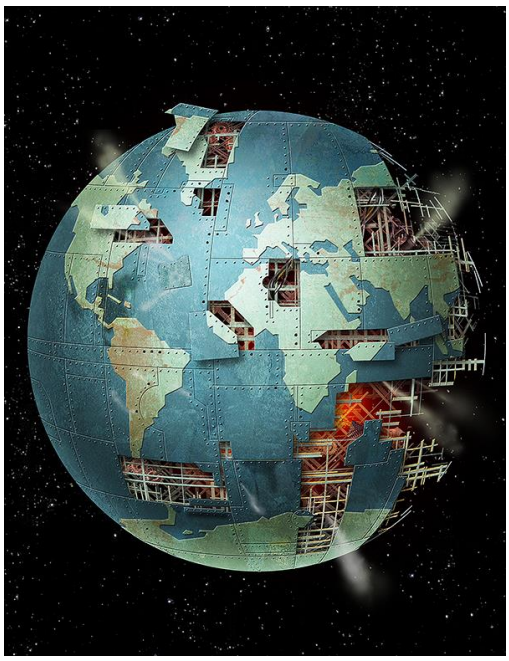
Course Description

Global Environmental Change in the Anthropocene



5 October –7 December 2017

Open to interested citizens and students from all degree programmes

ECTS:	4 ECTS
Day & time:	Thursdays @ 15.45 (see schedule)
Campus:	Belval
Room:	MSA (see guichet étudiants)
Responsible:	Dr Ariane König
Contact:	Marie Delafont
E-mail:	marie.delafont@uni.lu

UNIVERSITÉ DU LUXEMBOURG

1. Course Description

The course “Global change in the anthropocene” (MAGEO-04-21) is part of the common Introductory module “ European Territorial Trends and Policies” in the Master of Geography and Spatial Planning and counts as auxiliary course towards the Certificate in Sustainable Development and Social Innovation.

This course provides an overview on global environmental change and current accounts of the role of human activities in this. The nine sessions start with an introduction on sustainability science on current scientific descriptions of the functioning of the earth system and the role of the biosphere in stabilizing environmental conditions on earth. Subsequent sessions address sea level-rise, risks of flooding and land-use change with a focus on agriculture. Cross cutting themes that are also addressed in dedicated sessions include challenges in the characterisation of complex dynamic social-ecological systems and communication of scientific uncertainty. The concluding session will take up recurring themes of and the merits and pitfalls of current approaches to developing evidence-based policy and working with indicators for planning purposes, compares diverse approaches to anticipating future change, and provide a platform for critical discussion of the most relevant overarching EU and Luxembourg policies.

2. Learning outcomes

On completion of the module a student should be expected to be able to:

- Understand the relation between human activities and natural processes determining the quality of the environment (incl. the political and management dimension).
- Apply concepts of risk, vulnerability, adaptation, mitigation and resilience in analysing policies relating to global environmental change.
- Apply the concept of ecosystem services for taking environmental change into account in spatial planning policies.
- Understand merits and limitations, and potential abuse of scientific observation and assessment and associated uncertainties.
- Make judgments on the quality of science underlying evidence-based policies.
- Evaluate EU and Luxembourg spatial planning and environmental policy recommendations.

3. Evaluation

- 10% participation*
- 30% assignments
- 60% final report (see Annex I for more detailed instructions)

*All readings will be placed on Moodle, and we expect you to have done at least one reading *before* each session, as we assess engagement on class discussions also based on developing critical personal perspectives on the readings.

4. Scheduling

Dates: **Thursdays between 5 October and 7 December 2017**

Starting Time: 15.45

Ending Time: 19:15 (Please consult the schedule).

All sessions will take place at Campus Belval, Building MSA (Maison du Savoir, room …)

Session 1. Global Environmental Change in the Anthropocene

Thursday 5.10.2017 15.45-19.15

Ariane König, University of Luxembourg
Qiang Chen, University of Luxembourg

- **Overview: What role do humans play in global environmental change?**
- **An introduction to systems science to understand interdependencies in short term climate change**

This lecture starts with an overview on the course and introduces concepts of the anthropocene, planetary boundaries, and tipping points, and raises questions why some scientists consider these as problematic.

