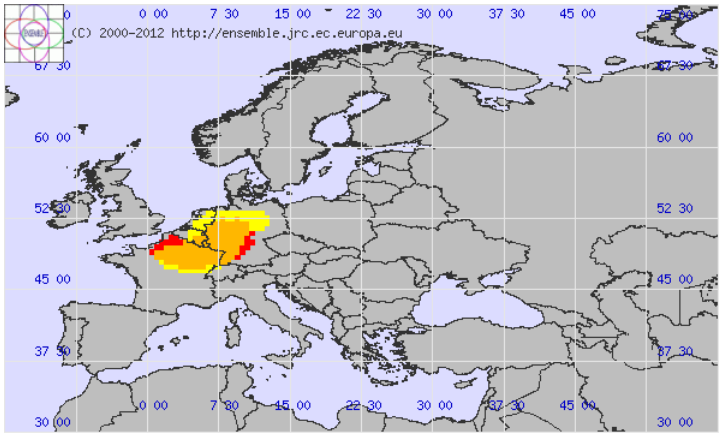
Visualization:
maps of concentrations,
depositions and doses
ftp.meteo.bg/hidden/bnsa/

Trajectories Web-site



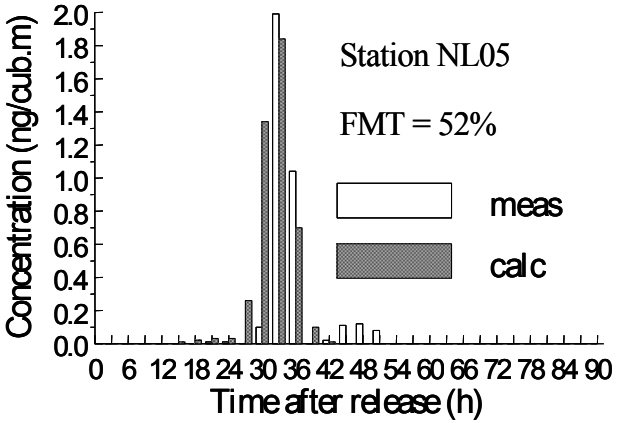
BERS verification (ETEX-I exercise)

