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https://www.ted.com/talks/tristram_stuart_the_global_food_waste_scandal#t-836383

Agriculture & Fisheries as drivers of change

Skills you gain:

- 1- Improve our knowledge on how agriculture might contribute to Global change
- 2- Get familiar with its perturbation of the planetary boundaries
- 3- Obtain knowledge on the future scenarios
- 4- Critically evaluate the current Agriculture & planetary boundaries

References:

RESEARCH

RESEARCH ARTICLE SUMMARY

SUSTAINABILITY

Planetary boundaries: Guiding human development on a changing planet

Will Steffen,* Katherine Richardson, Johan Rockström, Sarah E. Cornell, Ingo Fetzer, Elena M. Bennett, Reinette Biggs, Stephen R. Carpenter, Wim de Vries, Cynthia A. de Wit, Carl Folke, Dieter Gerten, Jens Heinke, Georgina M. Mace, Linn M. Persson, Veerabhadran Ramanathan, Belinda Reyers, Sverker Sörlin

Copyright © 2009 by the author(s). Published here under license by the Resilience Alliance. Rockström, J., W. Steffen, K. Noone, A. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, P. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society* 14(2): 32. [online] URL: <http://www.ecologyandsociety.org/vol14/iss2/art32/>

Research

Planetary Boundaries: Exploring the Safe Operating Space for Humanity

Johan Rockström^{1,2}, Will Steffen^{1,3}, Kevin Noone^{1,4}, Åsa Persson^{1,2}, E. Stuart III Chapin⁵, Eric Lambin⁶, Timothy M. Lenton⁷, Marten Scheffer⁸, Carl Folke^{1,9}, Hans Joachim Schellnhuber^{10,11}, Björn Nykvist^{1,2}, Cynthia A. de Wit⁴, Terry Hughes¹², Sander van der Leeuw¹³, Henning Rodhe¹⁴, Sverker Sörlin^{1,15}, Peter K. Snyder¹⁶, Robert Costanza^{1,17}, Uno Svedin¹, Malin Falkenmark^{1,18}, Louise Karlberg^{1,2}, Robert W. Corell¹⁹, Victoria J. Fabry²⁰, James Hansen²¹, Brian Walker^{7,22}, Diana Liverman^{23,24}, Katherine Richardson²⁵, Paul Crutzen²⁶, and Jonathan Foley²⁷

ECOLOGY THROUGH TIME

REVIEW

Historical Overfishing and the Recent Collapse of Coastal Ecosystems

Jeremy B. C. Jackson,^{1,2*} Michael X. Kirby,³ Wolfgang H. Berger,¹ Karen A. Bjorndal,⁴ Louis W. Botsford,⁵ Bruce J. Bourque,⁶ Roger H. Bradbury,⁷ Richard Cooke,² Jon Erlandson,⁸ James A. Estes,⁹ Terence P. Hughes,¹⁰ Susan Kidwell,¹¹ Carina B. Lange,¹ Hunter S. Lenihan,¹² John M. Pandolfi,¹³ Charles H. Peterson,¹² Robert S. Steneck,¹⁴ Mia J. Tegner,¹⁵ Robert R. Warner¹⁵

Forecasting Agriculturally Driven Global Environmental Change

David Tilman,^{1*} Joseph Fargione,¹ Brian Wolff,¹ Carla D'Antonio,² Andrew Dobson,³ Robert Howarth,⁴ David Schindler,⁵ William H. Schlesinger,⁶ Daniel Simberloff,⁷ Deborah Swackhamer⁸

Farming and the Fate of Wild Nature

Rhys E. Green,^{1,2*} Stephen J. Cornell,^{1,3} Jörn P. W. Scharlemann,^{1,2} Andrew Balmford^{1,4}

REVIEW

Food Security: The Challenge of Feeding 9 Billion People

H. Charles J. Godfray,^{1*} John R. Beddington,² Ian R. Crute,³ Lawrence Haddad,⁴ David Lawrence,⁵ James F. Muir,⁶ Jules Pretty,⁷ Sherman Robinson,⁸ Sandy M. Thomas,⁹ Camilla Toulmin¹⁰

