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Global Change

Terminology Brief Series

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Formal definition: Global change refers to planetary scale changes in the Earth system. The system consists of the land, oceans, atmosphere, poles, life, the planet's natural cycles and deep Earth processes. These constituent parts influence one another. The Earth system now includes human society, so global change also refers to large-scale changes in society (adapted from IGBP¹).

Global Change refers to planetary scale changes affecting the earth system as a whole. Changes encompass changes in atmospheric circulation, ocean circulation, climate, biogeochemical cycles, water cycle, biodiversity, fisheries, sea-ice and sea-level changes, land-use change, human society and many more². Drivers of global change can be classified as natural and anthropogenic. Natural drivers of global change are associated with external forcing such as solar variations, changes in the tilting of the Earth's axis and volcanism and system inherent forcing, such as climate change and biodiversity. Anthropogenic drivers have human origins and are, but not limited to, population growth, pollution, energy and resource use, agriculture, urbanization, transport and economic activity (Steffen et al, 2004) (Figure 1).

The Amsterdam Declaration (Moore et al 2001) highlights the fact that the Earth System

behaves as a single self-regulating system. Thus, interactions and feedback between components (physical, chemical, biological, human) are complex and exhibit multi-scale temporal and spatial variability. Under this assumption, global change cannot be understood only in terms of a simple cause-effect paradigm and human induced changes can cause multiple effects that cascade through the earth system in complex ways (Moore et al. 2001). These effects interact with each other and with changes at different scales in ways that are difficult to understand and predict. The Earth System dynamics is characterized by abrupt changes and thresholds, which human activities can inadvertently change with severe consequences for human and natural systems (Moore et al 2001).

Therefore, research on global change mainly tries to understand how drivers of change impacts socio-ecological systems across different scales going from the level of organisms to the whole earth system components (Camill 2010) and through complex non-linear processes, thresholds and feedbacks. Due to the full extent and complexity of the global change concept, research in this field is necessarily multidisciplinary in scope involving natural, social and human disciplines.

¹ www.igbp.net

² <http://www.igbp.net/globalchange/earthsystemdefinitions.4.d8b4c3c12bf3be638a80001040.html>

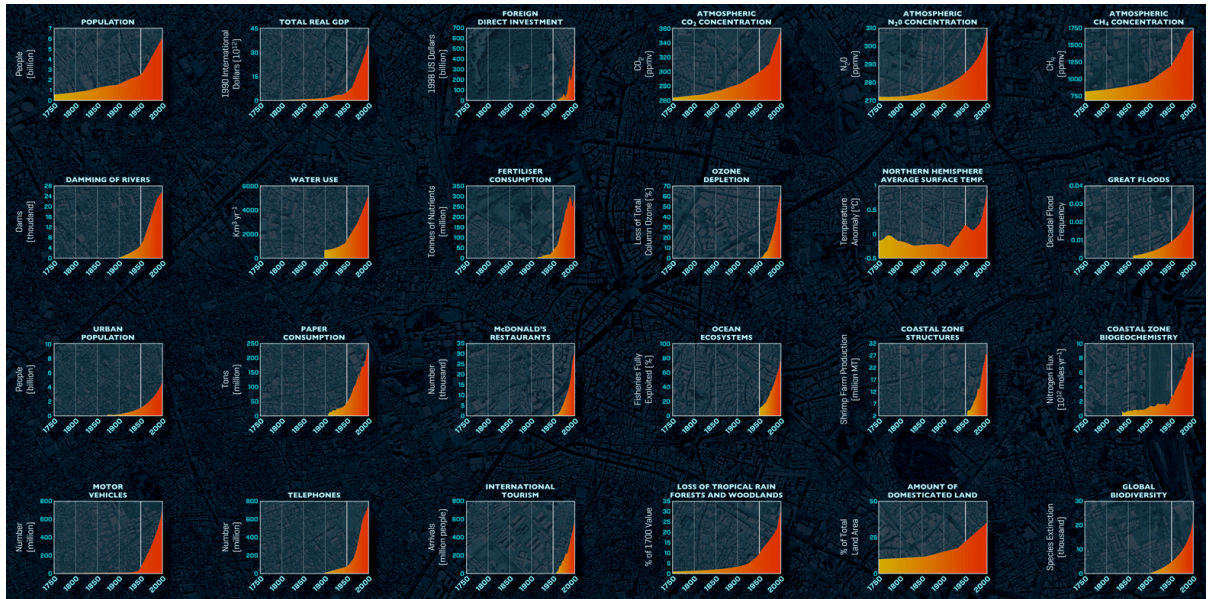


Figure 1: Rate of increase in many spheres of human activity for the last 300 years. Adapted from Steffen et al. (2004).

