

Beyond Climate Change: Keeping Track of Planetary Boundaries

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SRS Meeting 2010

24 March 2010

Stockholm University, Stockholm Sweden



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Outline

- Our new epoch: the Anthropocene
- Beyond climate change & Copenhagen – “planetary boundaries”
- It’s all connected
- Transformations on the global scale



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Main points

- We humans can cause the global environment to move into a state with which we have no historical experience
- We have identified a number of non-negotiable natural boundaries that we should not exceed
- Development and wellbeing can be created if these boundaries are respected



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Our new epoch: The Anthropocene



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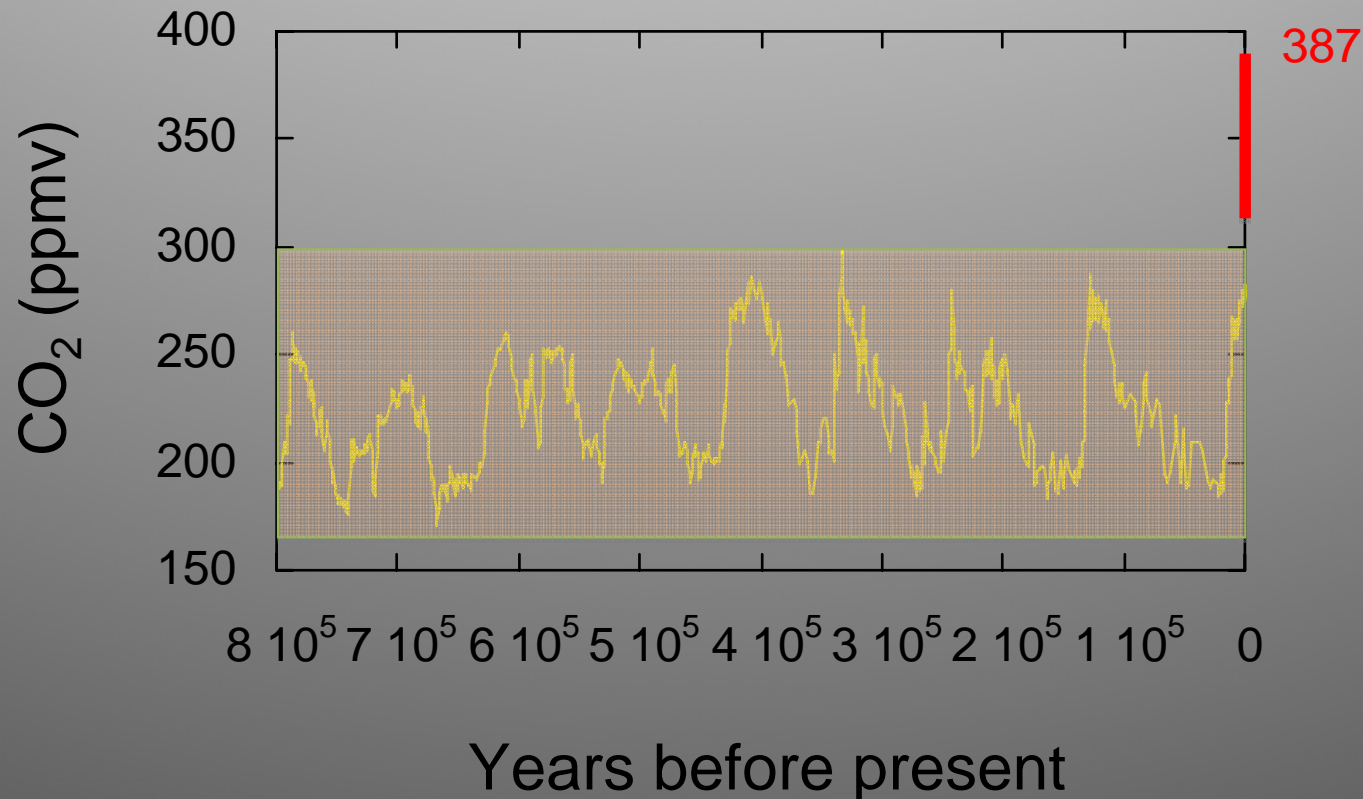
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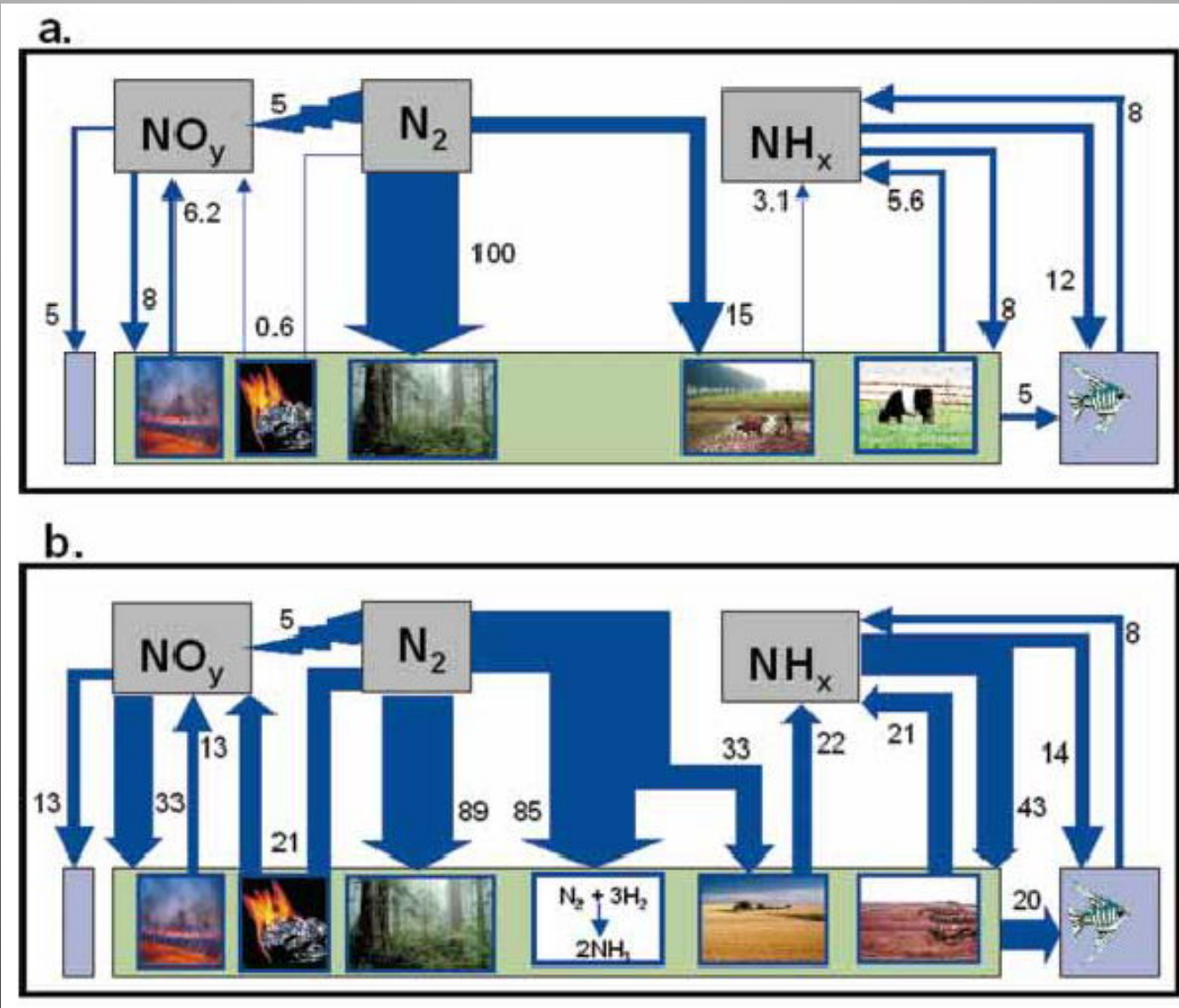
A look *farther* back in time