Agriculture: A major source of biogeochemical impacts

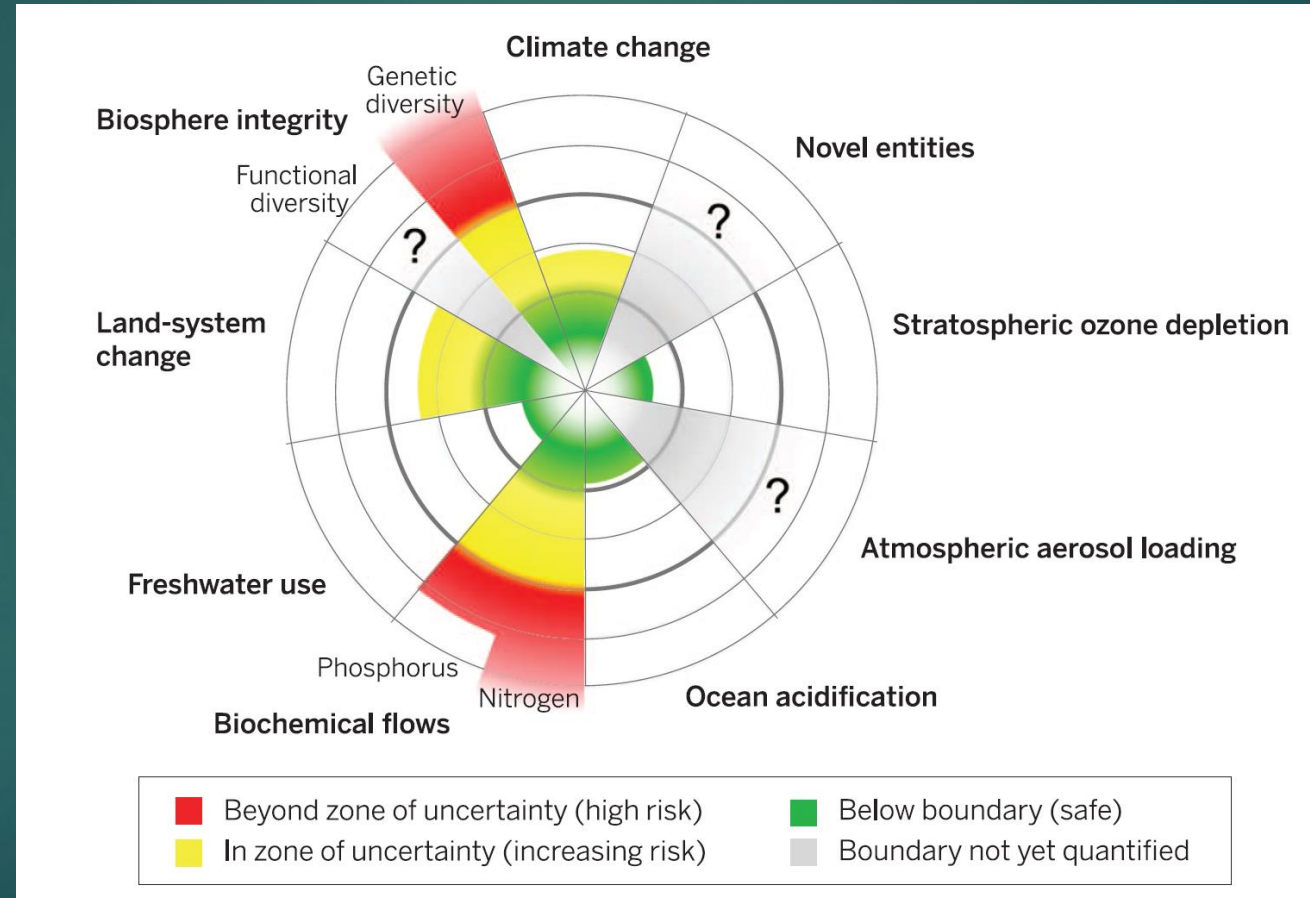


More information on N & P impacts on lecture about agriculture.

