European Commission

Impact of current conservation practices on sediment load reduction in the Danube River Basin

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Context of the research

- **Water Framework Directive** (WFD) requires freshwater bodies achieving good ecological status by 2015
- Conservation practices (Best Management Practices – BMPs) are at the core of strategies to achieve the WFD targets
- But what has been the impact of BMPs on pollution (e.g. sediments) so far?
- **Objective of the study** was to assess the impact of conservation practices already implemented on sediment reduction in a large European river basin (the Danube)

Workflow

BMPs estimation

- Spatial distribution
- SWAT implementation

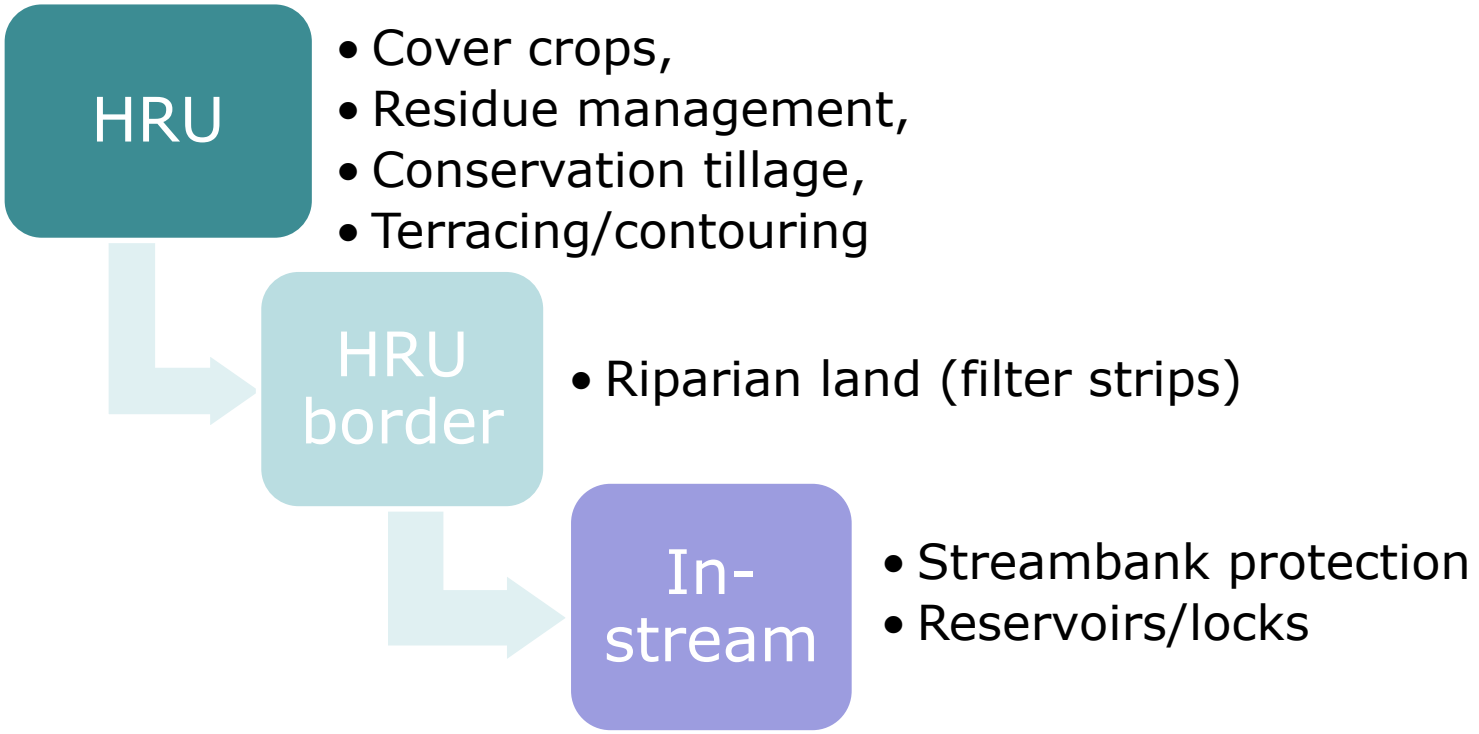
SWAT

- Model calibration
- Current BMPs, 1995-2004

BMP effectiveness

- SWAT run without each BMPS
- Ratio of sediment loads per regions

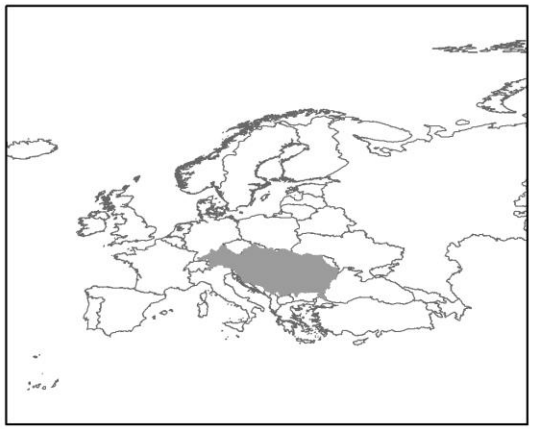
