



# Research and knowledge in the IO-BAS related to the Blue Growth initiative in the Black Sea

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NIKOLAY VALCHEV, KREMENA STEFANOVA, SNEJANA MONCHEVA,  
VALENTINA TODOROVA, OGNYANA HRISTOVA,  
VALENTINA DONCHEVA, ATANAS VASILEV, PRES LAV PEEV  
INSTITUTE OF OCEANOLOGY - BAS



- ▶ **Challenges for Good Environmental State**  
(Kremena Stefanova, Snejana Moncheva, Valentina Todorova, Valentina Doncheva, Nikolay Valchev)
- ▶ **Ecosystem related research and knowledge** (Kremena Stefanova, Snejana Moncheva, Valentina Todorova, Valentina Doncheva, Ognyana Hristova)
- ▶ **Blue energy: unconventional and renewable sources**  
(Atanas Vasilev, Ognyana Hristova, Nikolay Valchev)
- ▶ **Underwater cultural tourism** (Preslav Peev)
- ▶ **Coastal strategies for risk assessment and disaster management** (Nikolay Valchev)

# Challenges for Good Environmental State

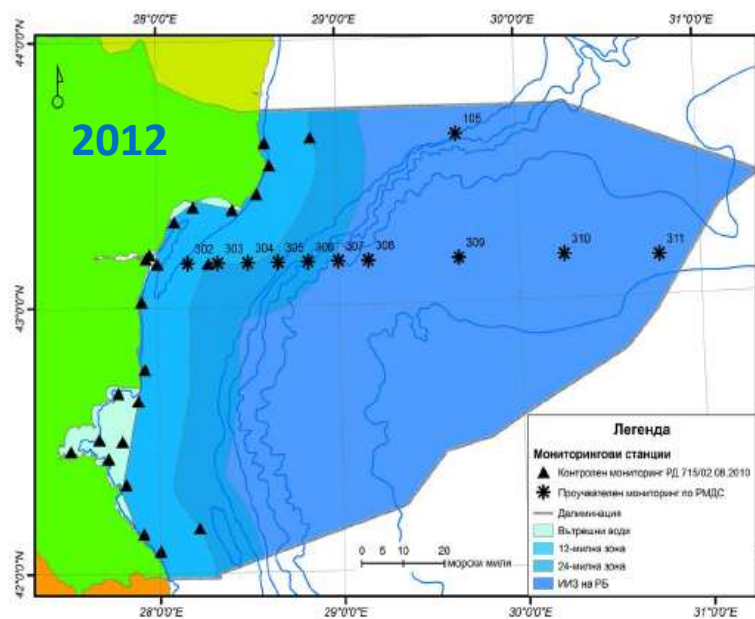


IO-BAS has been carrying out monitoring since 2012 (Agreement with MEW) and assessing the ecological status of waters by developing indicators and classification systems for the physico-chemical and biological elements of quality in the implementation of the Water Framework Directive 2000/EU/60.

Водно тяло	Биологични елементи за качество				Физико-химични елементи за качество		Екологично състояние
	Фитопланктон	Макрофити	Макрозообентос	Незадължителен БЕК зоопланктон	Общо състояние (биогени и кислород)	Специфични замърсители	
BG2BS000C001	Умерено	Не е определяно	Добро	Умерено	Добро	Добро	Умерено
BG2BS000C002	Умерено	Добро	Добро	Умерено	Добро	Не е определяно	Умерено
BG2BS000C1003	Умерено	Добро	Добро	Лошо	Добро	Добро	Умерено
BG2BS000C1004	Умерено	Отлично	Добро	Умерено	Умерено	Не е определяно	Умерено
BG2BS000C1013	Умерено	Добро	Умерено	Лошо	Умерено	Добро	Умерено
BG2BS000C005	Лошо	Лошо	Добро	Умерено	Умерено	Добро	Лошо
BG2BS000C1113	Умерено	Умерено	Умерено	Умерено	Умерено	Не е определяно	Умерено
BG2BS000C1006	Умерено	Не е определяно	Умерено	Умерено	Умерено	Добро	Умерено
BG2BS000C1007	Умерено	Отлично	Умерено	Умерено	Добро	Добро	Умерено
BG2BS000C1008	Умерено	Не е определяно	Добро	Лошо	Добро	Не е определяно	Умерено
BG2BS000C1108	Умерено	Добро	Умерено	Умерено	Добро	Не е определяно	Умерено
BG2BS000C1208	Умерено	Добро	Отлично	Умерено	Добро	Добро	Умерено
BG2BS000C1308	Умерено	Лошо	Добро	Умерено	Добро	Добро	Лошо
BG2BS000C1010	Умерено	Не е определяно	Умерено	Лошо	Умерено	Добро	Умерено
BG2BS000C1011	Умерено	Добро	Отлично	Лошо	Умерено	Не е определяно	Умерено
BG2BS000C1012	Добро	Отлично	Добро	Лошо	Добро	Добро	Добро
BG2BS000C1112	Добро	Не е определяно	Добро	Умерено	Умерено	Не е определяно	Умерено



# Challenges for Good Environmental State



IO-BAS deals with monitoring (2012, 2017-2018) and assessment of marine environmental state; develops criteria, indicators and objectives for achieving good status of the marine environment related to the MSFD.

Projects: PERSEUS, DEVOTES, COCONET (7FP)



