

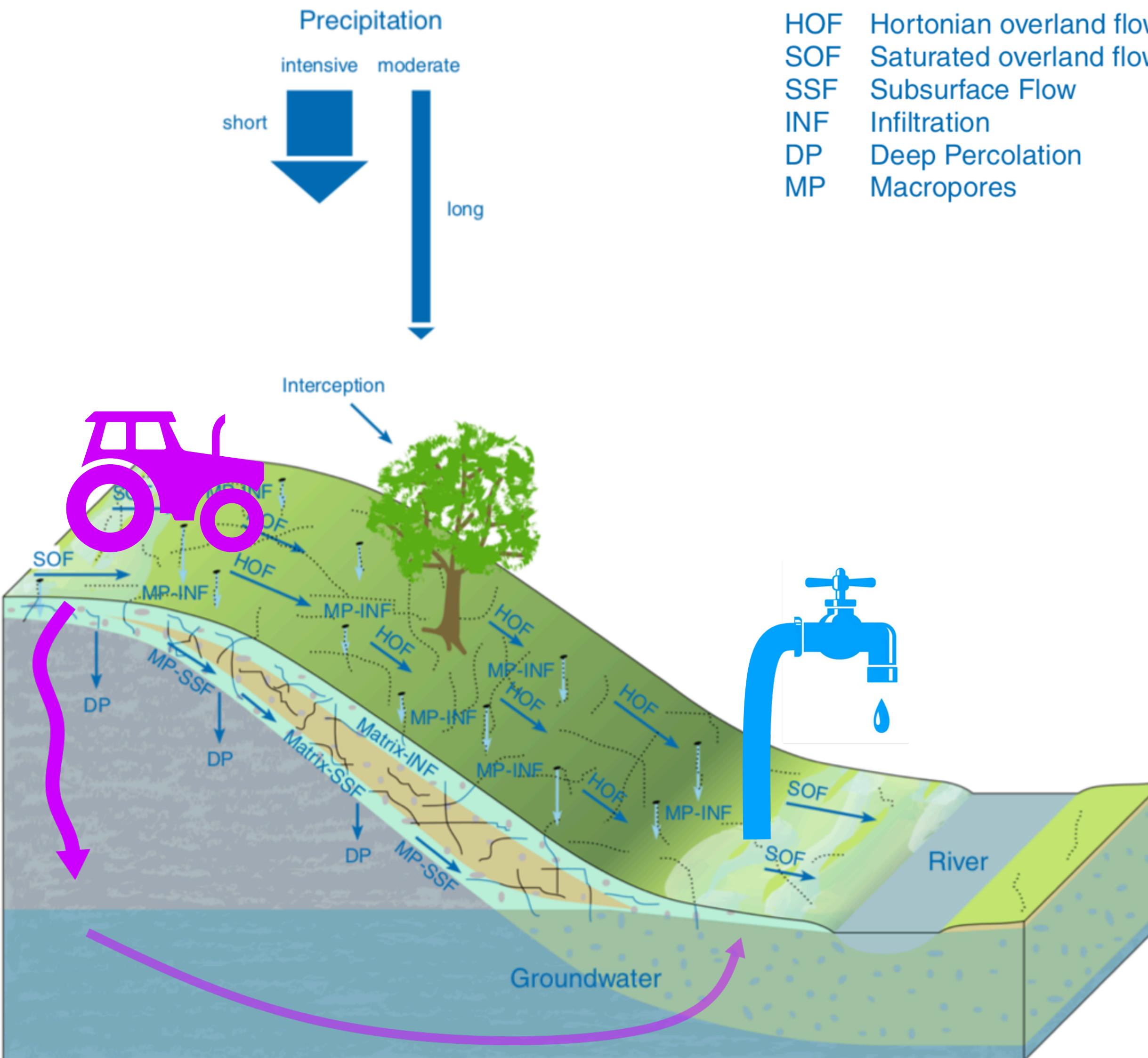
# Consistent modelling of transport processes and travel times

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coupling soil hydrologic processes  
with StorAge Selection (SAS) functions

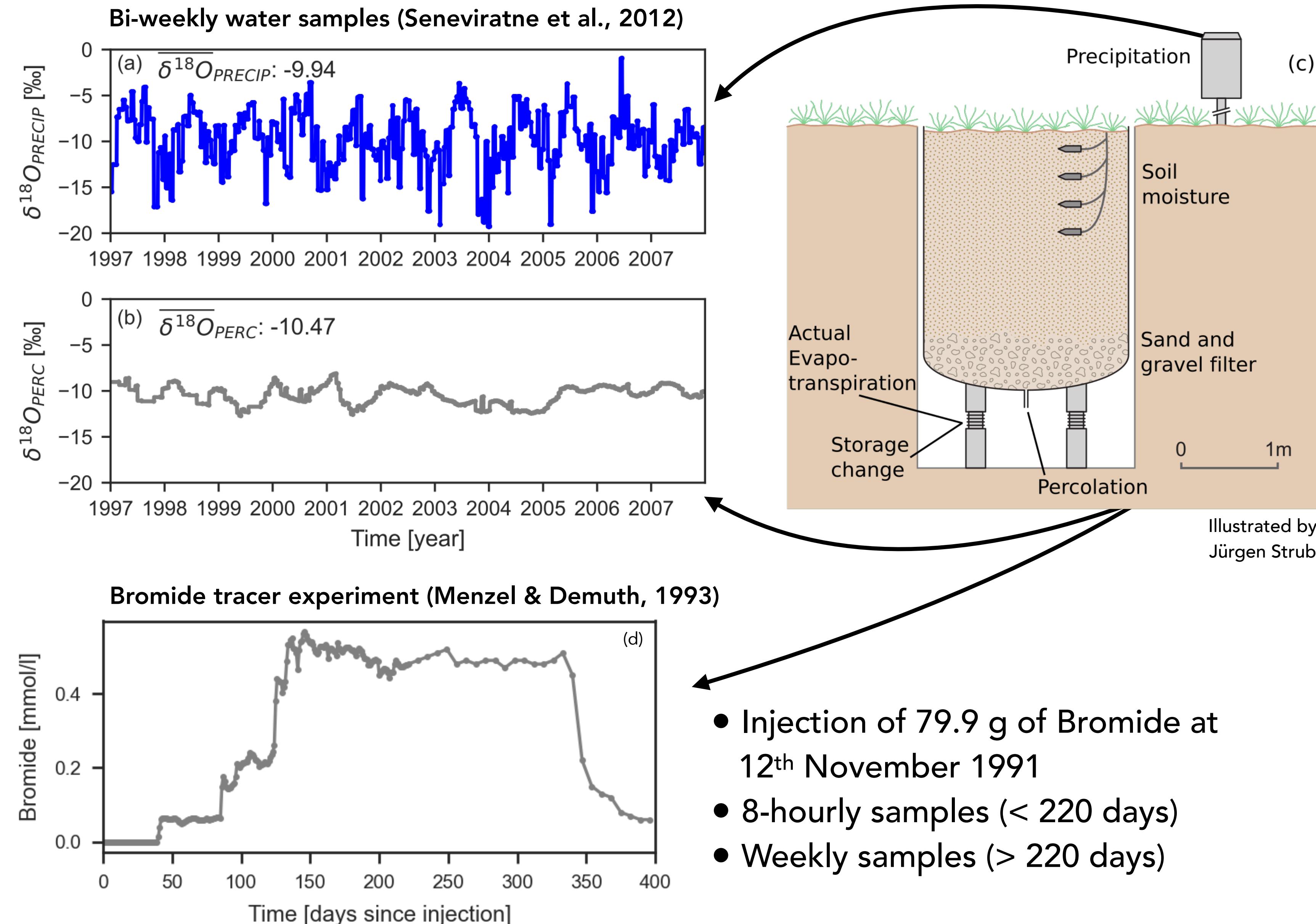


# Groundwater pollution caused by solute leaching



- Which transport hypothesis explains bromide and  $^{18}\text{O}$  transport at a weighing grassland lysimeter most realistically?
- What are the advantages of a coupled-SAS model compared to a physically-based model?