Lüthi, D., et al.. 2008. EPICA Dome C Ice Core
800KYr Carbon Dioxide Data.
IGBP PAGES/World Data Center for Paleoclimatology
Data Contribution Series # 2008-055



The global nitrogen cycle

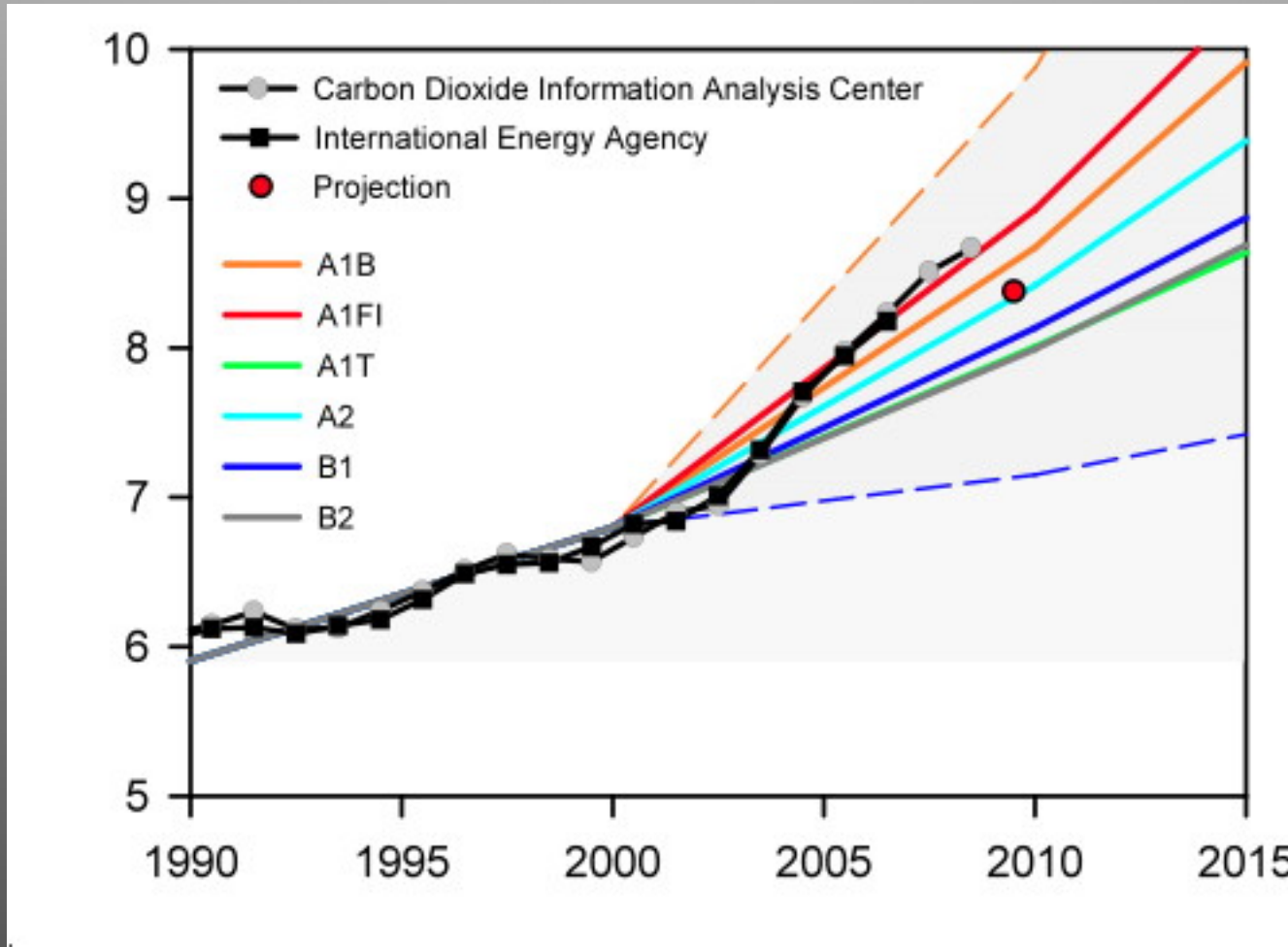


We can be seen from space



<http://visibleearth.nasa.gov>

Where are we heading?



[Raupach et al. 2007, PNAS, updated](#); [Le Quéré et al. 2009, Nature Geoscience](#); [International Monetary Fund 2009](#)

Beyond climate change: "Planetary Boundaries"



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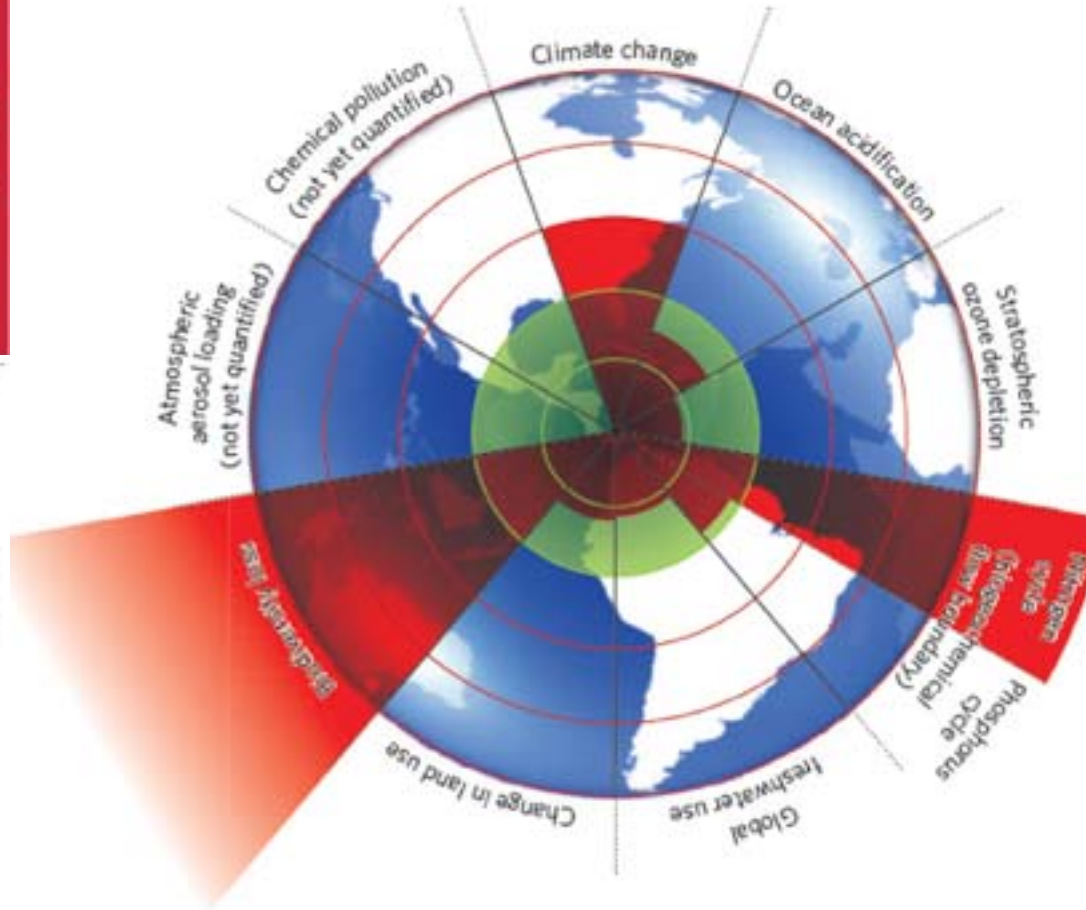
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Planetary Boundaries



