	Theme 3. Fresh water availability and access
SC 3.1	**Fresh water availability under drought conditions as a potential driver for water conflicts**
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Rapporteur	Carolien Caspers, Radboud University, the Netherlands
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Water security and climate change: an evolving research agenda
Declan Conway, London School of Economics, United Kingdom
The research agenda concerning the topics 'climate change (CC) water impacts' and 'CC water adaptation' has grown rapidly in number of papers from less than 50 up until 1990 to more than 500 per year nowadays. The adaptation publications have a time lag of 5 years; there is more focus on impacts than adaptation.
Several key papers have been published within the time range 1981 to 2012, that have led to an increase in, and change of, these research foci. An example of this is the 1986 paper by Gleick about the methodology of hydrological impact models. During the 2000s a diversification of research areas around CC and water took place into 5 broad topics, viz. downscaling; characterizing uncertainty; decision-making under uncertainty; institutional and policy contexts; and integrated assessments.
As expected, uncertainty remains a major topic, and will dominate the adaptation research. For example, characterizing more effectively the uncertainties, what the implications are of the uncertainties we are identifying and the need for decision making systems that can cope with the uncertainties.
Factoring in the influence of biological processes on the hydrological models sensitivity should be a future area of attention. Mainstreaming adaptation into water resources management is another one. Mainstreaming will likely still be driven by regulatory pressure of politics to factor climate risk into water resources management.
The last direction of the research agenda is the integration with multiple stressors and important cross-sectoral linkages with water and energy, water foot printing, irrigation and food production.

Regional headwater governance in Himalaya for water security in South Asia under climate change
Prakash Chandra, Tiwari Kumaun University, India
The Himalaya is a highly vulnerable mountain area, with many natural and anthropogenic vulnerabilities. Drivers of change, such as population growth, CC and urbanization, cause impacts both downstream and upstream, resulting in water resources stress. For example, Bangladesh is subject to many downstream hydrological impacts; it is dependent to the extent of 91 percent of its rivers waters from outside countries. Hydro-diplomacy between countries is not working well, with countries blaming each other. An important aspect is that countries do not exchange hydrological data with each other. There is political distrust between regions, leading the security issues in the area. Water is not simply a source of energy and drinking, it is a security issue as well and has to be considered as such.

Hotspots of climate change-enhanced conflict risks
Karen Meijer, Deltares, the Netherlands
This research project is a first exploration of water conflicts, aiming to answer two questions:
- What areas/countries are having the highest risk of conflicts as result of water scarcity and climate change.
- Understanding and identify measures, gaps and what can be done.

Literature shows different views and little consensus about the role of CC in conflicts between and within countries. Using statistical relationships of conflicts are not sufficient to find solutions. There are conflict risk indicators, but they are not water scarcity specific and when they are included, are only focused on extreme events and on the short term.

In this research maps are made using existing data from, inter alia, the World Bank. Despite lacking consensus, there are indicators identified in literature, but the exact weighting of them is not known.
Risk is a combination of hazard, vulnerability and exposure. For example, a flood event only poses risk if people live in that floodplain, impact is high if they are vulnerable, and not if there is, for instance, a warning system.
The chain goes as following: climate change leads to low water availability - water shortage - food insecurity - social inequality and instability. The exact thresholds going from, for example, social inequality to instability are not well known or no consensus exists.
For the simplified hazard map: water shortage (combine supply and demand).
Vulnerability: Four indicators were used, including governmental effectiveness. Based on the four indicators and their rankings, a map was prepared. Some African, middle-east and Asian countries show high vulnerability. The same goes for the exposure map: Four indicators were used, such as poverty and inequality and people working in agriculture. Many African and Asian countries display high risks.
This was combined with projections of increases in water shortage (CC and changes in water demand), and different scenarios were used in a tool that included a hydrological model.
The water shortage map only took countries into account that are already facing water shortage; these countries are highly vulnerable and are also affected by a future shortage effect. The final map shows some countries in sub-Saharan Africa that are at risk for conflict, due to societal reasons and expected water shortage.
The maps are aimed to help international decision makers where to focus with development aid.
Since it is a first attempt, improvements can be made on many fronts: data, other indicators for water shortage, how socio-economic scenarios translate into water use, using separate scenarios for CC and for socioeconomic scenarios, connecting models with global food production models, thresholds.

Using a novel climate – water conflict vulnerability index to capture double exposures in Lake Chad
Uche Okpara, University of Leeds, United Kingdom
Why a climate water conflict vulnerability index (CWCVI)? There is a lack of consensus how CC affects conflicts, because each individual location and conflict is different and collections of local data are often aggregated, which is not right way to go about this research. The CWCVI is location based, time- and context specific. It also captures the double exposure index, an embedded component of the index which highlights the exposure aspect of the index, and considers why there is unequal exposure in an environment where everyone is vulnerable.
Three steps were followed: 1. Identification on what is a vulnerable situation 2. Selection of indicator baskets and indicators via existing scientific knowledge. 3. Data collection, surveys and interviews.
Seven indicator baskets and individual elements were used to develop the index. The indicators have to be weighted.
The index was applied at Lake Chad, a lake that currently only is 1/5th of its original size in 1963 and is shared by 4 countries. Million(s) of people depend on the lake, mostly farmers and the changes have affected their daily occupations. Pastoralists are 'most vulnerable' in terms of the lake's water variability, livelihood strategies and social/political networks, while farmers are 'most vulnerable' in terms of water conflict and fishermen in terms of climate variability, physical/natural assets and socio-demographic profile.
An integrated vulnerability and double exposure triangle diagram illustrating the CWCVI and DEI for farming, fishing and pastoral livelihood groups was shown. Farmers may be more exposed to the double (combined) effects of climate variability and water conflict than other livelihood groups in a context where the CWCVI was highest for pastoralists, and the CWCVI and DEI for fishermen yielded similar values.