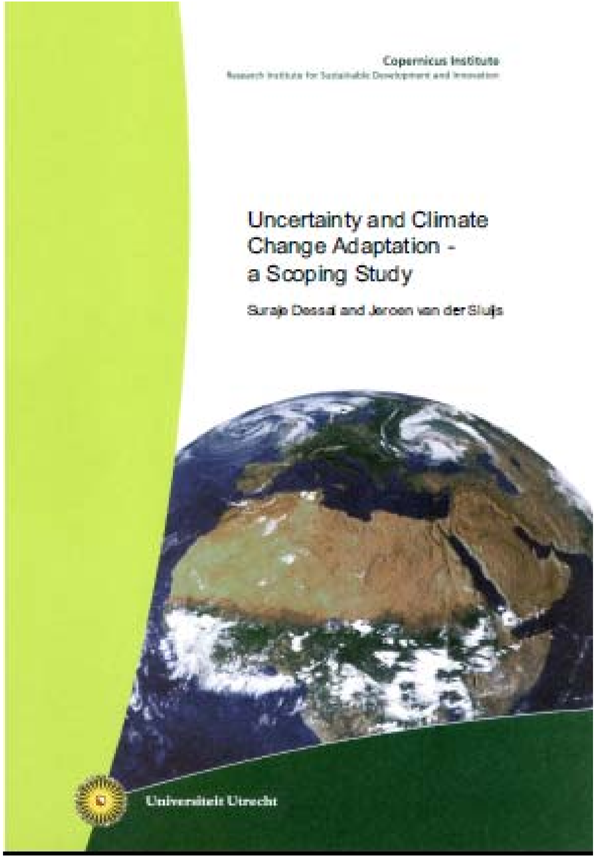
Download the full report: **http://www.nusap.net/downloads/reports/ucca_scoping_study.pdf**

Summary UU report "Uncertainty and Climate Change Adaptation"



When dealing with uncertainty regarding future states of the climate system, three types of uncertainty are important to consider: *statistical uncertainty* (possible outcomes and their probabilities are known), *scenario uncertainty* (a plausible range of possible outcomes can be established but the relative probabilities of each possible outcome are largely unknown) and *ignorance* (outcomes unknown: unanticipatable surprises).

The three types of uncertainty always exist simultaneously, but in each specific adaptation case their relative importance may differ. If there is no climate change, the most important uncertainty is the natural variability of the climate (statistical uncertainty). In that case, statistical uncertainty can be quantified as a probability density function and can be addressed in policy by a classic risk approach: an acceptable risk level is chosen, for instance the maximal allowable inundation probability of the urban area in the West of the Netherlands is set to once in 10000 year. Next, the tide that occurred historically with a frequency of once in 10000 years is chosen as design water-level for dimensioning the dikes and coastal defences. Along the same lines the bearing-strength for flat roofs of buildings to be prescribed in the building code can be based on historic data of frequency and amounts of peek snow fall and the drainage sewage system in a city can be dimensioned on frequency and intensity of past intense rainfall events to keep the risk of wet feet on an acceptable level.

However, when climate changes, the frequencies distributions in climate data from the past can no longer be used for guiding the decisions, because these frequencies will change as well. As a consequence we also need to address scenario uncertainty and ignorance. Future developments of the main drivers of climate change (economic growth and population growth) are inherently uncertain and highly unpredictable. These can only be explored using scenario's, but the frequentist probability of each scenario is fundamentally unknown. Further, our understanding of the climate system is incomplete and all kind of surprises and unforeseen responses of the climate system and unanticipated impacts may pop up (ignorance). The classic risk approach alone is then no longer adequate and needs to be complemented with approaches that can cope with scenario uncertainty (for instance a robustness approach) and ignorance (for instance a resilience based approach). **Understanding the relative importance of each of the three uncertainty types in a given adaptation case is crucial for the choice of a suitable policy strategy to address these uncertainties. This can be different for each particular adaptation problem.**

We can make a distinction between dealing with uncertainty in science and in policy making. On the one hand there are all kind of methods available to assess and map different types and sources of uncertainty in the knowledge (dealing with uncertainty in knowledge production). On the other hand there exist different strategies to take uncertainty on board in decision making and adaptation strategies (dealing with uncertainty in knowledge use).

Decision frameworks and analysis tools can roughly be grouped into two schools of thought: the **predictive top-down approach** and the **resilience bottom-up approach**. Some mixed approaches were also discussed. The difference between top down and bottom up is in the direction in which the causal chain is followed in the reasoning: **Top down** starts from the top by exploring the accumulation of uncertainty from each step going from emission scenarios, to carbon cycle response, to global climate response, to regional climate scenarios to produce a range of possible local impacts in order **to quantify what needs to be anticipated**. On the other hand, the **bottom up** resilience based approach starts at the other end of the causal chain: the impacted system, and explores how resilient or robust this system is to changes and variations in climate variables and how adaptation can **make the system less prone to uncertain and largely unpredictable variations and trends** in the climate. Resilience also means that the impacted system is adapted in such a way that its essential functions can recover more quickly after a shock and that restore times after damage and response time following early warning signals are made as fast as possible. Finally there are approaches that combine element of to down and bottom up approaches, such as the robustness approach, that seeks to make the system robust under all relevant uncertainties of all three types. That means that the system keeps performing within acceptable limits or can be restored within an acceptable time frame given the known climate variability, the range of relevant climate scenario's and with consideration of those conceivable surprises (wild cards) that one considers relevant for the adaptation problem at hand.

Roughly, the top down - prediction oriented approaches are strong in statistical uncertainty, can reasonably cope with scenario uncertainty and cannot handle ignorance. The resilience and robustness type of bottom up approaches are strong in coping with recognized ignorance and surprises. Without knowing what kind and magnitude of climate changes might impact the system at hand, one can still formulate reasonable policies to make the system less prone to possible changes. An essential first step in the selection of an appropriate decision making framework and appropriate methods for uncertainty analysis for a given climate adaptation decision making problem will thus be a well argued judgment on the policy-relevance of each of the three levels of uncertainty - along with a judgment of their relative importance - to the particular decision making problem at hand.

The various strategies and approaches to include uncertainty in adaptation policies ask for different sorts of uncertainty information and hence for different scientific methods to assess and map uncertainty in the knowledge. The top-down approaches require probabilistic estimates and (surprise free) scenarios. It uses Bayesian statistics and Monte Carlo analysis. The bottom-up approaches have a better match with qualitative uncertainty approaches (such as the NUSAP approach), participatory knowledge production and knowledge assessment and the use of wild cards and surprise scenario's (see table 5.2 of the report).

S. Dessai and J.P. van der Sluijs, 2007, *Uncertainty and Climate Change Adaptation - a Scoping Study*, report NWS-E-2007-198, Department of Science Technology and Society, Copernicus Institute, Utrecht University. 95 pp

The full report can be downloaded at:
http://www.nusap.net/downloads/reports/ucca_scoping_study.pdf
For more publications on dealing with uncertainty see:
http://www.nusap.net/guidance and http://www.jvds.nl