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The river routing scheme in Organising Carbon and Hydrology in Dynamic Ecosystems (ORCHIDEE) using high resolution data

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This study presents an improved version of river routing scheme in the Organising Carbon and Hydrology in Dynamic Ecosystems (ORCHIDEE) land surface model. The routing scheme in ORCHIDEE is designed to be resolution independent. This is achieved by routing water through sub-grid hydrological transfer units. An approach which also allows to use refined residence times in each transfer unit which also depend on the nature of the water to be routed. In the proposed evolution, the Hydrological data and maps based on SHuttle Elevation Derivatives at multiple Scales (HydroSHEDS) is used to enhance both these aspects. As a seamless near-global hydrological data set, HydroSHEDS is a suitable database for improving the water transfer scheme in ORCHIDEE. The approximately 1 km resolution HydroSHEDS data enables the construction of more adequate transfer units in each LSM grid box. In addition, the slope factor of each transfer unit, which is calculated with new averaging algorithm, improves the time constant of the reservoirs. Moreover, the new routing scheme is designed to function on generalized grids to make it applicable in modern regional and global climate models.
We will present an analysis of the optimal transfer unit size which ensures that the results of the routing scheme are independent of the grid at which ORCHIDEE operates. It is found that with transfer units of 10km^2 the model results are optimal and numerically stable. For the validation of this enhanced version of the routing scheme, 35-year simulations (1979-2013) were carried out forced by three atmospheric datasets on horizontal resolution of 0.5o and 0.25o. These datasets are: the Watch Forcing ERA-Interim dataset with bias-corrected precipitation using the (1) CRU station based product; (2) GPCCv5 satellite based estimates and (3) the higher resolution version E2OFD. Investigating on monthly and daily timescale at 22 stations of 12 rivers which contribute freshwater to Mediterranean sea shows that the new scheme captures well the annual cycle of river discharge. A first quantitative evaluation at daily timescales for 14 stations of 8 watersheds demonstrates the good quality of the sub-monthly simulated discharge. The results also show the necessity, especially in the Mediterranean region, of considering not yet represented processes such as irrigation or dams. In fact, the development of this new routing scheme is a first step towards the development of parametrization for human water usage in ORCHIDEE.