Beyond the boundaries

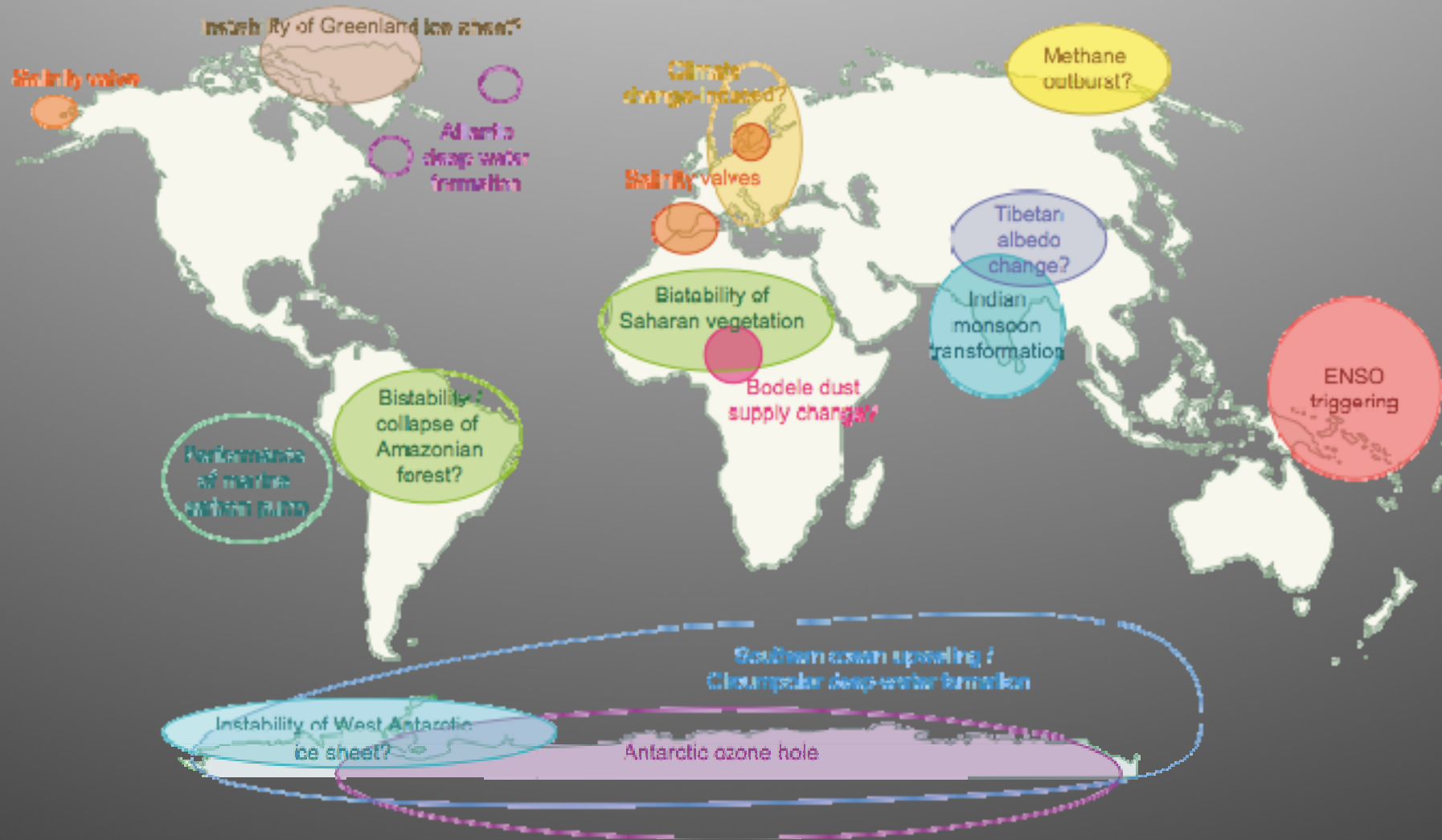


New Scientist
27 Feb
2010

Rockström, et al., Nature, 2009

Scientific American
April 2010

Tipping points

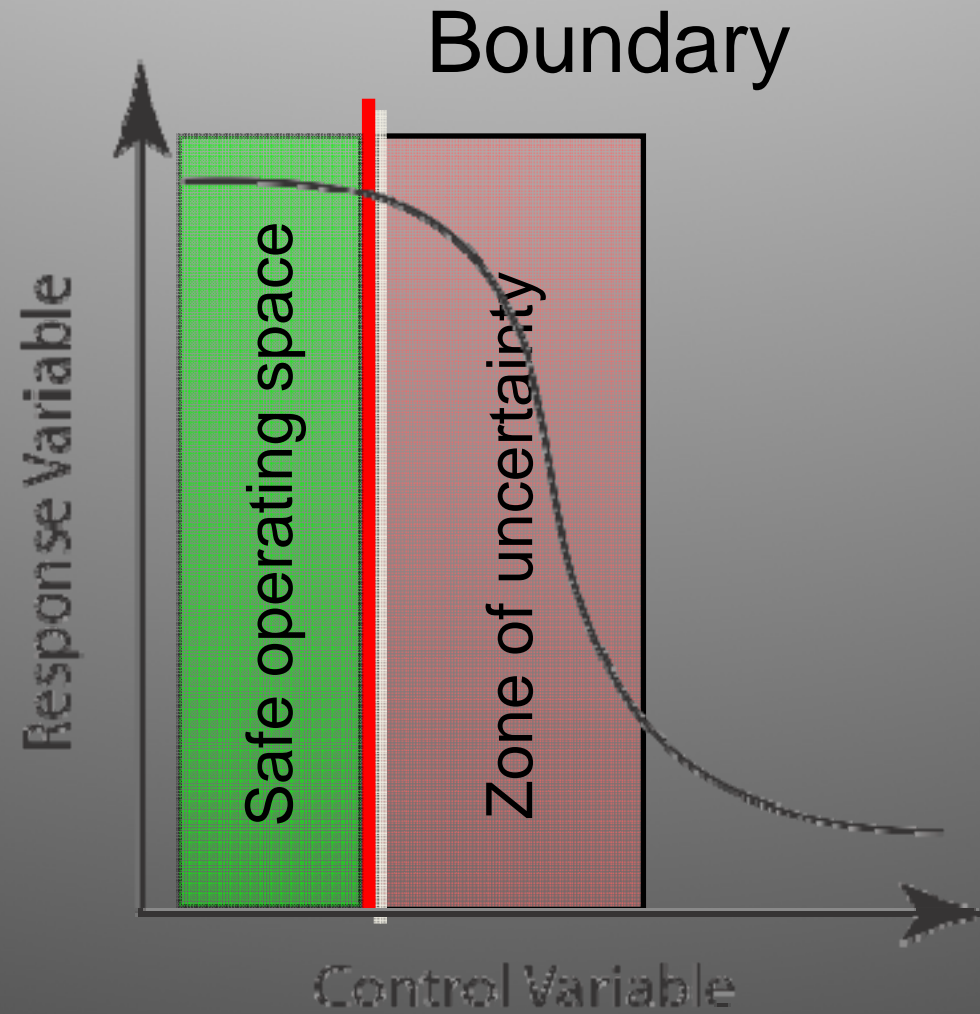


J. Schellhuber, in Steffen, et al., Challenges of a Changing Earth, 2002

Some properties of PBs

- Associated with a large-scale change in how planetary systems function (often a threshold or “tipping point”); these are non-negotiable
- Have some “control” variable
- Include normative aspects of defining preferred states - holocene stability
- Operate on time scales over which ethics and political action are relevant
- A “safe operating space” can be created within the boundaries

