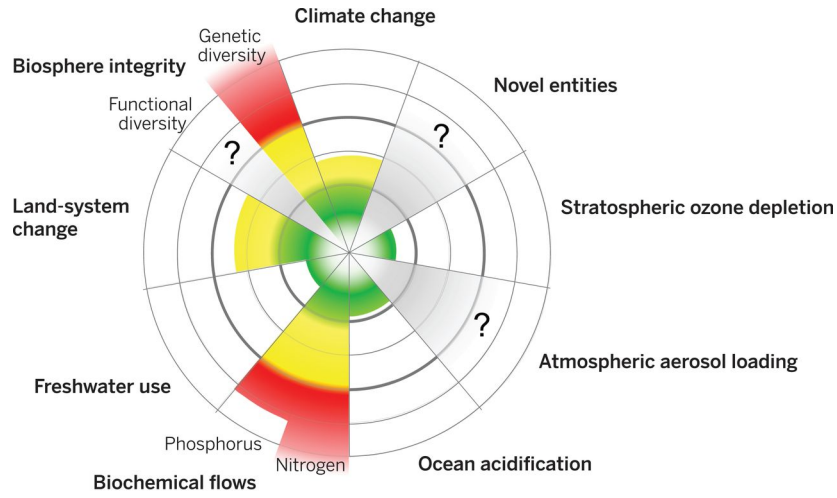
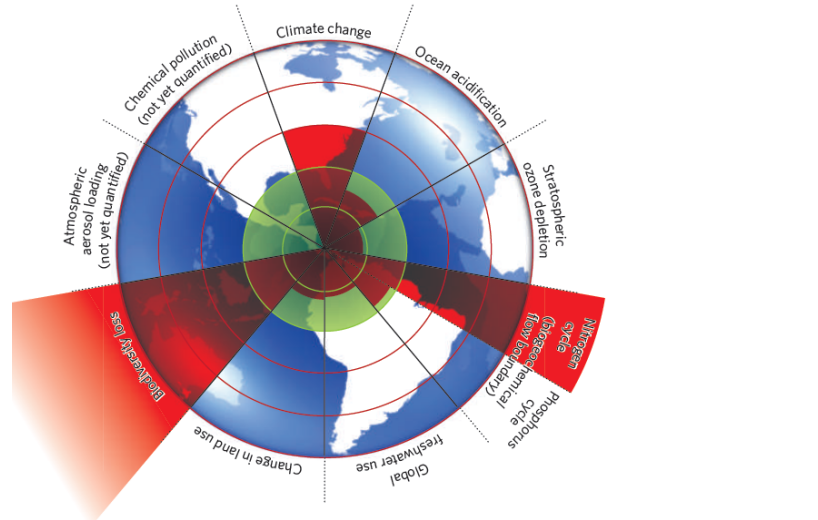


CNIS, Commission Environnement et Développement Durable
Les limites à l'activité humaine
mesurer pour agir

Xavier Timbeau
xavier.timbeau@sciencespo.fr

La contrainte environnementale

La capacité d'export, les limites à l'activité humaine



■ Beyond zone of uncertainty (high risk)
 ■ Below boundary (safe)
 ■ In zone of uncertainty (increasing risk)
 ■ Boundary not yet quantified

PLANETARY BOUNDARIES				
Earth-system process	Parameters	Proposed boundary	Current status	Pre-industrial value
Climate change	(i) Atmospheric carbon dioxide concentration (parts per million by volume)	350	387	280
	(ii) Change in radiative forcing (watts per metre squared)	1	1.5	0
Rate of biodiversity loss	Extinction rate (number of species per million species per year)	10	>100	0.1-1
Nitrogen cycle (part of a boundary with the phosphorus cycle)	Amount of N ₂ removed from the atmosphere for human use (millions of tonnes per year)	35	121	0
Phosphorus cycle (part of a boundary with the nitrogen cycle)	Quantity of P flowing into the oceans (millions of tonnes per year)	11	8.5-9.5	-1
Stratospheric ozone depletion	Concentration of ozone (Dobson unit)	276	283	290
Ocean acidification	Global mean saturation state of aragonite in surface sea water	2.75	2.90	3.44
Global freshwater use	Consumption of freshwater by humans (km ³ per year)	4,000	2,600	415
Change in land use	Percentage of global land cover converted to cropland	15	11.7	Low
Atmospheric aerosol loading	Overall particulate concentration in the atmosphere, on a regional basis		To be determined	
Chemical pollution	For example, amount emitted to, or concentration of persistent organic pollutants, plastics, endocrine disruptors, heavy metals and nuclear waste in, the global environment, or the effects on ecosystem and functioning of Earth system thereof		To be determined	

Boundaries for processes in red have been crossed. Data sources: ref. 10 and supplementary information

Rockström, J., Steffen, W., Noone, K., & Persson, Å., FS. (2009). A safe operating space for humanity. *Nature*, 461 (September).

