SWAN Progress Meeting
University of Arizona
November 10 - 13, 2014

Progress Report

National Institute of Geophysics Geodesy and Geography

Bulgarian Academy of Sciences

(NIGGG – BAS)

June – November 2014

National Institute of Geophysics
Geodesy and Geography

Content

1. Research visits
2. Research achievements
3. Dissemination
4. Future plans

National Institute of Geophysics
Geodesy and Geography

Research visits

Kremena Boyanova

Research visit September-November 2013

Study

- Application of the Water Footprint Concept and Hydrological Modeling for Quantification of Water-related Ecosystem Services.
- Comparative analysis of the flood regulating ecosystem services in Bulgaria and Arizona by applying the VIC and KINEROS hydrological models.

Participation

- Weekly SWAN meetings

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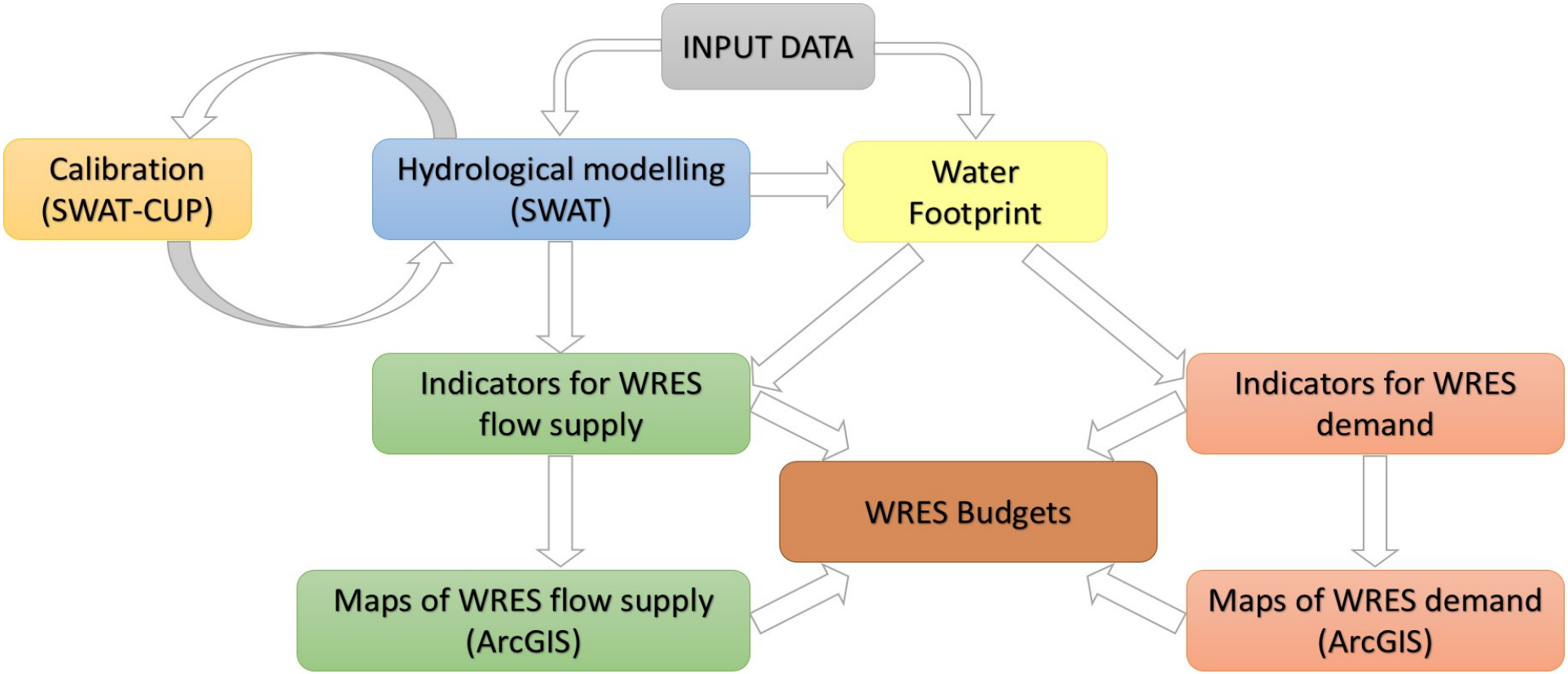
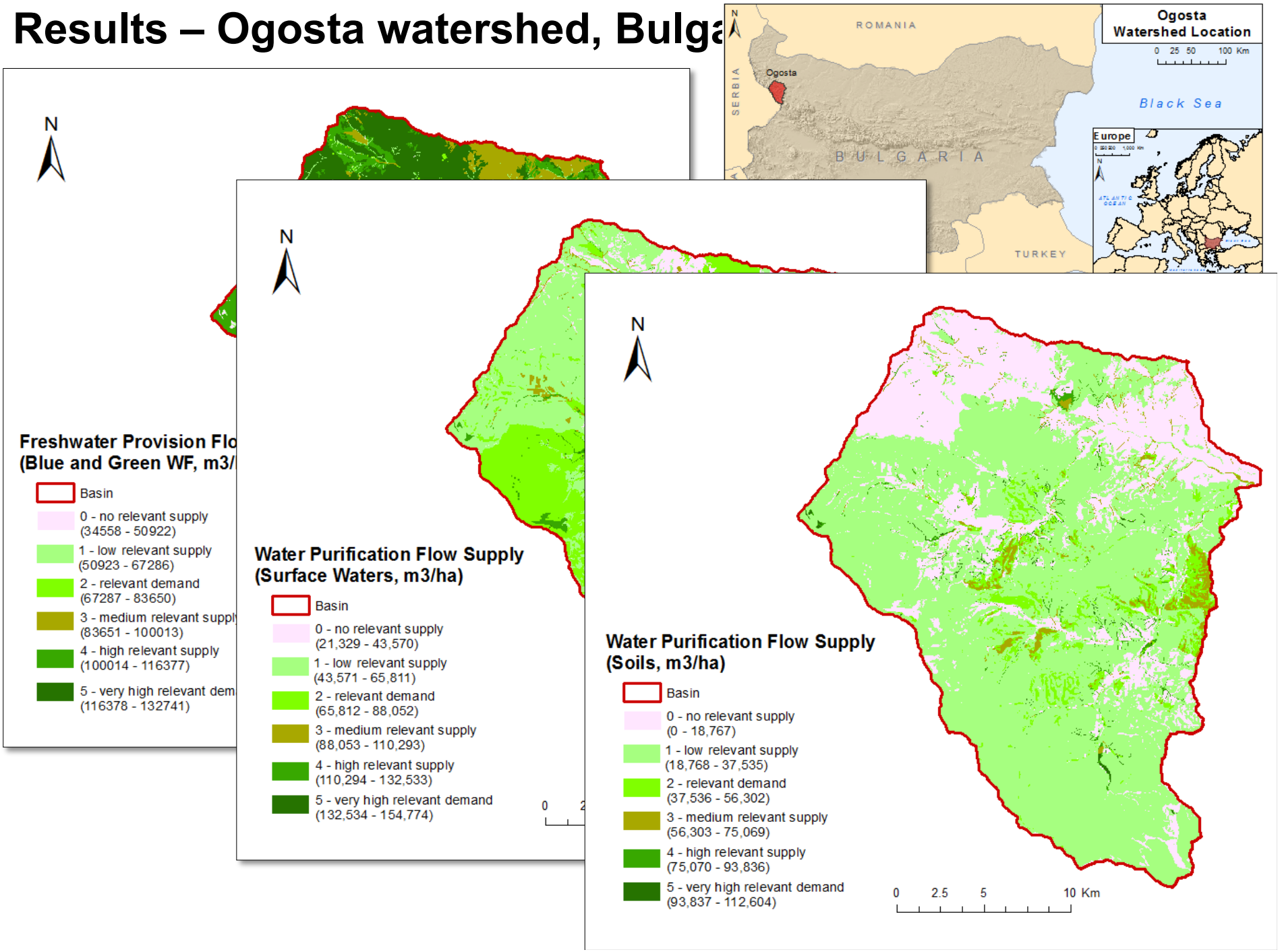
Research achievements

