Flood regulation ecosystem services accounting of mountain watersheds in Bulgaria

Introduction

Ecosystems' ability to absorb and store water provide flood regulation services - one of their most important contributions, which yearly save human lives and prevent property destruction. Accounting of flood prevention and mitigation effects allows for raising the efficiency and effectiveness of the utilization and adaptation of specific ecosystem characteristics that can reduce the extent and intensity of flooding and thus diminish the risks of loss of life and damage to build environments. In the case of river floods, the regulation functions include prevention and mitigation. Their geospatial aspects can be represented by the, so-called, Service Providing Areas (SPA) and the Service Demanding Areas (SDA). The geographic analysis of the interactions between SPA and SDA facilitates the development of a methodology for flood regulation accounting at national scale. We focus on three modules of flood regulation ecosystem accounting, i.e. ES potential, ES demand, and ES actual flow (AF), which are tested in three mountain watersheds.

Objectives

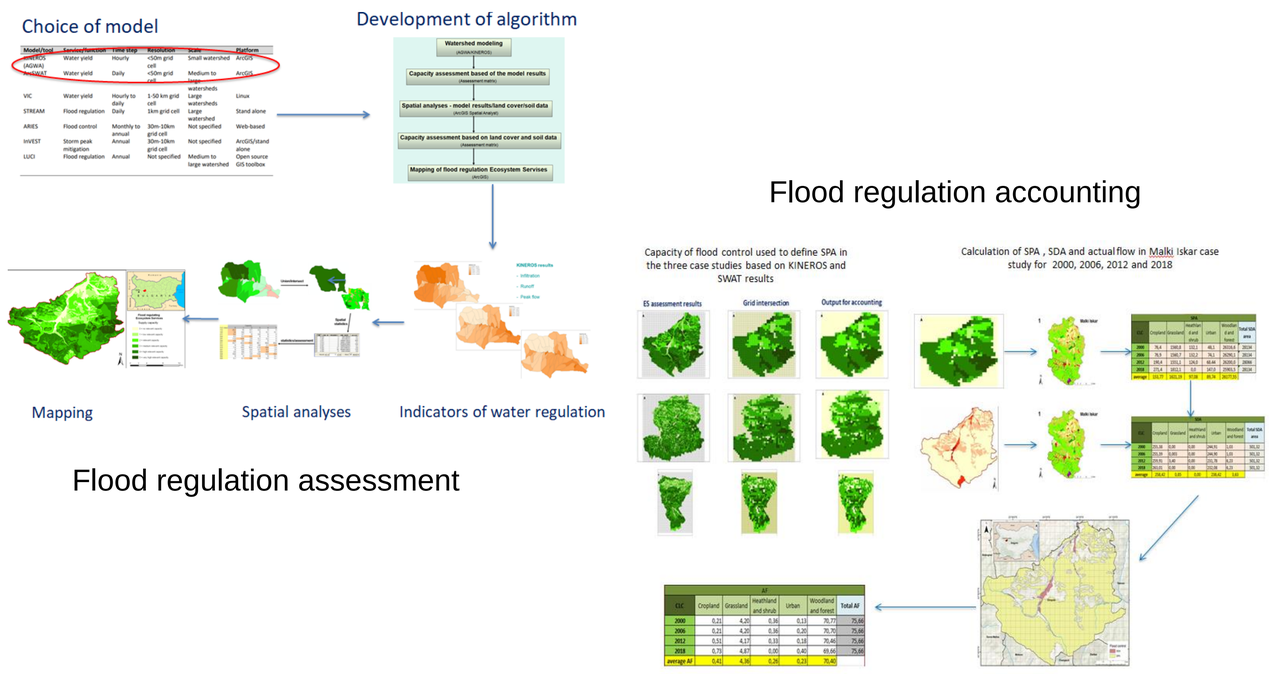
The main objective is to develop a methodology for accounting of flood regulation ES at national scale in Bulgaria.

The account is planned in two stages: 1) account, based on three case studies selected within the MAIA project; 2) national scale account within the INES project, planned to start in November 2022.

The main task for the first stage are:

- Utilization of the results from KINEROS and SWAT models for the ecosystem accounting
- Delineation of SPA, SDA, and AF for the test watersheds
- Generation of accounting tables for the test watersheds.

Methodological approach



Methods

The accounting of flood regulation is based on the assumption that specific ecosystem characteristics can reduce the extent and intensity of floods, thus avoiding or diminishing the risk of damage to build environments and loss of life. The GIS-based AGWA tool, which utilizes the KINEROS (Kinematic Runoff and Erosion) hydrologic model, is applied in the Malki Iskar and Yantra watersheds and the GIS-based ArcSWAT model is applied in the Ogosta watershed. The actual flood regulation accounting is based on the calculation of the Actual Flow (AF), as a function of SBA and SDA.

Results

The SPA, SDA, and AF are mapped in the three test watershed, based on the models' results. Accounting tables are prepared for 2000, 2006, 2012 and 2018. The calculations are made for the main ecosystem type, and also at subtype level.

Accounting table of flood regulation potential, demand and actual flow in Malki Iskar watershed

ES Flood regulation							
Components	Ecosystem types					Total [ha]	Years assessed
	Cropland	Grassland	Heathland and shrub	Urban	Woodland and forest		
ES Potential	76.35	1560.82	132.12	48.14	26316.60	28134.03	*2000*
	76.91	1560.71	132.15	74.10	26290.10	28133.97	*2006*
	190.40	1551.12	124.04	68.44	26200.00	28133.99	*2012*
	271.40	1812.11	0.00	146.97	25903.50	28133.98	*2018*
	153.76	**1621.19**	**97.08**	**84.41**	**26177.55**	**28133.99**	**average**
ES Demand	255.38	0.00	0.00	244.91	1.03		*2000*
	255.39	0.003	0.00	244.90	1.03		*2006*
	259.91	3.40	0.00	231.78	6.23		*2012*
	263.01	0.00	0.00	232.08	6.23		*2018*
	258.42	**0.85**	**0.00**	**238.42**	**3.63**	**501.32**	**average**
ES Actual flow	0.21	4.20	0.36	0.13	70.77		*2000*
	0.21	4.20	0.36	0.20	70.70		*2006*
	0.51	4.17	0.33	0.18	70.46		*2012*
	0.73	4.87	0.00	0.40	69.66		*2018*
	0.41	**4.36**	**0.26**	**0.23**	**70.40**	**75.66**	**average**

Analysis

The main critical point of the approach involves the identification of the SPA by hydrological modeling and, specifically, through determining the threshold value which delineates the SPA.
The results make be a valuable contribution to the updates of the Flood Risk Management Plans, which are among the main policy instruments in flood regulation accounting.

Conclusion

The quantification of the flood regulation function of the ecosystems is crucial for both ES assessment and accounting. The biophysical modeling provides the much needed quantitative data for the entire watershed, which is the main input, necessary for calculation of the accounting tables' parameters.

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