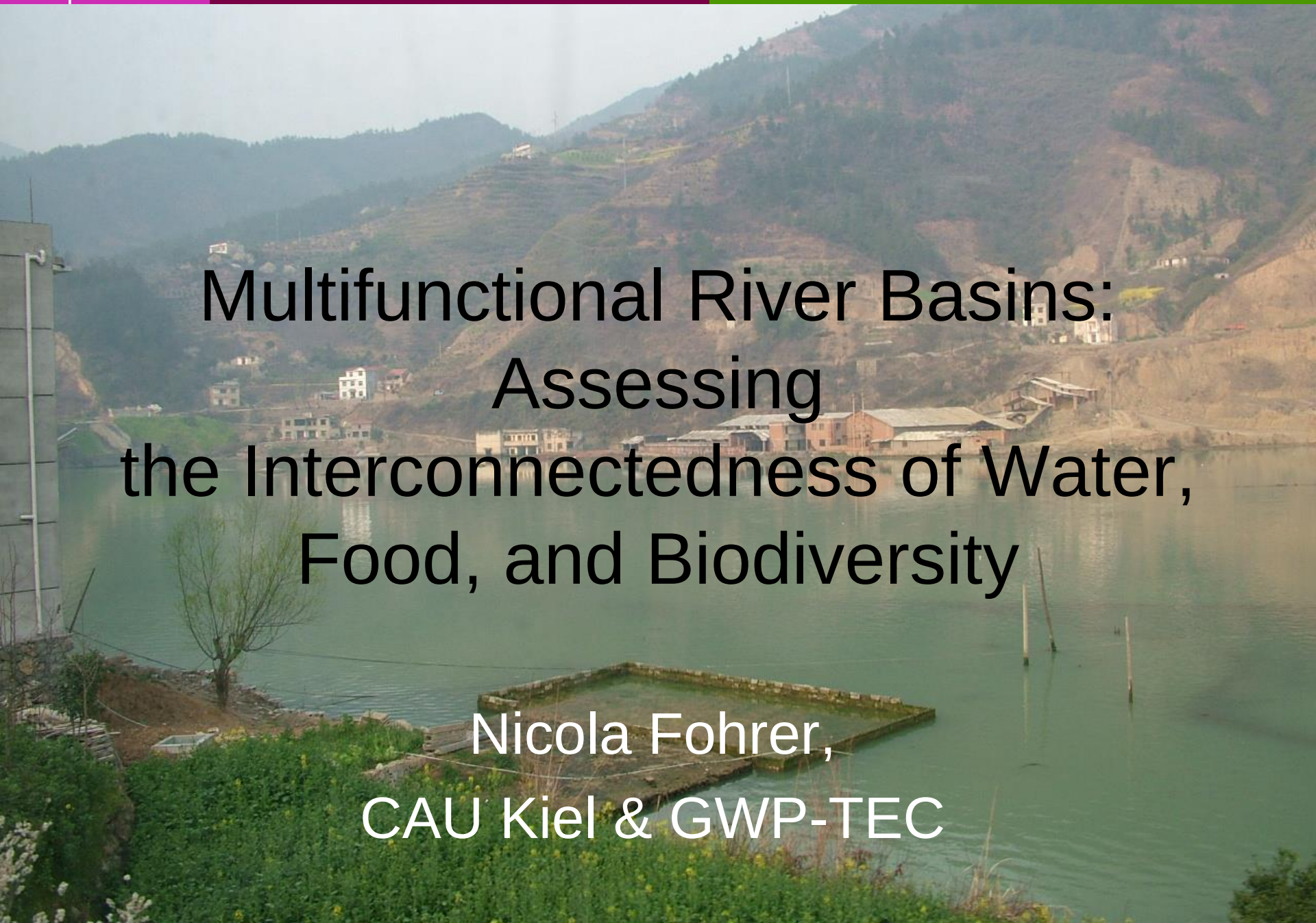


Multifunctional River Basins: Assessing the Interconnectedness of Water, Food, and Biodiversity

