TRACER
HELMHOLTZ INTERNATIONAL RESEARCH SCHOOL ON
Trajectories towards water security

TECHNISCHE UNIVERSITÄT DRESDEN

UF | UNIVERSITY of FLORIDA

UFZ HELMHOLTZ Centre for Environmental Research

UNIVERSITÄT KOBLENZ · LANDAU

Session 4: How to research transformative changes?

Can combining functional and structural metrics help to develop better assessments of ecosystem health?

Hugo Enrique Reyes Aldana

hugo.aldana@ufz.de @hugorealdana

Ute Risse-Buhl @dr_uribu

Markus Weitere

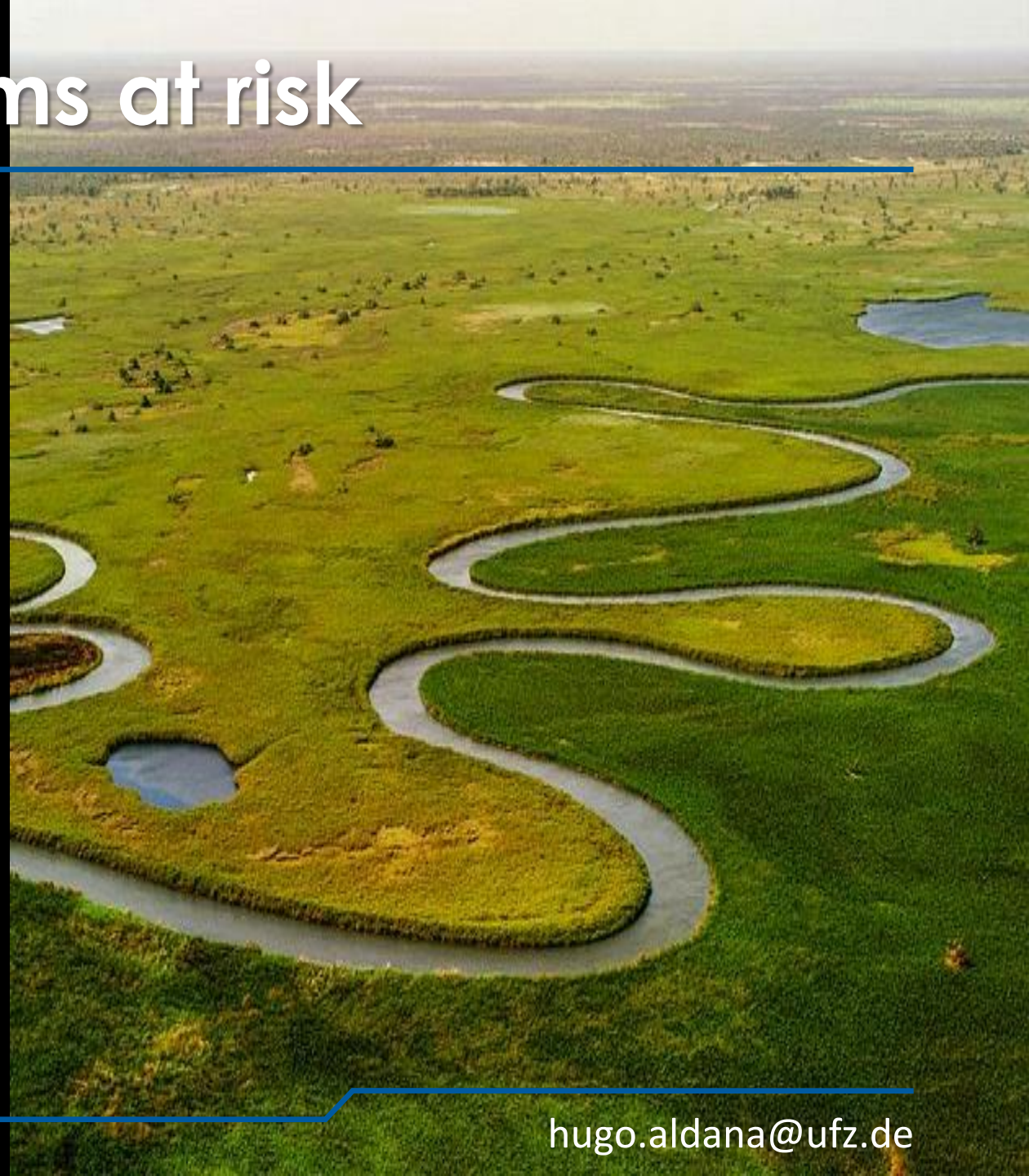
Matthew Cohen @DrAquaMatt

Daniel Graeber @StreamDaniel

Alternet conference
14-17 June 2022

Ecosystems at risk

- Rivers and streams are strongly threatened ecosystems
  - Anthropogenic activity (Brown et al. 2018, Nel et al. 2017)
  - Biodiversity loss (Soria et al. 2017; Arthington et al 2010)
  - Invasive species (Gallardo et al. 2016)
  - Habitat fragmentation (Fuller et al. 2015)
  - Etc.