<https://gerenciaderiesgosyseguros.com>

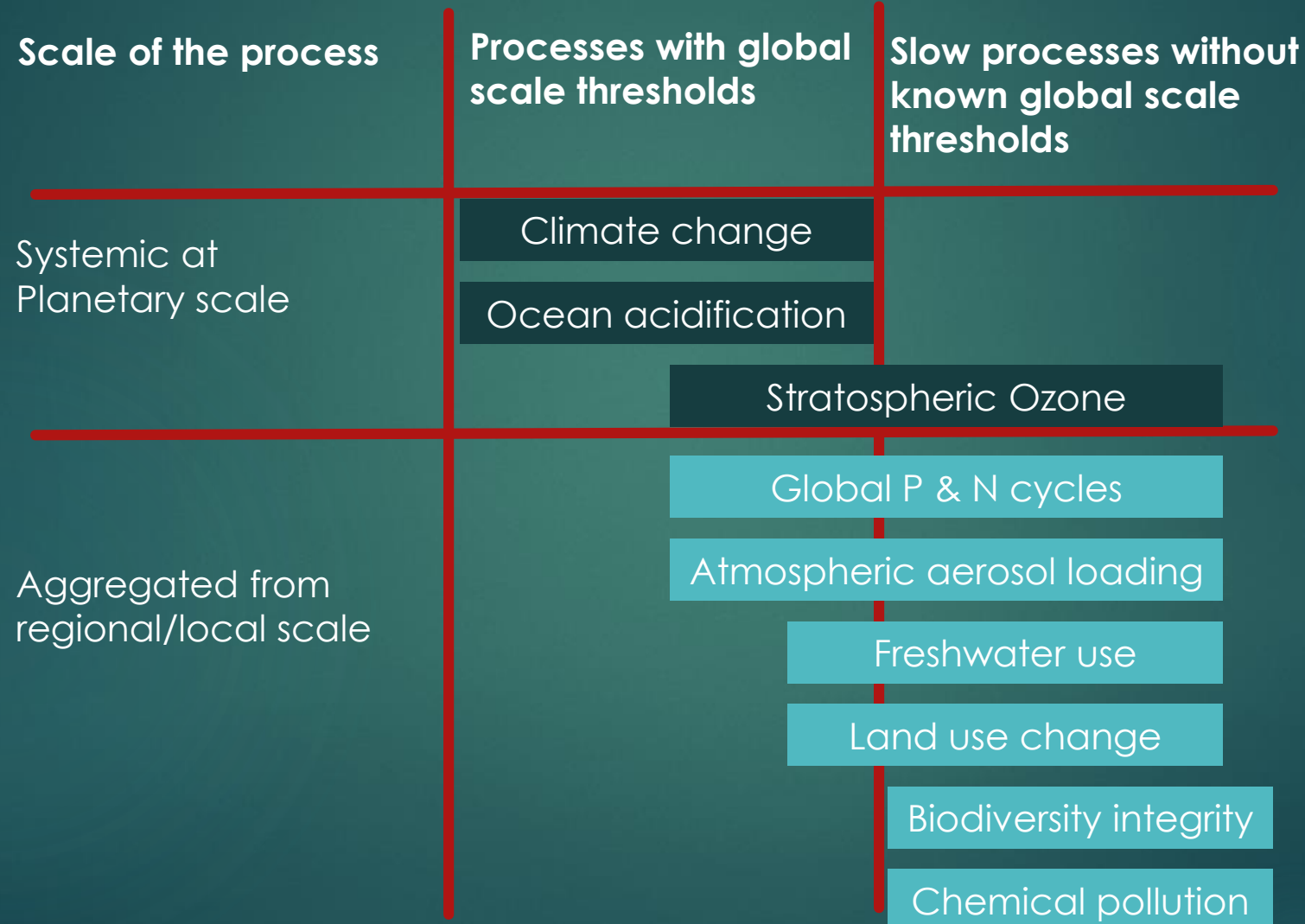
Few agricultural regions of very high N & P application rates are the main contributors to the transgression of this boundary. A redistribution of fertilization from areas where it is currently in excess to areas where the soil is naturally poor may simultaneously boost global crop production and reduce the transgression of the N-P boundaries.

