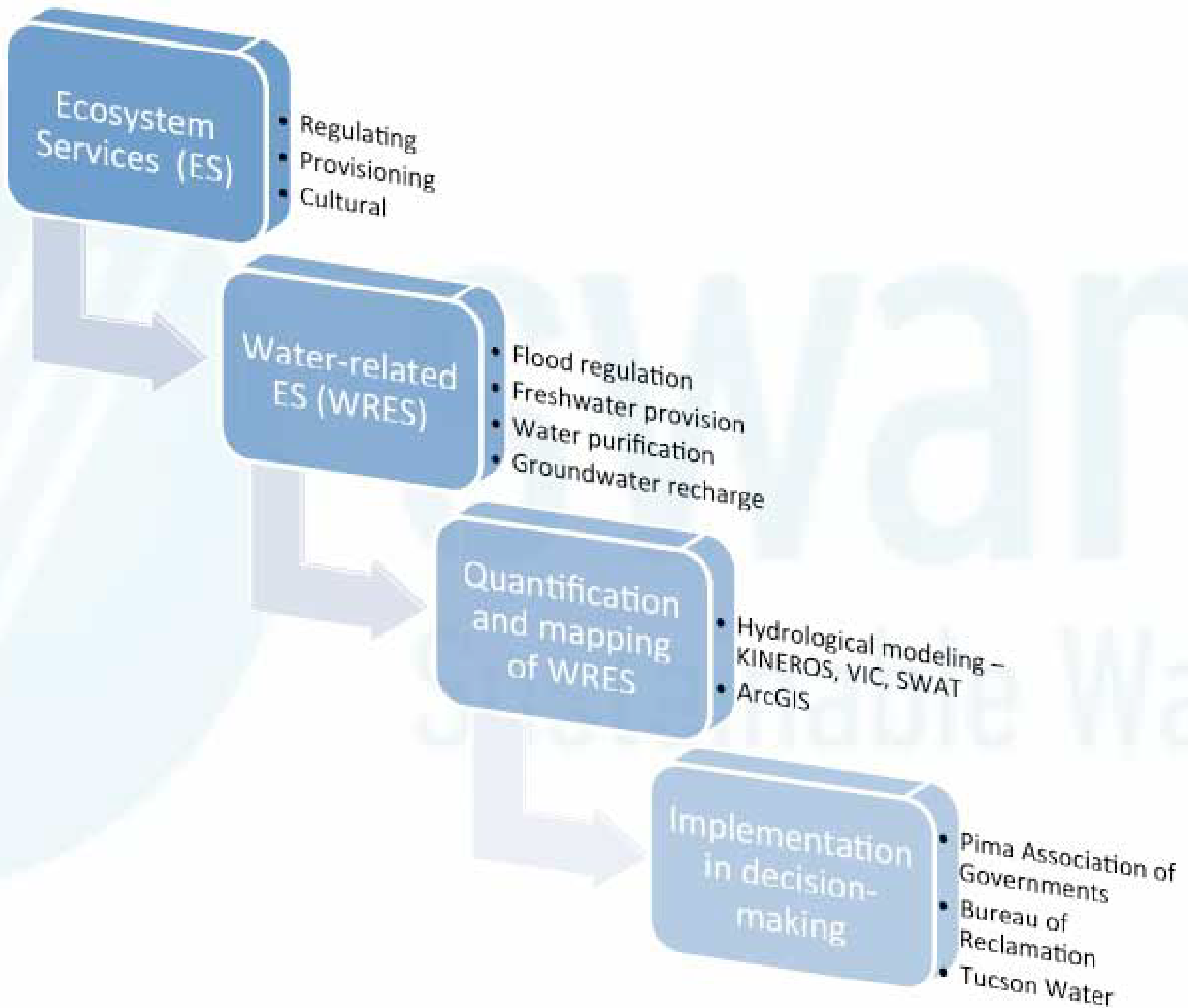


# Tucson Basin Case Study

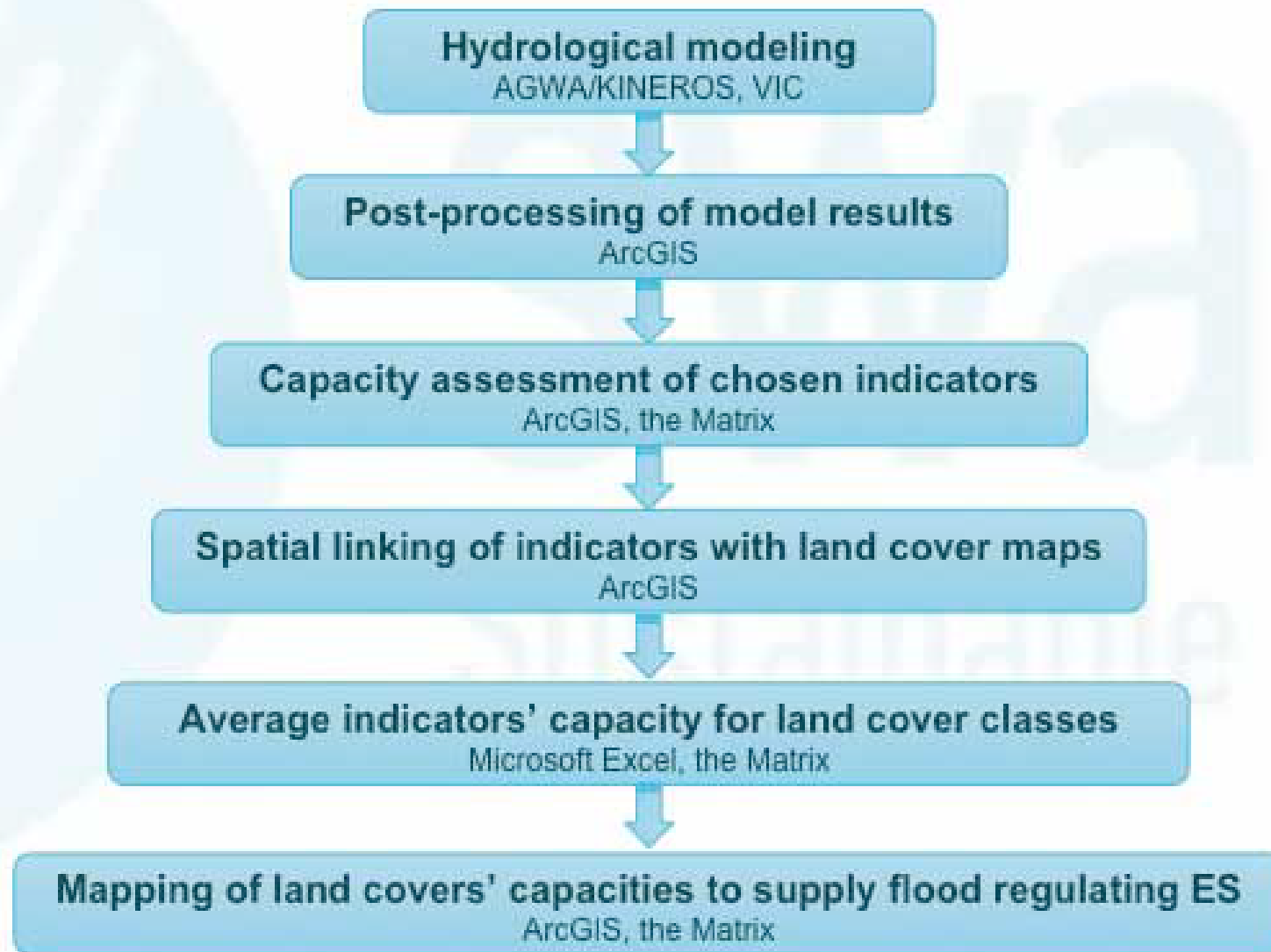
Quantification and Mapping of Water-related Ecosystem Services in Bulgaria and Arizona, USA (and Implementation in Policy and Decision Making)

