



Towards multifunctional agricultural landscapes in Europe

SWAT as a key to assess synergies and trade-offs between ecosystem services and biodiversity



Michael Strauch, Anne Jungandreas, Felix Witing, Christoph Schürz, Martin Volk

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SESSION G3:
ENVIRONMENTAL APPLICATIONS

 **HELMHOLTZ**
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TALE project

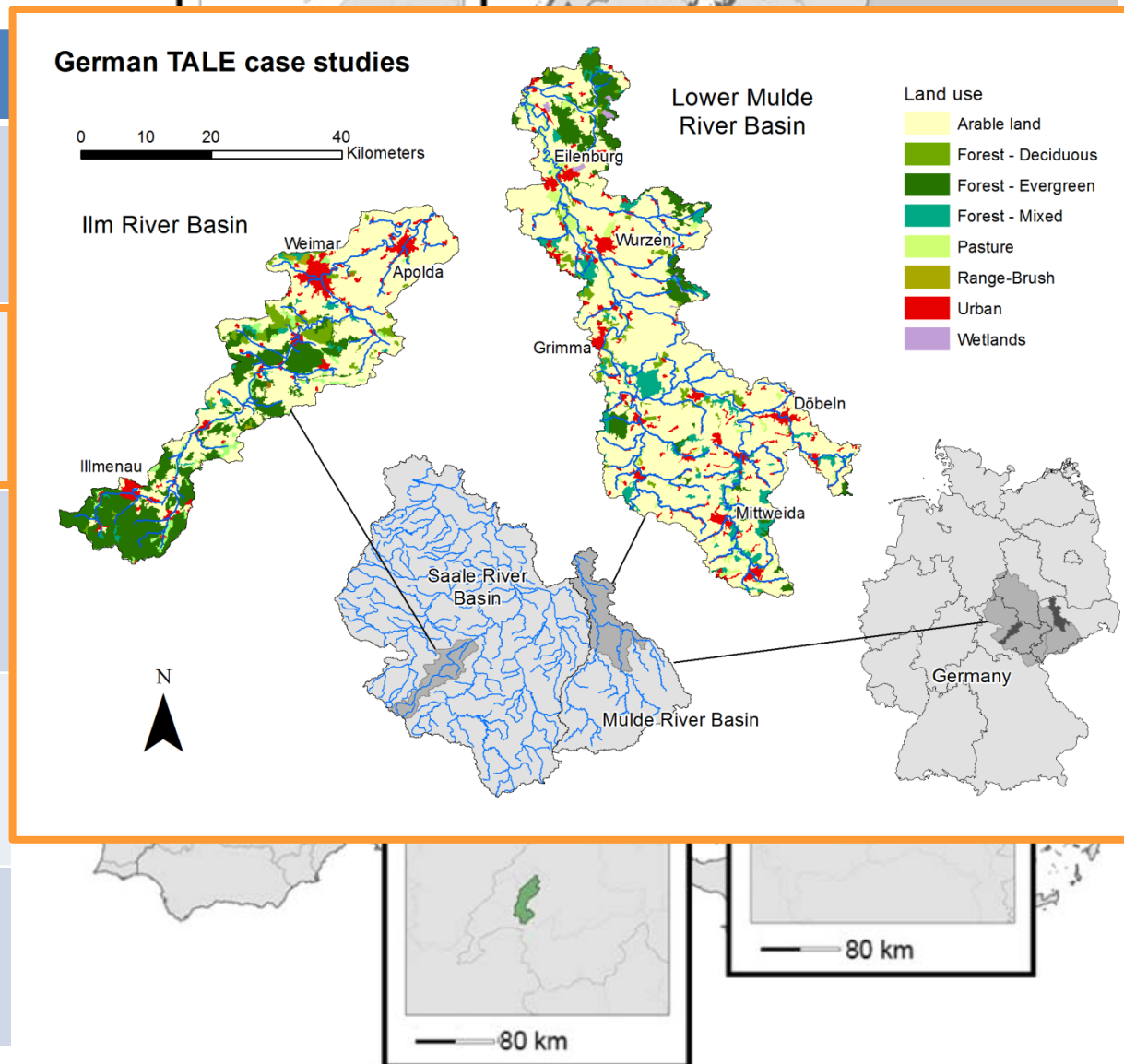
Main objectives

- **Disentangle** and **quantify** the multifaceted links between **agricultural production, biodiversity** and **ecosystem services (ESS)** in different European landscapes
- Develop & recommend **land use strategies** and **policy instruments** that minimize the trade-offs between biodiversity and ESS in each region.
- Provide a **learning environment** that supports the design and evaluation of policy options that can help to reconcile conflicting demands

