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Investigating algal blooms on ice in an Alpine glacier

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Glacier retreat is one of the most impressive consequences of current climate change. A deep understanding of the complex dynamics which modulate and govern ice melting and glacier retreat, is still lacking. One of the less investigated points concern the relationship between biotic and abiotic processes occurring on the surface of glaciers and their impact on ice albedo. The latter is a key factor in determining the radiative balance of glaciers and thus their response to external factors. It is known that the ablation region of retreating glaciers is often affected by darkening processes. These processes can be related to the formation of cryoconite (Takeuchi et al., 2002), the typical dark sediments forming on melting ice, but also to dust deposition (Oerlemans et al., 2009), to the accumulation of impurities entrapped within ice, or to algal blooms during summer (Lutz et al., 2014).
In this contribution, we present novel data gathered from the Alpine valley glacier Vadret da Mortertasch (Switzerland) during the summer season of 2016 and 2017. After having assessed the impact of cryoconite and mineral dust on snow and ice radiative properties (Di Mauro et al., 2015; 2017), we focus here the attention to the role played by algal blooms. This phenomenon is well known to occur on snow fields (Ganey et al., 2017), but few studies are available concerning their impact on bare ice (Stibal et al., 2017) and none in the Alpine context. We gathered extensive data from field spectroscopy, laboratory analysis and remote sensing (aerial photogrammetry using Unmanned Aerial Vehicles). Combining all these pieces of information it will be possible to disentangle the different contributes related to cryoconite, mineral dust and algal blooms, giving a first comprehensive picture of ice darkening in the European Alps.