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Spatio-temporal dynamics of flood regulating services in the Arno River basin

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HIGHLIGHTS

- Assessment of flood regulating services supply of different CORINE land cover classes using Soil and Water Assessment Tool (SWAT)

- Demand quantification derived by the existing flood management plans which contain the identification and the perimeter of hydraulic hazard classes

- Spatial explicit analysis of flood regulating supply, demand and budget in the Upper Arno River in the center of Italy from 1990 up to 2018 (1990, 2000, 2012, 2018)

Source: https://www.lifegate.it/persone/news/le-foto-della-piena-dellarno-firenze

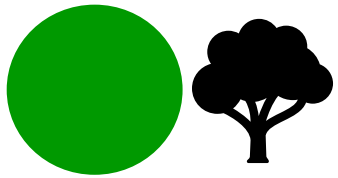
ECOSYSTEM SERVICES

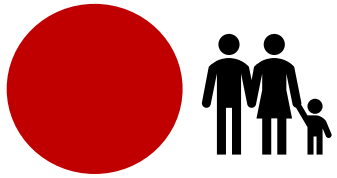
Ecosystem Services (ES): benefits that people obtain from ecosystems (MA, 20005).

- Supporting services
- Provisioning services
- Regulating services → Flood mitigation
- Cultural services

Flood mitigation → Supply → The capacity of the environment to provide the service

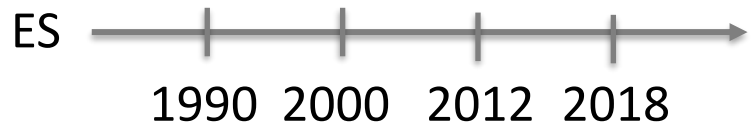
Flood mitigation → Demand → The human driven request of that service

