EO and GIS technics used in the extreme meteorological phenomena monitoring in Romania

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Outline

Context:

❖ EC-INSPIRE directive and Romanian transposition

❖ Romanian National Integrated Meteorological System (SIMIN), Surface Observational Network used in Romania

❖ Application for Transboundary Flood Management: the FLOODSAT online system

❖ Application for Drought Monitoring

❖ Application for nowcasting

❖ Conclusions

INSPIRE: Directive 2007/2/EC as regards interoperability of spatial data sets and services

GOAL: to achieve interoperability, harmonization across spatial data themes and benefit from the endeavors of users' and producers' communities:

➤ international standards are integrated into the concepts and definitions of the elements of spatial data themes listed in the Directive 2007/2/EC Annex III:

  ▪ "13. **Atmospheric conditions**" (measurements, models...);

  ▪ "14. **Meteorological geographical features**" (temperature, precipitation, wind speed and direction...).

➤ requirements for data types, identification of spatial objects, metadata for interoperability, generic network model, other concepts and rules have to be applied to all spatial data themes.

➤ the classifications/definitions of spatial objects, their key attributes and association roles, data types, value domains and specific rules that apply to individual spatial data theme, have to be used.

# Romanian INSPIRE transposition

➢ The Romanian Spatial Data Infrastructure (**SDI**) approach is truly national. Over the last years special efforts were made to develop and update key datasets which will become part of the Romanian SDI.

➢ Plans are made to develop components of the Romanian SDI, mainly through SDI related projects.

➢ SDI building blocks have reached a significant level of operation.

➢ As determined in **Ordinance nr. 4/2010 transposing the EC-INSPIRE directive,** the Council for National Infrastructure for Spatial Information (INIS Council) is the coordinating body established to implement INSPIRE and is composed from a number of National authorities and organizations.

➢ Initiating and developing of an **interoperable framework** for the management of the available **observation and forecasting meteorological geoinformation (Digital Elevation Model, Hydrological Network, Meteorological Network, Hydrometrical Network, Localities, Road Network etc.)**, able to contribute to rounding off a national spatial data infrastructure (SDI), in conformity with the provisions of the European Directive INSPRE.

SIMIN:
Surface Observational Network

Meteo Romania is operating:
- ✓ 159 weather stations;
- ✓ Vertical sounder data;
- ✓ Lightning detection;
- ✓ Actinometrical observations;
- ✓ Upper-air soundings;
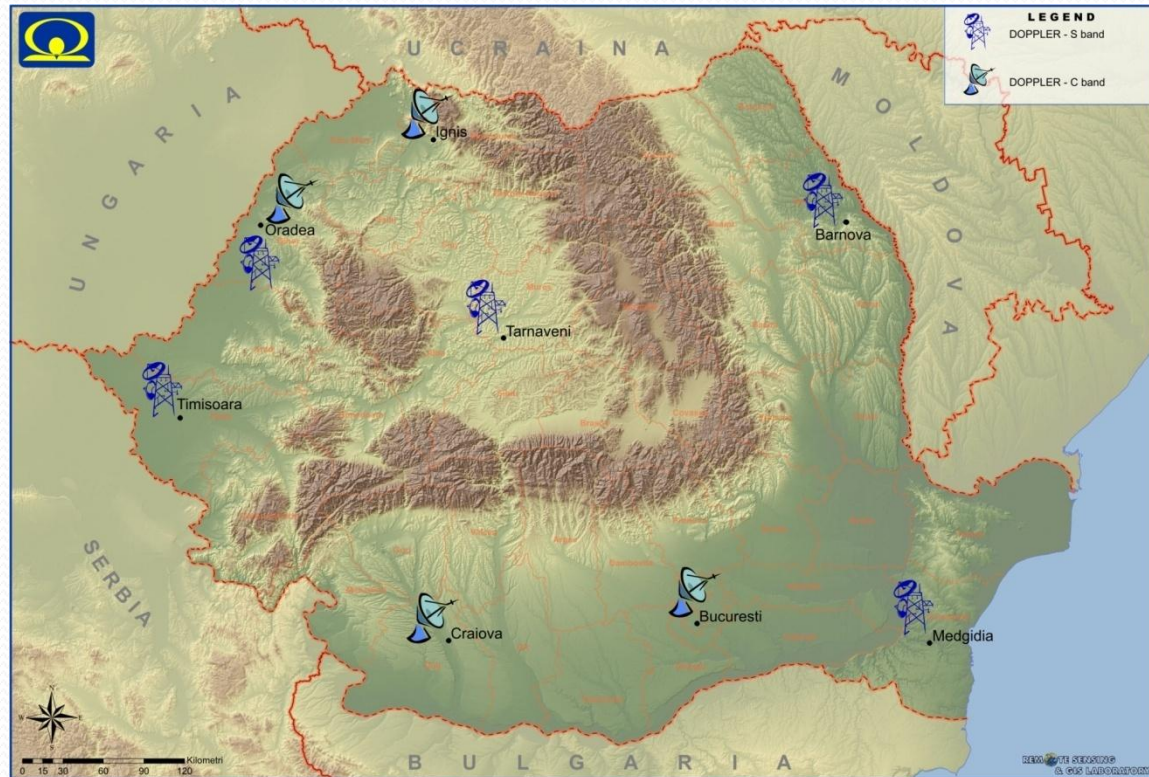- ✓ Radar data;
- ✓ Satellite data.
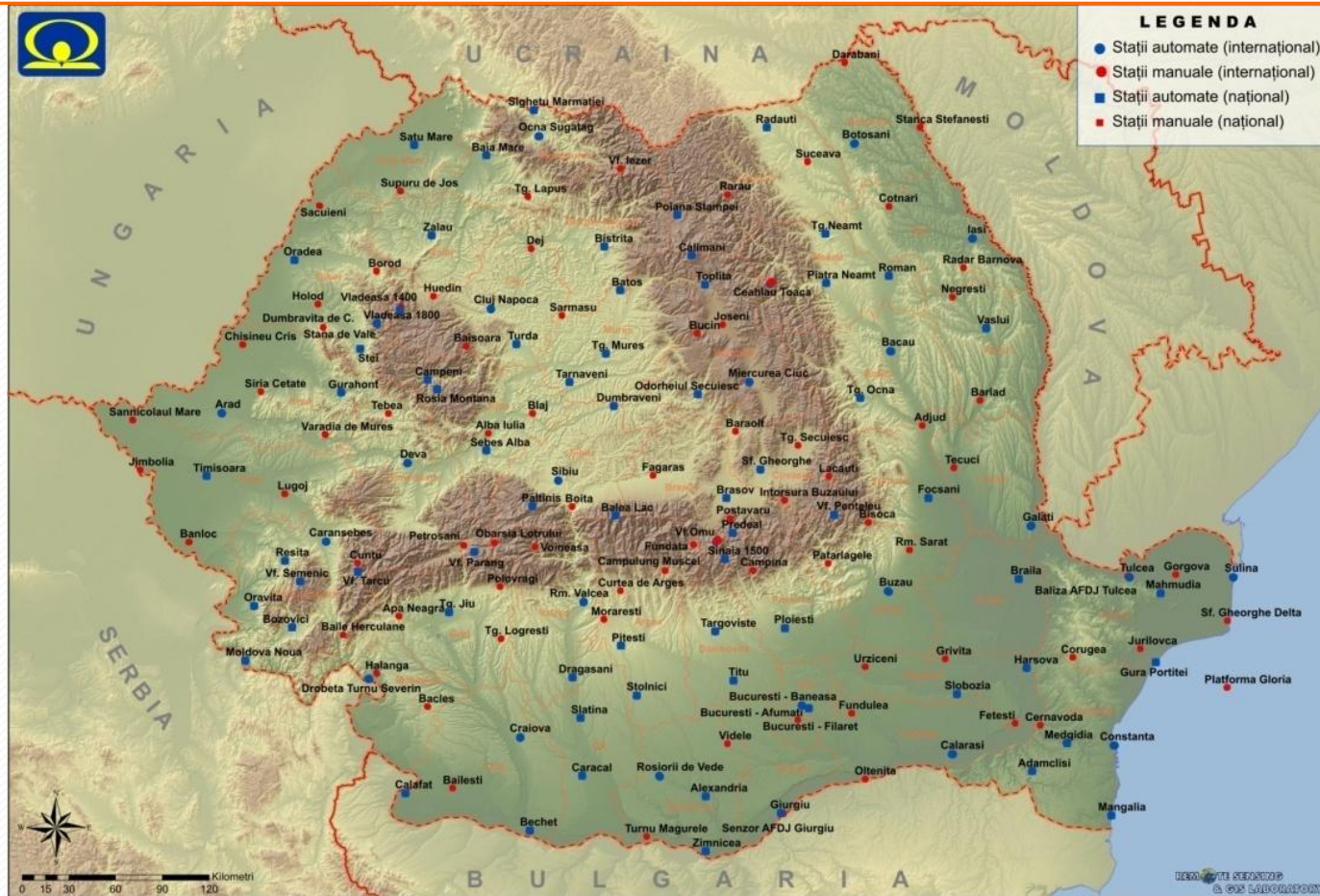
SIMIN: RADAR Network

Meteo Romania is operating a network of 8 Doppler radars:

5 S-band: WSR-98D,

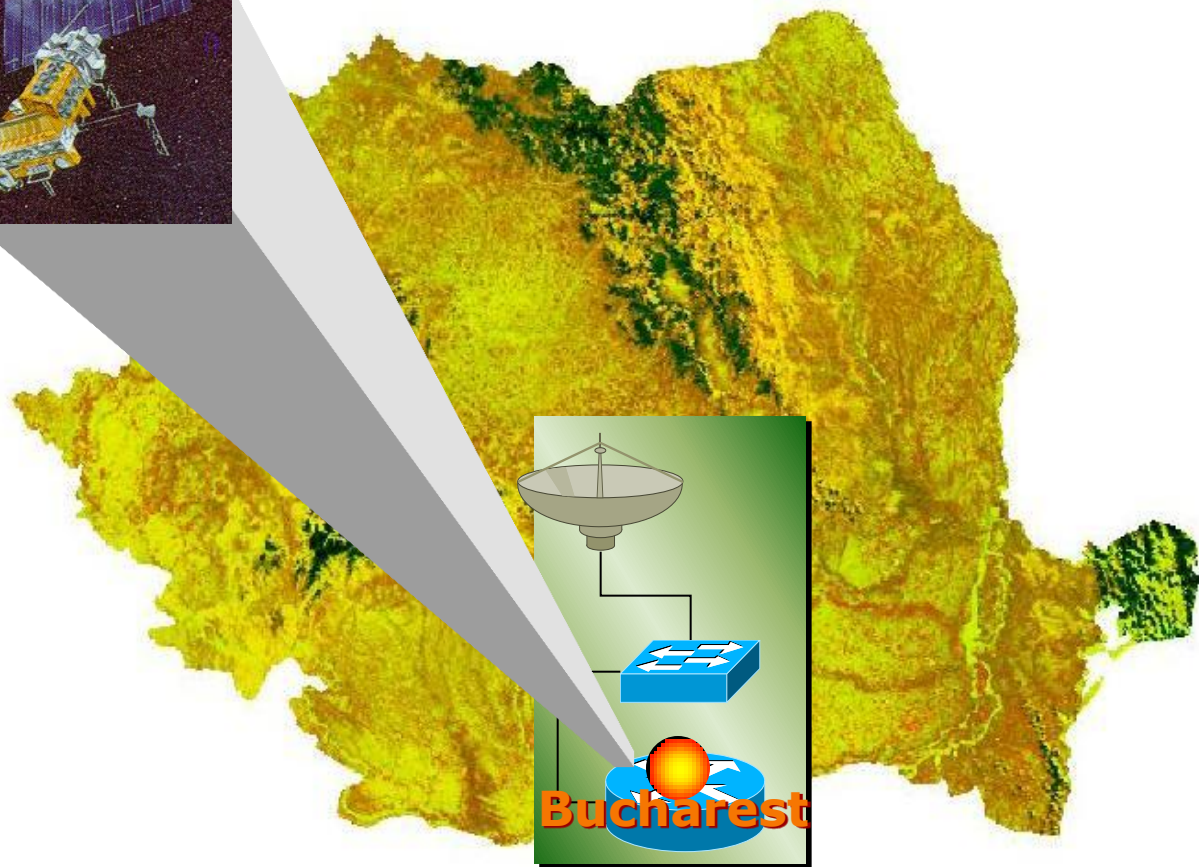**3 C-band**: 2 EEC

1 Gematronik.

SIMIN:
Lightning Detection Network (SAFIR)

4th Workshop on the use of GIS/OGC standards in meteorology, 4-6 March 2013, Reading UK

SIMIN: Satellite receiving station

Satellite numerical data

MSG data reception and processing station

NOAA HRPT data reception and processing station

Bucharest

SIMIN: The visualization system

neX_REAP*
(Next Generation Real-Time Environmental Application Program)

Main goal: to provide an easy, powerful way to analyze, forecast, and use weather data.
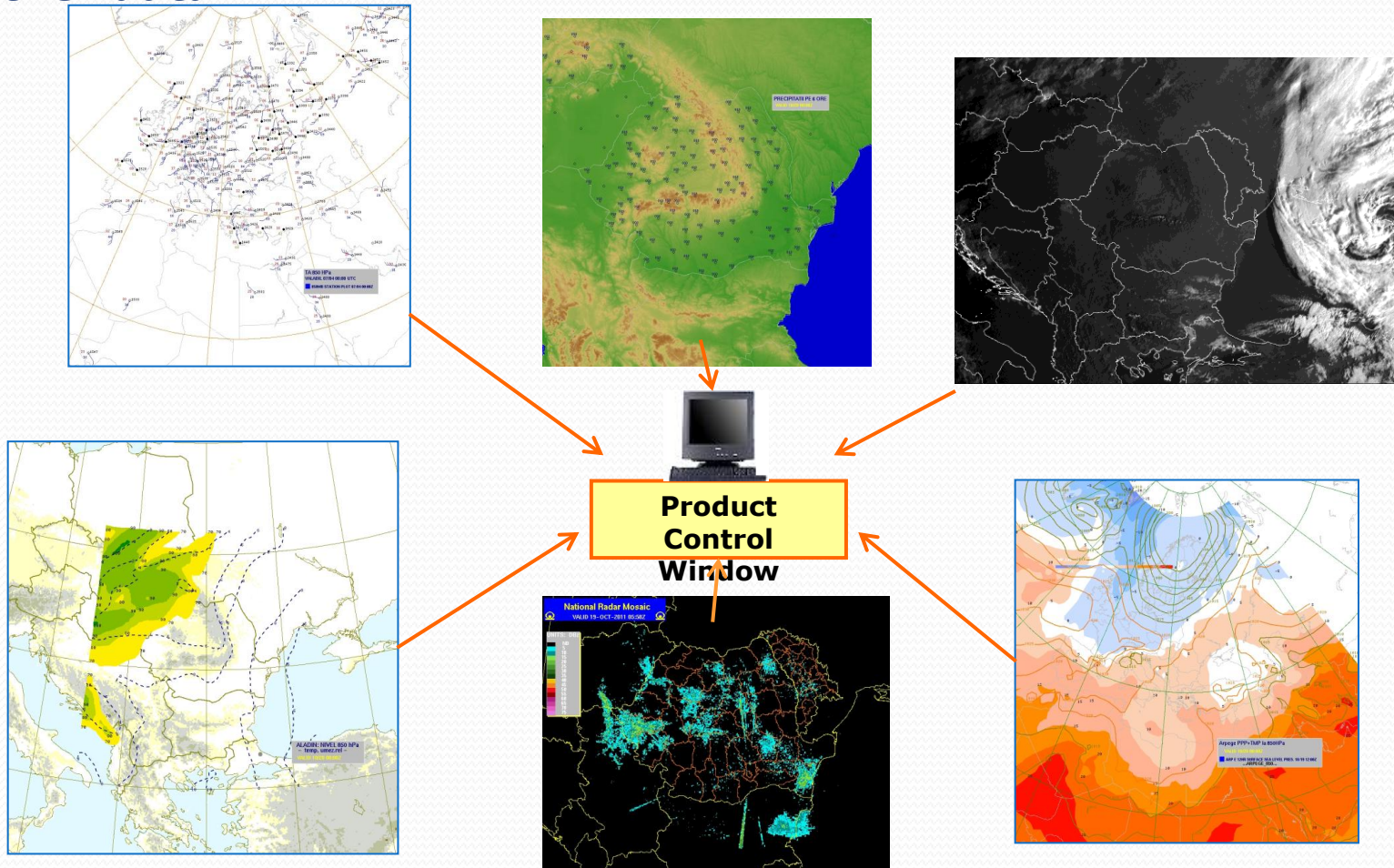
Product Control Window

