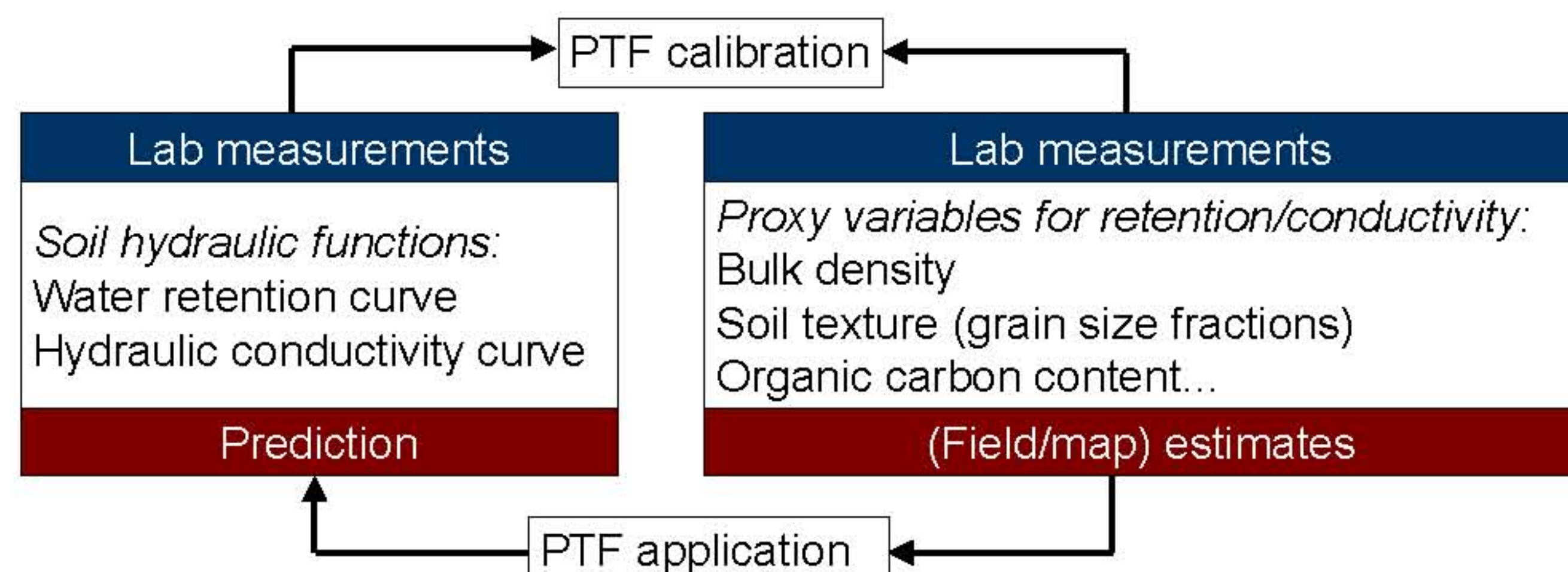


Problem

- Pedotransfer functions (PTFs) are commonly used for providing the soil hydraulic parameters needed in soil water transport models.
- PTFs are mostly derived on the basis of lab measurements of the PTF predictors (e.g., texture or bulk density), but their application very often relies on less precise data.

Research
questions

How are the PTFs' prediction accuracy and uncertainty affected when the PTF predictors are derived from different sources?

How propagate these errors and uncertainties into modelled soil water balances?

Materials & Methods

Sampling:

- ~450 forest soil profiles throughout Baden-Württemberg/Germany
- 1054 soil samples for PTF calibration/validation
- 516 soil samples for independent PTF testing

