

Surface water-groundwater interactions at river Moselle: Identifying transport processes along an important German waterway

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HS10.9 - 'Groundwater-surface water interactions: physical, biogeochemical and ecological processes':



Main Questions

Interactions of surface water – groundwater along the river Moselle

1. Are there places of increased interaction?
2. Which water compounds are suitable indicators?
3. Impact of interactions on water compounds?
4. How do different hydraulic situations impact the interactions?

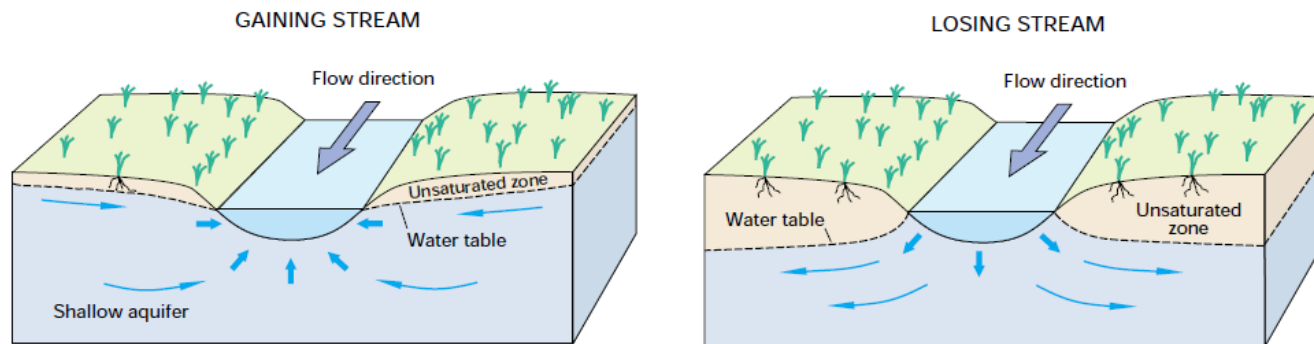


Figure 1: Two different hydrologic situations. Gaining stream with inflow of groundwater and losing stream with flow from surface water into ground water (Winter et al., 1998).

Moselle

Study site

- German part of the river Moselle (250 river km)
- $MQ \approx 320 \text{ m}^3/\text{s}$ (Koblenz)
- 13 locks

Sampling

- Sampling in October 2020 by ship
 - $Q \approx 200 \text{ m}^3/\text{s}$ (Cochem)
- 127 surface water samples
- 16 tributaries
- 16 groundwater monitoring wells

Analysis

- Hydrologic parameters, major ions, trace metals
- Radon, Tritium, $\delta^{18}\text{O}$, δD
- > 150 TrOCs [3]

Modelling

- FINIFLUX (based on Radon and Tritium)
- Cluster analysis (TrOCs) [4]