ENSEMBLE Web-site in JRC,Ispra



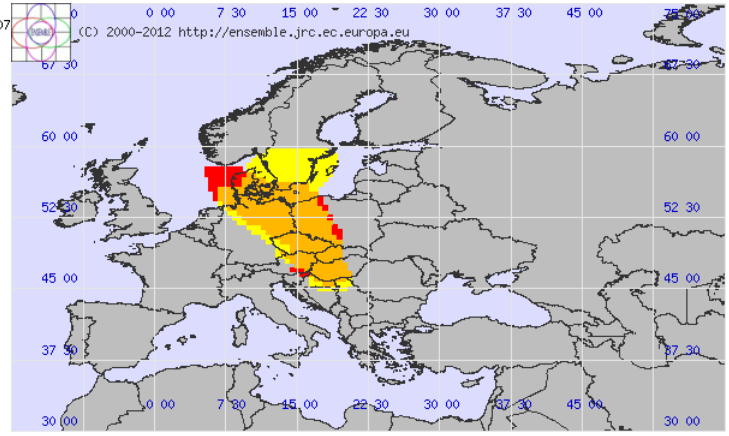
To + 24 h

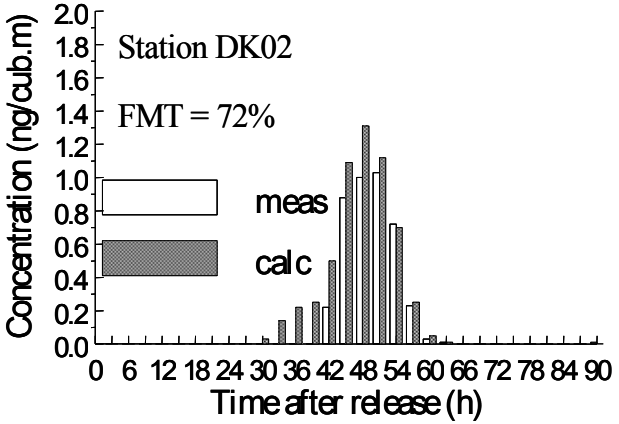
FMS = 62 %



To + 48 h

FMS = 60 %



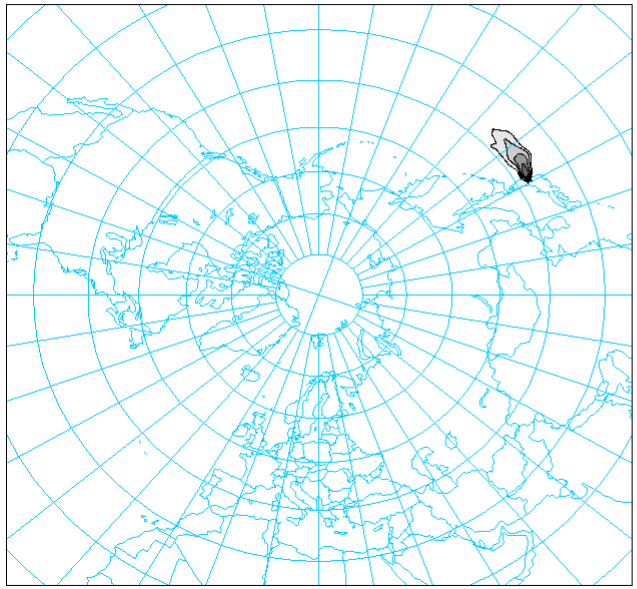


Measurement points

Application of BERS at the latest severe disasters

NATIONAL INSTITUTE OF METEOROLOGY AND HYDROLOGY

Numerical Simulation of Radioactive Pollution Distribution



Accumulated Deposition (Bq/sq.m)

Fukushima NPP

SIMULATION DESCRIPTION:

Source Location (*):
37.70N 141.05E

Release Rate:
0.100E+13 Bq/s

Release Height:
100.00 m

Release Duration:
3.00 h

Start of Release:
17/02/13 09:00 UTC

Forecast for:
20/02/13 10:00 UTC

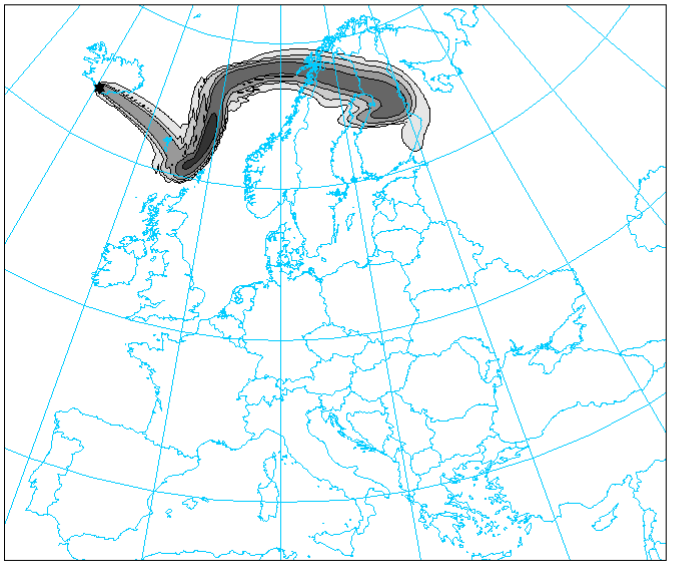
Maximum Value:
0.155E+06

100000
10000
1000
100
10

Iceland Volcano

NATIONAL INSTITUTE OF METEOROLOGY AND HYDROLOGY

Numerical Simulation of Iseland Volcano Eruption



Concentration in Air (mkg/cub.m) at level 6000 m

SIMULATION DESCRIPTION:

Source Location (*):
63.63N 19.44W

Release Rate:
0.552E+12 mkg/s

Release Height:
5710. m

Release Duration:
174.00 h

Start of Release:
14/04/10 06:00 UTC

Forecast for:
15/04/10 06:00 UTC

Maximum Value:
0.398E+03

100
10
1
0.1
0.01

Bulgarian Chemical Weather Forecast System (BgCWFS), v.2

MODELS USED

(US EPA Models-3 air quality modeling system)