Kremena Boyanova

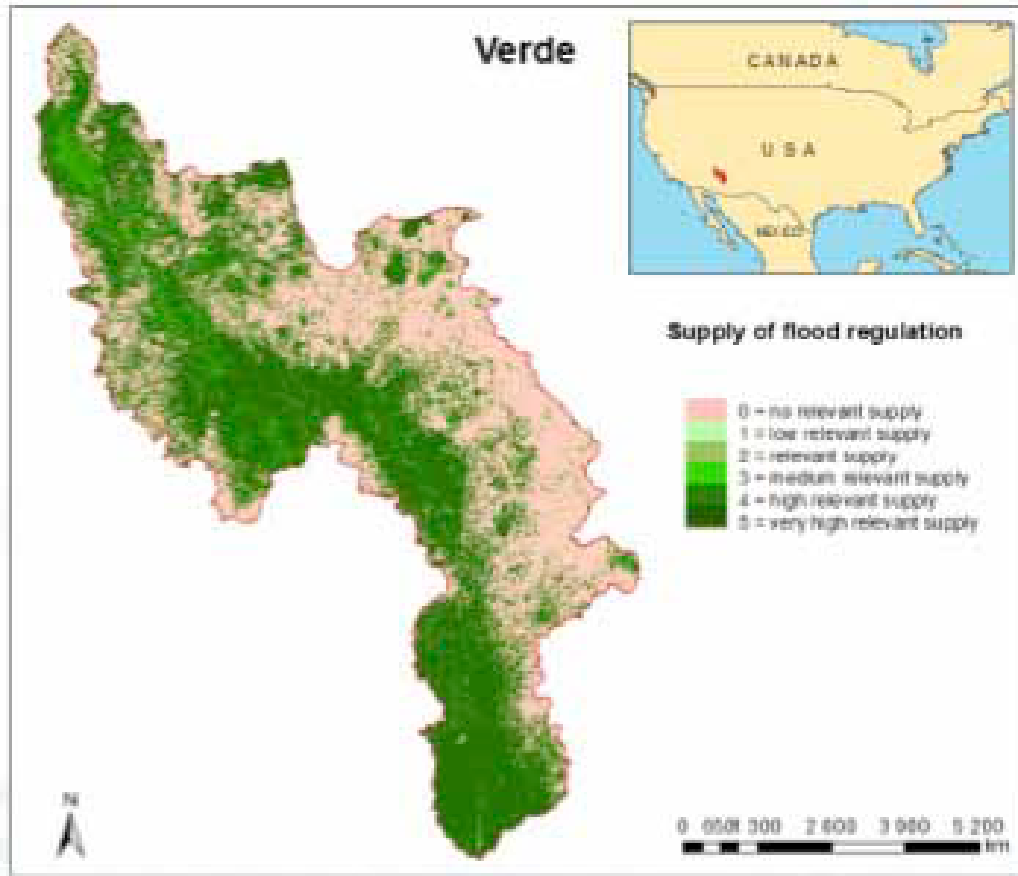
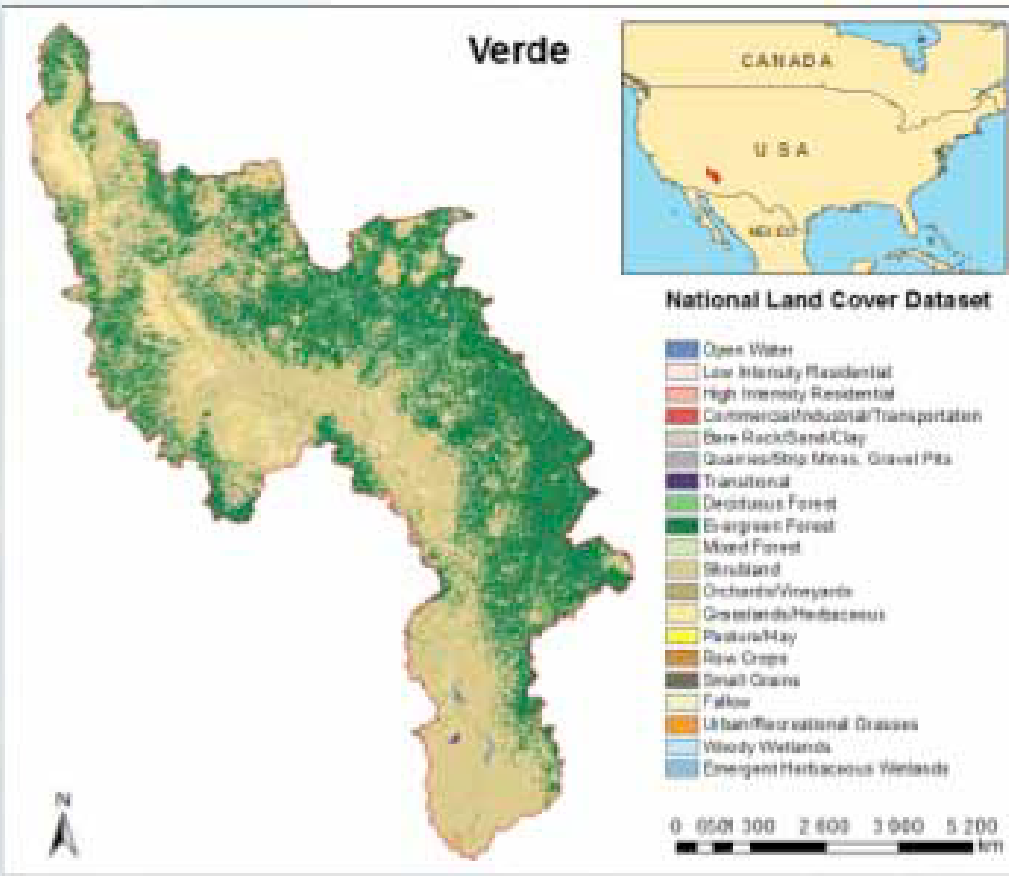
NIGGG-BAS