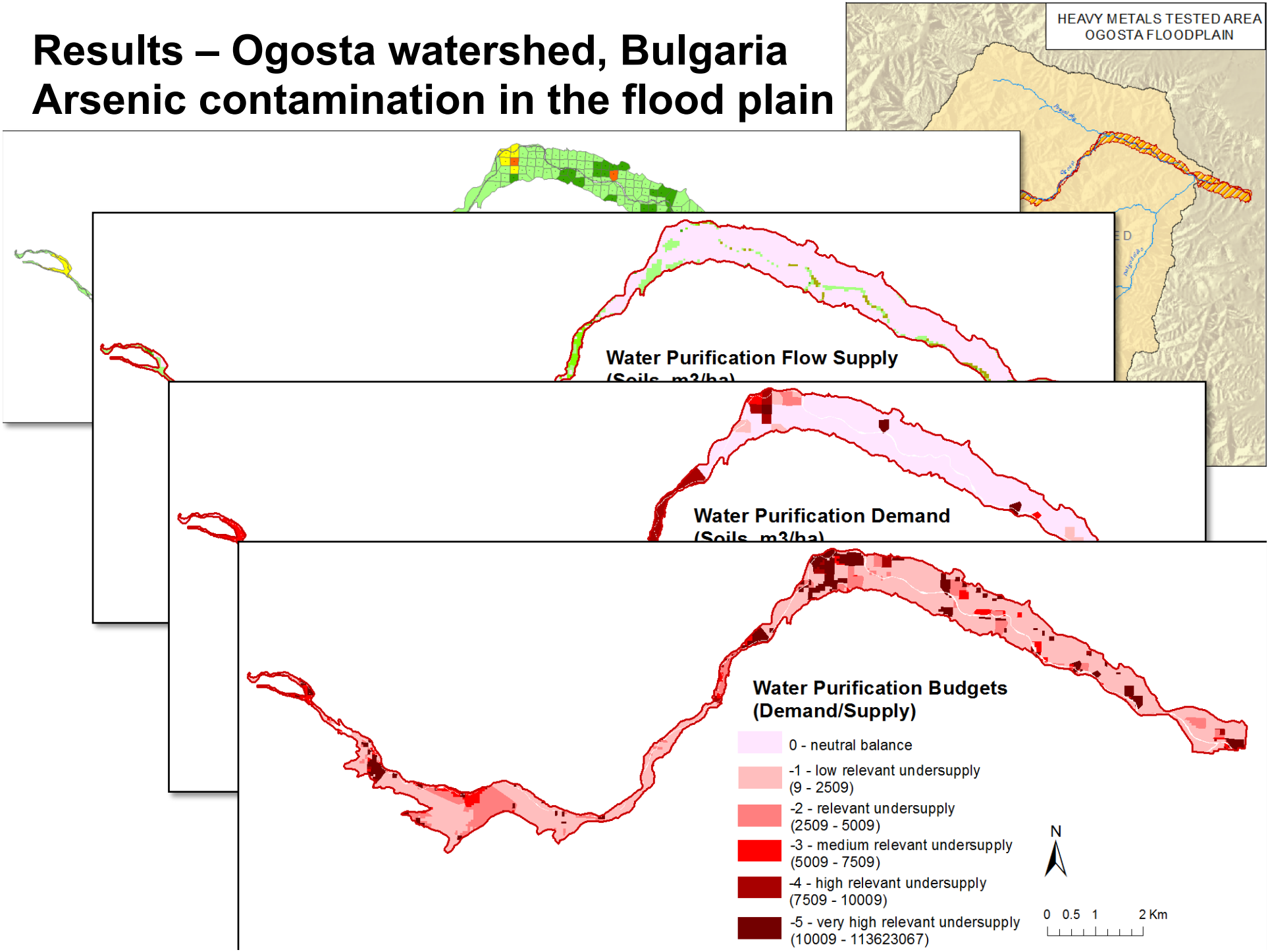
Application of the Water Footprint Concept and Hydrological Modeling for Quantification of Water-related Ecosystem Services



