Distributed hydrological modelling for forecasting water discharges from the land area draining to the Great Barrier Reef coastline

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The physical-conceptual distributed hydrological model Grid-to-Grid, or G2G, is applied across the $426,000$ km^2 land area draining to the Great Barrier Reef (GBR) coastline of Queensland, Australia. Of this area, $76,600$ km^2 is ungauged, this being the land between the most downstream gauging locations and the coastline. G2G provides gridded hourly river flows across the model domain, of use for both flood and water availability forecasting in Queensland, as well as hourly coastal discharges required by marine models of the Reef environment employed for conservation purposes.

G2G is underpinned by spatial datasets on terrain, land-cover and soil properties. The best sources for these datasets have been identified and developed to support generic application of G2G across Australia. These include the Australian Digital Elevation Model and Digital Atlas of Australian Soils and serve to shape the hydrological response to rainfall patterns in time and space. Raingauge observations along with the Australian Water Availability Project (AWAP) gridded rainfall are used to generate 1 km gridded historical rainfall. The ACCESS-R numerical weather prediction model is used to generate 1 km gridded forecast rainfall over a lead-time of three days.

The model's area-wide formulation allows for the production of real-time flow forecasts everywhere on a 1km grid across the model domain, including those areas which are ungauged. G2G is calibrated over the GBR land area, and the modelling capability assessed through comparison with gauged river flow records at 276 locations over a nine year period. A novel method, employing data assimilation of the furthest downstream gauged river flows, is used to obtain improved coastal discharge estimates required by the marine models.

The G2G historical simulations and nowcasts are linked to statistical water quality models to generate sediment, nitrogen and phosphorus loads for use in biogeochemistry models, and are being used in generating GBR Annual Report Cards by the Australian Government. Currently, the G2G modelling system to generate long-term historical simulations, nowcasts and forecasts is not operational but work is in progress to make the system operational in the near future.

The work is a collaboration between the Bureau of Meteorology Australia and the Centre for Ecology & Hydrology in the UK, and forms part of the eReefs Programme in support of the Reef 2050 Plan.