

## **Grand Challenge on Water for Food Baskets of the World**

### **1. Highlights for JSC**

The general structure of the grand challenge was developed last year. It hinges on a good understanding of the water cycle of the large food growing areas of the world in their natural state and the pressures they are subjected to by human activities. In particular the contribution of slower water reservoirs like groundwater, high mountain snow and glaciers requires more attention. The following structure was selected to organise the various activities under-way and identify more easily the needs and opportunities.

#### **a) Human needs have restructured the landscapes and controlled water flows.**

Over the last two centuries humans have modified their environment in significant ways to better exploit natural resources. Understanding how the natural processes of the continental water cycle were affected by these human activities in the food baskets of the world should be the first element in our effort to evaluate the feedbacks triggered and the change in the sensitivity of the continental surface to climate fluctuations. With the help of regional studies over large agricultural areas (RHPs in GEWEX terminology) the evolution of the human intervention needs to be quantified and in particular how the water fluxes and stores have changed since the area have been used for large scale food production. The knowledge gained on these issues needs to be transferred to land surface models and lead to a convergence with their hydrological and agronomic counterparts.

#### **b) Feedbacks of human land and water use on climate.**

Changes in the landscape and water usage have modified the structure of the planetary boundary layer, the sensitivity of the surface to extreme events and probably also coastal processes. The slower components of the continental water cycle, like ground water, have also been significantly affected over the last century by human processes. The knowledge on the feedback and sensitivity changes in these areas of high anthropogenic pressure will be consolidated with dedicated field campaigns and high resolution modelling. The modelling efforts needs to go hand in hand with improvement in the representation of human processes in the land surface components of regional Earth system models.

#### **c) Climate change: Modification of the resources and of the resilience of land surfaces under anthropogenic pressures.**

With the knowledge gained on the impact of land management and its interactions with the atmosphere we will be able to address some of the most important questions of the impact of climate change on food production and continental water cycle. We need to better evaluate how rainfall and evaporation changes will affect water resources, the impact of changing extreme events and the dwindling snow and glacier reserves. Agronomic and industrial infrastructures have been optimized for past states of the water cycle, can they cope with future needs and resources? WCRP also needs to help other organisations to evaluate how transferable their existing hydrological and agronomic expertise is in a changed climate.

#### **d) Combined land & water use and climate change impact on air & water quality.**

Climate change in agricultural regions can have consequences on atmospheric chemistry and affect air quality in nearby cities or the biochemical processes in lakes and coastal oceans. In a warmer climate agricultural practises and usage of fertilizers and other inputs will affect air and water quality differently than today. The higher temperatures will modify biological processes and ecological balances. Thus climate change could push environmental impacts of human activities to unacceptable levels.

### **e) Strategy and overall arguments**

Gathering our understanding of these processes and interactions available in various disciplines will help WCRP better separate in the geophysical records the changes attributable to human use of the environment from climate change. This knowledge will also allow to measure the impact of future climate change on the scale of past man made changes.

Moving from a vision where human activities are impacted by climate to one where human processes and climate change are analysed together will make WCRP science more relevant for society. It will require a re-evaluation of the observational network and the integration of human processes in regional Earth system models. In this grand challenge we aim to achieve this together with the organisations representing hydrological and agronomic sciences.

What we hope to produce in this Grand Challenge?

- Create in one of GEWEX's RHP a demonstrator of the interactions mentioned above and develop more integrated approaches together with other scientific disciplines. Not all these processes will be active in every region and thus the selection of RHPs should try to cover this diversity.
- Encourage "beautiful science" by identifying some critical issues and promoting them to the community.
- Break down barriers to other sciences (agronomy and hydrology but also economy).
- Communicate with the community through publications that human usage of natural resources affects and is affected by climatic processes

### **2. Early success and/or planned activities in 2017/2018**

- [GEWEX Convection-Permitting Climate Modeling Workshop](#) (Boulder, Sep. 2016).
- [Workshop on including human processes in land surface models](#) (Gif-sur-Yvette, Sep. 2016).
- Meeting with WMO hydrological forecasting unit and WMO Agronomic application units.

### **3. Partners for GC implementation (within and outside WCRP community)**

- All Core Projects of WCRP
- FutureEarth
- Involve more the hydrological and agronomic sciences.

### **4. Overall GC timeline**

- In 2017 prepare a document on the strategy of grand challenge.
- Work with GEWEX to encourage more regional hydro-climatological projects in food baskets of the world.
- The OSC (April 2018) will be the nearest major milestone to review achievements so far, and revise key scientific questions and timeline where appropriate.

### **5. Issues and challenges**

- Raise interest in CLIVAR for coastal processes.
  - Explore collaborations with SPARC on land use and air quality.
  - Encourage observations and modelling efforts of human processes.
  - The lack of funding to organise workshops and invite key people to this new vision of climate in the food baskets of the world will limit the impact.
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