



The formation of ice sails

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Ice sails are prominent pyramid-like ice forms which are found on certain debris-covered glaciers in the Karakoram, for example on Baltoro Glacier. Two questions immediately arise concerning their existence: what causes their formation (and their subsequent eventual disappearance), and why are they not found more widely? The answer to both of these questions can be provided by a mathematical model of glacier surface melting which takes account of the effect of debris cover on the melt rate. In particular, the effect noted by Östrem that very thin debris cover causes an increase in melt rate allows for instability in a uniform debris cover, and numerical solutions of the model show that sails of the correct dimensions and shape grow and subsequently decay as the debris cover thickens downglacier. The apparent distinguishing feature which promotes sail growth is a low relative humidity, which allows the bare ice melt rate to be significantly lower than the peak debris-covered value.