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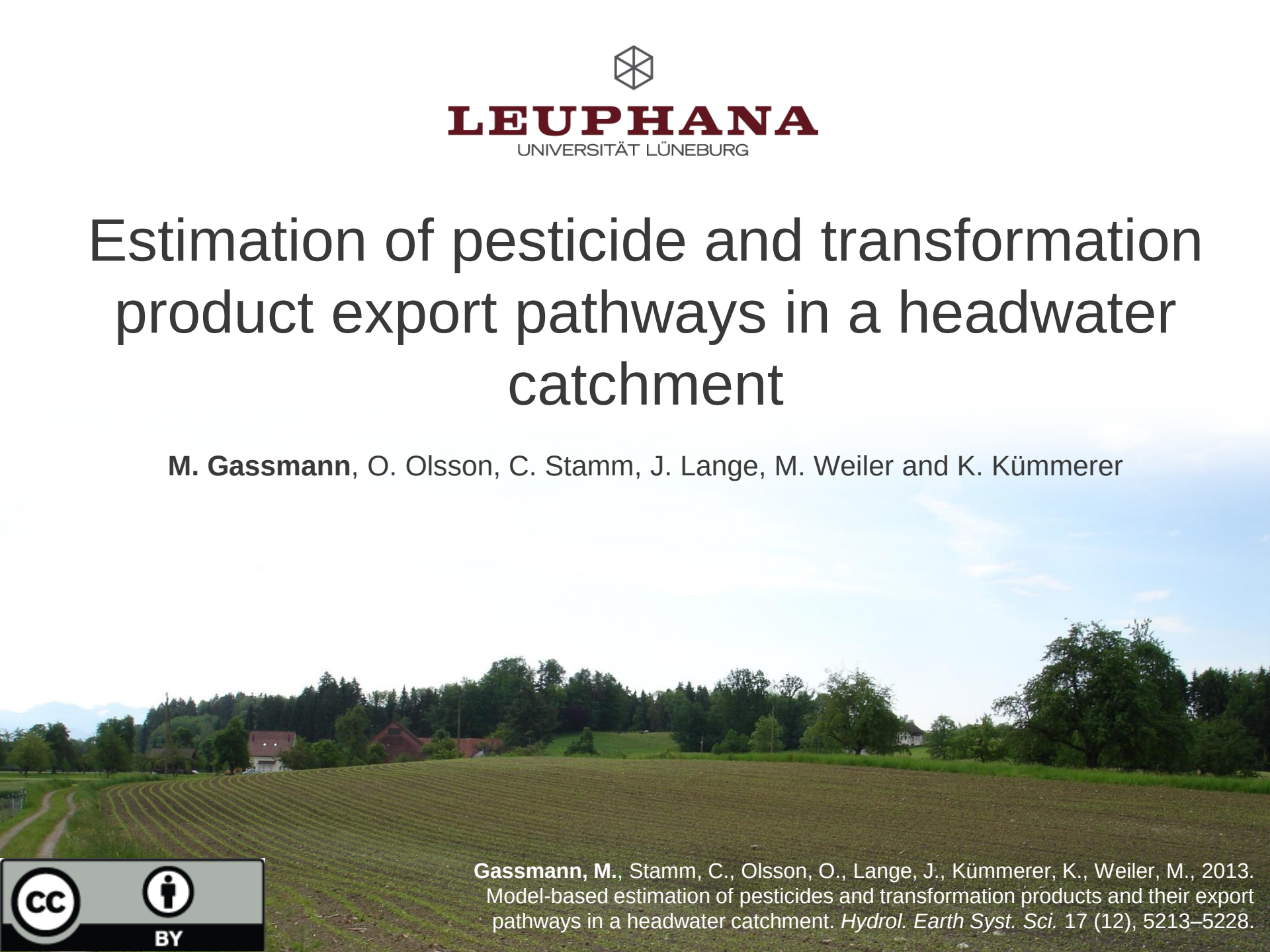
Estimation of pesticide and transformation product export pathways in a headwater catchment

