

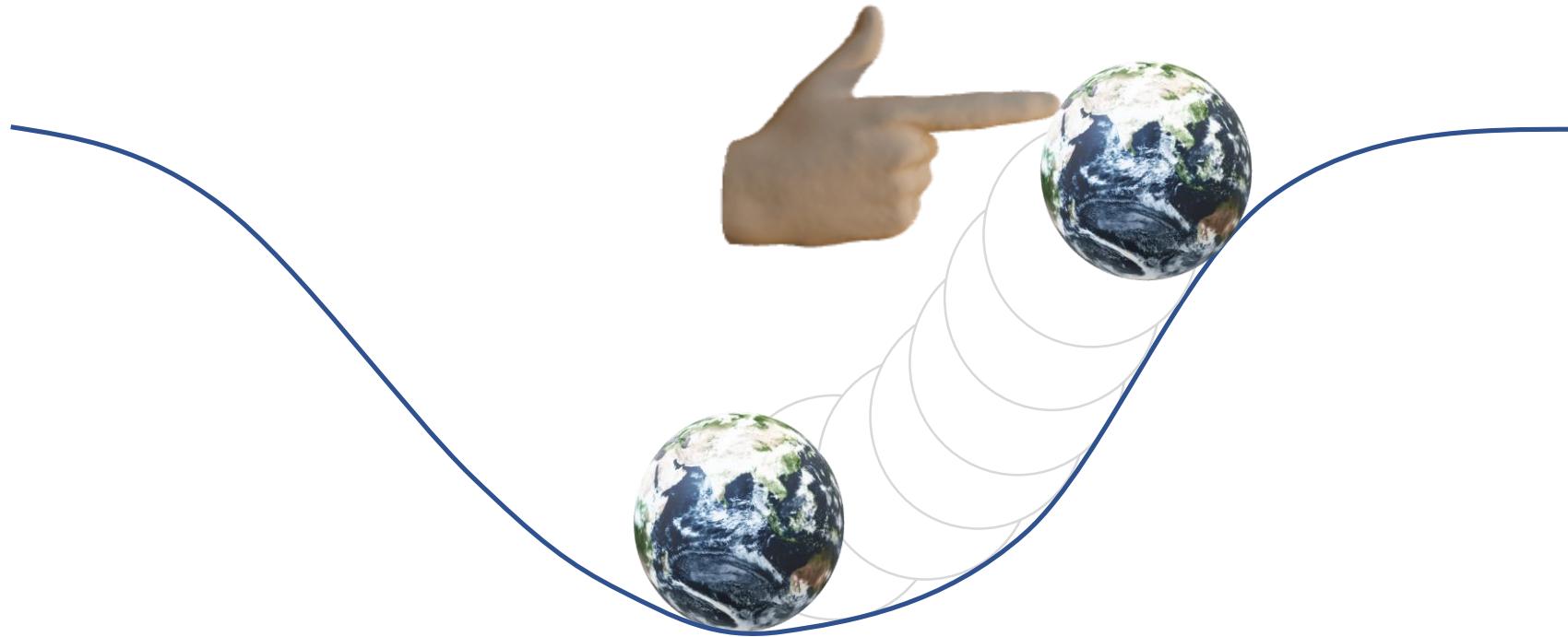
Launching a roadmap for a revised freshwater planetary boundary

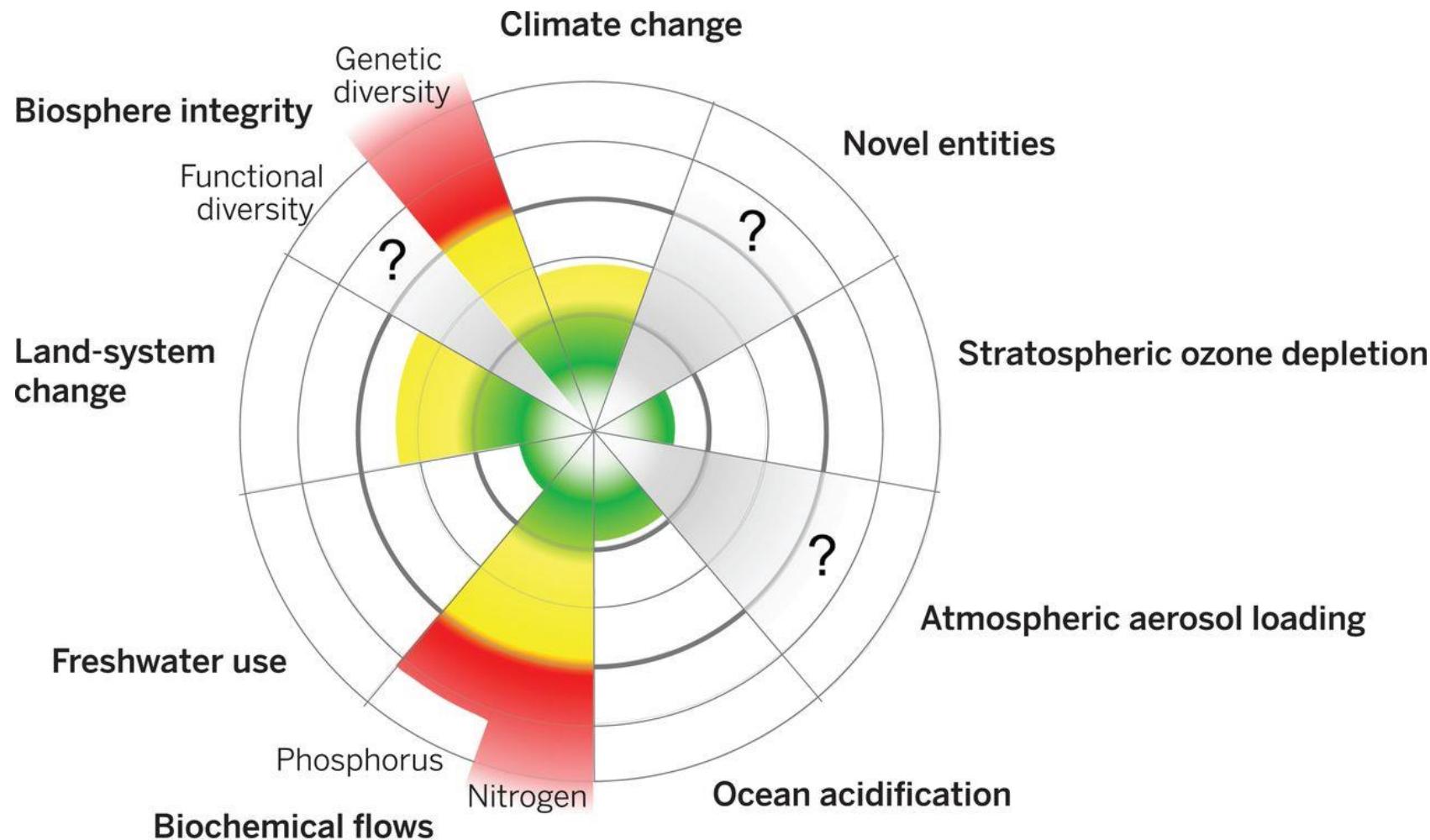


Photo: M. Eriksson/Azote

Showcase funded by: FORMAS & Research Institute for Humanity and Nature

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■ Beyond zone of uncertainty (high risk)

■ In zone of uncertainty (increasing risk)

■ Below boundary (safe)

■ Boundary not yet quantified

The water planetary boundary: a roadmap to illuminate water cycle modifications in the Anthropocene

Submitted to *Water Resources Research* for consideration for “*Grand Challenges Special Edition*”

Tom Gleeson ^{1,2}, Lan Wang Erlandsson ^{3, 4, 8}, Samuel C. Zipper ¹, Miina Porkka ^{3, 8}, Fernando Jaramillo ^{2, 5}, Dieter Gerten ^{6, 7}, Ingo Fetzer ^{3, 8}, Sarah E. Cornell ³, Luigi Piemontese ³, Line Gordon ³, Johan Rockström ^{2, 6}, Taikan Oki ⁹, Murugesu Sivapalan ¹⁰, Yoshihide Wada ¹¹, Kate A Brauman ¹², Martina Flörke ¹³, Marc F.P. Bierkens ^{14, 15}, Bernhard Lehner ¹⁶, Patrick Keys¹⁷, Matti Kummu ¹⁸, Thorsten Wagener ¹⁹, Simon Dadson ²⁰, Tara J. Troy¹, Will Steffen ^{3, 21}, Malin Falkenmark ³, James S. Famiglietti ²²



