Use-Case for Risk Analysis of Water Borne Vector Disease

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Space Research Institute NASU-NSAU, Ukraine

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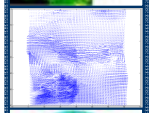
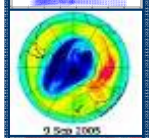
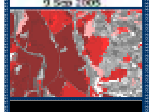
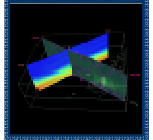
Bonn, Germany



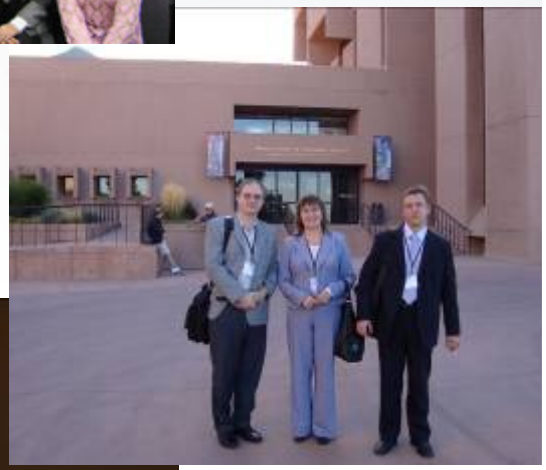






Who we are: Current Expertise & International cooperation

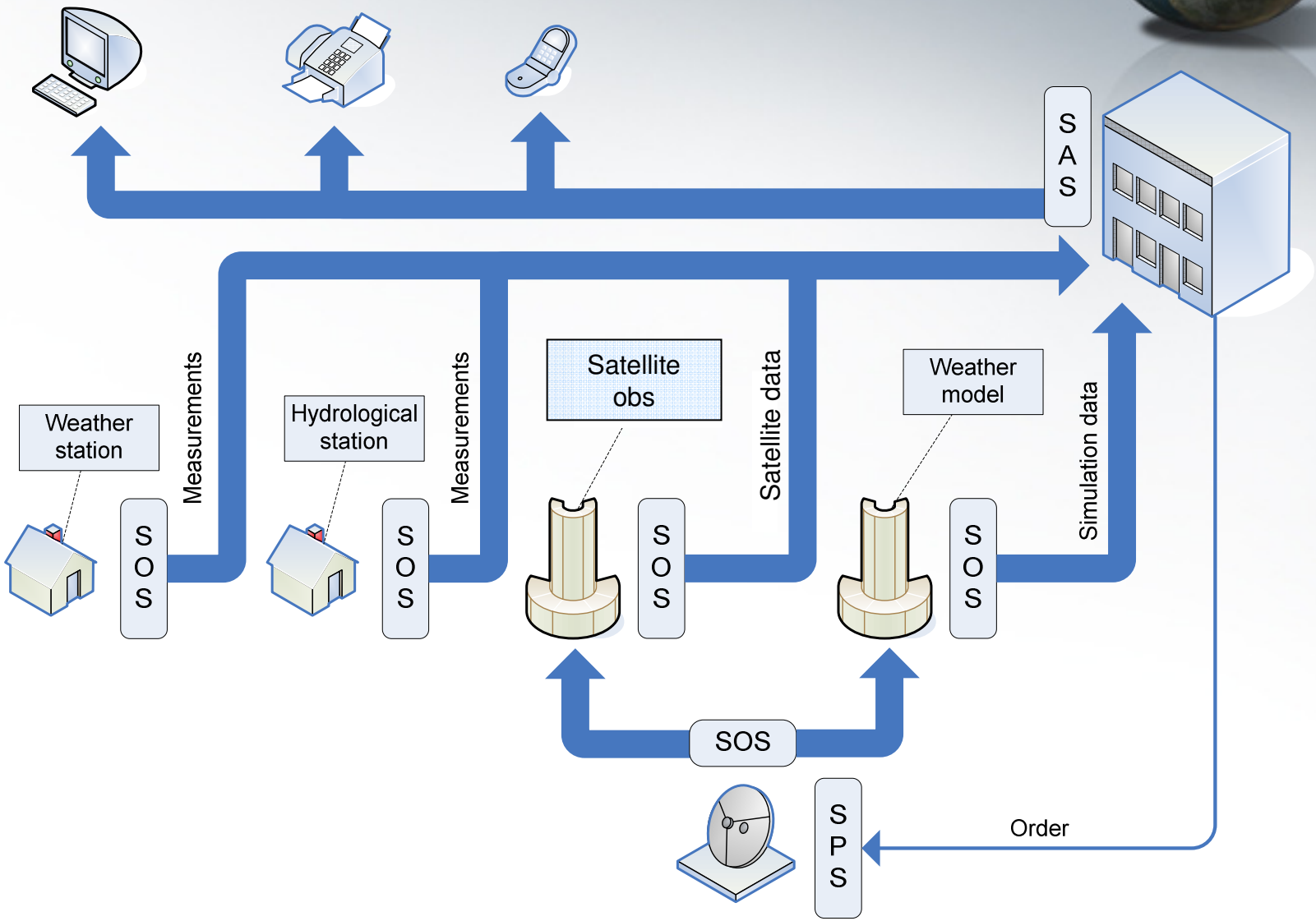
- Space Research Institute National Academy of Science & National Space Agency of Ukraine, department of Space Information Technologies
- Active participation at Working Group on Information System and Services (WGISS) of the Committee on Earth Observation Satellites (CEOS).
- Participation in international collaborative activities within GEO Working Plan and creation of GEOSS Architecture Implementation Pilot (1st and 2nd Calls) on topics Disasters and Sensor Web

