



Morphological changes of a restored reach: the case of the Spree River, Cottbus, Germany

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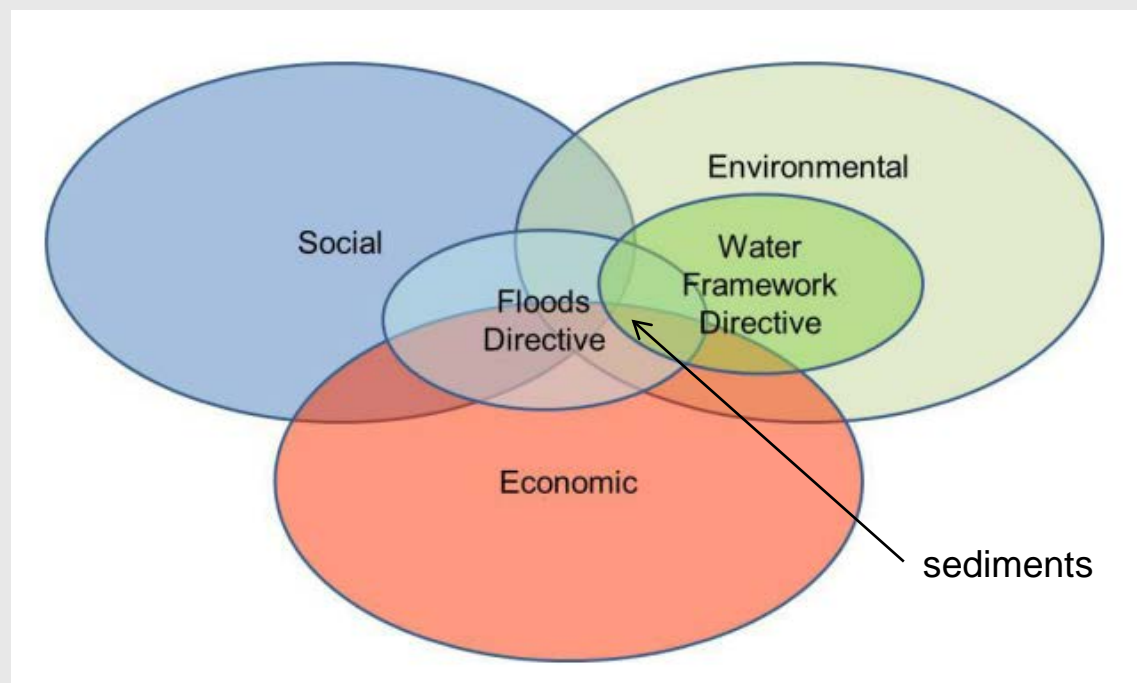
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Water Framework Directive and Floods Directive: missing links

Monitoring of sediment transport is not explicitly mentioned in the WFD

Hydro-morphology is considered only as supporting element in the case of good or lower water bodies (WFD)

No requirements regarding sediments in the Floods Directive

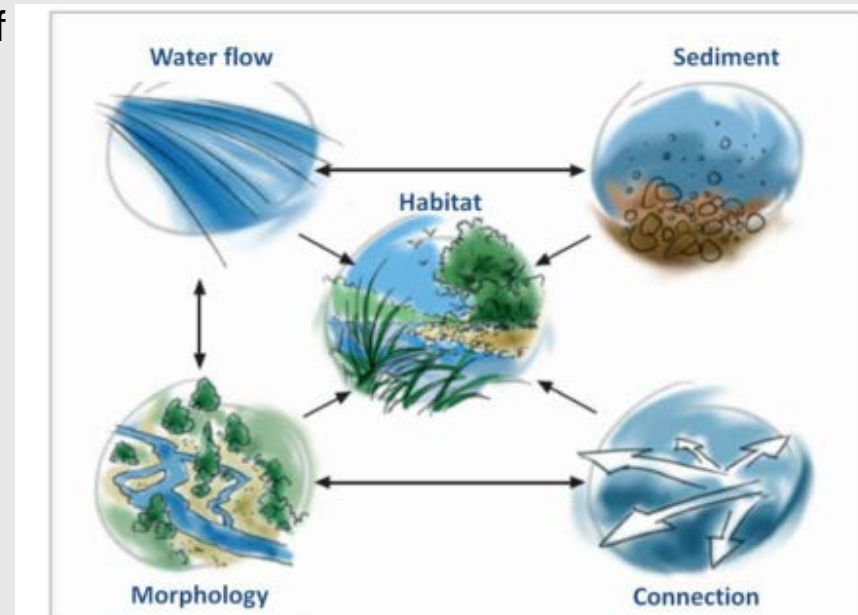


Hydromorphological elements

WFD ecological classification system describes hydromorphological elements as “supporting the biological elements” for rivers in good or lower status

