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Agroscope

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Impact analysis of land sharing vs. land sparing strategies on catchment-scale agroecosystem services using SWAT

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30 June 2017

FACCEJPI
biodiversa
FNSNF Swiss National Science Foundation
Soil as a Resource
National Research Programme NRP 68

Background

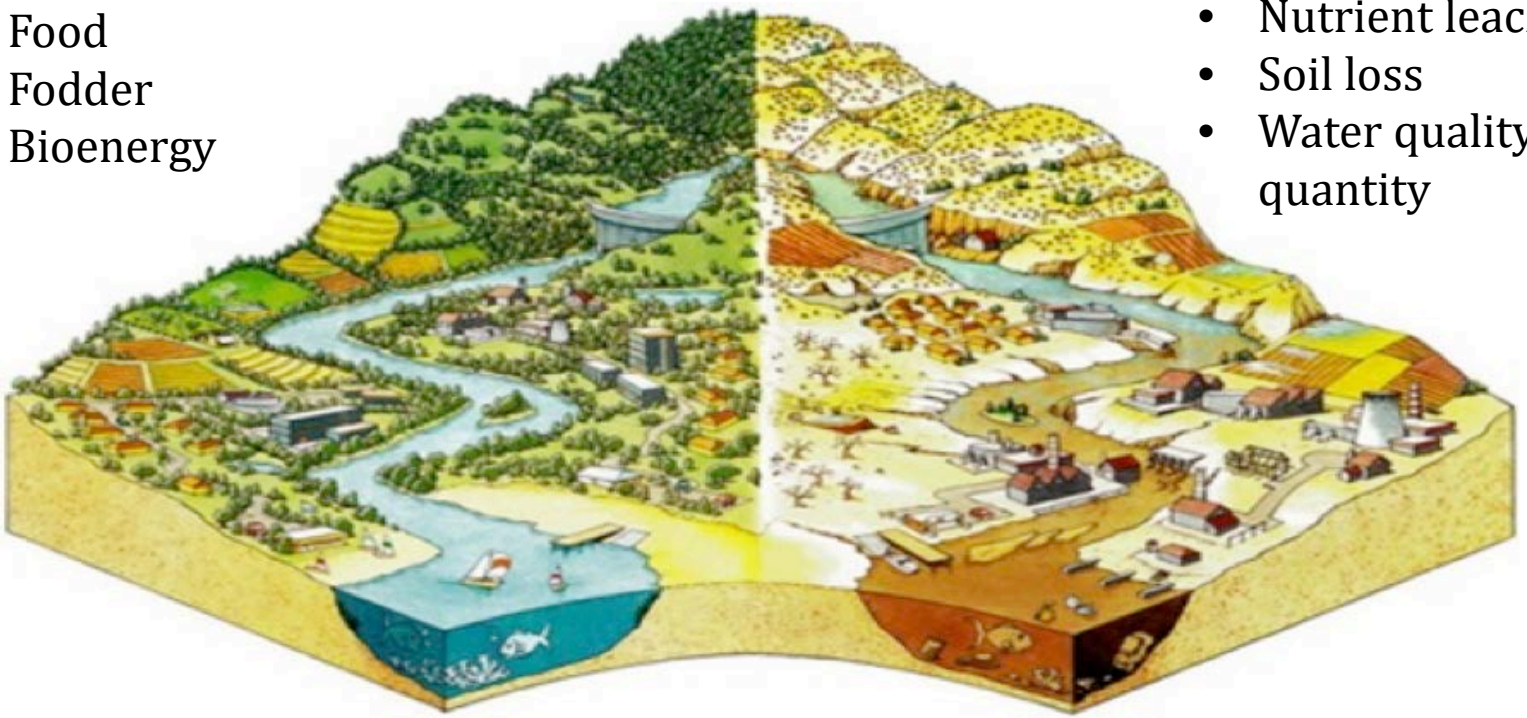
Agricultural management:

We get benefits:

- Food
- Fodder
- Bioenergy

We cause problems:

- Nutrient leaching
- Soil loss
- Water quality and quantity



Reference: catchmentguidelines.org.mw

Swiss case study: Broye catchment

Research questions

- What is the current status of ecosystem services in the study area? What are the main conflicts between them?
- Which land management strategies could mitigate conflicts between ecosystem services?