TALE project

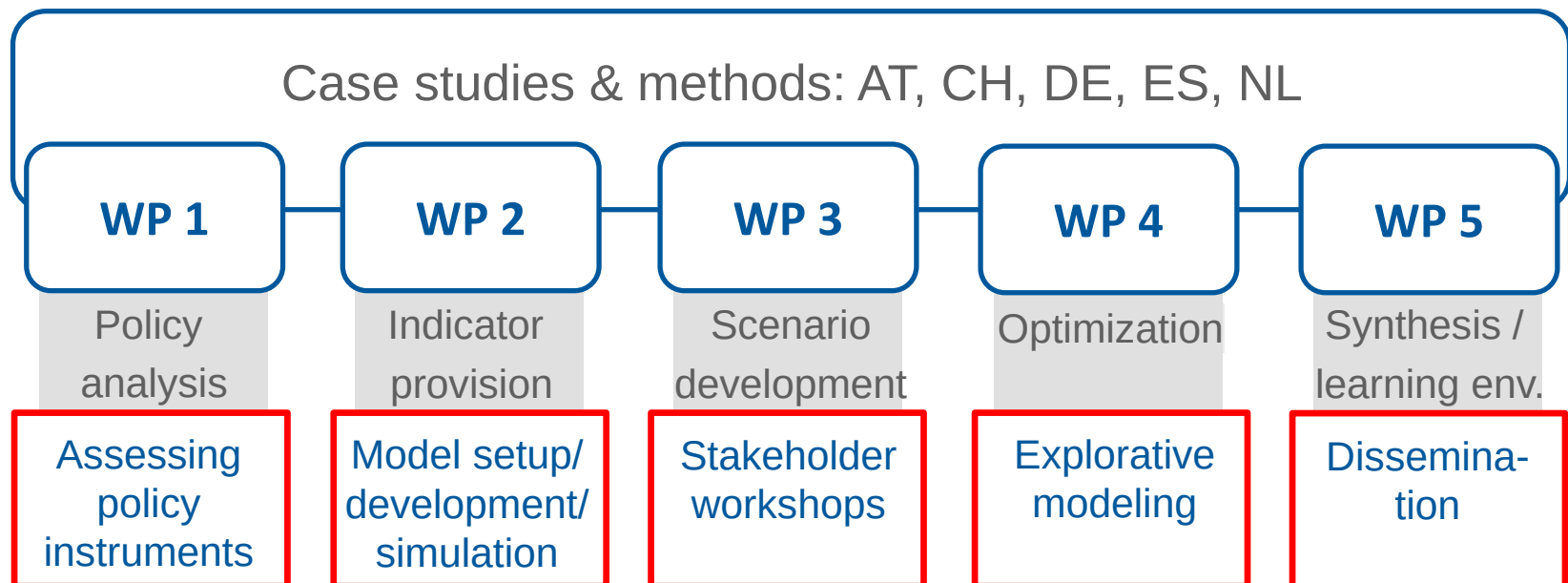
Case studies

Case study	Country
Broye catchment (598 km ²)	Switzerland
Sub-catchments of Saale and Mulde (904 and 1,611 km ²)	Germany
Kromme Rijn (219 km ²)	Netherlands
Cega-Eresma-Adaja region (7888 km ²)	Spain
Mostviertel region (19 and 20 km ²)	Austria



TALE project

Approach and methods



TALE project

Parameter	Fühher	Haupt	LGA	LSP	LSH
Siedlung/Verkehr	10.1	12.5	10	10.9	
Ackerland	53.9	49.1	58	52	
Dauerkulturen/Streuobst	0.8	0.3	1.5	0.8	
Wald	19.6	22	25	22	
Grünland - intensiv	6.8	6.8	5	0	
Grünland - extensiv	7	7	8	13.8	
Fauchtgebiete	0.1	0.1	0.1	0.1	
Vegetationslos (z.B. Tagebau)	0.4	0.4	0.4	0.4	
Schutzgebiete	48.5	48.5	51.5	48.5	
Naturschutzfachlich hochwertige Agrarflächen					
Landnutzungsfruchtarten:					
Wintergerste	15.6	15.6	8	17	
Winterroggen	3.1	3.1	0	5	
Winterweizen	36.1	41.1	41.5	41	
Wintererbsen	22.6	18	27.5	5	
Maïs	14	16.5	19	20	
Zuckerrübe	2.3	2.3	5	1	
Sommergerste	1.4	1.4	0	1	
Ackergras	3.8	2	0	6	
Alfalfa	1.1	0	0	4	
Bodenbearbeitung:					
konventionell	40	30	40	0	
konstrierend	60	70	60	100	
Grundfrucht	0.4	0.8	0	5	
Bioanbau	4	5	0	20	
Düngereinsatz auf Acker:					
N	151	140	166	100	
P	43	40	47	40	