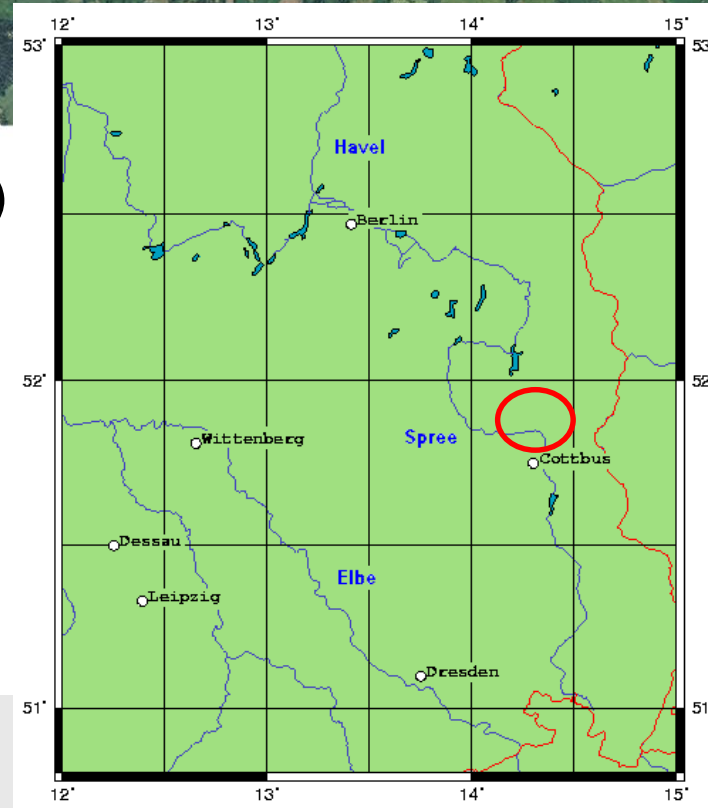
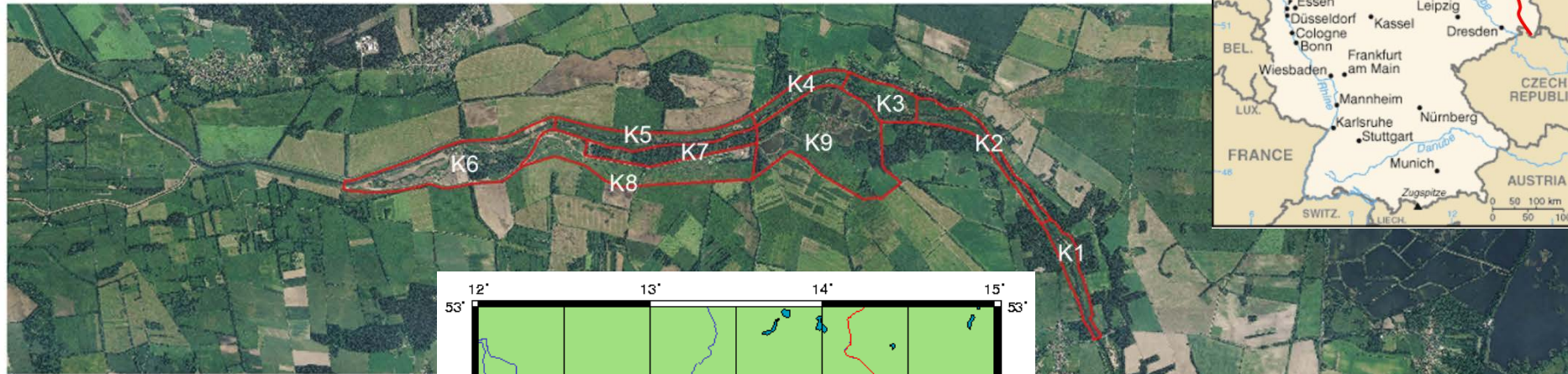
Assessment of pressures and impacts on:

- hydrological regime (quantity and dynamics of flow, connection to groundwater)
- continuity (ability of sediments and migratory species to pass freely up and down rivers and laterally with the floodplains)
- morphology (physical habitat, compositions of structure of bed, banks, riparian zone)



Source: Bourdin et al. (2011)

The Spree River



$S = 6240 \text{ ha (62 km}^2\text{)}$

$L = 9 \text{ km}$

$Q_{\text{mean}} = 7.5 \text{ m}^3/\text{s}$

$Q_{\text{bankfull}} = 35 \text{ m}^3/\text{s}$

$d_{50} = 0.66 \text{ mm}$



Why studying this restoration project?

High water levels and floods cause sediment deposition on floodplains and bed/bank erosion

Problems:

- narrowing and deepening of the river bed
- reduction of planimetric variability: single thread channel
- threats for habitat and ecological status (failure of the WFD goals)
- increase of flood risk (failure of the FD goals)
- failure of the restoration project

Integration of a sediment management plan in the implementation programme of the WFD/FD



Planimetric variations: comparison of aerial images

2014



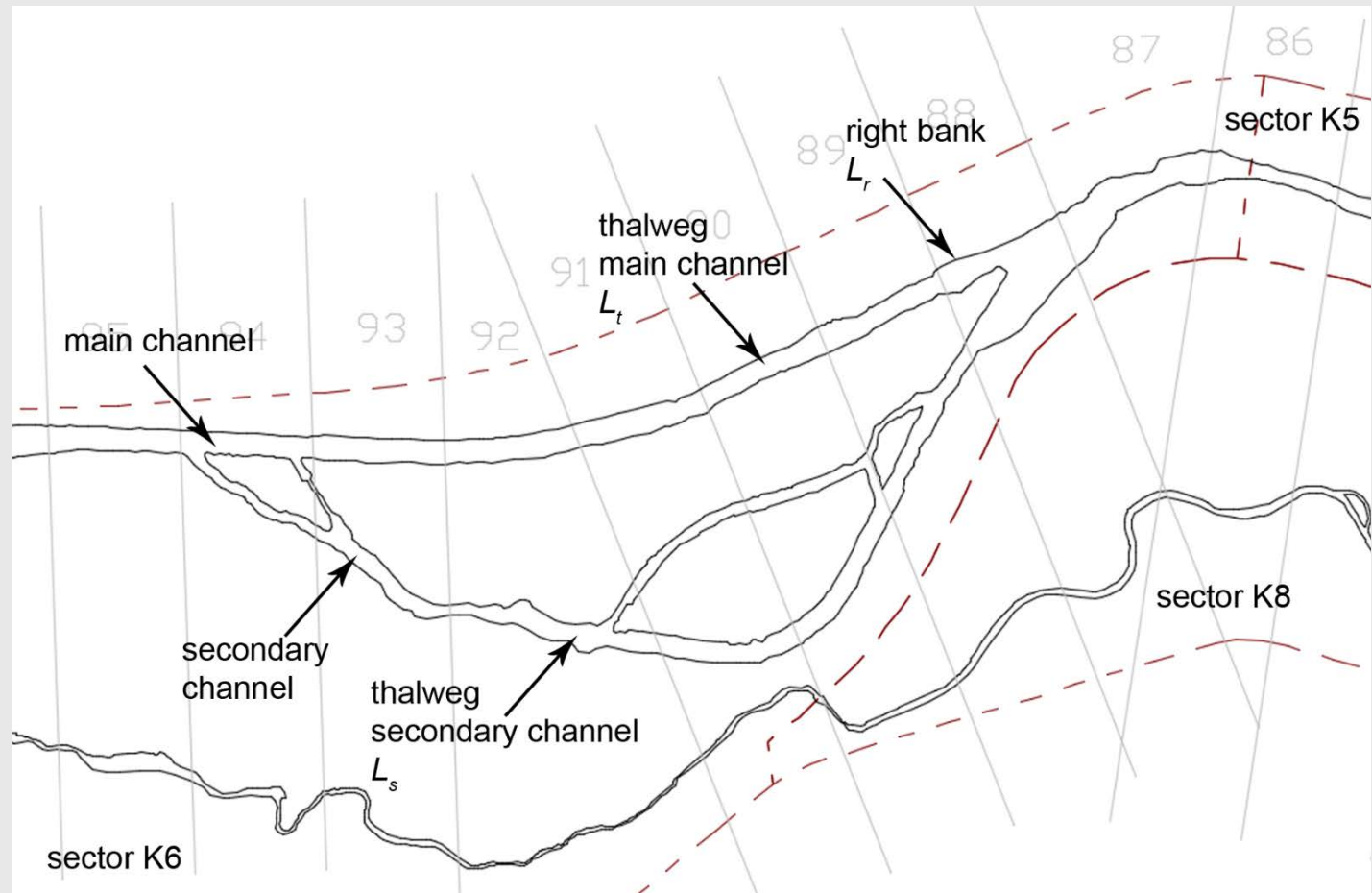
Planimetric variations: comparison of aerial images