GEO GROUP ON EARTH OBSERVATIONS

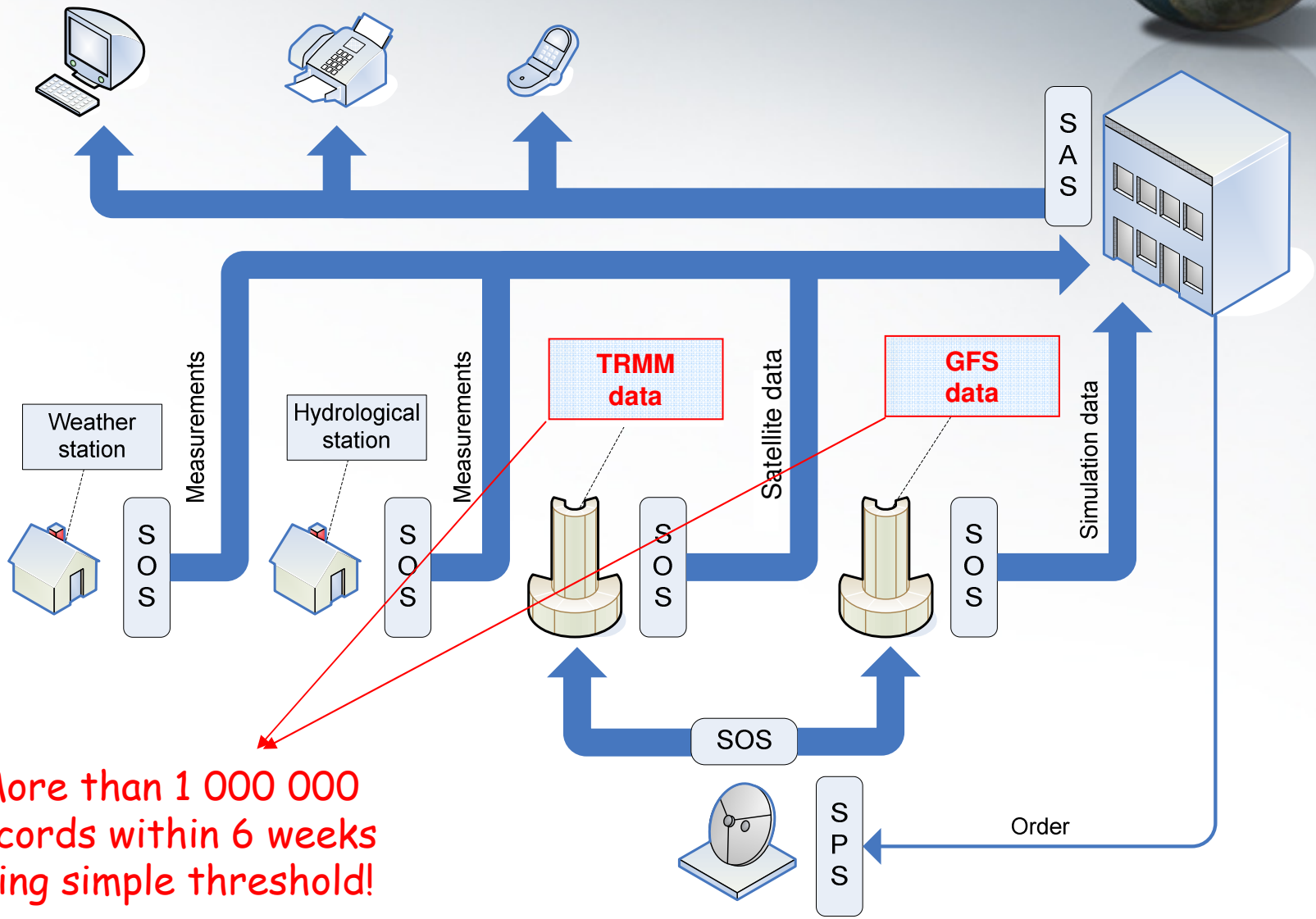
CEOS



Experience: SW Perspective for Flood Application

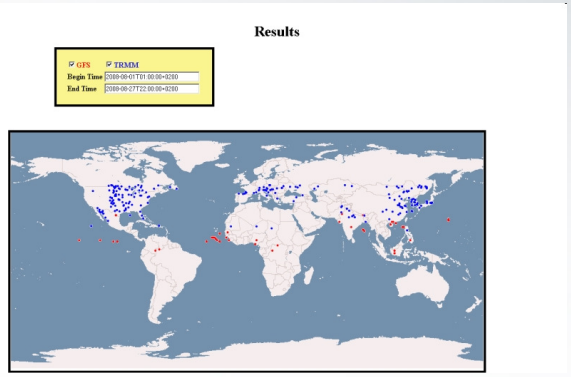


Experience: SW Perspective for Flood Application



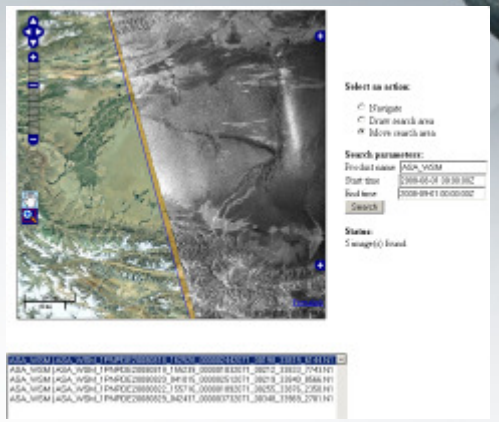
More than 1 000 000 records within 6 weeks using simple threshold!

Scenario of GEO-Ukraine Response to GEOSS AIP CFP-2



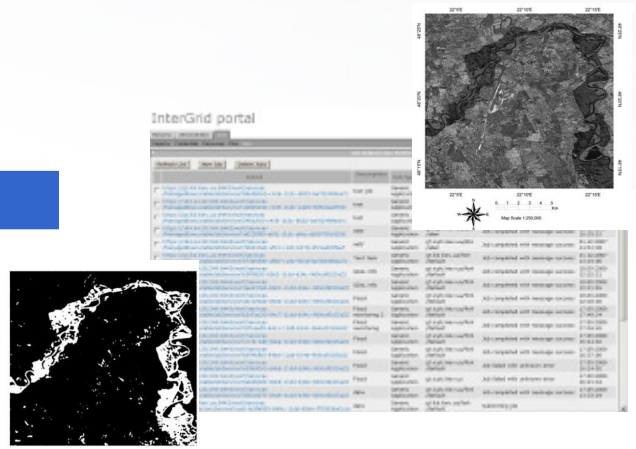
SOS Interface to GFS & TRMM data

SPS



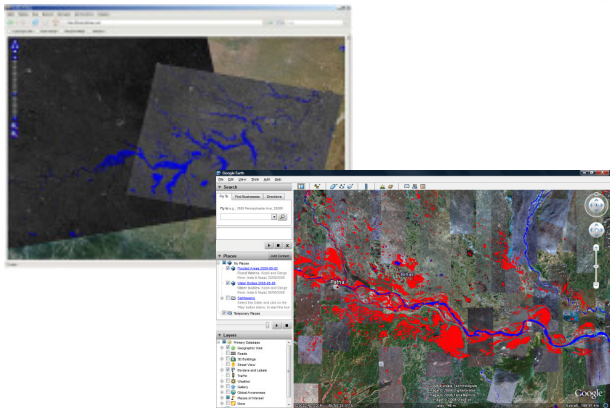
Satellite Observations

WPS



Data Processing in Grid

WMS



Visualization of Data

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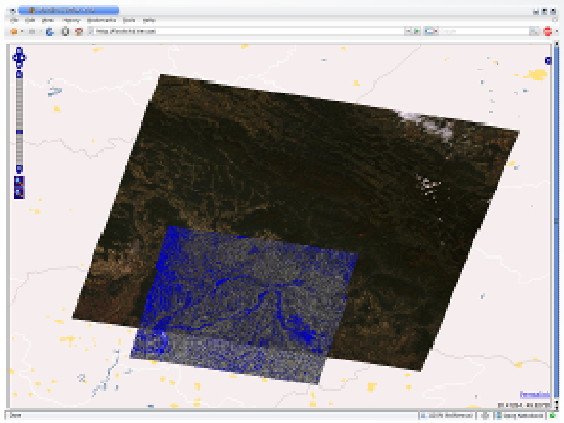
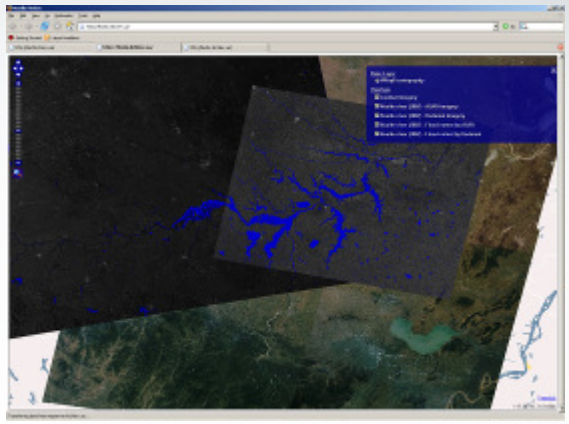
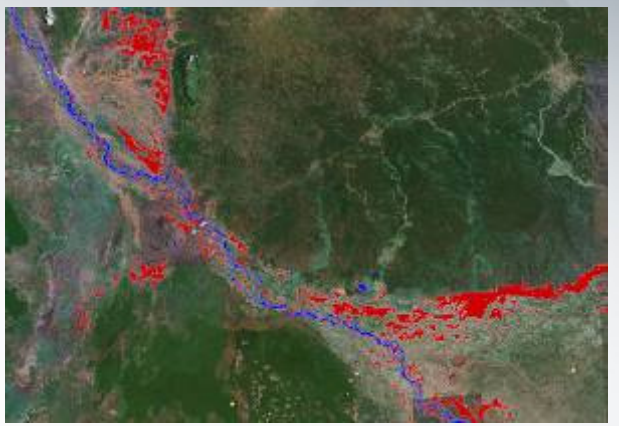
Case-Study Areas