Best Management Practices

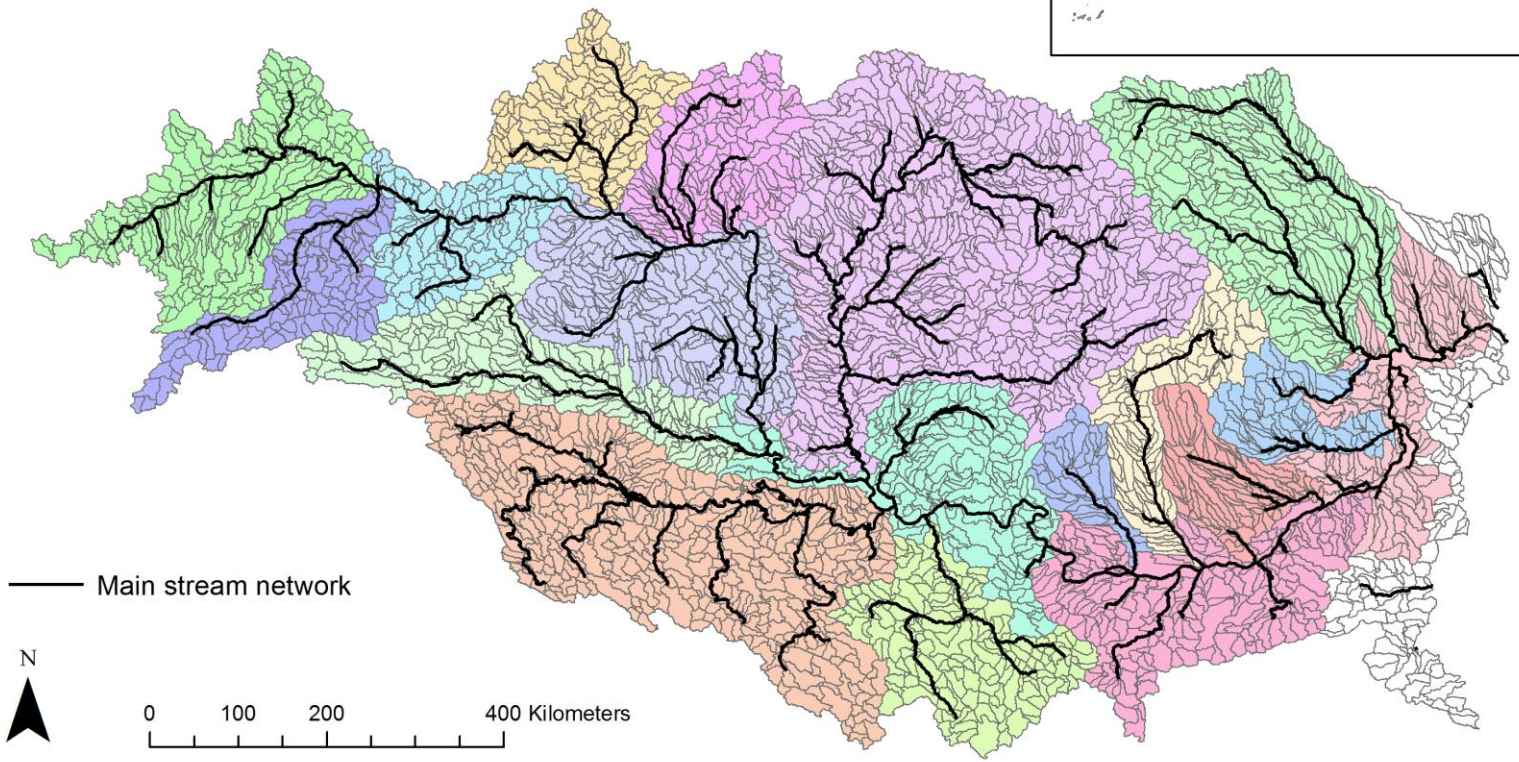


The Danube Basin

~2700 km, 834000 km^2 area, 19 Countries

(4663 subbasins of 172 km^2 average)





Research Centre

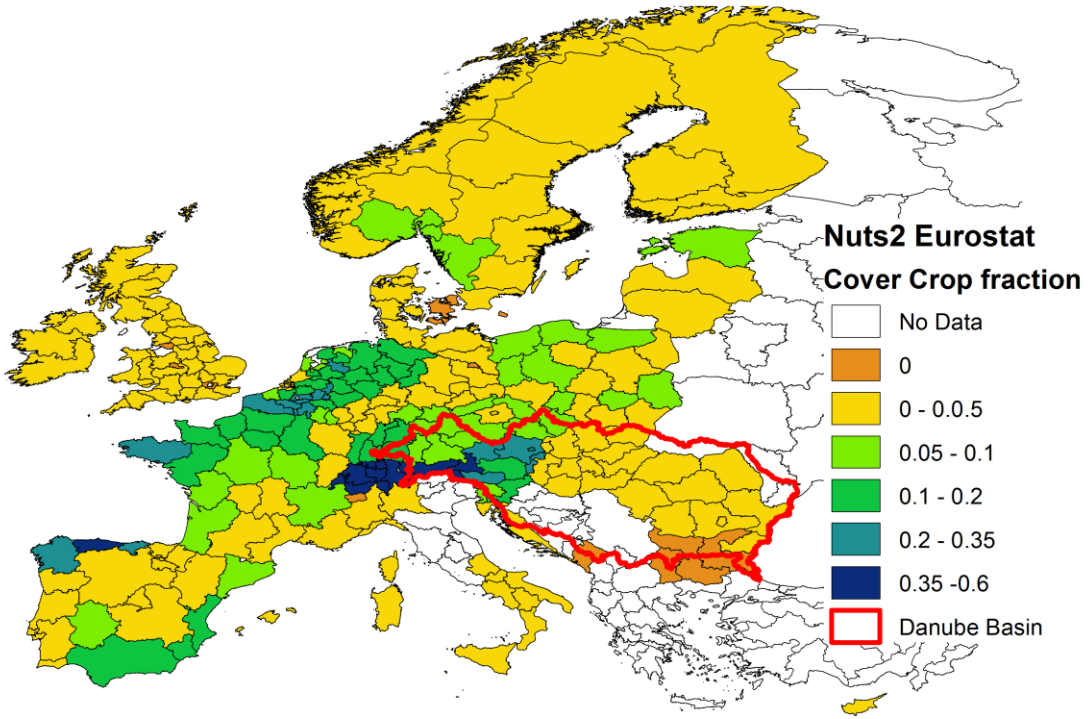
Farming system BMPs

Eurostat 2010 data (Nuts2)

Cover crops: 15013 km^2 (4%) arable land

Conservation (minimum or no till) tillage: 77469 km^2 (20%) arable land

Residue management: 18400 km^2 (5%) of arable land



Terracing: fraction of holdings with stonewalls ~ proxy for terrace density; ranged 0-25% (weighted mean 1.3%)

SWAT implementation

BMP	Approach	Applied to
Cover Crop	One year rotation (Arabi et al. 2008)	Annual crops
Conservation tillage	Minimum tillage (adapted from Ullrich and Volk 2009, Lam et al., 2011)	Annual crops
Residue Management	Change Harvest&Kill into Kill	Summer cereals
Terracing	Manual USLE P/slope look-up * changes in LS factor * fraction of terraced land	pastures and permanent crops, Slopes 5-60%