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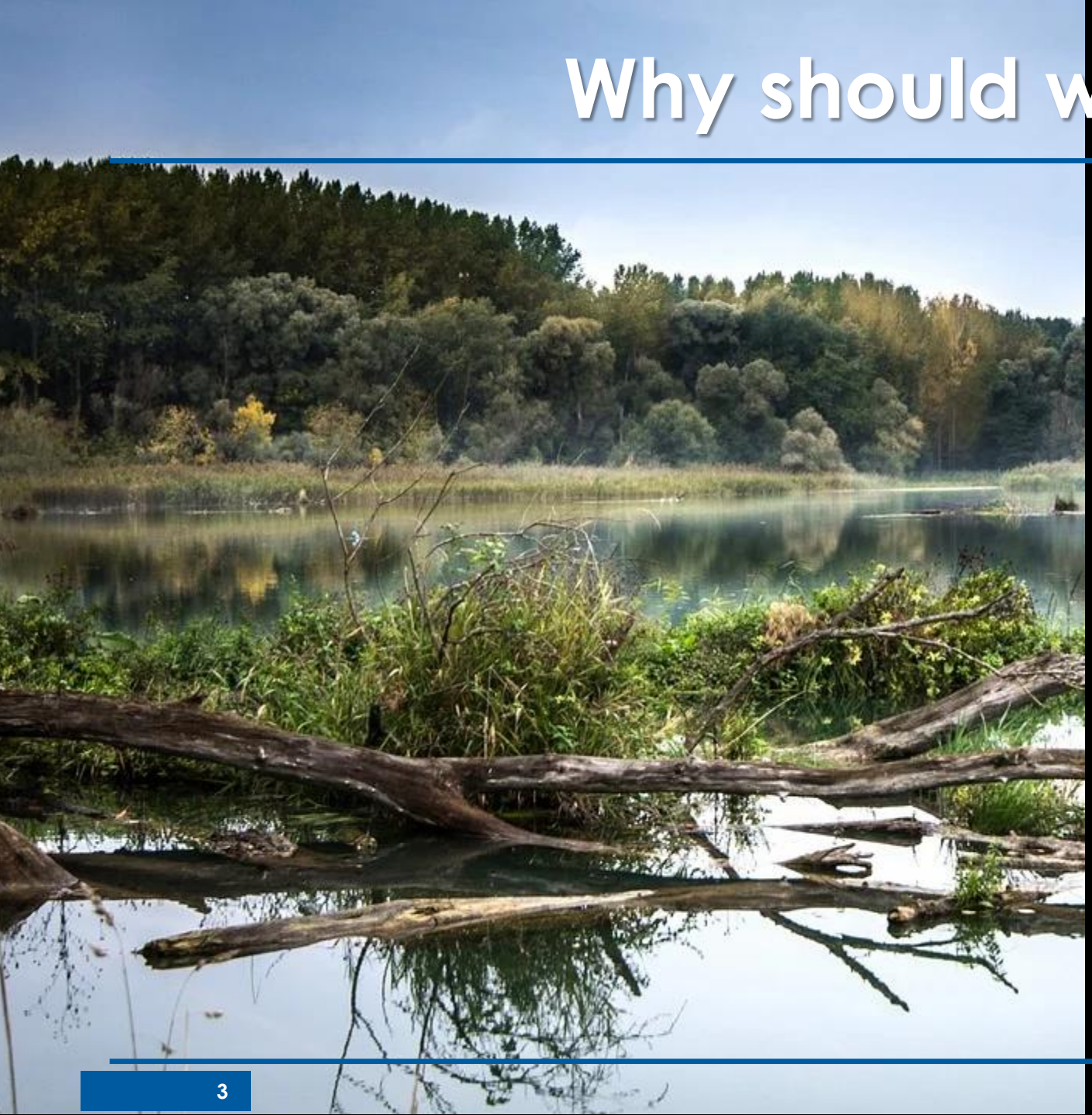
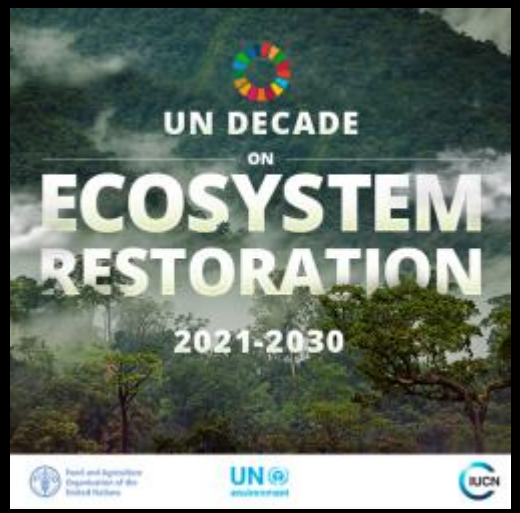
Why should we care?