# Investigations on Marine Environmental State and Improving of Monitoring Programs developed under MSFD



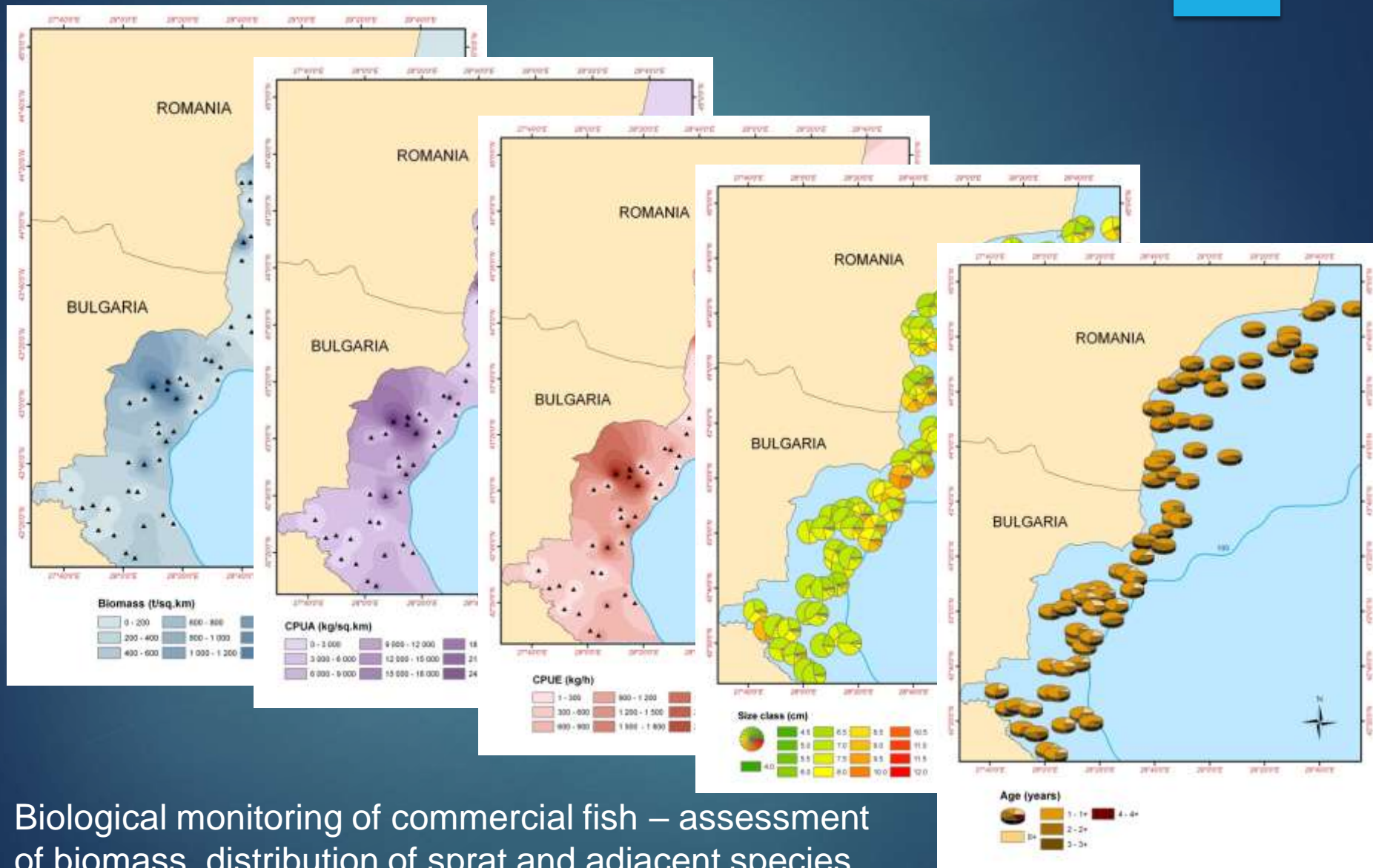
## Project ISMEIMP



## Results

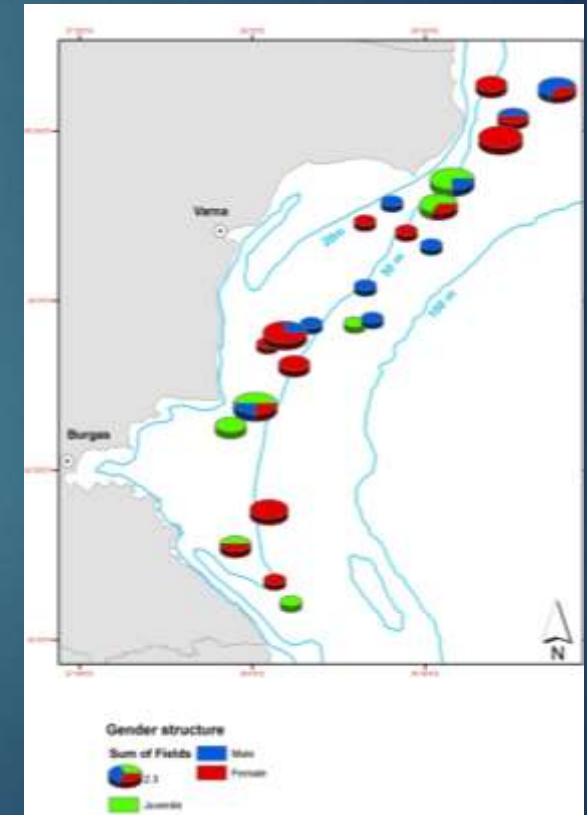
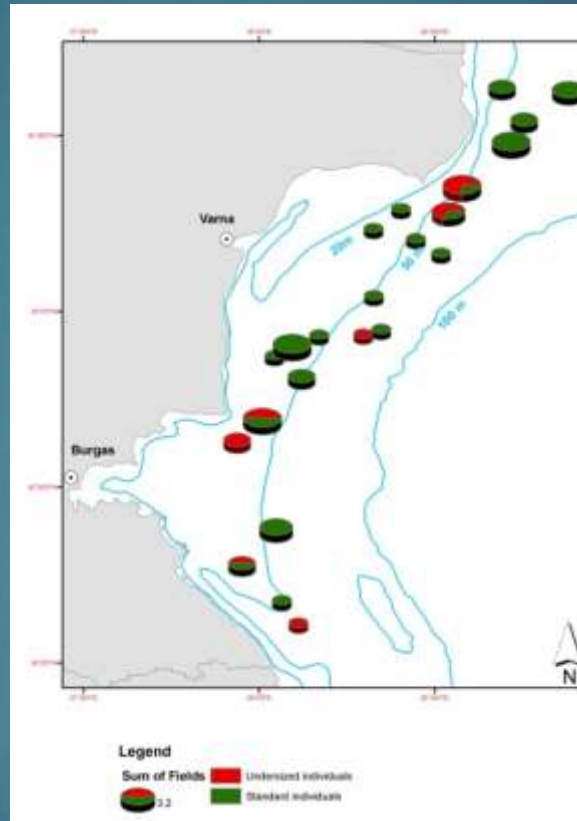
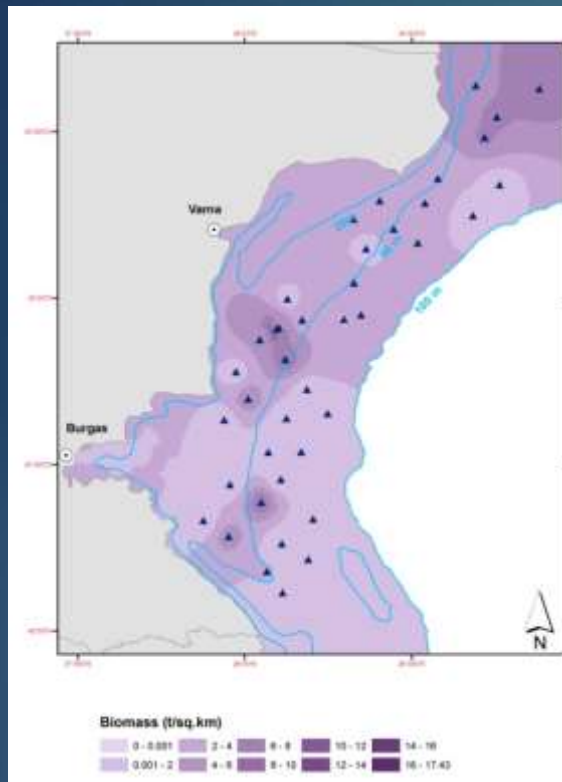
- development of the definitions of good status of the marine environment by descriptors;
- partially replenish the existing data gaps for all descriptors;
- updating of objectives for GES;
- development / validation of indicators and their thresholds to progress towards the achievement of GES;
- improvement of monitoring programs.

# Pelagic investigations



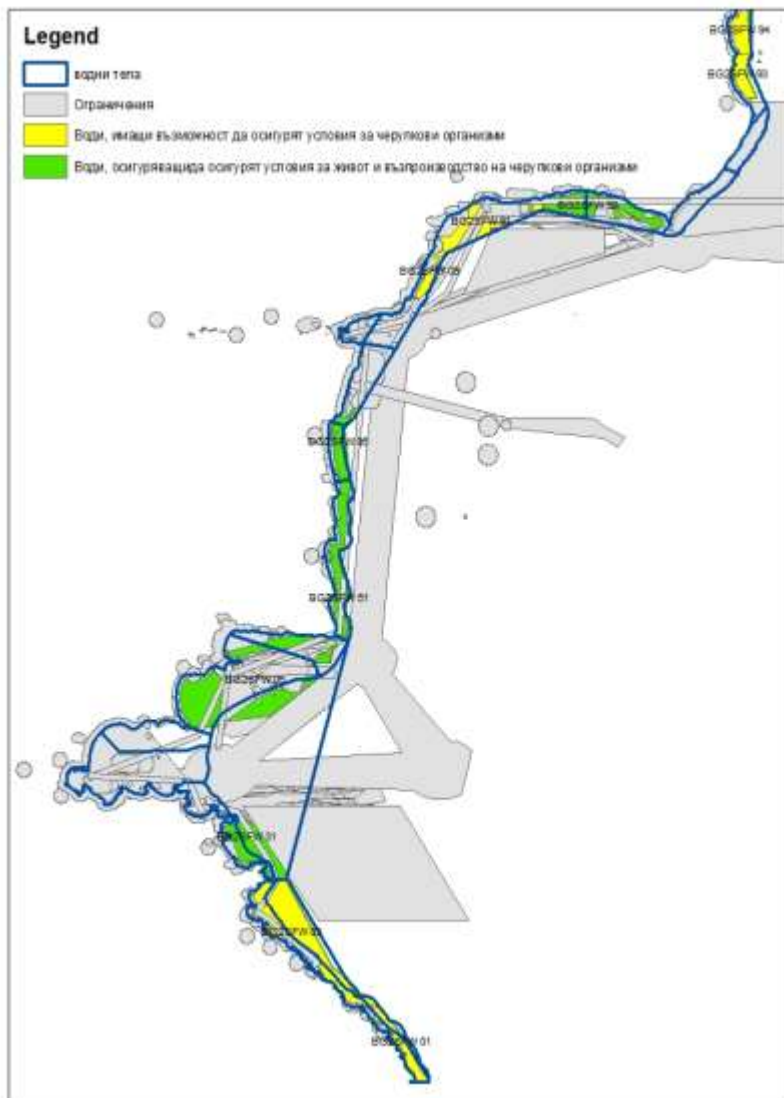
Biological monitoring of commercial fish – assessment of biomass, distribution of sprat and adjacent species