Results – Ogosta watershed, Bulga



Results – Ogosta watershed, Bulgaria
Arsenic contamination in the flood plain



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Research achievements

Ecosystem services assessment in Tucson basin

- Importance of certain ecosystem services and their potential in terms of natural resources

0 = no relevance
1 = low relevance
2 = relevance
3 = medium relevance
4 = high relevance
5 = very high relevance

Major Goals:

1. Investigation
2. Assessment matrix

capacities *supply* *demand*

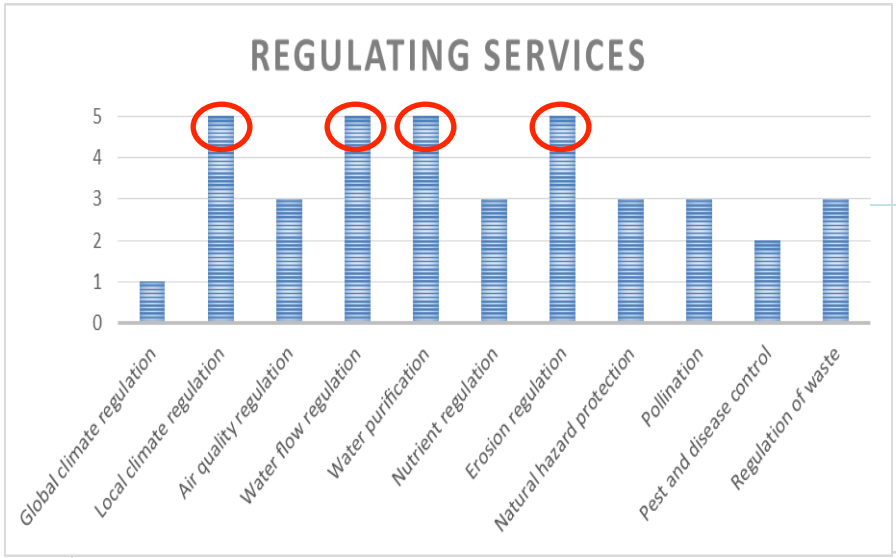
3. Mapping goods and services

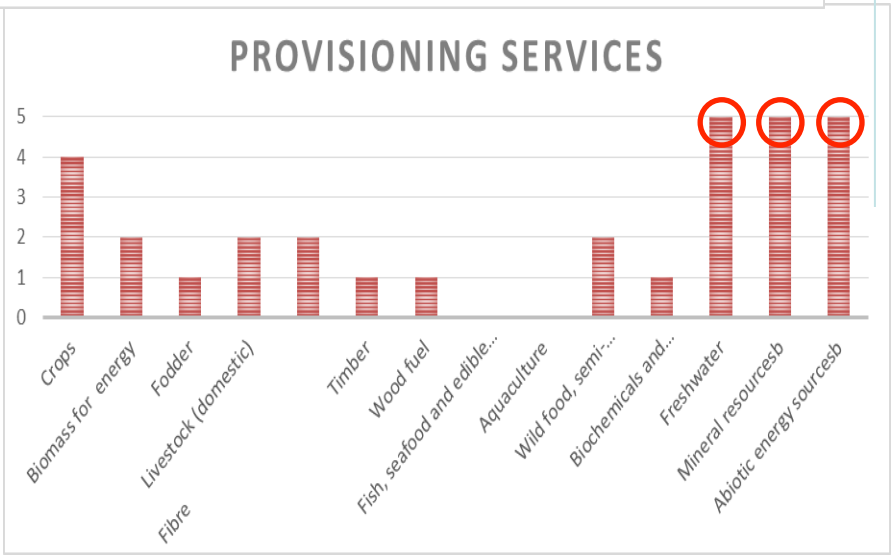
Target groups:

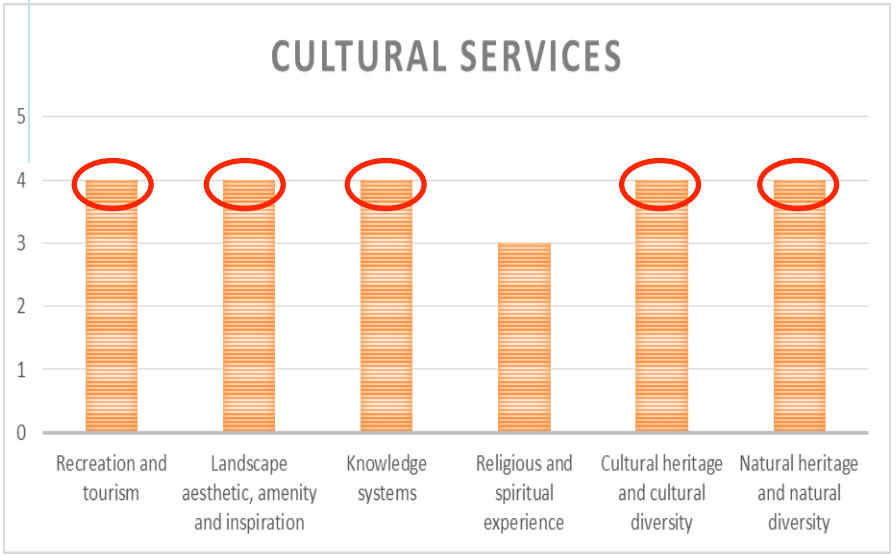
- SWAN members; 55/86
- UofA Academia; 65%
- UofA students.