- Rivers are the most biodiverse areas in the planet (Ward et al. 1999)
- Connection between terrestrial and aquatic ecosystems (Palmer & Febria, 2012)
- Provision of ecosystem services (Palmer & Febria, 2012)

What can we do?

- Management and Restoration
  - Planning
  - Personel
  - Long term
  - Expensive



The network for best practices of river restoration in Greater Europe
ECRR
European Centre for River Restoration

RIVER
RESTORATION.ORG

MISSISSIPPI
RIVER
NETWORK

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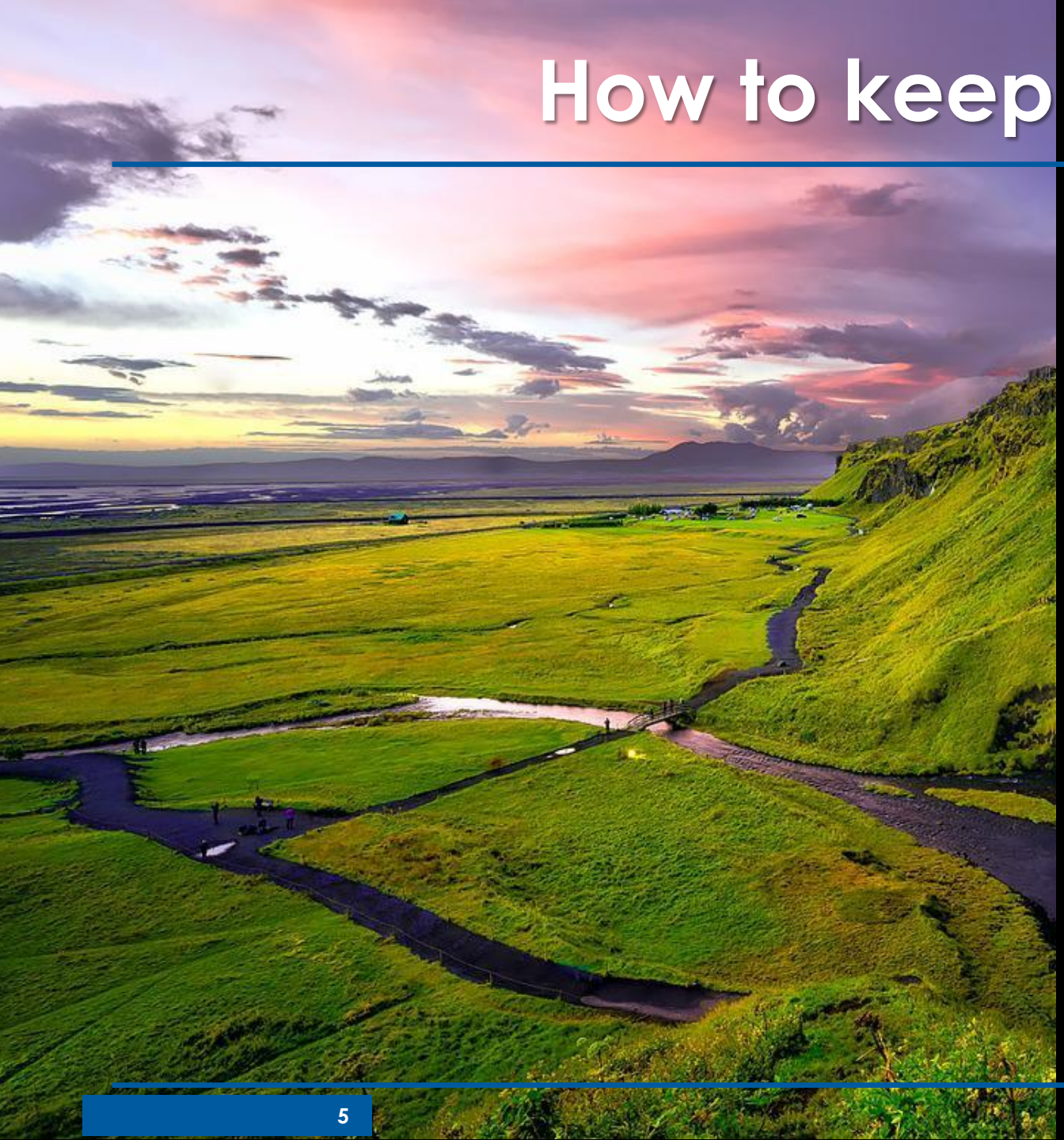
How to keep the track?



