Flood Hazard and Risk Mapping through the Romanian participation Projects: Danube FLOODRISK, e-LAC, VULMIN

Danube Floodrisk

Stakeholder oriented flood risk assessment for the Danube floodplains

PhD Prof. Mary-Jeanne ADLER, Scientific Director

Jointly for our common future

Project funded by the EUROPEAN UNION

MINISTRY OF DEVELOPMENT, PUBLIC WORKS AND HOUSING

SciNet NatHaz Prevention

Black Sea CROSS BORDER COOPERATION

Subject of presentation:

1. Short wrap-up - statistical method(BEAM) from Danube Floodrisk Projects review - large scale solution
2. Pilot activities - detailed analysis of demand of protection
3. Decision Support System for floodrisk management in case of reservoirs cascades – e-LAC
4. Stakeholders needs and societal vulnerability –VULMIN- proposing simplified methods for hazard identification (geomorphogical analysis)

WP3 HARM

Conclusion for Damage assessment for Danube Floodrisk Project

Requirements:

- Comparability of results all along the Danube
- Availability of input data
- To be displayed at a scale of 1: 100 000

WP6 MAPS

SOUTH EAST EUROPE
Transnational Cooperation Programme

Danube FLOODRISK

Programme co-funded by the EUROPEAN UNION

FLOOD HAZARD MAP

DIRECTIVE 2007/60/EC, CHAPTER III, Article 6:
3. Flood hazard maps shall cover the geographical areas which could be flooded according to the following scenarios:
(a) floods with a low probability, or extreme event scenarios;
(b) floods with a medium probability (likely return period ≥ 100 years);
(c) floods with a high probability, where appropriate.

4. For each scenario referred to in paragraph 3 the following elements shall be shown:
(a) the flood extent;
(b) water depths or water level, as appropriate;
(c) where appropriate, the flow velocity or the relevant water flow.

WP3 HARM outline

- Hazard and risk mapping
- Damage and risk assessment

How to calculate the inundation?

1. Generate a flood event of a given probability
   - Statistical method → $Q_{33\%}, Q_{1\%}, Q_{0.1\%}$ (Annual Maximum Series)
   - Generate a flood wave of a given (33%, 1%, 0.1%) probability
     - Based on simulated daily discharges or
     - Synthetic floods based on clustering of registered floods

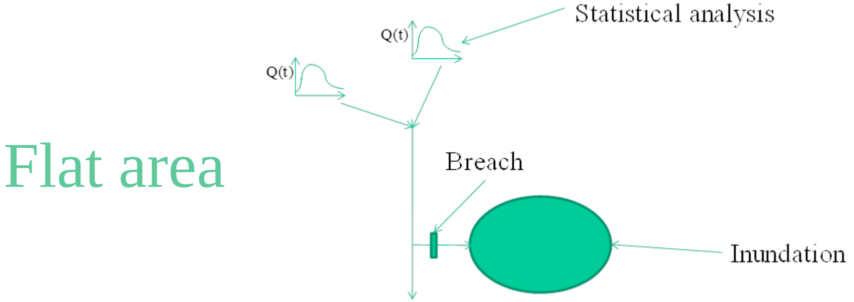
↓

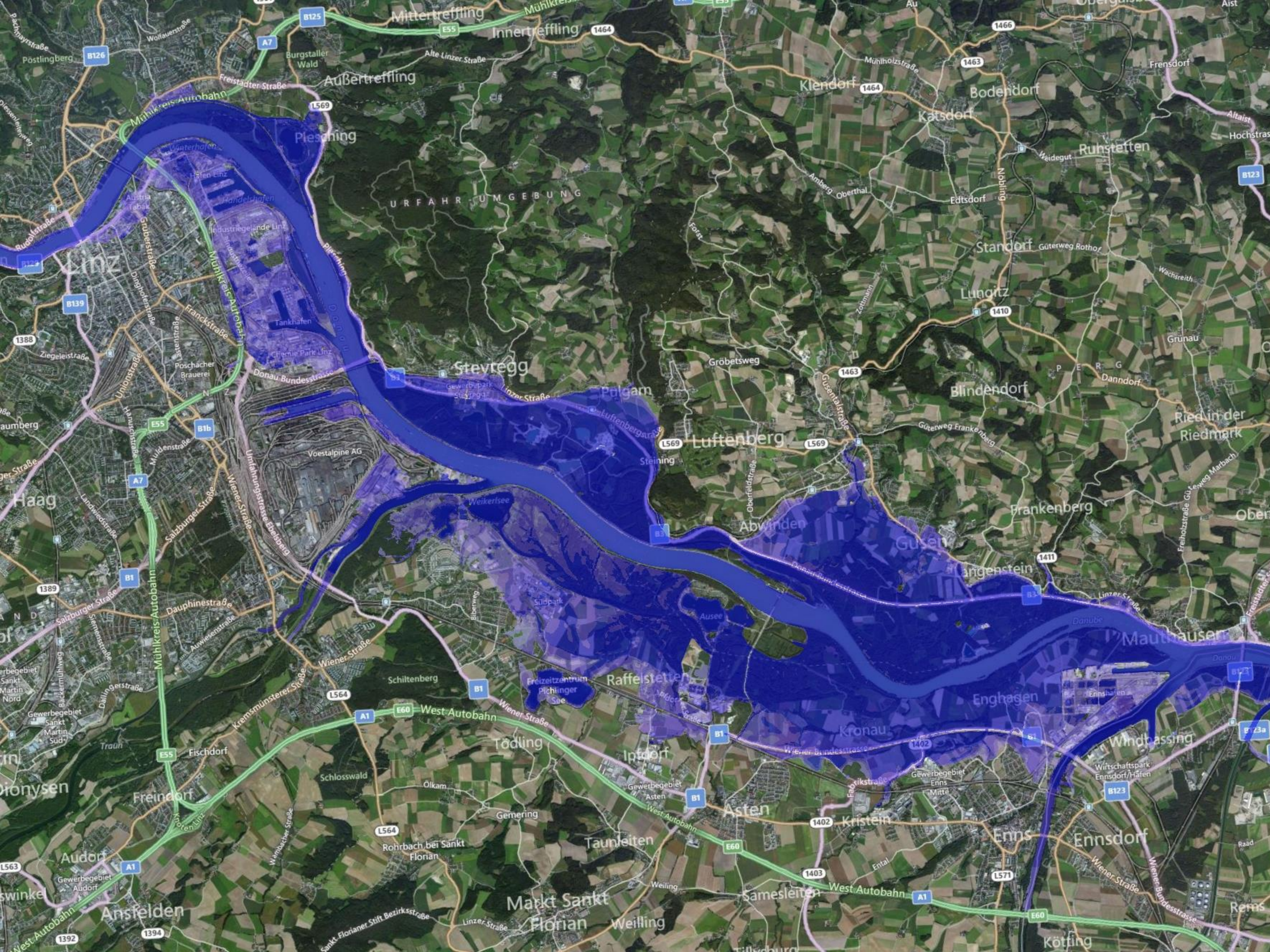
Generate a flood event of a given probability

WP3 HARM

How to calculate the inundation?

1. Generate a flood event of a given probability
   – Statistical method → $Q_{33\%}, Q_{1\%}, Q_{0.1\%}$ (Annual Maximum Series)
   – Generate a flood wave of a given (33%, 1%, 0.1%) probability
     • Based on simulated daily discharges or
     • Synthetic floods based on clustering of registered floods
2. Calculate the inundation
   – Steady state backwater curve calculation (1D or 2D)
   – Unsteady flood wave transformation (1D or 2D) and dyke breach simulation





Linz
Pöstlingberg
Mittertreffling
Innertreffling
Außertreffling
Burgstaller Wald
Alte Linzer Straße
Freistädter Straße
Mühlkreis Autobahn
Plesching
Urfahr Umgebung
Klendorf
Bodendorf
Katsdorf
Ruhstetten
Standorf
Lungitz
Edtsdorf
Mühllholzstraße
Grünau
Blindendorf
Danndorf
Ried in der Riedmark
Frankenberg
Steyregg
Pulgarn
Luftenberg
Steining
Gröbetsweg
Abwinden
Gusen
Langenstein
Mauthausen
Donau
Danube
Hafen Linz
Handelshafen
Industriegelände Linz
Tankhafen
Chemie Park Linz
Voestalpine AG
Weikerlsee
Austria Tabak
Poschacher Brauerei
Haag
Ausee
Freizeitzentrum Pichlinger See
Raffelstetten
Enghagen
Ennshafen
Kronau
Windpassing
Wirtschaftspark Ennsdorf/Hafen
Gewerbegebiet Enns Mitte
Ipfdorf
Asten
Kristein
Enns
Ennsdorf
Tödling
Schiltenberg
Schlosswald
Ölkam
Gemering
Taunleiten
Rohrbach bei Sankt Florian
Markt Sankt Florian
Weilling
Samesleiten
Freindorf
Fischdorf
Audorf
Ansfelden
Dionysen
Gewerbegebiet Sankt Martin Süd
Traun
West Autobahn
Wiener Straße
Salzburger Straße
Dauphinestraße
Kremsmünsterer Straße
Wiener Bundesstraße
Linzer Straße
Donau Bundesstraße
Umfahrungsstraße Ebelsberg
Köttling

WP3 HARM

Damage assessment

Search of existing methods (assets and damage functions):

- Atlases of Rhine, Elbe, Odra
- EU FP6/FP7-projects
- National methodologies/studies

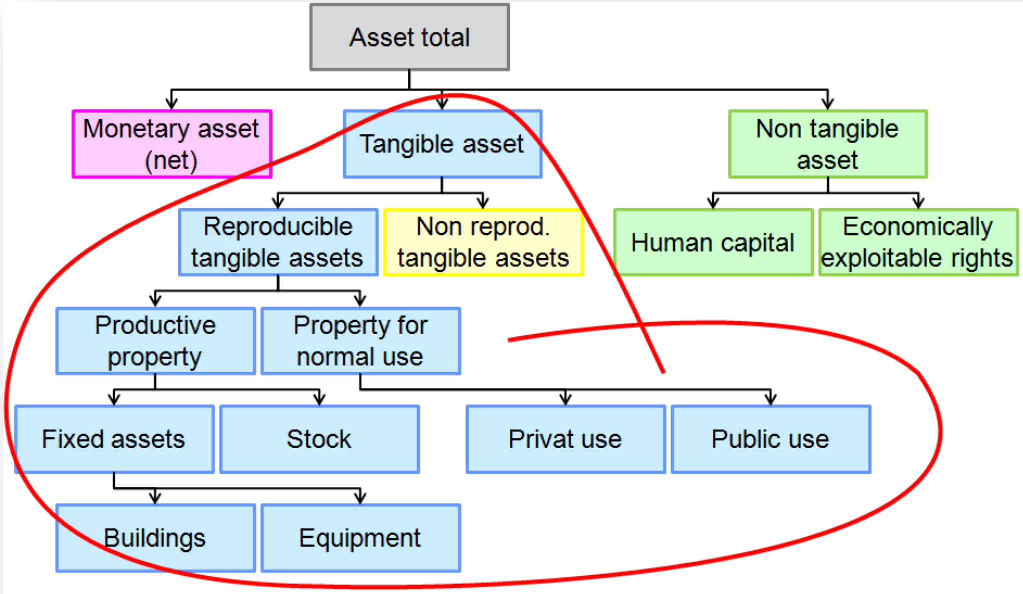
Decision:

- Usage of **BEAM-methodology**, developed in FP7-project SAFER
- Methodology is a advancement of the existing atlases
- Synergies between projects as SAFER had test areas in Romania/Bulgaria
- Use of existing damage functions, adaptations were necessary
- **TRAINING IN USING DAMAGE FUNCTIONS, ROME 29-30 MARCH**

Damage assessment

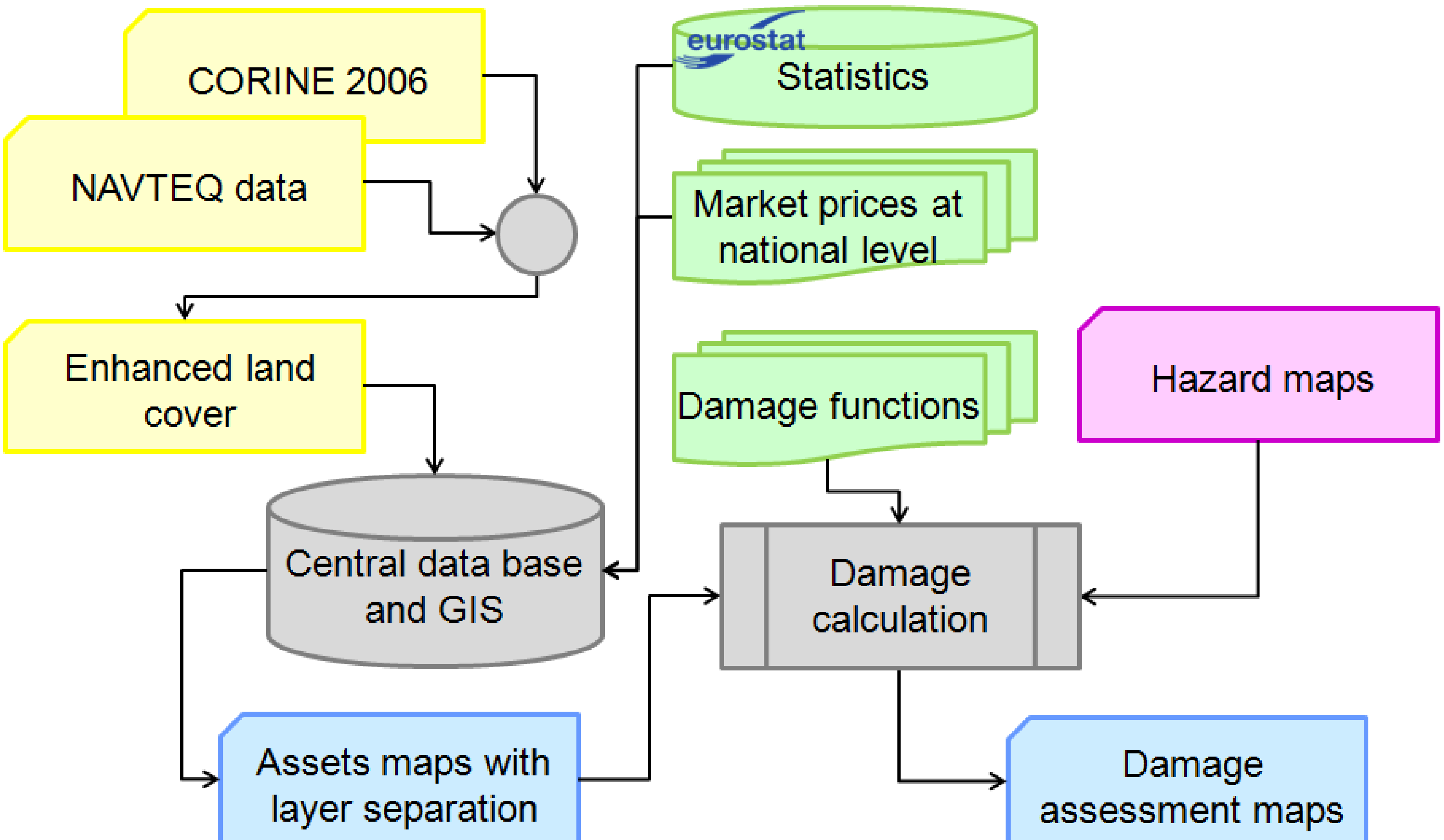
Assumptions:

- Only direct assets (tangible)
- Net concept (no restoration costs or insured assets)
- No costs of ground included
- No external planning costs included (i.e. building permits)
- Population to be located at place of living



Source: M. Frenkel & K.D. John, 1999 (modified)

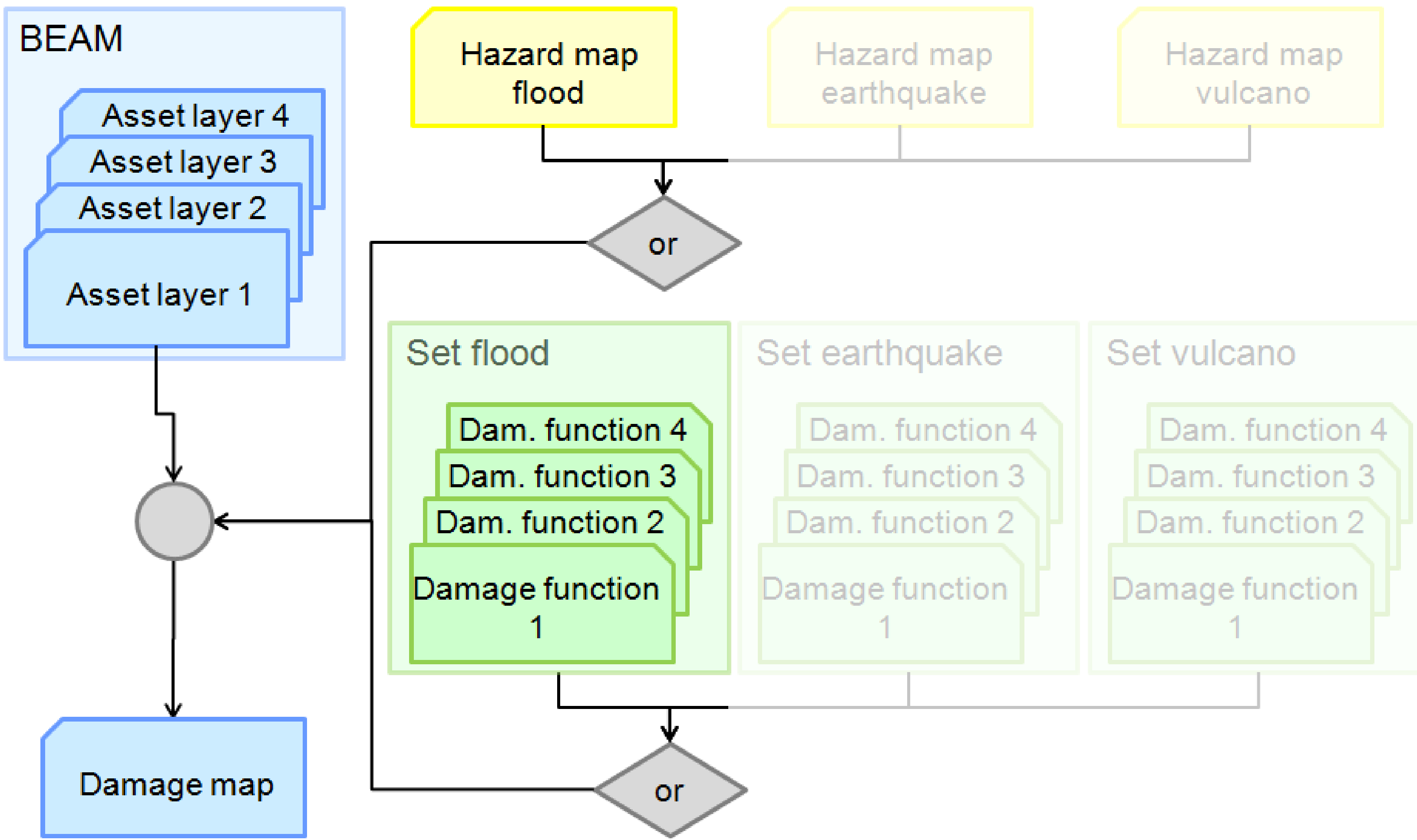
Assets calculation: processing



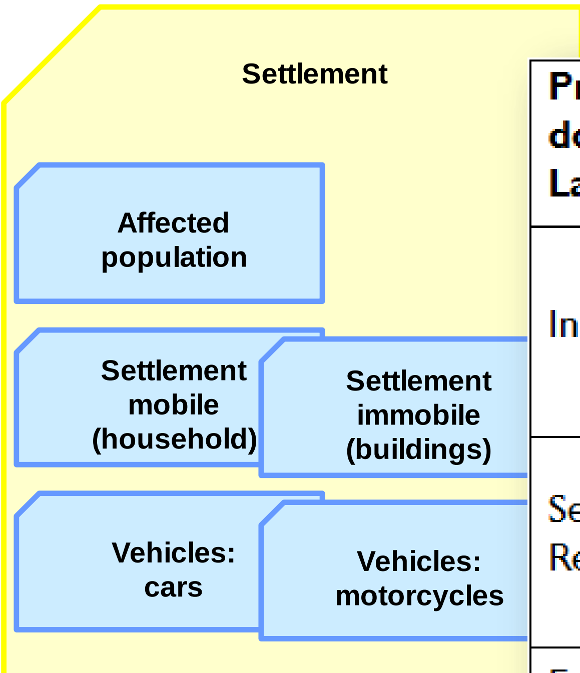
Assets map: scale

	Makro-scale < 1: 100 000	Meso-scale	Micro-scale > 1: 10 000
Land use	CORINE land cover, global vector data sets	Enhanced EO-data, national data sets	Catastre
Socialeconomic data	Eurostats and national statistics	Regional and community statistics	Field data acquisition, geomarketing data
Damage functions	Synthetic functions (Event analysis, expert knowledge)	-	Field data acquisition

