

A green tractor with a red implement is working in a cornfield. The tractor is moving from right to left, leaving a trail of tilled soil behind it. The corn plants are in the foreground and middle ground, and the background shows a vast green field under a clear blue sky.

Changing land management practices during model calibration and evaluation periods – importance, impact and interpretation

Antje Ullrich, Martin Volk

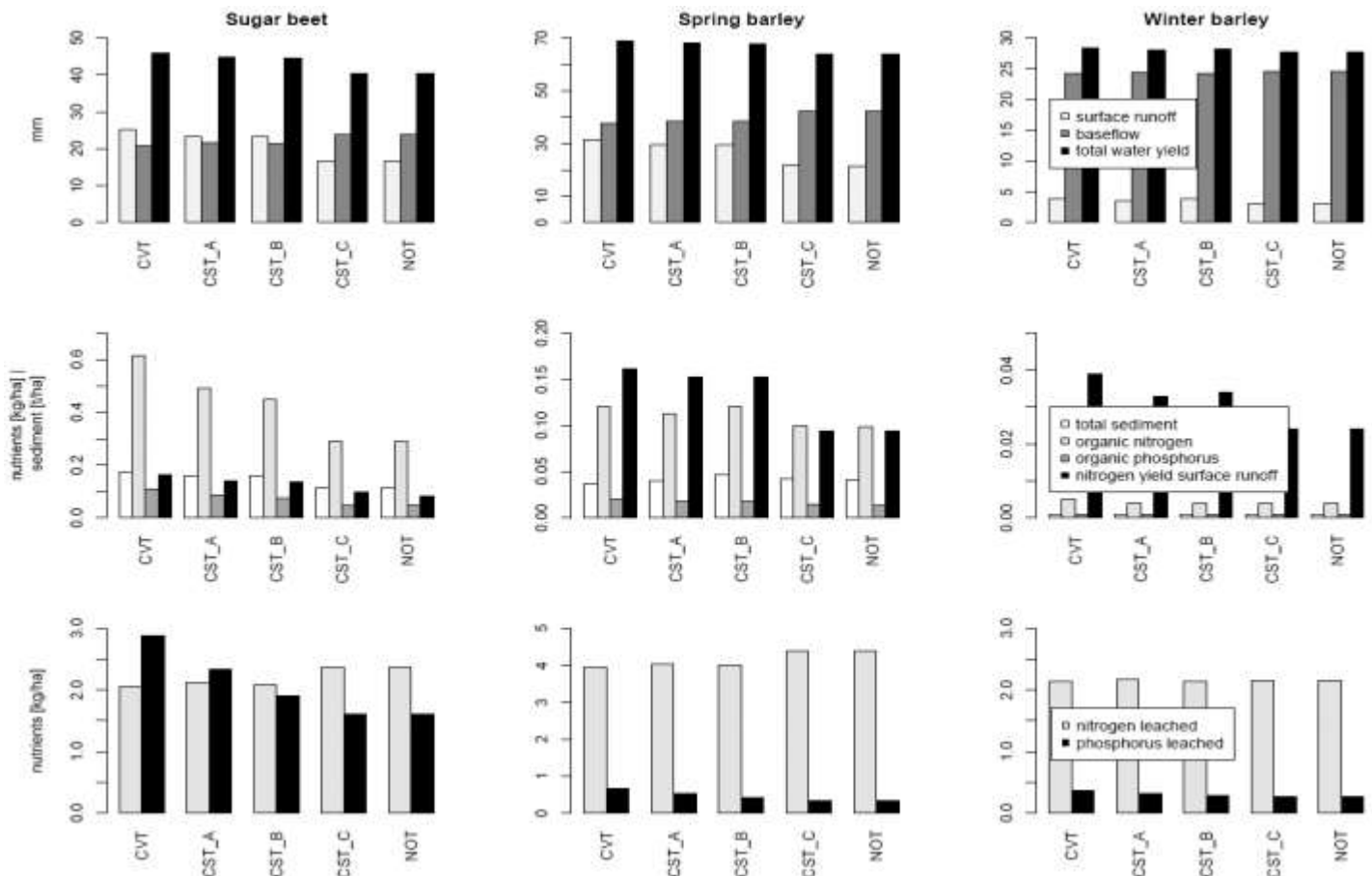
- Investigate the effects of variations of management practices on the watershed level (using SWAT)
- Identify the effects of variations of management practices on the calibration process
- Optimize parameterisation and regionalisation of land management practices