Application for flood monitoring

FLOODSAT is a dedicated on-line system, based on meteorological information, satellite data and GIS technology
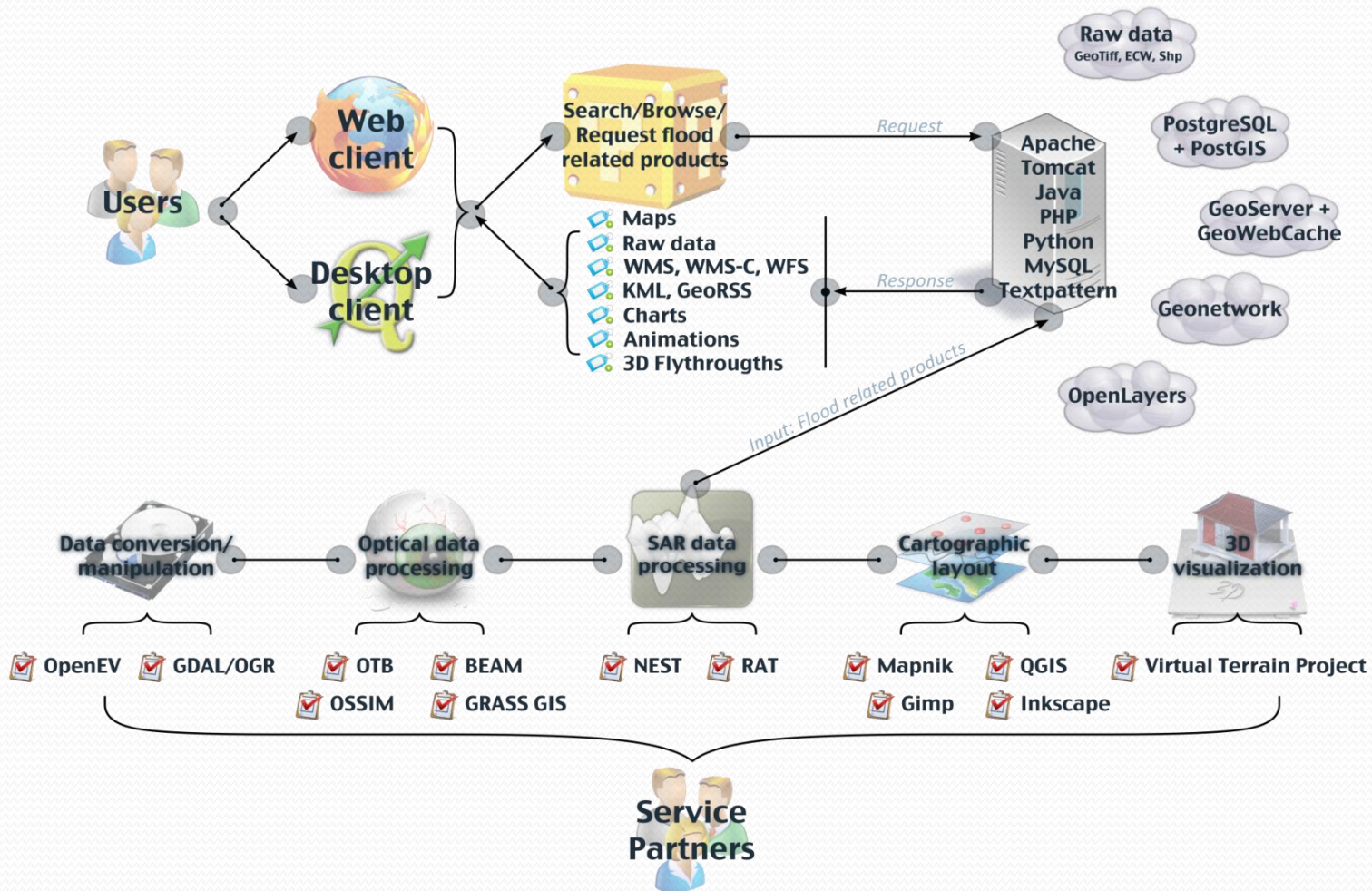
Data access examples
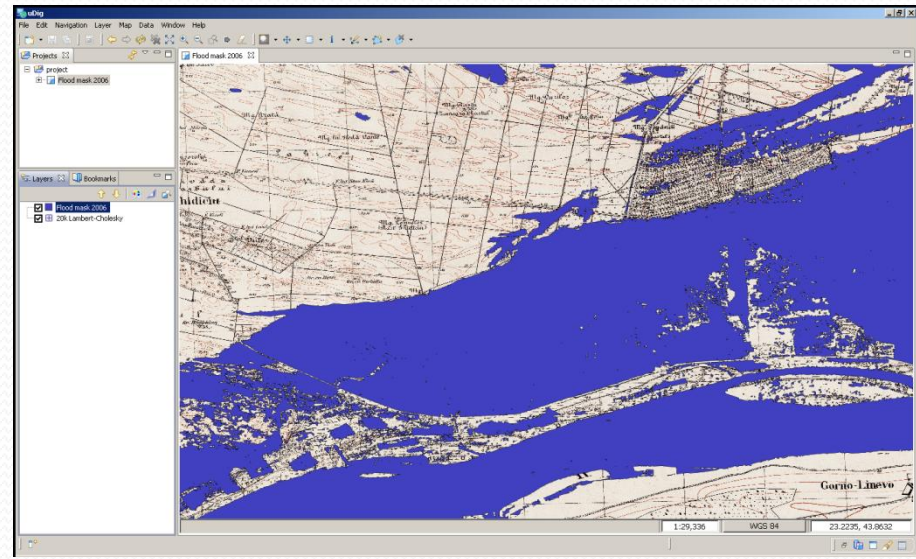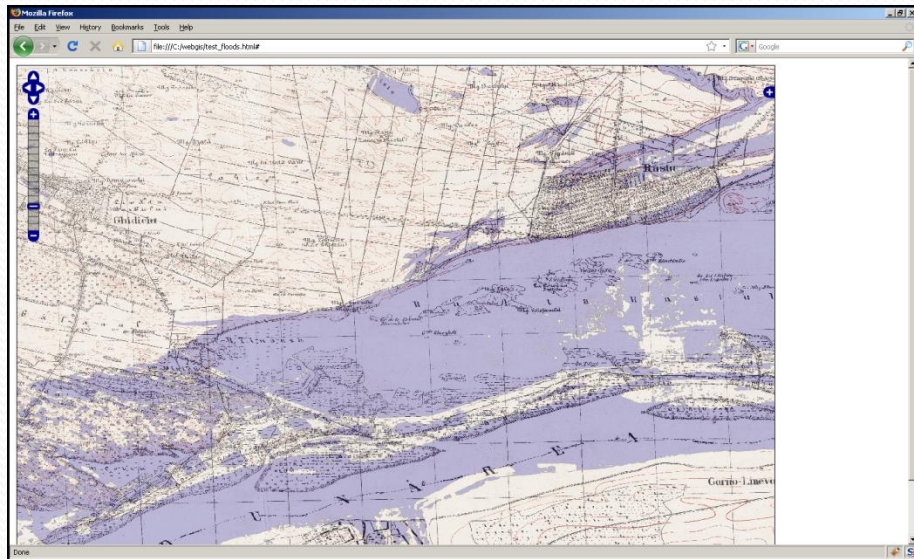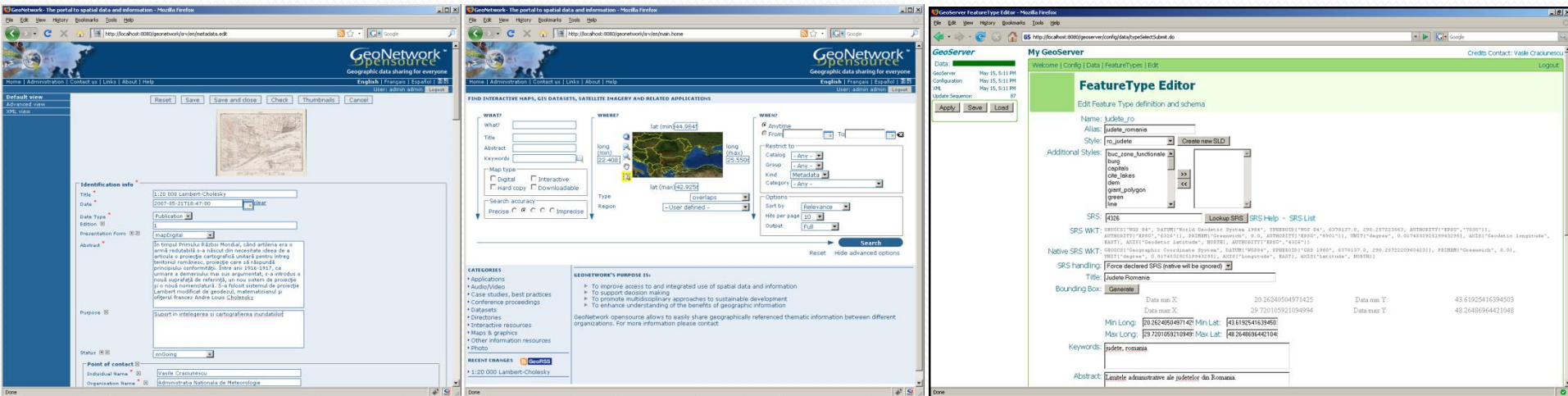
FLOODSAT online system: main functions

- Acquisition, storage, analysis and interpretation of data;

- Management and exchange of raster and vector graphic information, and also of related attribute data for the flood monitoring activities;

- Handling and preparation for a rapid data access;

- Updating the information (temporal modification);

- Data restoring, including the elaboration of thematic documents;

- Generation of value-added information (complex indices for flood prevention, risk maps);

- Distribution of the derived products to authorities, institutions, media, etc.