Tom Gleeson



Lan Wang-Erlandsson



Sam Zipper



Miina Porkka



Fernando Jaramillo



Dieter Gerten



Ingo Fetzer



Sarah Cornell



Luigi Pietmontese



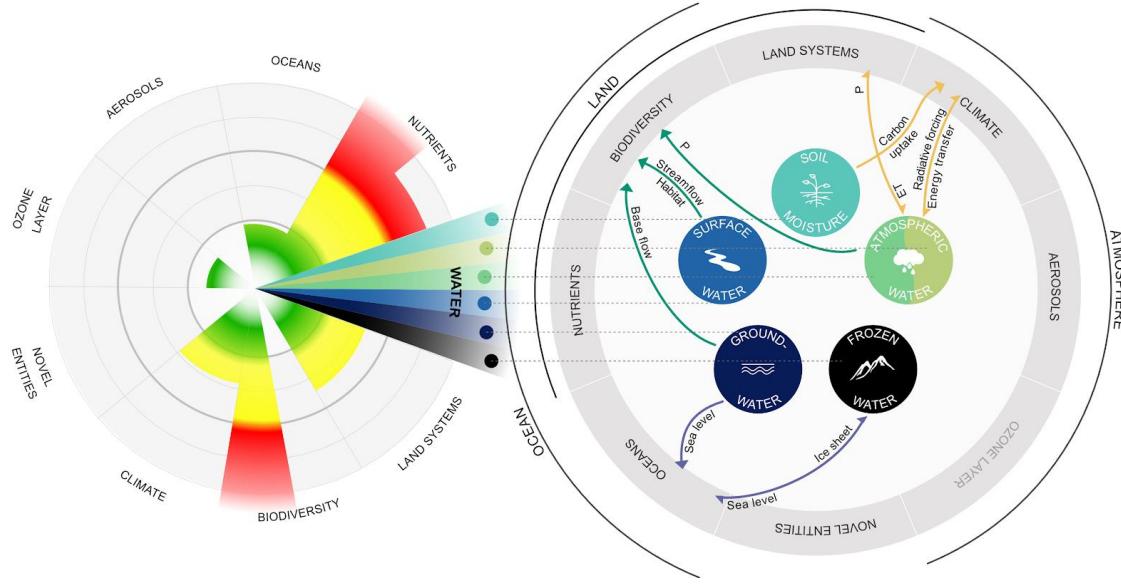
Line Gordon



Johan Rockström

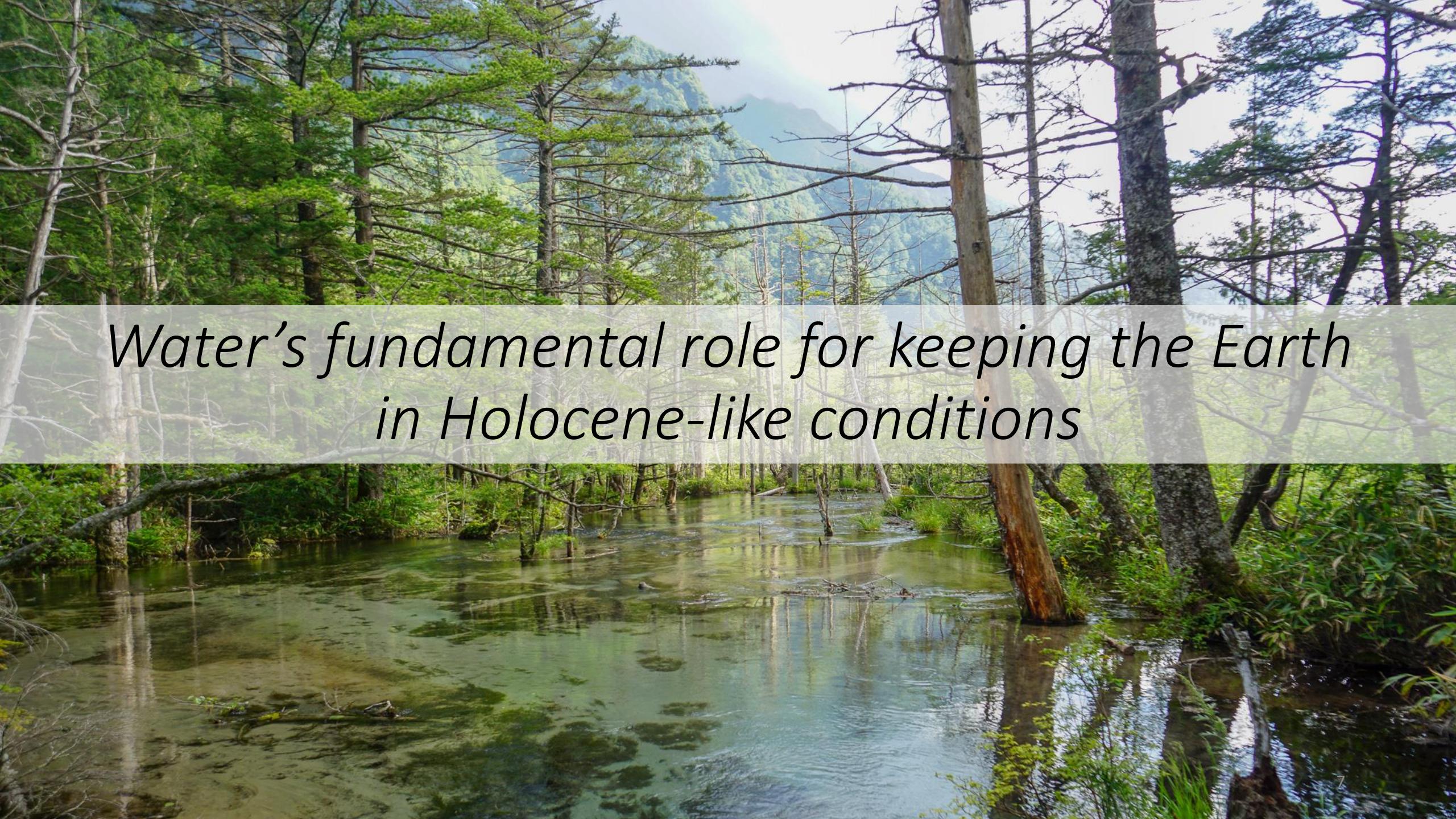
Why a revision? – Tom Gleeson



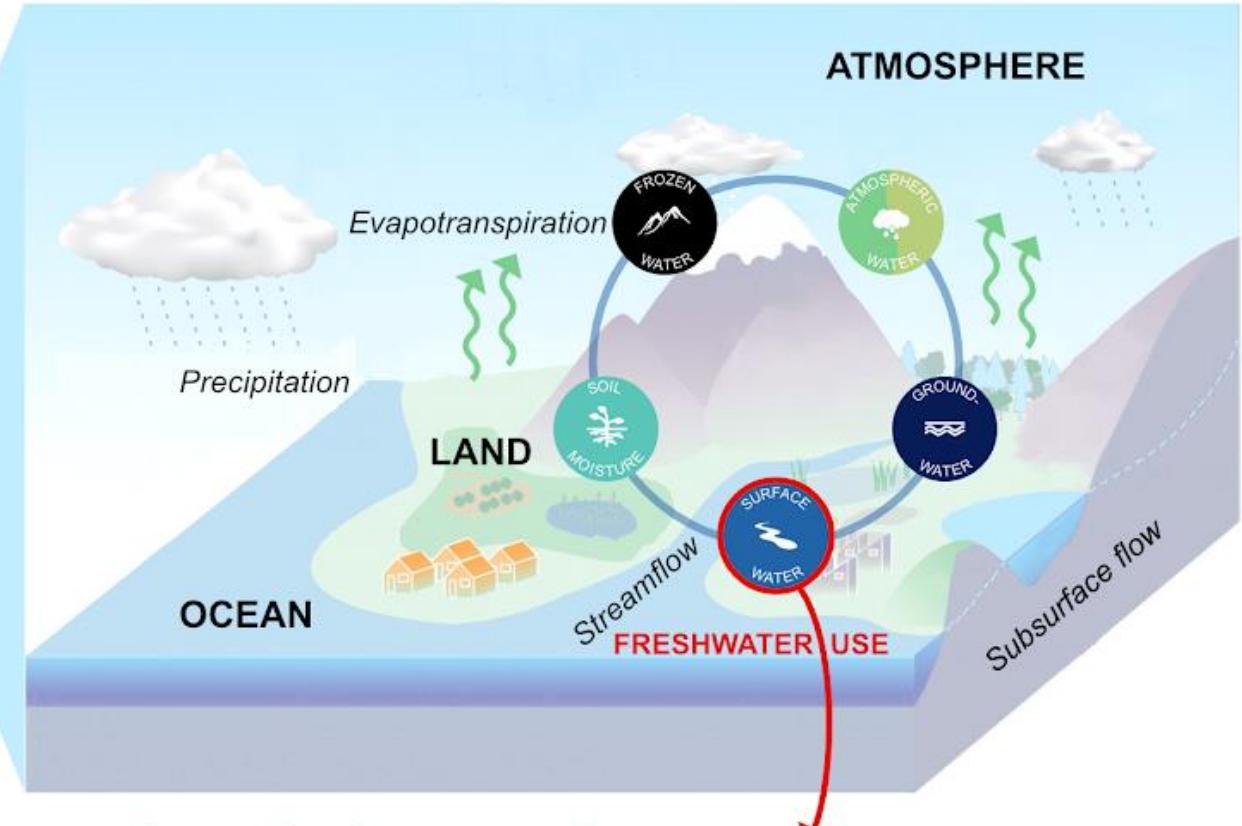
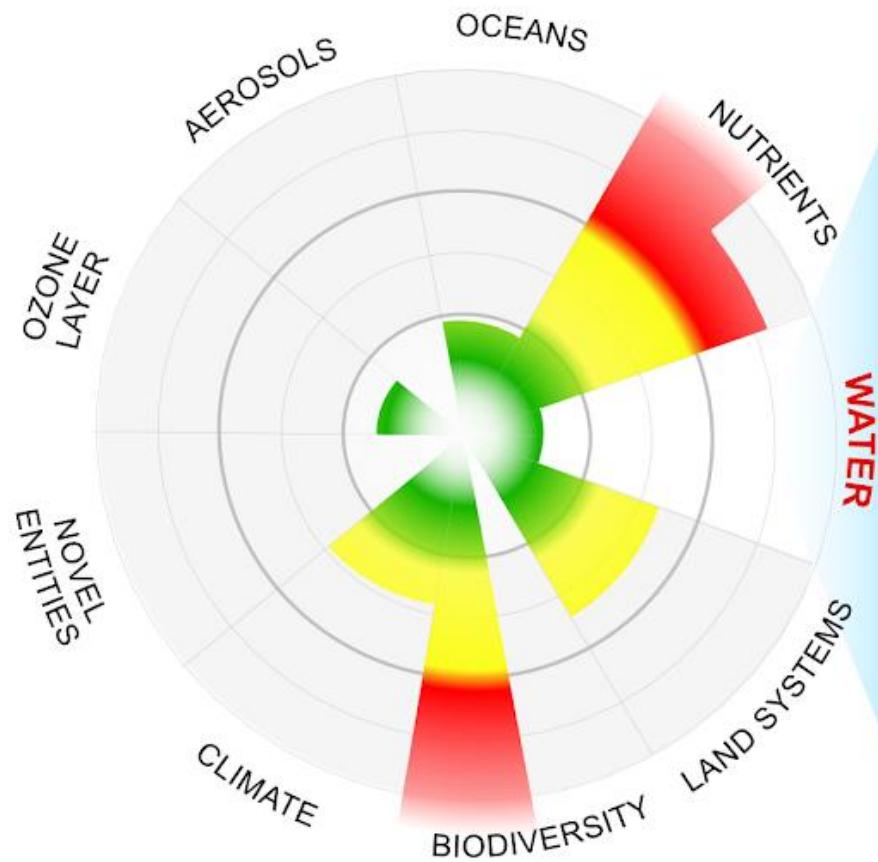


