WRA Bulletin 46

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OVERSEAS WORK

Mekong River Basin

Modelling Flow and Water Quality in the Mekong: Predicting impacts of Environmental and Climate Change on Delta Inputs

As part of a new project established by the University of Southampton, Paul Whitehead is heading a WRA team to assess impacts of environmental change on the Mekong River system. Our role is to understand how the upstream Mekong catchment impacts the downstream delta, and in order to achieve this, we have undertaken an integrated catchment modelling study. Flows and water quality will vary in the future in the catchment driven by changes in agriculture, land use, deforestation, population increase, atmospheric pollution and climate. So how can we predict these changes and is that at all possible?

Figure 1 The complete Mekong Basin, showing the 24 reaches and sub-catchments used in the INCA Model

Over the past 40 years there have been big advances in our understanding of how flow and water quality (eg nitrate, ammonia, phosphorus and sediments) intereract. Mathematical models have been developed that capture the key processes and hydrological dynamics and the necessary calculations can be executed rapidly on laptop computers. The Integrated Catchment Model (INCA) is one such model and we have applied this model to the whole of the Mekong basin, from the headwaters in China down to the delta in Vietnam (Figure 1). To facilitate this, Ron Manley made an important contribution by supplying observed flows and climate data from locations throughout the basin, as well as climate change projections, and flows simulated by the HYSIM model for comparison.

The INCA model generates daily river flows and water quality concentrations at different locations along the river, taking into account the land use and flows from all the subcatchments along the river. Different versions of INCA exist for modelling flow, nutrients (N and P), sediments, carbon, metals, organics etc., but in the current project we are using the INCA N and INCA P/SED versions of the model. Both models have been set up and calibrated against the observed flow and water quality data (Figure 2).

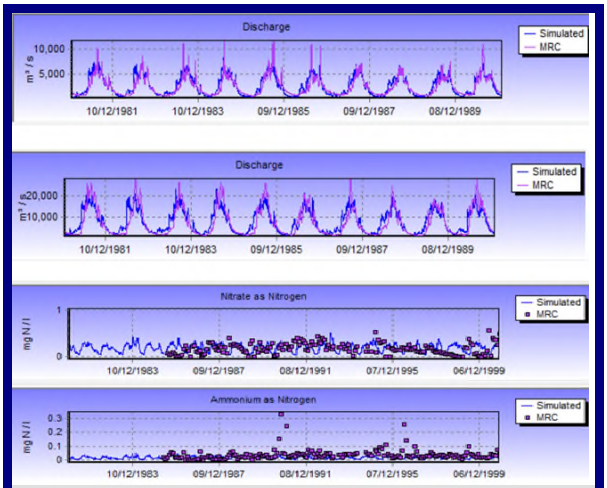

Figure 2 Simulated and observed flows shown for China and Thailand respectively, followed by simulated and observed nitrate and ammonia for Cambodia.

An excellent fit to the observed flow data has been obtained at several locations down the river system, and the fit to the nitrate and ammonia data is also good. We need to further calibrate the model, but once set up we can use the model to simulate impacts of climate and environmental change. Figure 3 shows an

example of this, assuming an increased intensification of agriculture practice upstream of Vietnam. This indicates significant increases in the concentrations of nitrate and ammonia, which would enhance eutrophication downstream, and would increase the flux of nutrients into the delta. In the project we will simulate changes in climate and land use impacts and make the data available to modellers simulating the delta system, as well as other stakeholders.

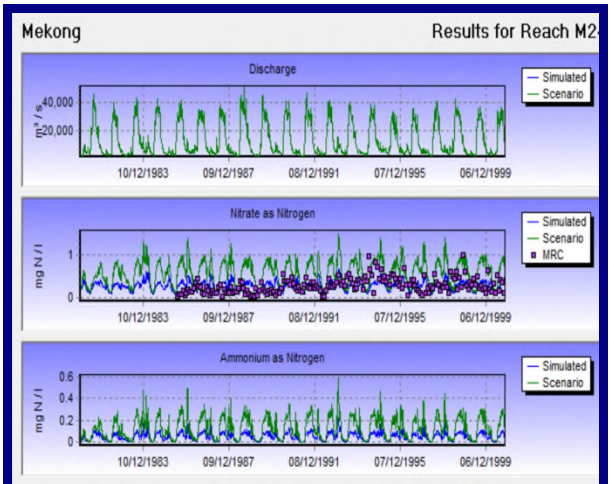

Figure 3 The simulated flows, and respective nitrate and ammonia concentrations (assuming a 30% increase in intensive agriculture practice upstream of Vietnam), which indicate likely changes to water quality at the delta.

UK WORK

Modelling the Severn-Thames Water Transfer

As part of the NERC MaRIUS project on Managing the Risks, Impacts and Uncertainties of Droughts (www.mariusdroughtproject.org), Paul Whitehead has undertaken research on modelling water quality. The study was concerned with the potential impacts of Dissolved Organic Carbon (DOC) pollution in the River Thames arising from transfers of water from the downstream reaches of the River Severn.

One of several water resource options being considered by Thames Water to ease water stress in the south east is to supply water from the River Severn across the Cotswold Hills into the Upper Thames (Figure 4). A potential issue is that of water quality, as the Severn river has different chemical characteristics to those of the Upper Thames catchment. Rising trends in DOC at Plynlimon in the upper Severn could create problems if water with high DOC is transferred across into the Thames, thereby affecting water supplies drawn from intakes located further downstream.

The INCA Carbon model has been set up for the Severn and Thames river systems, and a set of water transfer scenarios evaluated. It was concluded that, for most of the time, the transfers would be safe but occasionally an intense summer storm in the Severn could flush high rates of DOC down this river, that subsequently could be transferred across to the Thames catchment, with detrimental consequences.

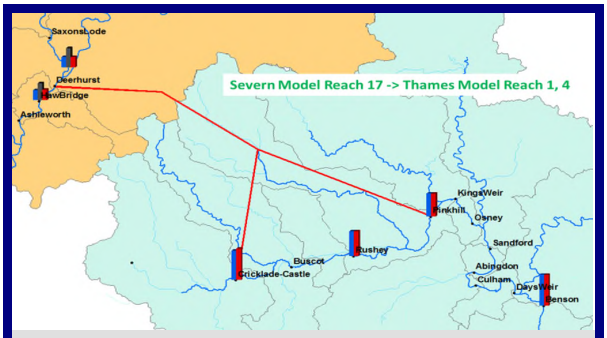

Figure 4 Potential water transfer from the River Severn to the Upper Thames catchment

Mill Meadows Local Nature Reserve

Paul Holmes is investigating the emergence of springs and mass movement in a SSSI at Billericay in Essex, as part of a programme using Lottery Funds to improve public access to the nature reserve and cattle grazing. The springs appear at the base of the Bagshot Beds and in the upper sandy horizons of the Claygate Member, giving rise to widespread soil movement and ground bulging in the clays which helps keep the fields waterlogged, populated by Juncus grass, and soggy for man and beast.

Spring and clay bulging at Mill Meadows

Social Media

WRA collates interesting news from various parts of the globe from local associates and ongoing projects: follow us on twitter @WaterResourceA.
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Next WRA Board Meeting

27th October 2017, Benson

The WRA Bulletin is a quarterly publication, and relies on contributions submitted by Partners, 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 Nick Mandeville: nick@watres.com

Water Resource Associates LLP, PO Box 838, Wallingford, Oxon OX10 9XA. Tel: +44[0] 1491 838 190, www.watres.com