Satellite data use for severe meteo-hydrological events monitoring and related risks in Romania

Romanian National Meteorological Administration
Remote Sensing and GIS Laboratory

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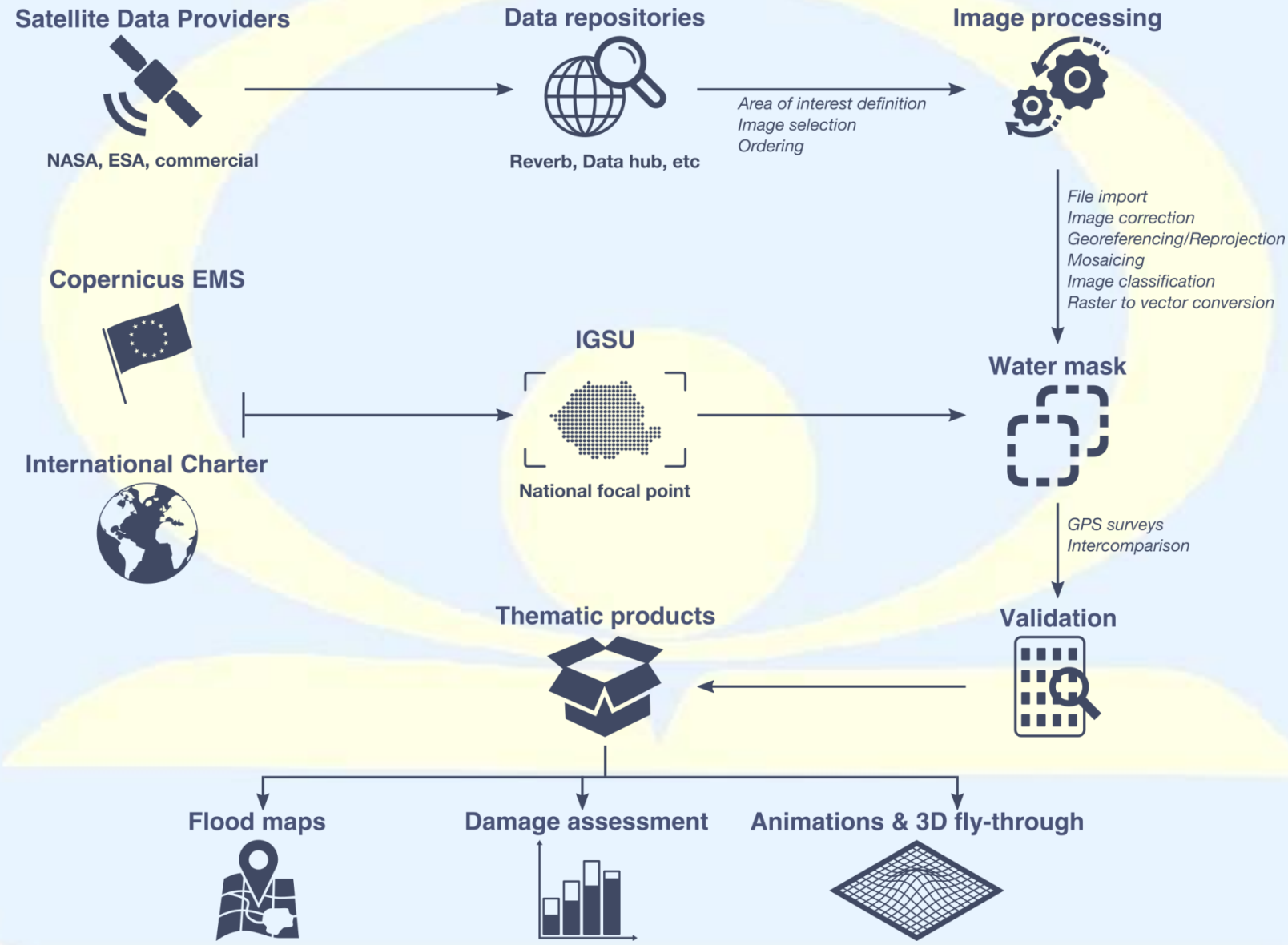
Vasile Crăciunescu, Argentina Nerţan, Denis Mihăilescu,
Simona Catană, George Morcov

REMOTE SENSING AND GIS ACTIVITY

- **OPERATIONAL and RESEARCH ACTIVITY**
  - Applications in monitoring of meteorological and hydrological hazardous phenomena
  - Applications in the environmental impacts studies
  - Satellite-based products validation using “in situ” measurements
  - Satellite data integration in crops growth models
- **RESEARCH DIRECTIONS**
  - Floods
  - Droughts
  - Soil moisture
  - Snow cover

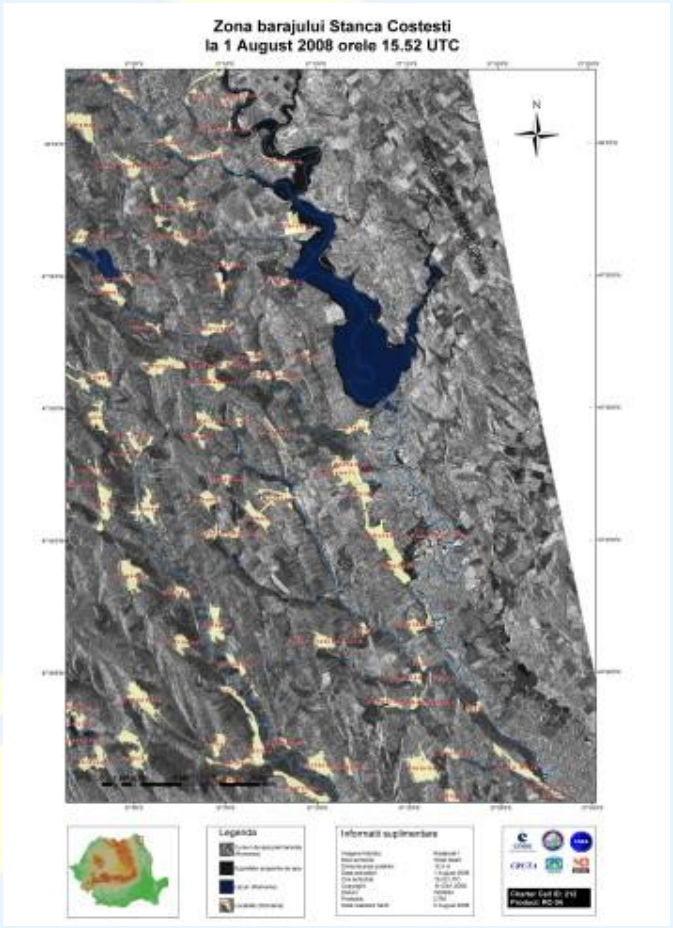
FLOOD MONITORING USING SATELLITE DATA

Flow chart


Satellite Data Providers
NASA, ESA, commercial
Data repositories
Reverb, Data hub, etc
Area of interest definition
Image selection
Ordering
Image processing
File import
Image correction
Georeferencing/Reprojection
Mosaicing
Image classification
Raster to vector conversion
Copernicus EMS
International Charter
IGSU
National focal point
Water mask
GPS surveys
Intercomparison
Validation
Thematic products
Flood maps
Damage assessment
Animations & 3D fly-through

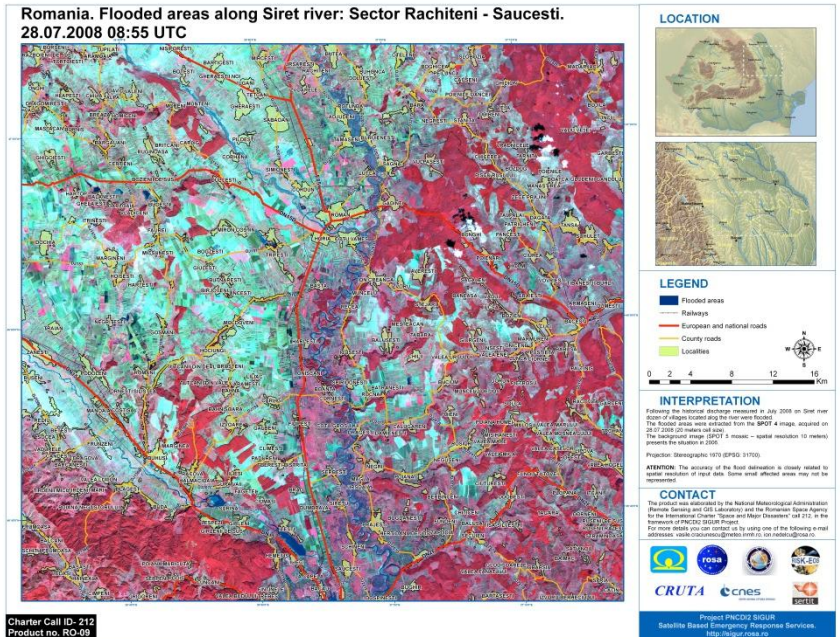
NE of Romania along Prut River
Map of the flooded areas – 27th of July - 3rd of August 2008

Flooded areas in Rădăuți – Prut, based on TERRA-SAR – X, 29.07.2008

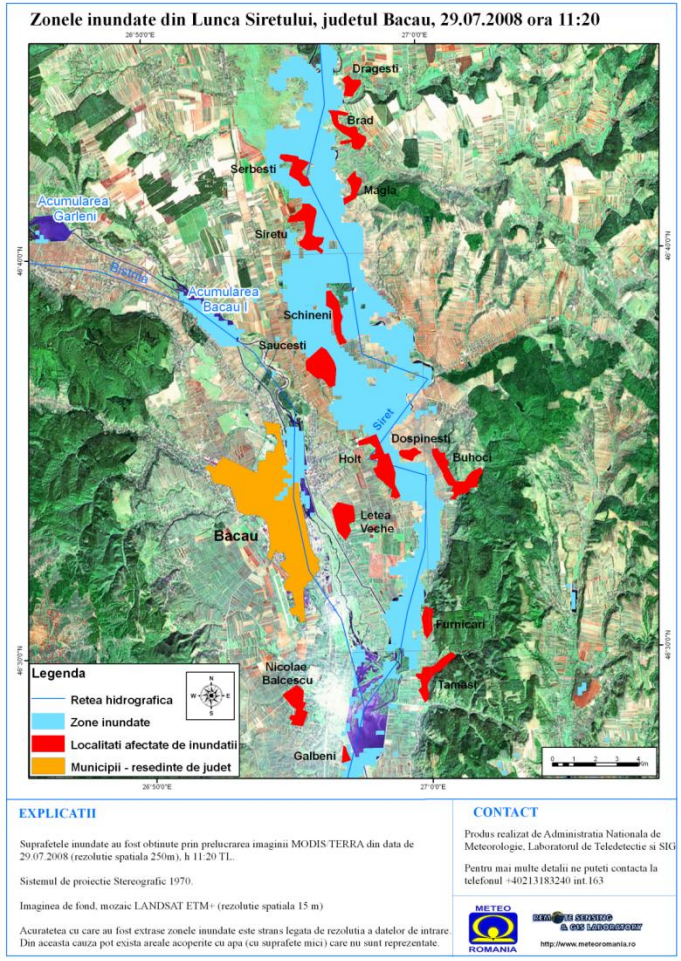


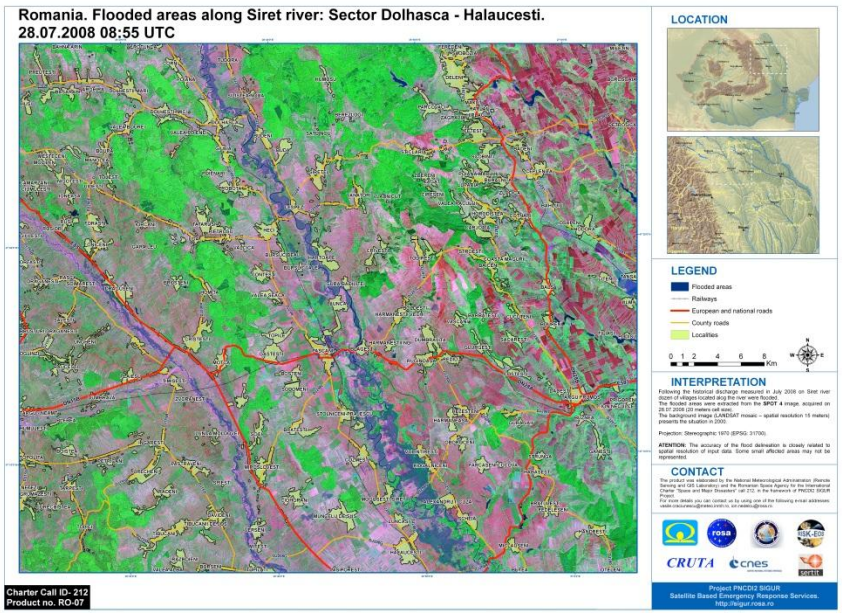
Flooded areas at Stânca Costesti Dam, based on RADARSAT, 1.08.2008

E of Romania along Siret River
Map of the flooded areas – 27th of July - 3rd of August 2008