Ecosystem services	Indicator
Yields	Crop production [t/ha]
Soil loss	Soil loss [t/ha]
Water quality	Nitrate concentration [mg N/l]
Low flows	5^{th} percentile [m^3/s]

Available data

Long term data is available for this project:

Weather data and flow observation daily data for 1981-2015 (35 years)
Water quality monthly data for 1986-2010

Data split for calibration and validation:

Warm up period	5 years
Calibration	18 years
Validation	12 years

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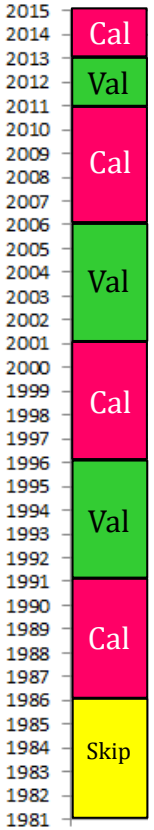


Multi-objective calibration strategy

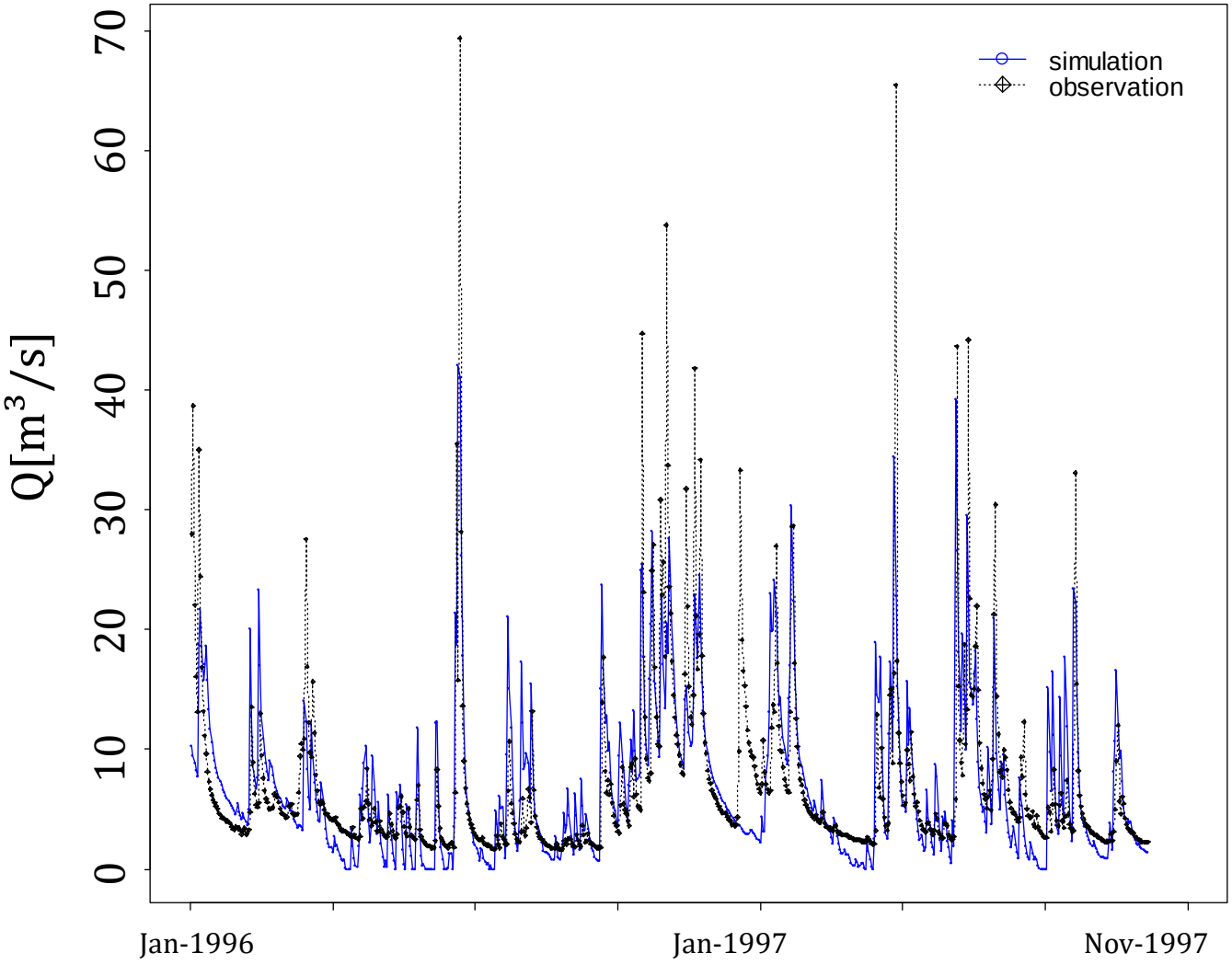
- Multi-objective calibration (stepwise refinement)
  1- Discharge (Daily)
  2- Improved discharge + water quality (monthly)