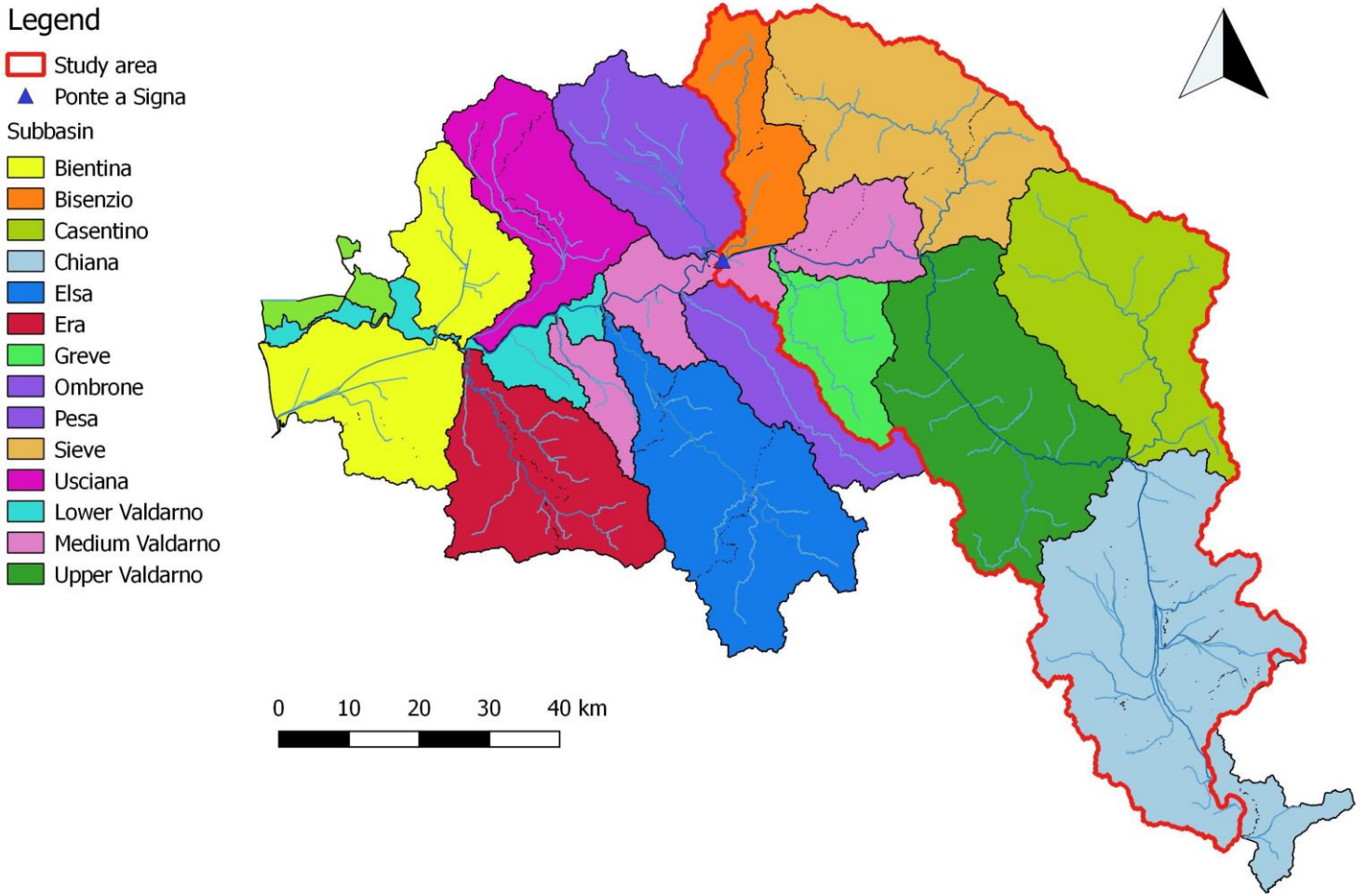




STUDY AREA

This study aims at analyzing the spatio-temporal dynamics of flood regulating ES in the Upper Arno River basin in the center of Italy.





SUPPLY ASSESSMENT

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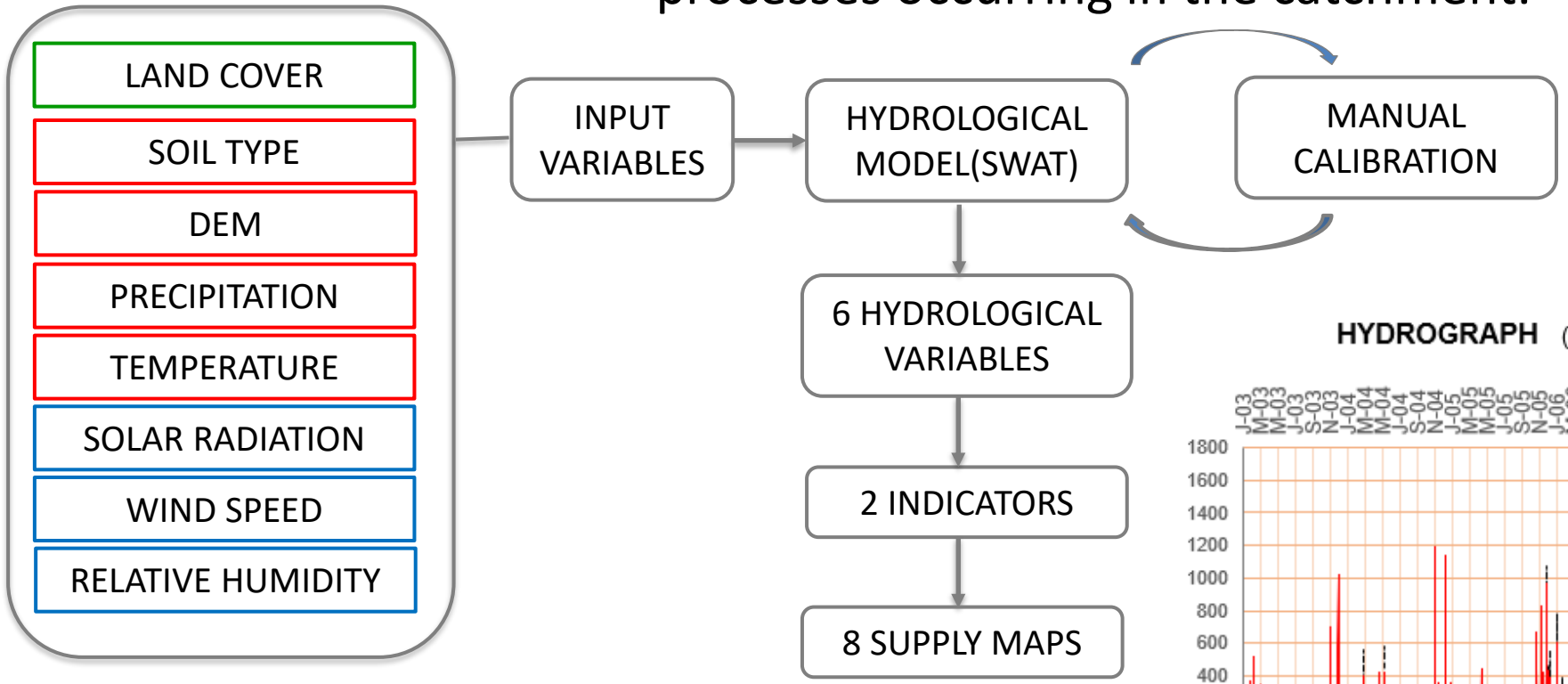
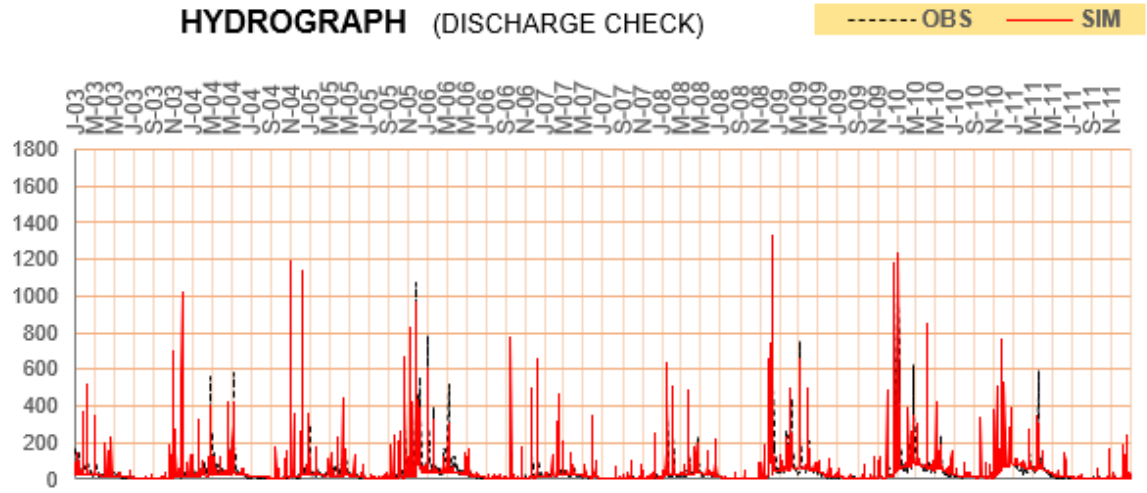
The assessment of flood regulating services SUPPLY is based on the evaluation of the hydrological processes occurring in the catchment.