Nicola Fohrer,
CAU Kiel & GWP-TEC

Drinking Water

Agricultural Income

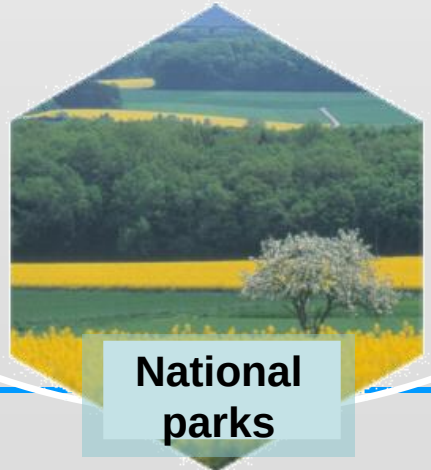
Employment

Habitat/Biodiversity

Multi-functionality of river basins

Food

Tourism

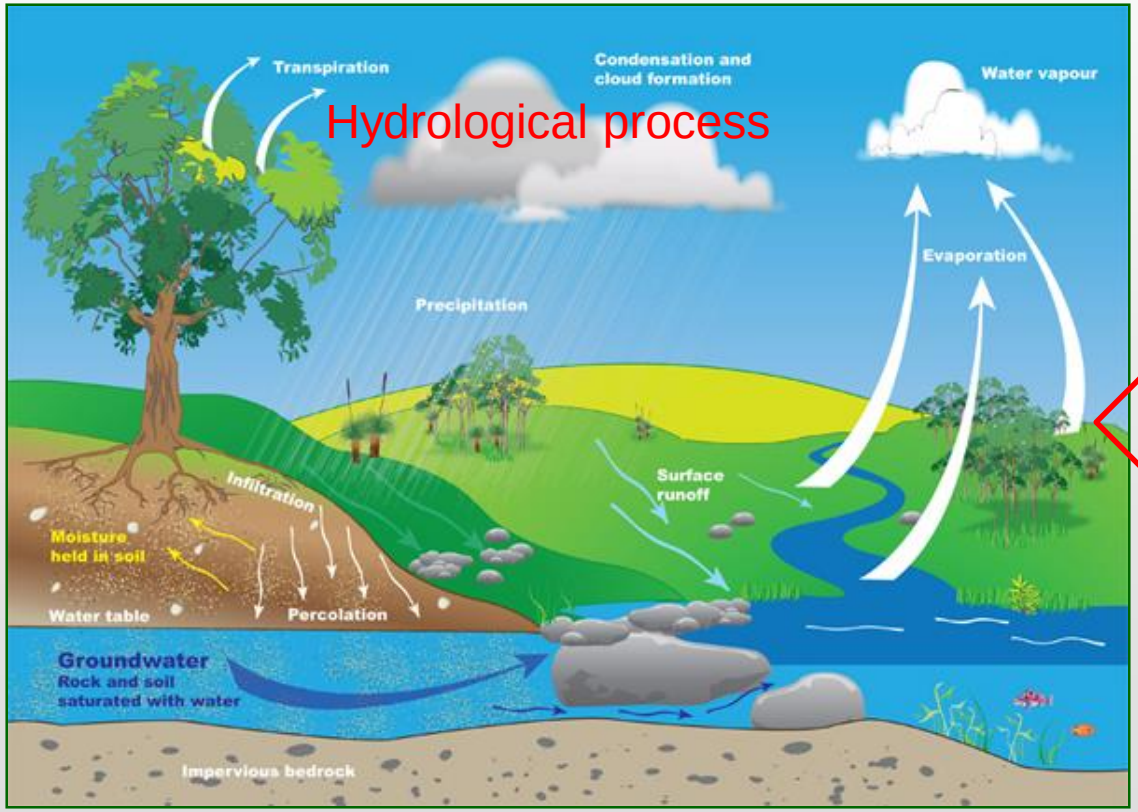


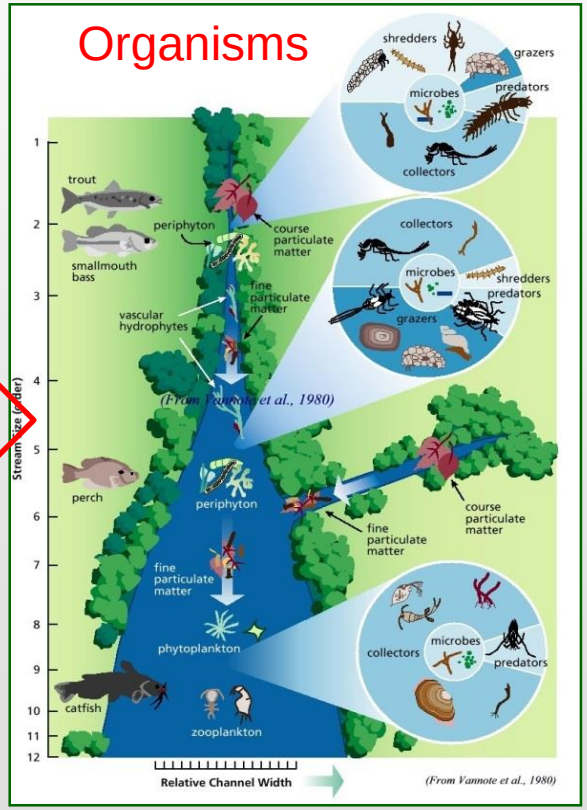
National parks

Settlement Area

How can we integrate biodiversity in IWRM?

- integrated and interdisciplinary modelling approach is required
- Interaction of key drivers, landscape processes and feedback mechanism





http://www.dpaw.wa.gov.au/management/fire/fire-and-the-environment/52-fire-and-the-landscape

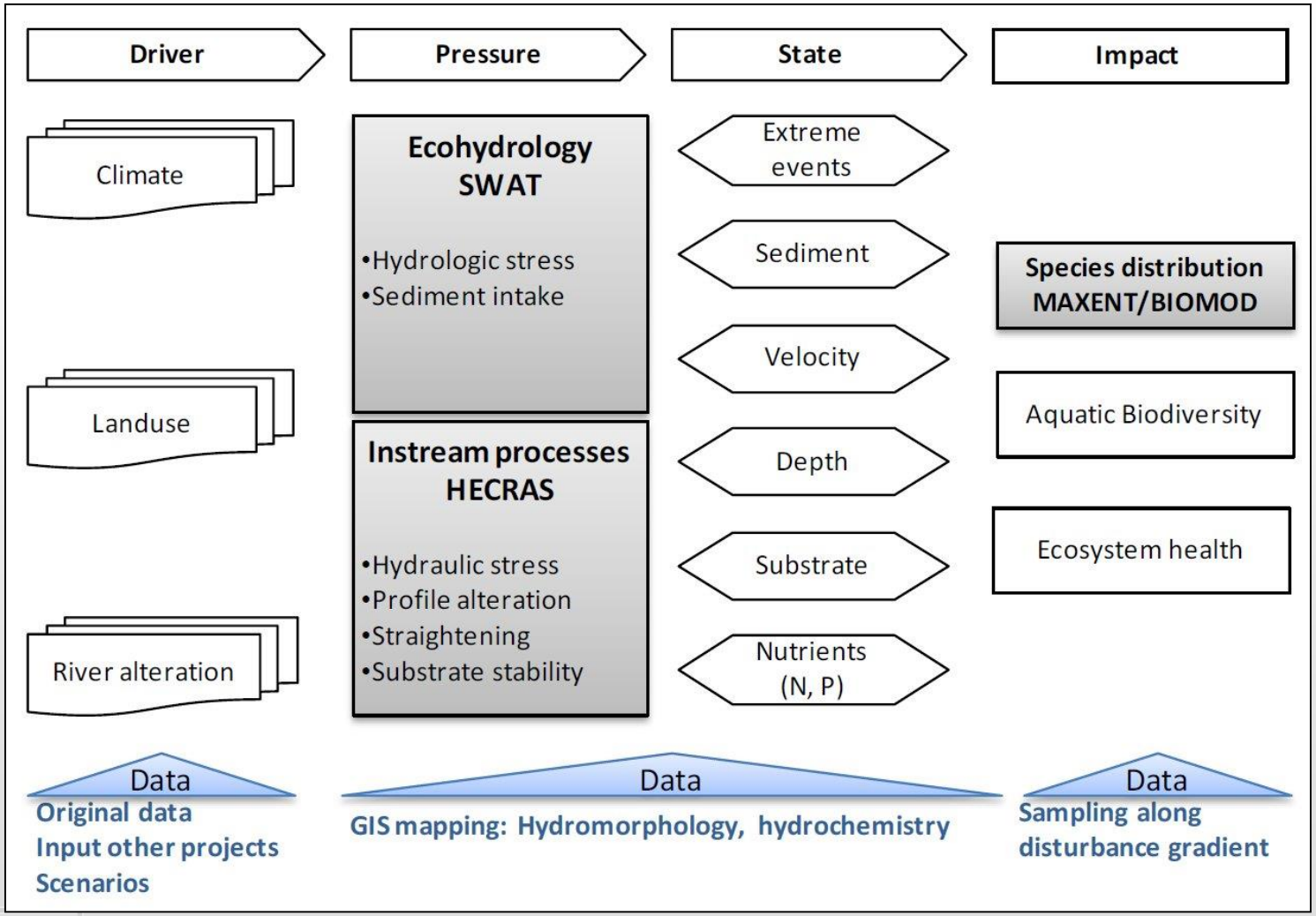
Example 1:
including biodiversity into IWRM:
The Changjiang River, China