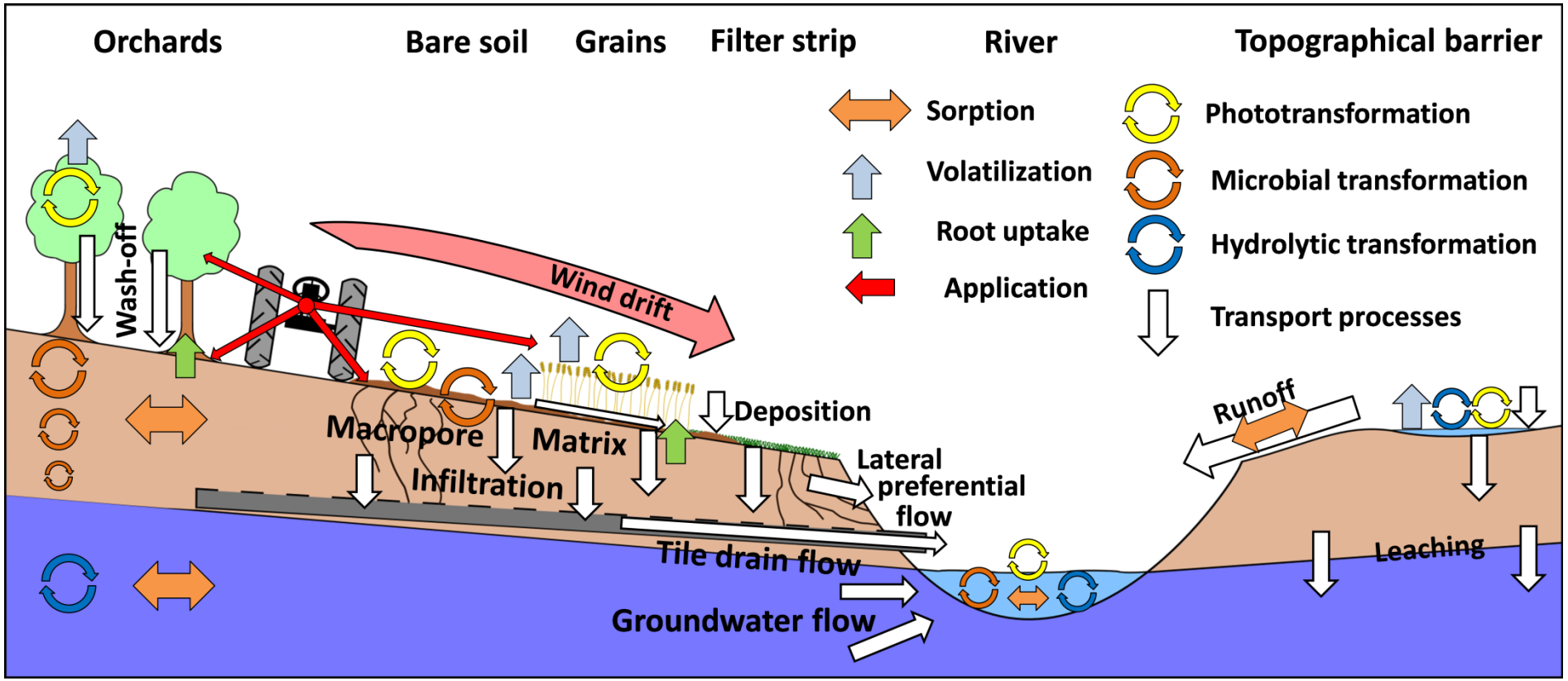
M. Gassmann, O. Olsson, C. Stamm, J. Lange, M. Weiler and K. Kümmerer



Gassmann, M., Stamm, C., Olsson, O., Lange, J., Kümmerer, K., Weiler, M., 2013. Model-based estimation of pesticides and transformation products and their export pathways in a headwater catchment. *Hydrol. Earth Syst. Sci.* 17 (12), 5213–5228.

