

Integrative hydrogeo-ecological assessment of the quantitative and qualitative response of groundwater to hydrological extremes

Steffen Birk, Johannes Haas, Raoul Collenteur

Institute of Earth Sciences, NAWI Graz Geocenter, University of Graz, Austria



Alice Retter, Christian Griebler

Department of Functional and Evolutionary Ecology, University of Vienna, Austria



Christine Stumpp

Institute for Soil Physics and Rural Water Management, University of Natural Resources and Life Sciences, Austria



Heike Brielmann

Environment Agency Austria



Objectives

Research question:

How do groundwater systems in an alpine and prealpine environment respond to extreme hydrological events such as droughts, heavy rain and floods in terms of water quantity and water quality?

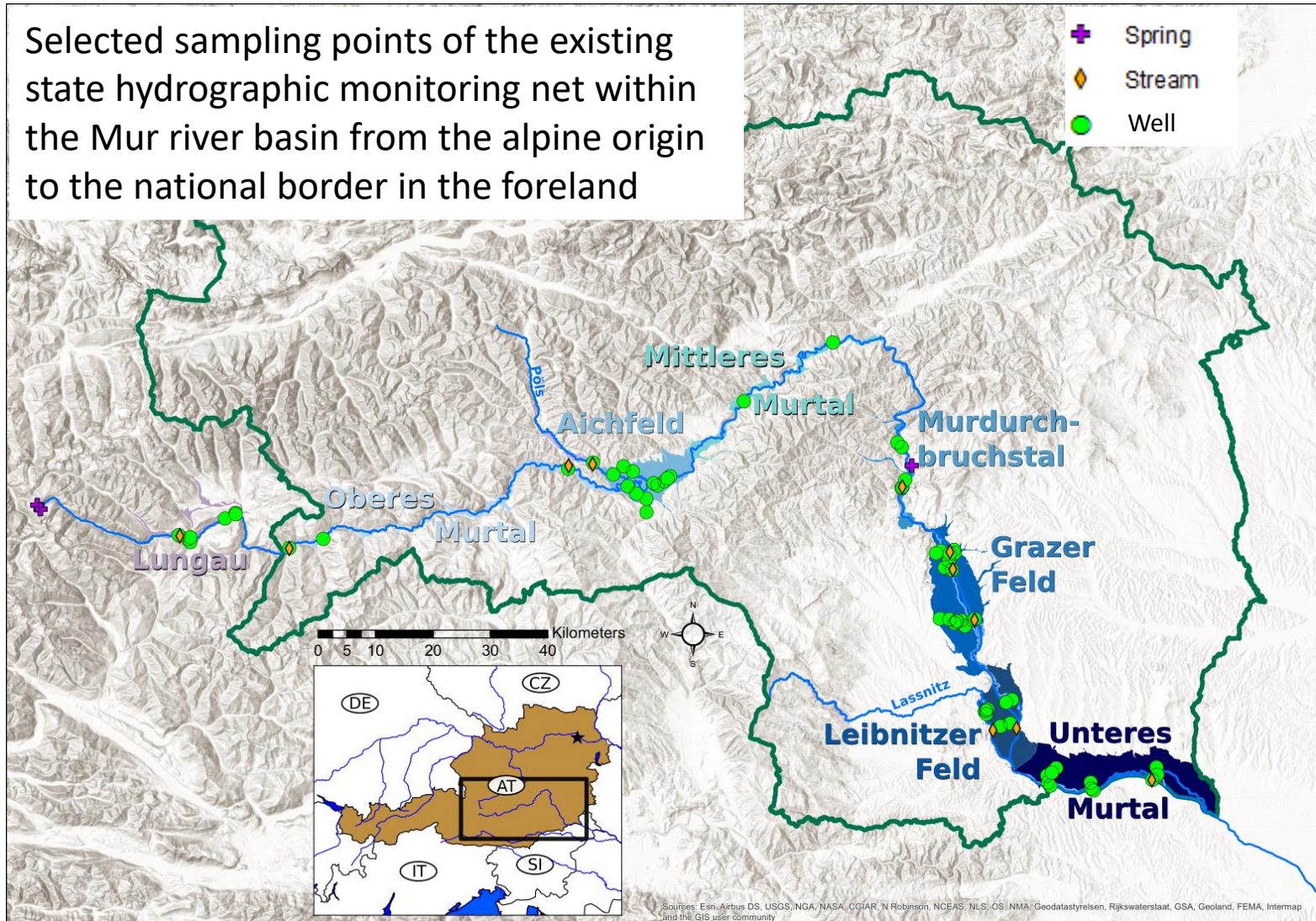
- Groundwater level: [Variability, response to drought](#), etc.
- Hydrochemical composition: [Contaminants indicative of wastewater and agricultural sources](#), DOC, stable isotopes, physico-chemical variables
- Ecological status: [Microbial biomass-activity-energy pattern](#), microbial diversity, groundwater fauna