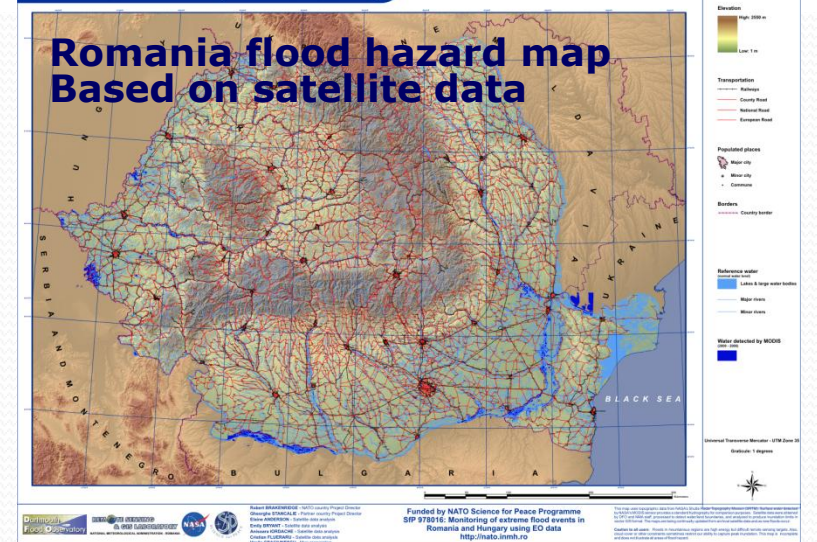# FLOODSAT: Satellite data processing chain
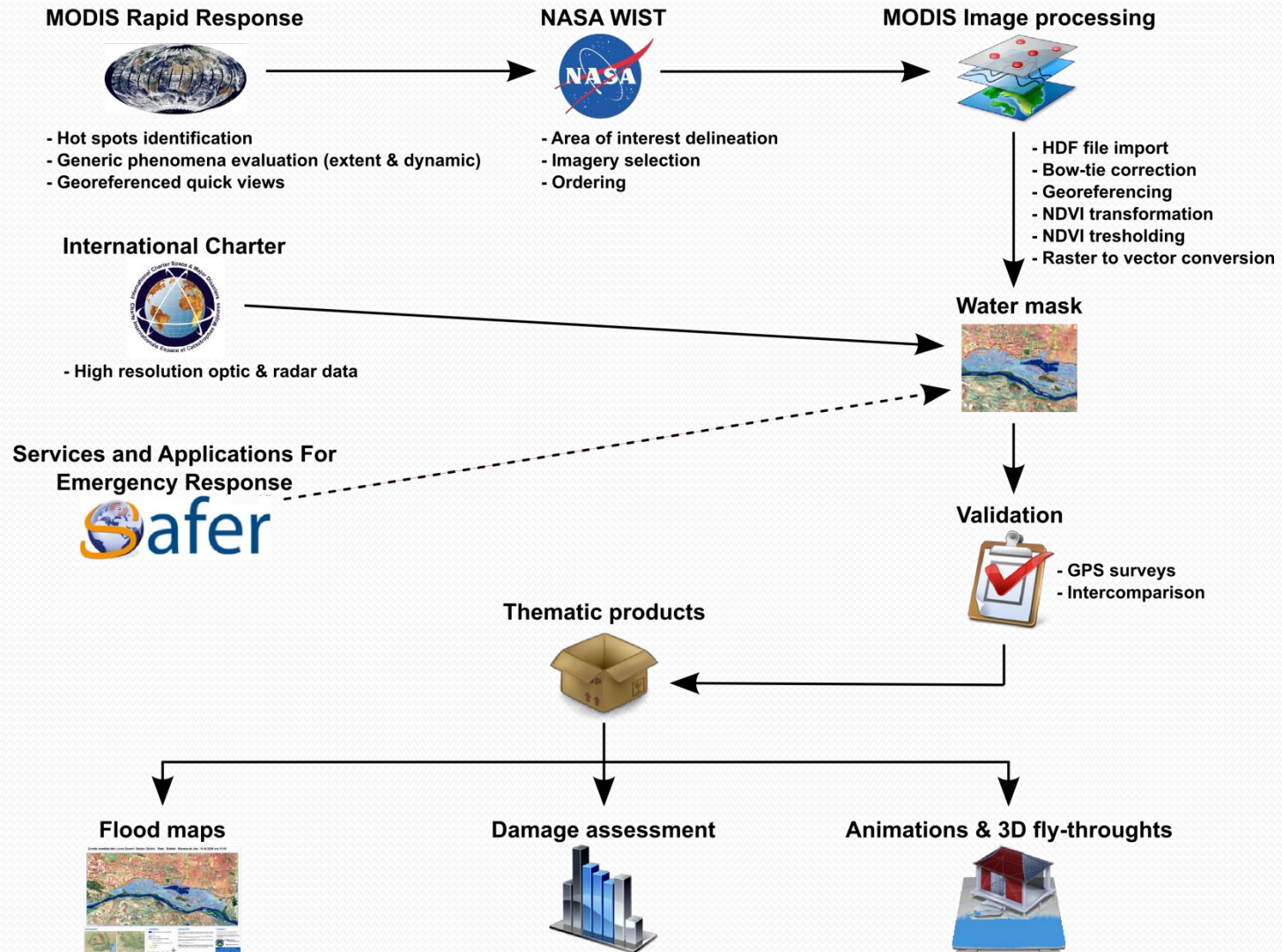
MODIS Rapid Response
- Hot spots identification
- Generic phenomena evaluation (extent & dynamic)
- Georeferenced quick views

NASA WIST
- Area of interest delineation
- Imagery selection
- Ordering

MODIS Image processing
- HDF file import
- Bow-tie correction
- Georeferencing
- NDVI transformation
- NDVI tresholding
- Raster to vector conversion

International Charter
- High resolution optic & radar data

Services and Applications For Emergency Response
Safer

Water mask

Validation
- GPS surveys
- Intercomparison

Thematic products

Flood maps

Damage assessment

Animations & 3D fly-throughts

FLOODSAT: geospatial products

Maps of the flooded areas with satellite image as background

Animations

Flooded areas merged in a GIS environment
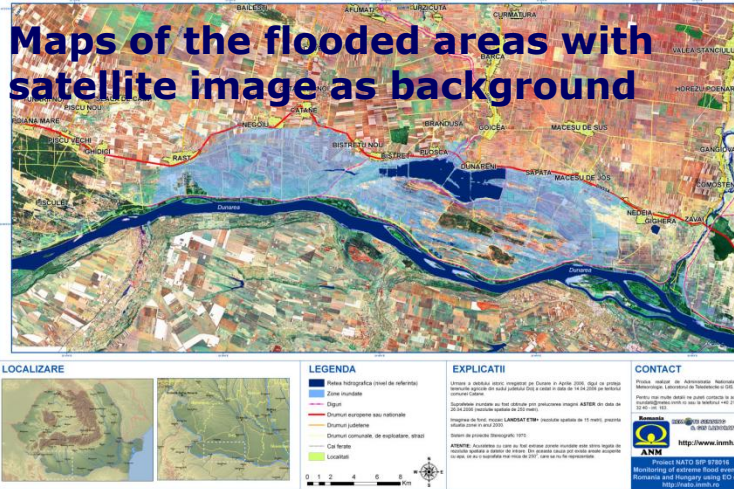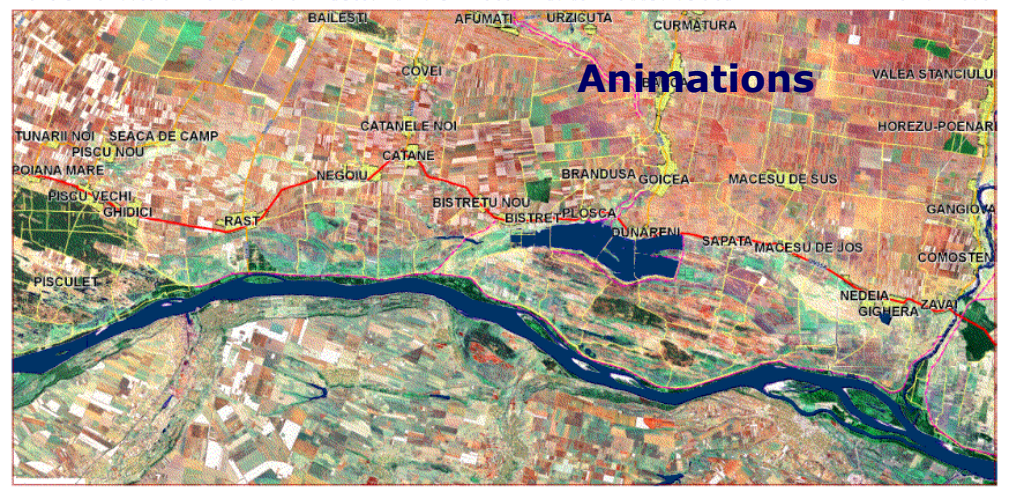
Romania flood hazard map Based on satellite data

