



**INSTITUTE OF GEOGRAPHY
ROMANIAN ACADEMY**



LAND USE/LAND COVER CHANGES ALONG THE ROMANIAN DANUBE VALLEY IN THE POSTCOMMUNIST PERIOD

Dan BĂLTEANU, Monica DUMITRAȘCU, Elena-Ana POPOVICI

Köln - 2012





Bridge over Danube, Apollodor din Damasc (103-105 A.D),
Source: Istoria Romanilor, vol II, 2001

Pillars of the Danube Strategy:

- 1.Connectivity
- 2.Environmental protection
- 3.Economic development
- 4.Strengthening the governance within the Danube Region



Data and methods

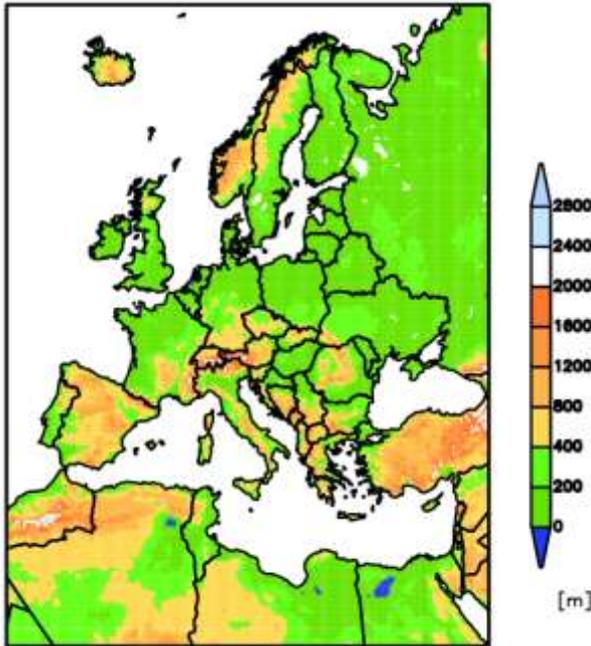
- ▶ Topographic maps 1: 100 000 from 1912, 1940, 1970, 1990
- ▶ Satellite images 2000, 20006
- ▶ Statistical data
- ▶ Case-studies based on
 - ▶ Air photos / ortophotoplans
 - ▶ Topographic maps 1: 25 000, 1:50 000
- ▶ Data on driving factors from different FP6, FP7 Projects (Clavier, EnviroGRIDS, Eclise, Romania-Bulgaria Crossborder Cooperation)



CLAVIER model ensemble

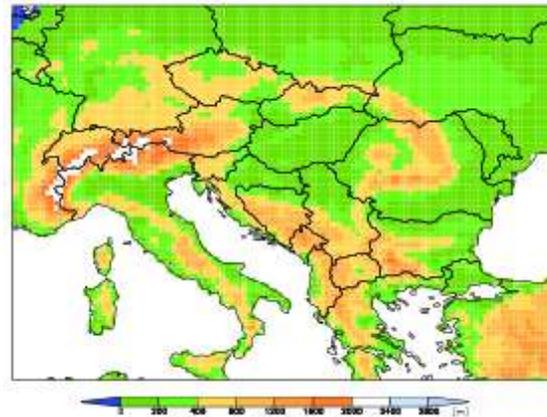
REMO5.7 (MPI-M):

A1B driven by
ECHAM5



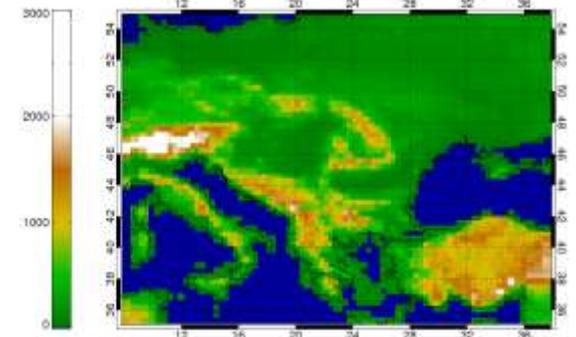
REMO5.0 (HMS):

A1B driven by
ECHAM5



LMDZ (IPSL):

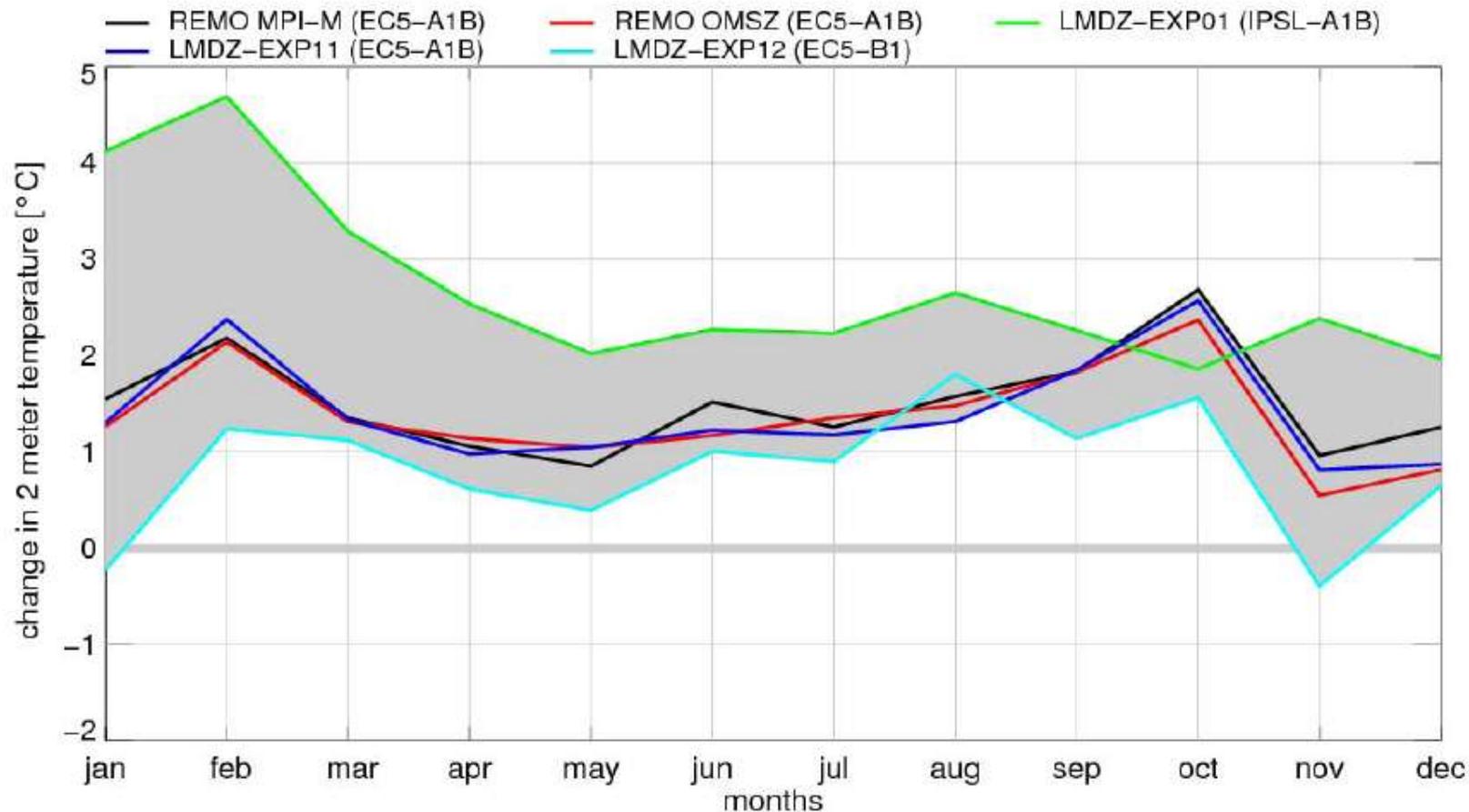
A1B driven by EC5
A1B driven by IPSL
B1 driven by EC5





Climate Change Signal in Romania in Mean Monthly Temperature (2021-2050 vs. 1961-1990)

CLAVIER simulations: Romania

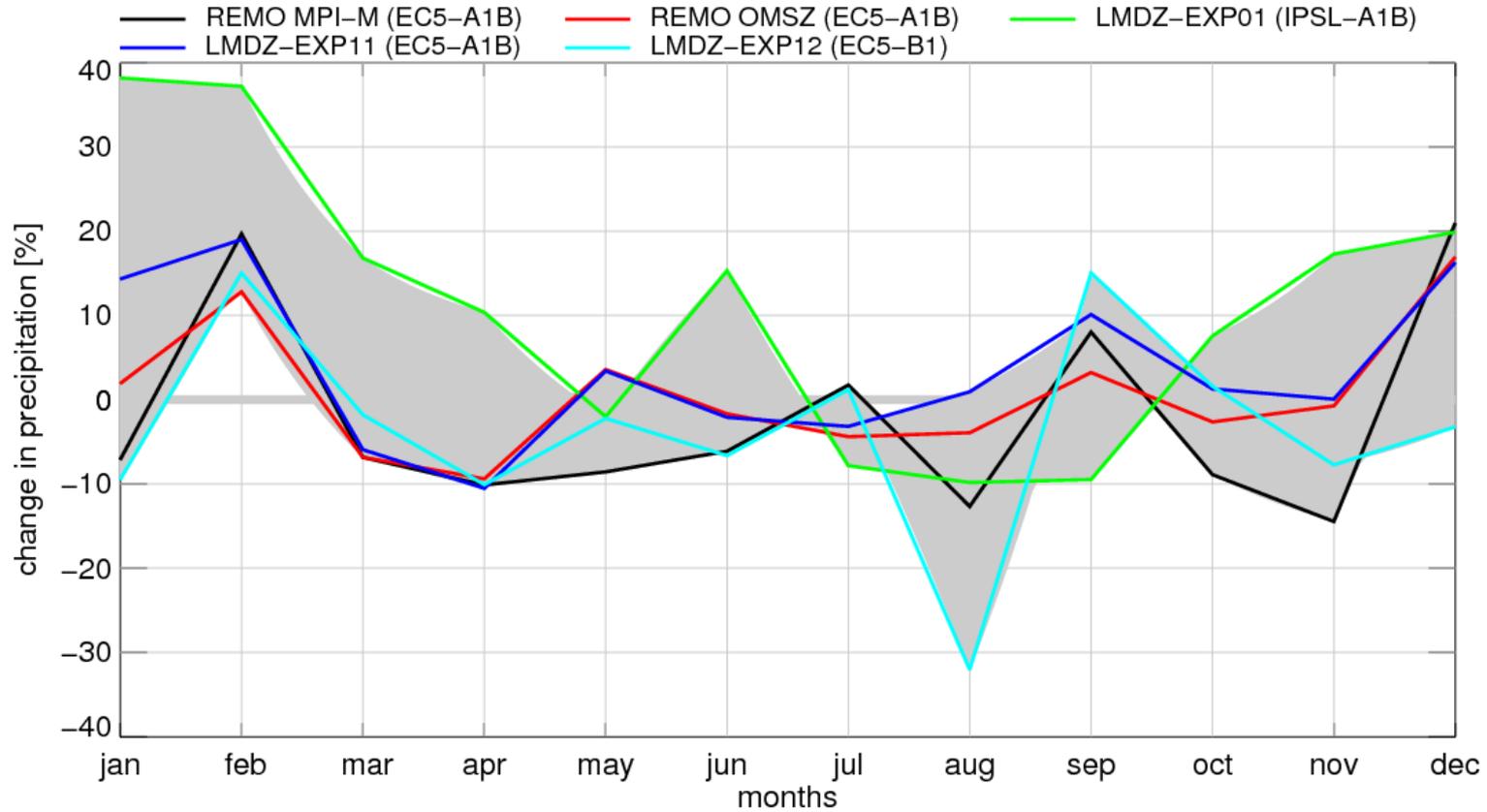


- Estimated increase of annual mean temperature: $\sim +2^{\circ}\text{C}$.
- Range of increasing rates: $\sim +1^{\circ}\text{C}$ to $+4^{\circ}\text{C}$.
- **General trend of climate warming: all seasons** (less than $+1^{\circ}\text{C}$).
- **Transition toward milder winters: $+2.8^{\circ}\text{C}$.**