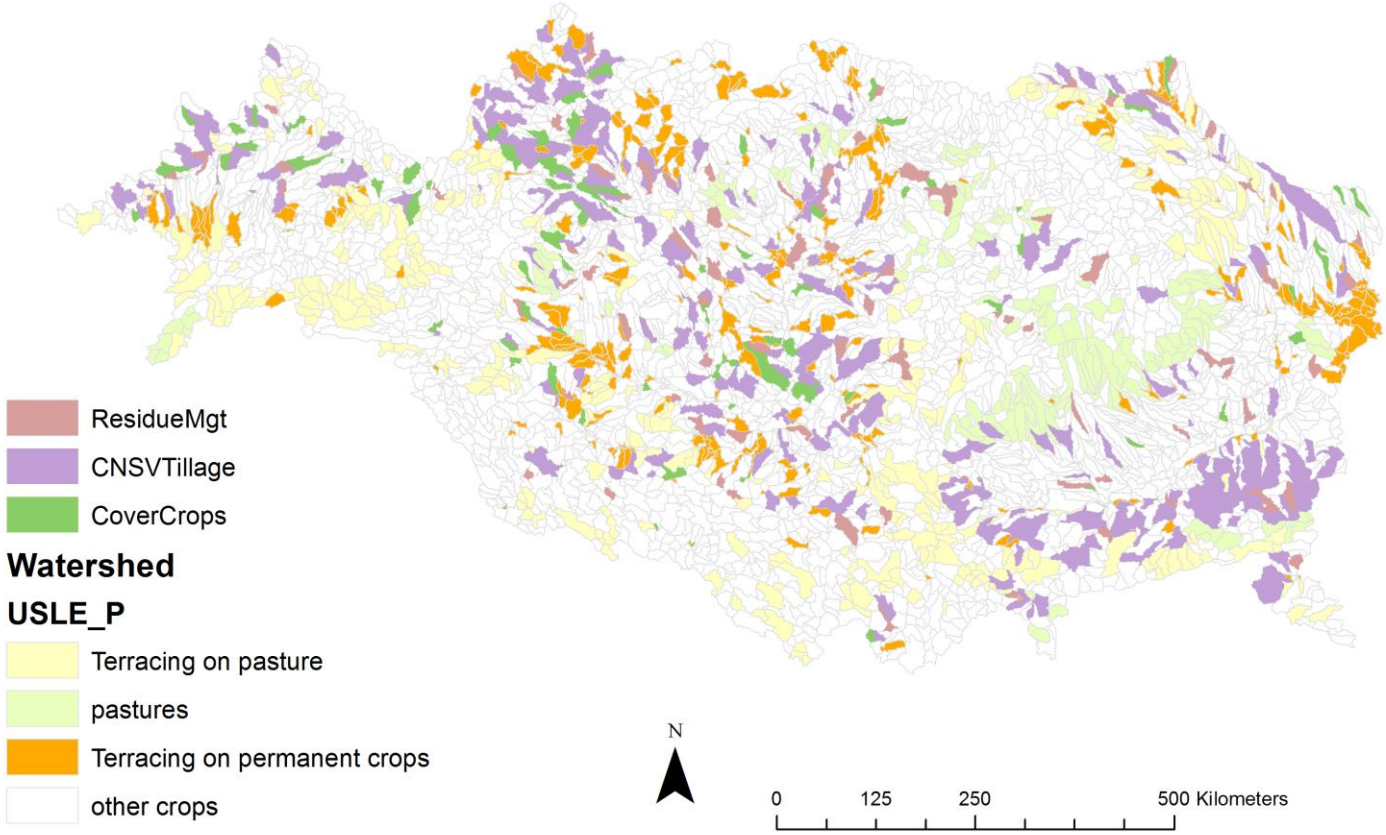
Overview of farming system BMPs

Current farming system BMPs cover

471 Hrus - 23% of arable HRUs; 28% of arable land area

Terracing USLE P correction ranged 0.77- 0.99

However, USLE P < 0.97 only in 10% of these HRUs



Riparian land map

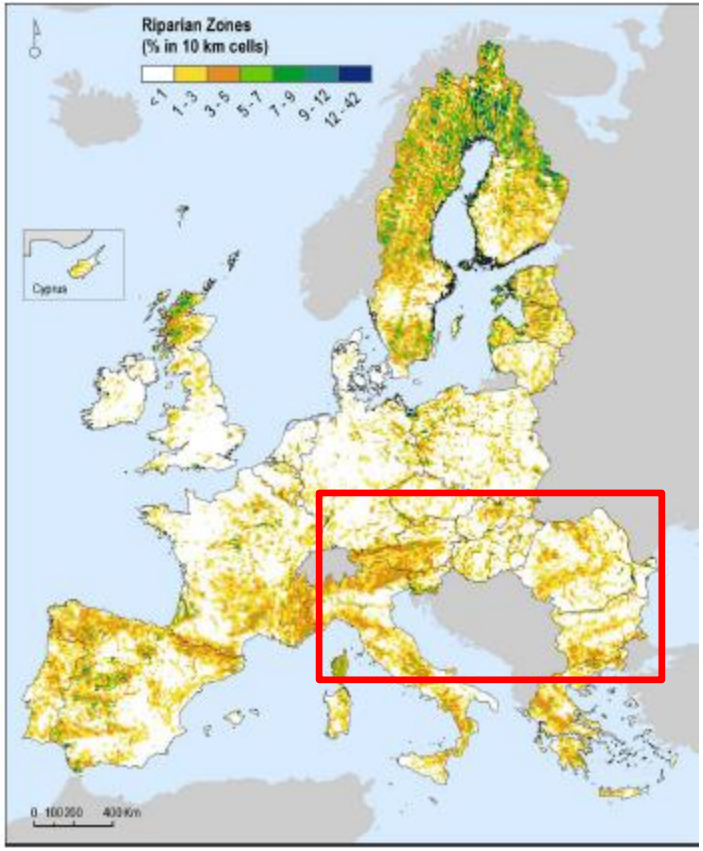
Pan-European map of riparian vegetation types at 25m resolution (Clerici et al. 2013; Weissteiner et al. 2013)
+ CORINE wetlands

Modelled as filter strips

VSFRATIO ~ area of subbasin/area of riparian zone in the subbasin (limited in the range 10-200)

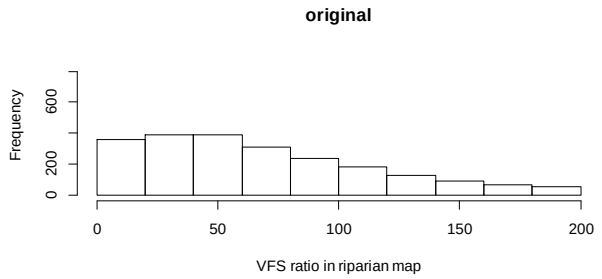
No data area: attributed characteristics of neighboring regions

Applied to pastures or cropland hrus

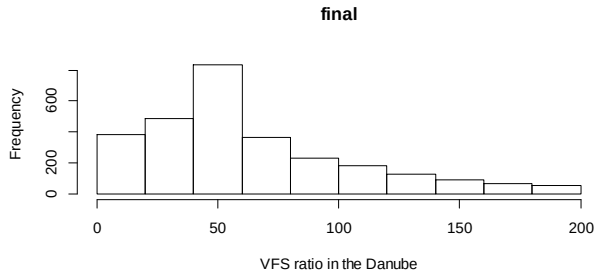


SWAT implementation (ops table)

original = from Clerici et al. map (2152 hrus)



final = including the nodata region (2815 hrus, 54%)



Operation	Parameters			
SWAT2012 (filter.f) MNG_OP=4	FILTER_I (VSFI)= 1	FILTER_RATIO (VSFRATIO) = 10-200	FILTER_CON (VSFCON): 0.25	FILTER_CH (VFSCH): 0.10