# Quantifying Flood Regulating ES in Watersheds – Arizona, USA and Bulgaria



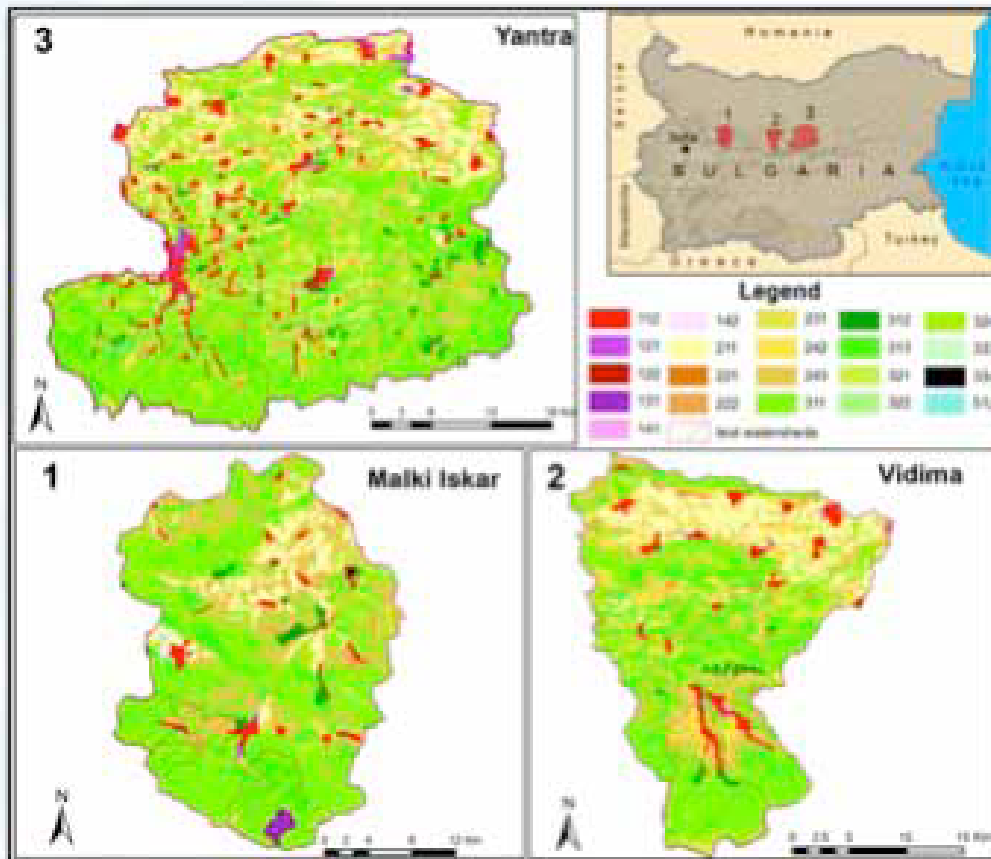
# Arizona, USA - VIC



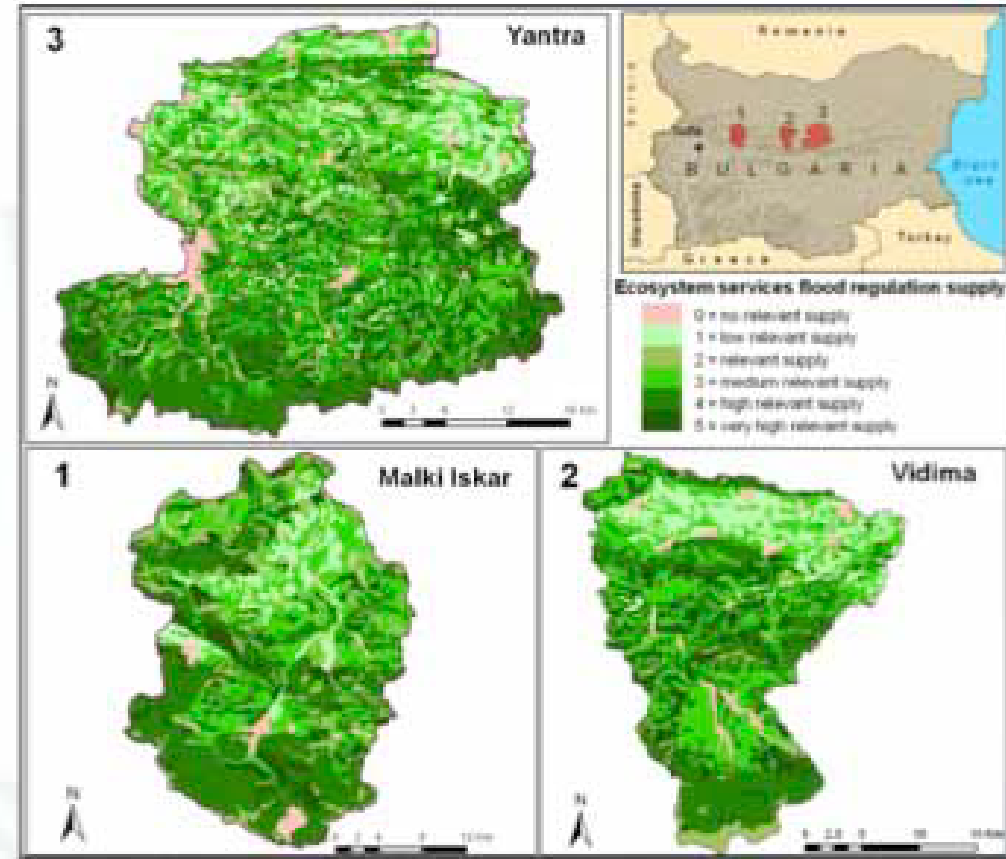
**NLCD 1992 - National Land Cover Dataset**  
maps of test watershed and the case study area's locations

