

A multi-method characterization of river-aquifer interaction at the meter-scale: combining field measurements, heat transport modelling and groundwater modelling

Ghysels G.¹, Benoit S.², Awol H., Tolche AD.³, Hermans T.², Nguyen F.^{4,5}, Anibas C.⁶ and Huysmans M.^{1,5}

¹Vrije Universiteit Brussel, Belgium;

²Ghent University, Belgium;

³Haramaya University, Ethiopia;

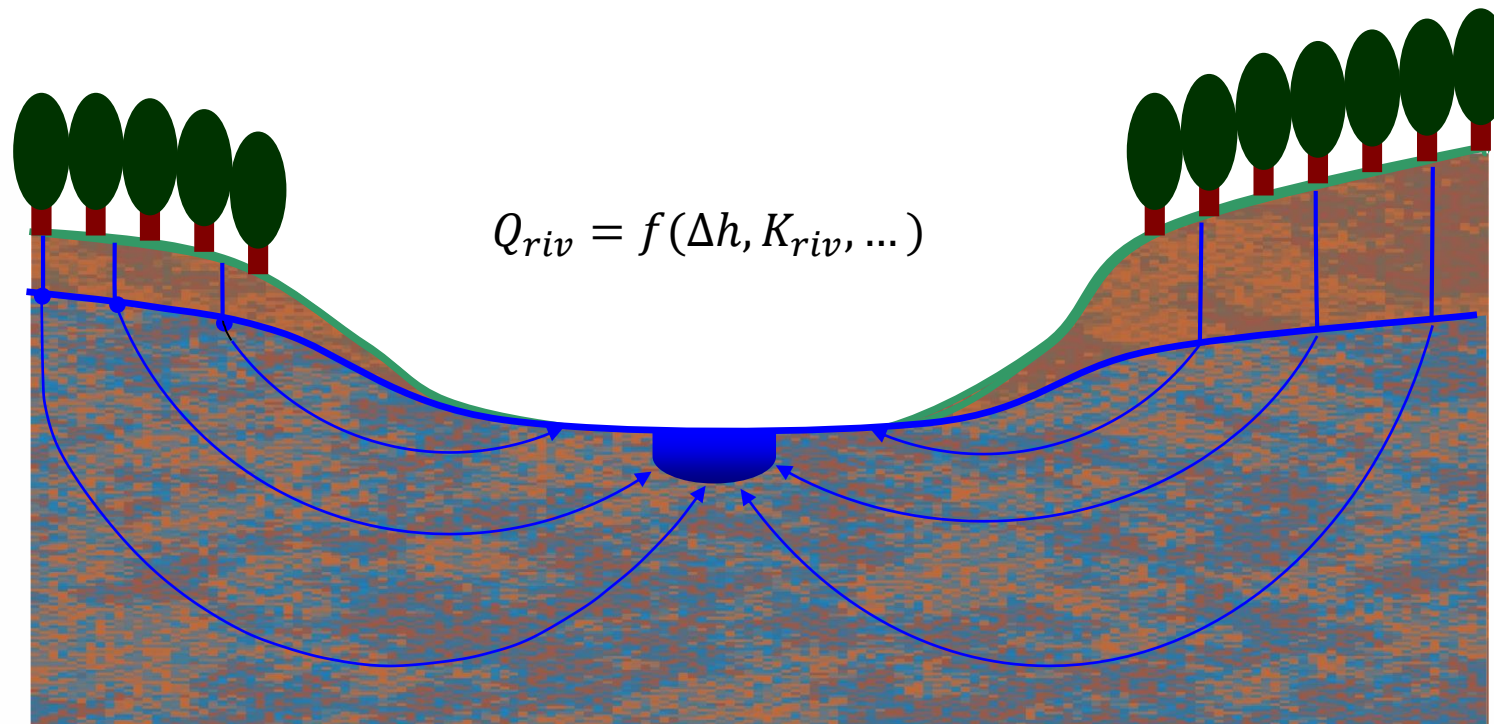
⁴University of Liège, Belgium;

⁵KU Leuven, Belgium;

⁶UNSW Sydney, Australia



WHAT IS THE INFLUENCE OF RIVERBED HETEROGENEITY ON RIVER-AQUIFER EXCHANGE FLUXES?

