



TOPEX/Poseidon observation of ice thinning over Mt. Tanggula, Tibet

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Retreat of glacier and thinning of ice cover over high-altitude mountains are recognized as symbols of global warming. Observations of such retreat and thinning can be based on terrestrial and space-borne methods. Here we show the thinning of the ice cover over Mt. Tanggula using height observations from the satellite altimeter mission TOPEX/Poseidon (T/P). With an average height of 5500 m, Mt. Tanggula is one of the origins of Yangtze River, China. Pass 155 of T/P travels through the southeastern part of Mt. Tanggula (also Jason-1 and 2, but no waveforms are found here). Here, the radar waveforms of T/P are over a relatively flat ice sheet (sloping at few degree) and are less contaminated compared to those over the non-ice covered region. We retrack such waveforms to form a time series of height change. The tropospheric delays are accounted for using the ECMWF model. We consider also slope and terrain corrections, but such corrections yield large uncertainties in the heights. Several techniques of height determination from the T/P observations are tested to best estimate the height changes. Use of only specular waveforms leads to an optimal result. The rate of height change from 1994 to 2002 is -14.60 m/year. In this period, a nearby weather station shows a temperature rate of 0.06 degree/year and a precipitation rate of 10 mm/year. Lake Chibuzhang, situated west of Mt. Tanggula and receiving Tanggula's melting ice, shows an increasing rate of 0.2 m/year at the lake level during 1994-2002. This paper will also report the problems and limitations of radar altimeter in the determination of ice cover change.