→ Interaction between physical, chemical, and biological processes

Here: [First results](#) characterizing the current status of water quantity and quality in the investigation area

Field sites and sampling points

Selected sampling points of the existing state hydrographic monitoring net within the Mur river basin from the alpine origin to the national border in the foreland



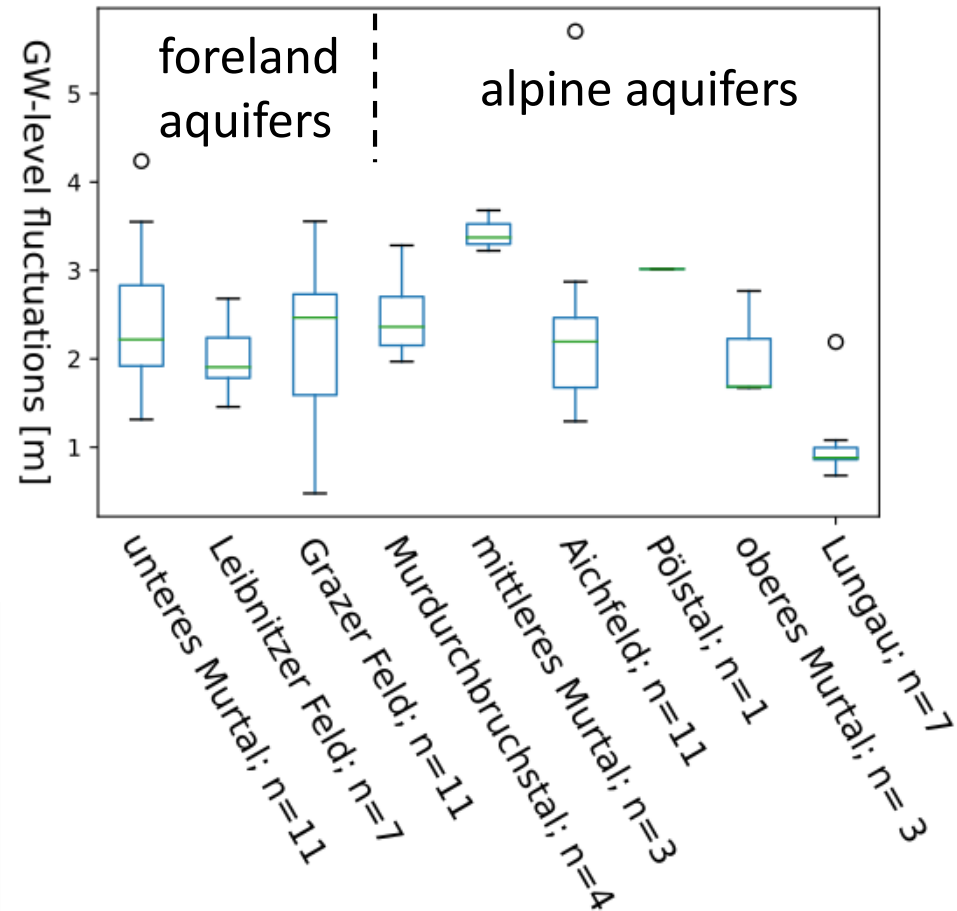
Groundwater levels – variability

Potential drivers of groundwater level fluctuations:

- Recharge from precipitation
- Interaction with surface waters
- Others, e.g. groundwater abstraction

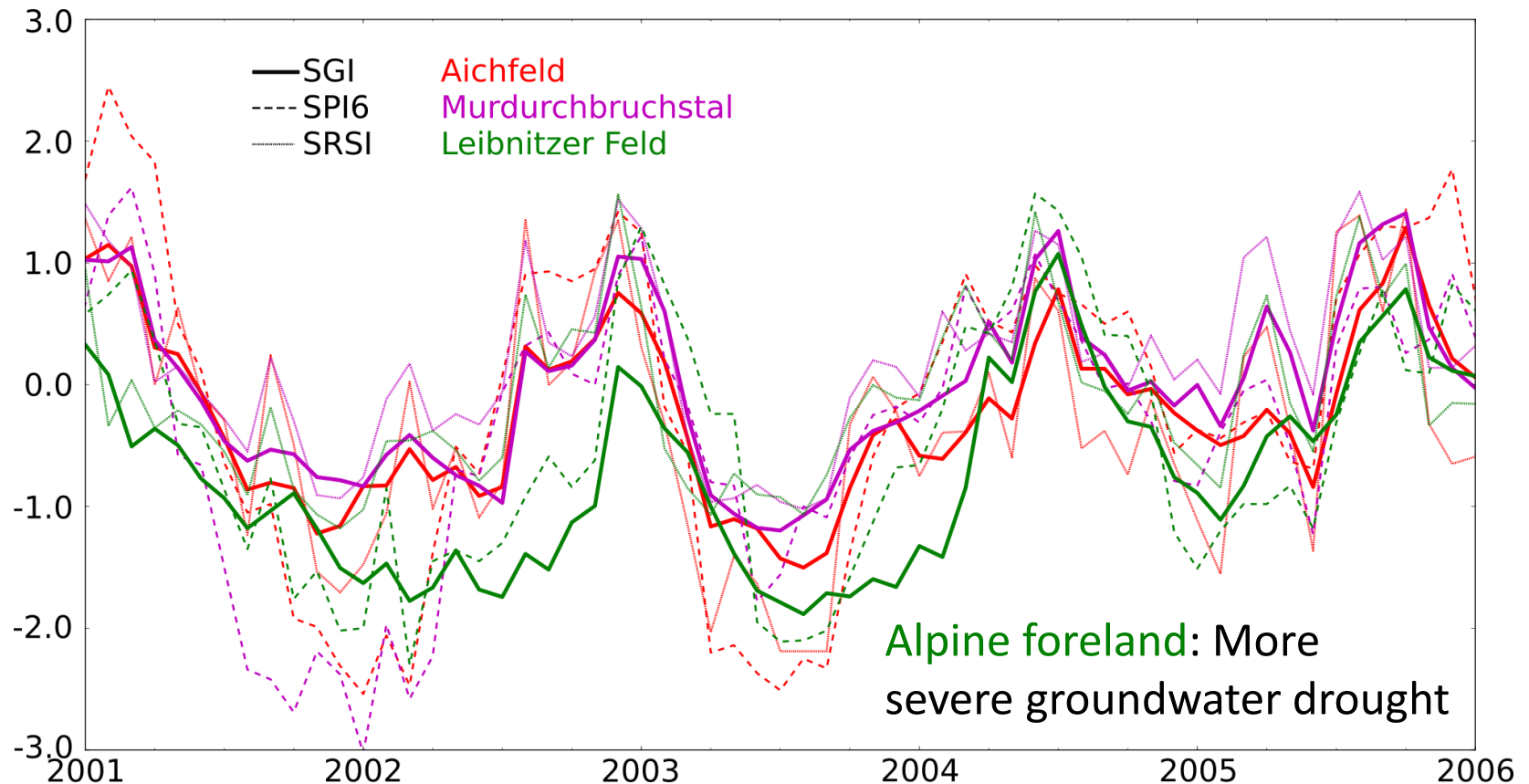
Observation wells exhibit different ranges of groundwater level fluctuation, particularly in the foreland aquifers (e.g. Grazer Feld), presumably related to different drivers.