The planetary boundaries define a safe operating space for humanity

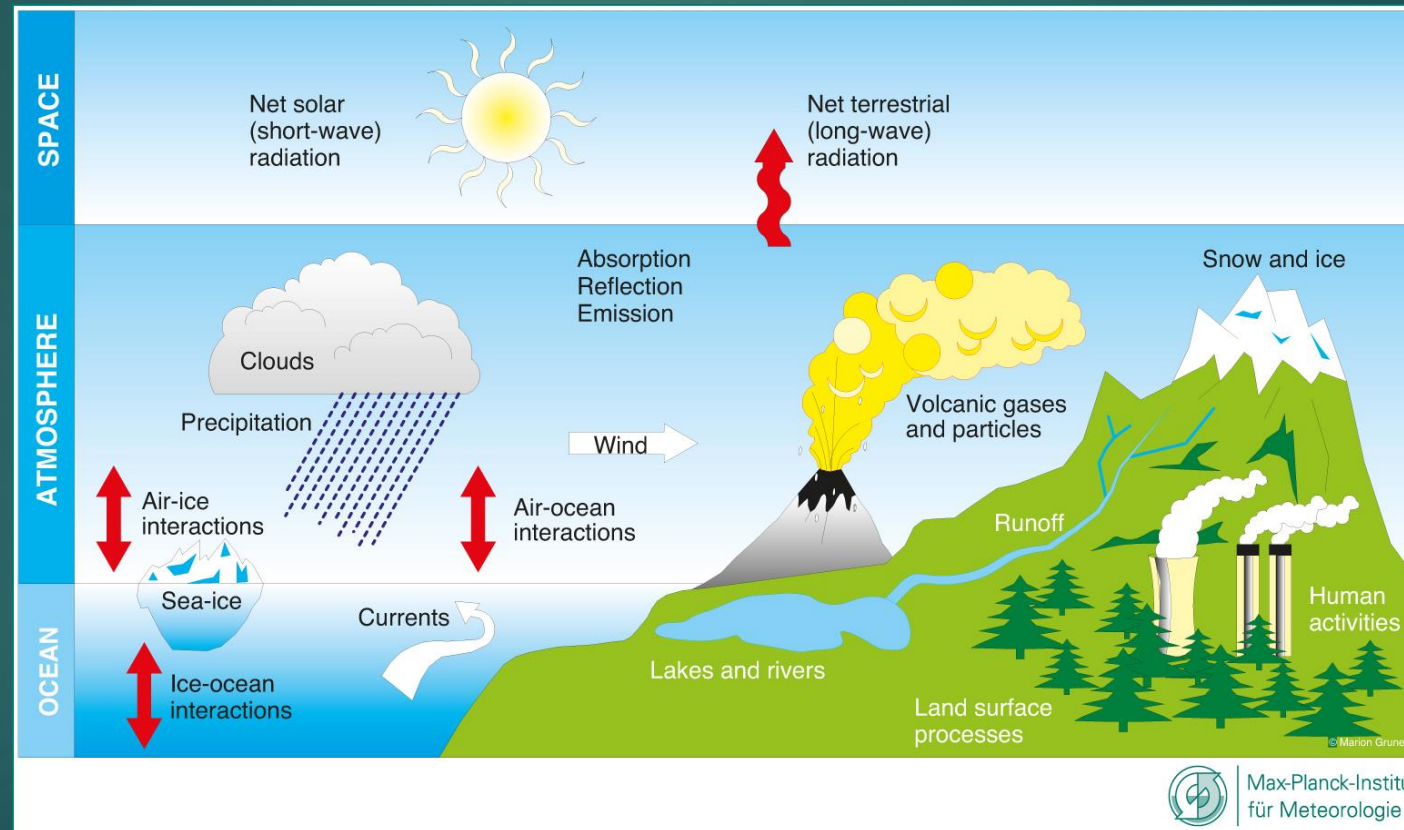


Two of the planetary boundaries- climate change and biosphere integrity- are recognized as "core" based on their fundamental importance for the Earth system.

Types of planetary boundaries



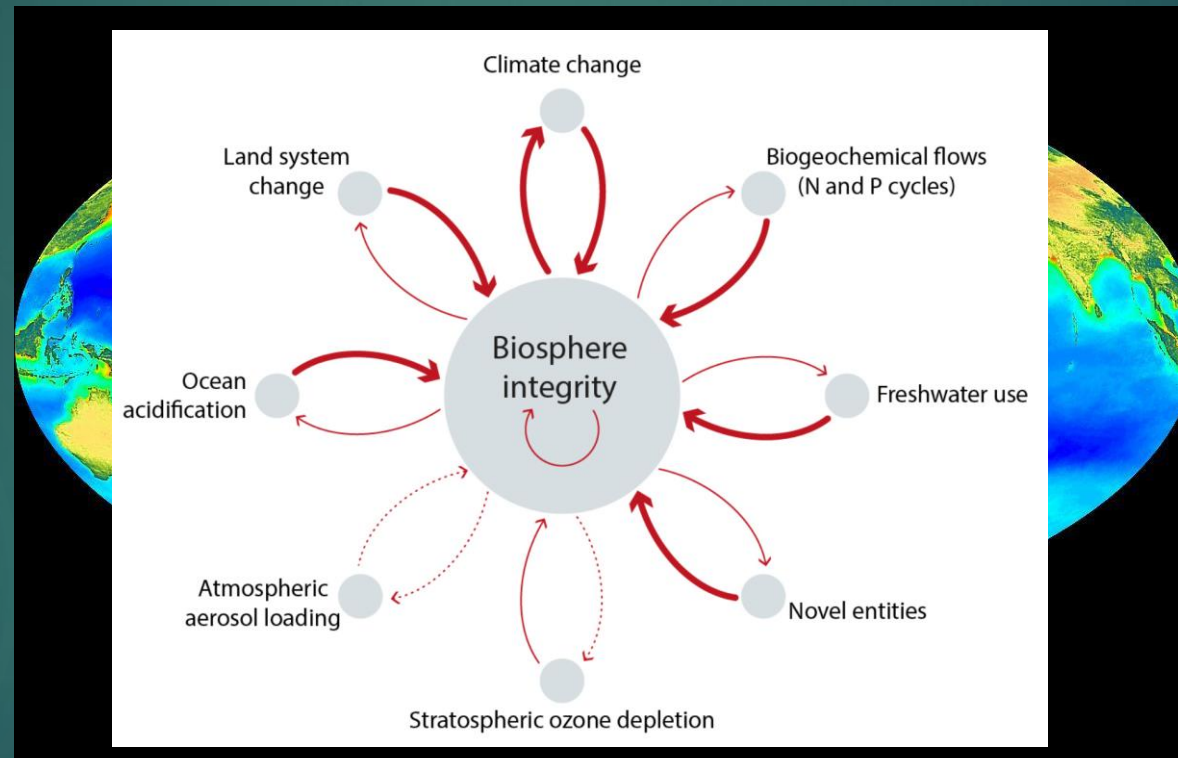
Core planetary boundary: Climate change



Activity: How could this be driven and impacted by agriculture and fisheries?

The climate system is a manifestation of the amount, distribution, and net balance of energy at Earth's surface. The total amount of energy sets the overall conditions for life.