- Approach
  1- Automated daily discharge calibration (SWAT-CUP, SUFI2 method, 2000 samples)

Snow	SFTMP, SMTMP, SMFMX, SMFMN
Elevation	T_laps and P_laps
Soil	SOL_BD, SOL_K, SOL_AWC
Ground water	ALPHA_BF, GW_REVAP, GWQMN, REVAPMN
Land cover	CN2, CANMX, EPCO, ESCO

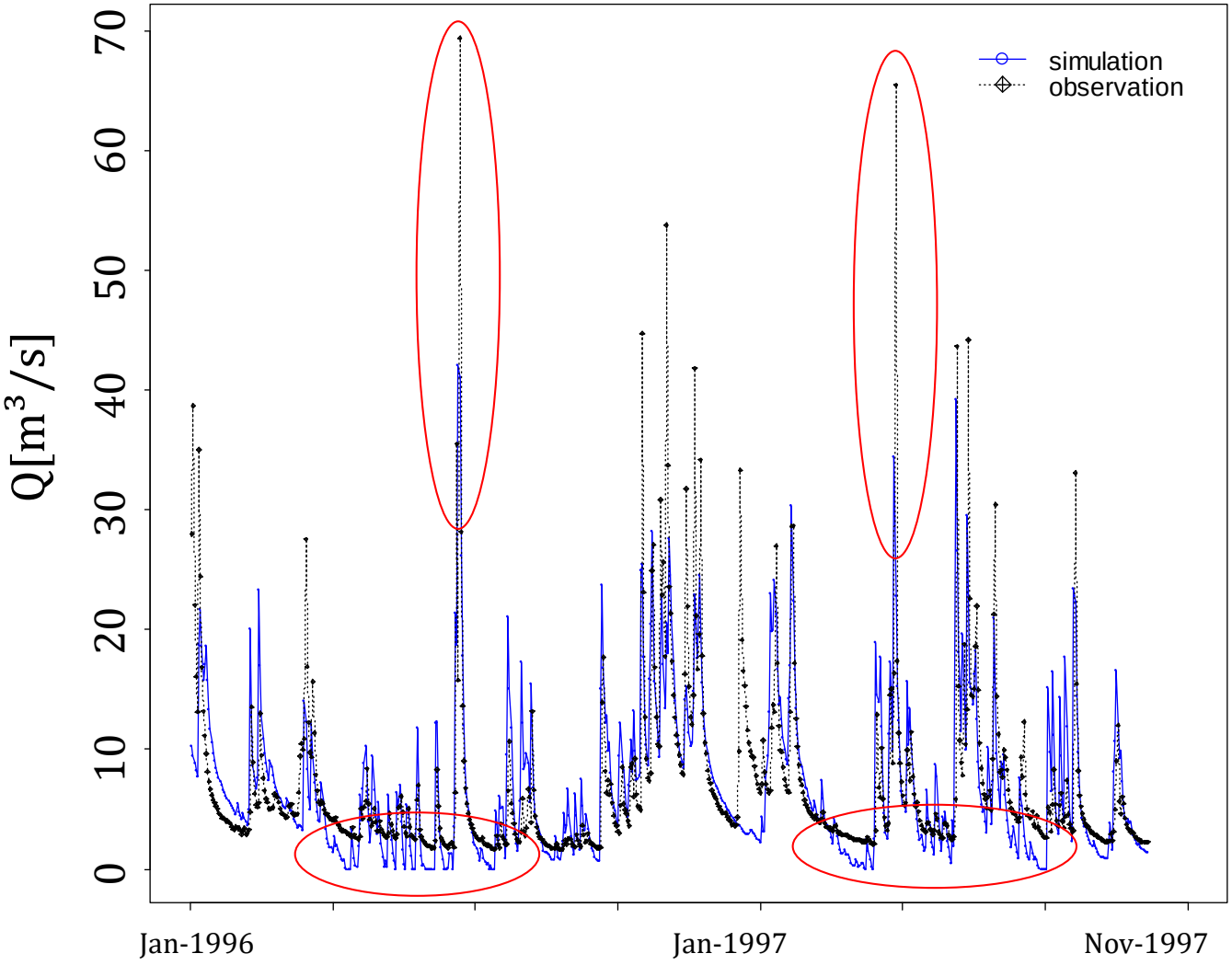
  2- Monthly nitrate load calibration (to be done)