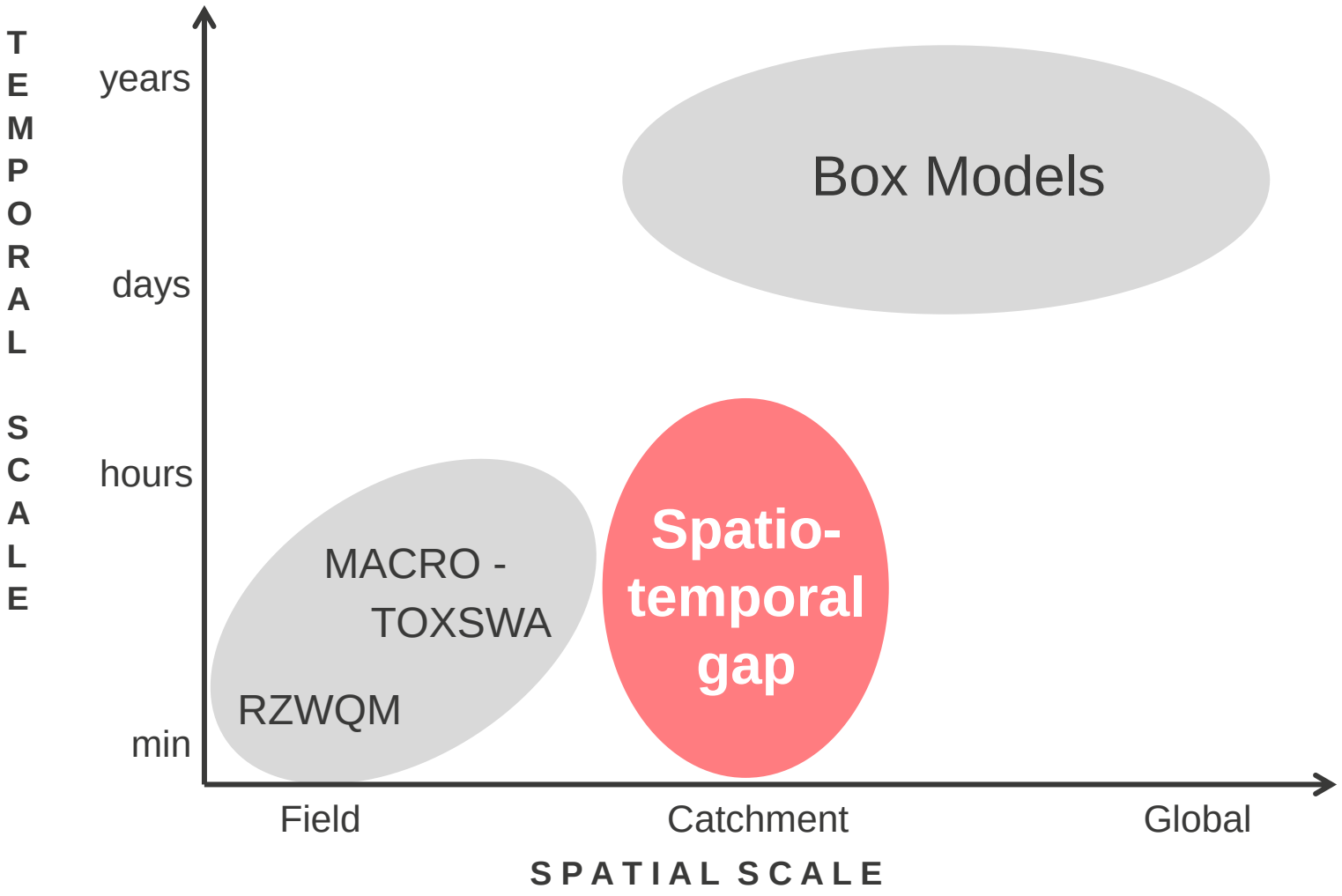
Environmental fate processes: Hypothesis

Export pathways of pesticides and their transformation products are generally different

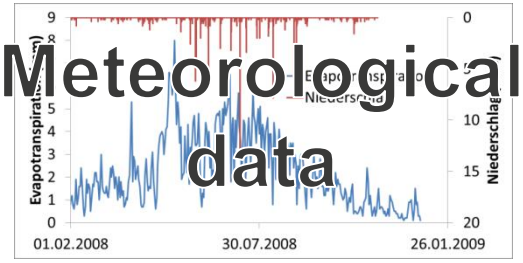


(Gaßmann, 2013)