METHODOLOGY: **Expert based assessment** of the provision of ecosystem services through **INTERVIEWS**

RESULTS







supply/demand for ES within different land cover classes

RESULTS

Local climate regulation	Water flow regulation	Water purification	Erosion regulation	…
Freshwater	Mineral resources	Abiotic energy sources		…
Recreation and tourism	Landscape aesthetic, amenity and inspiration	Knowledge systems		
Cultural heritage and cultural diversity	Natural heritage and natural diversity			

0 = no relevant supply/demand
1 = low relevant supply/demand
2 = relevant supply/demand
3 = medium relevant supply/demand
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5 = very high relevant supply/demand

LAND COVER AND LAND USE CLASSES	regulating services	Local climate regulation	Air quality regulation	Water flow regulation	Water purification	Erosion regulation	Natural hazard protection	Pollination	Regulation of waste	provisioning services	Crops	Freshwater	Mineral resources	Abiotic energy sources	cultural services	Recreation andtourism	Landscape aesthetic, amenity and inspiration	Knowledgesystems	Cultural heritageand cultural diversity	Natural heritageand natural diversity
(NLCD 2006)		2	3	4	5	7	8	9	11		12	23	24	25		26	27	28	30	31
Open Water																				
Developed, Open Space																				
Developed, Low Intensity																				
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Urban																				
Rock/Sand/Clay																				
Deciduous Forest																				
Evergreen Forest																				
Mixed Forest																				
Shrub/Scrub																				
Grassland/Herbaceous																				
Pasture/Hay																				
Cultivated Crops																				
Woody Wetlands																				
Wetlands																				

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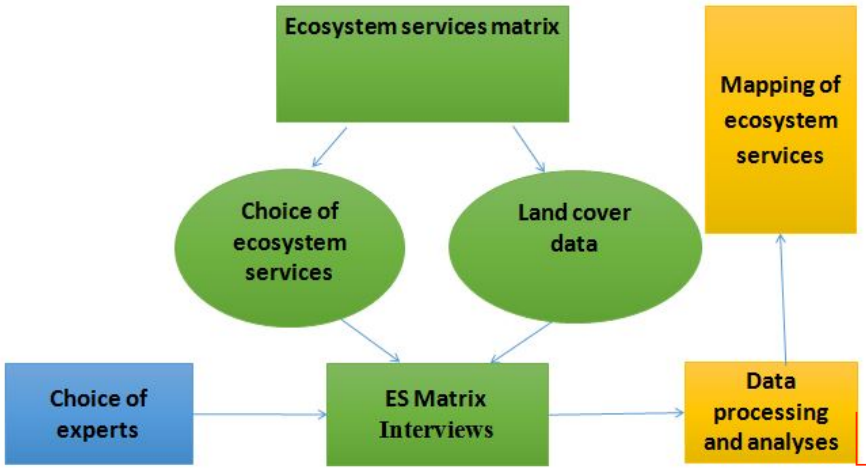
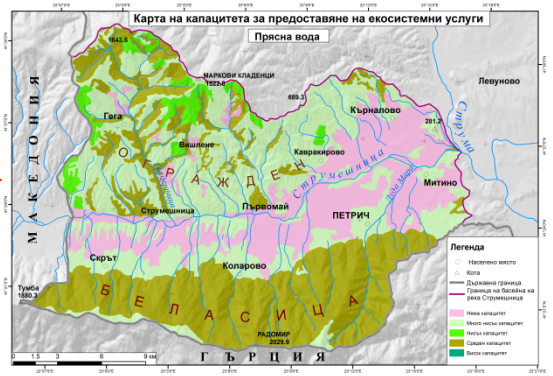
Research achievements

Ecosystem Services assessment in Strumeshnitsa basin (Bulgaria)





17 experts from
12 different institutions

кодове	Екосистемни услуги / Земно покритие	Материални услуги Σ	Храна (земеделие)	Храна (животновъдство)	Фураж / храна за животни	Енергия от биомаса	Естествени влакна	Добив на дървесина	Дърва за огрев	Риболов, морски дарове и води за консумация водорасли	Храна от дивораст. растения	Биохимикали и медицина	Прясна вода	Хдиотични енергийни източници	Регулационни и поддържащи услуги Σ	Регулиране на климата на глобално ниво	Регулиране на климата на локално ниво	Регулиране качеството на въздуха	Регулиране на водния кръговрат	Качество на водата	Регулиране на ерозията	Регулиране на природните бедствия	Опрашване	Контрол върху вредители и болест	Регулиране на отпадъците	Предоставяне на местообитания	Биоразнообразие	Културни услуги Σ	Рекреация и туризъм	Естетическа и духовна стойност	Образователна и научна стойност	Религия и духовна стойност	Културно наследство и културно разнообразие	Общо
112	Населени места със свободно застрояване	14	3	2	1	1	1	1	1	0	1	1	1	2	18	1	1	2	1	2	2	1	2	1	2	1	1	12	3	2	2	2	3	43
121	Индустриални или търговски обекти	5	0	0	0	0	0	0	0	0	0	1	1	2	12	1	2	1	1	2	1	1	1	0	2	0	0	2	1	0	1	0	0	18
211	Ненапоявана обработваема земя	16	3	3	2	2	2	0	0	0	1	1	0	1	18	1	1	1	2	2	2	1	2	1	1	2	2	4	1	1	1	1	1	37
221	Лозя	8	4	1	1	1	0	0	0	0	0	1	0	0	17	1	1	2	1	1	2	1	2	1	1	2	2	6	1	1	1	1	1	31
222	Овощни и ягодови насаждения	10	4	1	1	1	0	0	1	0	1	1	0	0	19	1	1	2	2	1	2	1	3	2	1	2	2	5	1	1	1	1	1	34
231	Пасища	18	1	4	4	2	1	0	0	0	2	1	1	1	20	1	1	2	2	1	1	1	3	1	1	3	3	6	1	1	1	1	1	43
242	Комплекси от раздробени земеделски зем	15	3	2	2	1	2	0	1	0	1	1	0	1	18	1	1	1	1	1	1	1	3	2	1	3	3	6	1	2	1	1	1	40
243	участъци естествена растителност	21	3	2	3	2	2	1	2	0	3	2	1	1	27	2	2	2	2	2	2	2	3	2	1	4	4	10	2	3	2	2	1	59
311	Широколистни гори	27	1	2	2	2	1	5	5	0	3	2	3	0	41	3	3	4	5	4	5	3	3	2	2	5	5	16	4	4	4	3	2	84
312	Иглолистни гори	22	1	1	1	2	1	5	4	0	2	2	2	0	36	3	3	4	3	3	4	3	3	2	2	4	4	14	3	4	3	2	2	72
313	Смесени гори	25	1	2	2	2	1	4	4	0	3	2	3	0	38	3	3	4	3	3	4	3	3	2	2	5	5	15	4	4	3	3	2	78
321	Естествени ливади	19	2	3	4	1	1	0	0	0	3	2	1	1	28	2	2	2	3	2	2	1	4	2	1	4	5	12	3	3	3	2	1	59
324	Преходна дървесно-храстова растителност	18	1	2	2	2	1	1	2	0	3	2	1	1	31	2	2	3	3	3	3	2	3	2	1	4	4	14	3	4	3	2	2	63
511	Водни течения	15	1	1	0	0	0	0	0	5	0	1	4	3	26	2	2	1	3	3	2	2	1	1	1	3	3	13	3	3	3	2	2	54

