Global utveckling inom Planetens Gränser

Seminarium Vision för Världens Skogar
16 dec 2014

Prof. Johan Rockström
Stockholm Resilience Centre

Photo: Yann Arthus-Bertrand

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Sustainability Science for Biosphere Stewardship
Stockholm University

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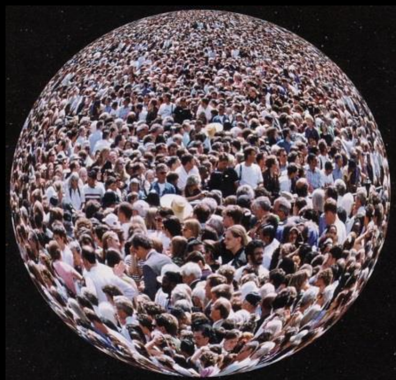
Article

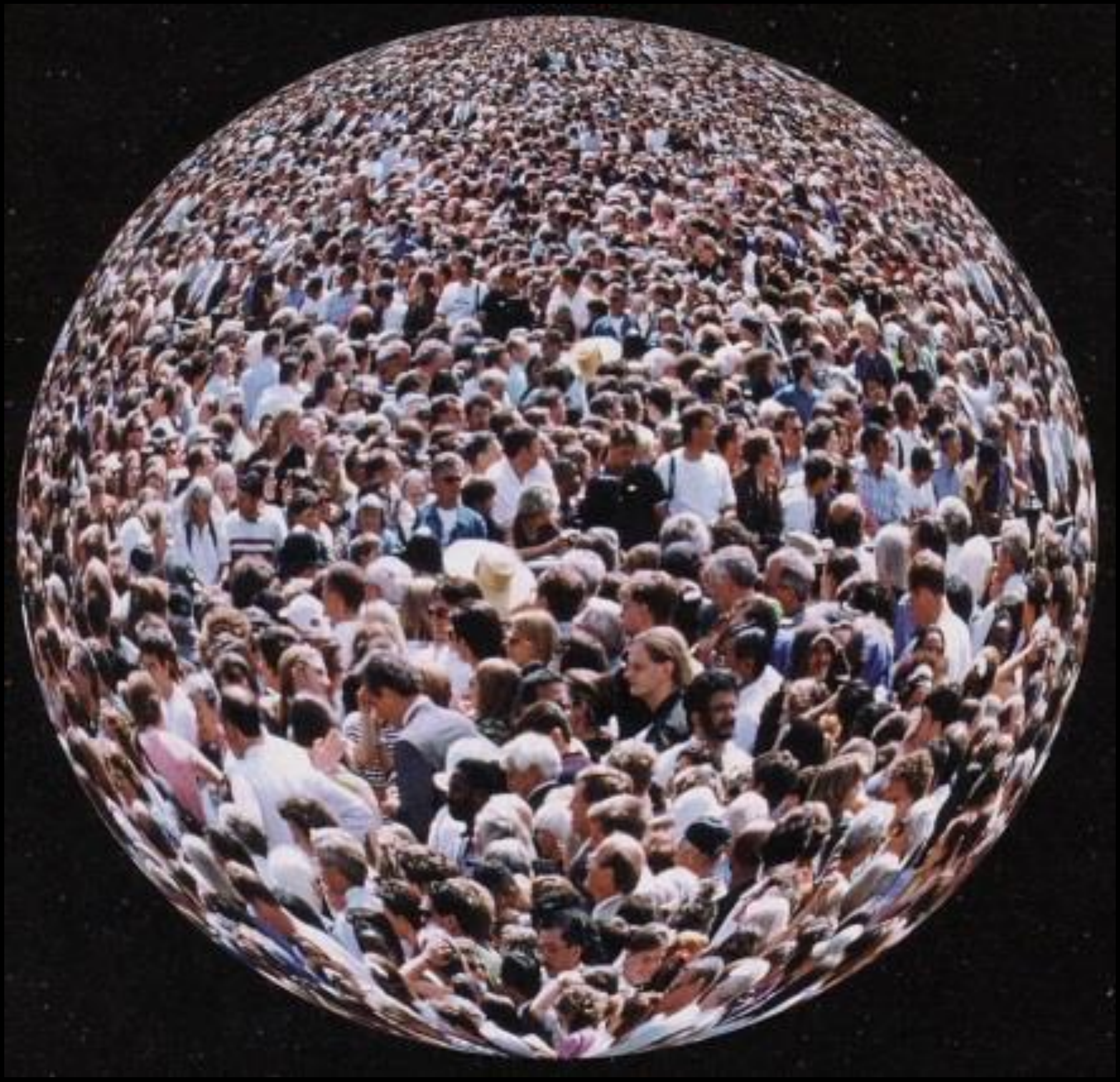
Will Steffen, Paul J. Crutzen and John R. McNeill

The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?