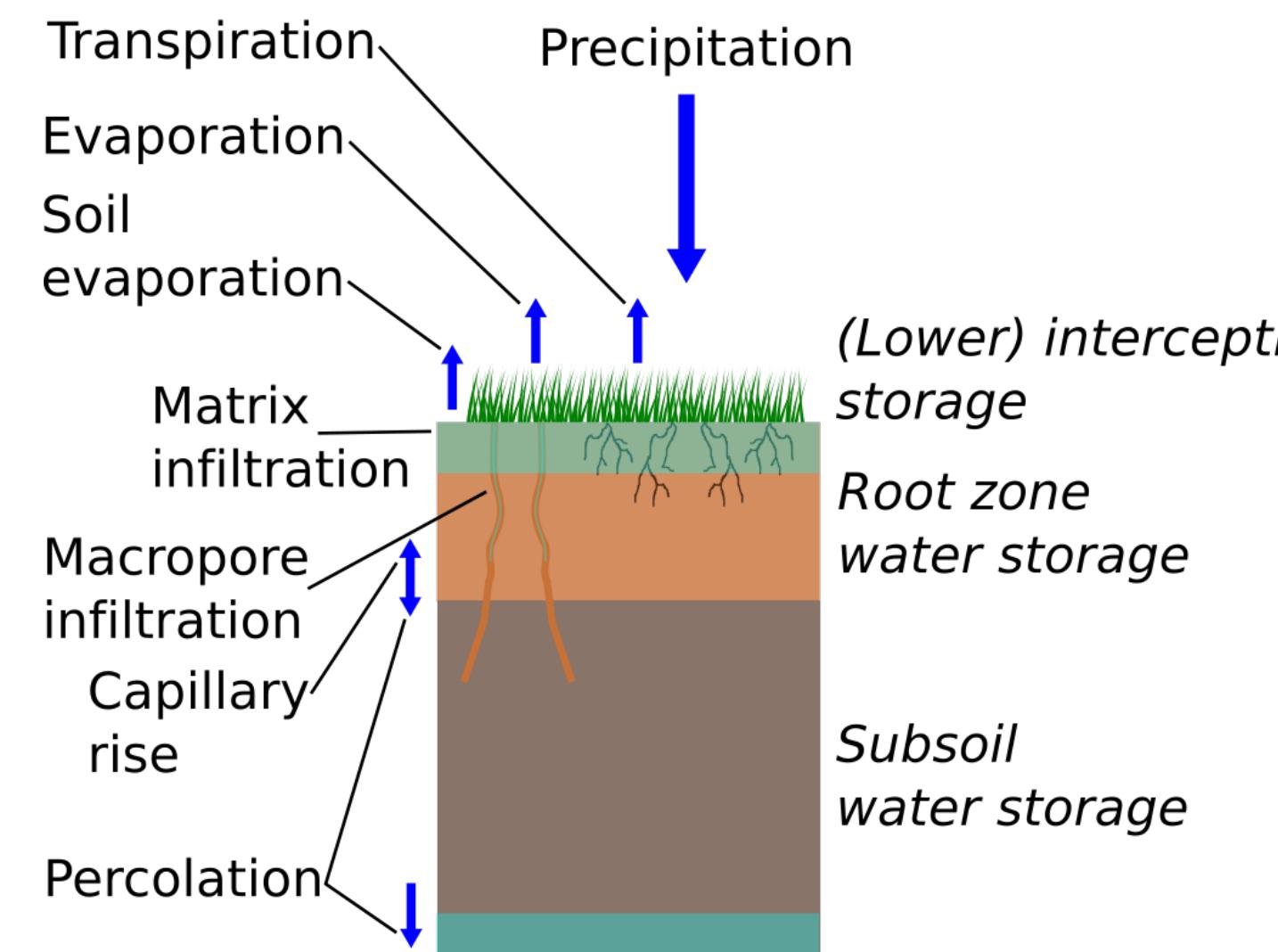
# Rietholzbach lysimeter, Switzerland



# Coupling soil hydrologic processes with StorAge Selection (SAS) functions

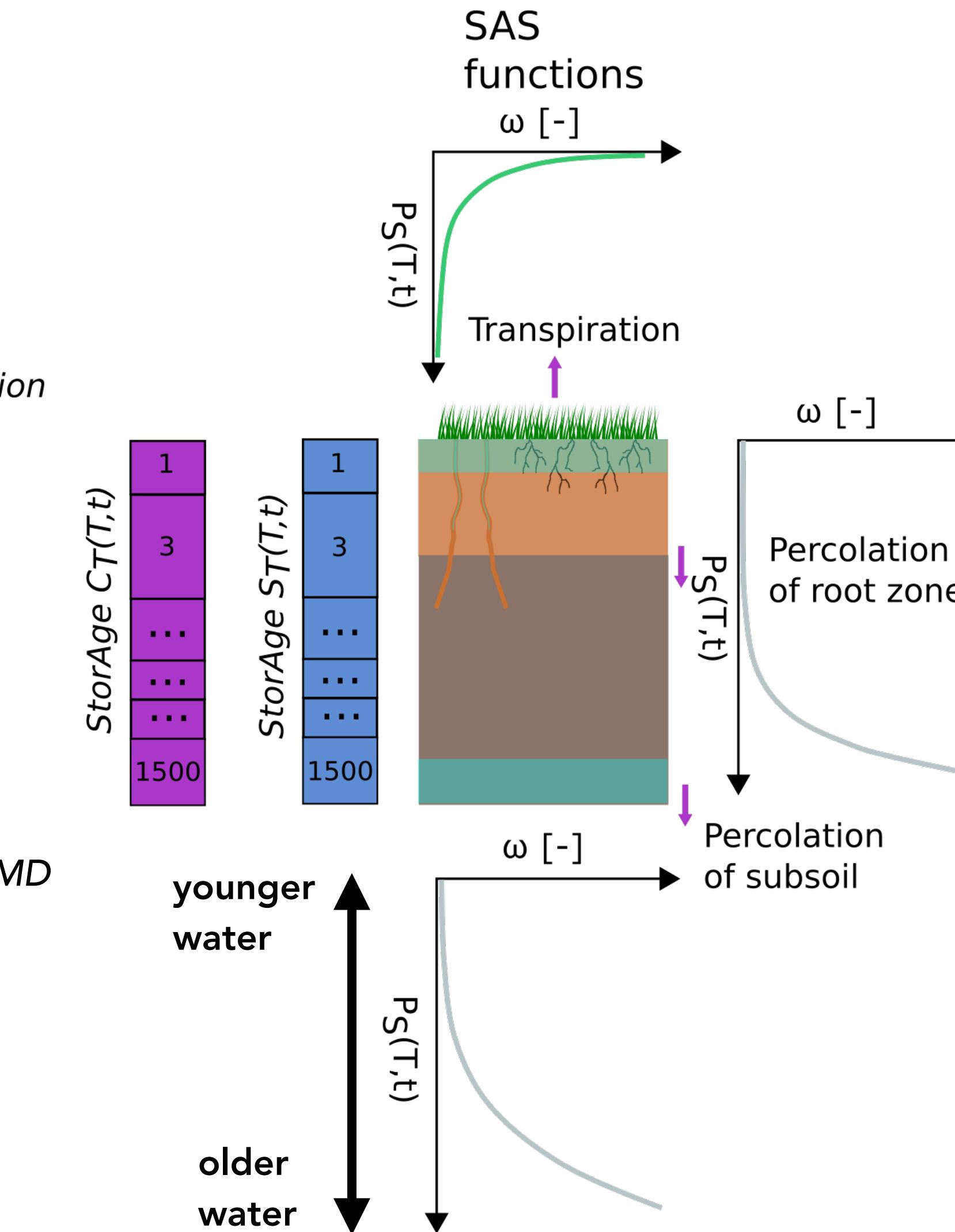