Planetary Boundaries



Planetary Boundaries

Climate

350 ppm CO₂
+1 W/m²

Ozone depletion

276 DU

Freshwater use

4000 km³/yr

Atmospheric aerosol loading

TBD

Biodiversity loss

10 E/MSY

Ocean acidification

Aragonite saturation ratio > 2.75

Agricultural land use

15%

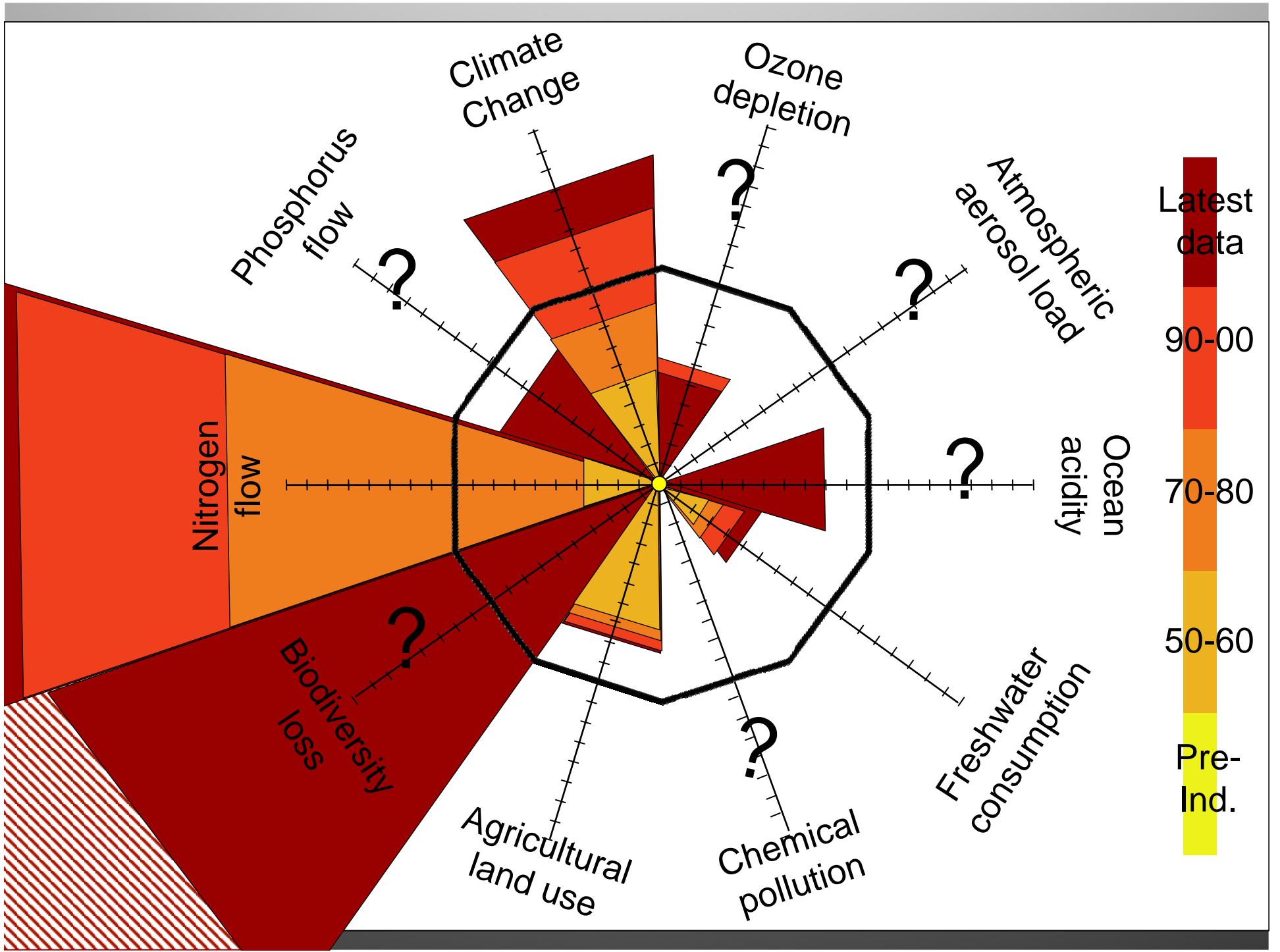
Biogeochemical loading

35 MT N/yr
11 MT P/yr

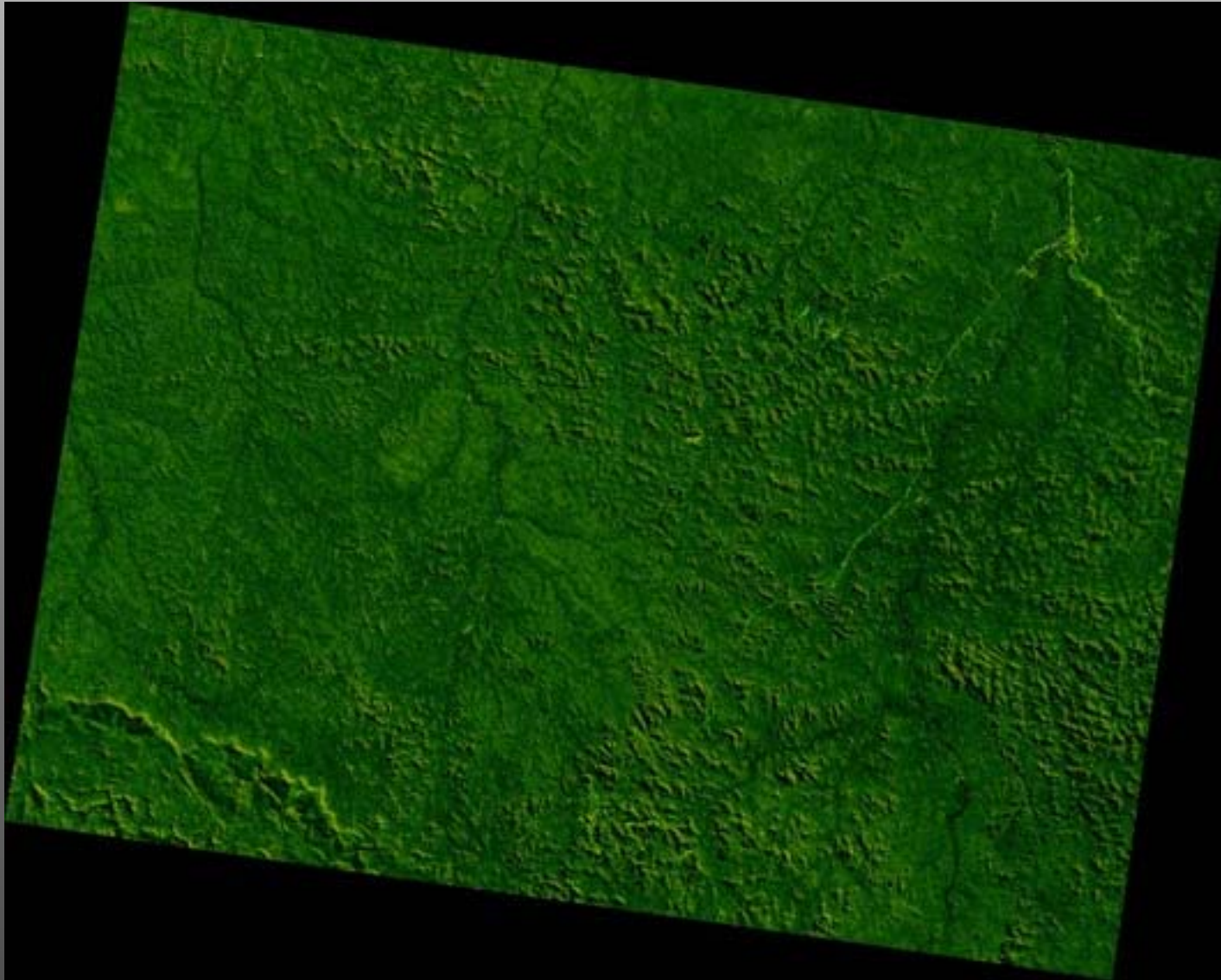
Chemical pollution

TBD





Amazonian land use change

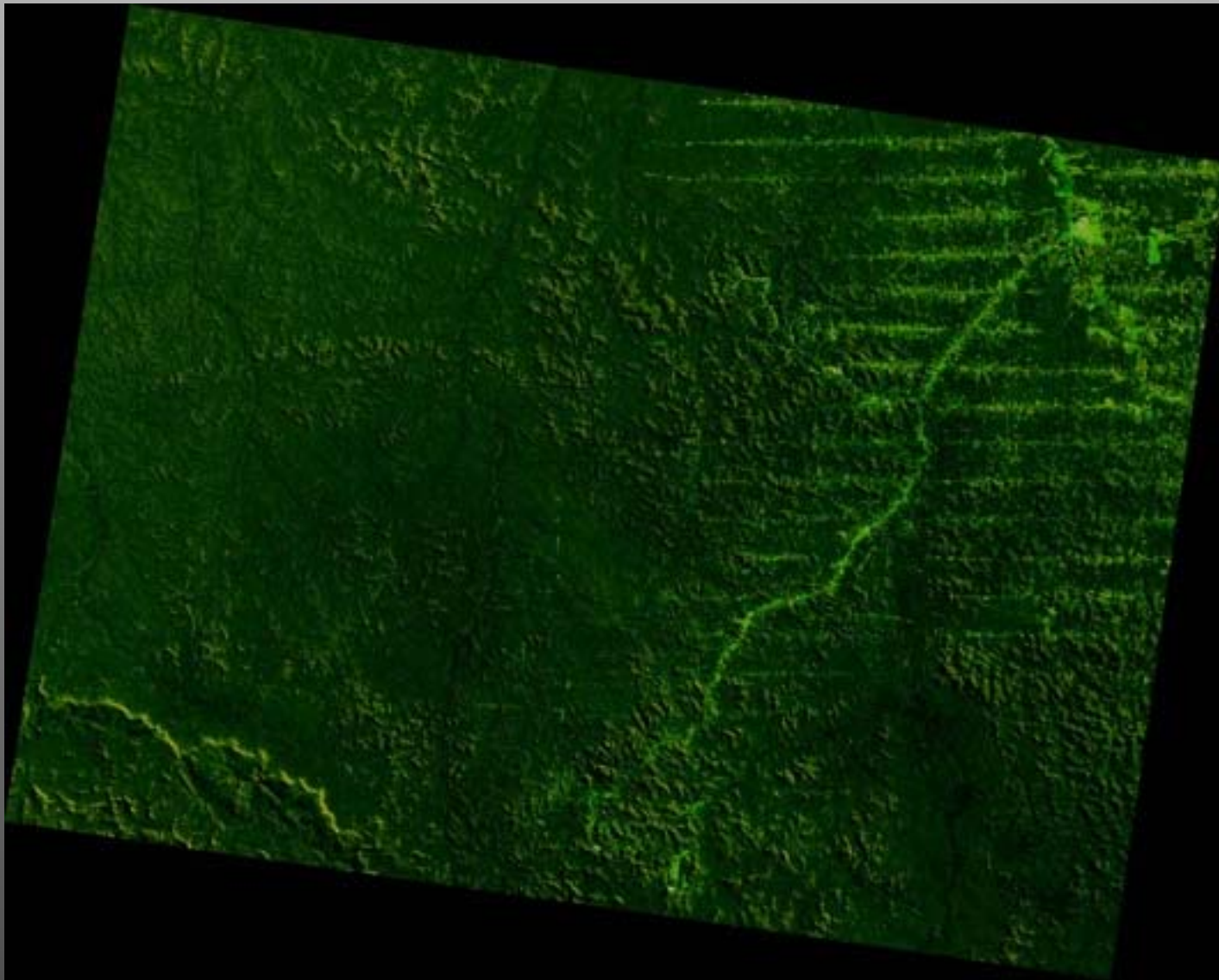


1975

<http://visibleearth.nasa.gov/>

Rondonia (central Amazon basin)