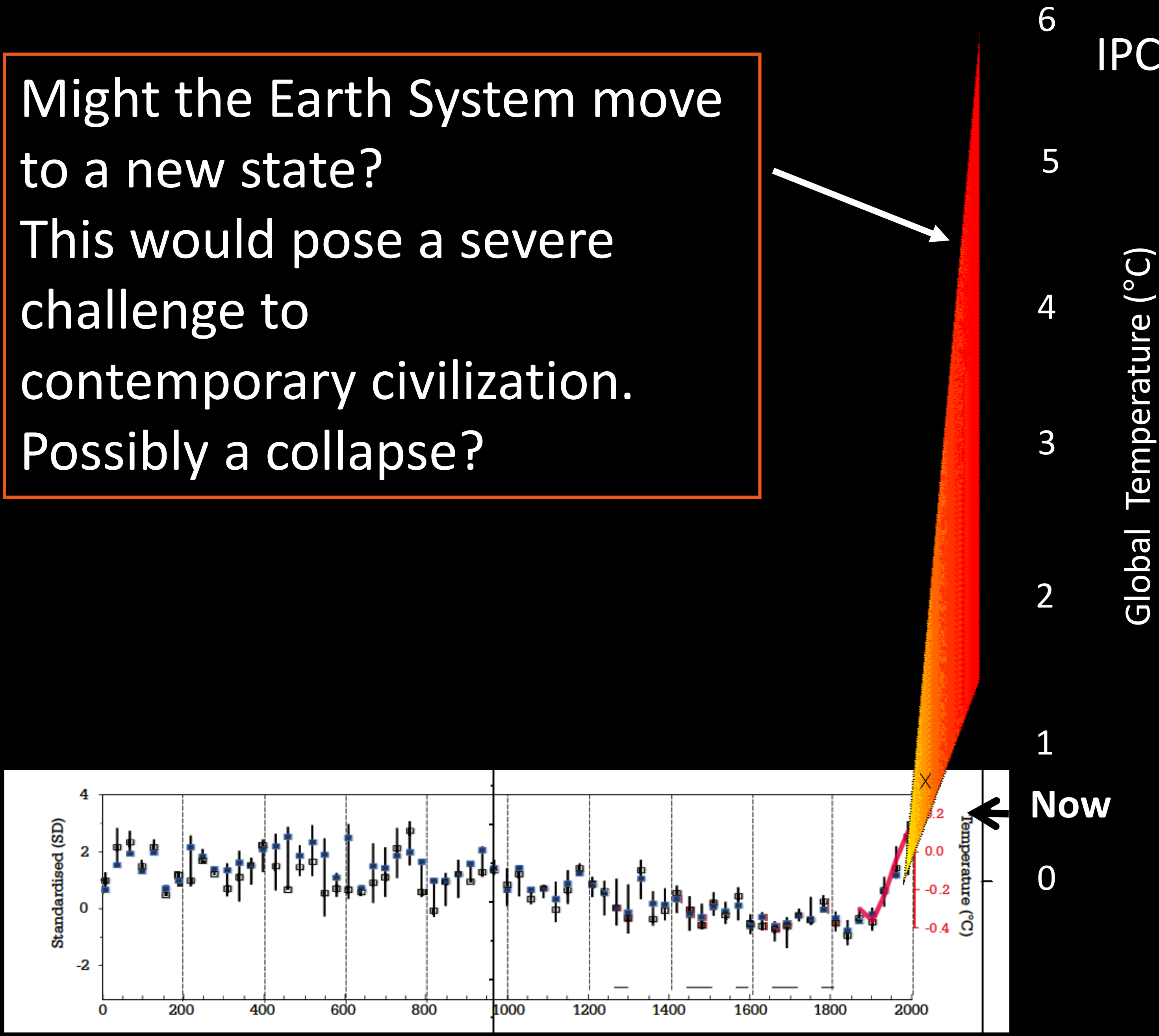
From a small world on a large planet …



To a large world on a small planet …

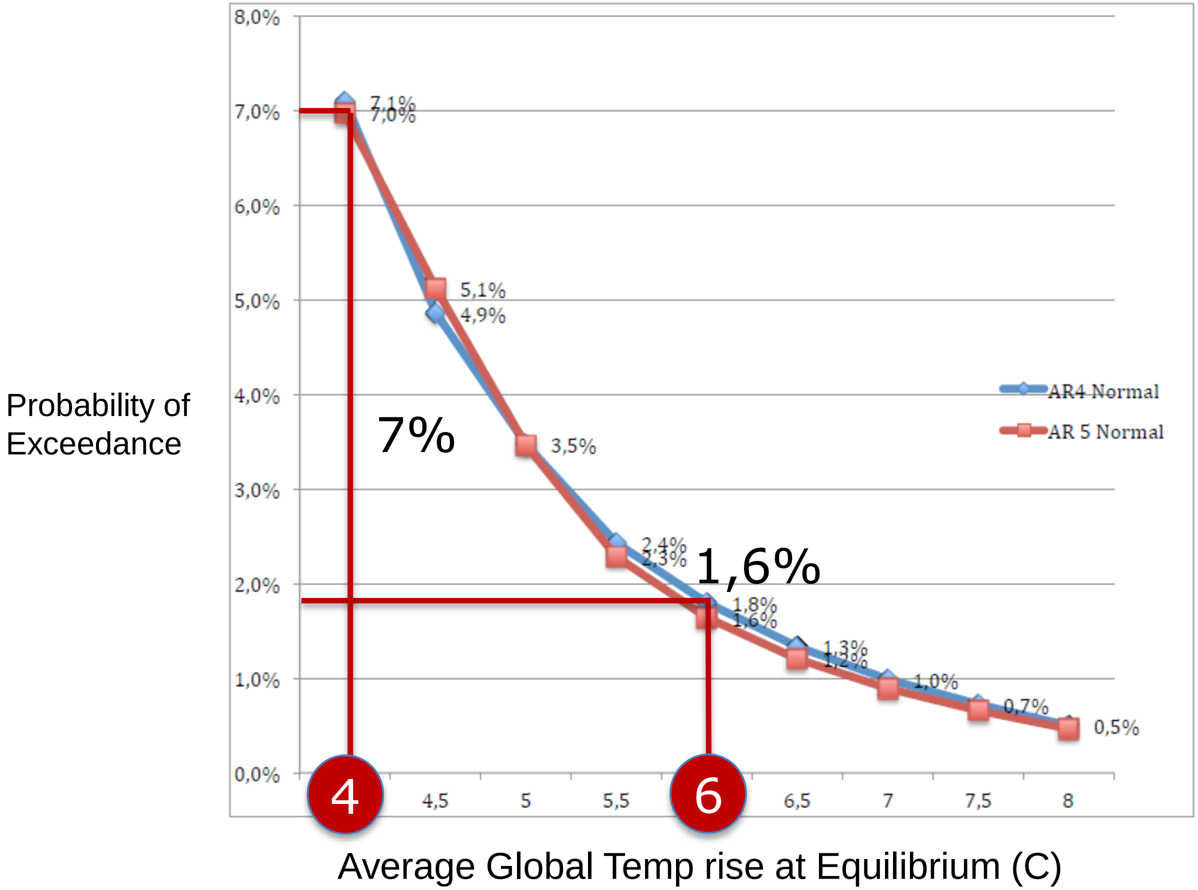


Might the Earth System move to a new state?
This would pose a severe challenge to contemporary civilization.
Possibly a collapse?



Source: IGBP.net

Risks related to agreed global goal of 450 ppm



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GLOBAL
RISK AND OPPORTUNITY
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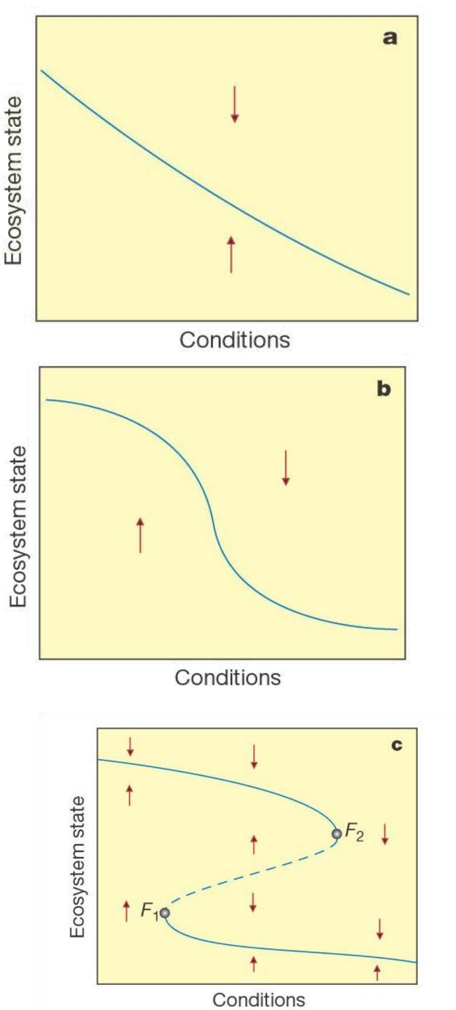
Critical transitions or regime shifts

Regime shifts are substantial, persistent, reorganizations in ecosystem structure and processes