Climate Change Signal in Romania in Precipitation (2021-2050 vs. 1961-1990)

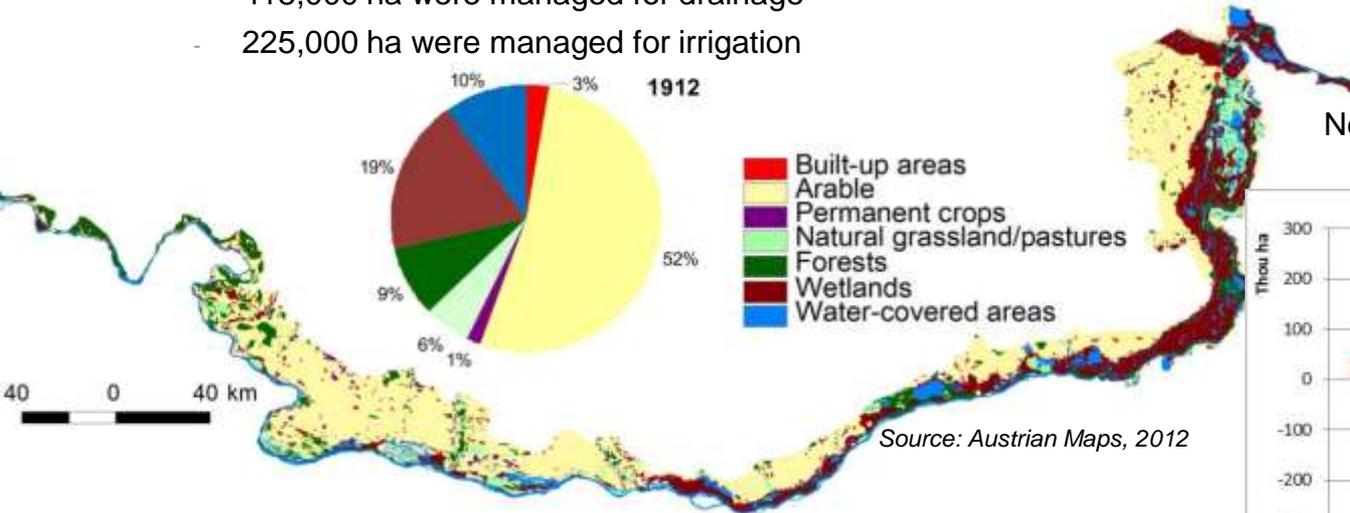
CLAVIER simulations: Romania



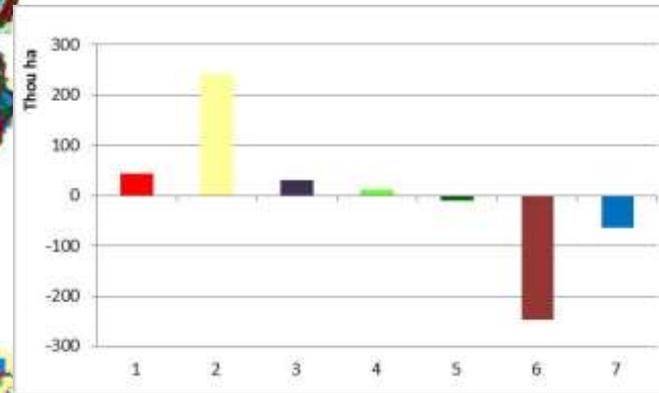
Land use changes over the communist period (1945-1989)

Danube Floodplain embankment

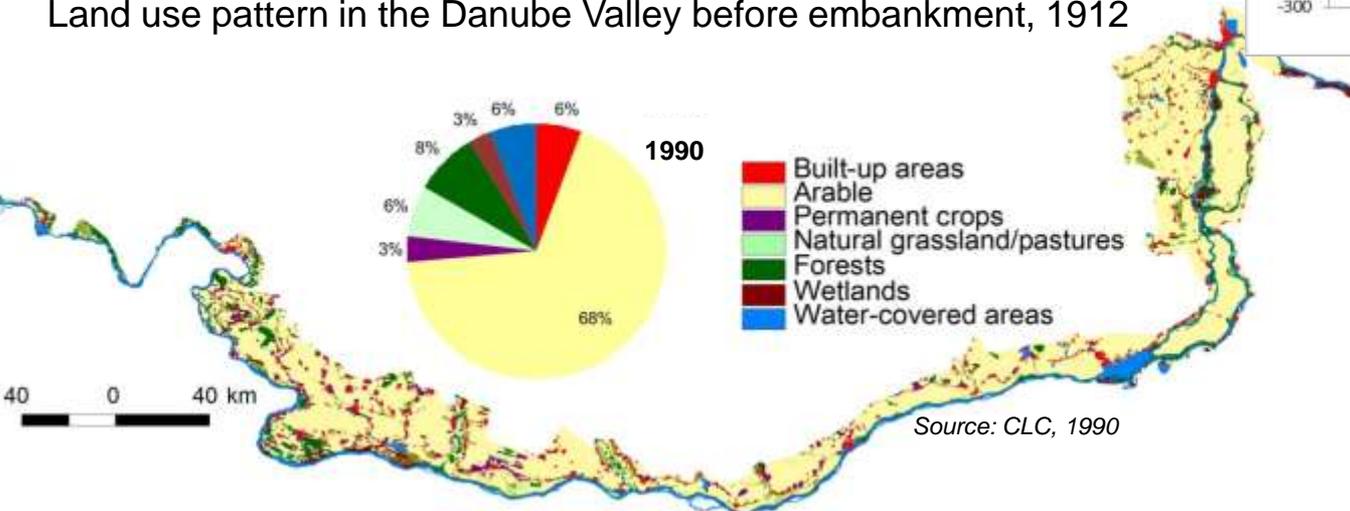
- ▶ The Danube Floodplain covers 573,000 ha
- **1960-1970 – 431,760** (75% of the overall area) were dammed:
 - 1,158 km of dams,
 - 418,000 ha were managed for drainage
 - 225,000 ha were managed for irrigation



Net changes in land use categories, 1912 - 1990

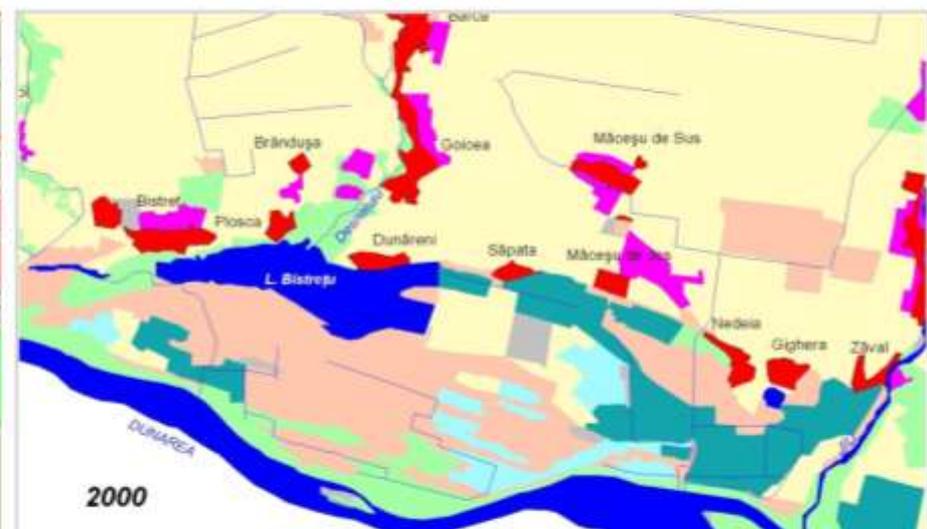
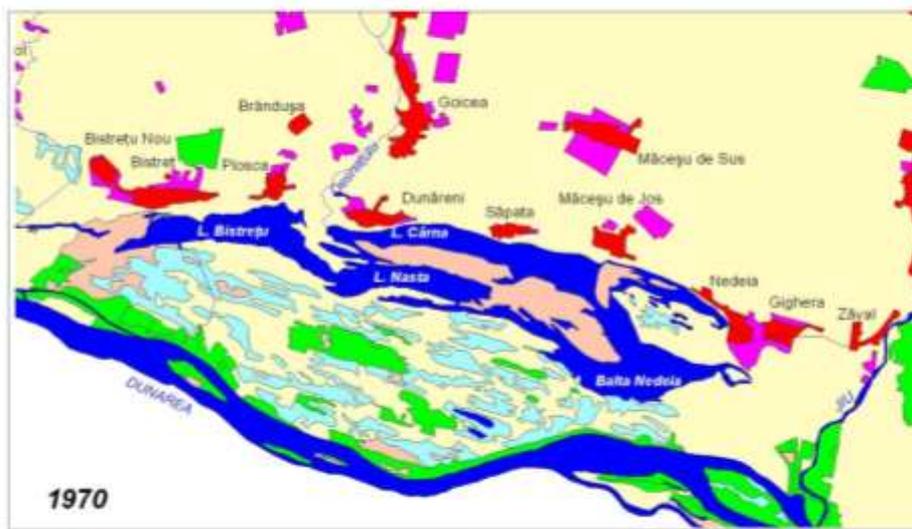
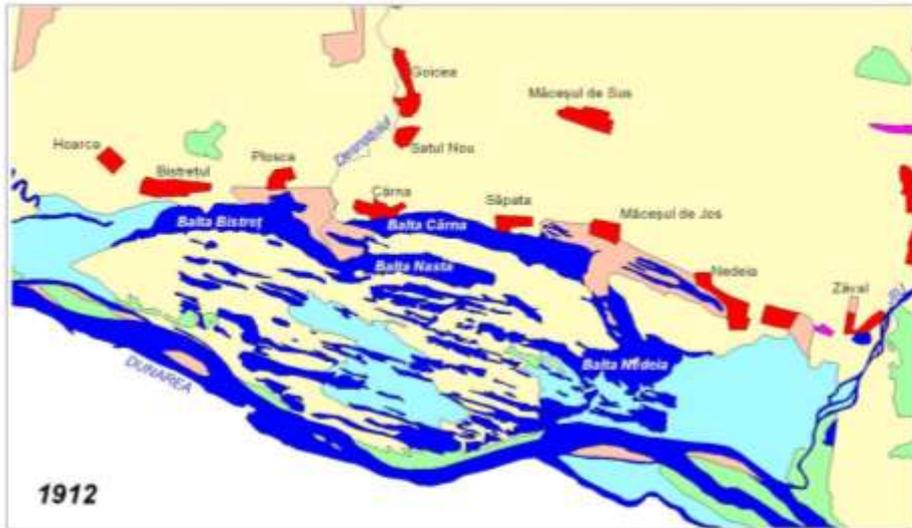


Land use pattern in the Danube Valley before embankment, 1912

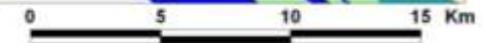


Land use pattern in the Danube Valley after embankment, 1990

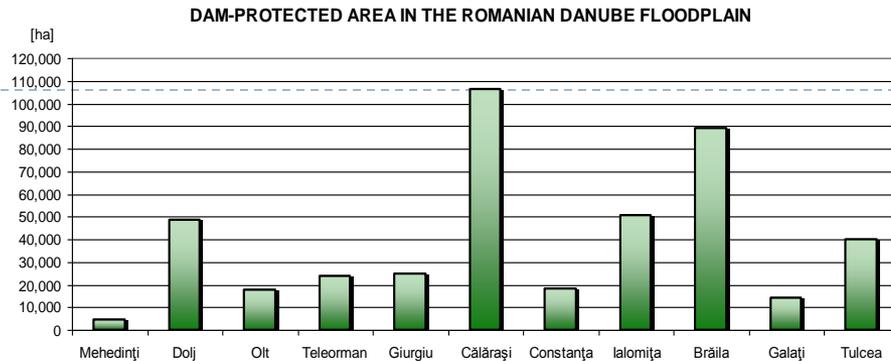
Land management and land use changes in western part of the Romanian Danube Floodplain