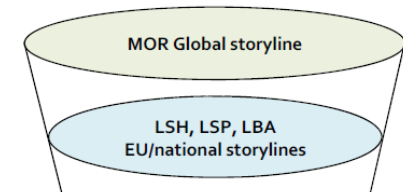
Current work

Scenario development (stakeholder discussion)



Scenarios

Constraints



Common storylines
for land sharing (LSH),
land sparing (LSP)
and business as usual (BAU)

Simulation

SWAT

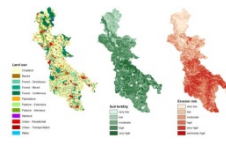
crop yield, runoff, water quality

Biodiversity model

bird species distribution

Result

Impact of LSH, LSP and BAU
on ESS and biodiversity



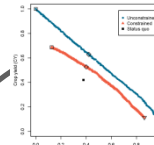
Explorative modelling

CoMOLA

Linking **SWAT**,
biodiversity model with
NSGAI

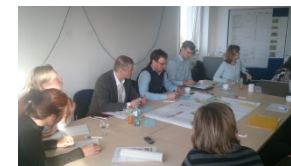
Result

Landscape potential
(Trade-off curves)

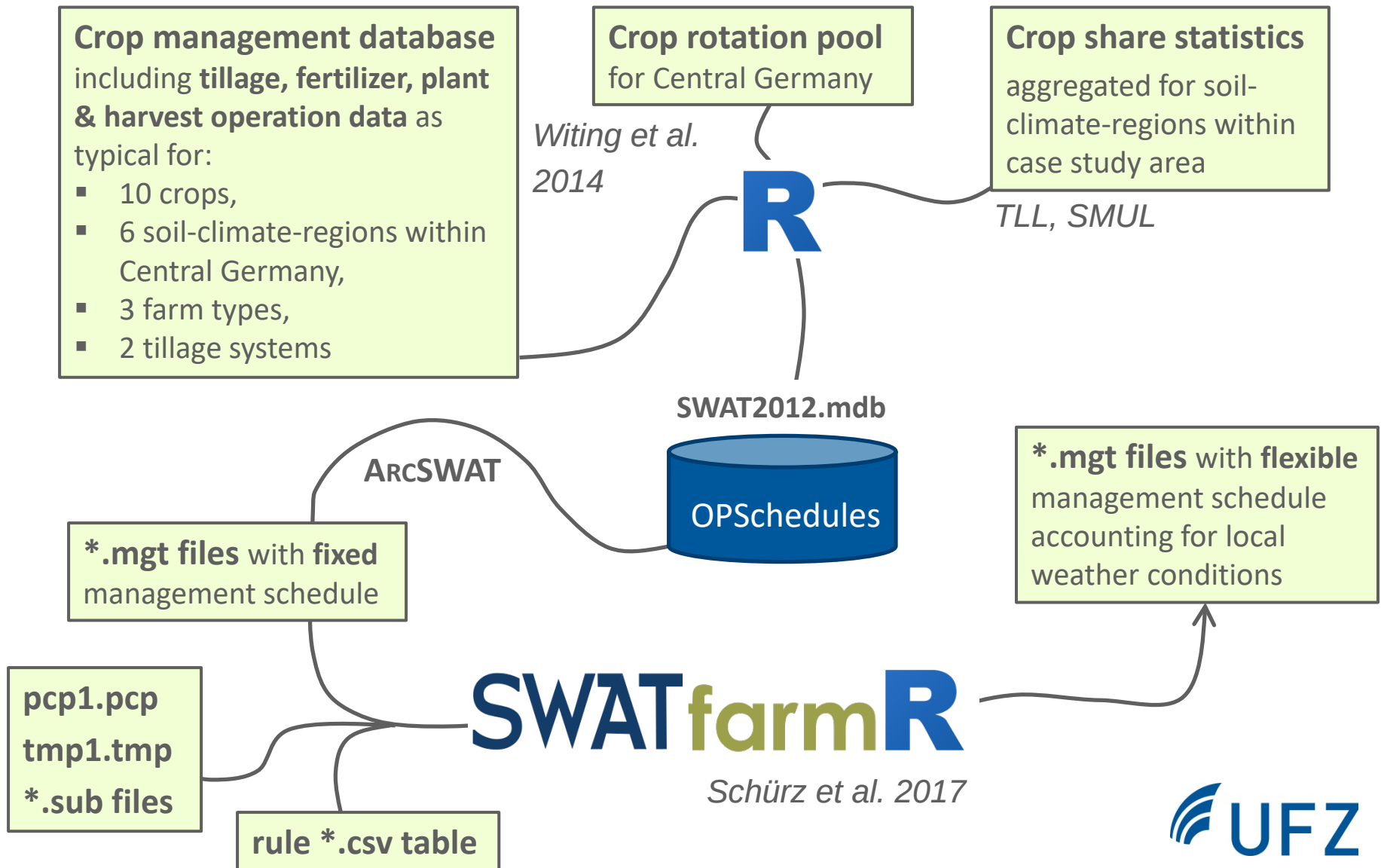


Comparison:

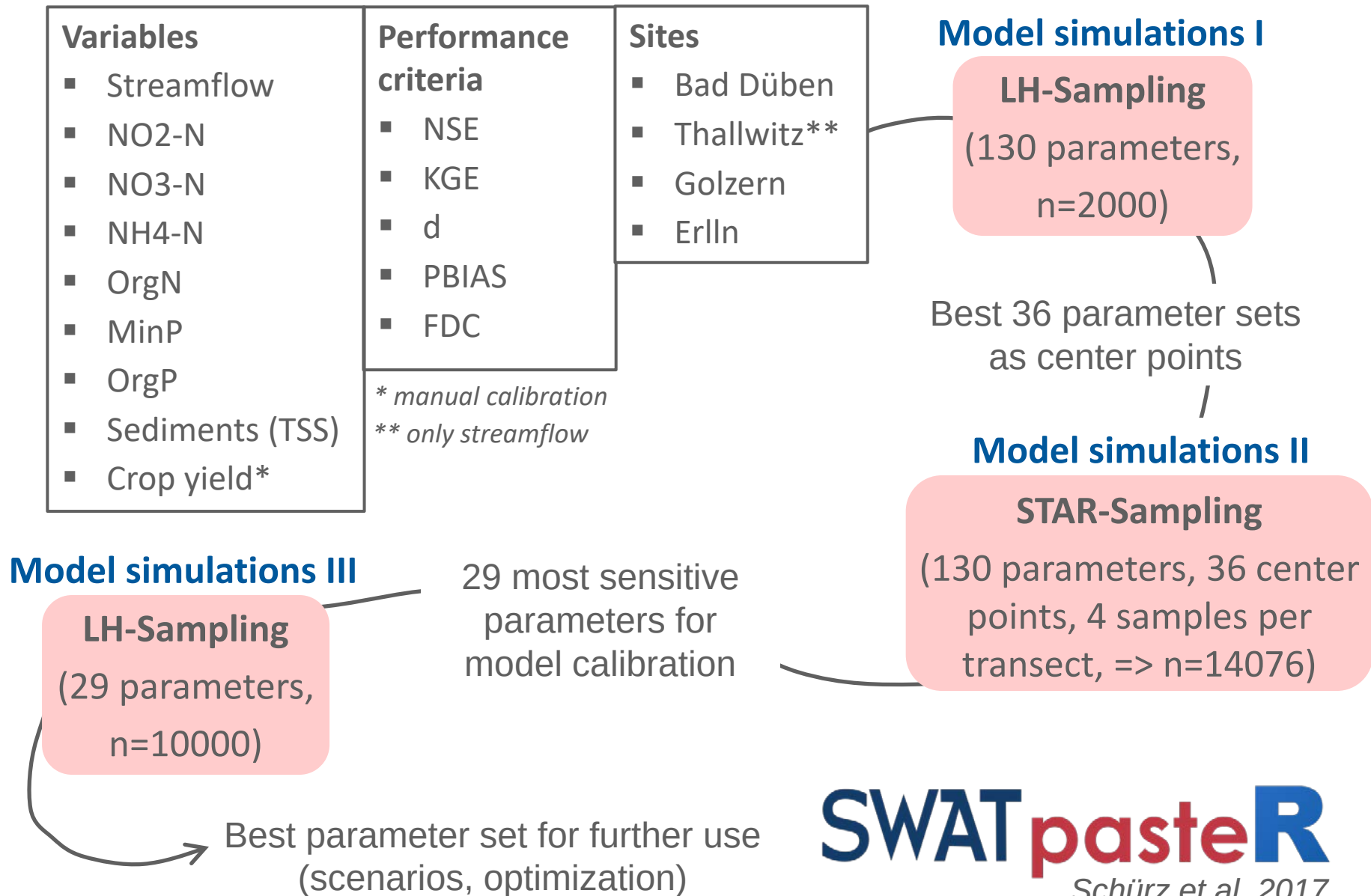
Where can we be more
efficient with measures?