Calibration challenges



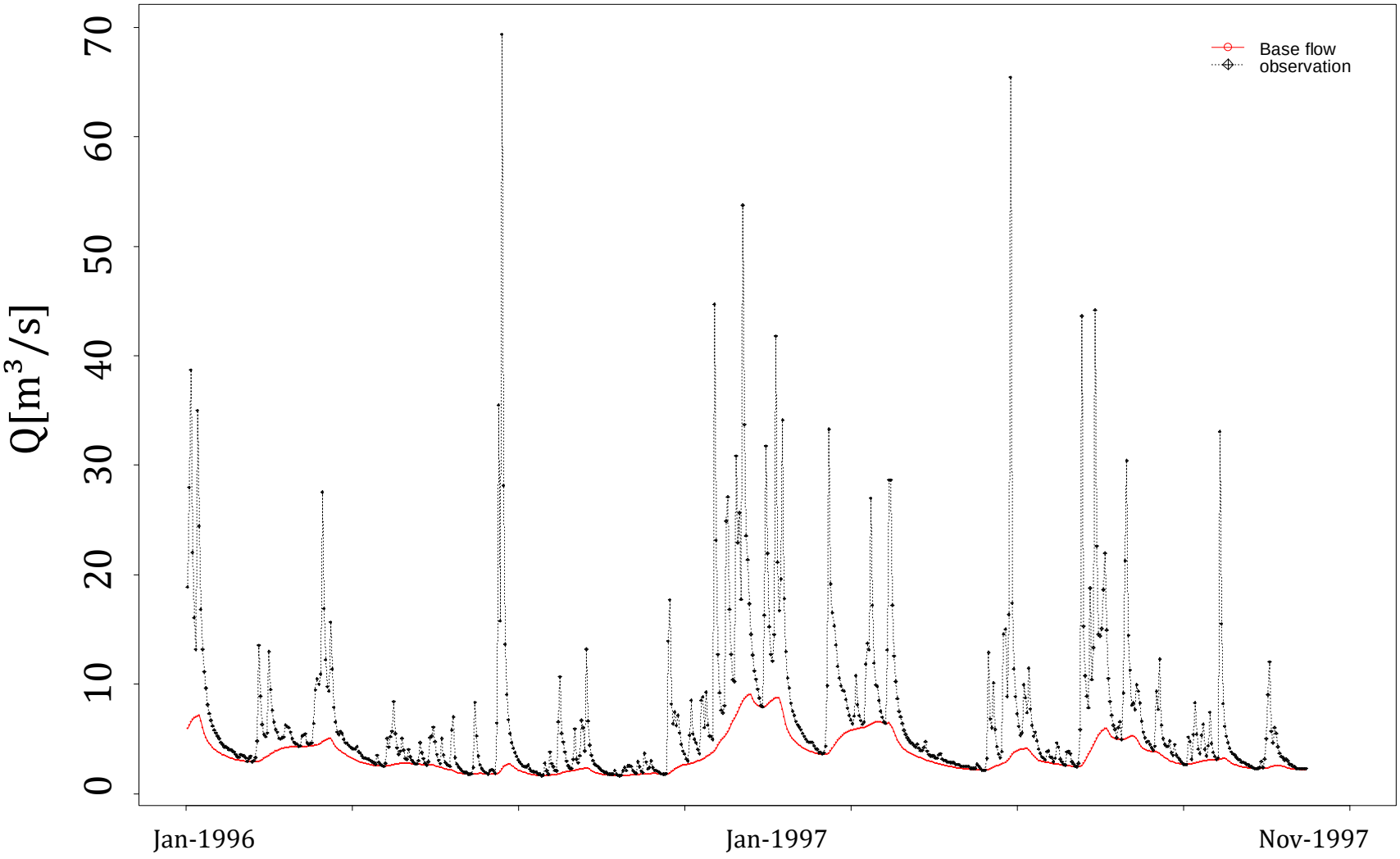
Nash Sutcliffe efficiency	0.6

Calibration challenges