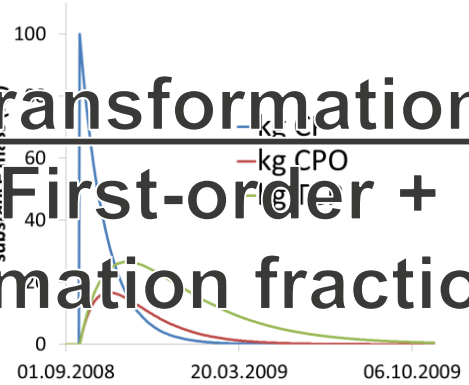
Research Gaps – Pesticide and TP models



ZIN-AgriTra: Reactive transport model at catchment scale

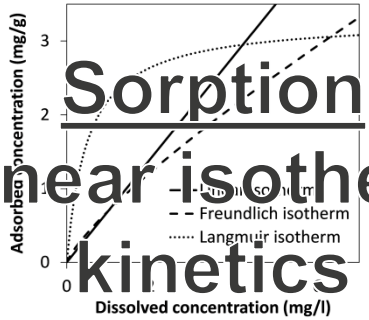


Meteorological data



Transformation

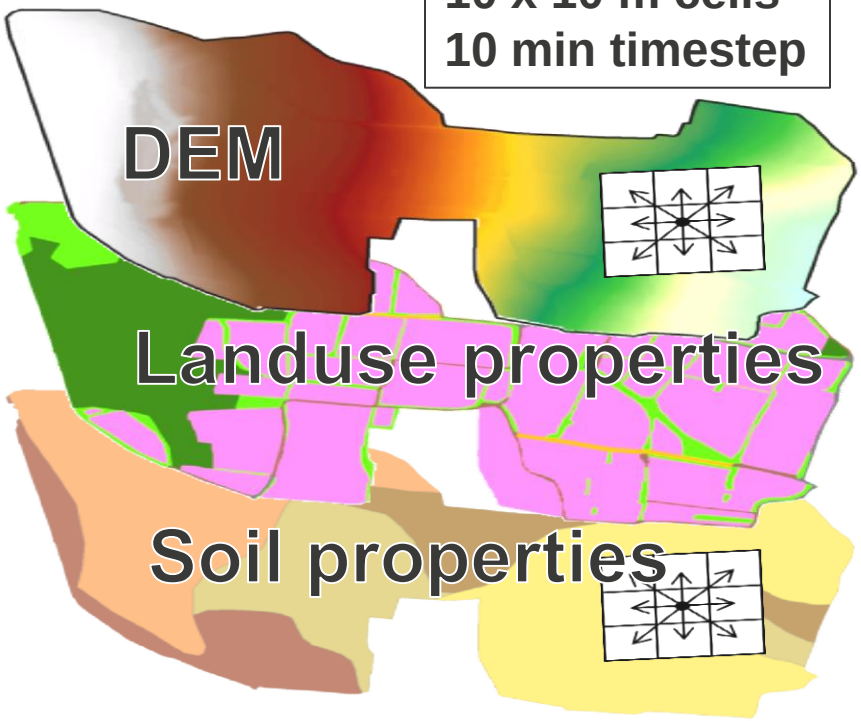
First-order + formation fraction



Sorption

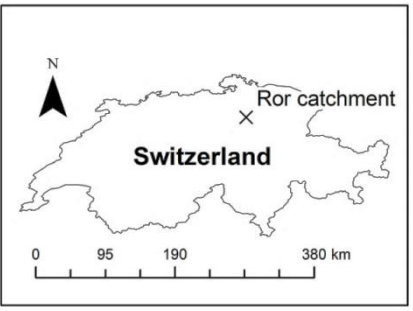
Linear isotherm + kinetics

10 x 10 m cells
10 min timestep



Discharge
Pesticide concentrations
TP concentrations

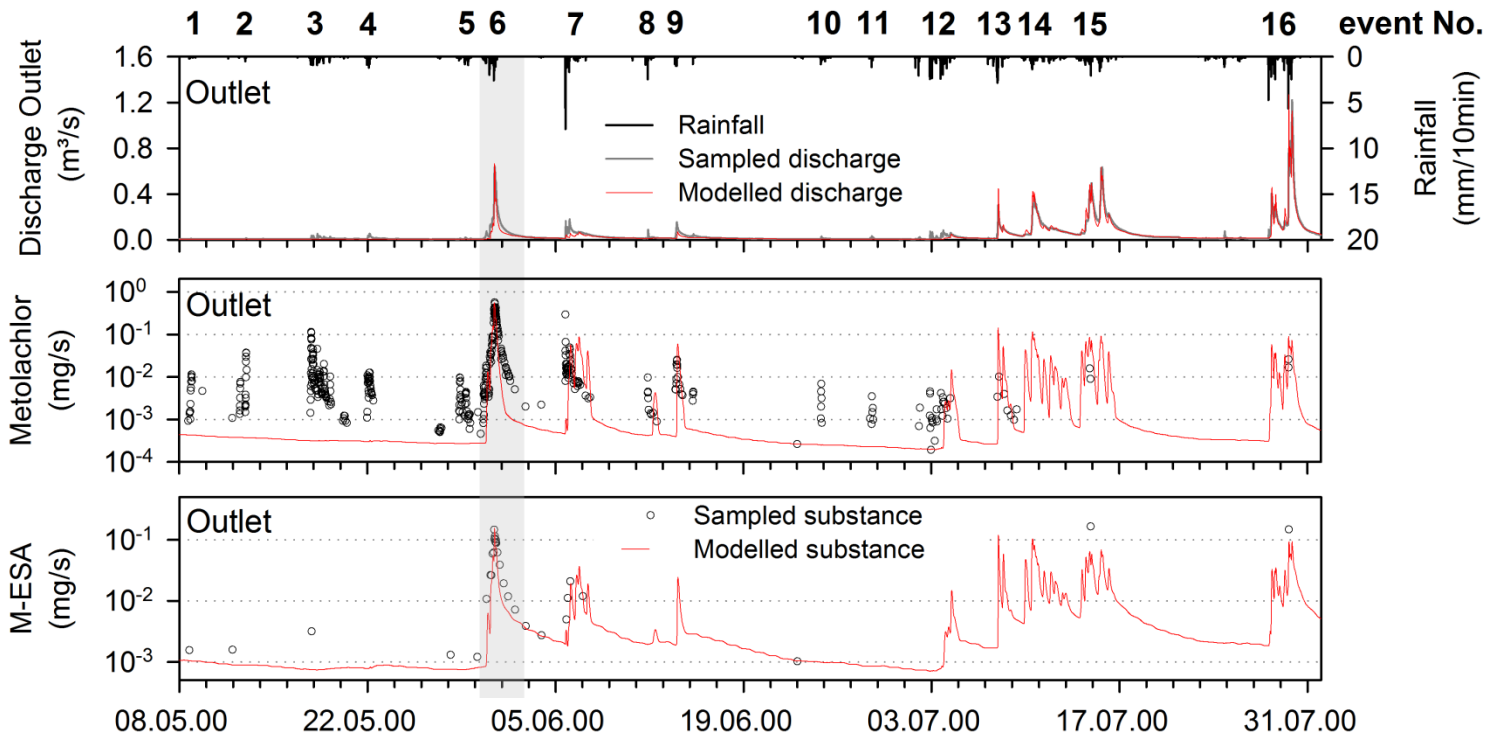
The Ror catchment (2 km²)