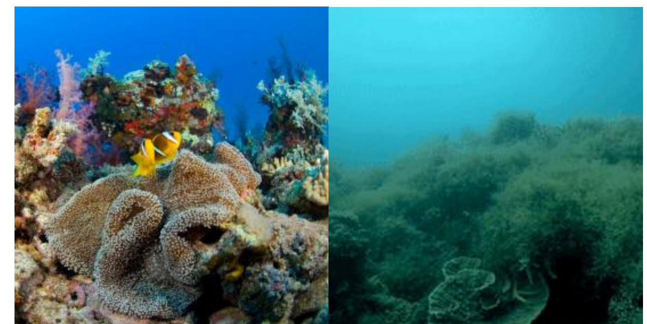


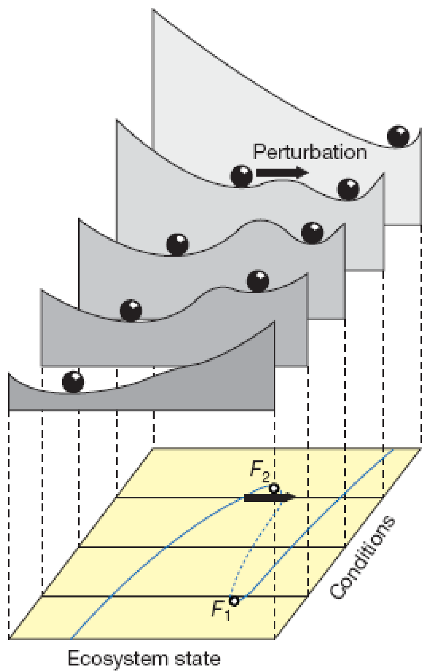
Parkland Savanna

Bush steppe

Diverse Coral dominated

Algae Dominated Reef





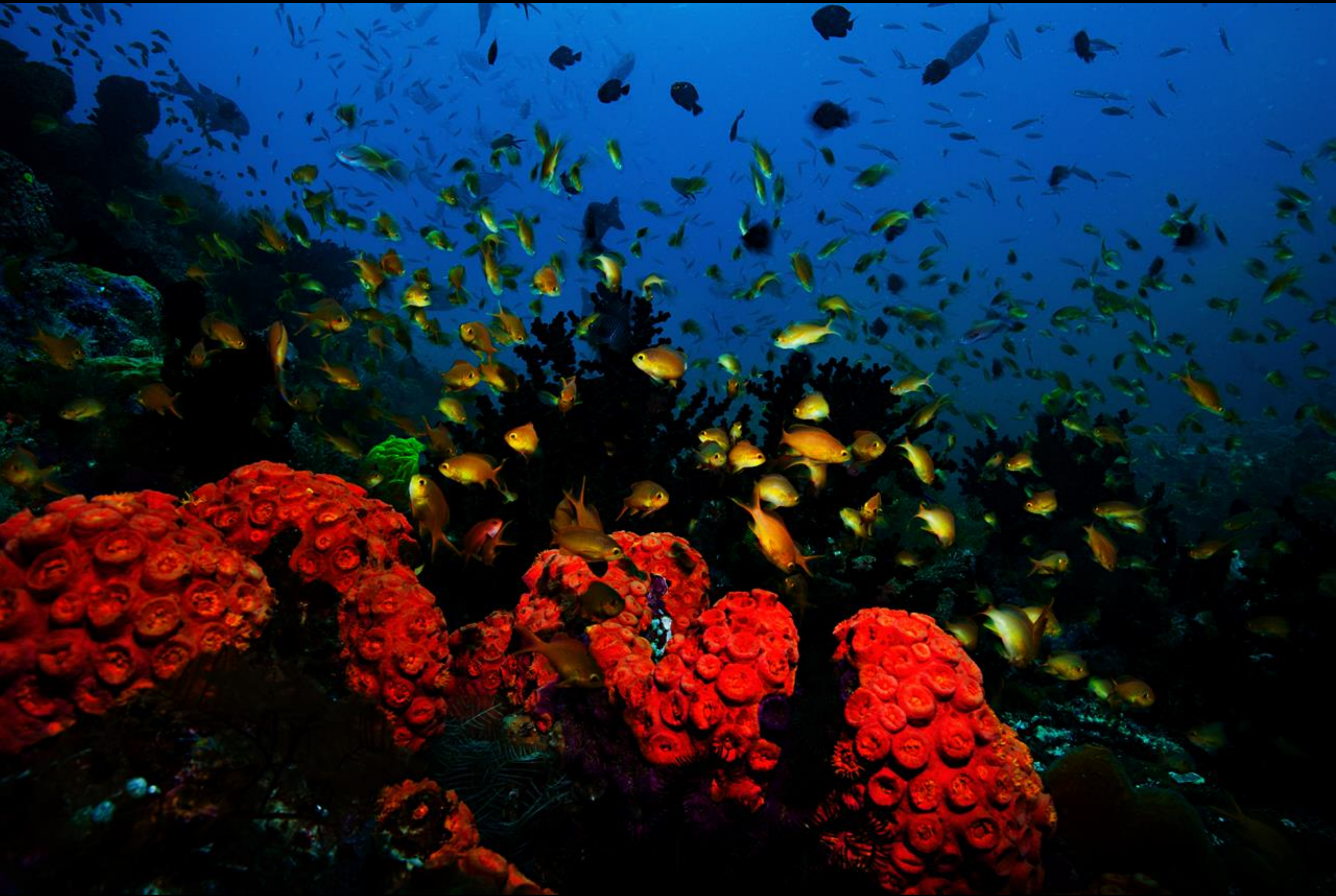
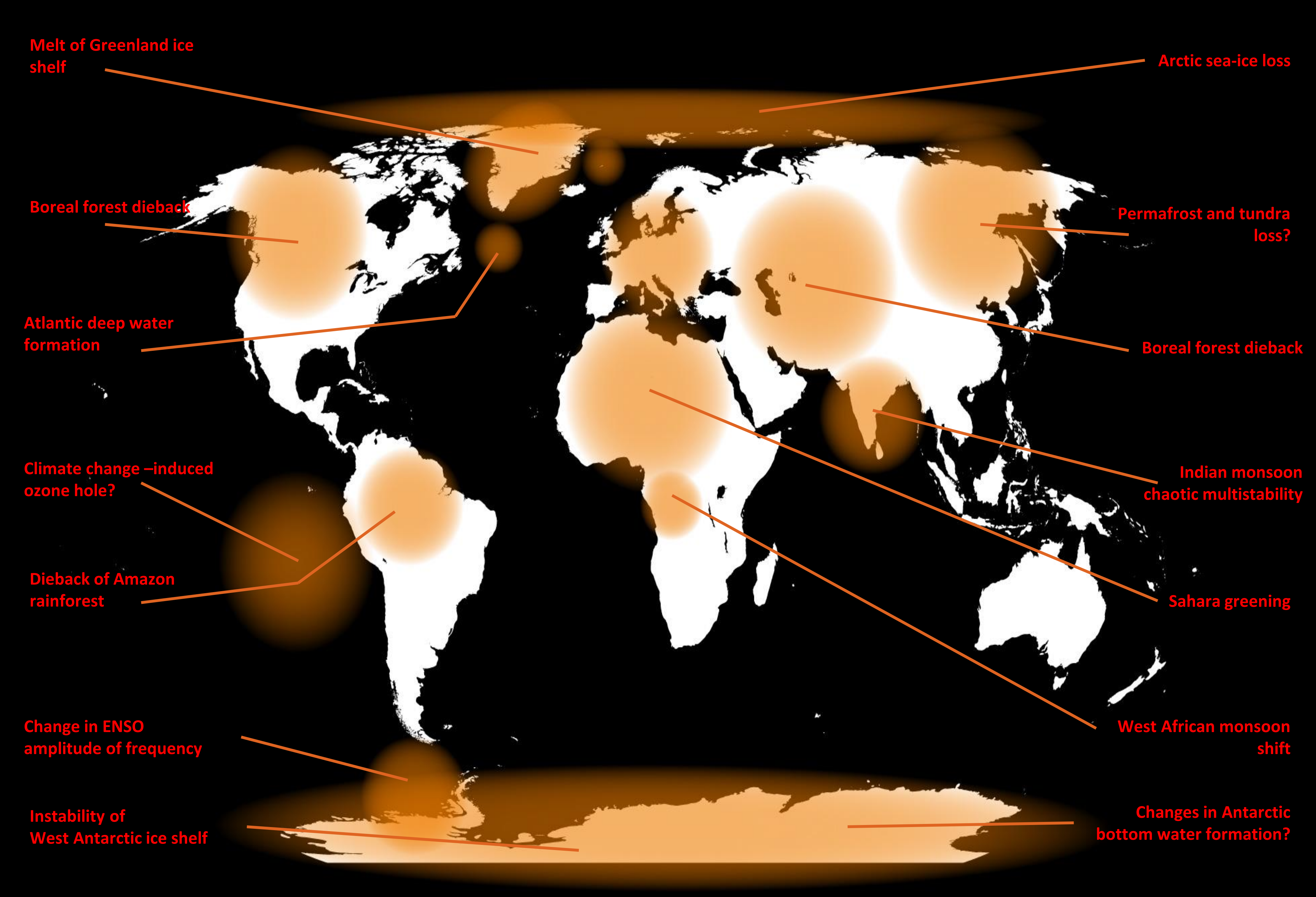
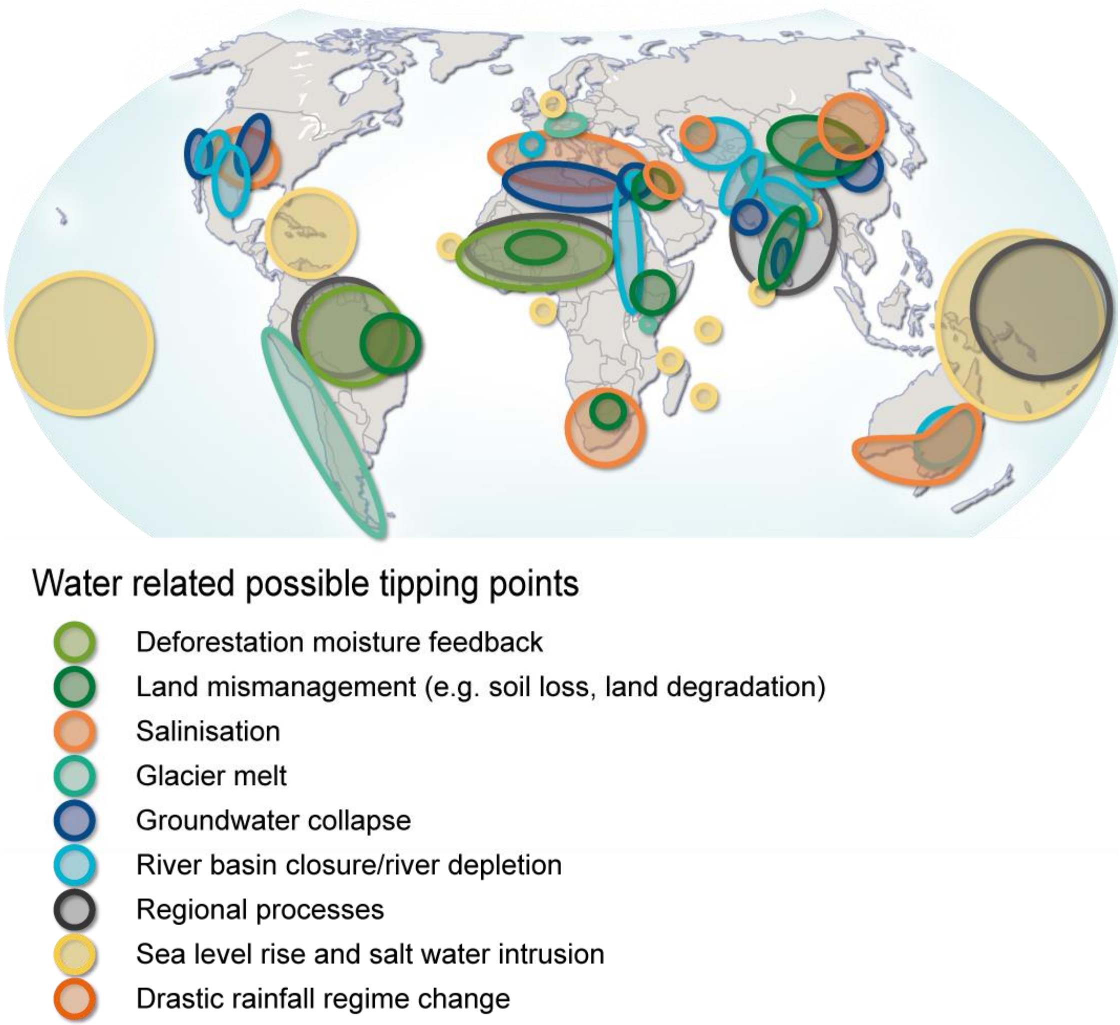