1. Objectives

2. Land Management
3. Study area
4. Method
5. Outlook

Results of former sensitivity analysis (tillage operations)



CVT – stubble cultivator and plough after harvesting / harrow before seed
 CST_A – stubble cultivator twice after harvesting / harrow before seed
 CST_B – stubble cultivator after harvesting / harrow before seed
 CST_C – harrow before seed
 NOT – no tillage

Ullrich and Volk (2009), Agricultural Water Management 96, 1207-1217

1. Objectives

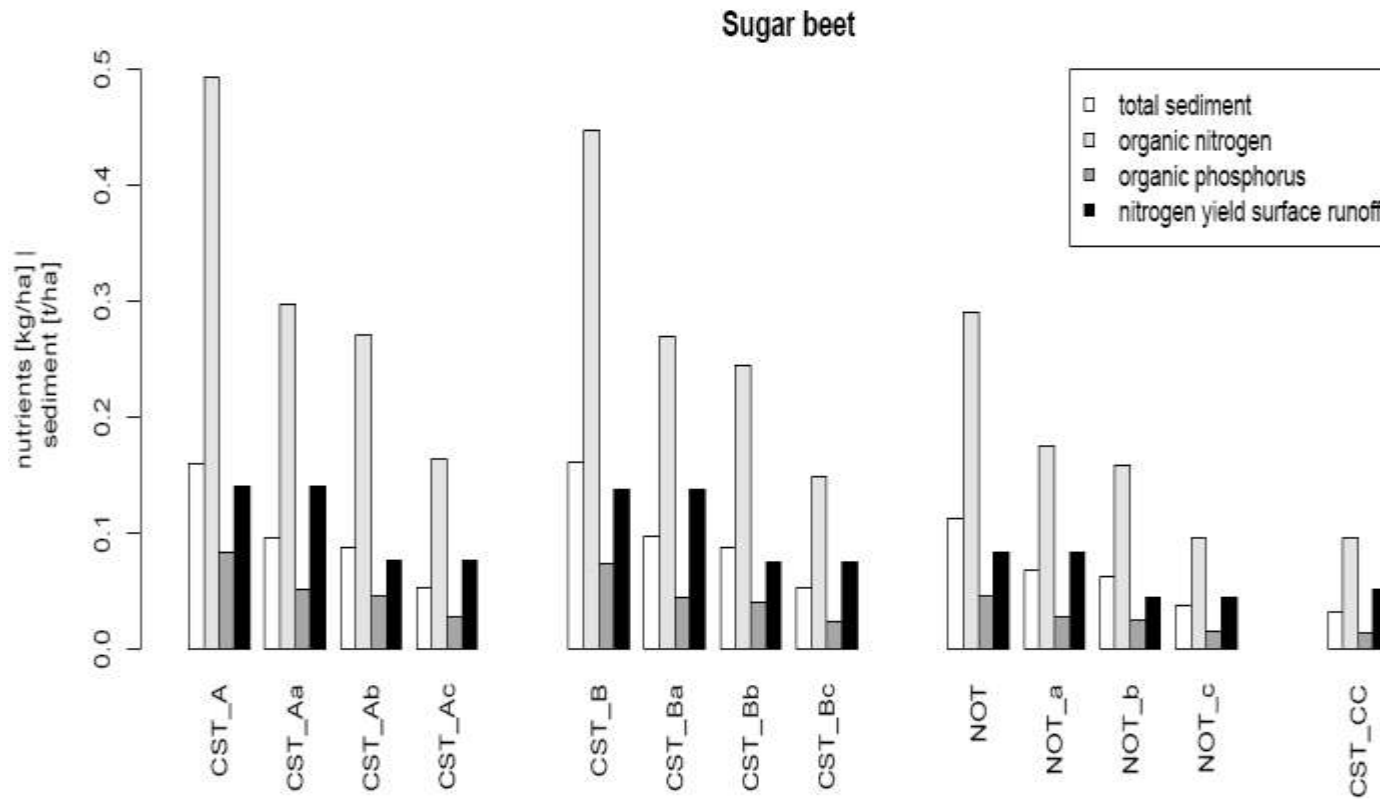
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Results of former sensitivity analysis (management practices)