国家自然科学基金委员会
National Natural Science Foundation of China

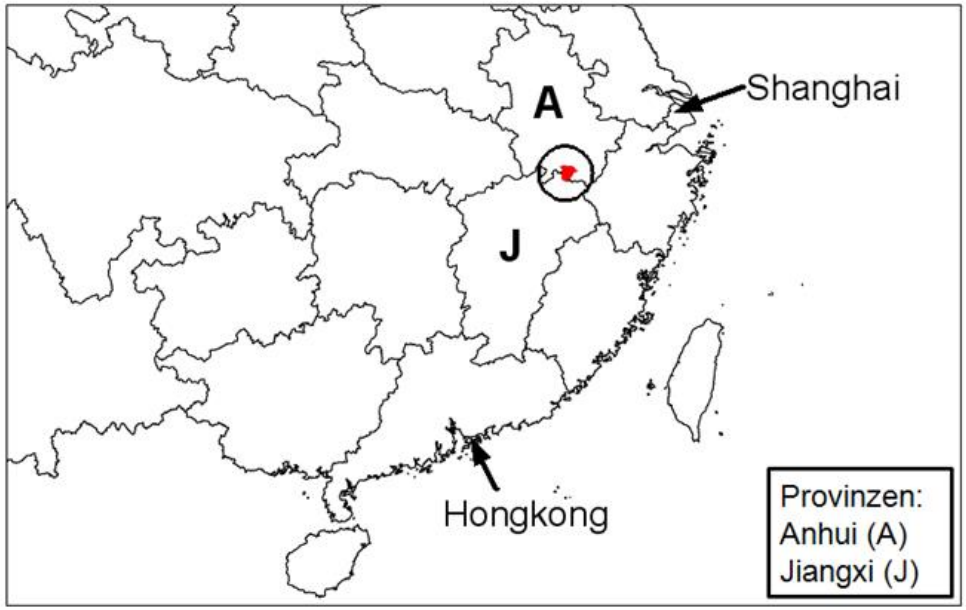
SENCKENBERG
world of biodiversity

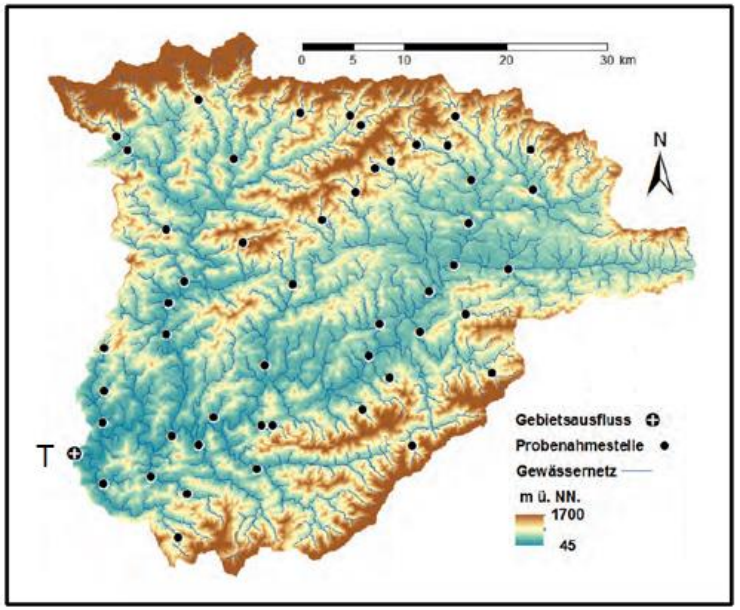
DFG Deutsche Forschungsgemeinschaft

Integrated Approach



Study Region: **Changjiang River** (昌江) **catchment**



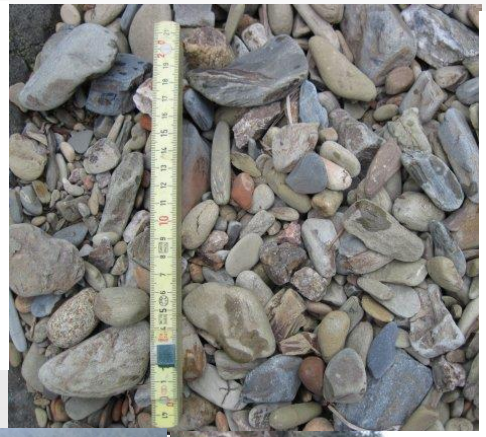


Mixed Forest	70.0%
Arable land	16.7%
Tea	10.8%
Rangeland	2.0%
Urban	0.3%
Water	0.2%

Interdisciplinary field work

Hydrology & hydraulics

- River width, Water depth, Geometry
- Flow velocity
- Substrate, Vegetation
- Bridges, dams
- Land use



Hydrobiology

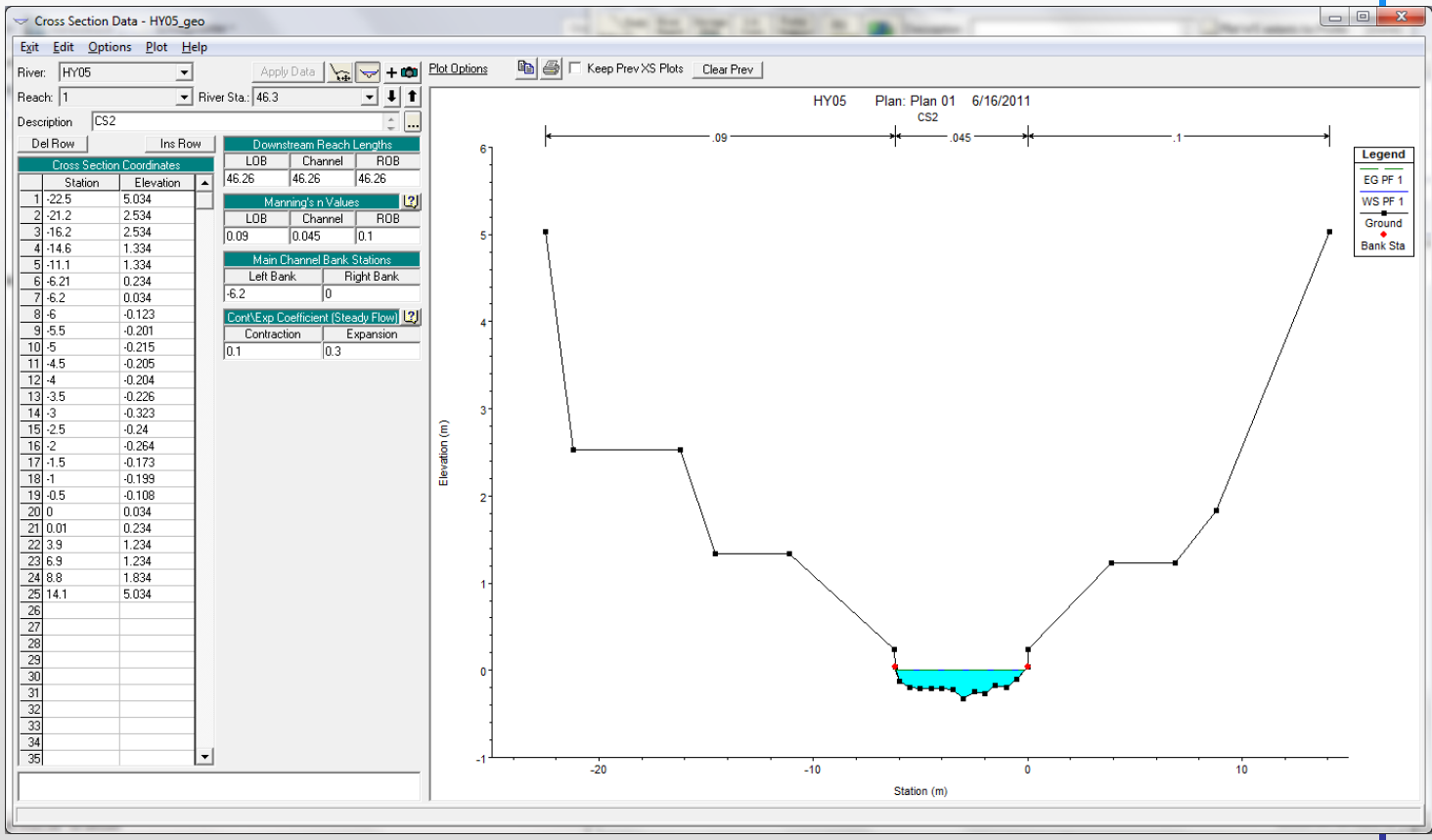
- Macroinvertebrates
- Substrate
- Water depth
- Flow velocity
- Distance to bank
- Water quality

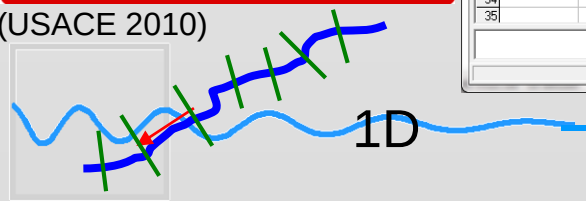
Implementing field data into the HECRAS model

