# Title for project

Including Water Management in large scale models

# Proposers/Contacts

Primary proposers: Richard Harding and Ali Nazemi

Advisory Group: Richard Harding, Howard Wheater. Taikan Oki, Ruby Leung, Jan Polcher, Eric Wood ….

# Motivation

*This section should provide the scientific rationale/motivation for the project, along with relevant institutional context. It should answer questions like: Why is this project important scientifically and to GHP? How does this project build on past studies/knowledge and take advantage of expertise and observations supported by GEWEX/GHP? What will this project contribute to the field and the GHP community if successful? How will this project contribute to the GEWEX Science Questions?*

The majority of the world’s rivers are heavily managed; primarily for water extraction, flood control and, where feasible, to maintain minimum flows for the health of the river. A recent modeling study showed the flow in many rivers is reduced by upto 30% by man’s activities. Impoundments also change fundamentally the seasonality and extremes in the flow. Most water extraction is for crop irrigation, either directly from rivers and impoundments or from groundwater. Extraction from groundwater will often have important consequences to river flows downstream. Much of the irrigation water is lost to the freshwater system through evaporation and this may have important impacts on regional climate. Reduced and modified river flows will also impact on the sediment dynamics in deltas and the salinity and temperature in coastal seas.

Increasing need for food and increasing use of water for domestic and industrial use will put substantial strains on water resources in many basins. Added to these strains is climate change, which is likely to reduce water availability in semi-arid regions and increase the likelihood of droughts and floods. To understand these changes we need better models of the terrestrial water cycle coupled to climate and resource allocation models.

Historically models of the global water and energy cycles have not included the impact of river management and extractions. However as the complexity, resolution and realism of climate and Earth systems models increases and, as these models are able to focus on regions as well as globally, it becomes increasingly practical and important to include the impacts of man’s activities on the freshwater cycle. In addition to provide simulations which are of relevance to policy makers and resource engineers it is imperative to provide analyses which include current and future management activities.

Nearly every major research basin has a number of operational and research models, which include water management. By their nature these models are diverse and generally specifically tailored to a particular basin. They do, however, embody a wealth of data and expertise on the management of rivers. At the other end of the spectrum a number of global hydrology models have simple representations of management, such impoundments and extraction, although it is true to say that development of these models are in their infancy. There is undoubtedly much to be gained in bringing together water scientists from different backgrounds to share ideas, algorithms and data to improve water resource models at all scales. GHP is well placed to co-ordinate this activity primarily through its RHPs. The most of the RHPs have a component covering water management and resources and have strong links to stakeholders within their study areas.

This crosscut specifically contributes to GEWEX question 2: Global Water Resource Systems: *how do changes in land surface and hydrology influence past and future changes in water availability and security?*

# Principal research questions to be addressed

*This section should contain the principle research questions that embody the aims/objectives of this project. It should distill the science focus in a clear and concise fashion.*

The project will aim to improve the scientific basis of the description of water management in global and regional freshwater models, suitable for coupling to climate models. The project will address issues of appropriate scale and complexity required for global and regional models. It will identify global and regional data needs for large scale water resource models, such as on water demand, operating rules etc, and, finally, it will provide a forum between climate scientists, hydrologists and water resource scientists to provide improved analyses of current and future freshwater supply and demand.

# Data requirements

*What observational or model data will be required to address the research questions? What data will be needed and how will they be obtained (open repositories, direct contact …) ? Of these data, which are available through accessible data repositories (e.g. satellite data, CORDEX)? And which need to be sourced through local or regional institutions/contacts? How will the RHPs contribute?*

An important task of this crosscut will be to review available global data sets (for example of irrigated area, dams etc) and identify the data requirements of a next generation of linked water management models. GHPs links to the RHPs will play an important role in identifying the availability of data regionally.

# Project methodology

*This section should present the proposed experiment design and analysis techniques. It could include information on data quality control, required model simulations, and data analysis to be performed. The experiment and data analysis should be connected to the research questions above. Enough detail should be included to foster discussion of the most appropriate techniques or potentially the requirement for development of new techniques.*

The project will review and co-ordinate the parameterisations of water management in global hydrology models, focussing initially on reservoirs and irrigation. It will also consider the inclusion of water management in land surface schemes , co-ordinating with GLASS and iLEAPS. Extensions in future cross-cuts could include representation of groundwater resources, and a more general approach to representation of anthropogenic effects, including land management.

# Collaboration Mechanisms

How will scientists collaborate in this project and interact with other GHP groups? Is there a need of collaboration with other GEWEX panels or WCRP groups? If so, what mechanisms are foreseen? Will there be a website? Email list? Workshops? Is there a plan for an initial workshop? When? Where?

The crosscut will develop a network of interested scientists from across GEWEX consisting initially of the Advisory group, representatives from the RHPs and relevant modelling experts. Two review papers by Nazemi and Wheater on current practice of modelling human influences on the water cycle have been prepared as a precursor to this initiative. We will use these papers as the basis of a Workshop, which will include a wider participation, in Autumn of 2015, to define and coordinate a programme of research. This programme will aim to review and intercompare modelling schemes and define future data needs, where possible in conjunction with RHPs. Out of this we plan a paper or special issue. Beyond this we might consider a wider engagement with water resource practitioners and water policy experts. We also propose the development of a website to provide a unified forum for data and algorithm sharing and disseminating the simulation results.

The cross cut will need to interact with other GEWEX projects (GLASS and GDAP). At some point it will need to also interact with CLIVAR – to investigate further how managed rivers interact with the ocean. We will also need to work with other international groups, IGBP, GWSP, ISI-MIP, WMO etc.