A Climate Information Services

Over the last 20 years it has become increasingly clear that climate change will have a severe impact on our environment as well as on water and food availability. Climate change impact assessments initially focused on "warning" the world about the potentially devastating impacts of climate change. The main aim of the impact studies was to stimulate and guide mitigation policies. Now it is clear that climate change is inevitable the development of adequate adaptation strategies is necessary. However, this development is hampered by the fact that much of the climate change data is not available, accessible, usable. Moreover, interpretation of the data is difficult for key stakeholders that need to implement climate change adaptation strategies.

To stimulate the use of climate data in adaptation projects and strategies, scientists within WIMEK started developing climate information services.

Research objectives and approach

The work on climate services within the WIMEK chair groups focus on two key research objectives. The first objective is to improve our general understanding by quantifying the impact of climate variability and climate change on water, food production and the (urban) environment. The second research objective focuses on how to communicate this information to a wider audience, and how to co-create actionable knowledge through the development of climate information services.

The development of the climate services within the WIMEK chair groups started with the development of modelling systems in which climate models were softly coupled with large scale hydrological and agricultural models (Supit et al. 2010a,b, Haddeland et al. 2010, Hagemann et al 2013). These multi

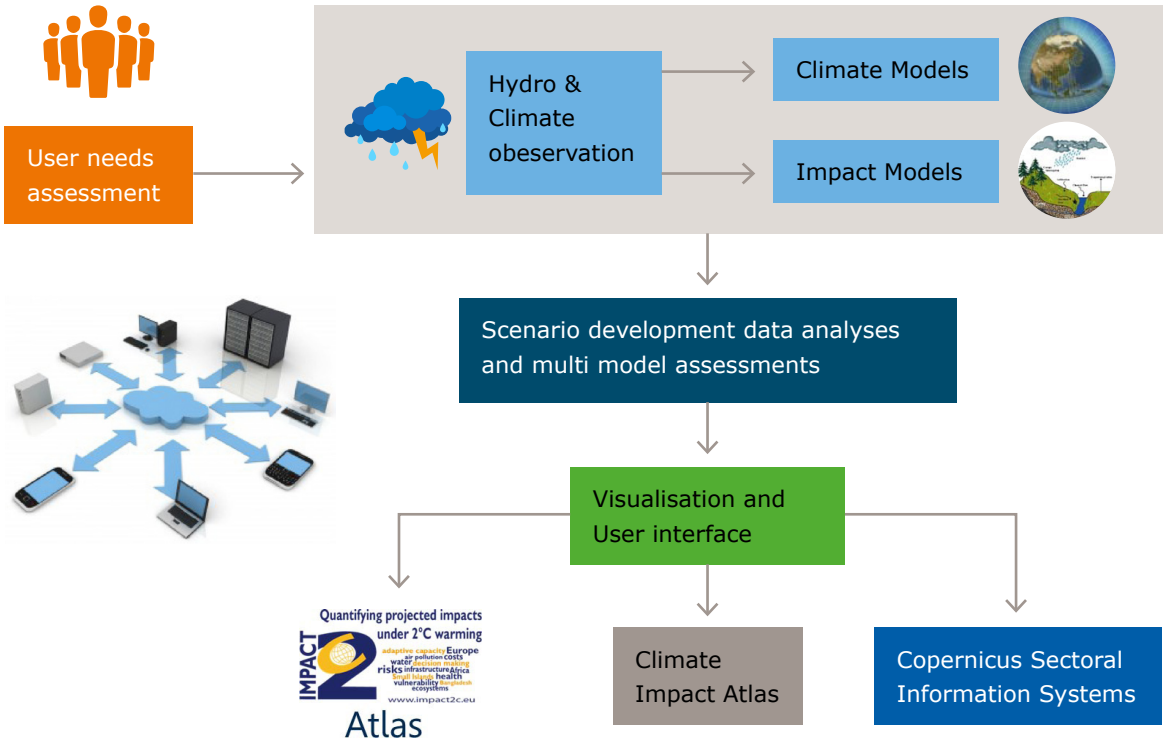

Figure 1. First generation climate information services. In this approach the focus is on improved knowledge and understanding of climate change impacts. Impact analyses, and the selection of scenarios and indicators are guided by assessment of the initial user demands. After this assessment, the team of scientists performs the impact analysis. Results are usually communicated through (assessment) reports, policy briefs, workshops and other outreach activities. Results are made available to the wider public through the development of (interactive) atlases.

climate and impact model approaches in WaterMip and ISIMIP resulted in a much better understanding of future climate change impacts. In a later stage we developed the first European climate services in the context of the EU projects Eclise, Impact2C and Euporias. Within these FP6 and FP7 projects we developed what we now call the first generation of climate services (figure 1). This first generation focused on the development of new data and modelling frameworks, and the integration of climate models, observations and impact models. These climate impact assessments and related climate services are developed within different groups involved in WIMEK. HWM and WRM focused on the development of hydrological models and drought assessments. MAQ on data collection, data integration, and meteorological model development, LAR on urban climate and ESA on environmental impacts. The WSG group has focused on developing a multi-model impact assessment framework, and on food, water quality and water quantity models. The AEW group studied how climate change may trigger different tipping points in the earth system, and to what extent climate change could result in irreversible changes in different (eco)systems.