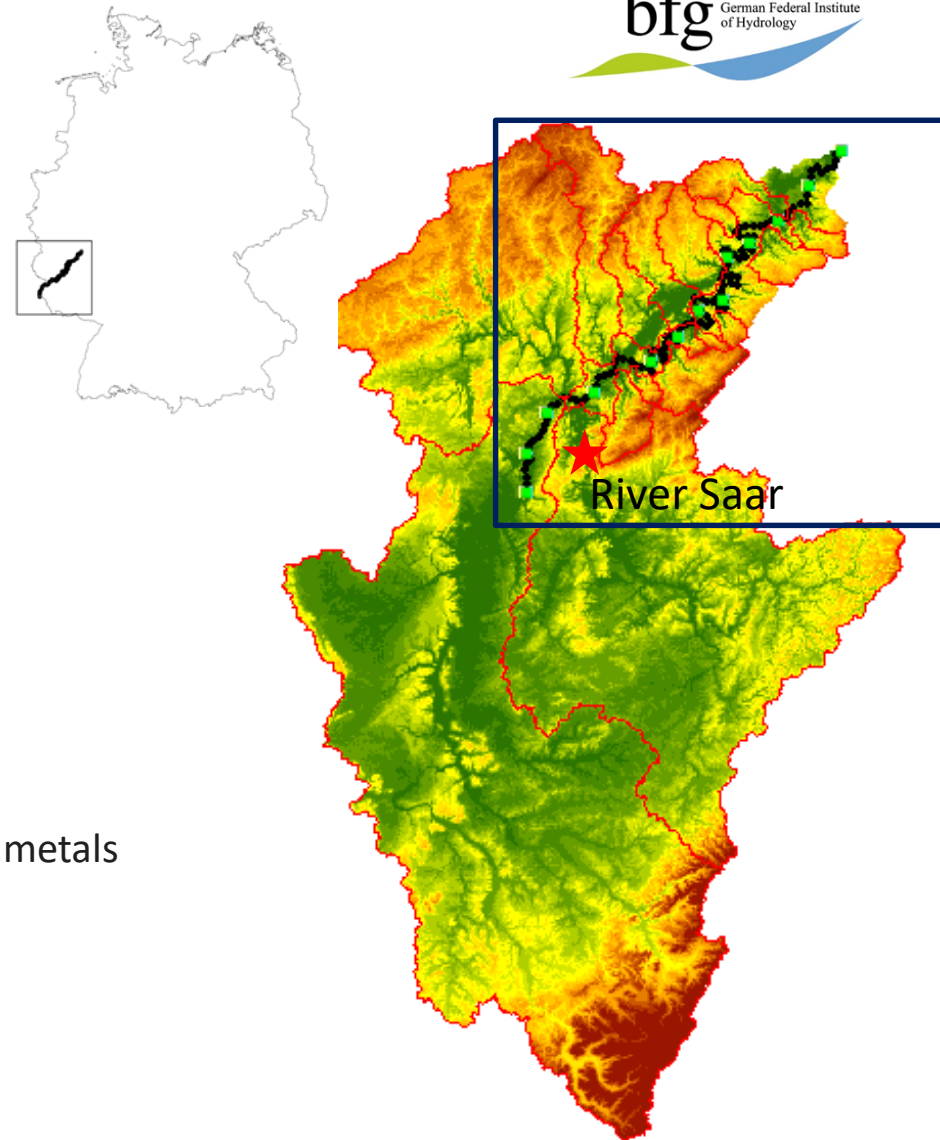


Figure 2: The catchment area of the river Moselle. The green squares mark the location of the locks.