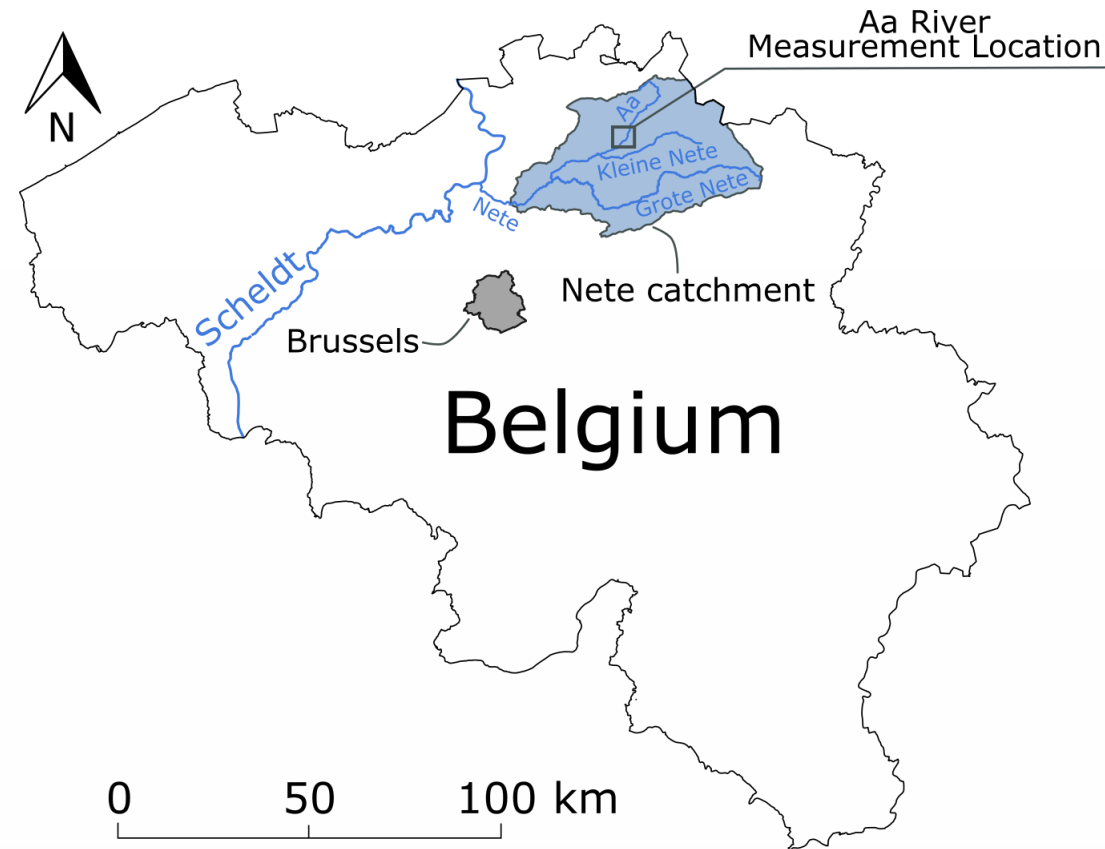


OUTLINE

- ▶ **Groundwater-surface water interaction** at the **Aa River**, Belgium
- ▶ Characterization of **meter-scale spatial variability** of **riverbed hydraulic conductivity**
- ▶ Estimating **river-aquifer exchange** fluxes from **vertical riverbed temperature profiles** based on the **1D heat transport equation**
- ▶ Estimating **river-aquifer exchange** fluxes with a **groundwater flow model (MODFLOW)**

