

GEOTEXTILES ON ALPINE GLACIERS: SCIENCE-DRIVEN RECOMMENDATIONS AND GOOD PRACTICES

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Summary

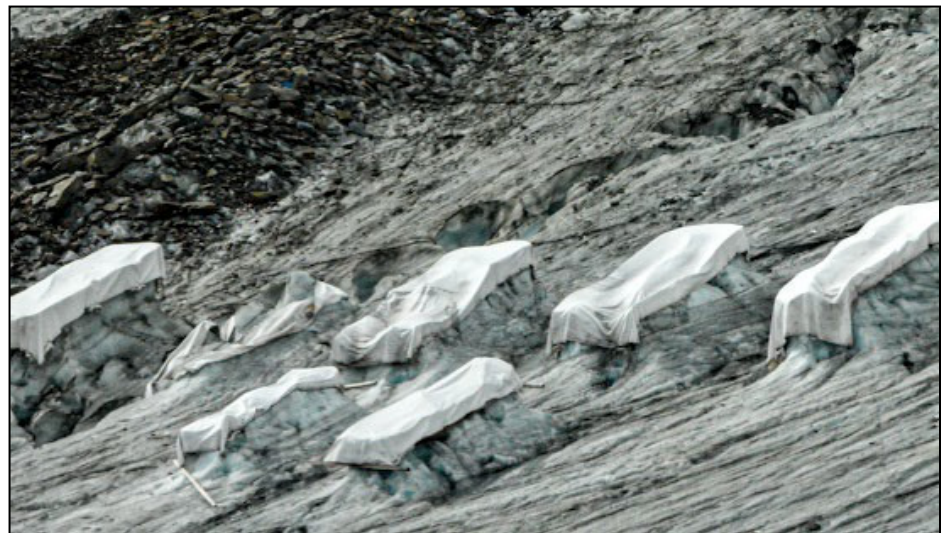
It is currently well known that climate change heavily threatens the quality and the conservation of glacial habitats worldwide. Glaciers are now melting at fast rates, and this process entails important socio-economic and

environmental consequences that should be promptly addressed. The use of geotextiles to cover alpine ice bodies to slow down ice loss has been on the rise in recent years, in an effort to preserve them wherever strong socio-economic interests are present (i.e., ski resorts). We highlight that such a strategy is not without negative consequences for the ecological status of these fragile ecosystems.



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Test fields on the Stubaier Gletscher, Sept. 2022 (©Birgit Sattler).

Introduction

Since the publication of the so-called *Brundtland Report* by the United Nations in 1987, the pursuit of a sustainable development path became increasingly more important, permeating multiple political contexts of our modern society. Concurrently, strong awareness arose among the public as well, which soon became a pillar of support for the implementation of more sustainable-driven policies. This way, for the first time, environmental concerns were recognized as a key component of a development “*that meets the need of the present, without compromising the ability of future generations to*

meet their own needs”. In a complementary way, a policy that - when declined on the three fronts of economic, social and environmental sustainability - does not yield a positive outcome for all of them, cannot be deemed truly sustainable. This framework should call for an even more careful assessment in all those cases in which the implementation of a policy could not just turn out fruitless but instead damaging towards the quality of natural resources. Such is the case for climate change adaptation and mitigation strategies in alpine glacial environments.

The Problem

*Fiber load in snow sampled from below the fleeces
(© Klemens Weisleitner - whiteframe-photo.com).*



It is well-known that glaciers are shrinking in a global fashion, the situation being particularly dramatic in the European Alps. In many cases, ski resorts located on glacial habitats represent strategic infrastructures that are directly affected by the consequences of ice loss, primarily due to public safety and economic concerns. For these reasons, during the last twenty years, we have been witnessing a steady increase in the deployment of geotextile fleeces made of polypropylene to preserve the ice on specific areas of ski slopes and around crucial infrastructure (e.g., pillars supporting lift operations). To our knowledge, no in-situ testing was conducted before their deployment to account for any possible environmental repercussions, nor any “good practices” have ever been agreed on to reduce their impacts.

Based on the results of our investigation, we are drawn to conclude that the state-of-the-art fleeces are not yet to be deemed a long-term solution. The plastic fiber release tendency of polymer-based geotextiles cannot be ignored, as clear signs of contamination can be found from the upper deployment areas to the multiple freshwater and riparian downstream ecosystems. This includes multiple matrices and habitats, from free-flowing water to the sediment where a plethora of organisms seek refuge. Making things worse, the long residency time of these fibers in cold environments implies that such an extensive contamination will characterize these fragile but precious ecosystems indefinitely, clashing directly against the sustainability paradigm of today.

The science-based evidence

Research has been conducted on the fleeces through test fields for the last twenty years, in parallel with their first deployment, in the framework of multiple bachelor and master's theses (ca. 20). The targeted technical issues and environmental concerns include fiber release, across different polymers, stitching strategies and layering, the (micro)biological shifts on the communities inhabiting the snow, ice and riparian habitats and the repercussions following additives leaching from the materials, among many others. Plastic fibers were found in all sampled habitats. We estimate that around 8km of fibers in accumulative length were present directly beneath a 9m² polypropylene test field. In the invertebrate samples taken from

multiple spots on the mainstream in the Stubai Valley, entanglement is particularly concerning when observed for Trichoptera, a clade that mistakenly uses the fibers to build their portable cases.

A stonefly from a glacial stream entangled in fibers (© Patrick Schwenter).



Recommendations

- Foster the collaboration of research institutes, stakeholders and manufacturers to develop environmentally friendly and truly sustainable alternatives.

- Inform the public about methods & purpose.

- Promote circularity in the form of a used fleece buy-back by the manufacturer from the ski resorts.