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How Groundwater Models Can Benefit from Near-Surface Seismic Data ?

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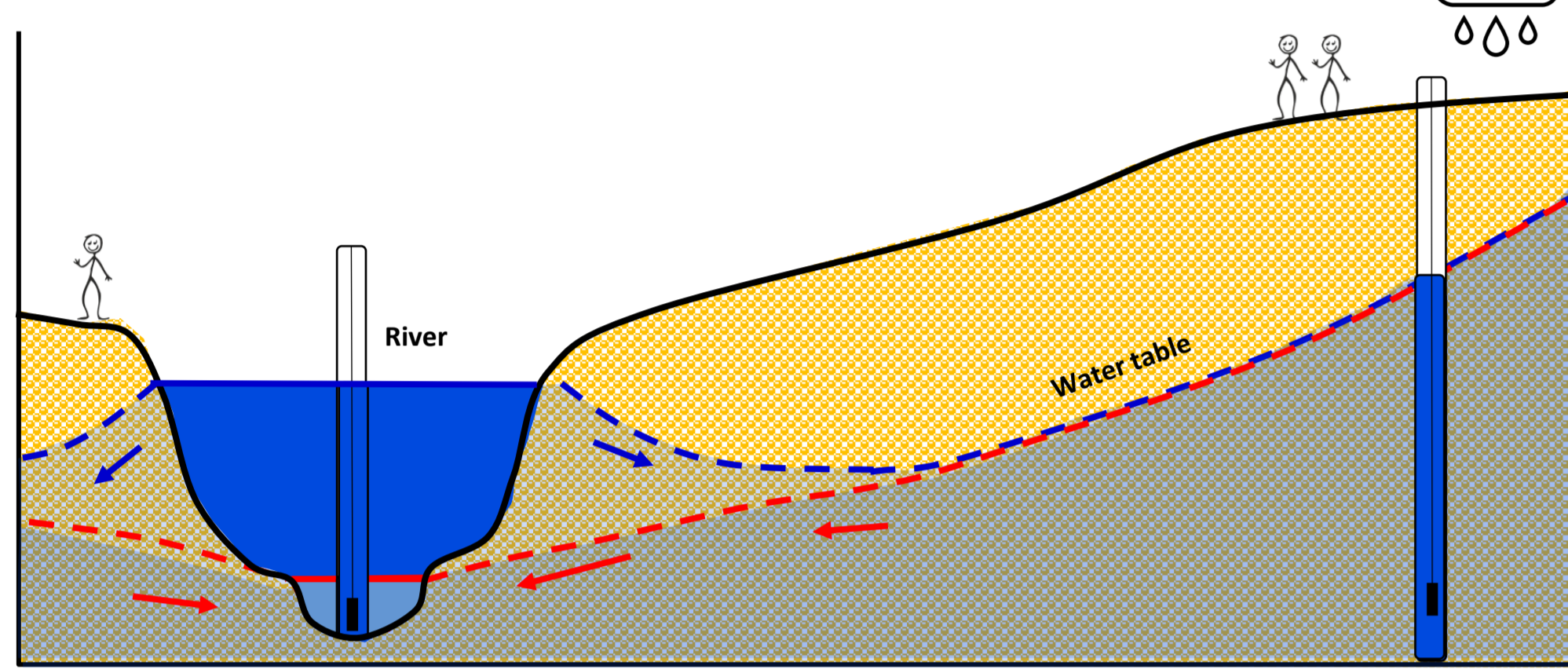
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1. Motivations

Groundwater (GW) systems exist in dynamic balance with the climate and human pressure, connecting interfacing zones of recharge and discharge with multiple feedbacks. These interfaces are composed of various morpho-sedimentary units with highly contrasting geometries and lithologies. GW recharge and SW-GW exchanges cannot be directly measured.