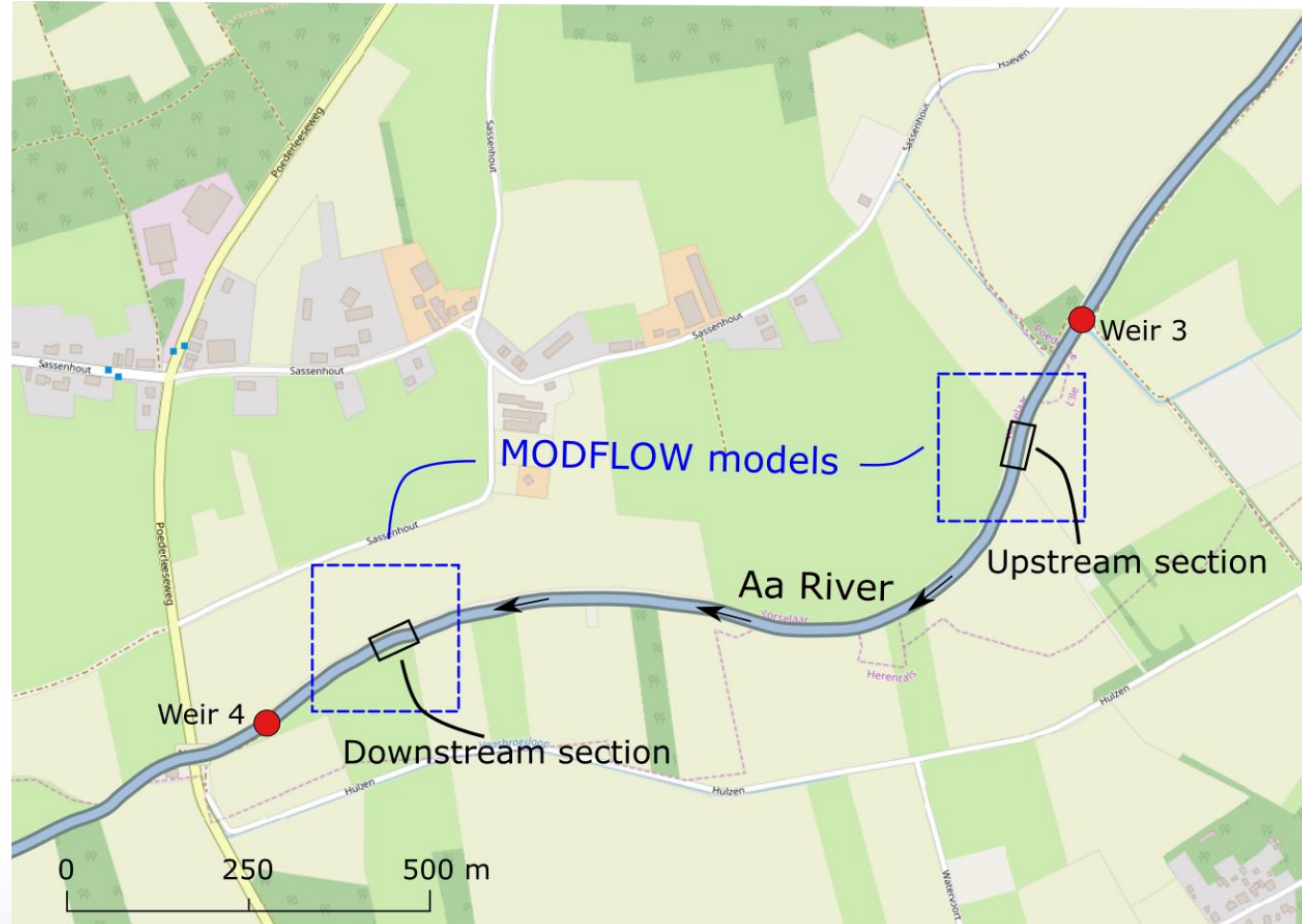
STUDY AREA

AA RIVER



STUDY AREA

AA RIVER



STUDY AREA

AA RIVER



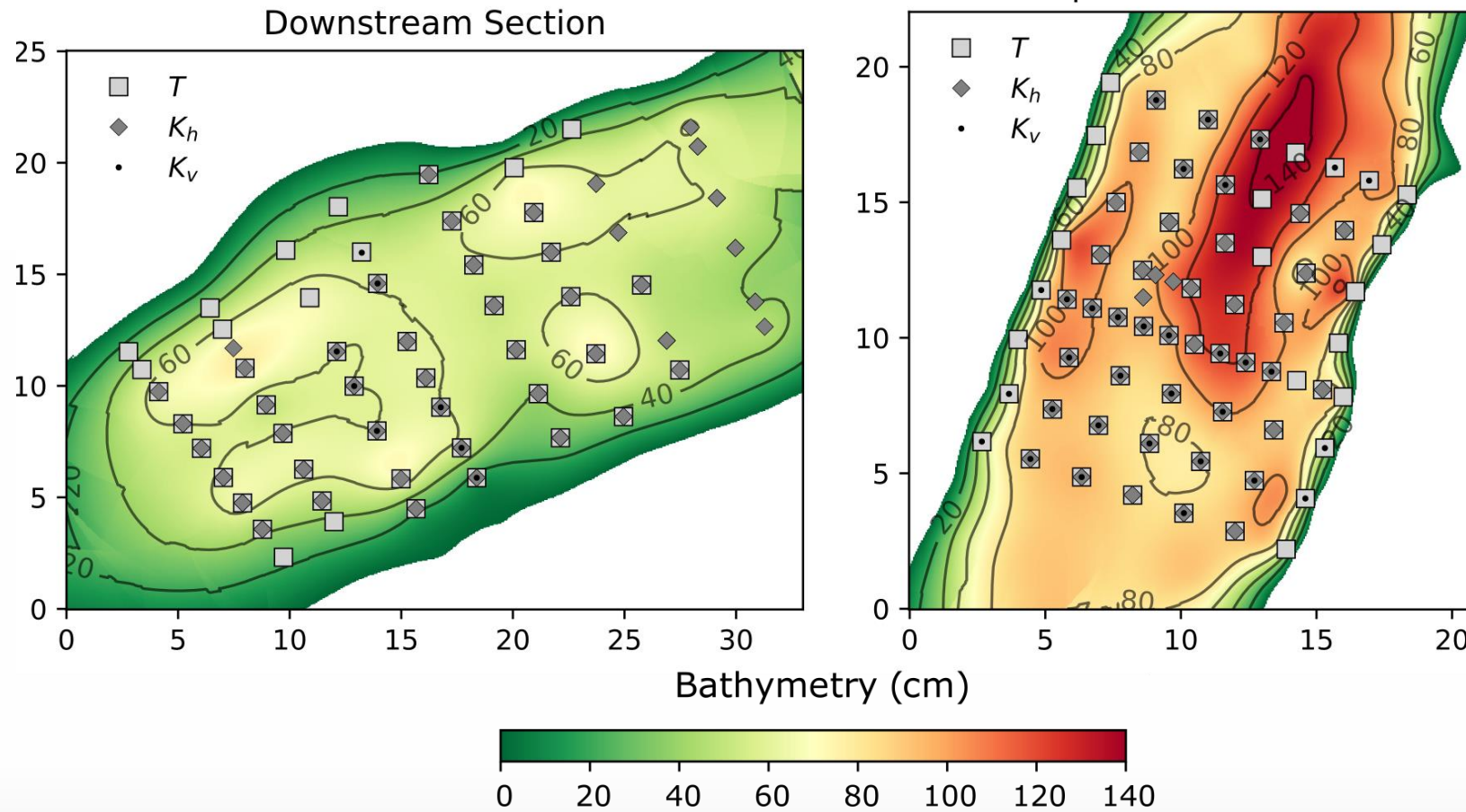
Downstream section



