Planetary Boundaries as potential measurable aspects in a global model

What aspects?

- Physical climate ppm CO₂, Wm⁻²
- Physicochemical processes
 - aerosols
 - ocean pH
- 'Human' processes
 - Land use change
 - Water abstraction
 - Chemical pollution (ozone depletion)
- Biogeochemical processes N and P cycles
- Ecological processes biodiversity loss



Image: © Edward Elgar 2014

Stockholm Resilience Centre Sustainability Science for Biosphere Stewardship



Sarah Cornell Linköping, May 2016





ategic Environmental Resear

A global model of what?

- Risks to social systems (LAWM)
- Consequences of resource use (WORLD)
- Risks of biophysical thresholds (ESCIMO?)
- Consequences of "system perturbation" (???)

Limits to Growth:

"With the model we are seeking to understand the causes of these trends, their interrelationships, and their implications as much as one hundred years in the future."

The linear Anthropocene:

Socio-economic trends Earth system trends Population Real GDP Foreign direct investment Carbon Nitrous Methane 1600 50 40 30 20 dioxide oxide 1400 1200 1000 800 10 1900 1950 2000 1750 1800 1850 1900 1950 2000 1750 1800 1850 1900 1800 1850 1900 1950 2000 1850 1900 1950 2000 1850 1900 1950 2000 1750 1750 1800 1750 1800 Vear Veau Stratospheric Urban Primary Fertilizer Surface Ocean 500 population energy use consumption ozone temperature acidification <u>ක</u> 400 300 200 100 -0.4 1750 1850 1900 1950 2000 1800 1850 1900 1950 2000 1750 1800 1850 1900 1950 2000 1750 1800 1850 1900 1950 2000 1800 1750 1800 1850 1900 1950 2000 1750 1800 1850 1900 1950 2000 Paper production Shrimp aquaculture Large dams Water use Nitrogen to coastal zone 30 70 Marine fish 25 25 20 D capture 50 40 30 15 1800 1850 1900 1950 2000 1750 1800 1850 1900 1950 2000 1750 1800 1850 1900 1950 2000 1750 1800 1850 1900 1900 1950 2000 1800 1850 1900 1950 2000 1950 2000 1750 Year Year Year 월 1200 달년 1000 Transportation Telecommunications International Tropical forest loss Domesticated 25 Terrestrial tourism land biosphere 800 degradation 600 40 400 200 1850 1900 1950 2000 1750 1800 1850 1900 1750 1800 1850 1900 1750 1800 1850 1900 1900 1950 2000 1800 1950 2000 1850 1750 1850 1900 1750 1800 1750 Yea Year http://www.slideshare.net/IGBPSecretariat/great-acceleration-2015 Climate change Subsurface Water • Sea ice Deserts Agriculture/Food Nitrogen Cycle Croplands Demographic Energy CarboAquatic Economic development Tundra Biochemical Cycles Land Surface Health Urban Climatic • Water Cylce ● G~assland Ice/Rock Wetland Surface Water Policy/Politics Atmosphere Coastal - Forest Infrastructure Hydrological Oceans **Muddles in models** J. Friedrich, 2013 Culture/Values



Sustainable Development Goals – Links among the environment-related targets



Targets with overlapping scope Sub-targets under an overarching target Planetary boundary related targets

Goal 8

- resource efficiency in consumption and production;
- decoupling of economic growth and development from resource use and environmental degradation

Goal 12

sustainable management and efficient use of natural resources For n

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Source: PBL Netherlands Environmental Assessment Agency

Experiences in expressing ideas with System Dynamics and/or Types of research questions in global models

What is the planetary boundaries system?

- "Holocene-like state"
- Compartmentalised biophysical "processes"
- Invisible, undifferentiated human unclear drivers





Characteristics?

- Precise and transparent representation of assumptions
- Full technical documentation
- Open to inspection and criticism by all

"There is more to integration, however, than combining algorithmic techniques. There is also the issue of problem formulation."

Hooker, Hybrid modelling, 2011,

LAWM

WORLD

What if present consumption trends continue?

- Population
- Food production
- Industrialisation
- Pollution
- Resource consumption

What is the material viability of a world free of misery of poverty ?

- Production*
- Energy
- Pollution
- Non-renewable resource

* nutrition, shelter, education, capital goods, other consumer goods

Other information:

CALL FOR PAPERS deadline 21 May: **European Union and Sustainable Development: Challenges and Prospects** 19-21 October 2016, Clermont-Ferrand, France https://www.univ-bpclermont.fr/IMG/pdf/call_for_paper-_EUSD_-_OR2D.pdf

3rd LOOPS workshop, October 2016 – date to be finalised...

Towards co-evolutionary modeling of global society-environment interactions

PIK, SRC, Southampton University, and partners

(old) https://www.pik-potsdam.de/members/donges/loops-2014-workshop



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