**Map of flood regulating ecosystem service supply capacities in the study areas**

# Bulgaria - KINEROS



**CORINE Land Cover maps of test watersheds and the case study areas' locations**



**Map of flood regulating ecosystem service supply capacities in the three study areas.**

# COMPARISON

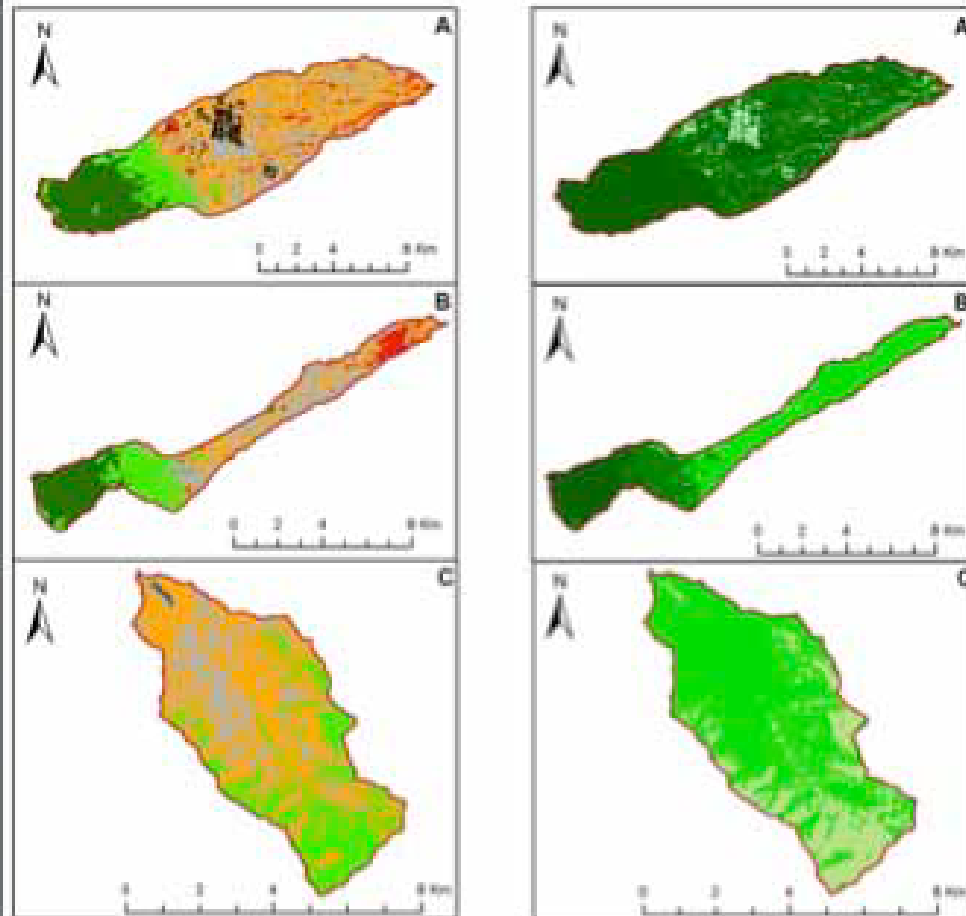
NLCD National Land Cover Dataset	Verde
11 Open Water	5
21 Low Intensity Residential	5
22 High Intensity Residential	3
23 Commercial/Industrial/Transportation	5
31 Bare Rocks/Sand/Clay	3
32 Quarries/Strip Mines, Gravel Pits	4
33 Transitional	2
41 Deciduous Forest	1
42 Evergreen Forest	0
43 Mixed Forest	0
51 Shrubland	5
61 Orchards/Vineyards	4
71 Grasslands/Herbaceous	4
81 Pasture/Hay	5
82 Row Crops	5
83 Small Grains	4
84 Fallow	4
85 Urban/Recreational Grass	3
91 Woody Wetlands	5
92 Emergent Herbaceous Wetlands	3

CORINE Land Cover class	Test watersheds			overall
	Malki Iskar	Yantra	Vidima	
112 Discontinuous urban fabric	0	0	0	0
121 Industrial or commercial units		0	0	0
122 Road and rail networks	0	0		0
131 Mineral extraction sites	0			0
141 Green urban areas		0		0
142 Sport and leisure facilities		4		4
211 Non-irrigated arable lands	1	0		1
222 Fruit trees and berries	2	1	5	3
231 Pastures	2	2	5	3
242 Complex cultivation patterns		1	5	3
243 Agriculture & natural vegetation	2	1	5	3
311 Broad-leaved forests	4	4	3	4
312 Coniferous forests	5	3	3	4
313 Mixed forests	5	5	5	5
321 Natural grasslands	3	4	0	2
322 Moors and heathland	3	2	2	2
324 Transitional woodland-shrub	3	3	1	2
332 Bare rocks			0	0
333 Sparsely vegetated areas		2	0	1

Flood regulating ecosystem service supply capacities of the different land cover classes for Bulgaria and USA case studies

# Arizona, USA - KINEROS

## San Pedro River Subwatersheds - Arizona, USA

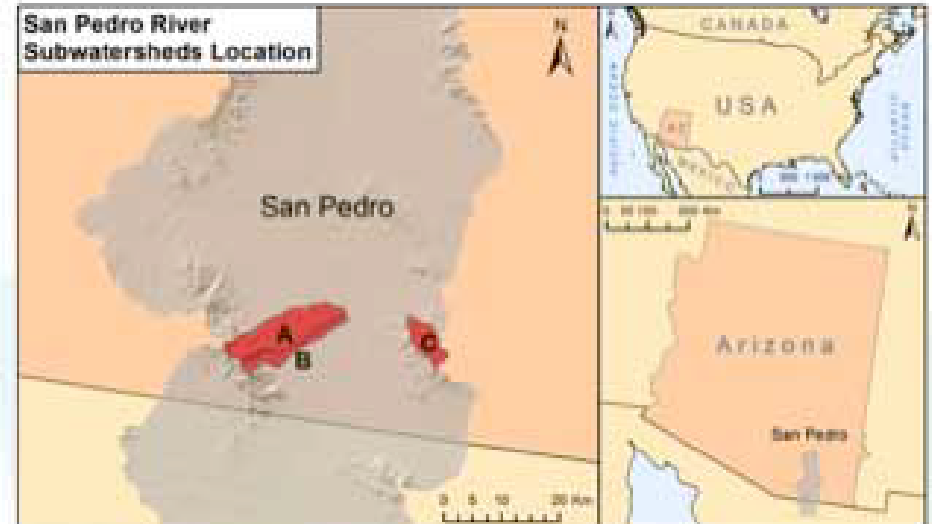


### North America Landscape Characterization Classification System

- 1 - Forest
- 2 - Oak Woodland
- 3 - Mesquite Woodland
- 4 - Grassland
- 5 - Desert shrub
- 6 - Riparian
- 8 - Urban

### Flood regulation ecosystem service supply

- 0 = no relevant supply
- 1 = low relevant supply
- 2 = relevant supply
- 3 = medium relevant supply
- 4 = high relevant supply
- 5 = very high relevant supply