Herbicide	TP
Dimethenamid	D-OXA
Metolachlor	M-ESA
Atrazine	DEA

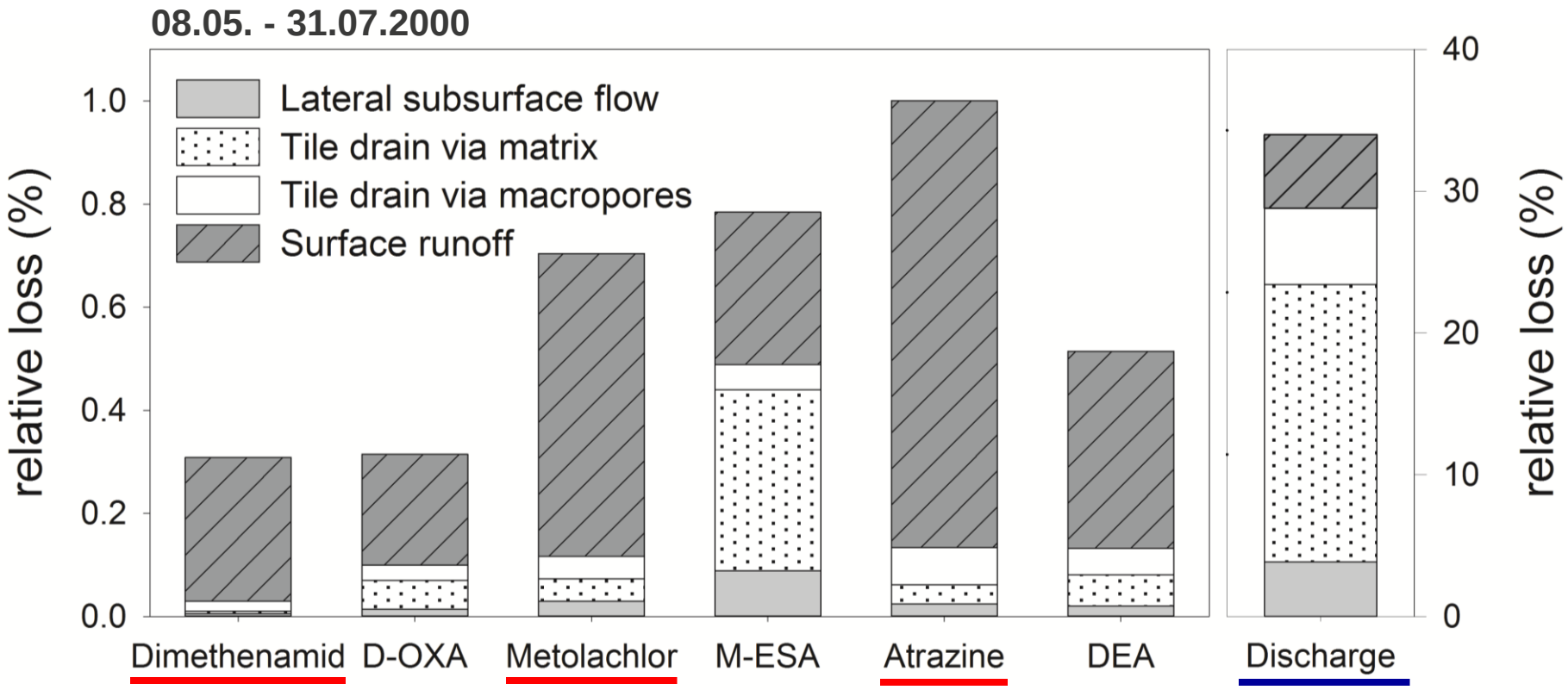
Sampling data from pesticide application experiment by Leu et al. (2004)