- Water depth, river geometry
- Geometry of river banks and floodplains

HEC-RAS

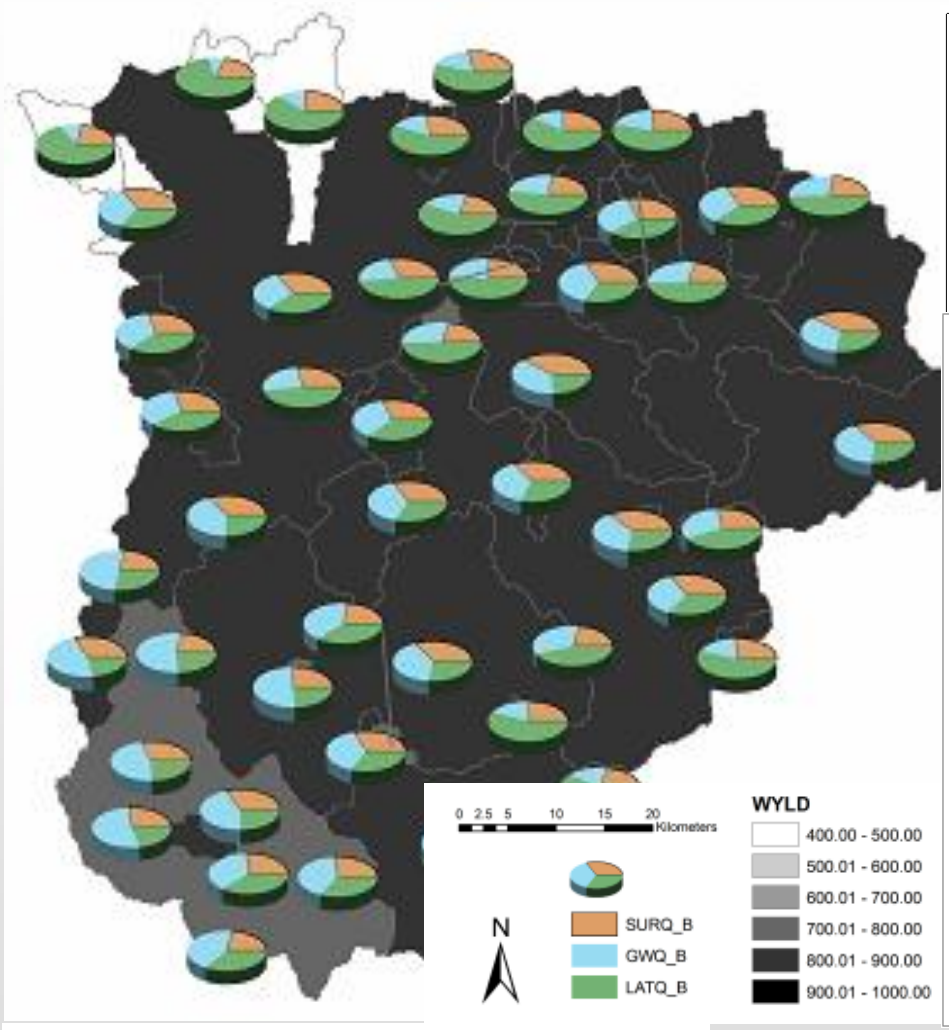
(USACE 2010)

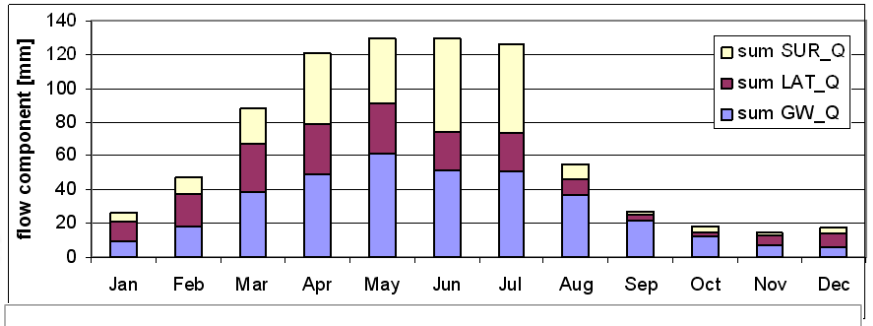


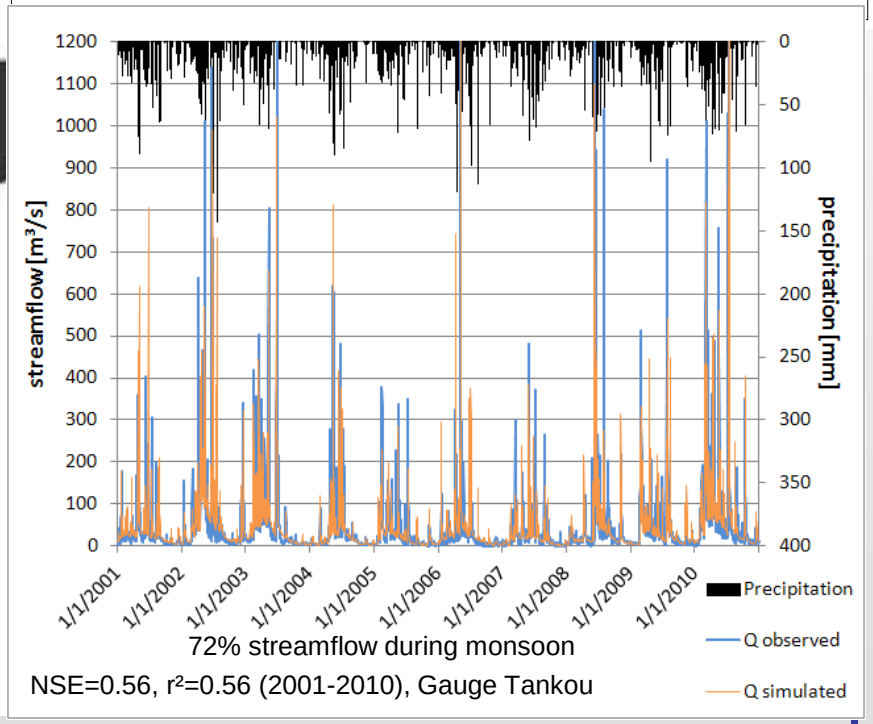


1D

Temporal and spatial streamflow assessment







72% streamflow during monsoon

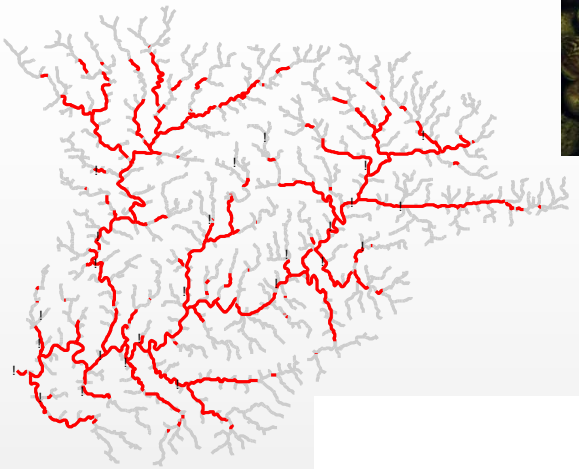
NSE=0.56, r^2=0.56 (2001-2010), Gauge Tankou

Soil & Water Assessment Tool | SWAT

SCHMALZ, B., KUEMMERLEN, M., KIESEL, J., CAI, Q., JÄHNIG, S.C. & FOHRER, N. (2015):. Ecohydrology 8(6): 1119-1136**)**

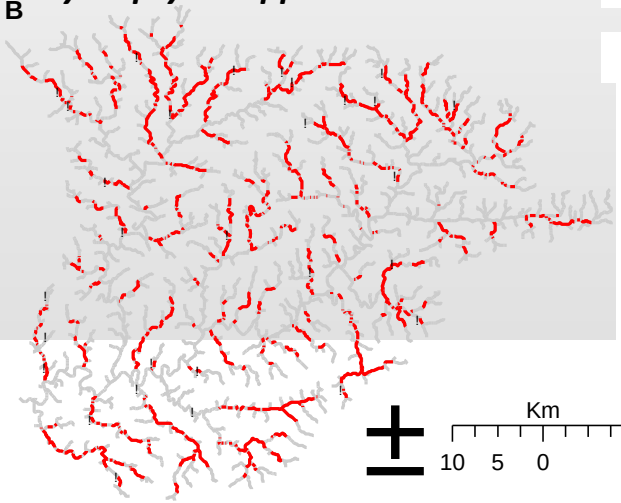
Joined hydrobiological and hydrological assessment

