25th International Congress on Modelling and Simulation, Darwin, NT, Australia, 9 to 14 July 2023
mssanz.org.au/modsim2023

Microwave data and climate information–based streamflow prediction using the surrogate river discharge model in the Murray–Darling Basin

Hae Na Yoon [a,b], Lucy Marshall [a,b] and Ashish Sharma [b]

[a] Faculty of Science and Engineering, Macquarie University, Sydney, Australia
[b] School of Civil and Environmental Engineering, University of New South Wales, Sydney, Australia
Email: lucy.marshall@mq.edu.au

Abstract: Accurate prediction of hydrologic events is essential for estimating potential damages and making informed decisions. While reliable streamflow monitoring gauges are typically used for predicting these events, recent research has explored the use of hydroclimatic flux data from space as an alternative to in-situ data, allowing for hydrologic predictions in ungauged areas. Novel techniques have been developed to estimate streamflow, such as the use of surrogate river discharge (SR), which is calibrated through spatial temperature retrievals to establish a correlation with streamflow. This approach has been further developed using temporal comparisons and incorporating L-band microwave data from soil moisture and ocean salinity. This study uses a hydrologic model calibration with the newly derived SR via a linear surrogate river discharge model (SRM) as a rating curve. The SRM method relies on basic information, such as mean streamflow obtained from climate and geophysical data, to estimate flow magnitude. The SRM approach incorporates the Budyko relationship, which includes precipitation and potential evapotranspiration data to calculate mean river discharge, enabling it to estimate the hydrologic signature in ungauged basins. A synthetic study demonstrates the effectiveness of the SRM method in producing reliable hydrologic predictions. Mean estimations within a range of -40% to 20% of the true mean flow value are appropriate for calibrating the SRM, enabled by the Budyko relationship. The developed framework is then applied to predict hydrologic events in Australian hydrologic stations located in the Murray–Darling Basin, and high Nash-Sutcliffe efficiency values are achieved, with a mean of 0.53, demonstrating the effectiveness of the new method. In summary, the SRM presents a promising approach for predicting hydrologic events using only remotely sensed data and climate information, and its simple and fast calibration process suggests it could become a widely adopted tool for predicting extreme hydrologic events in areas without in-situ monitoring.

Keywords: *Remote sensing, streamflow prediction, hydrologic reference stations, surrogate river discharge, hydrologic modelling*