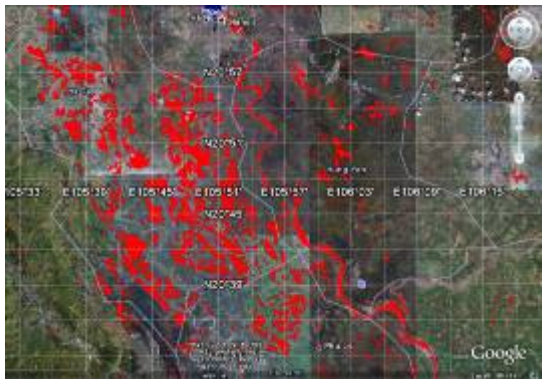
Ukraine, river Tisza, 2001



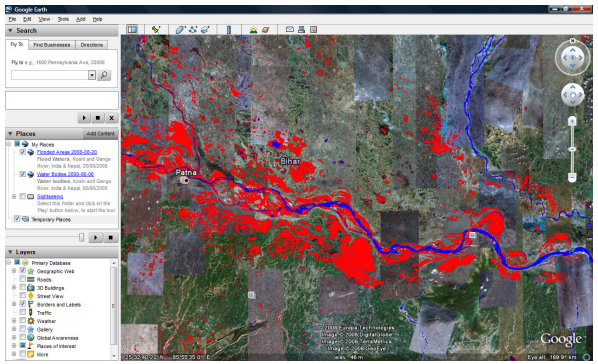
China, river Huaihe, 2007



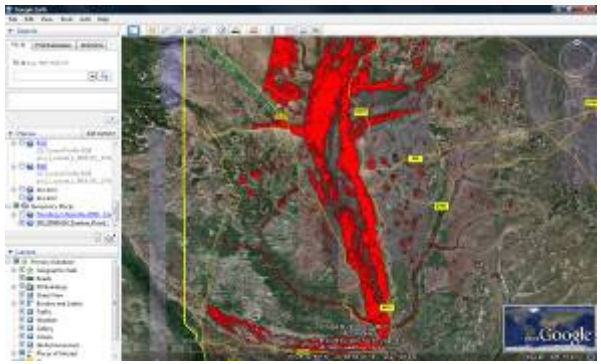
Mozambique, river Zambezi, 2008



Vietnam, 2008



India and Nepal, river Koshi, 2008



Zambia, river Zambezi, 2009

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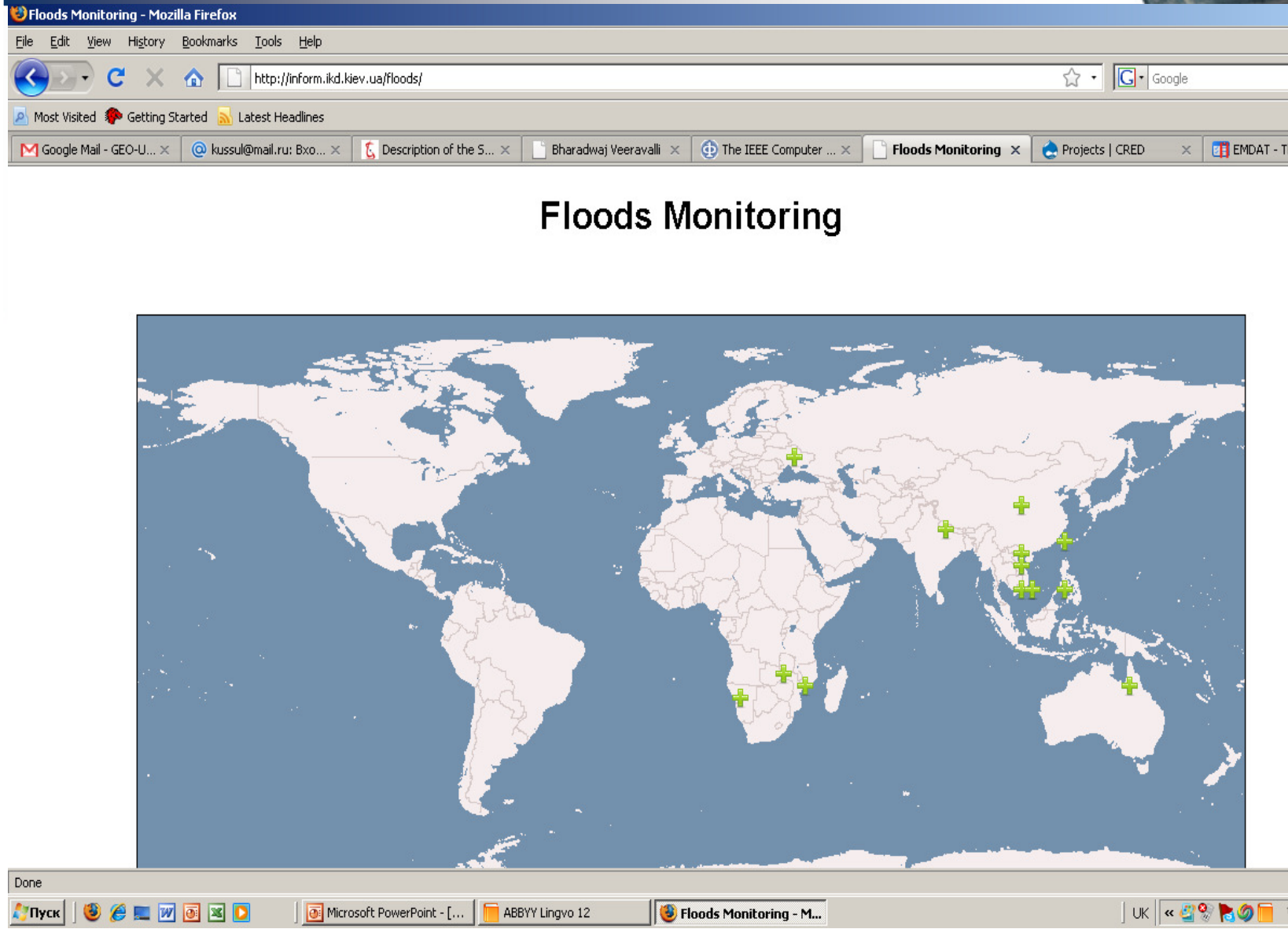
Scope of our activity



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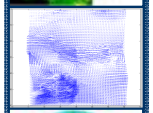
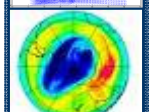
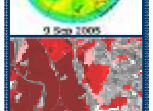
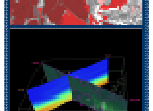
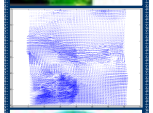
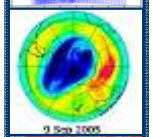
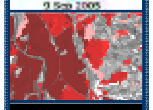
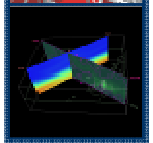





Challenge: To discover Flood Caused Risk of Epidemics

- Africa
  - rising flood waters **intensifies health risks** for millions of people, and exacerbates **health threats** for conditions including **malaria**, **diarrhea** and other potentially fatal communicable diseases [*UN, WHO*]
- Ukraine
  - major threats to health by water related diseases
  - **contamination of drinking water** in wells
  - leads to infectious diseases like **hepatitis**, **leptospirosis** etc with long incubation period [*Ministry of Health of Ukraine*]



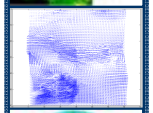
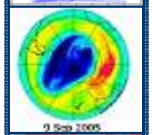
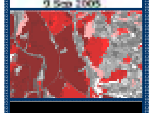
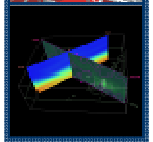






Challenge (cont.)

- GEOSS **Health** SBA
  - "… *Earth observation data can contribute to* ***improving our understanding of how the environment affects human health and well-being*** "
  - "… ***remote-sensing observations*** *of weather, land and ocean parameters can now be used to* ***predict outbreaks or trends in infectious diseases*** *such as meningitis, malaria and cholera…*"

GROUP ON EARTH OBSERVATIONS



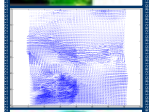
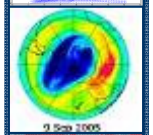
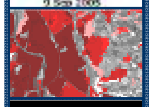
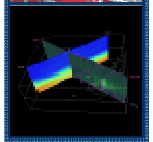






Challenge (cont.)

- GEOSS **Health** SBA in WP 2009-2011
  - **HE-07-01: Strengthen Observation and Information Systems for Health**
    - to improve in-situ environmental and health data collection for the utilization and validation of remotely sensed data relevant to health
  - **HE-07-02: Environment and Health Monitoring and Modelling**
    - to further develop and integrate databases of remotely sensed and in-situ environmental measurements together with new observations characterizing atmospheric, soil, river, lake and coastal marine pollution, and develop models to relate these to exposure and health effects data

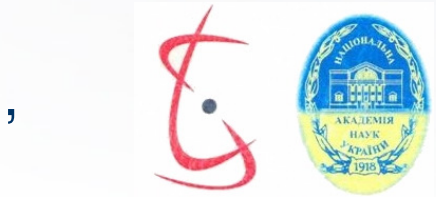
GROUP ON EARTH OBSERVATIONS

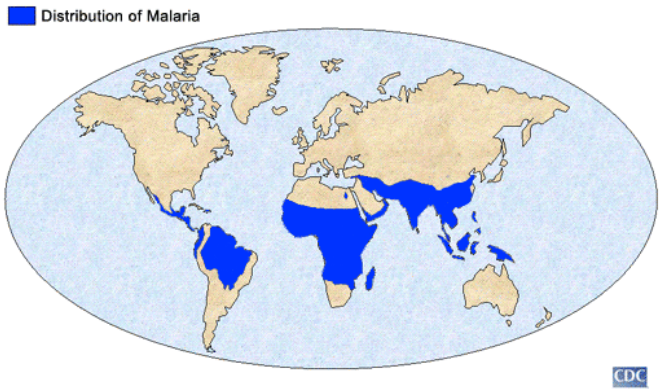


Our response: Initiated Project on Flood Forecasting and Epidemics Risk Assessment

- ***Main goal***
  - *to investigate environmental indicators of infectious disease and develop information technology for floods prediction and infectious disease risk assessment, in particular malaria*
  - Within the project we will work out the *flowing chains of data processing*:
    - flood monitoring and forecasting,
    - flood mapping,
    - environmental parameters assessment,
    - socio-economical factors assess
    - infectious disease risk assessment.