Model Performance

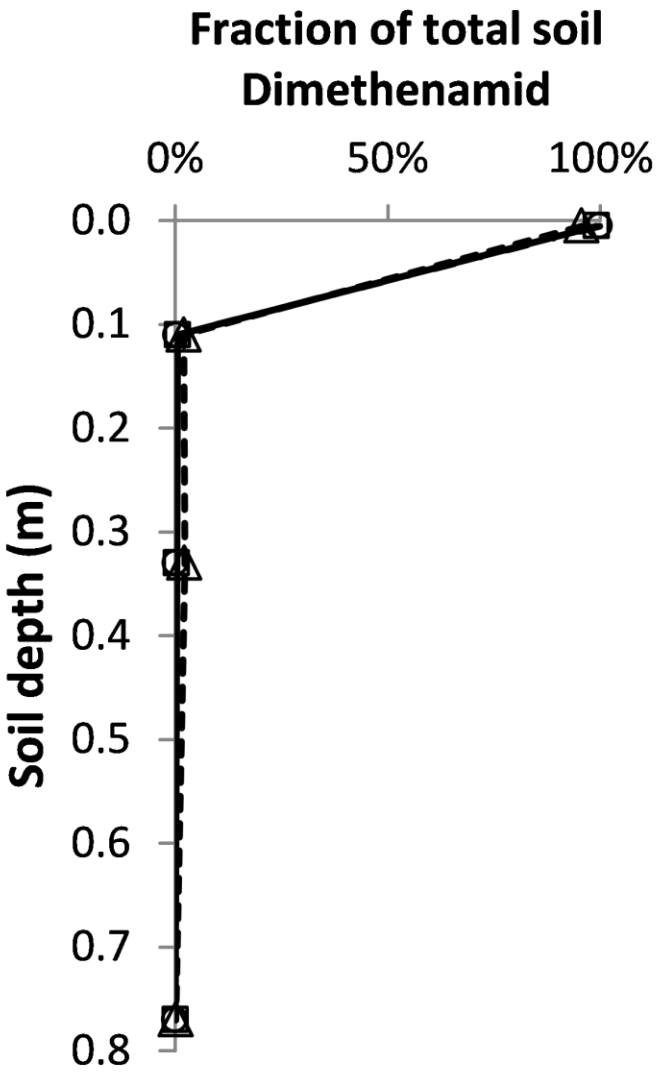


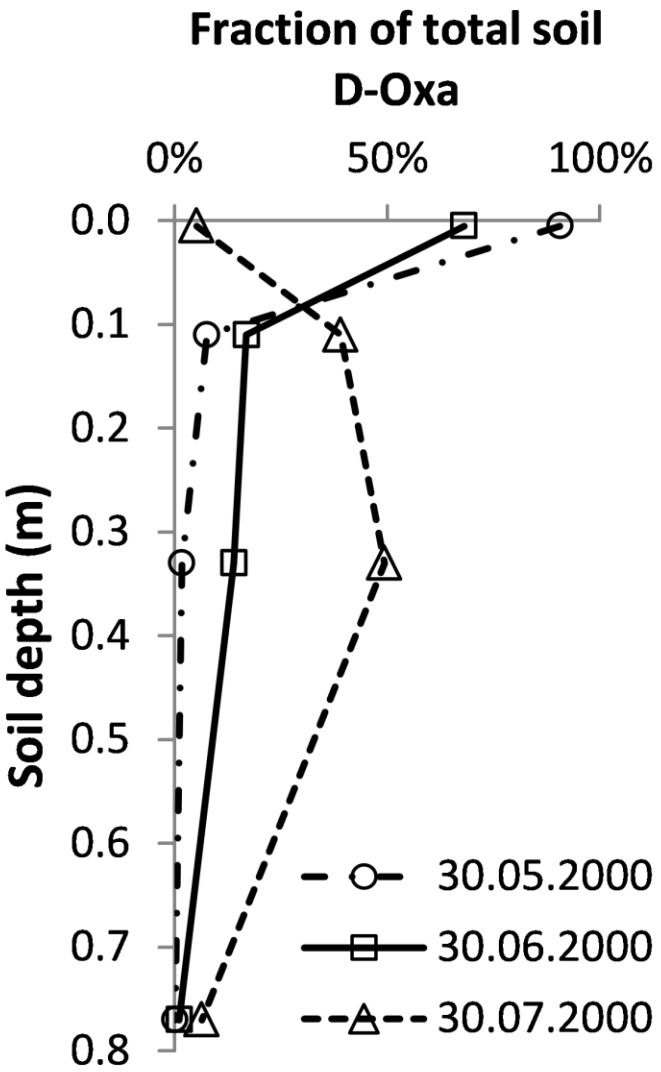
		Outlet		Eastern subbasin		Southern subbasin	
Substance	**unit**	**N_{eff}**	**RMSE**	**N_{eff}**	**RMSE**	**N_{eff}**	**RMSE**
Discharge	m³/s	0.93	0.022	0.80	0.015	0.77	0.019
Metolachlor	mg/s	0.76	0.046	-0.09	0.002	0.73	0.035
Meto-ESA	mg/s	0.69	0.028	0.25	0.004	-	-