Core planetary boundary: Biosphere integrity (Biodiversity loss)



Activity: How could this be driven and impacted by agriculture and fisheries?

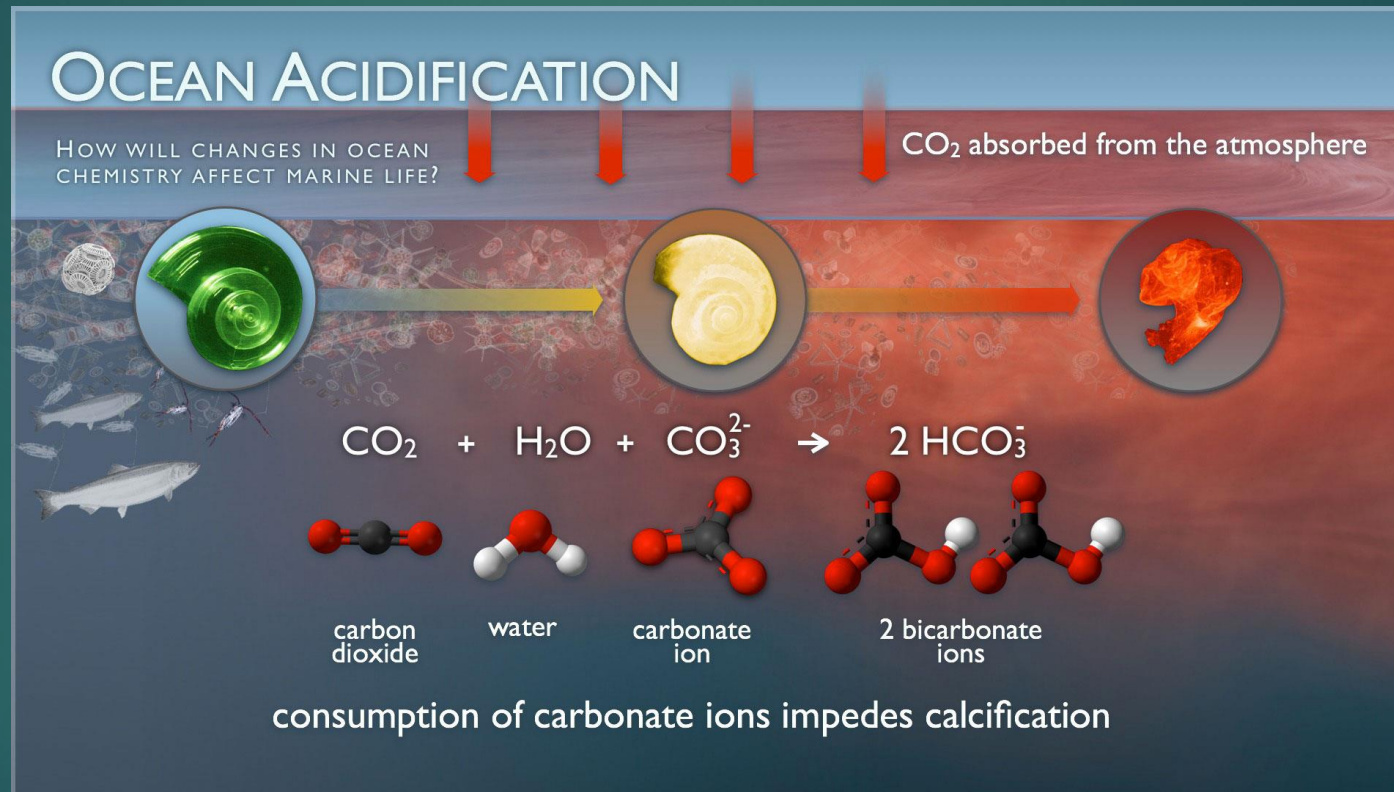
Biological diversity provides ecological functions that support biophysical sub-systems of the Earth, and thus the underlying resilience of other planetary boundaries.

DOI: <https://doi.org/10.1016/j.science.2019.05.005>

Planetary boundary: Ocean acidification

Activity: How could this be driven and impacted by agriculture and fisheries?

Ocean acidification poses a challenge to marine biodiversity and the ability of oceans to continue to function as a sink of CO₂ (~ 25% of human emissions).