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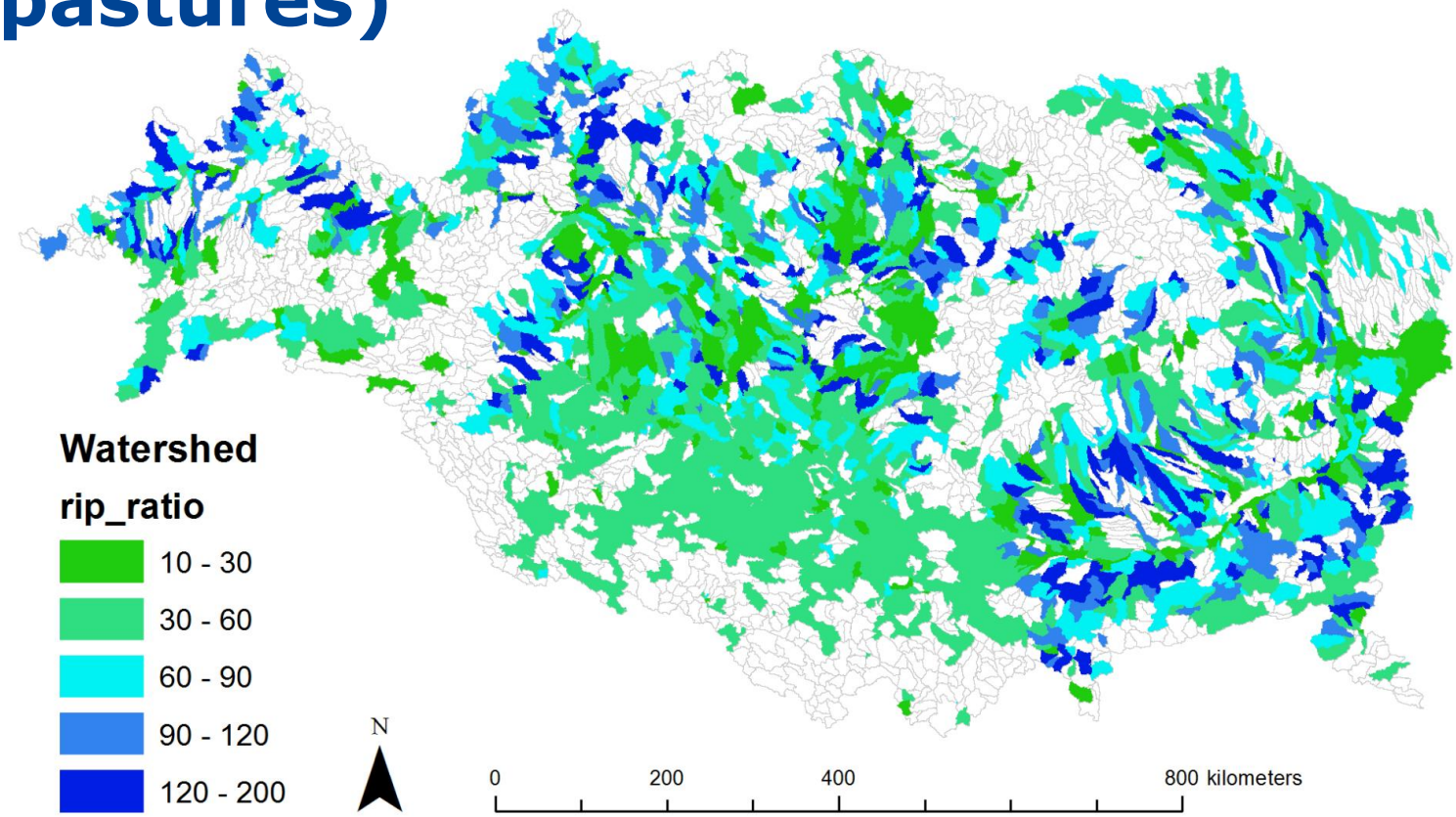
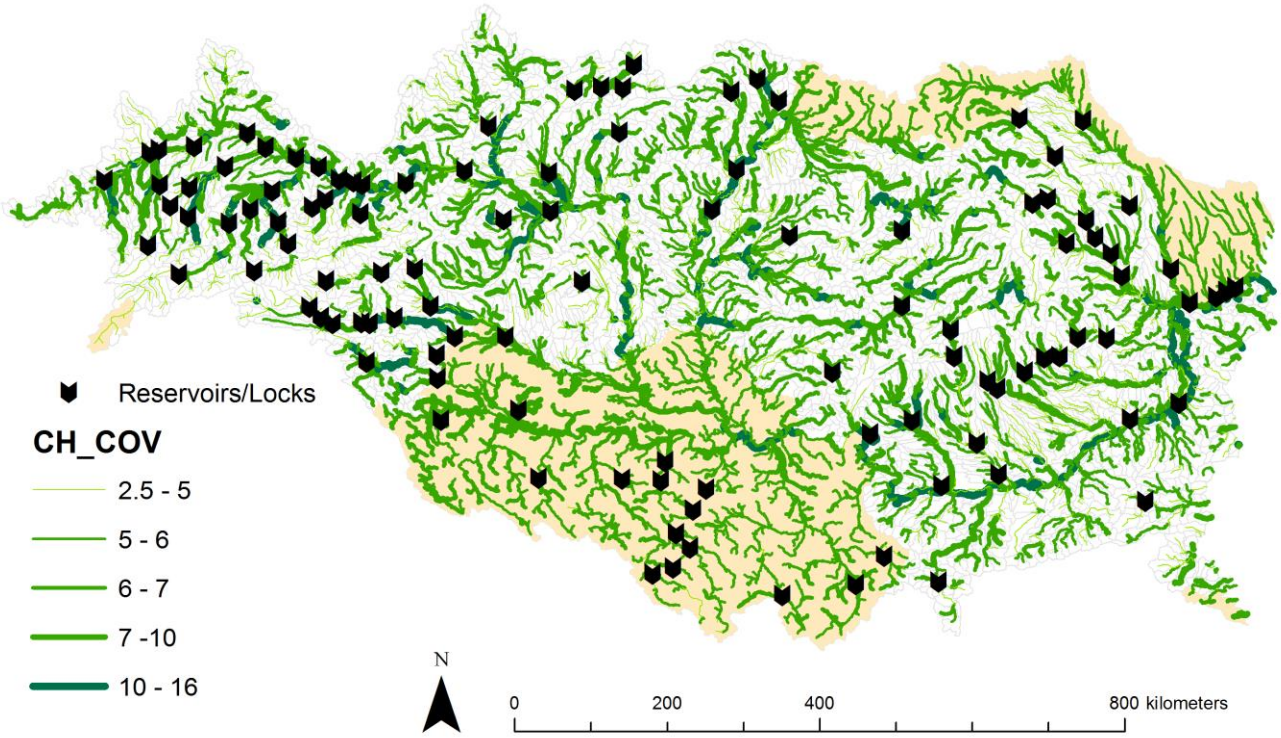
Riparian land in the Danube (cropland and pastures)



Joint Research Centre

In-stream (streambank & reservoirs/locks)

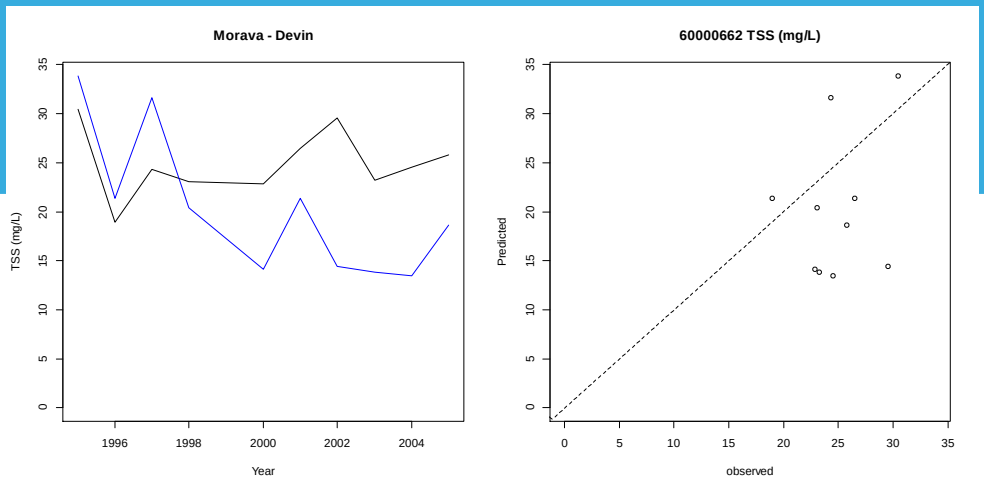
Clerici et al. 2013 riparian map (25m) used for estimating vegetation along the main stream (CH_COV; note: CH_EQN=3)