Amazonian land use change

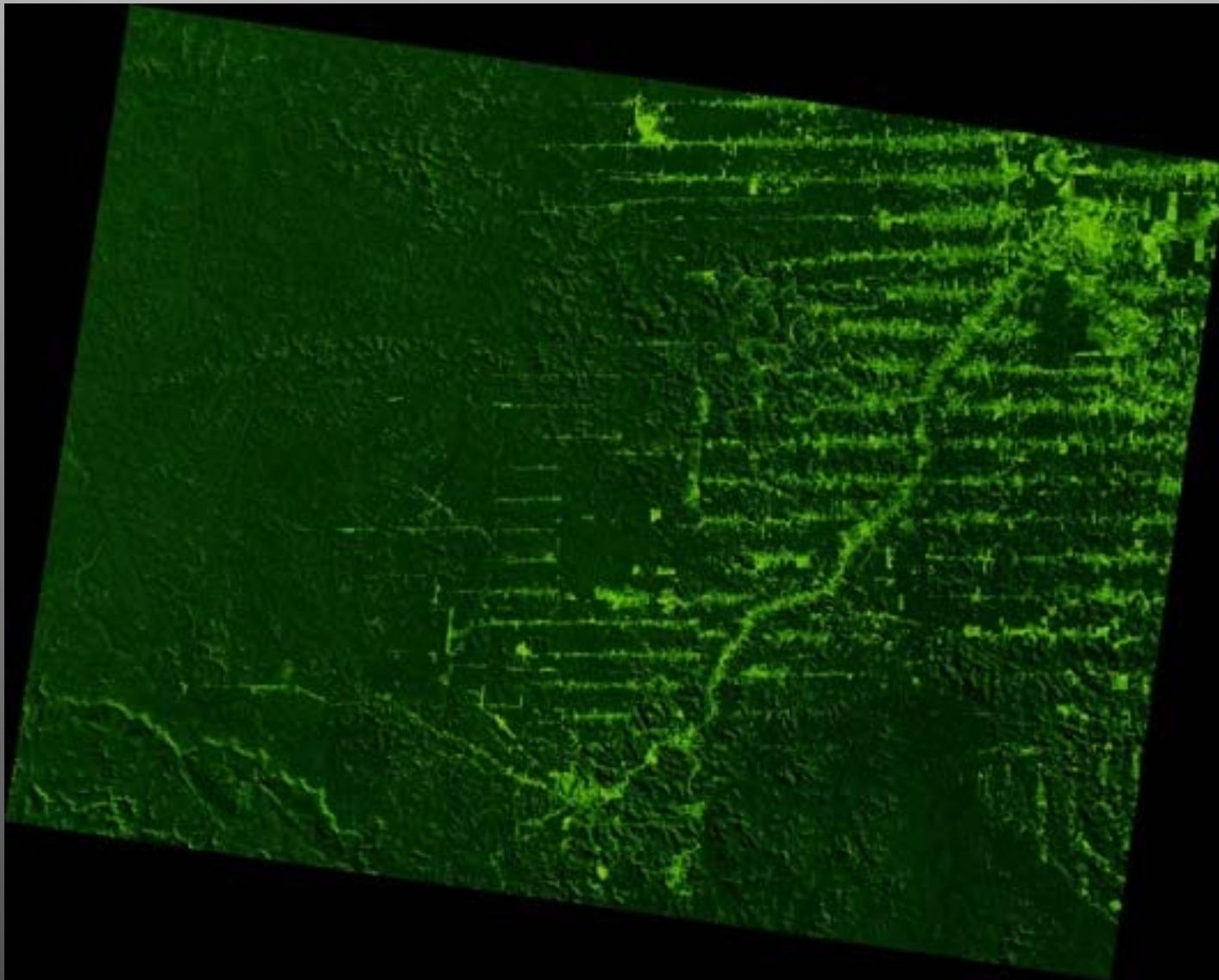


1986

<http://visibleearth.nasa.gov/>

Rondonia (central Amazon basin)

Amazonian land use change

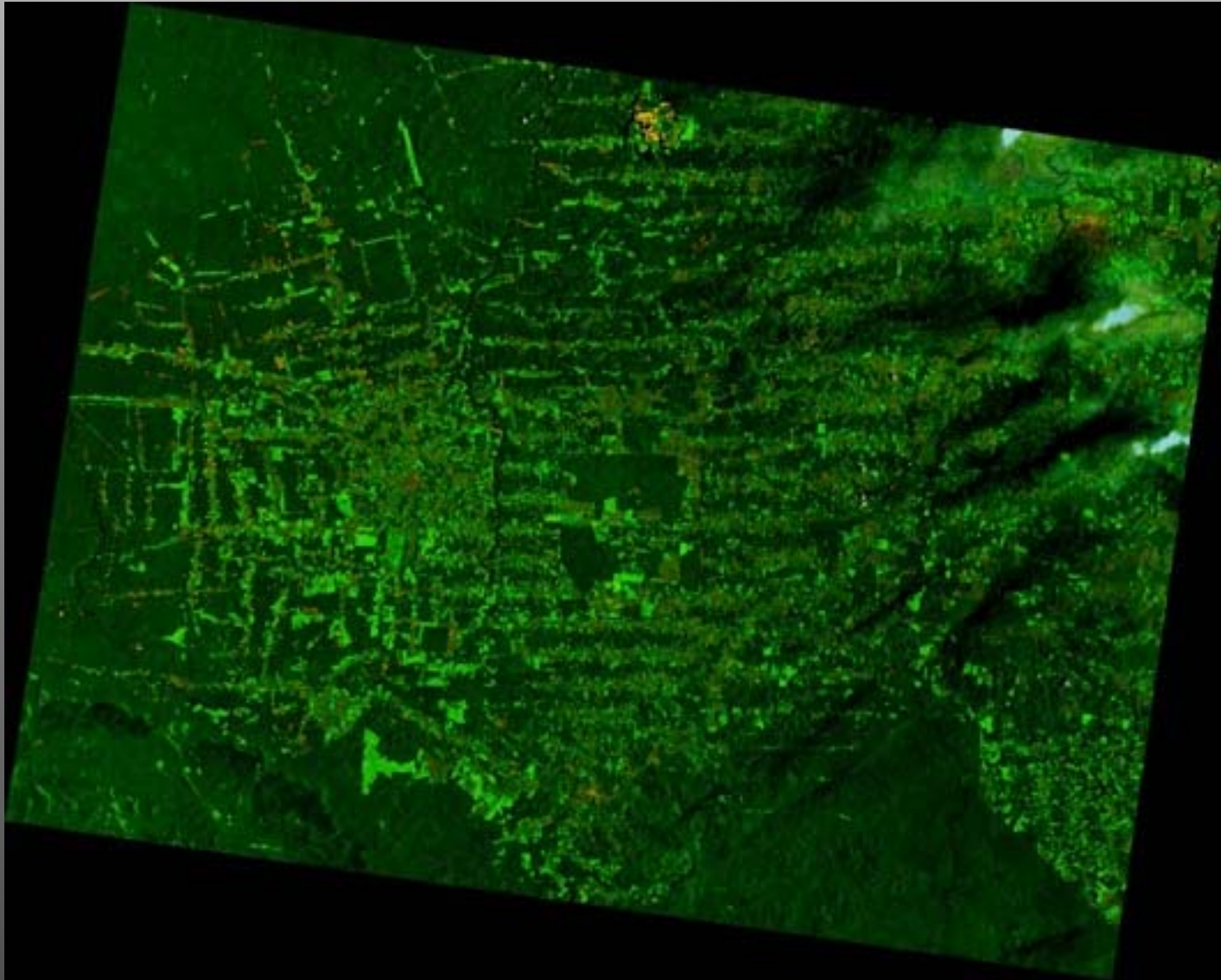


1992

<http://visibleearth.nasa.gov/>

Rondonia (central Amazon basin)

