Title: Understanding environmental problems and identifying sustainable solutions by scaling of water, carbon, mineral and material flows in catchments, ecosystems and societies.

Introduction

Relevance: Environmental problems and sustainable solutions deal with questions like

1) By how much will global precipitation increase due to global warming?

2) Is delayed temperature and carbon dioxide increase due to circulation in oceans?

3) Can artificial deposition of global sediment erosion combate lowland subsidence/sea level rise by using suspended solids contents in rivers?

4) Can damming in rivers reduce global sea level rise?

5) What are the environmental benefits of a downward shift in human diets from vertebrate (cattle, fish etc.) to invertebrate (insects, shrimps etc.), plant or bacterial food? [Clark et al. 2020, Pauly and Palomares 2005]

6) Can maximum reforestation bring back carbon dioxide level to pre-industrial levels? How does this relate to average burial of organic matter in natural/agricultural soil and sediments? [Bastin et al. 2019, Cook-Patton et al. 2020]

7) Can reduction of species richness be linearly/logarithmically related to a decrease in total habitat area?

8) What assumptions underly air travel carbon compensation?

Usually such questions are addressed by detailed but opaque models. To increase understanding in education and credibility in society, generic but transparent models may be developed and applied as well. While such simple scaling relationships are gradually emerging [Hendriks et al. 2012, Barbarossa et al. 2017], Hendriks 2007, Dos Santos et al. 2017] application is still limited.

Objective: A simple and transparent model linking flows of water, minerals and carbon to the size of the abiotic and biotic and anthropogenic systems involved. Sub-objectives: Select or develop specific relationships and apply these to one of the questions above.

Methods

Review: For the question selected, collect recent (model) studies, summarise the methods (data, models, equations) used and results obtained so far.

Model development: (if sufficient time remains) select (the) dominant equation(s), preferably parameterised by the scaling relationships mentioned above.

Model application: apply the simple model to the same issue and compare the outcome to that of the complex model.

Expected results

Tables and figures comparing complex and simple models material flows in ecosystems and economies. Uncertainties and explanations for the differences and similarities observed in the comparison.

Format: Scientific paper.