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Dust and Black Carbon size distributions in snow and some links to snow physics.

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Snow contain many insoluble particles, some of which can absorb light (such as mineral dust and black carbon) and are responsible for a large climate forcing, both directly through their influence on snow albedo and indirectly by inducing snow metamorphism – albedo feedbacks.

Light absorbing particles (LAPs) influence snow metamorphism and melting by changing the heat distribution in the snowpack. Conversely, some physical processes in snow influence the size distribution of LAPs in the snowpack: for example, melting partially redistributes the particles and dry metamorphism can induce vertical movement of particles. Yet, few studies investigate those couplings due to the scarcity of detailed physical and chemical characterization of snow.

During two consecutive winters, such detailed characterization of snow was conducted at a high altitude site in the Alps (col du Lautaret, 2058m a.s.l.). The physical properties used here include detailed profiles of snow types enabling to investigate links between LAPs size distribution and snow evolution.

Size distributions analysis shows that for both black carbon (BC) and mineral dust, concentrations are often underestimated due to a significant fraction of particles being too big to be detected by the instruments. The median value of this undetected fraction is at least 20% for dust and at least 5% for BC. In more than 10% of the samples, It even exceeds 60% for dust and 25% for BC.

We then used stratigraphic data to explore the impact of partial melt and refreeze on LAP size distributions through an hypothetic coagulation mechanism induced by freeze-thaw cycles. No visible effect was found for dust, due to the higher variability of deposited particles size distributions. Conversely, freeze-thaw cycles seem to lead to a slight shift of BC size distributions toward the big particles.