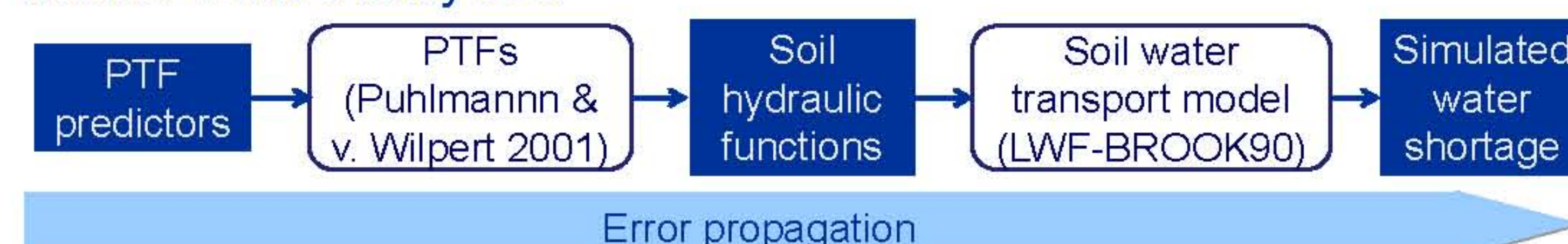
Soil hydraulic functions:

- measured in Multi-Step-Outflow exps. (Puhlmann et al., 2009)
- Mualem/van Genuchten parameters by inverse optimization

Proxy variables (PTF predictors) from different sources:



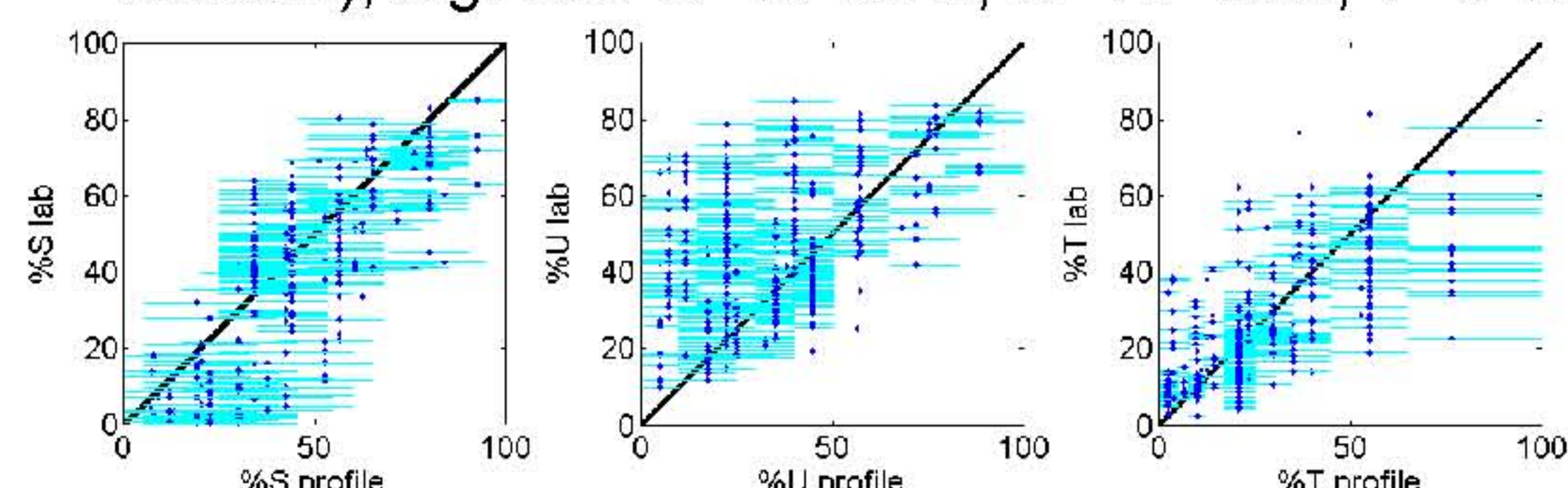
Monte Carlo Analyses:



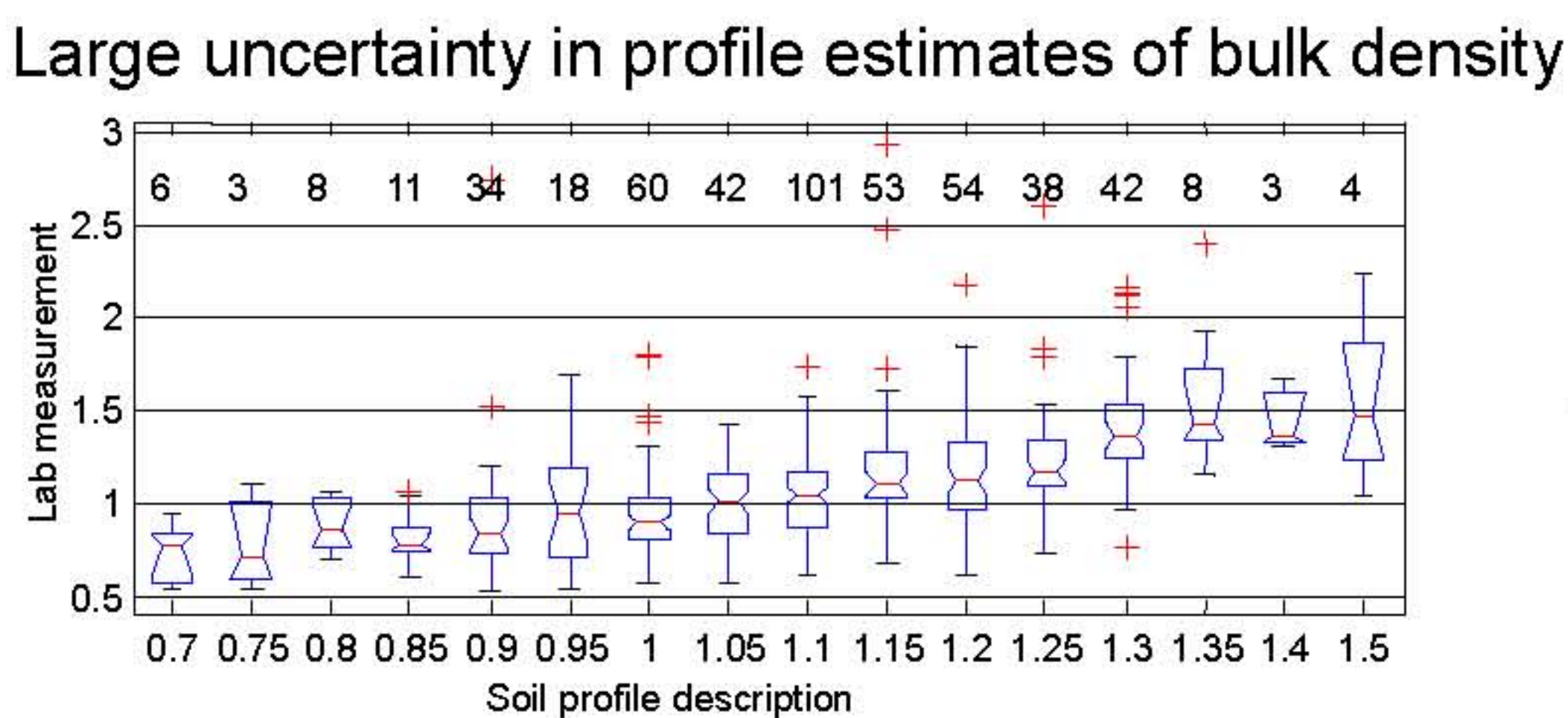
Results: PTFs' Prediction Accuracy & Uncertainty

Accuracy & uncertainty of PTF predictors

- Broad ranges in soil profile descriptions (texture classes), e.g. SI3: S=48-82%, U=10-40%, T=8-12%



- But also erroneous lab measurements!



- Large errors also in texture and carbon estimates!

