



Hydrological Changes in Polar Regions, An examination of linkages and feedbacks

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The effects of a warming climate on the terrestrial regions of the Arctic are already quite apparent; some subsequent impacts to the hydrologic system are also becoming evident. It is expected that the effects and consequences of a warming climate will become even more evident within the next 10 to 50 years. The broadest impacts to the terrestrial arctic regions will result through consequent effects of changing permafrost structure and extent. As the climate differentially warms in summer and winter, the permafrost will become warmer, the active layer (the layer of soil above the permafrost that annually experiences freeze and thaw) will become thicker, the lower boundary of permafrost will become shallower and permafrost extent will decrease in area. These simple structural changes will affect every aspect of the surface water and energy balances. As the active layer thickens, there is greater storage capacity for soil moisture and greater lags and decays are introduced into the hydrologic response times to precipitation. When the frozen ground is very close to the surface, the stream and river discharge peaks are higher and the base flow is lower. As the active layer becomes thicker, the moisture storage capacity become greater and the lag time of runoff increases. As permafrost becomes thinner, there can be more connections between surface and subsurface water. As permafrost extent decreases, there is more infiltration to groundwater. This has significant impacts on large and small scales. The timing of stream runoff will change, reducing the percentage of continental runoff released during the summer and increasing the proportion of winter runoff. This is already becoming evident in Siberian Rivers. As permafrost becomes thinner and is reduced in spatial extent, the proportions of groundwater in stream runoff will increase as the proportion of surface runoff decreases, increasing river alkalinity and electrical conductivity. This could impact mixing of fresh and saline waters, formation of the halocline and seawater chemistry. As the air temperatures become higher and the active layer becomes thicker, we have reason to believe the surface soils will become drier. As the surface soils dry, the feedbacks to local and regional climate will change dramatically, with particular emphasis upon sensible and latent heat flux. This may impact recycling of precipitation, capabilities to predict weather and may indeed increase variability of many processes and variables, including convective storms.