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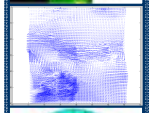
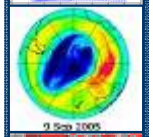
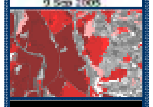
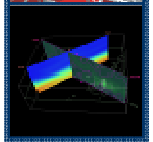
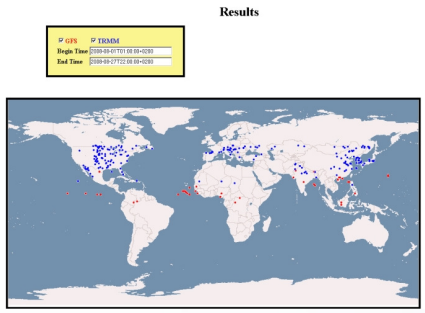





STCU-NASU Call

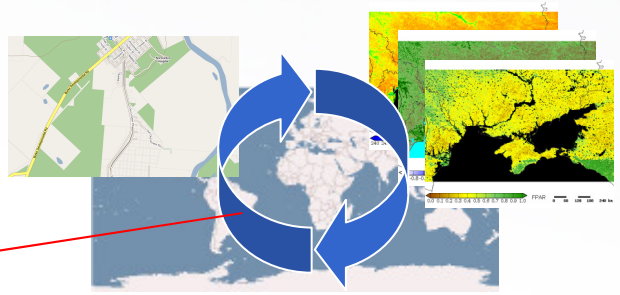
- Joint Call of the **National Academy of Science of Ukraine** and the **Science and Technology Center in Ukraine** “Targeted Research & Development Initiatives”
- Directions include
  - *Information technologies and systems for the needs of biology and medicine*
- Requires **foreign collaborations** to be involved


Use-Case Scenario



Flood warnings

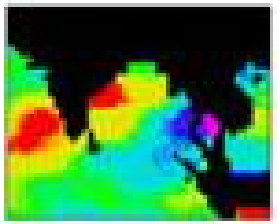
Infrastructure



EO products

Models

Socio-economic inf



Health risk analysis

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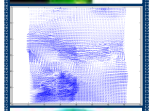
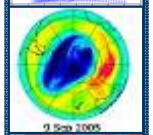
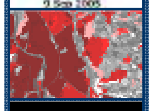
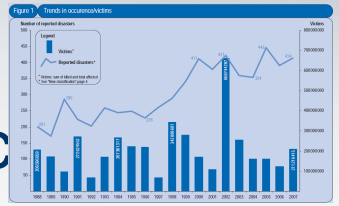
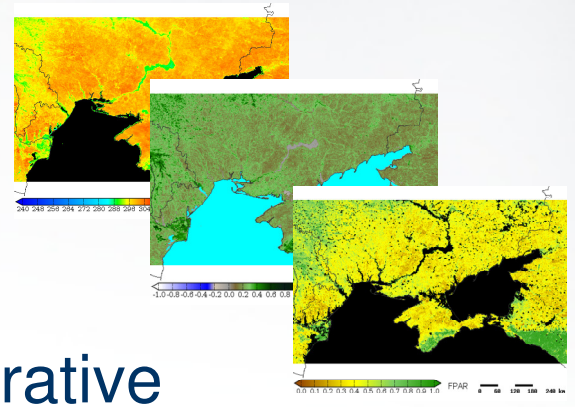
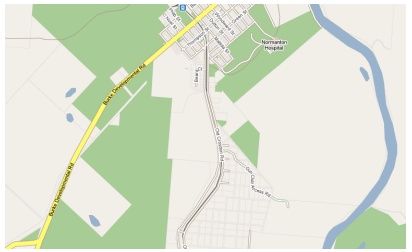
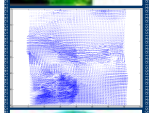
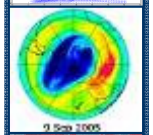
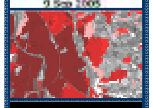
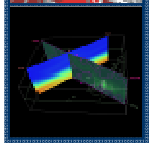




Data

- Models
  - GFS, hydro-predictors, …
- Statistical data
  - on infectious diseases in Ukraine & Afric
- Remote sensing
  - land and water related products
  - In-situ measurements
- Socio-economic information
  - distribution of population, administrative boundaries…
- Infrastructure
  - wells, channels, …



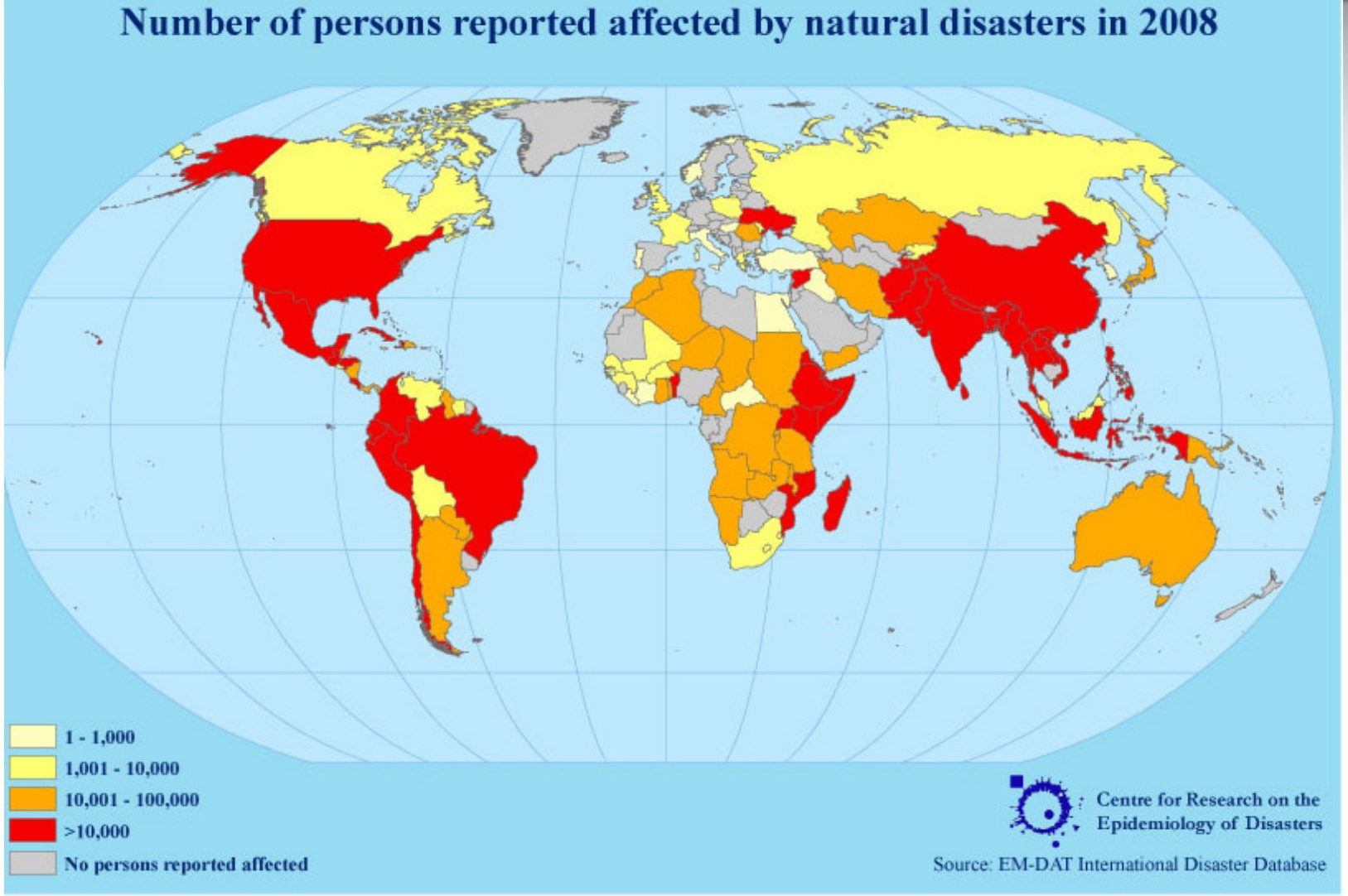
Methodology

- WP1 - "Diseases“
  - to capture relationship between the environmental parameters and the development of infectious diseases
- WP2 - "Environment“
  - environmental parameters assessment from EO, in-situ data & models
- WP3 - “Information technologies“
  - development of models to forecast the spread of diseases
  - risk = *f*(intensity of disaster, probability), error estimates
- WP4 - “Geoinformation services“
  - integration and visualization of the information to better manage infectious diseases

Case-Study

- Floods in Ukraine (Western regions), 2008
  - **29** people were **killed**
  - **17 201** people were **evacuated**
  - **762 865** people were **examined by doctors**
  - **24 411** people were **sick**
    - **1729** with **infectious diseases**, among them **917 children**
  - **Water quality issues**
    - **118000** objects **disinfected**
    - **31404** of **water wells**

Number of affected people according to CRED database (2008)