Damage assessment calculation



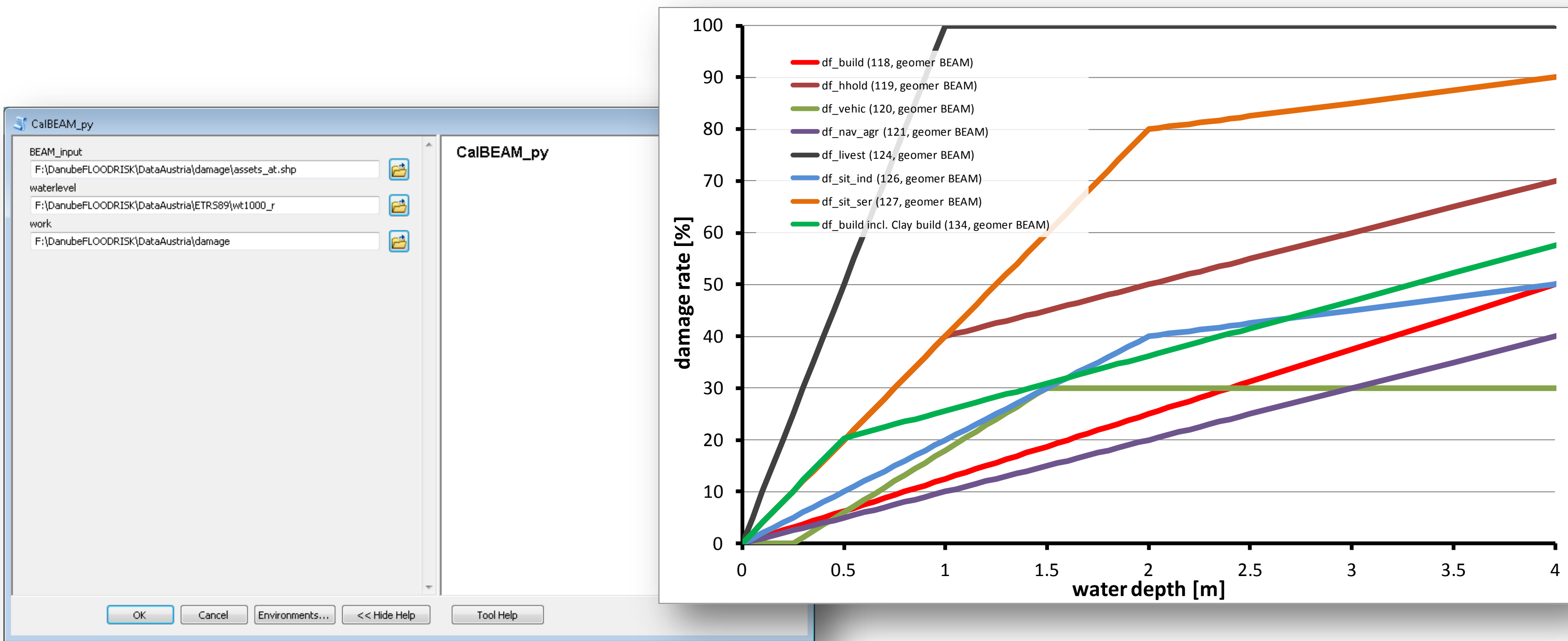
Assets map: available output layers



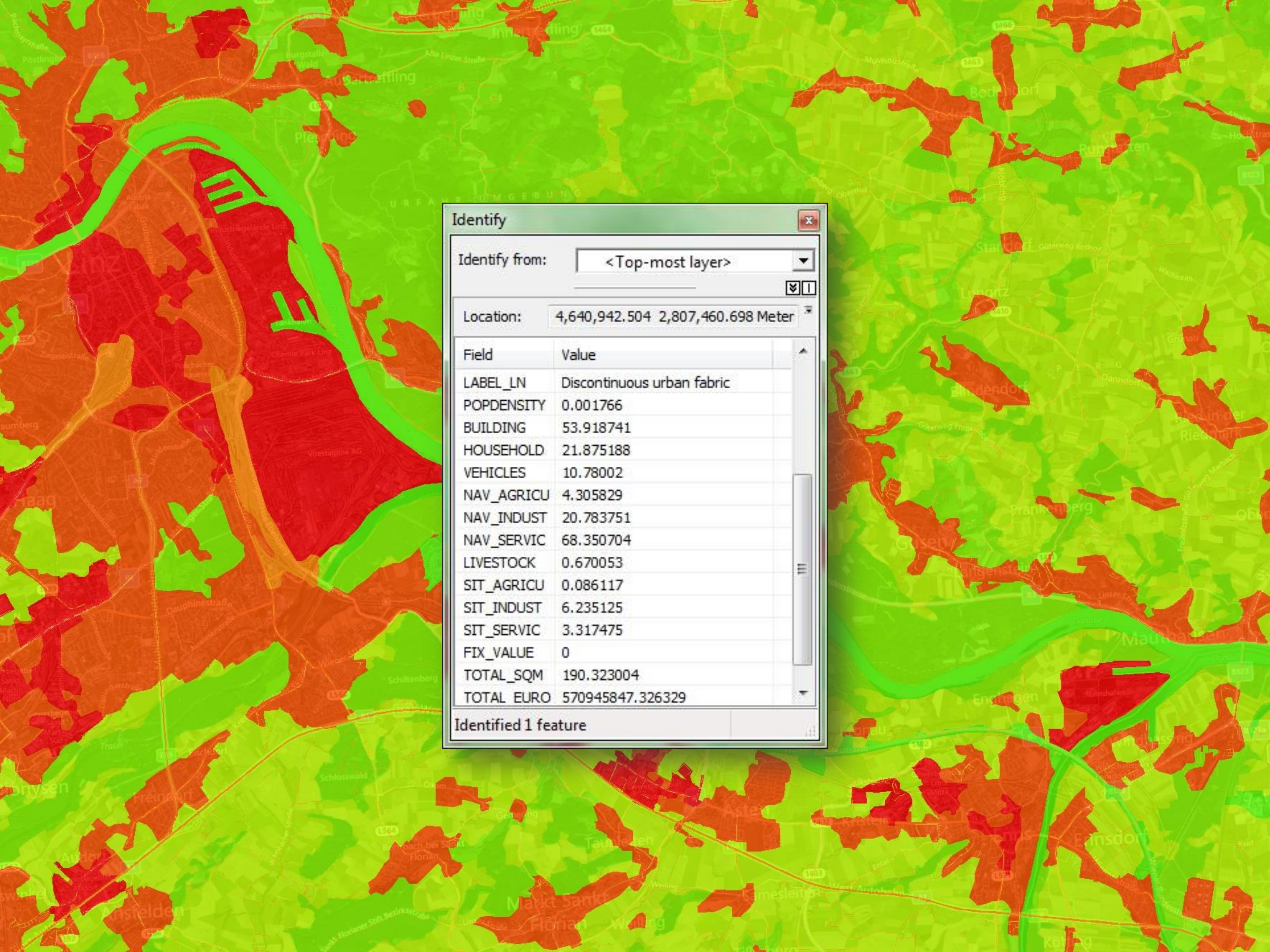
Pre-dominant Land Use	Damage Potential Class	r	g	b	C	M	Y	K
Industry	high	192	91	117	25	64	54	0
	medium	201	133	150	21	48	41	0
	low	244	143	169	4	44	34	0
Settlement/ Residential	high	237	28	36	7	89	68	0
	medium	247	160	132	3	37	48	0
	low	252	210	193	1	18	24	0
Forestry/ Agriculture	high	255	229	54	0	10	79	0
	low	255	247	143	0	3	44	0
Others	high	152	230	0	40	10	100	0
	low	209	255	115	18	0	55	0

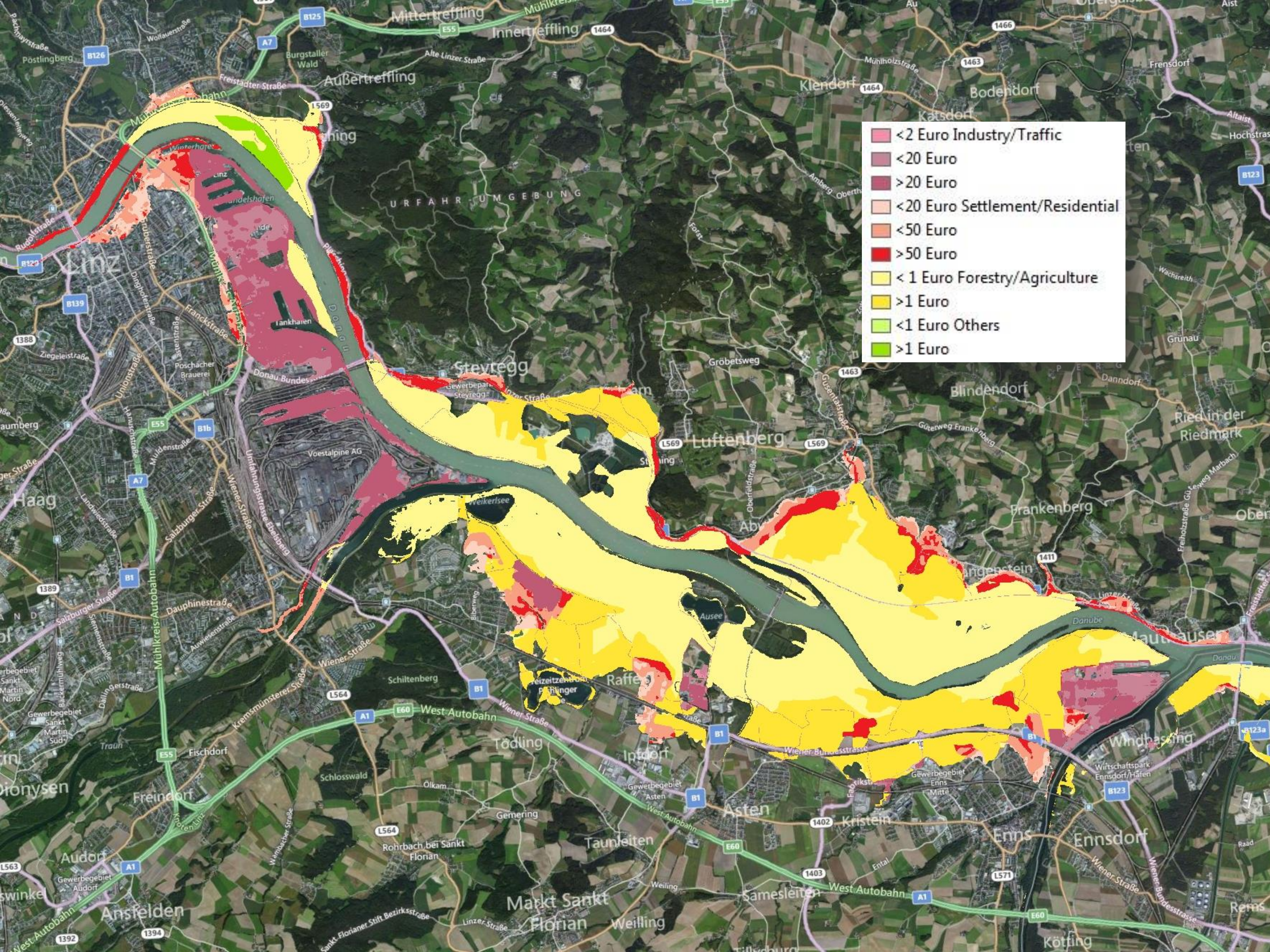
Application of selected of damage functions

- Set of one damage function per assets layer
- Automation of calculation process



Mittertreffling
Innertreffling
Außertreffling
Burgstaller Wald
Alte Linzer Straße
Freistädter Straße
Mühlkreis-Autobahn
Pöstlingberg
Plesching
Winterhafen
Hafen Linz
Handelshafen
Industriegelände Linz
Austria Tabak
URFAHR-UMGEBUNG
Linz
Rudolfstraße
Tankhafen
Chemie Park Linz
Poschacher Brauerei
Donau Bundesstraße
Donau
Steyregg
Gewerbepark Steyregg
Linzer Straße
Pulgarn
Luftenbergstraße
Luftenberg
Steining
Voestalpine AG
Weikerlsee
Haag
Salzburger Straße
Wiener Straße
Abwinden
Gusen
Langenstein
Südpark
Ausee
Danube
Mauthausen
Schiltenberg
Freizeitzentrum Pichlinger See
Raffelstetten
Enghagen
Ennshafen
Kronau
Windpassing
Wiener Bundesstrasse
West Autobahn
Tödling
Ipfdorf
Fischdorf
Schlosswald
Ölkam
Freindorf
Dionysen
Gemering
Asten
Gewerbegebiet Asten
Kristein
Gewerbegebiet Enns Mitte
Enns
Ennsdorf
Wirtschaftspark Ennsdorf/Hafen
Taunleiten
Rohrbach bei Sankt Florian
Markt Sankt Florian
Weilling
Samesleiten
Audorf
Ansfelden
Kötting
Klendorf
Bodendorf
Katsdorf
Ruhstetten
Edtsdorf
Standorf
Lungitz
Gröbetsweg
Blindendorf
Danndorf
Ried in der Riedmark
Frankenberg
Grünau
Frensdorf
Mühlholzstraße
Gusentalstraße
Güterweg Frankenberg


Identify
Identify from:
<Top-most layer>
Location:
4,640,942.504 2,807,460.698 Meter
Field
Value
LABEL_LN
Discontinuous urban fabric
POPDENSITY
0.001766
BUILDING
53.918741
HOUSEHOLD
21.875188
VEHICLES
10.78002
NAV_AGRICU
4.305829
NAV_INDUST
20.783751
NAV_SERVIC
68.350704
LIVESTOCK
0.670053
SIT_AGRICU
0.086117
SIT_INDUST
6.235125
SIT_SERVIC
3.317475
FIX_VALUE
0
TOTAL_SQM
190.323004
TOTAL_EURO
570945847.326329
Identified 1 feature

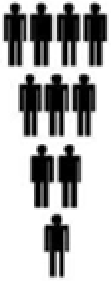


<2 Euro Industry/Traffic
<20 Euro
>20 Euro
<20 Euro Settlement/Residential
<50 Euro
>50 Euro
< 1 Euro Forestry/Agriculture
>1 Euro
<1 Euro Others
>1 Euro
Linz
Steyregg
Luftenberg
Asten
Enns
Ennsdorf
Mauthausen
Donau
Danube
Voestalpine AG
Tankhafen
Weikerlsee
Ausee
URFAHR UMGEBUNG
Ansfelden
Markt Sankt Florian
Haag
West Autobahn

Additional risk information

WP3 HARM-WP6 MAPS

- Effected population (one symbol per NUTS 2 or 3 region)
- Elements at risk
- Dikes
- Natural reserve areas (if too large to be displayed by symbol)



Hospitals (human health)
Airport
Main train station
Cultural heritage or
Nature protection sites
Industrial sites and waste water treatment plant (IPPC)

Symbol	Class	r	g	b	C	M	Y	K
	dikes designed for floods < HQ_{100}	221	236	204	13	7	20	0
	main dikes designed for floods ≥ HQ_{100}	106	178	28	58	30	89	0

2. PROTECTION DEMAND MAP (Meso scale-Micro scale)

Methodology for pilot activities – meso and small scale

- accordance with FLOOD DIRECTIVE (2007/60/EC)
- CROSSING THE INFORMATION coming from:

  - EXISTING LAND COVER FEATURES (Corine LC Maps) with
  - **PLANS OF FUTURE LAND DEVELOPMENT** (General Land Use Plan, in Romanian “Plan de Urbanism General”, referred to as “PUG”)
  - **PLANS FOR FLOOD PROTECTION OF LOCALITIES** (Contigency Plans) – emergency situations management.

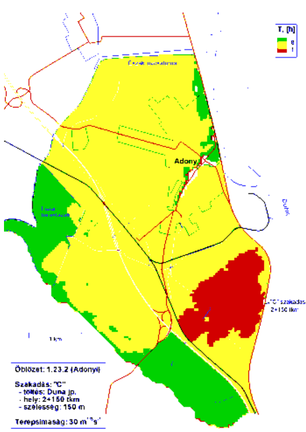
Flood hazard mapping

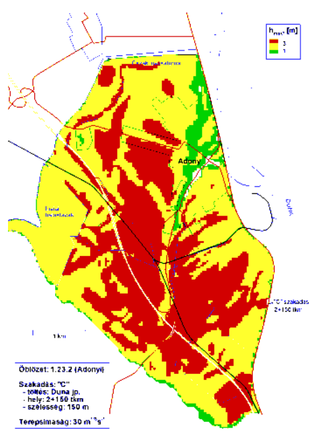
WP3 HARM

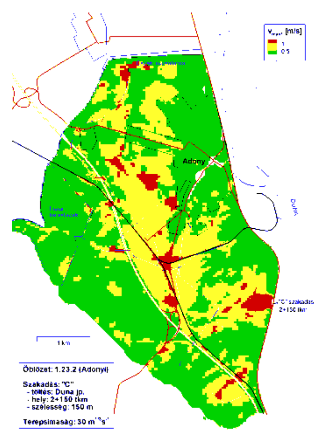
EUROPEAN UNION

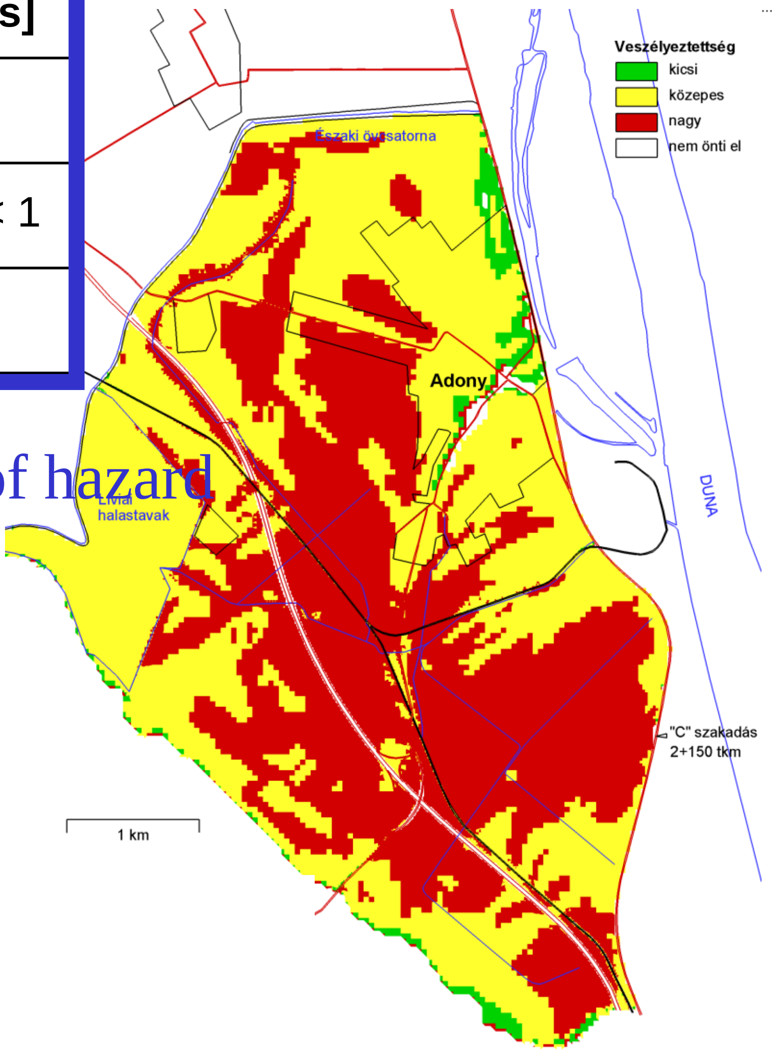
Flood hazard	T_{flood} [h]	h_{max} [m]	v_{max} [m/s]
low	8 < **T**	**h** < 1	**v** <0.5
medium	1 < **T** < 8	1 < **h** < 3	0.5 < **v** < 1
high	**T** < 1	3 < **h**	1 < **v**

Based on the highest local source of hazard









FLOOD HAZARD LEVEL

DISCARGE	DIRECTIVE 2007/60/EC SCENARIOS
$QTr_{20\ y}$	floods with a high probability
$QTr_{100\ y}$	floods with a medium probability (likely return period ≥ 100 years)
$QTr_{200\ y}$	floods with a low probability, or extreme event scenarios

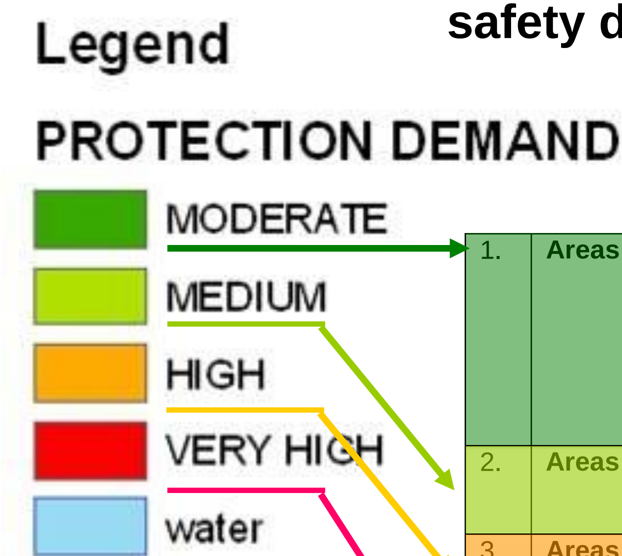
FLOOD HAZARD MAP

FLOOD HAZARD LEVEL RELATED TO PROTECTION DEMAND

FLOOD EVENT COMPATIBLE	PROTECTION DEMAND
whatever	MODERATE
> $QTr_{20\ y}$	MEDIUM
> $QTr_{100\ y}$	HIGH
> $QTr_{200\ y}$	VERY HIGH