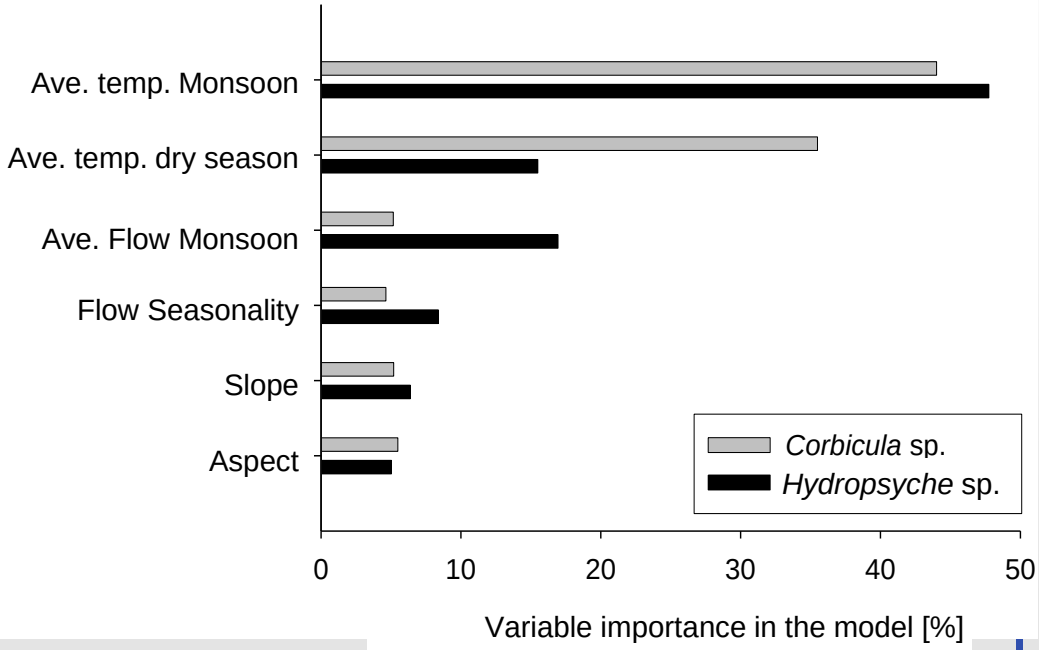
A ***Corbicula spp.*** AUC = 0.84



Occurrence prediction

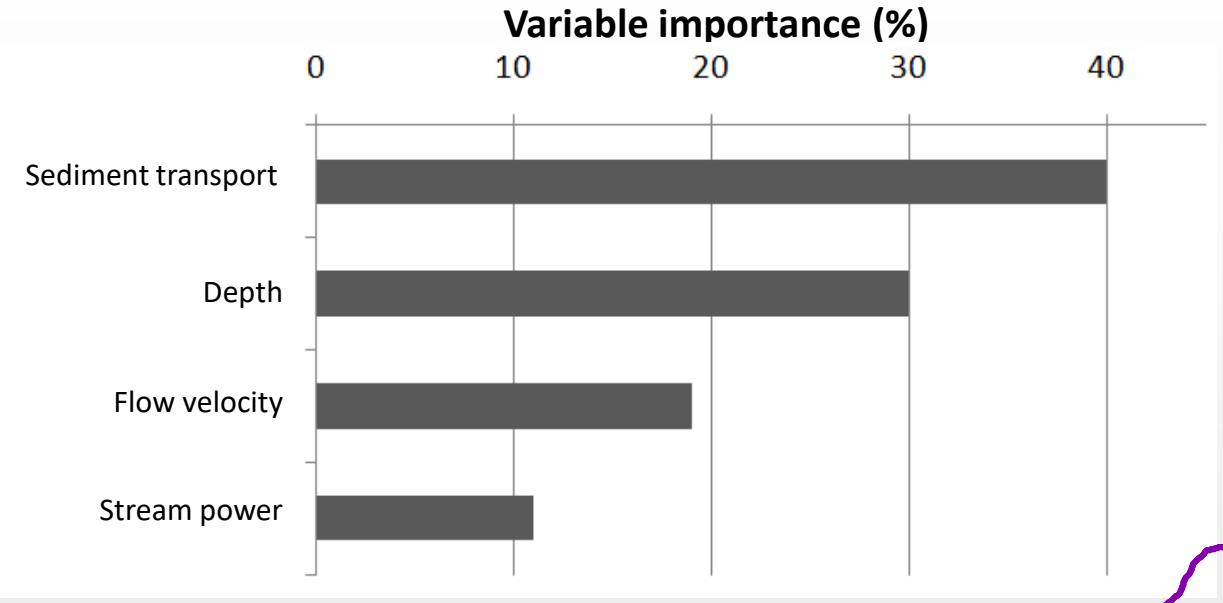
B ***Hydropsyche spp.*** AUC = 0.91

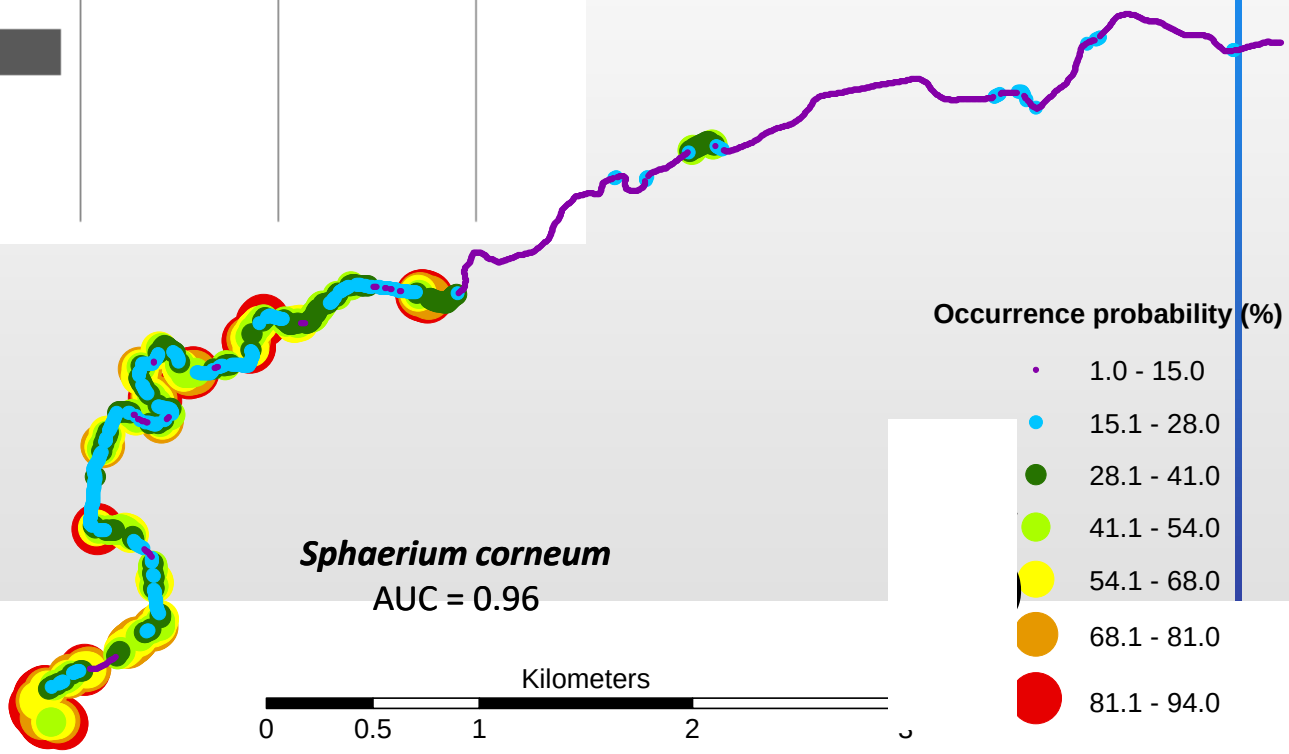




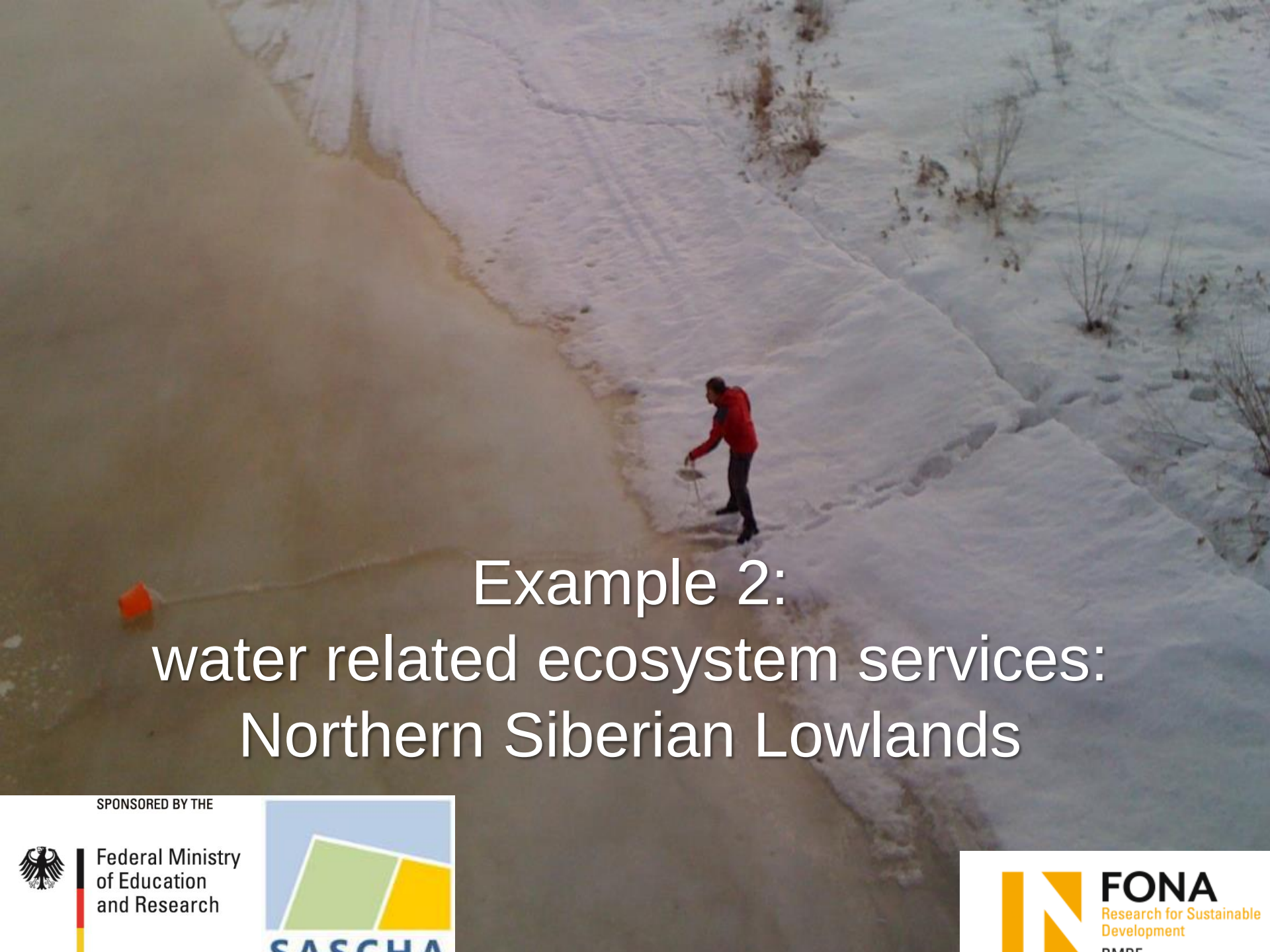
Kuemmerlen, M., S. Domisch, B. Schmalz. Q.H. Cai, N. Fohrer und S. Jähnig, 2012, HyWa, 56(4): 185-192.

Integrating hydraulic variables in biological models





Jähnig, S.C., M. Kuemmerlen, J. Kiesel, S. Domisch, Q. H. Cai, B. Schmalz and N. Fohrer, 2012 J. Biogeogr.,_39 (12): 2253-2263:



Example 2:
water related ecosystem services:
Northern Siberian Lowlands