## process-based RoGeR-SAS model

### Soil hydrologic cycle

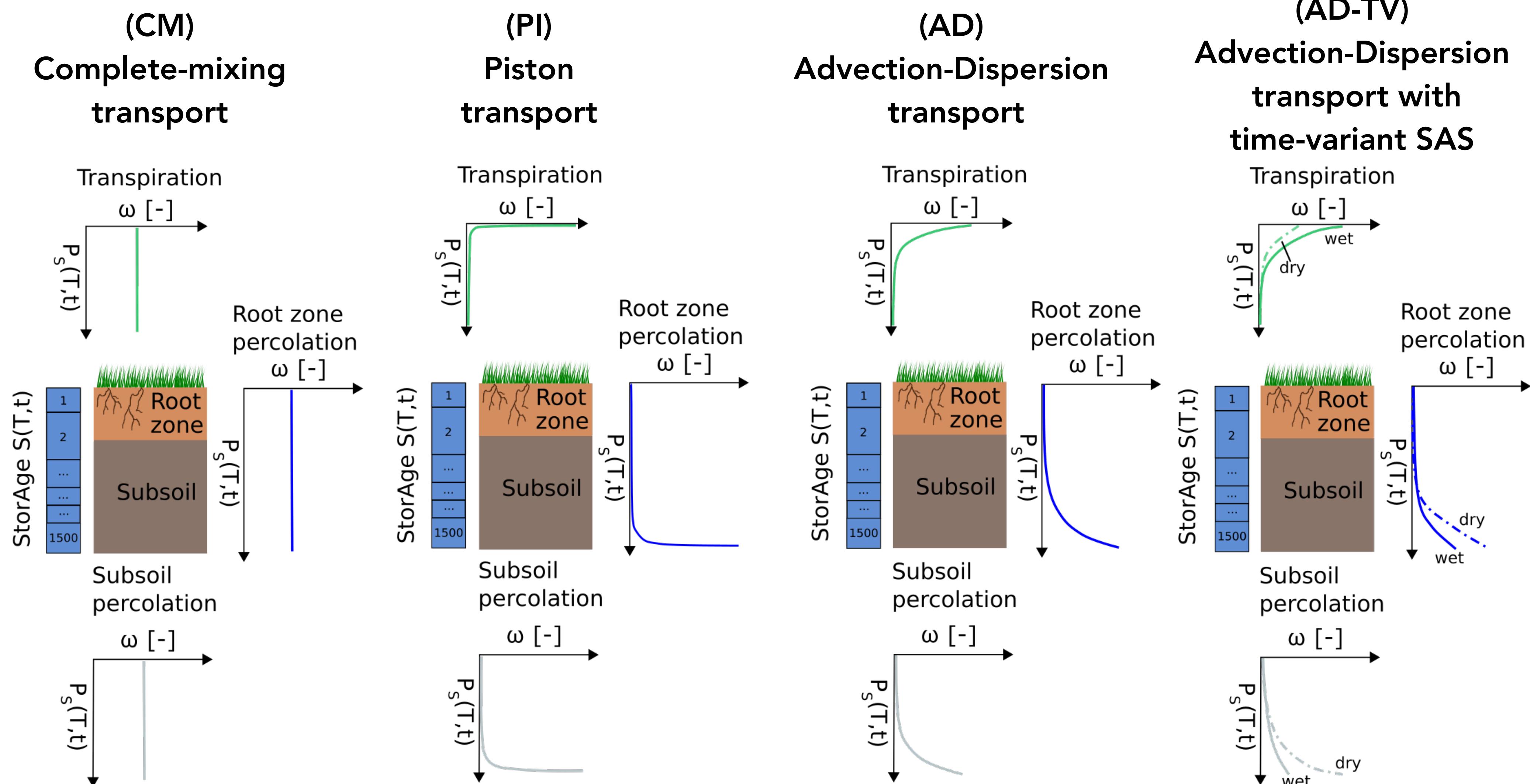


Schwemmle et al. (2023), will be submitted to GMD

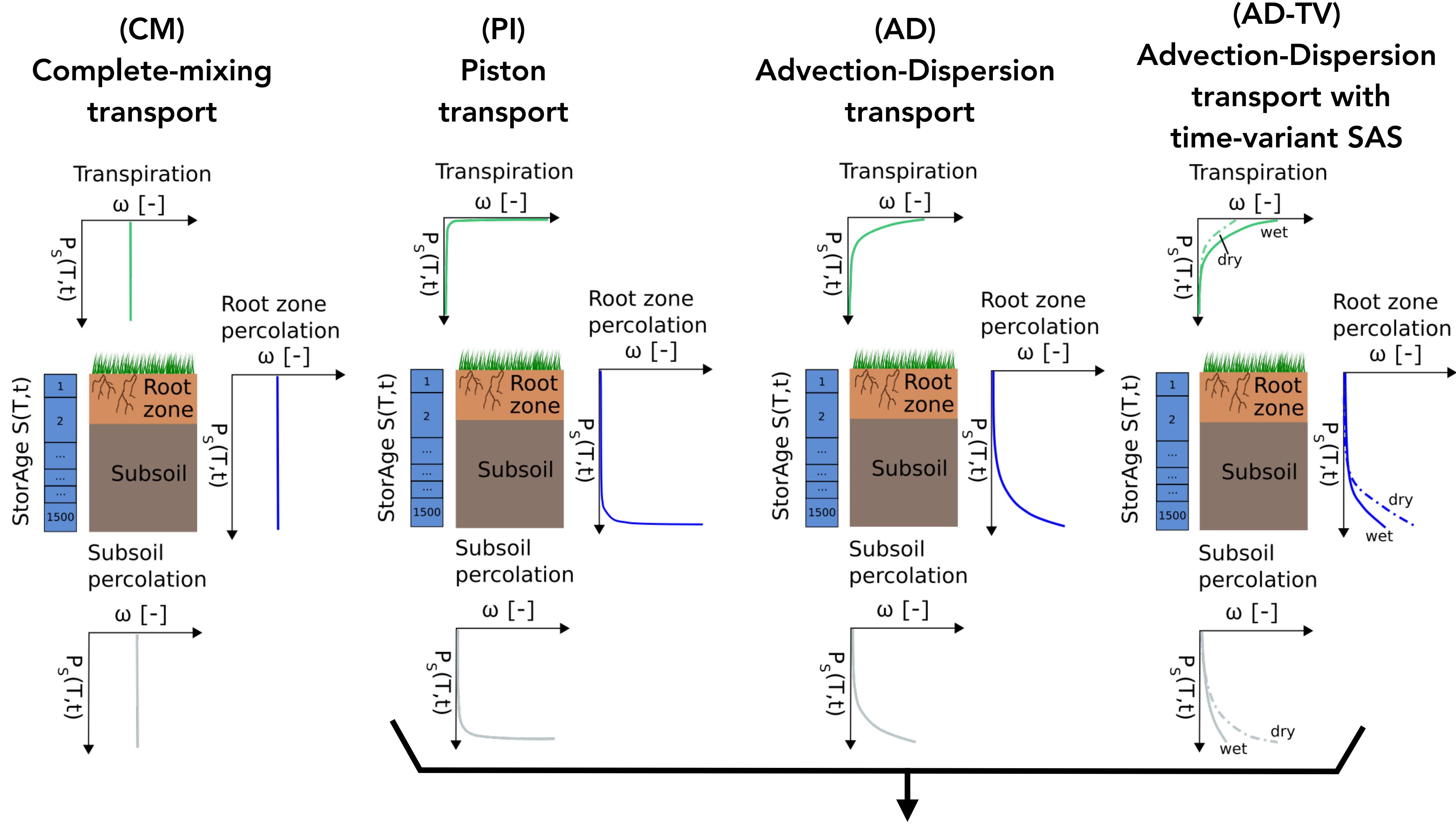