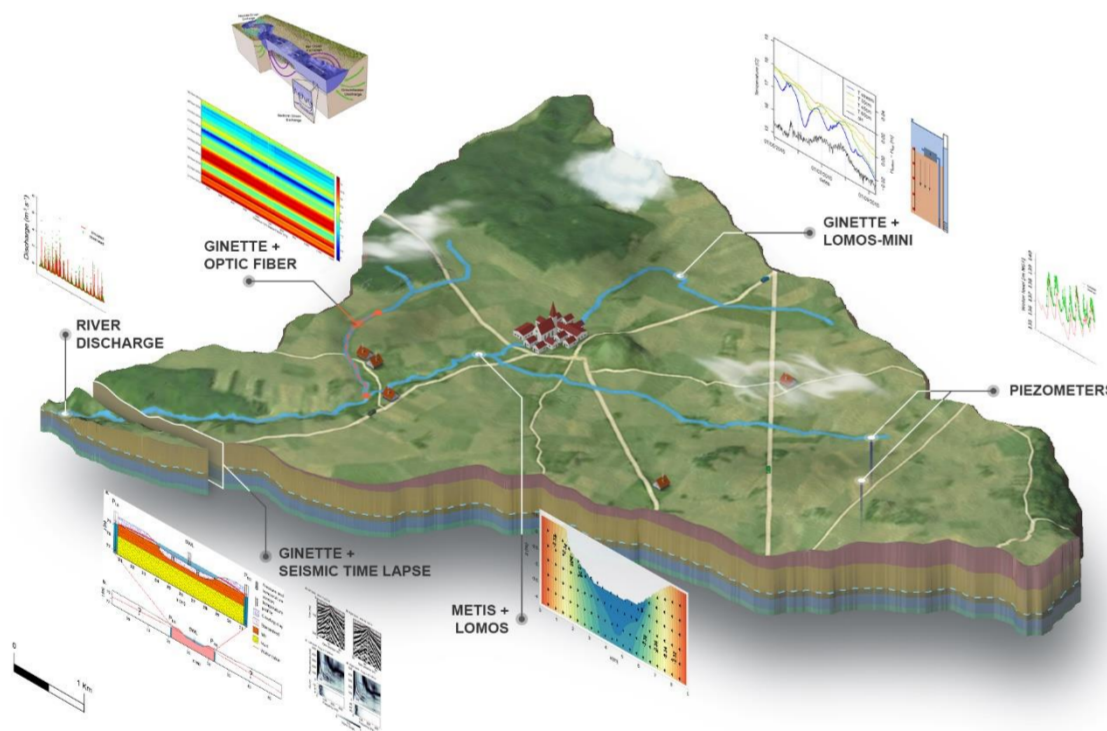


→ Quantifying Water Fluxes at Interfaces:

- Determining Hydrofacies Distribution?
- Defining Initial and Boundary Conditions?
- Calibration of Variable States?

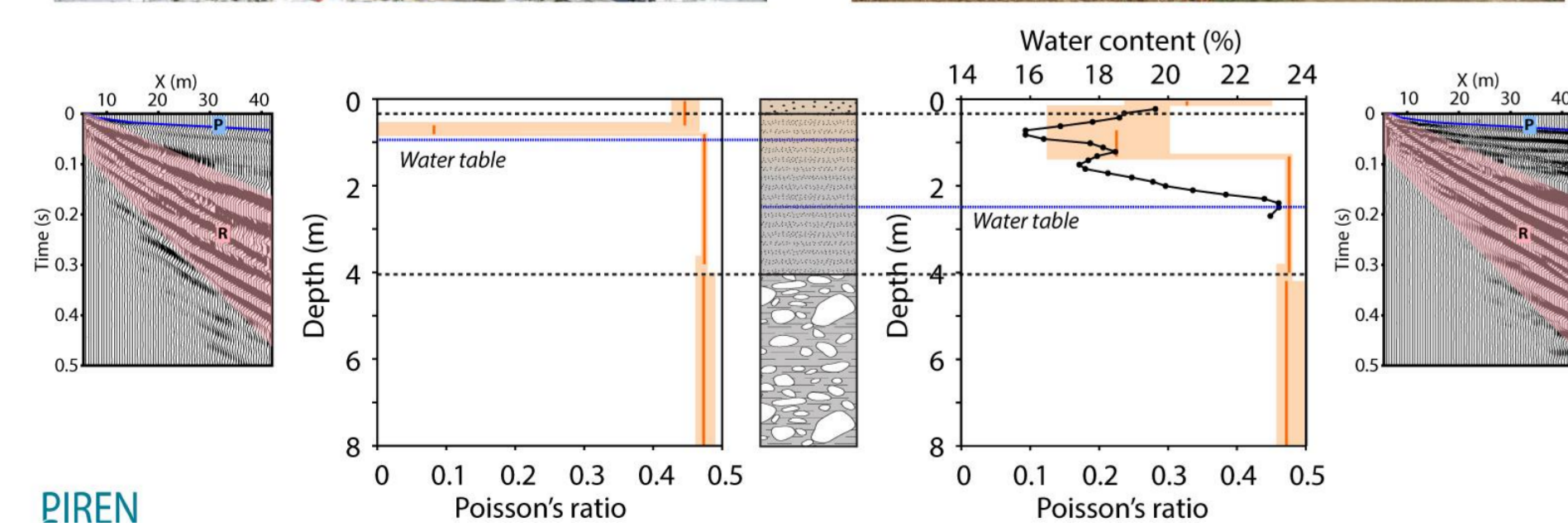
Orgeval Critical zone observatory

- Long-term experimental observatory and research site
- Area of 46 km²
- Representative of rural areas with intensive cereal farming