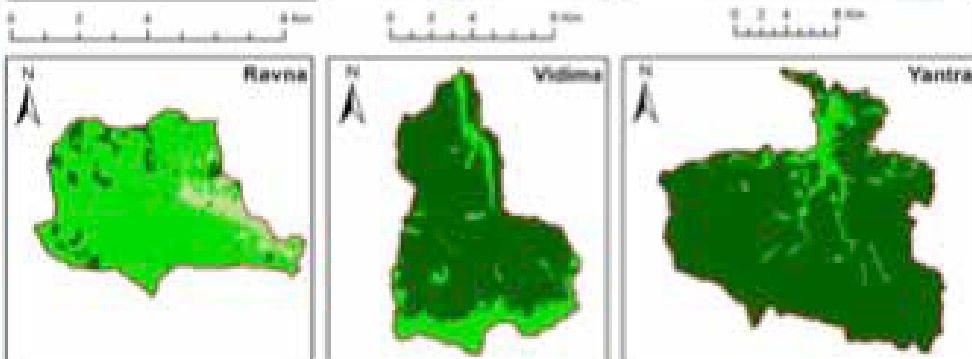
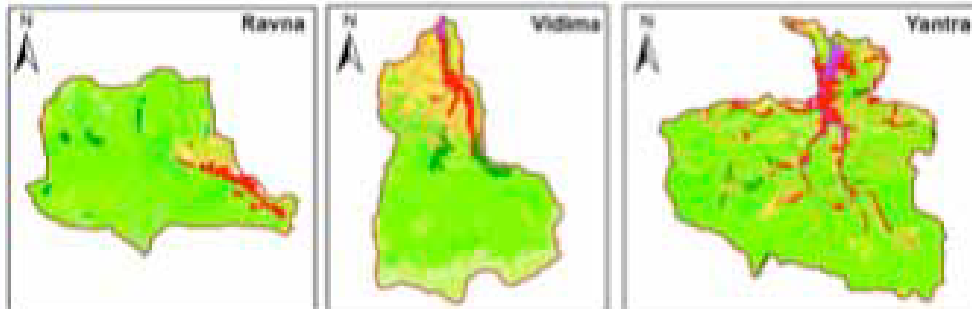
*Land cover maps (left) and maps of flood regulating ecosystem service supply capacities (right) in the three study areas in Arizona, USA.*

# Bulgaria - KINEROS

## Ravna, Vidima, Yantra Rivers Watersheds - Bulgaria

### CORINE Land Cover Classes

112 - Discontinuous urban fabric	243 - Land principally occupied by agriculture, with significant areas of natural vegetation
121 - Industrial or commercial units	311 - Broad-leaved forest
122 - Road and rail networks and associated land	312 - Coniferous forest
141 - Green urban areas	313 - Mixed forest
142 - Sport and leisure facilities	321 - Natural grasslands
211 - Non-irrigated arable land	322 - Moors and heathland
222 - Fruit trees and berry plantations	324 - Transitional woodland shrub
231 - Pastures	332 - Bare rocks
242 - Complex cultivation patterns	333 - Sparsely vegetated areas



### Flood regulation ecosystem service supply

0 - no relevant supply
1 - low relevant supply
2 - relevant supply
3 - medium relevant supply
4 - high relevant supply
5 - very high relevant supply



*Land cover maps (top) and maps of flood regulating ecosystem service supply capacities (bottom) in the three study areas in Bulgaria*



## *Ranges of the model results' values for the indicators of flood regulation ecosystem service supply*

	Watersheds					
	Bulgaria			San Pedro, Arizona, USA		
	Ravna (2578.6 ha)	Vidima (7677.9 ha)	Yantra (28627.0 ha)	A (9186.8 ha)	B (3190.1 ha)	C (2980.0ha)
<b>Infiltration capacity class</b>	<b>Model results (mm)</b>					
0	6.59 - 7.93	34.15 - 36.24	25.78 - 29.15	17.40 - 19.27	17.60 - 19.49	13.71 - 14.13
1	7.94 - 9.28	36.25 - 38.33	29.16 - 32.51	19.28 - 21.13	19.50 - 21.38	14.14 - 14.55
2	9.29 - 10.63	38.34 - 40.42	32.52 - 35.88	21.14 - 23.00	21.39 - 23.27	14.56 - 14.97
3	10.64 - 11.97	40.43 - 42.51	35.89 - 39.24	23.01 - 24.86	23.28 - 25.15	14.98 - 15.39
4	11.98 - 13.32	42.52 - 44.60	39.25 - 42.60	24.87 - 26.73	25.16 - 27.04	15.40 - 15.81
5	13.33 - 14.67	44.61 - 46.69	42.61 - 45.97	26.74 - 28.59	27.05 - 28.93	15.82 - 16.23
<b>Peak flow capacity class</b>	<b>Model results (mm)</b>					
0	25.17 - 21.30	17.41 - 14.81	22.95 - 19.52	45.21 - 38.55	66.34 - 57.68	73.49 - 71.61
1	21.29 - 17.41	14.80 - 12.20	19.51 - 16.07	38.54 - 31.87	57.67 - 49.00	71.60 - 69.72
2	17.40 - 13.52	12.19 - 9.59	16.06 - 12.63	31.86 - 25.20	48.99 - 40.32	69.71 - 67.82
3	13.51 - 9.64	9.58 - 6.98	12.62 - 9.18	25.19 - 18.53	40.31 - 31.64	67.81 - 65.93
4	9.63 - 5.75	6.97 - 4.37	9.17 - 5.74	18.52 - 11.85	31.63 - 22.96	65.92 - 64.04
5	5.74 - 1.85	4.36 - 1.75	5.73 - 2.28	11.84 - 5.17	22.95 - 14.27	64.03 - 62.14
<b>Surface runoff capacity class</b>	<b>Model results (mm)</b>					
0	8.48 - 7.10	13.74 - 11.55	22.10 - 18.56	12.82 - 10.98	20.97 - 19.08	25.72 - 25.22
1	7.09 - 5.70	11.54 - 9.35	18.55 - 15.01	10.97 - 9.13	19.07 - 17.18	25.21 - 24.70
2	5.69 - 4.31	9.34 - 7.16	15.00 - 11.46	9.12 - 7.28	17.17 - 15.29	24.69 - 24.18
3	4.30 - 2.92	7.15 - 4.96	11.45 - 7.91	7.27 - 5.43	15.28 - 13.39	24.17 - 23.66