HYDRAULIC SAFETY (PROTECTION) DEMAND MAP

Land cover polygons are subdivided into four main classes, according to their safety demand with respect to the flooding risk

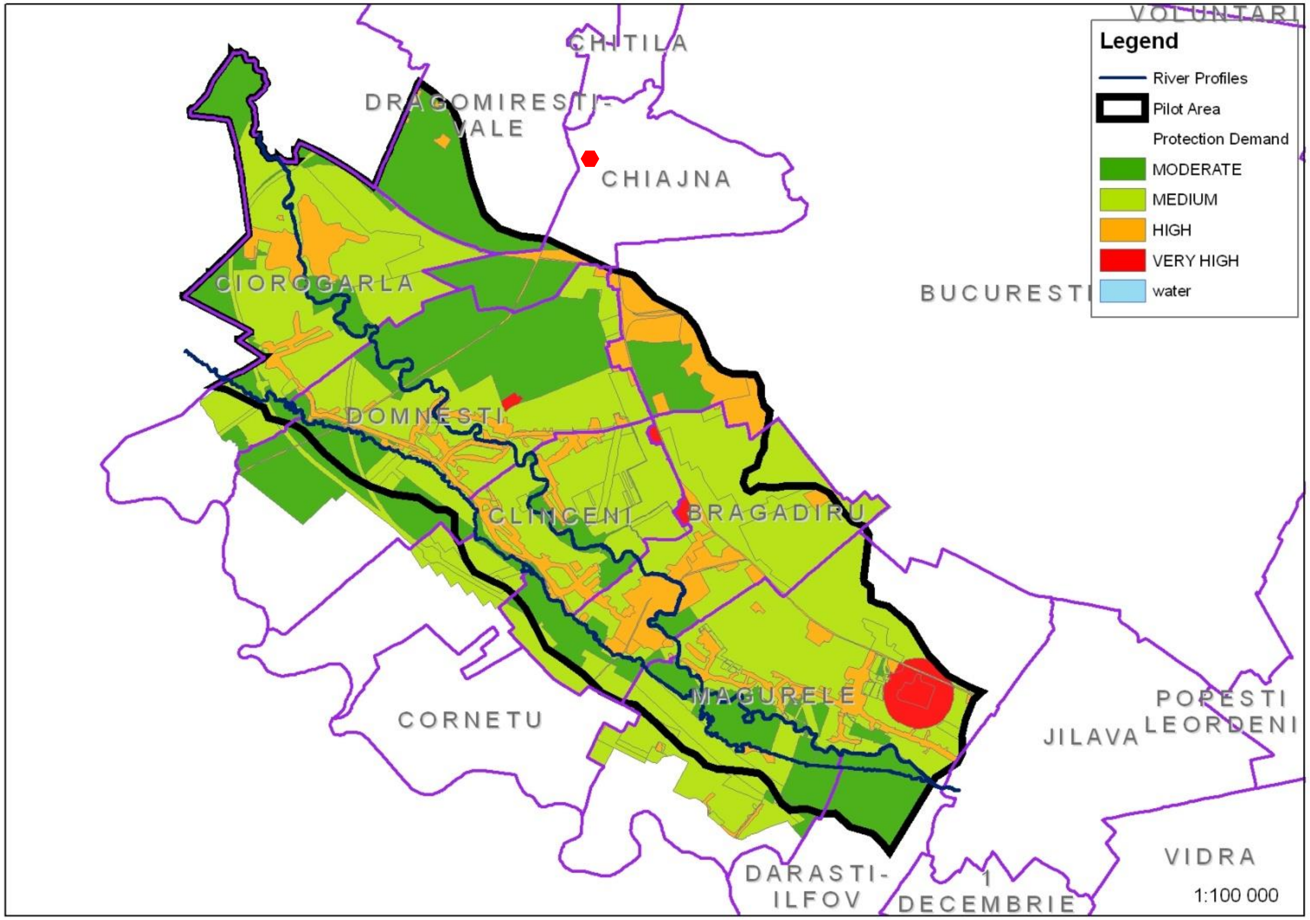


1.	**Areas with moderate protection demand**	Forested areas, forest and shrub vegetation areas, dense shrub formations, open areas with scattered or absent vegetation, uncultivated grasslands, wetlands, poplar groves, permanent grasslands or pastures, wood arboriculture, heterogeneous agricultural zones, seminativi ed impianti di produzione di biomasse, quarry and mining areas, inert waste landfills;
2.	**Areas with medium protection demand**	Discontinuous urban fabric, recreational areas, urban green areas, vineyards, orchards, vegetable gardens, greenhouses, nursery gardens
3.	**Areas with high protection demand**	Continuous urban fabric, commercial and industrial areas, roads and railroads networks, non hazardous waste landfills, composting/incineration plants, camping areas, wastewater treatment plants
4.	**Areas with very high protection demand**	Industrial sites treating dangerous substances, airports, hazardous waste landfills, Terrains with special destination (TDS).

Terrains with Special Destination are comprised in the

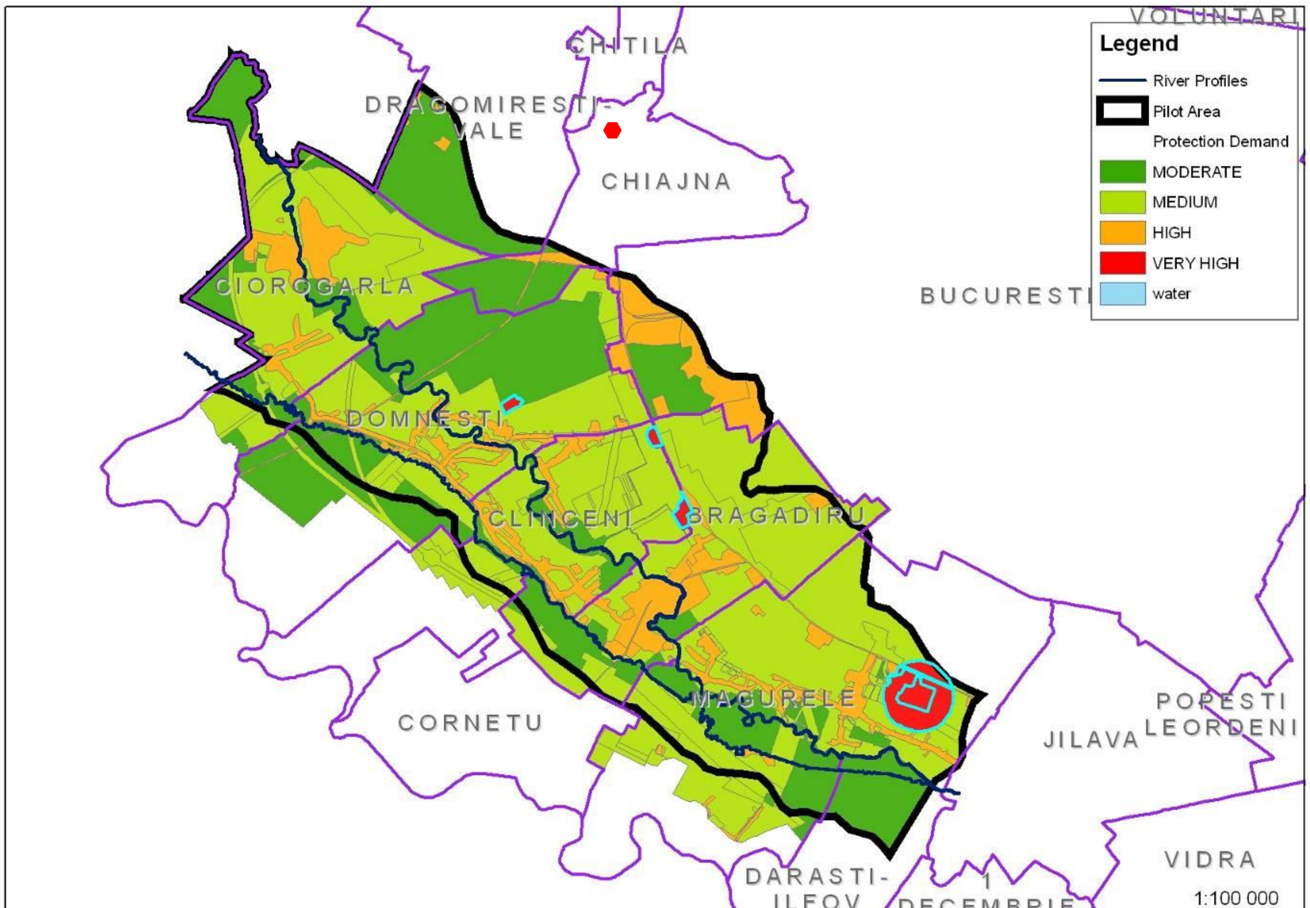
Highest Protection Demand Class

HYDRAULIC SAFETY (PROTECTION) DEMAND MAP



HYDRAULIC SAFETY (PROTECTION) DEMAND MAP

Special Destination Terrains

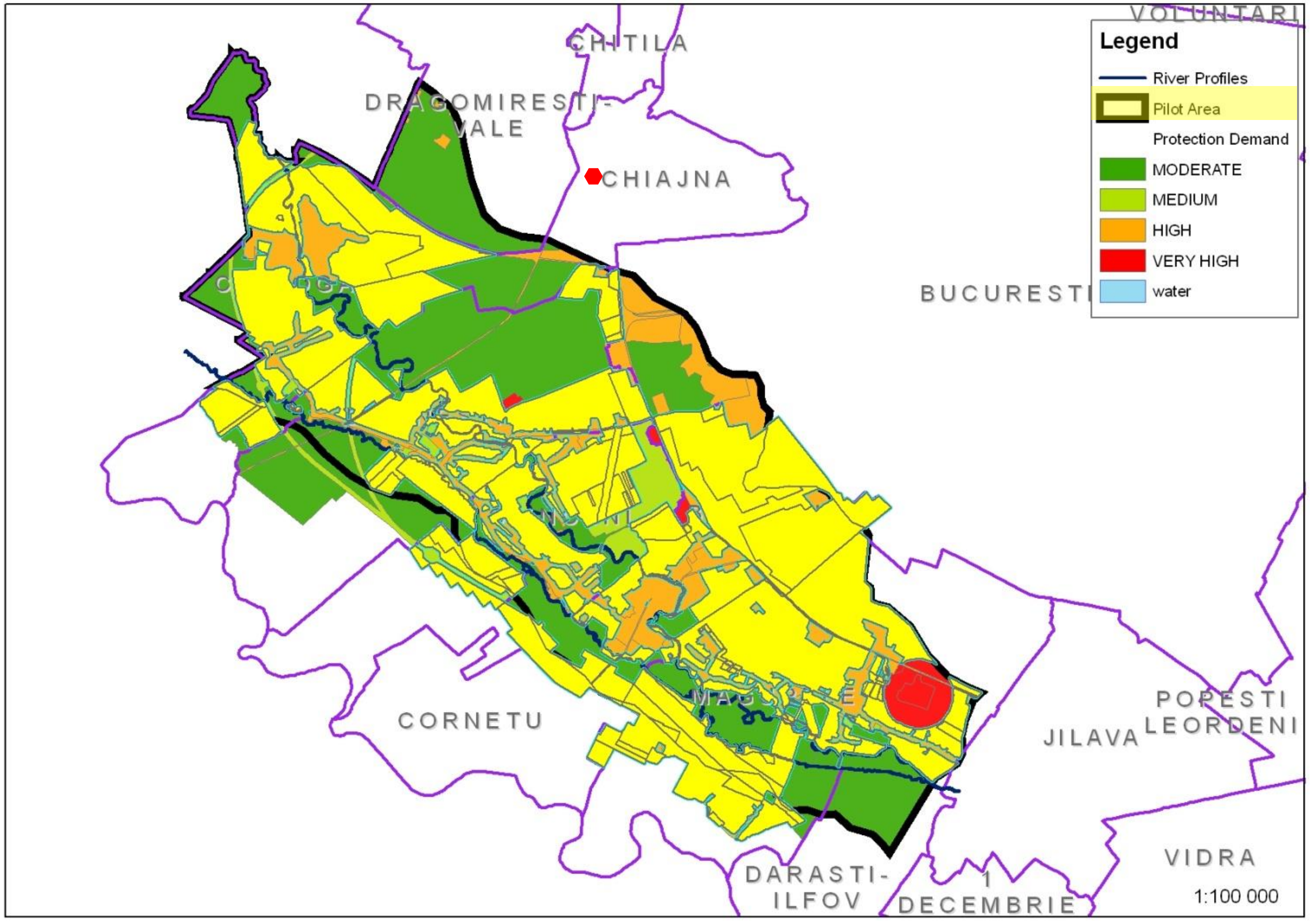


Due to their intrinsic vulnerability Special Destination Terrains (TDS, Terenuri cu Destinatie Speciala) were classified as subject to

VERY HIGH protection demand (from flooding risk).

HYDRAULIC SAFETY (PROTECTION) DEMAND MAP

Existing Urban Industrial Platforms & Urban Expansion

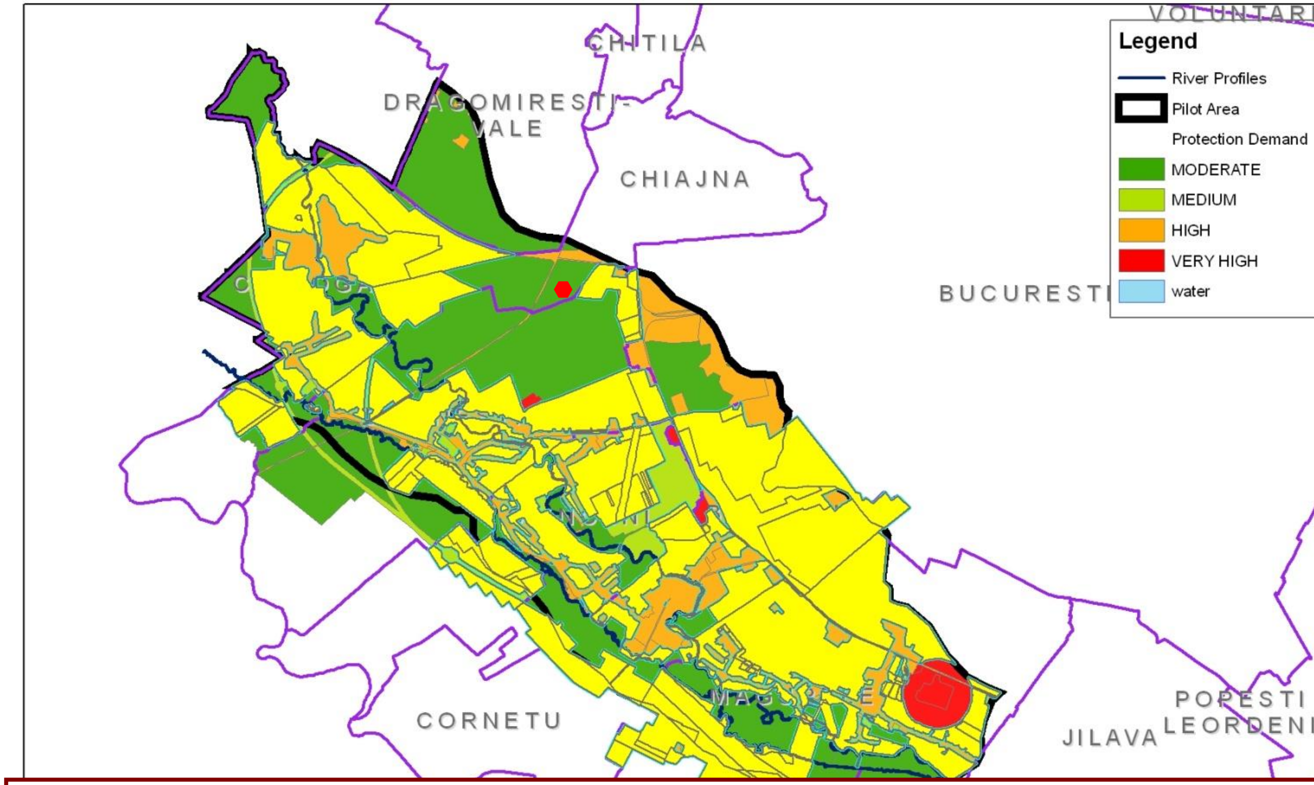


<u>EXISTING</u> Urban Fabric, Industries and Trade/Services Areas were classified as subject to a <u>HIGH</u> protection demand..

…whereas the corresponding <u>PLANNED</u> (PUGs) artificial land cover categories have been classified as subject to a <u>MEDIUM</u> protection demand.

HYDRAULIC SAFETY (PROTECTION) DEMAND MAP

Existing Urban Industrial Platforms & Urban Expansion



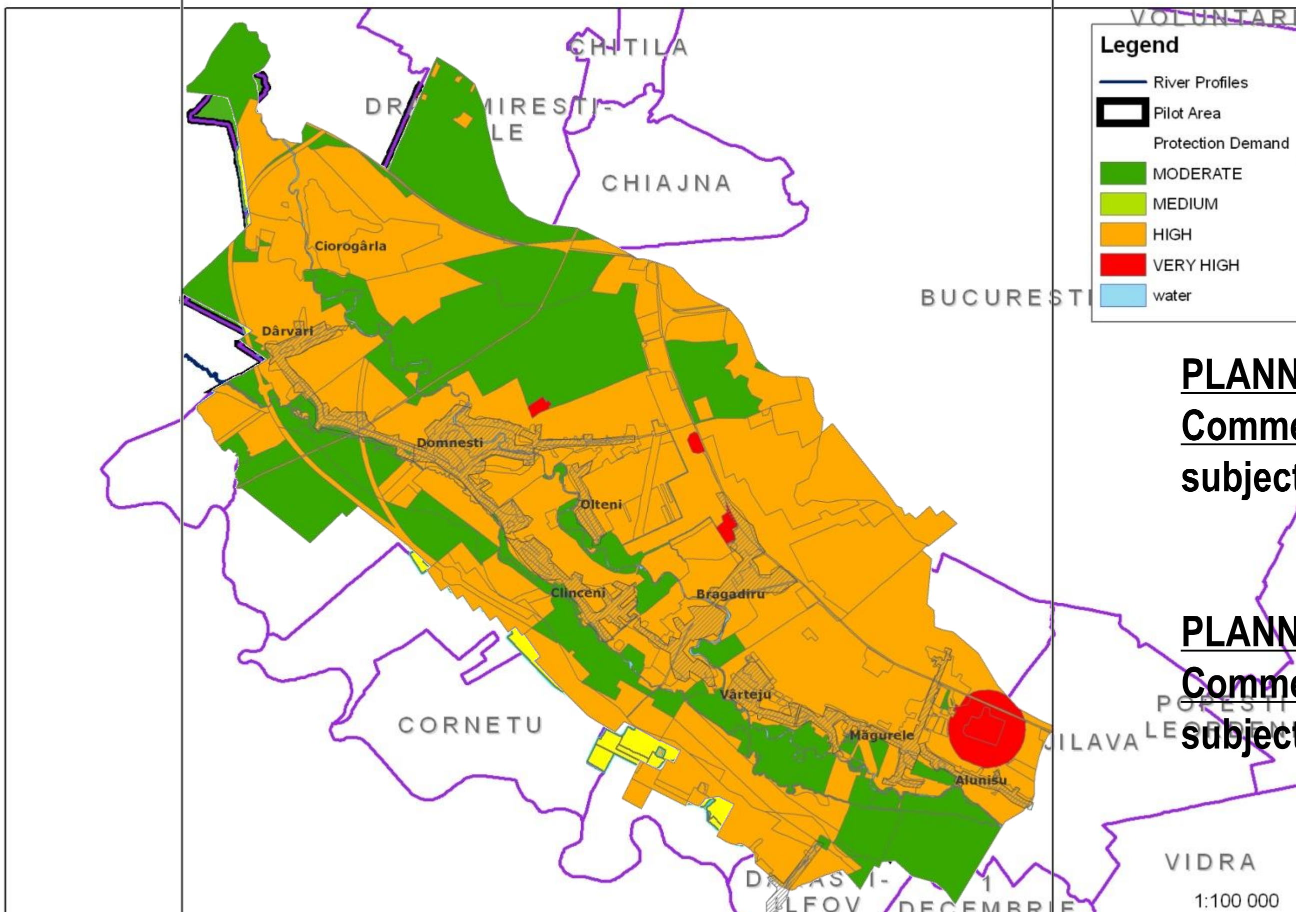
On average, according to the PUGs forecasts , **56%** of the municipal territories comprised within the Pilot Area would be covered by artificial surfaces (omitting the existent).

