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Leibniz Centre for Agricultural Landscape Research

Kettle holes: Hot-spots of biodiversity, carbon dynamics and greenhouse gas emissions in an agricultural landscape

G. Lischeid*, K. Attermeyer, P. Bodmer, P. Casper, S. Flury, A. Freibauer, A. Gessler, H.-P. Grossart, S. Hilt, C. Hoffmann, A. Jaconi, T. Kalettka, Z. Kayler, G. Kazanjian, A. Kleeberg, C. Lisboa, D. McGinnis, K. Nitzsche, M. Omari, M. Pätzig, K. Pirhofer-Walzl, K. Premke, F. Reverey, M. Sommer

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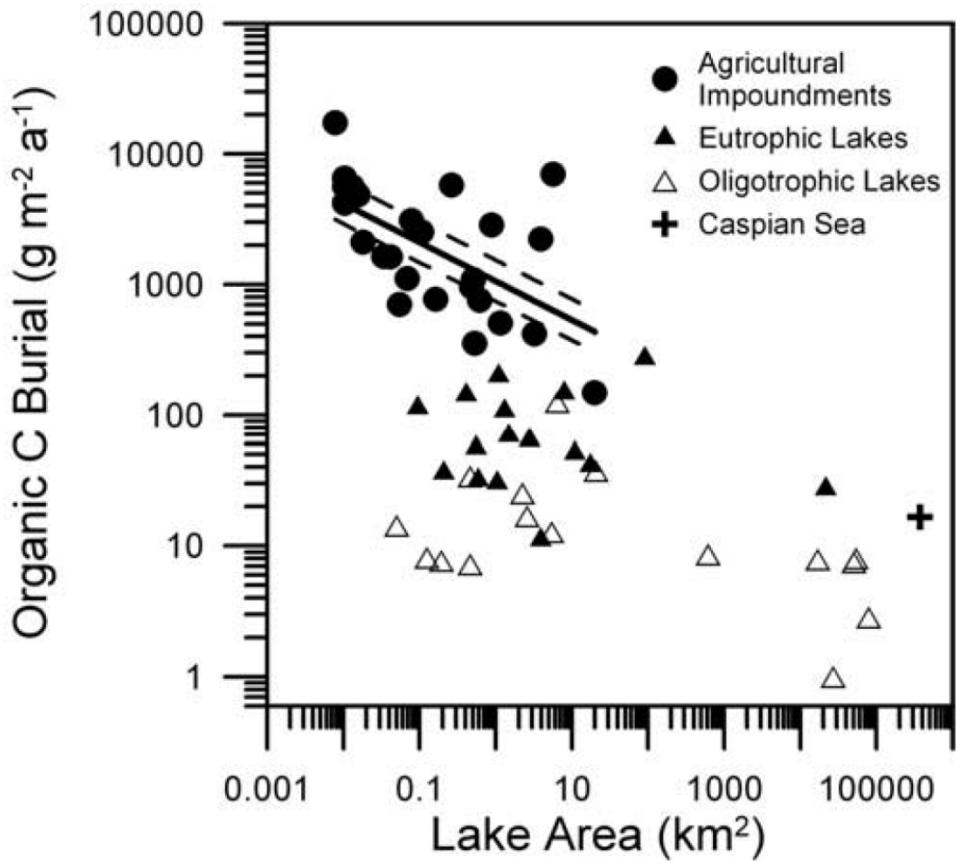
Small Lakes

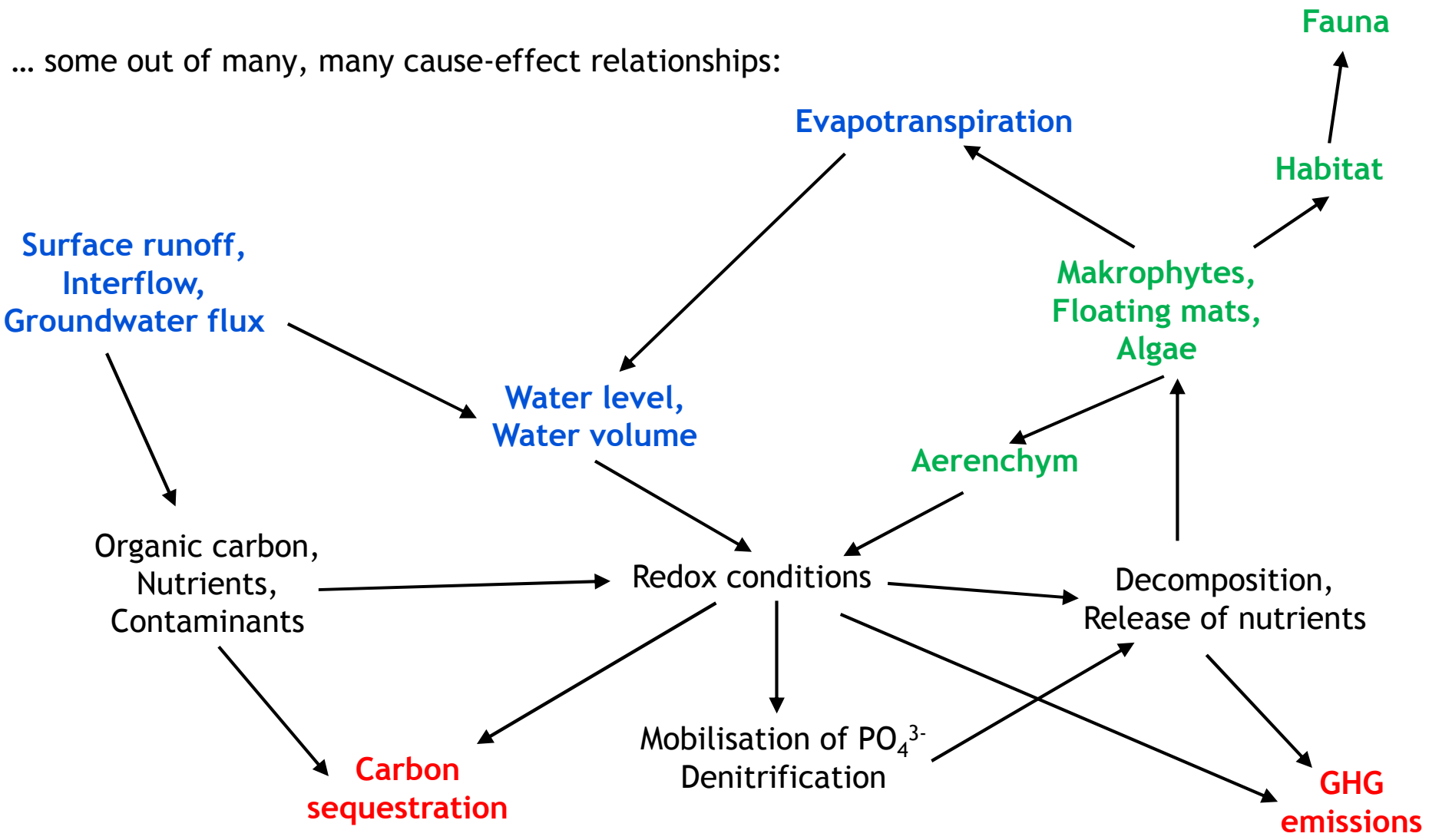
Downing et al. (2008):

- "Impoundments may bury 4 times as much carbon as the world's oceans."
- "The world's farm ponds alone may bury more organic carbon than the oceans"



