

## **An eddy covariance system to characterize the atmospheric surface layer and turbulent latent heat fluxes over a debris-covered Himalayan glacier.**

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Over debris-covered glaciers, water content variations in the debris layer can drive significant changes in its thermal conductivity and significantly impact melt rates. Since sublimation and evaporation are favoured in high-altitude conditions, e.g., low atmospheric pressure and high wind speeds, they are expected to strongly influence the water balance of the debris-layer. Dedicated latent heat fluxes measurements at the debris surface are essential to characterize the debris heat conductivity in order to assess underlying ice melt. Furthermore, the contribution of the turbulent fluxes in the surface energy balance over debris covered glacier remains uncertain since they are generally evaluated through similarity methods which might not be valid in complex terrain.

We present the first results of a 15-day eddy-covariance experiment installed at the end of the monsoon (September-October) on a 3-m tower above the debris-covered Lirung glacier in Nepal. The tower also included measurements of the 4 radiation components. The eddy covariance measurements allowed for the characterization of the turbulence in the atmospheric surface layer, as well as the direct measurements of evaporation, sublimation and turbulent sensible heat fluxes. The experiment helps us to evaluate the contribution of turbulent fluxes to the surface energy balance over this debris-covered glacier, through a precise characterization of the overlying turbulent atmospheric surface layer. It also helps to study the role of the debris-layer water content changes through evaporation and sublimation and its feedback on heat conduction in this layer. The large observed turbulent fluxes play a significant role in the energy balance at the debris surface and significantly influence debris moisture, conductivity and subsequently underlying ice melt.