4th Workshop on the use of GIS/OGC standards in meteorology, 4-6 March 2013, Reading UK
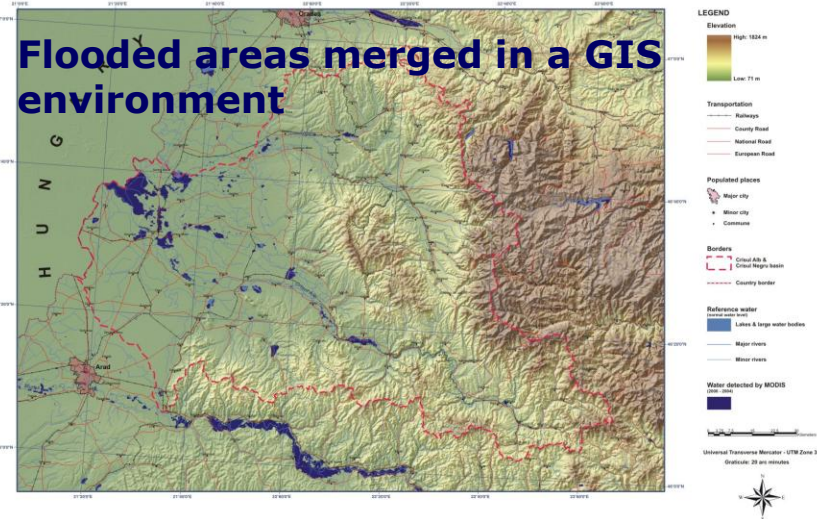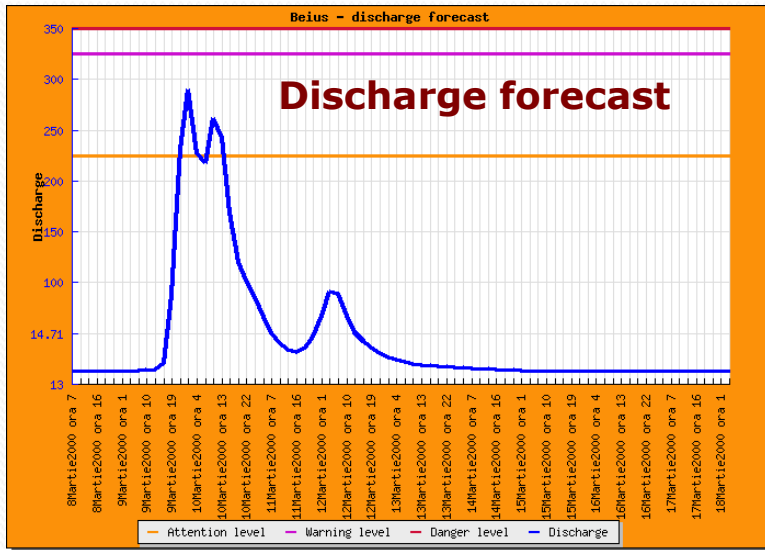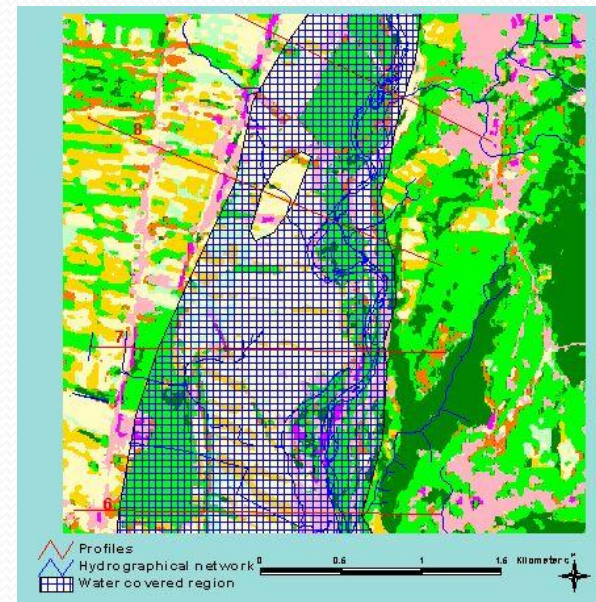
FLOODSAT: geospatial products
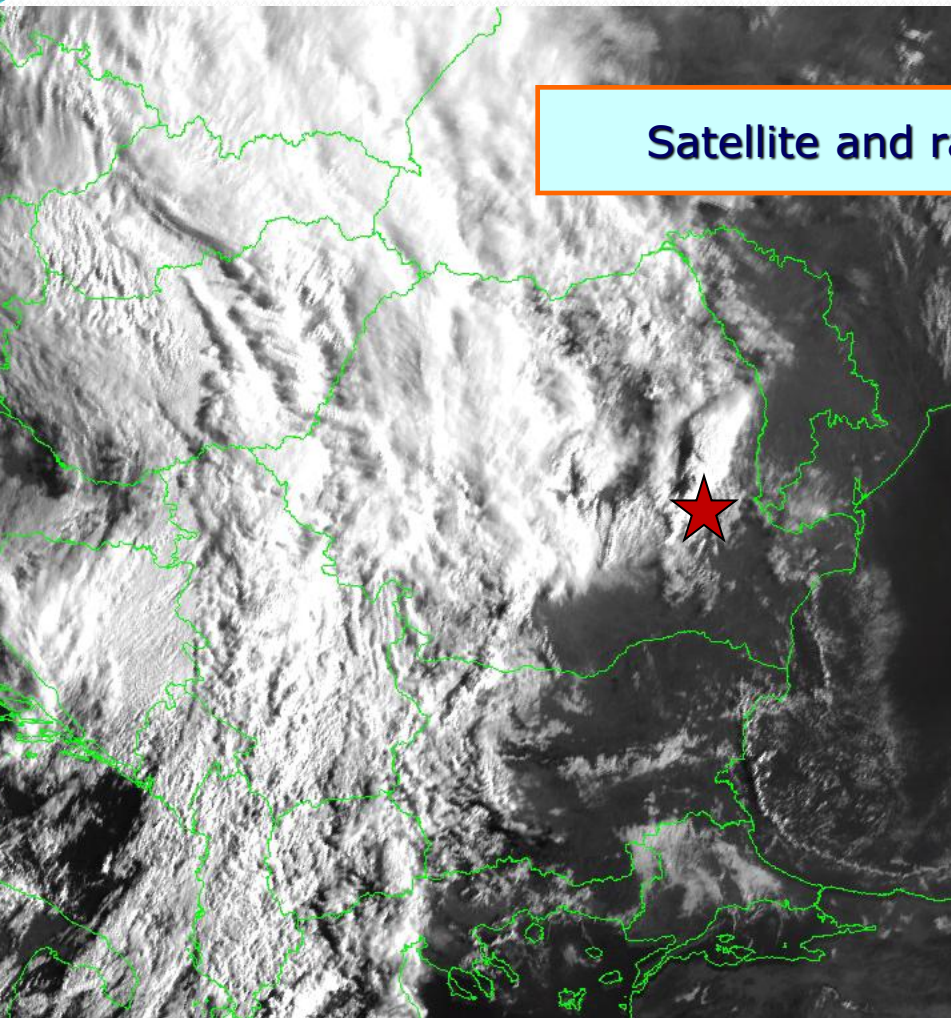
Satellite and radar loops
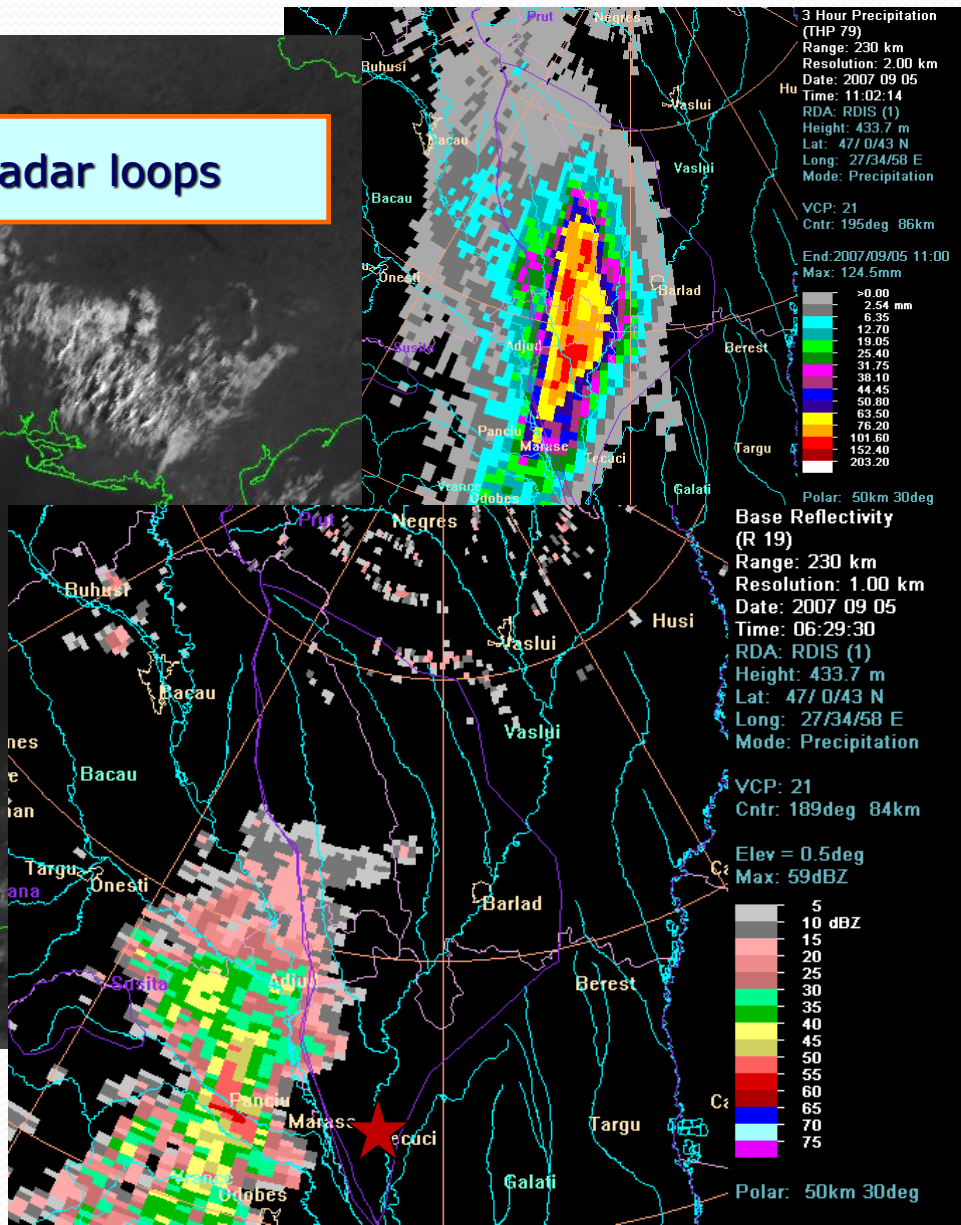
Barlad flash flood – 05.09.2007 – Tecucel basin