2. Seismic data and model

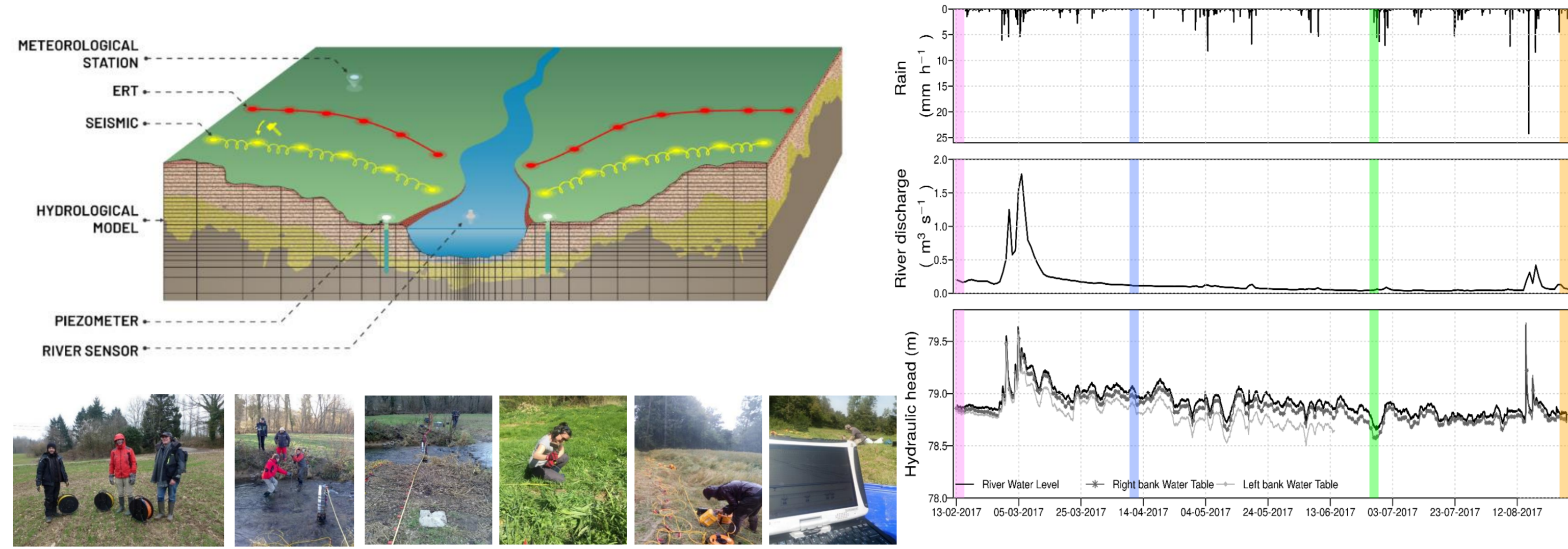
Combined P-wave first arrivals and surface-wave dispersion measurements and inversion