Towards a new water planetary boundary for Earth resilience

Presenters: Lan Wang-Erlandsson, Miina Porkka, Sam Zipper

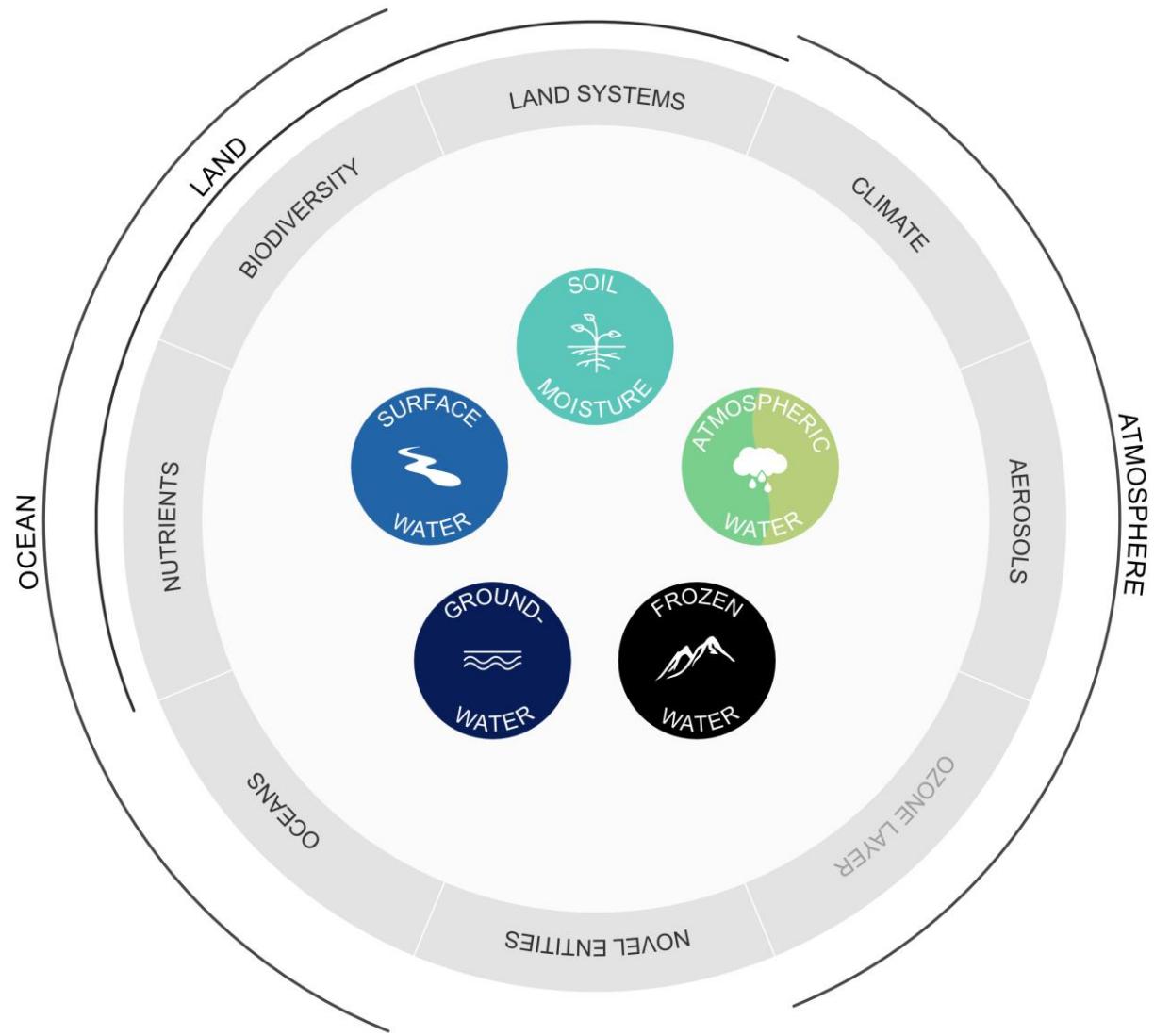


*Water's fundamental role for keeping the Earth
in Holocene-like conditions*

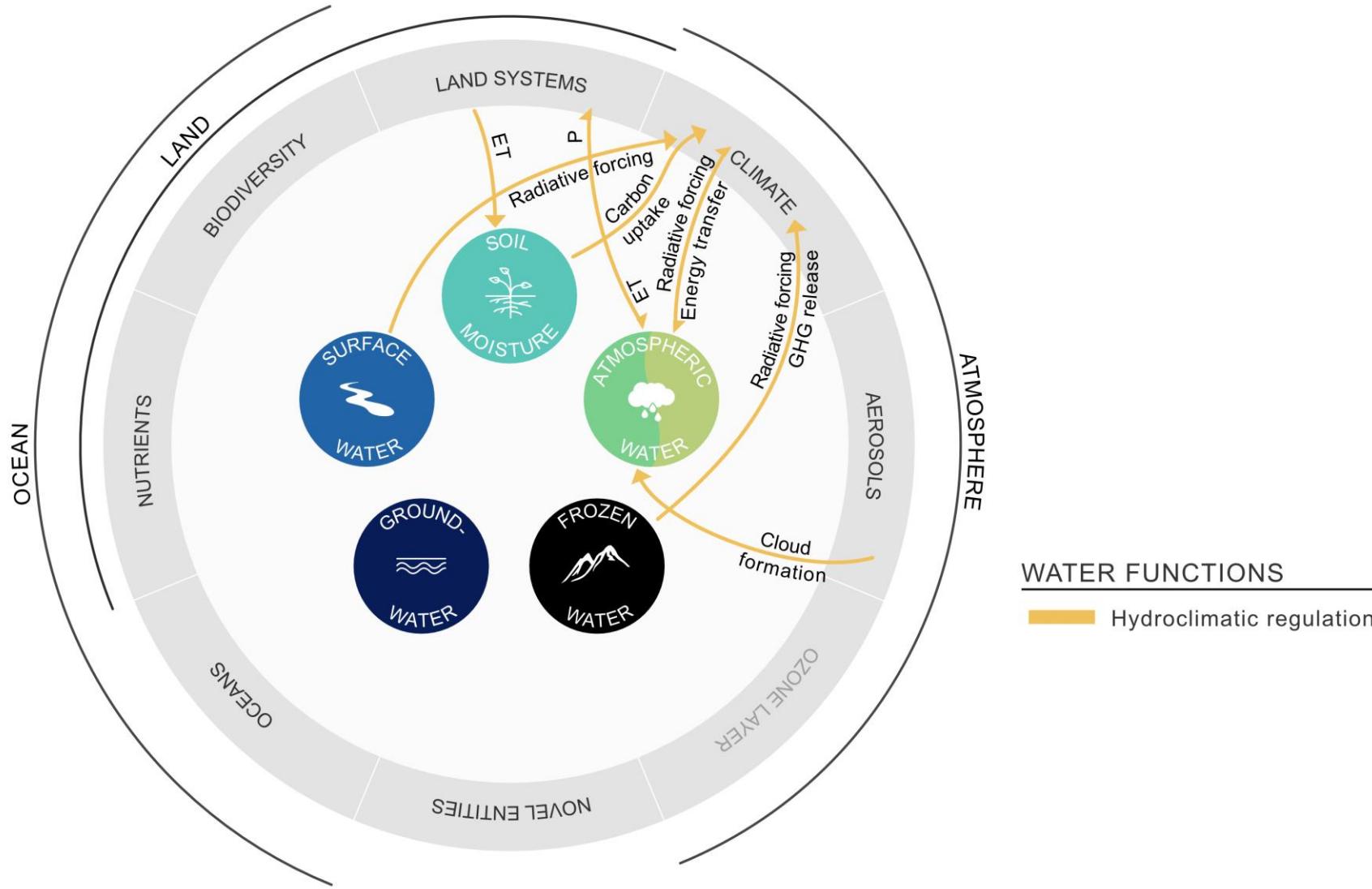


Current freshwater use planetary boundary only considers streamflow impacts on aquatic biodiversity.