- Monitoring is essential for management and restoration
- WFD and CWA suggest use of structural and functional metrics
- Most assessments are done using functional metrics.
- Inadequate monitoring can lead to failure and waste of resources

Better than the others?

- Structural
  - Attributes
  - Point-in-time-measures
  - Reflect existing status of the ecosystem
- Functional
  - Interaction between the attributes
  - Ecological processes
  - Reflect dinamics

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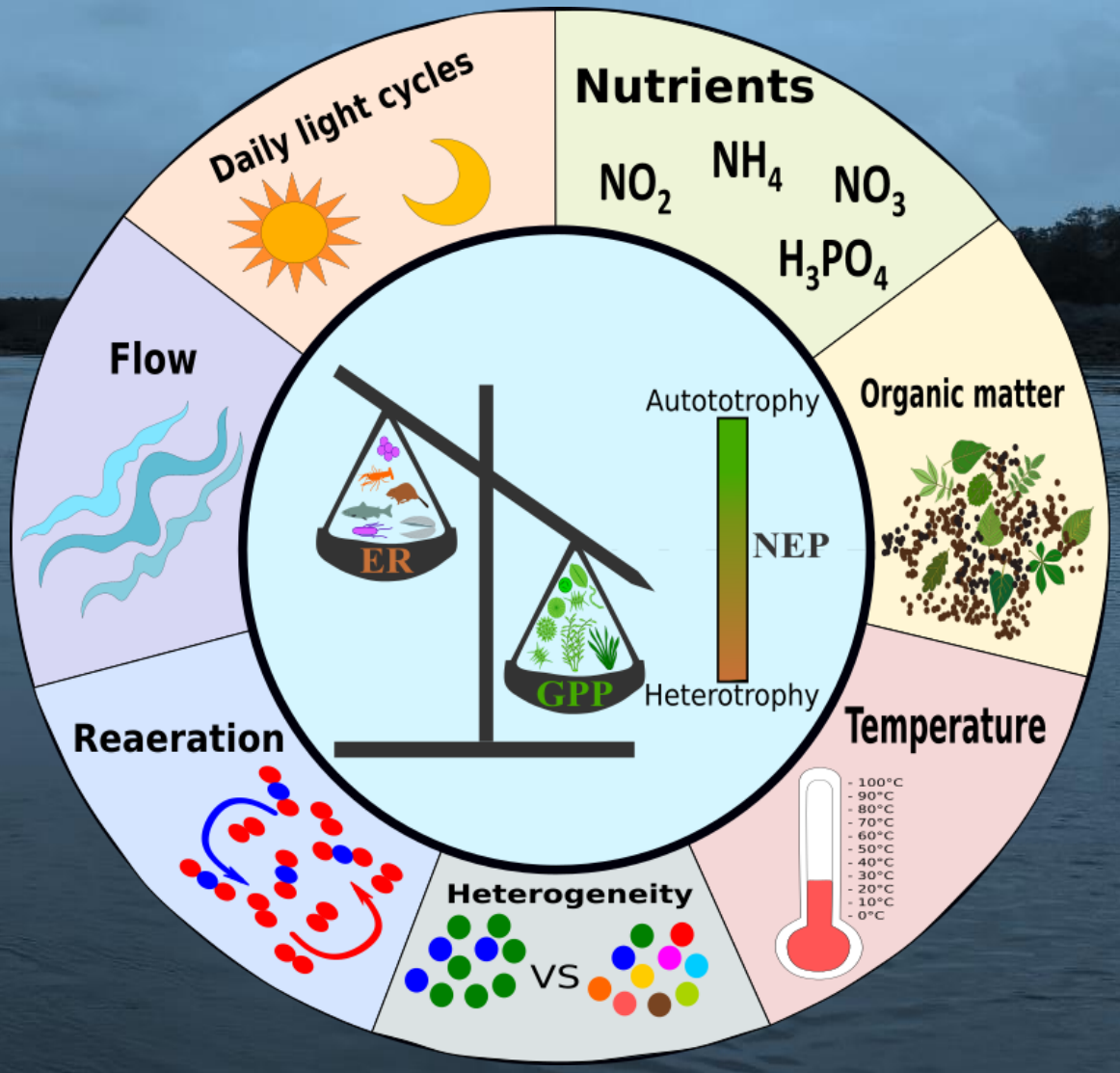
A comprehensive metric: Stream Metabolism

- Encompasses all the interactions in the ecosystem
- Simplification into a simple metric
- Reflects the dynamics of energy and matter

$$GPP\text{-}ER=NEP$$



What can we learn from the literature?