Charter Activation (for Romania) – too late

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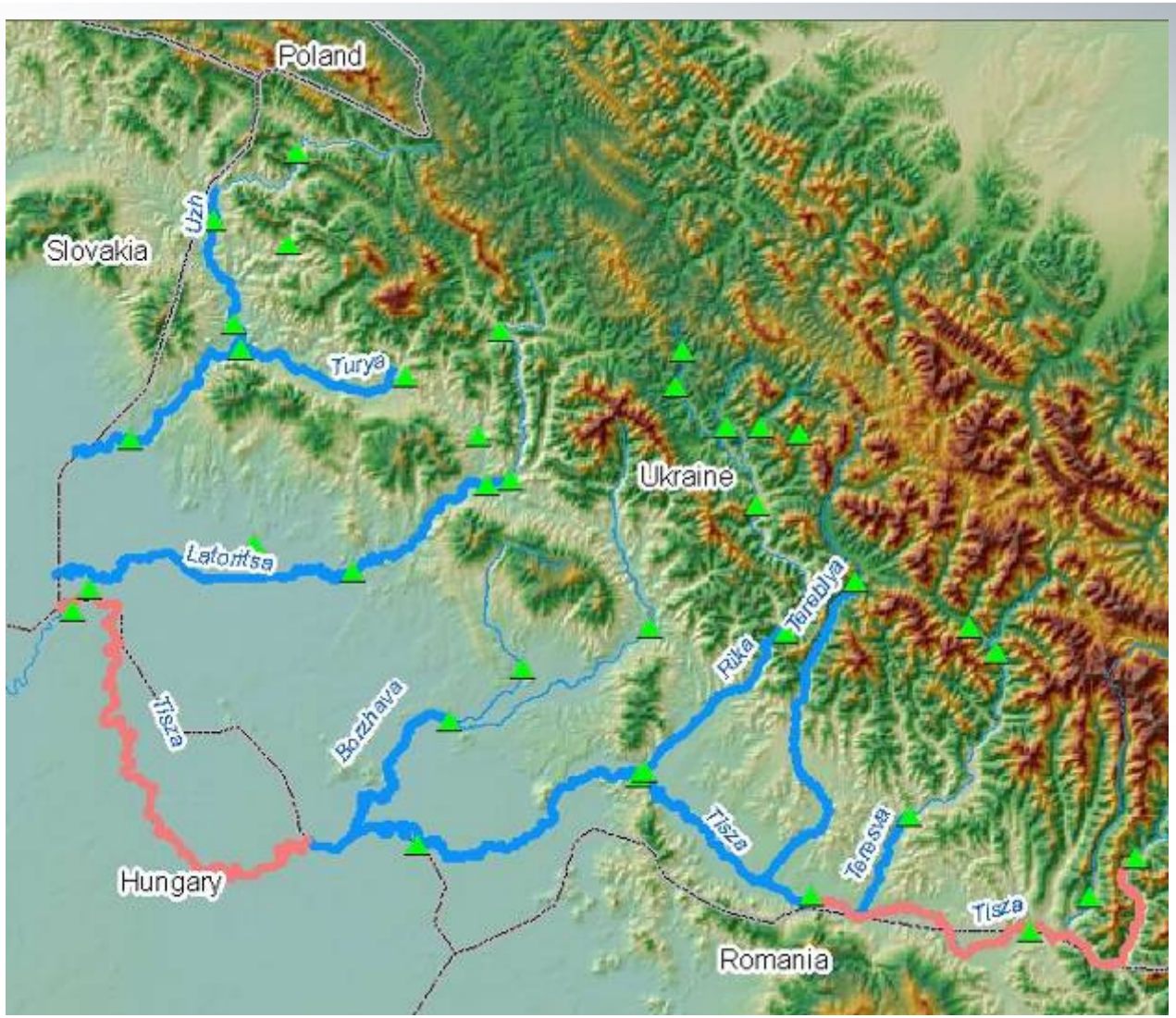
Flood forecasting system for the Ukrainian part of the Tisza River Basin



System development in 2002-2008 after the catastrophic floods in TransCarpathian region (Zakarpatska oblast) in 1998 and 2000.

Nowadays more then 40 automatic water gage stations, 25 of them use satellite communication lines

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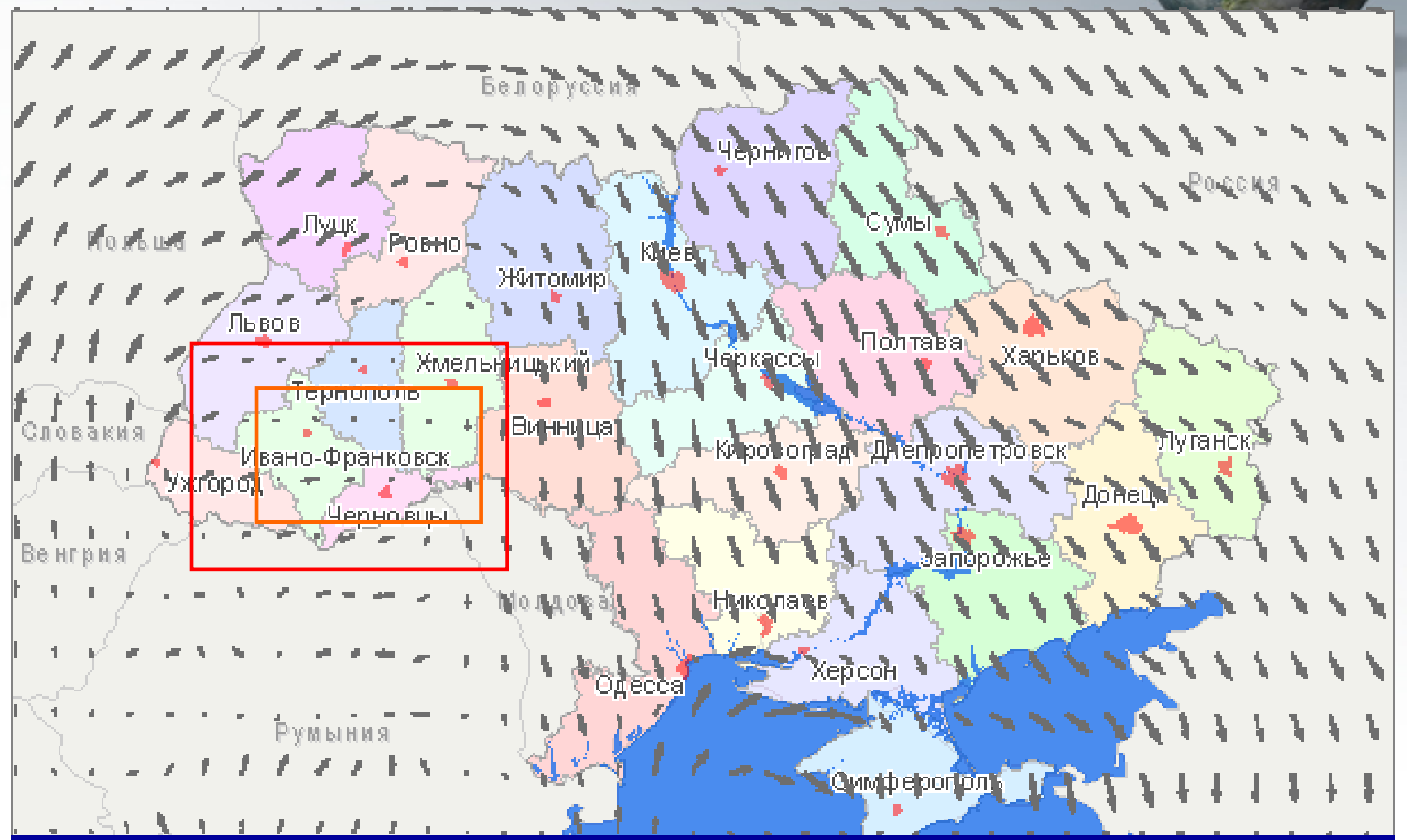
System testing for catastrophic flood July 2008



Zones of the catastrophic precipitation of 22-26 July 2008 on the Ukrainian wind map simulated by MM5- Ukraine model on the grid 27*27 km