Steffen W., Richardson K., Rockström J., Cornell S., Fetzer I., Bennett E., ... Carpenter S., 2015. "Planetary boundaries: Guiding human development on a changing planet", *Science (New York, N.Y.)*, 348(6240), 1217.

Définir les limites et les mesurer

- Repose sur l'incertitude radicale
 - Frank Knight, Cygne noir (Black Swan), *What you don't know you don't know*
 - Hans Jonas « Our power to do is greater than our ability to forecast » or the end of flat earth
 - Principe de précaution (retournement de la charge de la preuve)
- On s'attend à une catastrophe, difficile à mesurer, il s'agit d'éviter la zone de « danger » qui est la zone d'irréversibilité
- Pas d'analyse coût-bénéfice possible (distributions « pathologiques »)
- La mesure est celle de la distance aux seuils ou aux zones à éviter

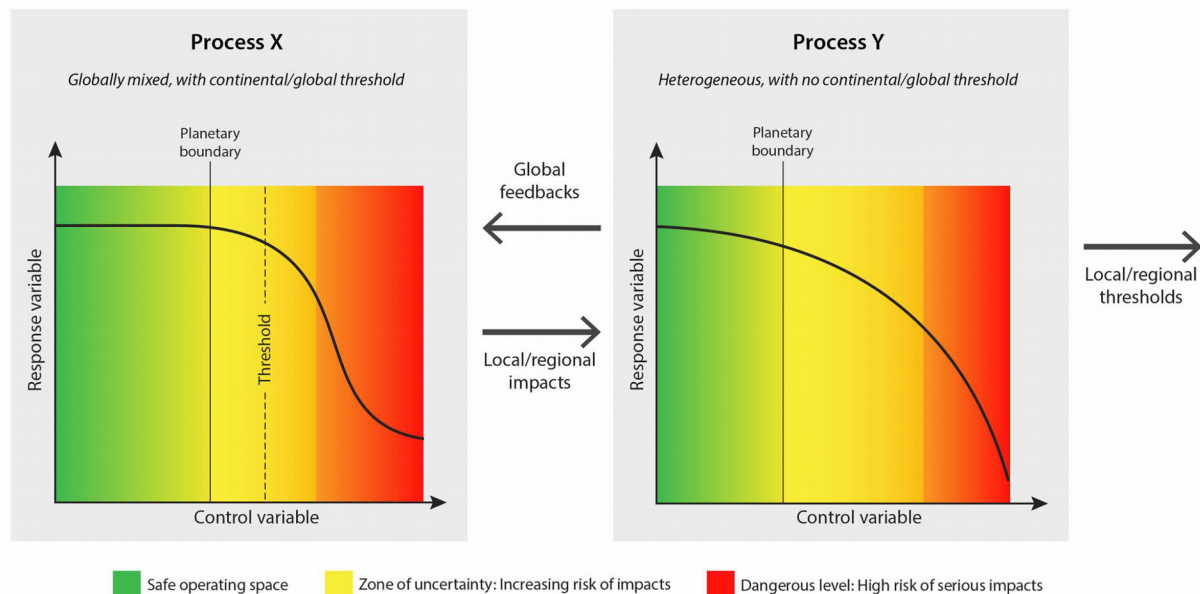
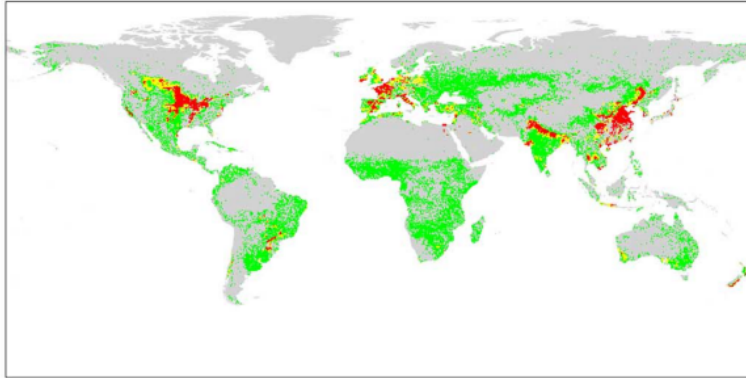


Fig. 1. The conceptual framework for the planetary boundary approach, showing the safe operating space, the zone of uncertainty, the position of the threshold (where one is likely to exist), and the area of high risk. Modified from (1).