Flooded areas in Răchițeni-Săucești, based on SPOT 4, 28.07.2008



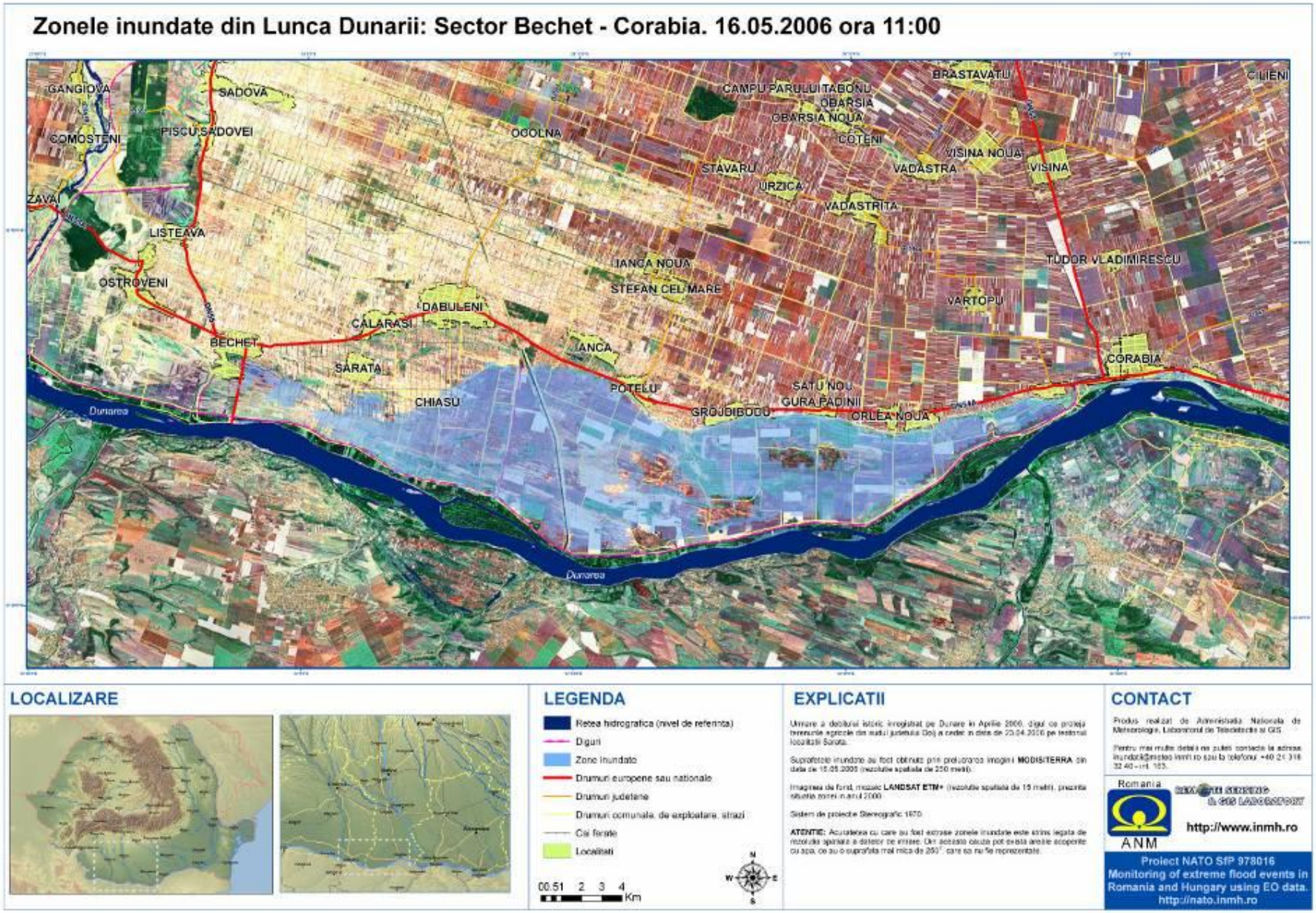


Flooded areas in Dolhasca-Hălăucești, based on MODIS, 28.07.2008

Flooded areas along Siret River, Bacău County, based on MODIS, 29.07.2008

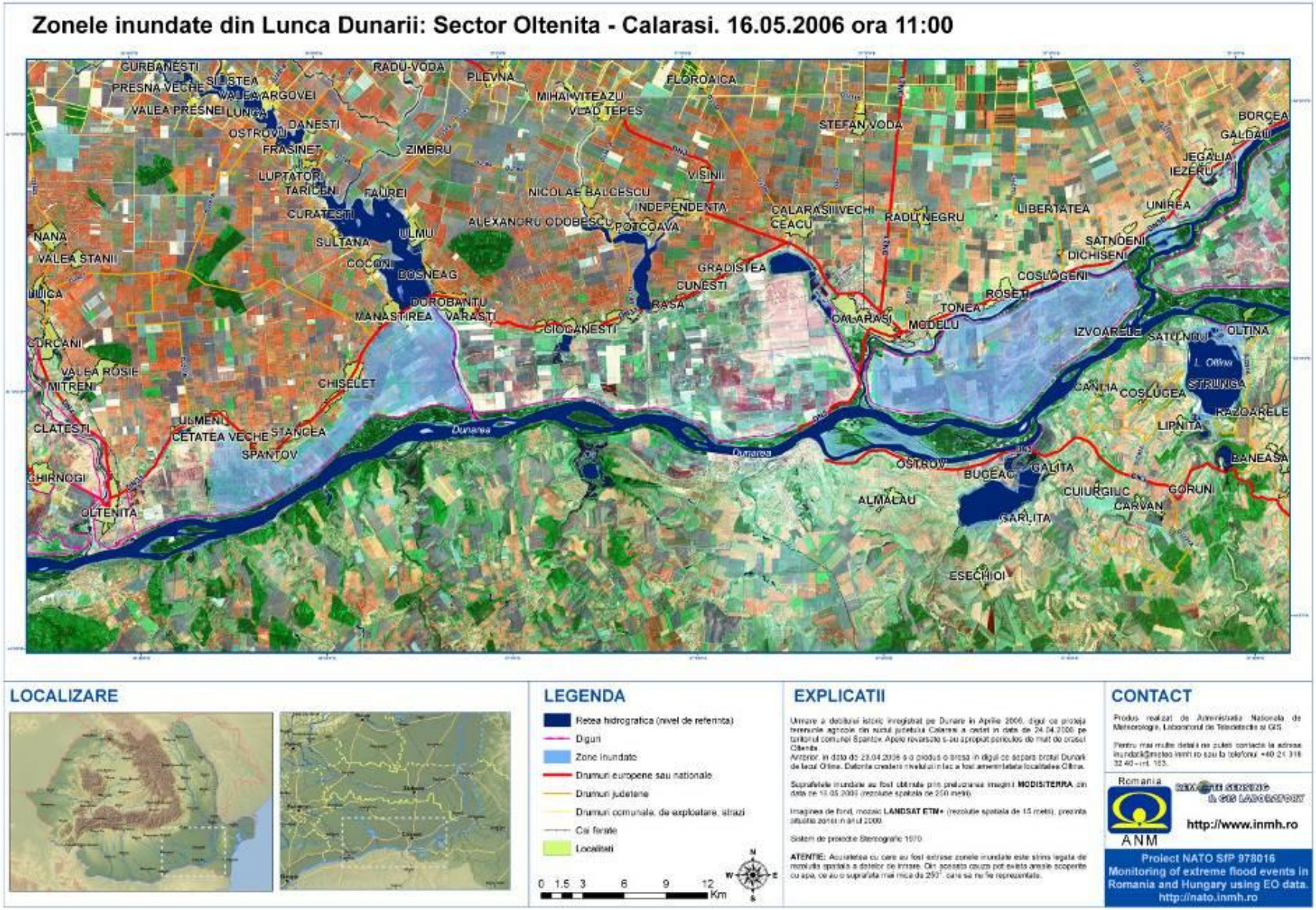
Romania – Lower Danube, Bechet sector

Maps of the flooded areas – April-May 2006



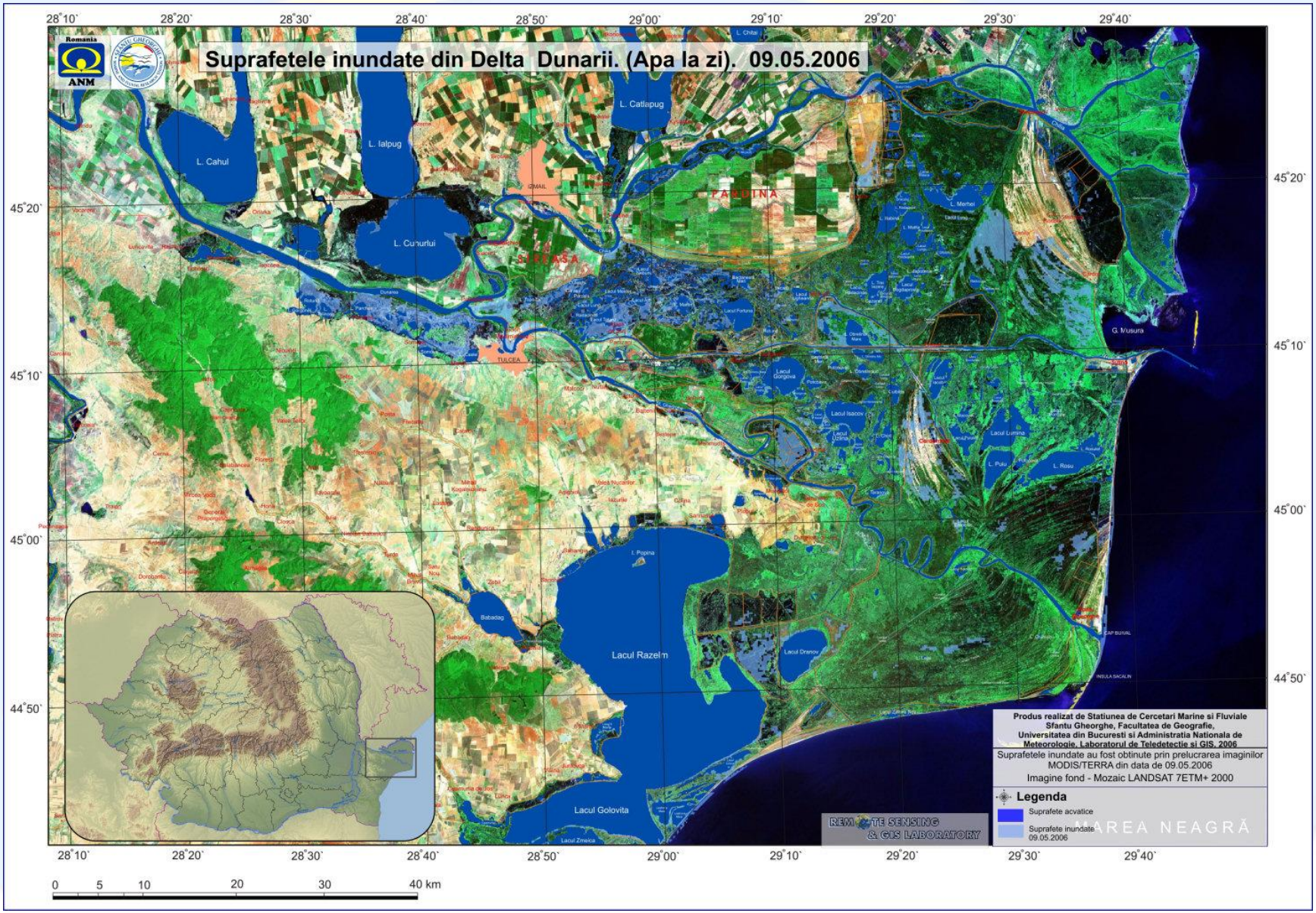
Romania – Lower Danube, Calarasi sector

Maps of the flooded areas – April-May 2006

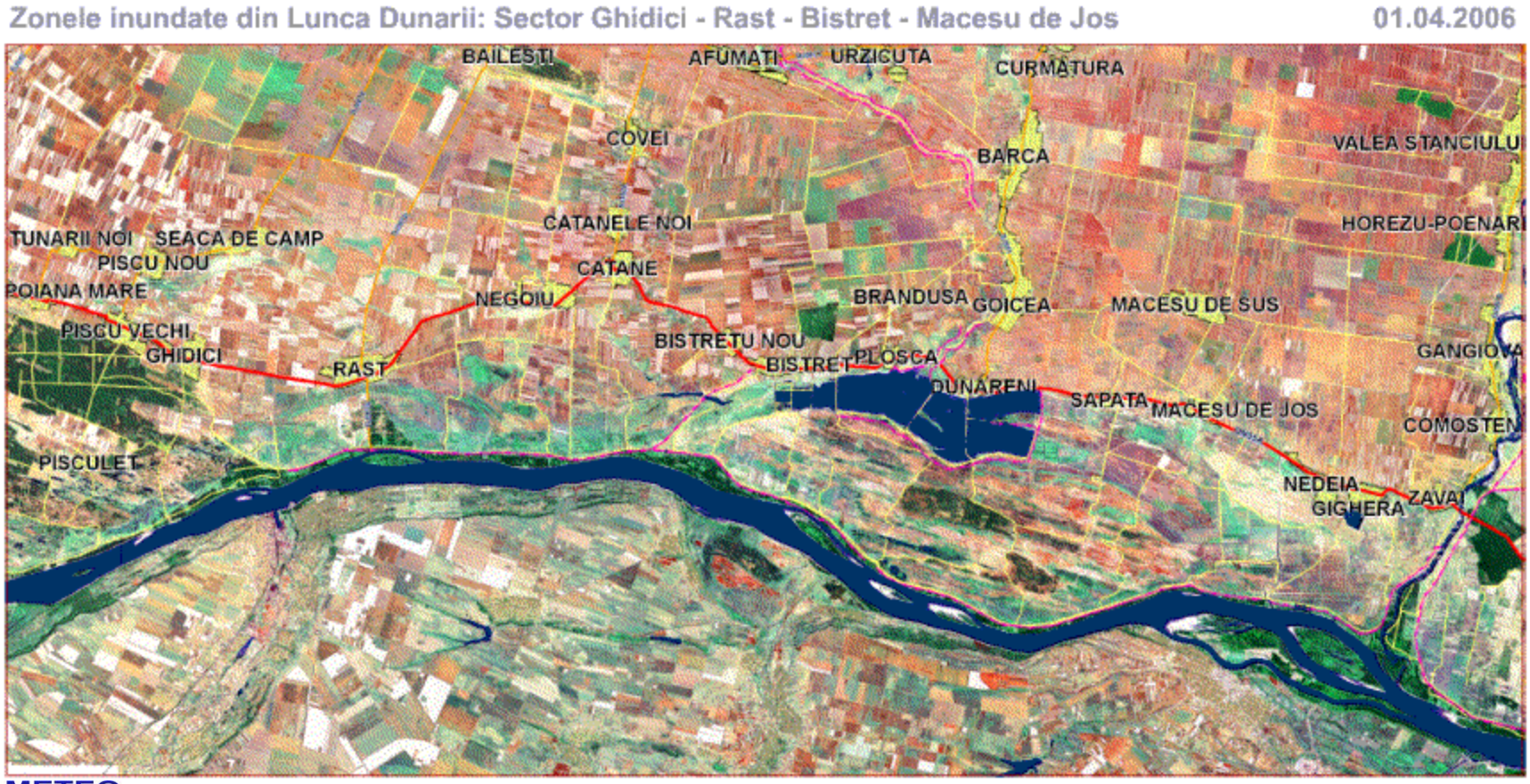


Romania – Lower Danube, Danube Delta

Maps of the flooded areas – April-May 2006



Map animation:
Romania – Lower Danube, Rast sector, April - May 2006



METEO ROMANIA

