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Forecasting snowmelt flooding over Britain using the Grid-to-Grid model: a review and assessment of methods

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In many regions of high annual snowfall, snowmelt modelling can prove to be a vital component of operational flood forecasting and warning systems. Although Britain as a whole does not experience prolonged periods of lying snow, with the exception of the Scottish Highlands, the inclusion of snowmelt modelling can still have a significant impact on the skill of flood forecasts.

Countrywide operational flood forecasts over Britain are produced using the national Grid-to-Grid (G2G) distributed hydrological model. For Scotland, snowmelt is included in these forecasts through a G2G snow hydrology module involving temperature-based snowfall/rainfall partitioning and functions for temperature-excess snowmelt, snowpack storage and drainage. Over England and Wales, the contribution of snowmelt is included by pre-processing the precipitation prior to input into G2G. This removes snowfall diagnosed from weather model outputs and adds snowmelt from an energy budget land surface scheme to form an effective liquid water gridded input to G2G.

To review the operational options for including snowmelt modelling in G2G over Britain, a project was commissioned by the Environment Agency through the Flood Forecasting Centre (FFC) for England and Wales and in partnership with the Scottish Environment Protection Agency (SEPA) and Natural Resources Wales (NRW). Results obtained from this snowmelt review project will be reported on here. The operational methods used by the FFC and SEPA are compared on past snowmelt floods, alongside new alternative methods of treating snowmelt. Both case study and longer-term analyses are considered, covering periods selected from the winters 2009-2010, 2012-2013, 2013-2014 and 2014-2015.

Over Scotland, both of the snowmelt methods used operationally by FFC and SEPA provided a clear improvement to the river flow simulations. Over England and Wales, fewer and less significant snowfall events occurred, leading to less distinction in the results between the methods. It is noted that, for all methods considered, large uncertainties remain in flood forecasts influenced by snowmelt. Understanding and quantifying these uncertainties should lead to more informed flood forecasts and associated guidance information.