### Solute transport



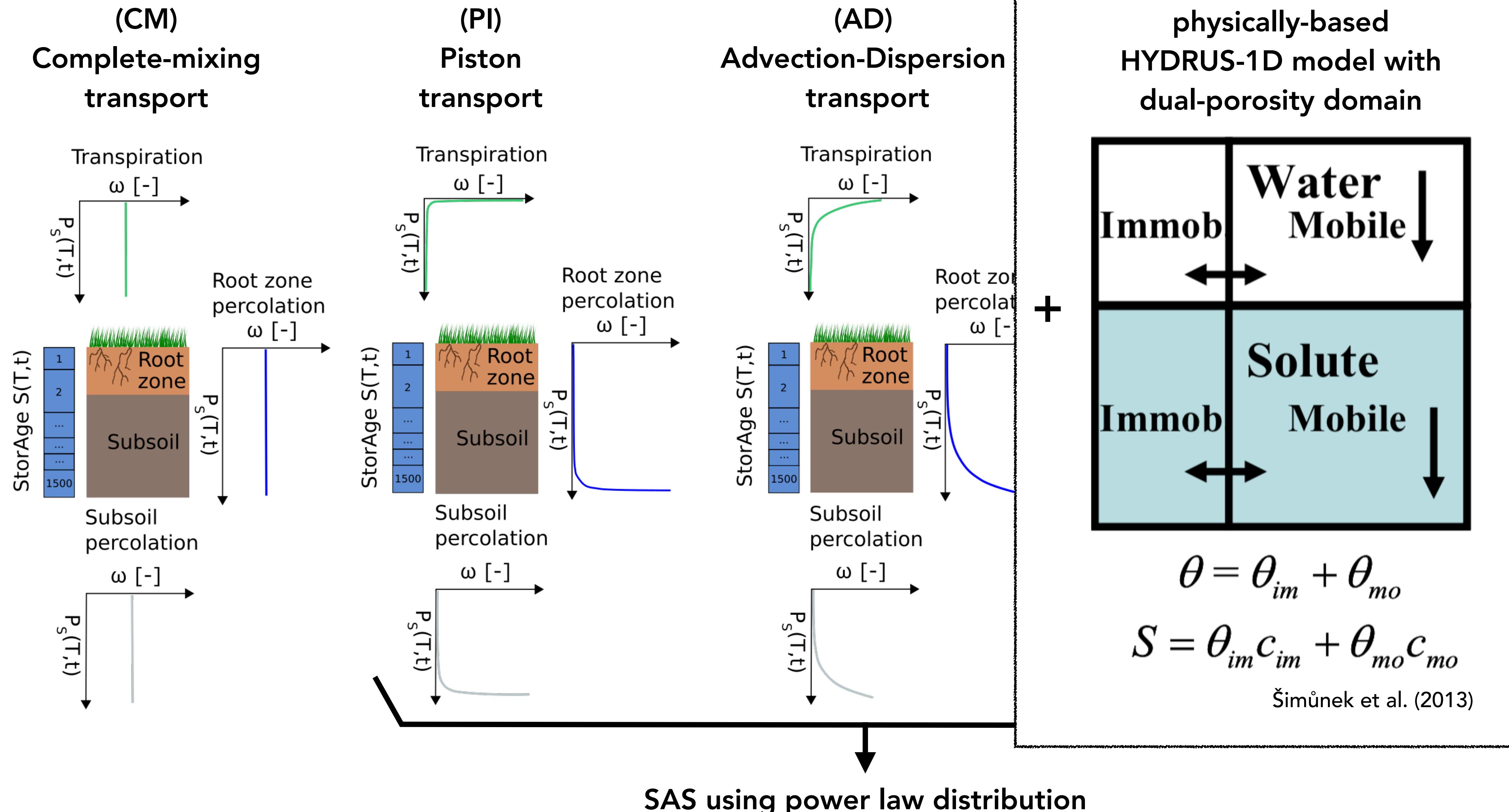
# Formulating transport hypotheses using SAS functions



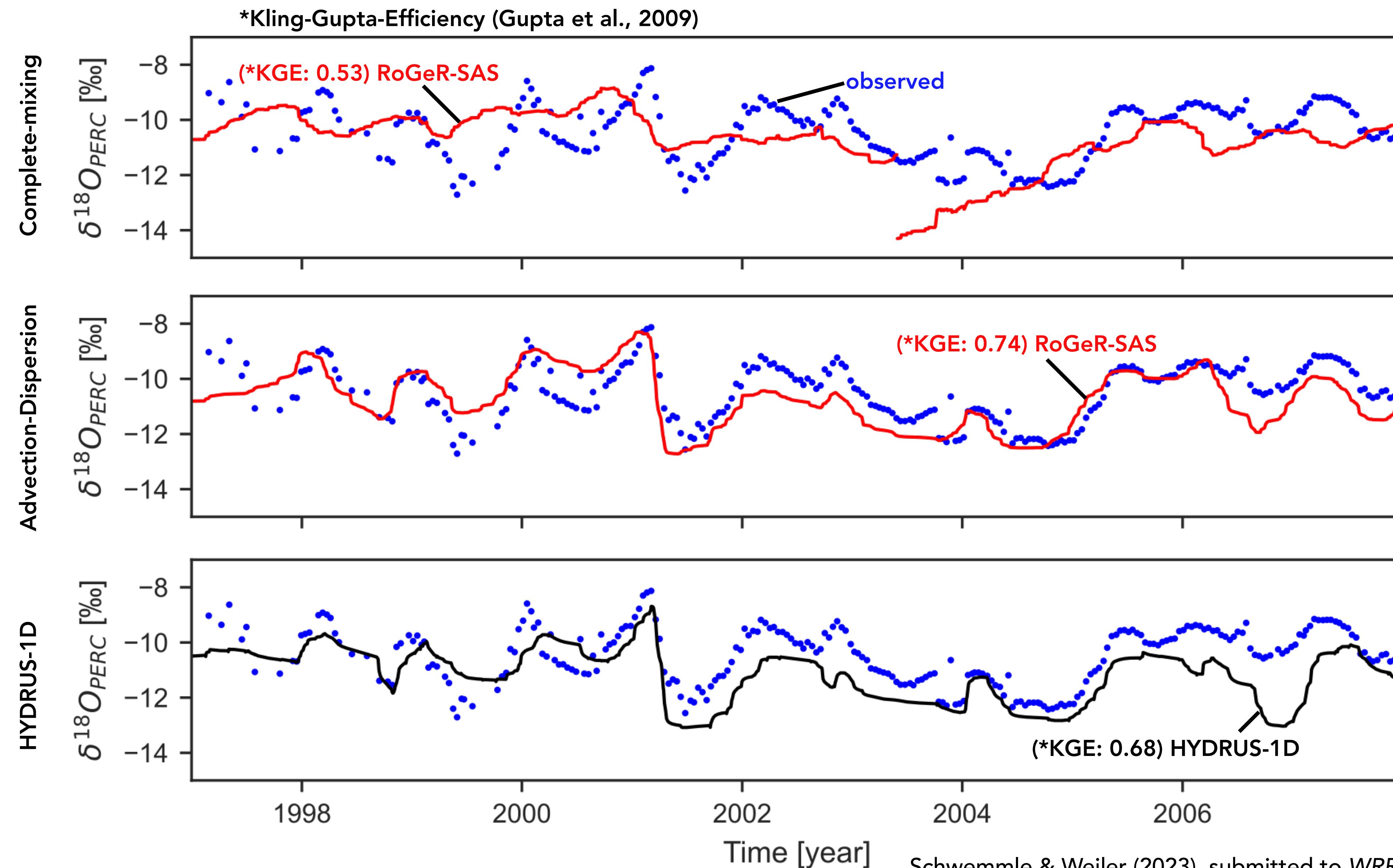
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