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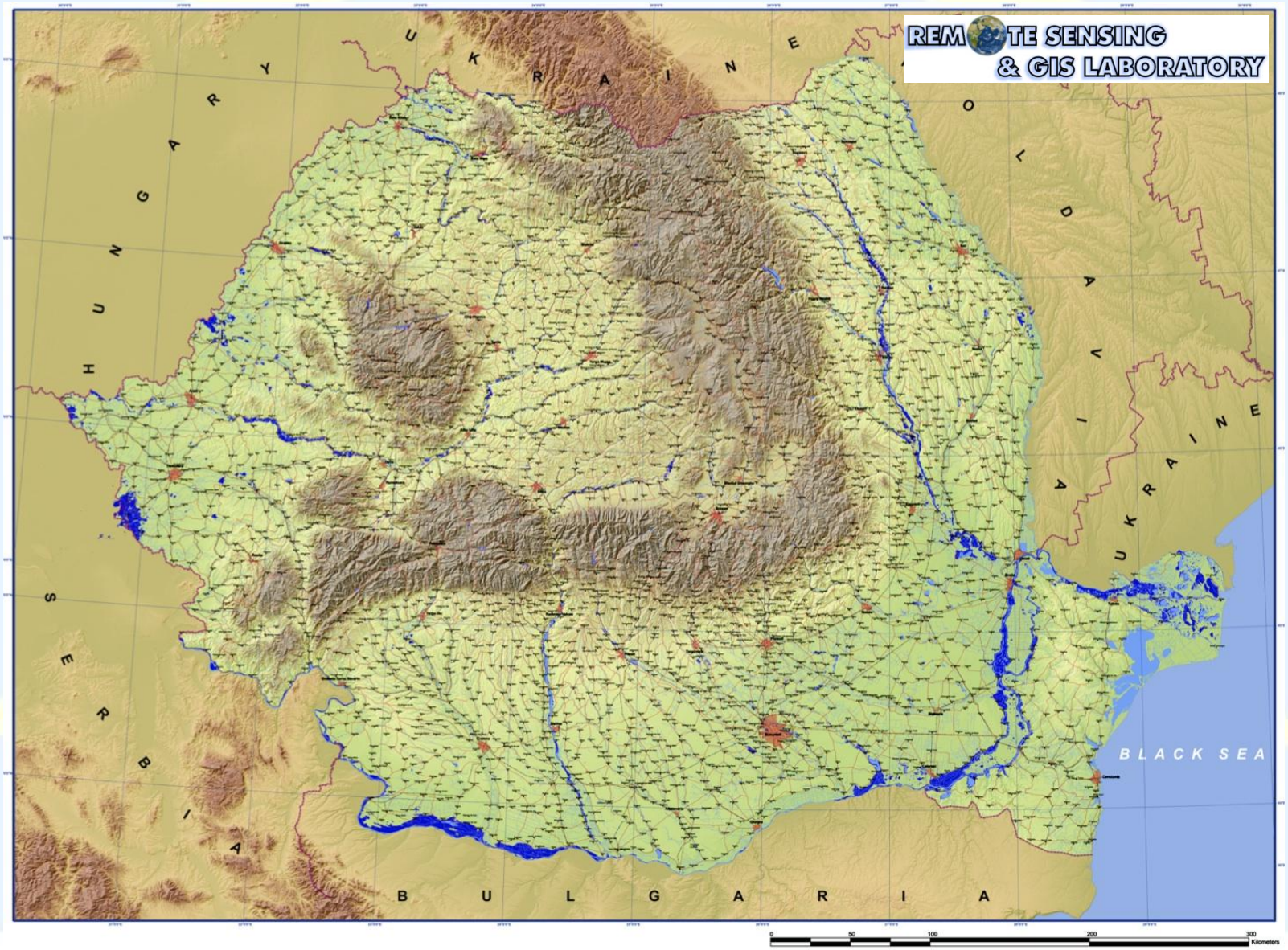
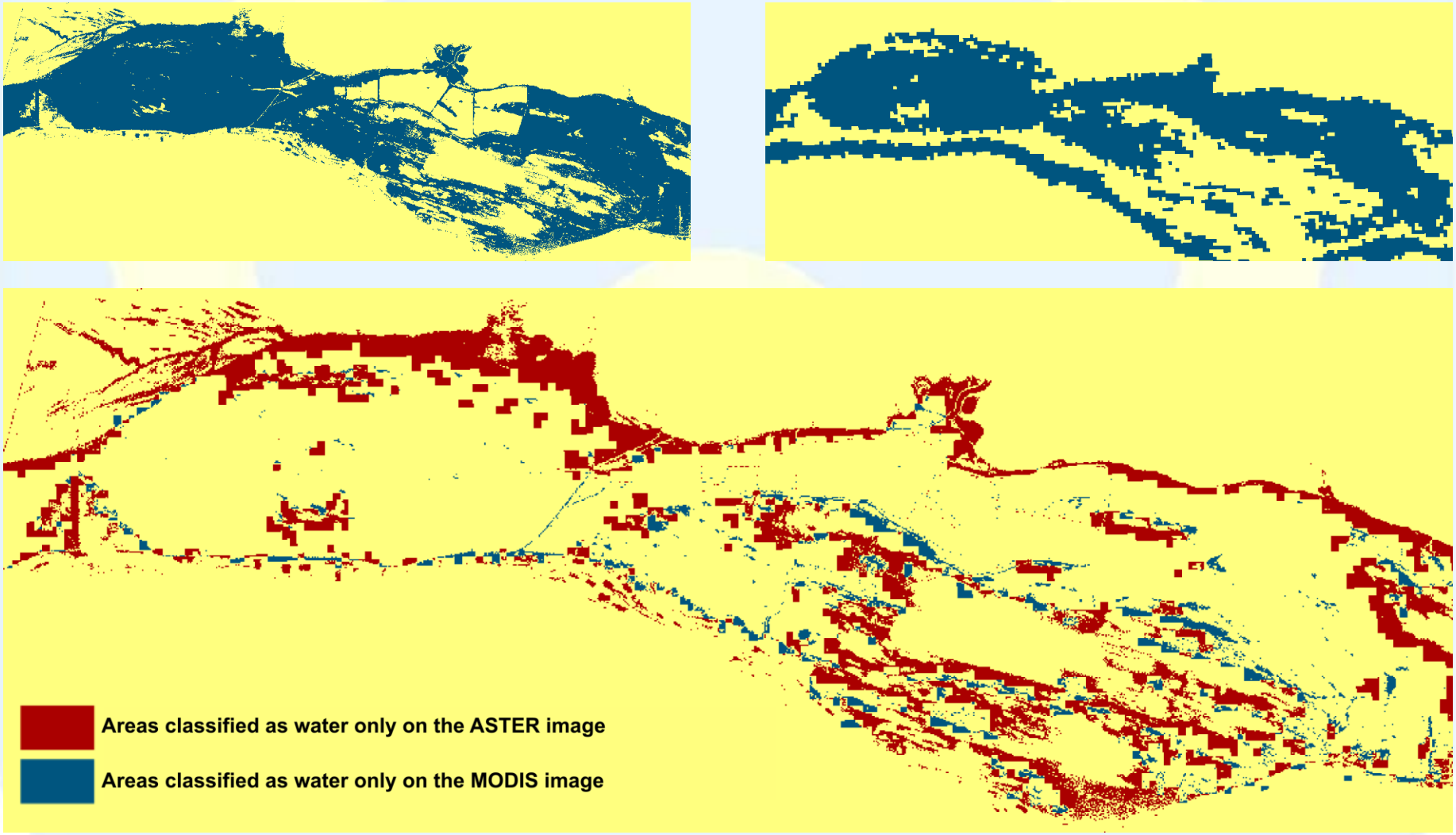
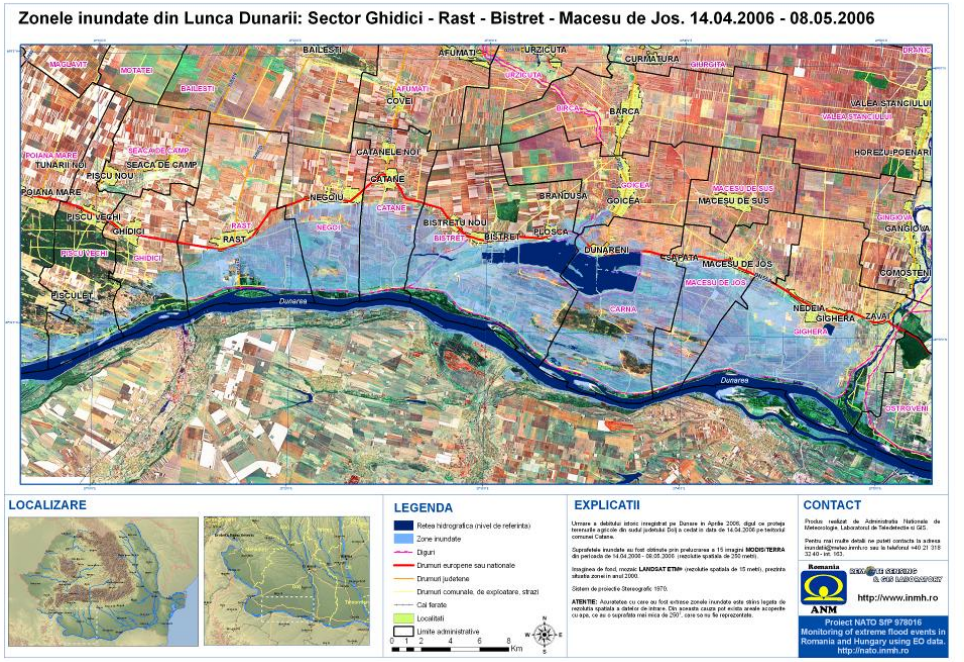
Flood hazard map for Romania, based on MODIS data for 2000-2014



Validation example

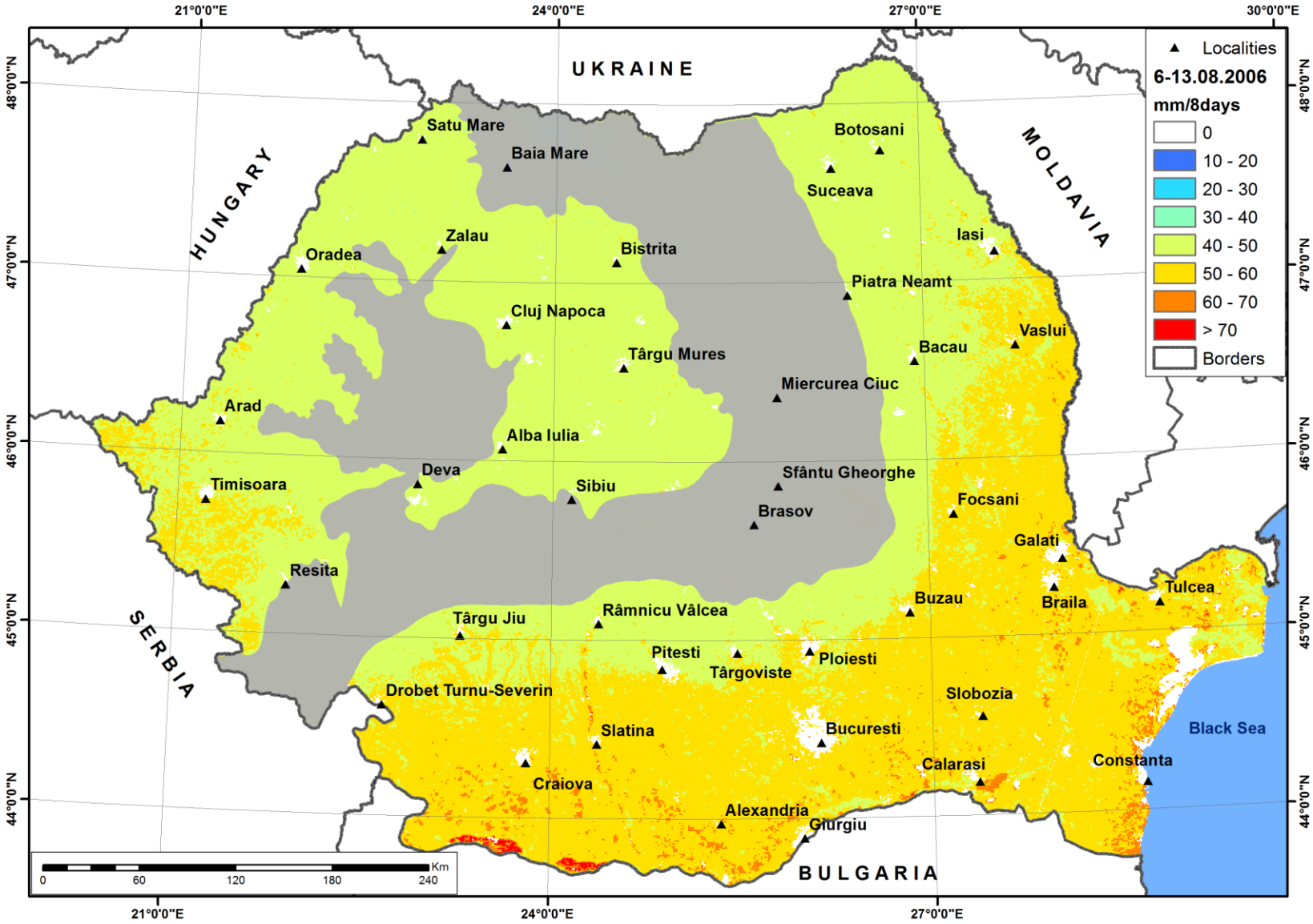


Estimation of the affected areas
Romania – Lower Danube, Rast sector



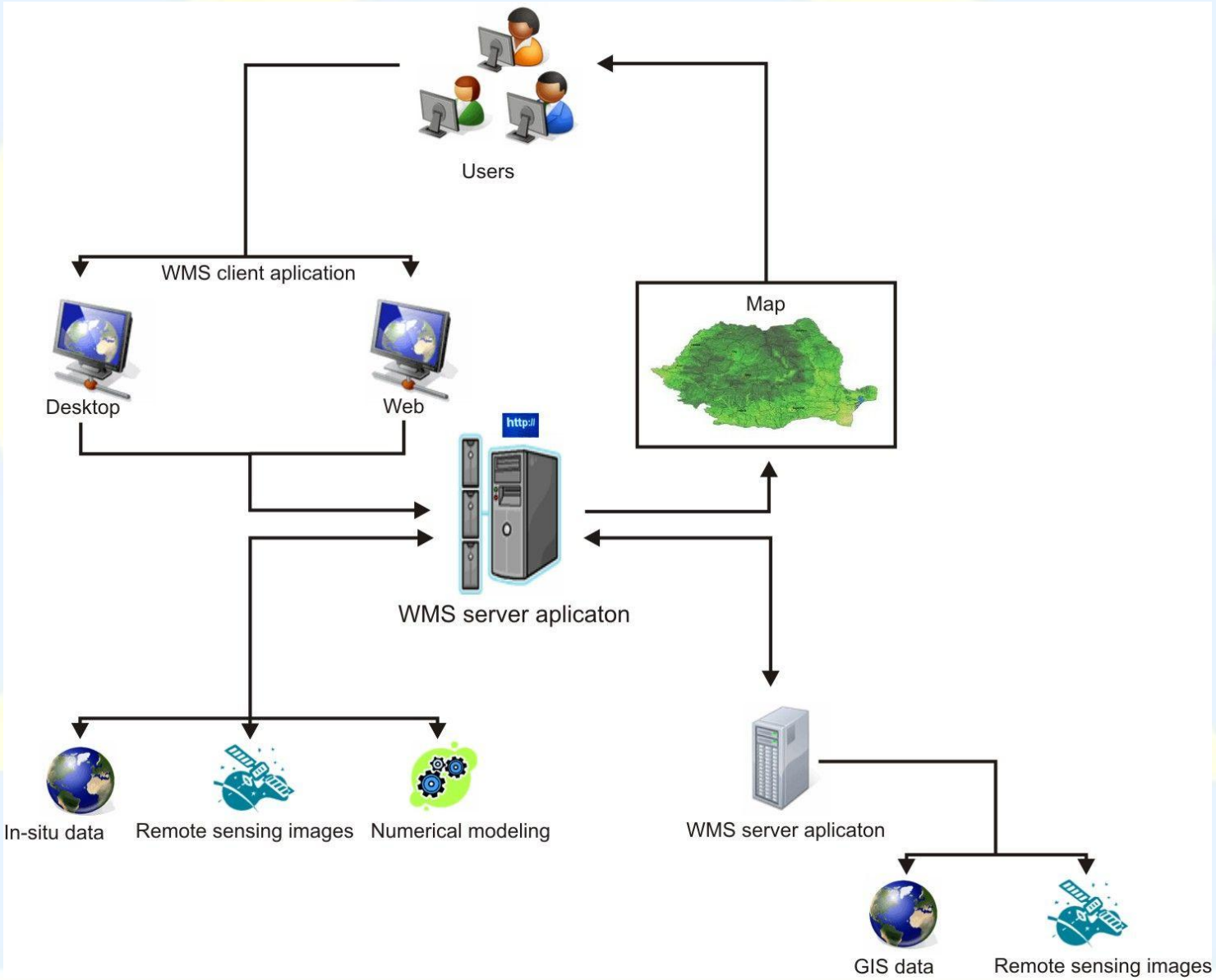
Name	Administrative area (Ha)	Affected area (Ha)	Affected percent of the admin. area (%)
RAST	8452	4500	53,2
BISTRET	12214	6632	54,3
GIGHERA	13154	6894	52,4
OSTROVENI	8245	590	7,2
MACESU DE JOS	5639	3428	60,8
CARNA	8475	5603	66,1
GOICEA	5841	324	5,6
CATANE	4702	2481	52,8
NEGOI	5019	3062	61
GHIDICI	4469	1585	35,5
PISCU VECHI	5782	1506	26,1