- ...a – contouring (USLE_P = 0.6)
- ...b – filter strips (FITERW = 2 m)
- ...c – contouring and filter strips
- CST_C C – catch crop (green manuring)

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Sensitivity ranking (tillage operations)

- 1) Duration of vegetation period and soil cover over the time with e.g. dates of planting (winter/spring crop)
- 2) Soil cover characteristics of applied crops (e.g. grains/row crops)
- 3) Tillage intensity (applied tillage practice)
- 4) Dates of tillage operations

Sensitivity ranking (management practices)

- 1) Implementation of undersown crops
- 2) Implementation of filter strips
- 3) Implementation of contouring

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What did we learn so far?

- Management / tillage is sensitive: information for all / or even the most important aspects during the modelling and the calibration and validation process is required!

But:

..the needed information is often hardly available

..rates and types of conservation methods vary in time

➡ e.g. subjected by changing political programmes like implementation of agricultural supporting programs

- supporting program – tillage without plough
- supporting program – implementation of filter strips
- ...

1. Objectives

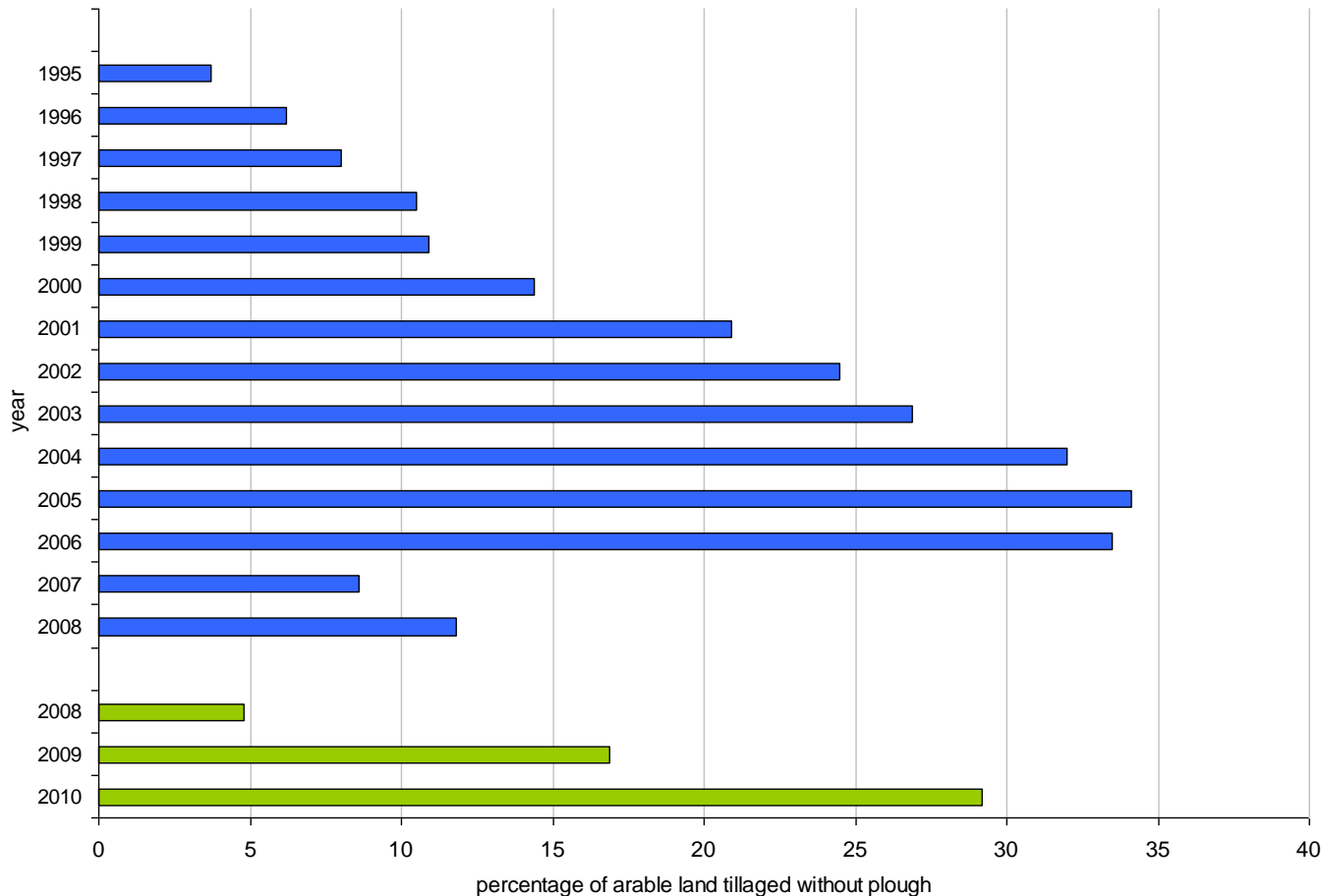
**2. Land
Management**

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Example: Changing percentage of arable land with no-plough tillage in Saxony (federal state of Germany)



(Schmidt and Nitzsche 2005, Saxony State Ministry of Environment and Agriculture 2010)

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How to implement conservation measures into the model?

Tillage operations

- crop rotations are easily to define on a yearly base including (if information are available):
 - different crops
 - changing intensity and dates of tillage operations

Management operations

- implementation of catch crops is easily to define on a yearly base
- implementations of filter strips and contouring are to define on the subbasin/HRU level

1. Objectives

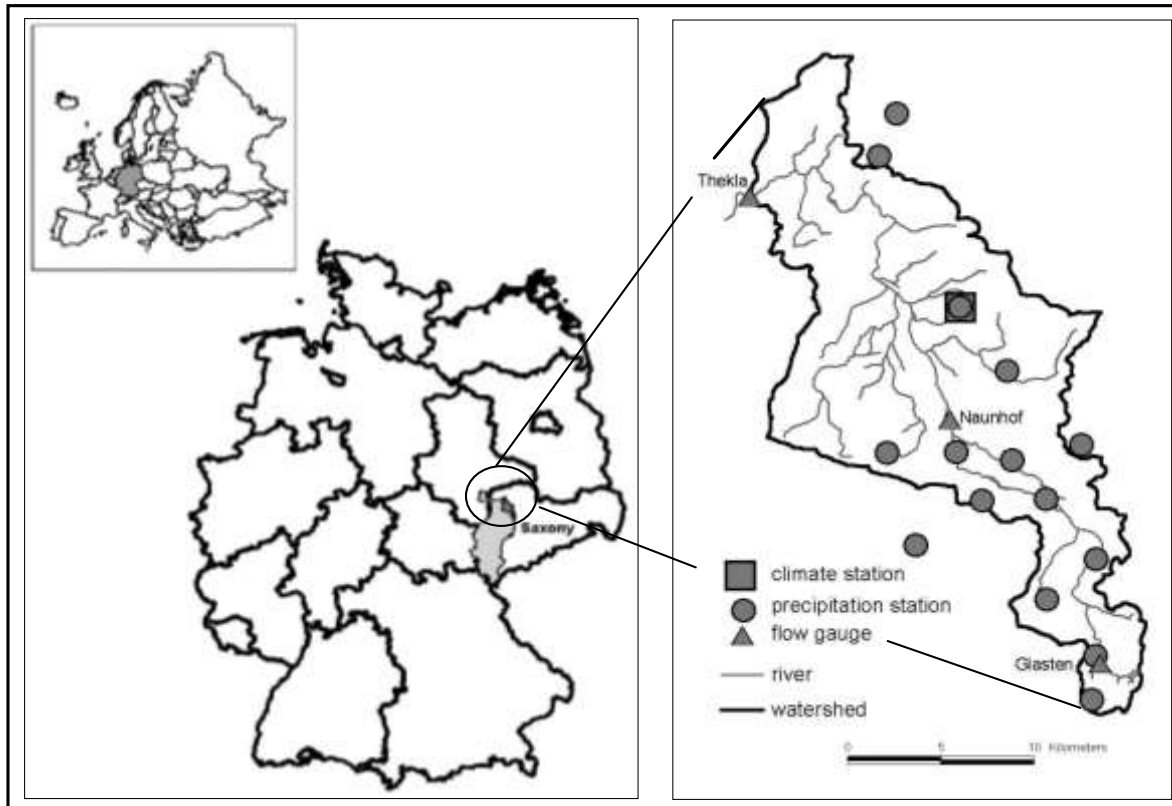
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Parthe watershed



- **Area:** 315 km² - **Topography:** Flat (106 m and 230 m a.s.l.)
- **Precipitation:** 590 to 640 mm/a (1981-2000).
- Typical lowland river.
- **Runoff dynamics:** High flows in spring (snow melt and rainfall)
Low flows in summer with occasional storm flow events.