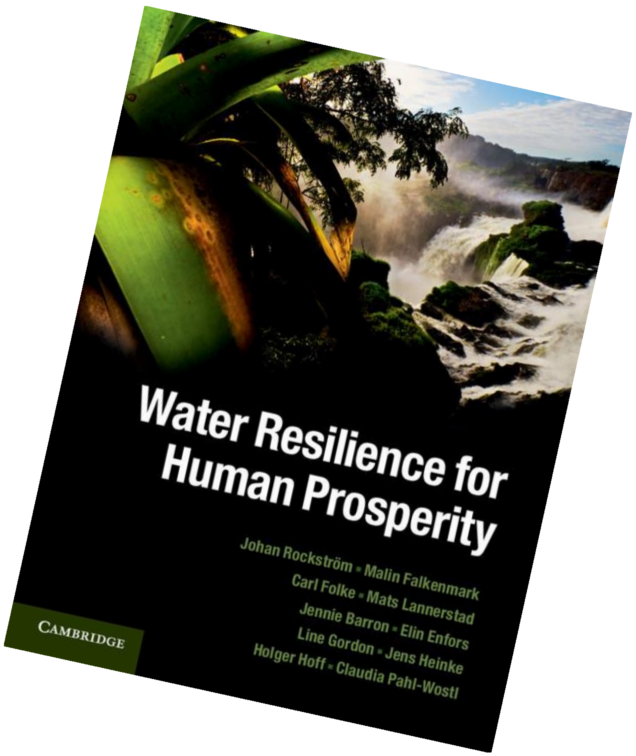
Photo: Mattias Klum



Global Tipping Elements

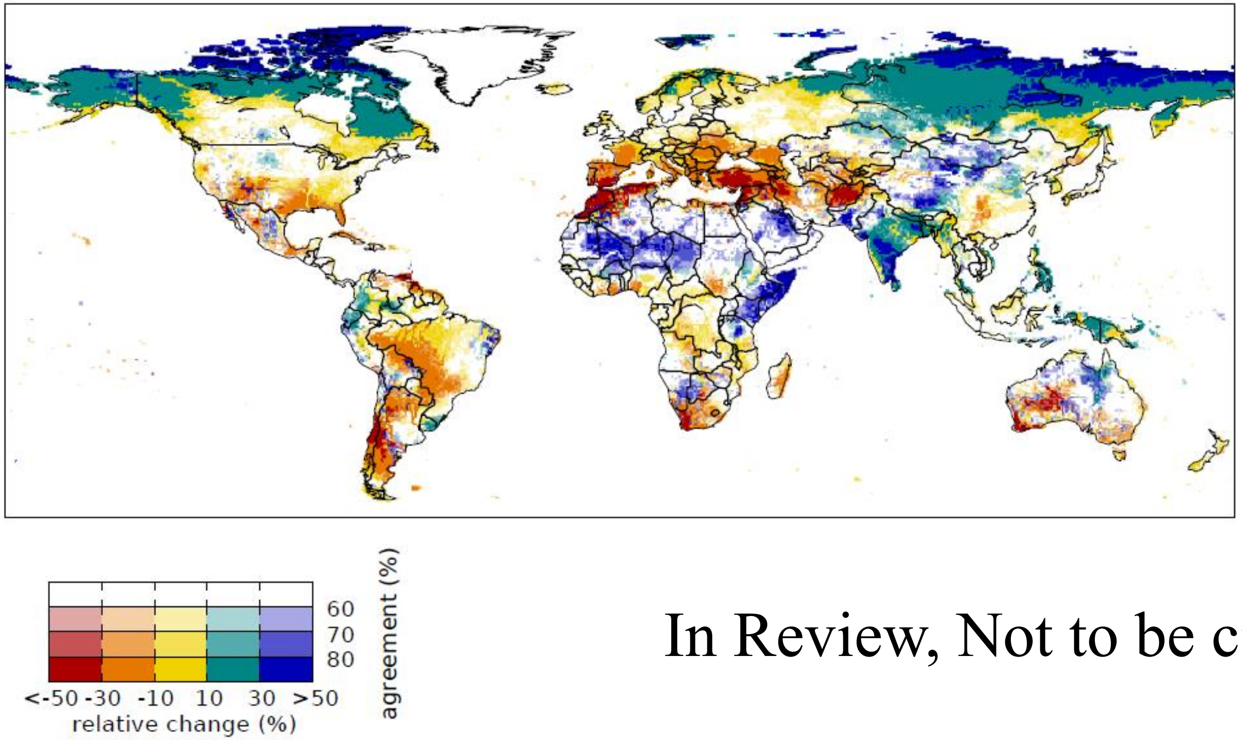
Water related Tipping Elements in the Earth system





Multi-model assessment of water scarcity under climate change

Jacob Schewe [*], Jens Heinke [*][a], Dieter Gerten [*], Ingjerd Haddeland [†], Nigel W. Arnell [‡], Douglas B. Clark [§], Rutger Dankers [¶], Stephanie Eisner [||], Balázs Fekete [**], Felipe J. Colón-González[b], Simon N. Gosling [††], Hyungjun Kim [‡‡], Xingcai Liu [§§], Yoshimitsu Masaki [¶¶], Felix T. Portmann [***], Yusuke Satoh [†††], Tobias Stacke [‡‡‡], Qiuhong Tang [§§], Yoshihide Wada [§§§], Dominik Wisser[c], Torsten Albrecht [*], Katja Frieler [*], Franziska Piontek [*], Lila Warszawski [*], and Pavel Kabat [¶¶¶]



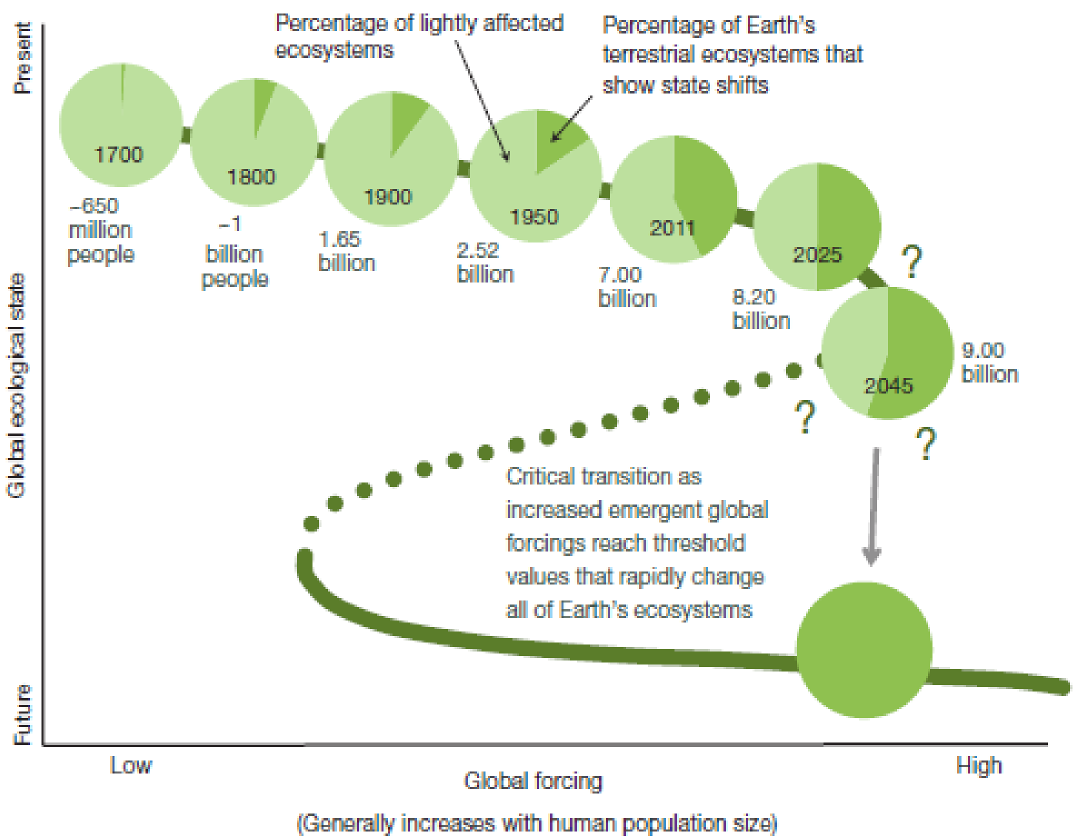
In Review, Not to be cited

REVIEW

doi:10.1038/nature11018

Approaching a state shift in Earth's biosphere

Anthony D. Barnosky[1,2,3], Elizabeth A. Hadly[4], Jordi Bascompte[5], Eric L. Berlow[6], James H. Brown[7], Mikael Fortelius[8], Wayne M. Getz[9], John Harte[9,10], Alan Hastings[11], Pablo A. Marquet[12,13,14,15], Neo D. Martinez[16], Arne Mooers[17], Peter Roopnarine[18], Geerat Vermeij[19], John W. Williams[20], Rosemary Gillespie[9], Justin Kitzes[9], Charles Marshall[1,2], Nicholas Matzke[1], David P. Mindell[21], Eloy Revilla[22] & Adam B. Smith[23]