Upstream section

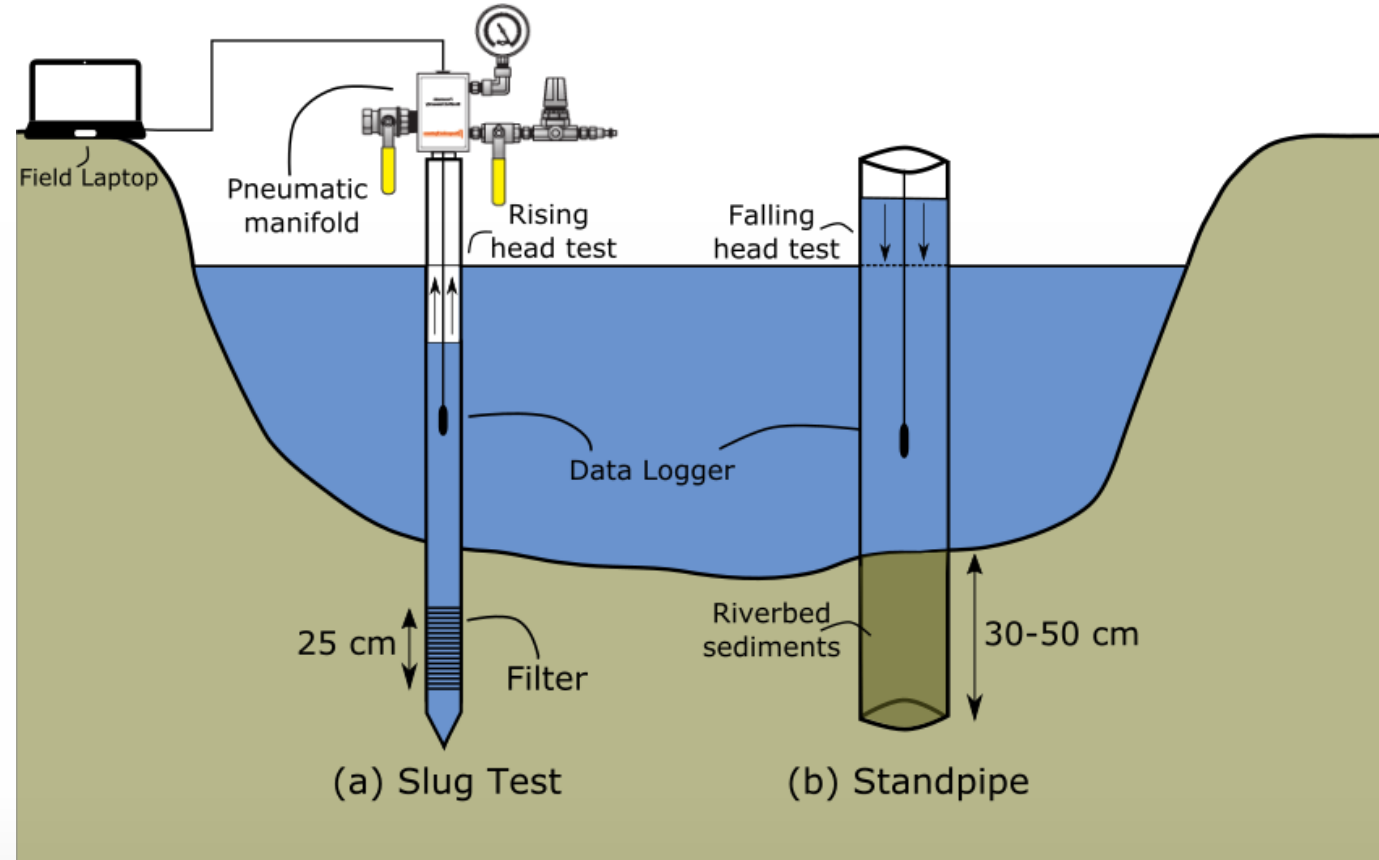
STUDY AREA

AA RIVER



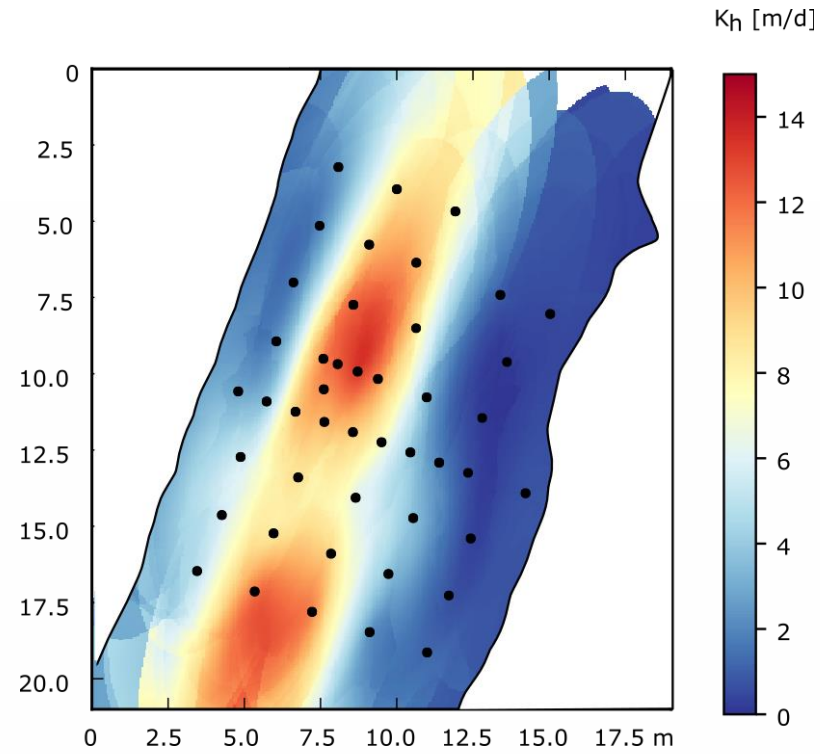
METHODOLOGY

RIVERBED HYDRAULIC CONDUCTIVITY (K_H AND K_V)

