

Assessing the impact of historical urbanization evolution patterns on surface water quality – the case of the Cértima catchment in central Portugal

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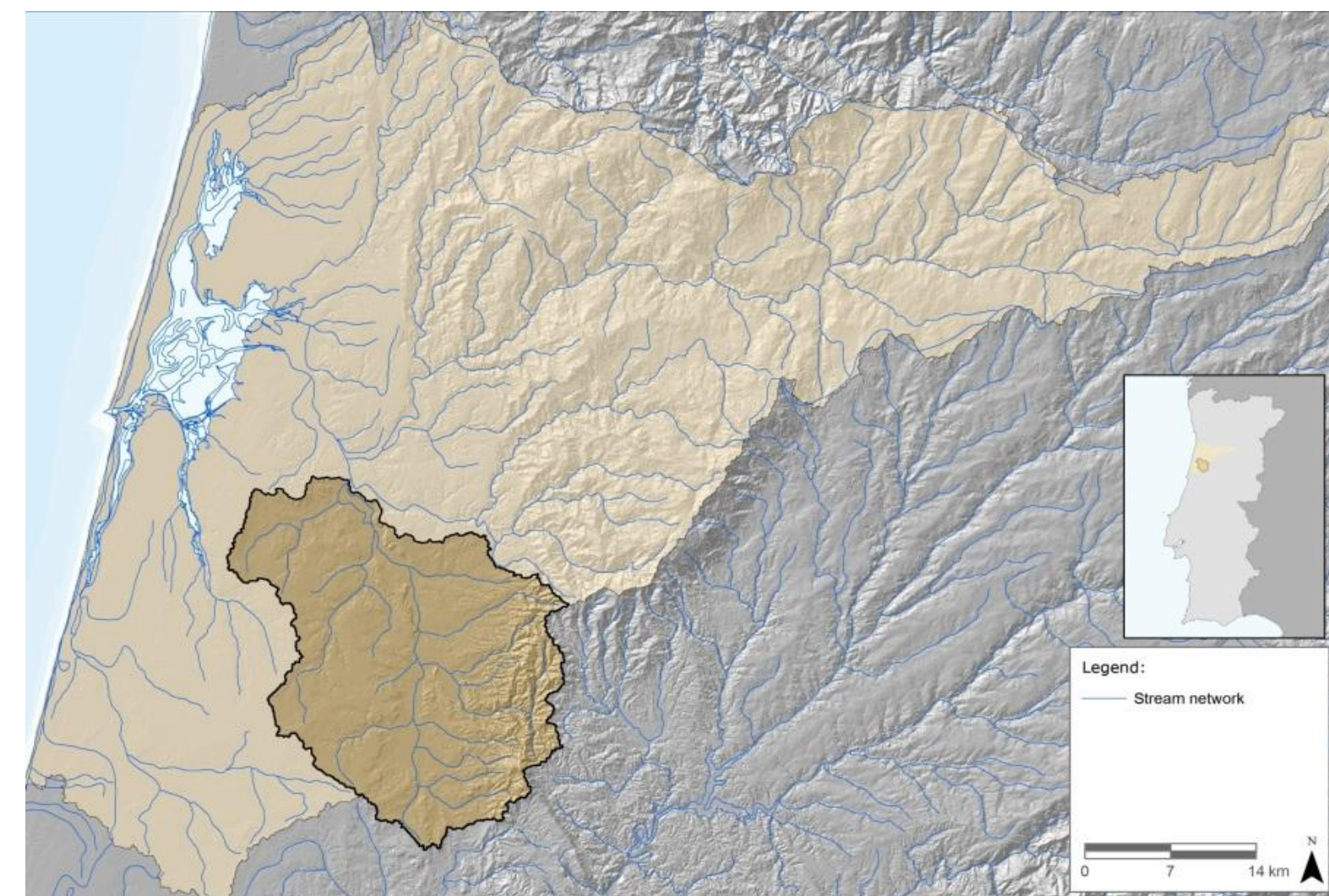
Introduction and objectives:

Main Objectives

- Assess the extent to which historical urbanization patterns evolution impacted on surface water quality in the Cértima catchment, focusing on the Pateira de Fermentelos lagoon
- Show the potential benefits of crossing the use of SWAT modelling with multitemporal cartography in helping to monitor, assess and plan the urban expansion with regards to improving the water quality in water masses and catchments