Flood analysis using PET – Lower Danube, Rast sector



DROUGHT MONITORING USING SATELLITE DATA

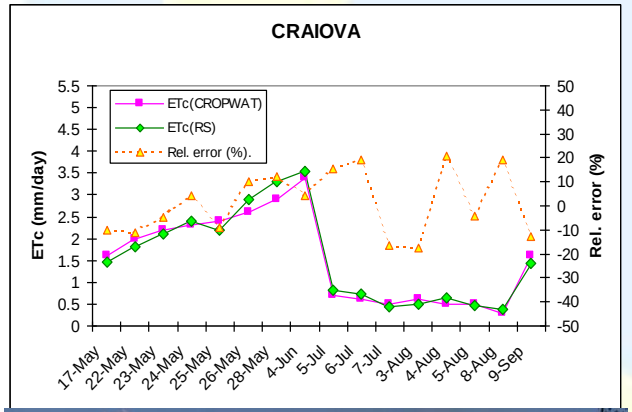
Flow chart


Users
WMS client aplication
Desktop
Web
Map
http://
WMS server aplicaton
In-situ data
Remote sensing images
Numerical modeling
WMS server aplicaton
GIS data
Remote sensing images

Satellite – Derived Information for Agricultural Drought Monitoring

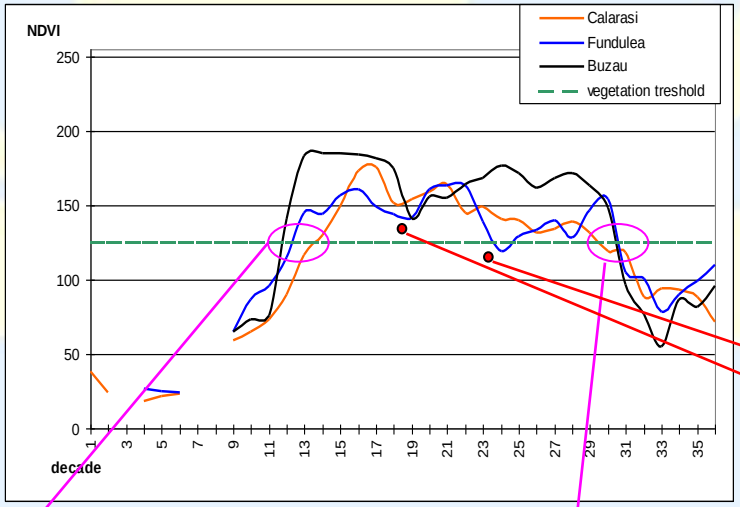
Drought prediction

- Assimilation of remotely sensed data into numerical prediction models (e.g. SWAT, crop models)



Monitoring and early warning

- Earth Observations from satellites are highly complementary to those collected by in-situ systems.
- Satellites are often necessary for the provision of synoptic, wide-area coverage and provision of the frequent information required to put in-situ information into broader spatial monitoring of drought conditions.

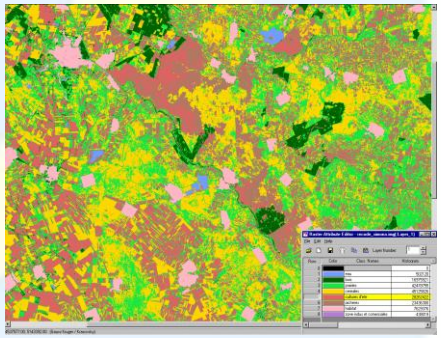


-vegetation season starts:
21-30.04 – Buzau, Fundulea; 1 –10.05 - Calarasi

-vegetation season ends 1-10.11

Assessment of impacts

- Land use type
- Intensity and areal extent
- Use of satellite data as input for crop model yield estimates.



• 01-10.07 plant stress period
• 11-21.08 at Fundulea, NDVI drops under Vegetation threshold

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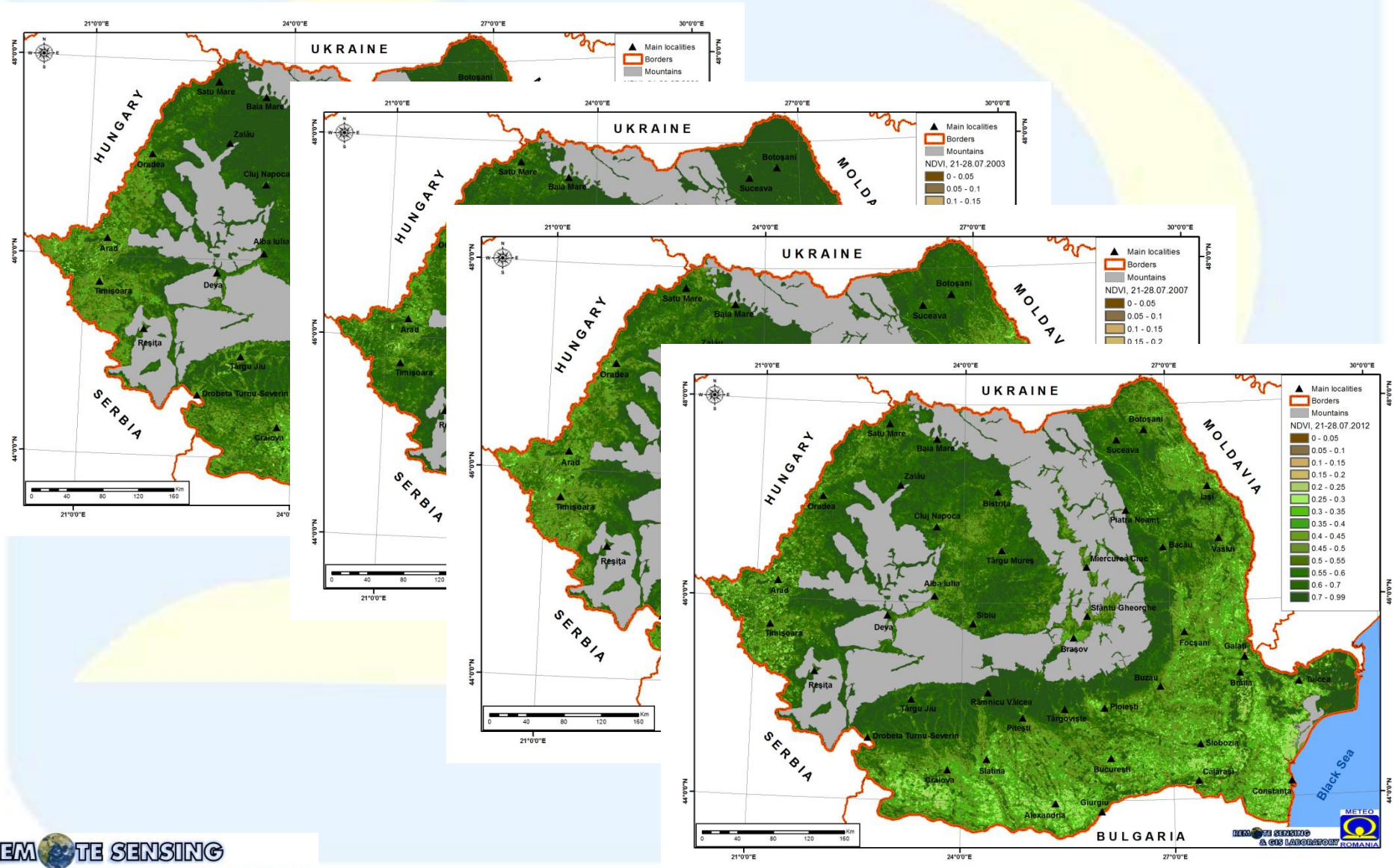
In-situ measurements – soil moisture and LAI

Vegetation Indices
Normalised Difference Vegetation Index- NDVI



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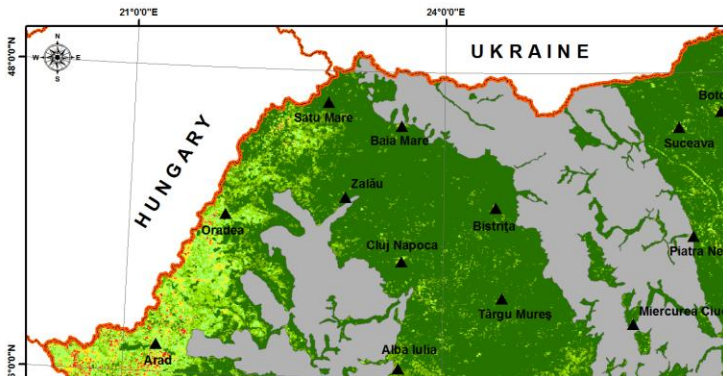
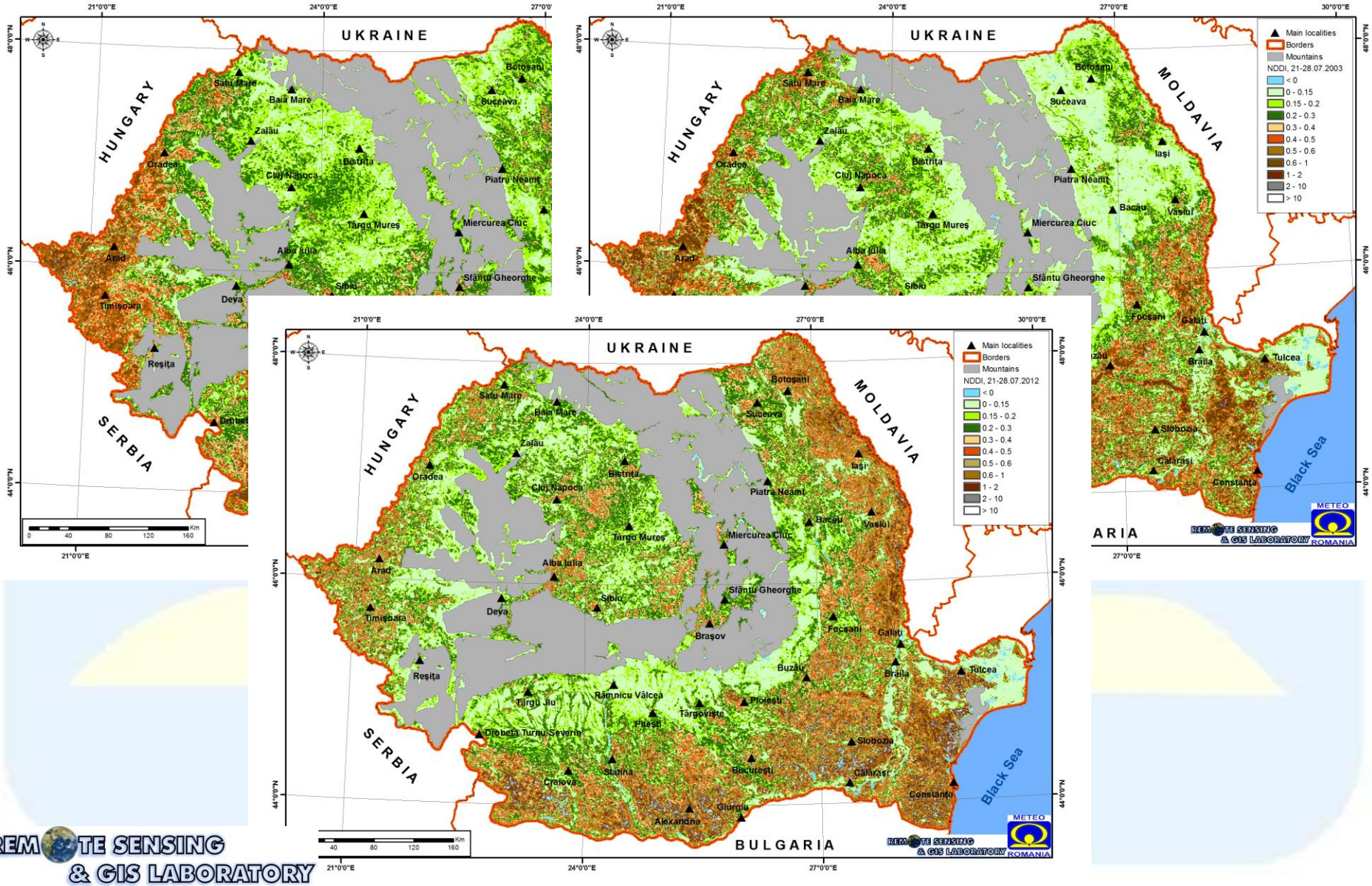
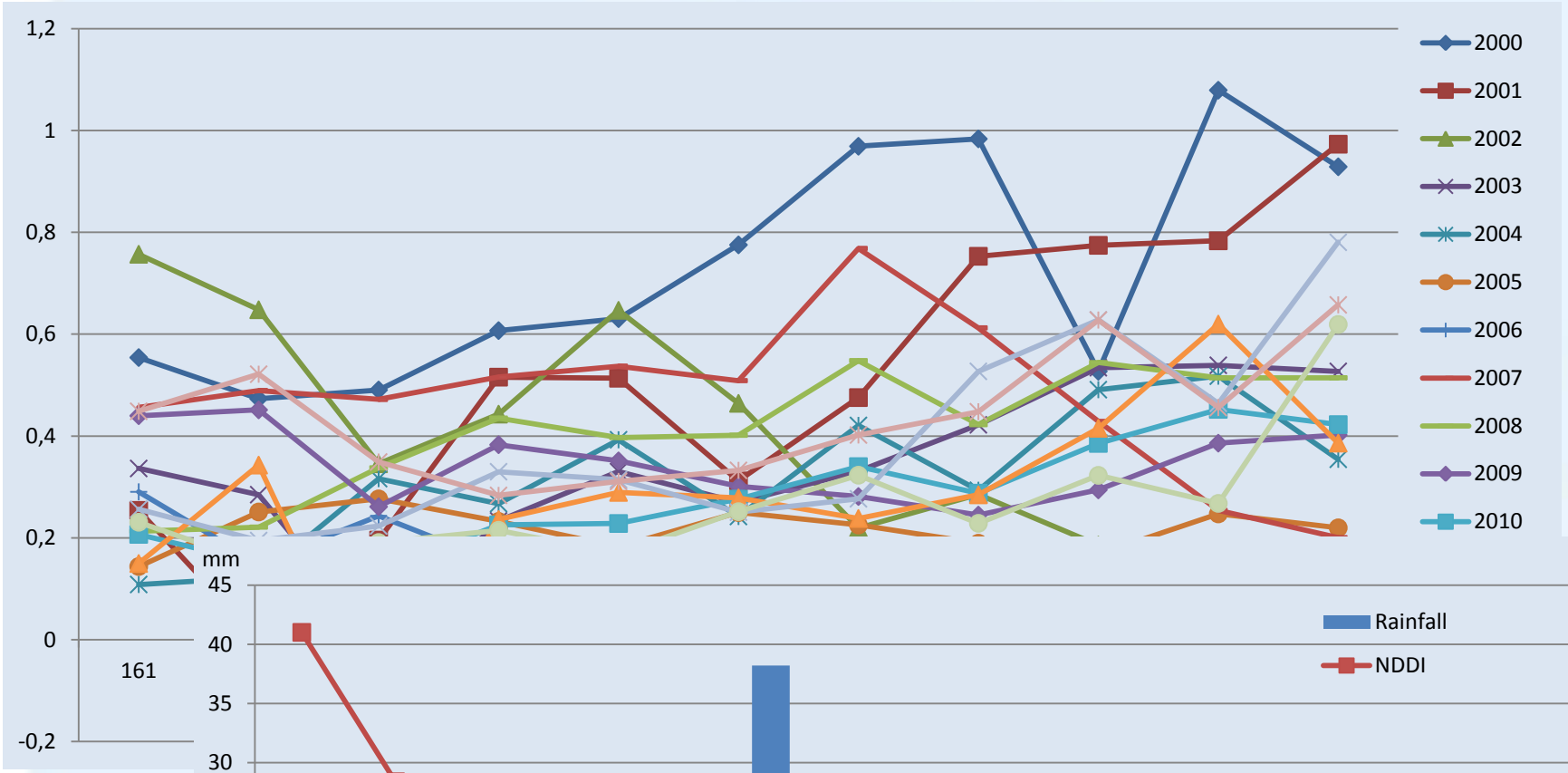
Vegetation Indices
Normalised Difference Water Index- NDWI