- **CMAQ v.4.6** - Chemical Transport Model (CTM);
- **WRF v.3.2.1** - Meteorological Pre-processor to CMAQ;
- **SMOKE v.2.4** - Emission Pre-processor to CMAQ.
- **Own FORTRAN interface programs**

==========

DOMAINS: 5 nested domains:

- **Europe, resolution 81 km**
- **Balkan Peninsula, resolution 27 km**
- **Bulgaria, resolution 9 km**
- **Sofia district, resolution 3 km**
- **Sofia city, resolution 1 km**

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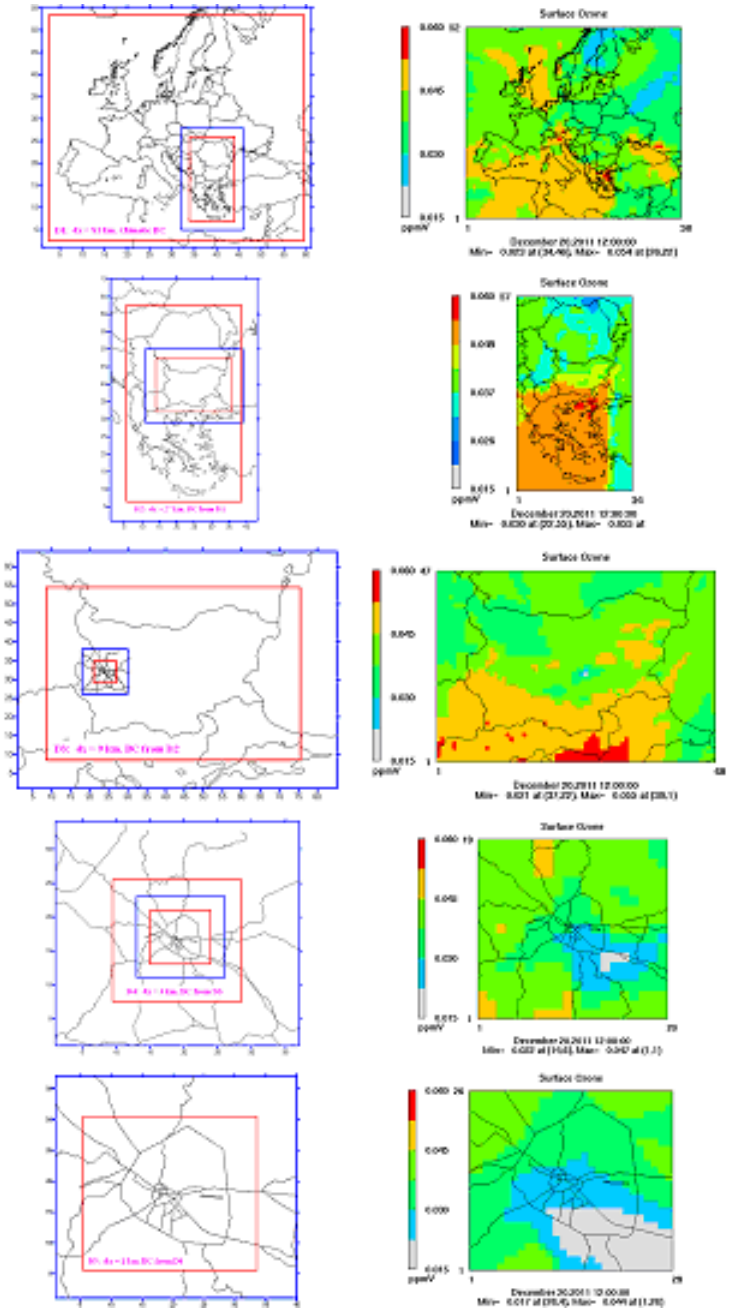
DATA SOURCES