CONTEXT: Urbanization continues to expand and world population increasingly concentrates in urban areas leading to an increase in:

- Impervious surface cover within urban catchments
- Municipal and industrial discharges increasing loading of nutrients and sediments
- Decline of the richness of algal, invertebrate and fish communities
- Impairment of use of water for drinking, industry, agriculture, recreation and other purposes



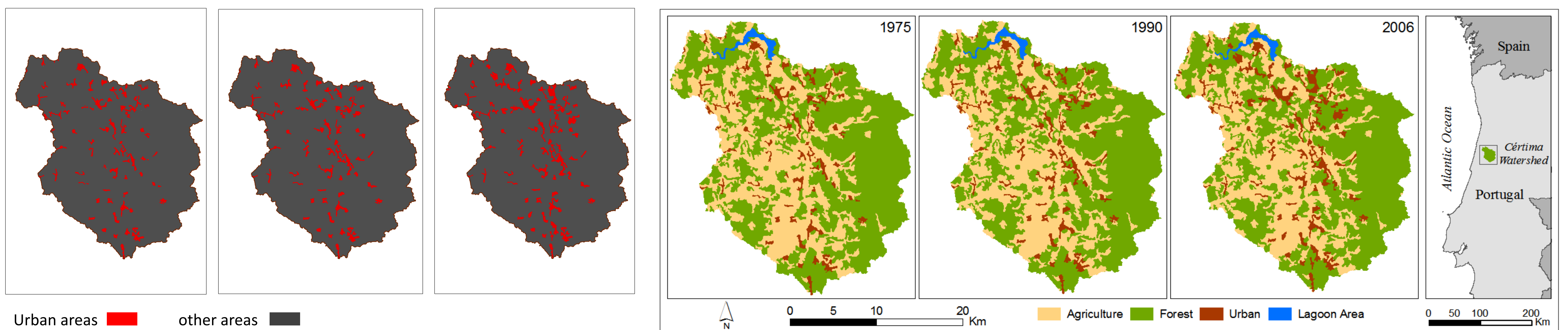
CONTEXT: The Cértima Catchment

- Sub-Basin of the Vouga River Basin
- Main River: Cértima
- Drainage area: 535 km²
- Drains into: Pateira de Fermentelos - a lagoon of variable area according to the seasons. One of the largest natural lagoons of the Iberian Peninsula, is a vulnerable and rich ecosystem with serious ecological threats

Methodology:

A combination of:

- The use of a previously built and calibrated SWAT model of the Cértima catchment for the period 1977 – 1984
- Multitemporal cartography (3 moments: 1975, 1990, 2006) using a combination of sources and crossing the information available to fill in the gaps
- Running the SWAT model for the 3 moments changing only the information regarding urban land use
- Measuring P, N, organic N and Total Suspended Sediments (TSS) at Pateira de Fermentelos



