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Visualizing heterogeneity at different spatial scales - a way to conceptualize and up-scale hydrological processes

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Hydrological functioning of watersheds is not only influenced by the driving forces of climate and weather and the resulting initial conditions in a watershed, but also strongly by the pattern and dynamics of responding areas and their connectivity within the landscape. The incorporation and conceptualization of process heterogeneity in hydrological models, however, is still in its infancy. So far, we either break up the landscape into hydrologically similar units (e.g. HRUs, dominant runoff process areas) and assume that similar units respond similarly or we use grid based distributed models and assume that the heterogeneity is captured by the distributed model. We also know that heterogeneity within a unit or subgrid variability within a grid cell is not accounted for and that the average of our observations is mostly used to parameterize the model. The plot scale IN3M model and the hillslope/watershed scale Hill-vi model were applied at different spatial scales to simulate water flow and solute transport. The simulation results in combination with visualization of simulated hydrological heterogeneity helped us to better understand how heterogeneity can be conceptualized and what parameters need to be measured to reproduce the simulated processes at a larger, homogenized scale. In particular, visualization of heterogeneous processes is a very powerful tool to develop different ideas and concepts to up-scale process heterogeneity.