Hotspots

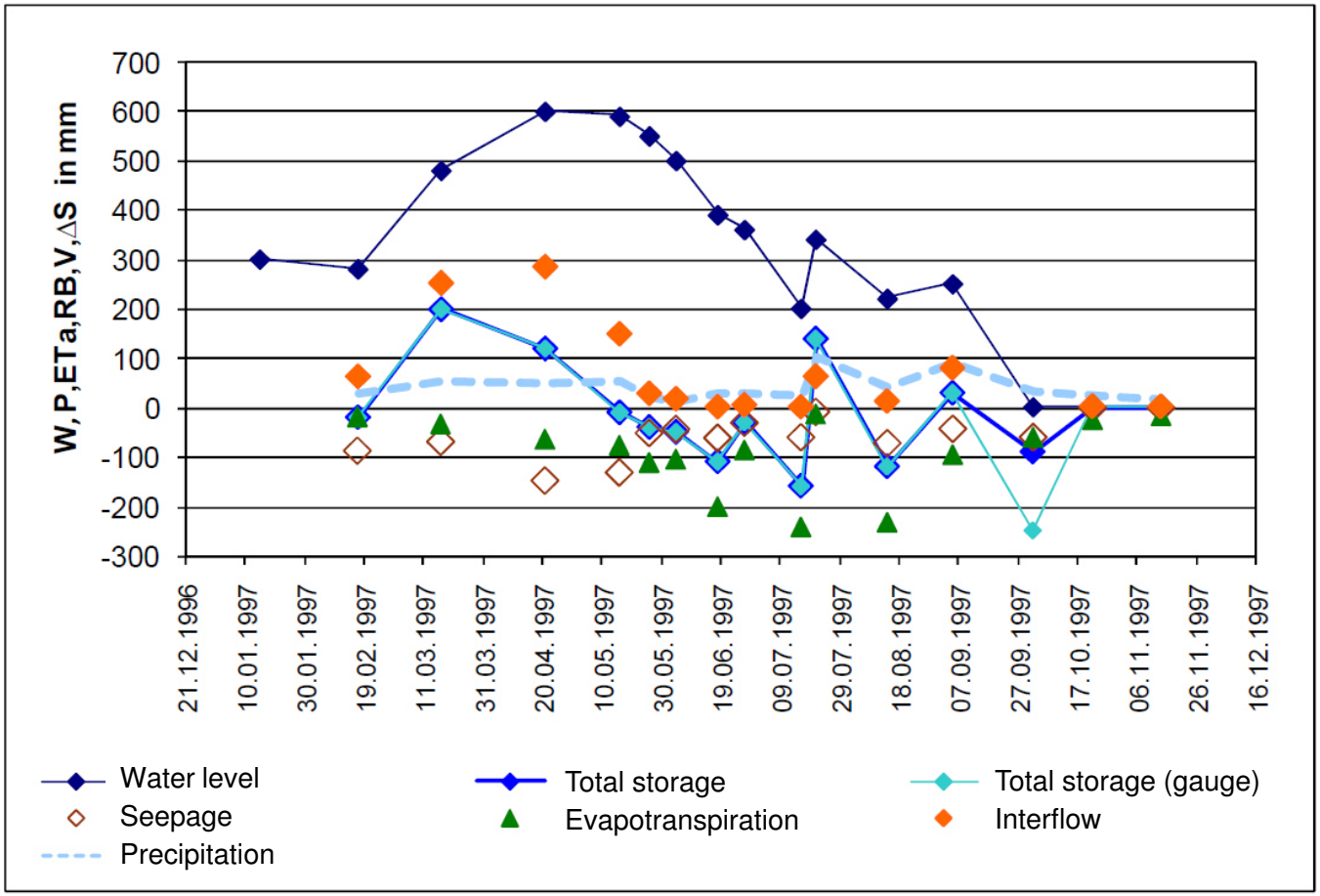
… some out of many, many cause-effect relationships:



Water Budget of a Kettle Hole

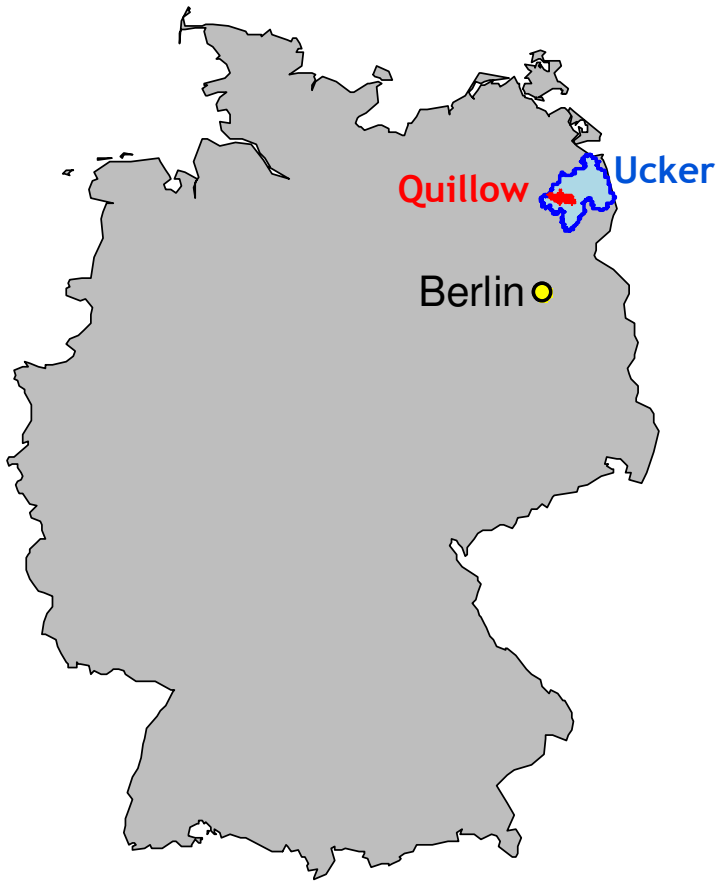
Kettle Hole MuGO3

(Riehl 2010)



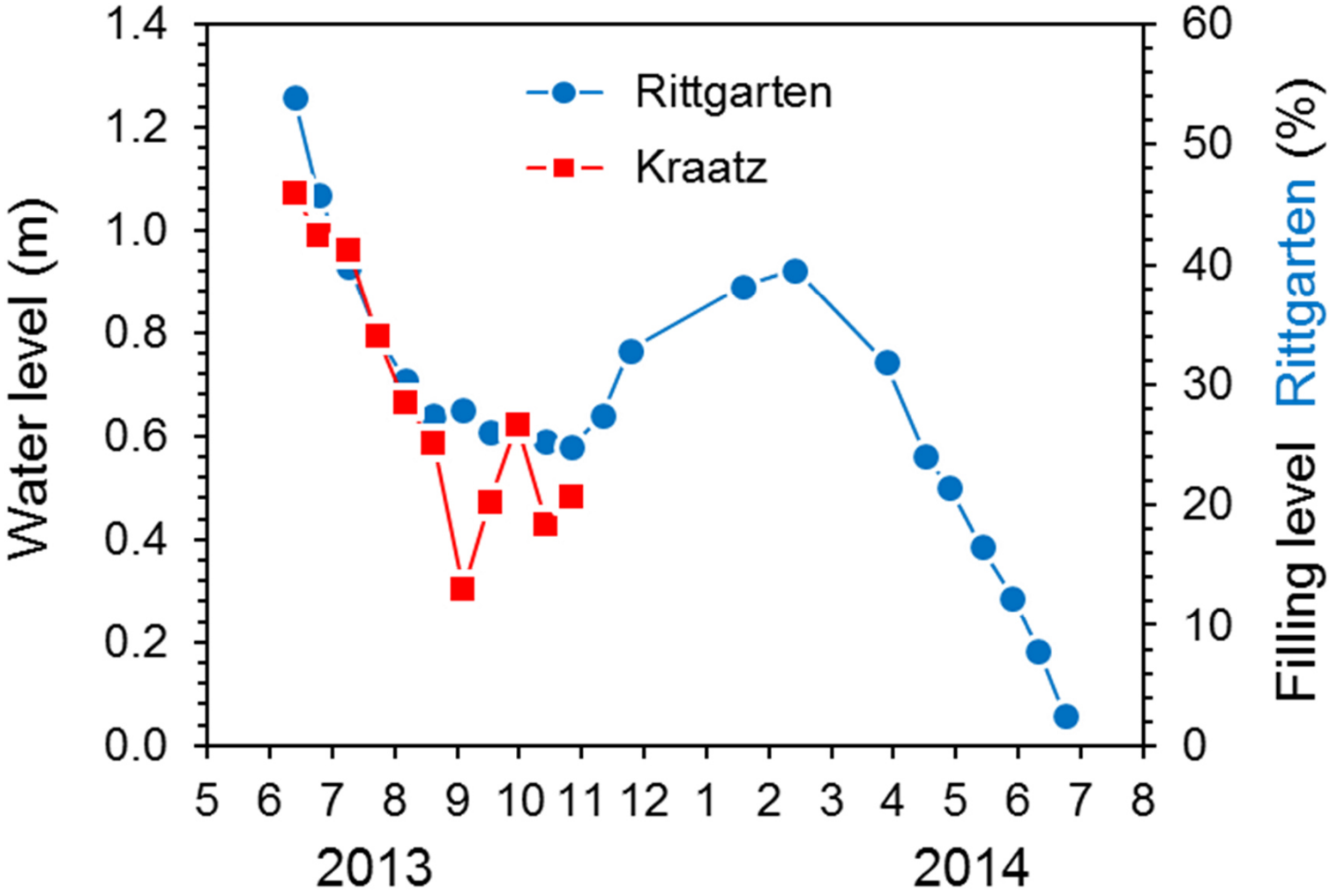
Quillow Catchment

- Part of TERENO Northeast Germany
- Pleistocenic lowlands of Northeast Germany
- Tributary to the U(e)cker
- Area 168 km^2 (188 km^2)
- Elevation 14 – 157 m a.s.l.
- Annual mean temperature (1961-1990): 7,8°C
- Annual mean precipitation (1961-1990): 508 mm
- Agricultural landuse: 73.5%
- Soils: 86,2% loam, 8,8% sand, 5% wetlands