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Research achievements

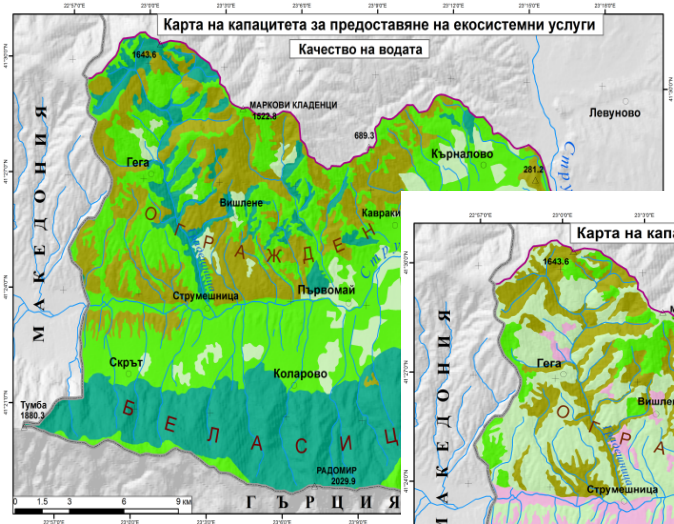
Ecosystem Services assessment in Strumeshnitsa basin (Bulgaria)

Капацитет	[illegible]	Храна (земеделие)	Храна (животновъдство)	Фураж / храна за животни	Енергия от биомаса	Естествени влакна	Добив на дървесина	Дърва за огрев	Риболов, морски дарове и годни за консумация	Храна от дивораст. растения	Биохимикали и медицина	Прясна вода	Абиотични енергийни източници	Регулиране на климата на глобално ниво	Регулиране на климата на локално ниво	Регулиране качеството на въздуха	Регулиране на водния кръговрат	Качество на водата	Регулиране на ерозията	Регулиране на природните бедствия	Опрашване	Контрол върху вредители и болести	Регулиране на отпадъците	Предоставяне на местообитания	Биоразнообразие	Рекреация и туризъм	Естетическа и духовна стойност	Образователна и научна стойност	Религия и духовна стойност	Културно наследство и културно разнообразие
0	km²	16	2	2	17	26	148	125	439.2	16	0	98	196	0	0	0	0	0	0	0	0	0	0	2	2	1	19	0	16	14
	общат	4	1	1	4	6	34	28	99.8	4	0	22	45	0	0	0	0	0	0	0	0	0	0	1	1	0	4	0	4	3
1	km²	221	40	55	85	281	120	37	0	99	118	170	227	118	116	75	43	42	17	163	13	2	252	16	15	102	72	103	97	196
	в %	50	9	13	19	64	27	8	0	22	27	39	52	27	26	17	10	10	4	37	3	1	57	4	3	23	16	23	22	44
2	km²	43	290	276	338	133	0	105	0	19	322	15	16	150	152	147	135	181	207	105	88	93	188	85	84	59	27	75	178	215
	в %	10	66	62	77	30	0	24	0	4	73	3	4	34	35	33	31	41	47	24	20	21	43	19	19	13	6	17	40	49
3	km²	137	105	59	0	0	0	0	0	307	0	156	0.2	172	172	46	124	79	45	172	299	345	0	16	16	122	104	124	149	15
	в %	31	24	13	0	0	0	0	0	70	0	35	0.0	39	39	10	28	18	10	39	68	78	0	4	4	28	24	28	34	4
4	km²	23	3	48	0	0	18	33	0	0	0	0.02	0	0	0	172	0	138	33	0	40	0	0	165	121	156	218	138	0	0
	в %	5	1	11	0	0	4	8	0	0	0	0.01	0	0	0	39	0	31	8	0	9	0	0	38	27	35	50	31	0	0
5	km²	0	0	0	0	0	153	138	0.2	0	0	0	0	0	0	0	138	0	138	0	0	0	0	155	201	0	0	0	0	0
		0	0	0	0	0	35	31	0.0	0	0	0	0	0	0	0	31	0	31	0	0	0	0	35	46	0	0	0	0	0

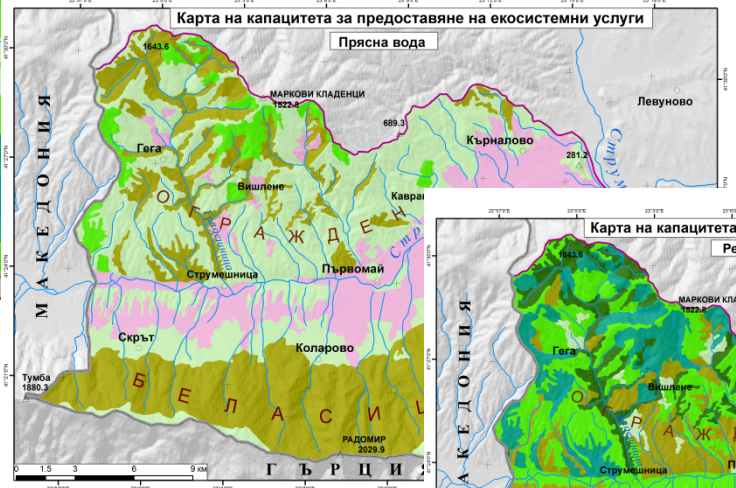
National Institute of Geophysics Geodesy and Geography