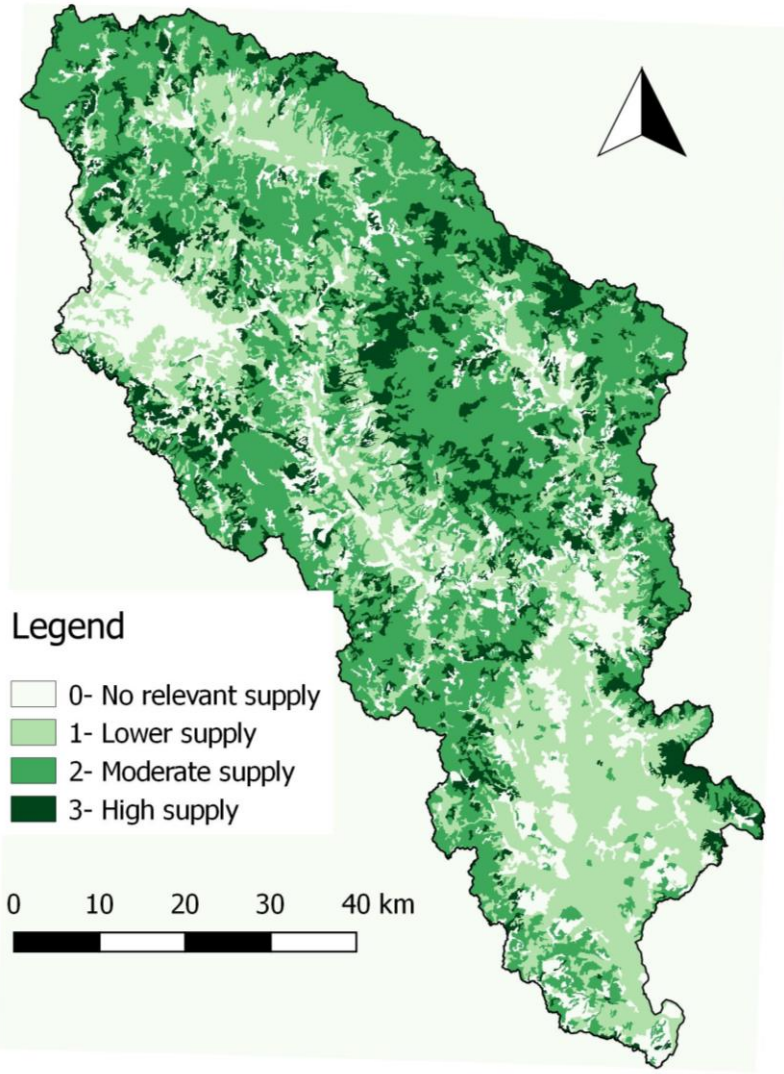
- Maps derived from the CORINE land cover (CLC) dataset
- Data from the Tuscany region dataset
- Data from the global climate database of the National Centers for Environmental Prediction (NCEP) - Climate Forecast System Reanalysis (CFSR)