$$P_t = L_t / L_r$$

$$BI = \sum L_i / L_t$$

$$S = \sum L_i / L_r$$

$$L_i = L_t + \sum L_s$$



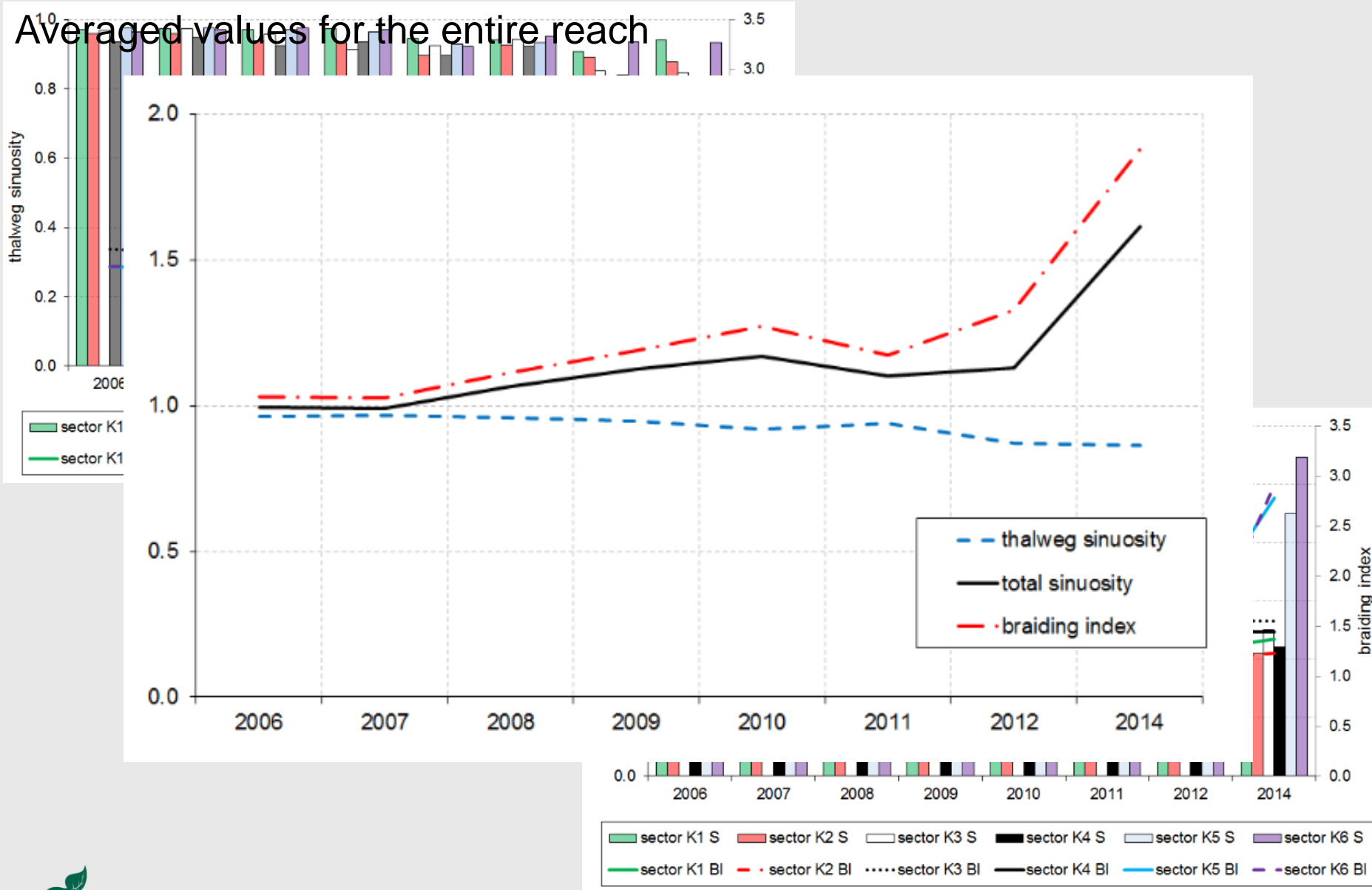
P_t = thalweg sinuosity

S = total sinuosity