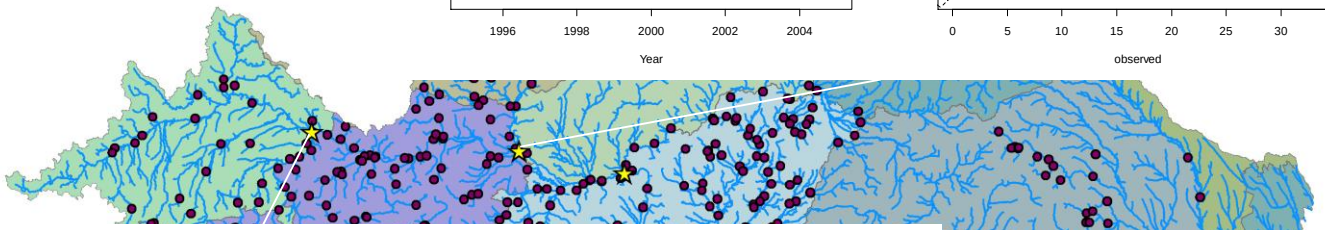


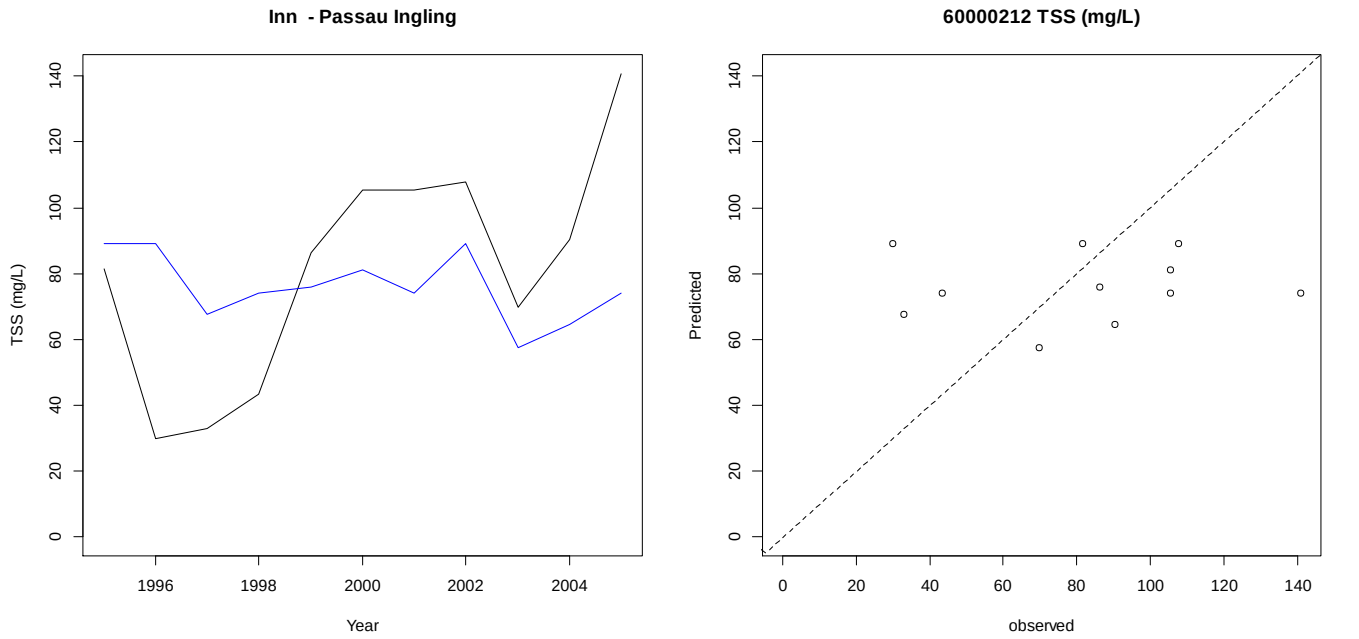
No data: values assigned depending on land use, slope and drainage area

Major reservoirs and hydropower plant locks (114) included

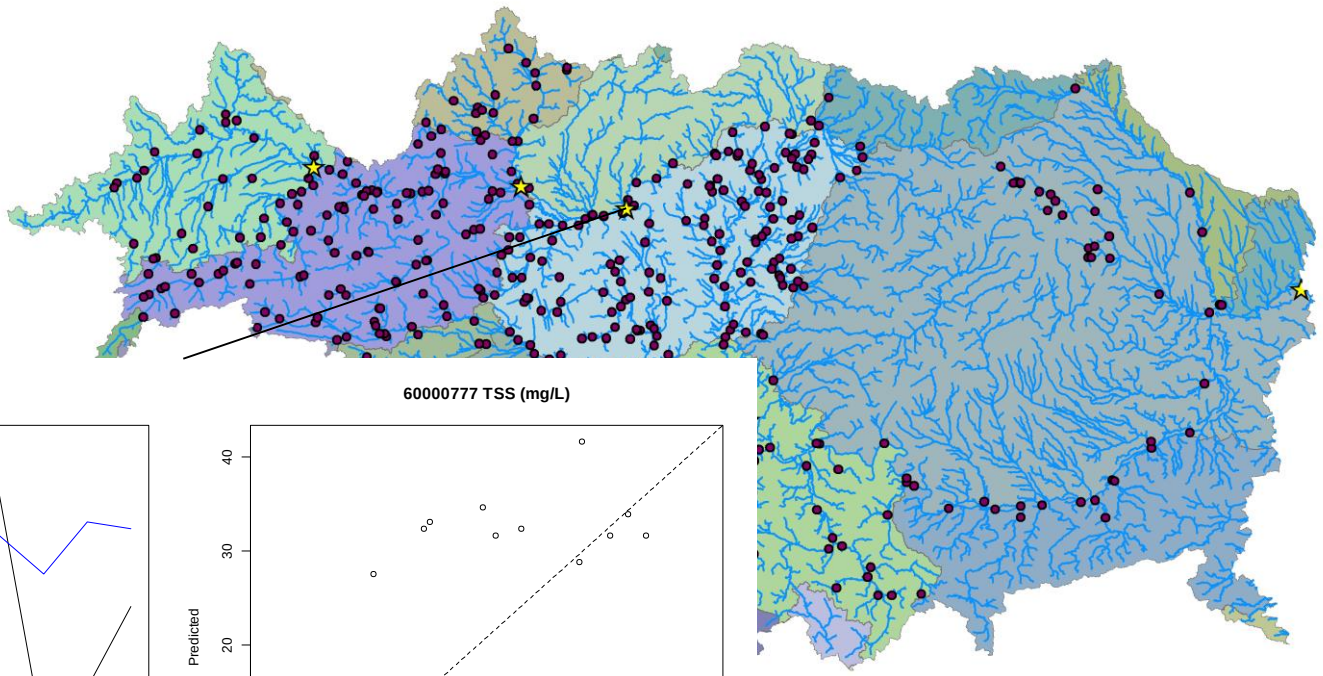
SWAT sediments (uncalibrated)