# COMPARISON

Land cover class	Capacities by watershed		
	Ravna	Vidima	Yantra
<b>CORINE</b>			
112 Discontinuous urban fabric	2	3	3
121 Industrial or commercial units	-	3	3
122 Road and rail networks	3	-	3
141 Green urban areas	-	-	3
142 Sport and leisure facilities	-	-	3
211 Non-irrigated arable lands	2	3*	3
222 Fruit trees and berries	3*	3	3
231 Pastures	2	3	3
242 Complex cultivation patterns	-	3	3
243 Agriculture and natural vegetation	2	3	3
311 Broad-leaved forests	3	3	3
312 Coniferous forests	3	3	3
313 Mixed forests	3	3	3
321 Natural grasslands	3	3	3
322 Moors and heathland	3	3	3
324 Transitional woodland-shrub	3	4	3
332 Bare rocks	3	3	3*
333 Sparsely vegetated areas	3*	3	3
<b>NALC</b>	<b>A</b>	<b>B</b>	<b>C</b>
1 Forest	3	3	-
2 Oak woodland	3	4	2
3 Mesquite woodland	2	3	-
4 Grassland	3	3	3
5 Desert shrub	4	3	3

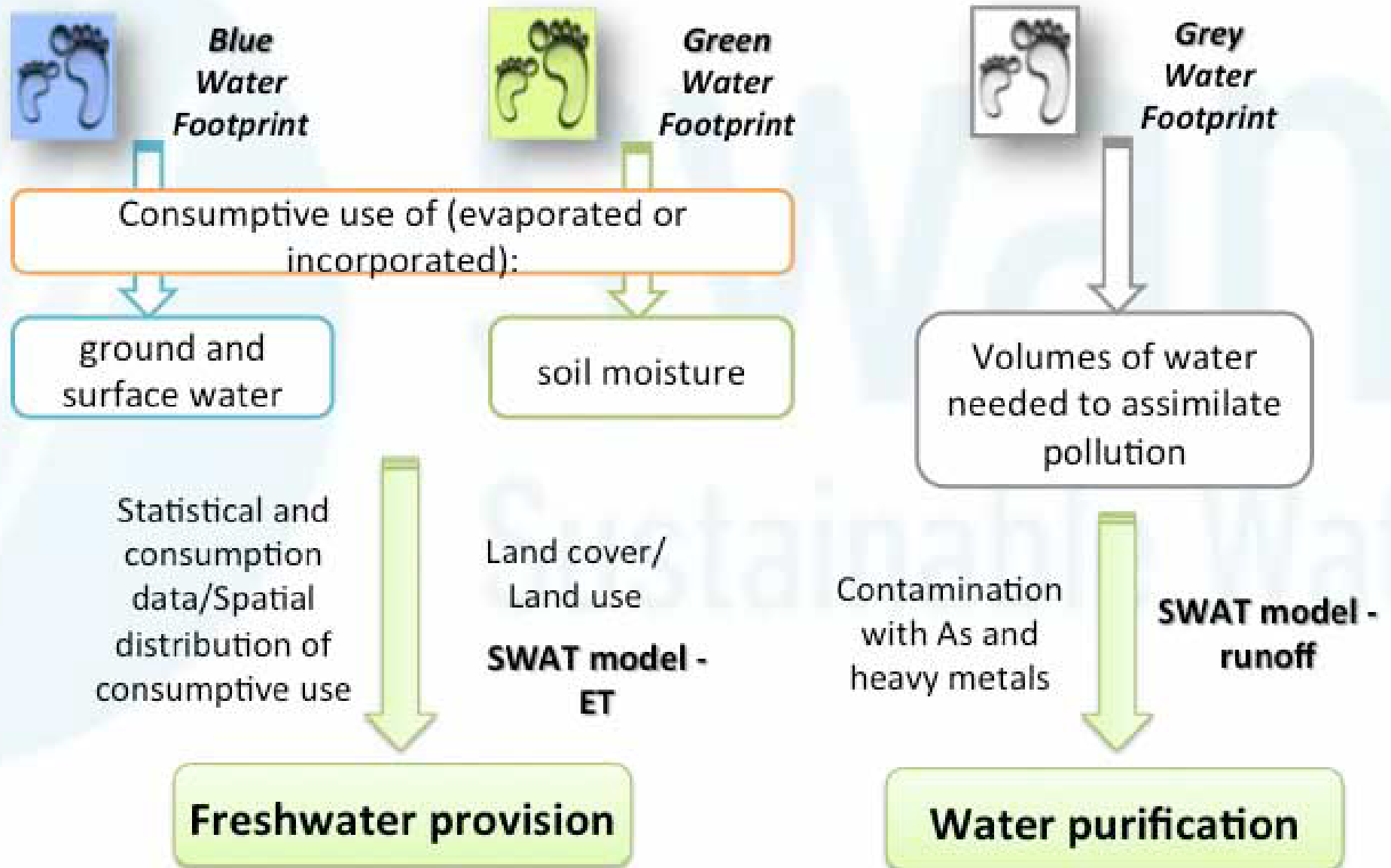
Wan  
Sustainable Water

*Flood regulating ecosystem service supply capacities of the different land cover classes (empty fields indicate that the land cover class was not present in the respective watershed)*