Range of fluctuation 2000-2020 for selected observation wells



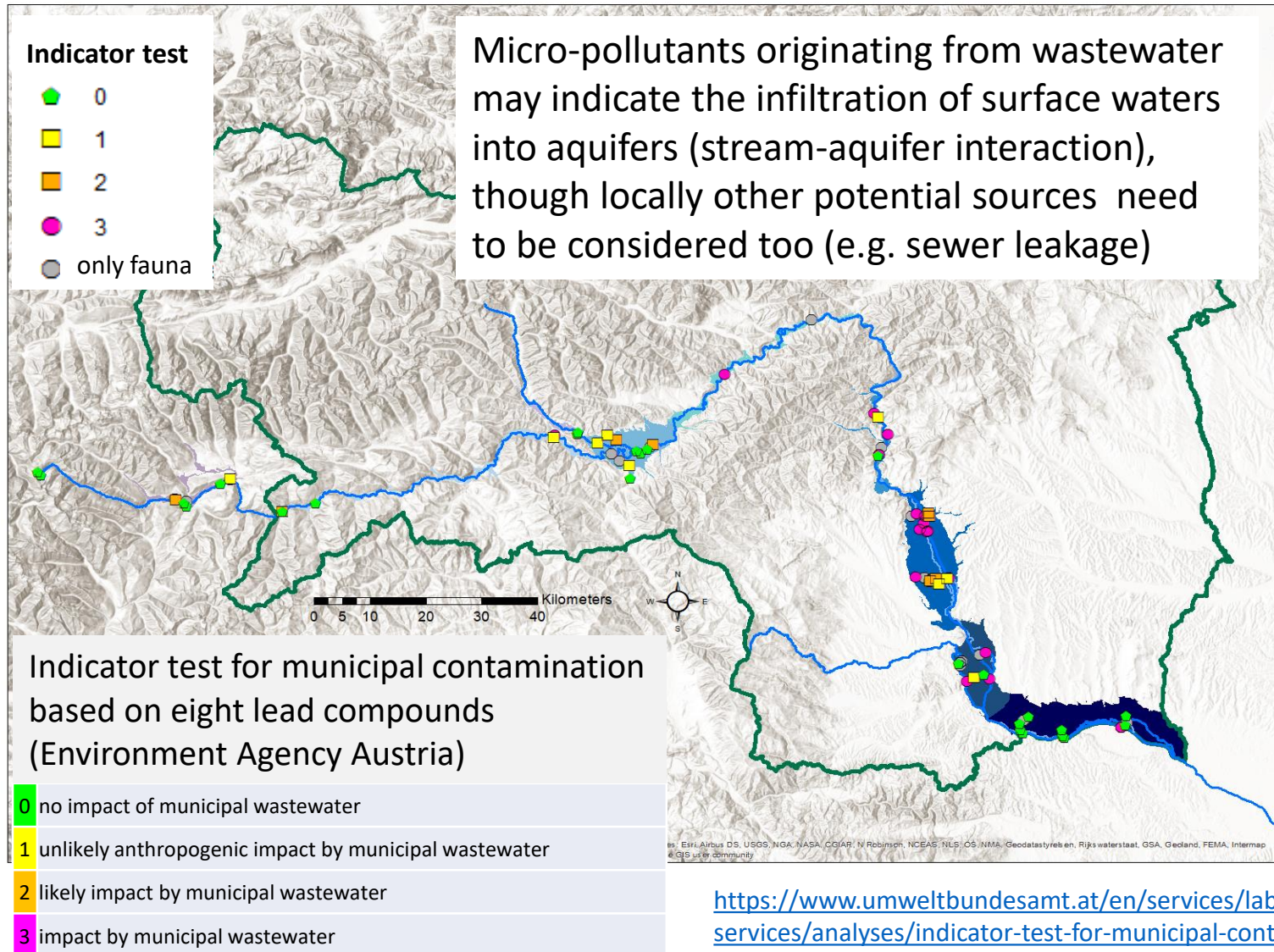
Groundwater levels under drought

Alpine basin (**Aichfeld**) and valley (**Murdurchbruchstal**) vs. foreland aquifer (**Leibnitzer Feld**)



Averaged standardized groundwater levels (SGI) compared with standardized river stages (SRSI) and