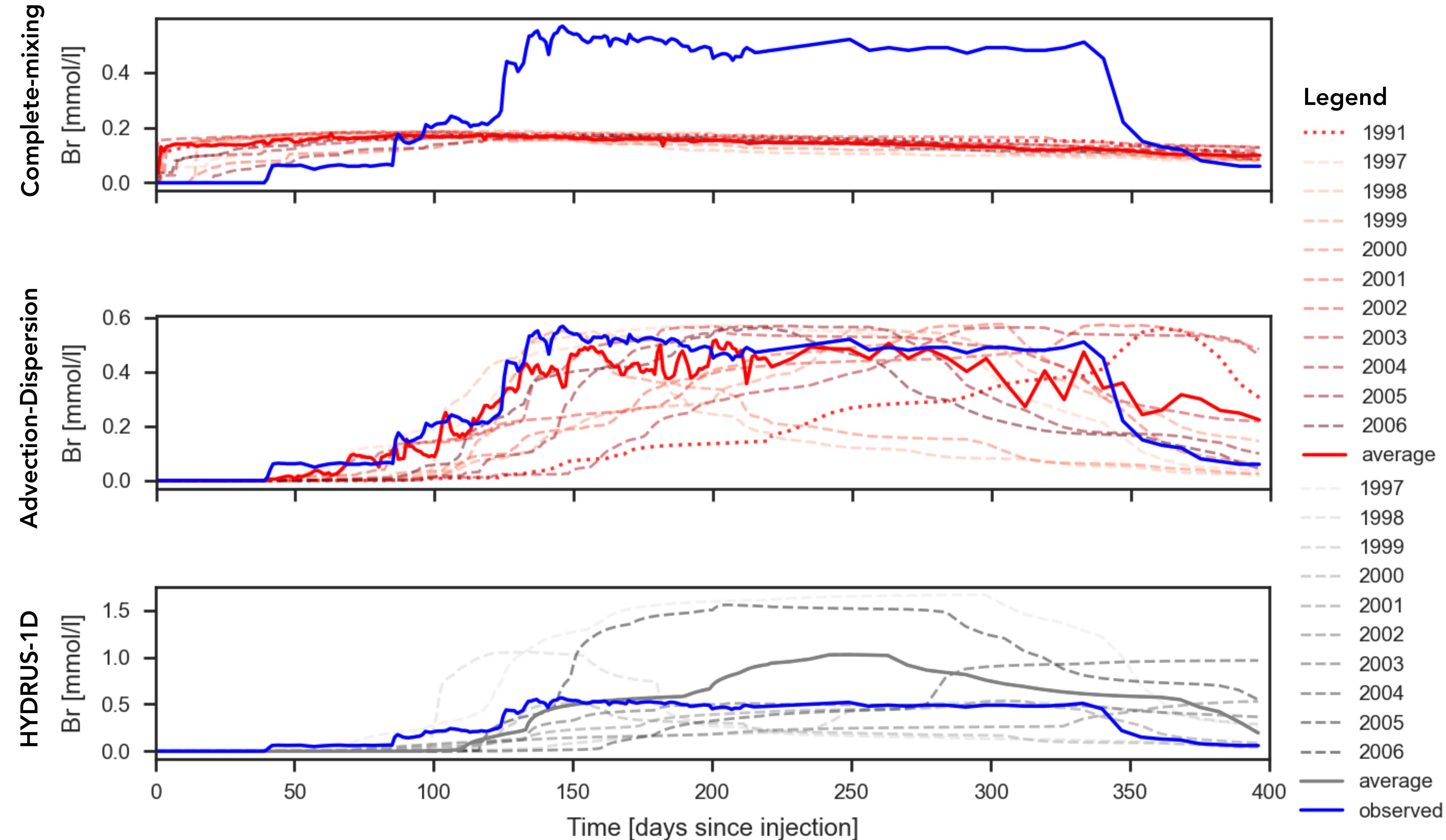
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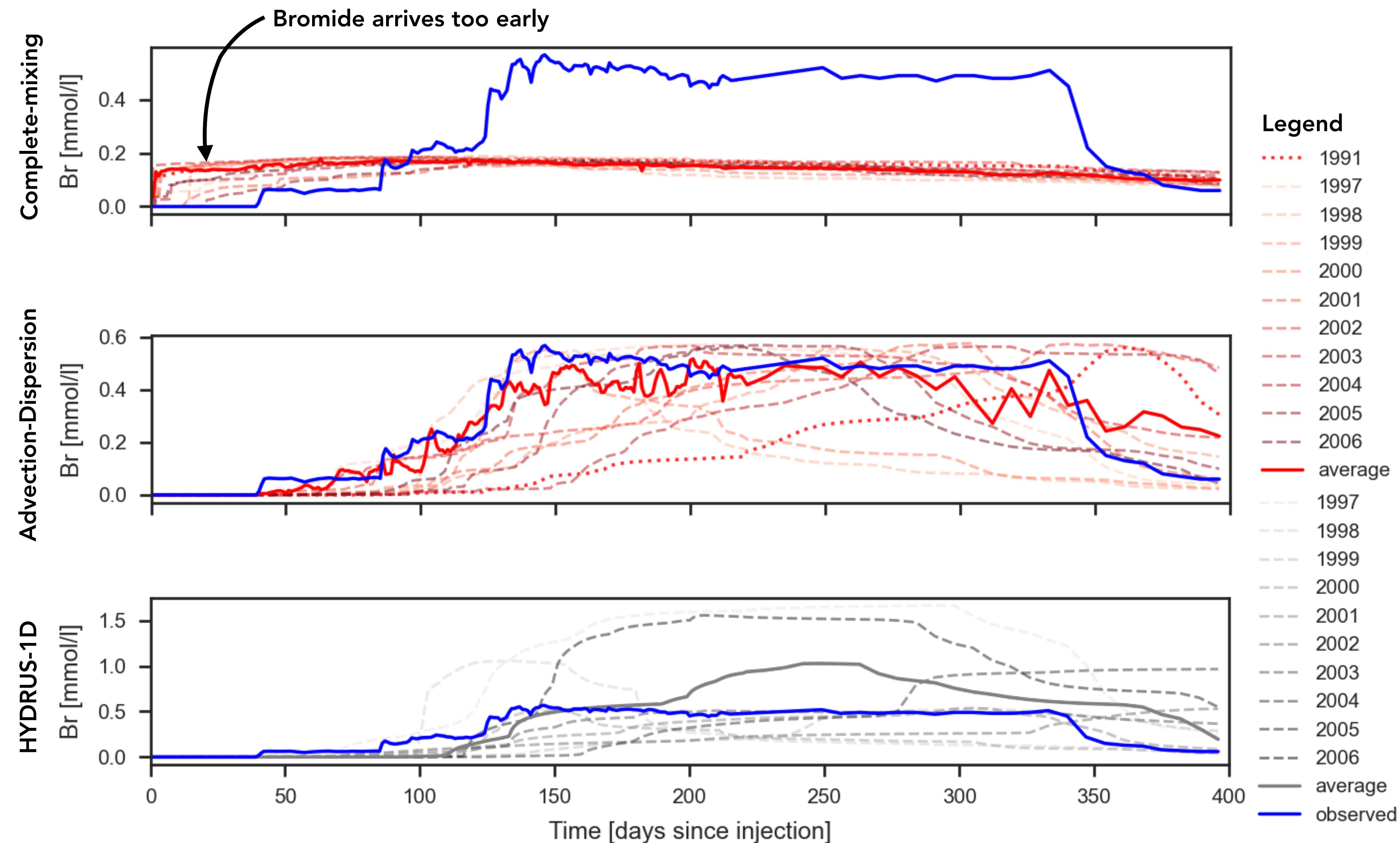
# Simulated $\delta^{18}\text{O}$ in percolation (PERC) from 1997 to 2007