# Bottom trawl exploration





# Aquaculture

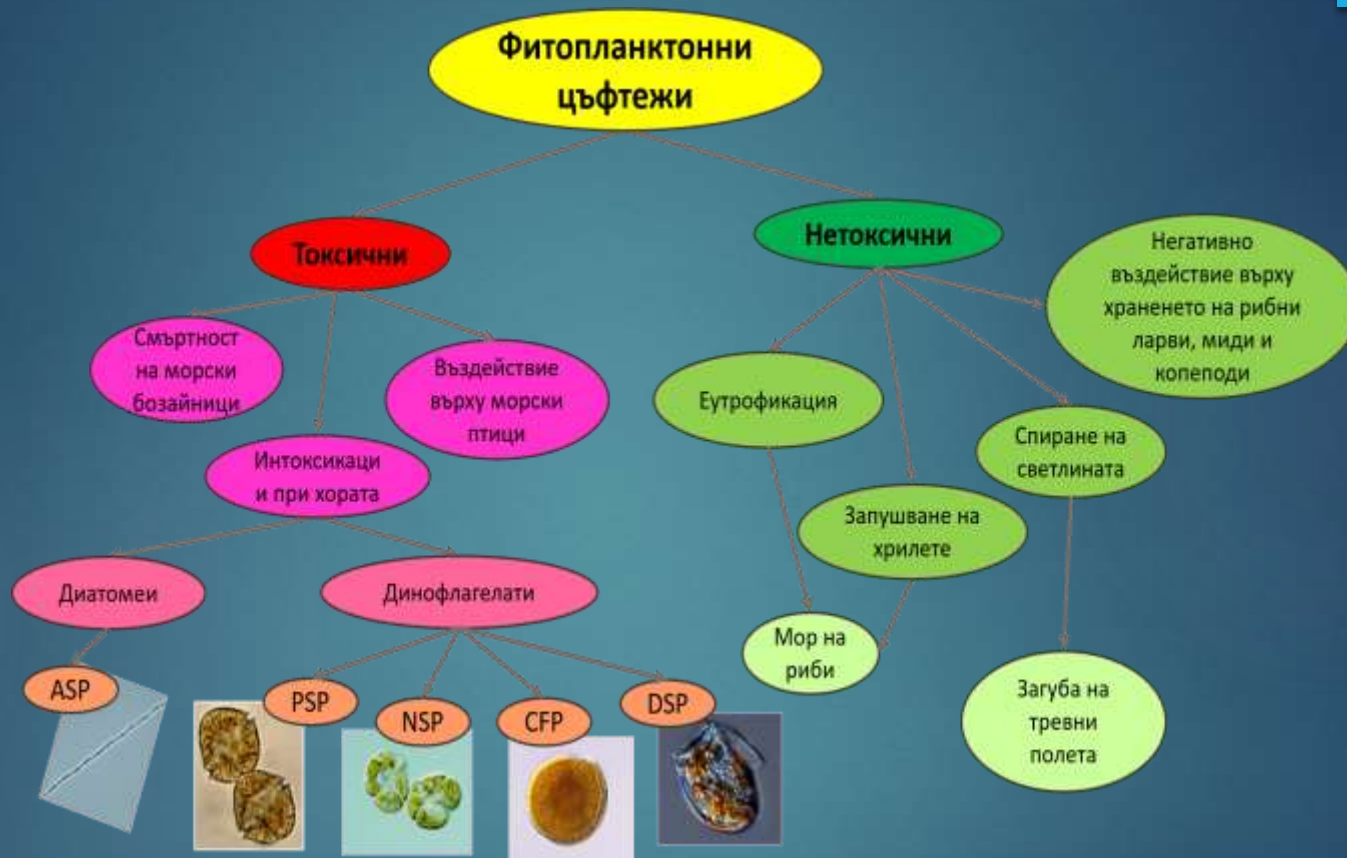


The Blue Growth Strategy and the Innovation Research Program of the Horizon 2020 aim to preserve marine water resources and their biodiversity.

Updated shellfish site selection in Bulgarian Black Sea coastal waters - task assigned by BSBD (Marine Chemistry Department)



# Phytoplankton blooms



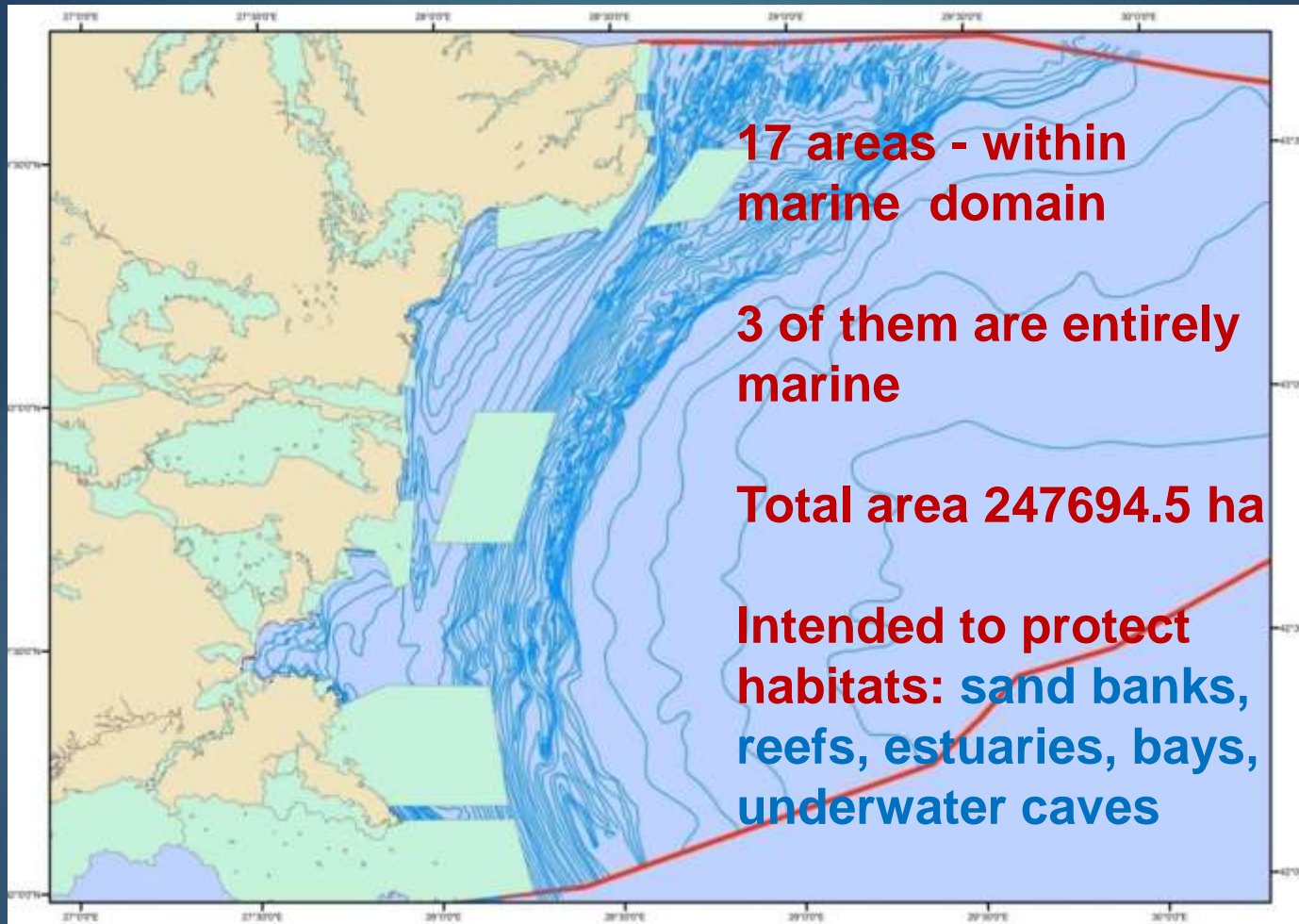
The main objective of the research of this phenomenon is the identification of “blooming” species, in particular establishment of toxic species which pose a threat to the ecosystem and human health (indirectly influences tourism)

# MOLECULAR GENETICS – innovative methods for marine environment protection, sustainable aquaculture and safety marine food



Application of innovative molecular methods for precise study of phytoplankton diversity (potentially toxic species), human health and environmental risk assessment and estimation of population genetic structure of commercial fish species along the Bulgarian Black Sea coast.

# Marine protected area NATURA 2000



IO-BAS develops scientific bases for conservation of species and habitats, prepares hazard and vulnerability assessments, identifies areas suitable for designation of protected zones and areas.

