Student Award 2009

The Society's student award was launched in 2002 to promote the study of hydrology and raise awareness of the Society at undergraduate level. Prizes are awarded on the achievement, relevance, originality and presentation of submitted final-year dissertations addressing scientific and applied issues in hydrology, judged by a panel drawn from the main BHS Committee.

This year we received 15 entries, more than in any previous year. All entries were of a very high or good standard and covered a range of hydrological aspects. The judges awarded the winner's prize to Christopher Fitzsimmons from the University of Cambridge for his excellent piece of work on 'Subglacial drainage system structure and morphology of Midtdalsbreen, Norway.' Christopher's work was described by our judges as *'an exceptionally well developed project which integrated both field based and remotely sensed data'*. Christopher was able to join us at our AGM in Oxford to receive his prize of £400, an engraved quaich and a certificate.

Two runners-up prizes were also awarded, to Kate Reilly, University of Edinburgh, for her work on 'Hillslope hydrological processes and flowpaths in the Borthwick water catchment, and their implications for the effectiveness of natural flood management', and to Jeffrey Wilkinson, University College London, whose project was titled 'Modelling climate change impacts and uncertainty on hydrology: application to the Mekong river basin, Asia.'

It was very encouraging to see the high standard and enthusiasm for hydrological research at the undergraduate level and I look forward to receiving entries for the prize in 2010.

Claire Walsh
Honorary Secretary

Below are the abstracts from the three prize-winning dissertations:

Winner - Christopher Fitzsimmons, University of Cambridge
Subglacial drainage system structure and morphology of Midtdalsbreen, Norway.

Digital Elevation Models are used to construct maps of subglacial hydraulic potential and drainage system structure for a number of assumptions of subglacial water-pressure at Midtdalsbreen, Norway, ranging from atmospheric pressure to ice-overburden pressure. In addition, twenty-two dye tests were performed at fourteen injection sites during the summer melt season. A number of past tracer tests are also used in conjunction with the most recent dataset. Dye return curve shape, together with calculations of mean transport velocity, dispersivity and storage, are used to infer the probable morphology of the subglacial drainage system. Measurements of proglacial stream discharge are used with dye test data. A simple distributed degree-day model is used to calculate the spatial distribution of melt on the glacier surface in an 'average year.' Model outputs are then used to calculate the average annual volume of meltwater travelling down individual flow pathways. The data suggest that during the height of the melt season under the eastern half of the glacier a hydraulically efficient, channelised drainage system exists – probably sinuous R-channels. In the western half of the glacier dye tests suggest that flow takes place within a hydraulically inefficient, distributed system – probably a linked-cavity system. The pattern of dye returns suggests that water pressure late in the melt season is close to 0.7 of ice-overburden pressure. The major drainage axis in the eastern half of the glacier transports 86.5% of the total meltwater generated by the degree-day model. Total volumes transported are of the order of $0.46m^3s^{-1}$ in the eastern half of Midtdalsbreen and $0.06m^3s^{-1}$ (11.8%) in the western half. The central stream transports a minor $0.009m^3s^{-1}$, 1.7% of total melt transported. These correlate well with observed discharges.

Runner up - Kate Reilly, University of Edinburgh
Hillslope hydrological processes and flowpaths in the Borthwick water catchment, and their implications for the effectiveness of natural flood management.

A conceptual model of streamflow generation in the Borthwick Water in the Scottish Borders was produced by evaluating the relationships between precipitation, infiltration capacity, soil moisture content and streamflow. Precipitation, soil moisture content and streamflow were recorded continuously throughout the winter using a tipping bucket gauge, time domain reflectrometry and current gauging respectively. Infiltration capacity was assessed on four occasions between August 2008 and March 2009 using a single ring infiltrometer. Hydrograph separation was used to determine the flowpaths by which rainfall reached the river channel, using both mass of chloride and conductivity as natural tracers. It was found that streamflow responded rapidly to precipitation due to overland flow from a zone of surface saturation that develops in the riparian zone. Subsurface flow also contributed to streamflow, resulting in a delay in the return to baseflow following a rainfall event. Infiltration capacities were found to be high, particularly in a small forested area at the top of the slope. The results were then used to discuss the implications of a natural flood management scheme in the Borthwick Water catchment. It is expected that riparian tree planting will increase local infiltration capacities, which may increase the lag time between precipitation and peak streamflow. However, it is not anticipated that this will have a discernible impact on peak discharges of high magnitude, or on downstream flooding.

Runner up - Jeffery Wilkinson, University College London
Modelling climate change impacts and uncertainty on hydrology: application to the Mekong river basin, Asia.

This investigation details the development of a semi-distributed hydrological model that is capable of simulating current and future discharge within the subcatchments of the Mekong River Basin. Using topographic data derived from the USGS GTOPO30 Digital Elevation Model (DEM), the subcatchments were delineated within the Soil and Water Assessment Tool (SWAT). This derived 13 subcatchments within the Mekong Basin. Interpolated climate data were used to run the hydrological model between 1960 and 1993. The calibration and validation were conducted against observed discharge records through the manipulation of model parameters under the Klemeš (1986) split-sample approach. Model performance was evaluated by several numerical assessments. The hydrological model was then driven by climate data obtained from ten General Circulation Models (GCMs) forced under two emissions scenarios for the future periods 2020-2050 and 2070-2100. GCM data were downscaled using the delta factor approach. This generated a range of future discharge simulations.

Results imply a modification to the annual river regime, with several simulations estimating peak discharge one month earlier than present in August. Additionally, climate change may exacerbate the difference between seasons, particularly through a reduction in discharge during dry seasons. Models disagree as to whether total annual discharge will increase or decrease into the future. These changes in discharge patterns may have significant implications for those inhabiting all areas of the Mekong Basin. Areas particularly vulnerable to change are the Tonle Sap in Cambodia, and the Mekong Delta regions in Vietnam.

Considerable uncertainty arises within future estimates of discharge. This is produced within model development, emissions scenarios and downscaling approaches. The largest source of uncertainty is produced by GCMs. This investigation highlights the urgent need to improve both hydrological models and GCM representations of the climate system. Until this is achieved, all climate change investigations should be interpreted carefully.