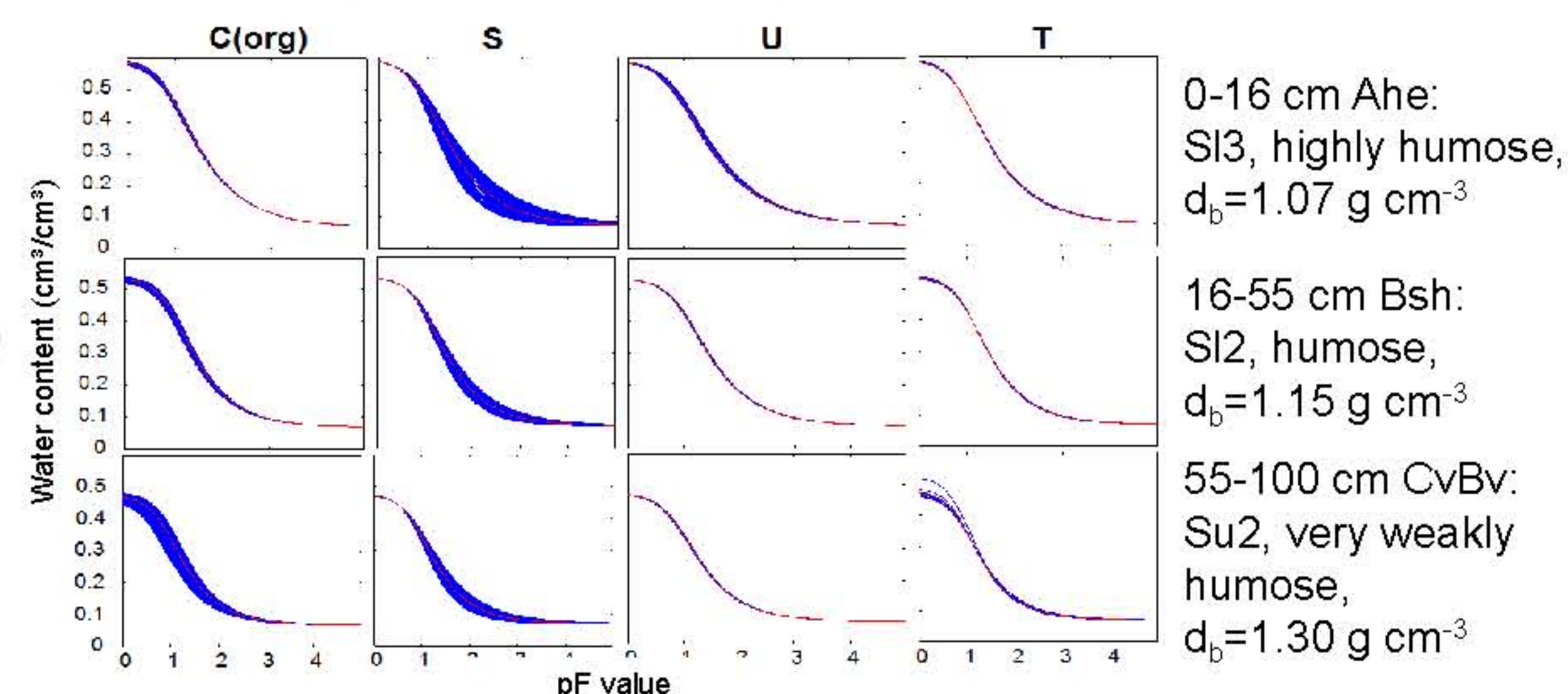
Case 1: Uncertainty due to aggregated predictor information

Predictor information often in the form of classes or value ranges.

