Developing climate services for water resources assessment

Background

Water is recognized as the main vector through which climate change will impact upon many different sectors. The need for water specific climate services has been identified as a priority by key stakeholders. This challenge is being taken up by four different "communities" – operations, research, service providers and users – and as result a number of parallel initiatives are developing.

Firstly, the World Meteorological Organization (WMO), and its partner organizations are developing a new Global Framework for Climate Services (GFCS) with the goal to:

> ***"Enable better management of the risks of climate variability and change and adaptation to climate change at all levels, through development and incorporation of science-based climate information and prediction into planning, policy and practice."*** [1]

This is targeted at addressing the need for improved climate information and to provide an effective interface between scientists, service providers and decision-makers. The scope of the WMO initiated Global Framework, is strongly oriented towards operational issues, and with less attention on the science required to support comprehensive climate predictions and impact assessments. This is particularly lacking in terms of linking climate forecasts to hydrological models and reducing uncertainties in water resource outlooks.

Secondly, the science community, through WCRP-GEWEX, IGBP and other fora, has identified the need for water specific climate services. At the Pan-GEWEX Meeting in October 2010, the GEWEX set out its Draft Imperatives for post 2013[2], outlining its science priorities for 2013-2023. At this meeting GEWEX-GWSP communities identified the need for the science to support development of seasonal hydrological forecasts. An action was agreed to prepare a white paper on the feasibility of an annual report on the state of the world's water[3]. This represents only one timescale of hydrological outlook. The GEWEX Post 2013 Imperatives reflect the science "push" supporting the development of specifically hydrological climate services. The GEWEX Imperatives focus upon scientific gaps, but are weaker in defining the mechanism for making this science operational and in terms of defining outputs of relevance to the wider community.

Thirdly, the Earth Observation community include delivery of water specific services among the wider GEO contribution towards climate services – reflecting a service "push". At the GEO User Engagement Session in November 2010 the Integrated Global Water Cycle Observation (IGWCO) Community of Practice outlined its target to: "produce by 2015, comprehensive sets of data, and information products and services to support decision-making for efficient management of the world's water resources, based upon coordinated, sustained observations of the water cycle on multiple scales"[4]. Again, this represents only one

[1] http://www.wmo.int/pages/gfcs/documents/GFCS_Position_Paper_DRAFT_REV_1_en_1.pdf

[2] www.gewex.org/2010pangewex/Draft_Imperatives.pdf

[3] http://www.gewex.org/2010pangewex/GEWEX_GWSP_Notes.pdf

[4] http://www.earthobservations.org/documents/committees/uic/201011_UES/26_RLawford_IGWCO.pdf

aspect of the many space and timescales required of hydrological outlooks focussing on assessment of the 'current' hydrological status. The GEO community are strongly focussed on technological development and on seeking greater use of EO products, and in particular of monitoring, near real-time data and information on the status of the global water cycle. This community is not primarily concerned about the science required to improve understanding of Earth System processes and the use of this science to develop better models to represent past, current and future hydrological regimes. The GEO community are not well integrated with hydrological policymakers, regulators or operators.

Fourthly, the diverse user community comprising policymakers, industry, citizens and researchers, are aware of the developing capacities in climate sciences and have been demanding improved information and access to more reliable water specific information about the impacts of climate change. This demand side "pull" is focussed upon the need for increasingly fine spatial and temporal resolution impact assessments, and particularly in seasonal, inter-annual and decadal forecasts. One of the greatest scientific challenges of the current age is to develop more reliable climate forecasts at these time and spatial scales, to put these into a regional hydrology/water resources framework and more importantly to effectively communicate the uncertainty of these forecasts to user communities that only wants simple answers.

These outcomes will extend beyond water sciences, and will enhance wider multi-disciplinary integration and improve dialogue between researchers and users involved in other sectors supported by the WMO and national climate services systems (Fig 4).