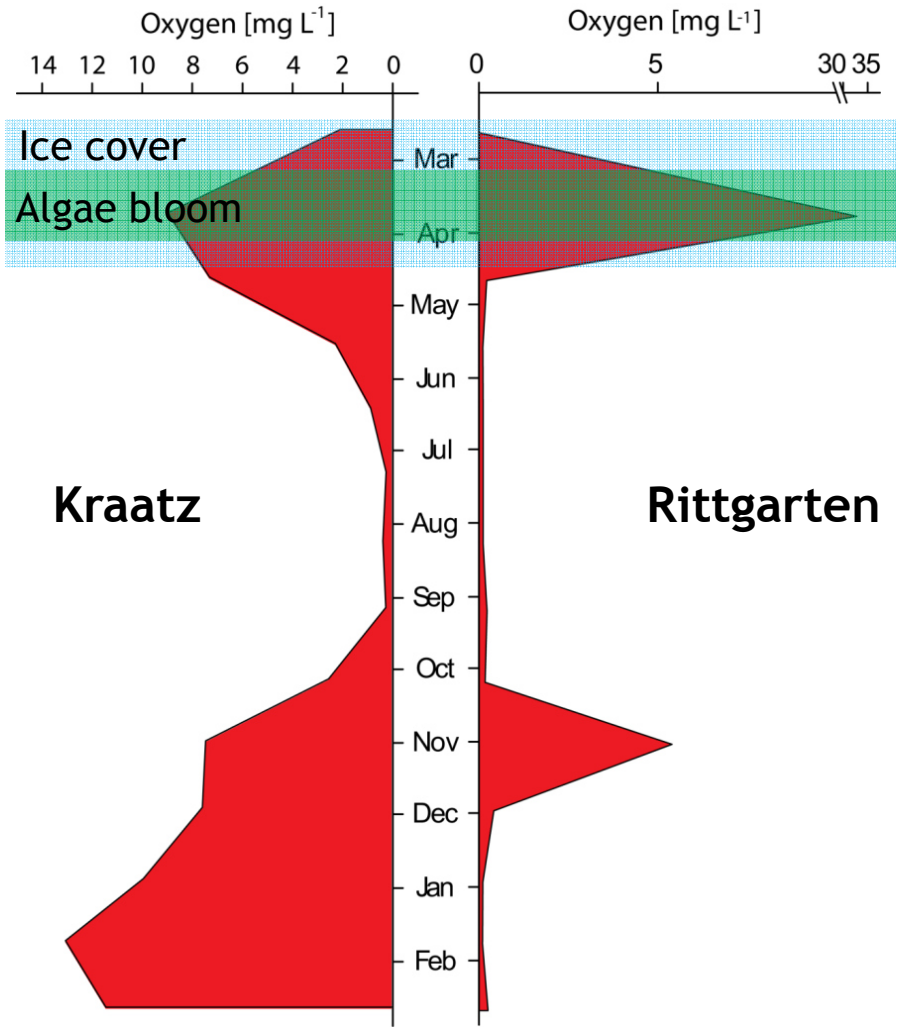


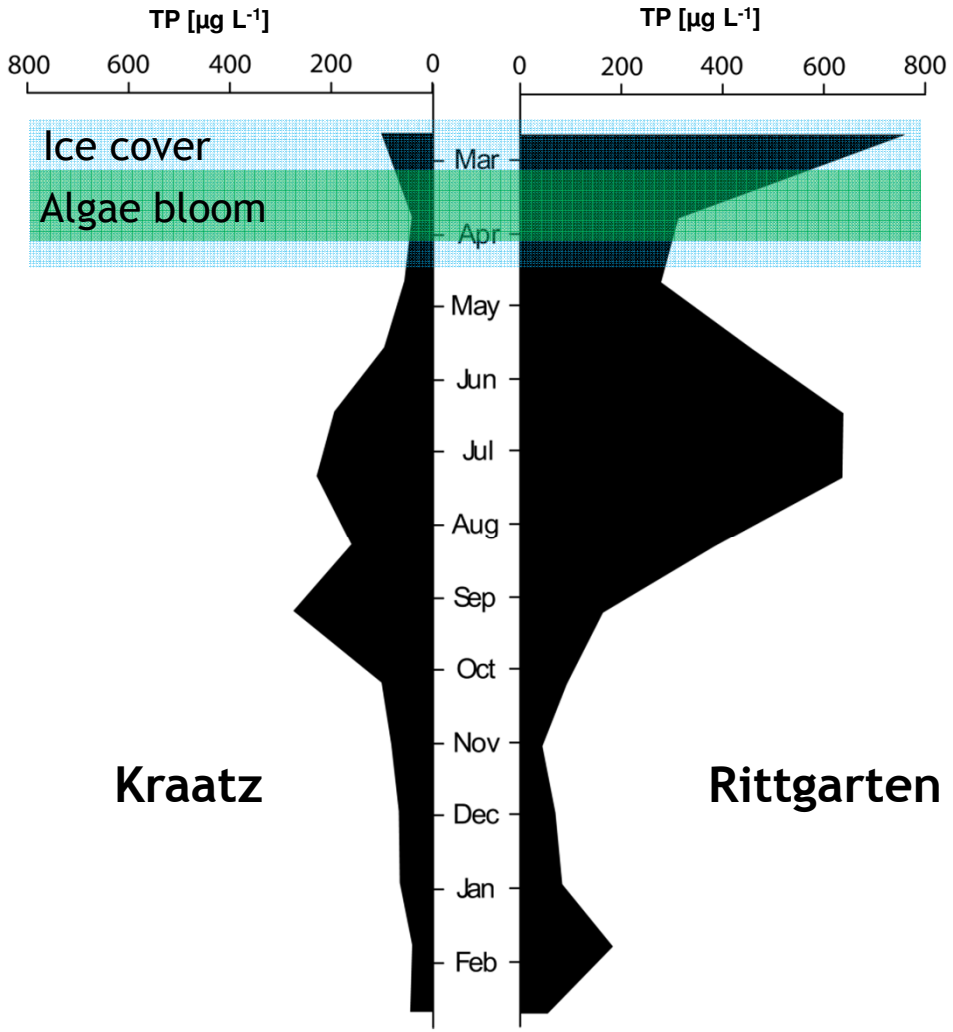
Intensively Studied Kettle Holes

Water Level (T. Kalettka)