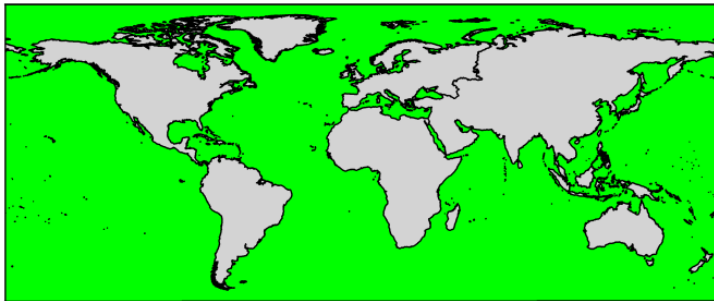
Addition of CO₂ to the oceans lowers pH of the surface seawater. Marine organisms are sensitive to changes in pH. Surface ocean pH has decreased by about 0.1 pH units (corresponding to a 30% increase in hydrogen ion concentration since pre-industrial times. This rate of acidification is at least 100 times faster than at any other time in the last 20 million years

www.pmel.noaa.gov

Ocean acidification: Past, present & future

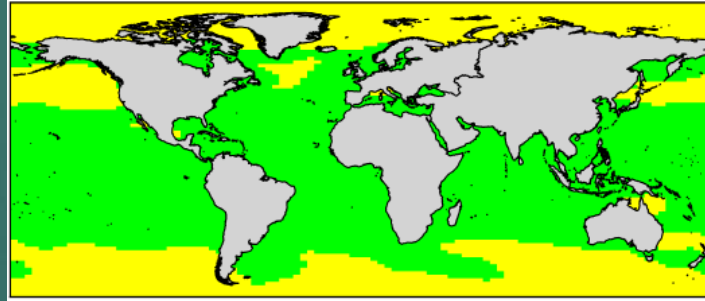
Pre-industrial state

(280 ppm CO₂ atm)



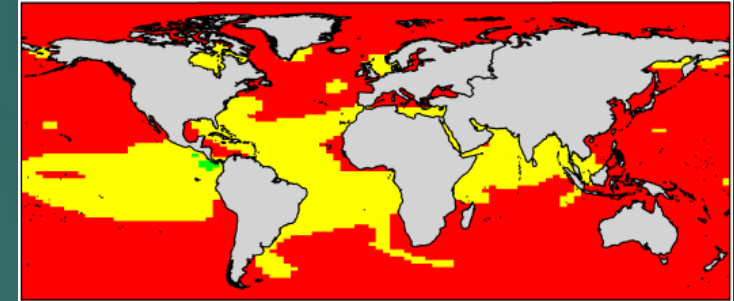
Current state

(~400 ppm CO₂ atm)



“Business as usual” state

(550 ppm CO₂ atm)



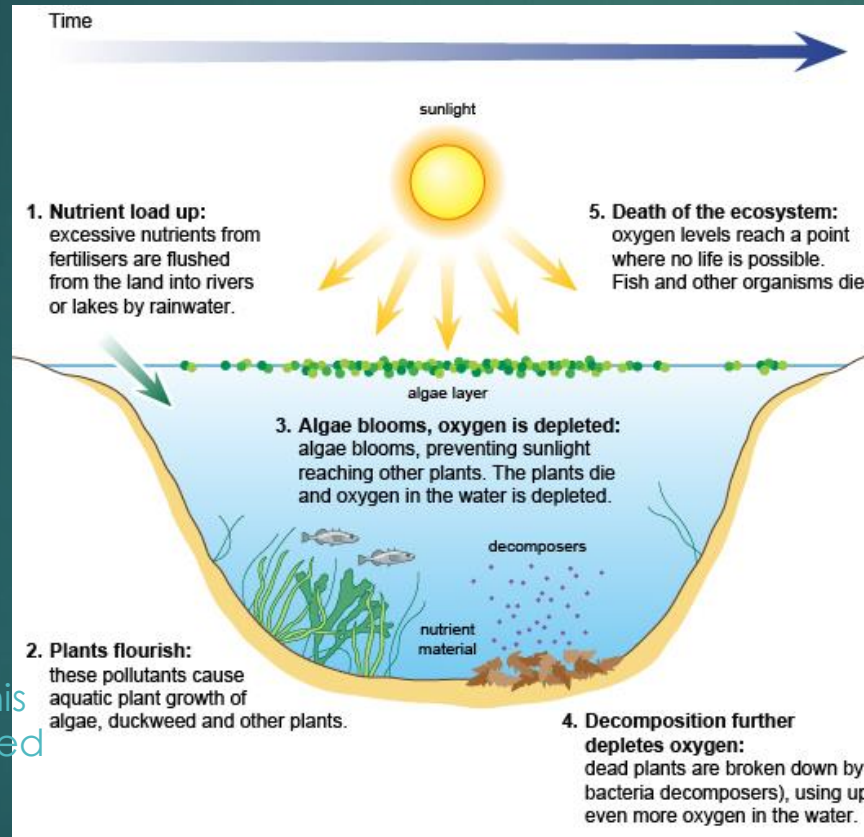
The ocean acidification boundary using as control variable aragonite saturation state

- Safe operating space Ω_{arag}
- Zone of uncertainty Ω_{arag}
- Dangerous level Ω_{arag}

DOI: [10.1126/science.1259855](https://doi.org/10.1126/science.1259855)

Activity: How could this be driven and impacted by agriculture and fisheries?

Planetary boundary: Biogeochemical flows



...ing as a slow driver
...ange at the planetary level.