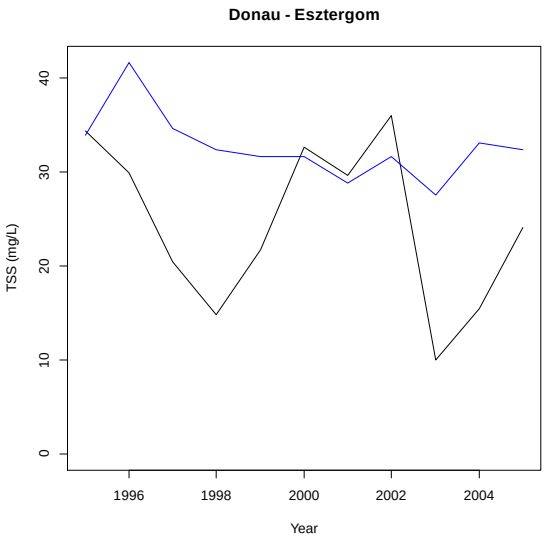




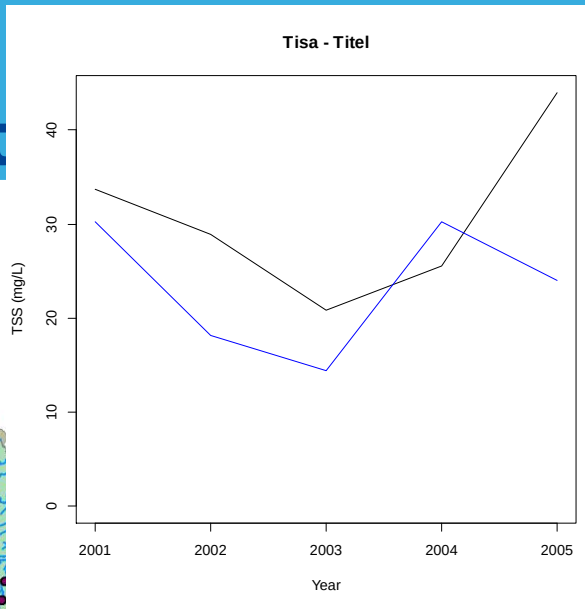


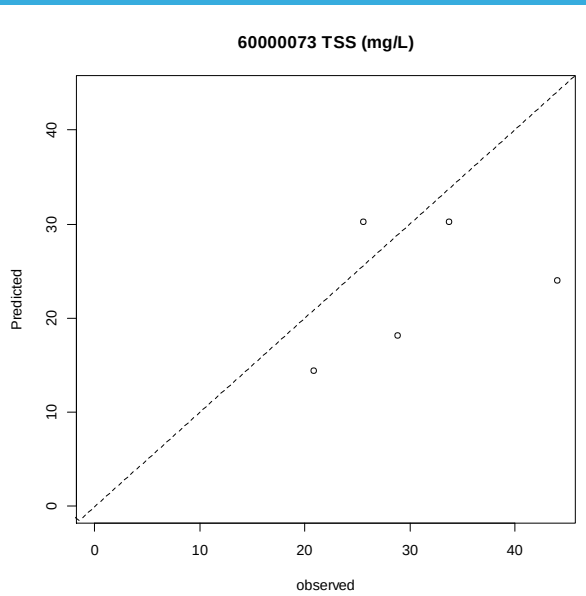
SWAT sediments (uncalibrated)

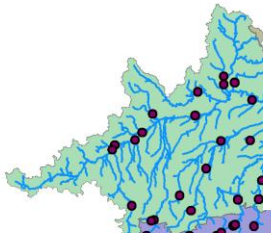


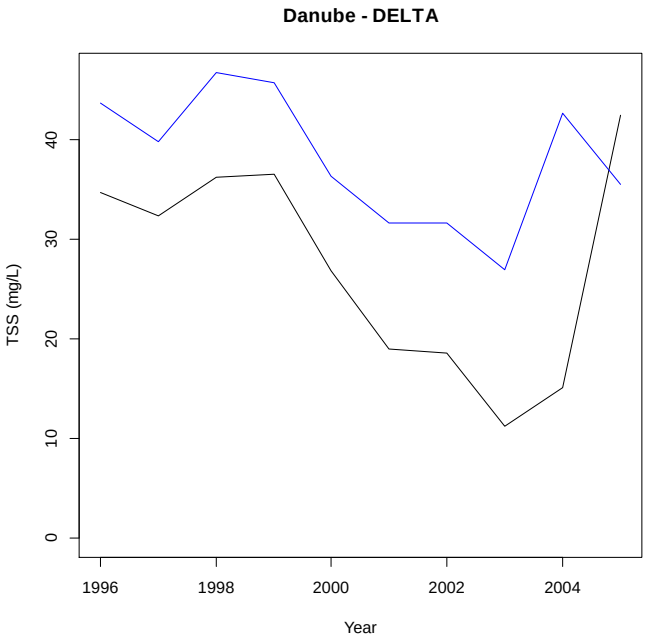


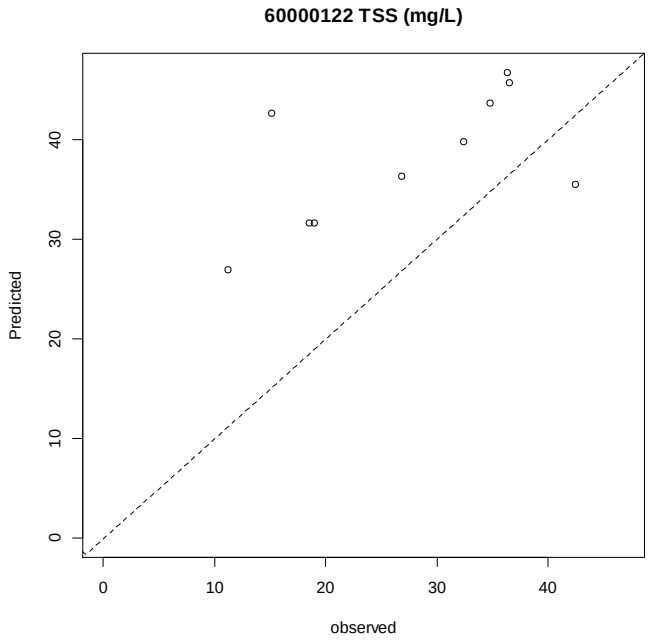
SWAT sediment (uncalibrated)