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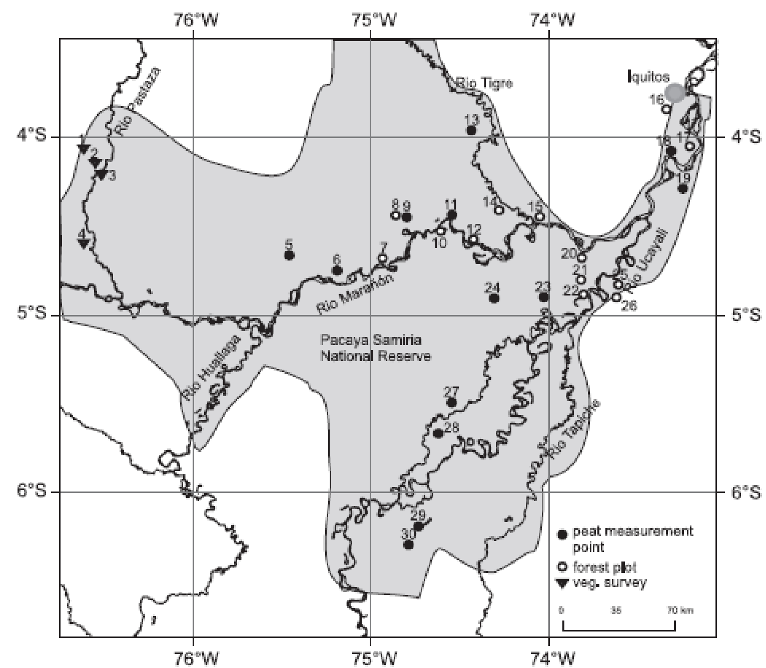
Environmental Research Letters
Environ. Res. Lett. 9 (2014) 124017 (12pp)
doi:10.1088/1748-9326/9/12/124017

The distribution and amount of carbon in the largest peatland complex in Amazonia

Frederick C Draper[1], Katherine H Roucoux[2], Ian T Lawson[2],
Edward T A Mitchard[3], Euridice N Honorio Coronado[4], Outi Lähteenoja[5],
Luis Torres Montenegro[6], Elvis Valderrama Sandoval[6],
Ricardo Zaráte[4] and Timothy R Baker[1]

Environ. Res. Lett. 9 (2014) 124017




Two giants colliding
Photo: N. Wijkmark/Azote

Are we leaving Edens Garden?

The Holocene - Humankinds 10 000 years of grace

Stockholm Resilience Centre and Rockström and others, Ecology and Society 2009:14

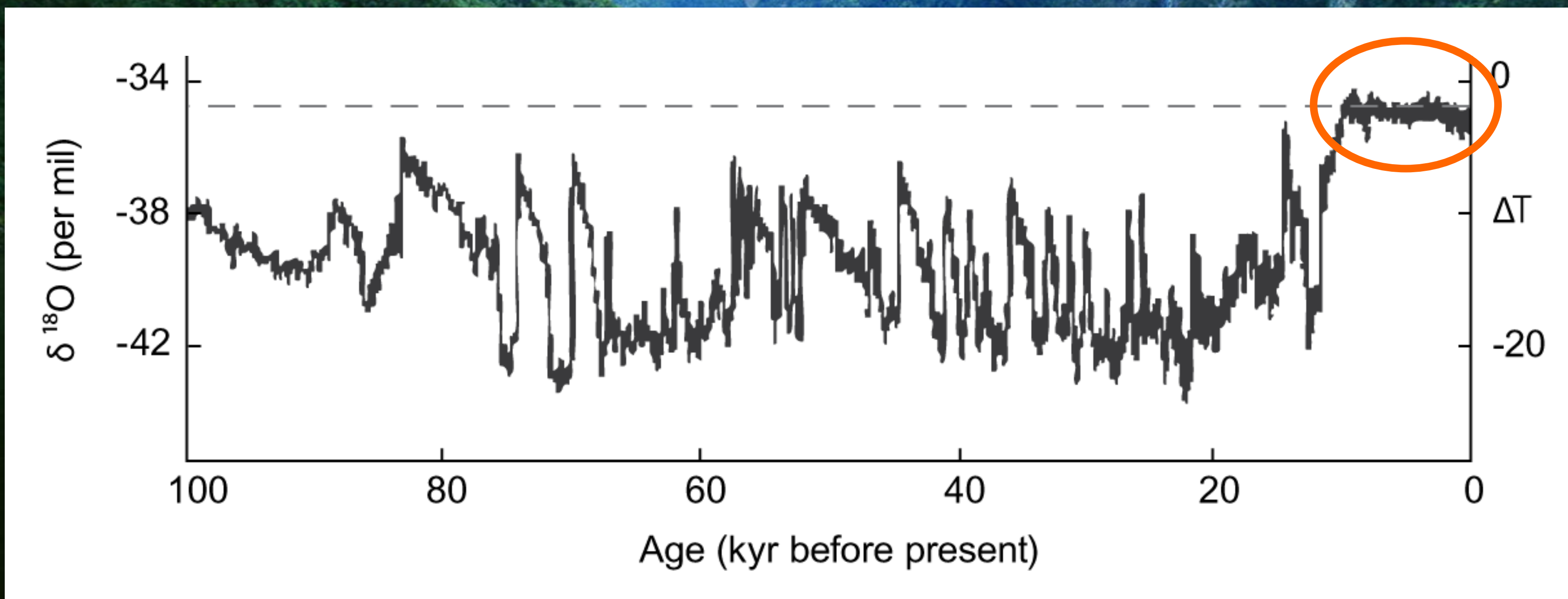
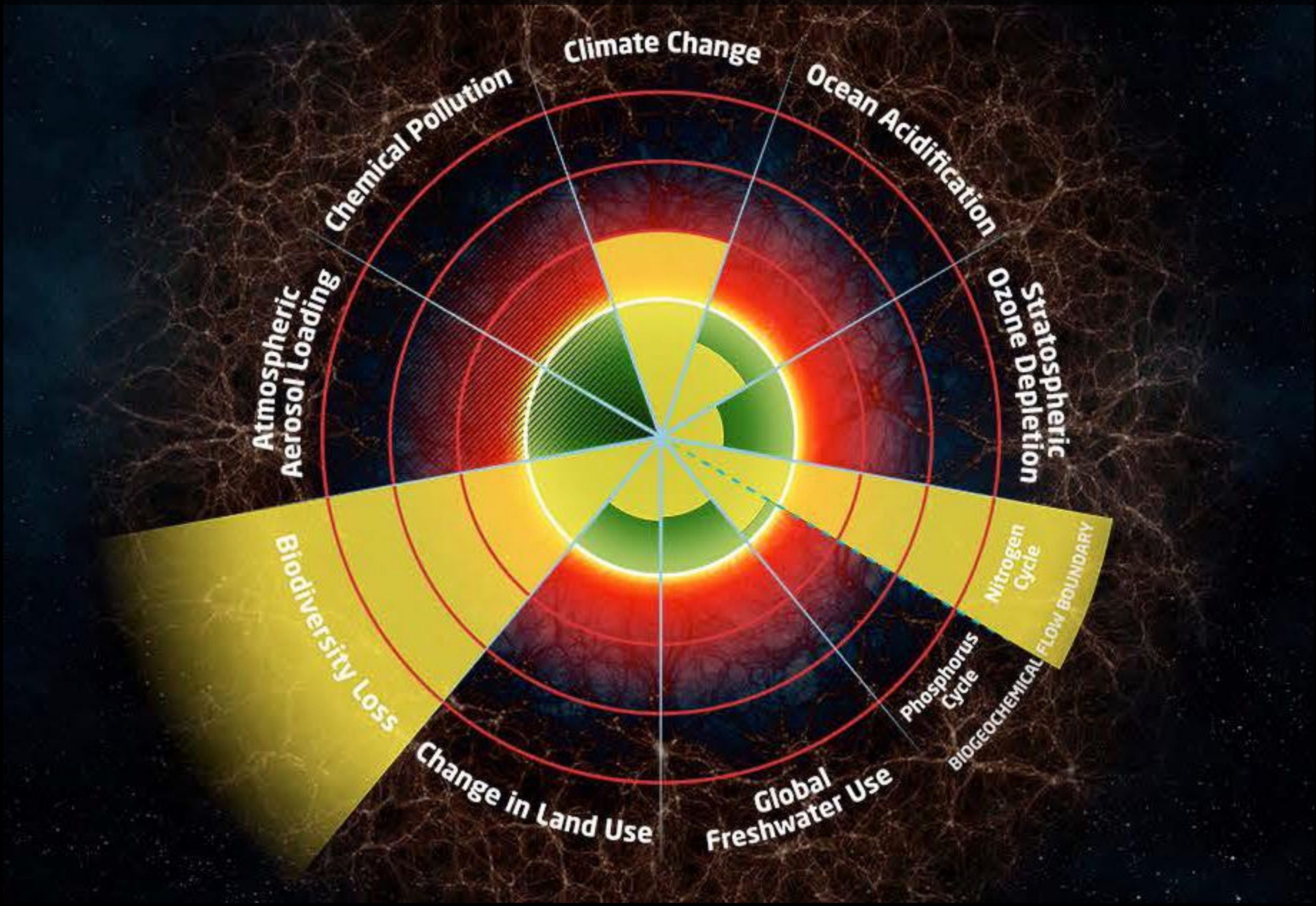


