Submitted Abstract

ID IMC22-FSAbstr- 701

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Country	Chile
Region	South America
Title	Geomorphological Control Of The Upstream Propagation Of Glacier Terminal Changes In The Patagonian Andes.
Keywords	Subglacial Topography, Climate Change, Thinning Propagation
Type	List Of Focus Session
Focus Session ID	06

Abstract

The global extension of glaciers peaked in the Holocene by the end of the Little Ice Age, followed by a nearly continuous decline although punctuated by growing periods in some regions. Nowadays, knowing where glaciers are going to shrink faster is uncertain. There are several examples where glaciers of similar size and elevation range within a region respond differently to the same changes in climate. The Karakorum anomaly is one of the most famous examples of this situation. Another example is the Vilcabamba area in Peru, where glaciers are above 5500 m.a.s.l. show higher shrinking rates than glaciers at 5300-5500 m.a.s.l., likely explained by prevalent higher slopes (>45°). Therefore, determining locations where glaciers may remain protected despite significant climatic changes (a concept called "Climate Change Refugia") becomes essential to support preparedness and adaptation measures. Glaciers of South America are responsible for a significant contribution to sea-level rise (SLR) in the 20th century, with an estimated mass loss of -30.4 ± 13 Gt/yr from 2012 to 2019. Natural hazards associated with glacierized environments in this region are also of concern. The receding glaciers are leaving new glacial lakes, expanding existing glacial lakes, and destabilizing steep hills that can collapse. Additionally, streamflow from small glaciers, which allow maintaining local ecosystems during the summer, are at risk when glaciers' volume decrease. The mass balance of glaciers depends on two main processes: (1) the thermodynamic mass balance, which is usually used to assess climate change impacts on glaciers or estimate streamflow from glaciers, and (2) glacier shape and subglacial topography, intrinsic characteristics basal shear stress that control downhill movement. We seek to determine characteristics that control the upstream propagation of glacier thinning in Andean glaciers as a response to changes in climate. Thus, this work aims to understand the impact of geomorphometric characteristics, emphasizing the relationship of glacier basal topography and mass balance sensitivity to the present climate. We hypothesize that changes in the glacier terminus propagate upstream constrained by the subglacial topography, for example, the degree of "U" of the subglacial valley, promontories' size and distribution, elevation concerning sea level, unevenness, and slope. To evaluate this, we will calculate the elevation difference of the Andean glaciers to estimate the loss of ice cover over time. Subsequently, we will estimate the surface mass balance anomaly to determine ablation, allowing us to model the thinning of the glaciers through the diffusive kinematic wave equation.