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of Education
and Research

SASCHA

FONA
Research for Sustainable
Development

Ecosystem Services

Millenium Assessment (2005)

• Provisioning

Goods produced or provided by ecosystems

• Regulating

Benefits obtained from regulation of ecosystem processes

• Cultural

Non- material benefits from ecosystems

Interdisciplinary methodological framework

ecohydrological model setups
by using information e.g. of land-use and agricultural management, weather and hydrological data

global climate scenarios were downscaled

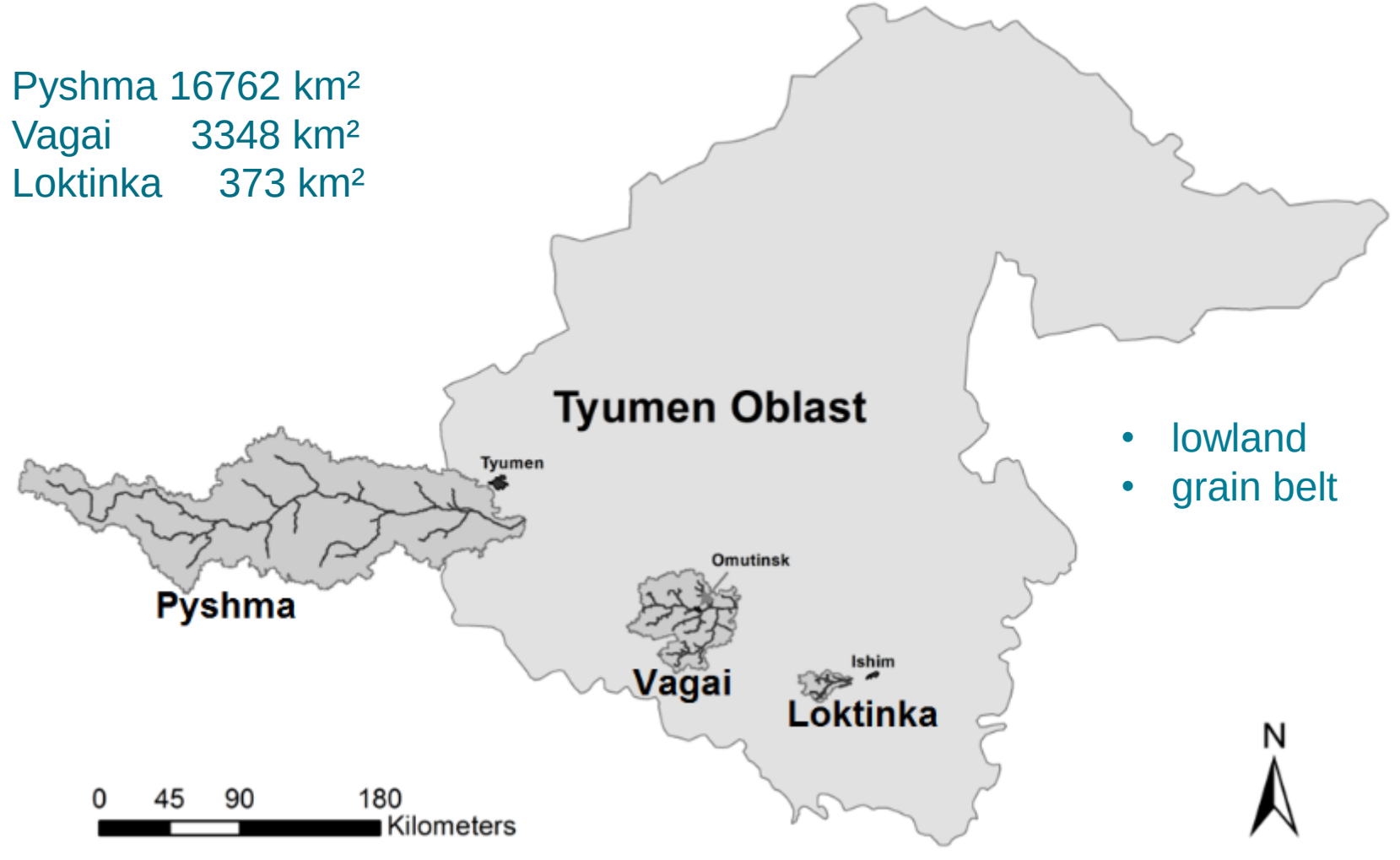
agricultural management scenarios were developed