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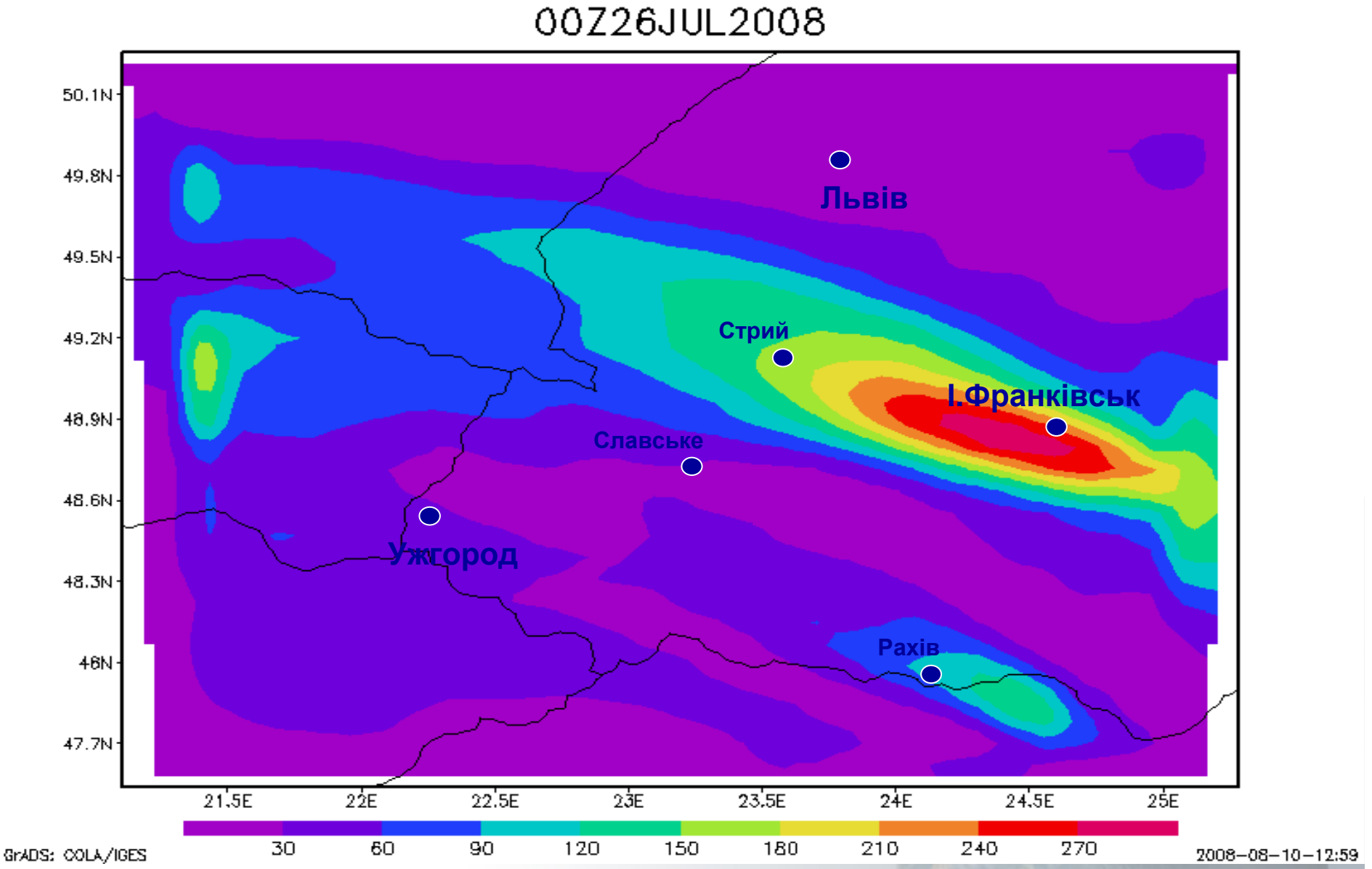
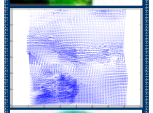
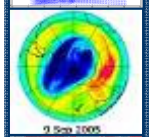
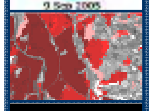
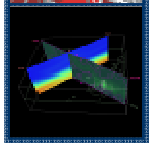
2009



Forecast 0:00 23 .0723 .07 total precipitations (мм) by model MM5 - Carpathian (grid 9*9 km) for the period 23-25 July 2008

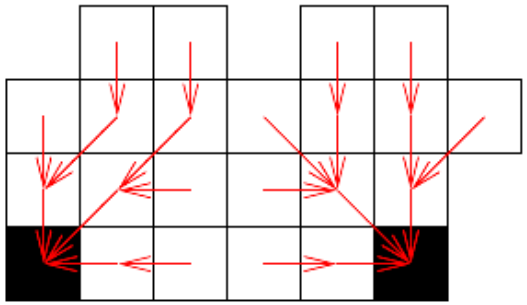


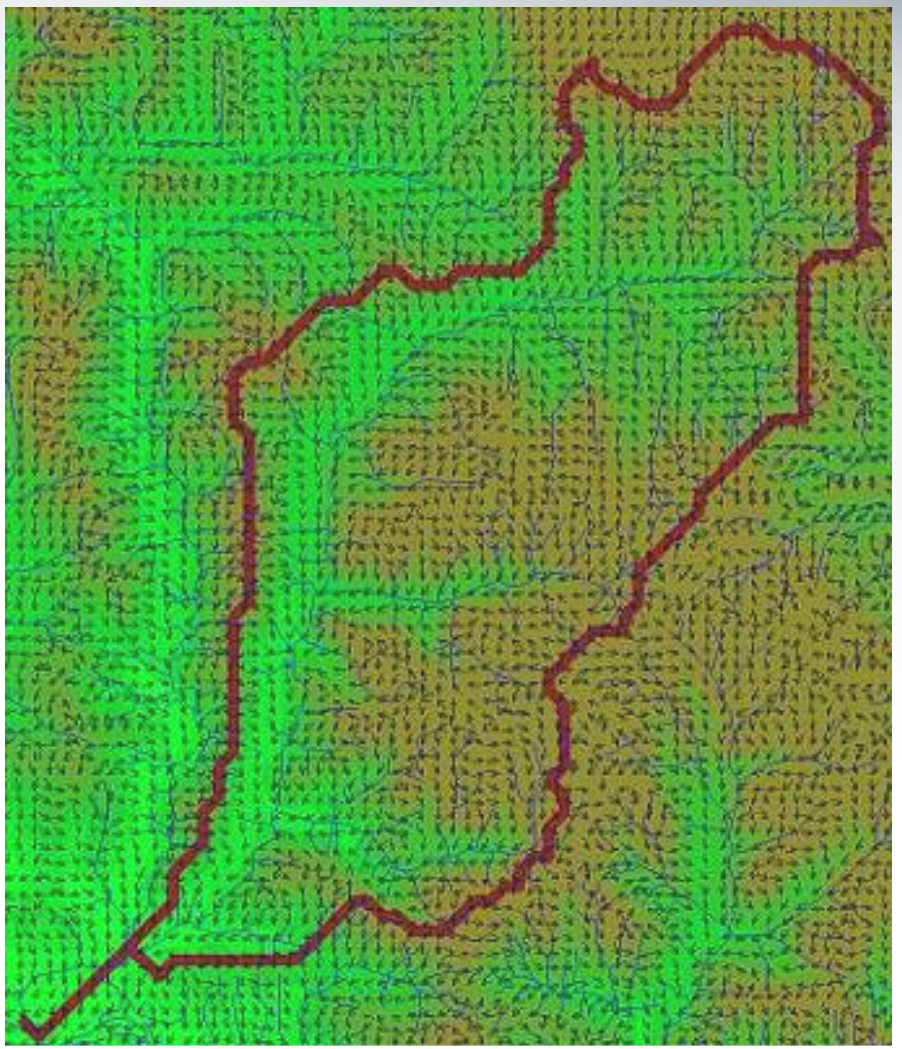






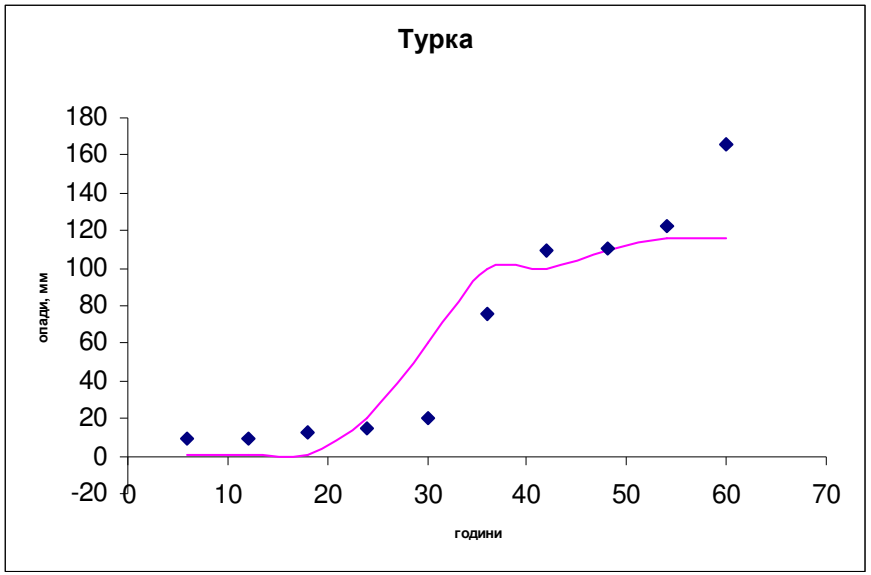
Distributed rainfall – runoff model TOPKAPI-IMMSP based on watershed's map

