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## Glacier Clusters identification across Chilean Andes using Topo-Climatic variables

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This study presents a glacier clustering for the Chilean Andes (17.6-55.4°S) realized with the Partitioning Around Medoids (PAM) algorithm and using topographic and climatic variables over the 1980-2019 period. We classified ~24,000 glaciers inside thirteen different clusters (C1 to C13). These clusters show specific conditions in terms of annual and monthly amounts of precipitation, temperature, and solar radiation. In the Northern part of Chile, the Dry Andes (17-36°S) gather five clusters (C1-C5) that display mean annual precipitation and temperature differences up to 400 mm/yr and 8°C, respectively, and a mean elevation difference reaching 1800 m between glaciers in C1 and C5 clusters. In the Wet Andes (36-56°S) the highest differences were observed at the Southern Patagonia Icefield (50°S), with mean annual values for precipitation above 3700 mm/yr (C12, maritime conditions) and below 1000 mm/yr in the east of Southern Patagonia Icefield (C10), and with a difference in mean annual temperature near 4°C and mean elevation contrast of 500 m.

This classification confirms that Chilean glaciers cannot be grouped only latitudinally as it has been commonly considered, hence contributing to a better understanding of recent glacier volume changes at regional and watershed scales. An example of this was observed in the Maipo watershed (33°S), where the Echaurren Norte glacier is located, which is the reference glacier for Chile and WGMS because it has the oldest time series of mass balance monitoring in the Andes, followed by the Piloto Este glacier, since the 70's. Indeed, we identified that Echaurren Norte glacier only has similarities with 5% of the glacierized surface area of the Maipo watershed. Echaurren Norte glacier is within a glacier cluster that presents warmer and wetter climate conditions (3.1°C, 574 mm/yr) than the average of the watershed, a cluster that contains also 68% of the glacierized surface composed of rock glaciers.