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Influence of seasonally frozen ground on hydrological partitioning – a global systematic review

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Seasonally frozen ground (SFG) occurs on ~25% of the Northern Hemisphere's land surface, and the influence of SFG on water, energy, and solute fluxes is important in cold climate regions. The hydrological role of permafrost is now being actively researched, but the influence of SFG has been receiving less attention. Intuitively, water movement in frozen ground is blocked by ice forming in soil pores that were open to water flow prior to freezing. However, it has been shown that the hydrological influence of SFG is insignificant in some cases, with soil remaining permeable to water even when frozen. There is a clear knowledge gap concerning (1) how intensively and (2) under what physiographical and climate conditions SFG influences hydrological fluxes. We conducted a systematic literature review examining the hydrological importance of SFG we found reported in 143 publications. We found a clear hydrological influence of frozen ground in small-scale laboratory measurements, but a more ambiguous effect when the spatial scale under study increased to hillslopes, catchments, or watersheds. We also found that SFG may be hydrologically less important in forested areas or in regions with deep snow cover. Our systematic review suggests that hydrological influence of SFG may become more important in a future warmer climate with less snow and intensified land use in high-latitude areas.