SWAT challenge 1: Agricultural management (German case)



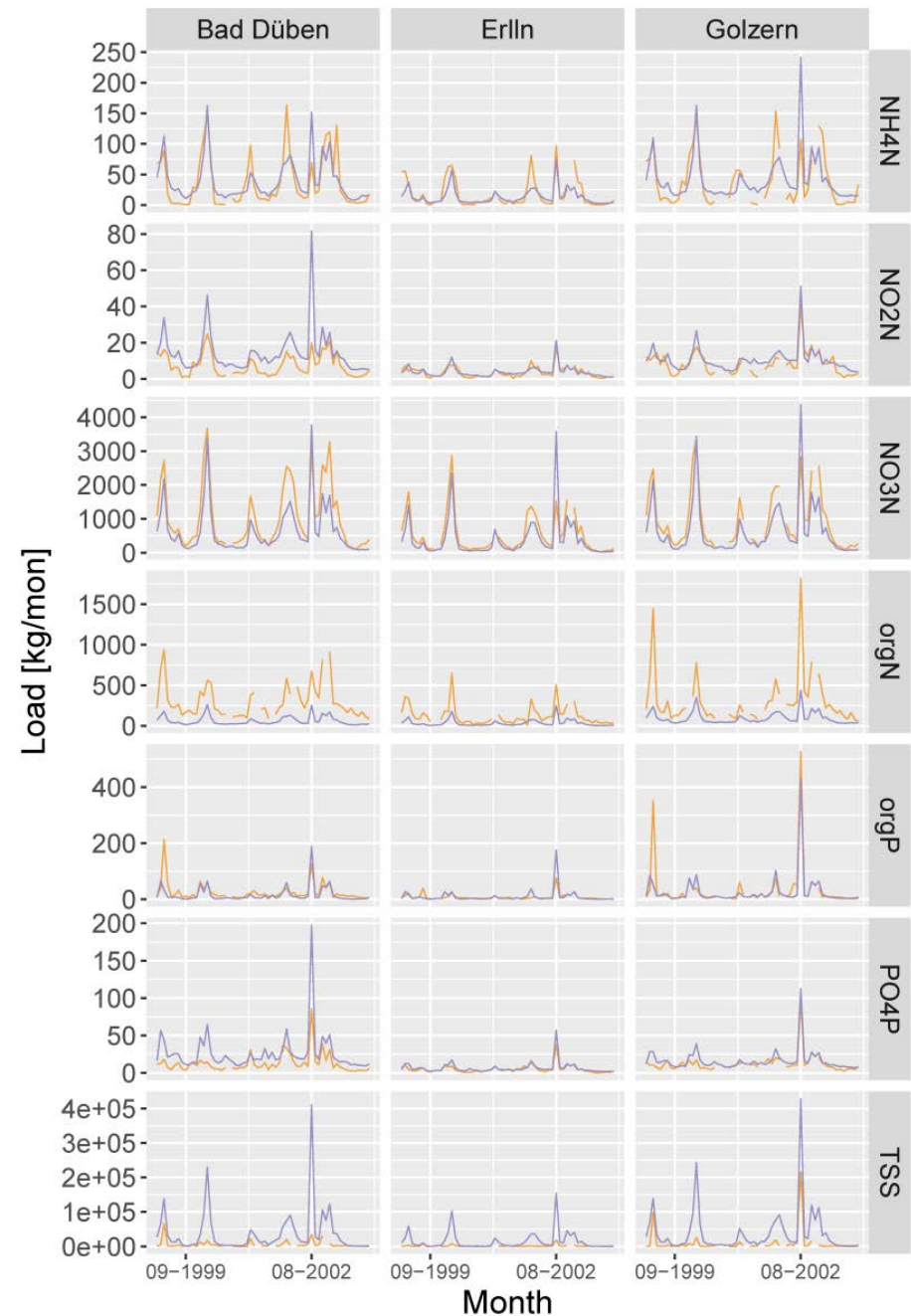