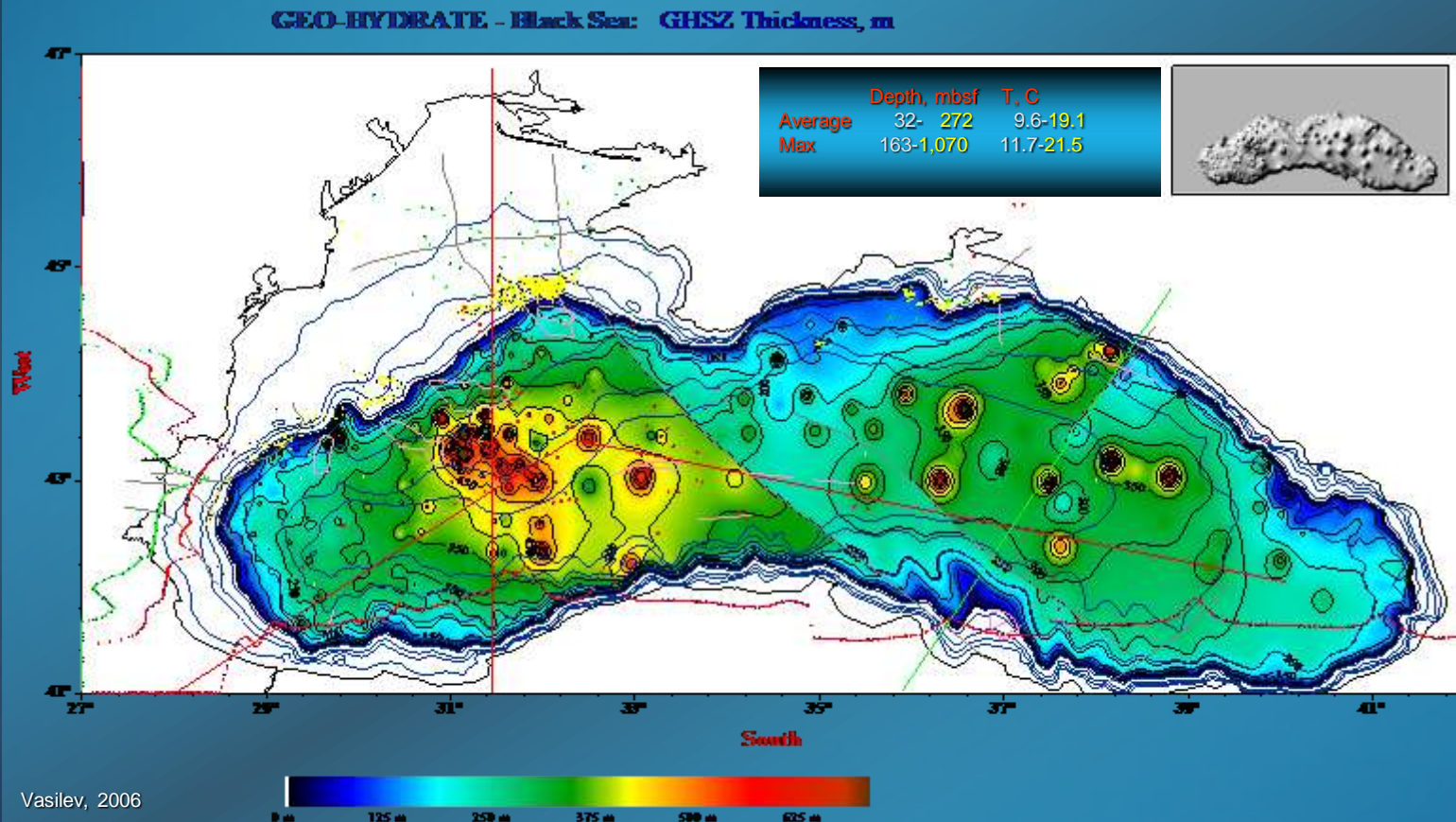


# Gas Hydrates in the Black Sea: Model estimations



Potential resources of methane in gas hydrates

CH<sub>4</sub>: 44,000 bcm (Optimistic) 500 bcm (Pessimistic models)



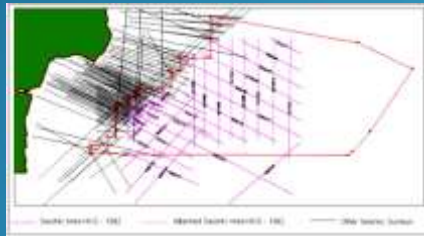
Vasilev, 2006





# Gas Hydrates in the Bulgarian EEZ

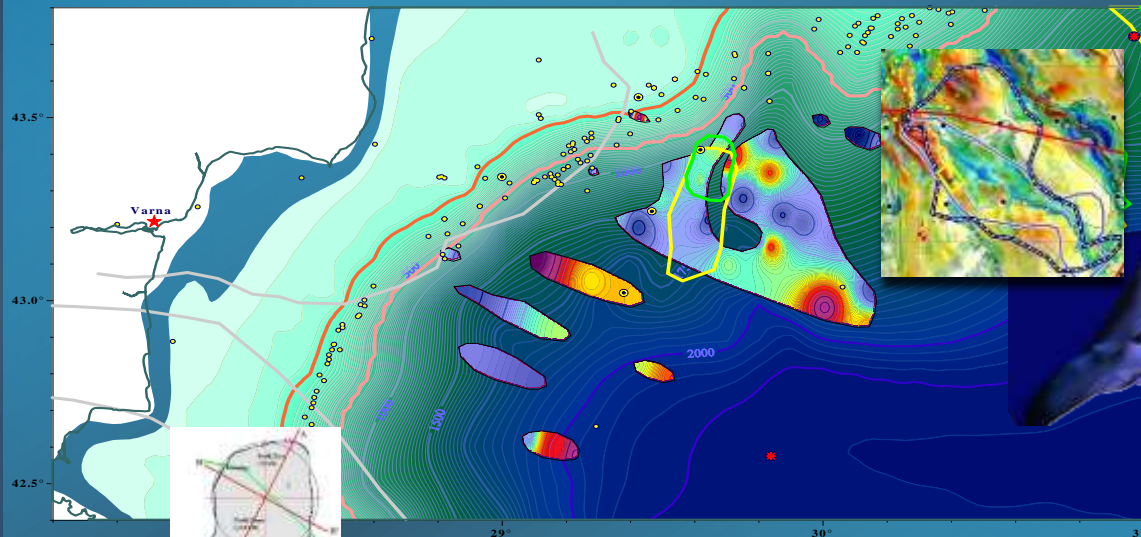
11 potential gas hydrates areas in the BEEZ  
 $\text{CH}_4$ : 7,800 bcm  $\pm$  25%



GEO-HYDRATE - Black Sea, BG Part:

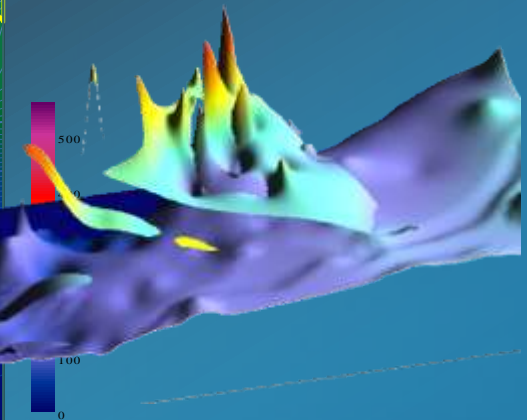


Total BSR Area – 11 fields	2,610 km <sup>2</sup>
Min, Av, Max GH Thickness	8-240-576 m
Total GH Sediments Volume	623 km <sup>3</sup>
GH Deposits	~50 bcm
Methane Volume	7,800 bcm $\pm$ 25%
Mass	4 $\pm$ 1 Gt
Total GH Methane = 4,300 Gas Fields Galata	



Vasilev, 2009

The smallest 3 areas are "stopped" from the East Moesian Fault System

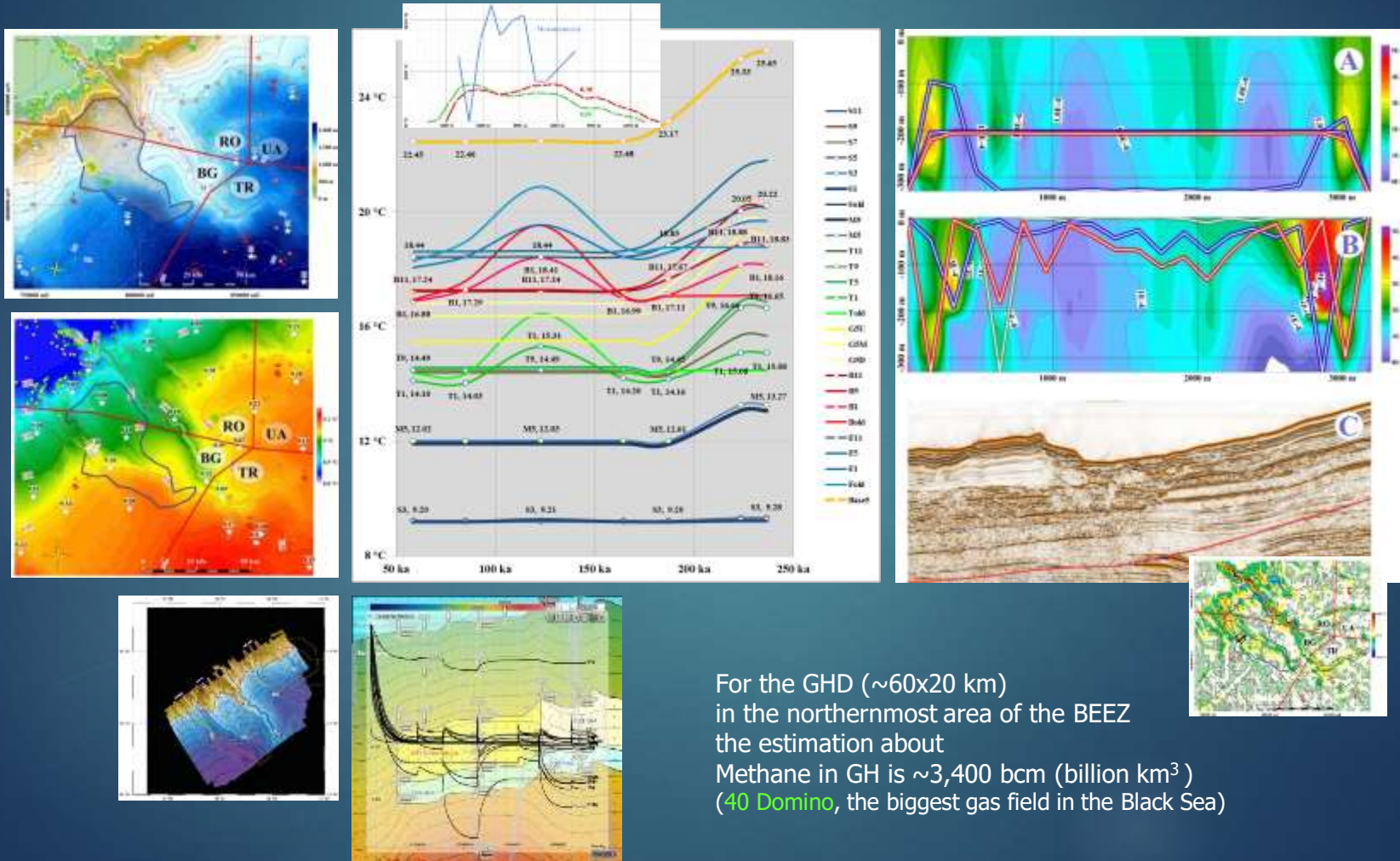


# Geothermy - the new key for GH study: GHD resource estimation (inverse problem)



## Danube paleodelta

CH<sub>4</sub>: in GH 3,400 bcm + 132 bcm in free gas  
1 BSR area, BEEZ 1,350 km<sup>2</sup>; water depth 675-1910 m;