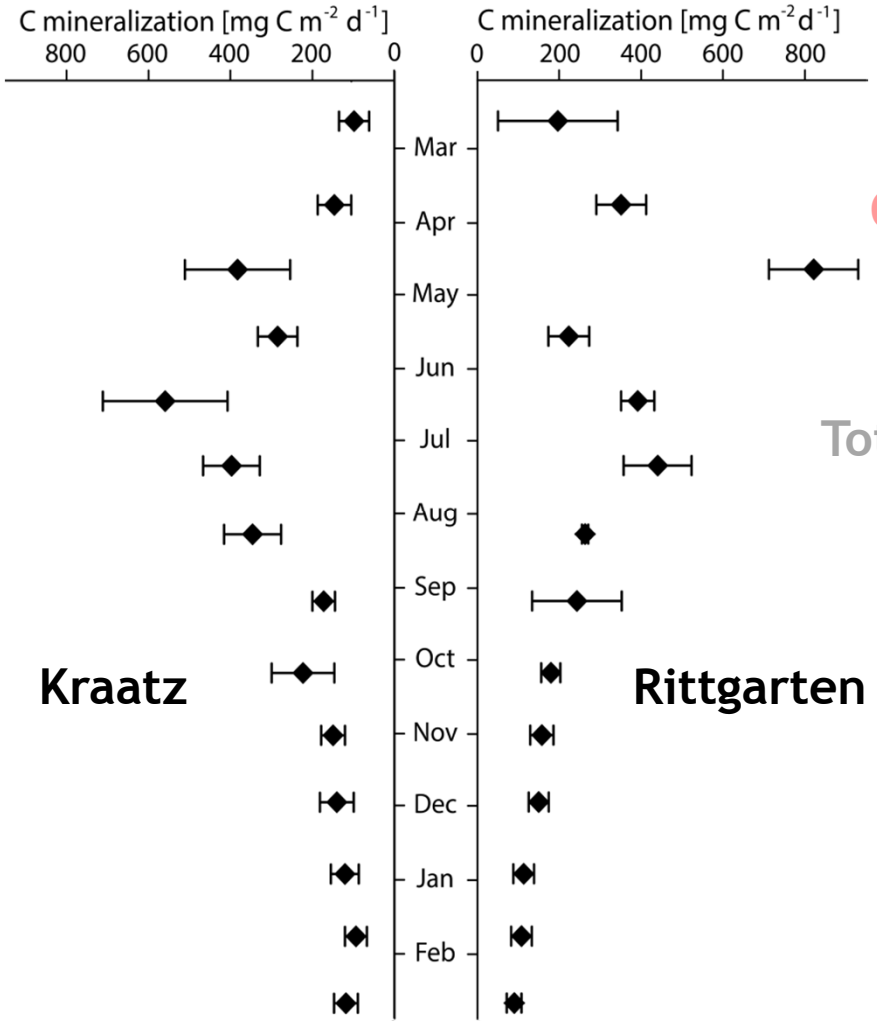


Water Quality: O_2 and TP (S. Flury, K. Attermeyer)





Mineralization (Sediment Cores) (S. Flury, K. Attermeyer)



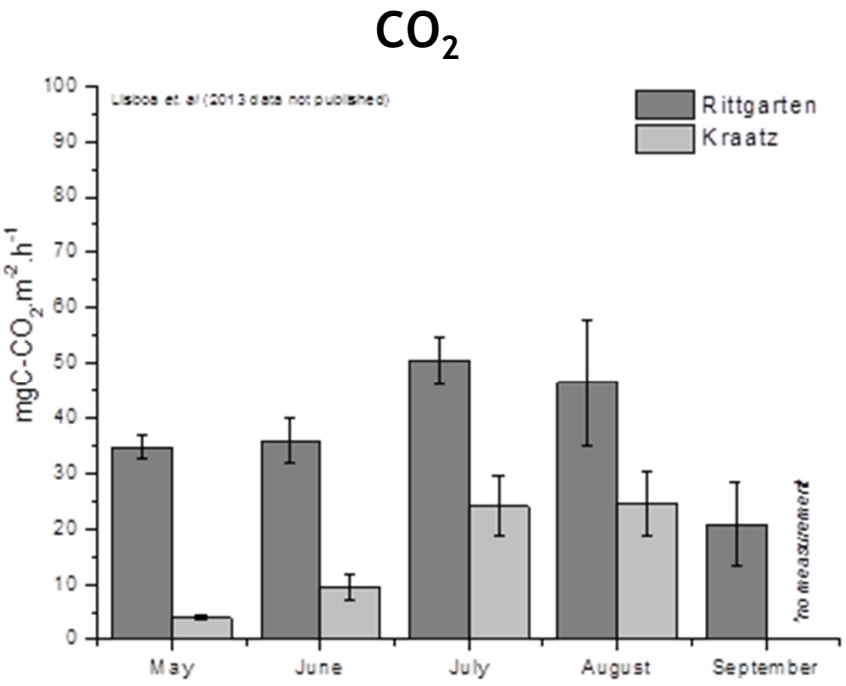
Oxygen

Total phosphorous

GHG Emissions (C. Lisboa, A. Freibauer, P. Casper)

Measurements:

- CO_2 and CH_4 fluxes using opaque dynamic chambers
- Gas concentration measured by OA-ICOS technique



GHG Emissions (C. Lisboa, A. Freibauer, P. Casper)

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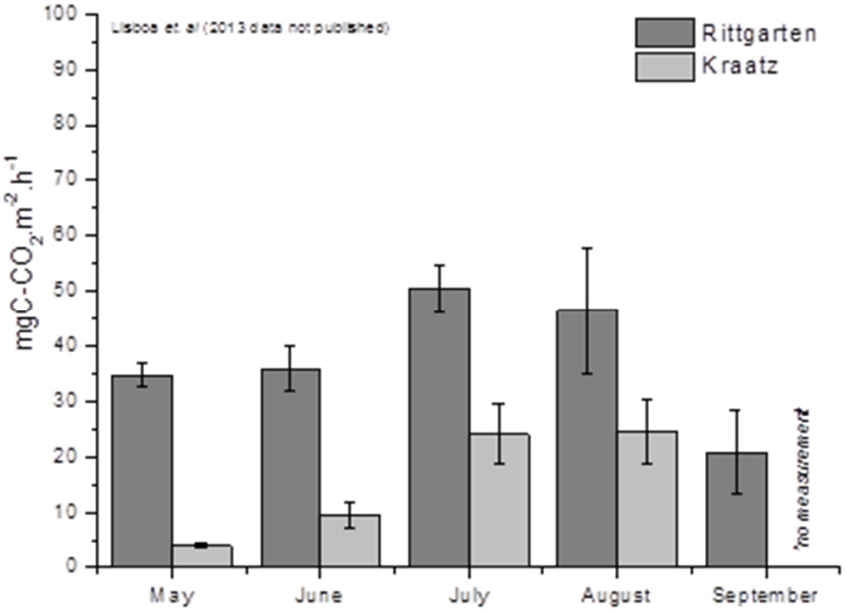
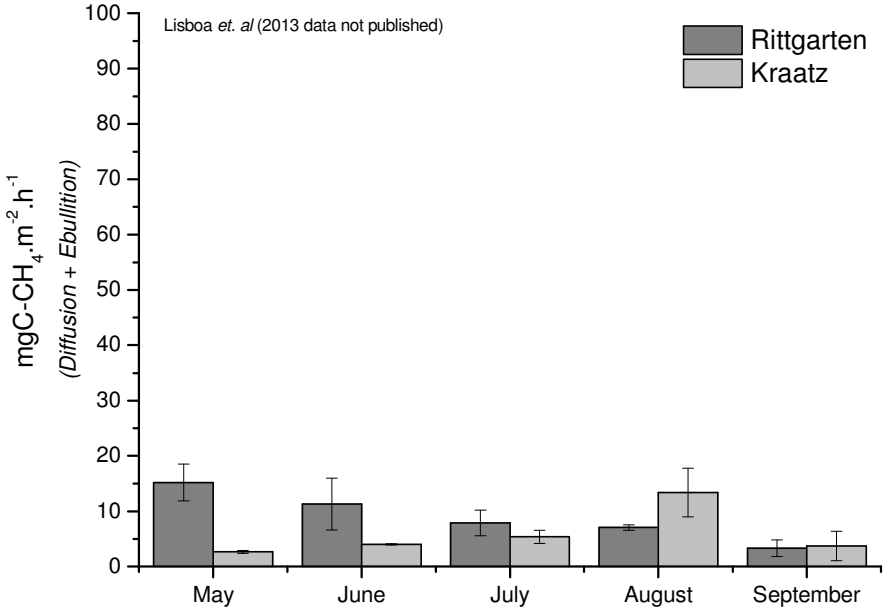
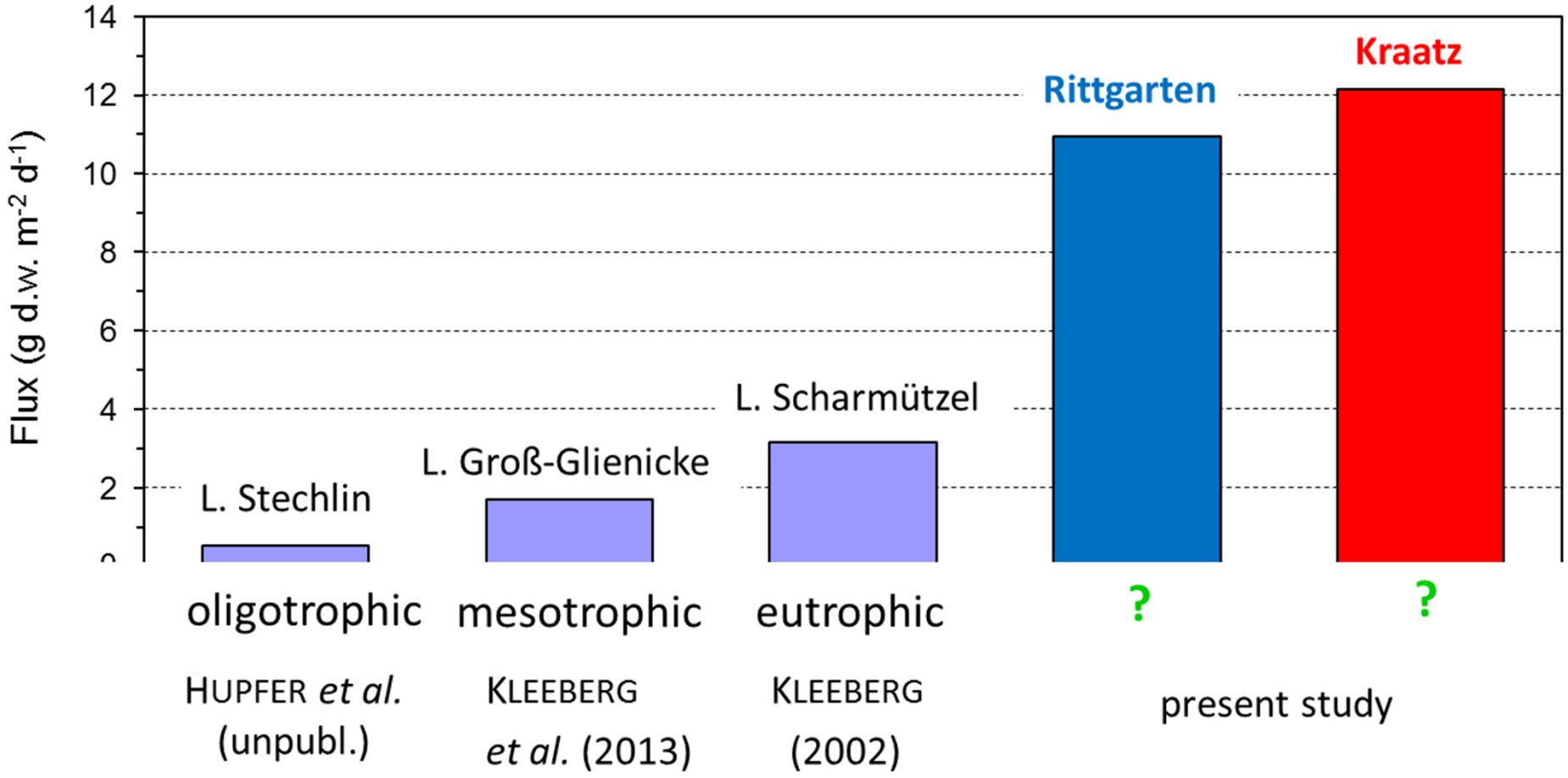
CO_2