Photo: Michael A. Stecker

Human Prosperity within Safe Operating Space of Planetary Boundaries

PB 1.0 - The planetary safe operating space

Rockström, J., Steffen W., Noone, K., et al. Nature, 2009

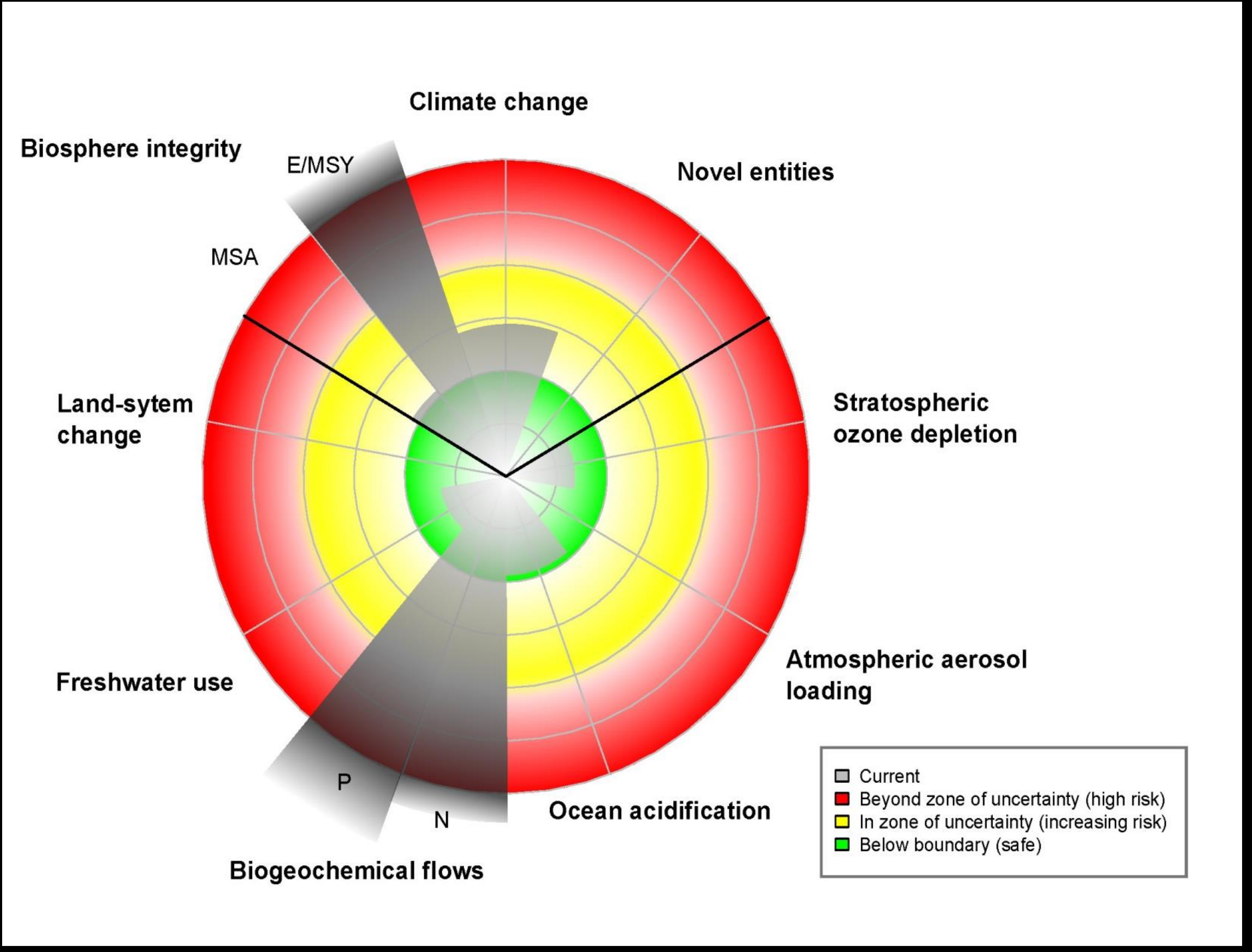


Defining Planetary Boundaries 1.0

CLIMATE CHANGE	OCEAN ACIDIFICATION	STRATOSPHERIC OZONE	BIOGEO-CHEMICAL	GLOBAL FRESH-WATER USE	LAND SYSTEM CHANGE	RATE OF BIODI-VERSITY LOSS	CHEMICAL POLLUTION	ATMOSPHERIC AEROSOL LOADING
CO_2 concentration in the atmosphere <350 ppm and/ or a maximum change of +1 W m^{-2} in radiative forcing.	Average surface seawater saturation state with respect to aragonite ≥ 80% of pre-industrial levels.	<5% reduction in O_3 concentration from preindustrial level of 290 Dobson Units.	**Nitrogen (N) cycle:** Limits industrial and agricultural fixation of N_2 to 35 Tg N yr^{-1}. **Phosphorus (P) cycle:** Annual P inflow to oceans not to exceed 10 times the natural background weathering of P.	<4,000 km^3 yr^{-1} of consumptive use of runoff resources.	<15% of the ice-free land surface under cropland.	Annual rate of <10 extinctions per million species.	Not yet quantified	Not yet quantified

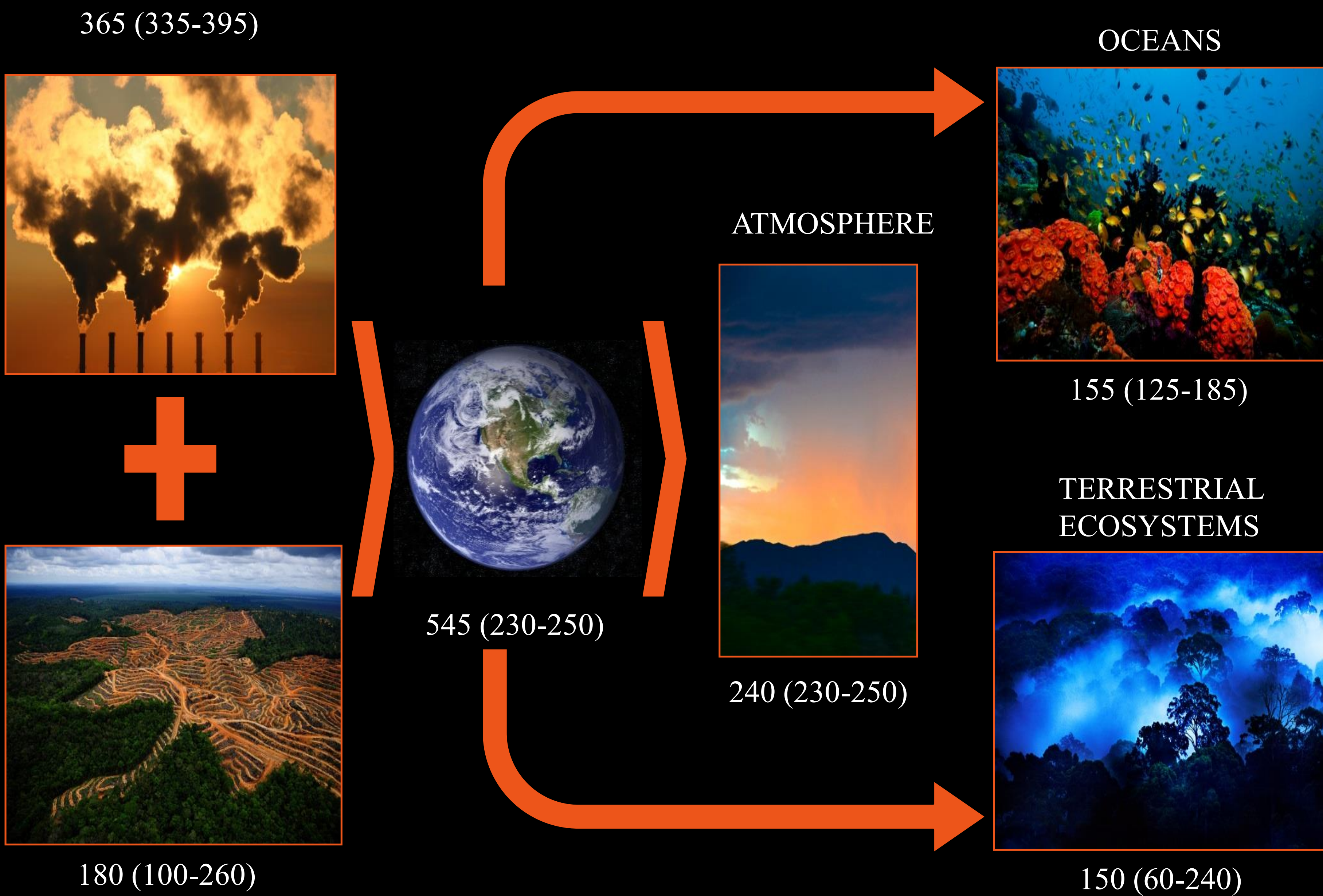
Planetary Boundaries 2.0

A work in progress



Why biosphere stewardship builds human prosperity

Global CO_2 Emissions & Distribution (GtC)



Functions and status of earth's biomes that regulate planetary resilience

Photos: World Wildlife Fund, breakingenergy.com, saguidedtours.com, Sierra Club Pennsylvania, Projectaware.com, Duncan Greene/Wired UK.

