

Earth exceeding “safe operating” limits

A study of nine key processes that are critical for maintaining the stability and resilience of Earth’s health has revealed that in all but three we are already outside the “safe operating space for humanity”

1 Biogeochemical flows

Fertilisers into soil and water

Phosphorous	Nitrogen
Boundary: 11Tg*	62Tg
Current: 22.6Tg	190Tg

Safe ▼ Boundary High-risk

Safe zone: Holocene period conditions during which agriculture and modern civilisation evolved

2

Freshwater flow change

Blue – rivers and aquatic ecosystems

Boundary: 10.2%

Current: **18.2%**

Green – held in soil

Boundary: 11.1%

Current: **15.8%**

Interdependent systems affected by anthropogenic activities. Mitigating one can improve others – but quantifying this remains a challenge

5

Sea pollution

Ocean acidification increasing

6

Air pollution

Atmospheric aerosol load increasing

7

Stratospheric ozone

Recovering after global ban on CFCs in 2010

3

Land change

Forest cover

Global average boundary: 75%

Current: **60%**

4

Biosphere integrity

Functional Photosynthetic energy and materials flow

8

Climate change

CO ₂ concentration	Radiative forcing
Boundary: 350ppm**	Boundary: 1 W/m ² ***
2023 level: 417ppm	2022 level: 2.91 W/m²

9

Novel chemicals

Introduced by humans, e.g. CFCs, plastics
Upper limit unknown

Genetic
Boundary: <10 Extinctions per Million Species Years
Current: **>100 E/MSY**

*1 teragram = 1 megatonne

**ppm = Parts per million

*** W/m² = Watts per metre squared

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