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# With thawing-freezing process, runoff generation in the Sources Area of the Yellow River on northeastern Qinghai-Tibet Plateau

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In cold region, precipitation, air temperature and snow cover significantly influenced soil water, heat transfer, freezing–thawing processes of active soil layer, and even runoff generation in cold region. Hydrological regimes of world major rivers in cold regions have changed remarkably since the 1960s, but the mechanisms underlying the changes have not yet been fully understood. On the basic of physical processes of water and heat balances and their transfers in the snow covered soil, a water-heat coupling model for snow cover and its underlying soil layers was established in this paper, in which we found that freezing–thawing processes can affect the thicknesses of permafrost layer and active layer, storage capacity for liquid water and subsequent surface runoffs. In this study, a water-heat coupling model for snow cover and its underlying soil layers was established. Based of the calculation of thawing-freezing processes, we investigated the hydrological processes, in particular the runoff generation, of the Yellow River's source (YRS) located in permafrost regions over the past four decades using ground observations. The impacts of runoff processes are assessed in terms of spatiotemporal distribution of precipitation, air temperature, and soil water dynamics in the active layer. Runoff generation in different seasons was influenced by the different main factors. In spring, the soil water storage played an important role in runoff generation. After water content being saturated in summer, the runoff increased along with precipitation. In winter, thick snow cover hinders temperature transfer from air to soil, resulting in prolonging the time lag between air and soil temperatures, decreasing variations of soil temperature and soil water content and reducing soil freezing depths of active soil. In addition, heavy evaporation ability and increased of air temperature further decreased soil water content. Without enough water supplies, river runoff decreased in winter.