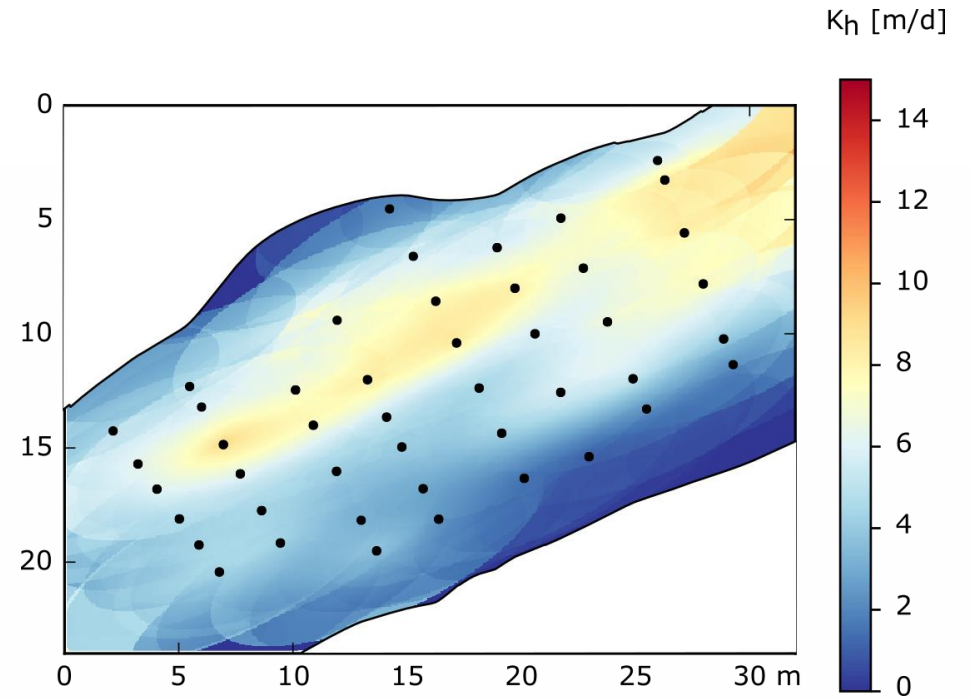


RESULTS

HORIZONTAL RIVERBED CONDUCTIVITY



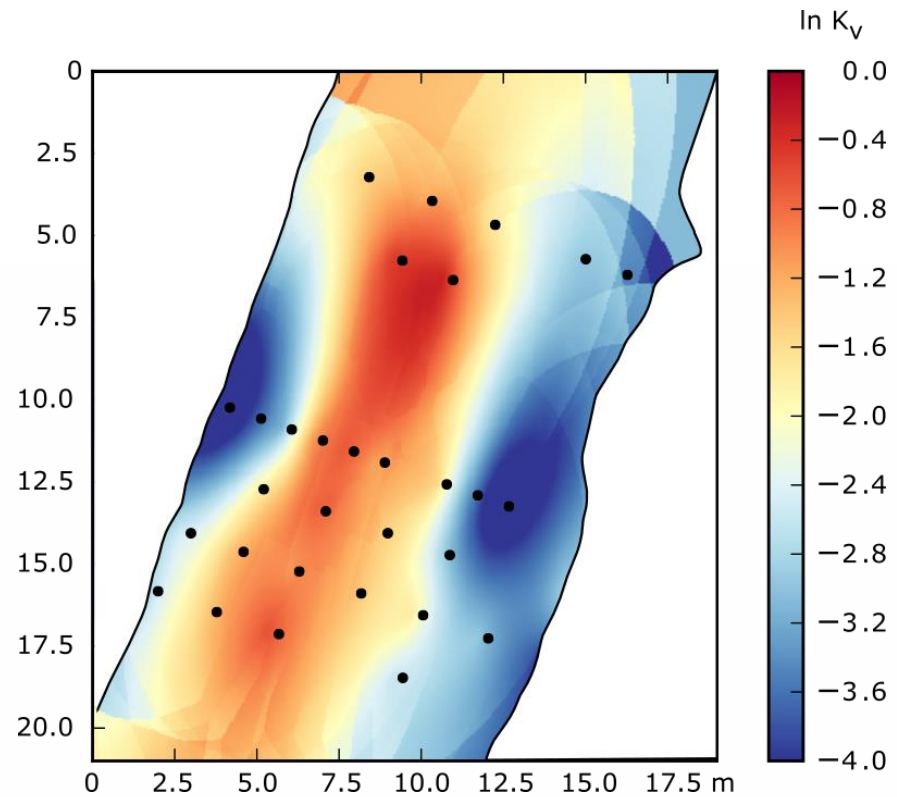
Upstream section



Downstream section

RESULTS

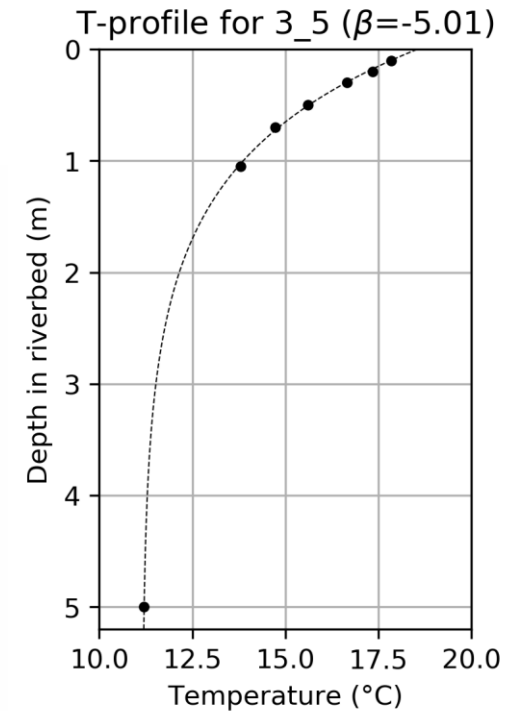
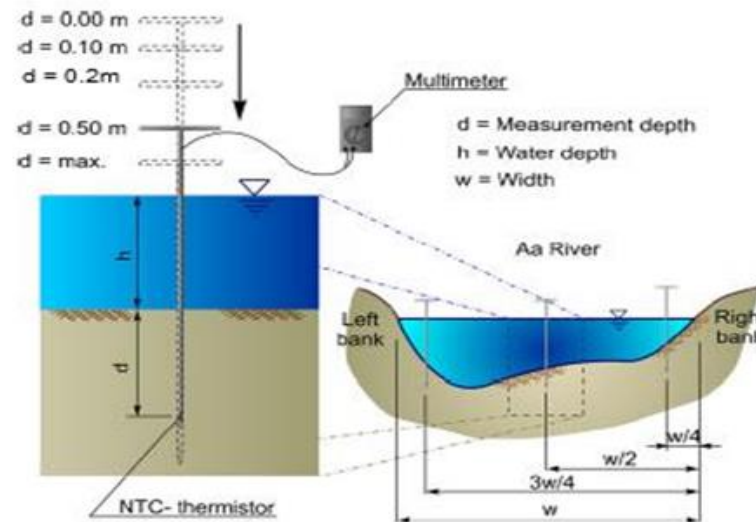
VERTICAL RIVERBED CONDUCTIVITY