The activity of humans is affecting the Earth system in ways that allow estimation and in some cases quantitative measurement of some of the impacts. In the second part of this session we introduce a set of simple tools from the systems approaches to discern and quantify some of the interdependent changes in the planetary system.

Readings:

Rockström, J. et al. (2009). A safe operating space for humanity. *Nature, 461 (September)*, pp.472-475.

Kump, L., Kasting, J.F. & Crane, R.G (2009). Global change. In Hall, P. (Ed.), *The Earth System* (3rd edition). Prentice Hall. Chapter 1, pp. 1–17

Miller, T.R. (2013). Constructing sustainability science: emerging perspectives and research trajectories. *Sustainability Science 8(2)*, pp.279-293

Policies:

EU2020 strategy for smart and sustainable growth: http://www.eea.europa.eu/policy-documents/com-2010-2020-europe-2020

Luxembourg Plan National pour le Développement Durable : http://www.developpement-durable-infrastructures.public.lu/fr/developpement-durable-infrastructures/plan-national/

Further reading:

Kump, L., Kasting, J., & Crane, R. (2009). Daisy world: An introduction to systems. In The earth system (3rd ed., pp. 18–33). Prentice Hall. Chapter 2

Schlesinger,,W. (1997). Global bio geo chemical cycles. In 'Bio geo-chemical cycles'.

Assignment 1 on the Daisy world
Due date: 26 October 2016

Detailed instructions will be sent out on E-mail and posted on moodle

Please post your completed assignment on moodle and send by E-mail to Qiang.chen@uni.lu by 30 October 2017.

Session 2. Land-use change and implications for agricultural systems

Thursday 12.10.2017 15.45-19.15

Nicolas Dendoncker, University of Namur

- **The global farming system**
- **Agricultural crises, land use change, and revolutions through history**

Agriculture is at the basis of all human activities: European cities first emerged in the most productive landscapes, and if our economies are now largely based on services, it is largely because most of us do no longer need to produce the food we consume, as this task is today accomplished by a very small number of farmers. In spite of this, today's model of globalized agriculture is in crisis. It is not sustainable as it largely rests on petrochemical energy and vast amounts of non-renewable resources; destroys natural and cultural biodiversity; furthermore, it will not be able to fulfil tomorrow's needs, and does not even answer the worlds' present needs. Agriculture is largely absent from spatial planning policies and deliberations. In this part of the course, we will argue that sustainable landscape planning cannot happen without and has to start with a drastic change of agricultural systems. We will approach this issue through a geographic (spatially explicit and anthropocentric) yet systemic and transdisciplinary lens: we will largely use concepts of agronomy, agro-ecology, economy, and sociology in order to go beyond disciplinary boundaries to propose integrated solutions facilitating a change of rural (and a fortiori urban) societies. In this first session on land-use change and agriculture, we will particularly focus on Wallonia (Belgium), as an example in the context of the global agricultural model.

Reading:

Mazoyer M. & Roudard L. (2006). *A History of World Agriculture: From the Neolithic Age to the Current Crisis*. London: Earthscan

Millenium Ecosystem Assessment - General Synthesis (http://www.maweb.org/en/Synthesis.aspx)

The Economics of Ecosystems and Biodiversity - TEEB - Synthesis Report (http://www.teebweb.org/TEEBSynthesisReport/tabid/29410/Default.aspx)

Further Reading:

Steel C. (2013). *Hungry City - How Food Shapes Our Lives.* London: Chatto & Windus.

Session 3. Impacts, and the use of ecosystem services as indicator for transition to more sustainable agriculture

Thursday 19.10.2017 15.45-19.15

Nicolas Dendoncker

- **Consequences of the anthropocenic agricultural system: Detrimental consequences in the North and South; Global and European agricultural policies**
- **Ecosystems services and transition to a new sustainable agricultural system**

The last agricultural revolution (coinciding with the start of the anthropocene) in particular had dramatic and detrimental consequences. In this second session we will focus on these consequences, bringing depth to our first statements, by specifically considering Northern and Southern countries. We will highlight the current agricultural policies at the global (WTO) and European level (CAP). Finally, the final yet key part of the course will focus on the perspectives of tomorrow's farming systems in the context of sustainable landscape and resource uses. In this last part, we intend to be normative and argue for the need of a new agricultural transition. The concept of ecosystem services (ES) might

prove a useful concept to push this transition forward. We will detail these initiatives at both the global and EU level, by linking them to EU policy (e.g. EU biodiversity strategy for 2020). We will promote ES in order to facilitate the implementation of integrated agrarian systems resting on the principles of agro-ecology. This transition towards sustainable agriculture will allow the emergence of new living spaces in rural settings by facilitating the endogenous development of rural territories.

