Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06633, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06633
EGU General Assembly 2008

Groundwater flow and heat transport in the arctic area of Ny-Ålesund, Svalbard

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Svalbard is a high arctic archipelago, where about 60 % of the land is covered by glaciers. Groundwater recharge on Svalbard mainly occurs along temperate zones under glaciers, since a thick permafrost layer prevents infiltration of water. The size and thermal regime of the glaciers, and the permafrost distribution are highly dependent on climatic conditions. When glaciers decrease as a result of global warming, the temperate zone under glaciers may decrease, and this will influence groundwater recharge directly. A decrease in recharge may in turn lead to a decrease in groundwater discharge in artesian springs. The influence of global warming on arctic groundwater systems can be investigated with coupled water and heat transport models. The main difficulty with arctic groundwater systems is the collection of field data, leading to the necessity of making assumptions while modeling such systems. We investigated the influence of recharge on an arctic groundwater system by means of modeling 3D coupled groundwater flow and heat transport. Simulated spring temperatures and permafrost boundaries were comparable with existing field data. In the simulations the artesian spring did not freeze when the recharge decreased 50%. Instead, the groundwater absorbed more geothermal heat, and the outflow temperature increased. This indicates the permafrost groundwater system is buffered towards freezing. Influence of spatial variation of infiltration was found limited.