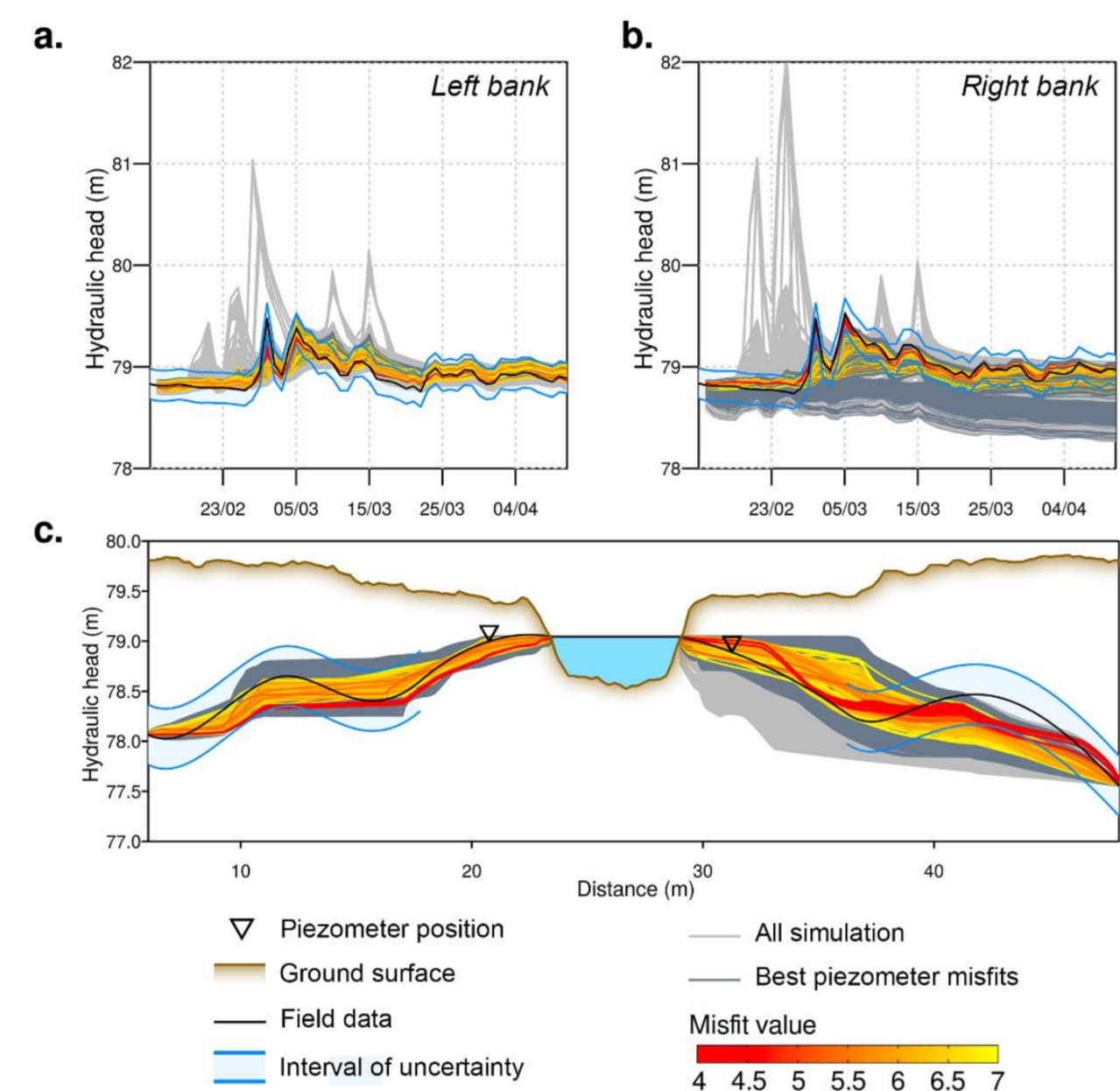
→ VP/VS or Poisson's ratio estimation = **Water table depth !!**
→ related to strong water content contrasts

Pasque et al. (JAG 2015)