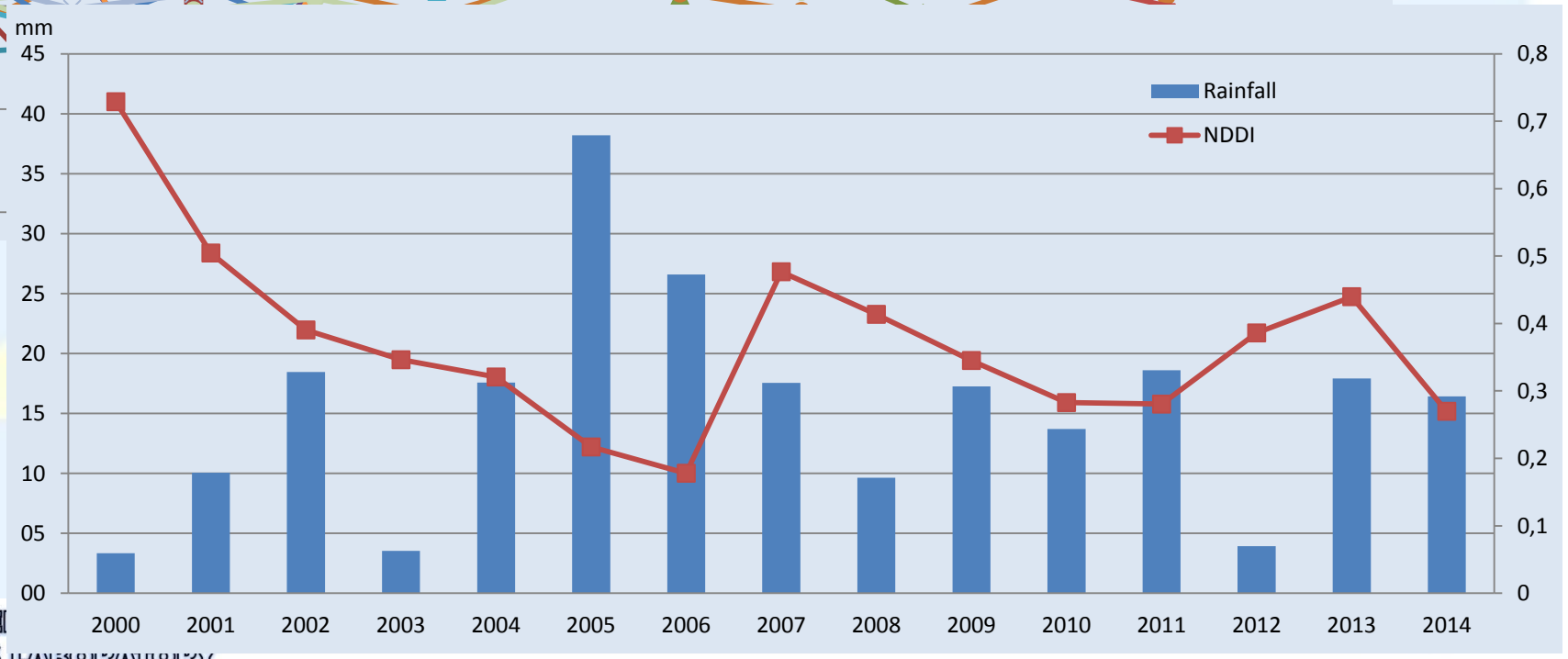


Vegetation Indices
Normalised Difference Drought Index- NDDI

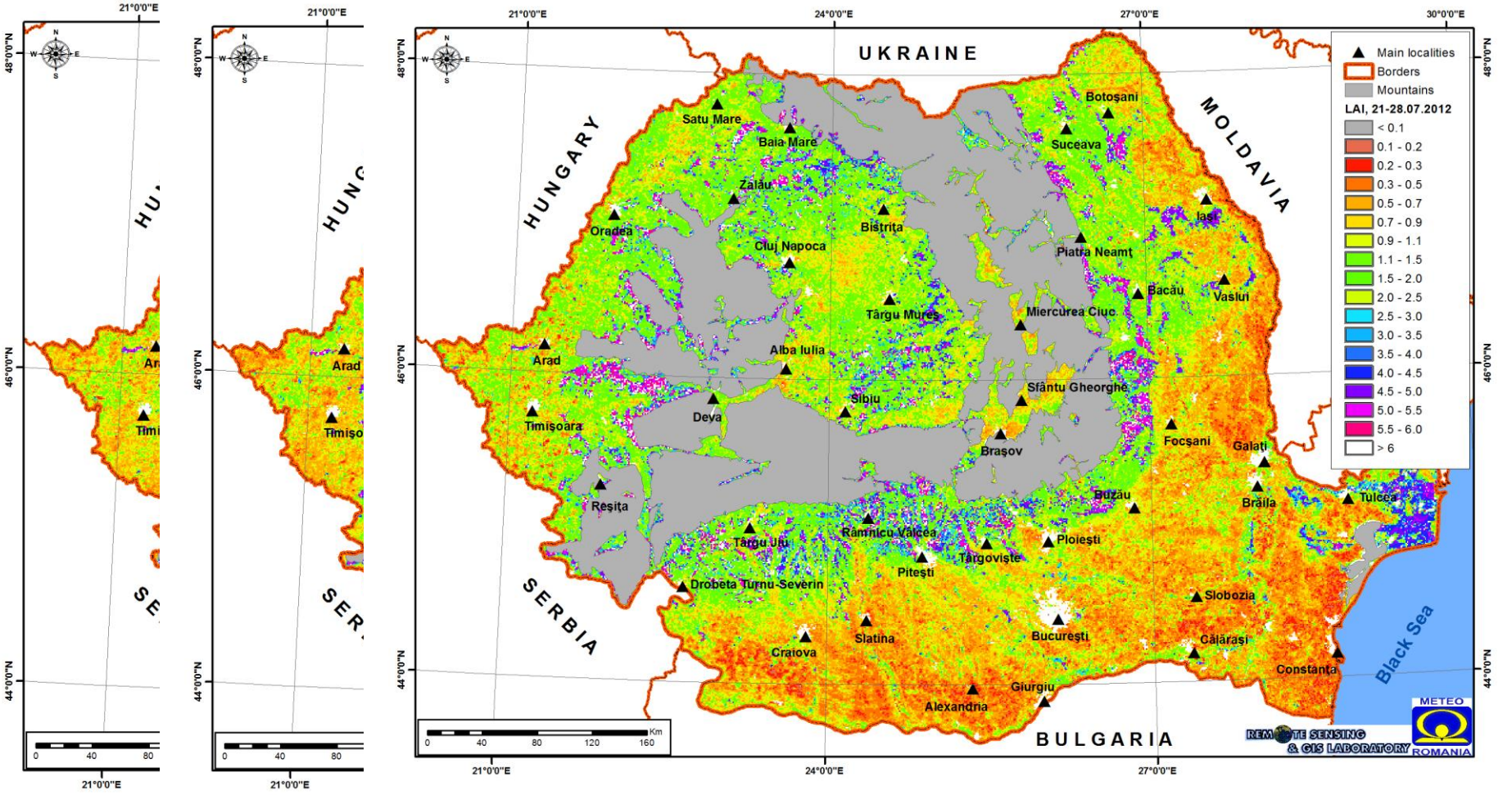


Long term analysis - Caracal





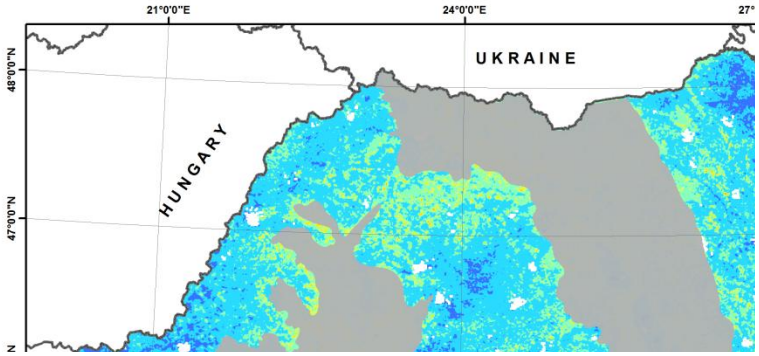
Vegetation Indices
Leaf Area Index - LAI

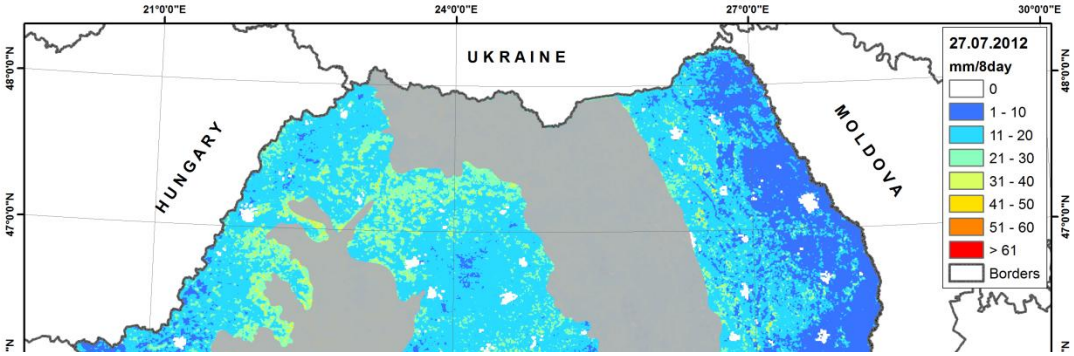


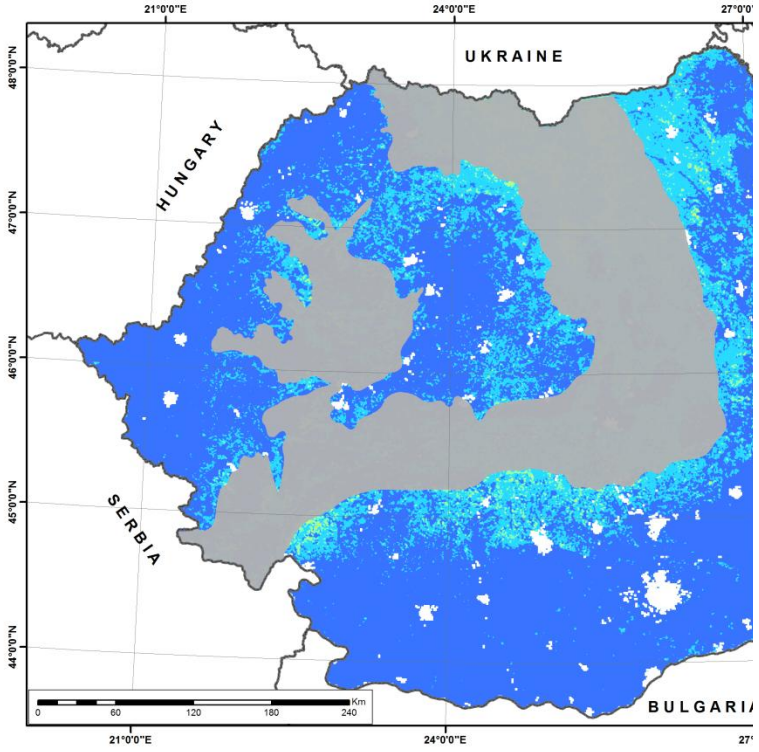
Vegetation Indices

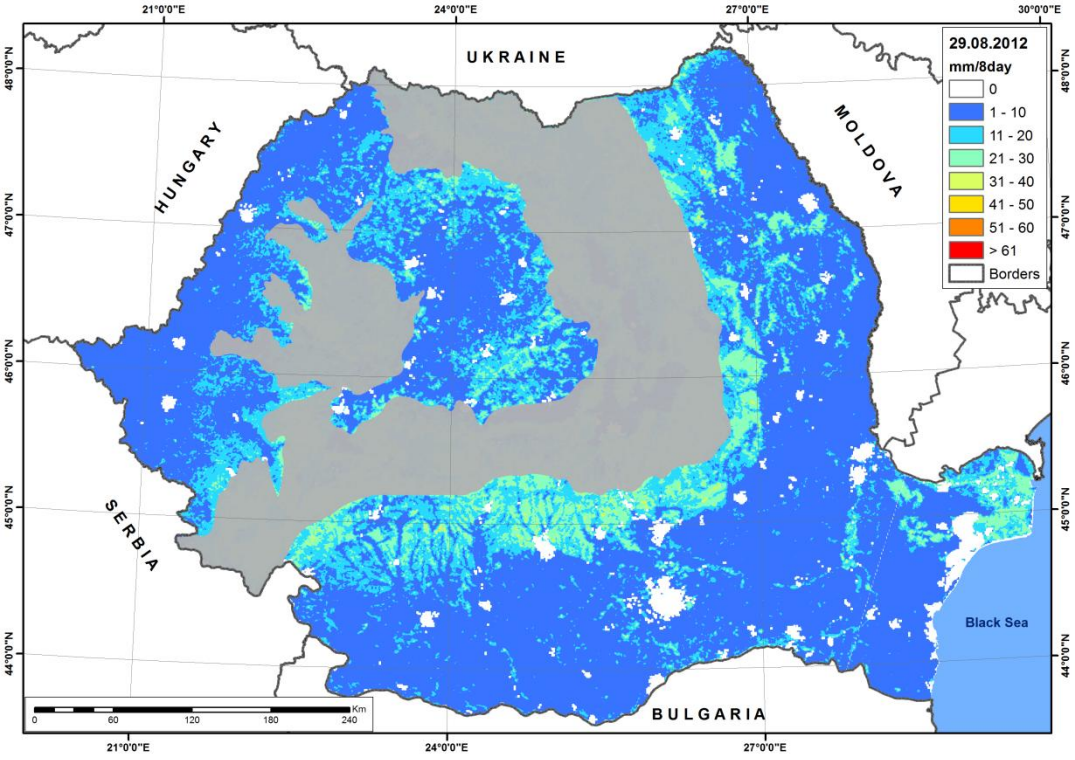
The Fraction of Absorbed Photosynthetically Active Radiation - fAPAR

