EGU24-13462, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-13462
EGU General Assembly 2024

Local anthropogenic factors contributing to constrasting glacier response in two mountain glaciers, located in Central Andes, Chile

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Contrasting behaviour of neighbouring mountain glaciers, sharing similar mass balance gradients, have been observed, suggesting the influence of local anthropogenic factors altering the surface energy balance and then explaining larger down-wasting trends in glacier response. It is in this context that for this work the comparison of two contrasting glaciers was used to analyze these differences: considering the Paloma Norte Glacier (PNG), exposed to anthropogenic emissions from local mining activities, and the Yeso Glacier (YG), isolated of these sources. The objective of this research is to combine the remote analysis of light-absorbing particles, such as Black Carbon (BC), Organic Carbon (OC), as well as the estimation of area and albedo, together with the analysis of local climatic trends of each glacier according gridded data, in order to evaluate their differences and the influence of each of these parameters on the surface variation of each glacier.

We determined glacier shrinkage, interannual albedo reduction and black carbon estimates using satellite images over the last 22 years for the Paloma Norte and Yeso glaciers. The results show that in the range 2000-2022, the GPN experienced a 27.11% greater surface loss than the GY, 83.49% higher albedo change rates, and almost 23 times higher BC+OC concentrations compared to the GY. Furthermore, the multivariate regression analysis identified that the most influential parameters was BC-OC, which is consistent with the disparities in glacial retreat observed in this period.

These results are part of an ongoing research, where, in addition, it is intended to contrast these values with measured data at ground stations, where we will use the data from NUNATAK-1 (-32,844, -70,129) and 2 (- 33,665, -70,086) refuge laboratories in the Central Andes. NUNATAK-1 is a portable, flexible, collaborative scientific platform belonging to CETAM, specially designed for research campaigns under extreme conditions equipped with different automatic and real-time monitoring instruments to measure meteorology, net albedo, solar radiation, gases and aerosols, among others. Which are parameters that will also be used to compare with glacial ablation and radiative transfer models, to evaluate the scenarios of albedo change under a pristine environment and another under the scenario of aerosol deposition on the surfaces of the glaciers of interest. All the above mentioned is being carried out to determine to whether these differences

are purely due to the orientation of each glacier or the local anthropogenic influence to which they are exposed, and thus decouple the natural effect of climate change from the local anthropogenic effect.

In summary, the results of this work will aim to guide decision-makers, to guarantee greater protection and awareness of the effects that local emissions may (or may not) have on the conservation of these important reservoirs of drinking water, which will allow for a decoupling of the influence and/or impact of local anthropogenic activity from the natural effect of climate change.

Acknowledgments: This research has been carried out with the financial support of CETAM-UTFSM, and the ANID projects: Fondecyt Initiation 11220525, Fondecyt Regular N° 1221526, ANID Anillo ACONCAGUA Project N°ACT210021 and FOVI230167.