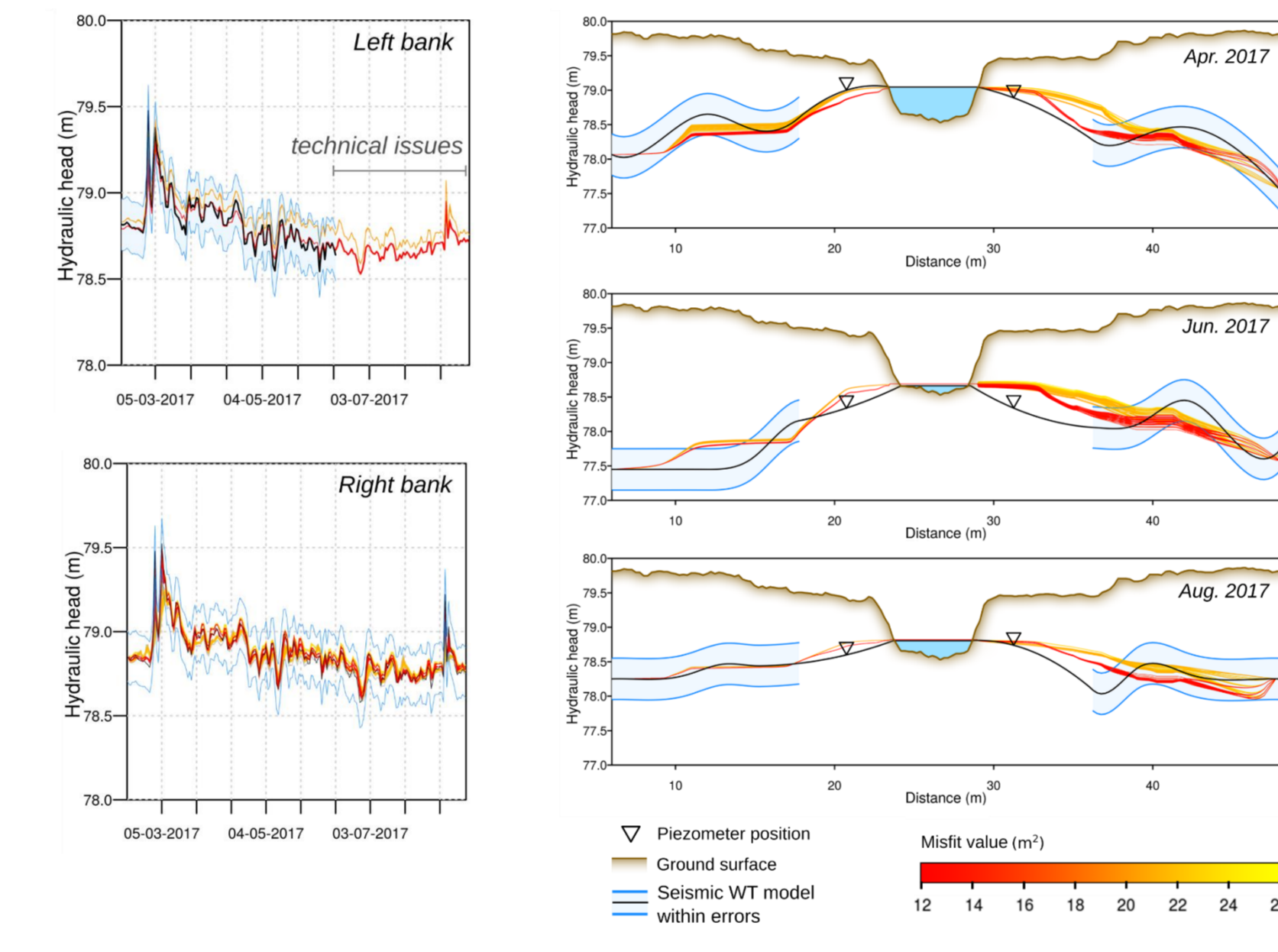
→ a. Field works



→ Calibration

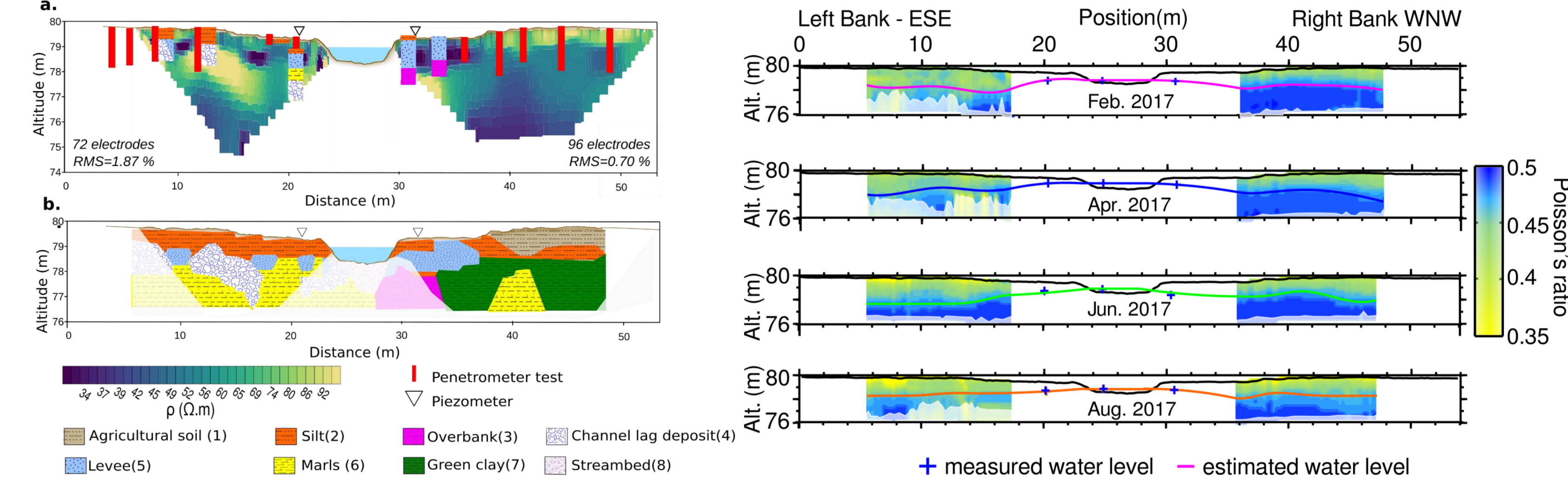


→ Validation

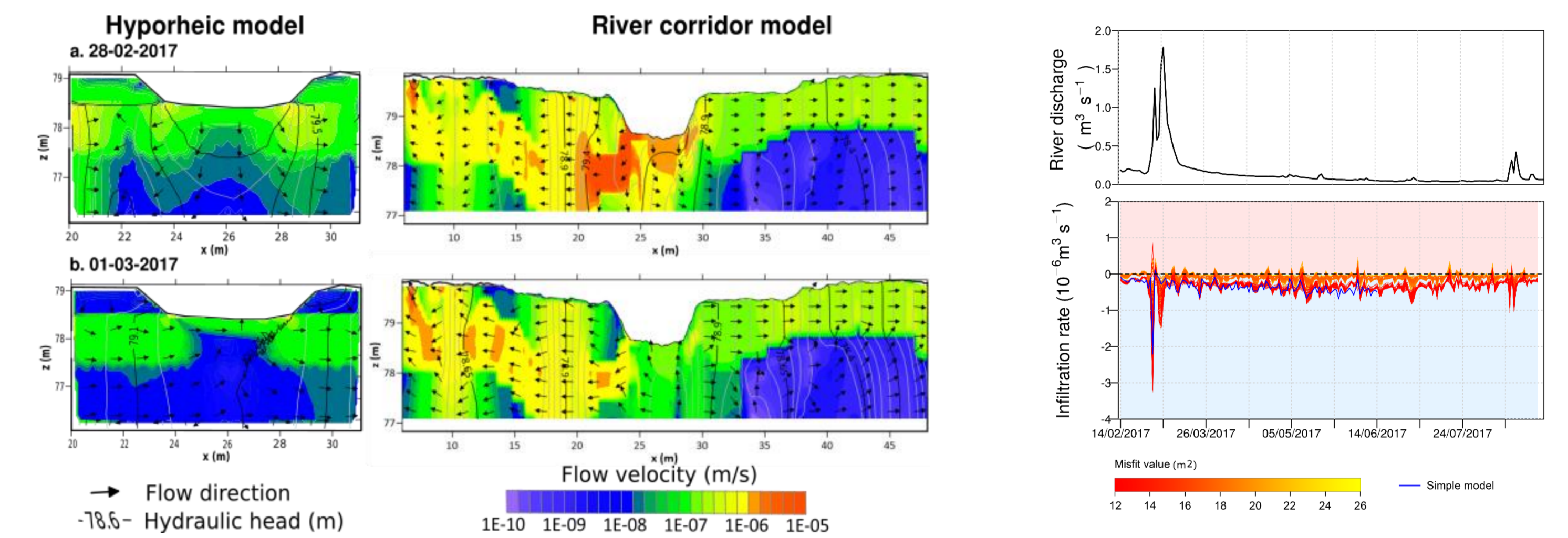