...ements (e.g. N, P, Si, S)

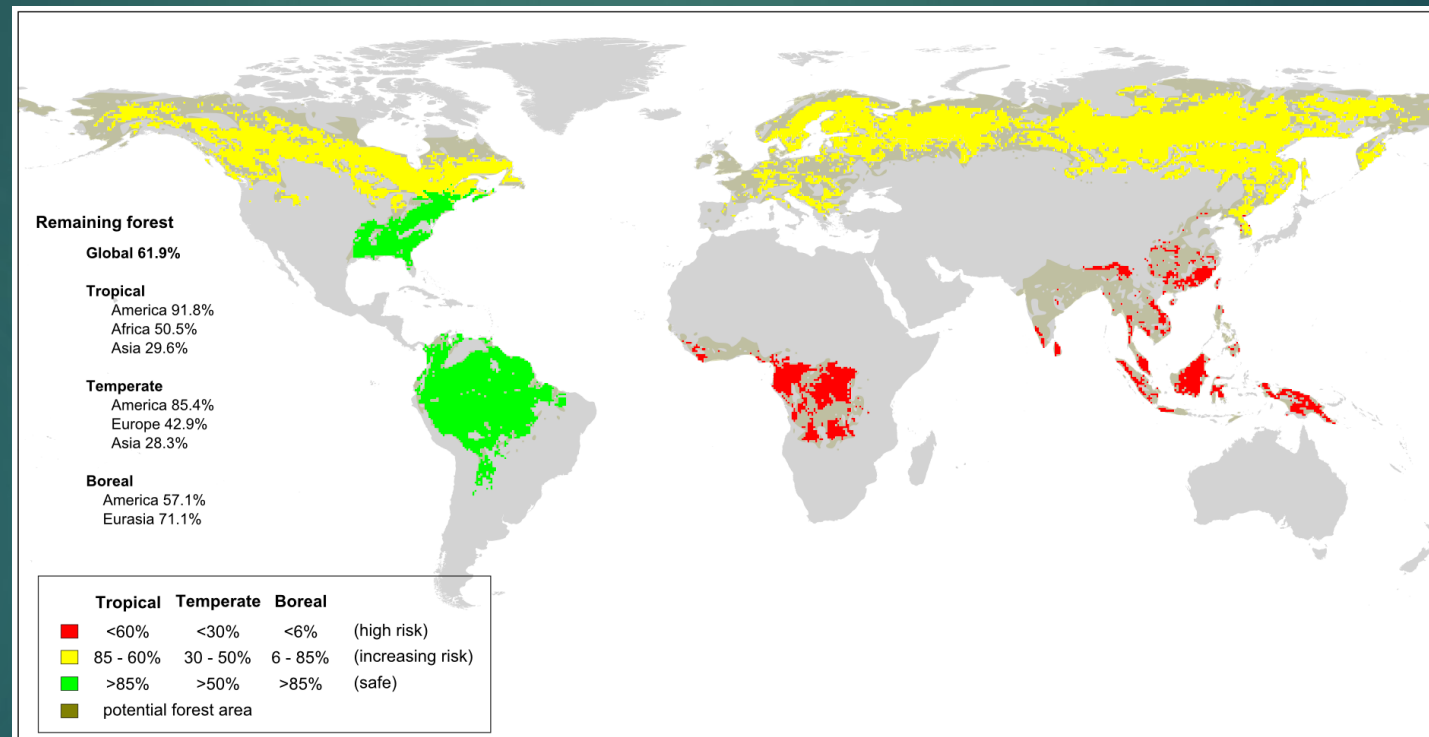
Activity: How could this be driven and impacted by agriculture and fisheries?

<http://www.bbc.co.uk>

Eutrophication due to human induced influxes of nitrogen & phosphorus push aquatic and marine systems across thresholds, generating abrupt non-linear change from, e.g. a clear-water oligotrophic state to a turbid-water eutrophic state

Land-system change

Forest cover remaining in the world's major continuous forest biomes



Activity: How could this be driven and impacted by agriculture and fisheries? This boundary focuses on a specific constraint: the biogeophysical processes in land systems that directly regulate climate—exchange of energy, water, and momentum between the land surface and the Atmosphere.

DOI: 10.1126/science.1259855

The biosphere integrity boundary provides a considerable constraint on the amount and pattern of land-system change in all terrestrial biomes.

Planetary boundary: Freshwater use

Activity: How could this be driven and impacted by agriculture and fisheries?

Risk: collapse of terrestrial and aquatic ecosystems, major shifts in moisture feedback, and freshwater/ocean mixing at regional to continental scales.



<http://riosvoadores.com.br/english/>

About 90% of global green water flows are required to sustain critical ecosystem services, whereas 20%– 50% of the mean annual blue water flows in river basins are required to sustain aquatic ecosystem functioning.