CH_4

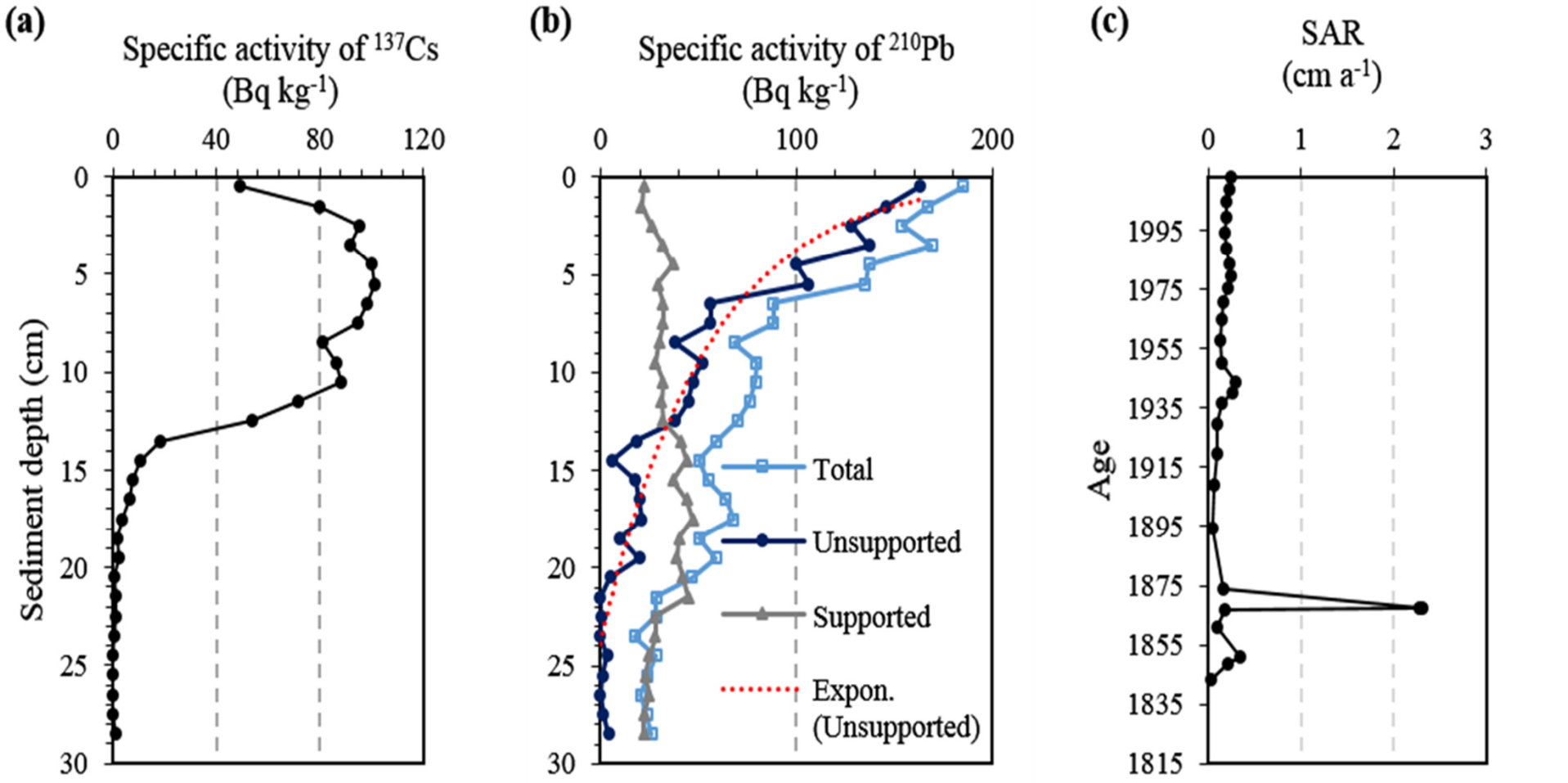


Sedimentation Rate (T. Kalettka, A. Kleeberg)