Session 4. The Earth 2100 – with a pinch of salt

Thursday 26.10.2017 15.45-19.15

• What might the planet look like in 100 years? Critical discussion of representations of Global Environmental Change in the Media triggered by analysis of the documentary Earth 2100.

Jan-Tobias Doerr, University of Luxembourg

Screening of the film Earth 2100 followed by a critical debate on stories, representations of data and social change.

Readings:

Vervoort, J.M., Bendor, R., Kelliher, A., Strik, O. & Helfgott, A.E.R. (2015). Scenarios and the art of worldmaking. *Futures 74*, pp. 62-70

Swart, R.J., Raskin, P. & Robinson, J. (2004). The Problem of the Future: Sustainability Science and Scenario Analysis. *Global Environmental Change 14*, pp. 137-146

Further reading:

Swyngedouw, E. (2010). Apocalypse Forever? Post-political populism and the spectre of climate change, *Theory, Culture & Society 27 (2-3)*, pp. 213-232

Assignment on representations of Global Environmental Change in Media and Politics – Critical perspectives

Due date: 10 November 2016

Please work with the questionnaire posted on Moodle for this session to prepare draft answers whilst watching the film during the course session, and improve your answers at home with reference to the class debate before submitting via Moodle.

Session 5. Sea levels, hydrological hazards and geodetic monitoring (part 1)

Thursday 9.11. 2017 15.45-19.15

Norman Teferle, University of Luxembourg

- **Climate change and sea level variations, hydrological hazards: sea level rise and flooding**
- **Uncertainties within the Intergovernmental Panel on Climate Change (IPCC) Reports**

This session will build on insights on climate change from previous sessions, introduce the modeling of climate and relate this to natural hazards. The focus throughout will be on hydrological hazards such as sea-level rise and flooding. This session concludes with a brief review of the treatment and communication of uncertainties in the Intergovernmental Panel on Climate Change (IPCC) reports.

Readings:

Cazenave,A & Llovel, W. (2010). Contemporary Sea Level Rise, *Annual Review of Marine Science 2*, pp.145-173. Doi: 10.1146/annurev-marine-120308-081105.

Jones, N. (2013). Rising Tide : Researchers Struggle to Project How Fast, How High, and How Far the Oceans Will Rise, *Nature 501*, 19 September. (http://www.nature.com/news/climate-science-rising-tide-1.13749)

IPCC (2013) Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi:10.1017/CBO9781107415324. Chapter 13 (http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter13_FINAL.pdf)

Further readings:

Dessler, A. (2012). *Introduction to Modern Climate Change*, Cambridge University Press: chapters 2, 7, 8 and 11.

Bryant, E. (2005). *Natural Hazards*, Cambridge University Press

IPCC (2014) Climate Change 2014 Synthesis Report, Contribution of the Working Groups I, II and III to the fifth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC, (http://ar5-syr.ipcc.ch/)

Session 6. **Sea level, hydrological hazards and geodetic monitoring** (part 2)

Thursday 16.11.2017 15.45-19.15

Norman Teferle

- **Concepts of vulnerability, risk, mitigation and adaption**
- **Geodetic monitoring and the Global Geodetic Observing System**

This session will carry on with the topic of natural hazards in which concepts of risk, vulnerability, adaptation and mitigation are discussed with respect to hydrological hazards. This part will finish some information European policies regarding sea level rise and flooding. The final part of this session will review modern geodetic techniques used to monitor natural hazards on regional to global scales as well as introducing the Global Geodetic Observing System (GGOS), which will provide the geodetic infrastructure necessary for monitoring the Earth system and for global change research.