The polar regions regulate global temperature, regional climate systems and ocean circulation. Melting faster than anticipated.

The World's rainforests act as carbon sinks, provide moisture feedback, are banks for genetic diversity and generate oxygen. In rapid decline but the rate has declined somewhat.

The ocean's marine systems act as a heat conveyer, carbon sink, a bank for genetic diversity and generates oxygen. In rapid decline

The world's temperate organic systems (such as permafrost) act as carbon & methane sinks and generate oxygen. Faster than anticipated thawing of permafrost & methane release

Temperate forests act as carbon sinks, regulate rainfall patterns & generate oxygen. Relatively stable but concern over rate of deforestation in Russia and severe warming impacts on disease.

Tropical savannah systems play a role in moisture feedback , regional rainfall patterns and act as carbon sinks. They remain relatively stable.

Rainfall dependent on moisture feedback from functioning forest landscapes

W09525 VAN DER ENT ET AL.: ORIGIN AND FATE OF ATMOSPHERIC MOISTURE **W09525**

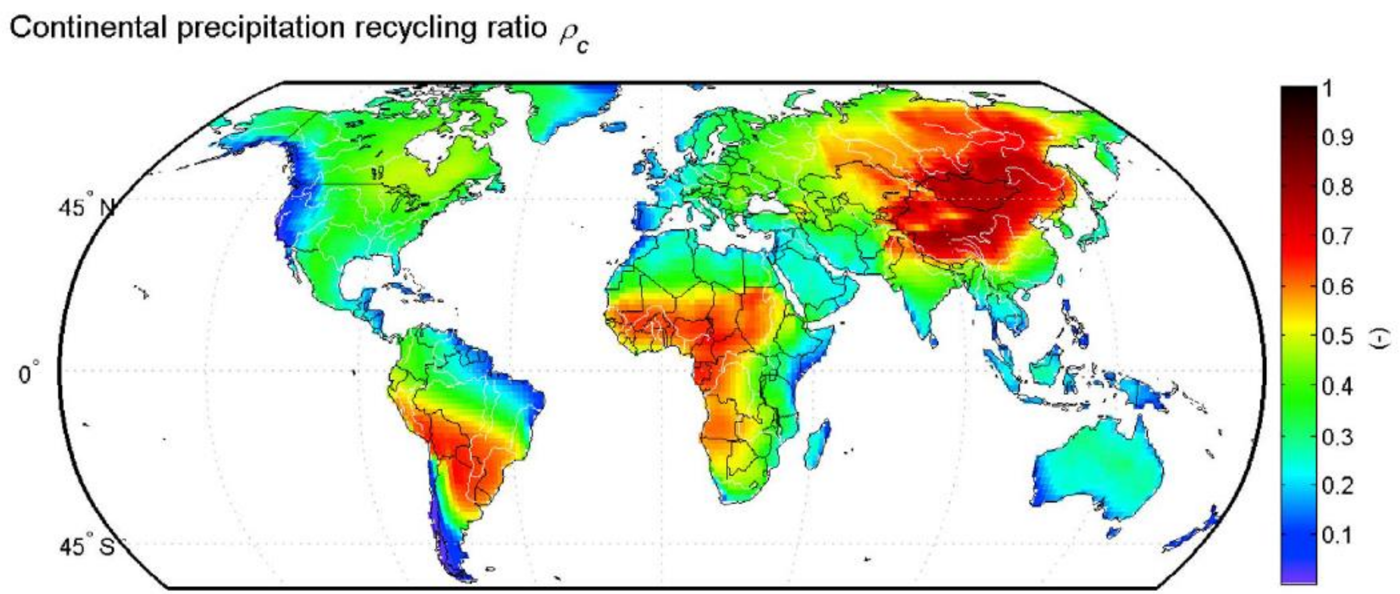
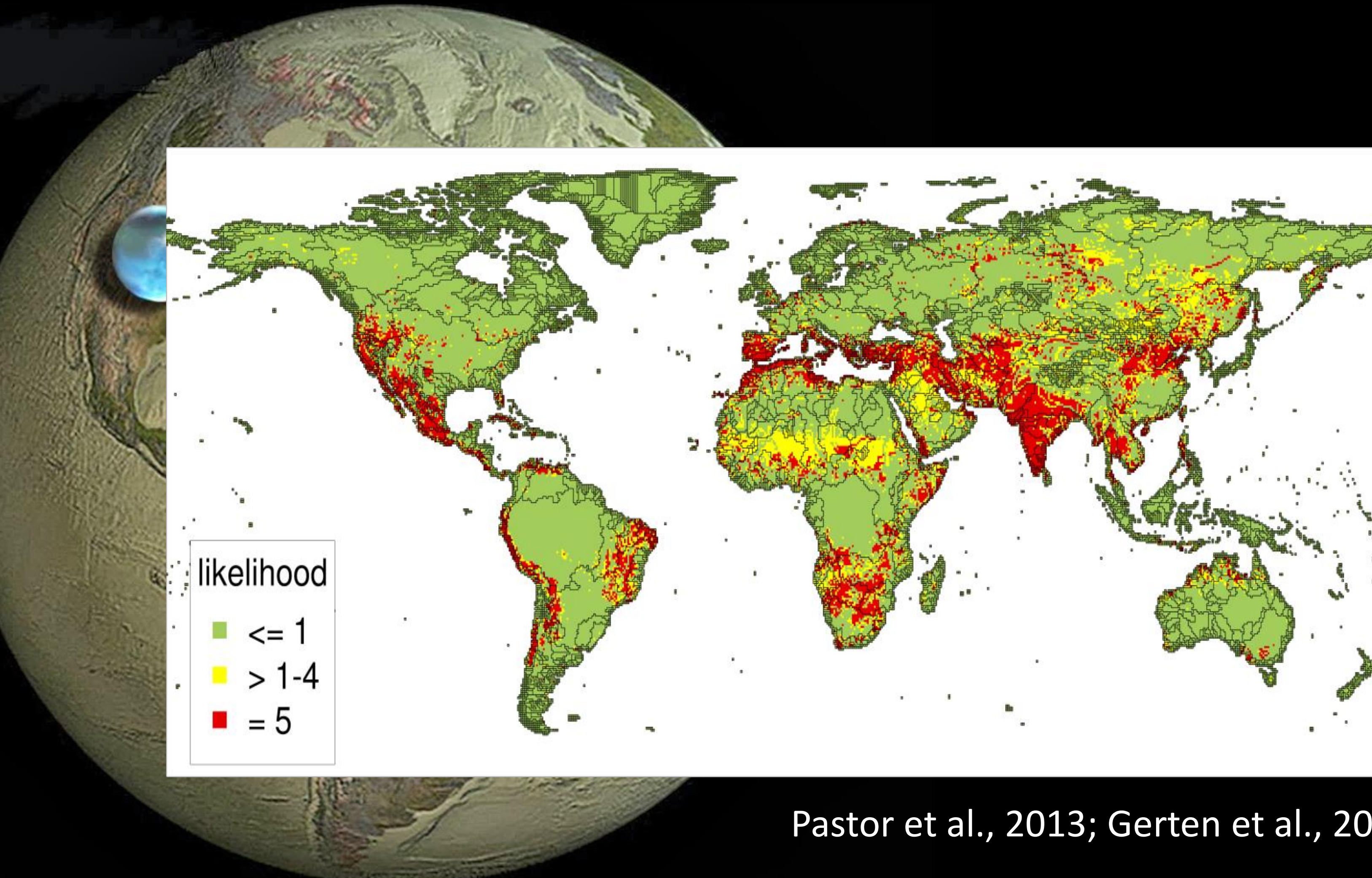


Figure 3. Average continental precipitation recycling ratio ρ_c (1999–2008).

Downscaling and Operationalising

Freshwater use boundary – work in progress

Kummu, Ward, de Moel, Varis, Environmental Research Letters 2010



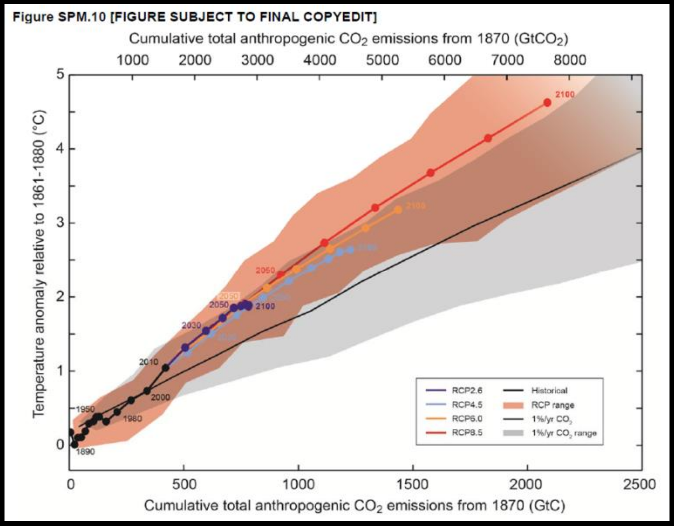
Pastor et al., 2013; Gerten et al., 2014)