- | | | |
|--|---|--|
| ■ așezări | ■ teren arabil | ■ pășuni și fânețe |
| ■ suprafețe acvatice | ■ vii și livezi | ■ terenuri necultivate |
| ■ depresiuni mlăștinoase | ■ păduri | ■ incinte indiguite |



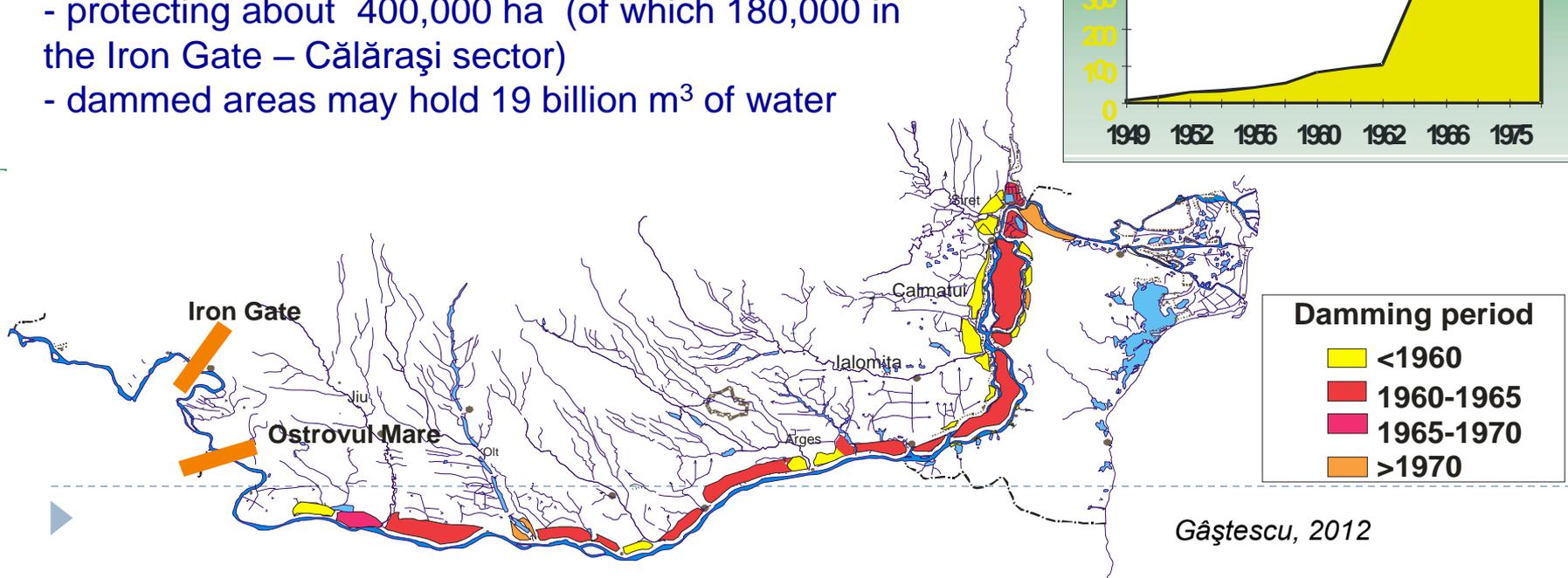
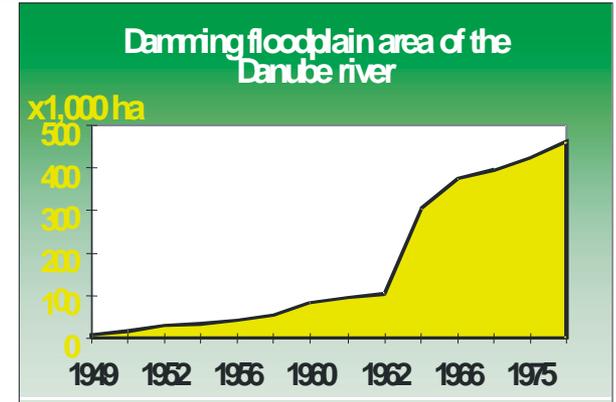
Danube Floodplain management works



Dams totalling 3,520 km of which 1,100 km in Romania

1,100 km of dams :

- protecting about 400,000 ha (of which 180,000 in the Iron Gate – Călărași sector)
- dammed areas may hold 19 billion m³ of water



Gâștescu, 2012

Land use changes over the post-communist period

- ▶ **transition period (1990-2003)**, marked by fundamental changes in agriculture when collective and state property was being replaced by private property
- ▶ **post-transition period (2003-to-date)**, corresponding to Romania's pre- and post-accession to the European Union (adoption and implementation of the CAP)

The driving factors involved in land-use changes are of a *political* nature, associated with *economic, technological, demographic* and *natural* drivers.

Main changes:

- ▶ ***changes in the property type of agricultural and forest lands*** (extension of the private property to over 95% of all agricultural land and to over 35% of the forest land)
- ▶ ***changes in the type of farms*** (under Land Law 18/1991, the large farms from the socialist period gave way to small, peasant-type family farms)
- ▶ ***changes in land use structure***

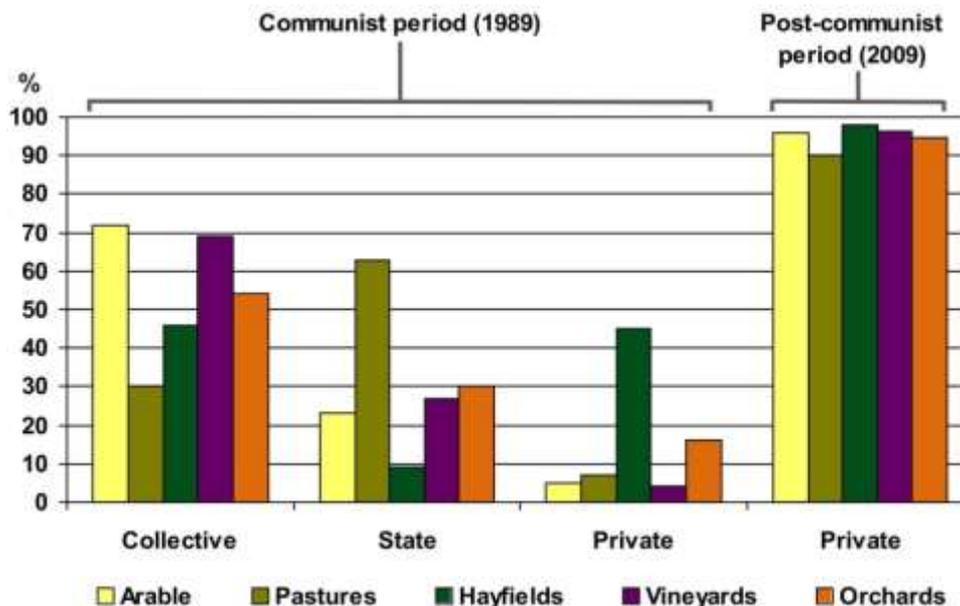
Consequences of those changes

- ▶ ***excessive fragmentation of agricultural land***
 - ▶ ***inadequate agricultural practices***
 - ▶ ***very high proportion of subsistence individual farms***
 - ▶ ***degradation of productive agricultural services***
 - ▶ ***degradation of agricultural land quality***
-



1. Changes in the type of property of agricultural and forest lands

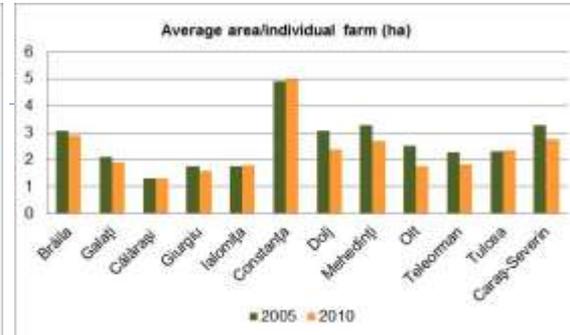
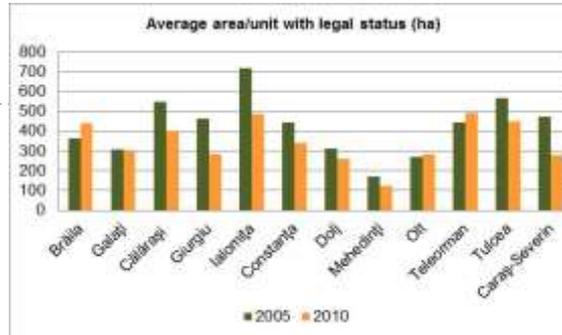
- ▶ the retrocession of farming land and forests to their former owners (Land Law 18/1991) led to expansion of private property to over 95% of all agricultural land to the detriment of collective and state property characteristic of the communist period



Land fund by categories of use and forms of property

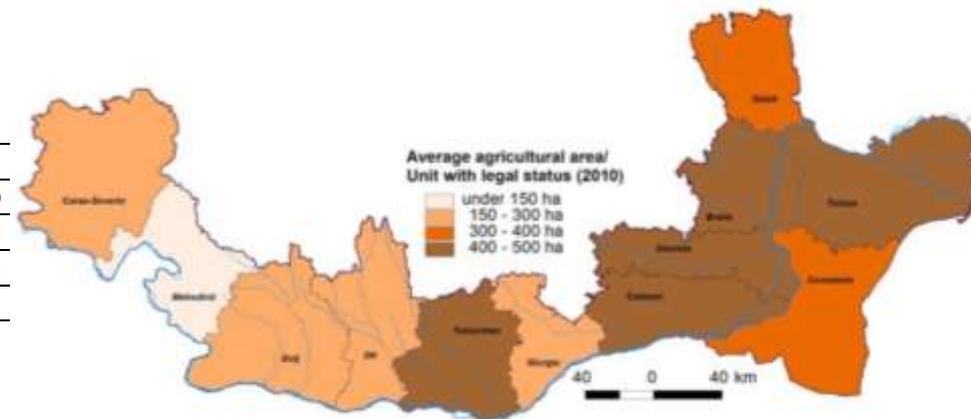
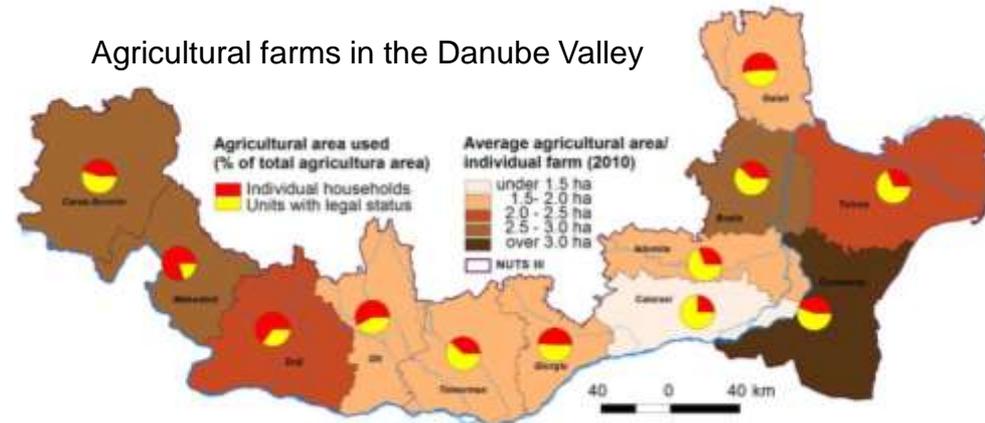
2. Changes in the type of farms

- under *Land Law 18/1991*, the large farms from the communist period gave way to small, individual farms, most of them practicing a subsistence agriculture)



- two categories can be clearly distinguished within the farm-size class:
 - *very small and small farms* of less than 5 hectares (over 90% of existing farms)
 - *large and very large farms* of over 100 ha, or 1,000 ha even (1%) – (ex. the largest farm has 56,132 ha, follow by several other farms with areas between 6,000 and 35,000 ha, most of them are hold by foreign investors (Portuguese, Lebanese, Danish, etc.).