Is ecosystem metabolism a reliable tool for evaluating river restoration efforts?

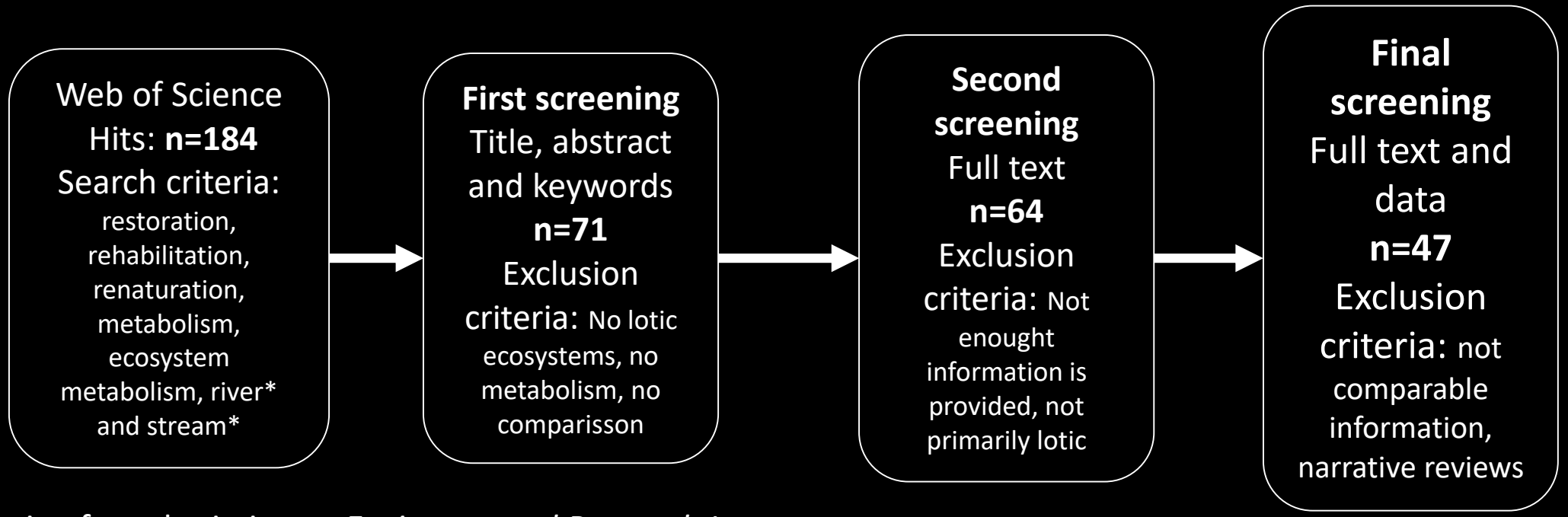
Reyes-Aldana, H. E.[1,2]; Graeber, D.[2]; Cohen, M.J.[3]; Weitere, M.[1]; Risse-Buhl, U.[1,4]

[1]Department of River Ecology, Helmholtz Centre for Environmental Research – UFZ. Magdeburg, Germany

[2]Department of Aquatic Ecosystem Analysis, Helmholtz Centre for Environmental Research – UFZ. Magdeburg, Germany

[3]School of Forest Fisheries and Geomatics Sciences, University of Florida, Gainesville, USA.

[4]Ecology Department, Faculty of Biology, University of Technology Kaiserslautern; Institute for Environmental Sciences, University of Koblenz-Landau, Germany



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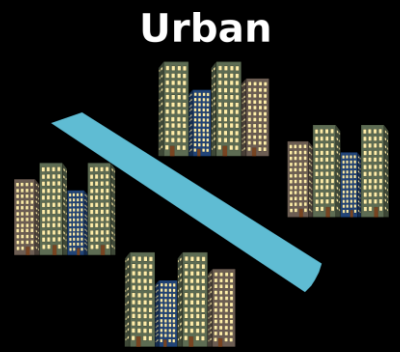
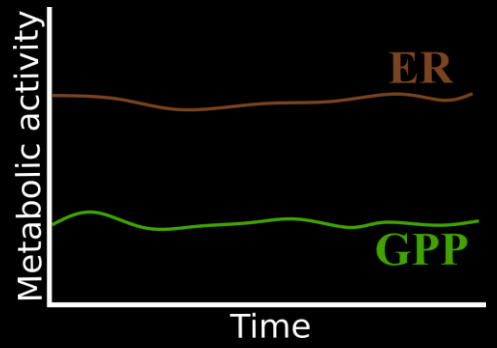
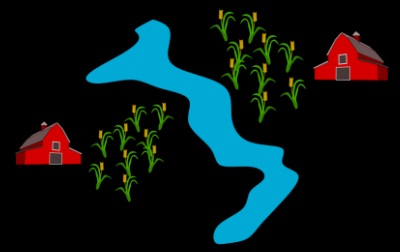
What can we expect?