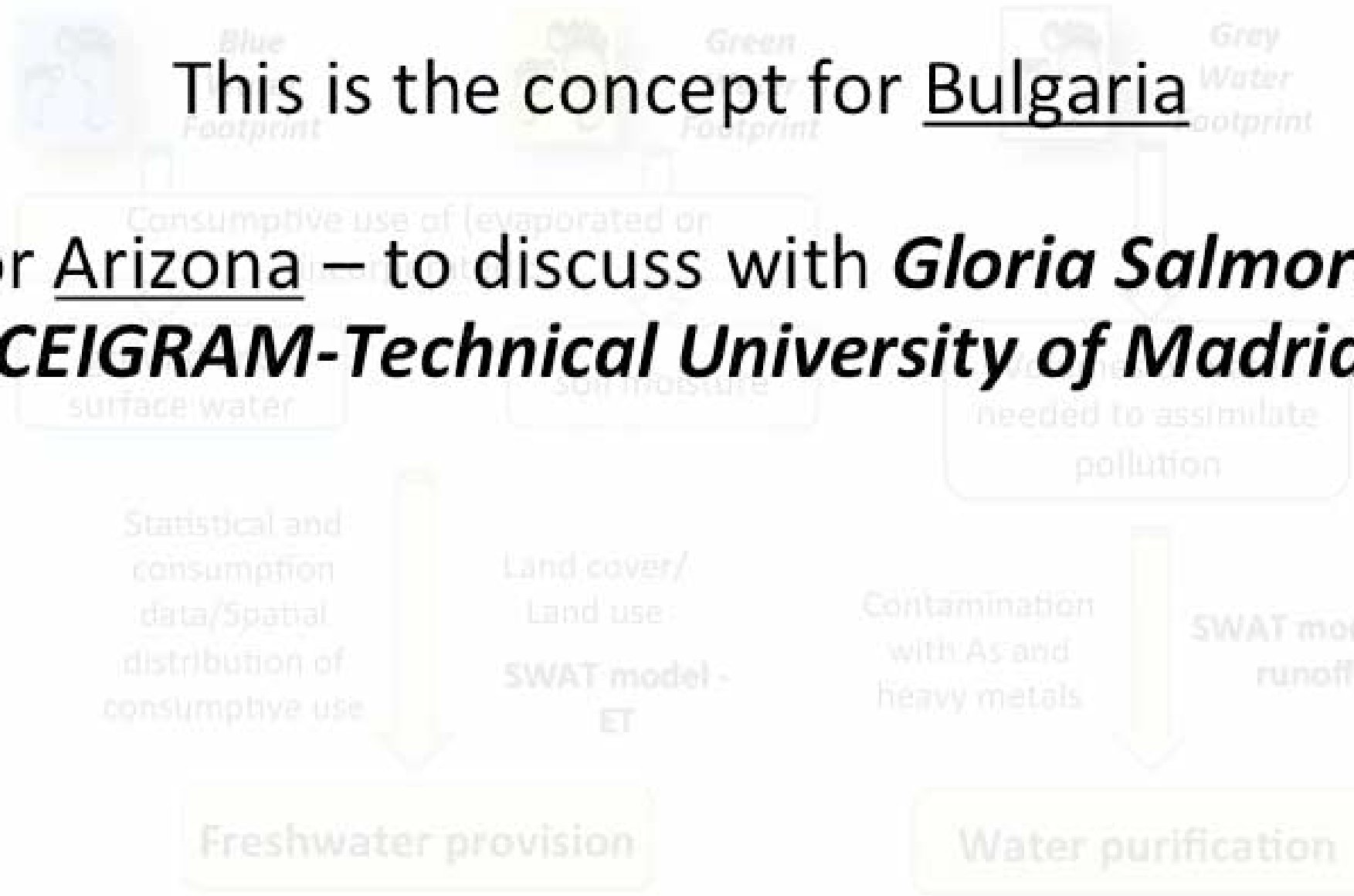
Publication: Boyanova, K., Nedkov, S., Burkhard, B., 2014.

**“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

# Quantifying freshwater provision and water purification ES in watersheds by applying **SWAT** hydrological model and **Water Footprint** concept



Quantifying freshwater provision and water purification ES in watersheds by applying SWAT hydrological model and Water Footprint concept



This is the concept for Bulgaria

For Arizona – to discuss with **Gloria Salmoral, CEIGRAM-Technical University of Madrid**

## Technical issues:

### USA-Europe Soil and Land cover classification differences

Complications:


- To run models
- For comparative analysis
- ...

***IMPORTANT TASK AND ISSUE FOR  
TRANS-ATLANTIC NETWORK!!!***

Quantifying groundwater recharge ES – to  
discuss with ***Natalia Limones, USE***

SWAN

Sustainable Water



Implementation in policy and decision-making –  
in collaboration with Owen/ Murielle/  
Violeta....and others



Thank you!

Gracias!

Merci!

Dank u!

...

Благодаря!