Obtaining and Extracting Multitemporal Cartography

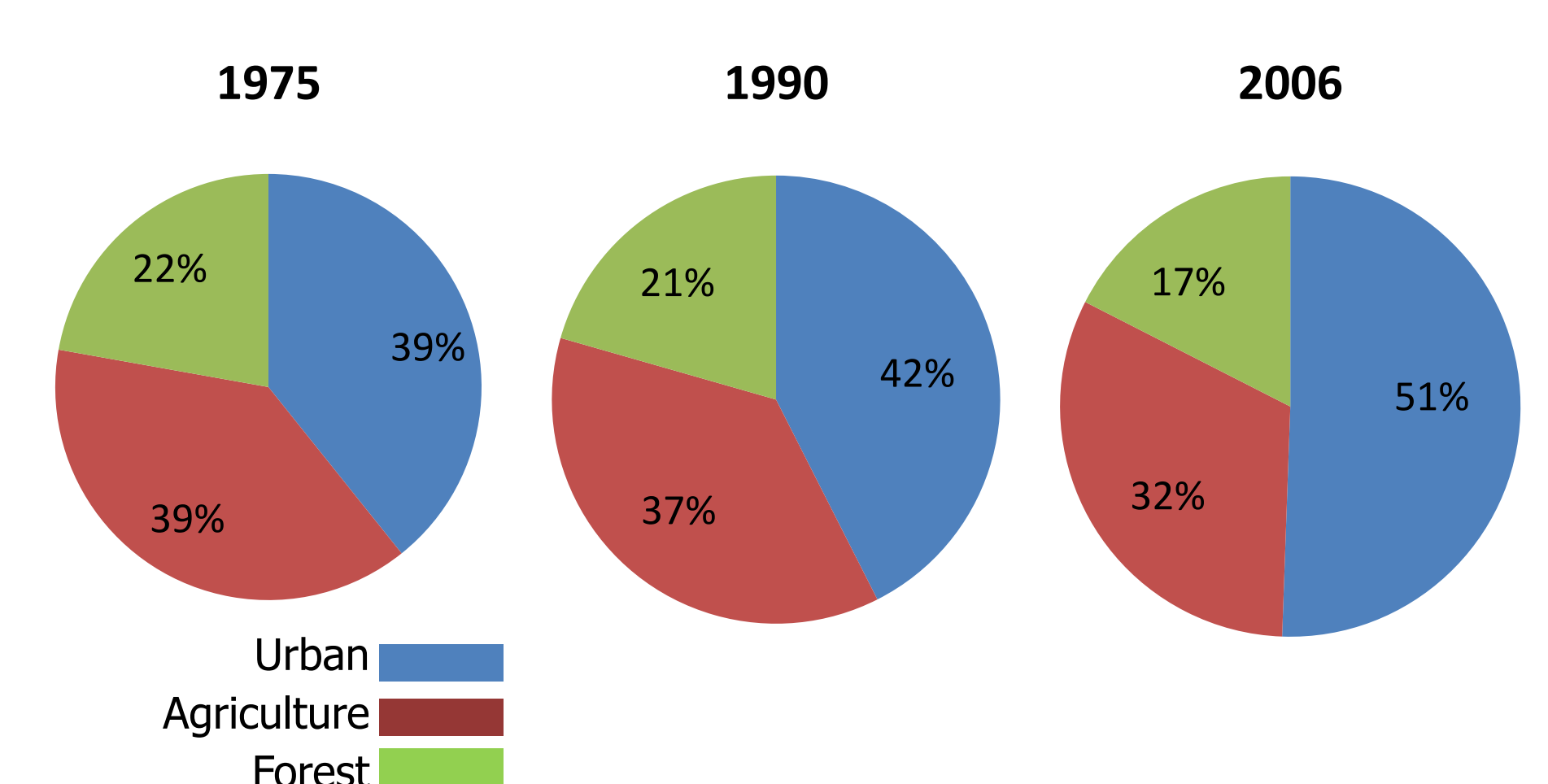
- 1990: CORINE Land Cover 90
- 1975: Military cartography from 1990 and 1975 comparison, and deleting of all urban areas which weren't present in 1975
- 2006: Superimposition of the 2006 urban areas to the 1990 map (thus discarding the LULC beneath the new urban areas, but maintaining all the rest intact)

Results:

Nutrients exports by year from the model outputs						
	1975		1990		2006	
Exports	ton	%*	ton	%*	ton	%*
N of NO ₃	293	8,4	318	8,4	369	25,9
P	49	-0,2	49	-0,2	49	-0,7
Organic N	153	0,02	153	0,02	153	-0,2
TSS	23404	-1,9	22954	-1,9	21967	-6,1

*growth relative to 1975 values

Nutrients exports by Land Cover type in 2006 from the model outputs (by area by year)				
Kg/ha/year	Urban	Agriculture	Forest	Cértima Watershed
N of NO ₃	45	5	2	7
P	0,5	3	0,1	0,9
Organic N	1,6	7,7	0,2	2,9



Main Conclusions:

- Results show an increase of the nutrient pollutants reaching the Pateira de Fermentelos lagoon by more than 25% between 1975 and 2006
- The exports of nitrates are strongly positively correlated to the expansion of urban areas
- On the other hand, the exports of P and Organic N suffer almost no variation or only a slight decrease
- The TSS exports show a steady decrease, which can be explained by the increase of impervious areas which inherently yield much less sediments than the agricultural or forestry soil
- while urban land use increased from only 5% to 8% over the period 1975/2006, nitrogen water pollution increased 25%
- It is shown that urban expansion has a strong impact, especially when compared to the extent it expanded, in the water quality of surface waters
- It is clear the potential of crossing the output of a SWAT model with multitemporal land use cartography, aiming at studying and understanding the impacts of urbanization evolution patterns on water quality

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