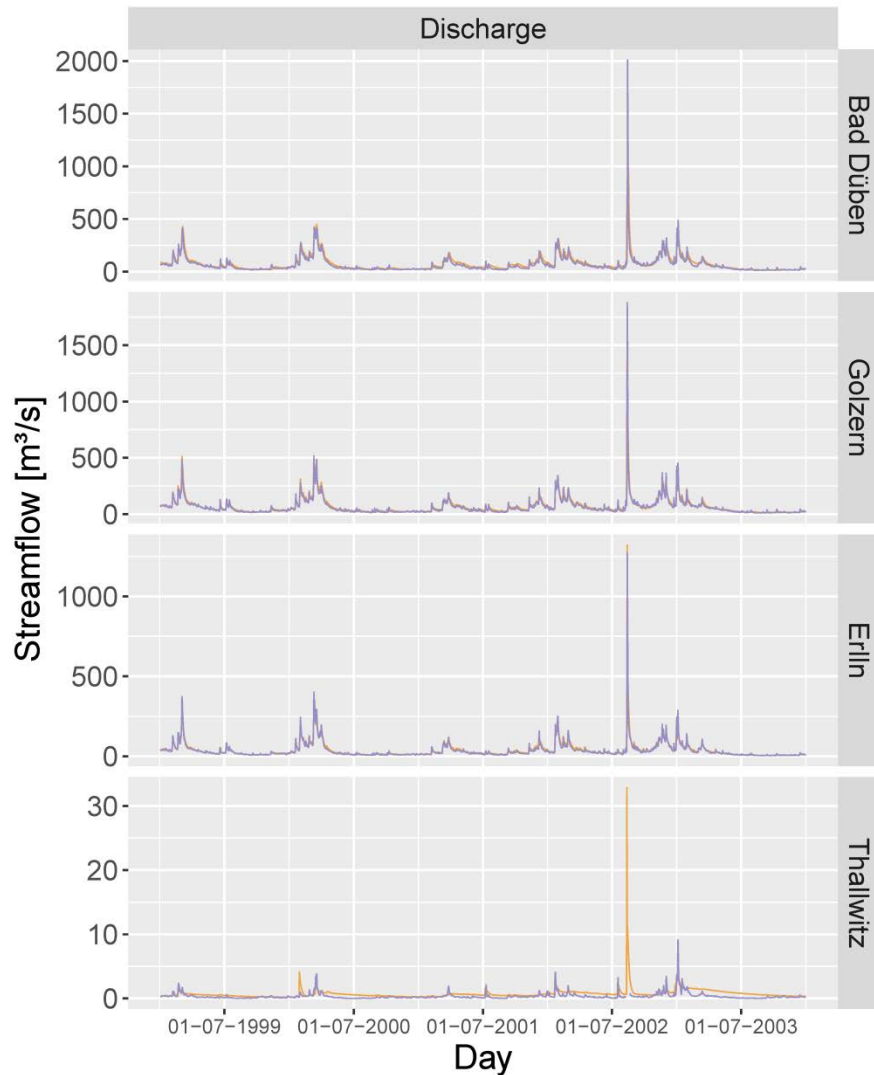
SWAT challenge 2: Multi-factor calibration (German case)