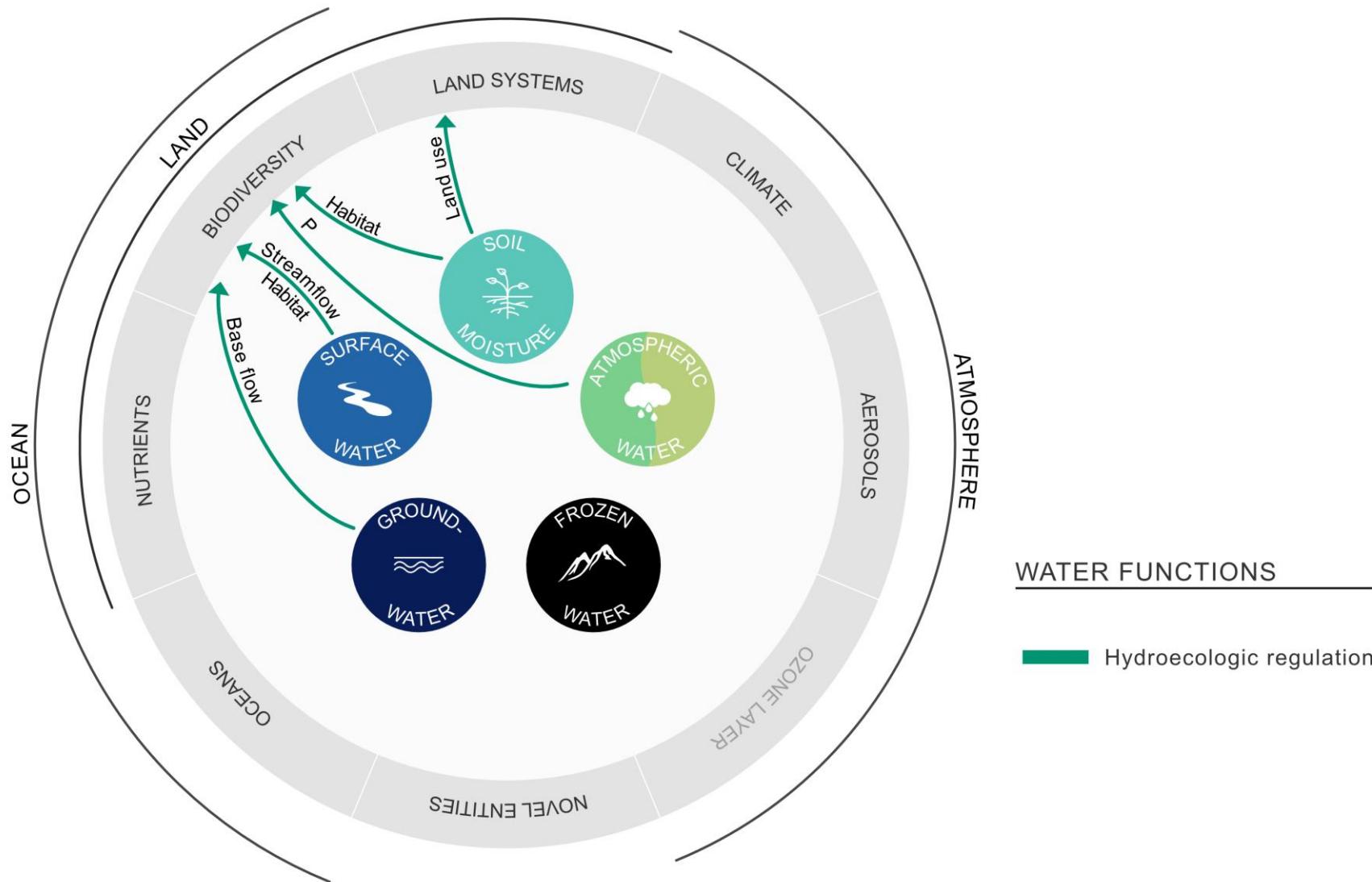
Earth system functions of water stores



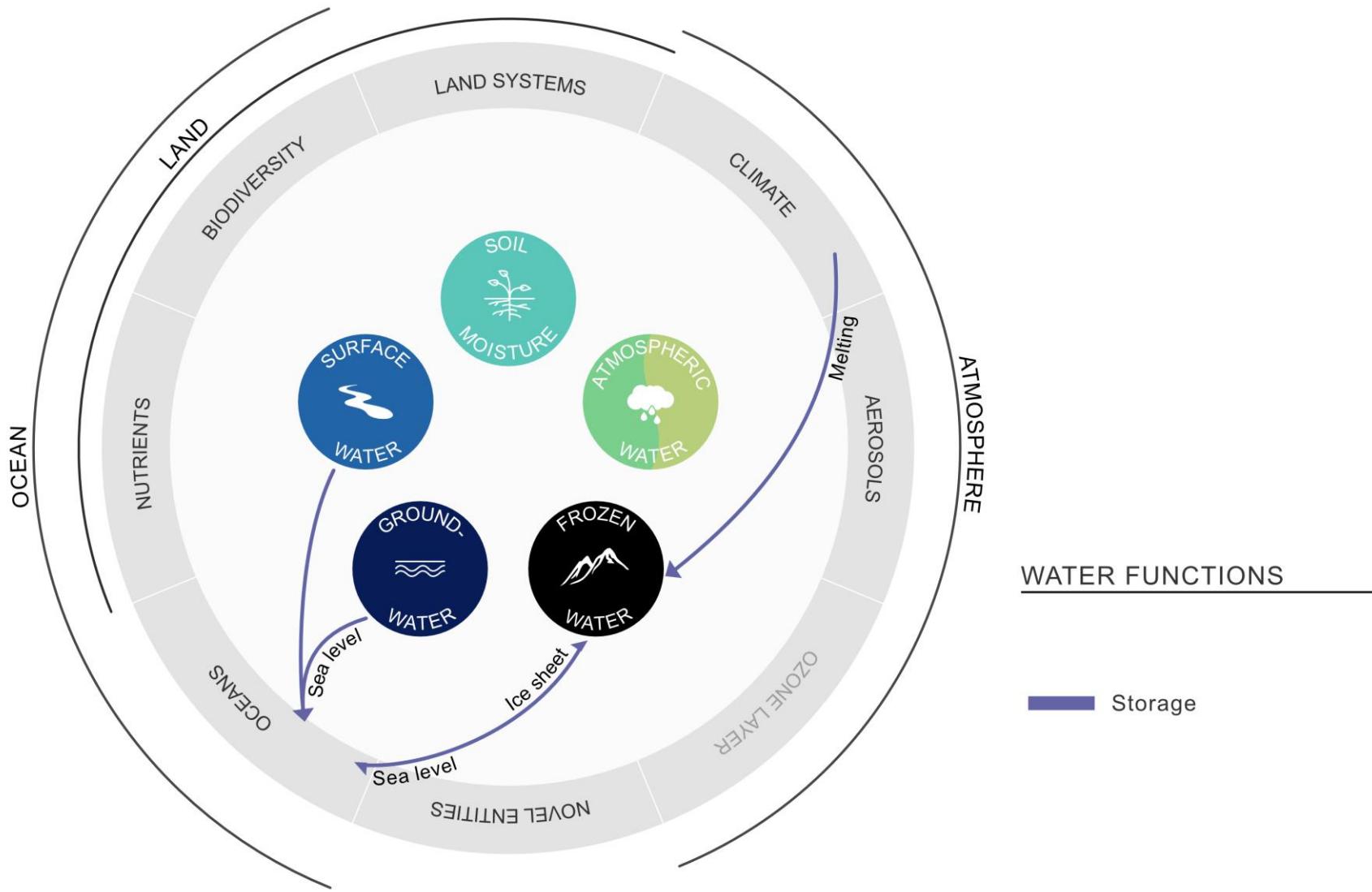
Hydroclimatic regulation function



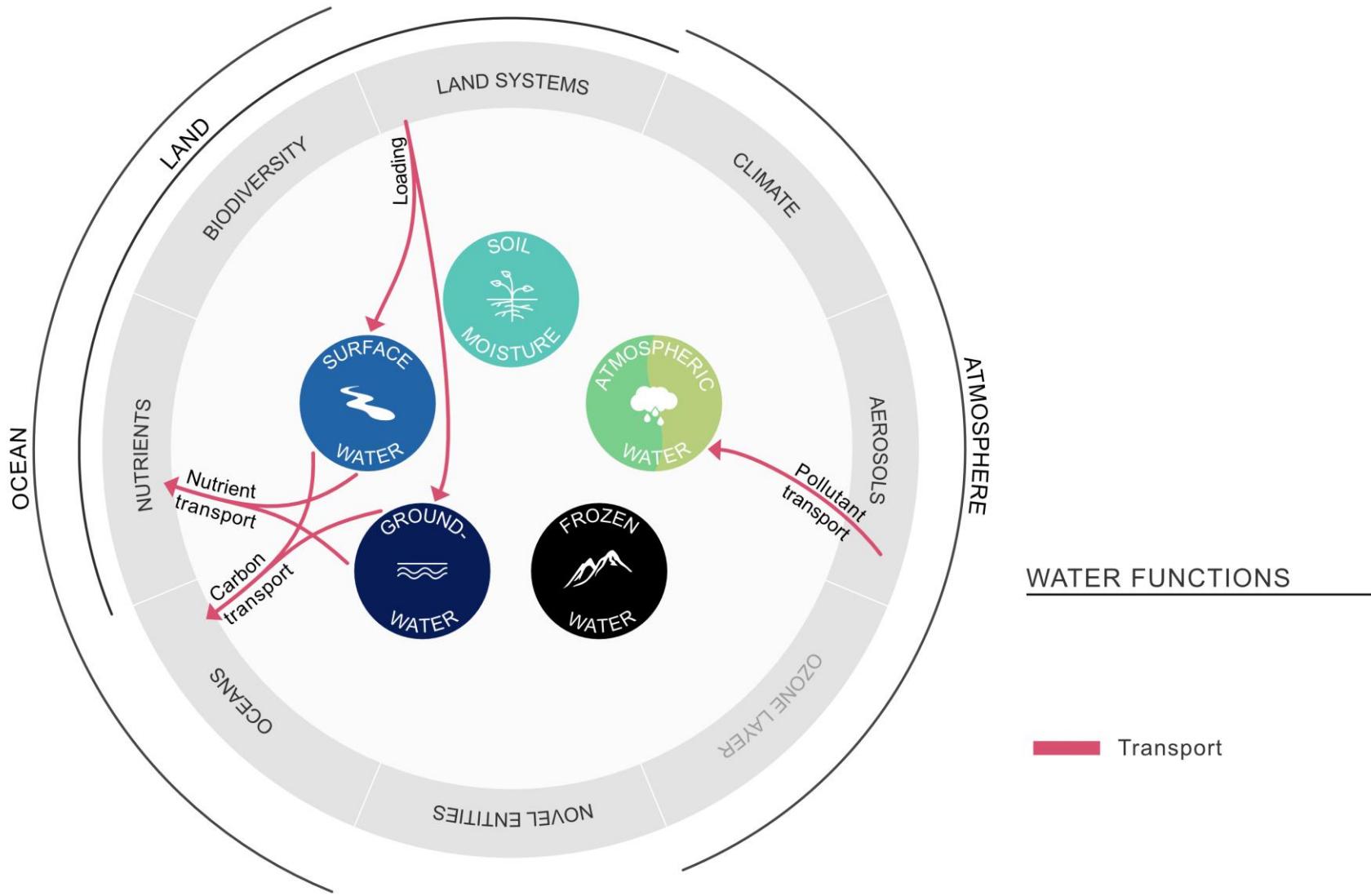
Hydroecologic regulation function



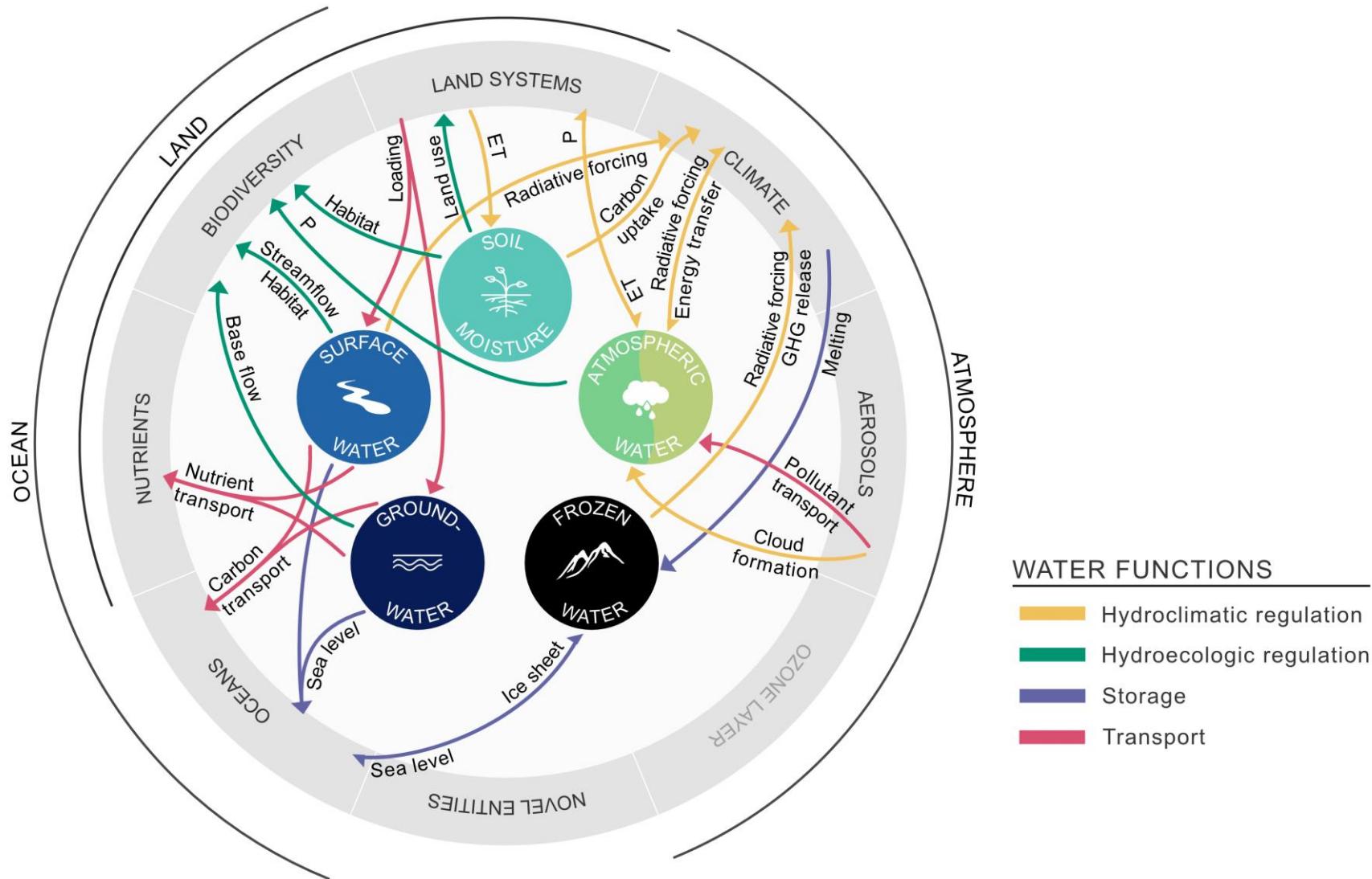