Export processes

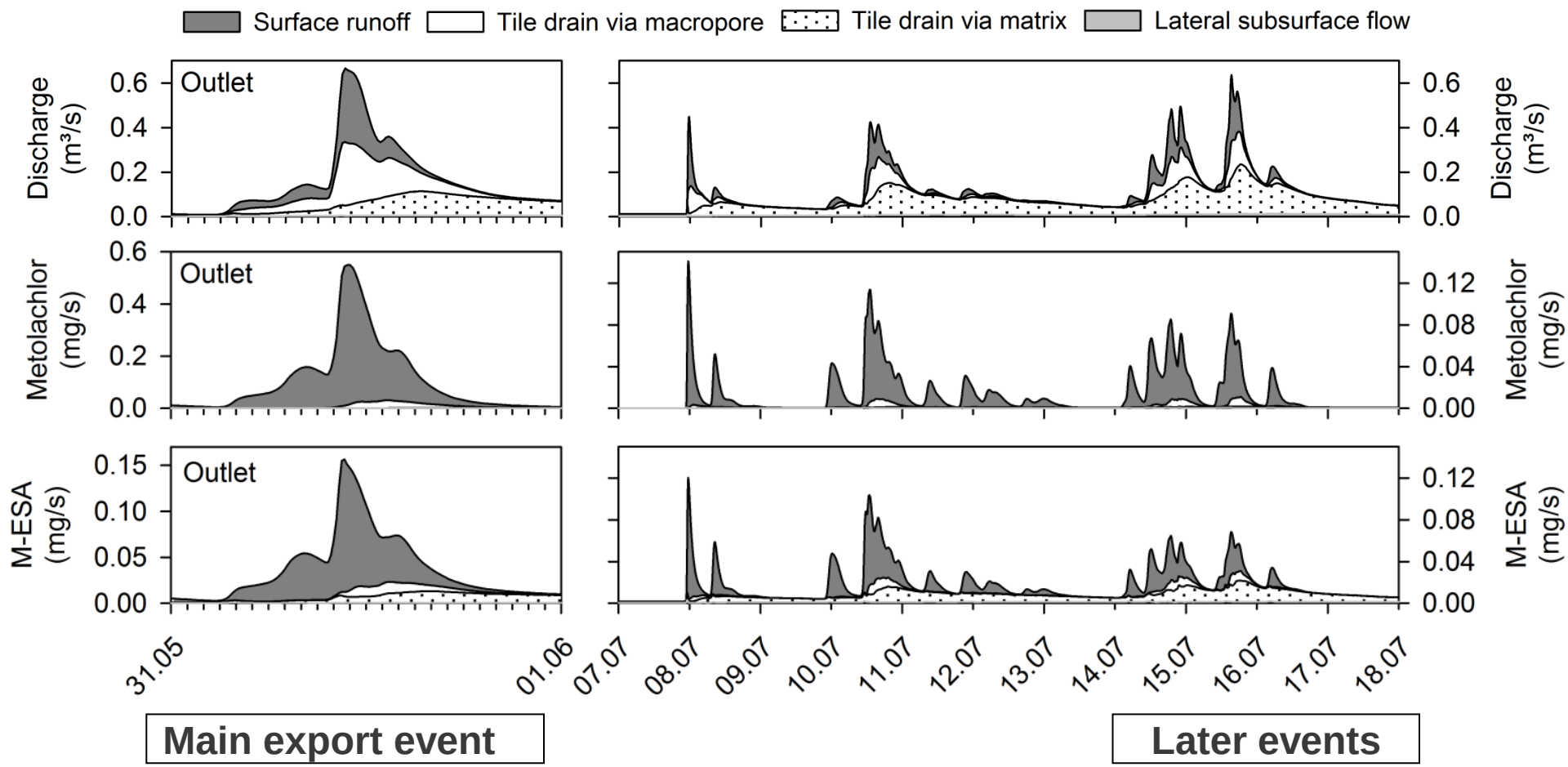


Behaviour in the soil matrix





Pathway timeseries

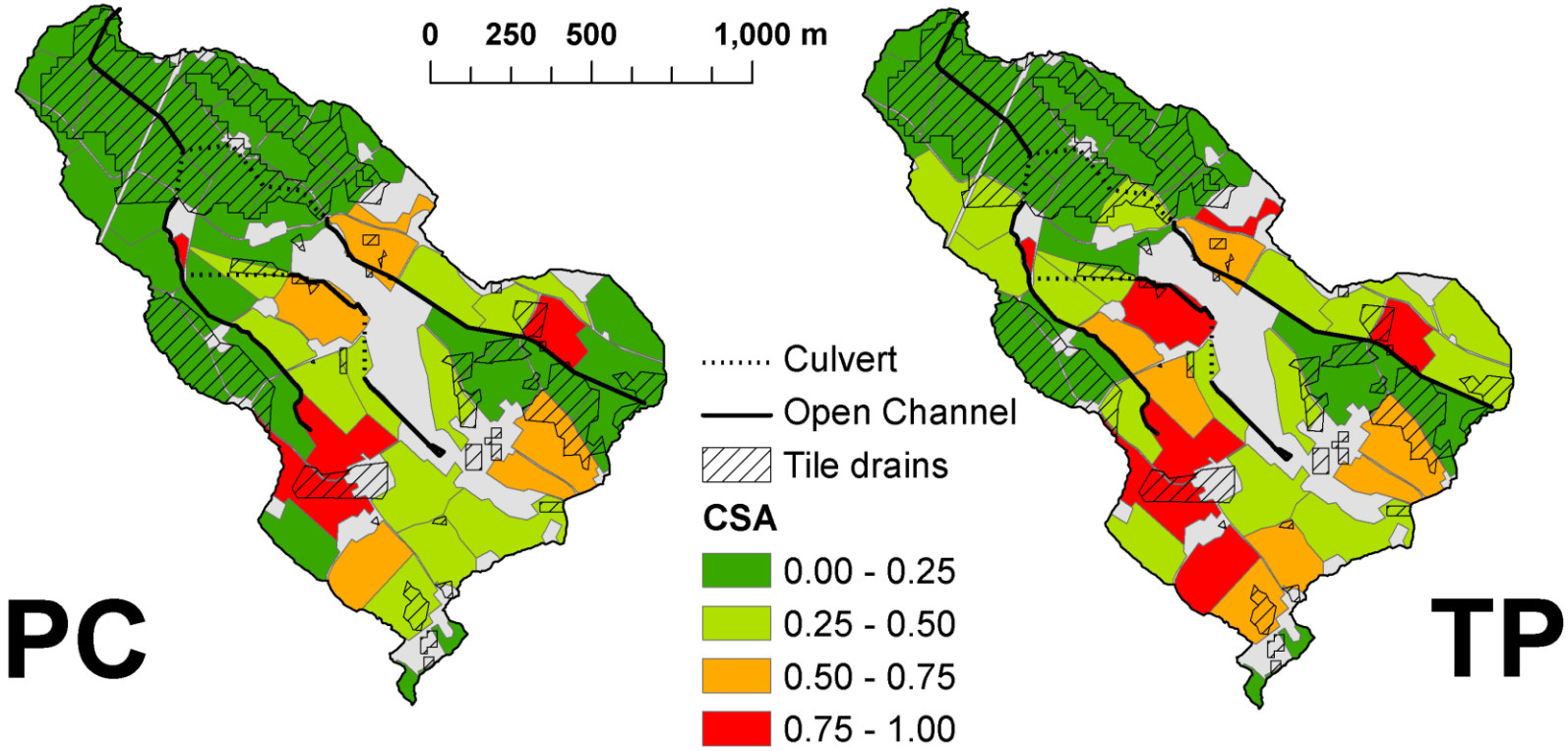


Critical Source Areas – a virtual experimental study

	Pesticide			
	unit	1	2	3	4
DT50	days	15	30	15	30
K_{OC}	ml/g	10	10	100	100

12 pairs

	TP			
	unit	a)	b)	c)	d)
DT50	days	30	60	30	60
K_{OC}	ml/g	10	10	100	100



Conclusions

- Export pathways of pesticides and transformation products are generally different
- Not only fate characteristics but also the delayed formation of TPs is important
- As a result, critical source areas may also be different

→TPs have to be considered explicitly in pesticide residue export risk assessment

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