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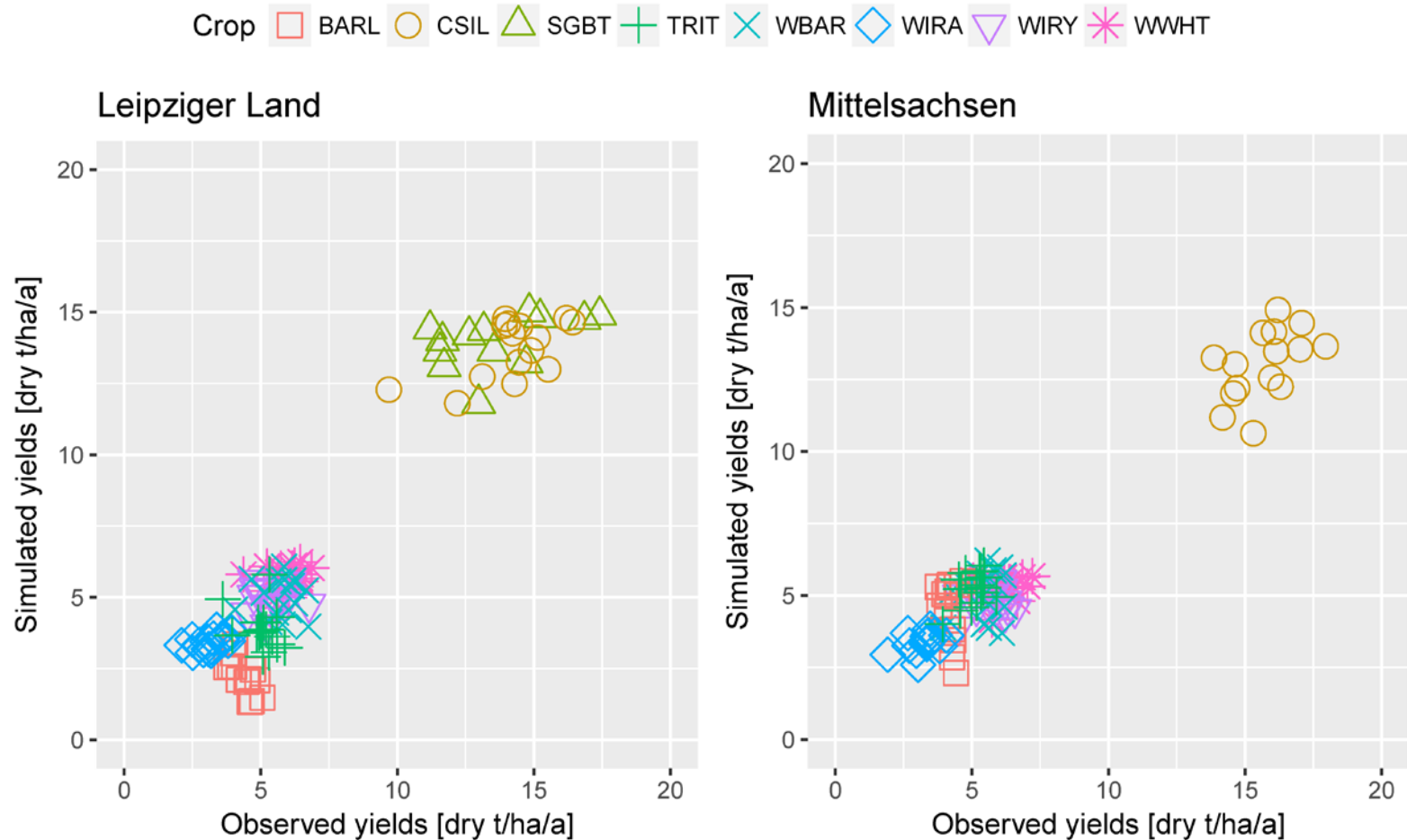
Lower Mulde Basin (preliminary results)