Amazonian land use change

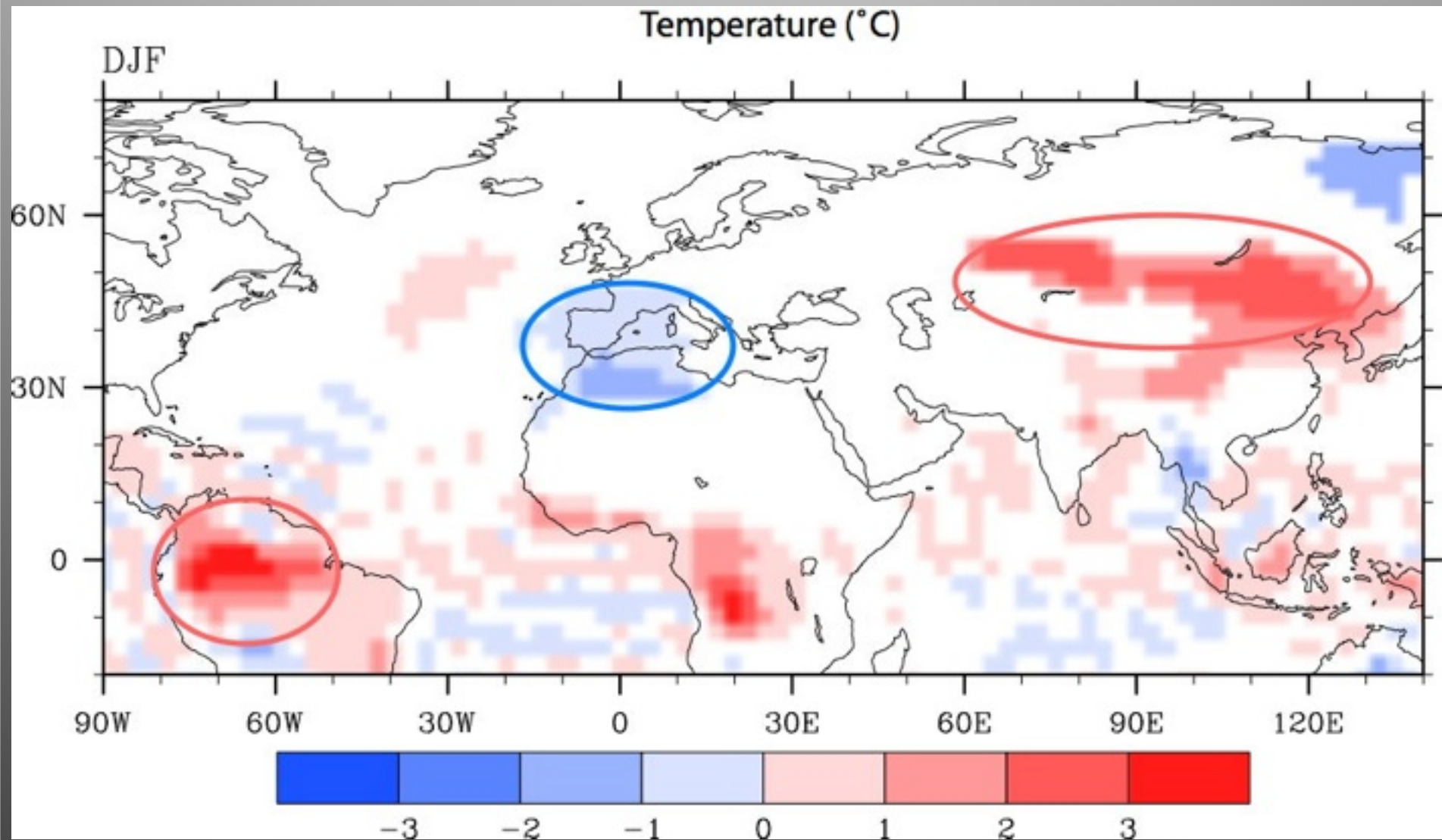


2001

<http://visibleearth.nasa.gov/>

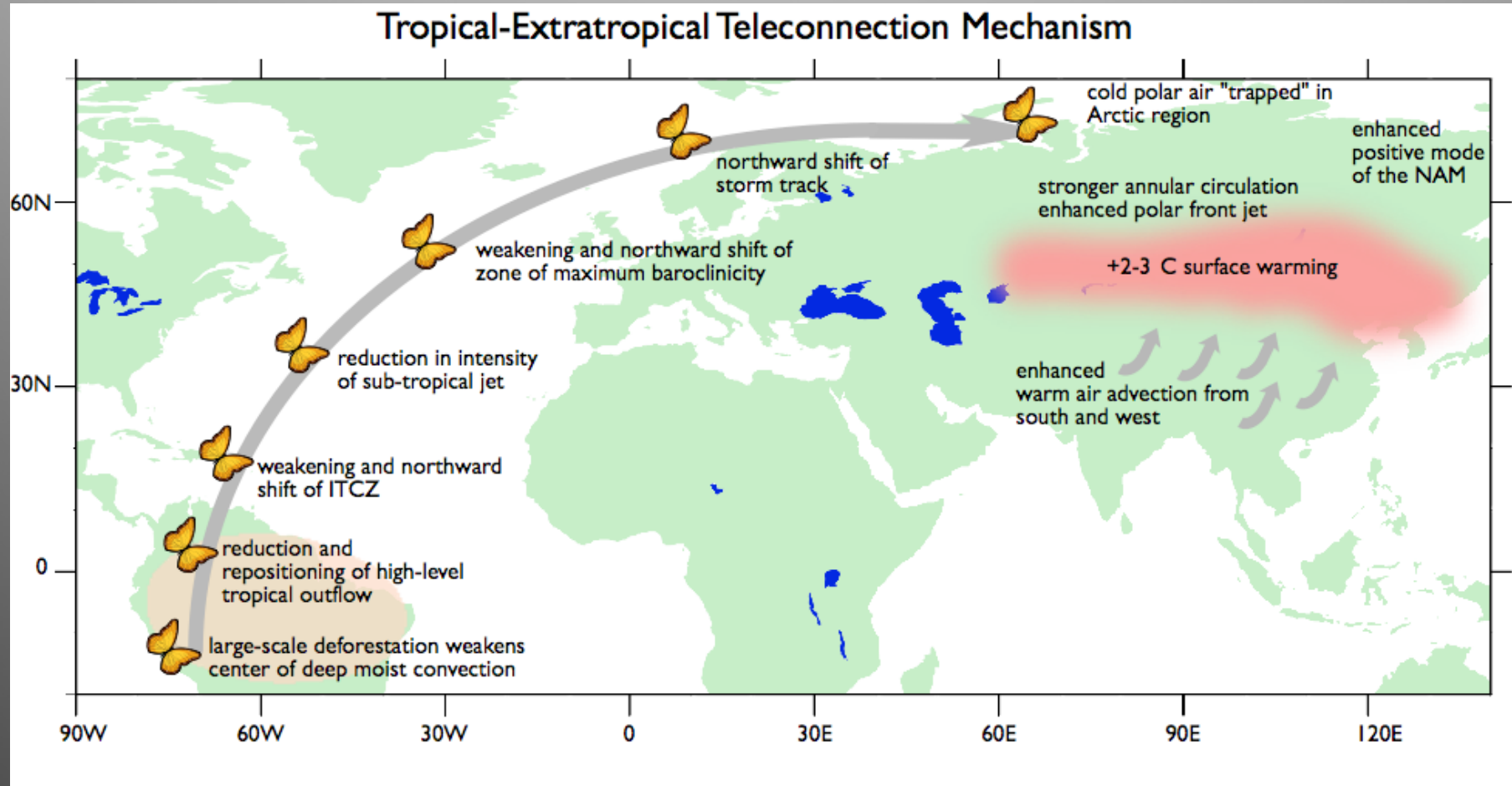
Rondonia (central Amazon basin)

