Spatial patterns of stream temperature and electric conductivity in a mesoscale catchment

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catchments as organised systems

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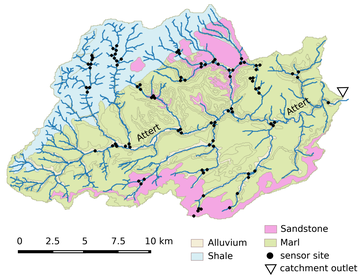
OVERVIEW AND MOTIVATION

WHAT CAN WE LEARN FROM SPATIALLY DISTRIBUTED TEMPERATURE AND EC TIME SERIES?

- Temperature and EC can be used as 'tracers' to study runoff generation processes
- Spatial data sets of temperature and EC make it possible to connect runoff generation processes with landscape controls
- Potentially useful to regionalize process understanding
- Identification of streams with high thermal & solute loading and high termal & amplitude sensitivities
- Monitoring of T and EC at confluences gives insight into connectivity and relative streamflow contribution of sub-catchments

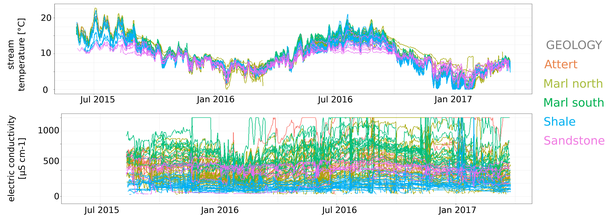
STUDY CATCHMENT & MONITORING DESIGN

Attert catchment (288km²), Luxembourg



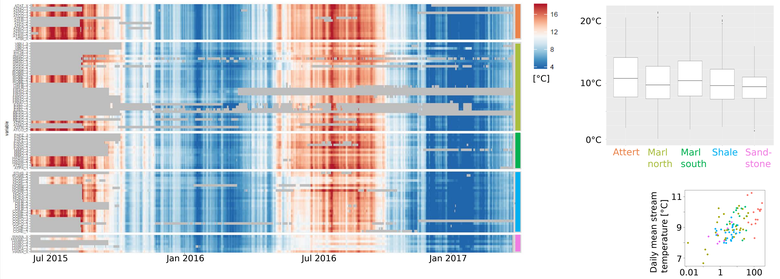
- 93 stream temperature and EC sensors at 35 sites across the basin
- Data collection since 06/2015
- Collected data is complemented by land use, geology and discharge data and an extensive climate data set
- For monitoring self-modified Hobo T/Light loggers were used