FLOODSAT: geospatial products

Discharge forecast

Hydraulic scenarios
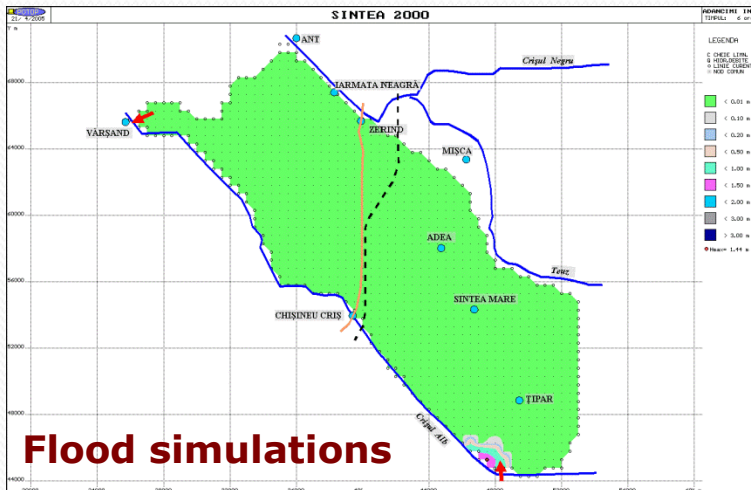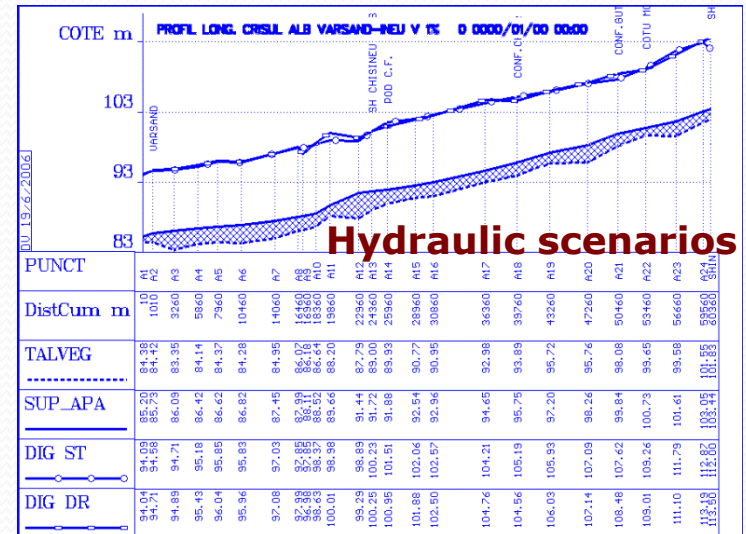
Flood simulations