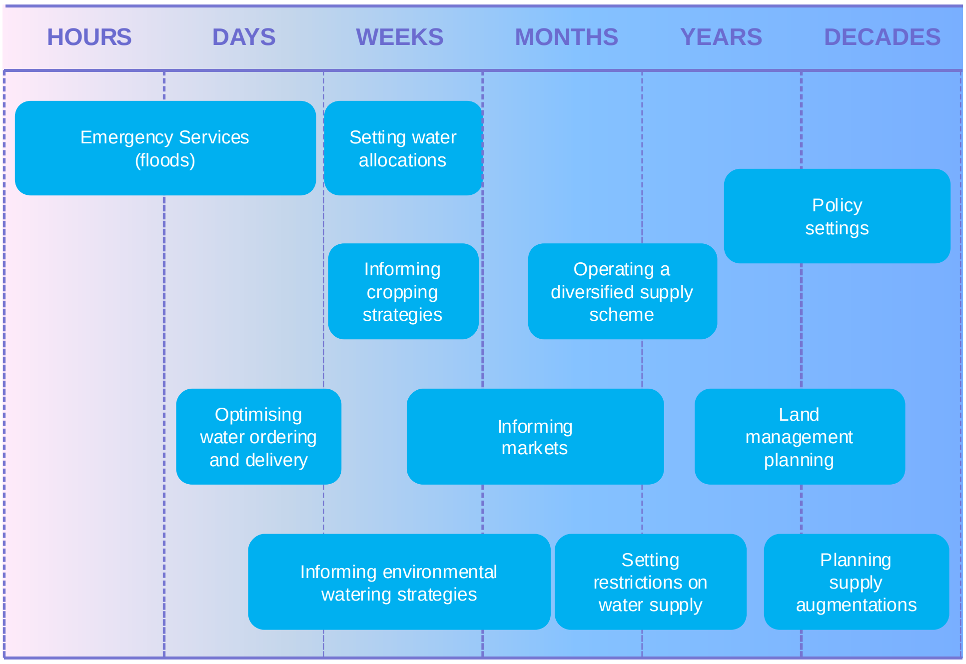

Figure 4 : Types of decisions that can be informed by Hydrological Outlooks

In addition, there is a need to focus on issues of standardization, exchange and quality assurance of information and communicating the highest quality information, products and services possible to decision-makers from global to local scales. Through enhanced international cooperation for development and transfer of technology related to meteorological and hydrological services and mobilization of resources, build capacity among national and regional meteorological and hydrological service providers.

A significant scientific challenge in water resources management is to develop more reliable forecasts of water resources, relevant at a range of timescales and at spatial scales of river basins to the whole globe. An assessment of the uncertainties in such forecasts is a clear requirement if the outputs are to be used in operational regional hydrology/water resources frameworks.

WMO GFCS – bringing existing services to users but recognising there are gaps in science. No clear way of how to do this for hydrology. The scope of the WMO initiated Global Framework, is strongly oriented towards operational issues, with less attention on the science required to support comprehensive climate predictions and impact assessments. This is particularly lacking in terms of linking climate forecasts to hydrological models and reducing uncertainties in water resource outlooks.

Climate Services: The following need to be developed.

1. What hydrologic information is available at regional to global scales for monitoring hydrologic states and water resource inventories, and how can they be best used in providing climate services?

2. What is the skill offered by seasonal climate prediction models that can be utilized in seasonal hydrological forecasting? Can multi-model systems (such as the EUROSIP suite of models – UKMO, ECMWF, MF) enhance the skill from a single model?

3. How can climate change projections be used by the water resources community for decisions regarding water infrastructure design, water related risk assessment for current infrastructure (reservoirs, water supply systems, etc.) and climate change adaptation strategies? What are the projections of the relative effects of various global change projections (climate, population, land use land cover, energy needs, etc.).

4. How can the uncertainty in the above monitoring, forecasting and projection products be best estimated and conveyed to operational users of the products?

Outcomes

Science strengthened across all three of these would help directly in scoping out the GFCS initiative. In particular, they would help define the boundaries of the current capabilities to deliver useful service products.

1. Established international network in hydrological climate services with UK in a leading role

2. Strategic research agenda for hydrological climate services supported and maintained beyond the timeframe of this project through the WMO

3. Established framework for integrating water science community with operational bodies and GMES community

Global	Not currently possible. Future - soil moisture (5yrs?)	Japanese system?	Not currently possible	Outputs available but clarity on uncertainty?
Continental	Europe could be achieved (2yrs?). Africa (10yrs?)	Europe – available through EFAS. Africa ?	Pre-Operational in Europe through EDFS	Outputs available but clarity on uncertainty?
National	Operational in many countries	Operational in many countries eg. UK, Pakistan, etc.	Pre-operational in some countries eg. Australia, US	Operational in UK through UKCP09 (?)
Basin	Operational in many basins across the world	Operational in many basins across the world		Many scientific studies – operational in European basins through WFD?
	Nowcast (Current status)	0 – 5 Days (Flood forecasting)	2 – 3 months (seasonal forecasting)	20 – 50 years (climate and population changes)