BI = braiding index

Planimetric variations: comparison of aerial images

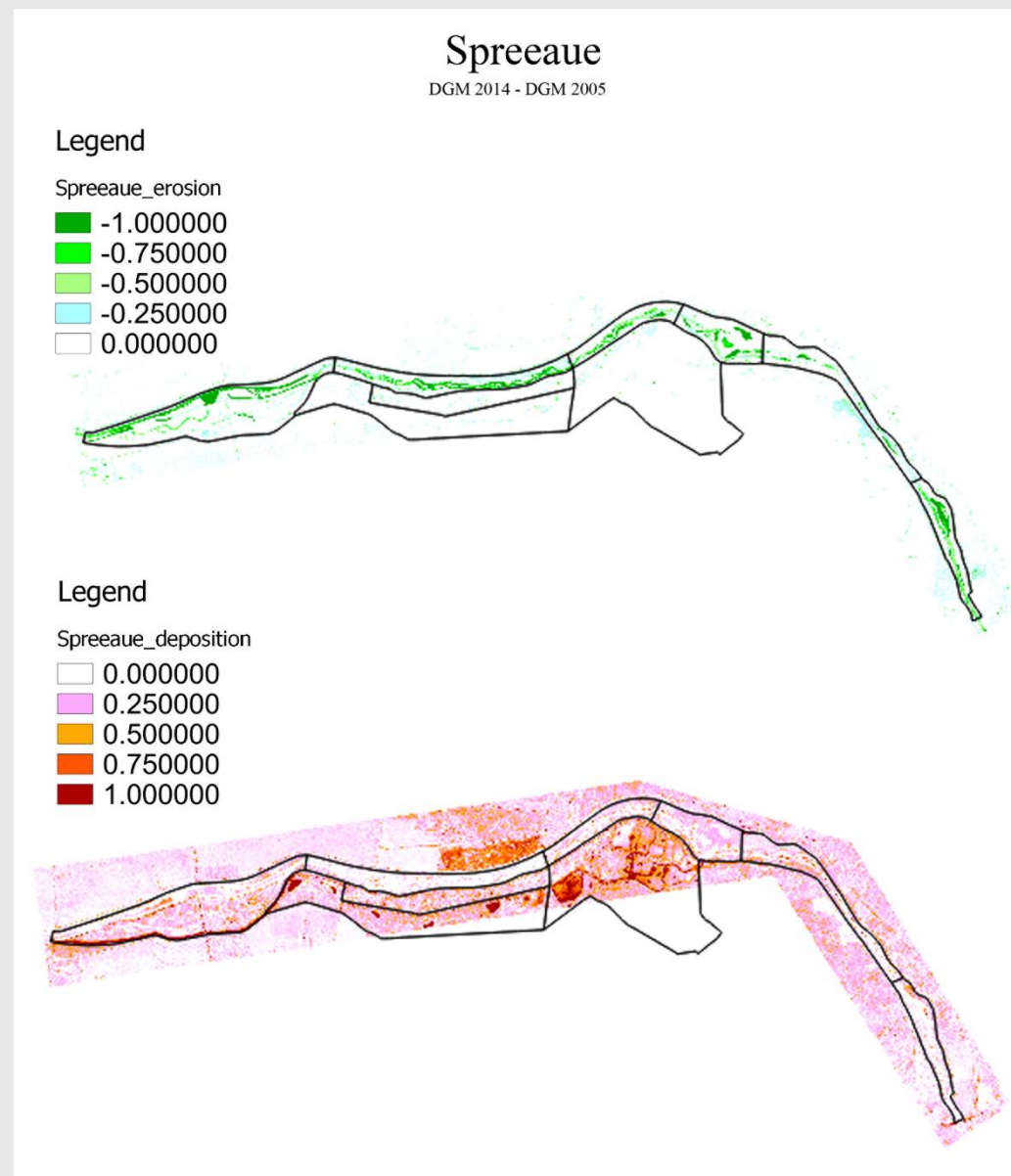
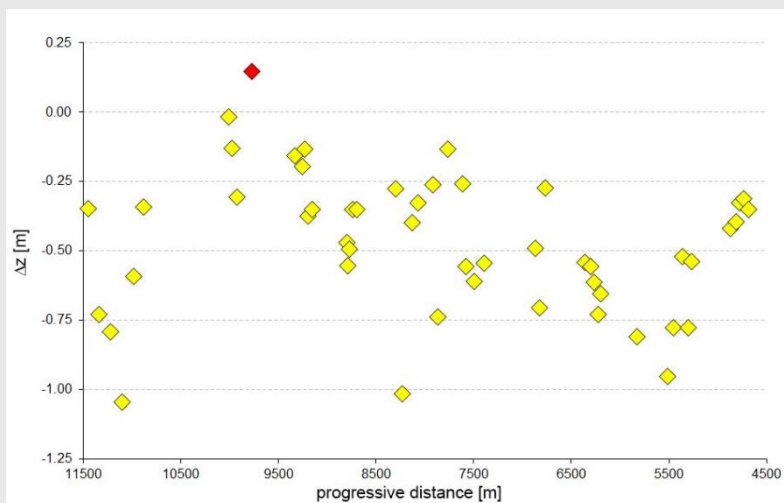
Averaged values for the entire reach