ecosystem services were analysed

scenario runs
for depicting **impacts** on hydrological components

Three studied river basins

Pyshma 16762 km²
Vagai 3348 km²
Loktinka 373 km²



- lowland
- grain belt

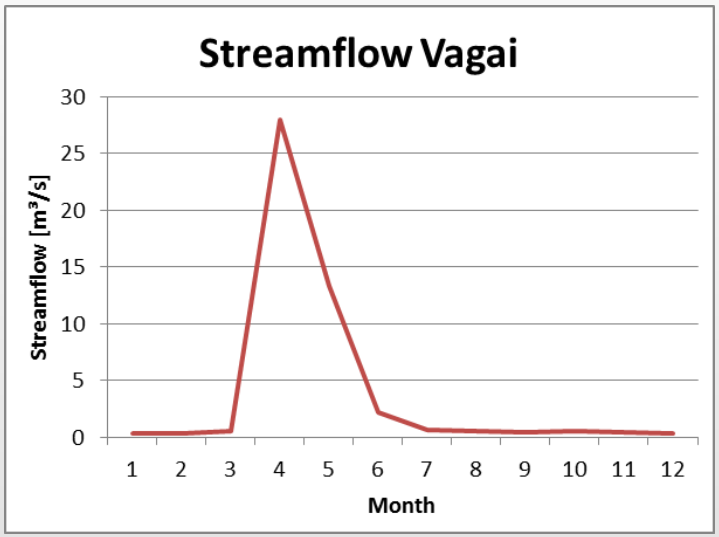
Schmalz et al. (2016)

Interdisciplinary methodological framework

Photos: see http://www.hydrology.uni-kiel.de/ext/sascha-blog/

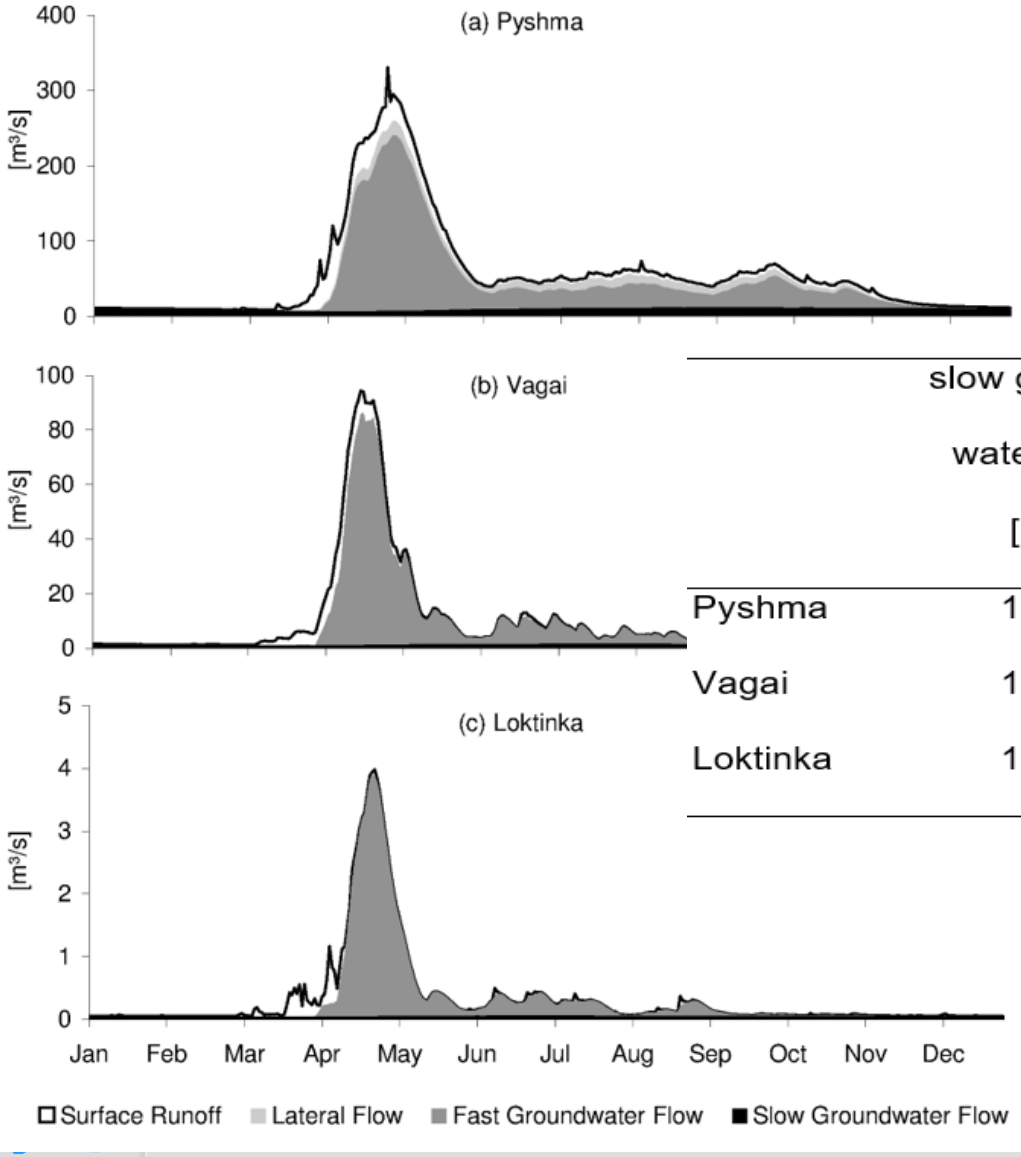
Current hydrological status

- high seasonal and spatial variability
- Snowmelt driven floods in spring
- High retention and groundwater flow dominating



Photos: Kiesel (2013)

Ecohydrological model results: Flow regime



	slow ground-water flow [%]	fast ground-water flow [%]	lateral flow [%]	surface runoff [%]
Pyshma	17.1	58.0	10.1	14.8
Vagai	13.8	74.6	0.001	11.7
Loktinka	15.4	75.2	0.0	9.4