# Blue energy: unconventional sources of energy from the sea



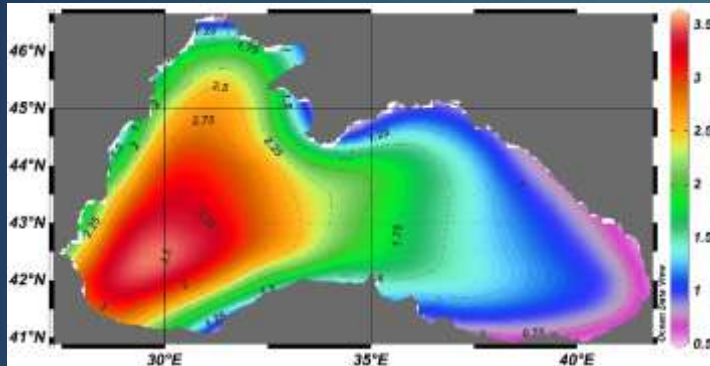
Successful pilot marine experiment to generate energy from hydrogen sulphide in Black Sea water through a sulphide fuel cell

## Project HYSULFCELL (BS ERANET)

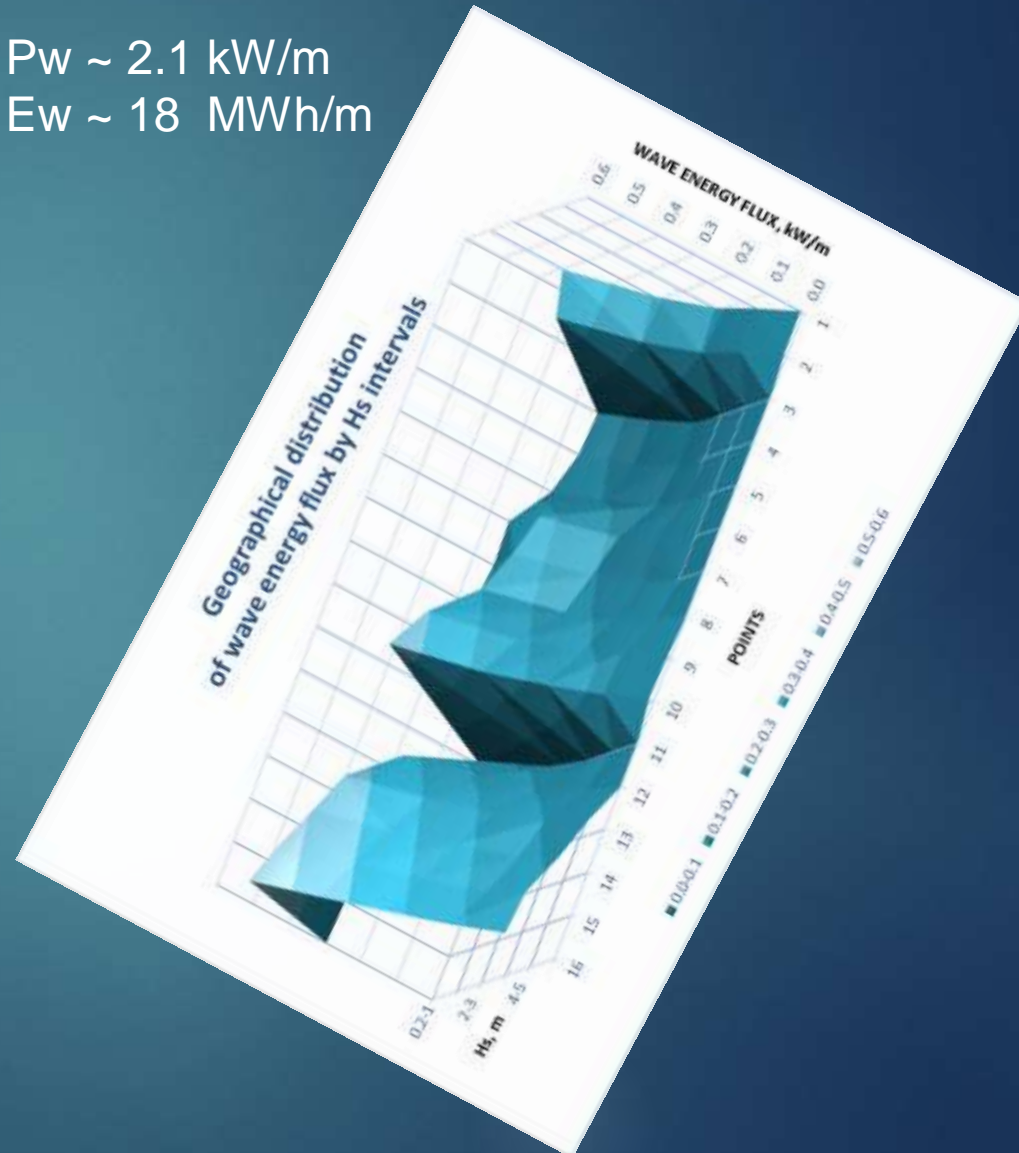
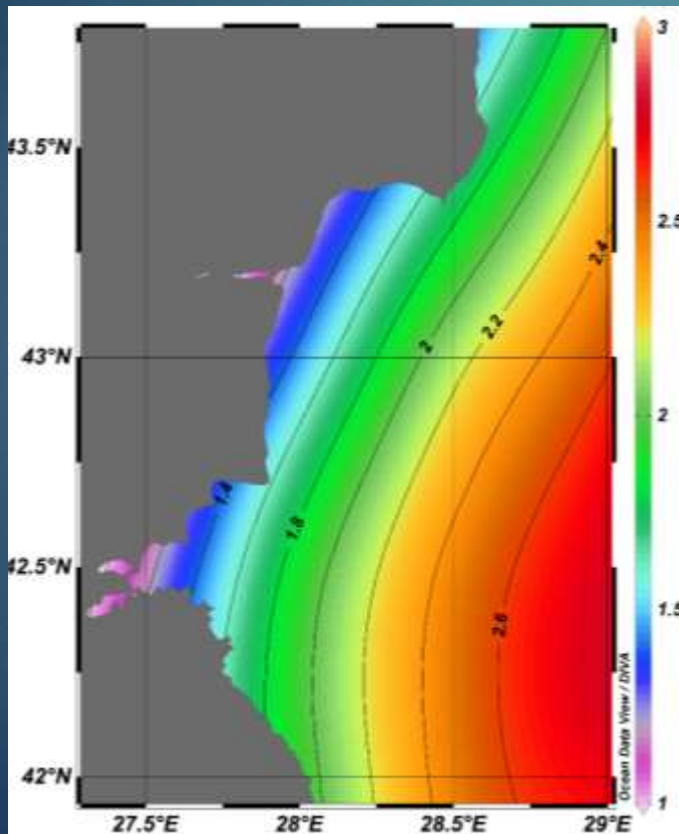
International cruise with RV "AKADEMIK" in July 2014 under the leadership of prof. Beshkov (participants from Bulgaria, Georgia, Romania)



# Blue energy: Wave energy

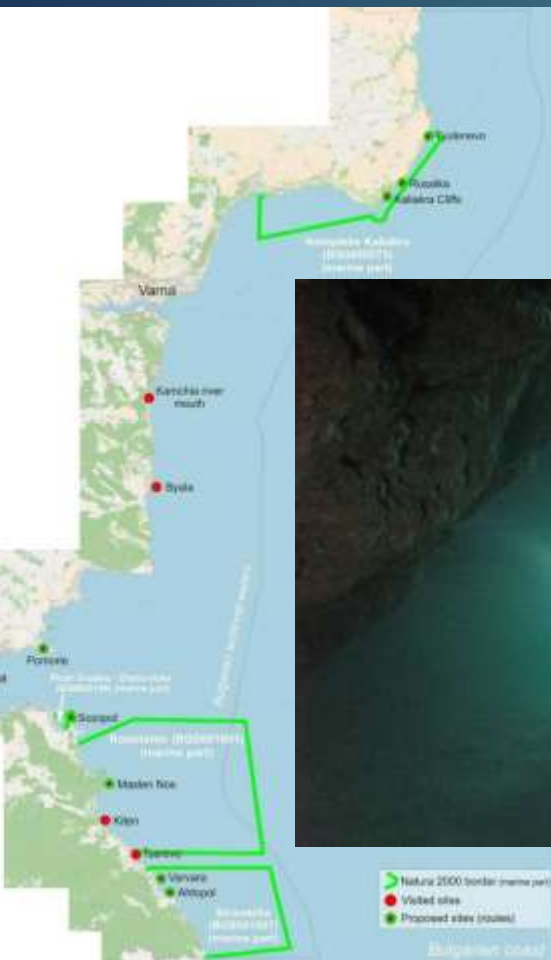


$P_w \sim 2.1 \text{ kW/m}$   
 $E_w \sim 18 \text{ MWh/m}$





# Western Black Sea Underwater Cultural Tourist Routes



Project aims at promoting Scuba Diving adventure tourism and developing the tourist potential of the Western Black Sea region

