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A comparison between a physical based and conceptual snowpack modeling to improve hydrological simulations

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The snowpack and snowmelt processes in cold climate have a great impact in modeling river runoff, as well as in the investigation on soil-vegetation-atmosphere mass and energy exchange. A complete physical description of the snow accumulation process can be very difficult involving heat and mass fluxes for a multiphase body. The lack of suitable dataset and the complexity of the phenomena have led several researchers to apply easier models to describe the evolution of snowpack and snowmelt. In the paper are described two model of snowpack - snowmelt processes with a different complexity. The first one is a conceptual model based on the energy budget the involves only solar radiation and precipitation with one calibration parameter. The second one is largely physical based involving all the main heat transfer processes in a snow layer. The two models are applied to the Reynolds Creek experimental watershed, located in Idaho, USA. Measurements of snow depth and snow water equivalent have been collected for several years in the Reynolds Creek watershed and are available for the investigation. Particularly the results of a 14 years simulation are compared with the at site measurement recorded by a snow pillow in term of snow water equivalent and snow depth. The average error for both the variables is of the 17% for the conceptual model and 14% for the physical based model. The balance between the disadvantages and the advantages to use a more complex model are discussed. The first model is applied also at watershed scale and the spatial results provided are compared with other snow-measurement points. The distributed results confirm the possibility to apply the model for hydrological modeling purposes.