- **Meteorology:** NCEP's GFS
- **Emission:** 2005 TNO inventory
- **Land-use:** USGS data base



cost
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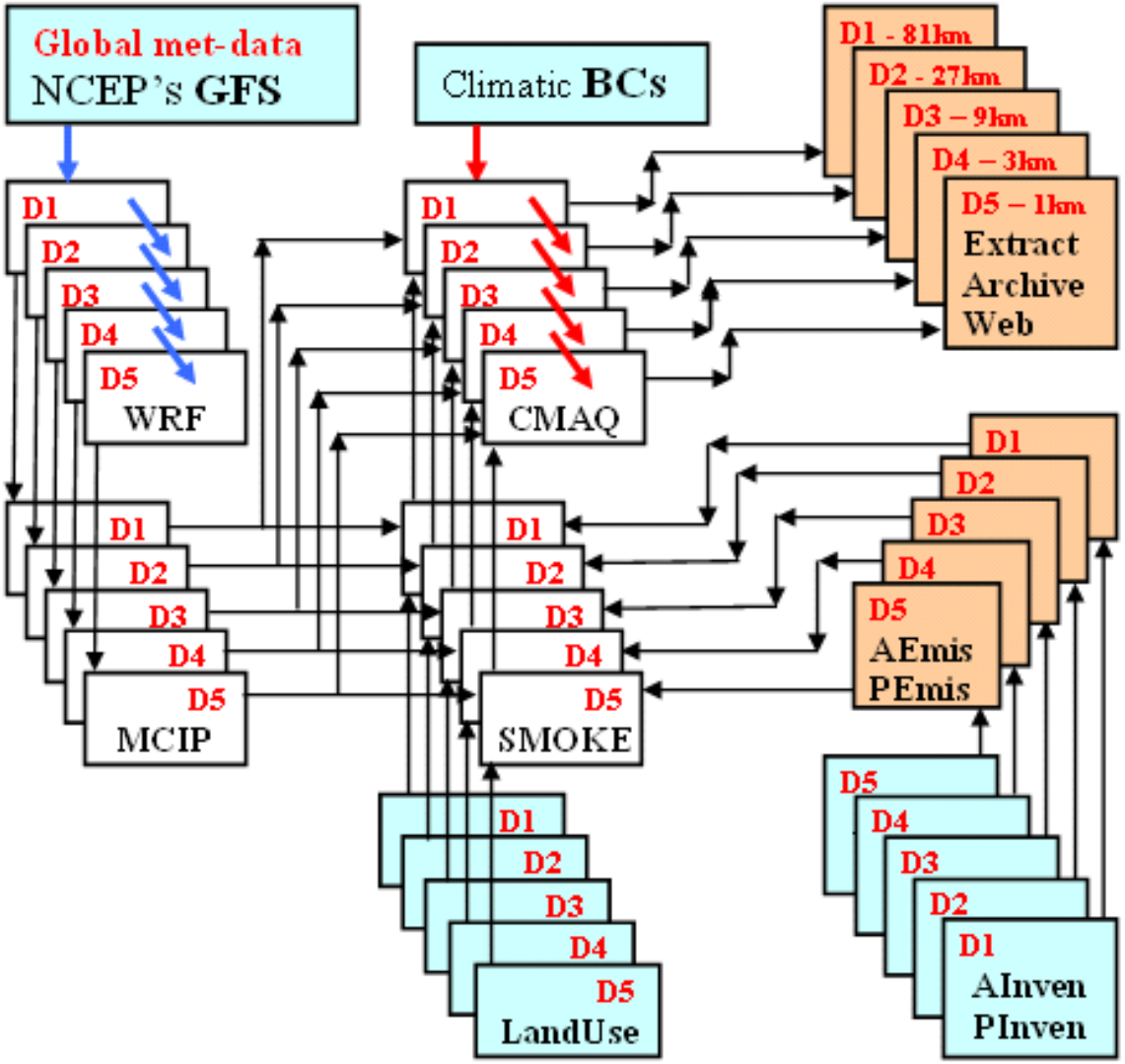
Information Flow Diagram



- White boxes:
  Models-3 elements
- **Blue boxes:**
  Input data
- **Brown boxes:**
  Own Fortran routines.