Storage function



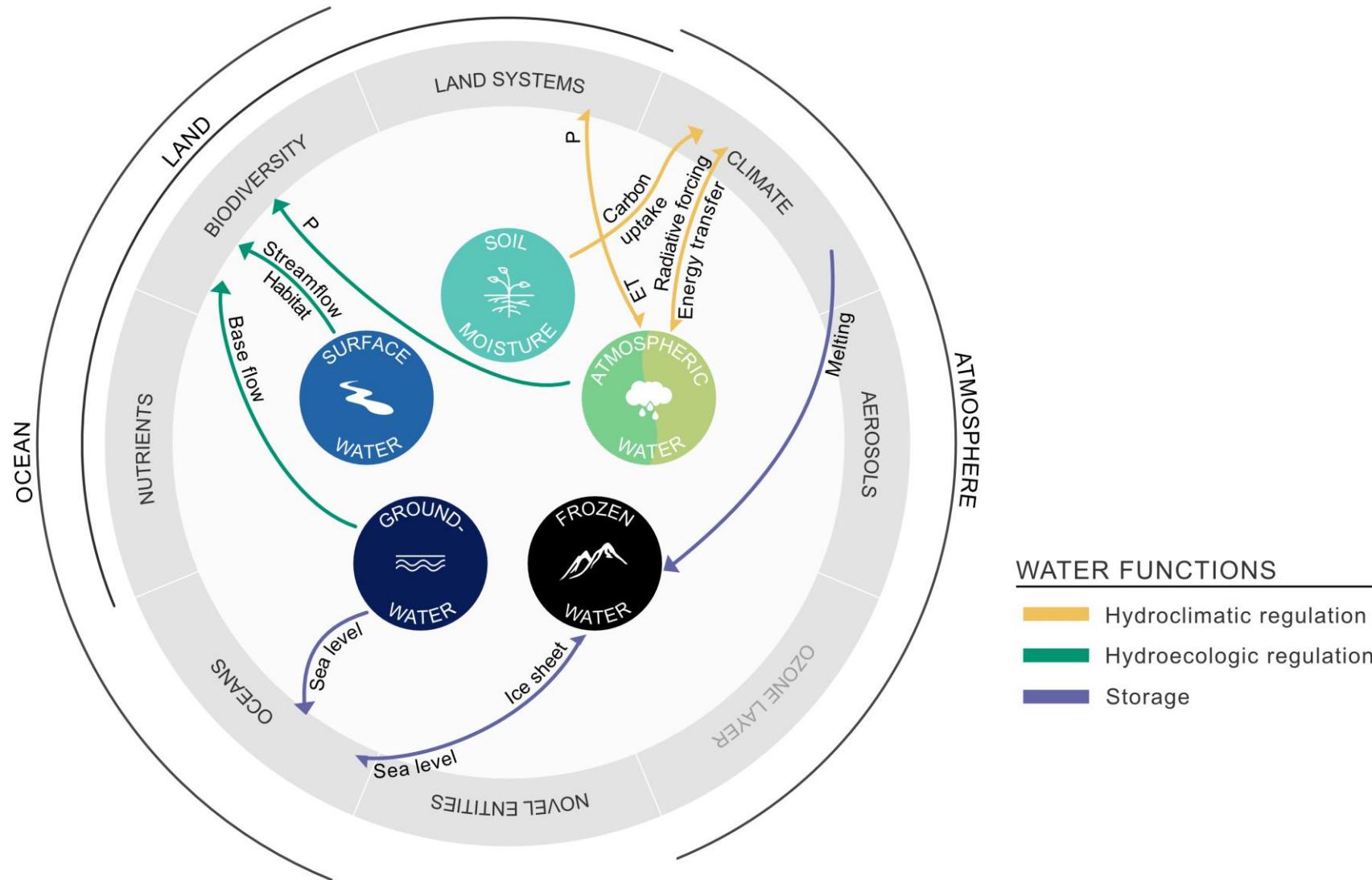
Transport function



Key water functions and processes

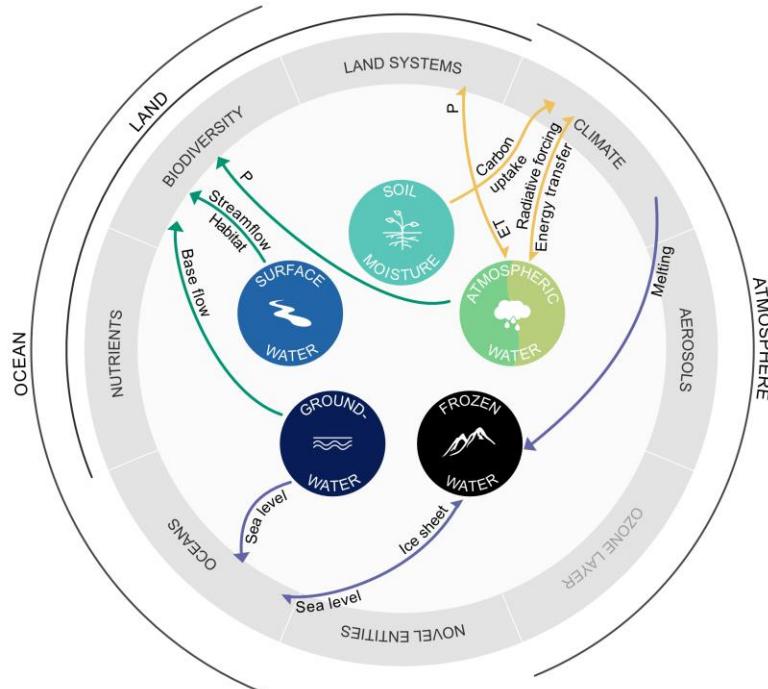


Key water functions and processes

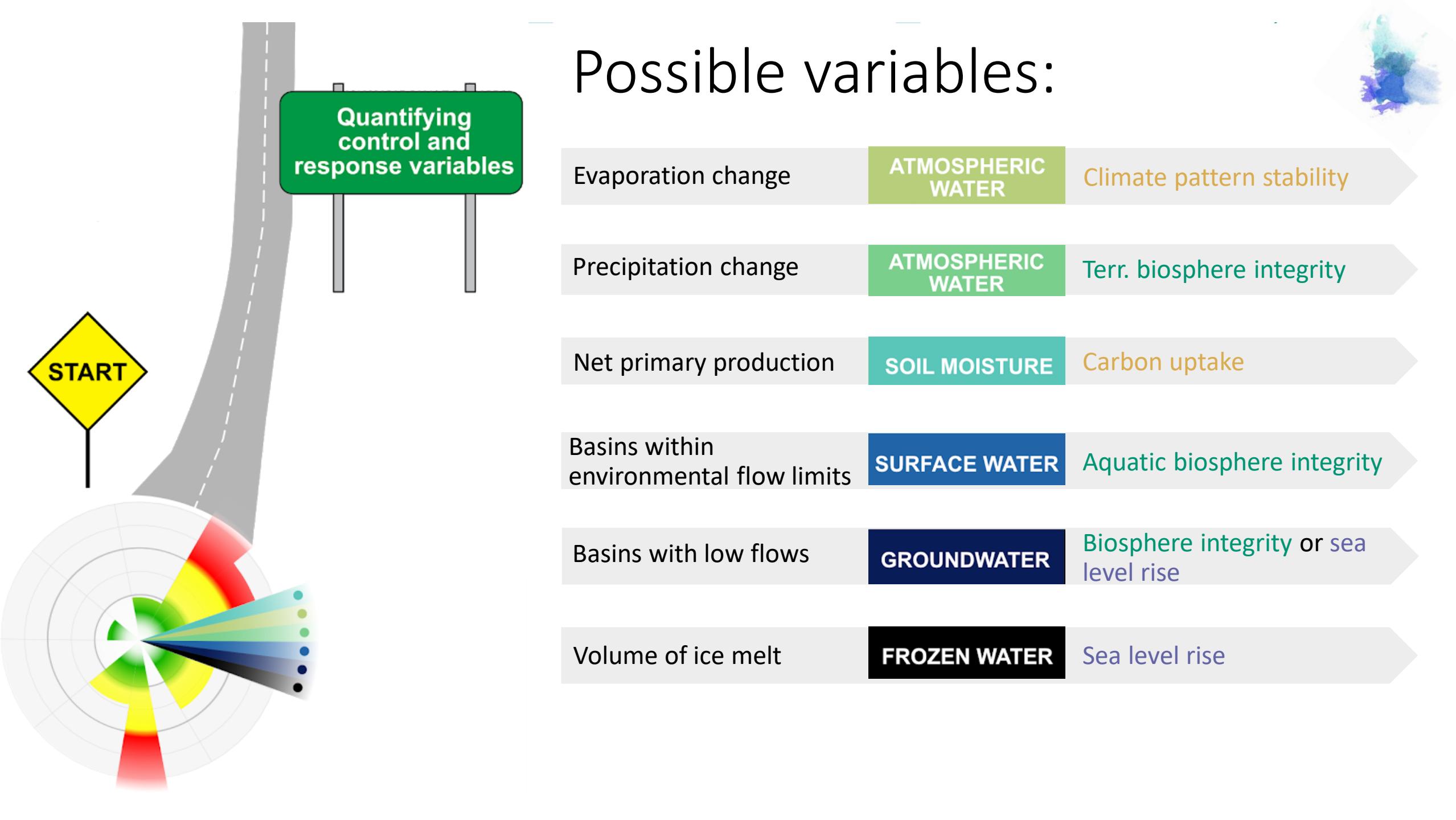




Possible variables:



Evaporation change	ATMOSPHERIC WATER	Climate pattern stability
Precipitation change	ATMOSPHERIC WATER	Terr. biosphere integrity
Net primary production	SOIL MOISTURE	Carbon uptake
Basins within environmental flow limits	SURFACE WATER	Aquatic biosphere integrity
Basins with low flows	GROUNDWATER	Biosphere integrity or sea level rise
Volume of ice melt	FROZEN WATER	Sea level rise



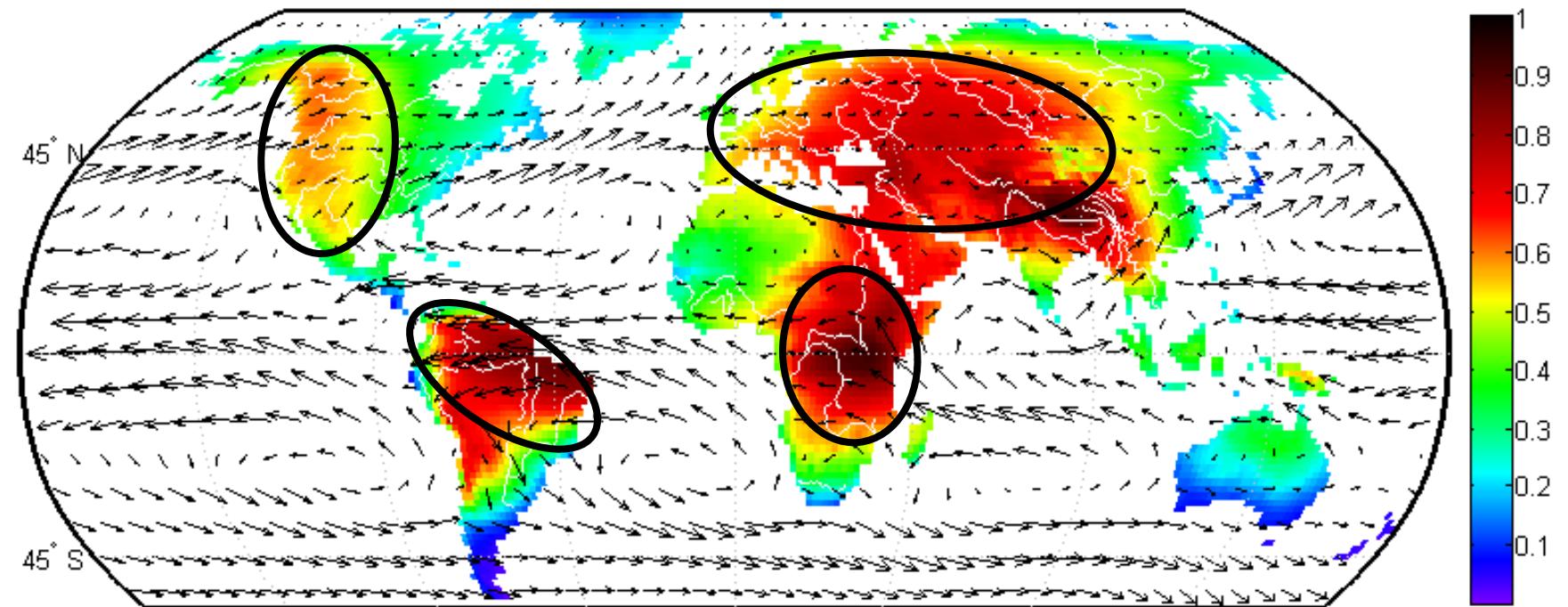


Are some regions more important than others?

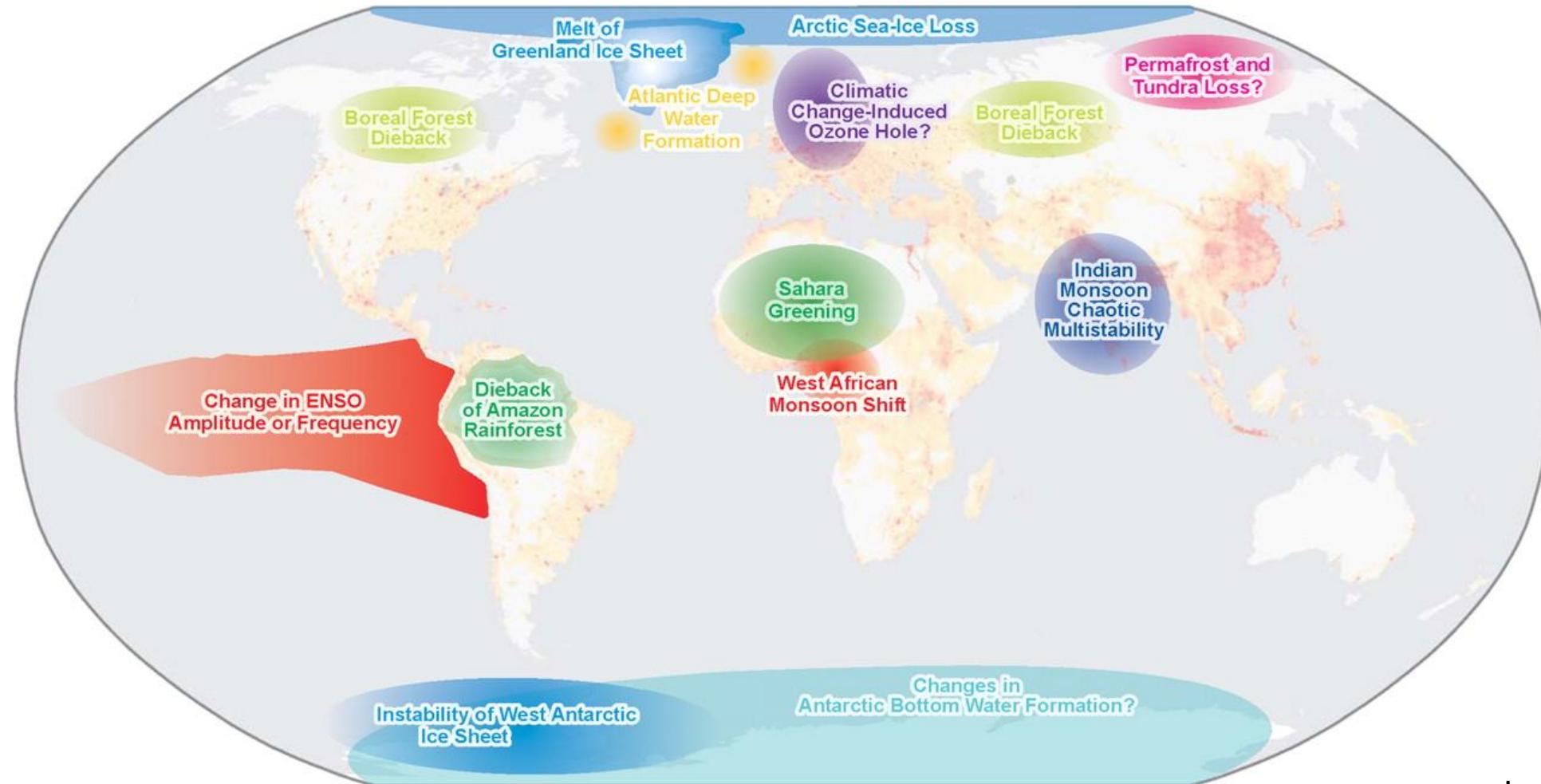
Weighting factors and keystone regions: Are changes in some regions more impactful than in others?

Example

Share of evaporation that become precipitation over land:



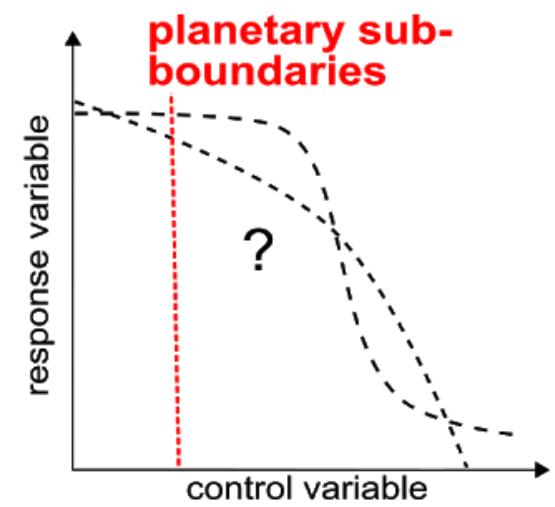
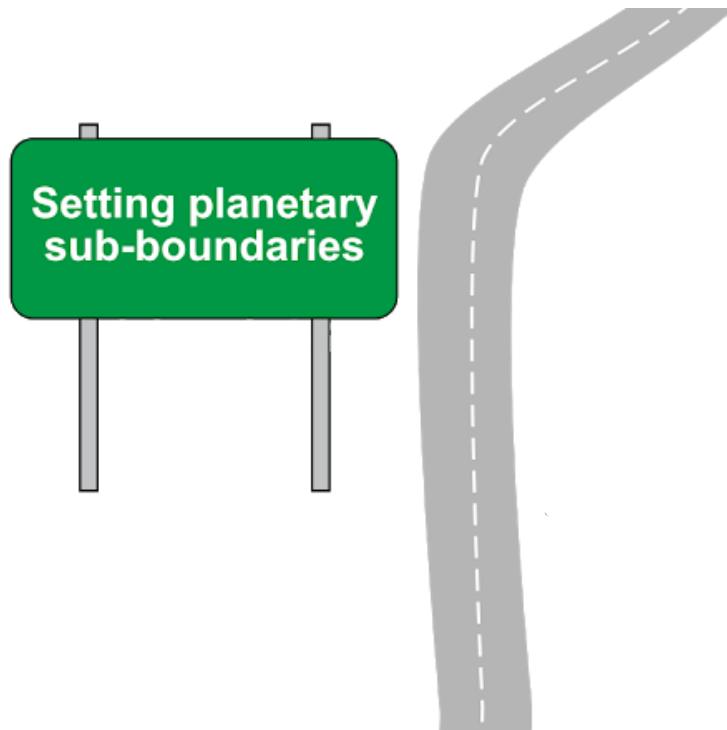
Tipping elements: Are some regions critical for Earth system stability?