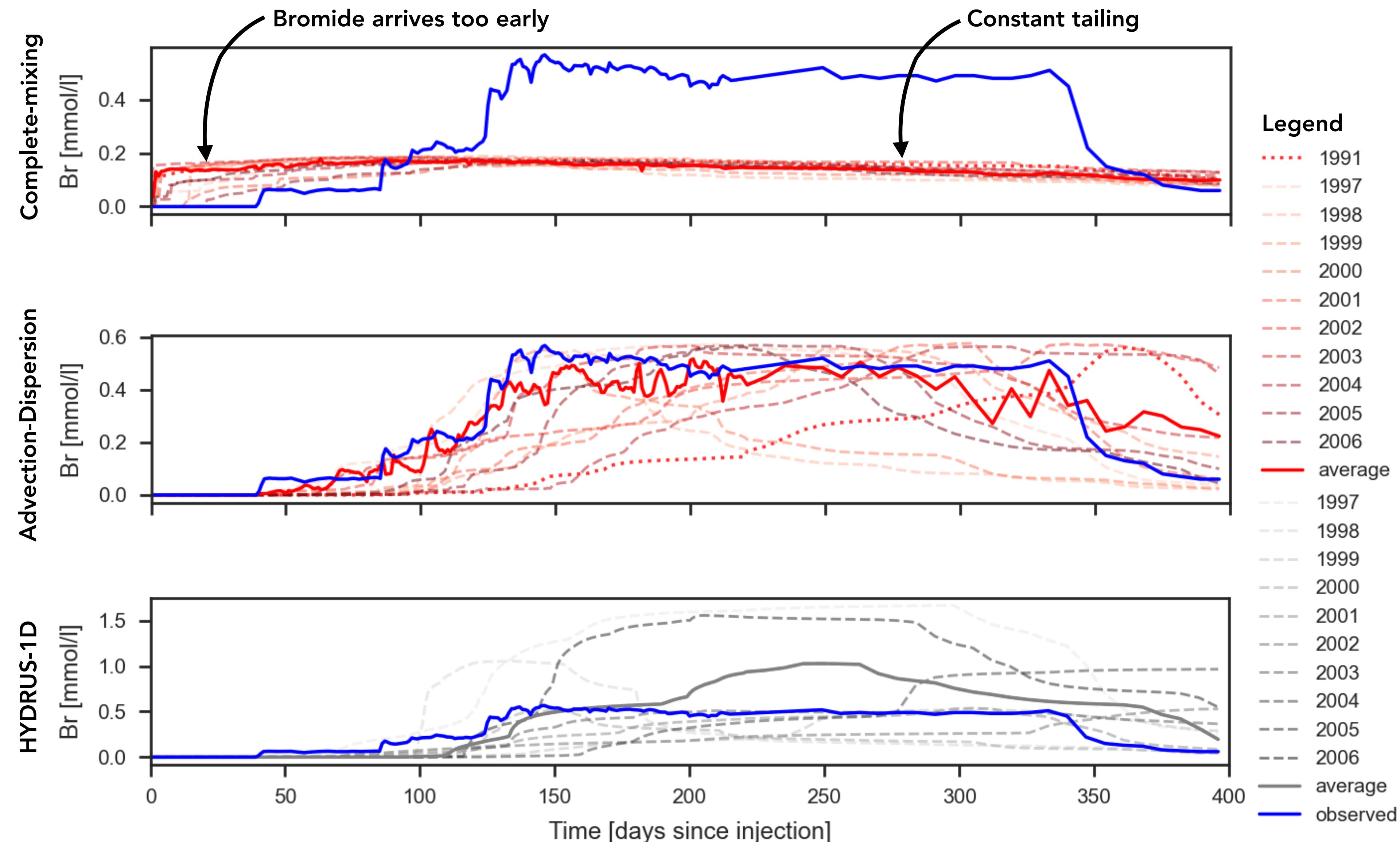
# Virtual bromide experiments



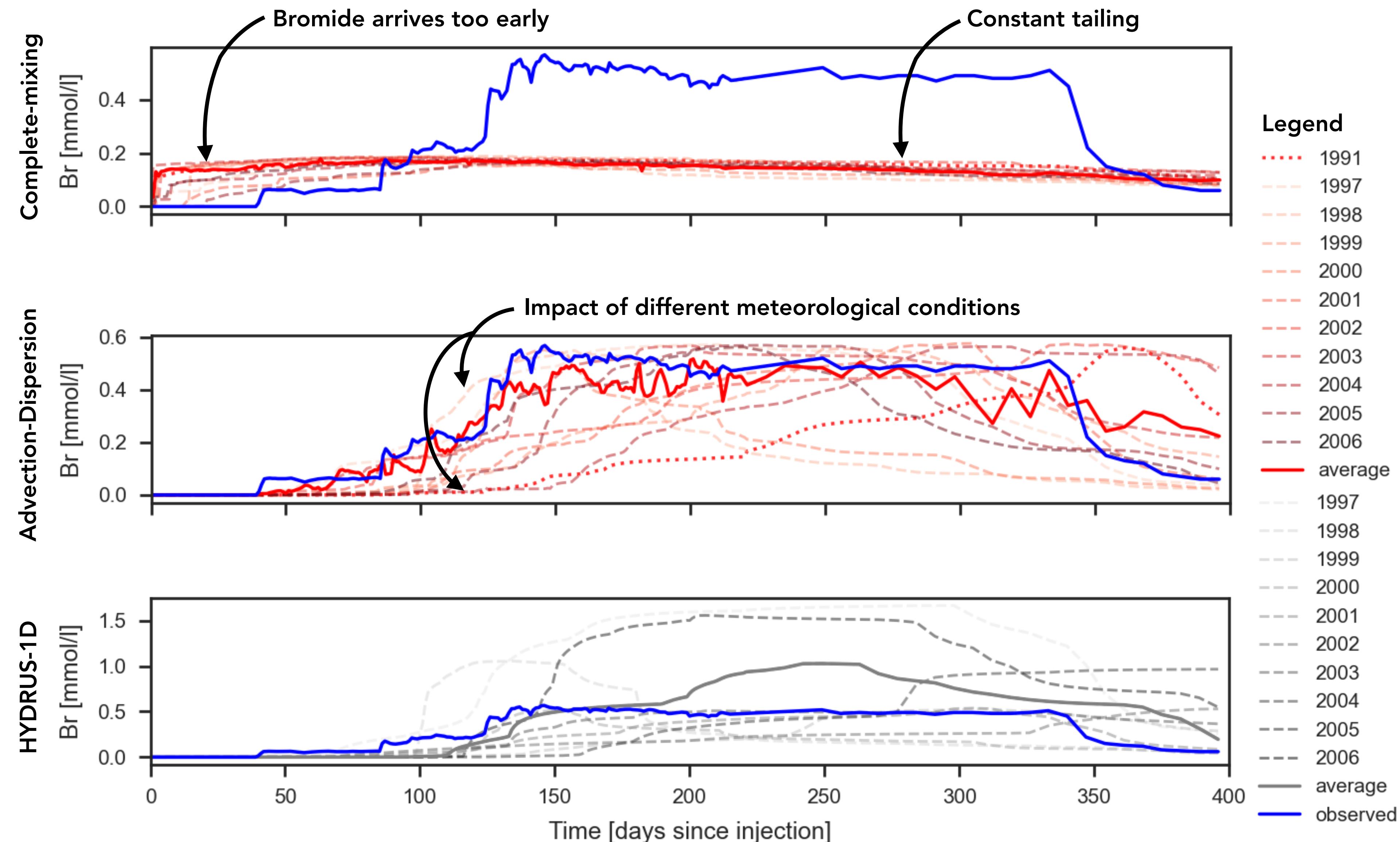
# Virtual bromide experiments



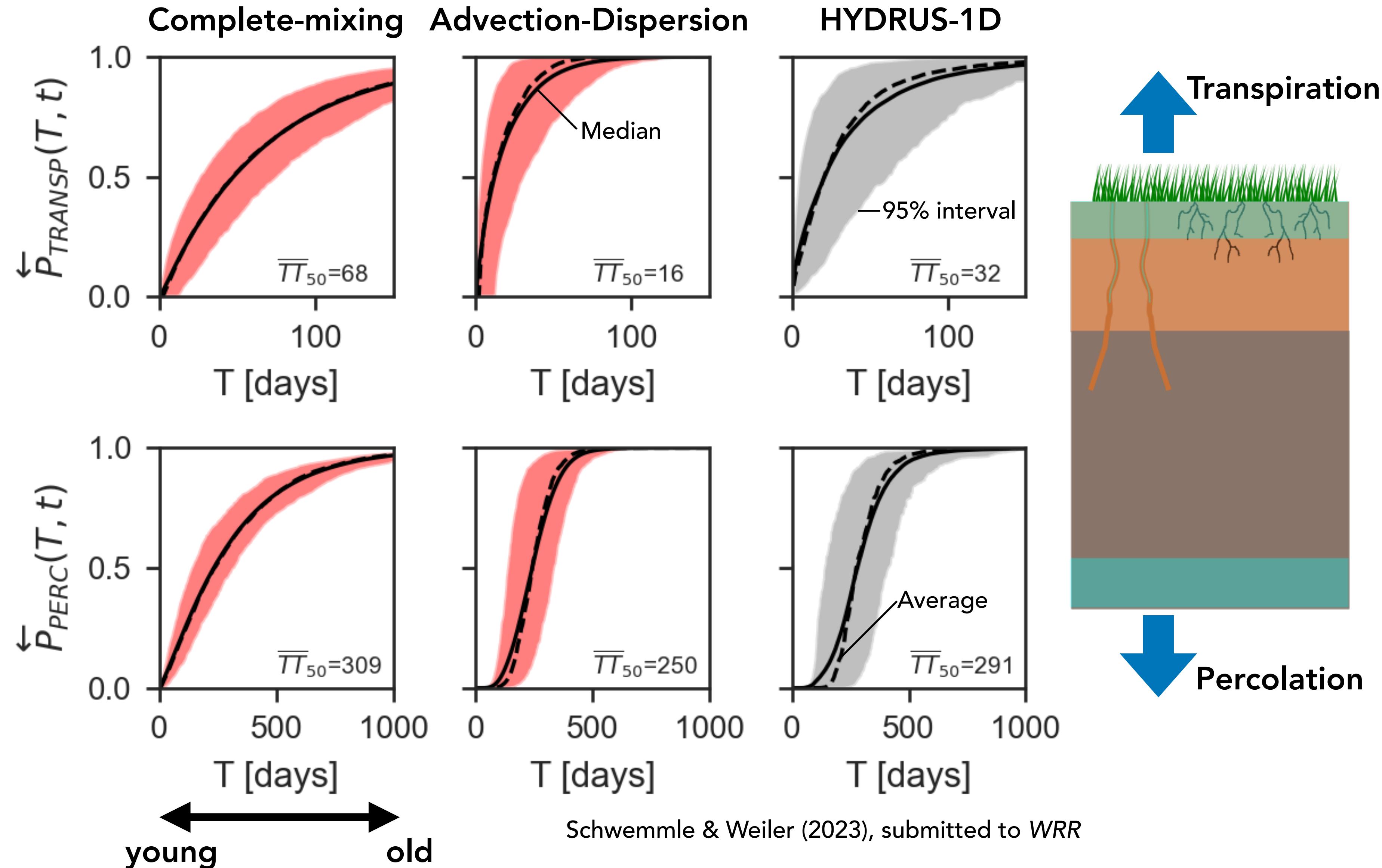
# Virtual bromide experiments



# Virtual bromide experiments



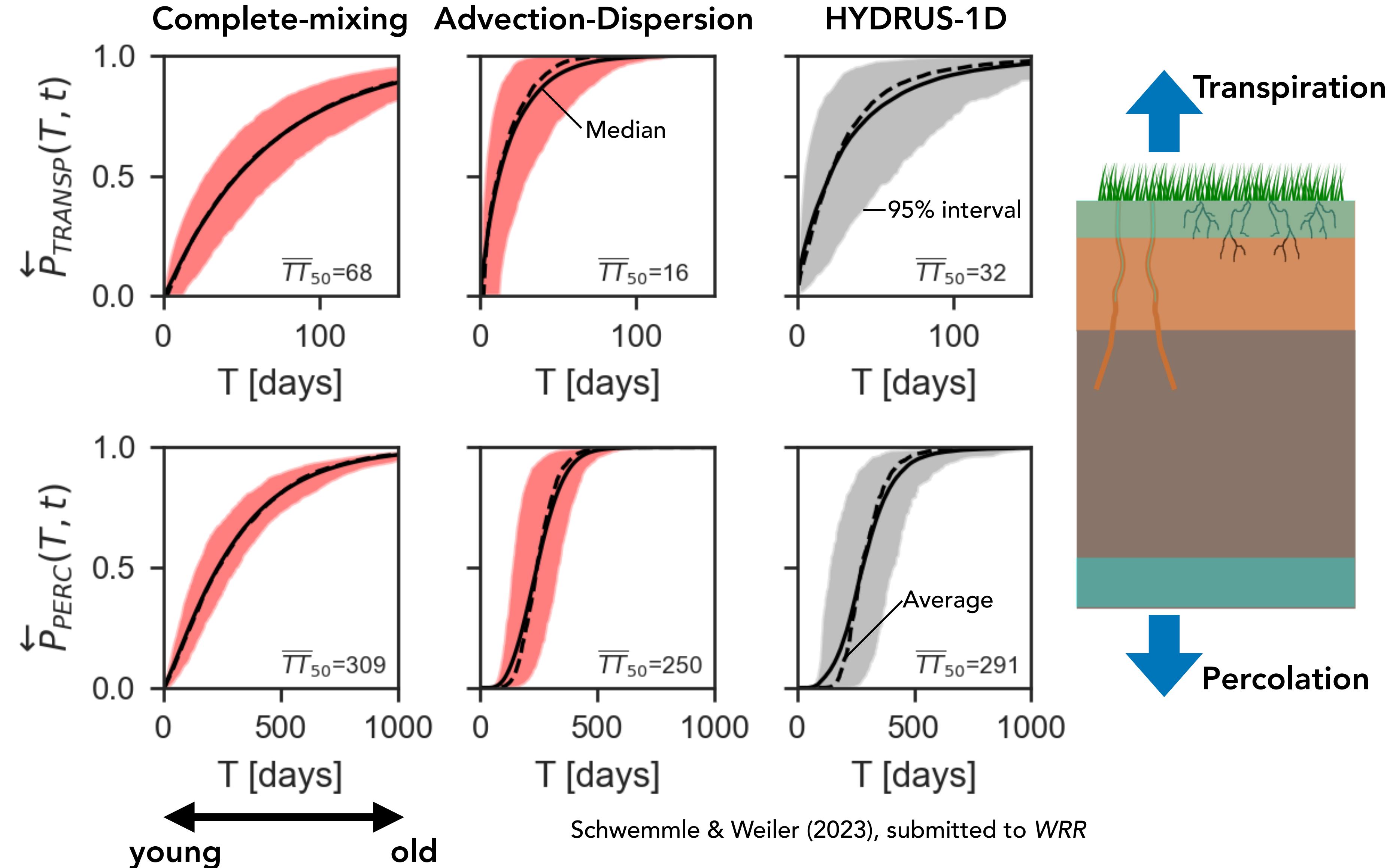