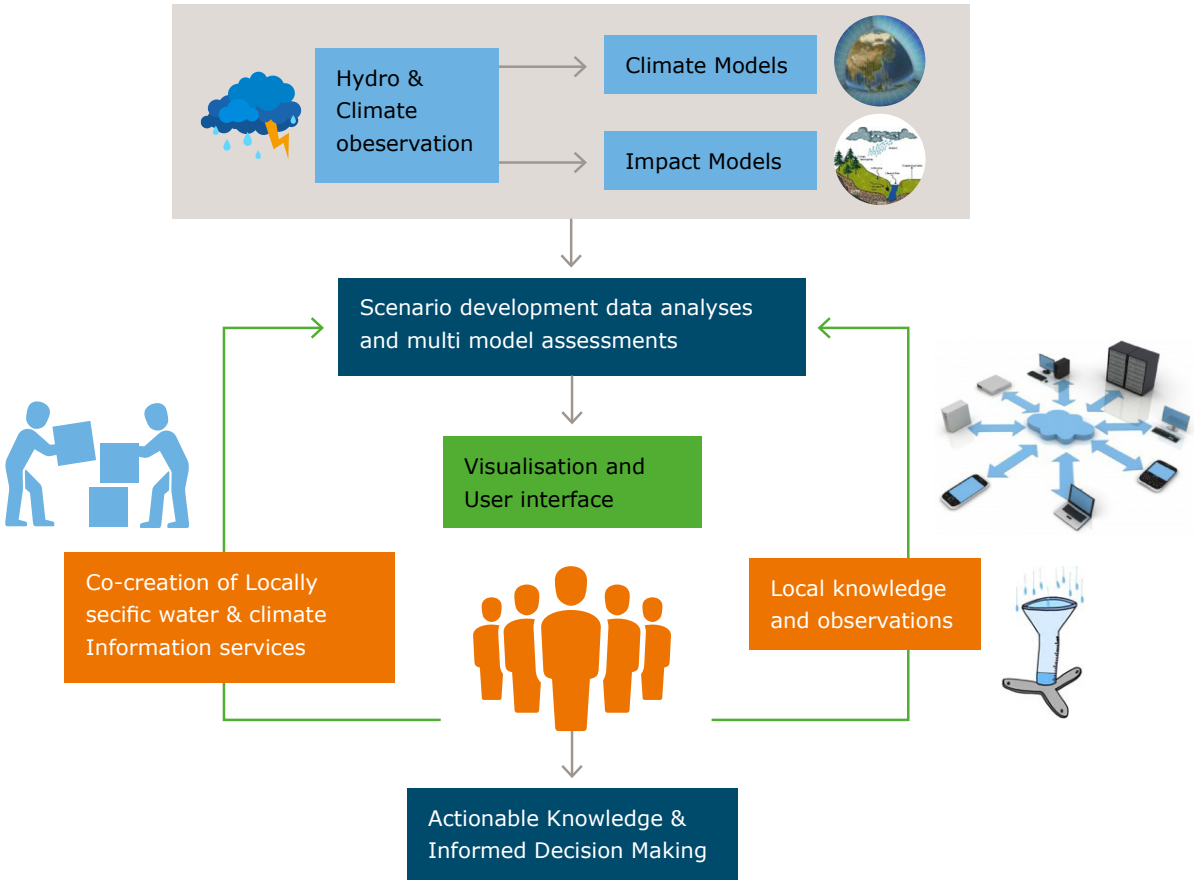

Figure 2. Second generation climate information services. In this approach the user has a central position. Together with users, information services are developed through co-production and co-learning approaches with the aim to develop actionable knowledge and information decision making.