- ▶ Route of wrecks and artificial reefs
- ▶ Route “Old submerged commercial roads” (underwater archaeological sites and artifacts)
- ▶ The Natural Underwater Heritage route
- ▶ Route of submerged artefacts exhibited in museums

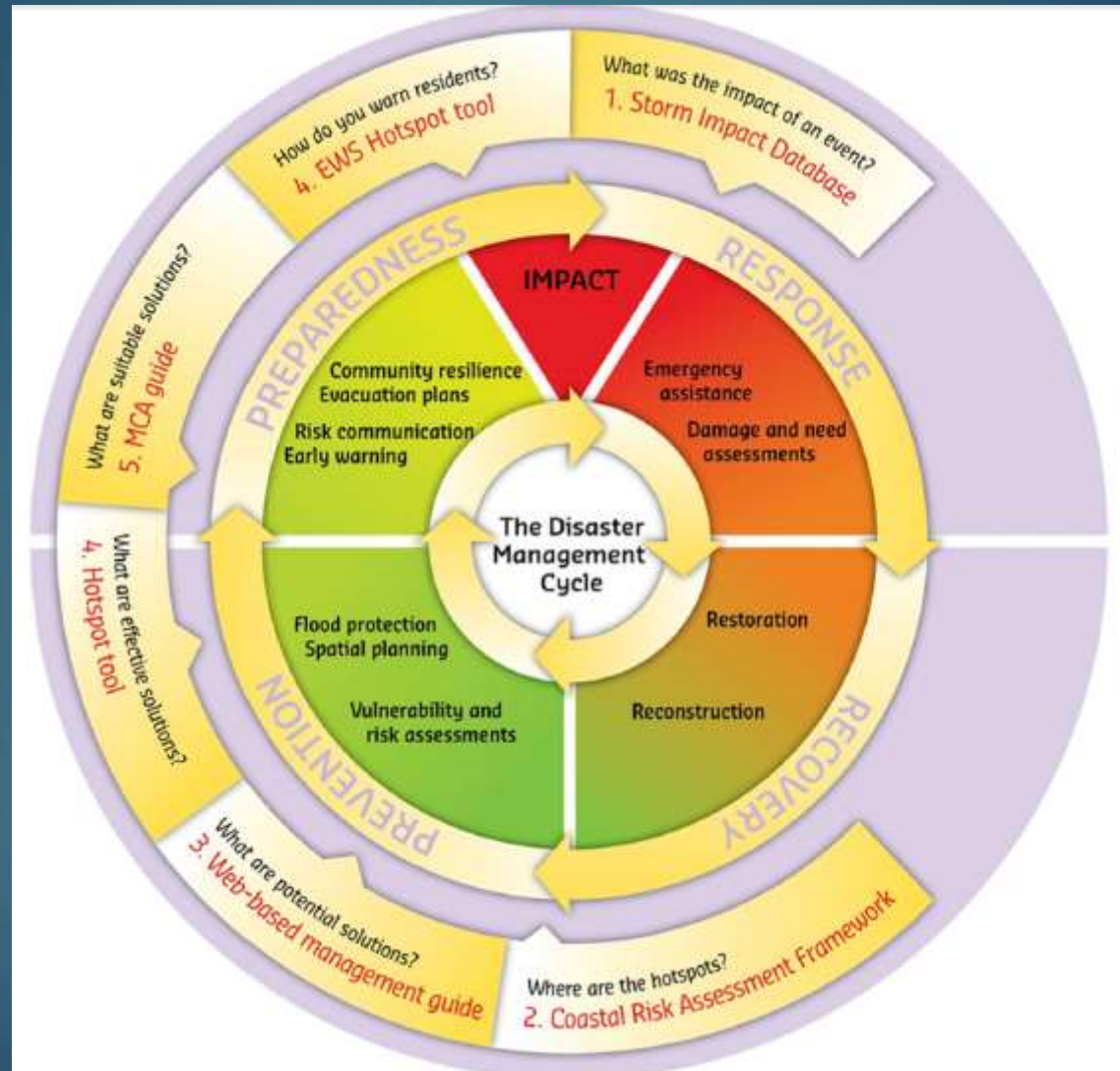
# Coastal strategies for risk assessment and disaster management



- ▶ **Storm Impact Database** (archive and contemporaneous physical, geomorphological, ecological, socio-economic and socio-cultural data)
- ▶ **Coastal Risk Assessment Framework (CRAF)** at regional level – identification of hotspots;
- ▶ **Forecasting and Early Warning System (EWS)** – based on Delft FEWS (Flood EWS)
- ▶ **Decision Support System (DSS)** – hazard modelling, DRR measures efficacy, long-term prediction of coastal state using Bayesian Network (BN)



# Disaster Management Cycle

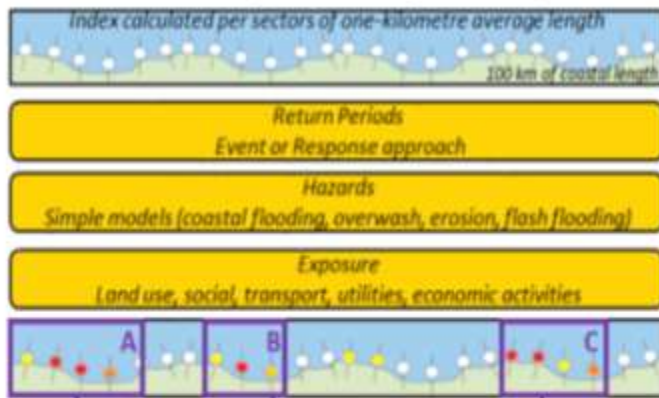


# CRAF / Essence

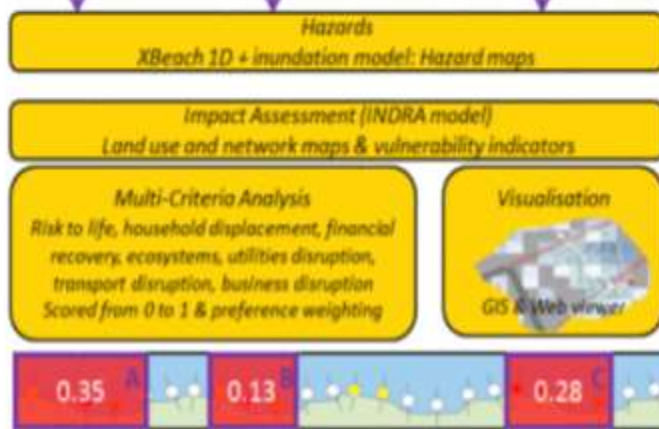


## Coastal Risk Assessment Framework

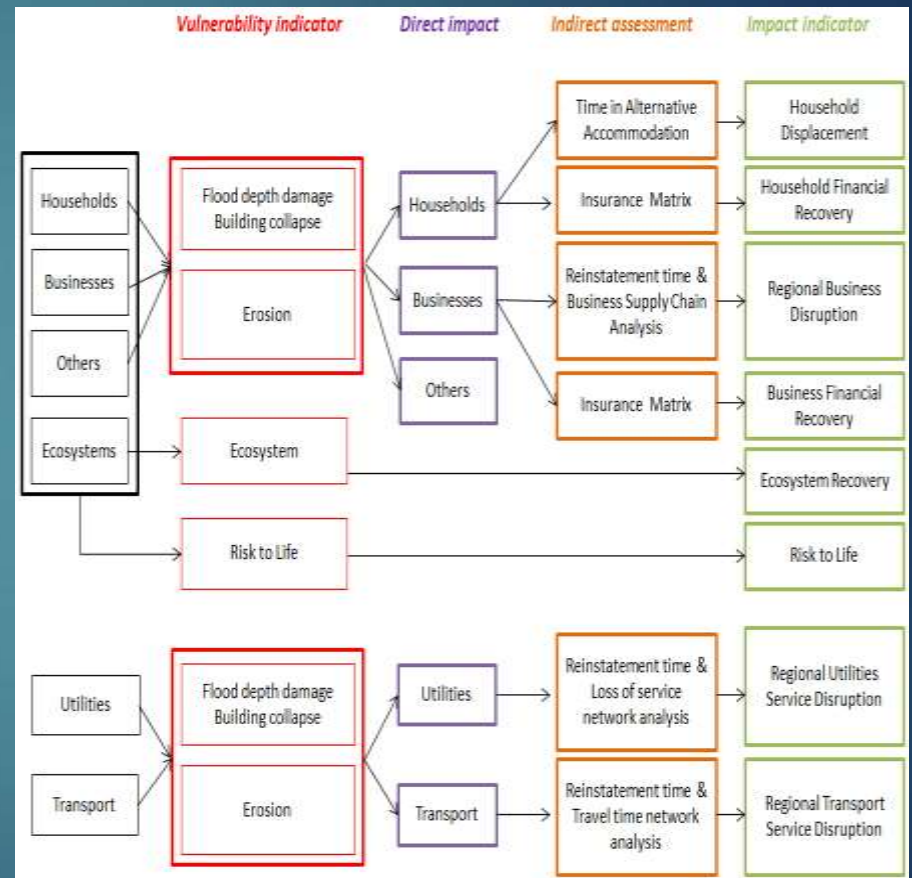
### Phase 1: A coastal-index approach delimiting several hotspots