precipitation (SPI) (using all available long-term time series)

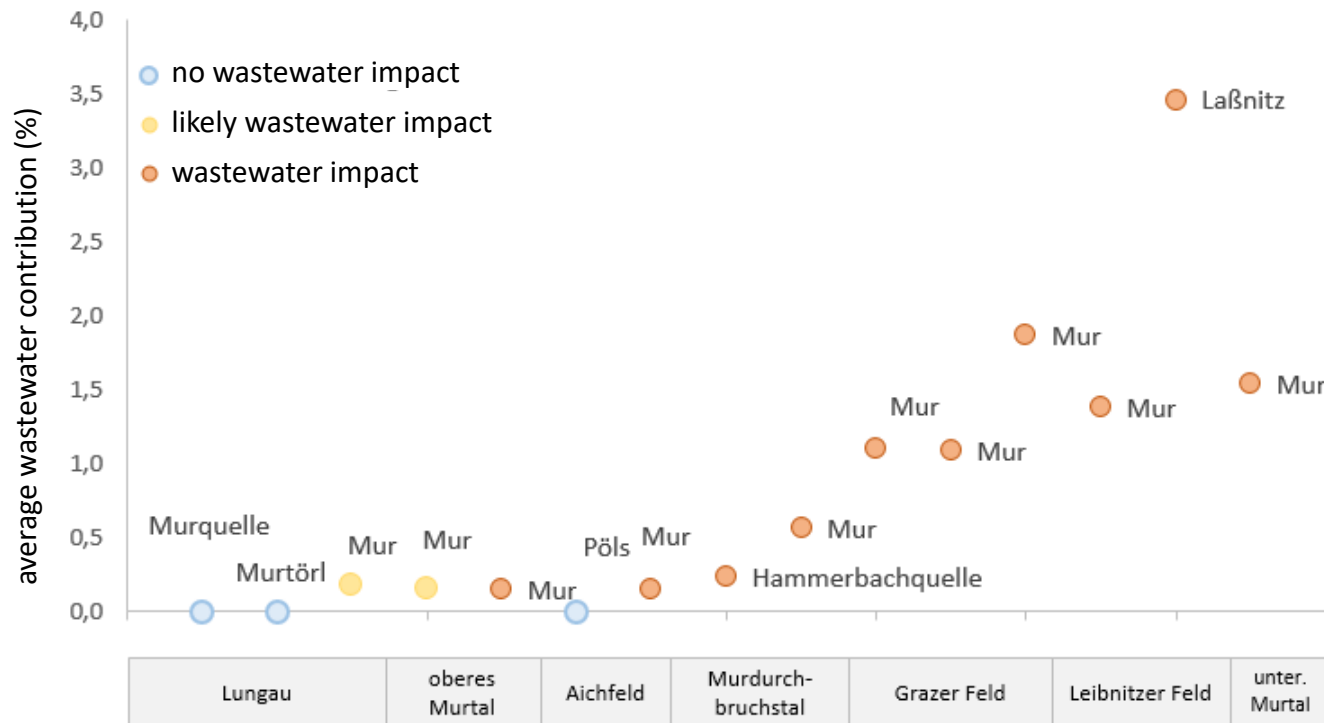
Wastewater micro-pollutants



Wastewater micro-pollutants

Summer 2020 sampling campaign – surface waters and springs

Estimation of wastewater contribution based on average concentrations of discharge from wastewater treatment plants