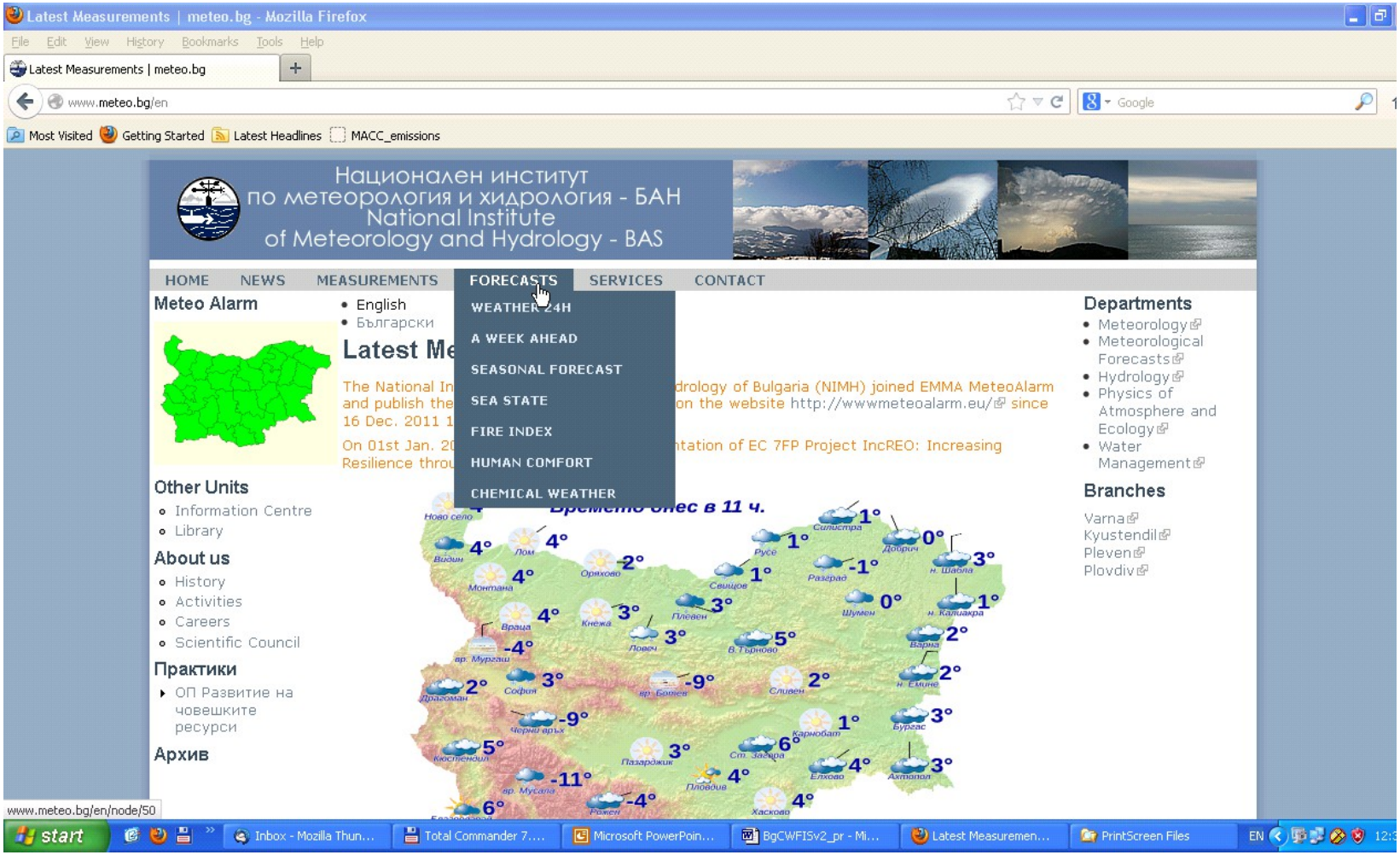
==========

TRANSFER OF DATA BETWEEN DOMAINS:

- **Blue arrows:**
  Meteorological BCs
- **Red arrows:**
  Chemical BCs
- **Black arrows:**
  Exchange of data inside each domain