— SWAT
— observed



SWAT challenge 2: Multi-factor calibration (German case)

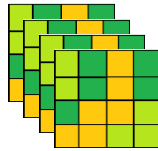
Lower Mulde Basin (preliminary results)



Biodiversity challenge: Predicting suitable habitats for birds

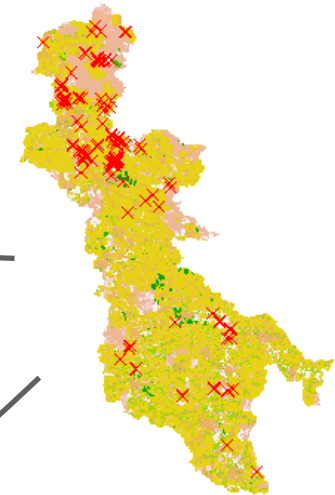
Single species niche models (RandomForest):

27 Predictors (Land use, linear landscape elements, distance parameters, climate, soil parameters)



dropping non-relevant predictors

Occurrence data (example: whinchat)

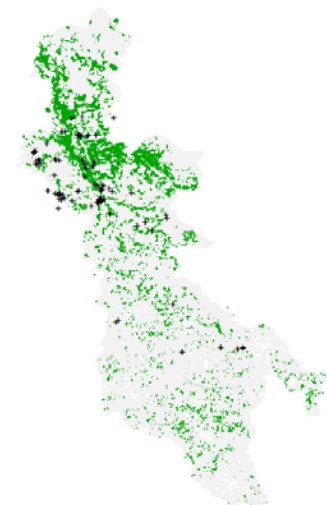


Selected predictor set for species



Model

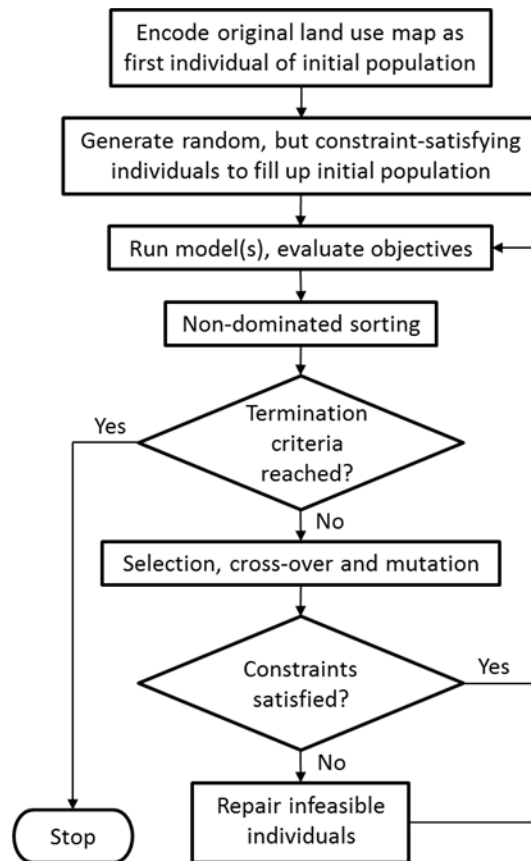
Prediction of suitable habitats:



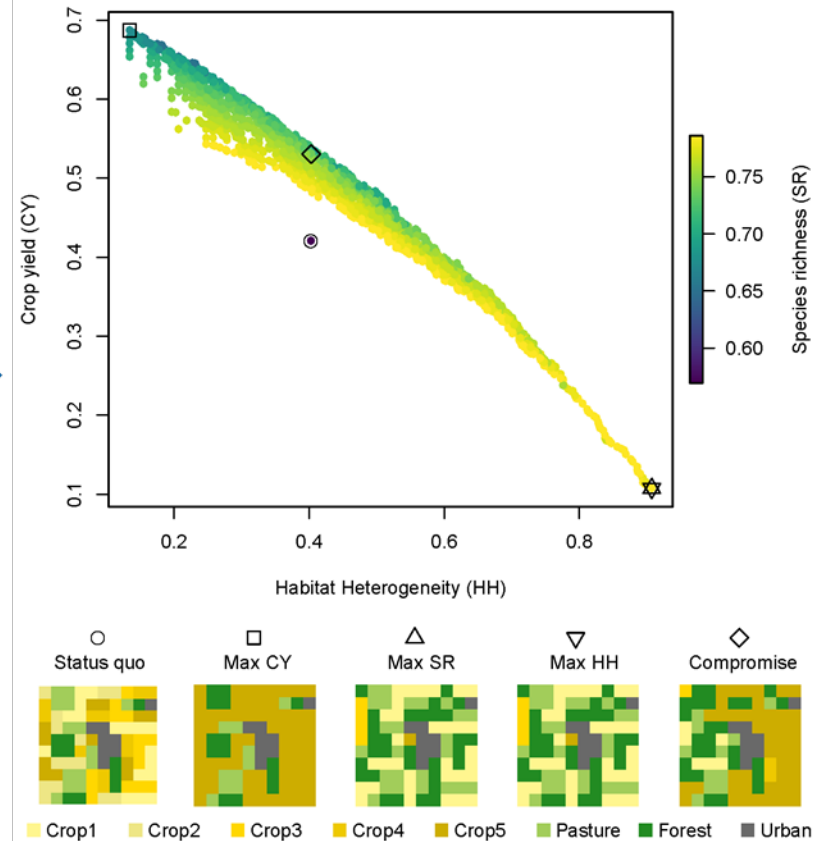
Land use optimization challenge

CoMOLA

A tool for
**Constrained
Multi-objective
Optimization of
Land use
Allocation**



Exemplary test results using simple R models and a virtual landscape:



SWAT and biodiversity models coupled with a genetic algorithm will be used to explore the Pareto-optimality of possible land use configurations for multiple objectives under consideration of land use change constraints

Conclusions

- **TALE** is **full of** interesting **challenges**
- TALE is on a good way to **identify Pareto-optimal land use configurations** for **agricultural production, biodiversity** and **ecosystem services**
- ...to discuss and **recommend land use strategies** and **policy instruments** towards more multifunctionality in agricultural landscapes

Thank you