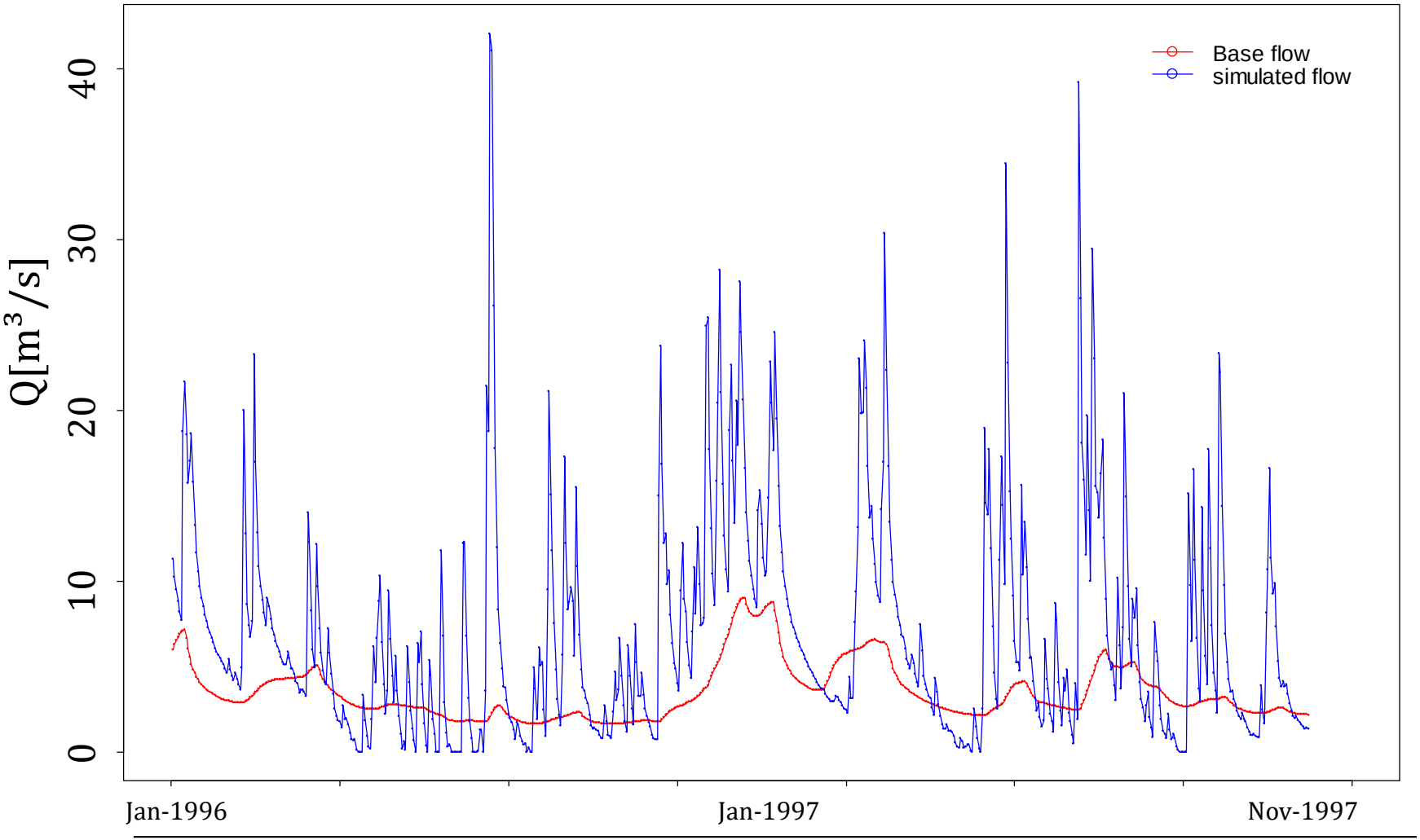


Nash Sutcliffe efficiency	0.6
5th percentile lowflow indicator	
observation	1.344 [m3/s]
simulation	0 [m3/s]

