

WRA Bulletin 36

November 2013

Climate Change

The issue of climate change has become a key drive for water resources and hydrology in recent years. This bulletin highlights how it has become an integral part of the expertise offered by WRA. As early as 1981, more than a decade before the formation of WRA, one of our principles, whilst working on a linear programming model of Libyan agriculture, was involved in discussion on whether to consider the greenhouse effect. At that time it was decided there was insufficient quantitative information to consider it in a meaningful way so it was taken no further. It did however provide an early indication of something which could be of relevance in the future.

In 1999 WRA carried out a study of climate change impact on the rivers Trent, Severn and Wye for Severn-Trent Water. HYSIM had already been calibrated to all these rivers and the model was run with projected changes to temperature and precipitation provided by the Hadley centre. The temperature projections were used to calculate changes to potential evaporation (PET). This early study presented some of the problems which arose in later studies. Is it valid to assume that temperature is the only one of the four variable needed to calculate PET that will change? It was concluded it was valid. Firstly it is implicitly assumed in climate change projections that temperature and water vapour will increase 'in step' and relative humidity will remain constant. The other two parameters, wind speed and solar radiation, are relatively minor. Another problem which was tackled was that of downscaling, particularly problematic for precipitation which has greater spatial variability than temperature.

In 2002 WRA examined the impact of climate change on flood risk for a coastal power station at Immingham. It soon became apparent the major potential risk was from sea level increase and projected values of these were used to estimate the potential future flooding danger.

In 2009 two of our principles set up the web site www.climatedata.info. This web site gives background on key aspects of climate change. It also demonstrates the ability of WRA to approach climate change studies in full awareness of the applicability and accuracy of climate projections and the data and models on which they are based.

The first WRA study of climate change outside of the UK was on the Yesilirmak basin in Turkey in 2009.

The basin is heavily developed with many reservoirs. The monthly version of HYSIM was calibrated to the basin. The main finding of the study was that projected climate change is likely to increase winter runoff due to reduced snow fall in winter. A consequence of this is that flows at the start of the irrigation season will be lower and extra reservoir storage would be required to compensate.

In 2010 WRA worked for United Nations Food and Agriculture Organisation on the great lakes of Africa (Victoria, Tanganyika and Malawi). Lake surface temperature data were available but with gaps due to cloud cover. A method of infilling these data was developed. The complete lake surface temperature data were then used with observations of climate at lakeside stations and climate projections to estimate the likely change in lake temperatures.

In 2010 and 2011 WRA carried out two other projects in Africa examining the impact of climate change. The first of these was on tributaries of the Shire River in Malawi. Here it was found that a major impact was in the duration the drought season. In the case of the Kagera basin the conclusion was that the increase in precipitation would be larger than the increased evaporation due to rising temperature and that overall runoff would increase.



River Tajo, Almoural, Portugal

In 2012/13 climate change impact studies moved into two new geographical areas: Southern Europe and South-East Asia. In Southern Europe a detailed study of the impact of climate change on the Tagus basin in Spain and Portugal was carried out. HYSIM was calibrated to 4 sub-basins in Spain and 11 in Portugal (the main focus of the study). The study used projections from 3 climate scenarios: A1B, A2 and B1.

The basin is heavily developed both in Spain and Portugal with 11 of the dams being larger than Kielder Reservoir (the largest in the UK). It was found that the impact of development had been larger in almost all sub-basins than that of projected climate change.

WRA assists the UK Environment Agency with the National Water Climate Impacts Card

Climate change is expected to modify rainfall, temperatures and catchment hydrological responses across the world, and adapting to these water-related changes is a pressing challenge. Paul Whitehead and Andy Wade have worked with the UK Environment Agency, DEFRA and LWEC to develop a Water Climate Impacts Card for UK Rivers, lakes and Catchments. This card reviews the impact of climate change on water in the UK and looks at projections of future change. The natural variability of the UK climate makes change hard to detect; only historical increases in air temperature can be attributed to climate change, but over the last fifty years more winter rainfall has been falling in intense events. Future changes in rainfall and evapotranspiration could lead to changed flow regimes and impacts on water quality, aquatic ecosystems and the water available for use by people. Summer flows may decrease on average, but floods may become larger and more frequent. Water quality may decline as a result of higher water temperatures, lower river flows and increased algal blooms.

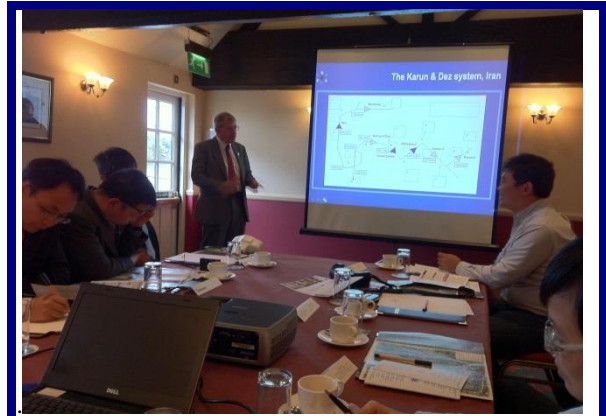


Details of the card are given at <http://www.lwec.org.uk/resources/report-cards/water> and a paper on the water quality and ecology aspects has been published by Paul and others:

P.G.Whitehead, R.L.Wilby, R.W.Battarbee, M.Kernan & A.J.Wade (2009) A review of the potential impacts of climate change on surface water quality, *Hydrological Sciences Journal*, 54:1, 101-123,

DOI: 10.1623/hysj.54.1.101. To link to this article: <http://dx.doi.org/10.1623/hysj.54.1.101>

WRA Partner/Associate News



Frank Farquharson presenting to the Shanghai –NERC delegation

On 24th September, WRA hosted a visit by a delegation of scientists from Shanghai. The visitors were from the National Engineering Research Centre which undertakes strategic research in water resources for Shanghai. The visit to the UK was aimed at building on the long history of involvement of British expertise in Shanghai ever since the first British built water treatment works was opened 130 years ago. Frank Farquharson, Paul Holmes, and Harvey Rodda gave presentations covering a range of WRA projects and expertise.

Next WRA Board Meeting

10th January 2014, Blewbury

The WRA Bulletin is a quarterly publication, and relies on contributions submitted by Directors, Associates and Consultants. The document is circulated by email, and published on the WRA web-site, aiming to keep the WRA network, up-to-date with respect to current activities. Please email contributions for future issues to Harvey Rodda: harvey@watres.com

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