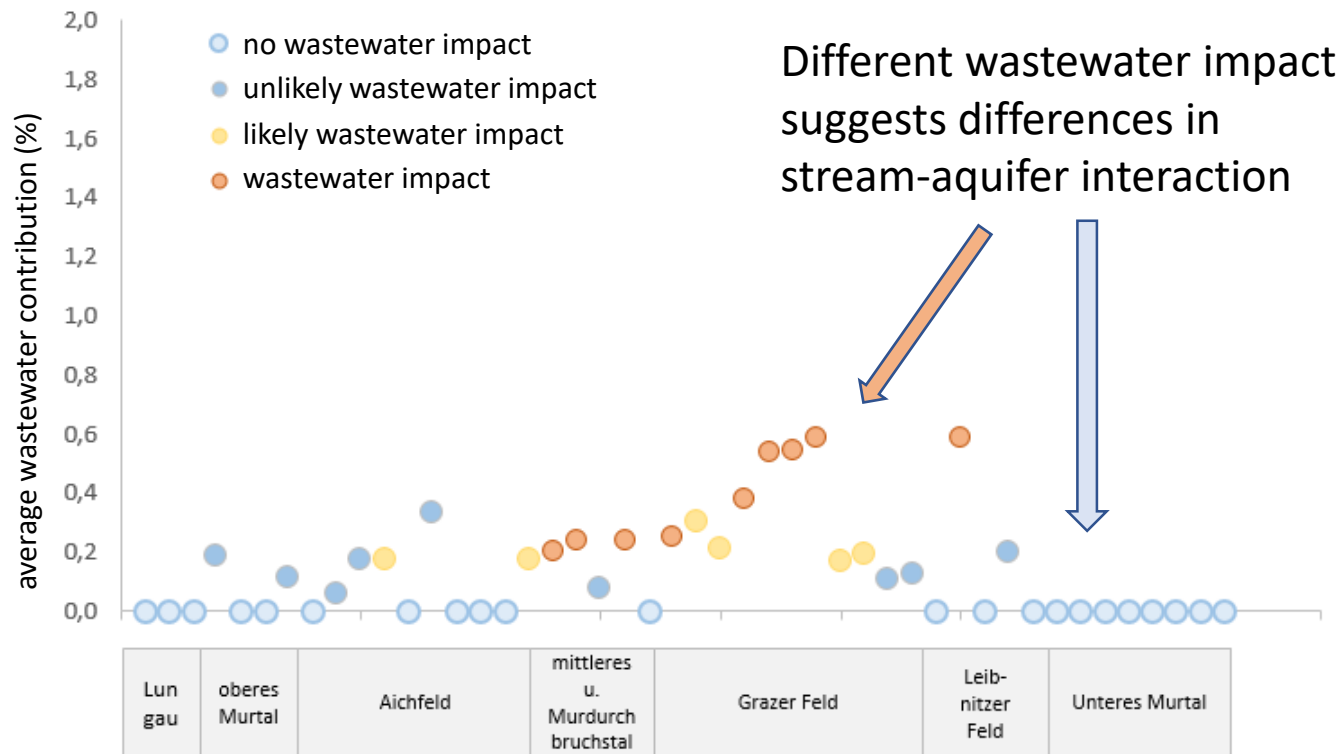


→ sampling points in flow direction of the river Mur

Wastewater micro-pollutants

Summer 2020 sampling campaign – groundwater

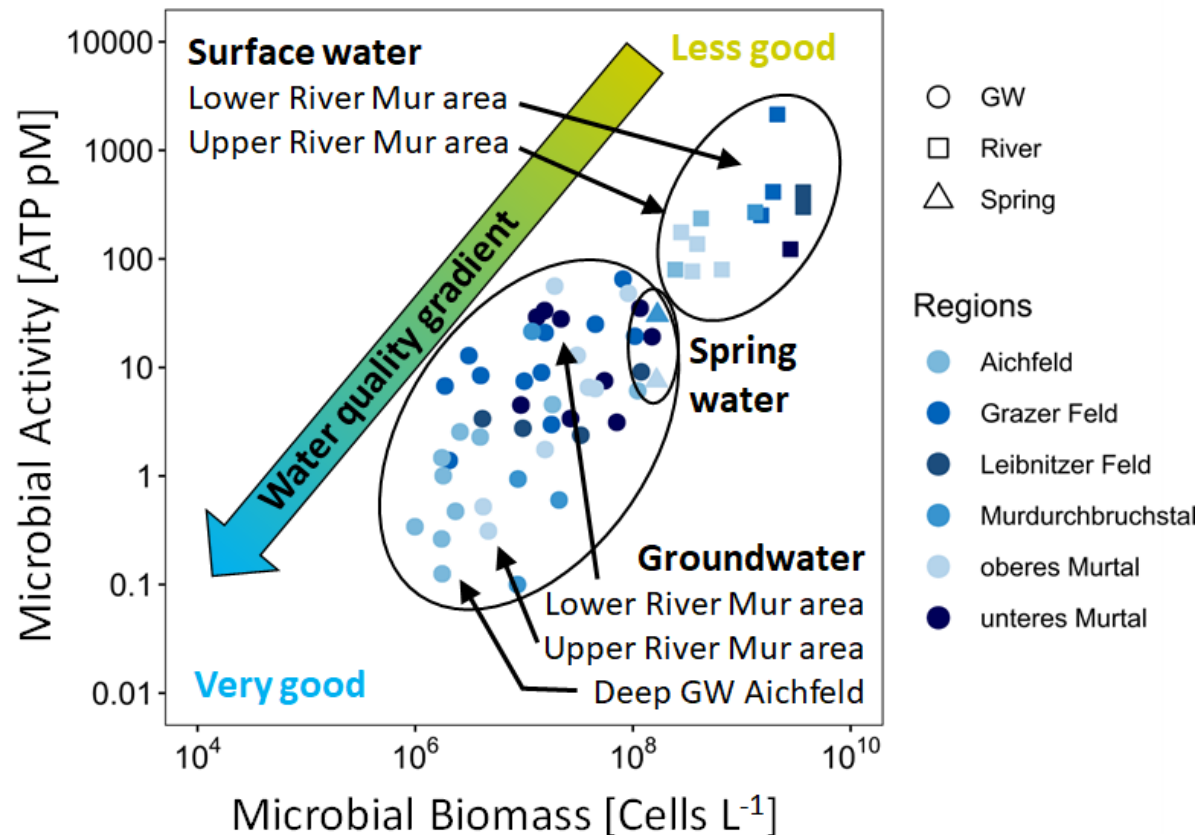
Estimation of wastewater contribution based on average concentrations of discharge from wastewater treatment plants



→ sampling points in flow direction of the river Mur

Microbial fingerprint

Microbial activity and microbial biomass exhibit increasing trends both in surface water and groundwater downstream along the river Mur. As opposed to the wastewater indicators, this trend continues within the groundwater of the foreland, suggesting other (e.g. agricultural) impacts deteriorating water quality.



Conclusion

- Groundwater levels in the foreland show more diverse variability and respond more strongly to drought than those of the alpine aquifers.
- Stream-aquifer interaction (as indicated by wastewater impact on groundwater) within the foreland changes along the course of the river Mur.
- The microbiological fingerprint indicates deterioration of water quality from
 - groundwater to surface water;
 - from the alpine region towards the foreland (corresponding to the more intense agricultural and urban land use in the foreland).
- Next step: Event-based water-quality monitoring using UV-Vis spectrometry at selected observation wells. See:
Haas et al. in Session "GI5.6, Instrumentation & measurements for water systems", EGU21-12895, <https://doi.org/10.5194/egusphere-egu21-12895>