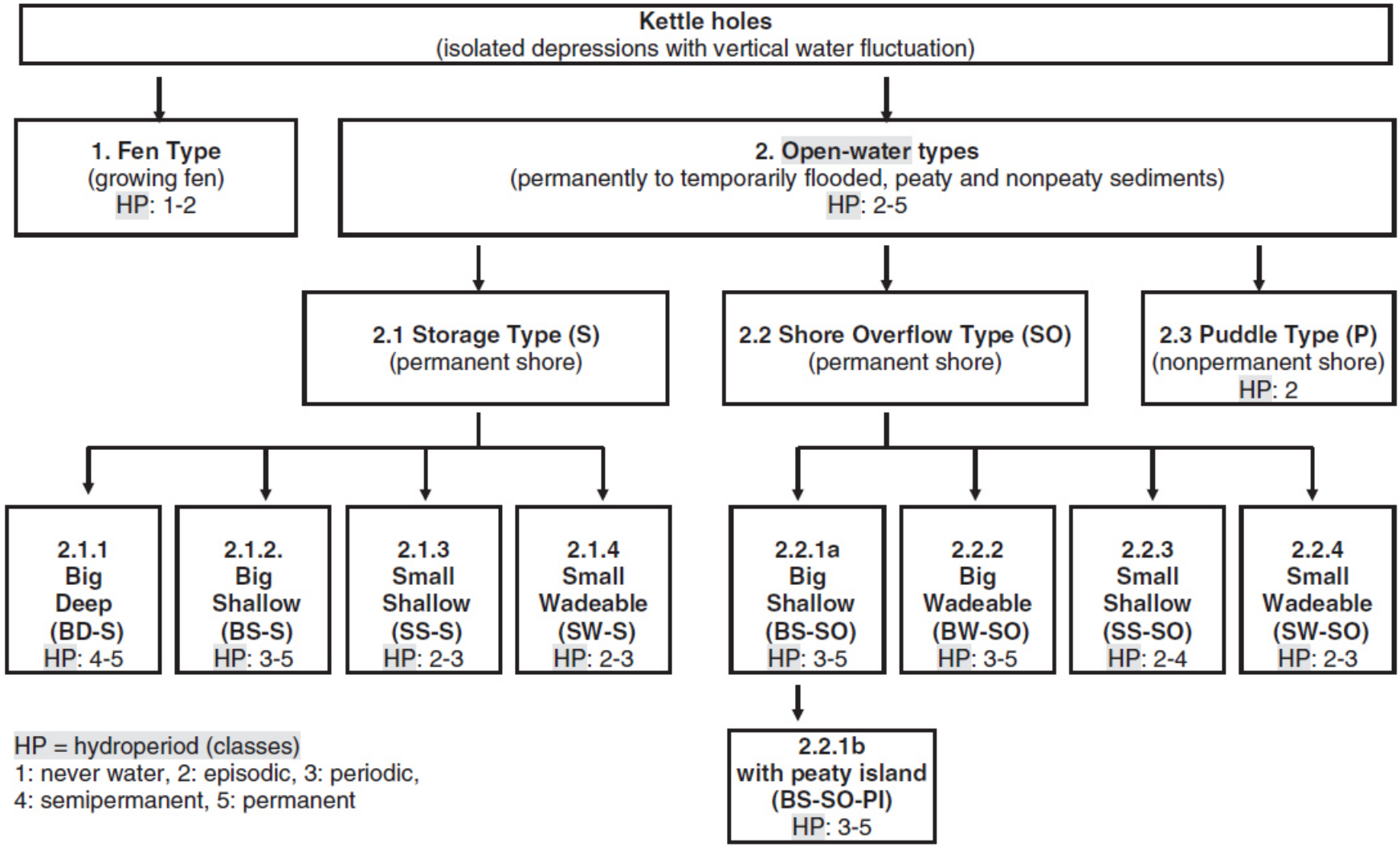


Sediment Core Rittgarten (T. Kalettka, A. Kleeberg, M. Neyen, U.-K. Schkade)

Sediment Accretion Rate



Hydrogeomorphic Classification (Kalettka and Rudat 2006)



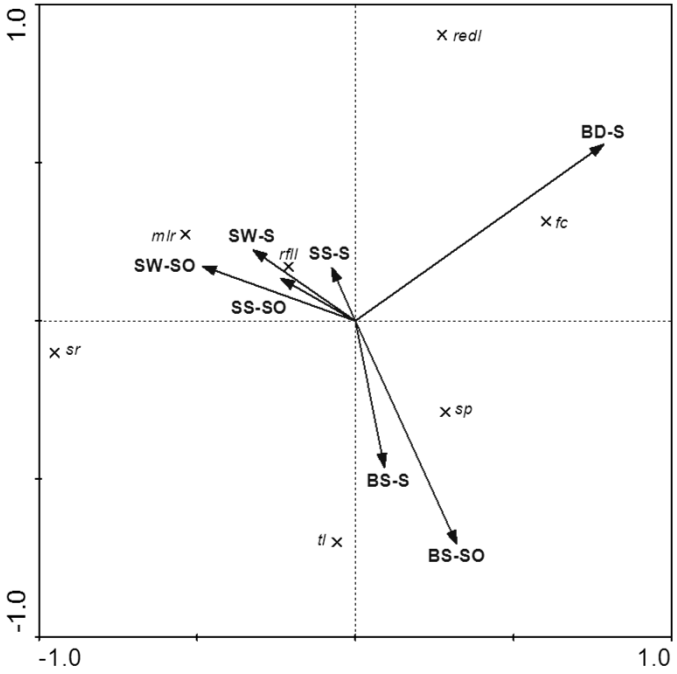
Macrophytes in Kettle Holes

Canonical Correspondence Analysis:

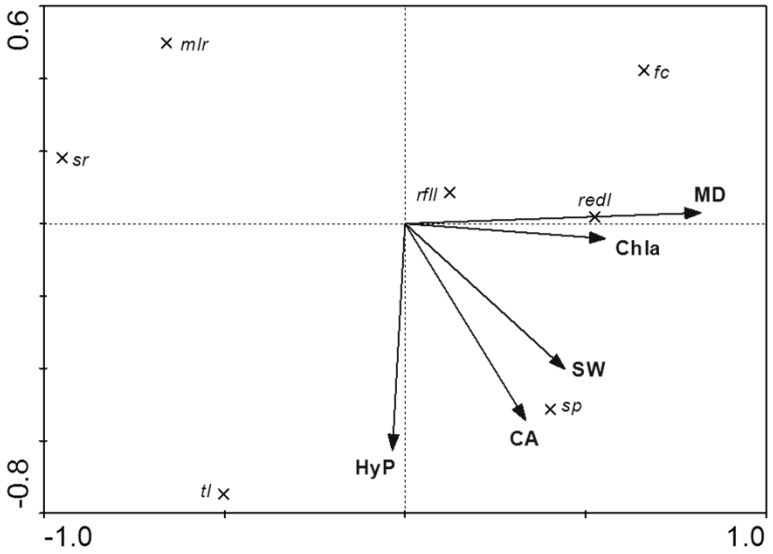
Richness of growth forms (199 kettle holes)

(Pätzig et al. 2012)

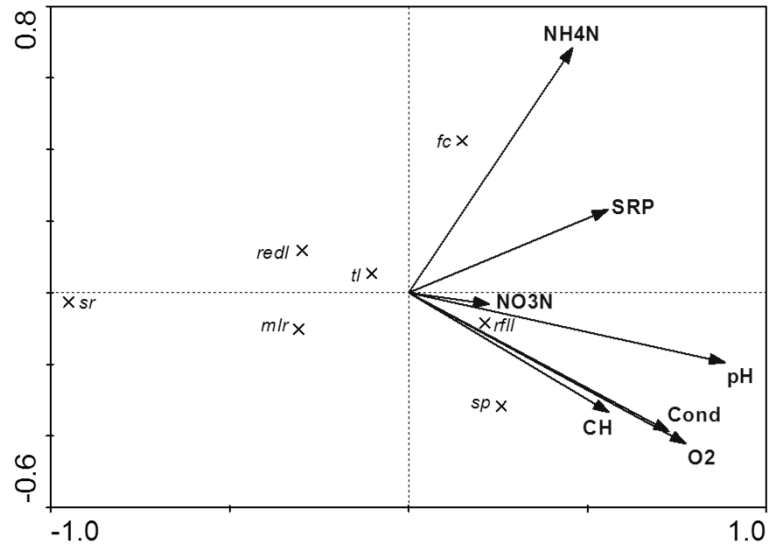
Hydrogeomorphic types (5.1%)



Physical parameters (8%).

