701-1252-00 V Climate Change Uncertainty and Risk: From Probabilistic Forecasts to Economics of Climate Adaptation

Updated version due to Corona Pandemics and related changes in teaching at ETH. Updates in *blue italic* and elements cancelled as ~~strikethrough~~.

David N. Bresch, IED ETH
Reto Knutti, IAC ETH

Assistants: Thomas Röösli, Joel Zeder, Benedikt Knüsel and Jamie McCaughey

The course introduces the concepts of predictability, probability, uncertainty and probabilistic risk modelling and their application to climate modelling and the economics of climate adaptation. It is offered in the Atmospheric and Climate Science Master, the Data Science Master, the MAS in Sustainable Water Resources, the Science, Technology, and Policy Master, and the Environmental Sciences Master.

Objective

Students will acquire knowledge in uncertainty and risk quantification (probabilistic modelling) and an understanding of the economics of climate adaptation. They will become able to construct their own uncertainty and risk assessment models (in Python), hence basic understanding of scientific programming forms a prerequisite of the course.

Content

The first part of the course covers methods to quantify uncertainty in detecting and attributing human influence on climate change and to generate probabilistic climate change projections on global to regional scales. Model evaluation, calibration and structural error are discussed. In the second part, quantification of risks associated with local climate impacts and the economics of different baskets of climate adaptation options are assessed – leading to informed decisions to optimally allocate resources. Such pre-emptive risk management allows evaluating a mix of prevention, preparation, response, recovery, and (financial) risk transfer actions, resulting in an optimal balance of public and private contributions to risk management, aiming at a more resilient society.

The course provides an introduction to the following themes:

1) basics of probabilistic modelling and quantification of uncertainty from global climate change to local impacts of extreme events

2) methods to optimize and constrain model parameters using observations

3) risk management from identification (perception) and understanding (assessment, modelling) to actions (prevention, preparation, response, recovery, risk transfer)

4) basics of economic evaluation, economic decision making in the presence of climate risks and pre-emptive risk management to optimally allocate resources

Lecture notes and literature

Powerpoint slides as pdf will be made available Friday at noon before the lecture on Monday (exceptions might apply). Many papers for in-depth study will be referred to during the lecture. Details, slides, etc. will be posted on:
www.iac.ethz.ch/edu/courses/master/modules/climate-risk.html

Prerequisites / Notice

Hands-on experience with probabilistic climate models and risk models will be acquired in the tutorials; hence good understanding of scientific programming forms a prerequisite of the course, in Python (teaching language, object oriented) or similar. Basic understanding of the climate system, e.g. as covered in the course 'Klimasysteme' is required.

Examination: graded tutorials during the semester (graded semester performance, benotete Semesterleistung)

Repetition only possible after re-enrolling for the course unit.

2h lecture each week, 1h exercise (2h every 2nd week), 3 ECTS credit points

Graded semester performance - Excercises and deliverables

At the beginning of the first exercise, students will be asked to form groups of three. Groups of two as well as single students are allowed, but not recommended, both for reasons of learning to work and perform as a group as well as for logistical constraints.

While group work is still possible, students working alone is absolutely fine. There is no joint presentation planned any more.

The graded semester performance is based on the two Python exercises (2 x 25%), a *small extension of one of the exercises* ~~short presentation~~ on a topic chosen by you (25%) ~~during the course~~ plus a briefing paper about the *extension* ~~presentation~~ addressing a decision maker chosen by you (25%).

With the small extension, we mean that you pose yourself a question or small challenge as you would have done so for the presentation. You can decide yourself to which one of the two exercises you'd like to add your small extension.

~~The short presentation on a topic chosen by you (either in the context of exercise 1 or 2) is evaluated based on relevance, content correctness, and the quality of delivery. The presentation lasts precisely 10 minutes (hard stop), followed by 3-5 minutes of Q&A. The audience consists of your colleagues, the lecturers and the assistants. Assistants will organize the schedule.~~

The final submission is due **Fri 26 June 2020** (one submission per group) and consists of:

- Answers to Exercise 1 (Toy model) and Exercise 2 (CLIMADA) – answers to the questions of the two exercise sheets (Exercise 1 and 2 each count for 25% of total grading). The file containing the answers should be well structured, so the answers can easily be found. It can be a handed in as a Word-Document or a PDF.
- Code used to solve Exercise 1 (Toy model) and Exercise 2 (CLIMADA) as executable Jupyter-Notebook files. Additionally a pdf-dump with calculated outputs of the same Jupyter-Notebooks (in case your Jupyter notebook documents all steps well, this can be handed in as the PDF requested above).
- A Policy Brief, which is (1) based on some quantification you produced using the toy model or CLIMADA *for your small extension* and (2) addressing a decision maker chosen by you (counts for 25% of total grading). Structure: 1'000-1'500 words, font 11pt,. As Word-Document or PDF. Guideline for Policy Briefs by the International Centre for Policy Advocacy: https://www.icpolicyadvocacy.org/sites/icpa/files/downloads/icpa_policy_briefs_essential_guide.pdf (especially chapter 4.1). Grading criteria are: Relevance (problem

defined, solution described, concerns addressed, next steps sketched), content correctness, quality of delivery (decision maker's perspective taken into account)

- *An Appendix to the policy brief documenting your small extension (not to exceed two additional pages, counts for 25% of total grading) The small extension on a topic chosen by you (either in the context of exercise 1 or 2) is evaluated based on relevance, content correctness, and the quality of your work. You will document it as an appendix to the briefing paper.*
- ~~For completeness, remember that the group presentation counts for 25% of total grading.~~