Readings:

IPCC (2012). Managing the risks of extreme events and disasters to advance climate change adaption: chapter 2. (http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml#SREX)

European Environment Agency (2012). Urban adaption to climate change in Europe, EEA Report no 2/2012: section 2.2 p35-52, (http://www.eea.europa.eu/publications).

GGOS (2014) Strategy Plan of the IAG Global Geodetic Observing System, http://192.106.234.28/HOME/GGOS-StrategicPlan-140421.1.pdf

Further readings:

Smith, K. & Petley, D.N. (2009). *Environmental Hazards Assessing Risk and reducing disaster*, 5th Ed, Routledge.

Keller E.A. & DeVecchio, D.E. (2012) *Natural Hazards*, 3rd Ed., Pearson Higher Education, Prentice Hall.

IPCC (2013) Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi:10.1017/CBO9781107415324. Chapter 13 (http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter13_FINAL.pdf)

Plag, H.P.& Pearlman, M. (2009) *Global Geodetic Observing System -Meeting the Requirements of a Global Society on a Changing Planet in 2020*, Springer.

Viewings:

Earth under Water – Worldwide Flooding | Sea Level Rise https://youtu.be/baGrtqyWSRM

Assignment on sea level rise and flooding

Due date : 25 December 2017

Topic will be announced in Moodle

Please post on moodle and send by E-mail to: norman.teferle@uni.lu

Session 8. What can go wrong with quantitative data and mathematical methods? A tale of caution on the use of numbers in the face of uncertainty and complexity

Thursday 23.11..2017 15.45-19.15

Jerome R. Ravetz, Independent Consultant, Oxford
Ariane, König,

- **Uncertainty assessment and representation – the NUSAP model**

How can anything go wrong with quantitative data, mathematical methods and numerical indicators?

In the tradition of Descartes and Galileo, mathematics is the infallible road to truth. But statistics is well known to be problematic, and now numerical models have come in for much criticism. However, we still use numerical indicators for describing our interactions with the environment.

In the first part of the session we will review the limitations and pitfalls of mathematical methods. After an analysis of the scientific status of models, we will discuss some examples, from climate science and finance. The root of the difficulty is the modern secular faith in numbers, whereby rhetoric masquerades as logic. The abuse described as 'proofiness', is then easily explained. There will be a learning activity in which we explore paradoxes in elementary arithmetic, starting with the classic 'fossils joke'.

The second part of this session will focus on indicators, as tools for representing complex information in an effective, simplified form. We will consider what sorts of information they can genuinely convey, along with the ways in which they can be fallible or confusing. We will conclude with a survey of methods of conveying uncertainty and quality in quantitative information. That will be the subject of an exercise on a familiar indicator.

Readings:

Models & Numbers

Funtowicz S. & Ravetz, J. R. (1990)**,** *Uncertainty and quality in science for policy***,** pp.115-172. http://books.google.fr/books

Funtowicz, S. & Ravetz, J.R. (2015). Quality in Science and Peer Review. Encyclopedia.

Further reading:

Pilkey O.H. & L. Pilkey-Jarvis (2007), *Useless Arithmetic – Why Environmental Scientists Can't Predict the Future*. New York: Columbia University Press.

http://www.amazon.com/Useless-Arithmetic-Environmental-Scientists-Predict/dp/0231132131

Session 8. Characterizing social-ecological systems: the challenges of critical Interdisciplinarity

Thursday 30.11.2017 15.45-19.15

Ariane König, University of Luxembourg

• Conceptual models and systems approaches for research on interactions between the environmental, social, and technological spheres

How can we gain a better understanding of global environmental change processes, their complexity, and interdependencies between changes in human action and natural processes? This lecture introduces systems thinking to characterise human-environment interactions, challenges of interdisciplinarity in sustainability science, and new requisites to knowledge production processes that help us to understand and act upon global environmental change better.

Readings:

Newell and Proust, K. (2018). Collaborative conceptual systems mapping. In König (ed.) Sustainability science: Key Issues. Routledge.

Dyball, R. & Newell, B. 2015. Chapter 6. Systems and sustainability. *In* Understanding Human Ecology: A systems approach to sustainability. Routledge.