SUPPLY ASSESSMENT

Two indicators have been processed by extracting the average annual value of six output variables for each land use. The land cover capacities were assessed and mapped on a relative scale ranging from 0 to 3.

CLASS	DESCRIPTION
0	No Relevant Supply
1	Low Supply
2	Moderate Supply
3	High Supply

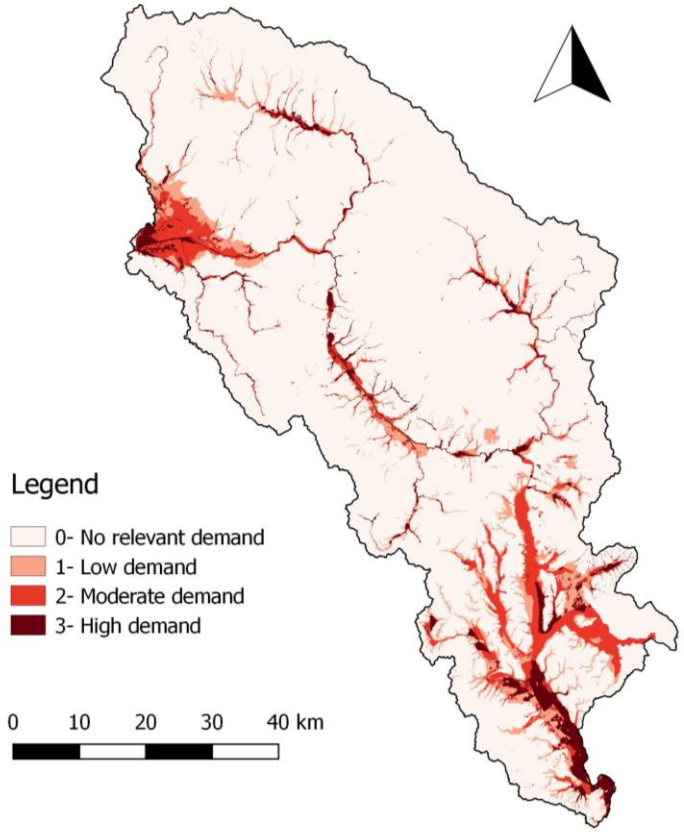
DESCRIPTION	ET	PERC	SURFQ	GWQ	LATQ
Agricultural Land-Generic	1	0	0	0	1
Barren	0	0	0	0	1
Dryland Cropland and Pasture	2	1	1	1	0
Cropland / Grassland Mosaic	1	1	1	1	2
Cropland/Woodland Mosaic	1	3	0	3	3
Forest-Deciduous	3	1	2	1	3
Forest-Evergreen	1	3	3	3	3



DEMAND ASSESSMENT

DEMAND quantification was obtained from the information derived by the existing flood management plans which contain the identification and the perimeter of hydraulic hazard classes.

CLASS	DESCRIPTION	PAI		PGRA	
		CODE	DESCRIPTION	CODE	DESCRIPTION
0	No Relevant Demand	-	-	-	-
1	Low Demand	PI1	0 < T ≤ 30	P1	T ≤ 30
2	Moderate Demand	PI2	30 < T ≤ 100	P2	30 < T ≤ 200
		PI3	100 < T ≤ 200		
3	High Demand	PI4	200 < T ≤ 500	P3	T > 200



PAI = Piano per l'Assetto Idrogeologico
PGRA = Piano di Gestione del Rischio di Alluvioni