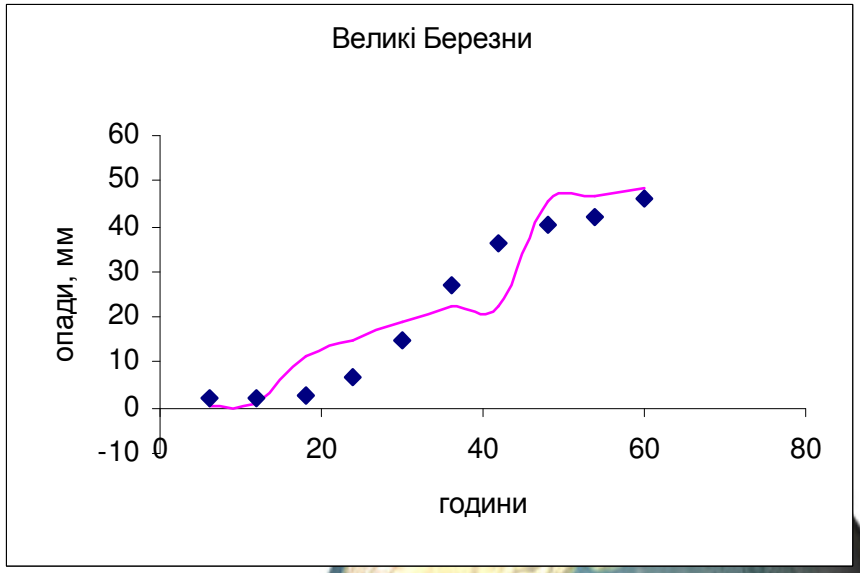
- Simulation of flow direction via DEM →