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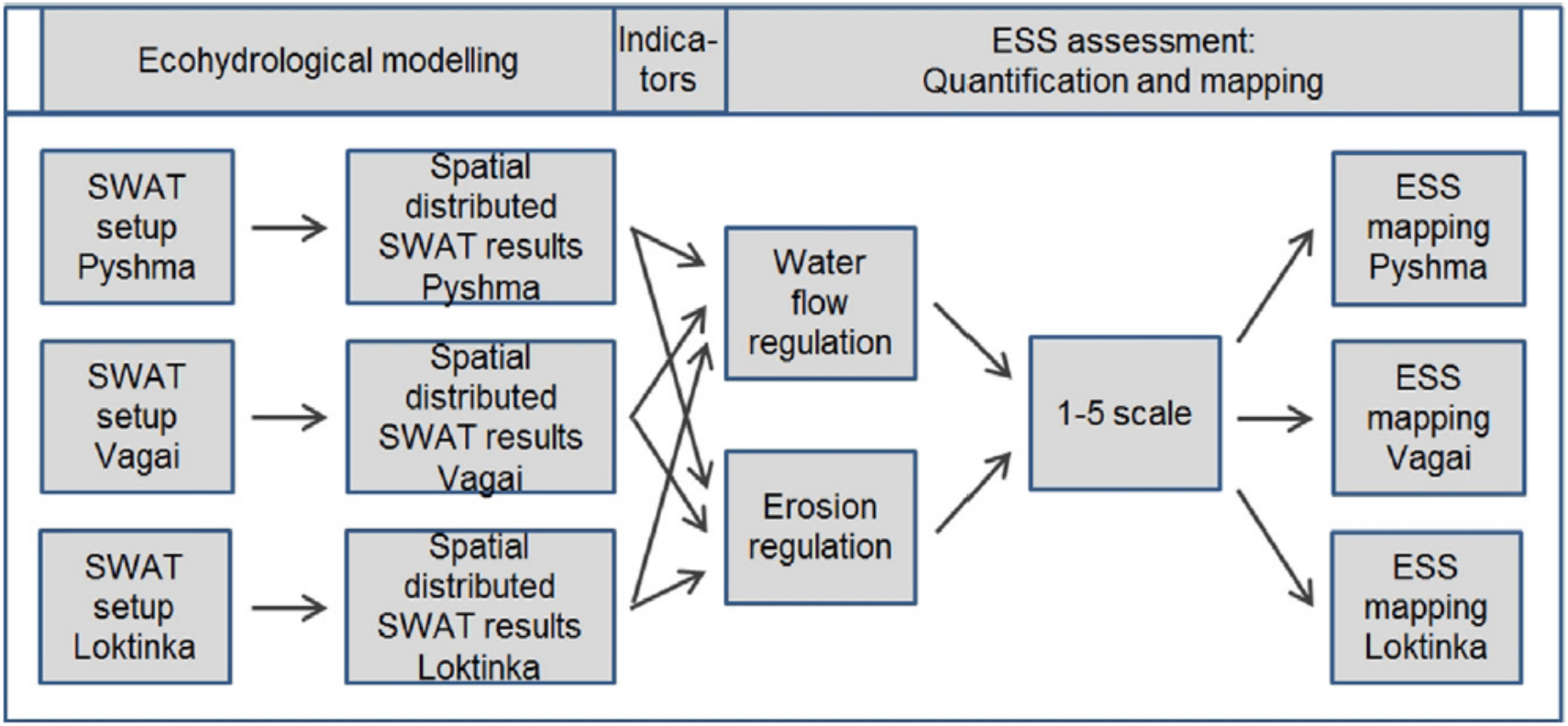
Kiesel, J., Schmalz, B. Fohrer, N,. 2017

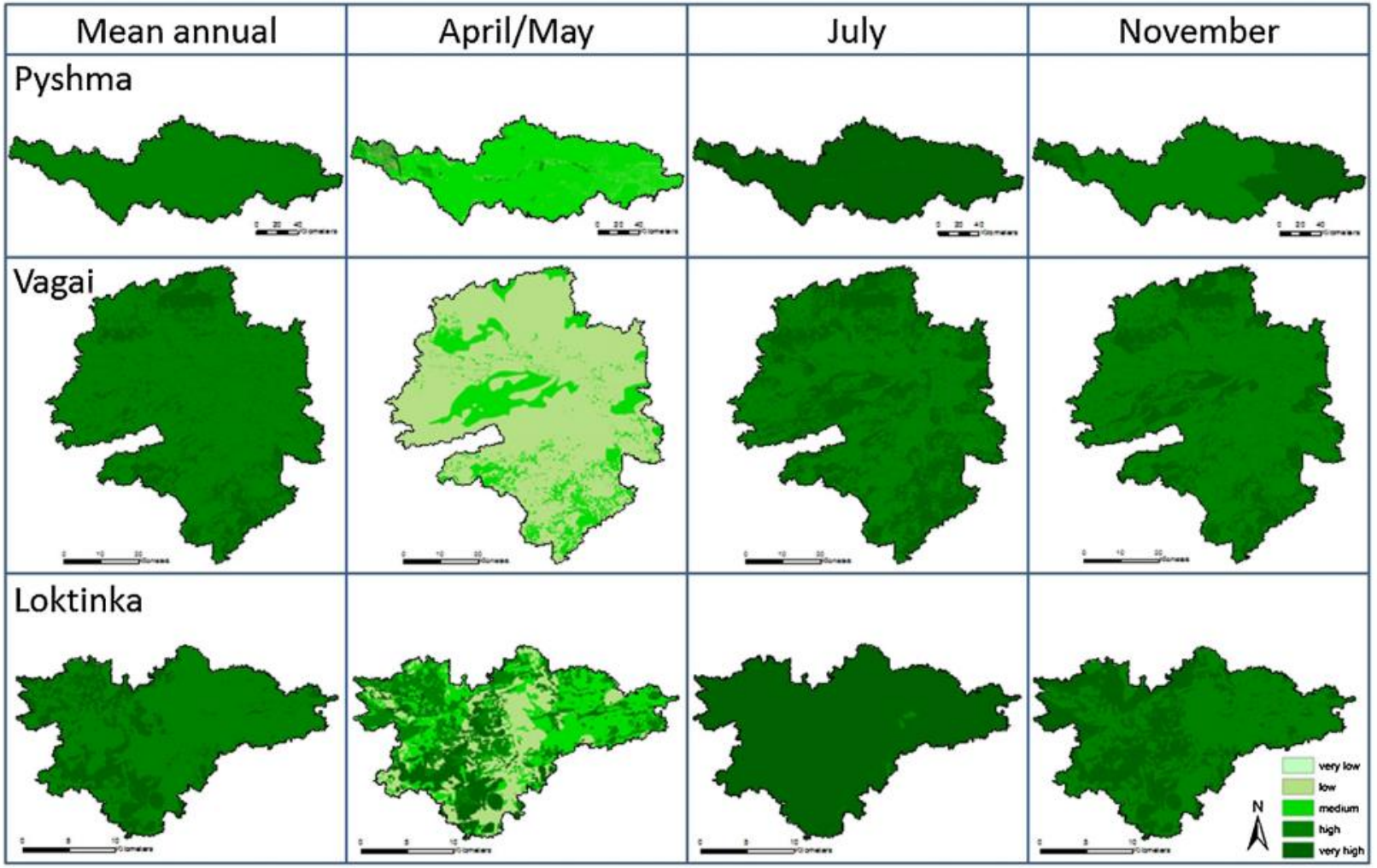
Ecosystem Services



Data analyses based on indicator generation, transformation of the biophysical model output values into a relative 1–5 scale, and mapping of the selected regulating ecosystem service (ESS)

Schmalz, B., Kruse, M., Kiesel, J., Müller, F., & Fohrer, N. (2016): *Ecological Indicators* 71, 55-65

Ecosystem Services: Water flow regulation



means for 2005–2010

Schmalz, B., Kruse, M., Kiesel, J., Müller, F., & Fohrer, N. (2016): *Ecological Indicators* 71, 55-65

Conclusions

- 1. linking IWRM and biodiversity
  - Interdisciplinary field campaings necessary
  - Linking hydrology and hydraulics to model aquatic biodiversity as a function of global change
- 2. linking IWRM and ESS concept
  - Interdisciplinary field campaings necessary
  - Define water-related ESS
  - Interdiciplinary assessment
- 3. necessary to reach SDG 6,3, 6.5, 6.6!


Thank you for your kind attention
nfohrer@hydrology.uni-kiel.de