Research achievements

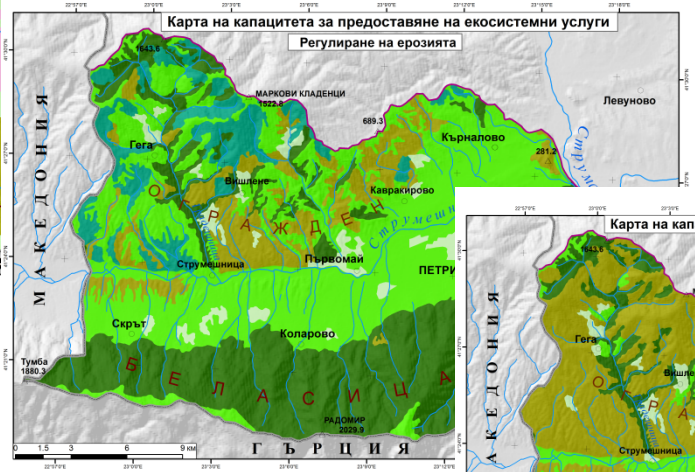
Ecosystem Services assessment in Strumeshnitsa basin (Bulgaria)



Water quality

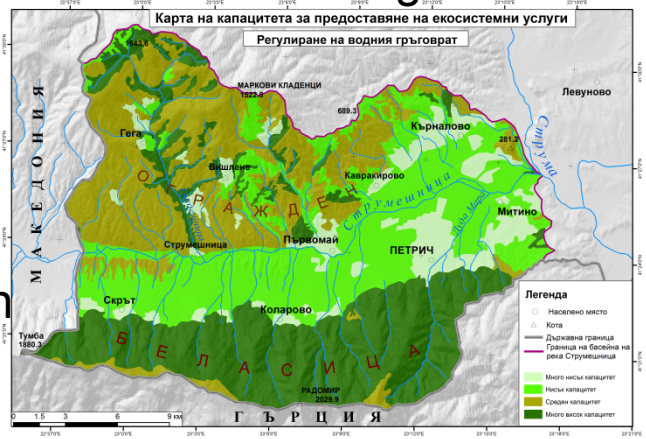


Water supply



Erosion regulation

Water cycle regulation



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Dissemination

Publications

Nedkov, S., Boyanova, K., Burkhard, B., 2014. Quantifying, modelling and mapping ecosystem services in watersheds In: Muller, F., Chicharo, L., Fohrer, N., Wolanski, E. (Eds.) Ecosystem services and river basin ecohydrology. Springer.

Boyanova, K., Nedkov, S., Burkhard, B., 2014. Quantification and mapping of flood regulating ecosystem services in different watersheds – case studies in Bulgaria and Arizona, USA. In: Bandrova, T., Konecny, M., Zlatanova, S. (eds). Thematic Cartography for the Society, Springer.

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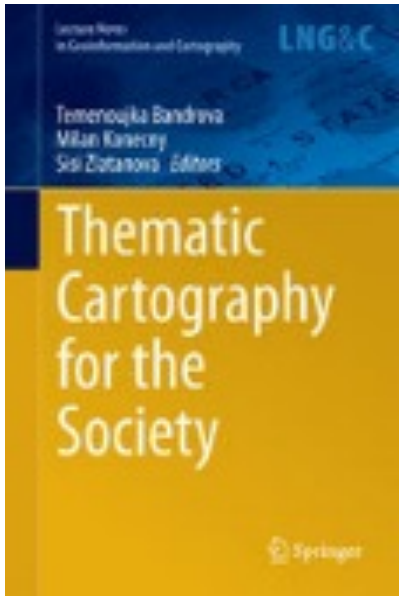
Dissemination

5th INTERNATIONAL CONFERENCE on CARTOGRAPHY & GIS
June 15-21, 2014, Riviera, Bulgaria



Acknowledgements:
SWAN project

Quantification and Mapping of Flood Regulating Ecosystem Services in Different Watersheds – Case Studies in Bulgaria and Arizona, USA

Kremena Boyanova*, Stoyan Nedkov, Benjamin Burkhard

Abstract There is great need for accurate and practical methods to assess the conditions of ecosystems, and the possible results of their interaction with social systems. The generation and interpretation of quantitative data for ecosystem service analysis is still not well established. Ecosystem service analyses demand an interdisciplinary approach that integrates knowledge with a high variety, and manifold verifications, of models and data. Maps seem to be the most preferable tool for the visualisation of results, being a comprehensive and intuitive tool for communication between decision makers and the general public. The following chapter presents an application and the verification of an approach for the quantification of flood regulating ecosystem services by using results from the watershed hydrological model KINEROS and the AGWA tool (Nedkov and Burkhard 2012). It is applied in six watersheds - three in Bulgaria and three in Arizona, USA, in order to check its reliability in case studies with differing geographic characteristics. The model results are used to define the capacities of the land cover classes in the different watersheds and to prepare flood regulating supply capacity maps. Capacities for flood regulation differ within the case studies and their land cover classes. Forests still show generally high capacities in both Bulgaria and Arizona, while grasslands and pastures in Bulgaria show higher capacities for flood regulation than in Arizona. The maps can provide valuable information for sustainable environmental management.