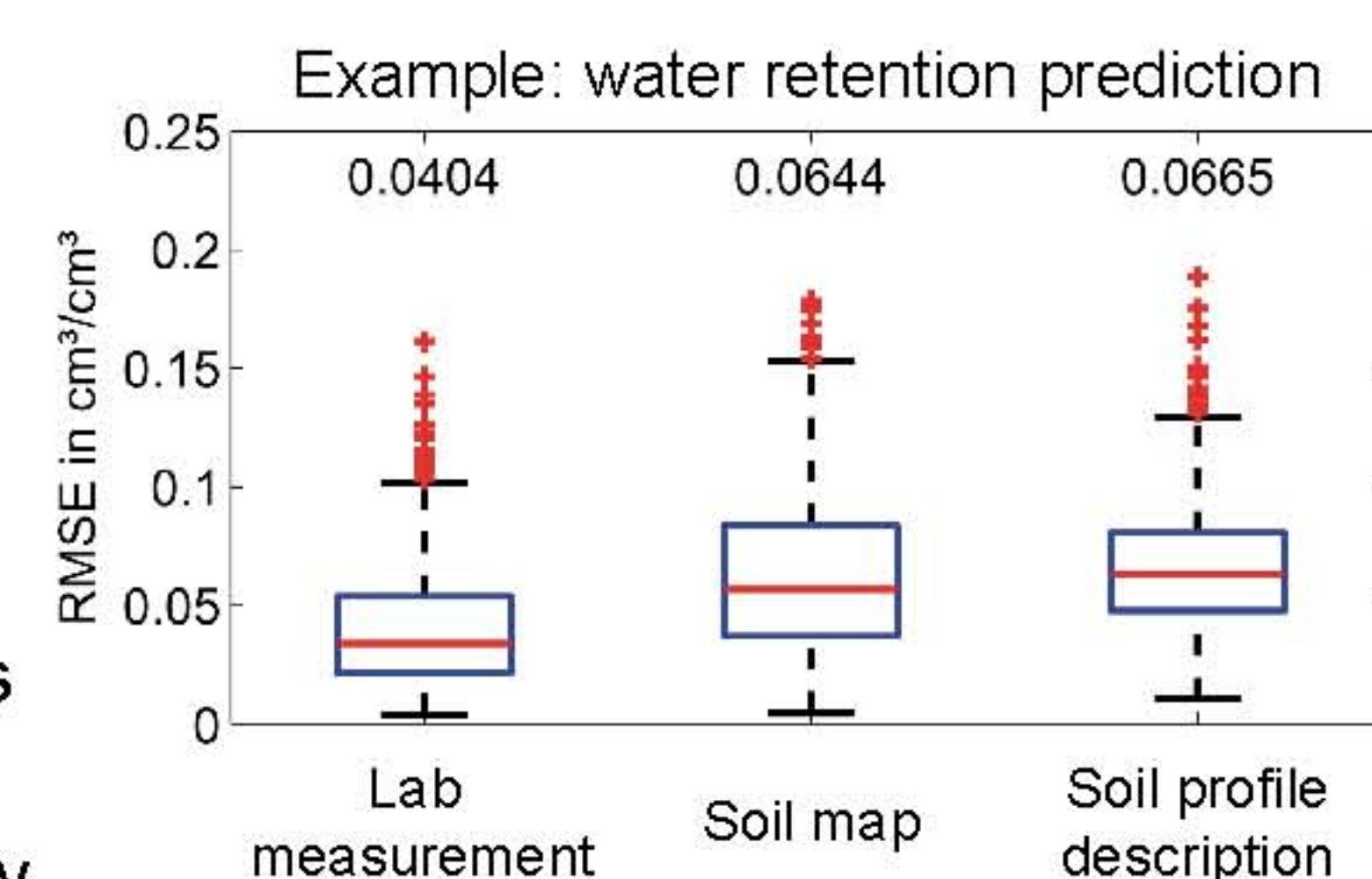
Case 2: Inaccuracy due to erroneous predictor estimates

Profile descriptions are subjective and have random and/or systematic errors. Soil maps have limiting spatial resolution.