MEAN DAILY TEMPERATURES AND EC OF STREAMS IN THE ATTERT BASIN

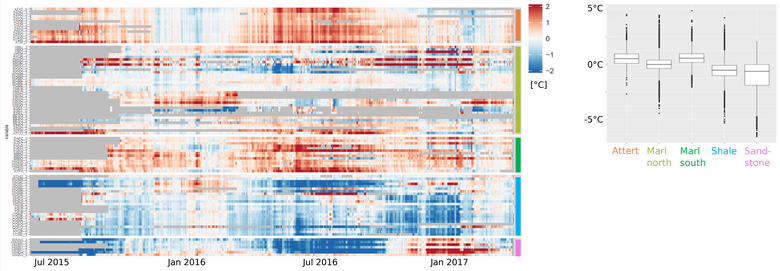


SPATIOTEMPORAL PATTERNS OF STREAM TEMPERATURE AND EC

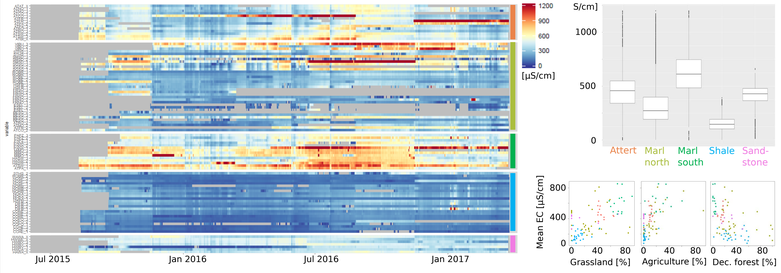
DAILY MEAN STREAM TEMPERATURE



DIFFERENCE TO DAILY SPATIAL MEAN TEMPERATURE



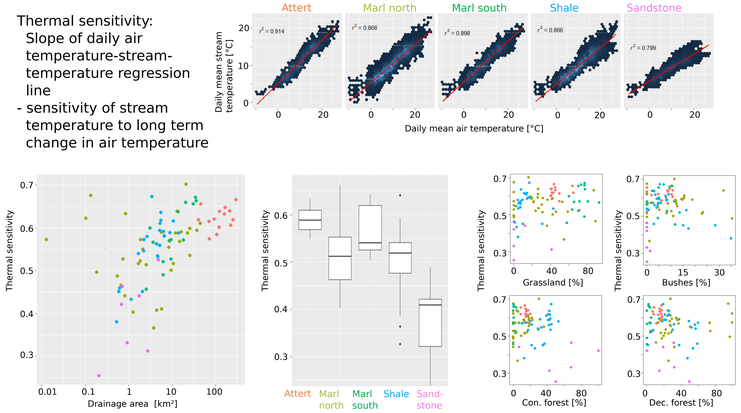
DAILY MEAN ELECTRIC CONDUCTIVITY



THERMAL - AND AMPLITUDE SENSITIVITIES

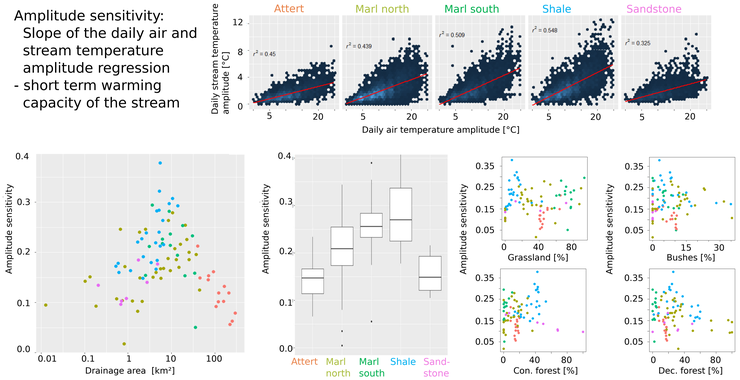
THERMAL SENSITIVITY (SEASONAL THERMAL SENSITIVITY)

Thermal sensitivity:
Slope of daily air temperature-stream-temperature regression line
- sensitivity of stream temperature to long term change in air temperature



AMPLITUDE SENSITIVITY (DAILY THERMAL SENSITIVITY)

Amplitude sensitivity:
Slope of the daily air and stream temperature amplitude regression
- short term warming capacity of the stream



CONCLUSIONS

SPATIO-TEMPORAL PATTERNS OF STREAM TEMPERATURE AND EC

- Groups with similar long term thermal and EC patterns are strongly related to different geological units
- Shale reaches: low daily mean EC and high amplitude sensitivities for larger areas -> fast runoff-components & potential heating of dark shale stream substrate
- Sandstone reaches: coldest temperatures and lowest annual thermal sensitivity to air temperature -> high groundwater contribution to streamflow
- Marl reaches: Potentially high EC values -> influence of land cover & geology

THERMAL - AND AMPLITUDE SENSITIVITIES

- Thermal sensitivities: increase exponentially with drainage area -> heat accumulation throughout the system
- Amplitude sensitivities: low for small streams; peak at intermediate reaches and then decreased again further downstream -> influence of solar radiation, while groundwater (small streams) & runoff volume (larger streams) have reducing effect
- Thermal and amplitude sensitivities show complex dynamics; analysis can be improved by incoorporating stream shading, radiation and runoff volume data

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