### Phase 2: Impact assessment and multi-criteria analysis for each hotspot



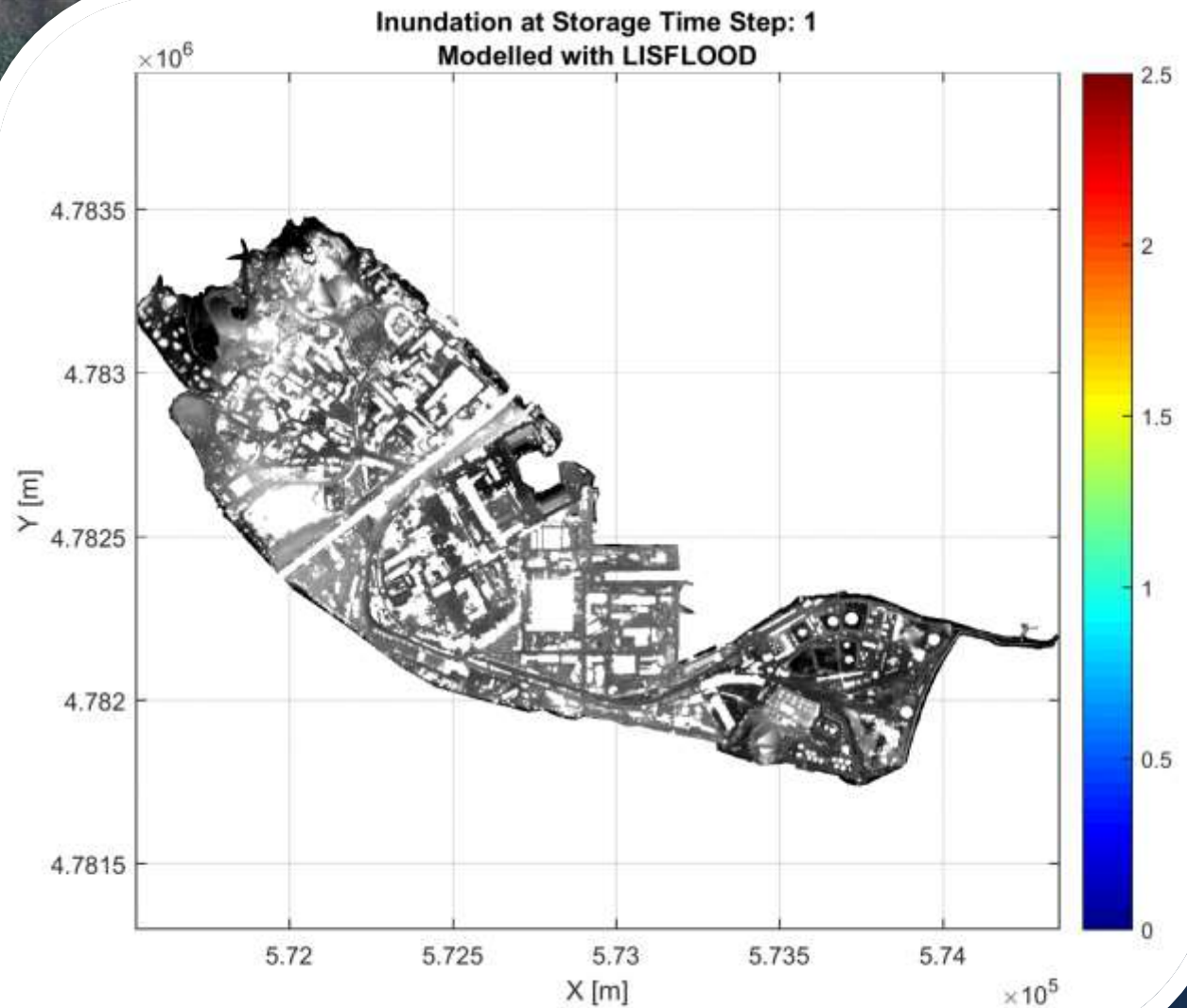
Early Warning System / Decision Support System



Where are the hotspots?



# CRAF results





# Possible DRR measures

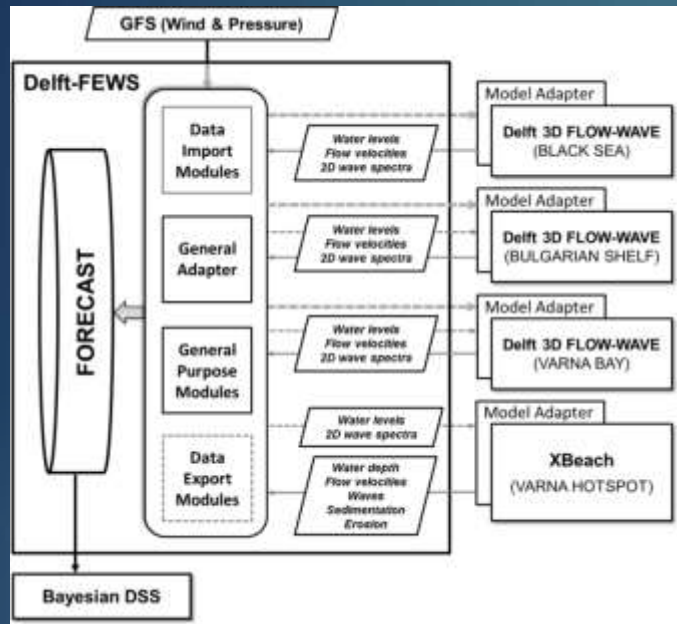
Hazard influencing (structural)	Vulnerability influencing	
	Primary	Non-primary
<ul style="list-style-type: none"> <li>• <b>Beach nourishment</b></li> <li>• Modify or extend coastal structures</li> <li>• <b>Breakwaters reinforcement</b></li> <li>• Submerged breakwater</li> <li>• ...</li> <li>• Ecosystem based (reefs, grass fields etc.)</li> </ul>	<b>Longer term preparedness and mitigation measures</b> <ul style="list-style-type: none"> <li>• Managed retreat (spatial planning and buffer zones)</li> <li>• Raising floor height of asset</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness raising measures</li> <li>• Emergency response and planning</li> <li>• <b>Early warning system</b></li> </ul>
	<b>Passive preparedness measures</b> <ul style="list-style-type: none"> <li>• Property level resistance measure</li> <li>• Demountable defences</li> </ul>	
	<b>Active preparedness measures</b> <ul style="list-style-type: none"> <li>• Event effective evacuation</li> <li>• <b>Moving assets out of risk (e.g. boats, cars)</b></li> <li>• Placing sandbags</li> </ul>	



What are potential solutions?