Agricultural farms in the Danube Valley

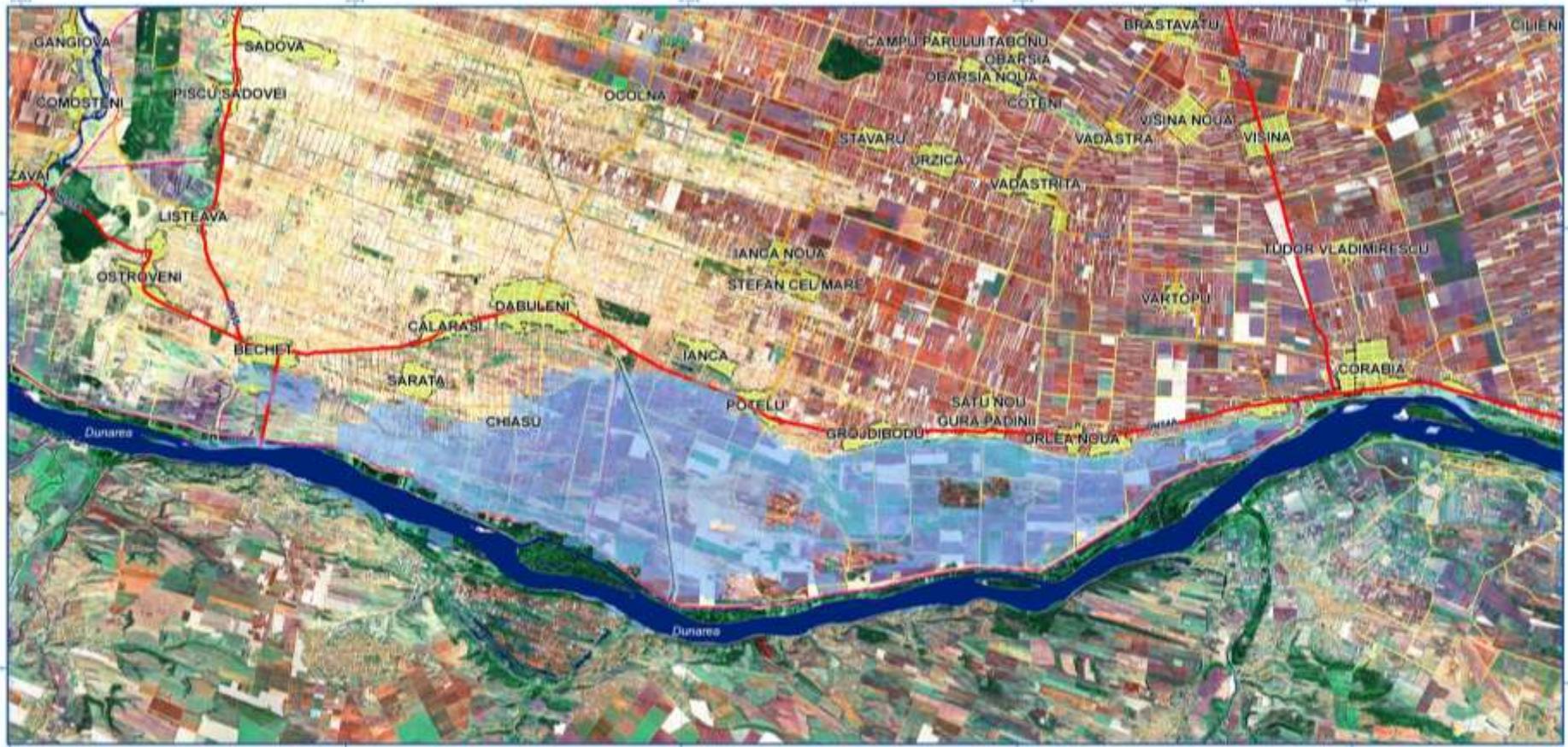


Agricultural farms in the Danube Valley counties, 2005 and 2010

	Number		Average area (ha)		Agricultural area used (%)	
	2005	2010	2005	2010	2005	2010
Individual farms	1,090,975	972,579	2.6	2.3	57.6	46.1
Units with legal status	4,742	7,335	423.3	344.8	42.4	53.9
Total	1,095,717	979,914	5.4	4.7	100.0	100.0

Land fragmentation in the western part of the Romanian Dabube Plain

Bechet-Corabia sector - flooded area in 2006



LOCALIZARE



LEGENDA

- Retea hidrografica (nivel de referinta)
- Dighi
- Zone inundate
- Drumuri europene sau nationale
- Drumuri judatene
- Drumuri comunale, de exploatare, strazi
- Cai ferate
- Localitati

00.51 2 3 4 Km



EXPLICATII

Unirea a debuta la inceput in aprilie 2006, sigei se protejea teritoriile agricole din sudul judetului Dolj a catar si data de 23.04.2006 pe teritoriul localitatii Sarata.

Duparatetele inregistrate au fost obtinute prin prelucrarea imaginii MODIS/TERRA din data de 13.05.2006 (inregistrate spatiale de 250 metri).

Imagines de fond, sursa: LANDSAT ETM+ (rezolutie spatiale de 30 metri), prezinta starea zonei in anul 2005.

Sistem de proiecte Stereografic 1070

ATENȚIE: Acuratetea cu care au fost extrase zonele inundate este strict legata de rezolutia spatiale a surselor de intrare. Din aceasta cauza pot exista erori ascunse de apa, de nu o suprafata mai mica de 250', care sa nu fie reprezentate.

CONTACT

Proiect realizat de Administratia Nationala de Meteorologie, Laboratorul de Telemetrie si GIS

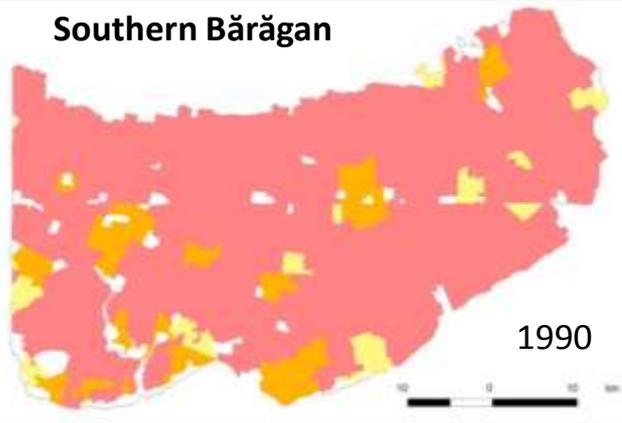
Pentru mai multe detalii ne puteti contacta la adresa inundatii@meteo.inmh.ro sau la telefonul +40 21 318 32 40 - ext. 153.



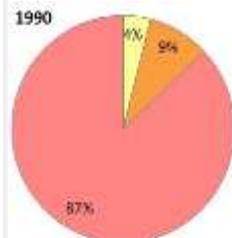
Proiect NATO SIP 978016
Monitoring of extreme flood events in Romania and Hungary using EO data.
<http://nato.inmh.ro>

Fragmentation of arable land

Southern Bărăgan

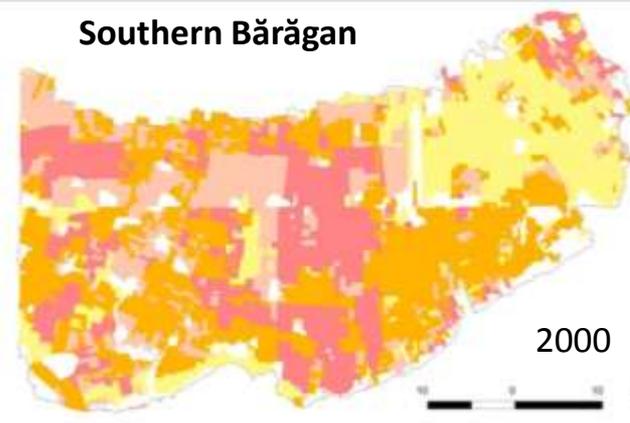


1990

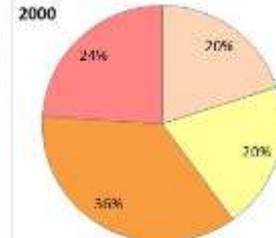


Medium size parcels (2-5 ha)
Large size parcels (5-50 ha)
Very large size parcels (> 50 ha)

Southern Bărăgan



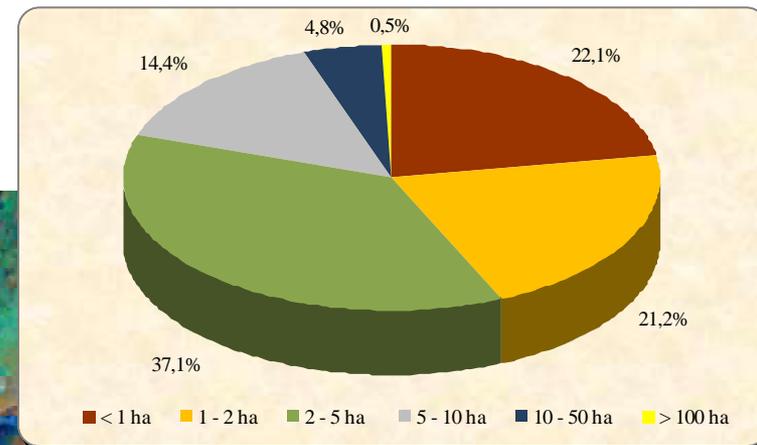
2000



Small size parcels
Medium size parcels (2-5 ha)
Large size parcels (5-50 ha)
Very large size parcels (> 50 ha)

- 15.3 million estimated number of parcels in Romanian agriculture:

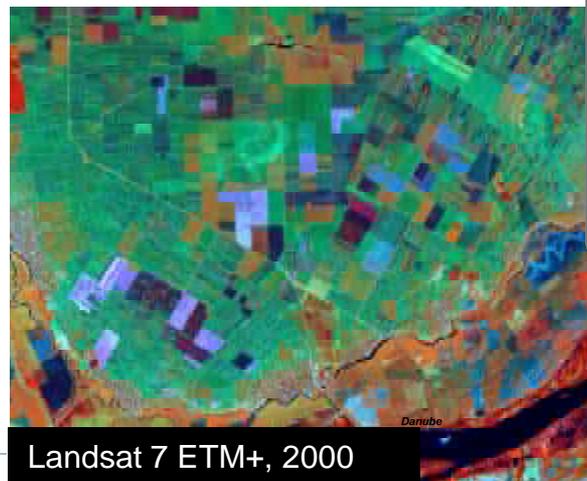
- 41.1% have below 2 ha
- 51.5 % have 2 - 10 ha
- 5.3 % have more than 10 ha.