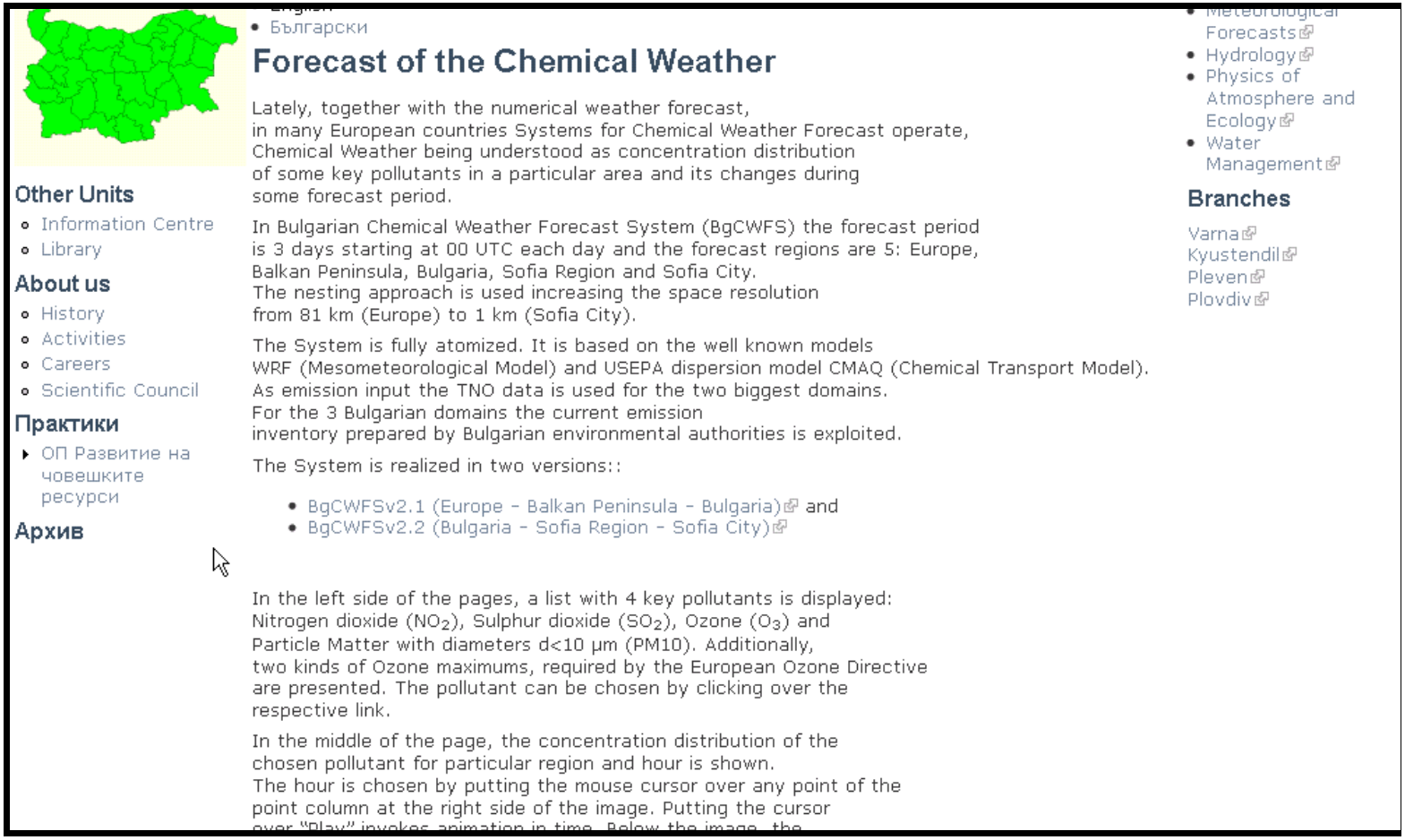
How to access BgCWFIS, ver.2, web-pages? From NUMH's MainPage

http://www.meteo.bg/



BgCWFIS, ver.2 Explanation Page

http://www.meteo.bg/cw



- Български

Forecast of the Chemical Weather

Lately, together with the numerical weather forecast,
in many European countries Systems for Chemical Weather Forecast operate,
Chemical Weather being understood as concentration distribution
of some key pollutants in a particular area and its changes during
some forecast period.

In Bulgarian Chemical Weather Forecast System (BgCWFS) the forecast period
is 3 days starting at 00 UTC each day and the forecast regions are 5: Europe,
Balkan Peninsula, Bulgaria, Sofia Region and Sofia City.
The nesting approach is used increasing the space resolution
from 81 km (Europe) to 1 km (Sofia City).

