Heat Balance Analysis during the Snow Covered Season in the Alpine Area

*Motoshi Nishimura[1], Akihiko SASAKI[2], Keisuke Suzuki[2]

1. Graduate school of Science and Technology, Shinshu University, 2. Faculty of Science, Shinshu University

This study investigates the characteristics of snowmelt in Norikura highland using heat balance method to calculate the amount of snowmelt and ablation process of snow cover. Since, snowmelt varies according to regions this study is vital in showing the various features of snowmelt in different environment; climate, vegetation and snowmelt seasons.Meteorological observation station was installed on the site of Norikura highland located at 1590 m. a. s. l. and heat balance analysis was carried out on the snow surface during the snow cover seasons. The following meteorological data were obtained: air temperature, related humidity, wind speed, atmospheric pressure, precipitation, net shortwave radiation, net longwave radiation and snow depth. Heat balance was used to analyze the energy budget and the turbulent flux on a snow surface for the four snow cover seasons.The result showed that multi-year datasets of meteorological observation had some characteristics like low air temperature, weak wind speed and low vapor pressure. Throughout each snow covered seasons: net radiation offered almost 100-110 % energy ratio to the total snowmelt energy, sensible heat flux occupied 10-15 % of energy and latent heat did about -20 % respectively. Days were classified into rainy hours or not rainy hours and the result showed that the former net shortwave radiation decreased to about 20-30 W m^{-2} while net longwave radiation increased to about 40-50 W m^{-2}. In addition, latent heat and sensible heat also increased to about 2-3 W m^{-2} and 11-13 W m^{-2} respectively. However, conducted heat from rain is little and consequently when it rains larger snowmelt energy was offered. In late snowmelt season, the measured volumes of melt water equivalent with the result of heat balance method were compared. Each method of snowmelt water equivalent was almost corresponding. In conclusion, meteorological features in this site showed specific snowmelt properties. Low temperature, low vapor pressure and weak wind speed caused small turbulent heat flux which shows that net radiation controlled the snowmelt process in this site. More snowmelt energy was supplied when it rained because, the cloud strengthens the downward longwave radiation, atmospheric temperature and vapor pressure is increased. Finally, appropriate policy suggestions were highlighted.

Keywords: heat balance analysis, snowmelt, meteorological observation