Image: Jack Cook, Woods Hole, USGS

Planetary Stewardship: Transitions to Global Sustainability

World Development within ”Absolute” global budgets

1. Global Land budget
2. Global Water budget
3. Global N and P budgets
4. Zero loss biodiversity



IPCC AR5 WGI 2013

2 ºC > 66% → 1000 GtC

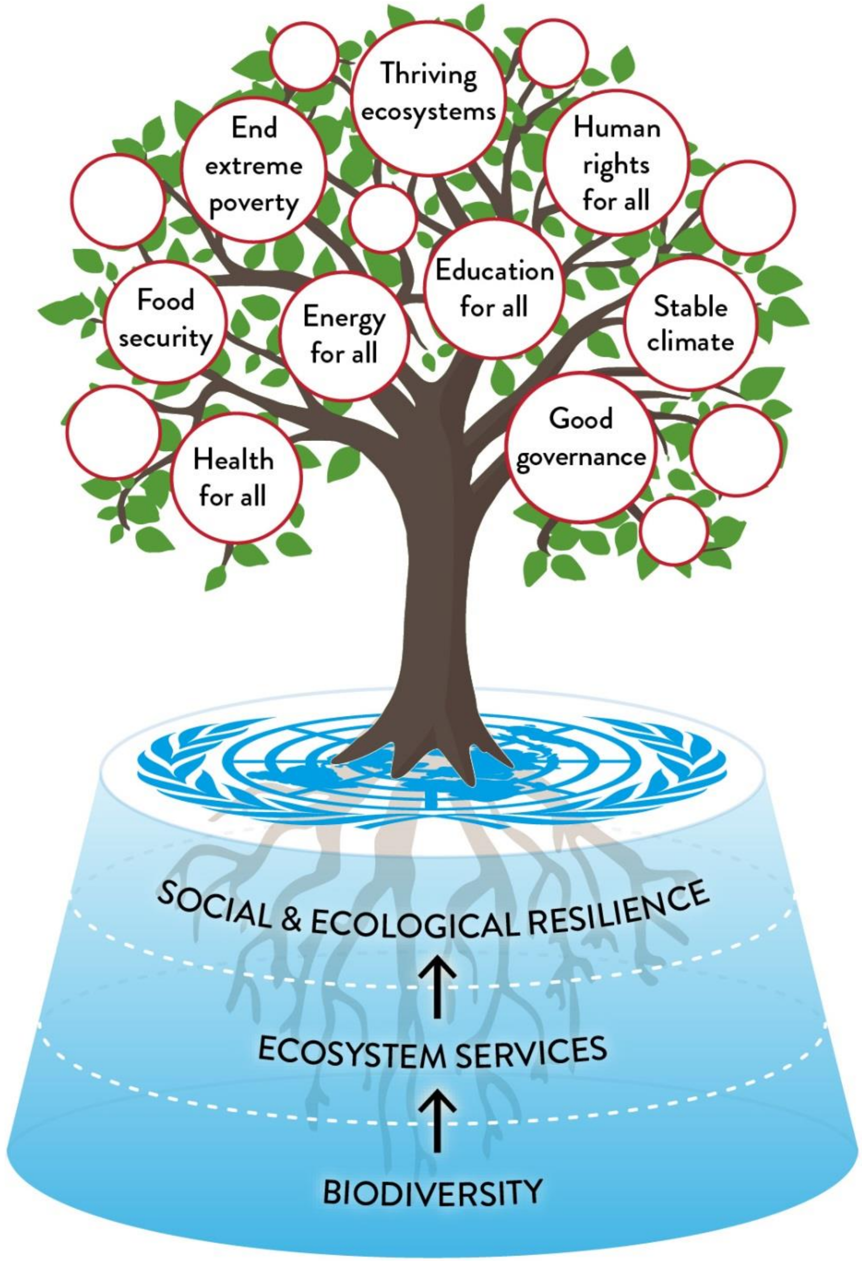
Non-CO2 forcing (RCP2.6) → 800 GtC

Used 531 GtC 2011

Gives 269 GtC left

→ 1000 Gt CO_2

40 Gt CO_2 /yr…


Thriving ecosystems
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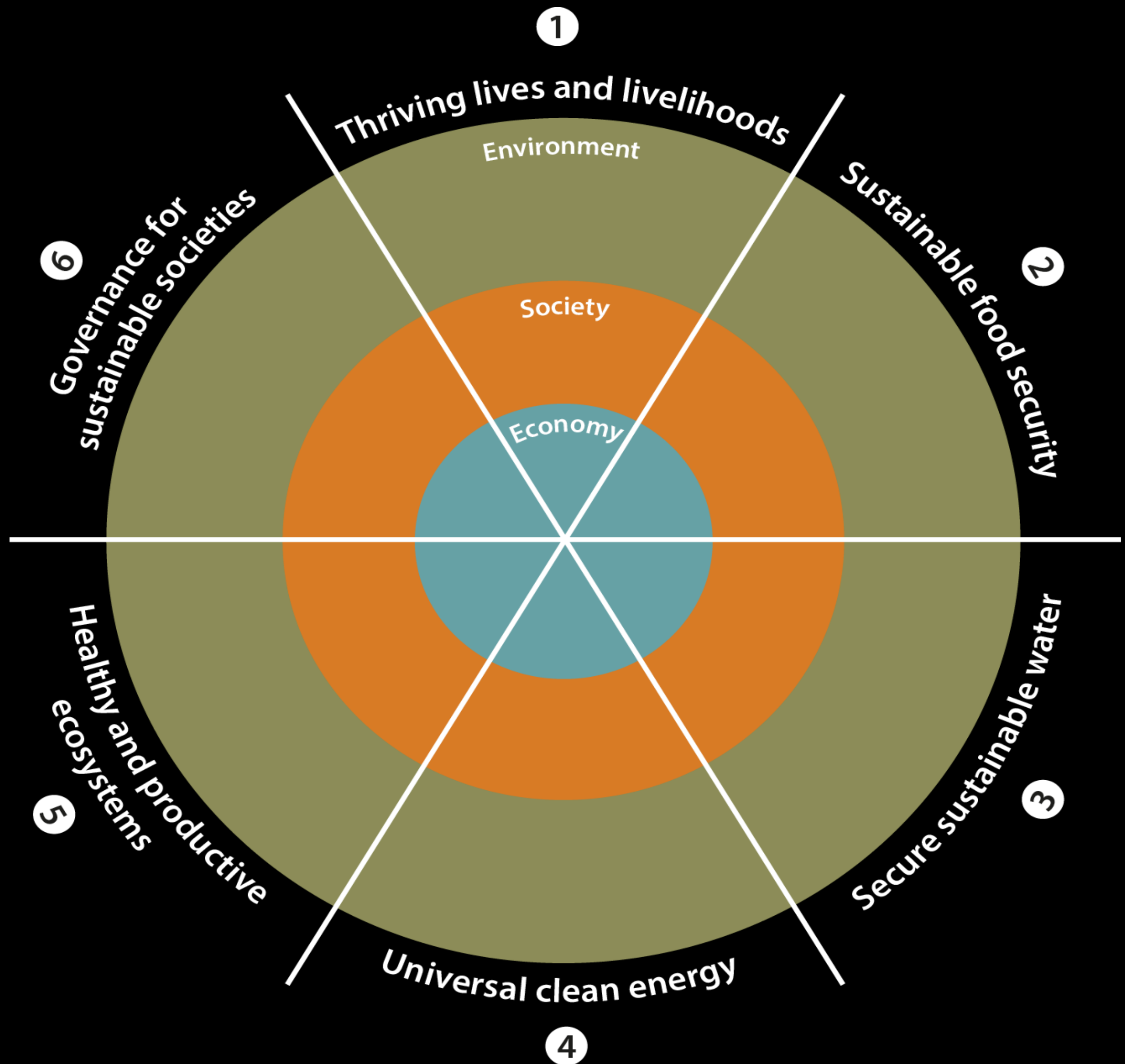
Human rights for all
Food security
Energy for all
Education for all
Stable climate
Good governance
Health for all
SOCIAL & ECOLOGICAL RESILIENCE
ECOSYSTEM SERVICES
BIODIVERSITY

A new direction: People and Planet

Setting the agenda on Sustainable Development Goals



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NATURE | COMMENT

Policy: Sustainable development goals for people and planet

David Griggs, Mark Stafford-Smith, Owen Gaffney, Johan Rockström, Marcus C. Öhman, Priya Shyamsundar, Will Steffen, Gisbert Glaser, Norichika Kanie & Ian Noble

Affiliations | Corresponding author

Nature 495, 305–307 (21 March 2013) doi:10.1038/495305a

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Planetary stability must be integrated with United Nations targets to fight poverty and secure human well-being, argue David Griggs and colleagues.

ILLUSTRATION BY PHIL DISLEY

The United Nations Rio+20 summit in Brazil in 2012 committed governments to create a set of sustainable development goals (SDGs) that would be integrated into the follow-up to the Millennium Development Goals (MDGs) after their 2015 deadline. Discussions on how to formulate these continue this week at UN headquarters in New York.

We argue that the protection of Earth's life-support system and poverty reduction must be the twin

Growth Without Limits

Limits to Growth

Growth within Limits