Agricultural area: size of parcels (ha), 2005



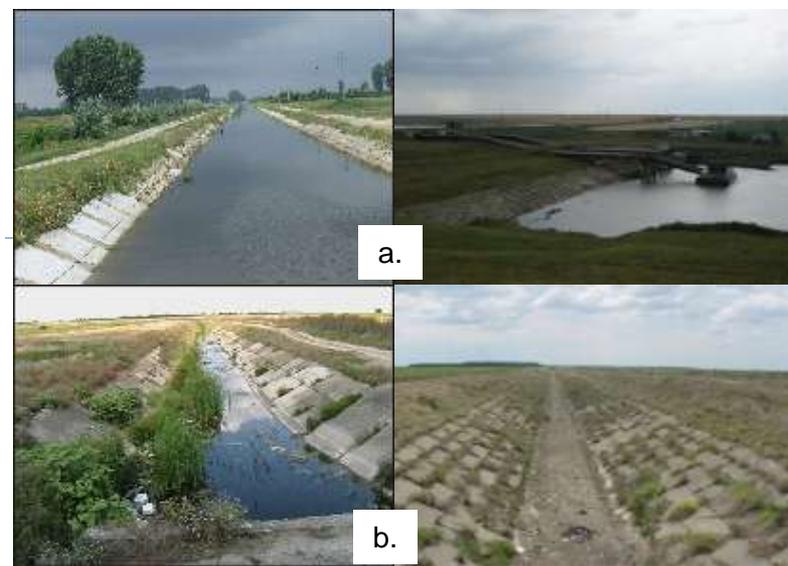
Landsat 5 TM, 1990



Landsat 7 ETM+, 2000

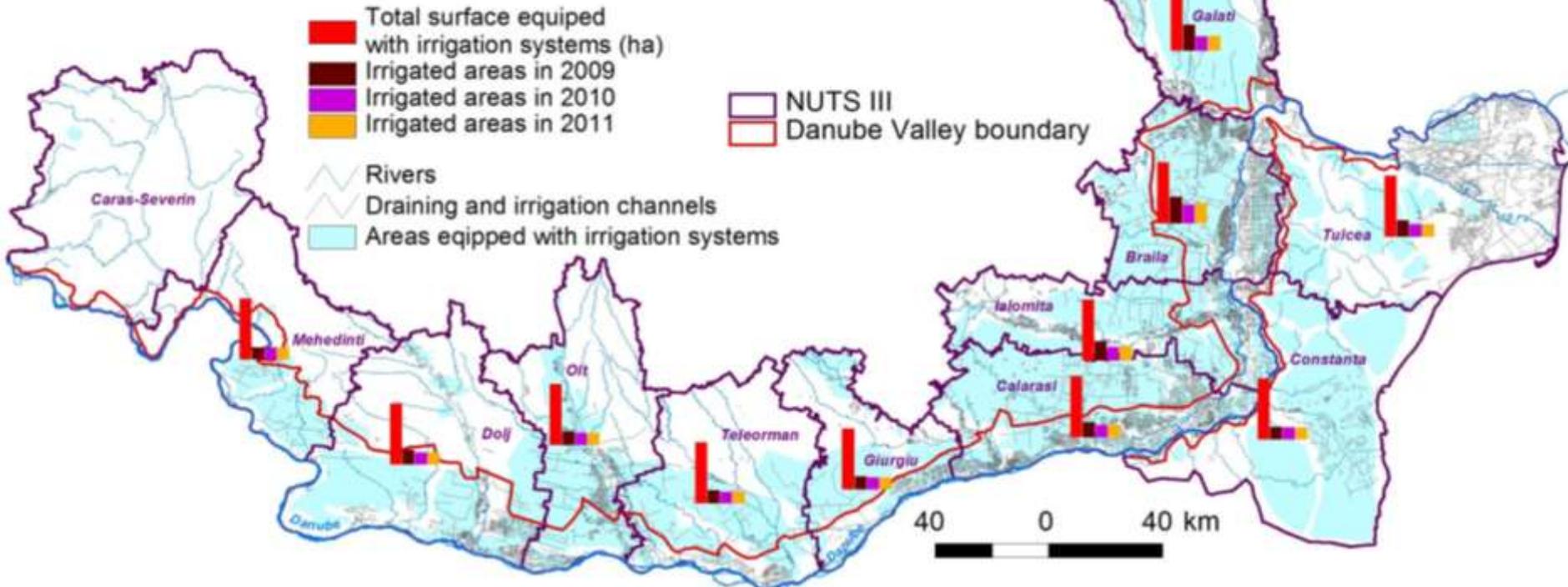
Abandoned or destroyed irrigation and drainage systems

- Over 2,677 thou ha of agricultural lands are managed with irrigation systems, but most of them were destroyed after 1990, or left in an advanced state of degradation.

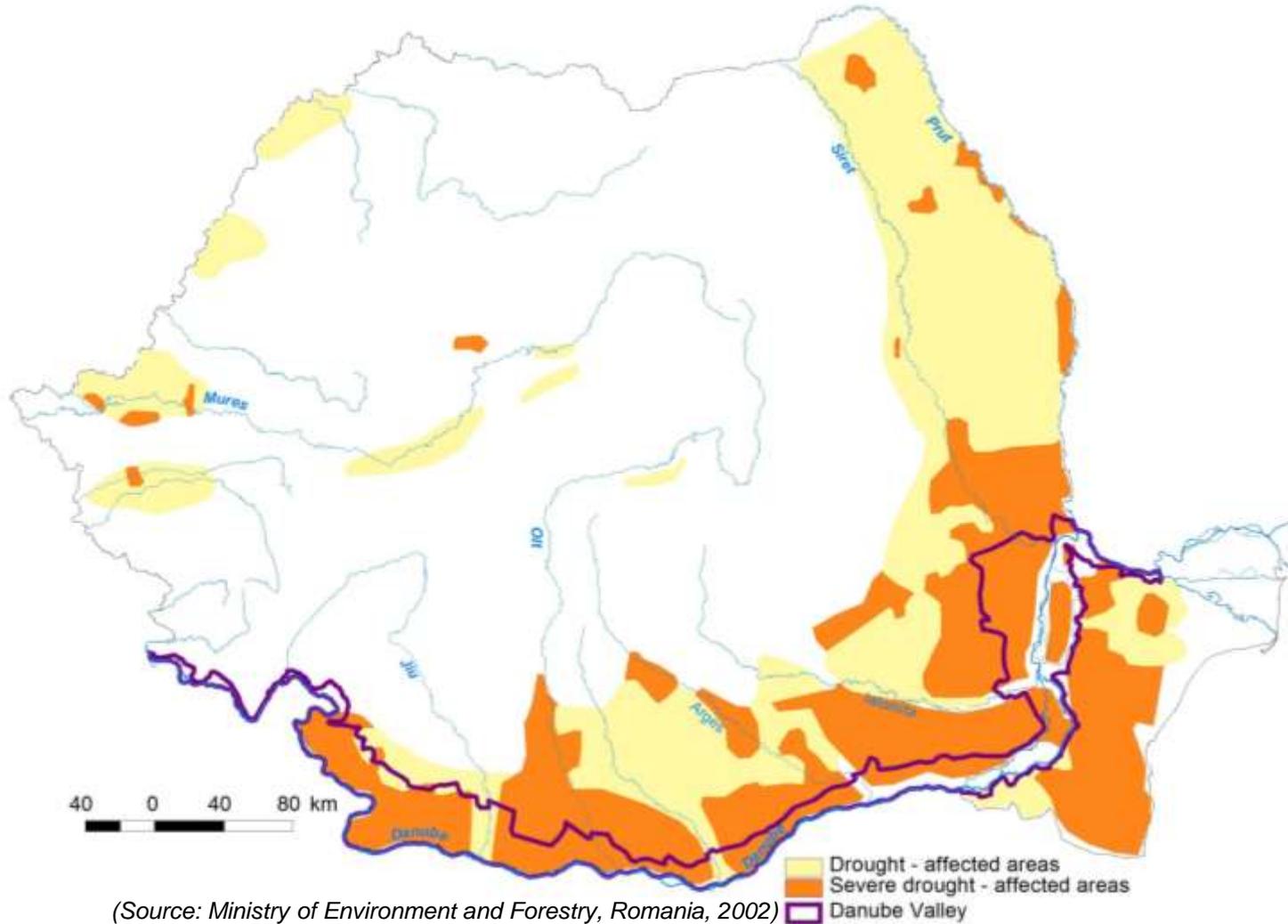


Irrigation systems.
Functional (a) and abandoned (b)

Dynamic of irrigated agricultural areas		
	ha	%
2009	279,49	10.4
2010	80,289	3.0
2011	99,755	3.7



Areas affected by drought phenomena in Romania

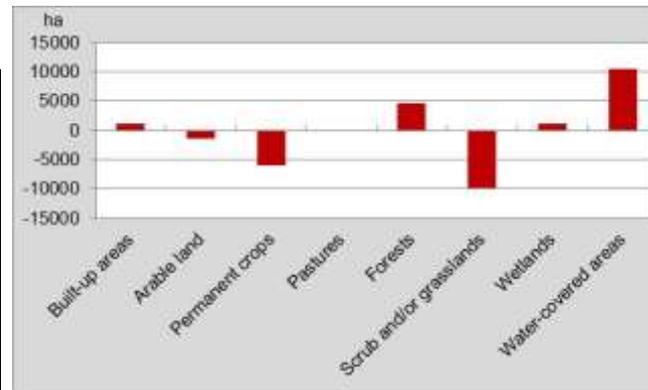


3. Changes in the land use structure

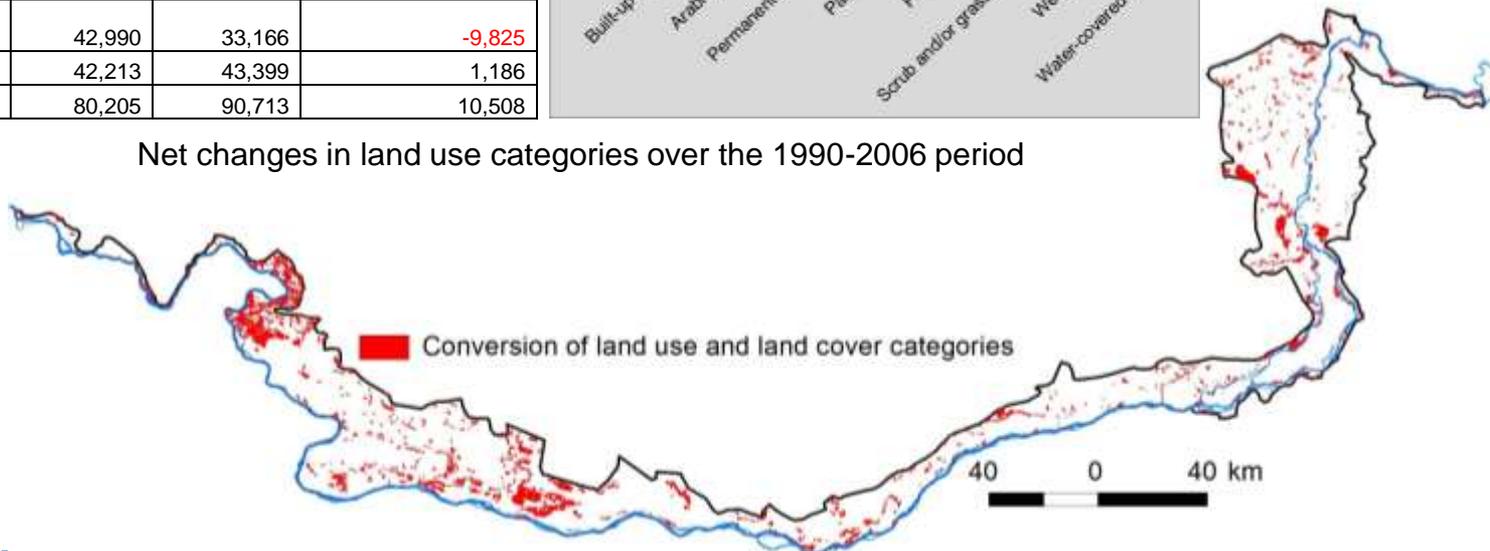
- ▶ *internal agricultural changes*
 - ▶ especially, transition of classes, associated with higher to lower intensity of use (conversion from permanent crops or arable to pastures),

- ▶ *suburbanization*,
 - ▶ to the detriment of all agricultural land-use categories
- ▶ *illegal logging*
 - ▶ cutting of protection forest belts, etc.