1 Our View

Our University Research Priority Programme on Global Change and Biodiversity³ addresses the key challenges of understanding the impact of global change on biodiversity and on the functioning and stability of ecosystems and the natural services that they provide. In this view, biodiversity is both a response variable affected by global change drivers and a factor modifying ecosystem processes and services that are essential to human well being (MEA, 2005) (Figure 2). Our presumption is that drivers affecting global change and biodiversity vary in their importance, magnitude and size among ecosystems and regions. Improved capability to predict the consequences of changes in drivers will aid improved prediction of the state of the environment, by using a latitudinal gradient approach with focus on interactions, feedbacks and scale.

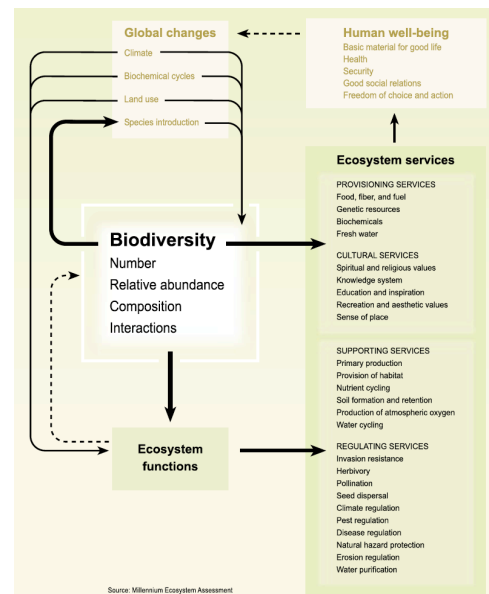


Figure 2: Biodiversity is both a response variable affected by global change drivers and a factor modifying ecosystem processes and services and human well-being. Source MEA, 2005.

The programme proposed activities are bundled in eight interdisciplinary projects. Projects concerned with interactions look at the importance of biodiversity for vegetation-atmosphere interactions, quantification and

³ www.gcb.uzh.ch

predictions of ecosystem services at policy-relevant scales and the political ecology of environmental conflicts in the tropical forest. Projects concerned with feedback look at the ecological genomics of plastic and evolutionary responses to environmental changes, interactions between global change, biodiversity, and feedback mechanisms and global change and biodiversity feedbacks as drivers of the carbon cycle in the plant-soil system. Two projects focus specifically on the issues of scales, i.e. the Integration of cross-scale effects minimizing feedback omission using a latitudinal gradient approach and Assessing uncertainty of global change using multi-scale Bayesian modeling.

- World Resources Institute, Washington, DC.
- Moore, B., Underdal, A., Lemke, P., Loreau, M. (2001). *Challenges of a Changing Earth: Global Change Open Science Conference Amsterdam*, The Netherlands 13 July 2001
- Steffen, W., Sanderson, R.A., Tyson, P.D., Jäger, J., Matson, P.A., Moore III, B., Oldfield, F., Richardson, K., Schellnhuber, H.-J., Turner, B.L., Wasson, R.J. (2004). *Global Change and the Earth System: A Planet under Pressure*, Global Change - The IGBP Series

Further Readings

- Steffen, W., Sanderson, R.A., Tyson, P.D., Jäger, J., Matson, P.A., Moore III, B., Oldfield, F., Richardson, K., Schellnhuber, H.-J., Turner, B.L., Wasson, R.J. (2004). *Global Change and the Earth System: A Planet under Pressure*, Global Change - The IGBP Series
- Vitousek, P.M. (1994). *Beyond Global Warming: Ecology and Global Change*, *Ecology*, 75:7, 1861-1876

Useful Links

- <http://www.nature.com/scitable/knowledge/library/global-change-an-overview-13255365>
- <http://www.igbp.net/globalchange.4.d8b4c3c12bf3be638a80001026.html>
- <http://www.globalchange.gov/about>

References

- Camill, P. (2010). *Global Change: An Overview*, *Nature Education Knowledge* 3(10):49.
- Millennium Ecosystem Assessment (MEA), 2005. *Ecosystems and Human Well-being: Biodiversity Synthesis*.