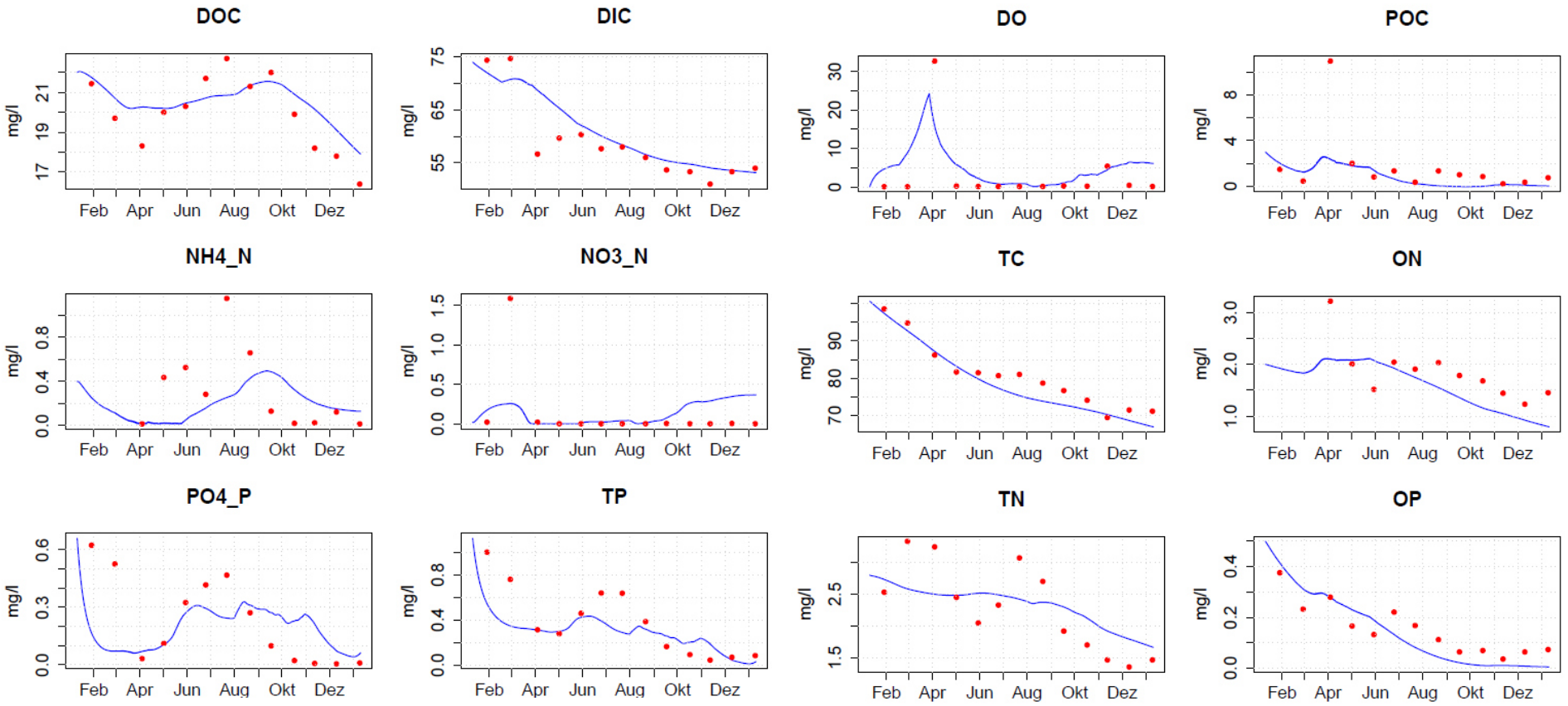


Chemical parameters (5.3%).



Model of Carbon and Nutrient Dynamics (M. Omari, G. Lischeid)

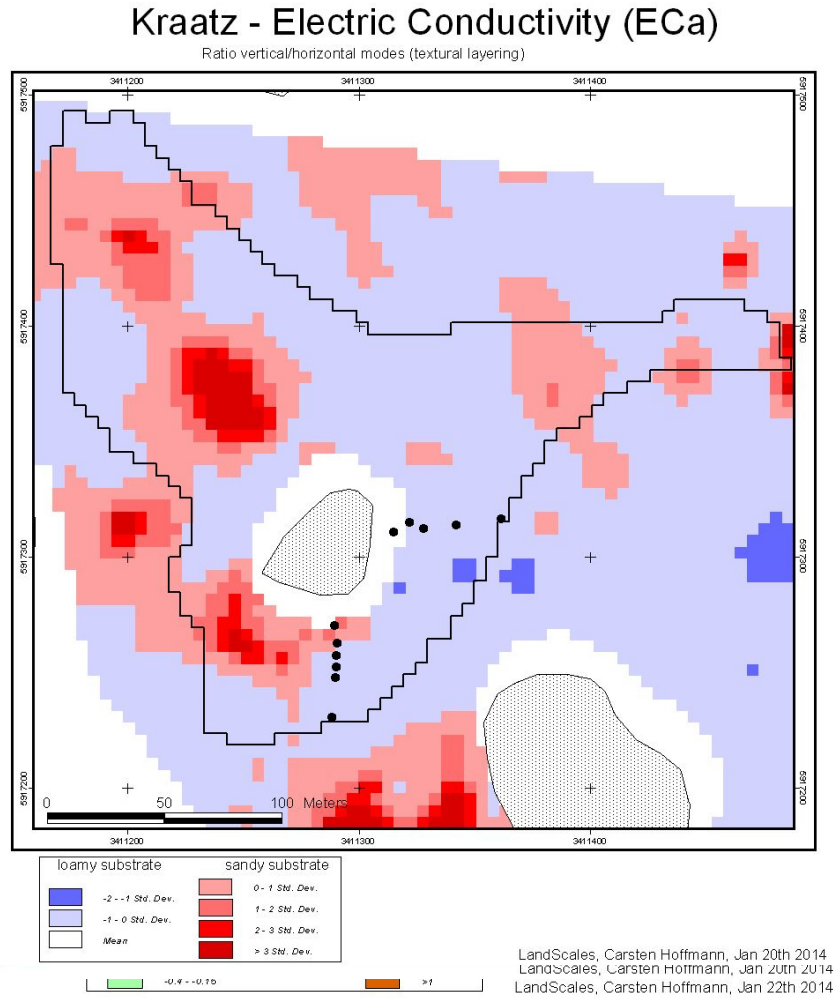
Rittgarten kettle hole



Topography, Soils, Vegetation (C. Hoffmann, M. Sommer)

Description of soils / vegetation dynamic by

-Topographic analyses
-Soil augering (50 points)
-NDVI (Rapid Eye)
-LAI measurements
-Electric conductivity (ECa)

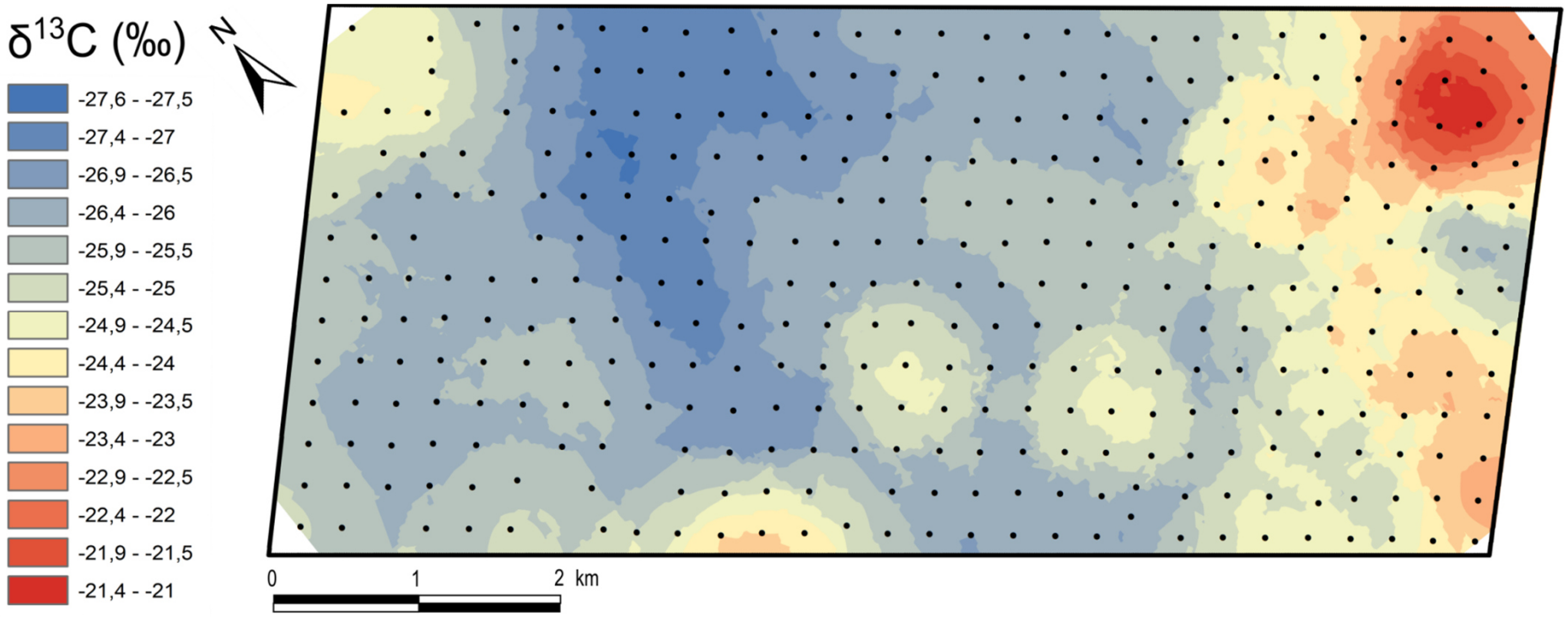


IsoScapes (K. Nitzsche, Z. Kayler)