Flooding Risk Map
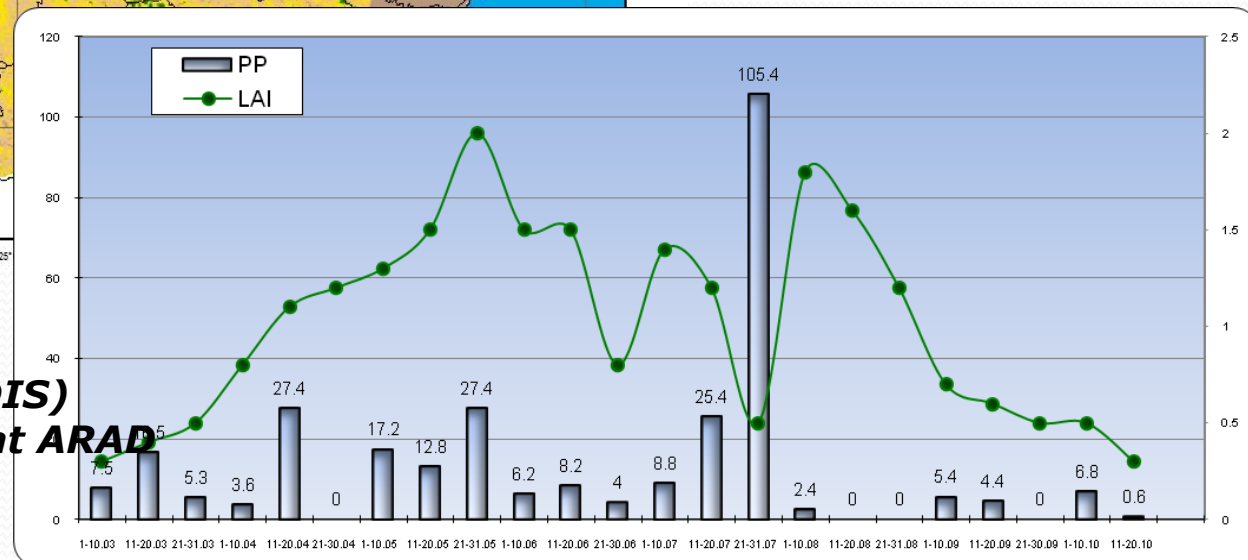
Application for drought monitoring: flow chart
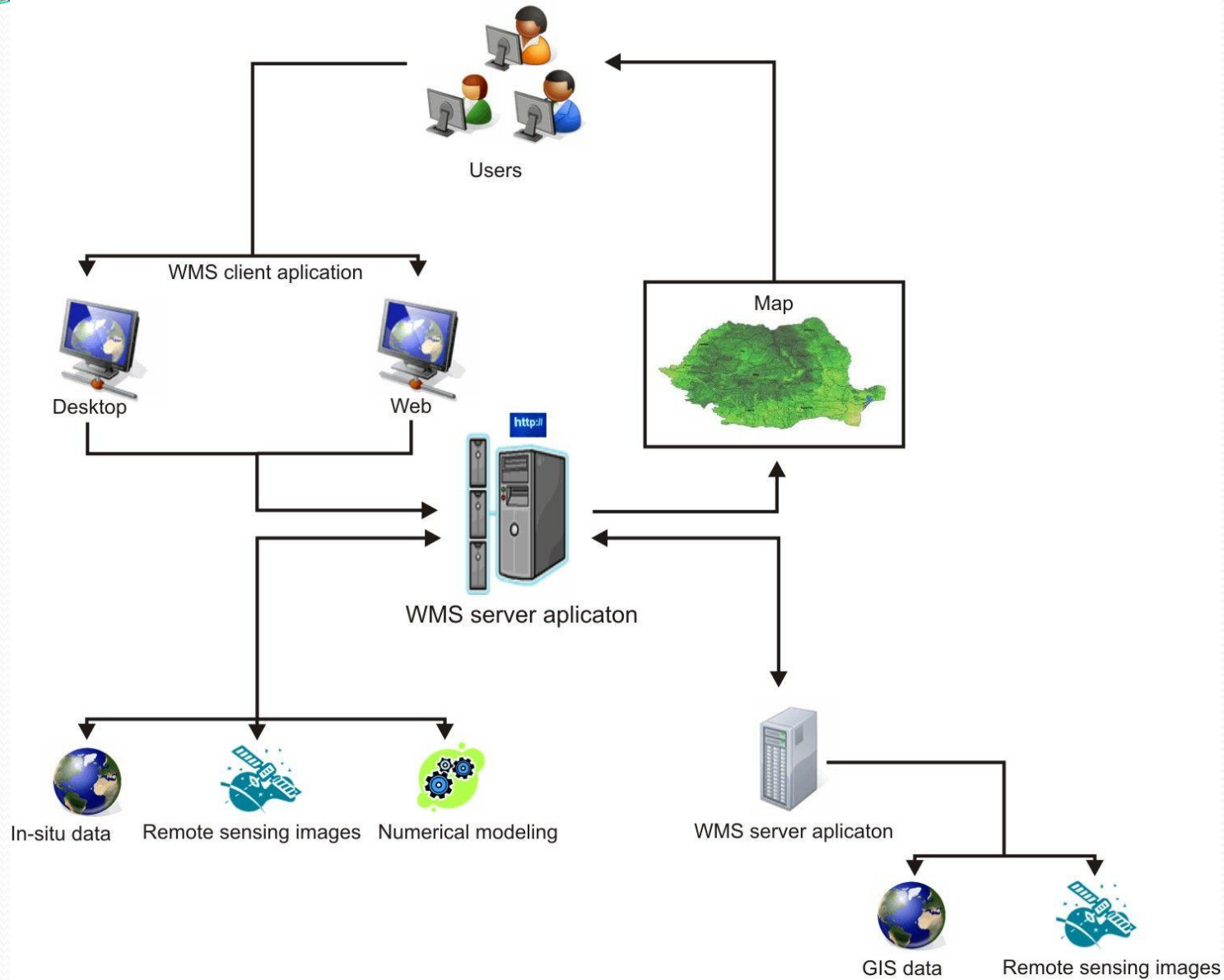
Application for drought monitoring: warning flow chart
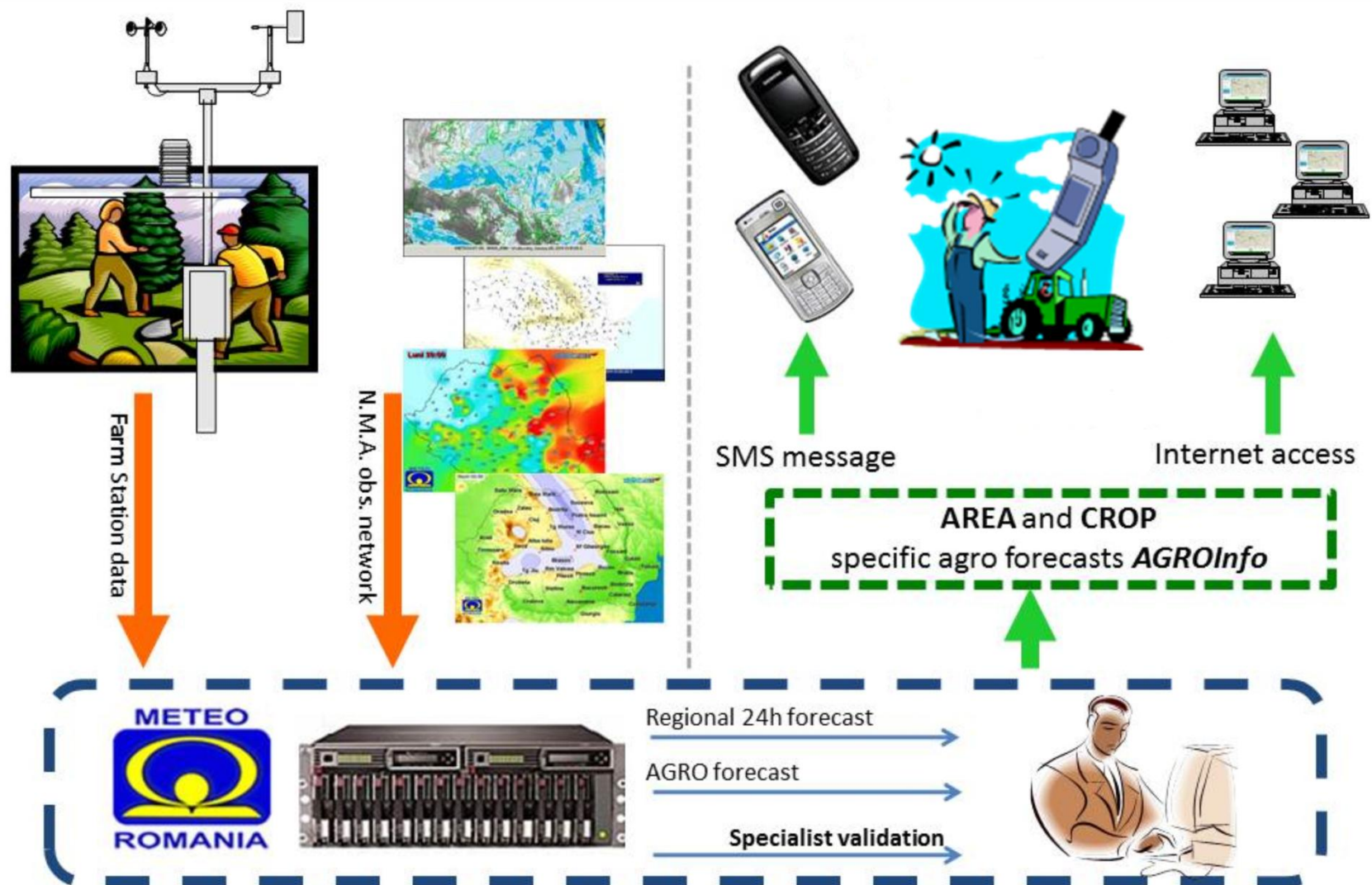
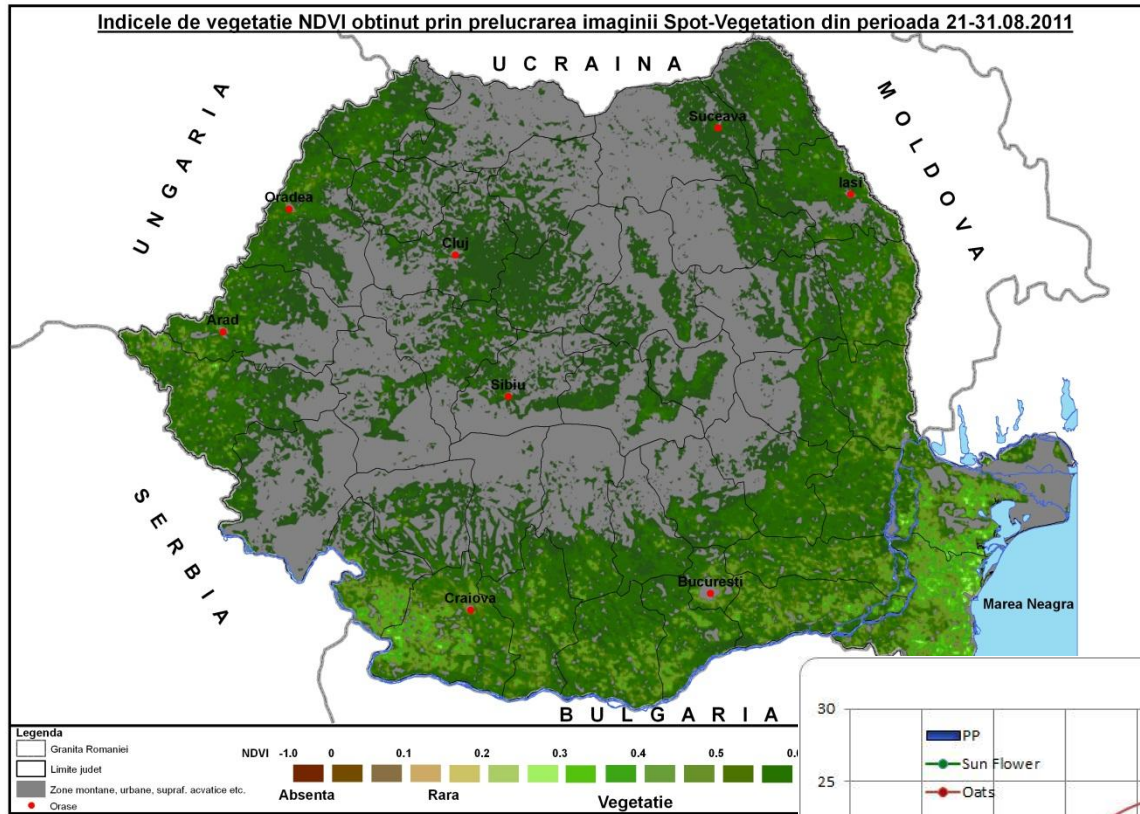# Drought: geospatial products (Leaf Area Index)
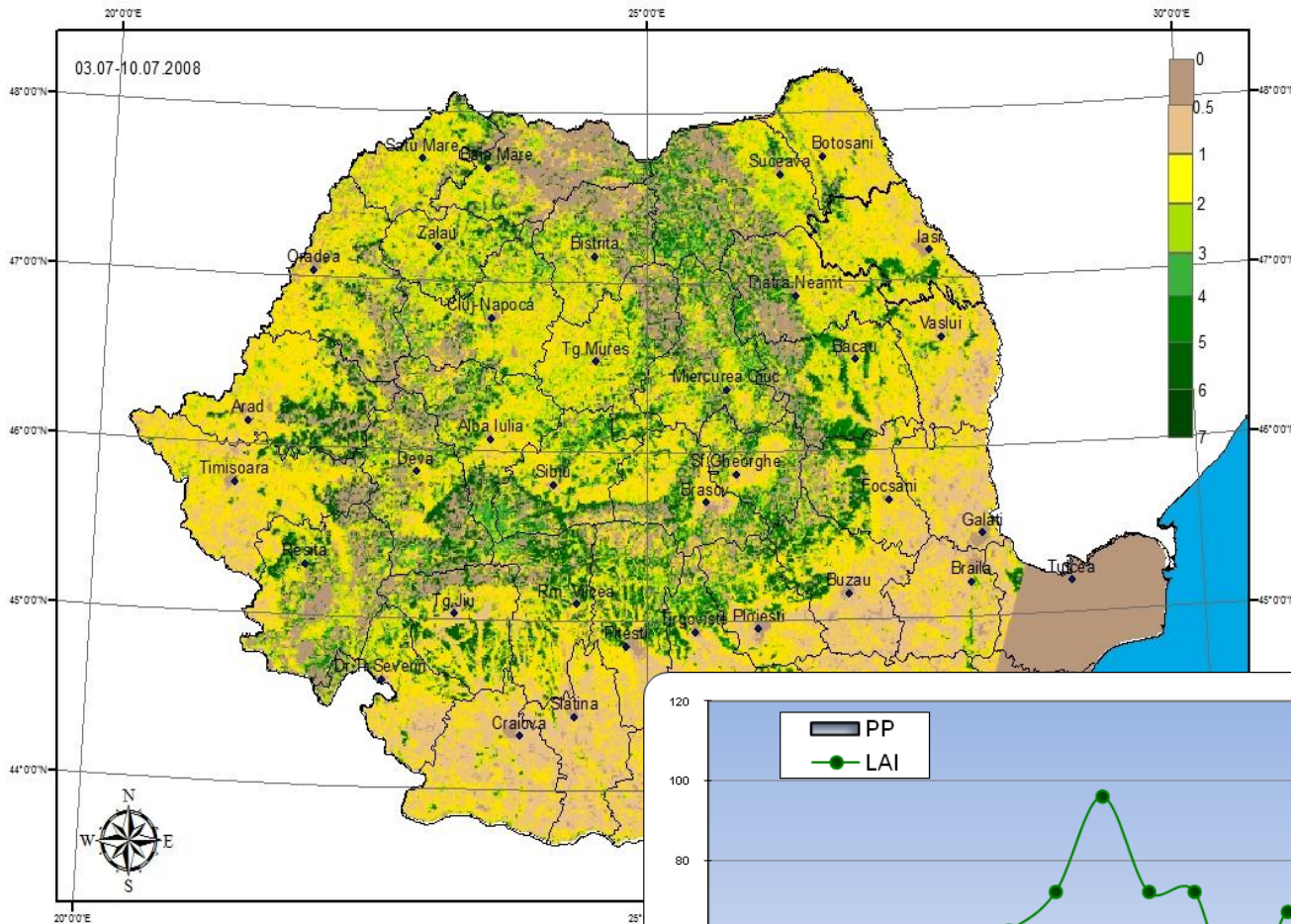
The correlation between LAI (extracted from TERRA/MODIS) and precipitation (recorded at ARAD meteorological station)
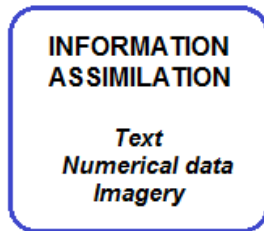
Drought: geospatial products
Normalised Difference Vegetation Index (NDVI)

The correlation between NDVI (extracted from SPOT VEGETATION)
and precipitation (recorded at ARAD meteorological station)

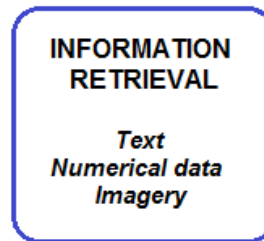# Application for nowcasting (storm) System Architecture