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Parameterization of land management practices

- used typical crop rotations (CR)

Year	Cattle farms				Cropping farms						
	1 CR	2 CR	3 CR	4 CR	1 CR	2 CR	3 CR	4 CR	5 CR	6 CR	7 CR
1	GR	AG	AG	SwC	WR	GR	WR	WR	WR	SB	SB
2	SiC	SiC	SiC	WW	WW	WW	WW	WW	WW	WW	WW
3	Trit	SiC	WW	WB	WB	Trit	WW	WB	WB	WB	WW
4	SiC		SiC		Pota	SiC			WR	SpB	
5	SpB				WB	WW			WW		
6									WRy		

GR – grass, **SiC** – silage corn, **Trit** – triticale, **SpB** – spring barley, **AG** – alfalfa grass, **WW** – winter wheat, **SwC** – sweet corn, **WB** – winter barley, **WR** – winter rape, **Pota** – potato, **Wry** – winter rye, **SB** – sugar beet

(developed by Abraham et al. 2004, based on agricultural statistics, 1999)

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Regionalisation of crop rotations

- based on agricultural statistics -

- percentage of arable land of agricultural land = > **90 %**

- ca. 85 % of arable land - cultivated by cropping farms
- ca. 10 % of arable land - cultivated by cattle farms
- ca. 5 % of arable land - cultivated by mixed farms

(Saxon Agency for Agriculture 1999)

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Parameterization of tillage operations and management practices

- **Conventional:** stubble cultivator / plough / harrow
- **Conservation (no-plough):** stubble cultivator / stubble cultivator / harrow
- **Catch crop / green manuring**
- **Filter strips**



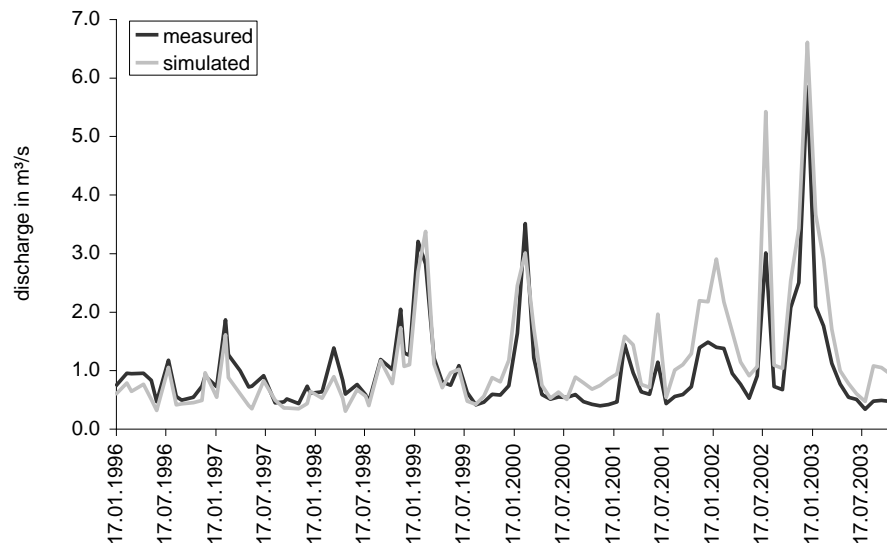
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Model calibration statistics I

Streamflow (monthly) at watershed outlet



	1996–1999		2000–2003	
	Observed	Predicted	Observed	Predicted
Mean flow (m ³ /s)	0.9	0.8	1.1	1.4
Max (m ³ /s)	3.2	3.4	5.8	6.5
Min (m ³ /s)	0.4	0.3	0.3	0.5
SD	0.57		1.1	
R ²	0.88		0.88	
NSE	0.84		0.63	
PBIAS	14		-42	
RSR	0.4		0.6	



