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Impacts of PET methods on variations of continental water balance components in a Global Hydrological Model

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Global hydrological models (GHMs) have been developed to calculate the water balance on global or continental scales which is essential for water resources management. The hydrological processes are complex, heterogeneous, and hardly characterized by laboratory and field measurements, especially for the evapotranspiration (ET) rate because of the difficulties of directly measuring atmospheric vapor flux. As a result, practical theories of potential ET (PET) and their impact on runoff generation remain elusive. PET/ET methods in GHM can behave differently because of different assumptions and input requirements. In this study, we assess the variations of the water balance components in Europe based on six PET methods, i.e. Penman-Monteith (PM), radiation-based Priestley-Taylor (PT), radiation-based Turc, temperature-based Hargreaves, an empirical temperature-based (empirical-T) method, and a PET product of Global Land Evaporation Amsterdam Model (GLEAM). Besides, a global Macro-scale Water and Snow Balance Modeling System (WASMOD-M) is calibrated at daily time step based on 66 gauged watersheds in Europe and applied with two regionalization methods (i.e. the Global mean method and the Koppen method) at the $0.5^\circ \times 0.5^\circ$ grid scale for the 1997-2008 period. Results show that (1) the Turc and empirical-T methods derive similar results of water balance with that of GLEAM while largely different from that of PT and PM; (2) the empirical-T and Turc methods show a slight decrease, while others show a slightly increase trend in Europe on average; as for the seasonal PET, all methods show a slight increase in spring and autumn and a slight decrease in winter; (3) all methods indicate that the increase of PET and Actual ET (AET) in central Europe is more obvious than other parts of Europe; and (4) different methods derive a similar spatial distribution of PET and runoff in Europe although they vary considerably in the quantity. Further study is in progress to characterize surface processes and to investigate the differences of water balance component regarding the assumptions of PET methods.