Submitted Abstract

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Abstract

Ice aprons (IAs) are very poorly studied components of the Alpine cryosphere. They are thin ice bodies adhering to high altitude steep rock faces above the equilibrium line altitude. In the Mont-Blanc massif (MBM), we mapped 423 IAs (from 0.001 to 0.04 km2) using very high-resolution optical satellite images from 2019.

To understand their evolution, we used three methods in the MBM:

- between c. 1850 and 2018, we quantified their surface area variations from terrestrial and aerial oblique photographs via photogrammetry; the studied IAs on four different faces shrank from 1854 to the 1950s, before expanding until the end of the 1990s, while the beginning of the 21st century shows a strong decrease in surface area;

- to precise the first results, we precisely mapped the surface area of the IAs using high-resolution aerial and satellite photographs from 1952, 2001, 2012 and 2019; the total area, from 7.93 km2 in 1952, was reduced to 5.91 km2 in 2001 (-25.5 %) before collapsing to 4.21 km2 in 2019 (-47 % since 1952);

- over the 5 last years, we monitored an IA on the Triangle du Tacul (TDT) using ablation stakes; it loses a thickness of several tens of cm each year.

We found a very robust correlation for temperature proxies with the relative area loss of IAs, indicating the strong influence of the changing climate on the evolution of IAs. This retreat is generally accompanied by a sharp increase in the frequency of rockfalls from recently deglaciated areas.

We also studied the dynamics and age of few IAs using ice cores from the MBM. Texture (microstructure and lattice-preferred orientation, LPO) analyses showed that IAs deforms under a low strain-rate simple shear regime. Micro-radiocarbon dating indicates that the TDT ice can be older than 6000 years BP at the rock-ice interface, making IAs probably interesting environmental archives.