3. SW-GW exchanges: Dangeard et al. 2021 (WRR)

→ Hydrofacies distribution → Water table image

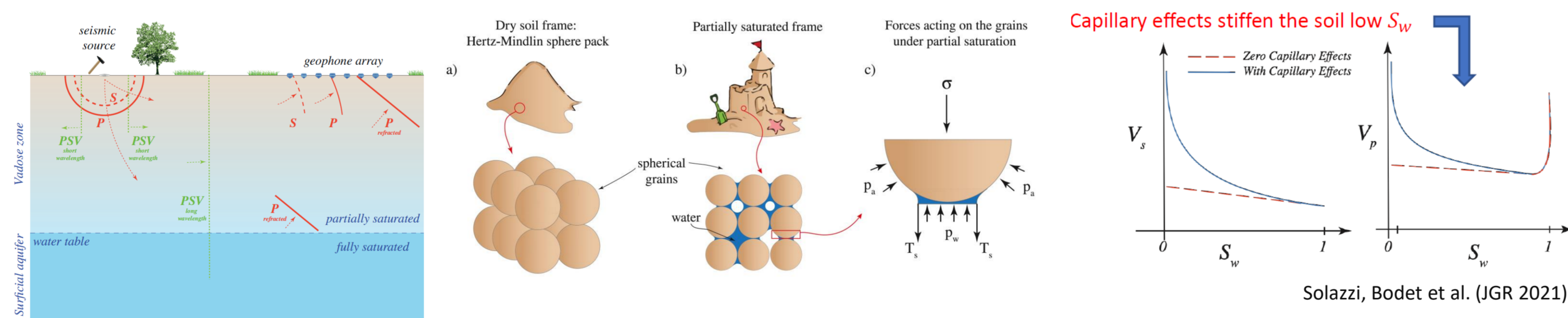


→ Simulations

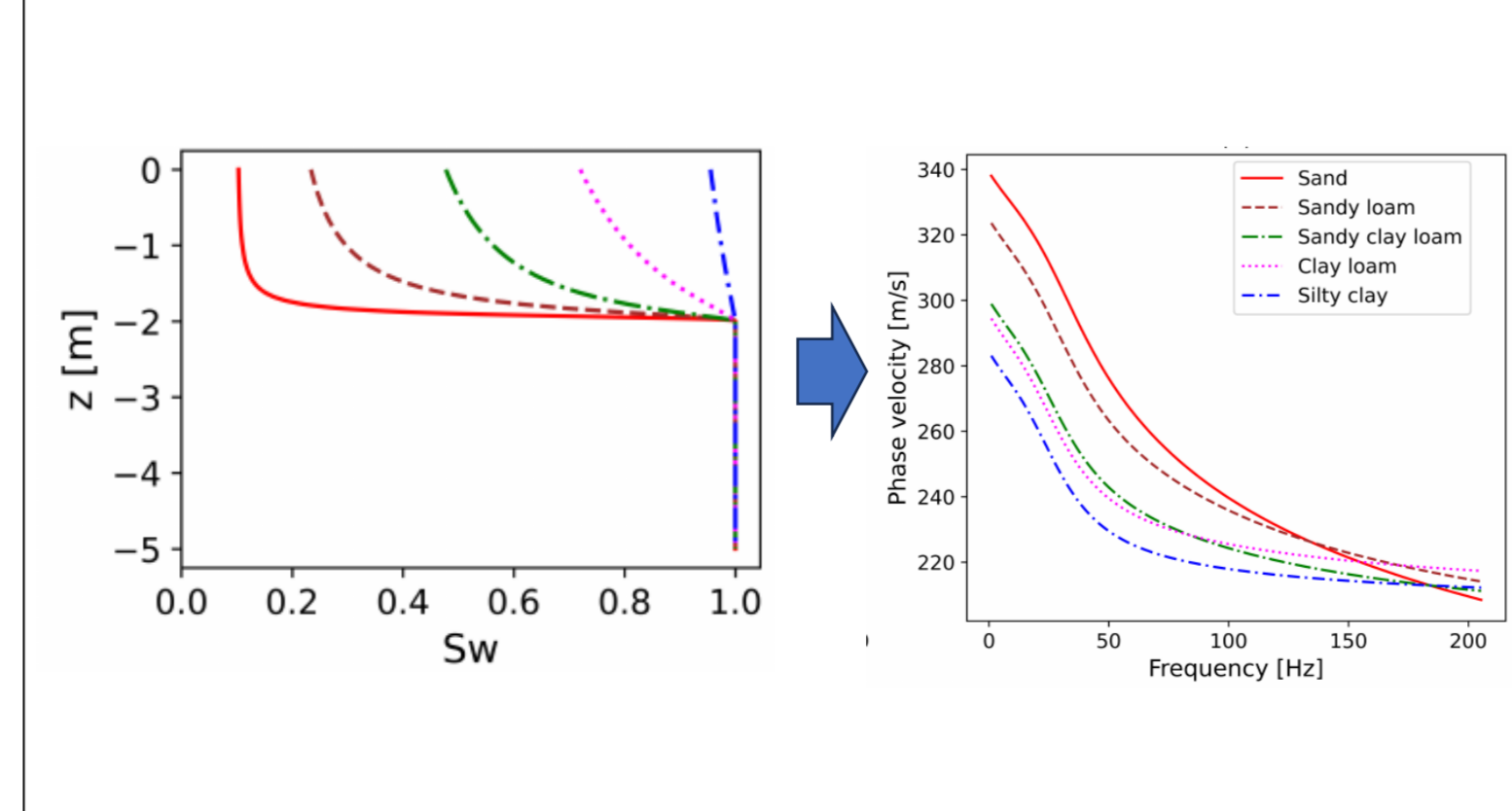


→ Geophysical models provide **initial-boundary conditions** to calibrate and validate the hydrogeological model & to **perform fully integrated 2D river corridor modeling**

