Seasonal Characteristics of Surface Meteorological and Radiative Fluxes on the East Rongbuk Glacier in the Mt. Qomolangma (Mt. Everest) Region

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Ground-based measurements are essential for understanding alpine glacier dynamics, especially in remote regions where in-situ measurements are extremely limited. Meteorological and radiative fluxes were measured over the accumulation area on the East Rongbuk Glacier, Mt. Qomolangma (Mt. Everest) at an elevation of 6,560 m a.s.l. Measurements were conducted using an automatic weather station (AWS) from May 1 through July 22, 2005 (spring-summer period) and from October 2, 2007 through January 20, 2008 (autumn-winter period). Surface meteorological and radiative characteristics were strongly controlled by two major synoptic circulation regimes: the southwesterly Indian monsoon regime in summer and the westerlies in winter. At the AWS site on the East Rongbuk Glacier, north or northwest winds prevail with higher wind speed (up to 35 m s^{-1} in January) in winter and south or southeast winds predominate after the onset of the southwesterly Indian monsoon, with relatively low wind speed in summer. Intensity of incoming shortwave radiation is extremely high due to its high elevation and high reflective surrounding surface. Mean hourly incoming shortwave radiation was higher in May than in June and July, 2005, although solar angle is higher in June than in May. Higher incoming shortwave radiation in May is mainly due to broken cloud effect,

while lower incoming shortwave radiation in June and July is mainly due to overcast cloud effect after the onset of the southwesterly Indian monsoon. A striking feature is that the observed 10-minute mean incoming shortwave radiative fluxes around local noon were frequently higher than the solar constant at the top of the atmosphere from May through July, 2005. The observed higher-than-solar-constant values are mainly due to the impact of local convective broken clouds and high surface reflectivity over the surrounding terrain. We estimated that the horizontal component of received diffusive solar radiation from the surrounding terrain ranged from 140 to 310 W m^{-2}, accounting for about 10 to 25% of the observed incoming shortwave radiation under clear sky conditions. This value could be even higher under overcast cloudy days. There was no single higher-than-solar-constant measurement from October, 2007 through January, 2008 at this site due to overall lower solar angle. The mean surface albedo ranged from 0.72 during the summer-spring period and 0.69 during the autumn-winter period. The atmospheric incoming longwave radiation was strongly controlled by cloud conditions and atmospheric moisture content. Overall impact of clouds on net radiation balance is negative in the Mt. Qomolangma region. The daily mean net all-wave radiation was positive during the entire spring-summer period and mostly positive during the autumn-winter period except for a few overcast cloudy days. On a monthly basis, net all-wave radiation was always positive.

Key Words: Mt. Qomolangma, glacier, snow surface, radiation feature, meteorological characteristic