Newell, B. & Dori, C. (2015). System thinking and the Cobra Effect. United Nations University.

Further Reading:

Meadows, D., & Wright, D. (2008). Thinking in Systems: A Primer. Chelsea Green Publishing. Retrieved from https://books.google.lu/books?id=JSgOSP1qklUC

Session 9. Anticipating challenges at the food water energy nexus

Thursday 7.12. 2017 15.45-19.15

Ariane König,

- **Transformative sustainability science and the role of scenario analysis to co-create actionable knowledge with diverse stakeholders in governments, science, the private sector and organised civil society**

In the anthropocene we bear ever greater responsibilities for better understanding and acting upon how human activities impact the earth system. Science has a role to play in fostering social learning and social change towards an improved governance of the commons. In order to plan for effective transition to more sustainable societies, it is however also key that we recognise limits of our disciplinary scientific methods and models, and embrace complexity and uncertainty and areas of ignorance on how the social and the material world interact and change in an interdependent manner. What can we know? What role do stories play compared to quantitative approaches to describing a changing world? How might we sensibly use scenario or fore- or back-casting techniques to contribute to giving direction to society's developmental pathways?

Reading:

Swart, R.J., Raskin, P. & Robinson, J. (2004). The Problem of the Future: Sustainability Science and Scenario Analysis. Global Environmental Change 14, pp. 137-146

Burt, G. & van der Heijden, K. (2008). Towards a framework to understand purpose in Futures Studies: The role of Vickers' Appreciative System. *Technological Forecasting & Social Change 75,* pp. 1109-1127. doi:10.1016/j.techfore.2008.03.003

Vervoort, J.M., Bendor, R., Kelliher, A., Strik, O. & Helfgott, A.E.R. (2015). Scenarios and the art of worldmaking. Futures 74, pp. 62-70

ANNEX I: Assignments and Final Report

We recommend doing the assignments after the relevant sessions, but the synthetic written work after the course has finished. We need the final report to be sent to ariane.koenig@uni.lu by 15 January 2016.

1. The Assignments

Assignment 1. DAISY WORLD

Qiang Chen

Due date: **30 October 2017**

Learning objective: Gain experience with simply models of complex systems.

Please post your completed assignment on moodle and send by e-mail to qiang.chen@uni.lu

Assignment 2. Representations of Global Environmental Change in Media and Politics – Critical perspectives

Jan Doerr

Due date: 10 November 2017

Please work with the questionnaire posted on Moodle for this session to prepare draft answers whilst watching the film during the course session, and improve your answers at home with reference to the class debate before submitting via Moodle.

Please post your completed assignment on moodle and send by e-mail to ariane.koenig@uni.lu

Assignment 3. Sea level rise and flooding

Norman Teferle

Due date : 5 December 2017

Topic will be announced in Moodle

Please post on moodle and send by E-mail to: norman.teferle@uni.lu

2. The Final Report on the course

Learning objective: *This report with two parts will serve to draw together material from all sessions in order to make sense of the course in its entirety.*

Part I. In the first part of the report please synthesize and critically discuss the course material and course readings. Part I should have about 5000 words. You may choose to cover each session, one after the other, discussing the main contents of the lecture and one or two readings critically, whilst highlighting the main insights you have personally gained form them; and then picking out over arching themes for the introduction and conclusion. You may think of an entirely different way to organize your report – as long as you are sure to cover most lecture material to show you have understood the essence of the course and how it 'hangs together'. Make sure you add a table of content that gives an overview on your chosen structure.

Please cite the literature you summarise as in a scientific paper for publication at the end of your report.

Part II. The second part serves as a starting point for your personal reflection on how you have related and would like to relate in future to challenges of sustainable development in the anthropocene. Please address the question on whether the course has in part or as a whole affected your views. Has this course affected your plans on whether and how to engage personally and/or professionally in addressing global environmental change? To do so, you might like to share how you are engaging with these problems in practice, and whether you might like to engage or not engage in the future. Any recommendations for next year's course will be welcome. Part 2 should have 1500 – 3000 words.

Please consider keeping a reflective diary in which you write up key impressions, positive or critical after each course session. This reflective diary can be included in Part II.