

Earth system process	Abbreviation	Approach	Control variable (Richardson et al, 2023; Steffen et al, 2015)	Time dimension	DPSIR location (according to Veà et al, 2020 and Hellweg et al, 2023)	Unit	Planetary boundary (zone of uncertainty) (Richardson et al, 2023)	Sources	Natural background level (Steffen et al, 2015 and references therein, Richardson et al, 2023)	Current value (2023) (Richardson et al, 2023)	Full SOS (min)	Full SOS (max)
Climate change (CO2 concentration)	CCc	PB framework (last version)	Atmospheric CO2 concentration (only)	Implicit	(state)	ppmCO2	350-450	Richardson et al, 2023	(278) 280	417	70	170
Climate change (energy imbalance)	CCe	PB framework (last version)	Total anthropogenic radiative forcing at top-of-atmosphere	Implicit	(state)	W/m2	1-1.5	Richardson et al, 2023	0	2.91	1	1.5
Ocean acidification	OA	PB framework (last version)	Carbonate ion concentration, average global surface ocean saturation state with respect to aragonite (Ω_{arag})	Implicit	(pressure/state)	Ω_{arag}	2.75-2.408	Richardson et al, 2023 Steffen et al, 2015	3.44	2.8	0.69	1.032
Stratospheric ozone depletion	OD	PB framework (last version)	Stratospheric O3 concentration, (global average) (DU)	Implicit	(state)	DU	276-261	Richardson et al, 2023	290	284.6	14	30
Atmospheric aerosol loading	AAL	PB framework (last version)	Interhemispheric difference in Aerosol Optical Depth (AOD)	Implicit	(state)	/	0.1-0.25****	Richardson et al, 2023	0.03	0.076	0.07	0.22
Biogeochemical flows - N	BGn	PB framework (last version)	Nitrogen global: industrial and intentional fixation of N	Explicit	(pressure)	Tg N/yr	62-82**	Richardson et al, 2023	0	190	62	82
Biogeochemical flows - P	BGp	PB framework (last version)	Phosphate global: P flow from freshwater systems into the ocean; regional: P flow from fertilizers to erodible soils	Explicit	(pressure)	Tg P/yr	($r=6.2$)11-100*	Richardson et al, 2023	0	Global: 22.6 Tg of P/yr; regional: 17.5 Tg of P/yr	(6.2)11	100
Land-system change (global)	LS	PB framework (last version)	Global: area of forested land as the percentage of original forest cover; biome: area of forested land as the percentage of potential forest (% area remaining)	Implicit	(pressure/state)	%	75-54***	Richardson et al, 2023	100	Global: 60% [(72, 97) and see the Supplementary Materials]; tropical: Americas, 83.9%; Africa, 54.3%; Asia, 37.5%; temperate: Americas, 51.2%; Europe, 34.2%; Asia, 37.9%; boreal: Americas, 56.6%; Eurasia: 70.3%	25	46
Freshwater use (global)*	FU	PB framework, previous version: Steffen et al 2015	Blue water: human induced disturbance of blue water flow / Maximum amount of consumptive blue water use	Explicit	(pressure)	km3/yr	4000-6000*****	Steffen et al, 2015	0	~2600 (in 2015)*****	4000	6000
Biosphere integrity (functional biodiversity)**	BII	PB framework, previous version: Steffen et al 2015	<i>Functional diversity:</i> Biodiversity Intactness Index (BII) LOSS	Explicit	(impact)	% BII LOSS	10-70*****	Steffen et al, 2015 (Semper et al, 2025 & Lund et al 2025)	0	(100-84=16)% BII LOSS, applied to southern Africa only (in 2015)	10	70
Novel entities	NE	PB framework (last version)	Percentage of synthetic chemicals released to the environment without adequate safety testing	Implicit	(pressure)		0-NA	Richardson et al, 2023	0	Transgressed	0	NA