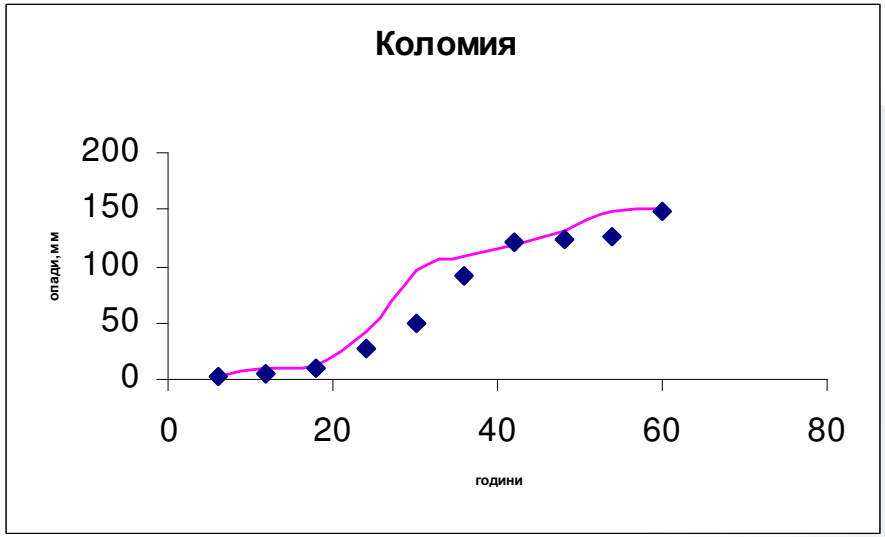
3	2	4
7	5	8
7	1	9

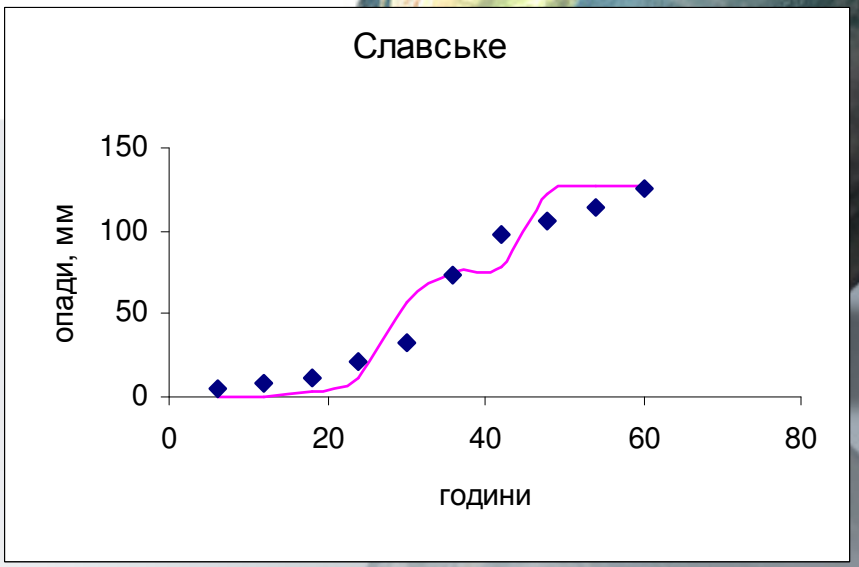




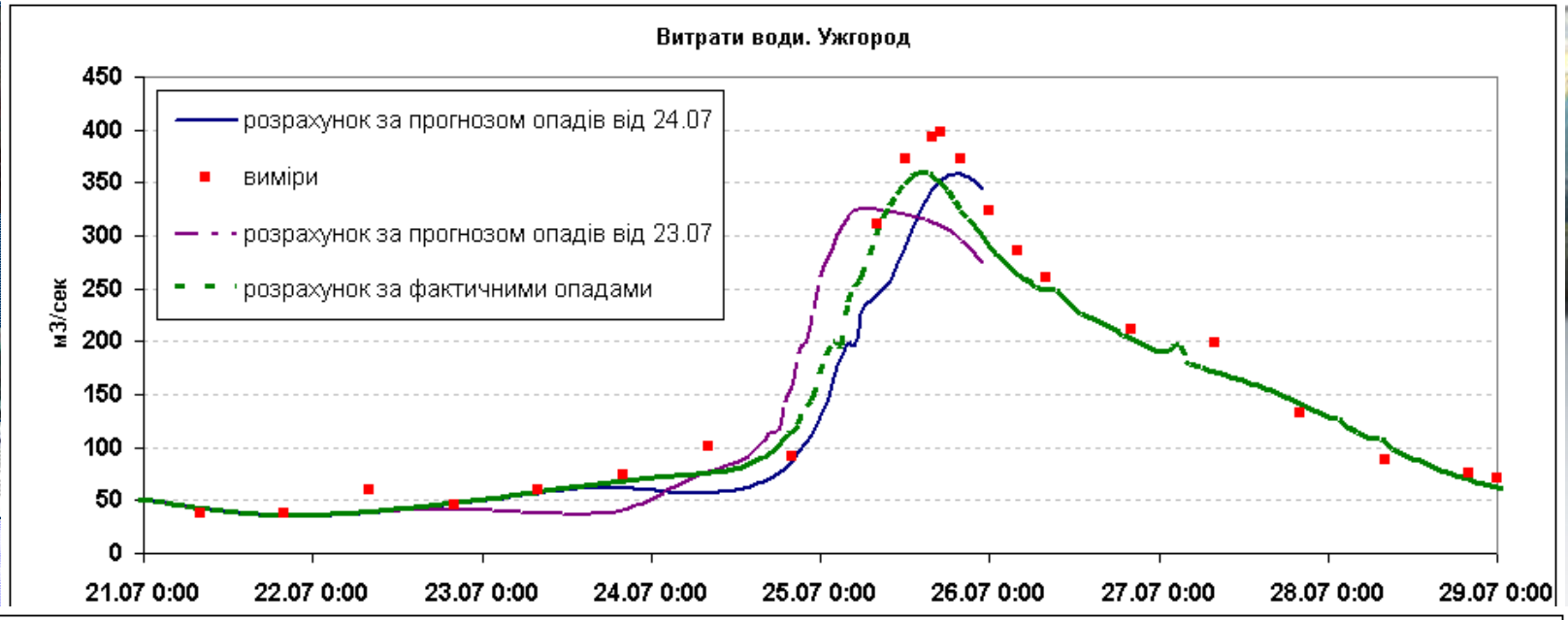


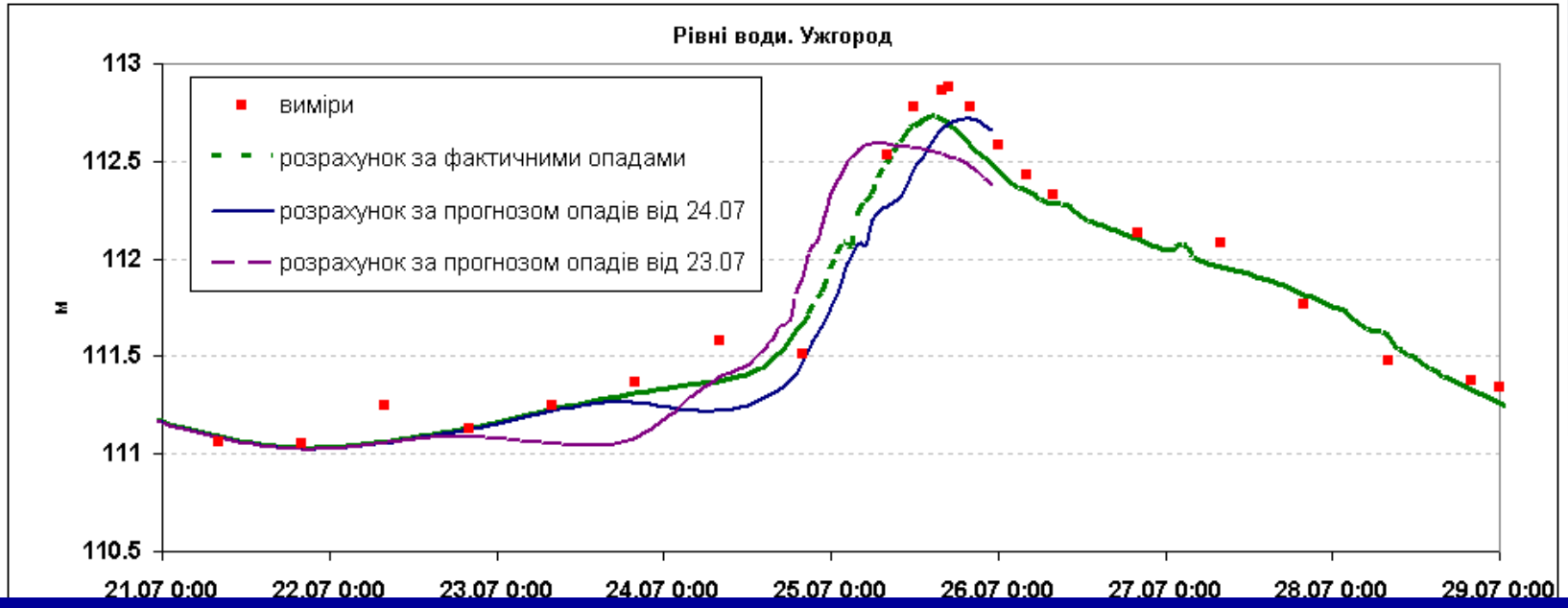






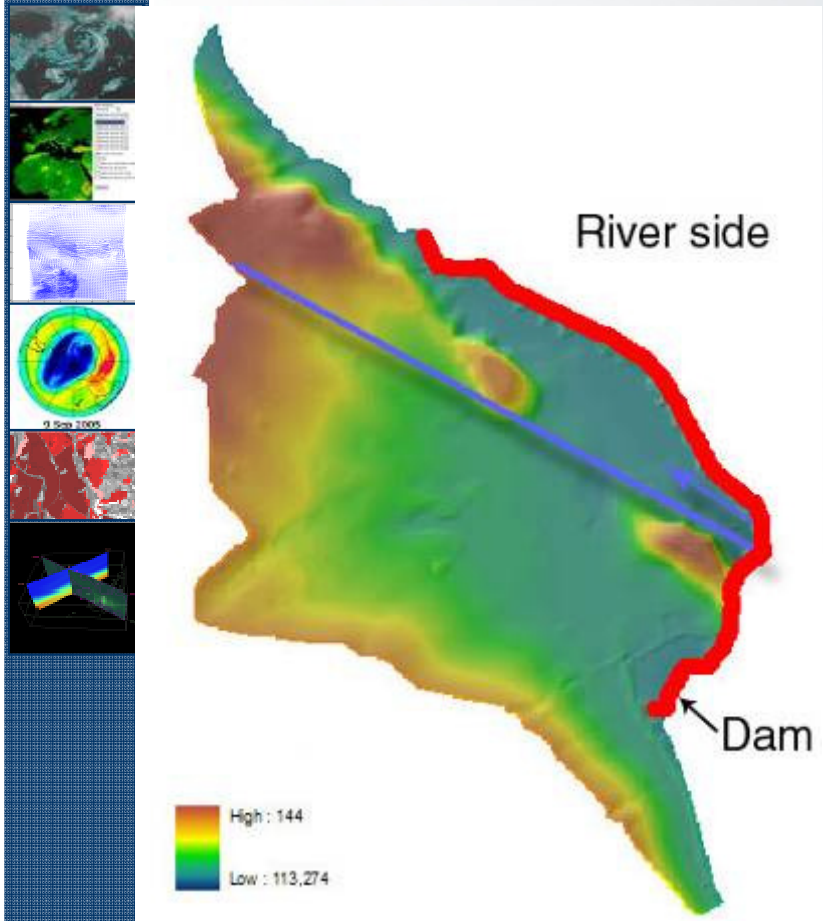
Forecast MM5 - MM5-Carpathian , grid 3*3 км. From 12:00 23 .07 total precipitation. Dots –measured data



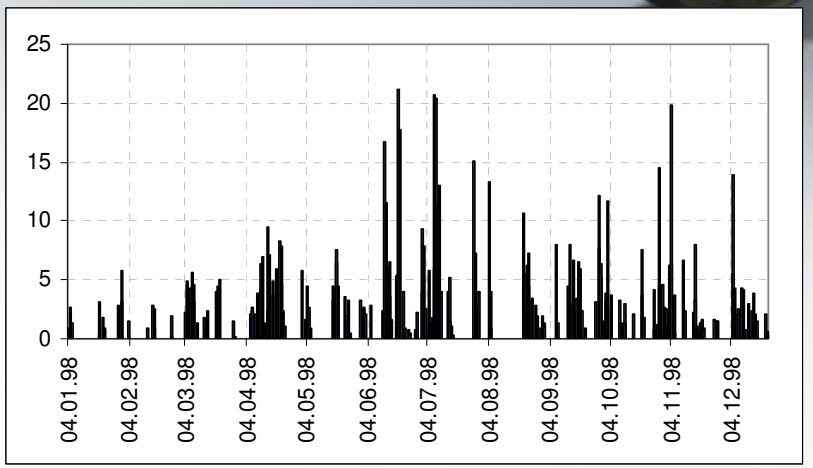


Simulation of the water levels and discharges of Uzh River near Uzhgorod based on the measured precipitations (solid line) and precipitations predicted by MM5- Carpathian models for 3*3 км grid

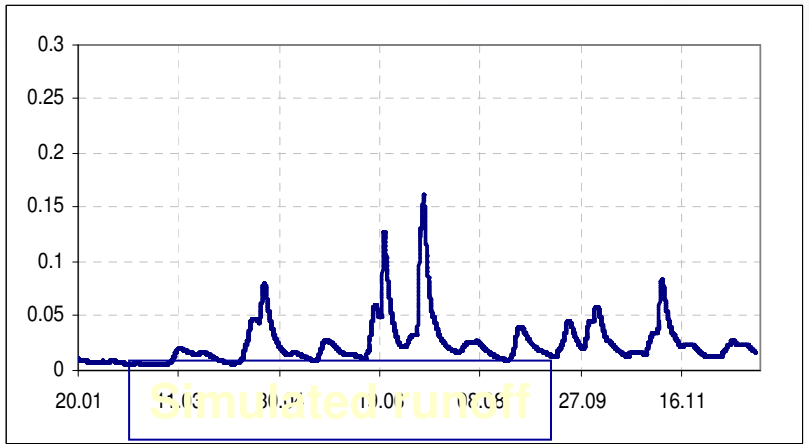
Ungauged watershed case study



DEM of Kvasovo area



Observed time series of precipitation



Simulated runoff

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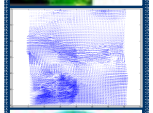
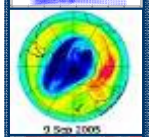
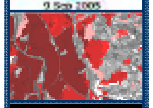
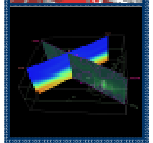
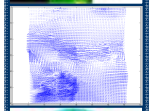
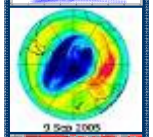
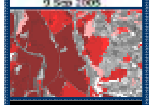
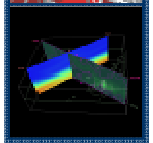





Future Plans: Statistical and Socio-economic information

- L.V. Gromashevsky's Institute of Epidemiology and Infectious Diseases from Ukraine
  - *will provide*
    - expertise on infectious diseases
    - statistical information over west Ukraine
- NOAA
  - will provide statistical information on Malaria in Africa
  - other partners?
- *Challenges & Prospects*
    - environmental information to be used for risk assessment of health threats due to floods
    - great interest in the use of modern geoinformation technologies
    - visualization of geospatial information and time-series



- We are looking for collaboration!