# Travel time of transpiration (*TRANSP*) and percolation (*PERC*)



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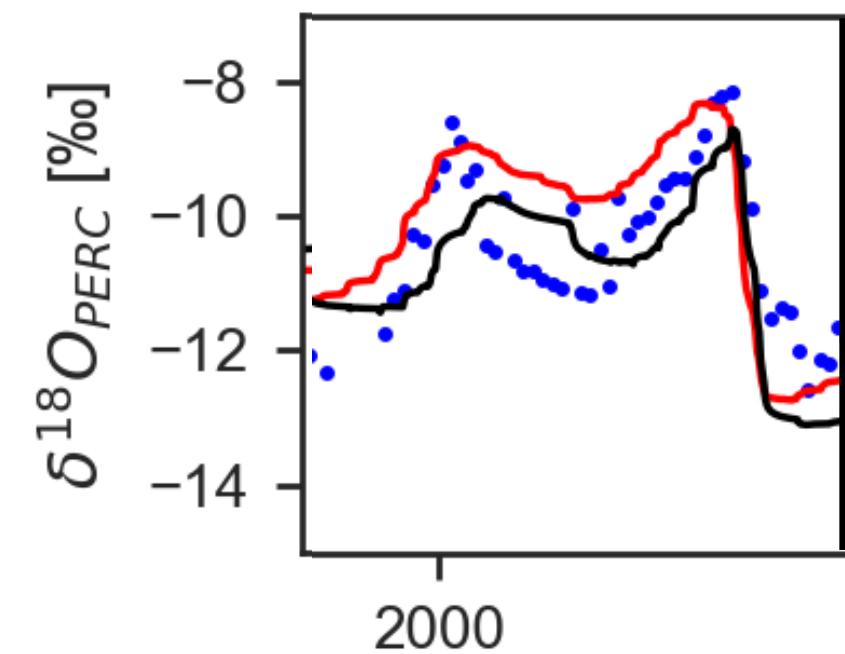
Computation time:

1 : 340



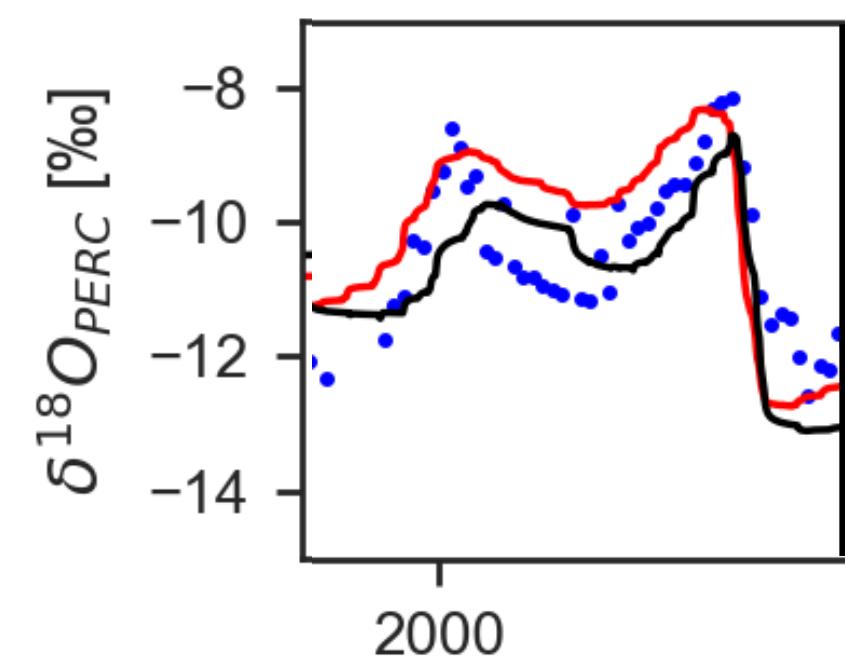
# Main findings

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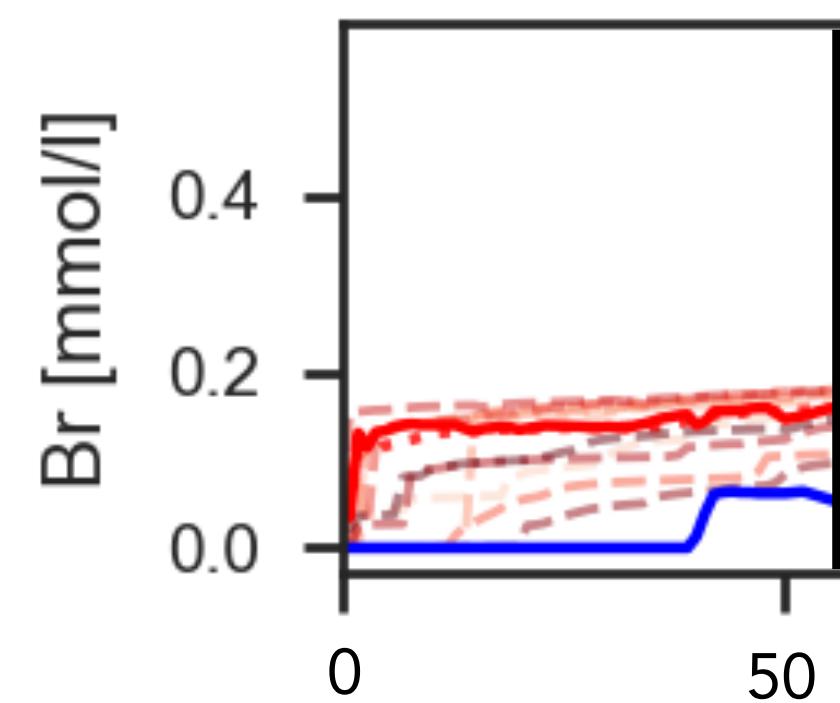