Base flow filtering



Model analysis



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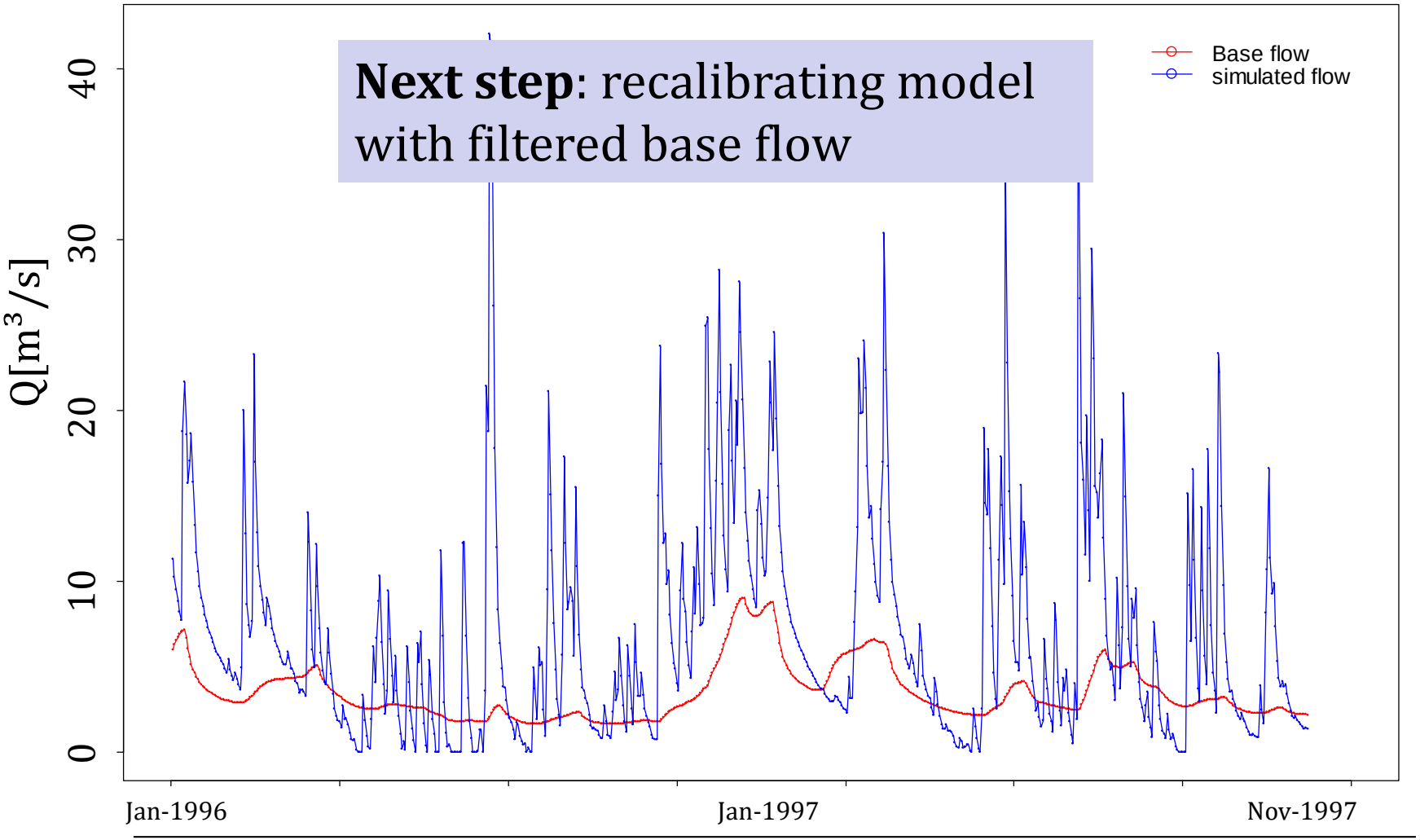