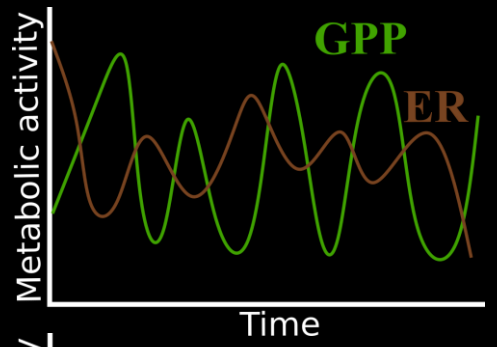


Urban

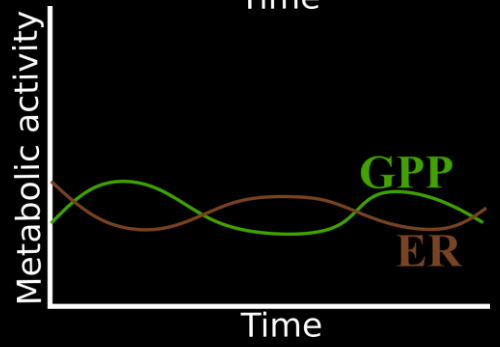


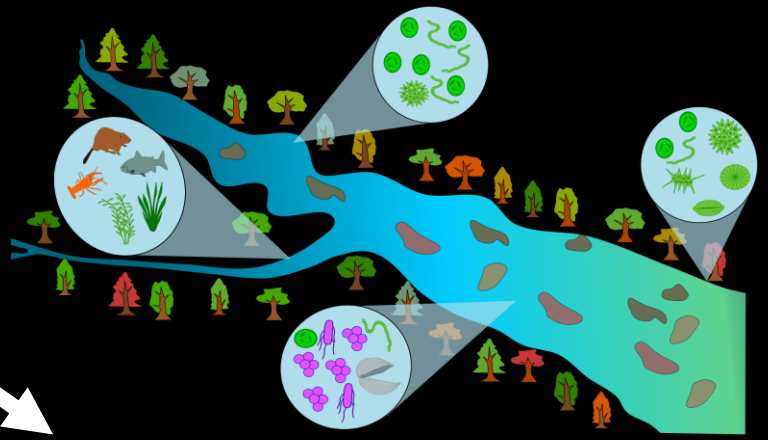
Agricultural



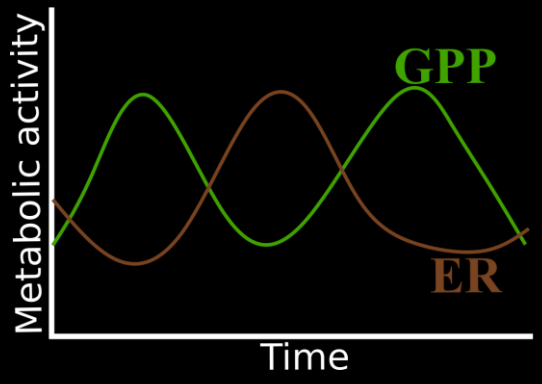


Disturbed





Restored reach



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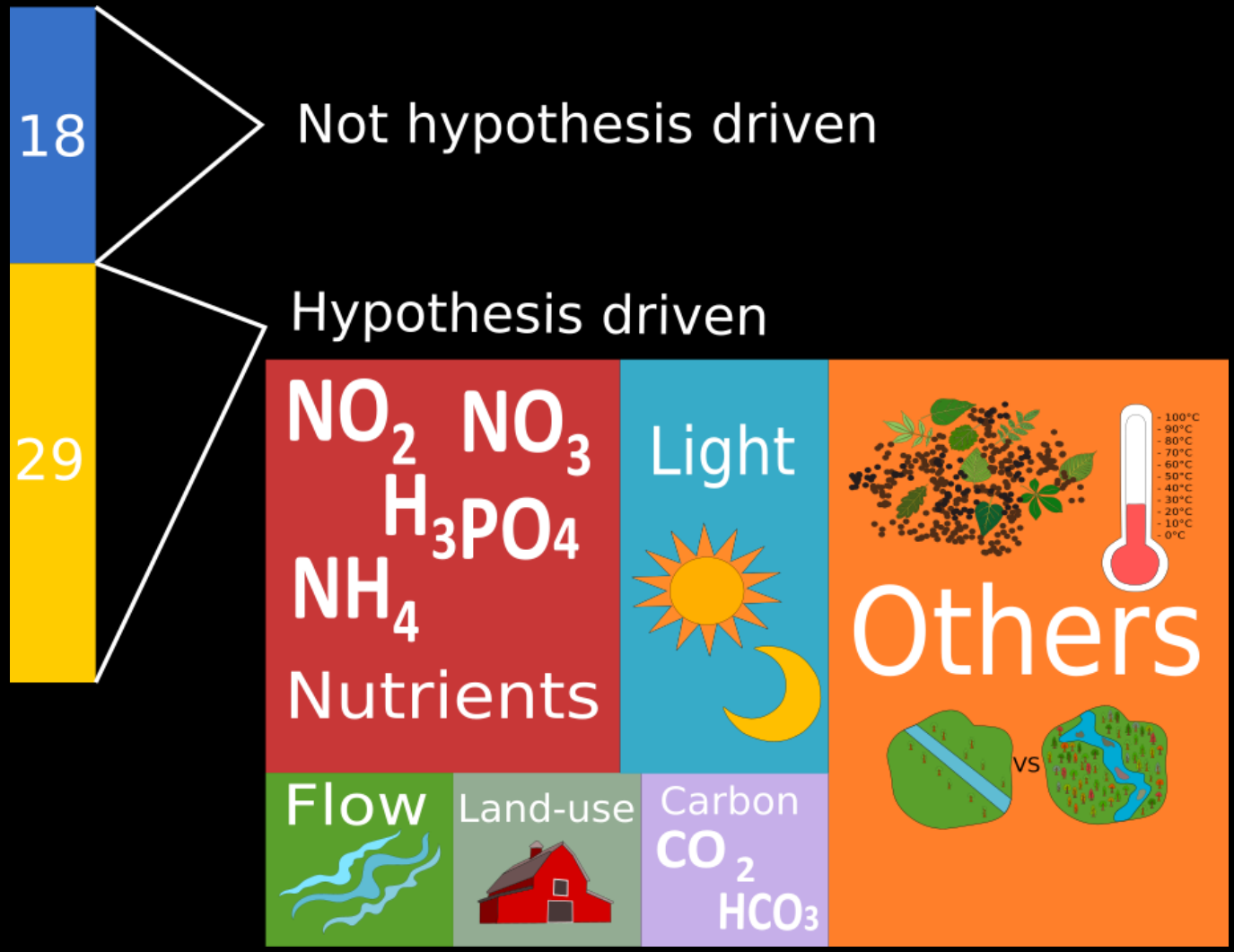
What did we find?



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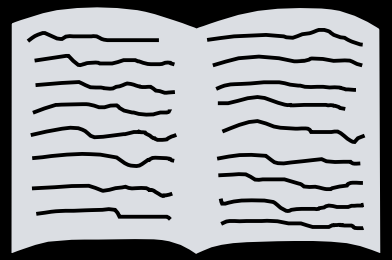