Potential Evapotranspiration









Drought analysis

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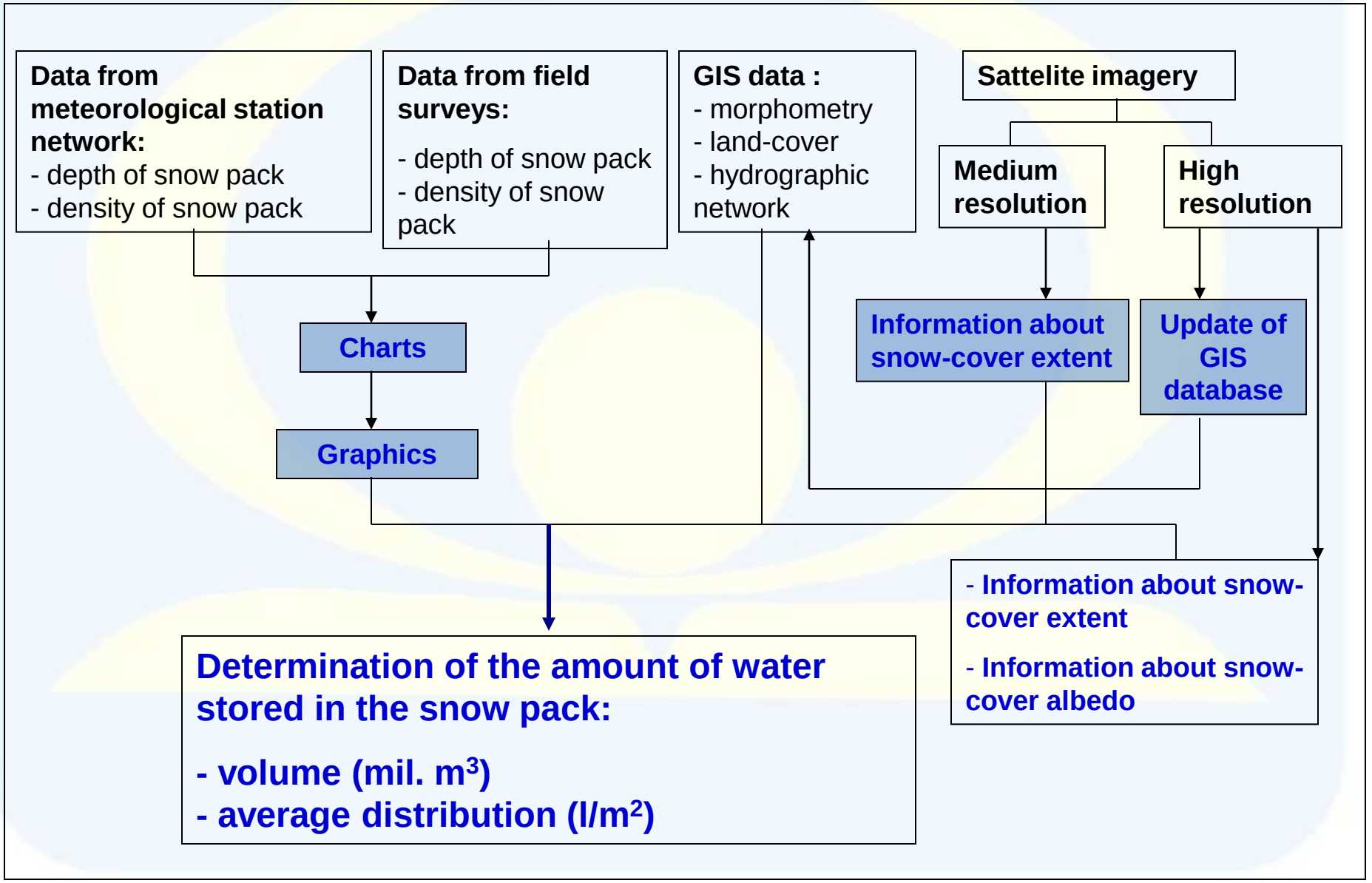
SNOW MONITORING USING SATELLITE DATA

Snow cover monitoring

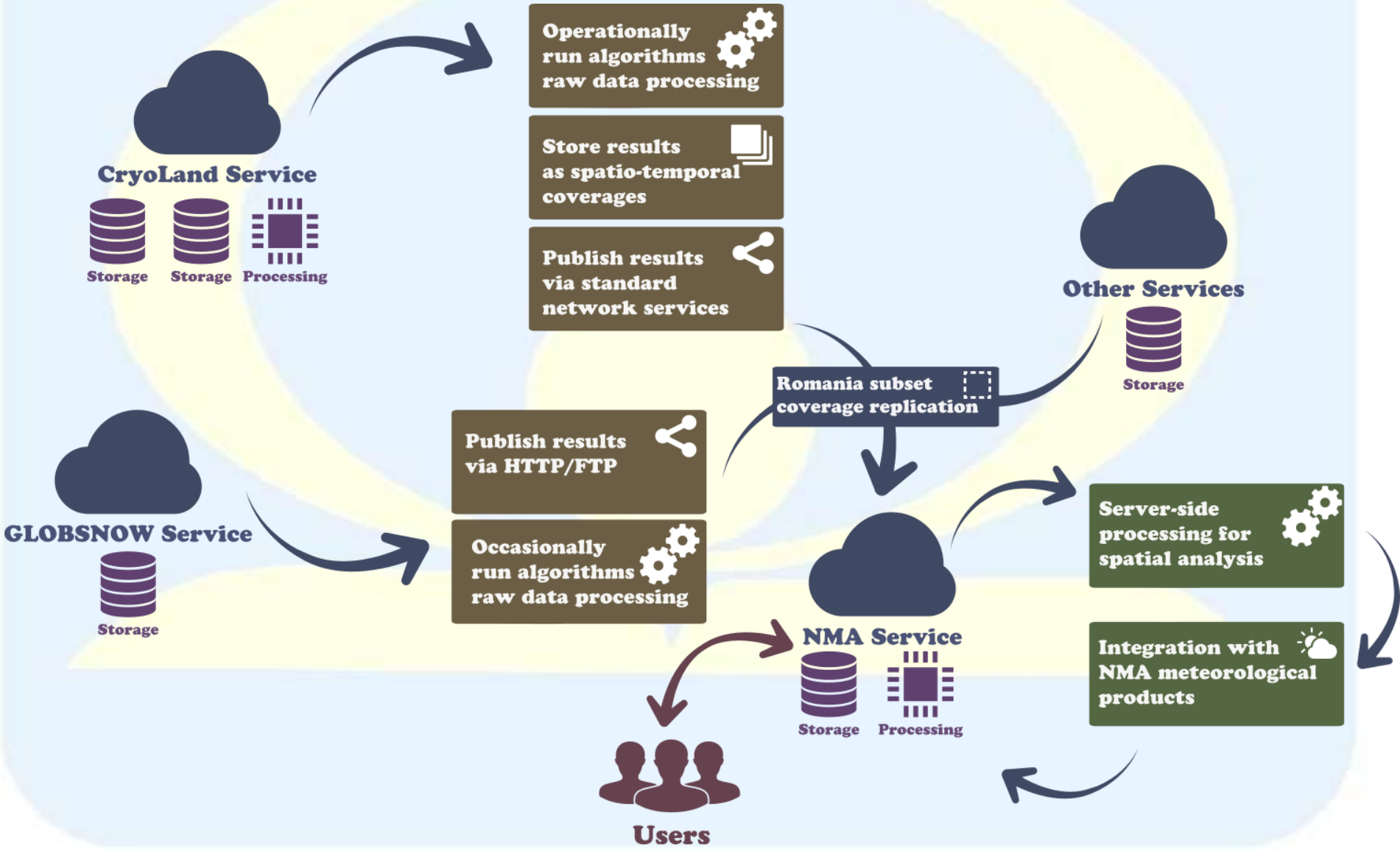
- The evaluation of SWE for the main hydrographic basins