Informational system

```
┌─────────────────┐
│ INFORMATION     │
│ ASSIMILATION    │
│                 │
│   Text          │
│  Numerical data │
│   Imagery       │
└─────────────────┘
        │
        ▼
   DATABASES
        │
        ▼  Filtering operations
┌─────────────────┐
│ INFORMATION     │
│ RETRIEVAL       │
│                 │
│   Text          │
│  Numerical data │
│   Imagery       │
└─────────────────┘
    │         │
    ▼         ▼
```
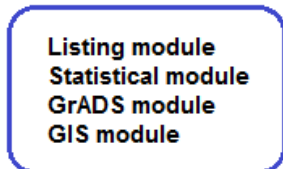
Analytical component   Predictive component

```
┌─────────────────┐
│ Listing module  │
│ Statistical module │
│ GrADS module    │
│ GIS module      │
└─────────────────┘
```

Programming languages:

C#
for creating the software modules

Microsoft Visual Studio 2010 Professional

SQL
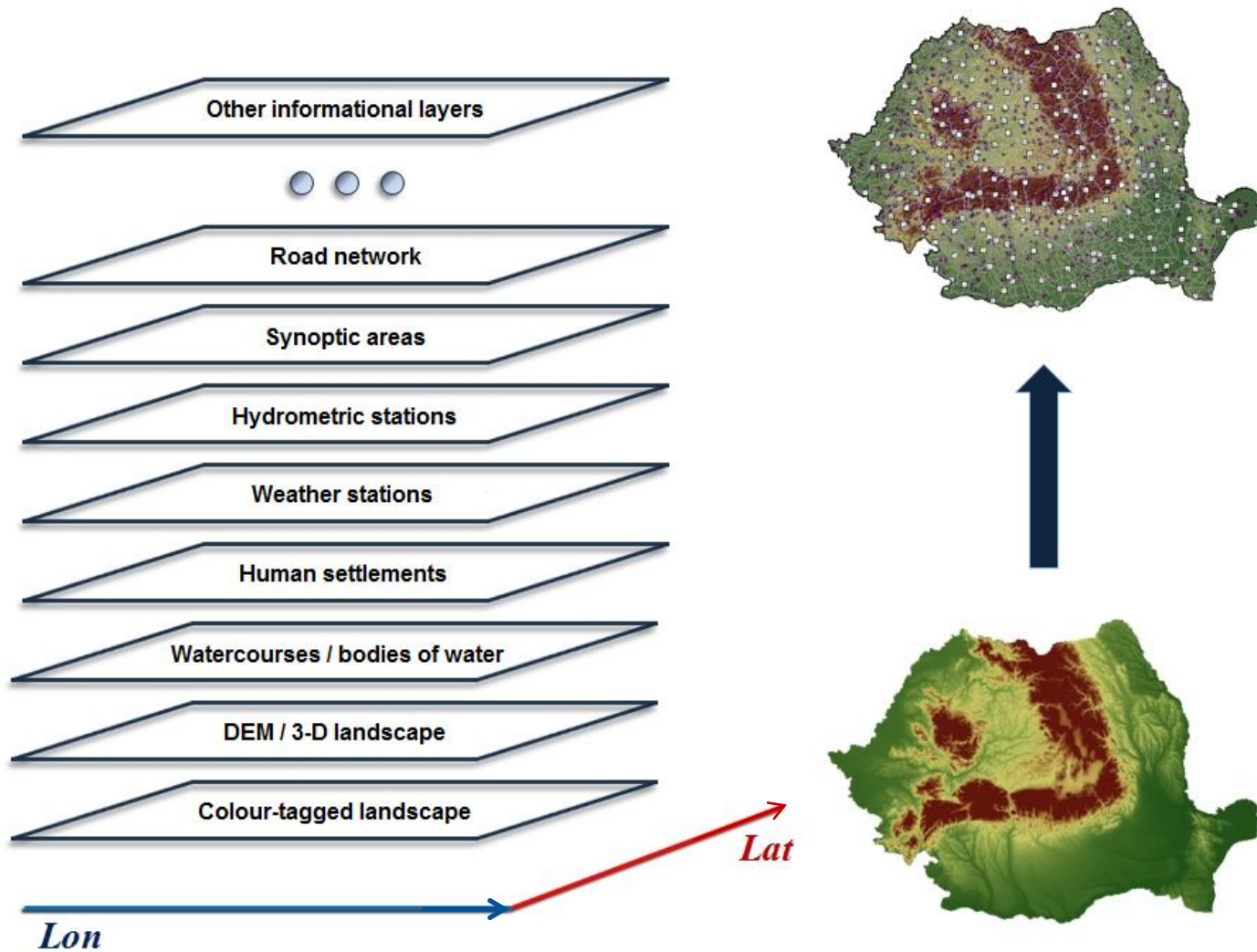**(Structured Query Language)**
for database access

Microsoft SQL Server 2008 R2
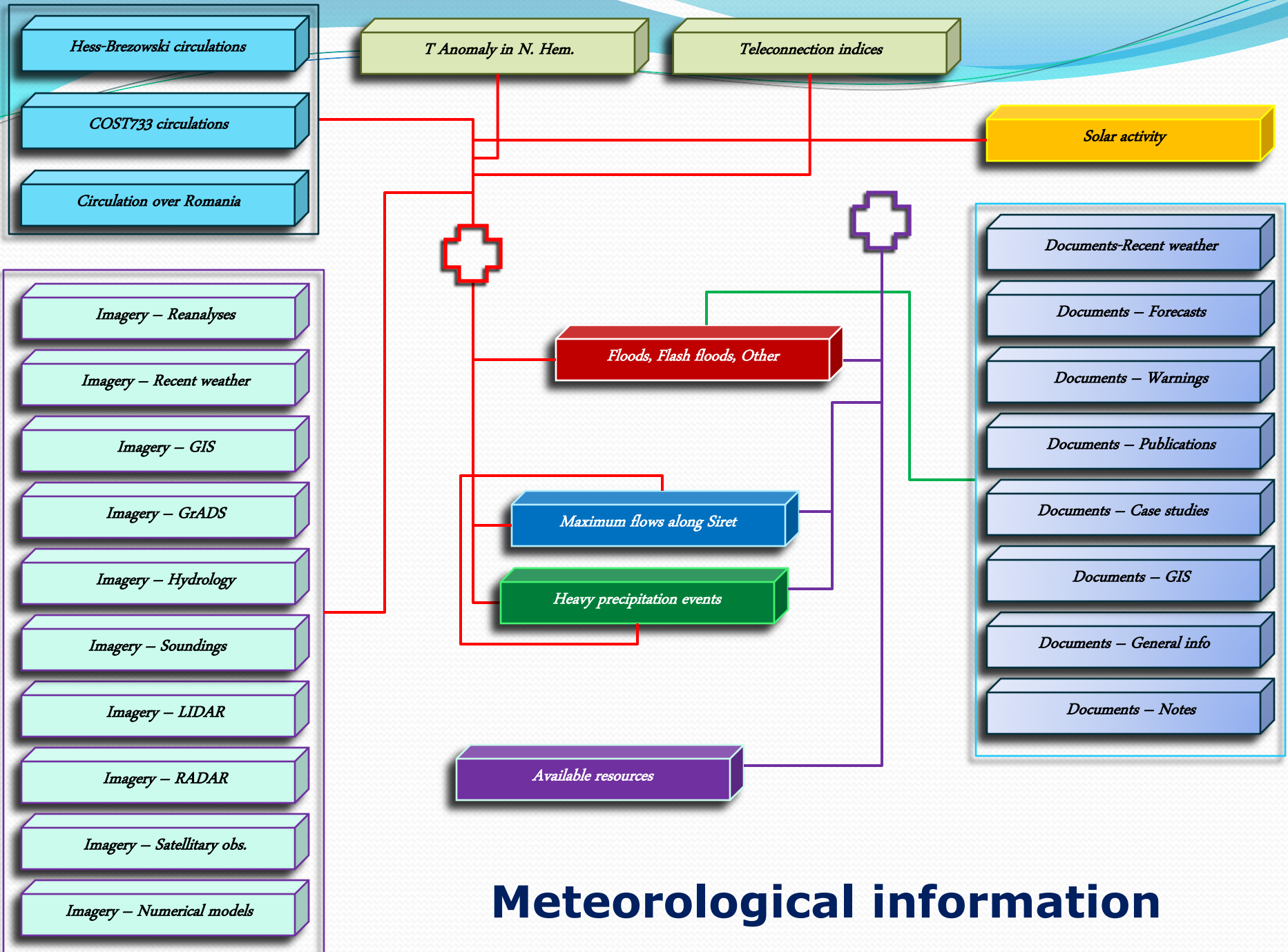
Meteorological information

Application for nowcasting (storm)
GIS – geoinformation layers

Warning System in case of severe weather

Warning System: dissemination

Conclusions

➢ The Romanian Meteorological Administration started the actions to develop and implement an interoperable framework for the management of meteorological information. This effort will contribute to carrying out a national spatial data infrastructure (SDI), in conformity with the provisions of the **European Directive INSPRE**.

➢ **The Web-based Information System for Flood Monitoring** (FLOODSAT), based on satellite data and GIS technology, was implemented in Romania. The data registered into the system is published through standard compliant services and can be accessed by users via a web or desktop client.

➢ Collaboration with different end-users, for the extreme meteorological and hydrological phenomena generated disasters has been already established; a good example of cooperation work between the existing actors from different Romanian institutions was done during the floods in 2005, 2006, 2009, 2010.

Thank you for your kind attention !

http://www.meteoromania.ro