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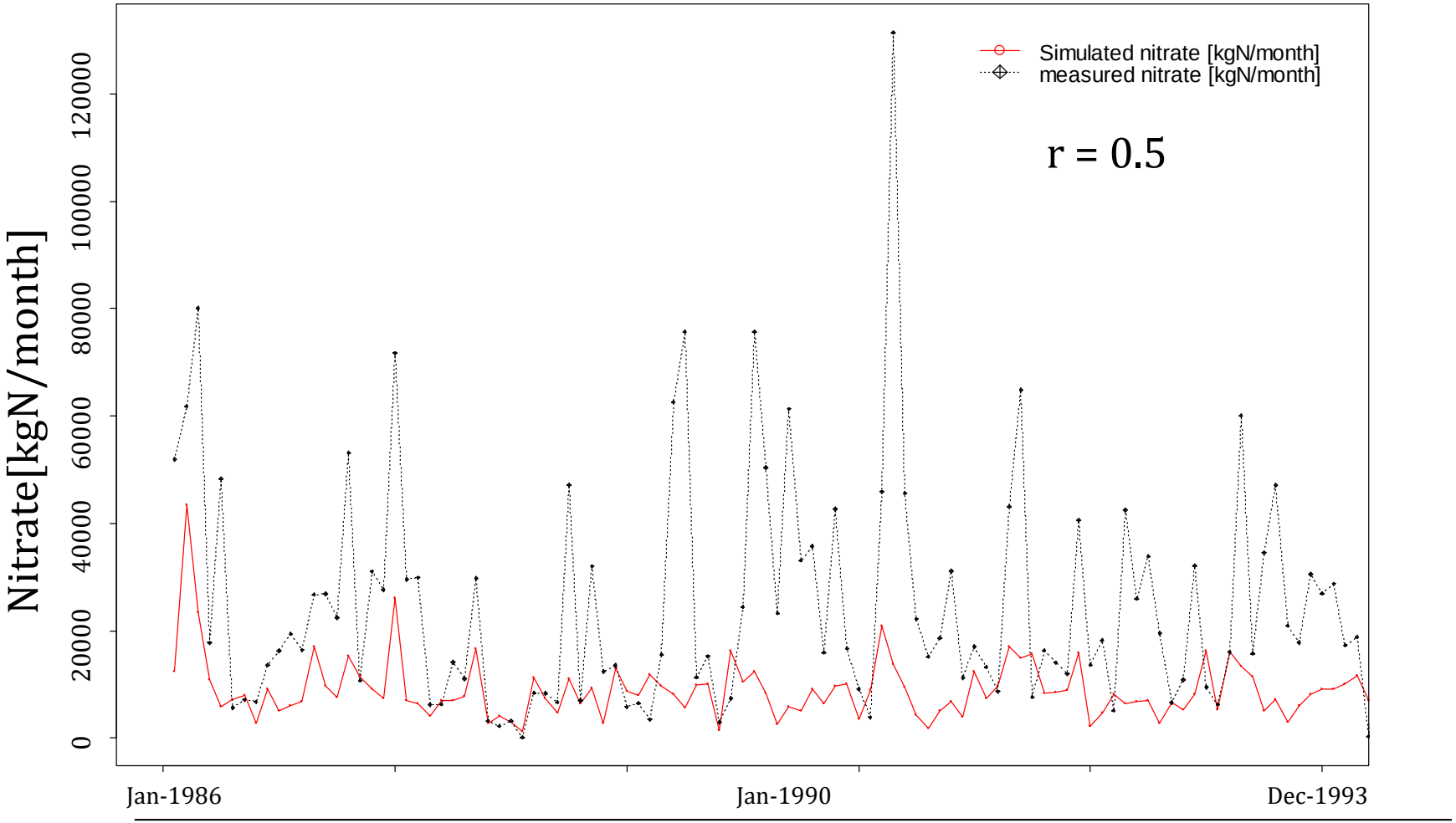
Water quality