Upstream section

METHODOLOGY

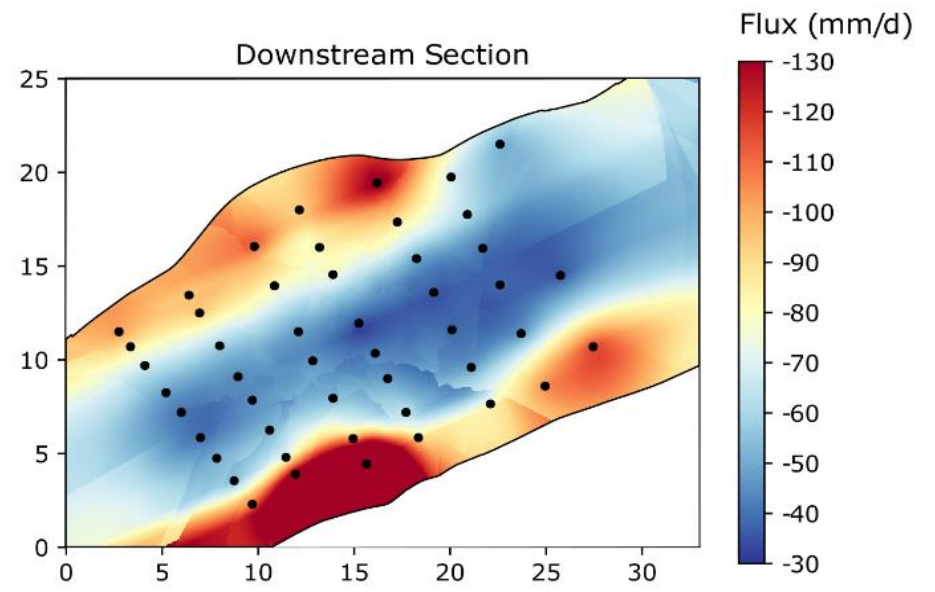
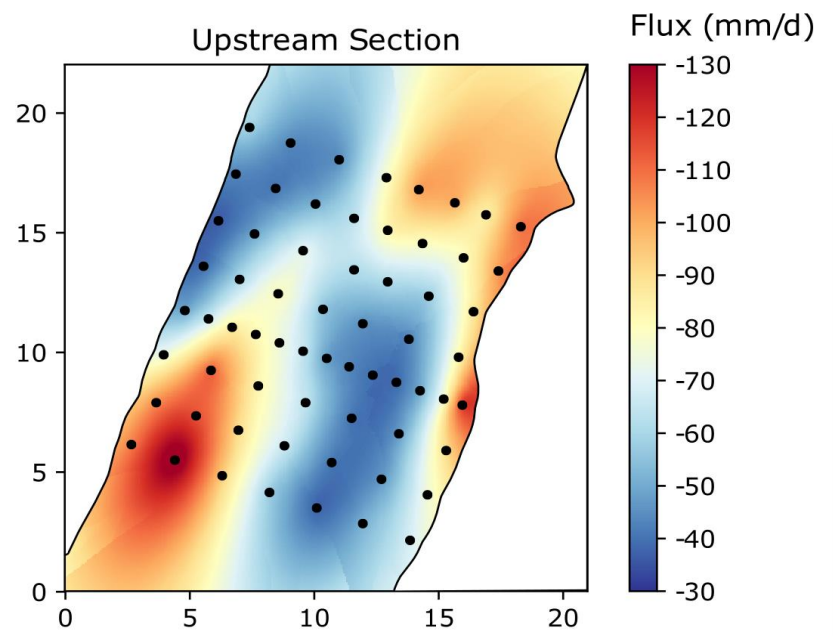
VERTICAL RIVERBED TEMPERATURE PROFILES



Analytical solution of Bredehoeft and Papadopoulos (1965) for 1D steady-state, vertical, anisothermal heat transport