Geology of the study area

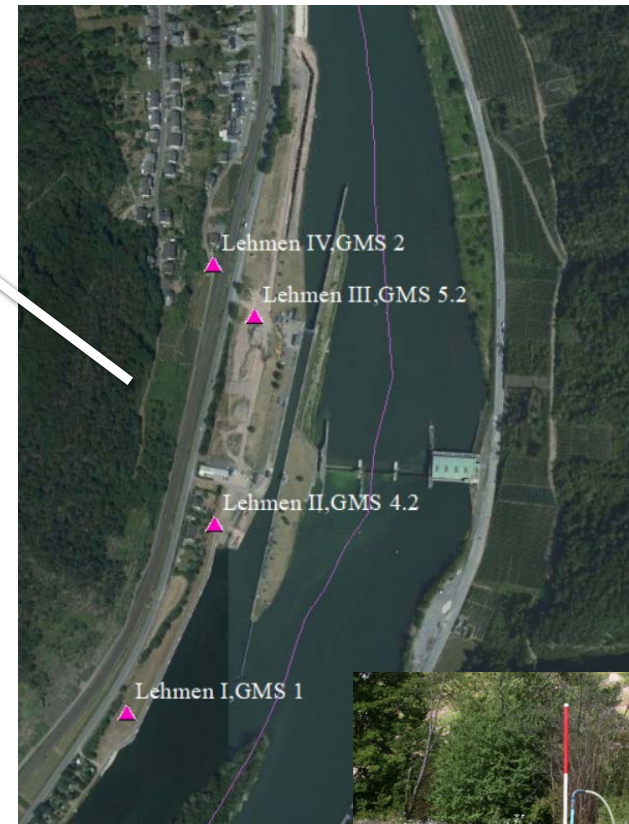
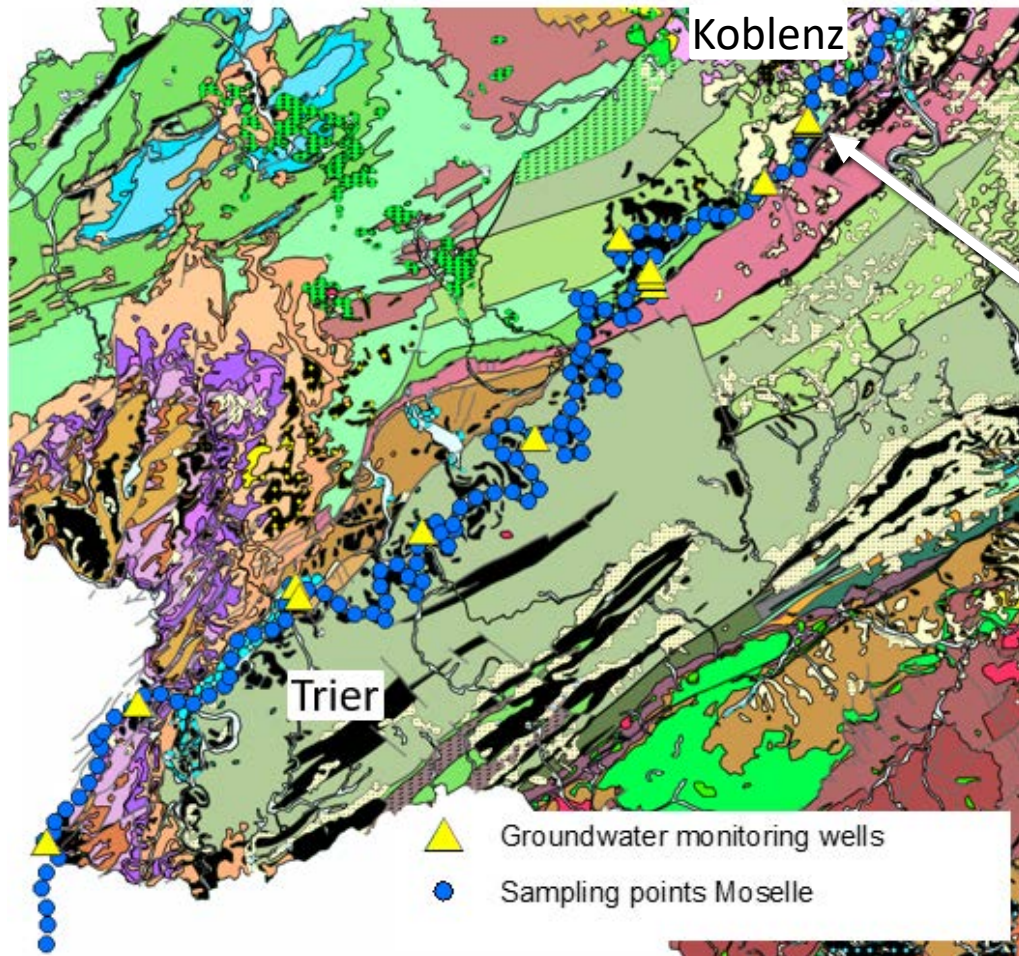


Figure 3: Geology of the research area: Violet colors in the west mark Jurassic limestone and sandstones. Dark green and magenta colors towards south and east mark Devonian slates of the Rhenish slate mountains.