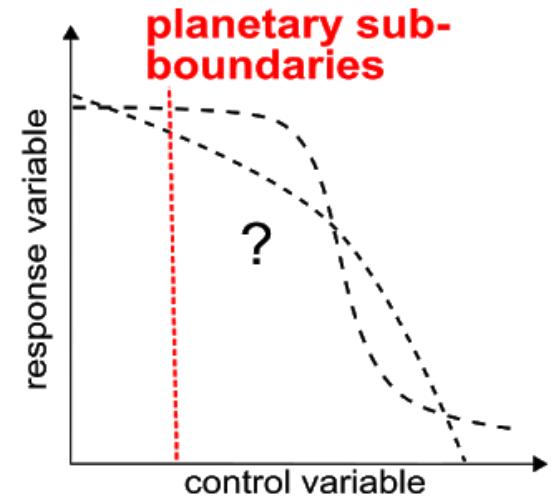
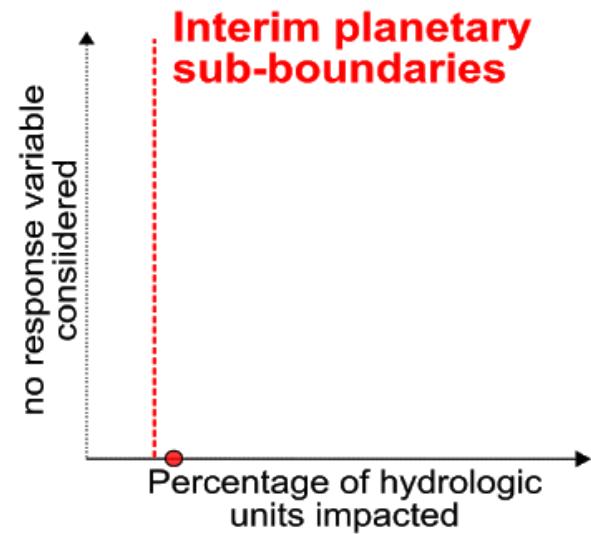
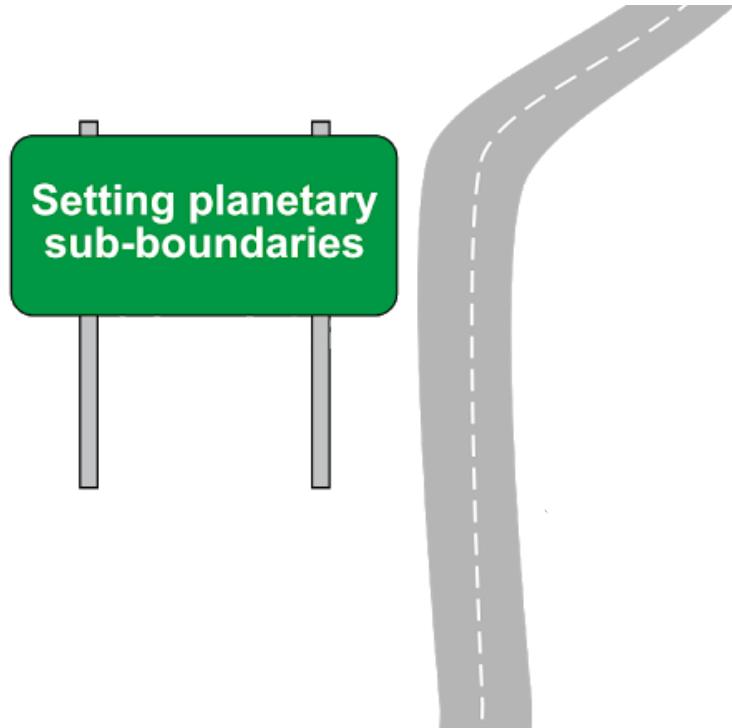


Lenton et al. 2008



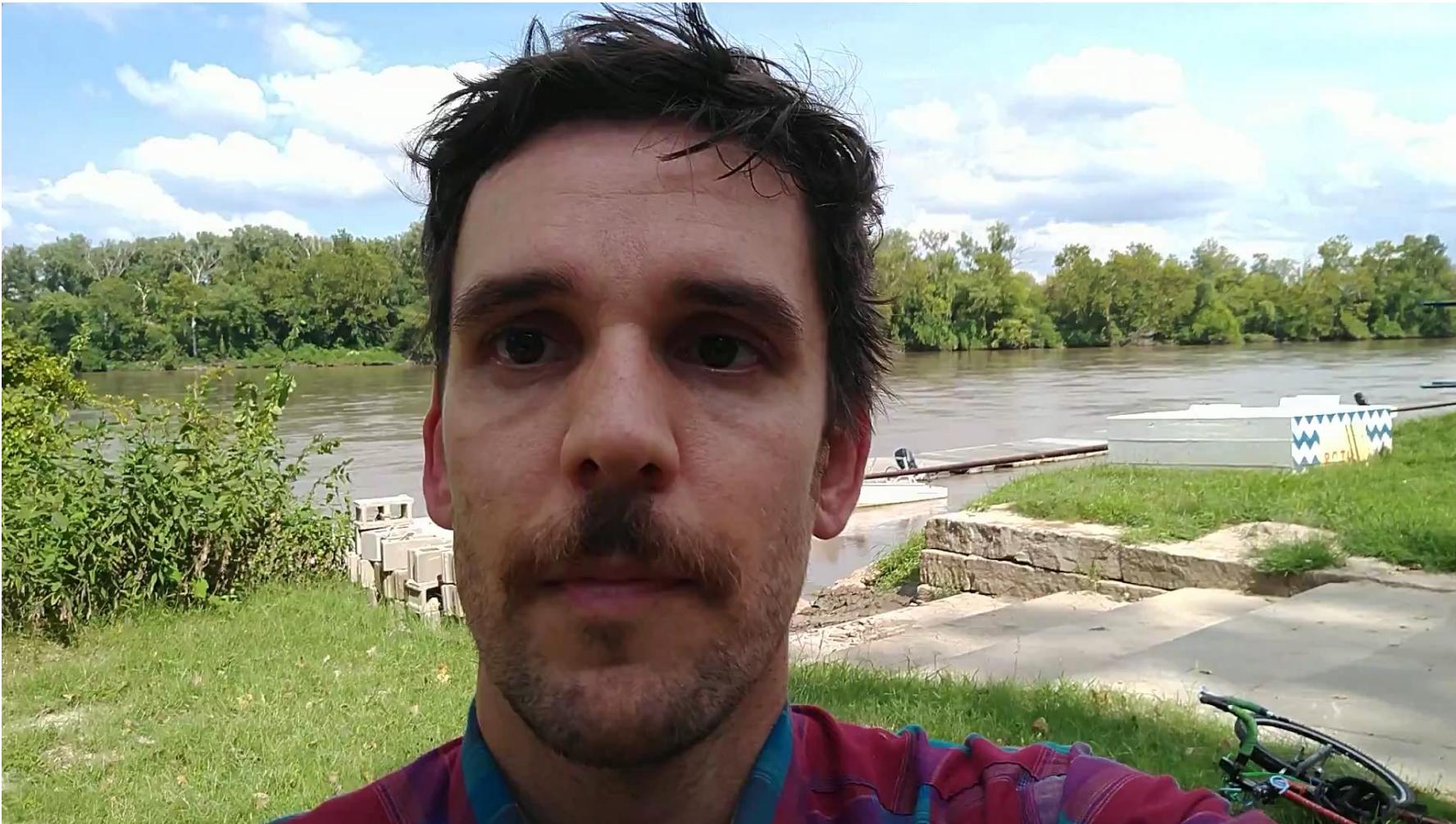
Where is the boundary?