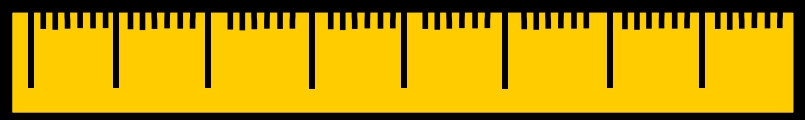
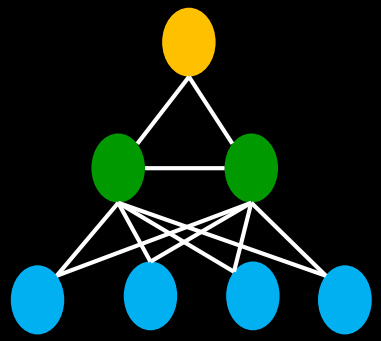
hugo.aldana@ufz.de

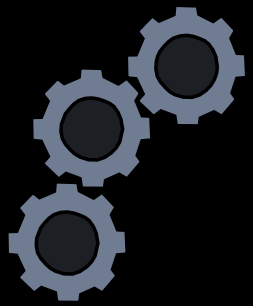
Some challenges

- Scarcity of data and literature
- Ecological refence estate and metabolism
- Scale mismatch
- Integration of structural and functional metrics









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How does this research contribute to TC for biodiversity and health?