It would be an impressive burden to the landscape carrying capacity, and a serious threat to the flooding safety of the area.

Suggested Future Strategy

It would be wise individuating in a more precise way – within the General Urban Plans (PUG) – areas of urban growth (expansion), keeping in mind the extent of the surfaces potentially subject to flooding.

PROTECTION DEMAND MAP



<u>FLOOD RISK LEVEL for</u>

<u>PLANNED Urban Fabric and Industrial or Commercial Units</u> from PUGs classify as subject to a <u>MEDIUM</u> protection demand.

<u>FLOOD RISK LEVEL for</u>

<u>PLANNED Urban Fabric and Industrial or Commercial Units</u> from PUGs classify as subject to a *<u>HIGH</u>* protection demand.

FLOOD EVENT COMPATIBLE	PROTECTION DEMAND
whatever	MODERATE
> $QTr_{20\,y}$	MEDIUM
> $QTr_{100\,y}$	HIGH
> $QTr_{200\,y}$	VERY HIGH

DISCARGE	DIRECTIVE 2007/60/EC SCENARIOS
$QTr_{20\,y}$	floods with a high probability
$QTr_{100\,y}$	floods with a medium probability (likely return period ≥ 100 years)
$QTr_{200\,y}$	floods with a low probability, or extreme event scenarios

FLOOD RISK LEVEL

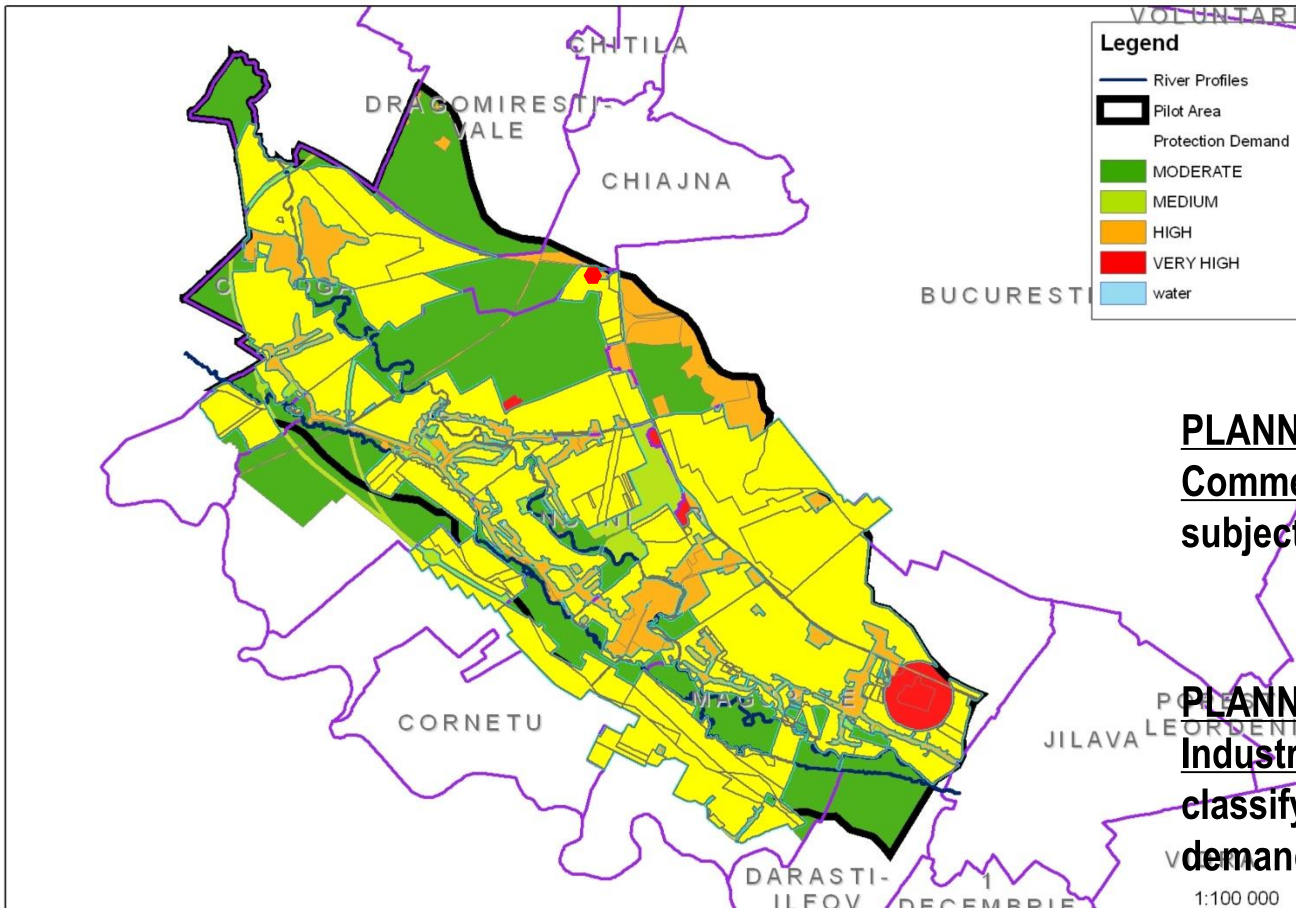
PROTECTION DEMAND	FLOODING PROBABILITY				
	whatever	high	medium	low	none
MODERATE	-1	0	+1	+2	+2
MEDIUM	-2	-1	0	+1	+2
HIGH	-3	-2	-1	0	+1
VERY HIGH	-3	-3	-2	-1	0

worse ← FLOOD RISK CONDITIONS — better

+ REPRESENT A SURPLUS OF FLOOD RISK CONDITIONS

- REPRESENT A DEFICIT OF FLOOD RISK CONDITIONS

PROTECTION DEMAND MAP



FLOOD RISK LEVEL for

<u>PLANNED Urban Assets and Industrial or Commercial Units</u> from PUGs classify as subject to a <u>MEDIUM</u> protection demand.

FLOOD RISK LEVEL for

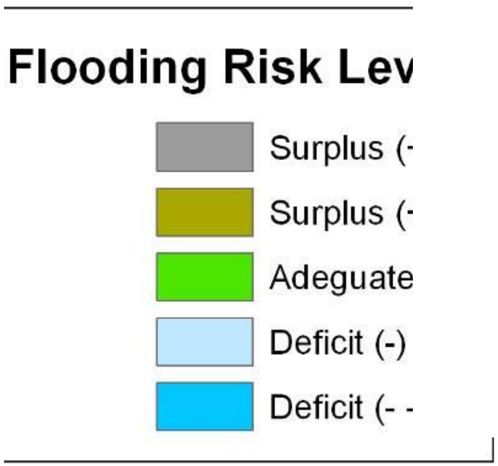
<u>PLANNED Urban Industrial platfor and Industrial or Commercial Units</u> from PUGs classify as subject to a *<u>HIGH</u>* protection demand.

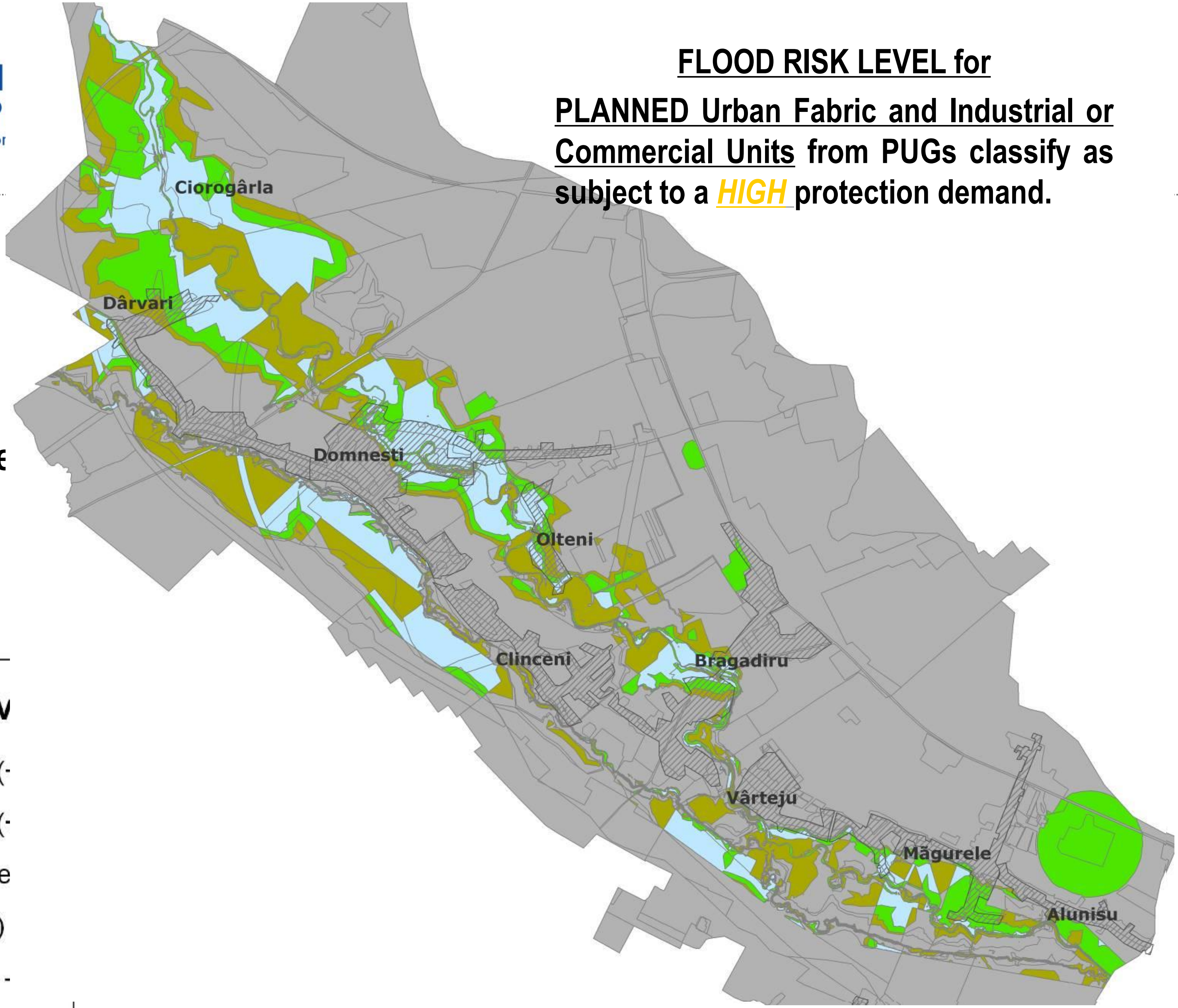
<u>FLOOD RISK LEVEL for</u>

<u>PLANNED Urban Fabric and Industrial or Commercial Units</u> from PUGs classify as subject to a *<u>HIGH</u>* protection demand.

<u>PROTECTION DEMAND:</u>

High = 100 years
Very high = 200 ye
<u>FLOOD RISK LEVEL:</u>





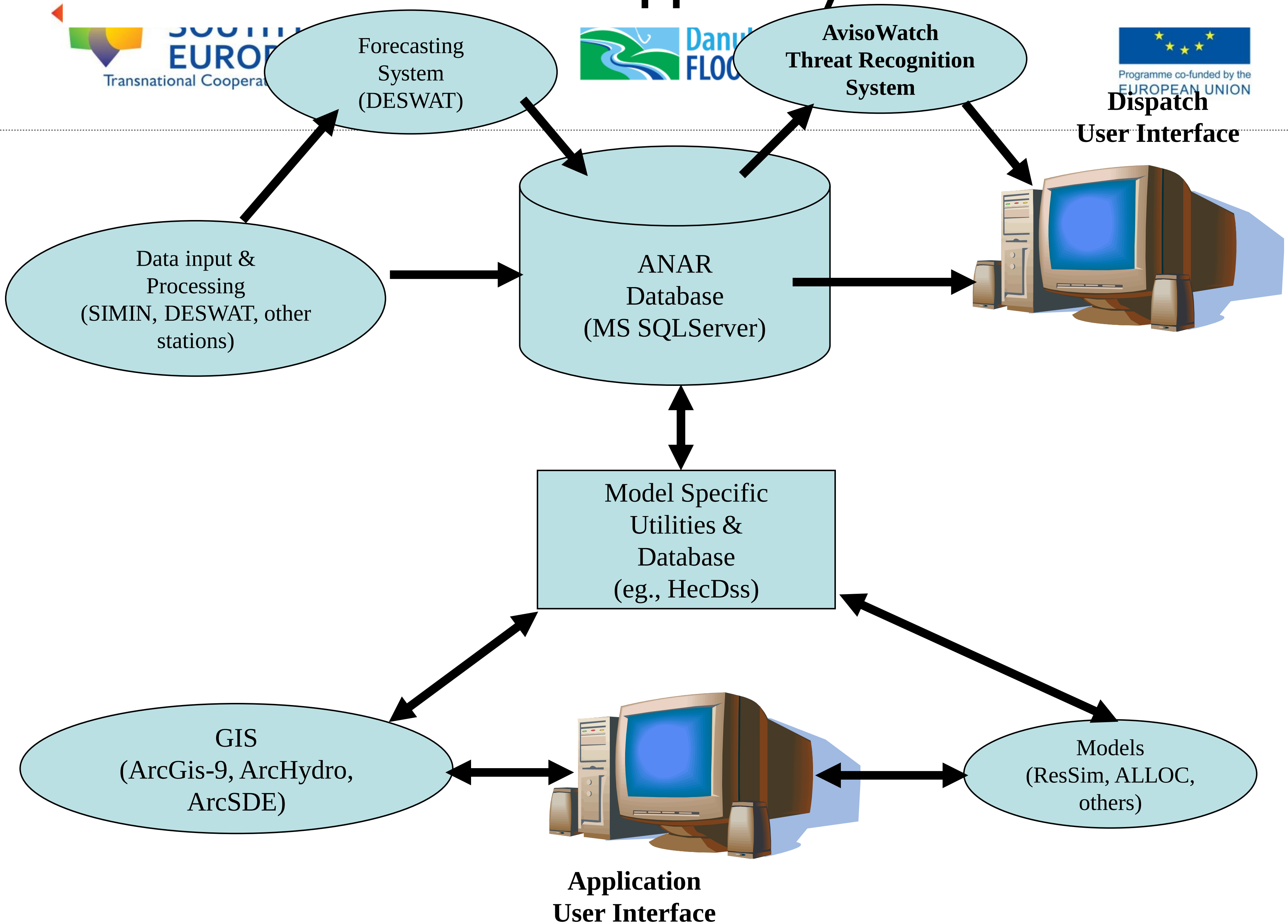
Flood Management through Reservoirs (e-LAC - Pro-active operation of cascade reservoirs)

Follow-up project

Danube Floodrisk
Stakeholder oriented flood risk assessment for the Danube floodplains

Jointly for our common future

Decision Support System



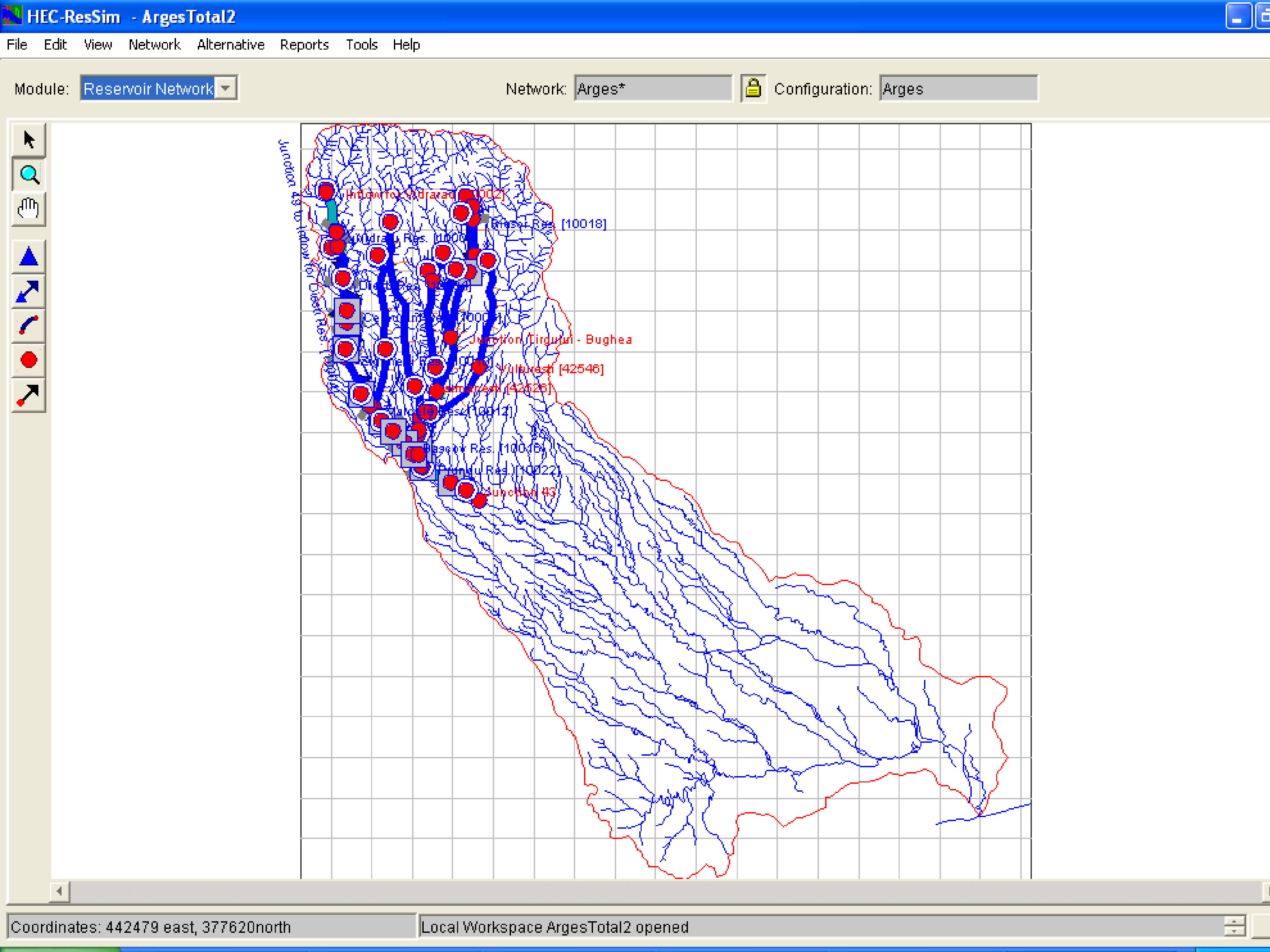
SOUTH EAST EUROPE

Reservoirs in the Model

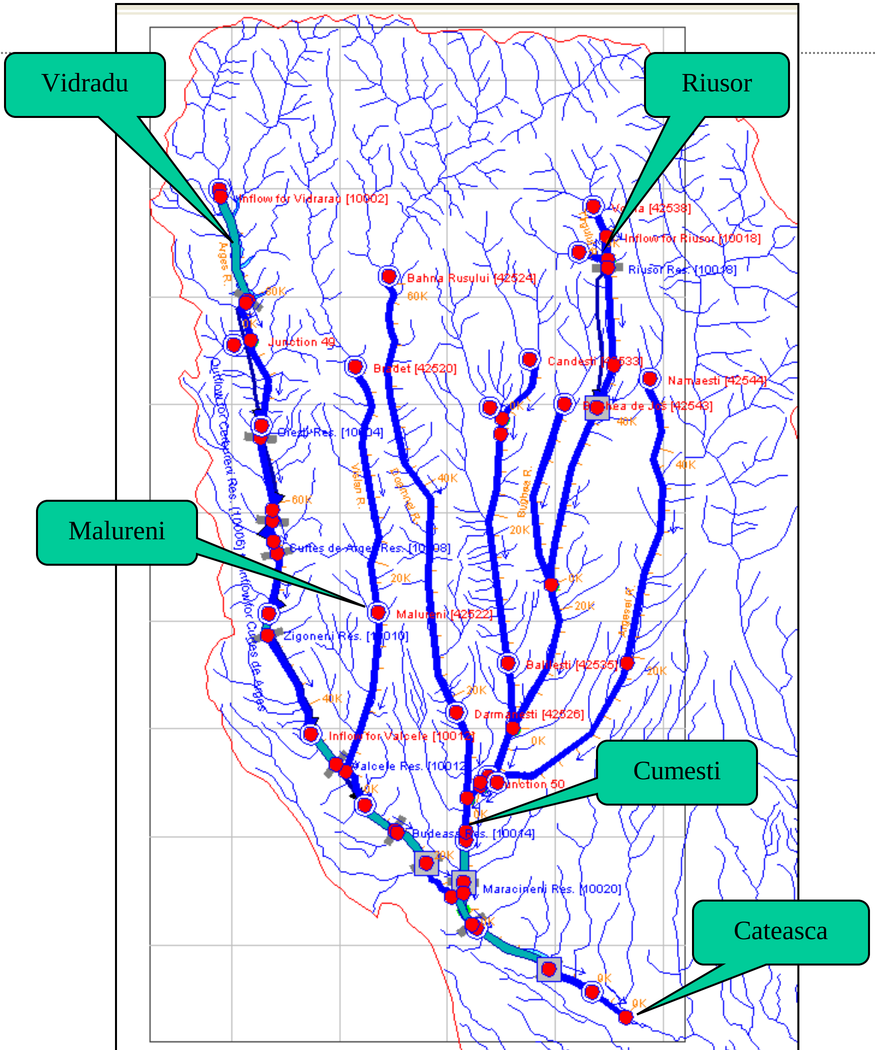
Danube FLOODRISK

Programme co-funded by the EUROPEAN UNION

	Reservoir	River	Height (m)	Volume (mill.m^3)	Area (ha)	Hydropower	
						Tailwater (m)	Capacity (MW)
1	Vidradu	Arges	166	465.0	1000	314	15
2	Oiesti	Arges	20	1.7	42	465	15
3	Cerbureni	Arges	18	1.6	35	425	15
4	Curtes de Arges	Arges	19	1.4	26	394	15
5	Zigoneni	Arges	29	13.3	165	339	15
6	Valcele	Arges	35	54.8	640	525	220
7	Budeasa	Arges	33	54.9	643	285	15
8	Bascov	Arges	21	5.3	140	264	15
9	Rausor	Targului	120	60.0	190	745	19
10	Maracineni	Doamnei	20	38.5	380	n/a	n/a
11	Prundu	Arges	21	4.8	158	n/a	n/a
12	Golesti	Arges	32	78.5	680	236	4

