Water Management
Volume 167 Issue WM3

Editorial
Hankin

ice | proceedings

Proceedings of the Institution of Civil Engineers
Water Management 167 March 2014 Issue WM3
Page 125 http://dx.doi.org/10.1680/wama.2014.167.3.125

ice
Institution of Civil Engineers
publishing

Editorial

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Fluid flow is notoriously difficult to predict, but this month's papers use a variety of analytical, empirical, physical scale-models, and numerical techniques to further our understanding of fluid flow in different media, its interaction with structures, and its mixing characteristics. Knowing which tool to use is often difficult, and it might be confusing to outsiders from our discipline to understand why there still needs to be this range of modelling methods. There are clear advantages to deriving an analytical solution for a sluice gate, a ubiquitous control structure, yet formulating such an approach is not always possible, and can also rely upon a weight of empirical experience. Similarly, a physical scale model can yield insights into fluid flow, and has the reassurance of avoiding discretisation errors and instability that afflict numerical modelling but, as we see in this issue, it can be subject to non-linearities rendering the assumption of Froude scaling incorrect.

With a third of the world's population dependent on groundwater for freshwater supply, and much of this stored in shallow aquifers, techniques for sustainable groundwater management are required in coastal aquifers to allow the safe withdrawal of freshwater, whilst avoiding the reversal of freshwater gradient and saltwater intrusion. Basack *et al.* (2013) demonstrate a sustainable management option comprising withdrawal of coastal freshwater by means of qanat-well structures associated with artificial recharge through rainwater harvesting aided by percolation ponds and recharge wells. The approach is particularly relevant for heavily populated coastal areas, but clearly requires significant annual precipitation to drive the recharge aspect.

Sun *et al.* (2013) undertake numerical hydrodynamic and dispersion modelling of key determinands representative of nutrient enrichment (dissolved inorganic nitrogen, DIN) and pollution (chemical oxygen demand), which is synonymous with rapid economic growth in the region. Boundary conditions are set using estimates from measurements and flows to provide influxes via eight inlets to the Pearl River Estuary which flows into the South China Sea. Some of the concentrations are the worst level 5 on the Chinese scale 1–5 for saline water quality. The numerical modelling study concludes that so significant are the levels of DIN that a 66% reduction in terrestrial inputs, would be required in order to meet compliance with environmental quality targets, this being twice the current planned rate of mitigation.

Khalili Shayan *et al.* (2013) present a theoretical and experimental investigation into flow through sluice gates, and how the coefficient of discharge varies with geometry for drowned and free flow. Improved engineering knowledge in this area is significant because of the huge number of rivers, navigation and irrigation channels controlled by sluices.

In another paper studying flow control structures, this time a reservoir spillway, Chinnarasri *et al.* (2013), favour the use of computational fluid dynamics, using a k-ε closure model to predict the subtleties of fluid flow for both stepped and smoothed spillway. The physical models have recently come back into favour, but the authors place a cautionary note for situations where viscous forces become more significant, and the air bubbles forcing detrainment of flow over the steps can be proportionately larger for the scaled down physical model, rendering the assumption of Froude similarity incorrect.

In their modelling of bottom outlet dam flows, Daneshmand *et al.* (2013), also use results from physical and numerical modelling to explore the pressure distributions impacting flow in the conduit controlled this time by a radial control gate. The authors demonstrate how turbulence-induced pressure fluctuations are sufficiently random and discordant to the resonant frequency of the radial gate (based on the use of an additional Finite Element Model), so as not to cause problems with its long-term operation.

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