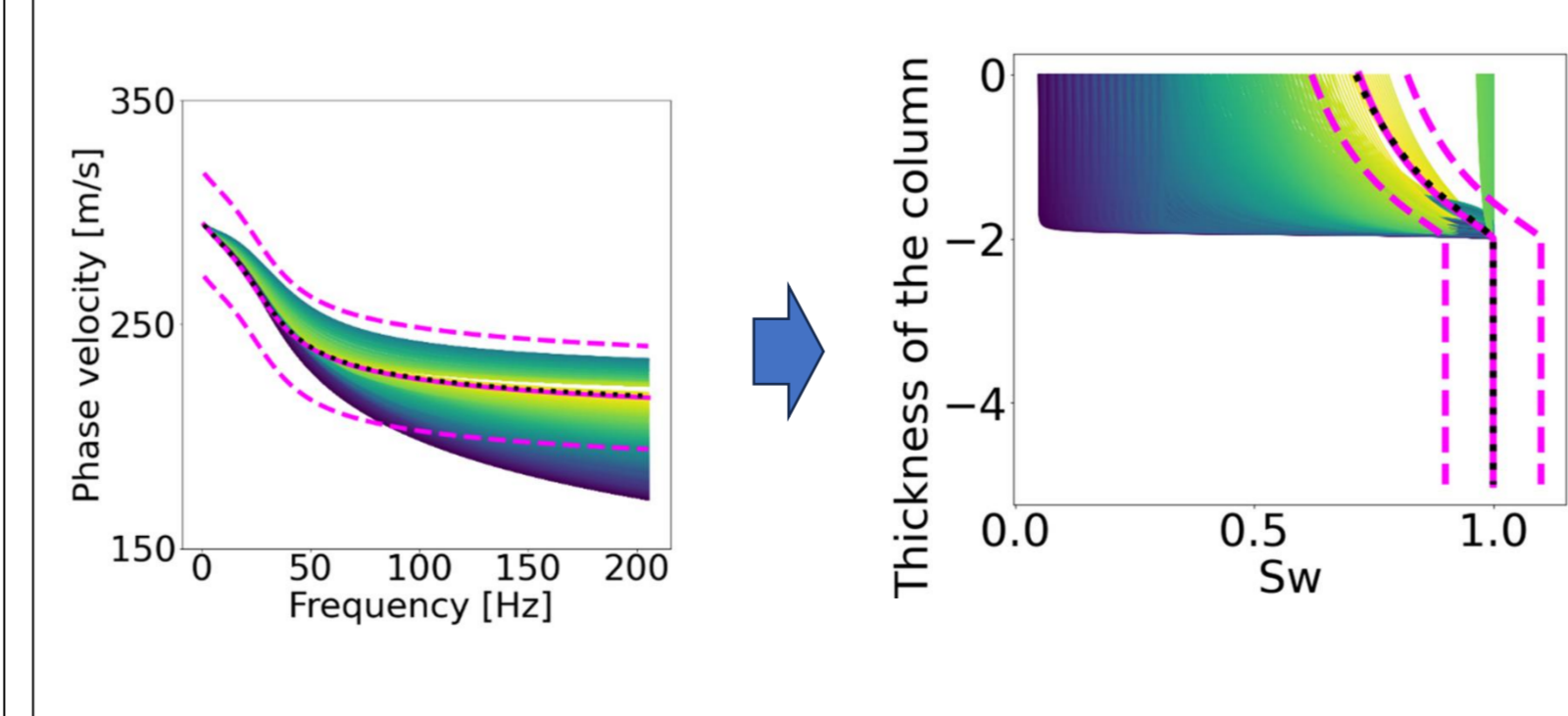
4. GW recharge



→ Forward problem sensitive to the hydrofacies (e.g. van Genuchten model)



→ We can then implement the inverse problem... means retrieving a model of saturation profile from dispersion data



Ramon Sanchez Gonzalez (PhD thesis 2021-2024)

5. Next steps

1. Characterizing the Propagation of Uncertainty from Geophysical Data to the Models
→ Probabilistic Joint Inversion Approach;
2. Exploring the Consideration of these Geophysical Models as 'Inputs' to Hydrogeological Models
→ Propagation of Uncertainties from Geophysical Models
→ to Petrophysical Relationships;
→ to Hydrogeological Models...
3. Combining Hydrogeological Simulations with Geophysical Simulations
→ Achieving More Reliable Calibrations

→ Thermal Seismic Coupling!!

We are currently seeking candidates for the following positions:

- 1 Postdoctoral Researcher
- 1 PhD Candidate

If you are interested in these positions, please do not hesitate to contact us.

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