	Area in 1990	Area in 2006	Changes 1990_2006
Built-up areas	85,963	87,080	1,117
Arable land	1,069,641	1,068,130	-1,511
Permanent crops	58,841	52,898	-5,943
Pastures	67,140	67,061	-78
Forests	120,982	125,659	4,677
Scrub and/or grasslands	42,990	33,166	-9,825
Wetlands	42,213	43,399	1,186
Water-covered areas	80,205	90,713	10,508

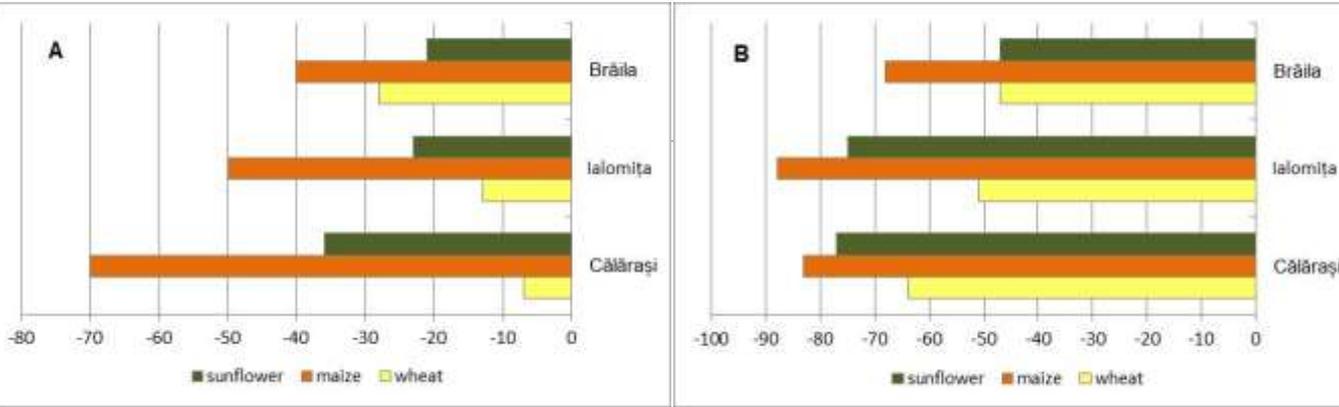


Net changes in land use categories over the 1990-2006 period

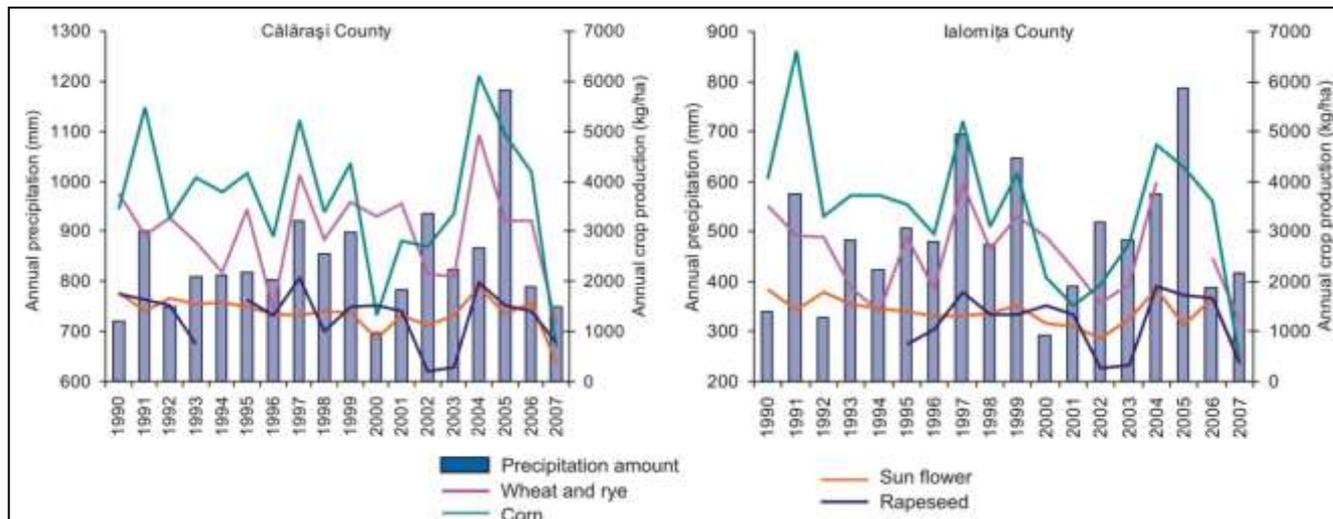


Land use changes over the 1990-2006 period

Impact of drought on crop production along the Danube Valley



Impact of the drought on average yield for main crops (% reduction) for 2000 relative to 1999 (A) and 2007 relative to 2006 (B) in Bărăgan Plain



Correlation between the average yields of the main crops and annual precipitation amounts (1990-2007)

- in particularly droughty years of 2000 and 2007, average yields/ha for grain cereals were significantly depleted (under 1,000 kg/ha)

The lowest Danube level in the last 160 years



Zimnicea, 30 august 2003



Foto: Jeni Drăgoi



Intensive agriculture. Great Brăila Island

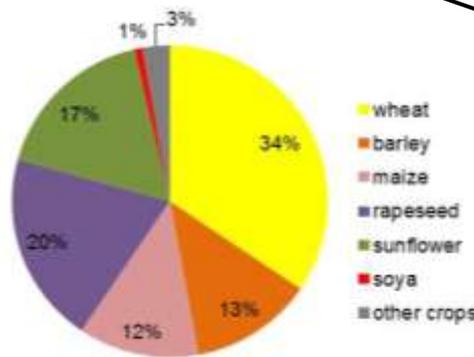
Land use 1912

Land use 2006

- the largest private agricultural exploitation in Europe - **56,132 ha**, of which **40,000 ha** are managed for irrigation

Average yield for main crops, 2009

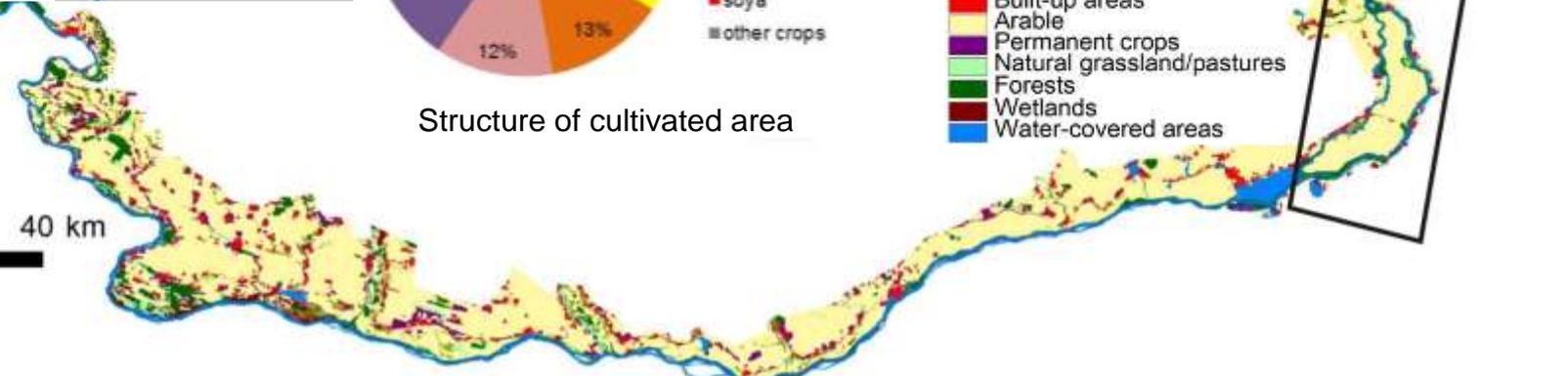
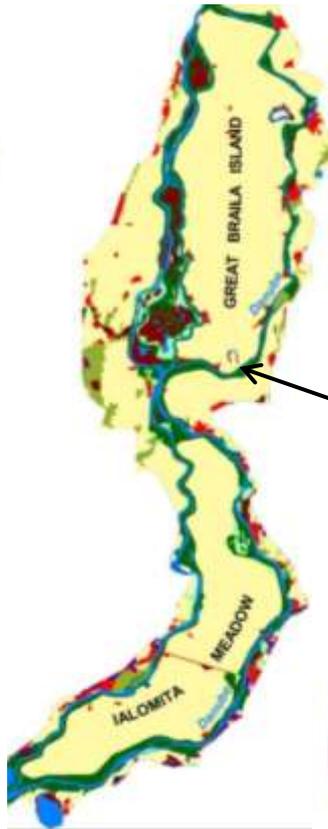
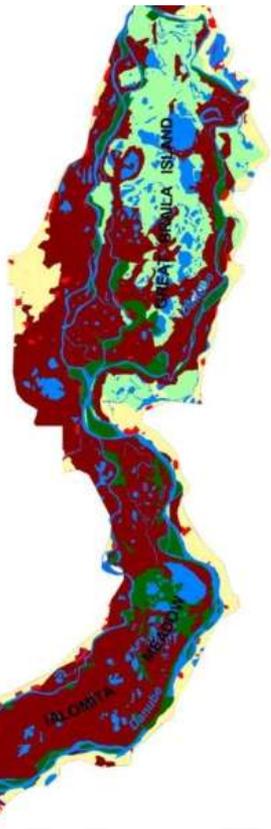
	Great Brăila Island		Romania
	2010	2011	2011
wheat	6,000	5,800	3,663
barley	6,700	5,900	3,628
maize	9,300	10,000	4,525
rapeseed	3,600	2,800	1,882
sunflower	2,600	2,700	1,798
soya	2,900	2,900	1,980



Structure of cultivated area



40 0 40 km



**Impact of the natural hazards
on land use change**

DANUBE FLOODS - 2006



RISCU LA INUNDATII

AREALE INUNDABILE PE REȚEAUA PRINCIPALĂ DE RĂURI

Lacuri de acumulare
(mil. m³)

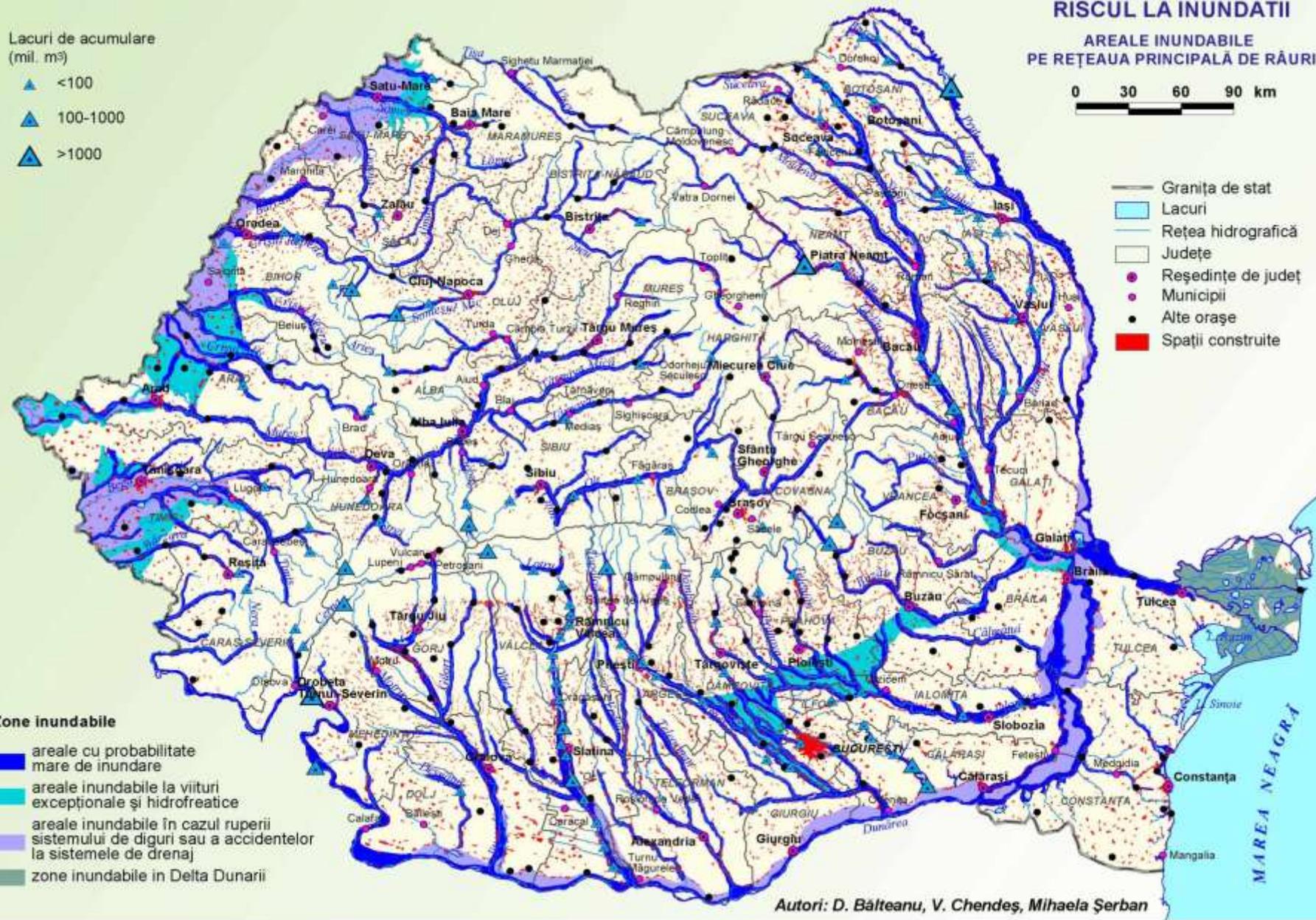
- ▲ <100
- ▲ 100-1000
- ▲ >1000

0 30 60 90 km

- Granița de stat
- Lacuri
- Rețea hidrografică
- Județe
- Reședințe de județ
- Municipii
- Alte orașe
- Spații construite

