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Adapting JULES for improved hydrological predictions in Australia: Challenges, strategies and future plans

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Abstract: Accurate hydrological predictions are crucial for effective water resources management, through enabling consistent, large-scale predictions of water availability and identification of potential impacts caused by weather and climate extremes such as floods and droughts. Over the past decade, the Australian Water Resources Assessment Landscape (AWRA-L) model has underpinned the Bureau's operational water information services, and contributed to the National Water Account and Water Resources Assessment reports. However, the AWRA-L model runs as a standalone model outside the operational Numerical Environmental and Weather-climate prediction (NEWP) systems. The climate and weather predictions are influenced by the land surface at a variety of temporal and spatial scales, and vice versa. To improve the accuracy of hydrological, weather, and climate predictions across Australia, and maintain consistency with weather forecasts, it is necessary to integrate hydrological modeling into the weather and climate prediction system. The current land surface scheme used within the operational NEWP system at the Bureau of Meteorology is the Joint UK Land Environment Simulator (JULES). JULES was developed and optimized to perform well for the Northern Hemisphere, thus it requires a comprehensive uplift to deliver water products with accuracy of AWRA-L and perform optimally across all hydroclimatic regions of Australia, and consequently across similar arid and semi-arid regions across the world.

This presentation will discuss the challenges and plans for improving the representation of land surface processes within JULES, specifically, by enhancing soil hydrology, surface water routing, and vegetation dynamics. To achieve this, we need to leverage the knowledge and experience gained from other Australian models, such as AWRA-L and CABLE, and integrate Earth Observations optimally through data assimilation to enable reliable hydrological predictions. We will also highlight the benefits of using high-resolution satellite observations to improve our understanding of land surface properties and assist with re-parameterization. Joint assimilation of remotely sensed soil moisture and leaf area index (LAI) is proposed to enhance the soil-vegetation interactions within JULES in addition to the proposed improved physics and ancillaries. We will present the results of recent investigations into model configuration, parameterization, and changes in model structure, along with our future plans. Ultimately, these efforts will contribute to more accurate hydrological and weather prediction and enabling informed decision-making in water resources management.

Keywords: *Land surface modelling, hydrology, land data assimilation*