- Snow cover extent, albedo and fractional snow cover extent maps

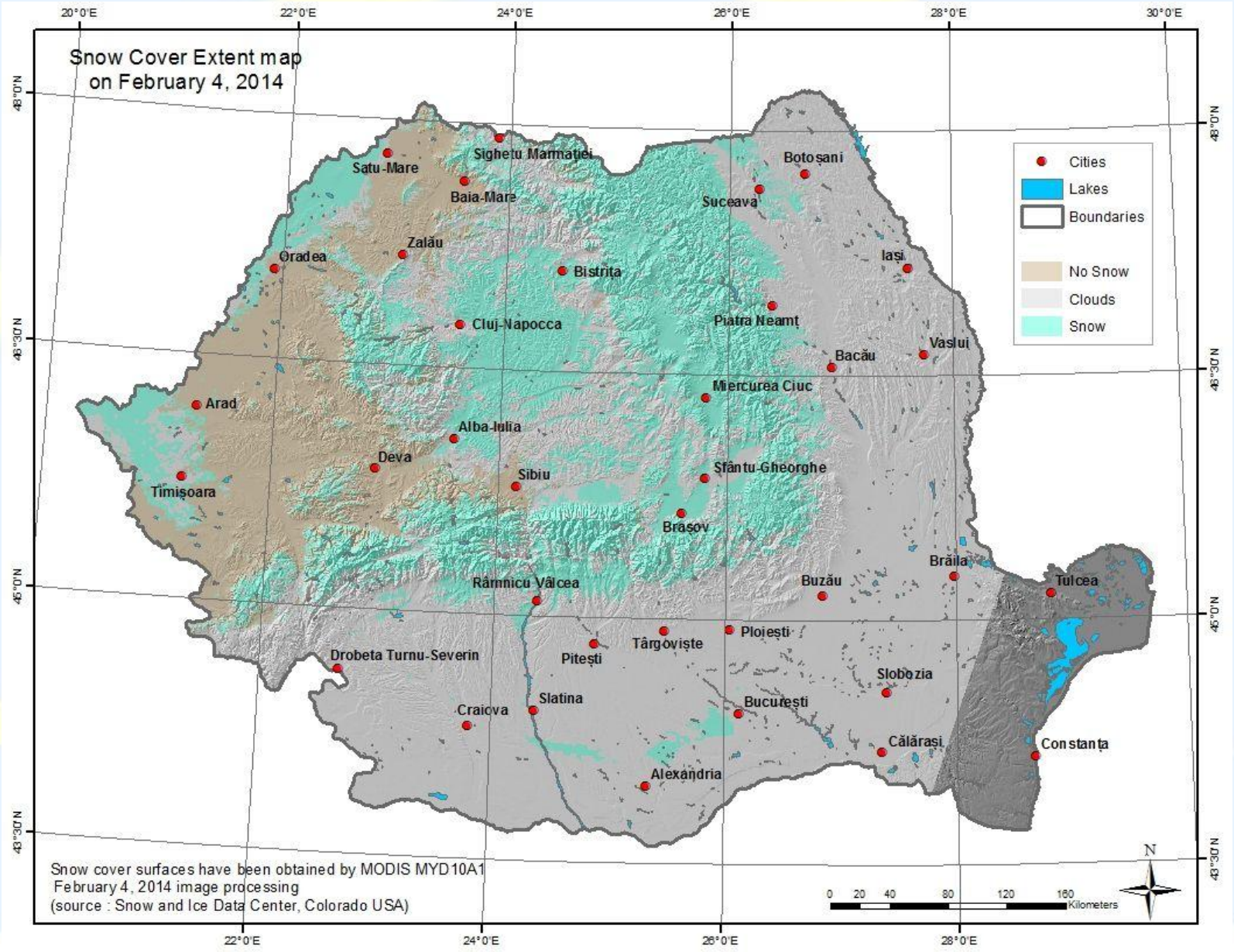
Flow chart – internal procedure



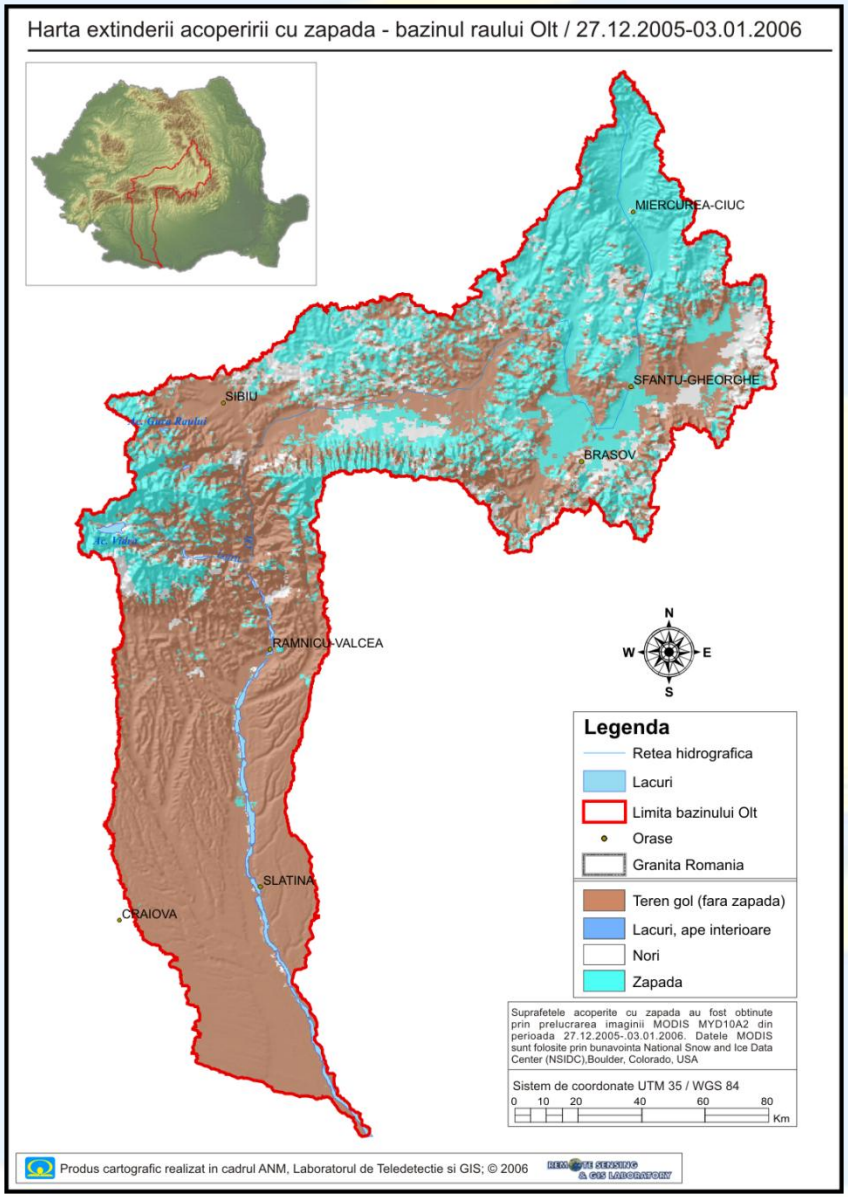
Flow chart – Cryoland integration

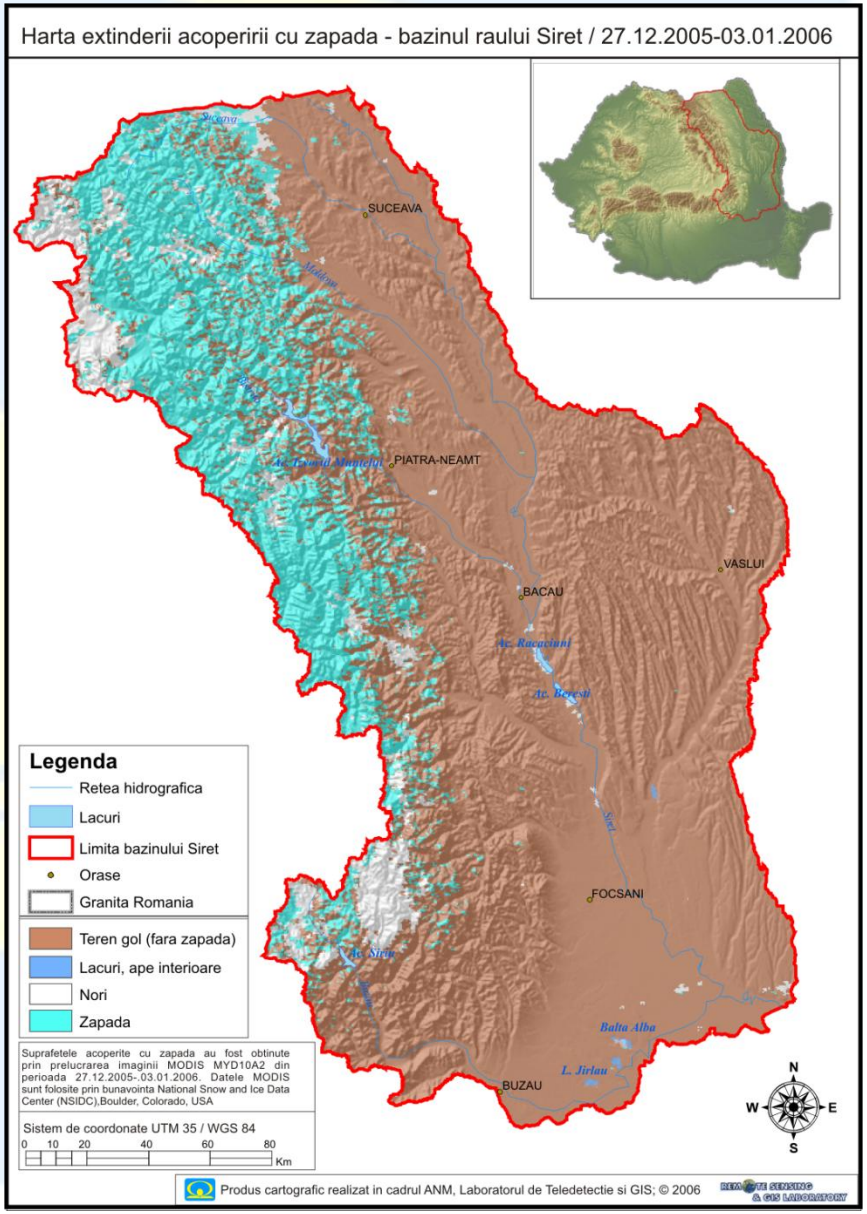


Snow cover extent map

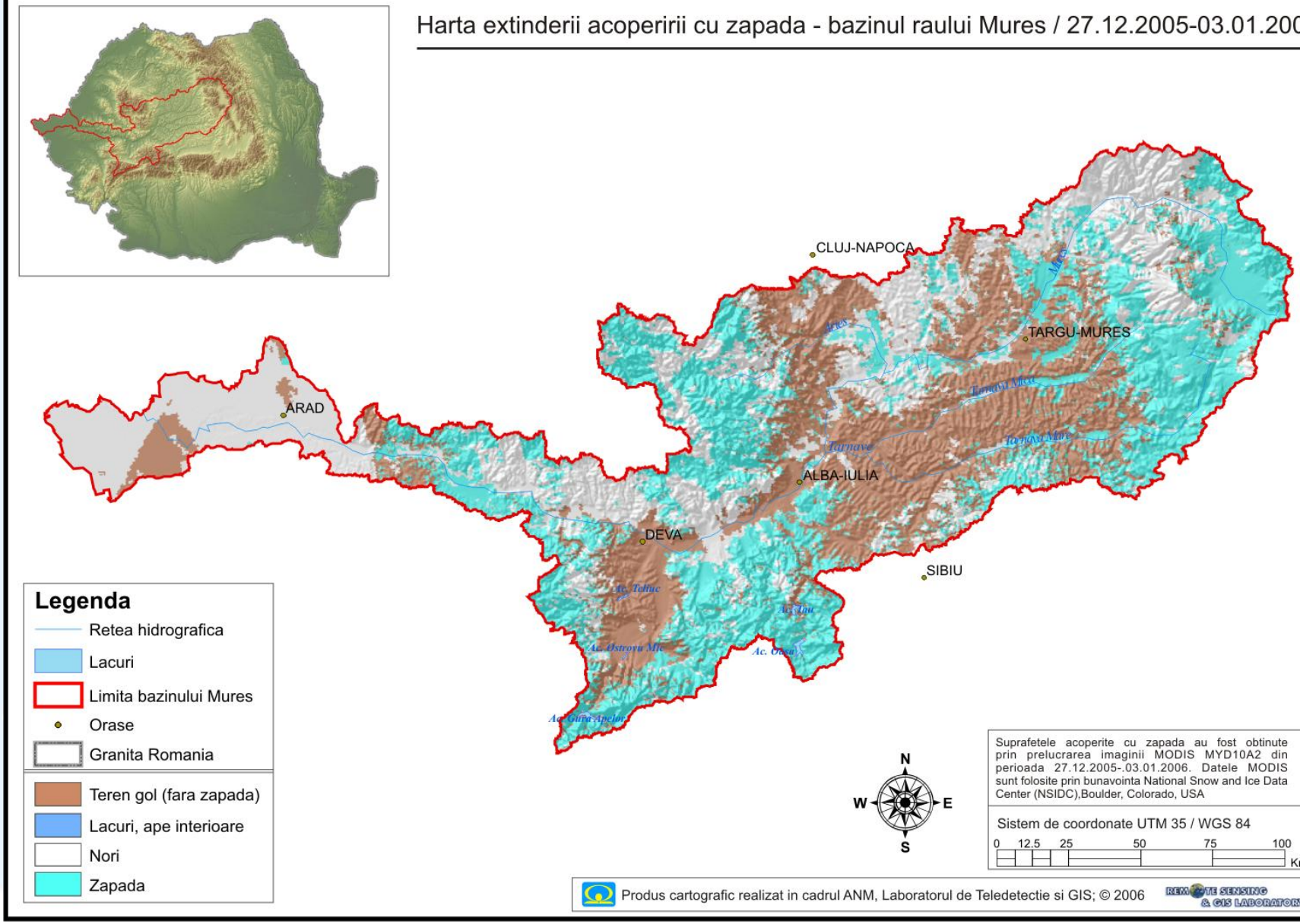


Snow cover extent map – details for the major hydro. basins

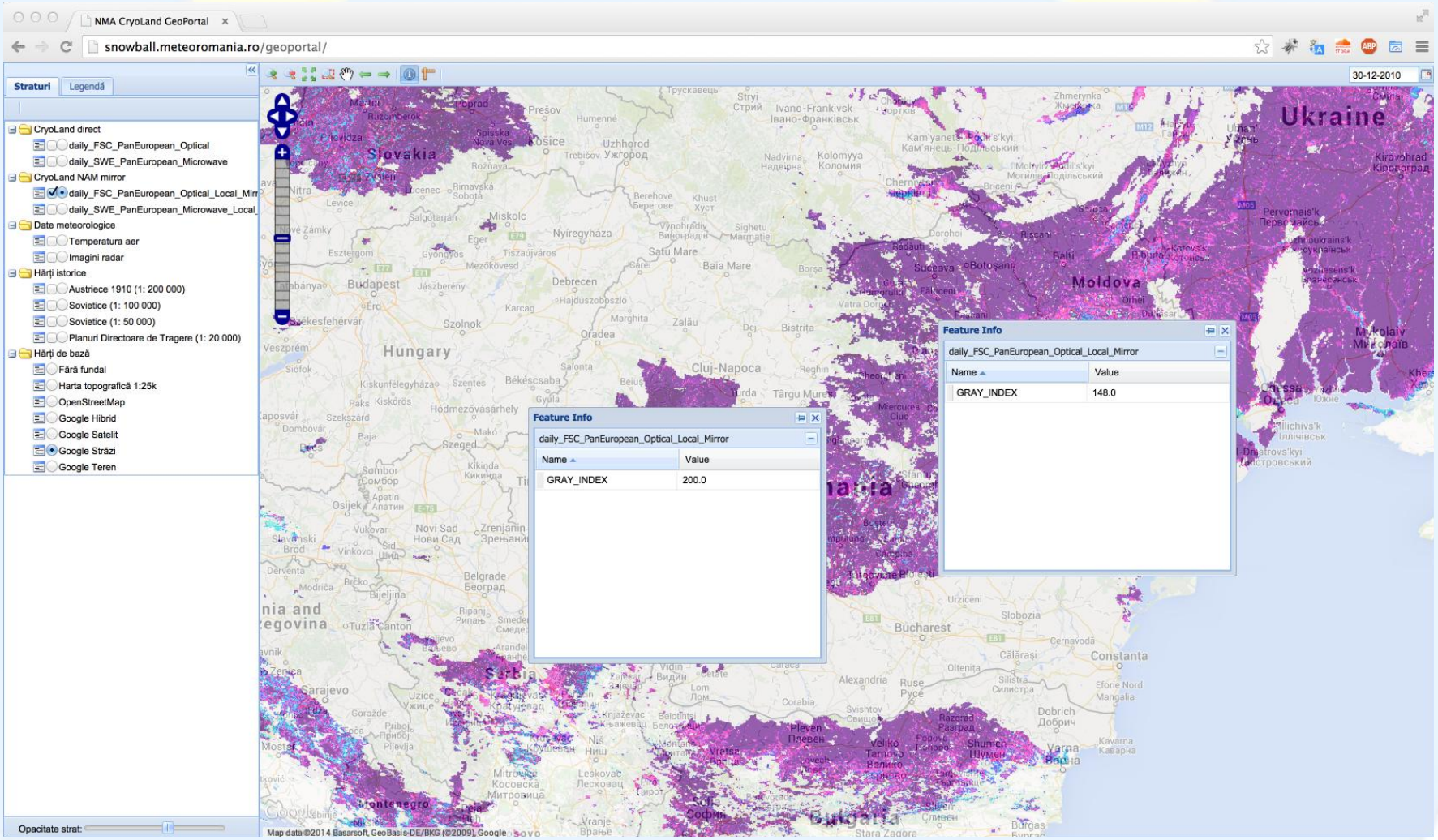




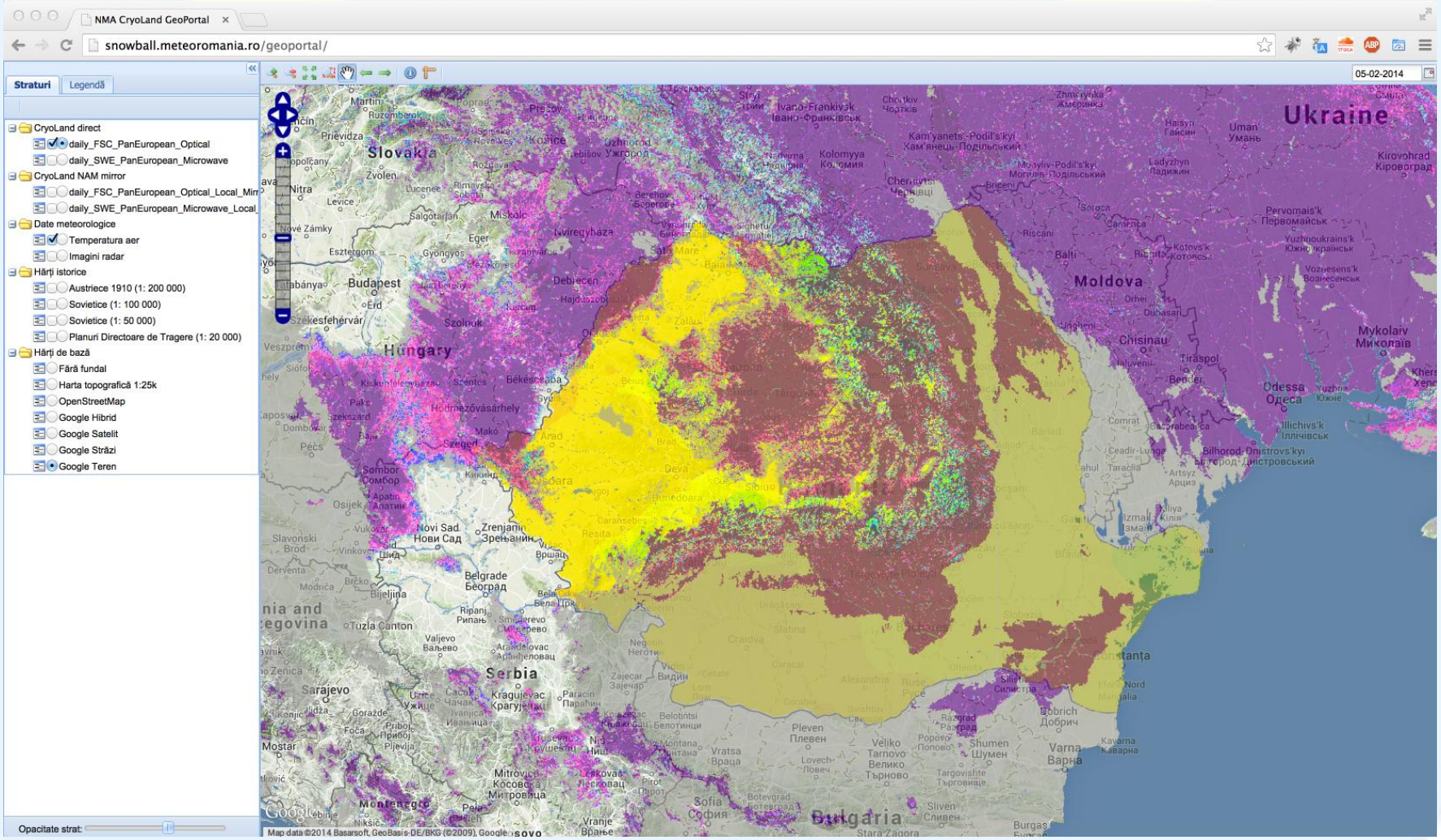
Snow cover extent map – details for the major hydro. basins