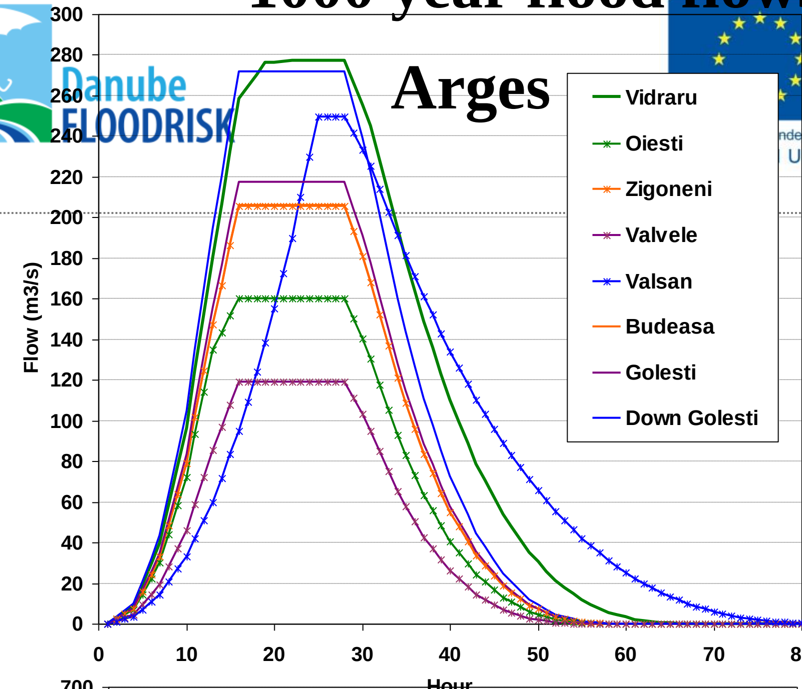

HEC-ResSim - ArgesTotal2
File Edit View Network Alternative Reports Tools Help
Module: Reservoir Network
Network: Arges*
Configuration: Arges
Bresat Res. [10018]
Junction Tirgului - Bughea
Vulturesti [42546]
Coordinates: 442479 east, 377620north
Local Workspace ArgesTotal2 opened

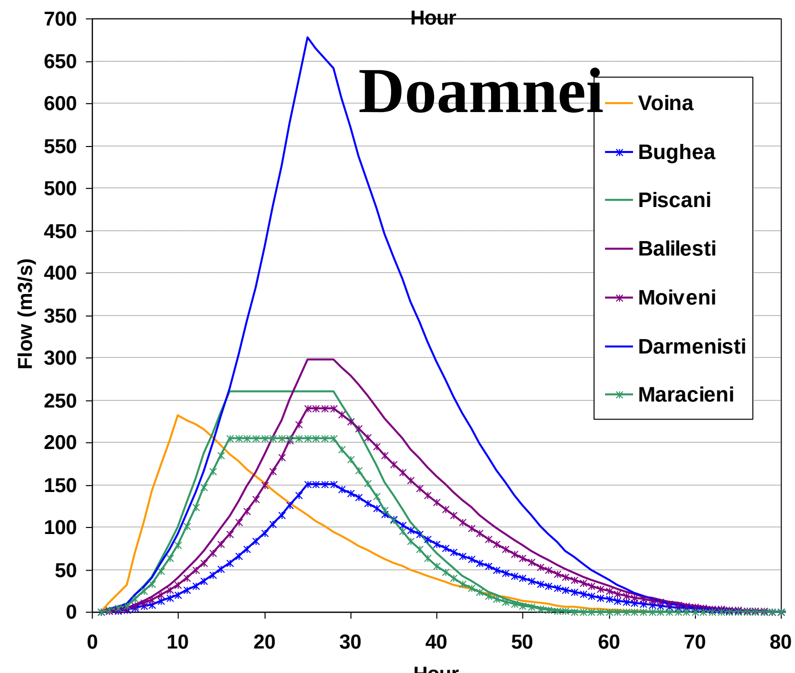
ResSim Model

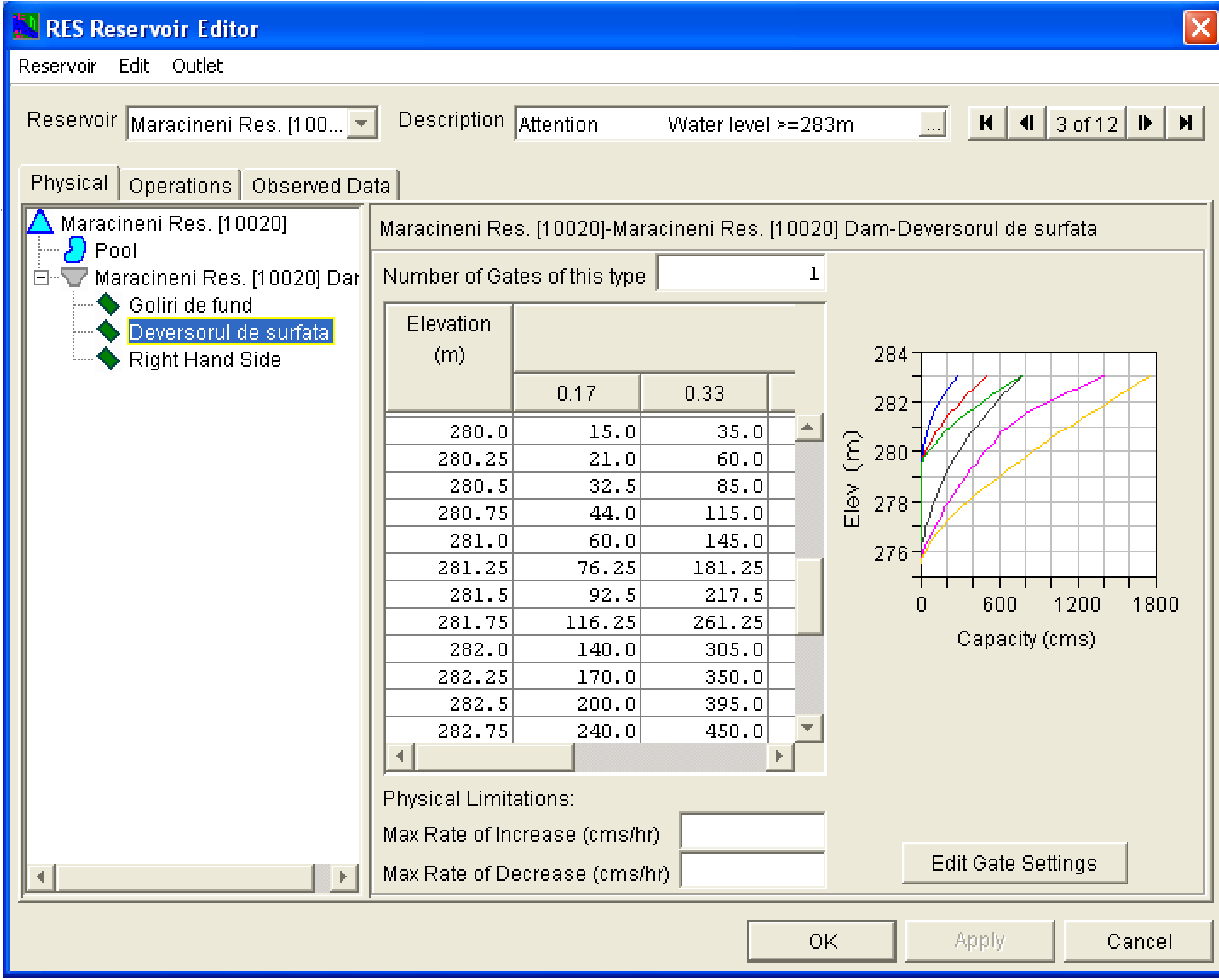


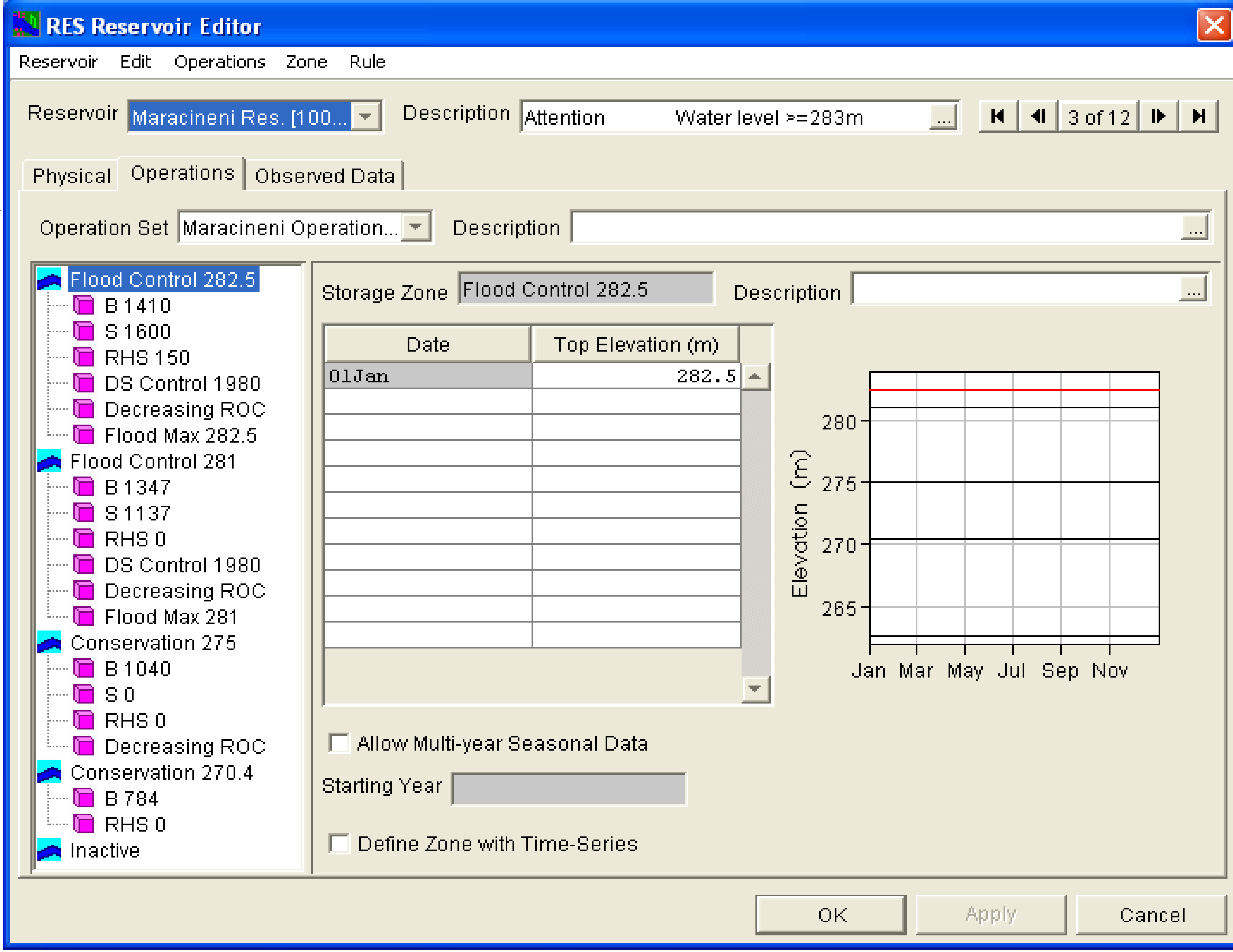
Model Schematic

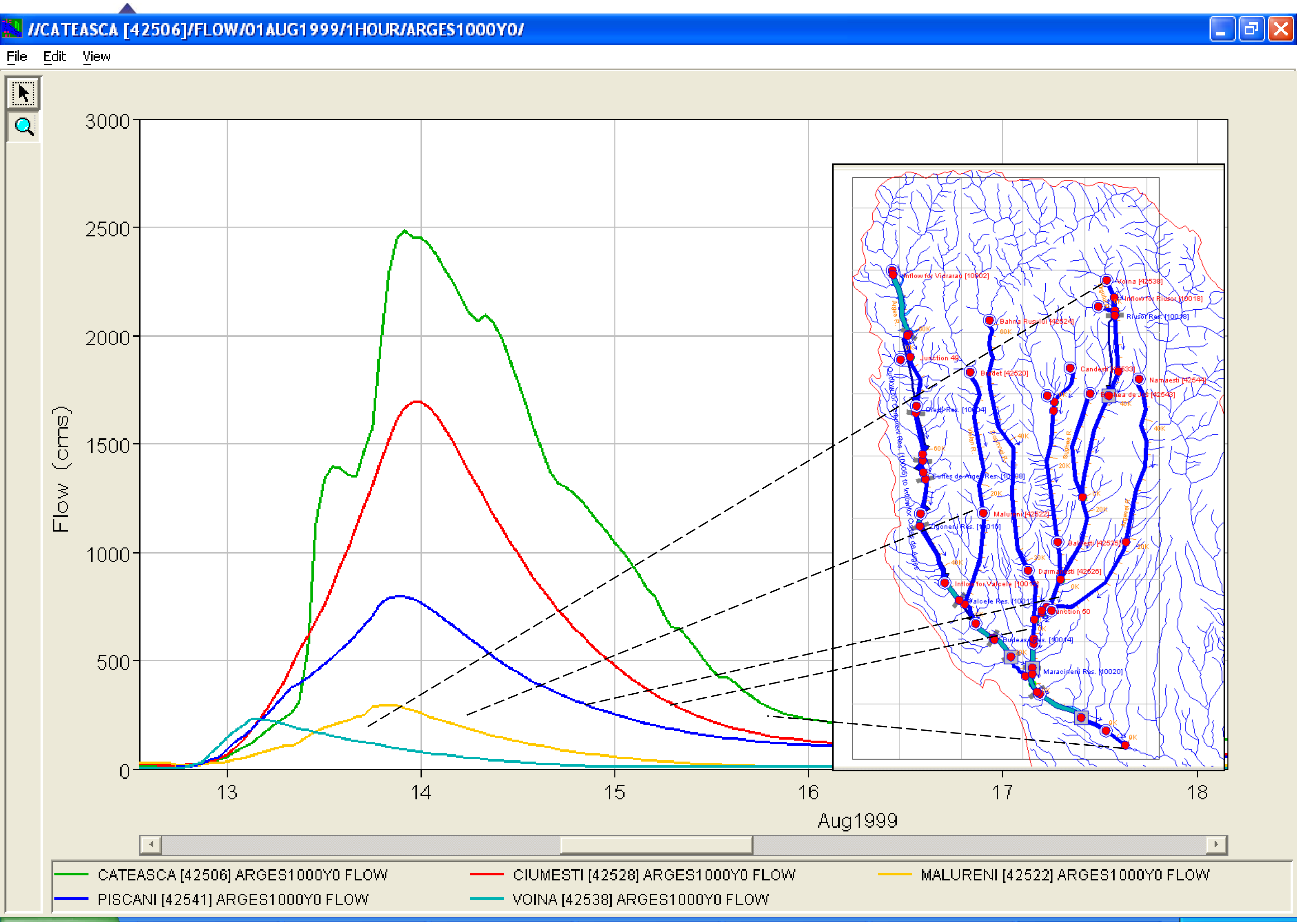
1000 year flood flows



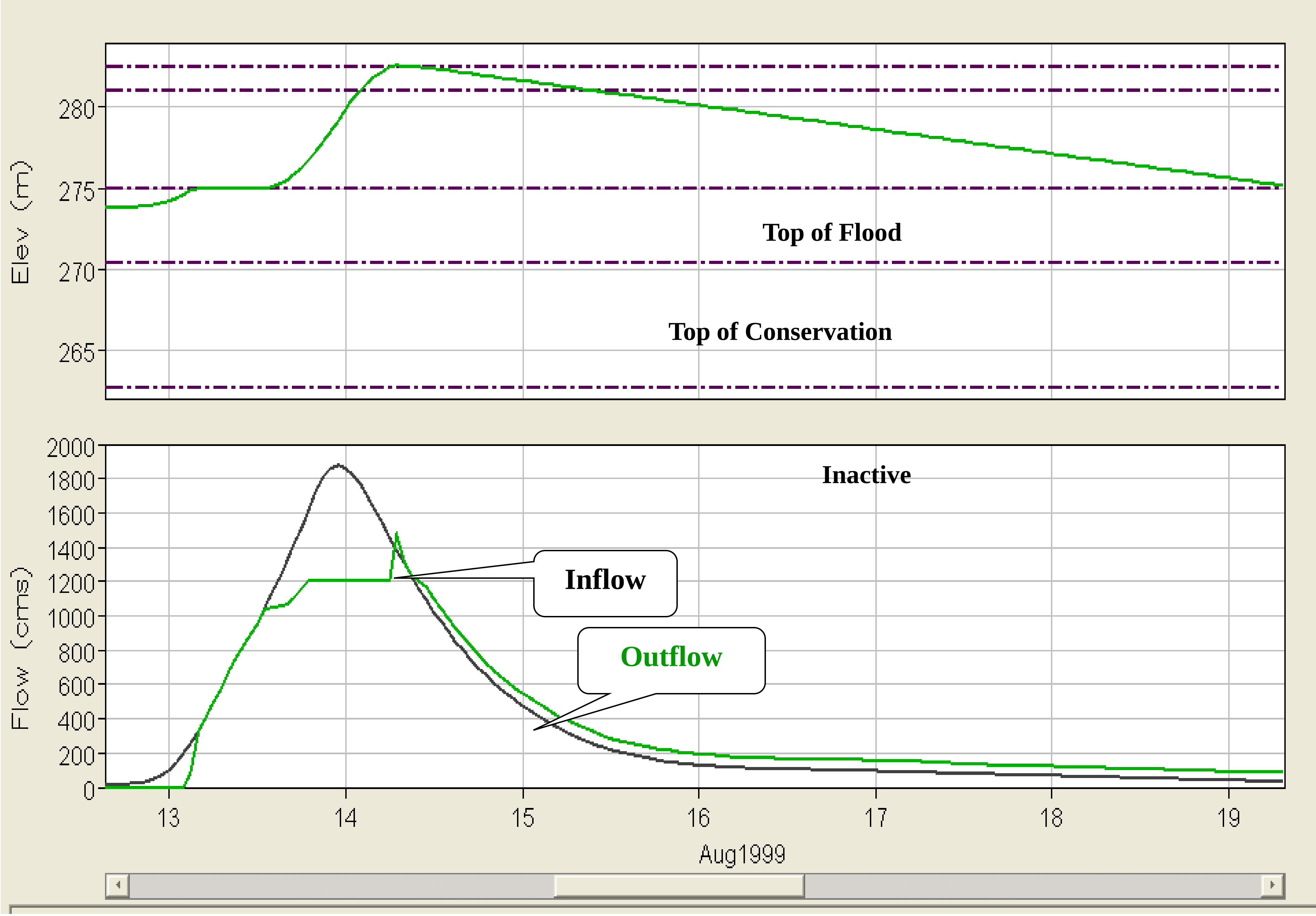



RES Reservoir Editor
Reservoir
Edit
Outlet
Reservoir
Maracineni Res. [100...
Description
Attention Water level >=283m
3 of 12
Physical
Operations
Observed Data
Maracineni Res. [10020]
Pool
Maracineni Res. [10020] Dar
Goliri de fund
Deversorul de surfata
Right Hand Side
Maracineni Res. [10020]-Maracineni Res. [10020] Dam-Deversorul de surfata
Number of Gates of this type
1
Elevation (m)
0.17
0.33
280.0 15.0 35.0
280.25 21.0 60.0
280.5 32.5 85.0
280.75 44.0 115.0
281.0 60.0 145.0
281.25 76.25 181.25
281.5 92.5 217.5
281.75 116.25 261.25
282.0 140.0 305.0
282.25 170.0 350.0
282.5 200.0 395.0
282.75 240.0 450.0
284
282
280
278
276
Elev (m)
0
600
1200
1800
Capacity (cms)
Physical Limitations:
Max Rate of Increase (cms/hr)
Max Rate of Decrease (cms/hr)
Edit Gate Settings
OK
Apply
Cancel