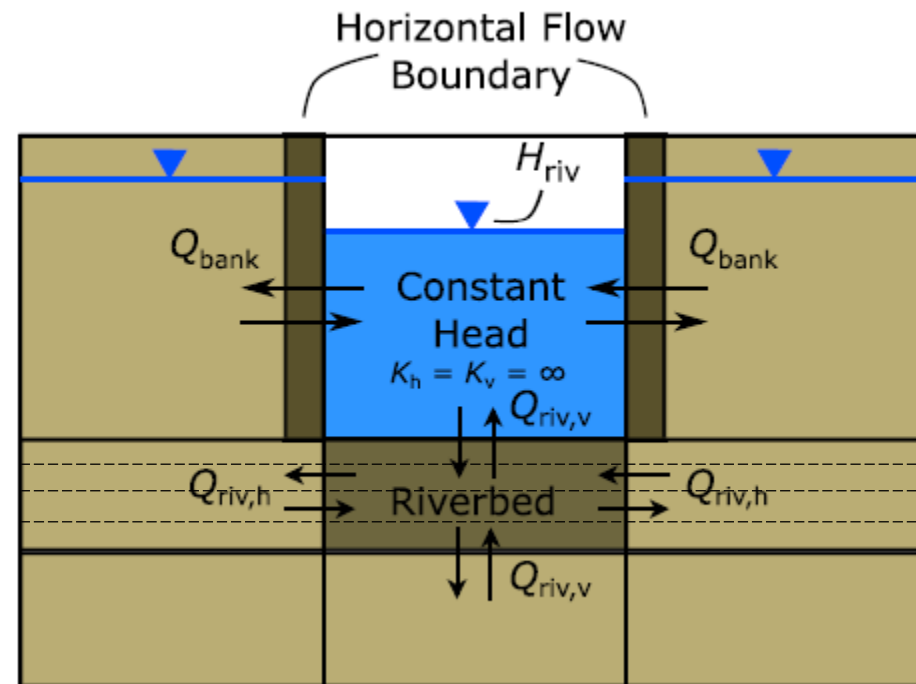
RESULTS

ESTIMATED RIVER-AQUIFER EXCHANGE FLUXES



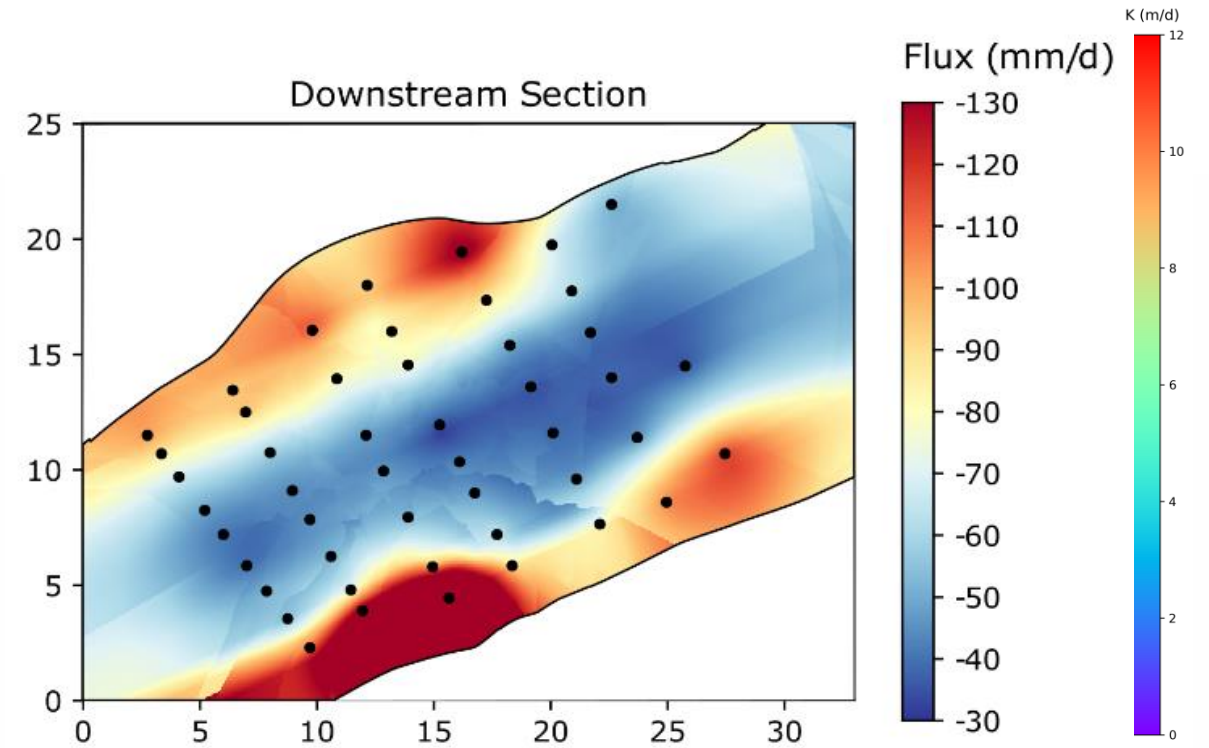
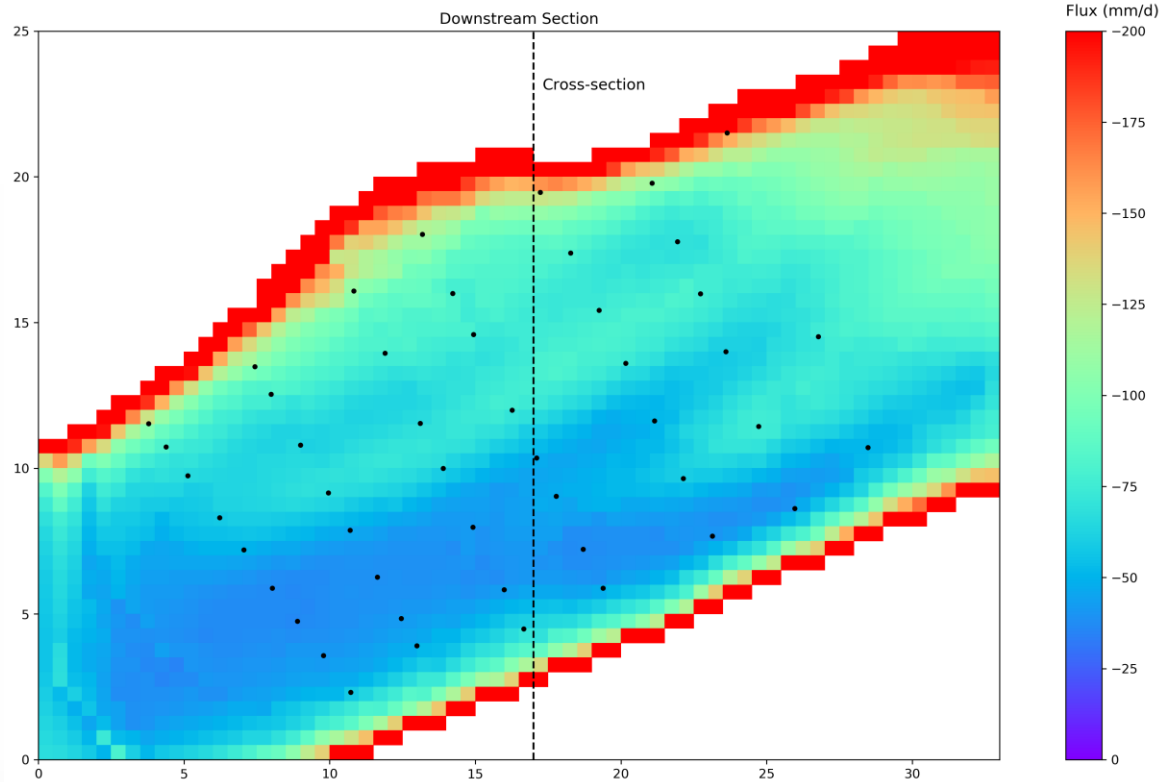
METHODOLOGY