Sampling by boat

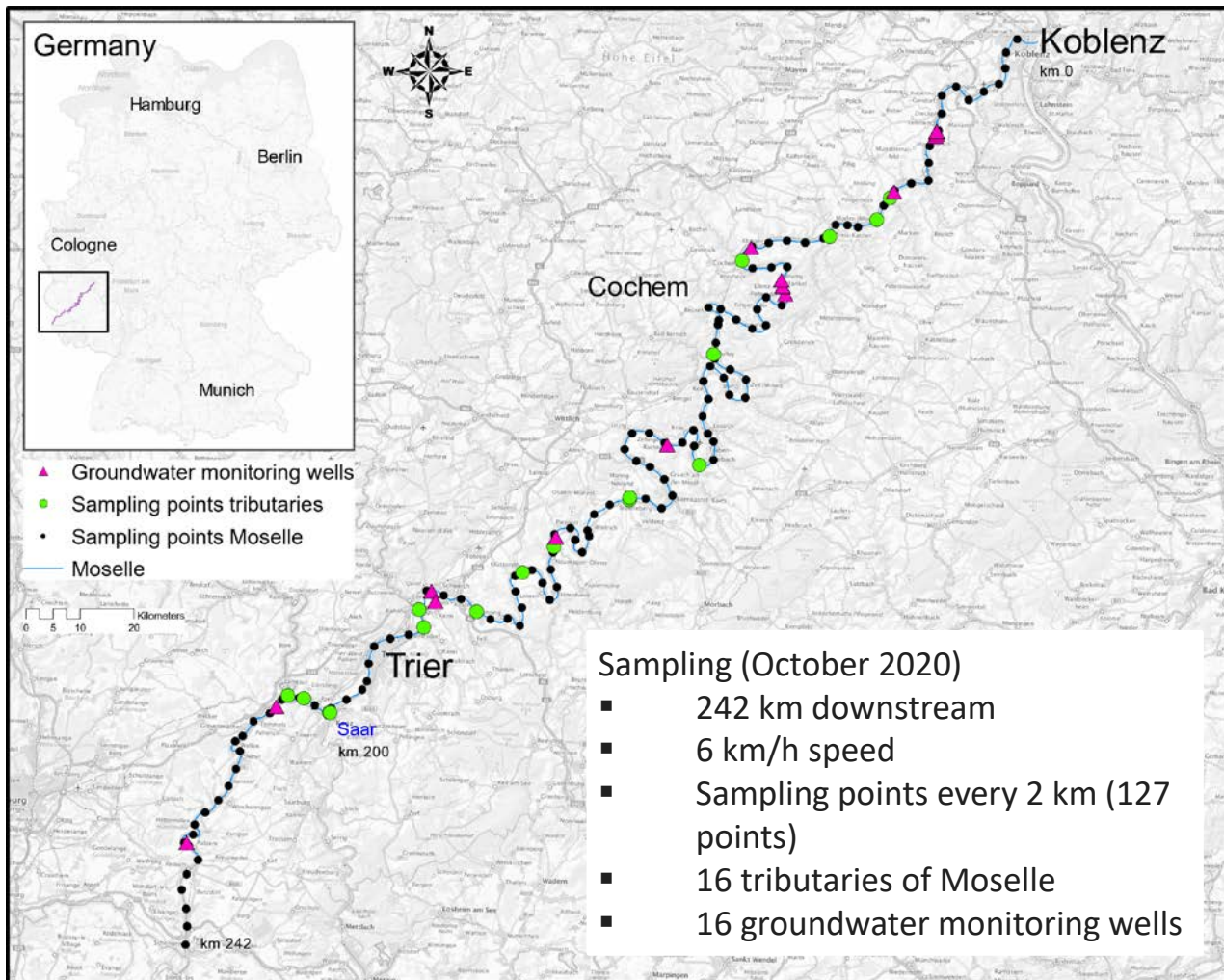


Figure 4: Map of the sampling site according to the location in Germany with all sampling points, supplementary information of the sampling parameter.