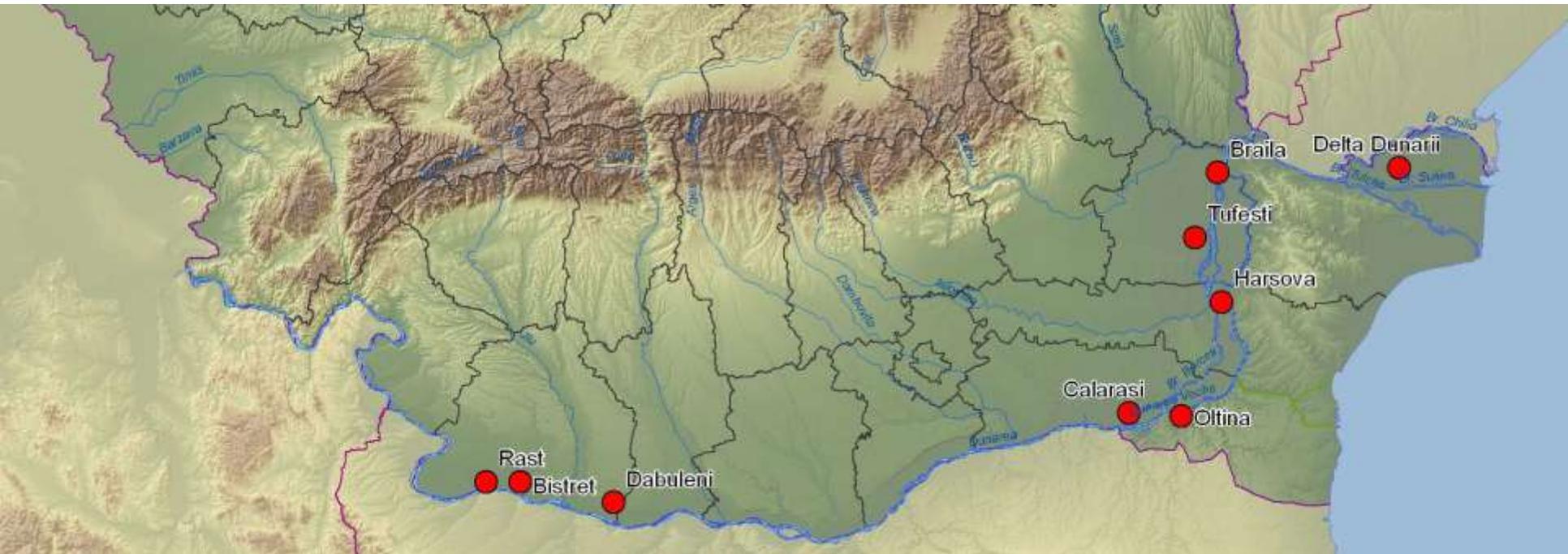
Zone inundabile

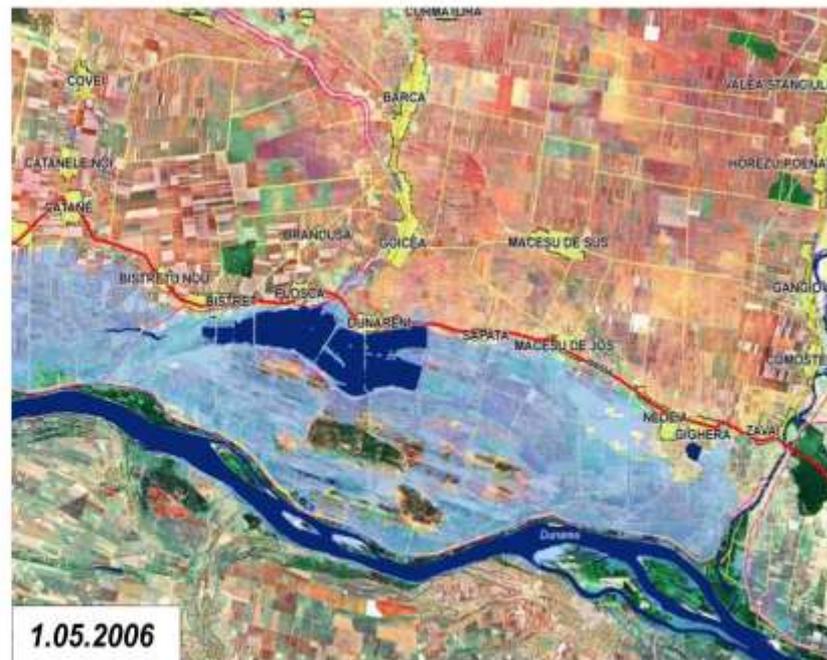
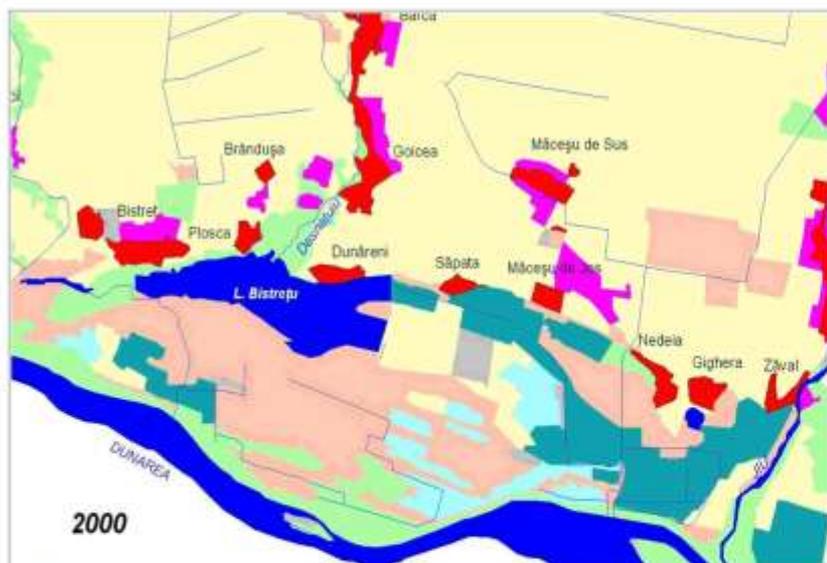
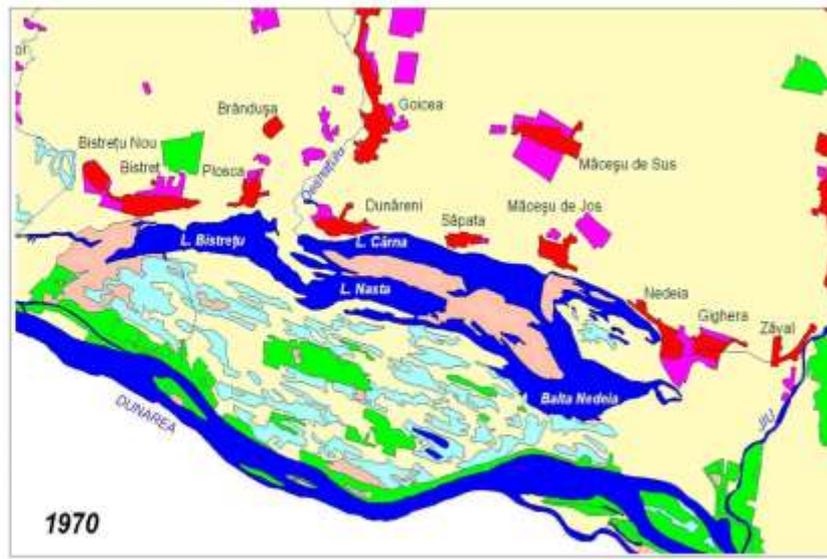
- areale cu probabilitate mare de inundare
- areale inundabile la viituri excepționale și hidrofreatice
- areale inundabile în cazul ruperii sistemului de diguri sau a accidentelor la sistemele de drenaj
- zone inundabile în Delta Dunării



Autori: D. Bălțeanu, V. Chendeș, Mihaela Șerban

Major hot-spots of dam breaking (April – May 2006 flood)





- | | | |
|---|---|---|
| ■ așezări | ■ teren arabil | ■ pășuni și fânețe |
| ■ suprafețe acvatice | ■ vii și livezi | ■ terenuri necultivate |
| ■ depresiuni mlăștinoase | ■ păduri | ■ incinte îndiguite |



Zonele inundate din Lunca Dunării: Sector Ghidici - Rast - Bistret - Macesu de Jos. 01.05.2006 ora 12:40



LOCALIZARE



LEGENDA

- Retea hidrografica (nivel de referinta)
- Zone inundate
- Diguri
- Drumuri europene sau nationale
- Drumuri judetene
- Drumuri comunale, de exploatare, strazi
- Cai ferate
- Localitati

0 1 2 4 6 8 Km



EXPLICATII

Urmasa a debitului istoric inmaginat pe Dunare in Aprilie 2006, digul ca proteja terenurile agricole din sudul judetului Dolj a cedat in data de 14.04.2006 pe teritoriul comunei Catane.

Suprafetele inundate au fost obtinute prin prelucrarea imaginii MODIS/TERRA din data de 01.05.2006 (rezolutie spatiala de 250 metri).

Imaginesa de fond, mosaic LANDSAT ETM+ (rezolutie spatiala de 15 metri), prezinta situatia zonei in anul 2000.

Sistem de proiectie Stereografic 1970

ATENTIE: Acuratetea cu care au fost extrase zonele inundate este stricta legata de rezolutia spatiala a datelor de intrare. Din aceasta cauza pot exista erori de acoperire cu apa, ce nu o suprasita mai mica de 250', care sa nu fie reprezentate.

CONTACT

Proiect realizat de Administratia Nationala de Meteorologie, Laboratorul de Teledetectie si GIS.

Pentru mai multe detalii ne puteti contacta la adresa inundati@metec.inmh.ro sau la telefonul +40 21 318 32 40 - ext. 165.