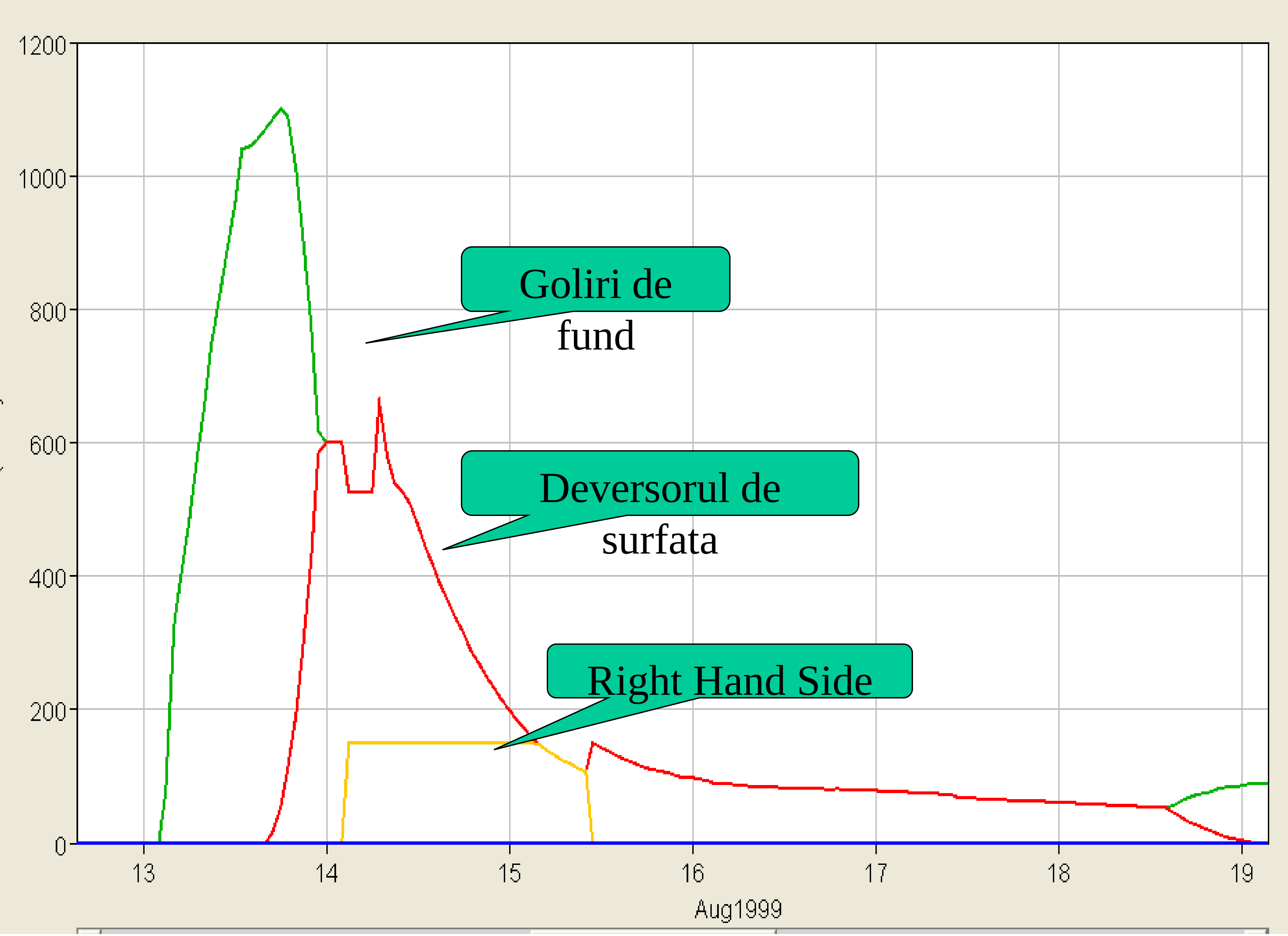

RES Reservoir Editor
Reservoir
Edit
Operations
Zone
Rule
Reservoir
Maracineni Res. [100...
Description
Attention Water level >=283m
3 of 12
Physical
Operations
Observed Data
Operation Set
Maracineni Operation...
Description
Flood Control 282.5
B 1410
S 1600
RHS 150
DS Control 1980
Decreasing ROC
Flood Max 282.5
Flood Control 281
B 1347
S 1137
RHS 0
DS Control 1980
Decreasing ROC
Flood Max 281
Conservation 275
B 1040
S 0
RHS 0
Decreasing ROC
Conservation 270.4
B 784
RHS 0
Inactive
Storage Zone
Flood Control 282.5
Description
Date
Top Elevation (m)
01Jan
282.5
Elevation (m)
280
275
270
265
Jan
Mar
May
Jul
Sep
Nov
Allow Multi-year Seasonal Data
Starting Year
Define Zone with Time-Series
OK
Apply
Cancel



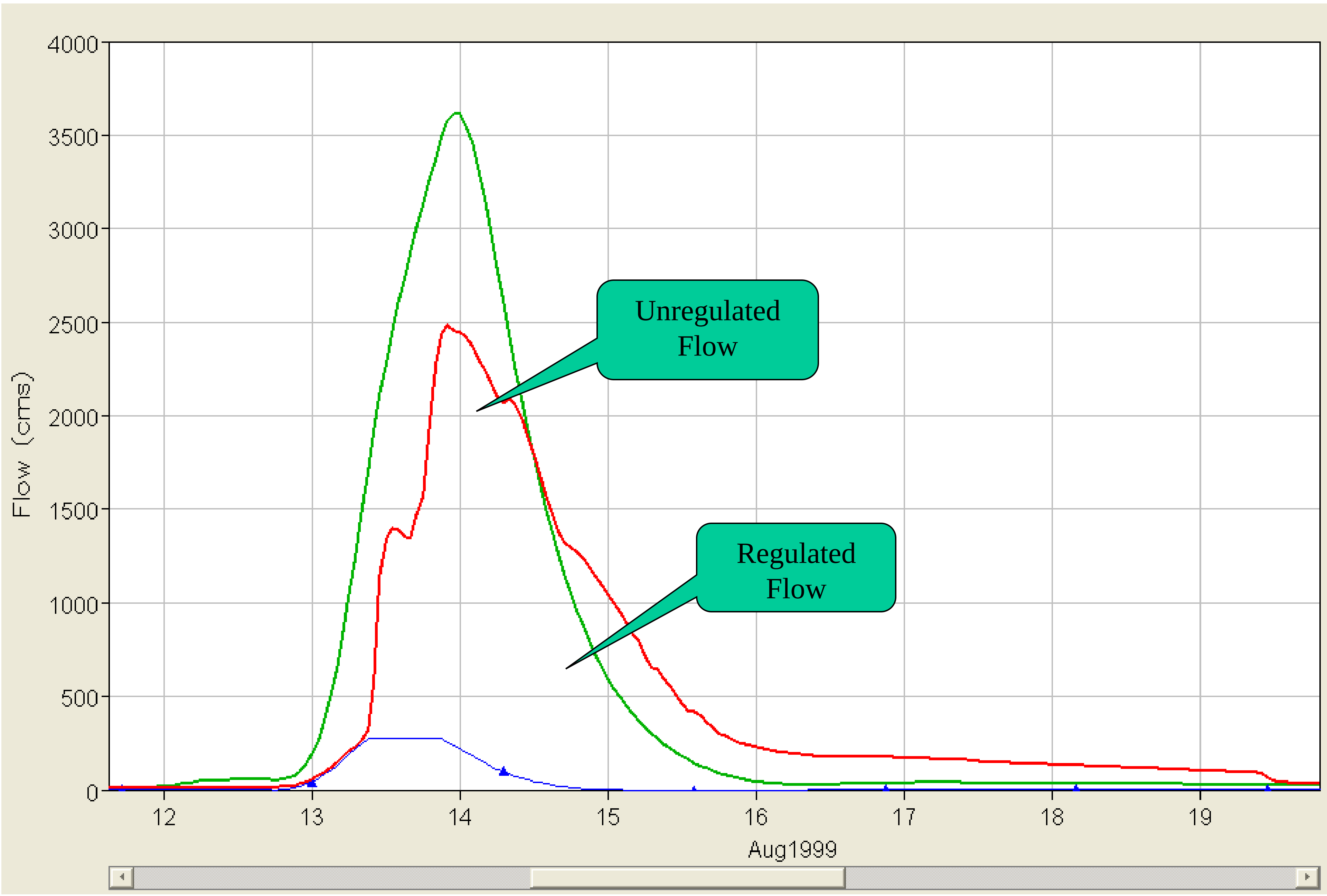
//CATEASCA [42506]/FLOW/01AUG1999/1HOUR/ARGES1000Y0/
File
Edit
View
3000
2500
2000
1500
1000
500
0
Flow (cms)
13
14
15
16
17
18
Aug1999
CATEASCA [42506] ARGES1000Y0 FLOW
CIUMESTI [42528] ARGES1000Y0 FLOW
MALURENI [42522] ARGES1000Y0 FLOW
PISCANI [42541] ARGES1000Y0 FLOW
VOINA [42538] ARGES1000Y0 FLOW



Elev (m)
280
275
270
265
Top of Flood
Top of Conservation
Inactive
Flow (cms)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Inflow
Outflow
13
14
15
16
17
18
19
Aug1999



Goliri de fund
Deversorul de surfata
Right Hand Side
1200
1000
800
600
400
200
0
13
14
15
16
17
18
19
Aug1999



Unregulated Flow
Regulated Flow
Flow (cms)
4000
3500
3000
2500
2000
1500
1000
500
0
12
13
14
15
16
17
18
19
Aug1999

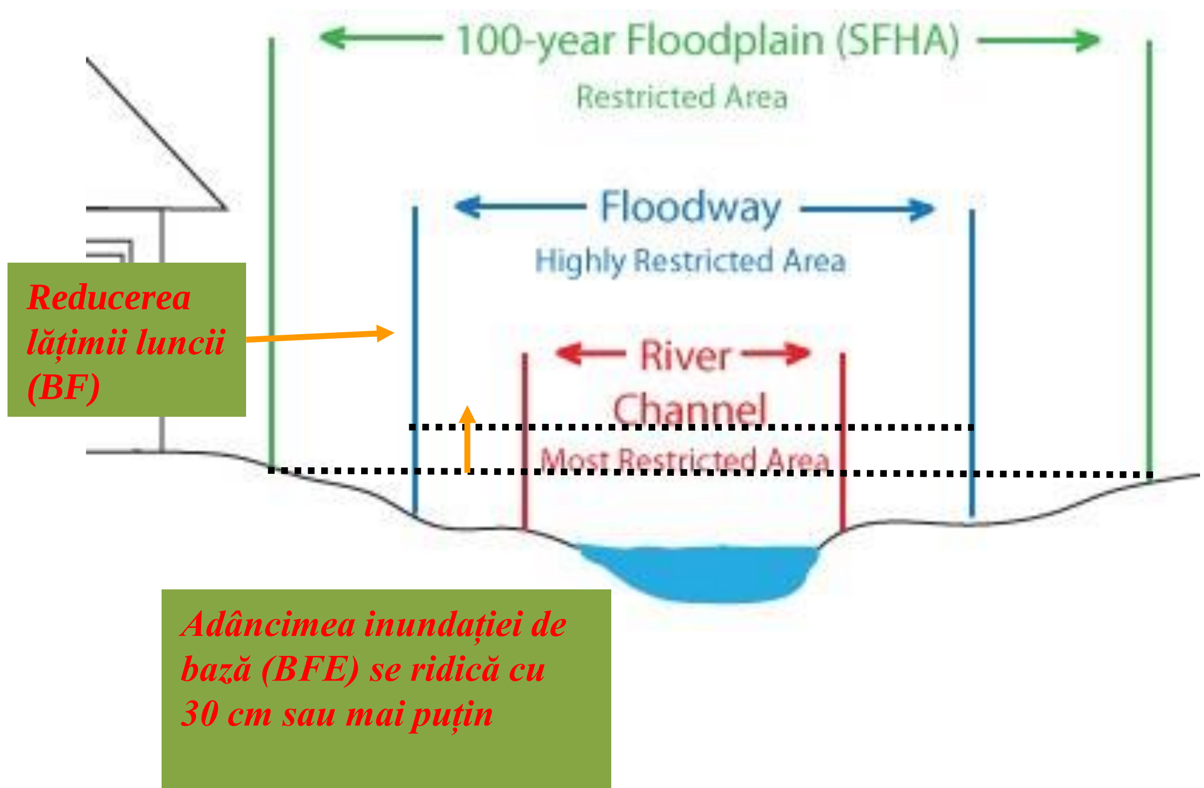
Bascov Reservoir
Doamnei River
Maracineni
Arges River
Prundu Reservoir
Golesti Reservoir
Arges River
Колибаши
Вьероши
Плоскару
Стежерец
Глымбоку
Рогожина
Пэйшешти
Енкулешти
Валя-Маре-Подгория
Валя-Попи
Флоря
Балотешти
Уяска
Григорешти
Изворани
Штефэнешти
Тыргу
Дялулуй
Валя-Боеряскэ
Чокэнешти
Лэпучешти
Чокэнэй
ПИТЕШТИ
Змеура-де-Сус
Тырдешти
Сурдешти
Писку-Мошулуй
Басанджешти
Хинцешти
Джамэна
Дялул-Вийлор
Лакулуй
Зяма-Рече

National Rollout – e-LAC application for INHGA and Flood CBA methods

- Identifying infrastructure and operations for basins
- Developing ResSim models for basins
- Interconnecting with ANAR database, AvisoWatch/warning system and dispatch application
- Testing, training, practicing application and response

VULMIN – simplified identification of hazard maps

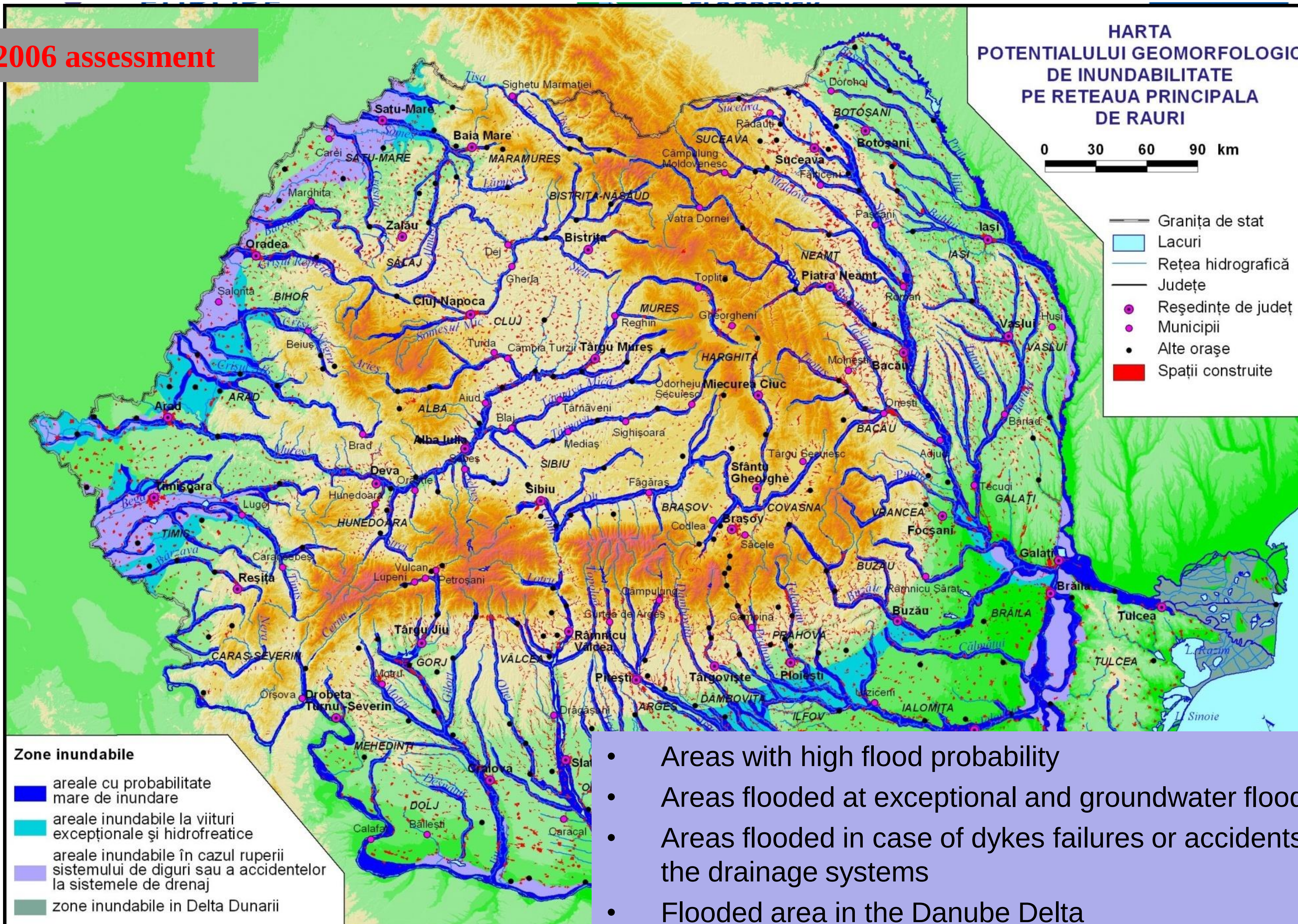
- DTM data and analysis of the geomorfological aspects



Flood-prone area: geomorphological approach

GEOMOPHIC POTENTIAL FOR FLOODS ON THE MAIN RIVER NETWORK IN ROMANIA

2006 assessment



- Areas with high flood probability
- Areas flooded at exceptional and groundwater floods
- Areas flooded in case of dykes failures or accidents at the drainage systems
- Flooded area in the Danube Delta

