Assessing snow accumulation patterns and changes on the Patagonian Icefields

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Recent evidence shows that most Patagonian glaciers are receding rapidly. Due to the lack of in situ long-term meteorological observations, the understanding of how glaciers are responding to changes in climate over this region is extremely limited, and uncertainties exist in the glacier surface mass balance model parameterizations. This precludes a robust assessment of glacier response to current and projected climate change. An issue of central concern is the accurate estimation of precipitation phase. In this work, we have assessed spatial and temporal patterns in snow accumulation in both the North Patagonia Icefield (NPI) and South Patagonia Icefield (SPI). We used a regional climate model, RegCM4.6 and four Phase Partitioning Methods (PPM) in addition to short-term snow accumulation observations using ultrasonic depth gauges (UDG). Snow accumulation shows that rates are higher on the west side relative to the east side for both icefields. The values depend on the PPM used and reach a mean difference of 1,500 mm w.e., with some areas reaching differences higher than 3,500 mm w.e. These differences could lead to divergent mass balance estimations depending on the scheme used to define the snow accumulation. Good agreement is found in comparing UDG observations with modeled data on the plateau area of the SPI during a short time period; however, there are important differences between rates of snow accumulation determined in this work and previous estimations using ice core data at annual scale. Significant positive trends are mainly present in the autumn season on the west side of the SPI,

while on the east side, significant negative trends in autumn were observed. Overall, for the rest of the area and during other seasons, no significant changes can be determined. In addition, glaciers with positive and stable elevation and frontal changes determined by previous works are related to areas where snow accumulation has increased during the period 2000-2015. This suggests that increases in snow accumulation are attenuating the response of some Patagonian glaciers to warming in a regional context of overall glacier retreat.