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Dynamic Ablation Due to Debris from Ice (DADDI)

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Whilst several studies have investigated the melt-rates of debris covered glaciers, the dynamic process by which glaciers endogenously contribute (via melt-out) to the debris layer, has received less attention. This dynamic process implies that the supra-glacial debris depth is a function of time, and thus the energy transmission between debris surface and ice surface will also be time dependent. Consequently, static estimates of melt rates over long enough periods of time will be inaccurate. In order for models to make up for this discrepancy, we produced an energy balance model, based upon a mathematical construct similar to a (modified) classical 'Stefan Problem'. However, for such a model to capture empirical evidence of melt-rate phenomenon as the debris depth increases (fast rising limb of the meltdebris-thickness plot, followed by a slow decline), we show that an additional thermodynamic consideration must be included: evaporation when the debris layer is thin. The results replicate observed melt-rates, and (it is hoped) the model may be used to produce improved estimates of the life-time of glaciers.