Snow cover extent map – interactive map example

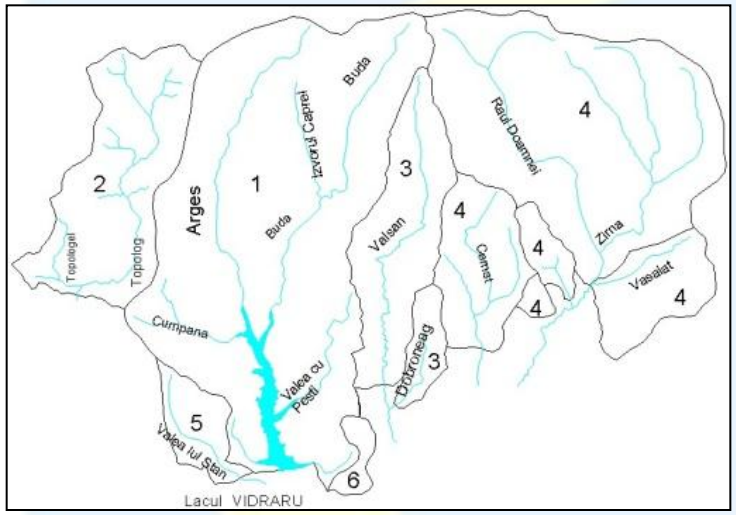


Integration with other meteorological products

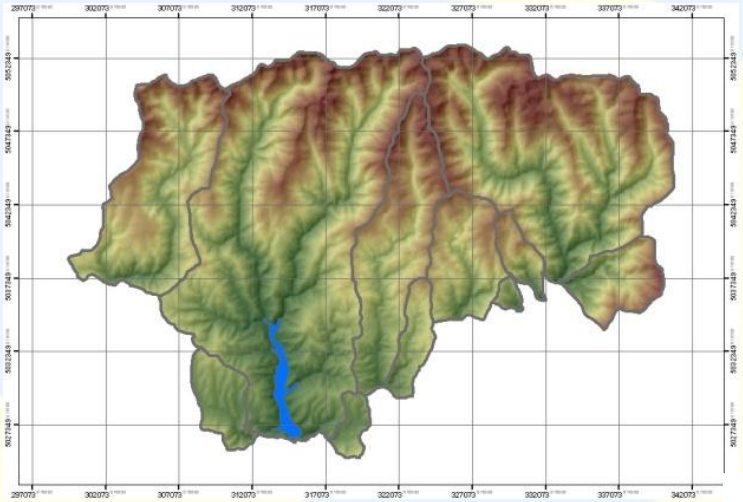


Arges Catchment - the evaluation of SWE (I)

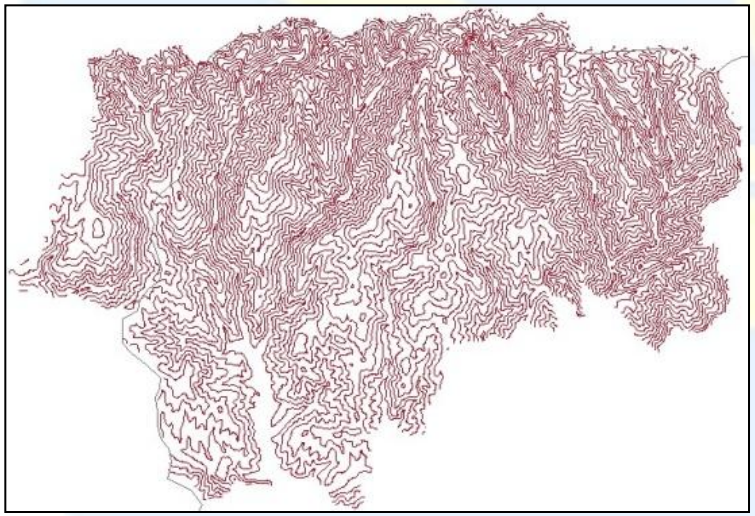
1. GIS data:



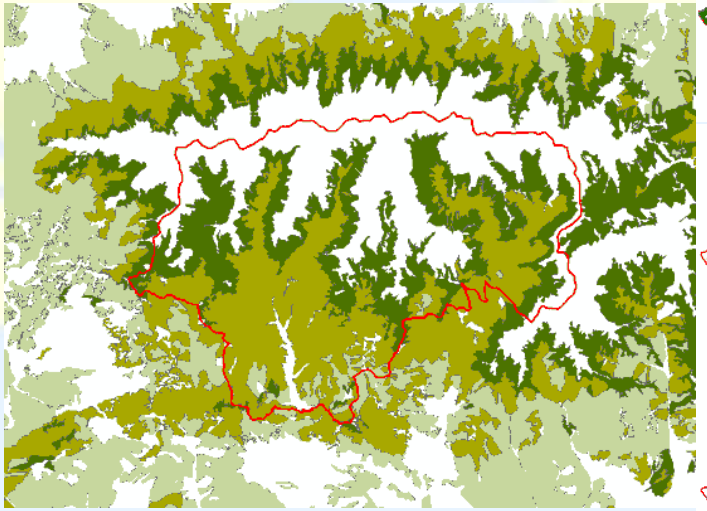
Hydrographical network



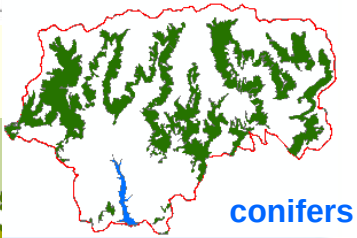
Digital elevation model



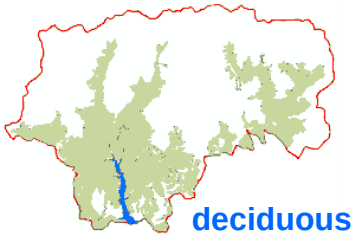
Contour levels



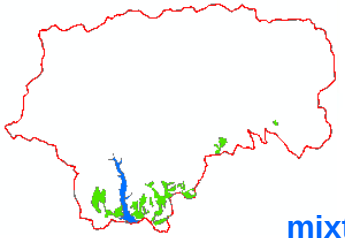
Land cover - forests



conifers



deciduous



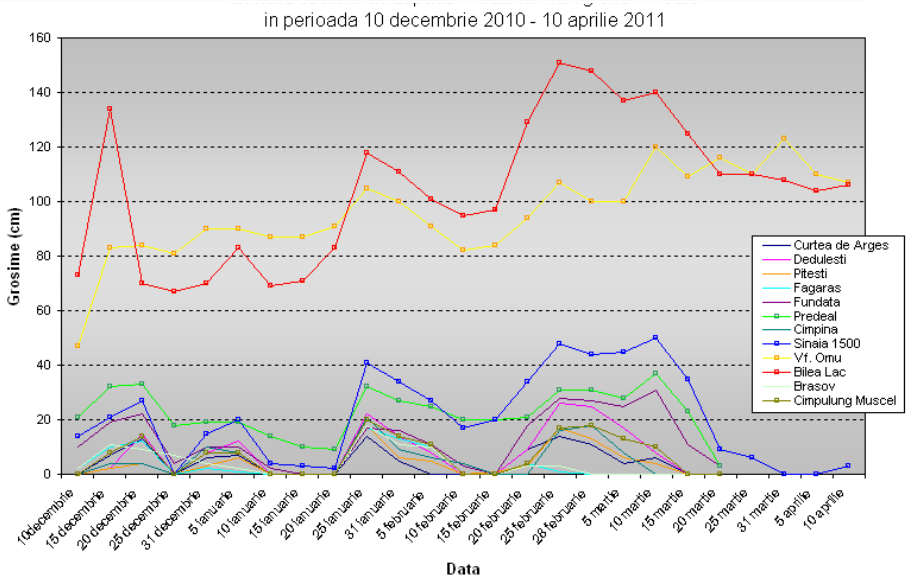
mixt

Arges Catchment - the evaluation of SWE (II)

2. SWE on altitude:

	Basin name	Surface	Forest surface	Total Water volume	Water stratum
		(Km^2)	(Km^2)	(mil. m^3)	(l/m^2)
1	Arges basin (including Vidraru Lake)	274.43	190.97	45.335	165.197
2	Topolog basin	87.87	53.76	17.460	198.703
3	Valsan+Dobroneag basins	85.41	52.17	16.748	196.089
4	Raul Doamnei+Bradului+ Draghina+Cernat basins	256.43	163.23	54.131	211.095
5	Valea lui Stan basin	19.09	17.45	1.504	78.785
6	Limpedea basin	7.76	6.74	0.606	78.093
	TOTAL	731	484.32	135.784	

10 of February 2015

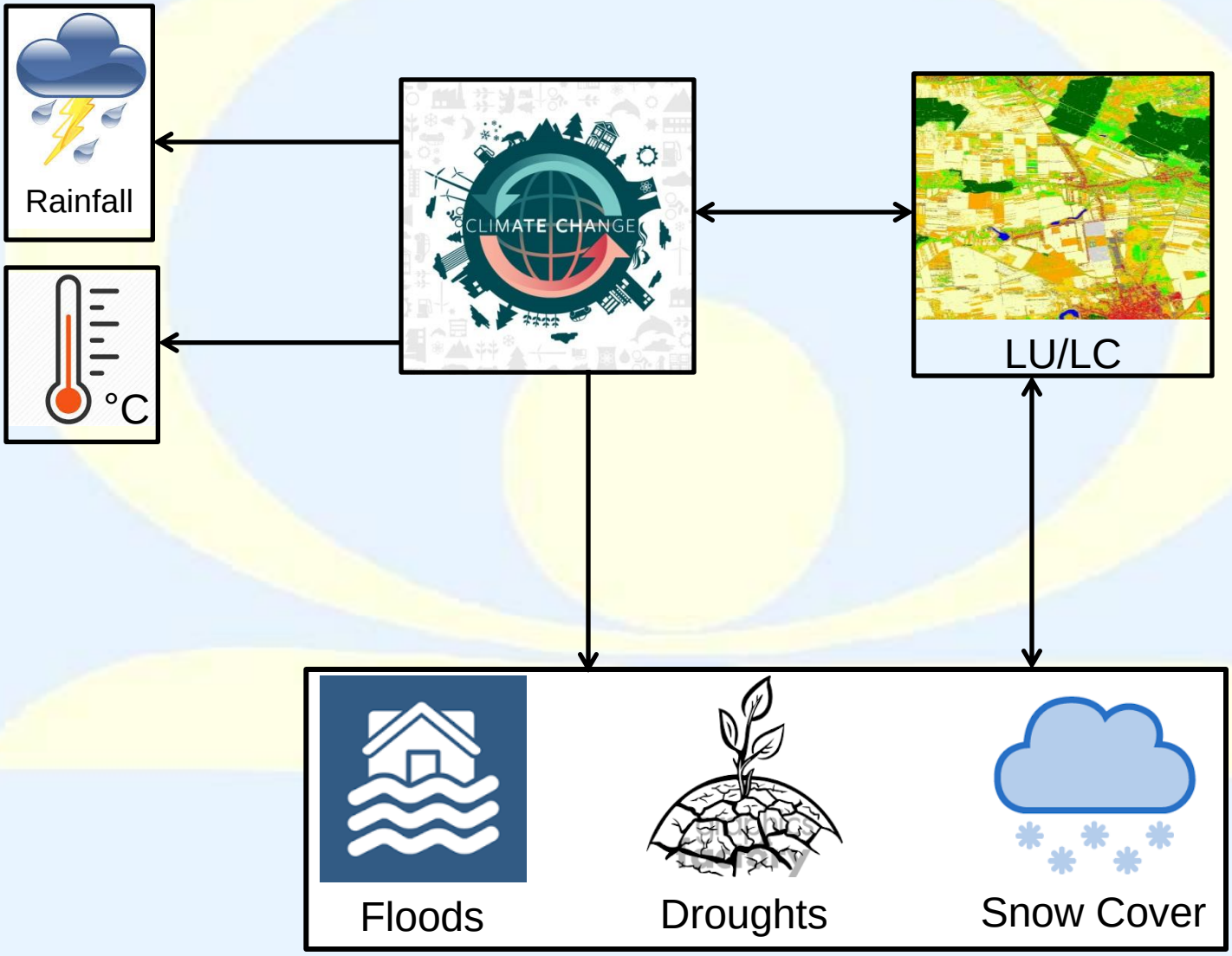


Snow cover in 2010 - 2011 winter

Research Projects

- **SNOWBALL** “Remote sensing, model and in-situ data fusion for snowpack parameters and related hazards in a climate change perspective”, 2014-2017;
- **MEDGAME** “Serious Games based Virtual Centre for education and training in natural hazards emergency situations”, 2014-2016;
- **SiAiR** “Satellite & in-situ Information for Advanced Air Quality Forecast Services”, 2014-2015;
- **ASSIMO** “Assessment of Satellite Derived Soil Moisture Products over Romania”, 2013-2016;
- **GEODIM** “Platform for GeoInformation in Support of Disaster Management”, 2012-2016;
- **CLIMHYDEX** “Changes in climate extremes and associated impact in hydrological events in Romania”, 2012-2015;
- **DROMOSIS** “Drought monitoring based on space and in-situ data”, 2012-2014;
- **ORIENTGATE** “A structured network for integration of climate knowledge into policy and territorial planning”, 2012-2014;
- **CLEANWATER** “Integrated system for protect and analyse the status and trends of water threatened by nitrogen pollution”, 2010-2014;
- **CRYOLAND** “Service Snow and Land Ice - Stimulating the development of downstream GMES Services”, 2014-2015;
- **MIDMURES** “Mitigation Drought in Vulnerable Area of the Mures Basin”, 2010-2012;
- **MACC** “Monitoring atmospheric composition & climate”, 2009-2011;
- **HYDRATE** “Hydrometeorological data resources and technologies for effective flash flood forecasting”, 2006-2010;
- **EFFS** “European Flood Forecasting System”, 2003-2004;
- **NATO SfP 978016** “Monitoring of extreme flood events in Romania and Hungary using EO data”, 2002-2006.

Land cover/Land use change



Thank you for attention!

anisoara.irimescu@meteoromania.ro