The System is fully atomized. It is based on the well known models
WRF (Mesometeorological Model) and USEPA dispersion model CMAQ (Chemical Transport Model).
As emission input the TNO data is used for the two biggest domains.
For the 3 Bulgarian domains the current emission
inventory prepared by Bulgarian environmental authorities is exploited.

The System is realized in two versions::

- BgCWFSv2.1 (Europe - Balkan Peninsula - Bulgaria) and
- BgCWFSv2.2 (Bulgaria - Sofia Region - Sofia City)

In the left side of the pages, a list with 4 key pollutants is displayed:
Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), Ozone (O_3) and
Particle Matter with diameters d<10 μm (PM10). Additionally,
two kinds of Ozone maximums, required by the European Ozone Directive
are presented. The pollutant can be chosen by clicking over the
respective link.

In the middle of the page, the concentration distribution of the
chosen pollutant for particular region and hour is shown.
The hour is chosen by putting the mouse cursor over any point of the
point column at the right side of the image. Putting the cursor
over "Play" invokes animation in time. Below the image, the

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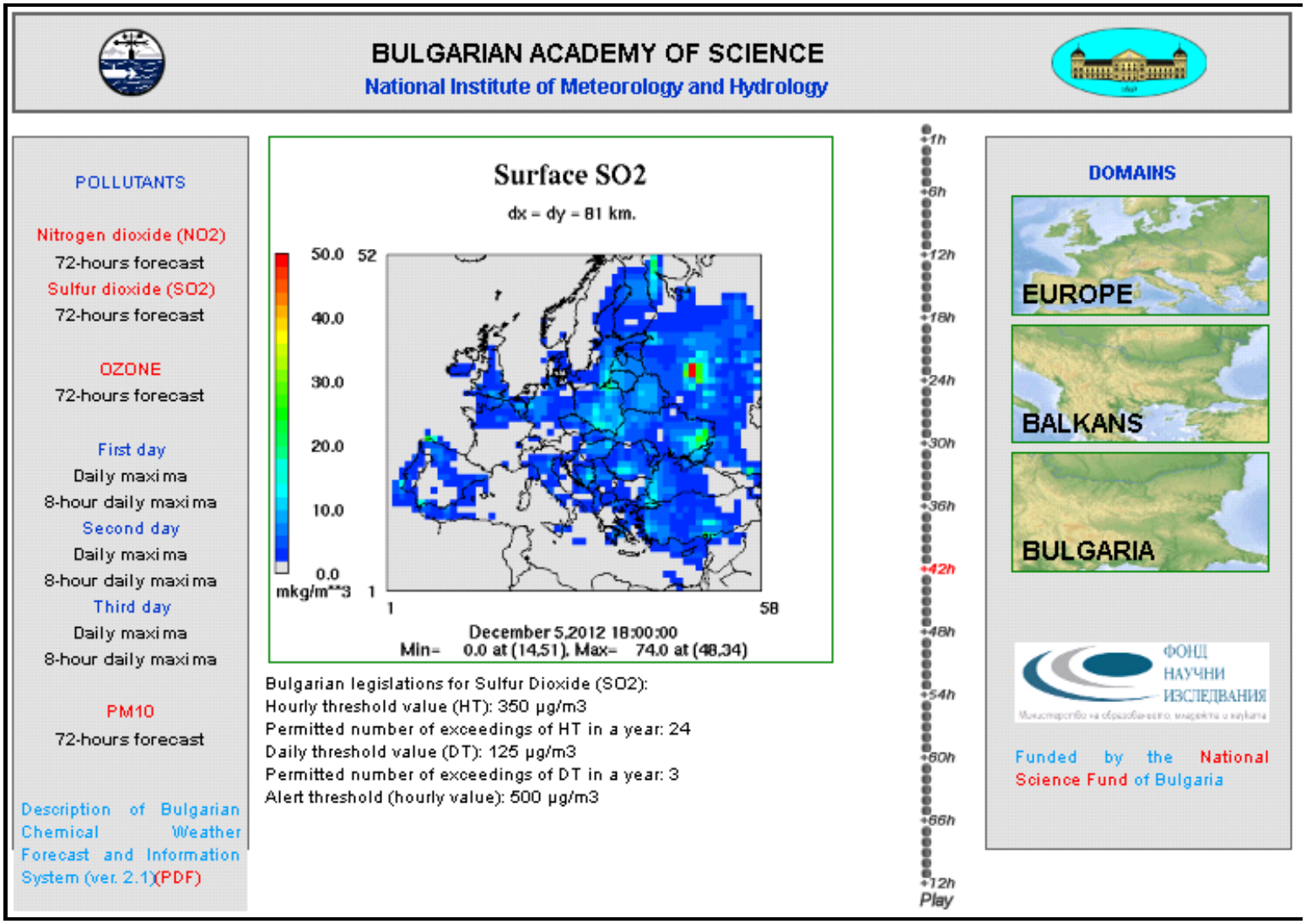