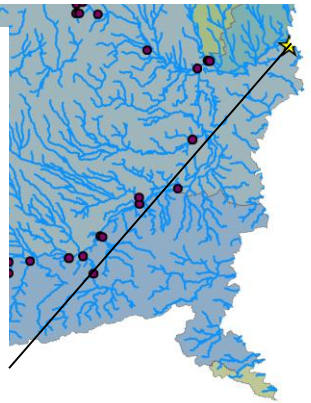




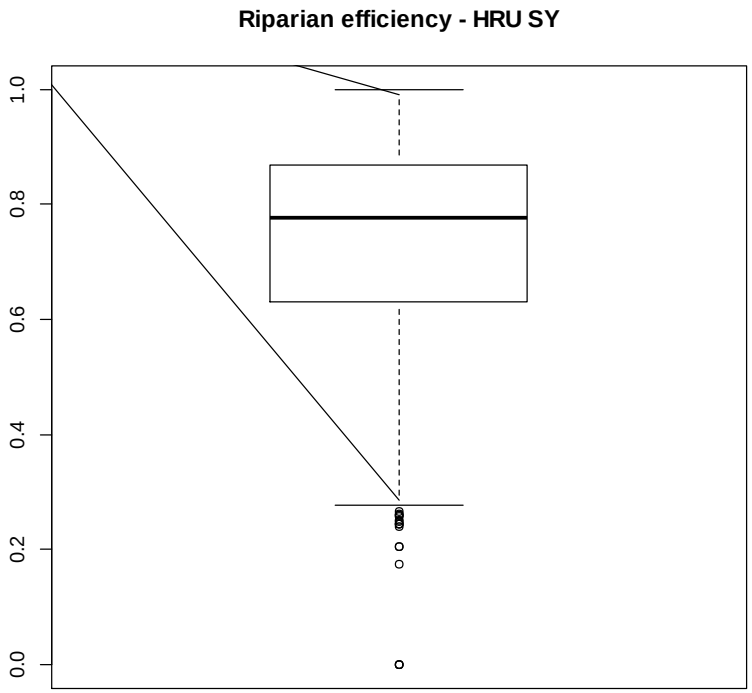


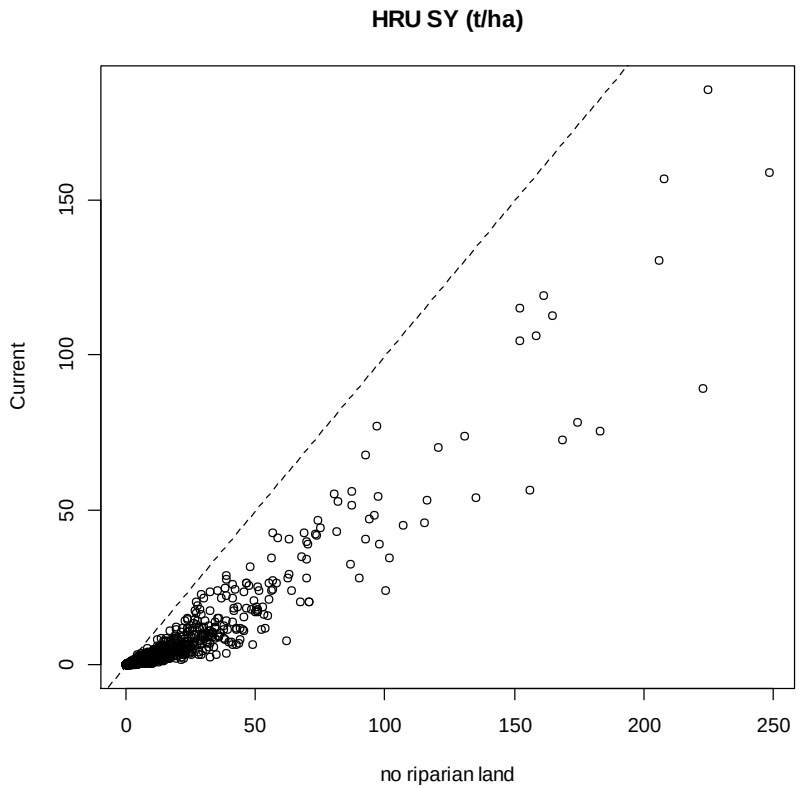




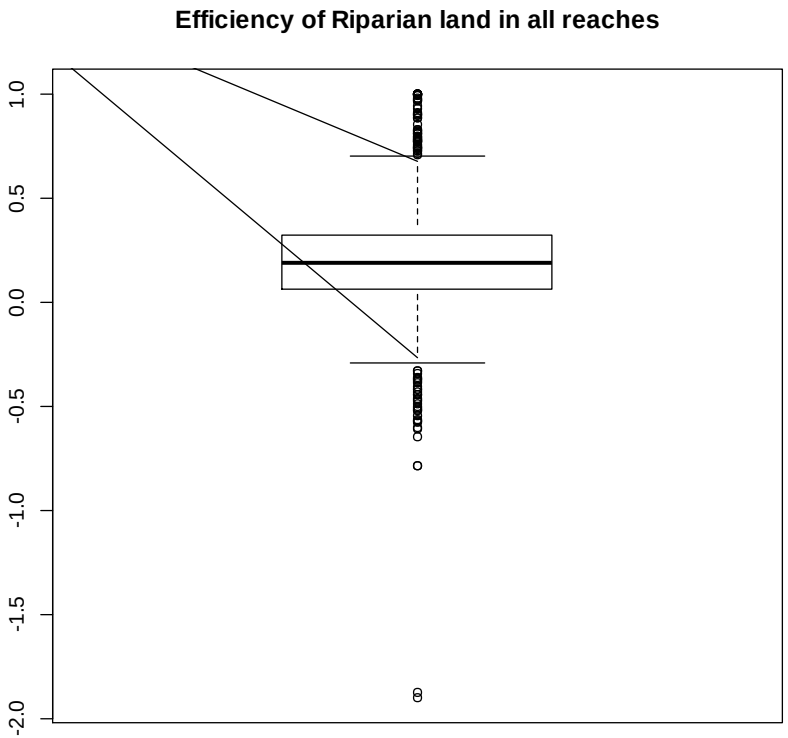


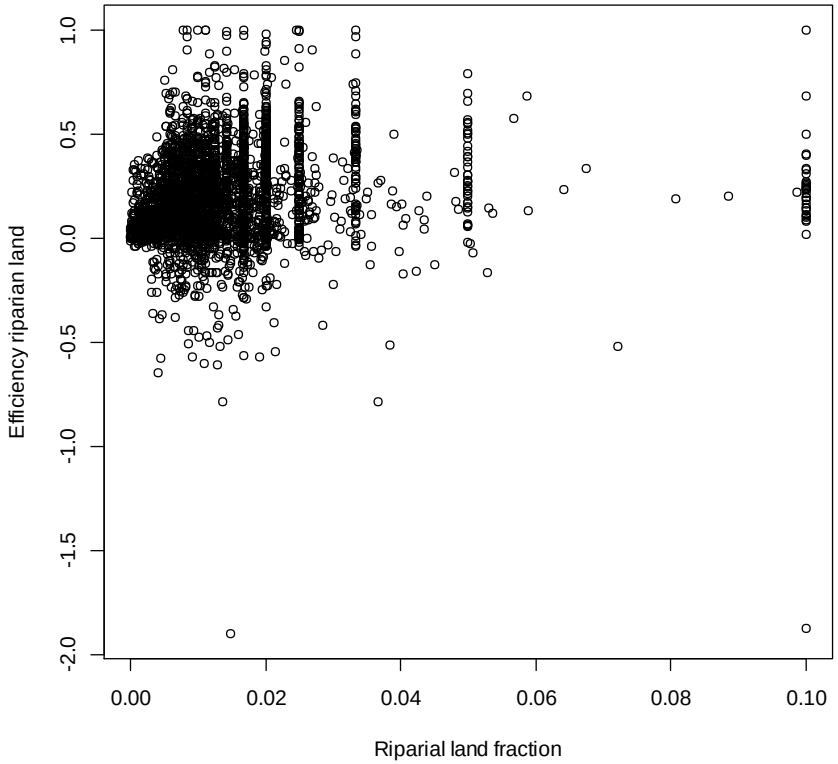
Results example:
(i) impact of riparian land at HRU scale