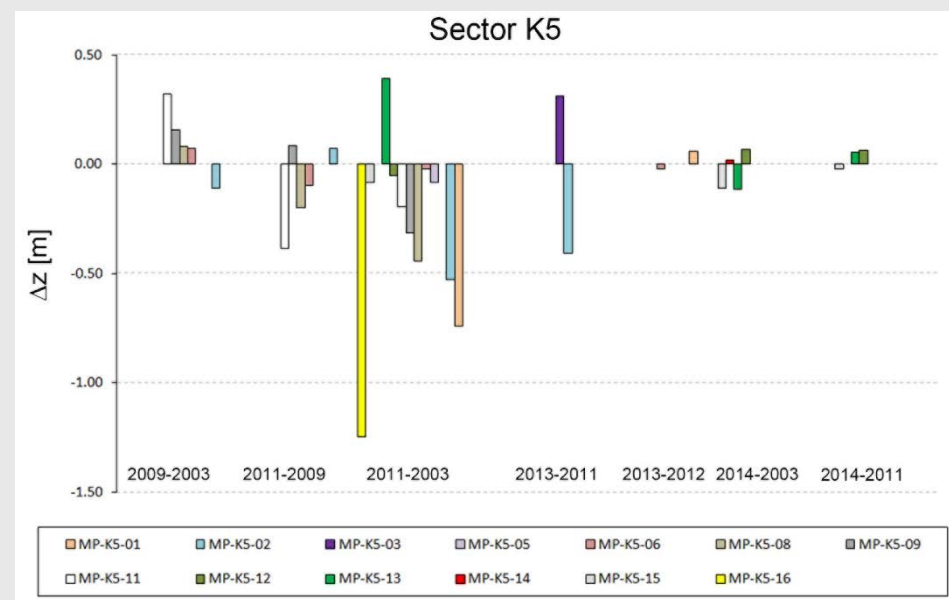
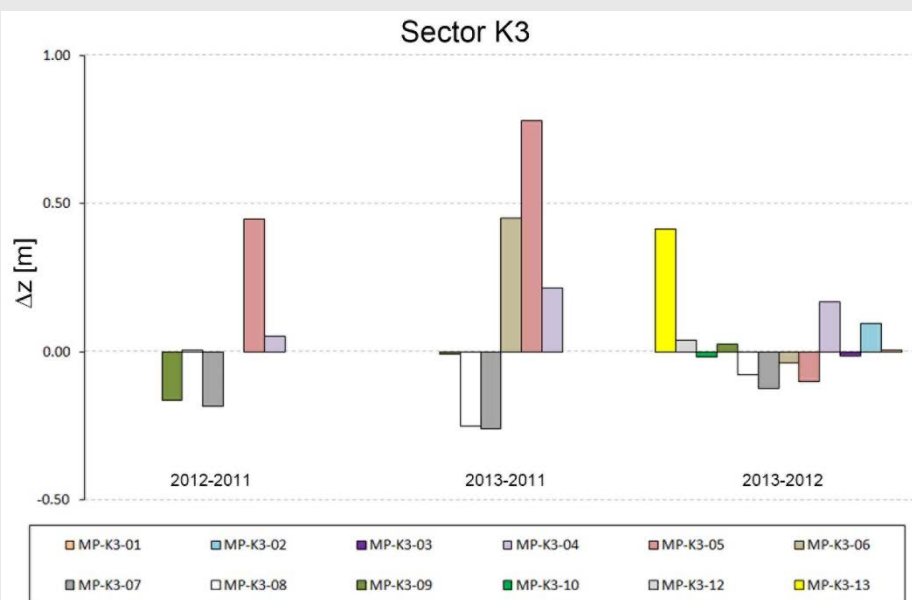
Altimetric variations: comparison of DGMs