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Dissemination

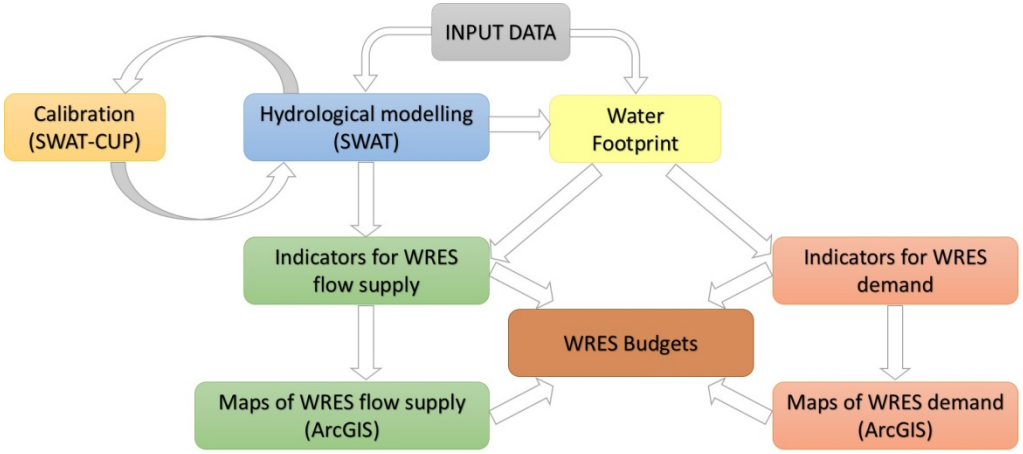
ESP Conference 2014

7th Conference of the Ecosystem Services partnership

Local action for the common good

8-12 September 2014, Costa Rica

Application of the Water Footprint Concept and Hydrological Modeling for Quantification of Water-related Ecosystem Services



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Future plans

Research Visit of Sofia Kostadinova January – April 2014

Preparations in progress

Study - Work on the assessment and mapping of the water-related ES

Research Visits of Tania Trenkova January – May 2015

Preparations in progress

Study - Work on *Web-based GIS applications supporting the integrated water management*

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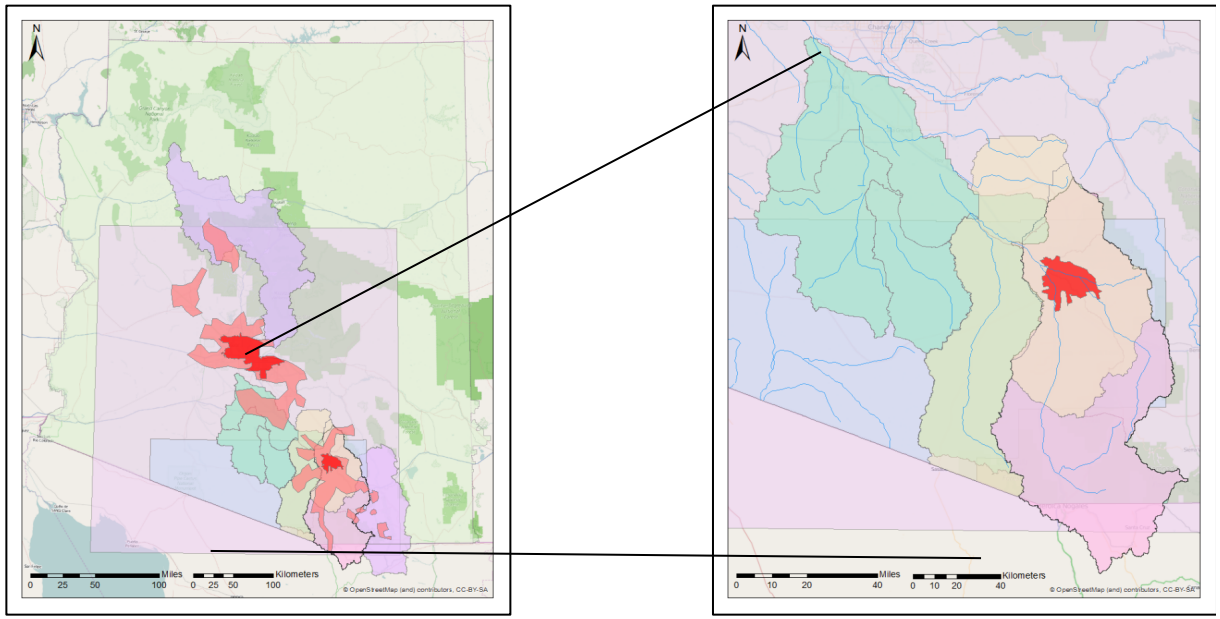
Future plans

Kremena Boyanova Implementation of her approach in the SWAN Case Study



- **Climate and land cover change** future scenarios data from modeling can be used as **input for SWAT** hydrological model
- Understanding the **hydrological cycle** within the basin is important for recognizing **the drivers of the decisions** that have been taken in the area
- **Ecosystem services** analysis will provide understanding on the **supply/demand budgets**
- Key services in the area are **groundwater recharge** and **riparian vegetation protection,** which are both dependent on the **hydrological cycle**

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Future plans

Rositsa Yaneva - ES Assessment step 2

Q1: What is the **capacity** of different land **cover classes to supply** ES?

Q2: What is the **demand** for ES within different land **cover classes**?

in scale from **0** to **5**

Ecosystem's supply capacity refers to the capacity of a particular area to provide a specific bundle of ecosystem goods and services.

Demand for ecosystem services is the requirement for optimum realization of a specific activity.

