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Time series of the snow microstructure metamorphism in presence of mineral dust

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Light absorbing impurities in snow such as black carbon or mineral dust are known to decrease snow albedo. This engenders several positive feedbacks generally leading to an acceleration of snow metamorphism. Though many studies have been focused on measuring, modeling and quantifying the radiative impact of light absorbing impurities in snow, only a few have been focused on the non-radiative impact of such impurities and especially on the impact of the presence of impurities directly on snow metamorphism. In this study we present 'in vivo' X-ray tomography monitoring of snow microstructure containing mineral dust (desert sand with size distribution centered at 1 micron) under isothermal and temperature gradient boundary conditions. Under temperature gradient metamorphism, the dust particles exhibit a downward movement due to a loss of contact with the ice matrix induced by vapor transport, while the ice mass flux is aligned (upward) with the temperature gradient. The specific surface area decrease is also observed to be faster next to dust particles. Snow microstructure evolution along with the change in the spatial distribution and exact location of the dust particles observed during such an experiment are especially relevant to understand metamorphism/impurities interplays for polar snowpacks that frequently undergo high temperature gradient.