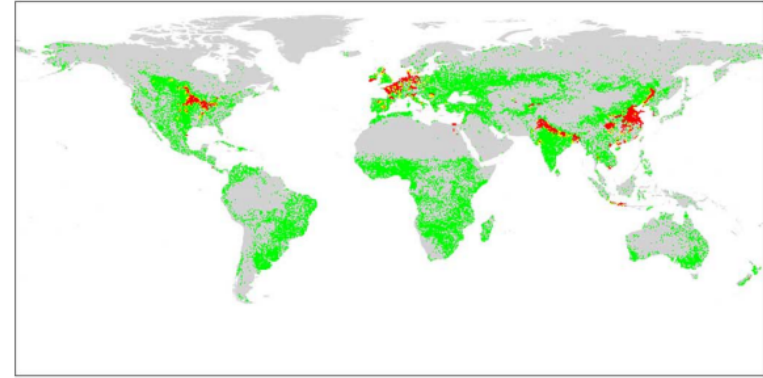
Qui connaissent une déclinaison locale

- A la fois dans la distance à la limite mais aussi dans la mesure des impacts

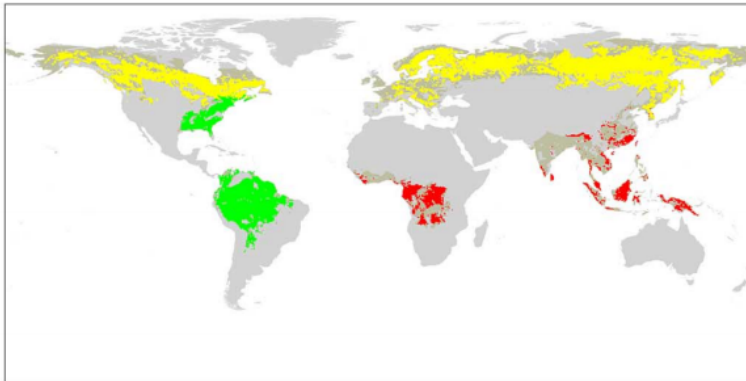
A Phosphorus



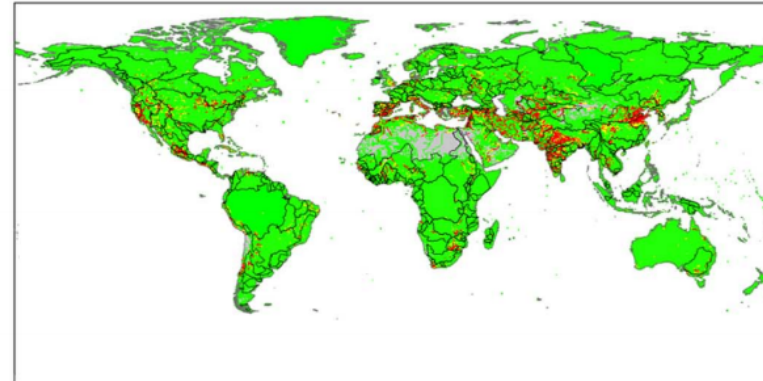
B Nitrogen



C Land-system change



D Freshwater use



■ Beyond zone of uncertainty (high risk) ■ In zone of uncertainty (increasing risk) ■ Below boundary (safe)

Fig. 2. The subglobal distributions and current status of the control variables for (A) biogeochemical flows of P; (B) biogeochemical flows of N; (C) land-system change; and (D) freshwater use. In each panel, green areas are within the boundary (safe), yellow areas are within the zone of uncertainty (increasing risk), and red areas are beyond the zone of uncertainty (high risk). Gray areas in (A) and (B) are areas where P and N fertilizers are not applied; in (C), they are areas not covered by major forest biomes; and in (D), they are areas where river flow is very low so that environmental flows are not allocated. See Table 1 for values of the boundaries and their zones of uncertainty and (33) for more details on methods and results.

- La mesure est par construction multidimensionnelle
 - Gaz à effet de serre
 - seuil global, mesures des émissions, de la concentration des GES
 - Modélisation pour anticiper les changements climatiques
 - Difficile (impossible à partir d'un certain point) d'anticiper les dégâts associés; d'autant qu'ils sont très hétérogènes (pas de dégâts agrégés)
 - Effondrement des écosystèmes, perte de biodiversité de biomasse, épuisement des sols
 - Pas de connaissance claire du seuil (pas de +2°C de la biodiversité)
 - dynamique alarmante
 - mesure difficile
 - impossible d'apprécier les impacts
 - Pollutions non GES
 - Anthropique
 - Multidimensionnelle et complexité endogène
 - Hétérogène (mode de vie, localisation, activité économique)
 - Nécessité d'une mesure fine pour accroître la connaissance des impacts et en lien proposer les actions
- Disposer de mesures solides, riches et continues
 - Haut degré de conflictualité sociale et internationale: interdire, contraindre, limiter
 - Complexité des réponses et des arbitrages