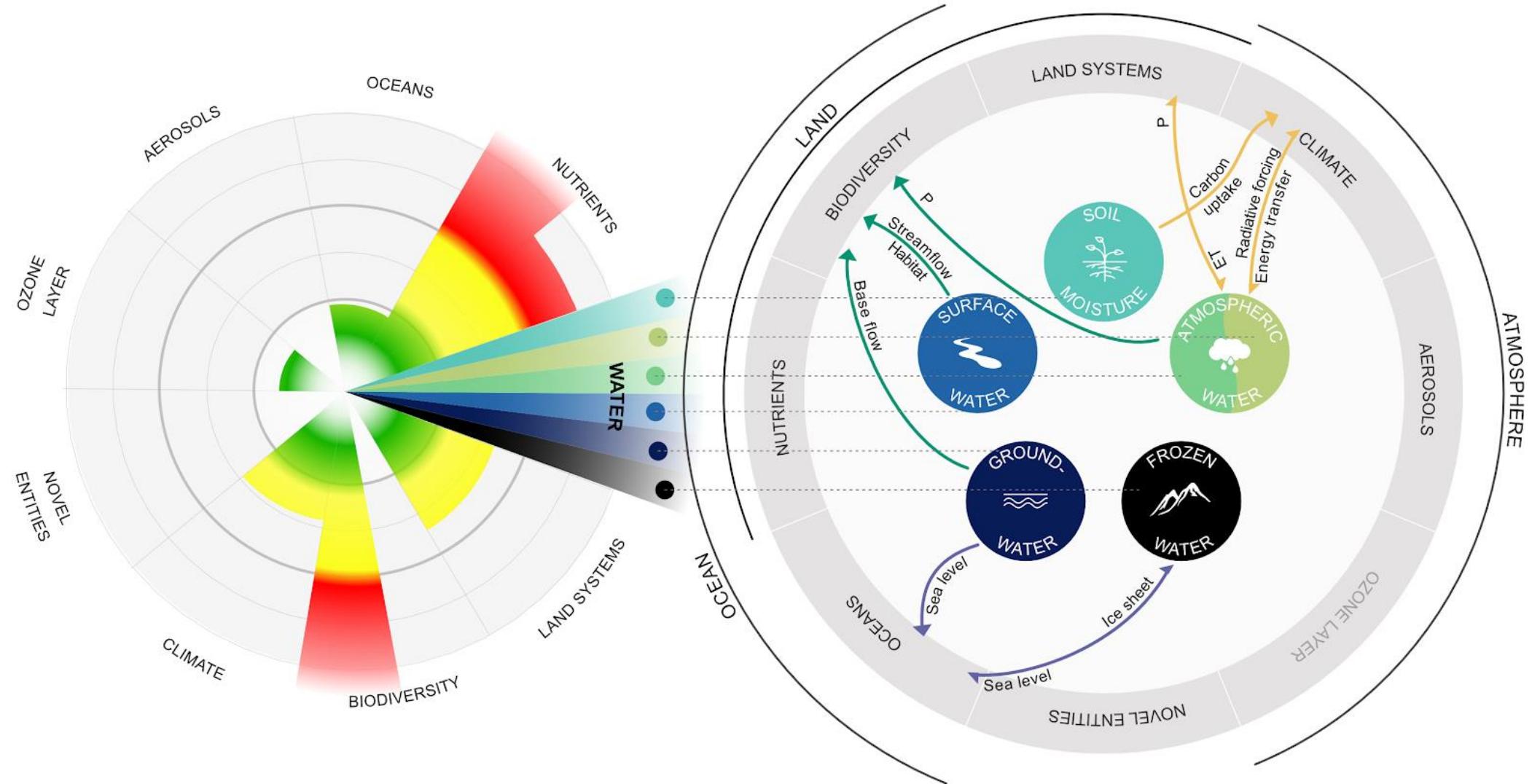






Using the water PB - Sam Zipper



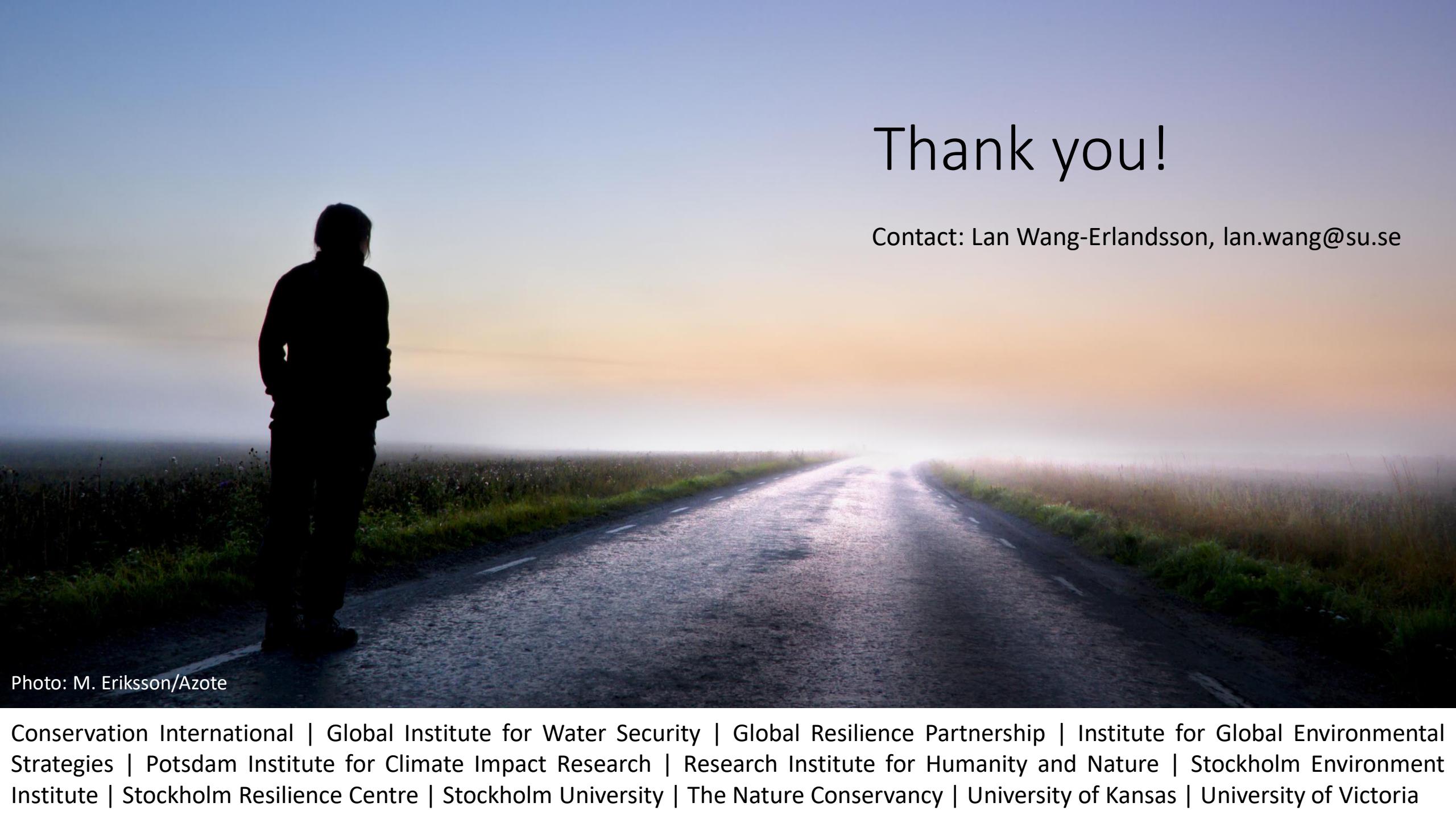


Establishing the control and response variables

Aggregating to the global

Setting the safe boundary

Using the water planetary boundary

A photograph showing a person from behind, standing on a paved road. The person is silhouetted against a bright, hazy horizon. The road curves to the right, and the surrounding landscape is a mix of green grass and low-lying mist. The sky is a soft, warm orange and yellow.

Thank you!

Contact: Lan Wang-Erlandsson, lan.wang@su.se

Photo: M. Eriksson/Azote

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Panelists:

Jay Famiglietti, Global Institute for Water Security, Canada

Holger Hoff, Stockholm Environment Institute, Sweden; PIK, Germany

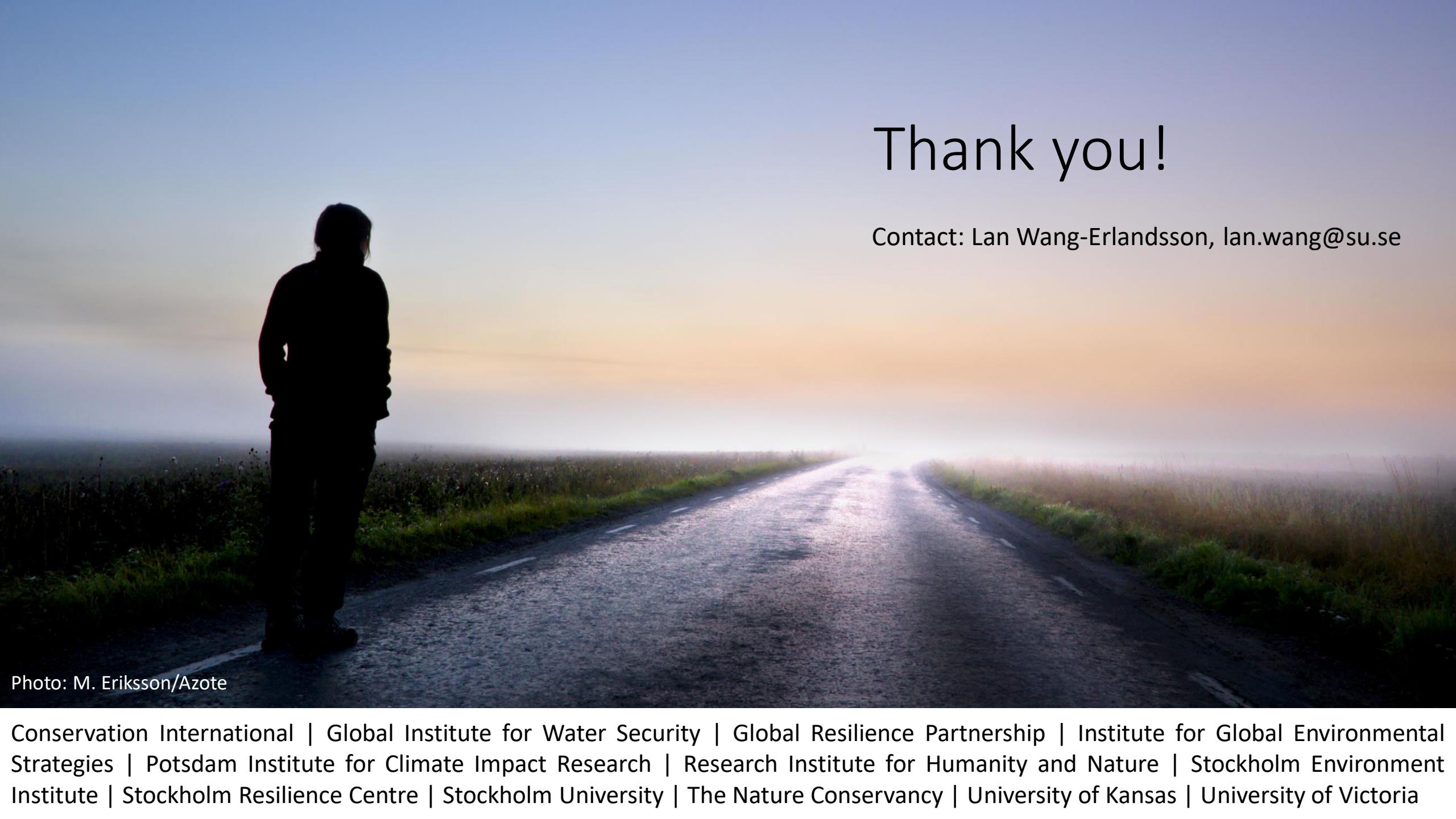
Nathaniel Mathews, Global Resilience Partnership, UK

Kari Vigerstol, The Nature Conservancy, US

LEE Sanghyun, Research Institute for Humanity and Nature, Japan

Panel moderator:

Sarah Cornell, Stockholm Resilience Centre, Stockholm University, Sweden

A photograph showing a person from behind, standing on a paved road. The person is silhouetted against a bright, hazy horizon. The road curves to the right, and the surrounding landscape is a mix of green grass and low-lying mist. The sky is a soft, warm orange and yellow.

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Emerging Trends in Global Freshwater Availability from GRACE (2002-2016)

M. Rodell, J. S. Famiglietti, D. N. Wiese, J. T. Reager, H. K. Beaudoin, F. W. Landerer and M.-H. Lo

Emerging Trends in Global Freshwater Availability
Nature, May 16, 2018, <https://doi.org/10.1038/s41586-018-0123-1>

