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Distribution of debris thickness and its effect on ice melt at Hailuogou Glacier, southeastern Tibetan Plateau

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Debris cover is widely present in glacier ablation areas of the Tibetan Plateau, and its spatial distribution greatly affects glacier melt rates. High resolution in situ debris thickness measurements on Hailuogou Glacier, Mount Gongga, south-eatern Tibetan Plateau, show its pronounced inhomogeneous distribution in space. An analysis of transverse and longitudinal profiles indicates that the ground-surveyed debris thicknesses and ASTER-derived thermal resistances of debris layers correlate strongly over the entire ablation area. Across- and along-glacier patterns of ASTER-derived thermal resistance correspond well with spatial patterns of debris thickness, which may reflect large-scale variations in the extent and thickness of the debris cover. The ice melt rate variability over the ablation area simulated by a surface energy-balance model, in which thermal resistance of the debris layer is taken into account, clearly indicates the crucial role of debris and its spatial continuity in modifying the spatial characteristics of melt rates. Due to the inhomogeneous distribution of debris thickness, about 67% of the ablation area on Hailuogou Glacier has undergone accelerated melting, whereas about 19% of the ablation area where the debris inhibits melting, and only 14% of the ablation area where the sub-debris melt rate equals the bare-ice melt rate.

Keywords: Hailuogou Glacier, debris, ice melt, effect, Tibetan Plateau