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The relative importance of the evaporation components for modeling the land surface-atmosphere interactions in temperate European forests

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The increasing demand for ecosystem services, in conjunction with climate change, are expected to significantly alter the terrestrial ecosystems and, by consequence, the energy, water, and carbon fluxes between land and atmosphere. In order to evaluate the severity of the sustainability issues, in particular water availability, that we might face in the future, there is a need for a better understanding of the relationships between the land surface characteristics, and the energy and water cycles. Simulating the various processes that interact to form the water cycle is a challenging task for climate models. Successful simulation of these interactions by the land surface component of a climate model requires detailed representation of processes such as interception, throughfall, snow accumulation, infiltration, runoff, soil moisture recharge and uptake, as well as the partitioning of evapotranspiration between canopy evaporation, transpiration, and soil evaporation (Oleson et al., 2008). An important factor affecting this partitioning is the forest structure and tree species composition.

In this study, JULES (Best, 2011), which is the land surface model used in the climate model of the UK Met Office, has been evaluated for temperate forests in Europe. Europe accounts for one-quarter of the total forest area in the world and most of these forests are classified as temperate. According to Bonan (2008), the future of temperate forests and their climate services is highly uncertain as well as the net climate forcing of these forests. Change in the balance between deciduous and evergreen trees within these forests is likely in the future (Bonan, 2008). The response of European forests to climate variability and change, in particular during heat waves, has also been discussed in Teuling et al. (2010) from the point of use of water use strategy, and contrasted with that of grasslands.

Particular attention has been paid to the different components of the evaporative flux and to the role of the forest composition on the partitioning of these components. JULES has mainly been evaluated against the European Eddy Fluxes database (formerly FLUXNET), which provided spatio-temporal information of the energy and water balance fluxes and related variables above deciduous, evergreen and mixed forests. Despite the lack of detailed measurements, limited data on flux partitioning are now available and an attempt was made to understand the model shortcomings and to improve the process descriptions underlying the evaporative flux and its components. This helped to increase the performance of the model to simulate the spatial and temporal variability of the fluxes over temperate forests.

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