LAND COVER AND LAND USE CLASSES	regulating services	Local climate regulation	Air quality regulation	Water flow regulation	Water purification	Erosion regulation	Natural hazard protection	Pollination	Regulation of waste	provisioning services	Crops	Freshwater	Mineral resources	Renewable energy sources	cultural services	Recreation and tourism	Landscape aesthetic, amenity and inspiration	Knowledge systems	Cultural heritage and cultural diversity	Natural heritage and natural diversity
(NLCD 2006)		(NLCD 2006)									(NLCD 2006)					26	27	28	29	31
Open Water		Open Water									Open Water									
Urban		Urban									Urban									
Rock/Sand/Clay		Rock/Sand/Clay									Rock/Sand/Clay									
Deciduous Forest		Deciduous Forest									Deciduous Forest									
Evergreen Forest		Evergreen Forest									Evergreen Forest									
Mixed Forest		Mixed Forest									Mixed Forest									
Shrub/Scrub		Shrub/Scrub									Shrub/Scrub									
Grassland/Herbaceous		Grassland/Herbaceous									Grassland/Herbaceous									
Pasture/Hay		Pasture/Hay									Pasture/Hay									
Cultivated Crops		Cultivated Crops									Cultivated Crops									
Wetlands		Wetlands									Wetlands									

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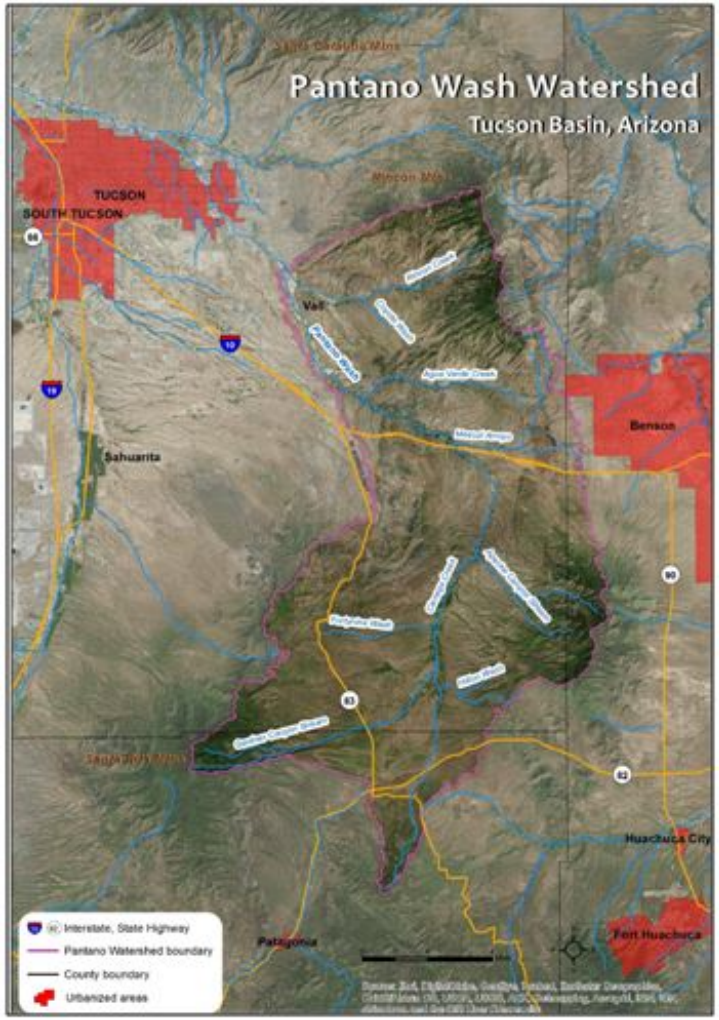
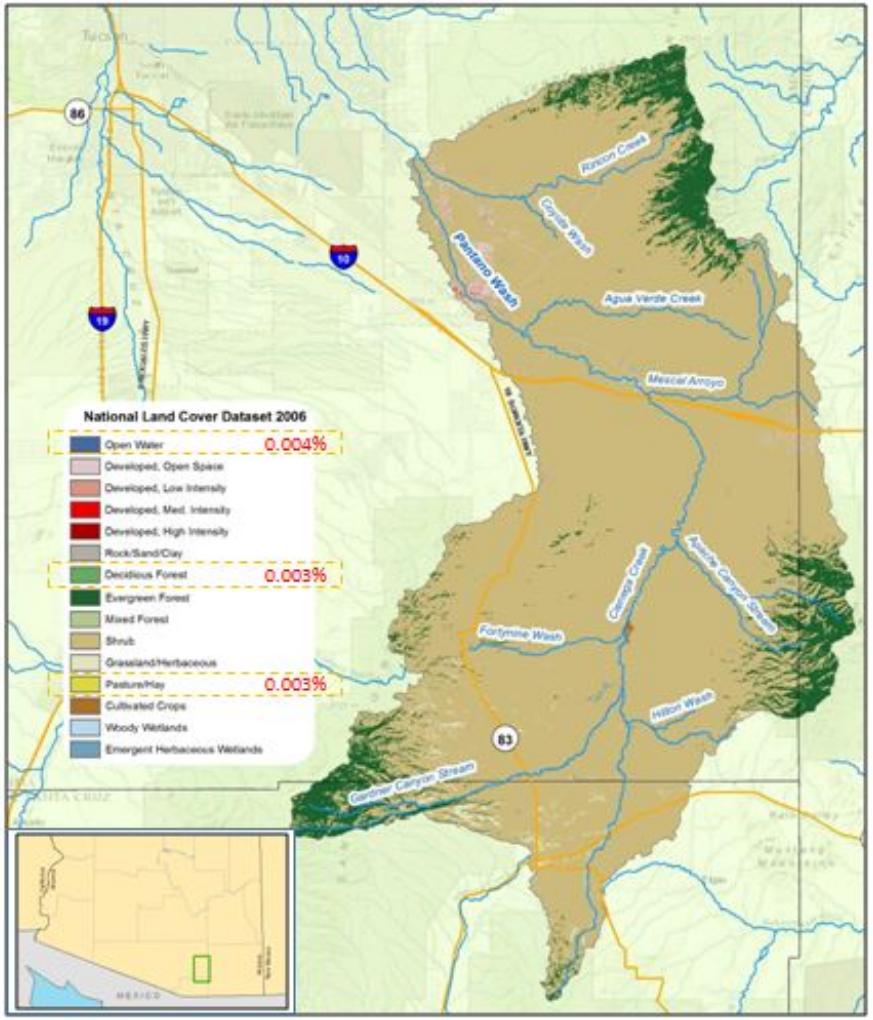
Future plans

Rositsa Yaneva - ES Assessment step 2






Thank you for your attention!