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Evaluating the use of sub-tile Bulk Averaged inputs to simulate evapotranspiration within Heterogeneous Land-Atmosphere Systems

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Evapotranspiration plays a crucial role in the regional water and energy balance and often takes place within heterogeneous land-atmosphere systems. Heterogeneity usually appears in the resolvable elements in Land Surface Models (LSMs). Typically, Land surface modelling to simulate evapotranspiration tends to oversimplify the sub-Tile heterogeneity of a Land-atmosphere parameter by a single representative value. This paper evaluates the inaccuracy of LSMs resulting from inaccurately representing the heterogeneity within resolvable elements by a bulk average value.

In a synthetic experiment, seven Probability Density Functions (PDFs) were used to simulate the different scenarios of heterogeneity of Leaf Area Index (LAI) and top Soil Moisture (SM). Evapotranspiration estimates based on bulk averaged LAI and SM status were compared with the one obtained by the real distributed LAI and SM. Their difference is due to the combined effect of heterogeneities in LAI and SM, and the nonlinear processes in the LSMs.

Besides the synthetic numerical experiment, we also tested the reliability of the bulk average scheme in a real world case for the Heihe river basin, northwest of China, to further demonstrate the importance of accounting for sub-Tile heterogeneity in evapotranspiration estimates and its implications for the regional and irrigation water management.