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Streamflow simulations by the land surface model ORCHIDEE over the Mississippi river basin. Uncertainties and sensitivity.

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The aim of this study is to validate the ability of the Land Surface Model (LSM) ORCHIDEE (Organising Carbon and Hydrology In Dynamic EcosystEms) to simulate streamflows. The routing scheme adopted is activated in the LSM in order to simulate the transporting of the runoff to the ocean by the rivers. The study focuses on the Mississippi river basin over the period 1997-1999 and an hydrological balance is performed for each of the five sub-basins. We compare streamflows simulated by the model forced by NCC (NgoDuc & al., 2005) to measurements available at seventeen gauge stations (River UCAR and USGS). Most of the streamflow seasonalities are correctly represented over many stations during the three years, specifically streamflow associated with large basin. When we force the model by NLDAS forcing (Cosgrove & al., 2003) which has a higher resolution (1° for NCC to (1/8)° for NLDAS), the peak of streamflow is hugely shifted comparing to the observations. We explain this difference by the time constants of the routing reservoirs in ORCHIDEE which were only calibrated with the NCC resolution. With a high resolution, we have to put a lower value of time constant for the stream reservoir which should represent a water amount routed more quickly. When we divided by a factor 10 the time constant of this reservoir and the routing time step, the seasonality of the streamflow is found back and similar to NCC. We also compare ORCHIDEE to four other models which have performed the same simulation with NLDAS (Lohmann & al., 2004). For the five stations of the Mississippi river basin studied in this paper, we compare their measured streamflow variations to the simulated ones. We notice a large difference between the five models. ORCHIDEE and NOAH are the most similar and able to represent the peaks accurately. Finally, we point out the good ability of the model ORCHIDEE to simulate streamflows which can be very contrasted according the region. We show also the incertitude in the seasonality of streamflows due to calibrated parameters such as time constant and routing time step. Overall, this study shows the necessity to find a general law to switch over spatio-temporal scale to another in a same LSM.