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Development, testing and application of thermos-dynamics and hydro-geomorphic components in GSSHA hydrologic model - Dynamic coupling across different modelling domains

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Embedding complex hydrologic and geomorphic processes in a hydrological model improves decision support capability for water resource management, especially in floods, droughts and other natural hazards. Such complex hydrologic components include thermo-hydrodynamics, and instream hydro-geomorphic dynamics. To explicitly simulate the soil moisture effects of soil thermal conductivity, heat capacity and the effects on hydrological response, we included the capability to simulate the soil thermal regime, frozen soil and permafrost in the Geophysical Institute Permafrost Laboratory (GIPL) model into the physically based, distributed watershed model Gridded Surface Subsurface Hydrologic Analysis (GSSHA). To enhance the in-stream sediment transport capacity, the instream USACE Sediment Transport Library (SEDLIB) is linked to the GSSHA distributed hydro-geomorphic processes. Natural hazards like fire increases ground thermal conductivity and decreases surface albedo which could alter a catchment thermo-hydrodynamics. Also, fire hazard significantly increases the Newtonian and non-Newtonian sediment erosion and transport processes. The newly enhanced capabilities, thermo-dynamics and sediment transport, in GSSHA were applied to address the impacts of fire on catchment hydrology.