These climate impacts assessments have generated a wealth of information and resulted in many high impact publications and a special PNAS issue. However, a first evaluation of the developed climate services indicated a number of limitations for the users. The information was too uncertain, not at the right spatial scale, projected too far into the future, and thus did not warrant immediate action. These limitations triggered us to develop a second generation of climate services. This new approach focusses on co-development and co-learning and puts the users central in the development of the climate services. This approach ensures more intensive interactions with the users and makes them partly responsible for the development of the products. This interactive approach has been used at local to global scale. Within the EVOCA and WaterApps project we have co-developed apps and other digital

communication services with local farmers in Ghana and Bangladesh. These services focussed on the integration of local, indigenous knowledge with global scientific knowledge on climate and weather to develop services which aimed at improved agricultural production. Seasonal and long-term weather forecasts help the farmers to prepare for extreme events. At regional and global scales, climate information systems have been developed for the water, agriculture and tourism sectors. Together with users it was studied how the Copernicus Climate Change Service can be improved to develop tailored products in the different sectors. We developed a global data and modelling platform in combination with novel visualization tools to make the climate data usable to key users in the public and private sectors. These new approaches require more intensive collaboration between biophysical and social scientist and the co-creation projects include not only the ESA and WSG groups, but also the ENP and PAP groups.

Involvement of stakeholders, users and partners

From the beginning, development of the climate information services has been in collaboration with a range of partners and end users. Our regional and global scale information services focus on informing policy makers from national government, the EU and international organizations (IPCC, UNDP, FAO, WMO and WHO) and river basin management authorities. Over the last 5 years our focus has shifted from top-down approaches guided by stakeholder consultation, to a co-production and co-learning approach in which the services are developed with and for the targeted users. These targeted users still include policy makers but in addition we also started to work with local water boards, farmers, consultancy companies, NGOs, foundations and the private sector. This work is funded by a large range of organizations, including NWO, Copernicus Climate Change Services, INREF, EU, Rabobank, and JPI, NUFFIC, Ministry of Foreign Affairs. Finally, it is important to acknowledge the importance of working with a wide range of partners. In terms of research partners, we work with universities across the world, with meteorological organizations such as KNMI, SMHI, ECMWF, Ghana Met Office, and the CCAFS program of CGIAR. Within Wageningen UR, Wageningen Environmental Research (WEnR) is a very important partner and many climate service projects are run together with WEnR.

Impact

The work of WIMEK has had clear scientific and societal impacts. In terms of science the work has resulted in a large number of papers in prestigious journals and many of these papers are highly cited. The work is also highly valued by research funders showing the large number of research grants supporting this work. In terms of societal impacts, our work has informed national, international (EU/UN) and regional policymakers. We have contributed to the IPCC and a range of other policy relevant documents on climate change services, impacts and adaptation. In addition, the climate services have helped local government, businesses (for example Thomas Cook, De Heus, Heineken, PGM pension fund), and local farmers to better manage their climate risks and adapt to future climate change. For example, our climate services developed in Bangladesh gave farmers access and trust in longer term forecasts of cyclones. During interviews the farmers indicated that they used the 7-day cyclone warning to inform relatives about the predicted emergency. In response, the population started to repair households and livestock sheds, cutting of tree branches above their roofs, and did not allow livestock to graze in open field. They also collected additional fodder for their cows, and bought emergency household supplies to prepare for the cyclone. Many farmers indicated that the (financial) damage of the cyclone was much lower because of the longer preparation time they had as a result of the developed weather and climate service.

Link to education and capacity building

Our research on climate information services is well linked to our education. In terms of Bachelor and Master Education he main links are with the Masters Climate Studies and Master Earth and Environment and the BSc minor climate change mitigation & adaptation. The concepts and techniques of tailoring climate data, developing climate services and stakeholder and user interaction are discussed in a number of courses. Often the cases from our research projects are used in our BSc and MSc education. In addition in many of our projects most of the research is done by MSc and PhD students. In our projects in Africa and Asia, we work with local universities and educate PhD students from the region. However, we do not only educate our students. The development of climate services is very often embedded within co-learning and co-creation processes. Results of our projects have shown that by being closely involved in developing and testing of the services the envisioned users of our services go through a learning process which is essential to trusting and appropriately using the services for decision making. Finally, together with Wageningen Environmental Research and Wageningen academy,

a user learning services (ULS) platform was developed for Copernicus Climate Change Services (C3S). In addition, 28 different training events in almost all EU countries were organised to train professionals in using the C3S climate data store and the associated toolbox for developing tailor made climate services.

Key Publications

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Gbangou, T., E. Van Slobbe, F. Ludwig, G. Kranjac-Berisavljevic, and S. Paparrizos. 2021. Harnessing Local Forecasting Knowledge on Weather and Climate in Ghana: Documentation, Skills, and Integration with Scientific Forecasting Knowledge. Weather, Climate, and Society 13:23-37.

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