

WRA Arid Zone Hydrology

Continuing the theme of arid zone hydrology from Bulletin No.40, WRA has been involved in a recent water resources project in the United Arab Emirates which has considered rainwater harvesting as a means of boosting the water supply. The study area is at Jabal Dhana, on the coastal plain of the Arabian Gulf some 200 km west of Abu Dhabi. The study investigated the rainfall across the area together with the hydrogeology and the different landforms and land cover in order to identify areas where potential harvesting of rainfall would be most effective. The landforms and land cover were mapped using GIS including digitising from satellite images and terrain analysis using a digital terrain model (DTM) in the 3-d Analyst extension of ArcGIS (Figure 1).

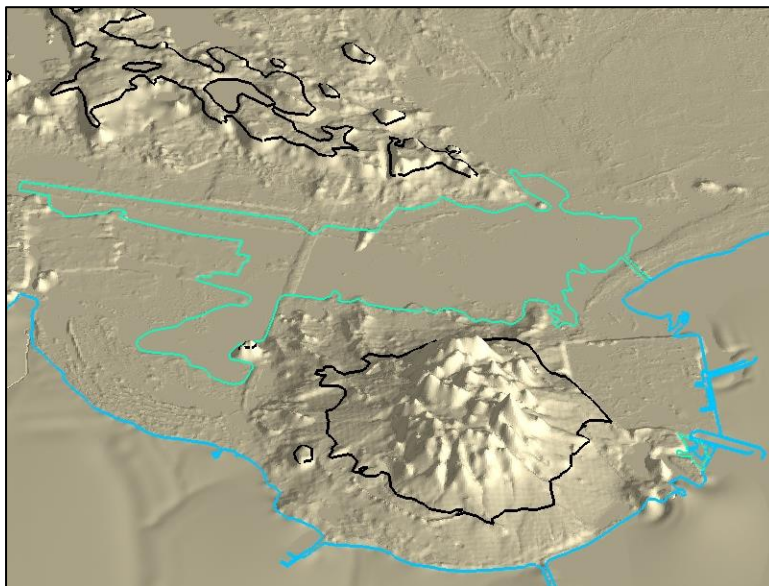


Figure 1. The coastline (blue), salt flats (green) and mesas (black) identified from the DTM using the 3-d analyst software.

The landforms included areas of coastal and inland salt flats (sabkah), mesas, mobile dunes, and calcreted desert plains. Land use classes included areas of scrubby natural vegetation and large areas of planted vegetation which were evident as rectangular areas from the satellite images. In an area which has less than 100mm of annual rainfall any method for collecting water from such a sparse resource is highly prized.

Software News

Versions of the QUASAR model (Whitehead et al, 1997) and the INCA model (Whitehead et al, 1998, 2011) have been set up for a range of water quality determinands and applied to many rivers such as the Lambourn, Kennet, Tamar, Tame, Tweed and Lugg (Wye). The Environment Agency required a simplified version of the instream component of the models so that alternative land use scenarios could be simultaneously modelled together with the impacts of point source discharges from wastewater treatment works or industrial sources. The new Excel version of the model utilizes a differential equation solver that allows for the QUASAR/INCA instream mass balance equations to be solved. The model simulates Flow, Nitrate, Ammonia, Total Phosphorus, Soluble Reactive Phosphorus, Sediment, E.coli, Pesticides and Pathogens. The Excel version is simple to use and is set up to simulate up to 4 reaches in a multi-reach river simulation, using a daily time step over a year. Thus overall seasonal and monthly patterns of behaviour can be evaluated as well as short term dynamics. Figure 1 shows a typical daily simulation over 2011 for the River Dearne for nitrate at 4 reaches along the river system. The model also generates statistic summaries for environmental impact assessment.

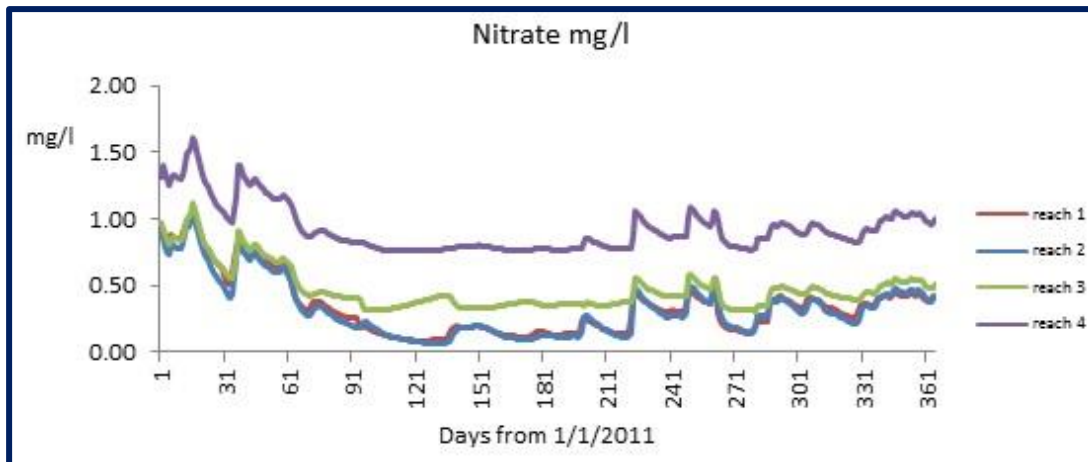


Figure 2. Daily Nitrate Simulation for River Dearne at 4 Reaches over 2011

References

- Whitehead, P.G.,** Wilson, E.J. And Butterfield, D. (1998) A semi-distributed Integrated Nitrogen Model for Multiple source assessment in Catchments (INCA): Part I - Model Structure and Process Equations, *Science of the Total Environment*, 210/211 pp. 547-558.
- Whitehead, P.G.,** Williams, R.J. And Lewis, D.R. Quality Simulation Along Rivers (QUASAR) (1997) Part 1: Model Theory and Development. *Science of the Total Environment*, 194/195. 447-456.
- Whitehead, P G,** L Jin, HM Baulch, DA Butterfield, SK Oni, PJ Dillon, MN Futter, AJ Wade, R North, EM O'Connor, HP Jarvie. (2011). Modelling phosphorus dynamics in multi-branch river systems: a study of the Black River, Lake Simcoe, Ontario, Canada. *Science of the Total Environment* 412-413:315-323.

WRA Partner/Associate News

New Associates



Two new associates have joined WRA, these are Prof Martyn Futter (left) and Dr Robert Willows (right) Martyn is an associate professor at the Department of Aquatic Sciences and Assessment, Swedish Agricultural University, Uppsala, Sweden, with a PhD in watershed ecosystems. He has undertaken much research in the field of water quality modelling in North America and Europe. He is currently involved with the EU MARS project on the River Wye modelling the effects of climate

change on hydrology, nitrogen and ecology (macro invertebrates) in collaboration with Prof Steve Ormerod at Cardiff University. He will also be setting up the INCA Carbon water quality model on a catchment in Finland. Robert has expertise in the design of environmental risk assessments, he has a PhD in population and ecology modelling and has spent the past 16 years working for the Environment Agency as a risk and forecasting policy manager. Through WRA he has just been awarded a contract from DEFRA to undertake a review of the FARMSCOPER model.

Next WRA Board Meeting

24th April 2015, Benson

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

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