- Metabolism is capable to reflect the changes in lotic ecosystems
- Those changes are provoked by the biological communities and also depend on them
- A healthy ecosystem is a dynamic ecosystem

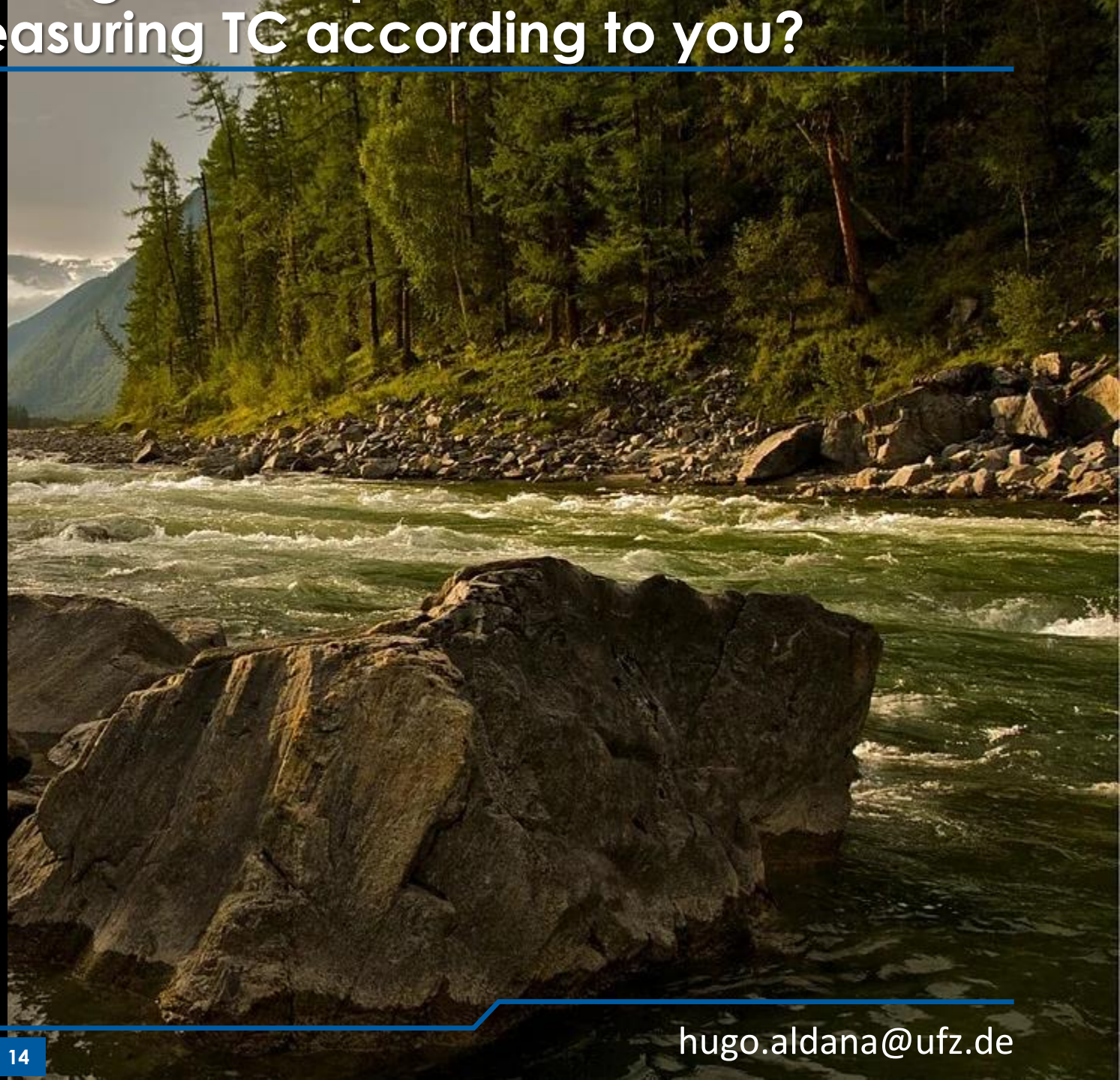
hugo.aldana@ufz.de

What are your recommendations regarding adequately researching and tracking progress on TC processes and initiatives?

- Homogenized protocols
  - To make meta-analyses and reviews easier and faster
- Long term measurements
- Integrating metrics (structural and functional)
  - None is better than the other
- Clear goals from the functional and structural perspectives from the start

gaps/needs in measuring TC according to you?

- Reference state
- The links between strucuture and function



hugo.aldana@ufz.de

How should research on these gaps be facilitated and incentivized by policy-makers?

- Regular monitoring of functional and structural parameters
- More direct interaction of scientists, practitioners and stakeholders
- Understanding the capacities and limitations of metrics and scientists

Thank you for you attention!

Questions?

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