1. Objectives

2. Land Management

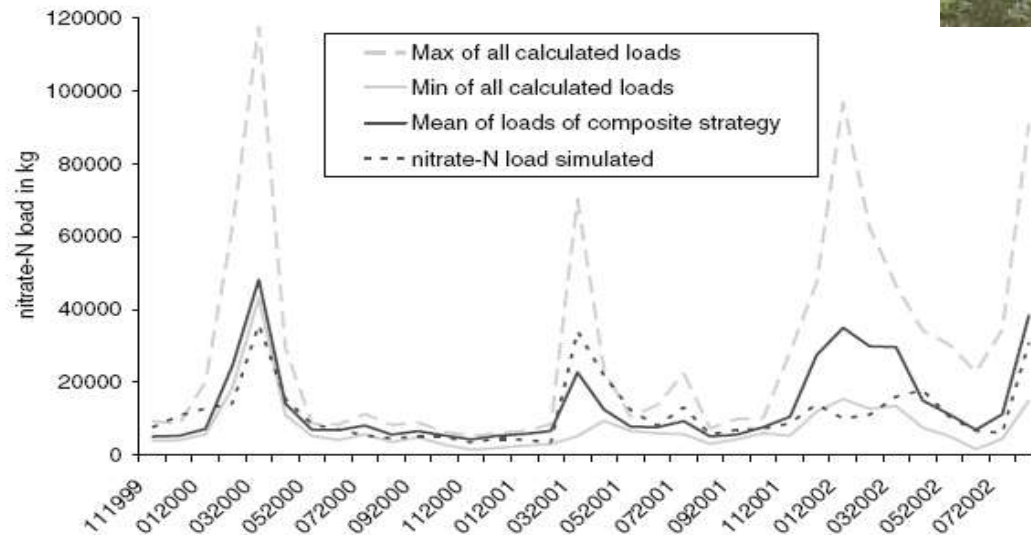
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Model calibration statistics II

Nitrate-N (monthly) at watershed outlet



	2000–2002	2000	2001	2002
R^2	0.55	0.88	0.94	0.39
NSE	0.52	0.81	0.55	0.23
PBIAS	15	8	-25	39
RSR	0.69	0.31	0.97	1.1

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Ullrich and Volk (2010), Environmental Monitoring & Assessment 171: 513-527

Implementation of conservation tillage operations

- Change rates of no-plough tillaged arable land
- Change regionalisation of no-plough tillaged arable land considering soil and slope conditions

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Implementation of conservation management practices

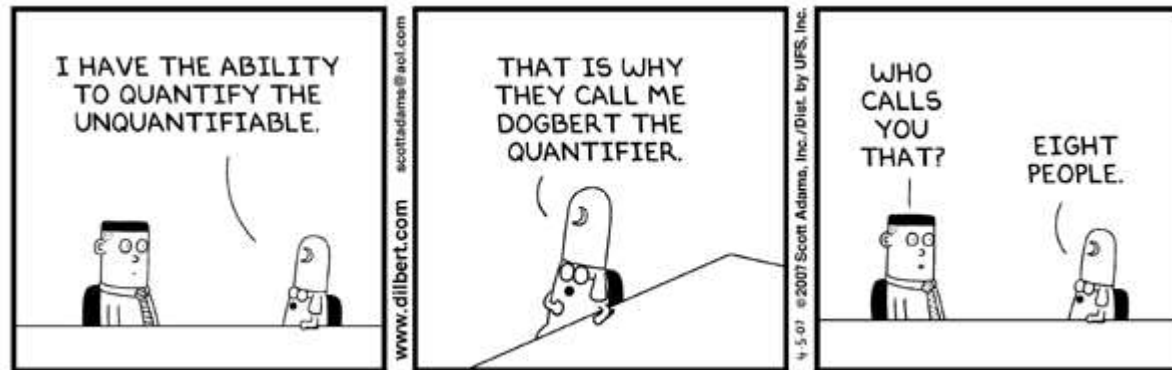
- Change rates of implemented catch crops and filter strips
- Change regionalisation of implemented catch crops and filter strips

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- Implementation of the method
- Further work and recommendations on land management parameterisation on different catchment sizes
- Further work and recommendation on regionalisation of land management practices on different catchment sizes

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Thank you!



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