It's all connected



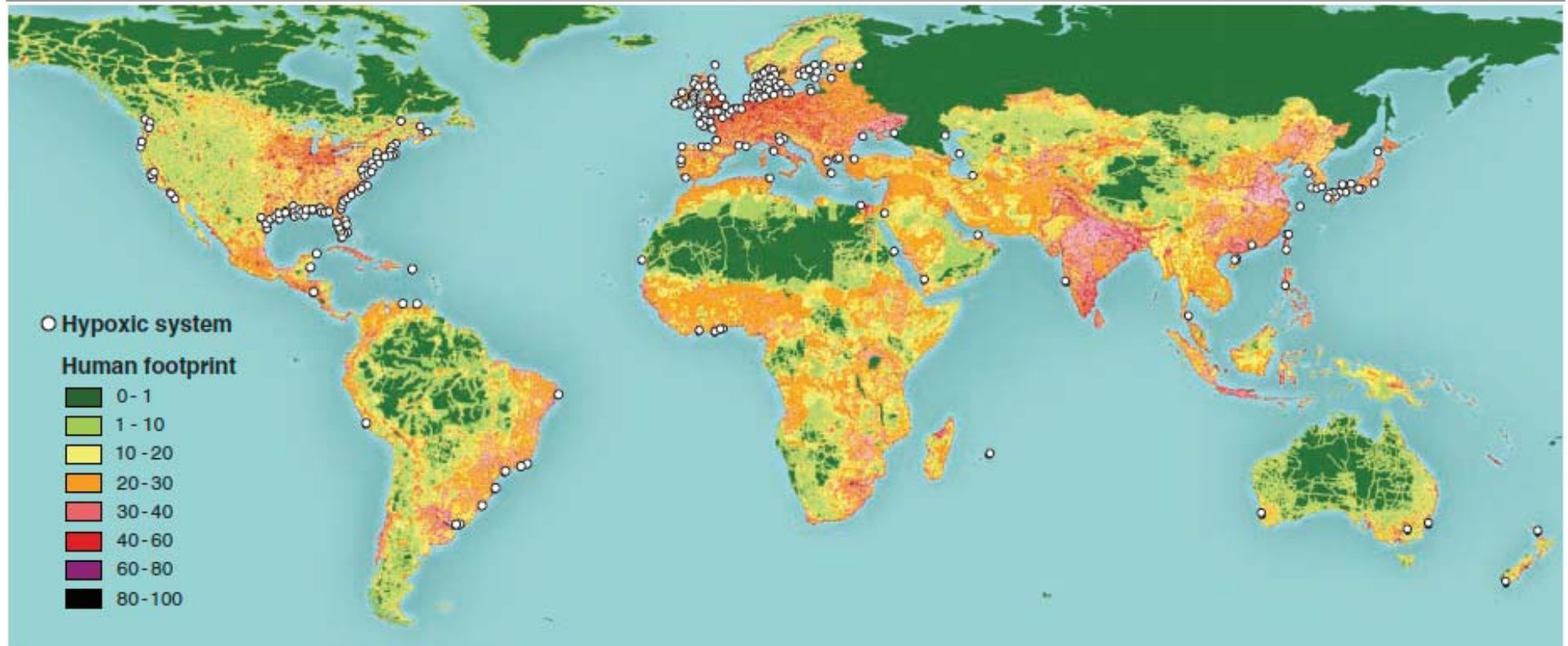
Rockström, et al., Nature, 2009

... and how they work



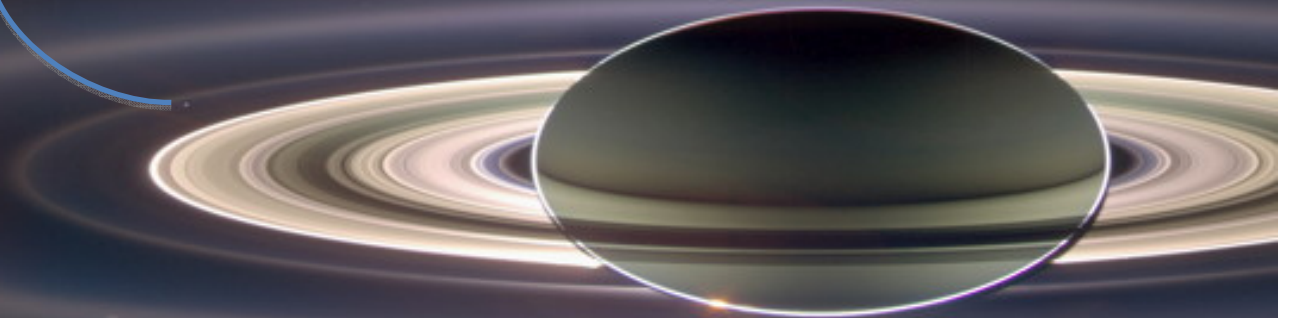
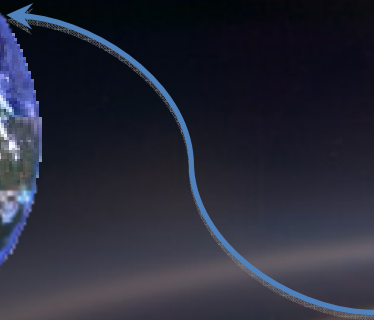
after Snyder, et al., *Climate Dynamics* 23, 279-302, 2004;

Dead zones



Diaz, R. J. and R. Rosenberg, 2008: Spreading Dead Zones and Consequences for Marine Ecosystems. *Science*, 321, 926-929.

We're in the same boat



Cassini spacecraft, Sept 15 2006

Observing Planetary Boundaries

Climate

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276 DU

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Future directions

- Higher time resolution on surface observations; free and efficient access to data
- Observations of ocean chemistry and biology
- How do we observe biodiversity from space?
- More coordination between *in situ* and space-based observations
- Maintain independent access to space-based observations (STEAM?)



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Main points - again

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A close-up photograph of a branch heavily laden with white, snow-like or frost-like crystals against a dark background. The crystals are intricate and layered, creating a textured, almost sculptural appearance. The lighting highlights the edges of the crystals, giving them a bright, glowing quality. The background is a deep, dark blue or black, which makes the white crystals stand out prominently.

Thanks for your
attention!