Geophysical Research Abstracts
Vol. 14, EGU2012-13690, 2012
EGU General Assembly 2012

Effects of Chinook winds (foehn) on snow cover in western Canada

M.K. MacDonald (1), R.L.H. Essery (1), and J.W. Pomeroy (2)

(1) School of GeoSciences, University of Edinburgh, Edinburgh, United Kingdom, (2) Centre for Hydrology, University of Saskatchwan, Saskatoon, Saskatchewan, Canada

Chinooks are the North American variety of foehn: strong, warm and dry downslope winds that occur as a result of synoptically driven cross barrier flow. In Alberta, Canada, these winds occur as the predominant cold Arctic air mass is displaced by westerly Pacific winds as they descend the eastern slopes of the Rocky Moutains. The strong wind speeds, high temperatures and humidity deficits cause the ablation of important prairie surface water stores, particularly snow cover during winter. The aim of this study was to characterize and quantify the ablation of surface water stores during Chinooks. This was accomplished using detailed in-situ observations of meteorological variables, and snowpack and subsurface conditions at three open, prairie sites over two winters. One site is a FluxNet site located in southern Alberta, and is subject to frequent Chinooks and low winter precipitation. Another site is located in an open area immediately adjacent to mountains, and is subject to other strong wind events in addition to Chinooks. The other site is located in central Alberta, and is least affected by Chinooks. Eddy covariance systems were deployed and manual snow surveys were performed. A number of snow models were evaluated to supplement observations, to elucidate important snowpack processes and to establish a model that is appropriate for Chinook conditions. Observations and modelling results show that ablation during Chinooks can generally be considered as three phases: the cold, transitional and warm phases. Winds tend to remain strong throughout Chinooks. During the cold phase, ambient temperatures increase but are below freezing and snow covers (if present) are complete. As a result, considerable snow transport by wind occurs and blowing sublimation rates are high. During the transitional phase, ambient temperatures rise above freezing. Snow covers warm and begin to become discontinuous. Sublimation from the snowpack occurs. Blowing snow is mostly suppressed; only particularly strong winds can erode snowpacks. During the warm phase, ambient air temperatures are considerably above freezing. Both snowmelt and sublimation are significant. Snow covers become highly discontinuous or even completely vanish, and meltwater evaporates. Latent heat fluxes exceeding 200 W•m-2 (upward) were observed during Chinooks, and sensible heat fluxes approaching this value (downward) were also observed. Model results show that snow cover simulations are most sensitive to parameterizations for turbulent transfer, liquid water content and the effects of protruding vegetation on snow transport.