Flood-prone area: geomorphological approach

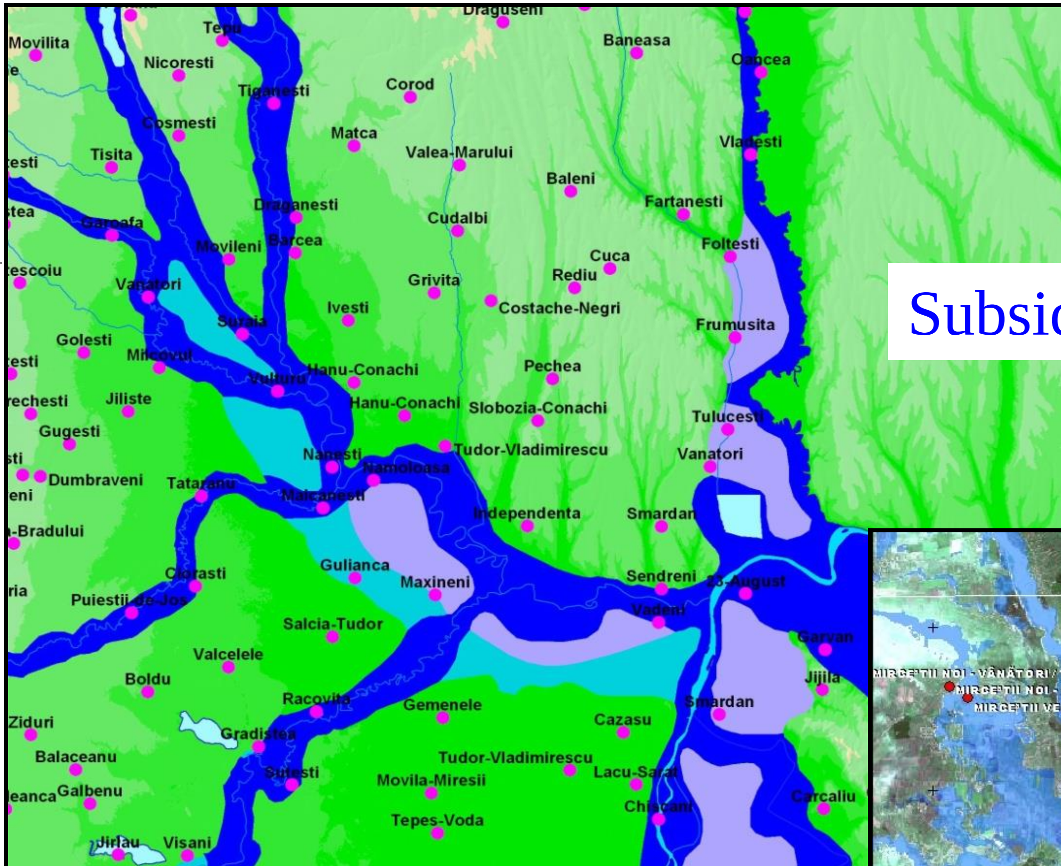
Spatial patterns of flooding

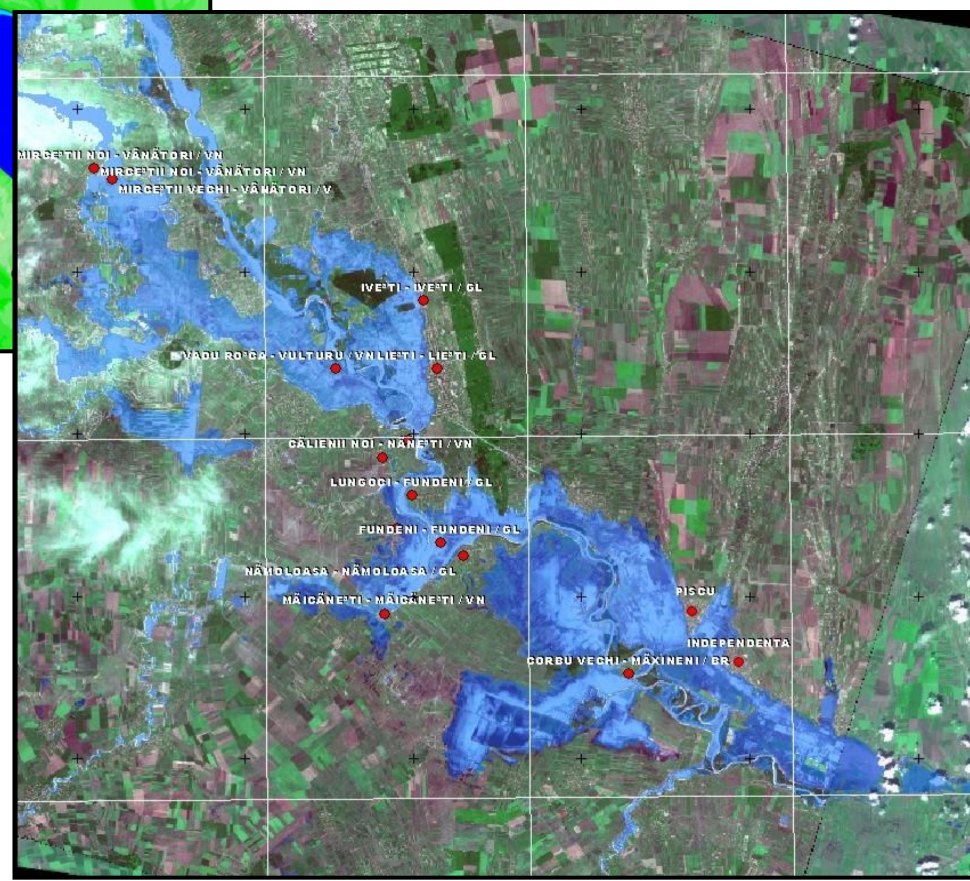
- Mountain and hilly regions:
  - Floods in subsident depressions
  - Flash-floods
  - Floods caused by: dam failures, landslides, debris, ice, undersized bridges
  - Floods in areas with narrow and large river reaches
- Plain regions:
  - Floods in the low and subsidence plains
  - In the confluence sectors
  - In the regulated floodplains and sand dunes areas
  - In the Danube Delta
  - Hydrophreatical floods related to the loess piping depressions generated through piping
  - Floods caused by pond failures (Domino effect)

Black Sea CROSS BORDER COOPERATION

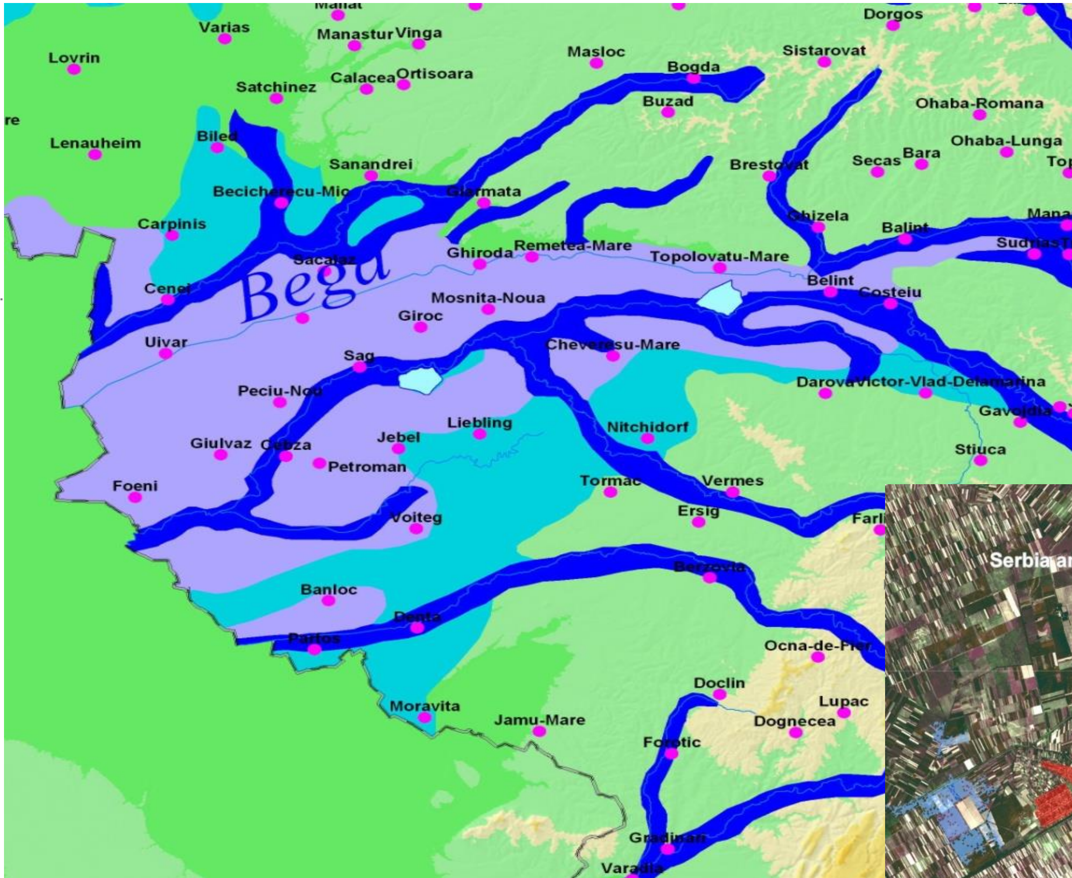
Subsidence area of the Siret river

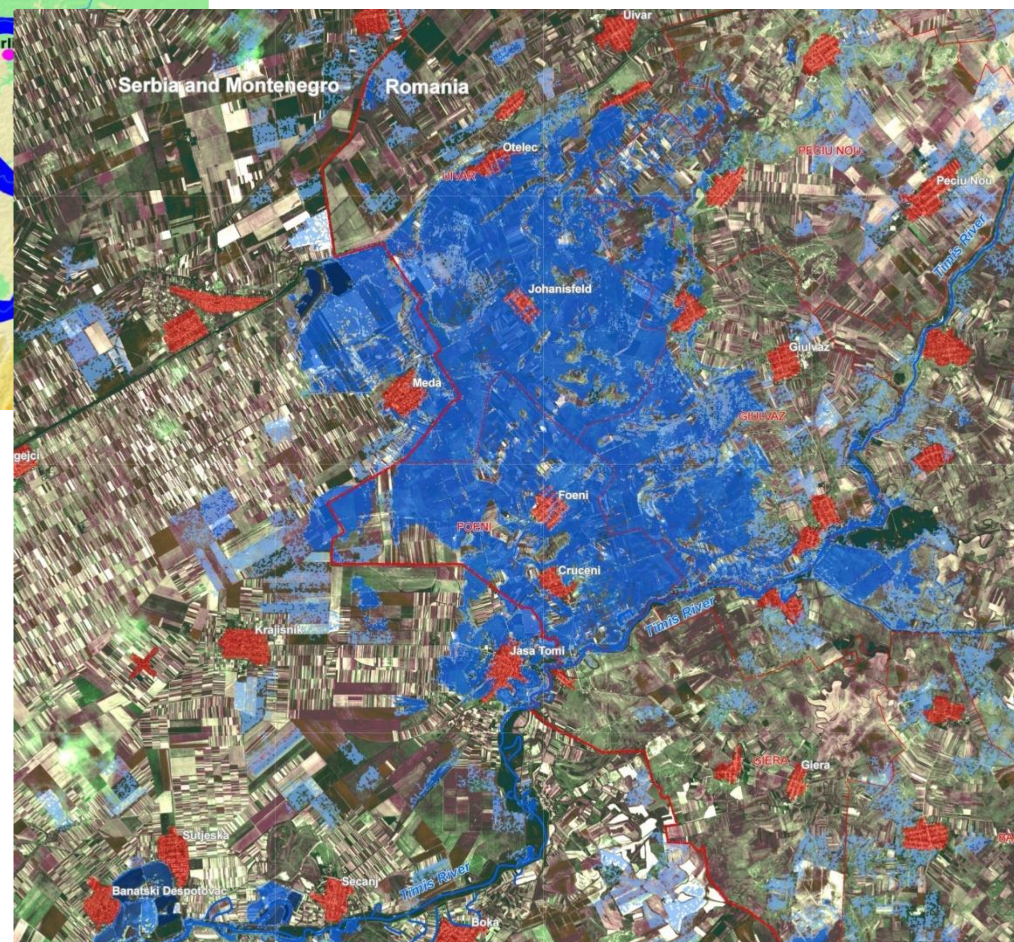
2005 floods

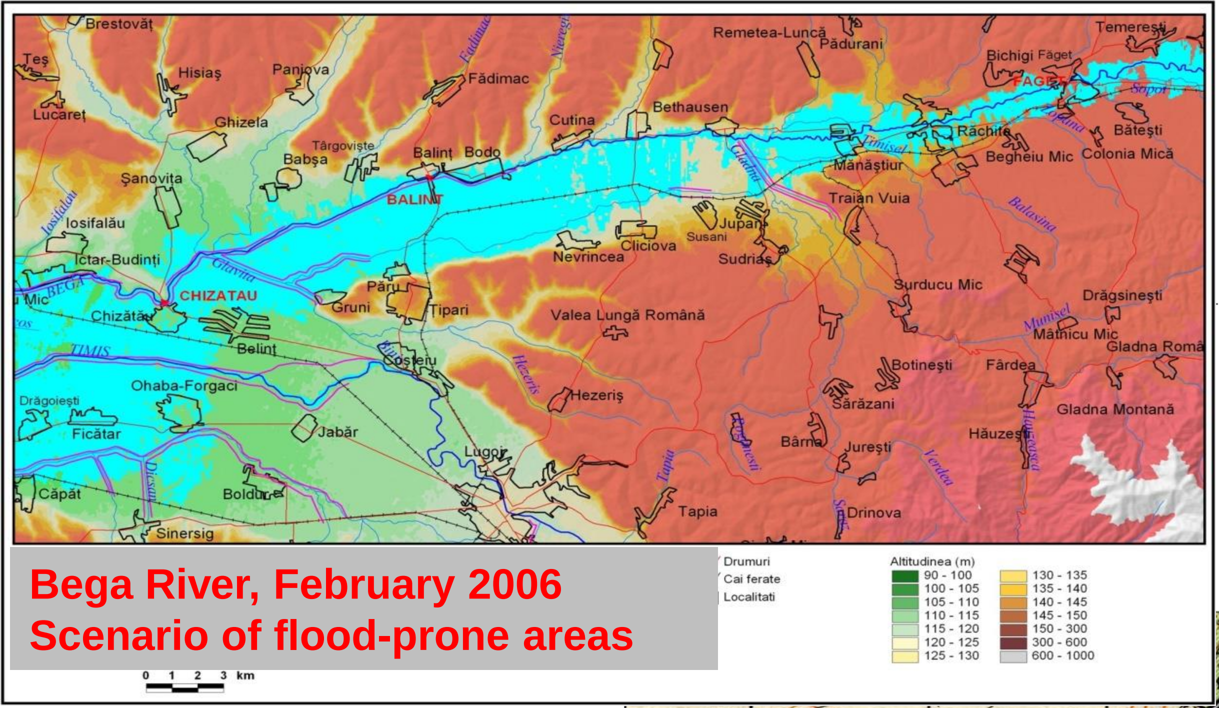




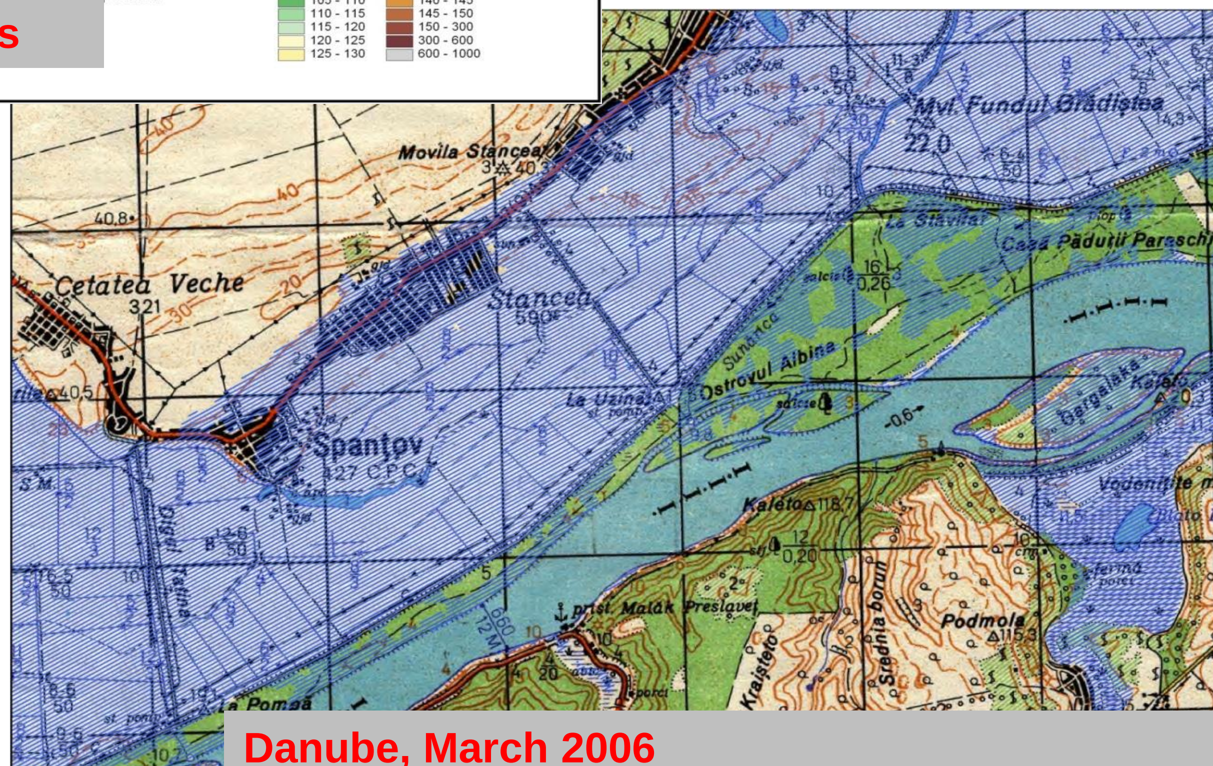
Dykes failure in the subsidence plain (Banat, 2005)



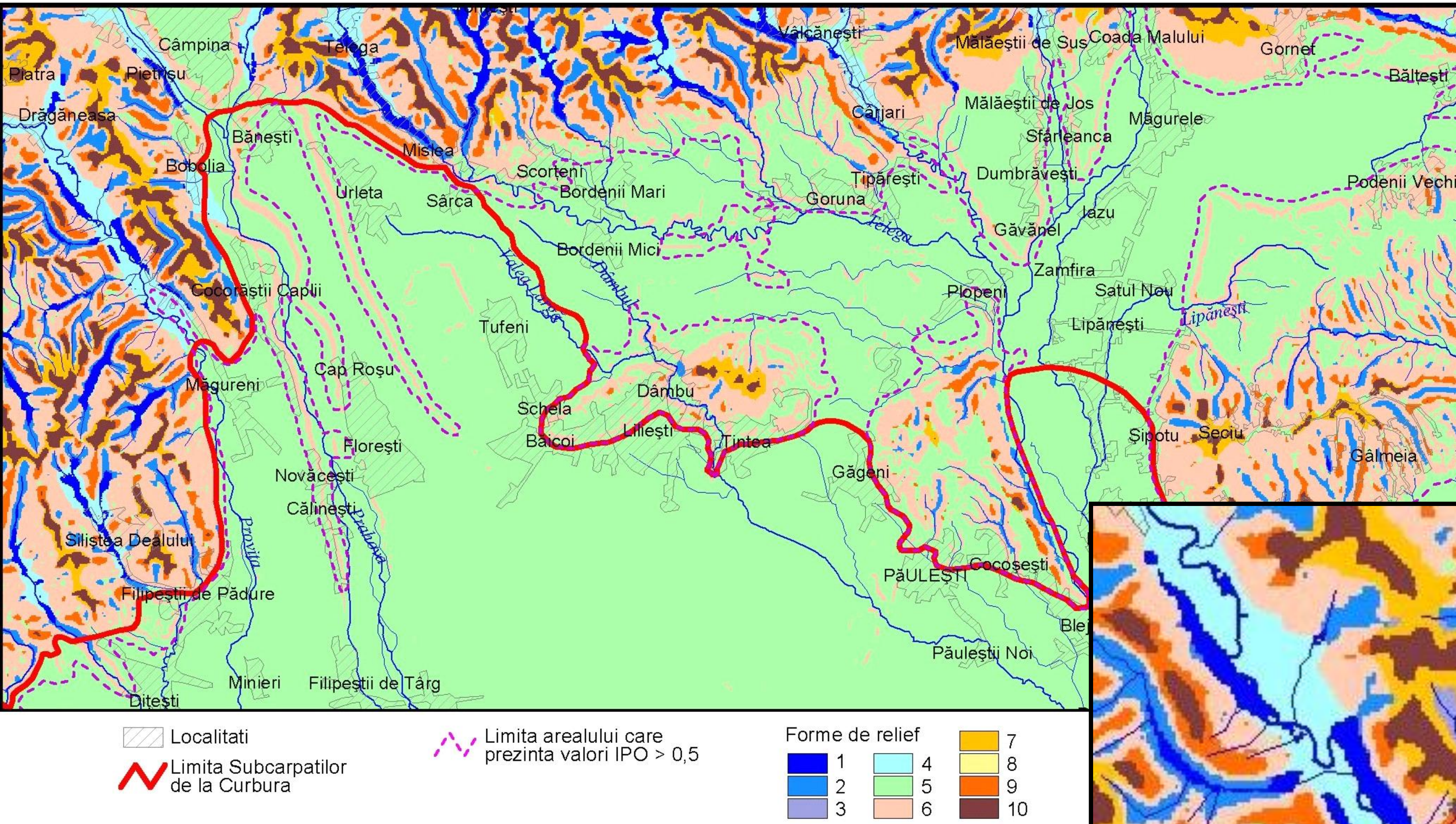




Bega River, February 2006
Scenario of flood-prone areas



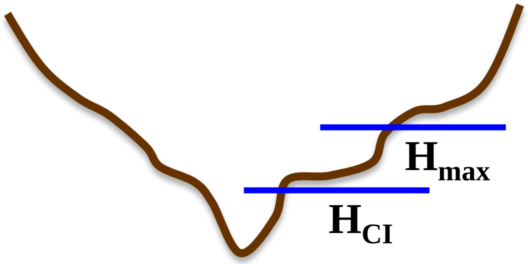
Danube, March 2006
Forecast discharge at entrance point = 14.600 mc/s



Câmpina
Telega
Vâlcănești
Mălăeștii de Sus
Coada Malului
Gornet
Piatra
Pietrișu
Băltești
Drăgăneasa
Cârjari
Mălăeștii de Jos
Măgurele
Bănești
Mislea
Sfârleanca
Bobolia
Scorțeni
Tipărești
Dumbrăvești
Podenii Vechi
Urleta
Sârca
Bordenii Mari
Goruna
Iazu
Găvănel
Teleajen
Bordenii Mici
Zamfira
Valea Largă
Dâmbul
Cocorăștii Caplii
Plopeni
Satul Nou
Lipănești
Tufeni
Cap Roșu
Măgureni
Dâmbu
Schela
Șipotu
Seciu
Liliești
Băicoi
Tintea
Florești
Gâlmeia
Găgeni
Novăcești
Călinești
Prahova
Provița
Siliștea Dealului
Păulești
Cocoșești
Filipeștii de Pădure
Blejoi
Păuleștii Noi
Minieri
Filipeștii de Târg
Ditești
Localitati
Limita Subcarpatilor de la Curbura
Limita arealului care prezinta valori IPO > 0,5
Forme de relief
1
2
3
4
5
6
7
8
9
10