El. Conductivity and tritium activity along river Moselle

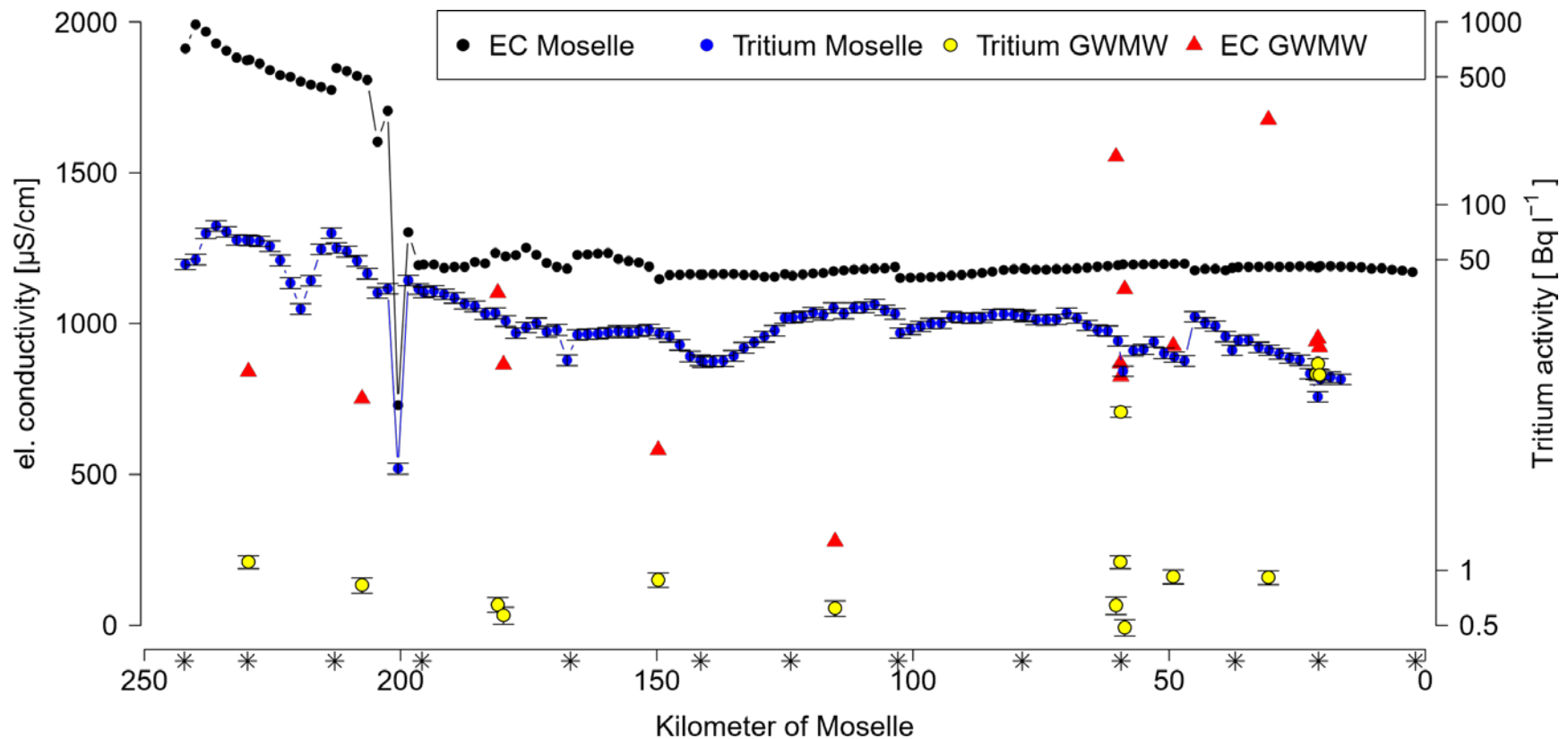


Figure 5: Electrical conductivity (black) and the tritium activity (blue) along the river Moselle. The EC (red triangles) and the tritium activity (yellow) of the groundwater monitoring wells is also shown. The asterisks mark locations of the locks.

Results

- The EC shows initially high values around 1800 $\mu\text{S}/\text{cm}$.
- The inflow of the river Saar (at river km 200) has a relevant impact on the EC in the river Moselle (Fig. 5). After the inflow the values are substantial lower (approx. 1200 $\mu\text{S}/\text{cm}$)
- Tritium activity is high and variable due to waste water inputs from NPP Cattenom (10-80 Bq/l^{-1} , Fig. 5).
- Groundwater monitoring wells at locations with locks show signs of SGI, indicated by high EC and high tritium activity (Fig 5).
- Concentrations of analyzed tracers and solutes in the tributaries have a minor impact on the concentrations in the river Moselle. An exception is the river Saar.

Summary

- The multi-tracer approach will allow the identification of gaining and losing stream conditions and associated processes throughout the river.
- Further analysis and statistical examination (e.g. cluster analysis, factor analysis) of the data is key to understand processes by combining all tracers
- Additional sampling campaigns during different flow scenarios, especially low-flow, will be performed to validate the first results.

Main Questions – first findings

1. Are there places of increased interaction?

Yes, locations with locks show higher hydrologic gradients and therefore more pronounced interactions

2. Which water compounds are suitable indicators?

Radon (groundwater flow towards river), Tritium (surface water into groundwater), TrOC to be further tested

3. Impact of interactions on water compounds?

TrOC are prone to degradation, transformation or translocation, further data is required

4. How do different hydraulic situations impact the interactions?

The next sampling campaign is planned during low-flow conditions

Thank you for your attention!