Nitrate mass [kg N /month]



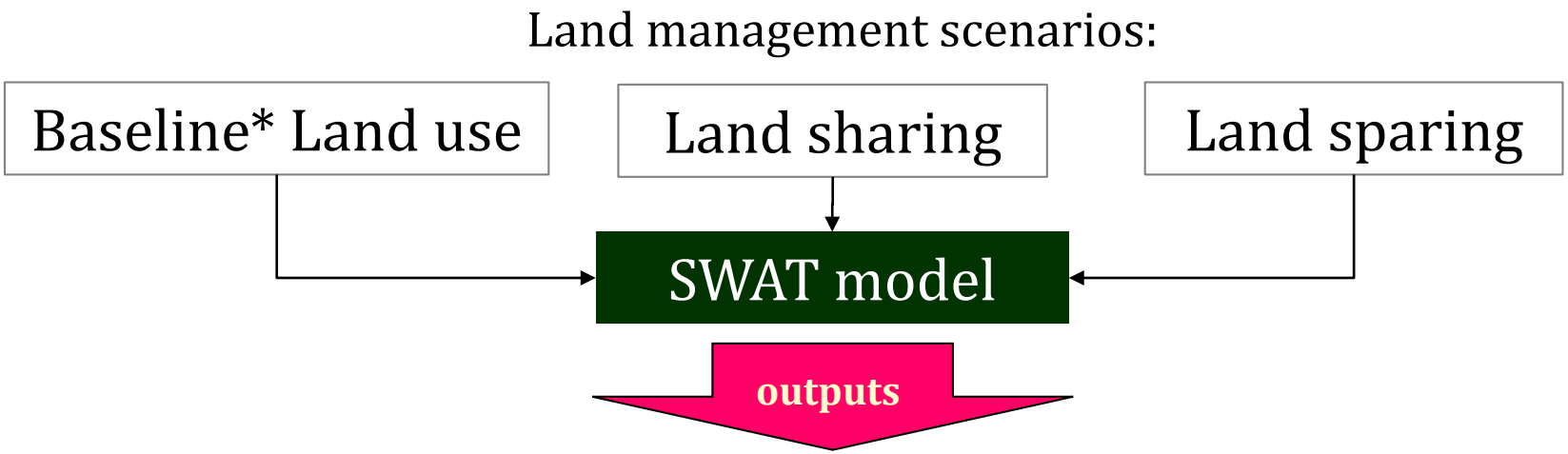
Land sharing vs land sparing

Land sparing (segregation) ⟷ Land sharing (integration)

- Unlimited irrigation In lowlands
- Intensifying permanent grassland on fertile soils
- transforming arable areas with high slope to intensive permanent grassland
- Areas with low fertile areas (e.g. forest) turned into the nature protection areas (permanent grassland)

- No irrigation
- Reduction of nutrient inputs
- Increase of cropped grassland within rotations

Overview of approach



Land management scenarios	Baseline	Land sharing	Land sparing
Crop Yield	…	…	…
Soil loss	…	…	…
Water quality	…	…	…
Low flow	…	…	…

* Model is calibrated and validated for baseline and is used for testing two other scenarios

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