ANM

<http://www.inmh.ro>

Proiect NATO SFP 978016
Monitoring of extreme flood events in
Romania and Hungary using EO data.
<http://nato.inmh.ro>

Rast – May 2006

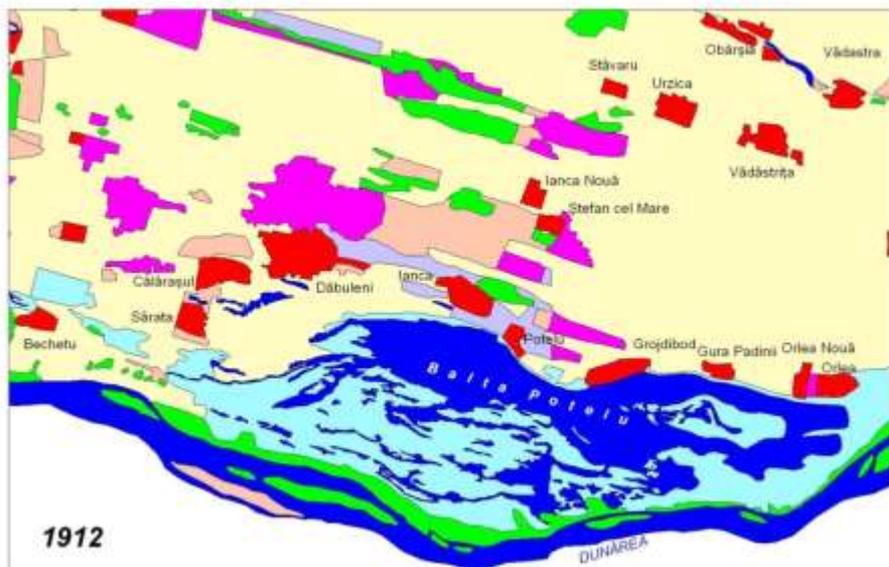


Rast – November 2006

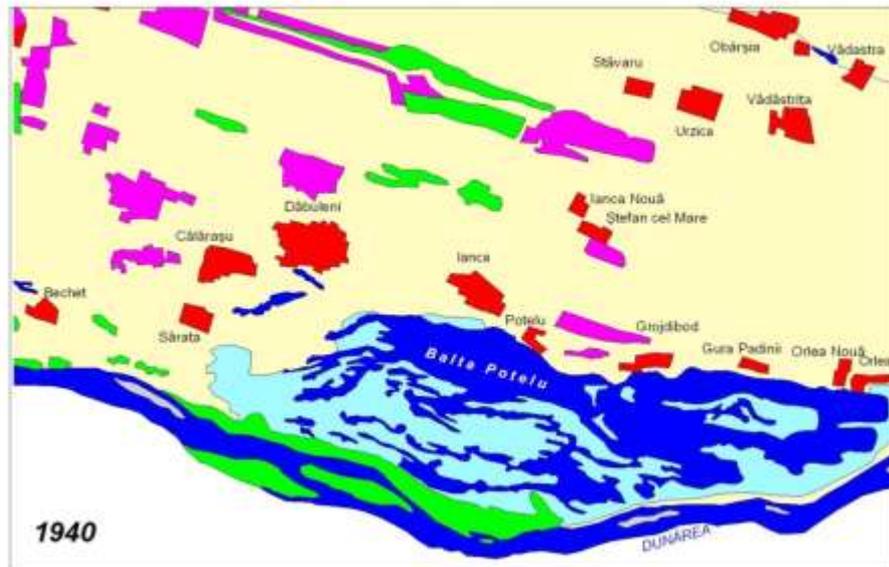


Rast – May 2011

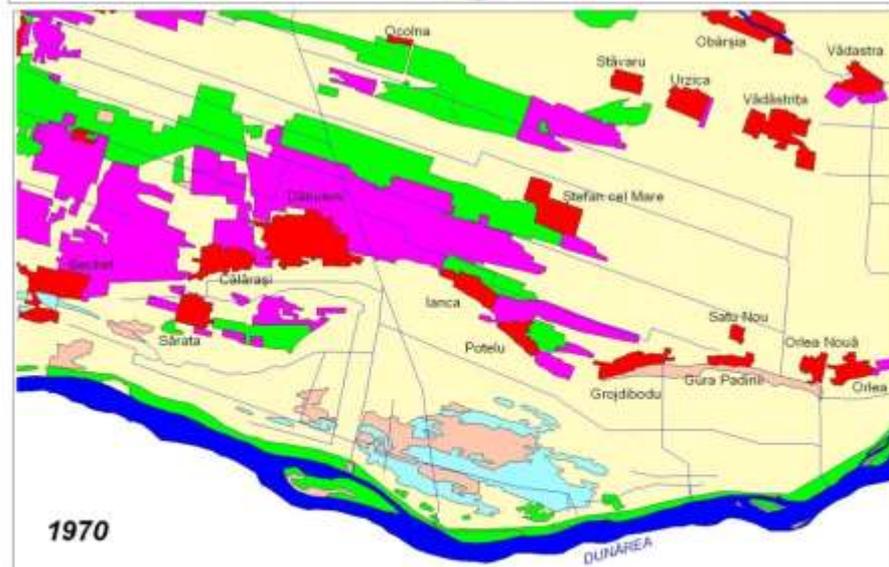




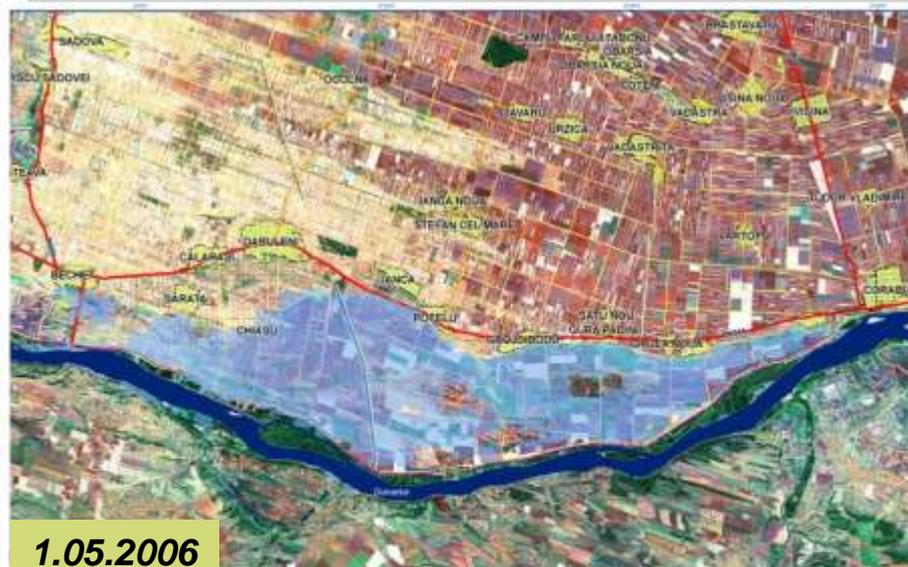
1912



1940



1970

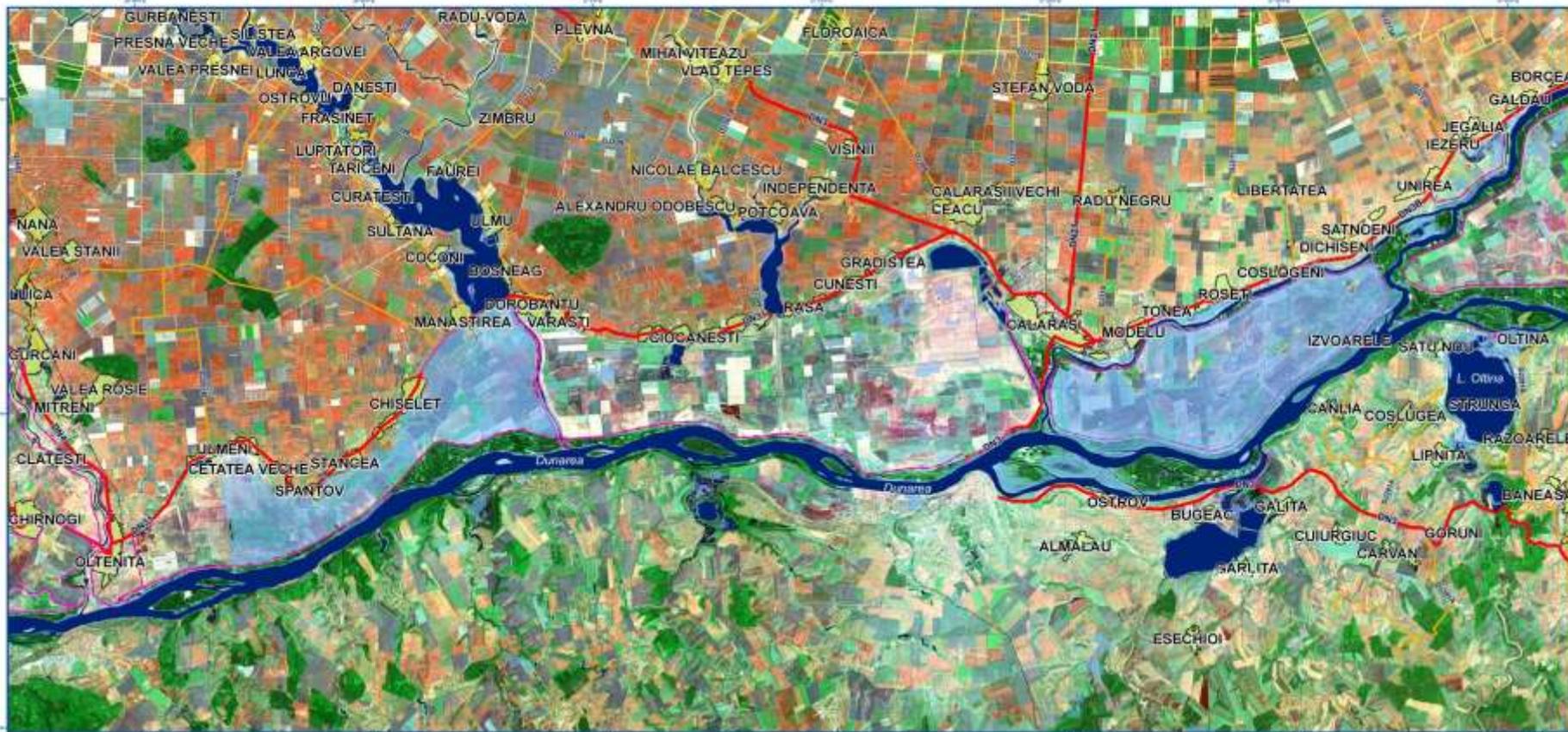


1.05.2006

- | | | |
|---|--|--|
| ■ așezări | ■ teren arabil | ■ pășuni și fânețe |
| ■ suprafețe acvatice | ■ vii și livezi | ■ pădure tânără, plantație |
| ■ depresiuni mlăștinoase | ■ păduri | ■ tufărishuri, mărăcinișuri |

0 5 10 15 km

Zonele inundate din Lunca Dunarii: Sector Oltenita - Calarasi. 14.05.2006 ora 11:10



LOCALIZARE



LEGENDA

- Reteza hidrografica (nivel de referinta)
- Digi
- Zone inundate
- Drumuri europene sau nationale
- Drumuri judetene
- Drumuri comunale, de exploatare, strazi
- Cai ferate
- Localitati



EXPLICATII

Urmasa a debitului istoric inegalizat pe Dunarea in Aprilie 2006, digul ce protejeaza terenurile agricole din sudul judetului Calarasi a cedat in data de 24.04.2006 pe teritoriul comunei Spantov. Apoi revarsate s-au apropiat pericolos de mult de orasul Oltenita. Anterior, in data de 23.04.2006 s-a produs o breasa in digul ce separa bratul Dunarii de lacul Oltina. Datorita cresterii nivelului in lac a fost amenajata localitatea Oltina.

Suprafata inundata au fost obtinute prin prelucrarea imaginii MODIS/TERRA din data de 14.05.2006 (rezolutie spatiala de 250 metri).

Imaginie de fond: mosaic LANDSAT ETM+ (rezolutie spatiala de 15 metri, precizie situatia zonei in anul 2000).

Sistem de proiectie Stereografic 1970.

ATENTIE: Acuratetea cu care au fost trasate zonele inundate este strict legata de rezolutia spatiala a datelor de intrare. Din aceasta cauza pot exista unele acoperite cu apa, de au o suprafata mai mica de 250', care sa nu fie reprezentate.

CONTACT

Proiect realizat de Administratia Nationala de Meteorologie, Laboratorul de Teledetectie si GIS.
Pentru mai multe detalii ne puteti contacta la adresa inundat@meteo.inmh.ro sau la telefonul +40 21 318 32 40 - int. 103.



Proiect NATO S/P 978016
Monitoring of extreme flood events in Romania and Hungary using EO data.
<http://nato.inmh.ro>

Conclusions

- ▶ **Changes in the Communist period (1945-1989)**
 - ▶ 1950-1960 abusive concentration of land in large collective and state farms
 - ▶ 1960-1970 land management works in the Danube Floodplain and sharp increase of agricultural land; large irrigation systems
- ▶ **Transition period (1990-2003)**
 - ▶ Excessive fragmentation of land
 - ▶ Abandoned of the irrigation systems
 - ▶ Small subsistence farms
- ▶ **Post transition period in the pre and post accession to UE (2004-today)**
 - ▶ with a tendency of concentration of land in the new associative farms
 - ▶ Investments in the rehabilitation of irrigation systems and land management in the floodplain.