http://info.meteo.bg/cw2.2/

BULGARIAN ACADEMY OF SCIENCE
National Institute of Meteorology and Hydrology

POLLUTANTS

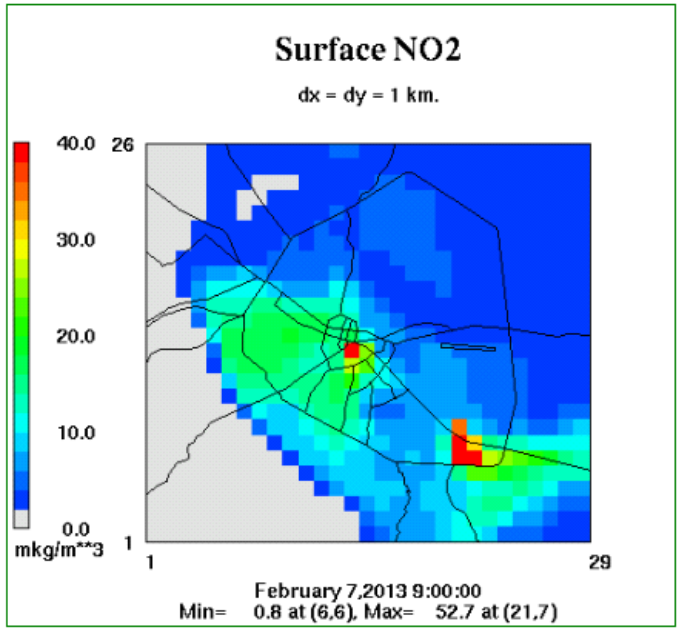
Nitrogen dioxide (NO2)
72-hours forecast
Sulfur dioxide (SO2)
72-hours forecast

OZONE
72-hours forecast

First day
Daily maxima
8-hour daily maxima
Second day
Daily maxima
8-hour daily maxima
Third day
Daily maxima
8-hour daily maxima

PM10
72-hours forecast

Description of Bulgarian Chemical Weather Forecast and Information System (ver. 2.2)(PDF)



Bulgarian legislation for Nitrogen Dioxide (NO2):
Hourly threshold value (HT): 200 µg/m3
Permitted number of exceedings of HT in a year: 18
Yearly threshold value (YT): 40 µg/m3
Permitted number of exceedings of YT: impermissible
Alert threshold (hourly value): 400 µg/m3

+1h +6h +12h +18h +24h +30h +36h +42h +48h +54h +60h +66h +12h
Play

DOMAINS

ФОНД НАУЧНИ ИЗСЛЕДВАНИЯ

Funded by the National Science Fund of Bulgaria

CONCLUSION

Research directions as PRIORITIES/INOVATIONS:

Development of a new version of Bulgarian CWF System for providing services to the authorities and to the community by applying:

- **Increased number of key pollutants (O3, NO2, SO2, PM10, CO).**
- **Downscaling the forecast from 9km resolution over Bulgaria to 1km resolution over Sofia city area**
- **Calculating and presenting maps of Air Quality Index (AQI)**
- **Maps of Dominant pollutant in AQI (innovation)**
- **Adding proper Thermal Comfort Index (innovation)**
- **Upgrade of Bulgarian Nuclear Emergency Response System – increasing the number of nuclides and exposure dose calculations (innovation), web-presentation of animations of possible release from a number of European and Northern Hemisphere NPPs (innovation).**
- **Participation in the *International Air Quality Model Inter-comparison Exercise AQMEII***