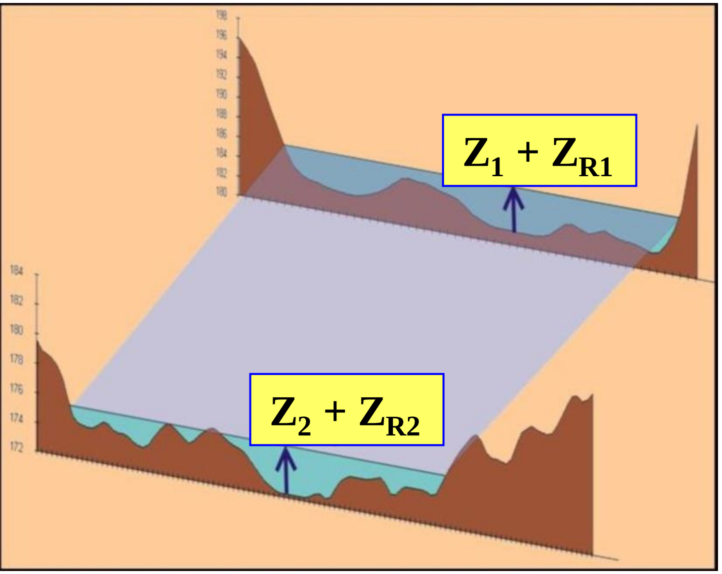
Bo

VULMIN – simplified identification of hazard maps

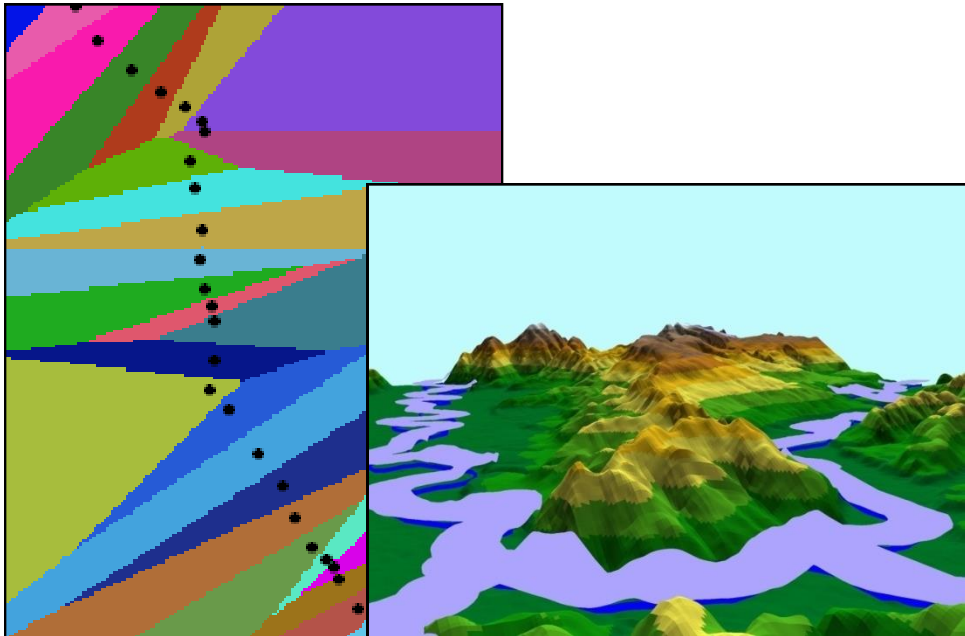


$$Z_R = H_{max} - H_{CI}$$

Z_R = cota relativa a nivelului apei la inundatii



Procedura bazata pe retea de poligoane Thiessen



VULMIN Project – Vulnerability of settlements and environment to floods in Romania within the context of global change

Vulnerability assessments are indicator-based approaches

The coordinates of indicator selection are based on exposure and sensitivity charaterstics of a region / area

Geographical scales and contexts

Flood-prone areas

Landscape transformations and management

Demographic trends

Economic development, social characteristics and human well-being

Governance structures and institutional capacity

Indicators

- Number of people, households potentially affected by floods
- Land-use types and tenure; areas covered by crops, agricultural productivity by crops
- Income, education level, health, living standard, employment, etc.
- Population density, migration, percentage of rural population
- Education level, unemployment, net increase in number of jobs
- Number of people who live within walking distance of a center of local services
- Incentives for farmers, number and value of infrastructure development projects etc.
- Industrial productivity, value added by economic sectors
- Percentage of occupied people by economic sectors
- What is actually being done for mitigation and adaptation
- Institutional coordination, ways to monitor progress, advancement, conditions for innovation

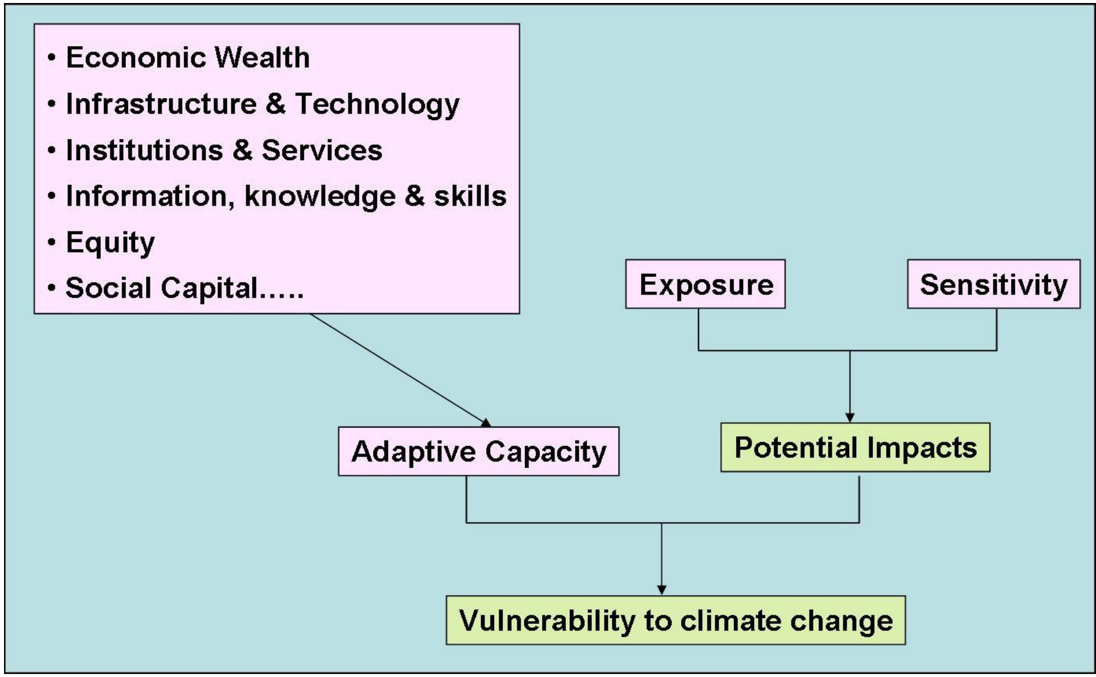
CLAVIER Approach - Methodological issues

EUROPEAN UNION

- **Economic Vulnerability = f (Exposure, Sensitivity, Adaptive Capacity) (IPCC, 2001, Stern, 2007, CLAVIER 2009)**

- **Broader, all sector encompassing mapping of adaptive capacity**

- ***Expected outcomes*: absorption capacity of a regional economy with respect to macroeconomic shocks from climate change**



Source: The IPCC 3rd Assessment Report, cited by Stern, 2007

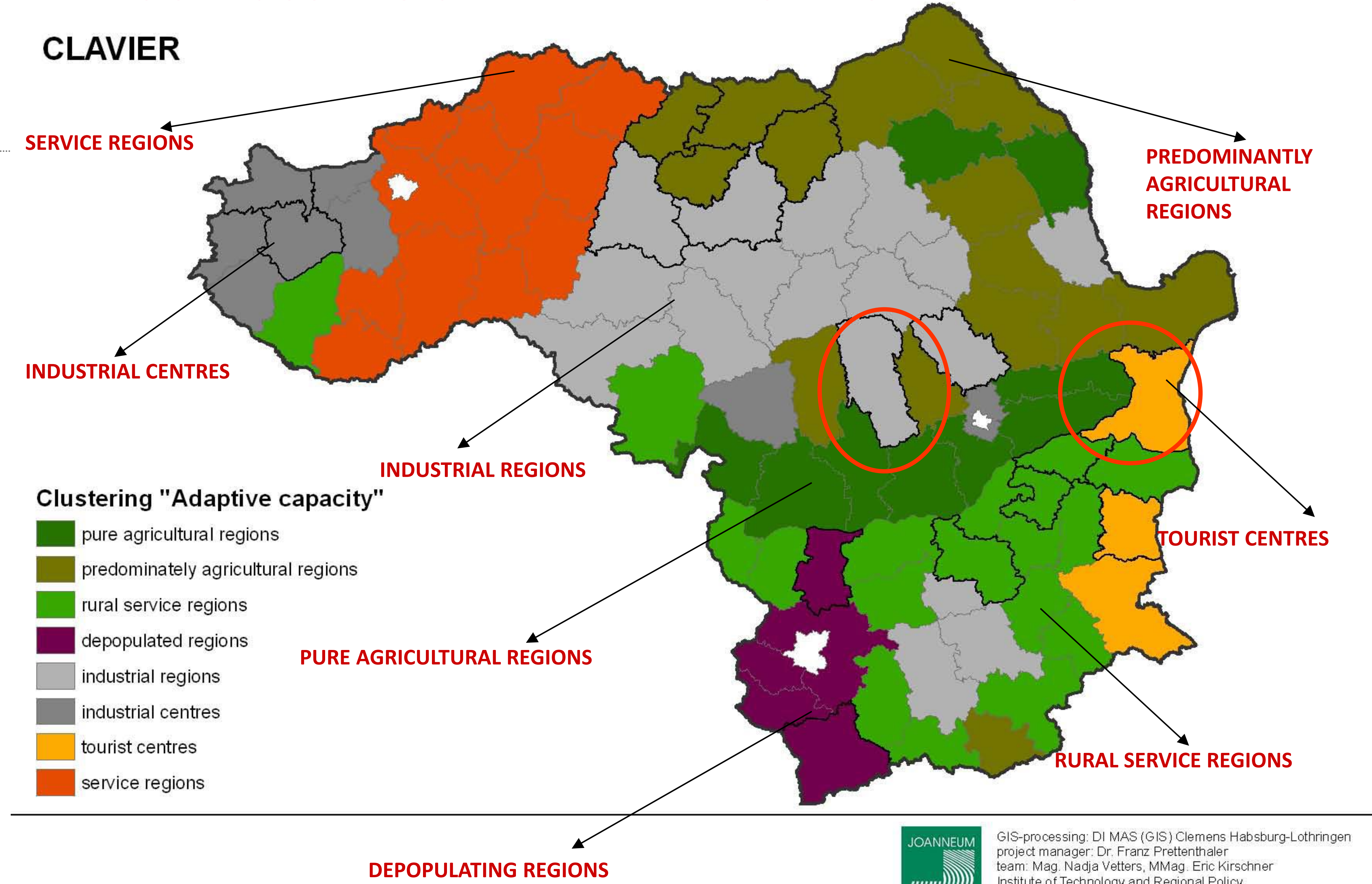
- **Exposure and sensitivity indicators relevant in determining the regional adaptive capacity to climate change**

Individual case studies on regional sector-specific vulnerability were meant to complete the overall picture of regional vulnerability of a particular region.

Variables and Indexes

- **Regionalized population projections 2025**
- **Education level in relation to CLAVIER average**
- **Growth rate of regional GDP per habitant/pps 2001-2005**
- **Ratio of regional GDP per habitant/pps in terms of national averages**
- **Sectoral Employment Shares**
- **Regional Employment Shares**
- **Sectoral Value Added Shares**
- **Sectoral Productivity Indicators**
- **Accessibility indicators**
- **Hirschman-Herfindahl (HHI)**

ENDOGENOUS REGIONAL ADAPTIVE CAPACITY – ERAC



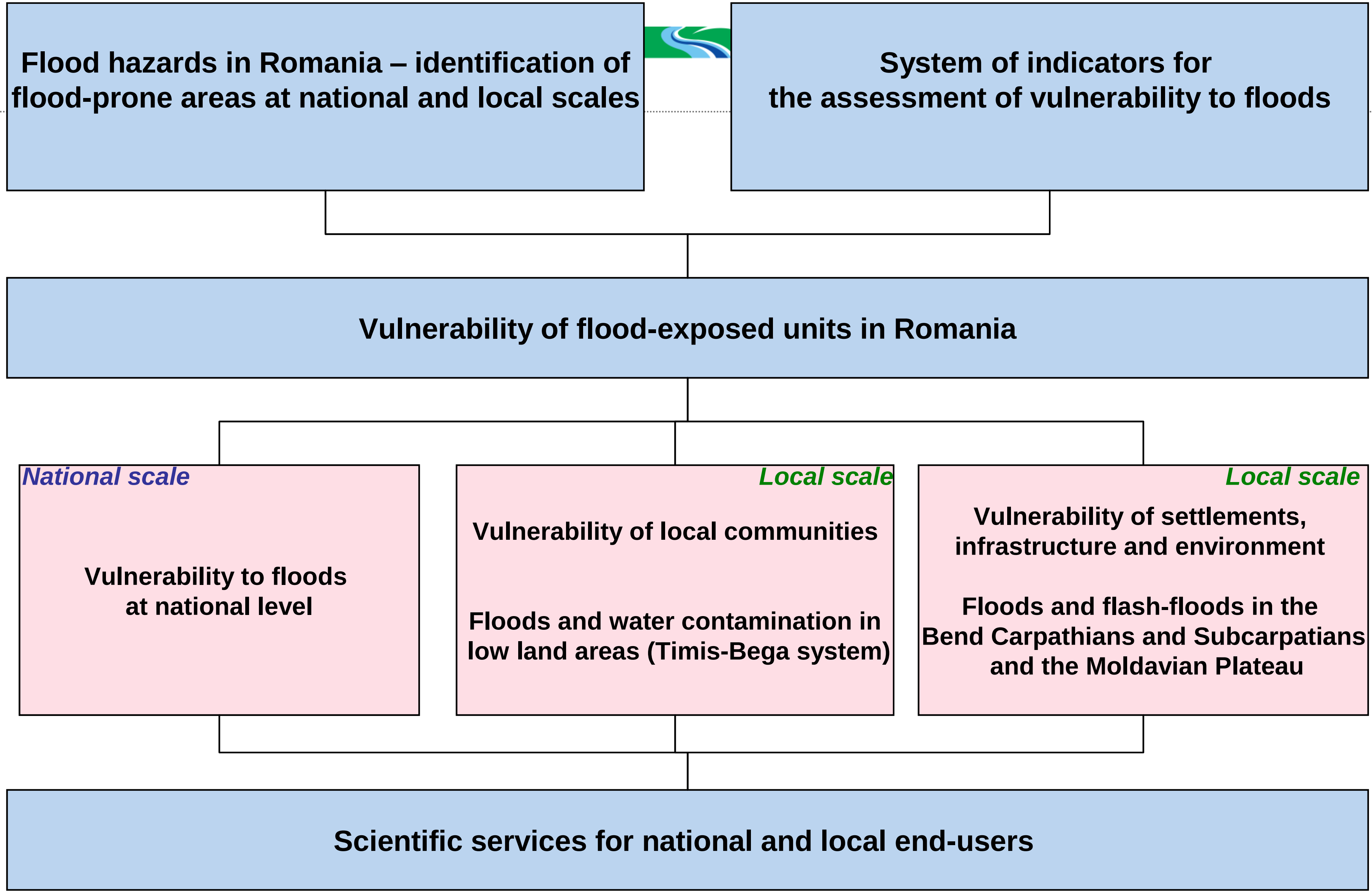
JOANNEUM RESEARCH

GIS-processing: DI MAS (GIS) Clemens Habsburg-Lothringen
project manager: Dr. Franz Prettenthaler
team: Mag. Nadja Vetters, MMag. Eric Kirschner
Institute of Technology and Regional Policy
JOANNEUM RESEARCH

Kilometer
0 30 60 120

N

VULMIN Project – Vulnerability of settlements and environment to floods in Romania within the context of global change



Workflow Diagram of VULMIN Project

VULMIN Project – Vulnerability of settlements and environment to floods in Romania within the context of global change

Research directions

1. **Flood hazards in Romania – identification of flood-prone areas at national and local scales**

2. **System of indicators for the assessment of vulnerability to floods**

3. **Vulnerability of flood-exposed units in Romania**

4. **Scientific services for national and local end-users**

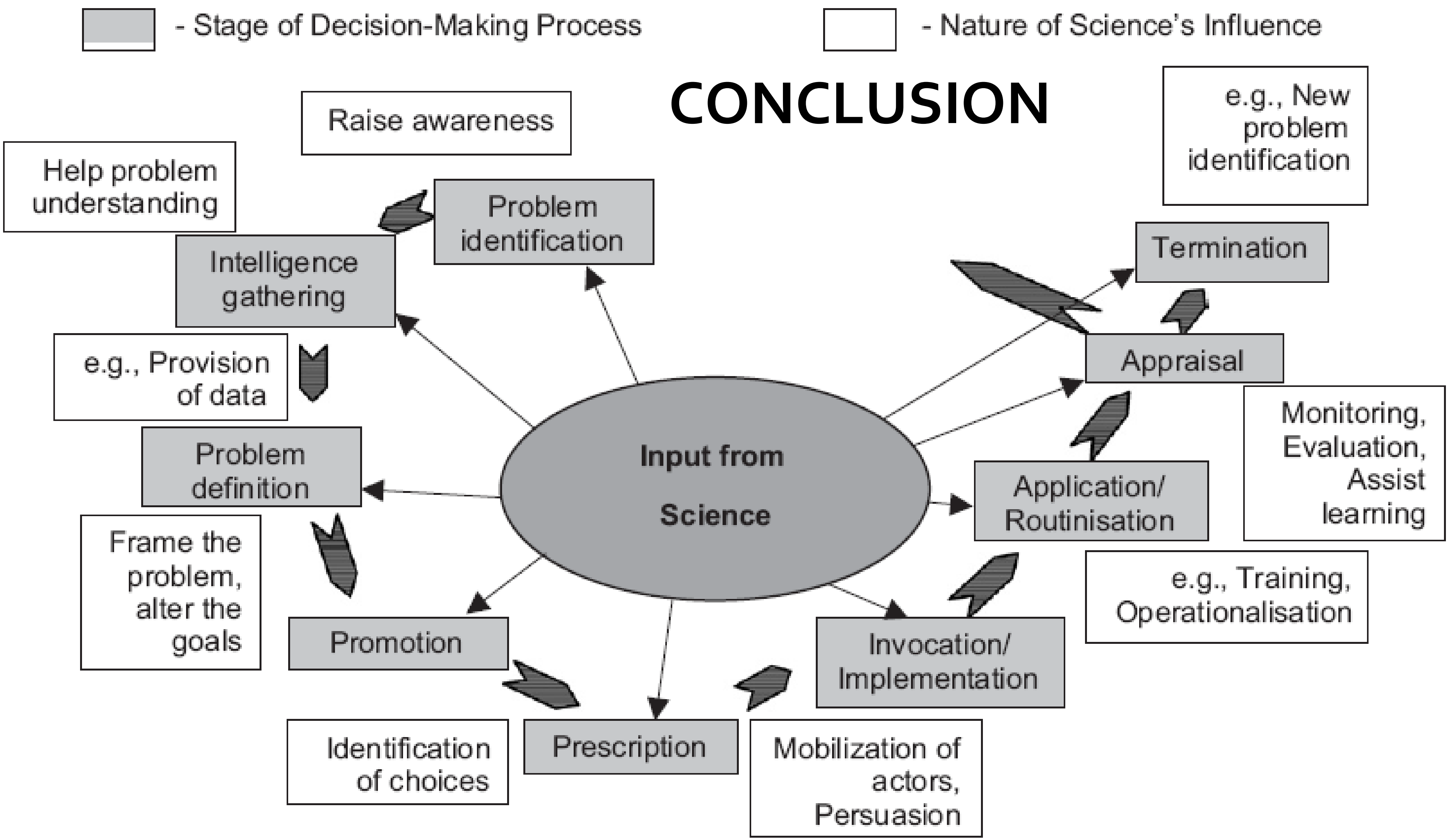
- Identification of flood-prone areas at national and local level and regionalization of extreme events
- To determine and collect indicators of vulnerability at national and local scales
- To analyze the vulnerability of settlements, infrastructure and environment to floods and flash-floods in the Bend Carpathians and Subcarpathians and the Moldavian Plateau
- To assess the communities' vulnerability to floods and water contamination in low land areas
- To assess the vulnerability to floods at national level & to regionalize of the endogenous potential of adaptive capacity
- To inform on the future trends in the hydrological regime change, as a basis for adaptation plans of water users
- To evaluate the end-users requirements in terms of scientific services related to floods
- To identify the most relevant end-users in the study areas of the project

SciNet NatHaz Prevention

Black Sea CROSS BORDER COOPERATION

EUROPEAN UNION

CONCLUSION



Scientific input for decision-making process, Vogel et.al, 2007 adapted from Clark, 2002 and Mitchell et al., 2006

CONCLUSION

UNDERSTANDING STAKEHOLDERS NEEDS

- **Stakeholder involvement strategy and coordination**: development of a common approach (method) for transnational, national and regional stakeholder identification and participation (related to floodrisk) in the Danube River basin build on the results of the ICPDR analysis;
- collection of feedback of the involved organisations and persons;
- in this action the overall participation process was set up.