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Controls and variability of solute and sedimentary fluxes in Arctic and sub-Arctic Environments

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Six major factors consistently emerge as controls on the spatial and temporal variability in sediment and solute fluxes in cold climates. They are climatic, geologic, physiographic or relief, biologic, hydrologic, and regolith factors. The impact of these factors on sediment and solute mass transfer in Arctic and sub-Arctic environments is examined.
Comparison of non-glacierized Arctic vs. subarctic drainage basins reveals the effects of these controls. All drainage basins exhibit considerable variability in rates of sediment and solute fluxes. For the non-glacierized drainage basins there is a consistent increase in sediment mass transfer by slope processes and fluvial processes as relief increases. Similarly, a consistent increase in sediment mass transfer by slope and fluvial processes is observed as total precipitation increases. Similar patterns are also observed with respect to solute transport and relief and precipitation. Lithologic factors are most strongly observed in the contrast between volcanic vs. plutonic igneous bedrock substrates. Basins underlain by volcanic rocks display greater mass transfers than those underlain by plutonic rocks. Biologic influences are most strongly expressed by variations in extent of vegetation cover and the degree of human interference, with human impacted basins generating greater fluxes.
For glacierized basins the fundamental difference to non-glacierized basins is an overall increase in mean annual mass transfers of sediment and a generally smaller magnitude solute transfer. The principal role of geology is observed with respect to lithology. Catchments underlain by limestone demonstrate substantially greater solute mass transfers than sediment transfer. The influence of relief is seen in the contrast in mass transfers between upland and lowland drainage basins with upland basins generating greater sediment and solute transfers than lowland basins. For glacierized basins the effects of biology and regolith appear to be largely overridden by the hydrologic impacts of glacierization.