RoGeR-SAS representing advection-dispersion transport by power law distribution function explains the transport of  $^{18}\text{O}$  and bromide in a grassland lysimeter better than other transport hypotheses

# Main findings

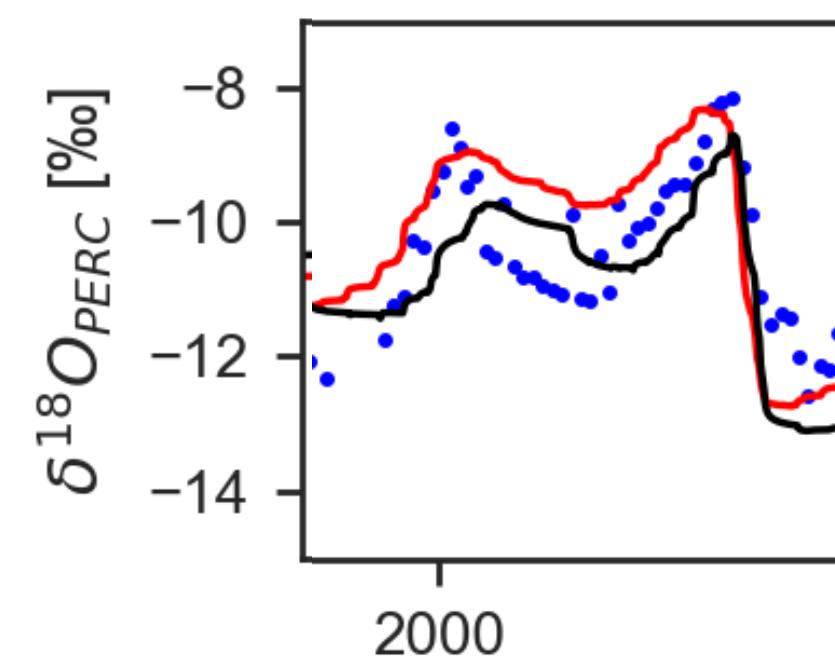


RoGeR-SAS representing advection-dispersion transport by power law distribution function explains the transport of  $^{18}\text{O}$  and bromide in a grassland lysimeter better than other transport hypotheses

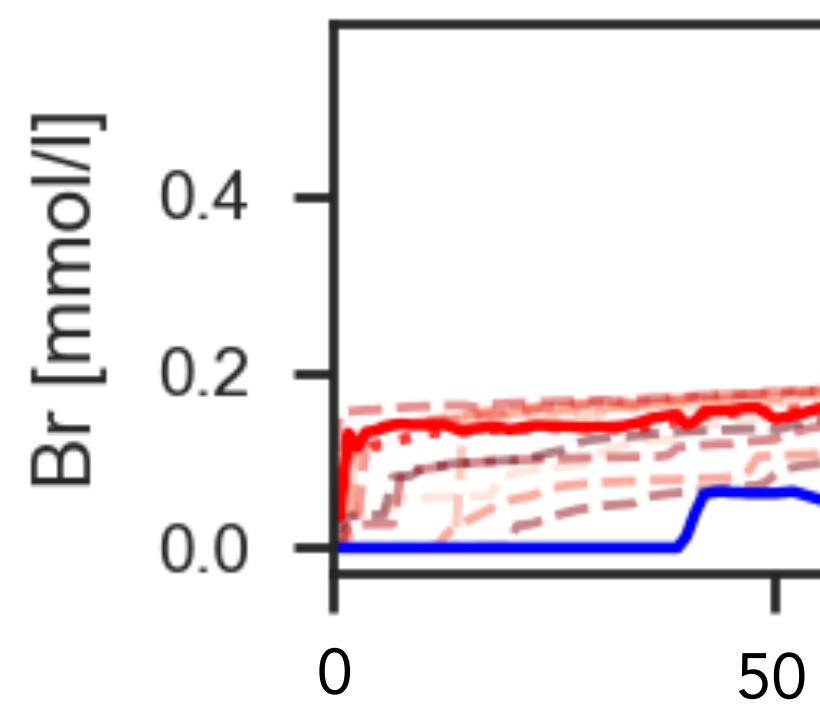


The complete-mixing transport based on uniform SAS functions and a parsimonious vertical discretization may lead to errors in tracer arrival

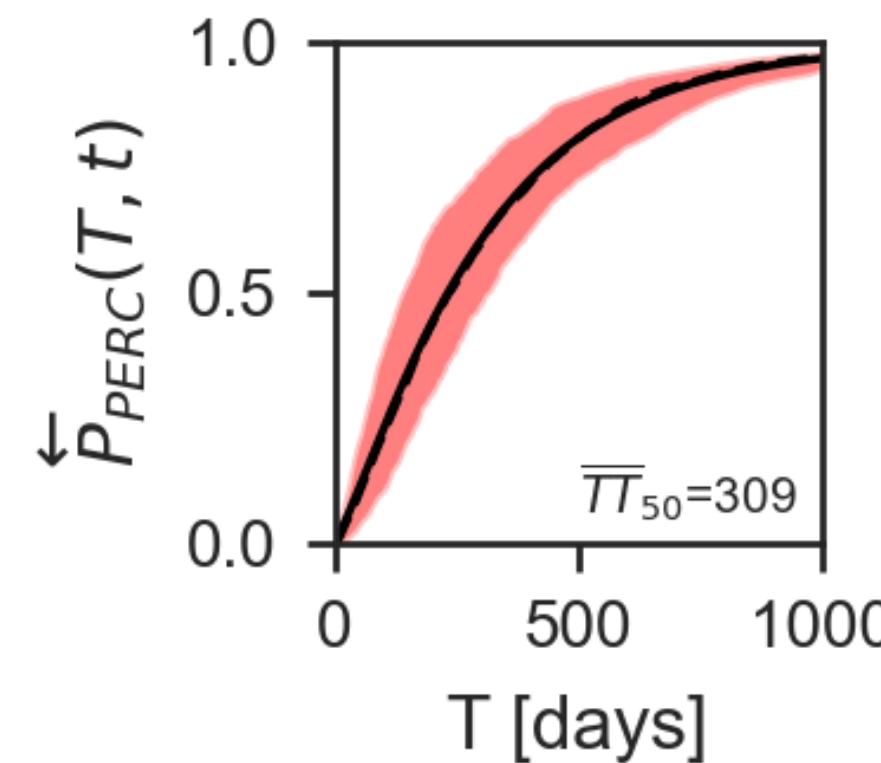
# Main findings



RoGeR-SAS representing advection-dispersion transport by power law distribution function explains the transport of  $^{18}\text{O}$  and bromide in a grassland lysimeter better than other transport hypotheses



The complete-mixing transport based on uniform SAS functions and a parsimonious vertical discretization may lead to errors in tracer arrival



RoGeR-SAS and HYDRUS-1D produce similar results, while RoGeR-SAS improves computation time of travel times significantly

# Entire modelling experiment (Sensitivity analysis, ...)

manuscript submitted to *Water Resources Research*

**ESS OPEN ARCHIVE** <https://www.doi.org/10.22541/essoar.167751575.55537069/v1>

## **Consistent modelling of transport processes and travel times – coupling soil hydrologic processes with StorAge Selection functions**

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# FAIR modelling experiment



<https://roger.readthedocs.io/>

[https://github.com/Hydrology-IFH/roger/examples/plot\\_scale/rietholzbach](https://github.com/Hydrology-IFH/roger/examples/plot_scale/rietholzbach)



<https://pypi.org/project/roger>



<https://doi.org/10.5281/zenodo.7633362>

<https://doi.org/10.5281/zenodo.7632281>

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