FINAL BUDGET ASSESSMENT

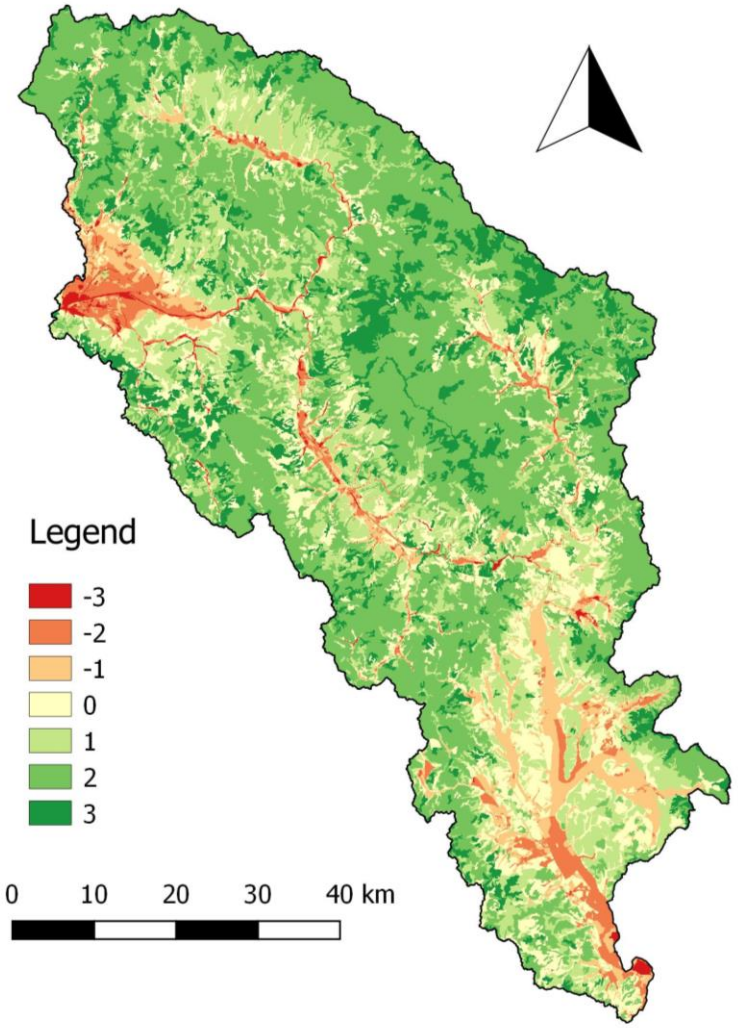
8 maps of flood regulating ecosystem service budget were created as a result of spatial overlay between the supply and demand map layers.

For both indicators:

SUPPLY maps for 1990 and 2000 → DEMAND map obtained from PAI

SUPPLY maps for 2012 and 2018 → DEMAND map obtained from PGRA

%	INDICATOR 1				INDICATOR 2			
Sub-basin	1990-2000	2000-2012	2012-2018	Σ	1990-2000	2000-2012	2012-2018	Σ
Chiana	2.49	-4.73	4.15	+1.92	1.99	0.18	0.27	+2.44
Medium Valdarno	-0.38	-7.74	2.03	-6.08	-0.17	-4.91	0.17	-4.92
Bisenzio	-1.38	-2.73	0.66	-3.45	-1.19	-1.67	0.71	-2.15
Sieve	-0.75	-2.38	0.12	-3.02	-0.73	-2.34	0.18	-2.89
Greve	-0.26	-0.39	0.85	+0.2	-0.36	0.14	0.64	0.42
Casentino	-0.22	-1.18	-0.12	-1.52	-0.21	-1.18	-0.16	-1.55
Upper Valdarno	-0.20	-1.28	1.41	-0.06	-0.27	-0.30	0.23	-0.34
Arno basin	-0.10	-2.18	0.98	-1.30	-0.14	-1.16	0.19	-1.11



CONCLUSIONS

The impacts of socio-economic and land use changes over time on the demand and supply of flood regulation ecosystem services were identified and mapped in the Arno river basin.

These results can :

- help decision makers;
- facilitate understanding of information which otherwise might be difficult to interpret;
- help to discover spatial distributions and patterns about areas of low and high ES supply and demand in the watershed.

Source: https://it.cleanpng.com/cleanpng-gxrb01/download-png.html

CONCLUSIONS

- Free data;
- SWAT model provides significant information and allows several physical processes;
- CORINE land cover allows to see the changes in land use over time.

- Demand maps consider only topographical aspects and relative hydrologic analysis.

- Assess multiple ecosystem services;
- Obtain demand maps with other assessment tools;
- Use better input data .