Patterns of top soil $\delta^{13}C$, related to

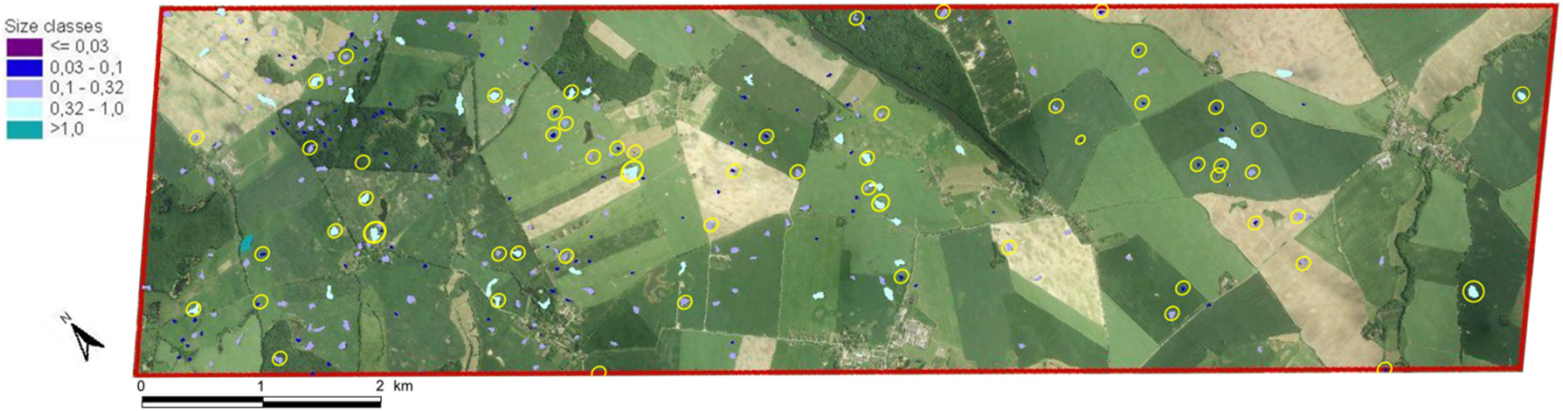
- Forest and crop plant type (C3 vs. C4)
- Land managment history

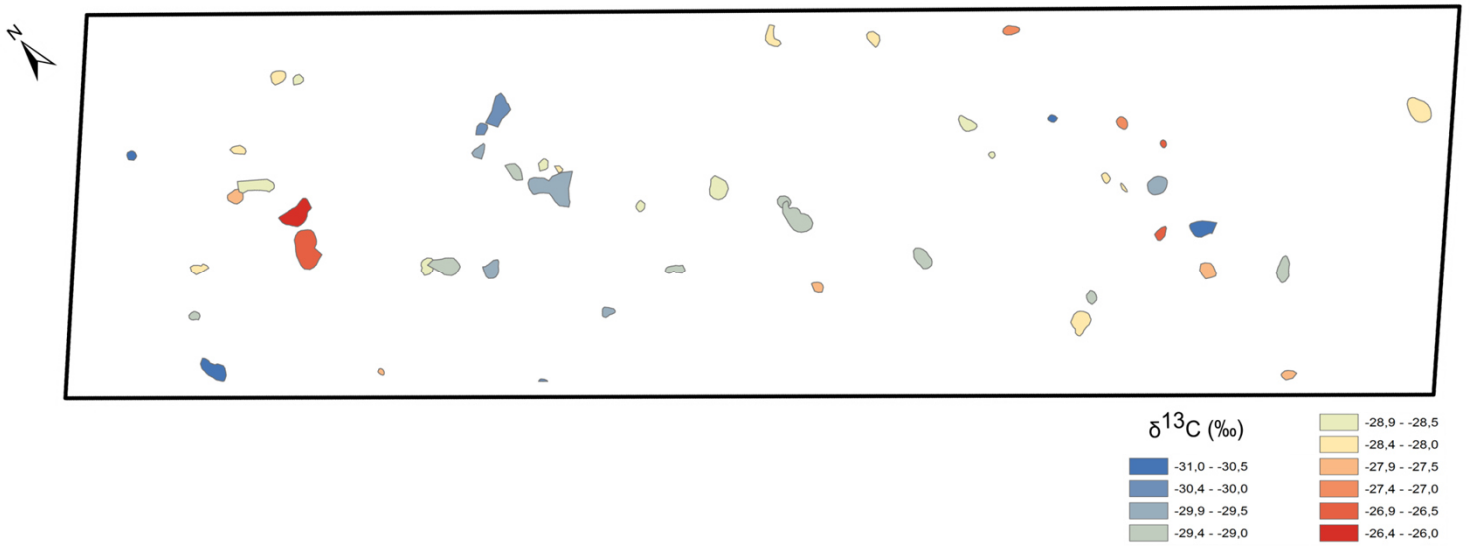
- Sampling area: 11.5 km * 3 km
- Soil: 250 m grid, plant and soil samples
- 50 Kettle holes → 120 sediment cores, 130 plant, 50 water samples



IsoScapes (K. Nitzsche, Z. Kayler)

Kettle holes:



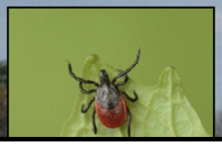


AgroScapeLabs (K. Pirhofer-Walzl)

Agro ScapeLabs

Bats: Impact of land use and landscape structure and relativ insect abundance on bat diversity and bat activity

Plant-microorganism-interactions: Landscape complexity, land use intensity and microclimate as multifactorial drivers of the diversity of plant-microbes-interactions



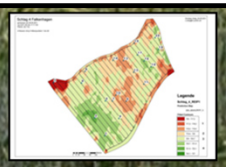
Small mammals/thicks/lyme-borreliosis: Impact of land use and landscape structure on the transmitting of lyme-borreliosis

Distribution of small mammals: Impact of land use, resource dynamics and habitat fragmentation on small mammals in agricultural landscapes

BBIB (Berlin-Brandenburg Institute of Advanced Biodiversity Research):
IZW (Leibniz Institute for Zoo and Wildlife Research)
TUB (Technical University of Braunschweig)
TUM (Technical University of Munich)
UP (University of Potsdam)
ZALF (Leibniz Centre for Agricultural Landscape Research)

Land-use change and bird diversity: Investigate the relationship between long-term change of bird communities, land use change and habitat composition

Impact of land use and landscape structure on the plant diversity and composition of kettle holes embedded in agricultural landscapes



In-field heterogeneity and plant diversity: Impact of land management on heterogeneity driven biotic processes

Concluding Remarks

- Kettle holes at the aquatic-terrestrial interface are a paramount example for ***highly interconnected systems*** at the interface between hydrology, soil science, biogeochemistry, biology, … and require a joint interdisciplinary approach.
- Want to learn more or to contribute? Session submitted for ***EGU General Assembly 2015***, Vienna (BG4 – Freshwater Biogeosciences and HS10 – Ecohydrology, Limnology, and Estuaries)
- Links:
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  - www.scapelabs.org
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  - lischeid@zalf.de