Use-Case for Risk Analysis of Water Borne Vector Disease

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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.
Experience: SW Perspective for Flood Application
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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

Visualization of Data

WMS

Data Processing in Grid
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
Scope of our activity

Floods Monitoring
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…”
• 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
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 assessment,
    - infectious disease risk assessment.
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
- Models
- EO products
- Socio-economic inf
- Health risk analysis
Data

• Models
  – GFS, hydro-predictors, …

• Statistical data
  – on infectious diseases in Ukraine & Africa

• 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
    - 1,729 with infectious diseases, among them 917 children
- Water quality issues
  - 118,000 objects disinfected
  - 31,404 of water wells
Number of affected people according to CRED database (2008)

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

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![Flow Direction Diagram](image)
Forecast MM5 - MM5-Carpathian, grid 3*3 km. 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 km grid.
Ungauged watershed case study

DEM of Kvasovo area

Observed time series of precipitation
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!