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The simulations of energy, water and carbon cycle by an Australian land-surface model

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In the development of the Australian Climate Community Climate Earth System Simulator (ACCESS), the CSIRO Atmosphere Biosphere Land Exchange (CABLE) model is being developed and evaluated to realistically represent the land-surface energy, water and carbon cycles in the global climate system. As part of the model development, in this study we have conducted 50-year global offline simulations to explore the characteristics of interannual and decadal time-scale variations of land-surface processes and the interactions between energy, water and carbon cycles simulated by the model. We have compared CABLE surface climatology against the ones produced by three land-surface schemes participating in the Global Land-surface Data Assimilation Project (GLDAS) for the same period of 1979-2000. Results suggest that the CABLE surface climatology offers similar features as seen in those three models using GLADS forcing data. Another important aspect in the model evaluation is to assess whether it has skills in simulating some observed variations of land-surface/water processes in the last several decades. The offline results showed that CABLE is able to reproduce the nonlinear relationship between rainfall decline and a sharp reduction in surface runoff area-averaged over the SW of Western Australia. Evaporation, as a significant water loss term, contributes to such discrepancy. In addition, we have found that simulations by CABLE shows a significant downward trend of Net Primary Products (NPP) over tropical rainforest regions, suggesting a weakening of its carbon uptake in past decades, consistent with some recent observations. Finally, a simple river routing scheme named TRIP has been coupled to the outputs from the model

50-yr offline experiment to explore the model skills in simulating river discharge over large river basins. Results are compared to observed datasets available over some river basins. Overall, results in this study demonstrate the potential of this scheme in conducting integrated studies of complex feedbacks among the energy, water and carbon cycle in regional and global climate system.