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Process-based simulation of channel transmission losses

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During flood events in ephemeral dryland streams various processes (e.g. erosion and deposition of sealing fine material layers, losses into flooded overbank areas) are active, constantly modifying the intensity and amount of channel transmission losses. These processes are hardly measurable and highly variable in time and space, making the accurate quantification of loss volumes during real flood events difficult, especially at larger scales. Therefore we tried to include process and field knowledge into a flood routing scheme to realistically simulate channel transmission losses during real flood events. Infiltration rates were described by the Newton-Raphson iteration of the Green-Ampt model accounting for changes in initial moisture content by an antecent moisture index. Overbank losses by infiltration and evaporation were included by a linear storage concept. To account for the sealing effect of deposited silt layers, channel infiltration reached its maximum rate only when the flow velocity exceeded a specified critical velocity. Aerial photographs, topographical maps and TDR-measurements in the channel alluvium during flood events served to parameterize the model, still calibration was required. The model was applied to two channel reaches in Wadi Zin, the Negev Desert, Israel, 5.5 and 76 km long. Since events without lateral inflow were chosen, measured hydrographs at the downstream end of the reaches could be used for model calibration and independent model checks. In the 5.5 km reach the model was calibrated for the largest (100 m3 s-1) event and applied to small events (8, 14 m3 s-1) with the same parameter set resulting in close model fits. However, re-calibration was necessary when the model was applied to the 76 km reach, which was attributed to different channel characteristics rather than to scale effects.