# FEWS / Structure & Domains

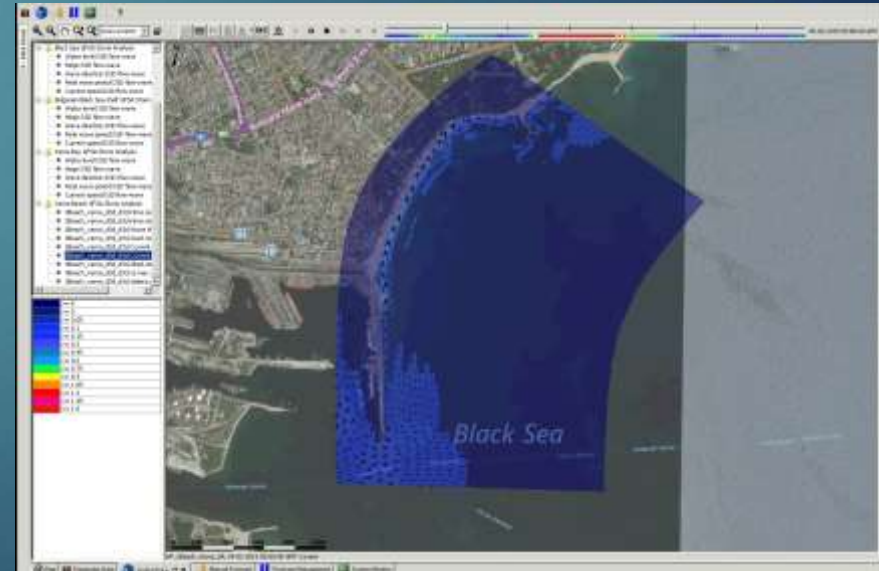
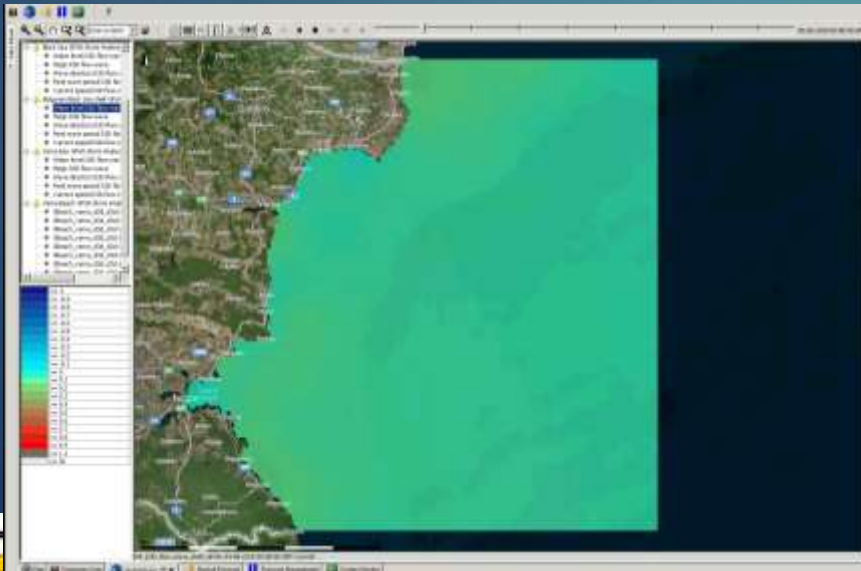
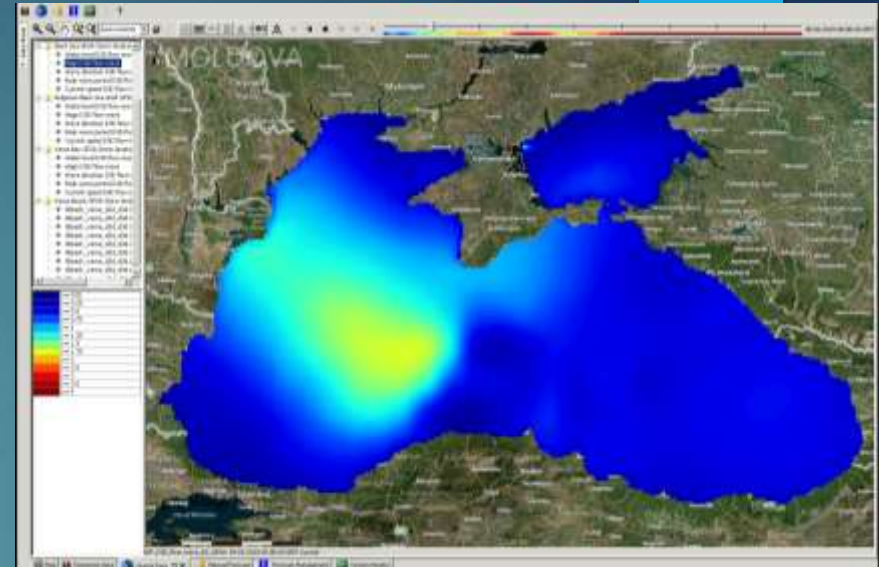
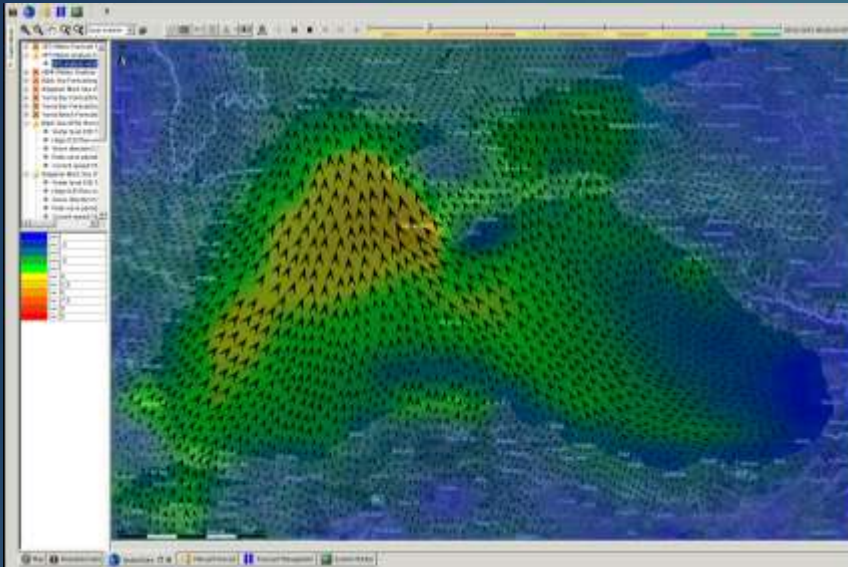


How do you warn residents?



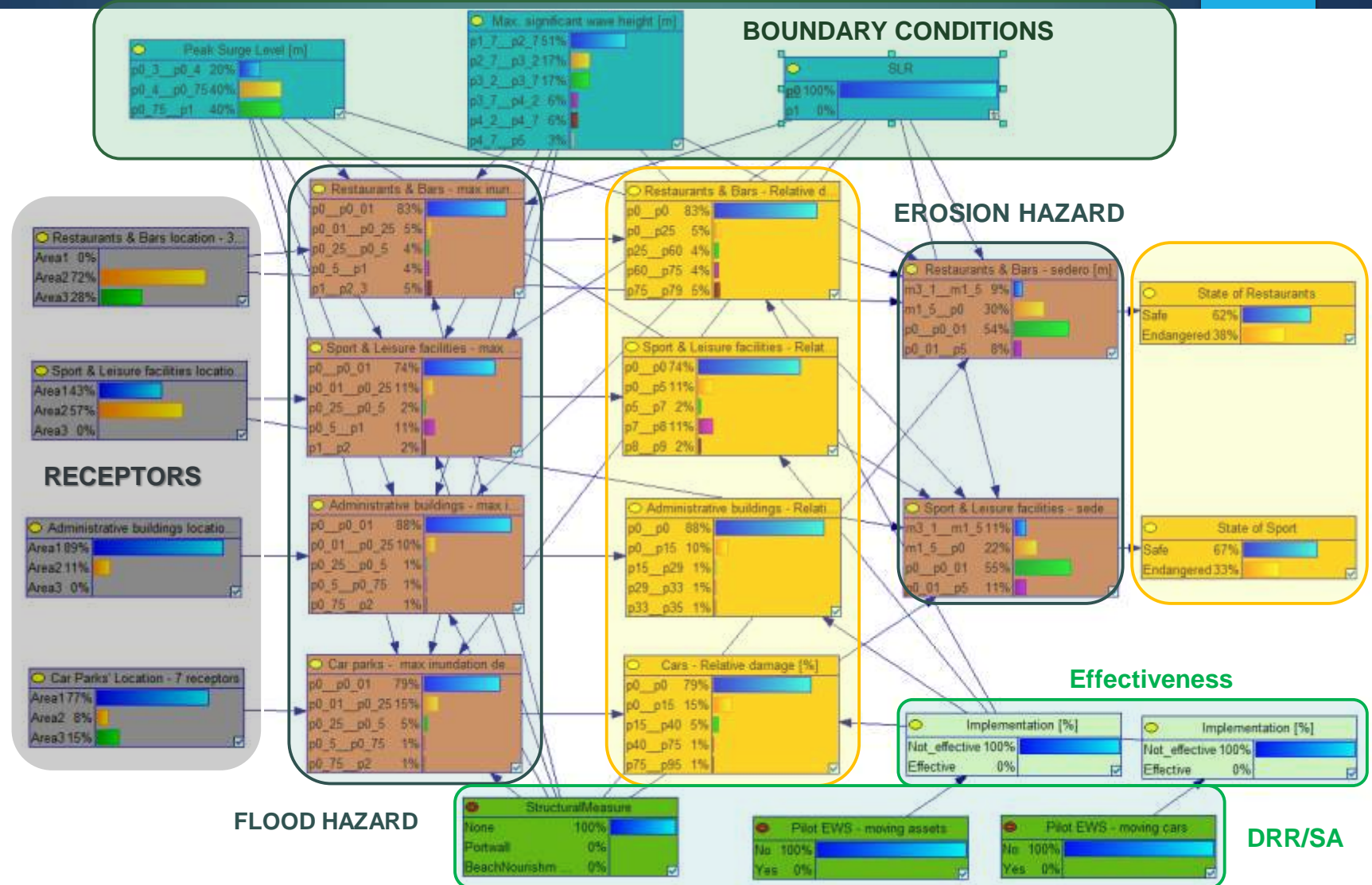


# FEWS / Examples of prediction





# DSS / Bayesian network design



What are effective solutions?



THANK YOU FOR YOUR ATTENTION!