Planetary boundaries KoM

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Planetary boundaries

A "safe space for human development"

- nine planetary boundaries (pb) within which humanity can continue to develop and thrive for generations to come

- concept established in 2009 by Johan Rockström et al

- measured by control variables

- crossing these boundaries increases the risk of generating large-scale abrupt or irreversible environmental changes

- pb can interact, but I think at least for starting we can look at them individually

List of PB

1. Stratospheric ozone depletion

2. Loss of biosphere integrity

3. Chemical pollution and the release of novel entities

4. Climate change

5. Ocean acidification

List of PB (cont.)

6. Freshwater consumption and the global hydrological cycle

7. Land system change

8. Nitrogen and phosphorus flows to the biosphere and oceans

9. Atmospheric aerosol loading

10. novel entities*

* note to self: check `https://doi.org/10.1021/acs.est.1c04158`

1. Stratospheric ozone depletion

control variable: Stratospheric ozone concentration (Dobson units)

We don't have this in ISIMIP.

2. Loss of biosphere integrity

control variables:

1. Genetic diversity: Extinction rate measured as E/MSY (extinctions per million species-years)

2. Functional diversity: BII (Biodiversity Intactness Index)

We have an ISIMIP sector biodiversity, I am currently not sure how the output of that sector can be translated into the 2 control variables. Most promising look to me e.g. *summed probability of threatened amphibian species*, available for other species types as well.

3. Chemical pollution and the release of novel entities

control variable: Concentration of toxic substances, plastics, endocrine disruptors, heavy metals, and radioactive contamination into the environment (not yet quantified)

We don't have this in ISIMIP.

4. Climate change

control variable:

- Atmospheric carbon dioxide concentration (ppm by volume)

OR

- increase in radiative forcing (W/m2) since the start of the industrial revolution (↑1750)

In ISIMIP we have CO_2 concentrations for CMIP5 and CMIP6 scenarios (not all of them).

5. Ocean acidification

control variable: Global mean saturation state of calcium
carbonate in surface seawater (omega units)

In ISIMIP we have the pH-values, I need to check if this is the
same or how this translates.

6. Freshwater consumption and the global hydrological cycle

control variable: Global human consumption of water (km3/yr)
In ISIMIP we have water abstraction data as input, I would need

to investigate if it covers everything or just part of the total
human consumption

7. Land system change

control variable: Part of forests rested intact (percent)

In ISIMIP we have landuse projections. We don't publish the forest part, but the dataset we base our data on certainly has forests. They provide *forested primary land*, I would need to check whether this counts as "intact". I will also check whether the landuse projections that are currently prepared for ISIMIP3b contain something suitable.

8. Nitrogen and phosphorus flows to the biosphere and oceans

control variable:

- anthropogenic nitrogen removed from the atmosphere (t / year)
- anthropogenic phosphorus going into the oceans (t / year)

In ISIMIP we have input data related to N, (n-fertilizer, n-deposition [NH_x and NO_y]). Also various output variables describes aspects of N and P cycles. I need to check whether / how well we can infer the control variables from this.

9. Atmospheric aerosol loading

control variable: Overall particulate concentration in the atmosphere, on a regional basis

We don't see aerosols in ISIMIP at all.