SIMULATING RIVER-AQUIFER EXCHANGE IN MODFLOW



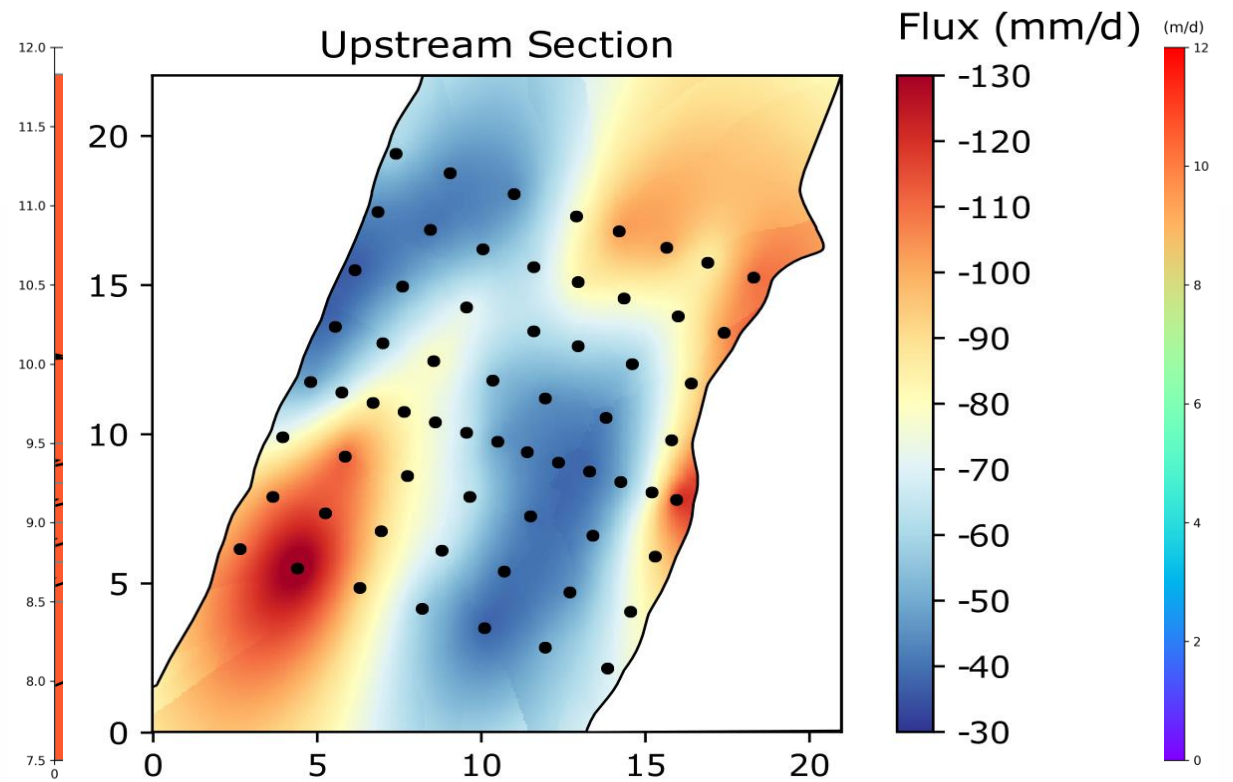
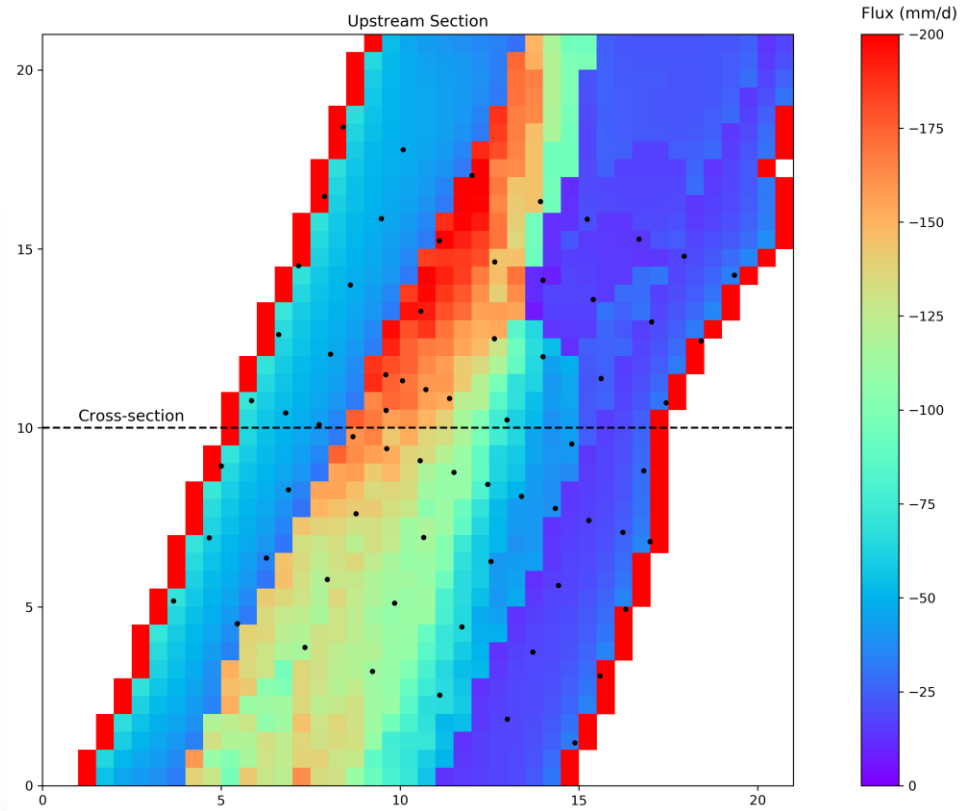
RESULTS

SIMULATED FLUXES IN MODFLOW



RESULTS

SIMULATED FLUXES IN MODFLOW



CONCLUSION

- ▶ Riverbed K and flux estimates display **strong spatial variability at meter-scale**
- ▶ **No clear correlation** between **riverbed K** and **vertical flux estimates**
- ▶ **Riverbeds** are **complex** structures that are characterized by **complex flow fields**
- ▶ **Lateral fluxes** through the river banks and riverbed are an **important contributor** to total river-aquifer exchange fluxes
- ▶ **Assumption of strictly vertical fluxes violated near banks**

THANK YOU!

QUESTIONS?

CONTACT: GERT.GHYSELS@VUB.BE