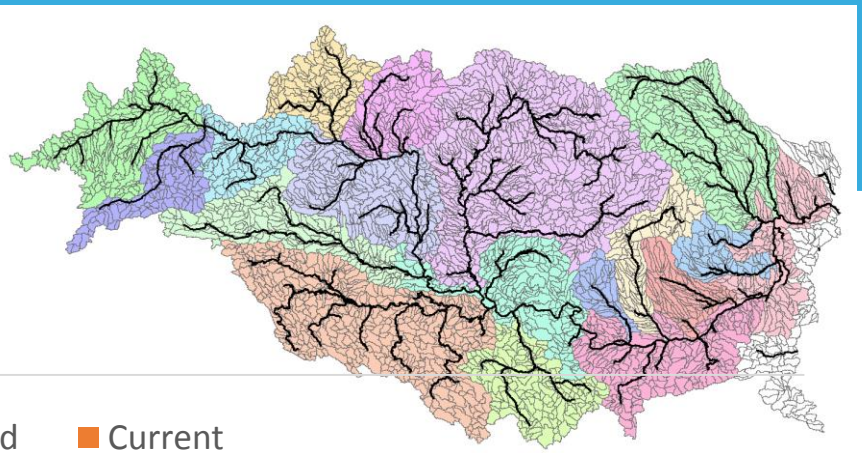




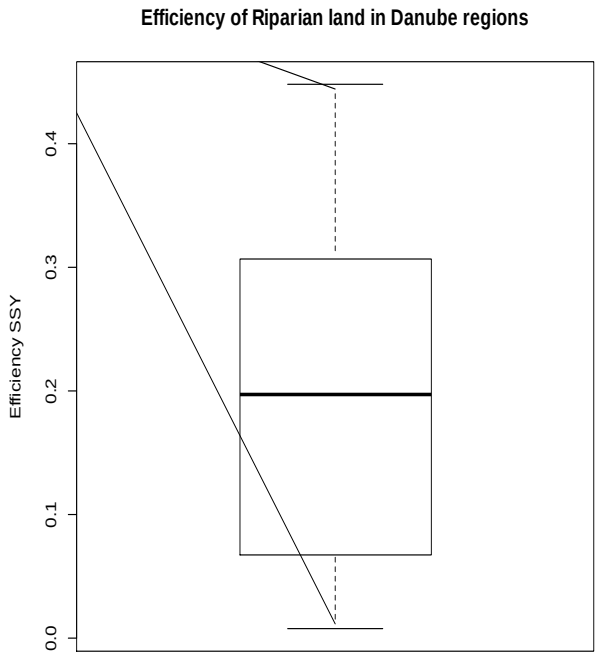
(ii) impact at reach scale

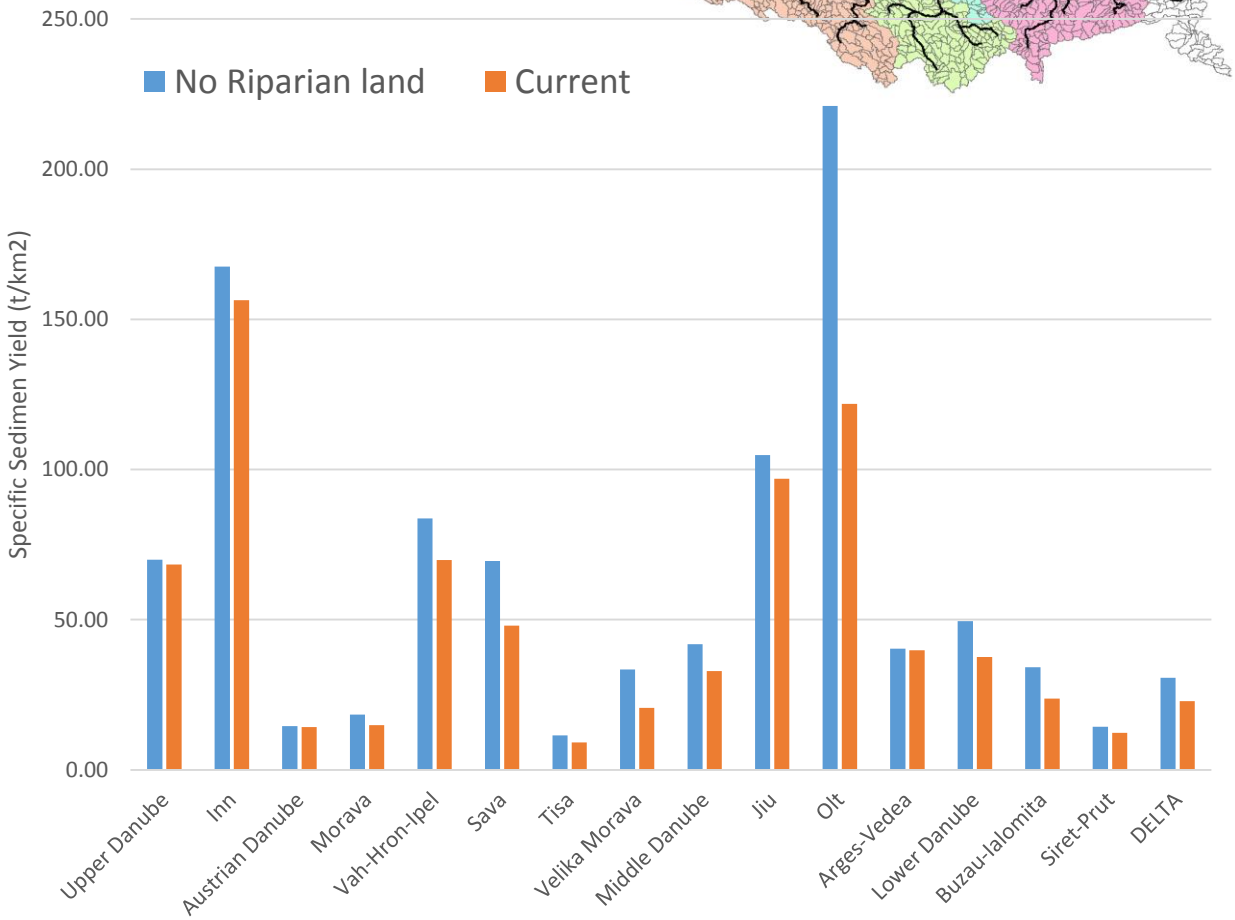






(iii) Impact at regional scale





Discussion

- Potential errors in spatial attributions of BMPs
- Literature reports different implementation of BMPs in SWAT (e.g. conservation tillage) -> impact on BMPs 'effectiveness'
- Wetlands: currently SWAT only consider impact on the subbasin, cannot consider upstream reaches load (longitudinal connectivity)
- Careful calibration (water and sediments) is needed to achieve correct representation of sediment generated in land vs stream phase processes

Conclusions & outlook

Good general performance of SWAT for suspended sediment modelling even in uncalibrated conditions (but careful set-up)

This study will help revealing the real impact of BMPs on sediment (and in the future, on nutrients) at several scales (from local to regional)

The BMPs rules & calibrated SWAT model can be used for scenario analysis

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Selected references

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