25% of the world's river basins run dry before reaching the oceans due to use of freshwater resources in the basins

Planetary boundary: Introduction of novel entities

Scientific challenges:

- Chemicals with unknown disruptive effect on vital Earth-system process
- Disruptive effect may not be discovered until it is a problem at the global scale
- Effect may not be readily reversible
- Database for timely screening of chemicals
- Which boundary?



<http://medlarge.com>

Activity: How could this be driven and impacted by agriculture and fisheries?

The novel entities might display:

- Persistence
- Mobility across scales with consequent widespread distributions
- Potential impacts on vital Earth-system processes or subsystems

Originally as chemical pollution, the revised version of this planetary boundary is referring to new substances, new forms of existing substances, and modified life forms that have the potential for unwanted geophysical and/or biological effects.

Agriculture & Fisheries

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HUMAN ALTERATION OF THE GLOBAL NITROGEN CYCLE:
SOURCES AND CONSEQUENCES

PETER M. VITOUSEK,² JOHN D. ABER,³ ROBERT W. HOWARTH,⁴ GENE E. LIKENS,⁵ PAMELA A. MATSON,⁶ DAVID W. SCHINDLER,⁷ WILLIAM H. SCHLESINGER,⁸ AND DAVID G. TILMAN⁹

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REVIEW

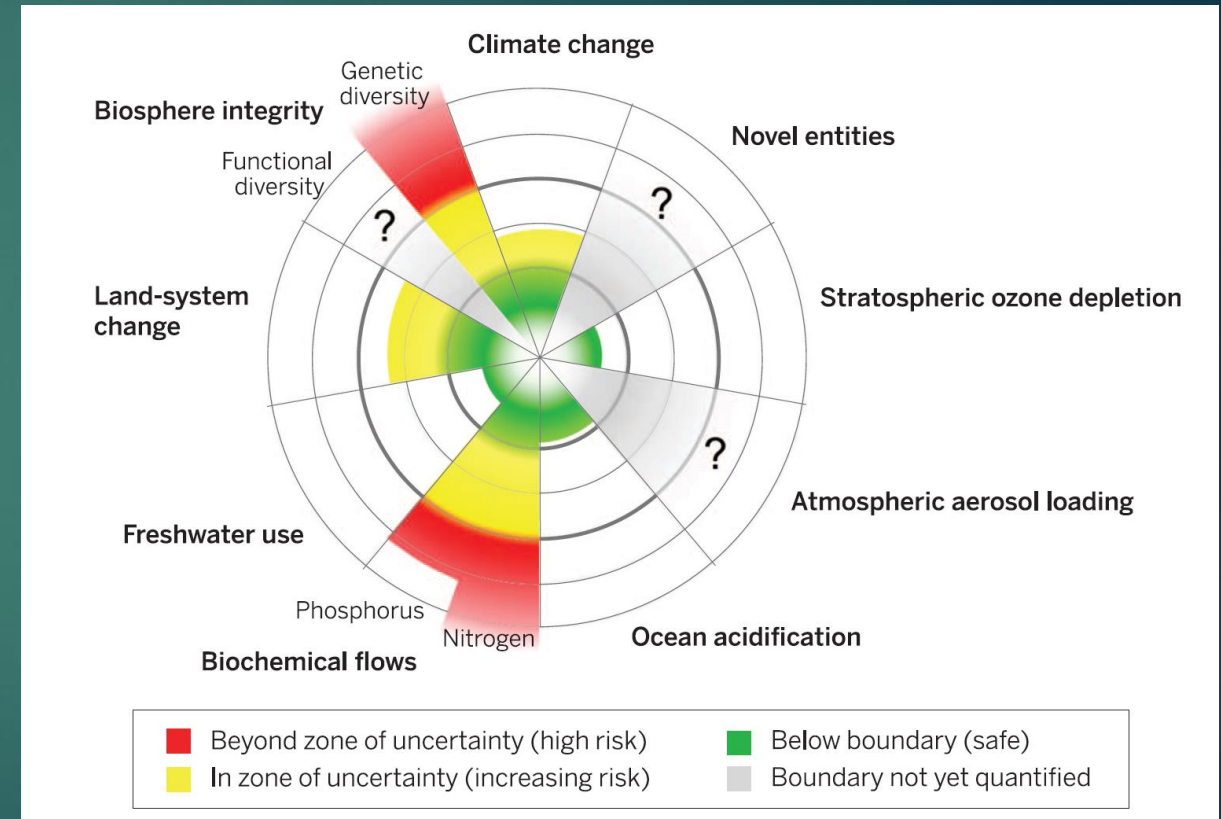
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AN UNDERGROUND REVOLUTION

Summary: Planetary boundaries

- ▶ Providing food security is costly to the planet and impacts several planetary boundaries.
- ▶ Agriculture is the single most impacting human activity.
- ▶ The use of fertilizers are beyond the limits that the planet can support.
- ▶ Fisheries are driving marine stocks to a significant dangerous zone.





Thanks

Do not forget to check your paper for our next discussions