Accuracy & uncertainty of PTF predictions

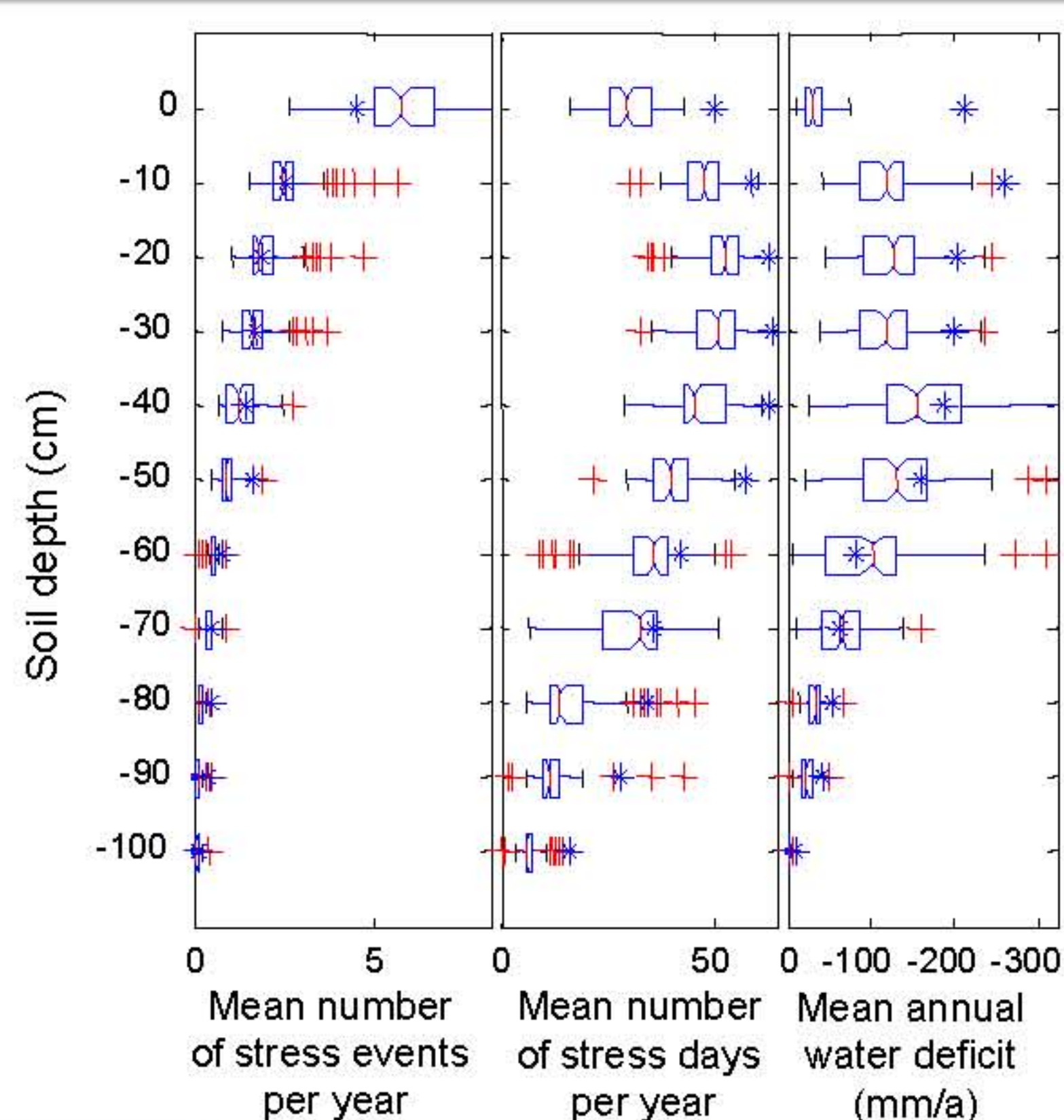


- Large RMSE when no lab analyses of PTF inputs are available
- Similar RMSE for small-scale soil map & profile descriptions
- Similar results for hydraulic conductivity



Results: Effects on Soil Water Modelling

Case 1: Impact of aggregated predictor estimates



- PTF prediction error & uncertainties propagate in simulated soil water deficit.
- Large deviation from calibrated model (blue asterisks) for deficit volume
- Lesser deviations for stress duration and stress frequency
- Bulk density has largest impact on prediction accuracy.
- Prediction uncertainty was mainly due to broad soil texture ranges in the profile description.

References: Puhlmann et al., 2009, Europ. J. Soil Sci., 60(5), 792-806; Puhlmann & von Wilpert, 2011, Archiv Waldökol., Landschaftsforsch. und Natursch., 12, 61-71 (in German); Zirlewagen et al., 2012, Archiv Waldökol., Landschaftsforsch. und Natursch., 12, 73-84 (in German)

Case 2: Impact of erroneous predictor estimates