Bed erosion

Deposition along floodplains

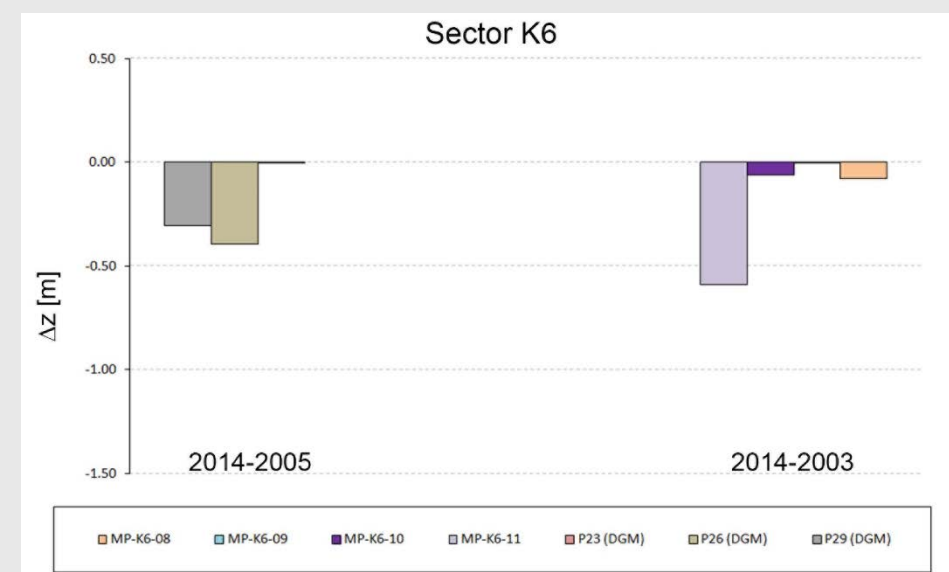


Altimetric variations: comparison of bathymetric surveys



Lack of detailed measurements

Bed erosion visible in the latest surveys



Lessons learnt

- river restoration does not restore fluvial environment to natural/pristine conditions per se: habitat diversity is related to flow condition, variability and substrate composition
- increase in channels number, redesign of their shape and addition of coarser sand could be not sufficient to improve rivers status
- problem of sand transport with high flow conditions
- secondary channels and floodplains are affected by depositional phenomena
- diffuse erosion along the main channel during the last years
- no significant impact on macrophytes and macroinvertebrates
- additional results will be available at the end of 2015, with the analysis of new bathymetric surveys and monitoring data of fish and macrophytes token during 2014

THANK YOU FOR YOUR ATTENTION

