EGU21-10973
https://doi.org/10.5194/egusphere-egu21-10973
EGU General Assembly 2021

Projected increases in surface melt and ice loss and their potential feedbacks for the Northern and Southern Patagonian Icefields

Claudio Bravo[1,2], Deniz Bozkurt[3], Andrew N. Ross[4], and Duncan J. Quincey[1]

[1]School of Geography, University of Leeds, United Kingdom (claudiobravo.lechuga@gmail.com)

[2]Centro de Estudios Científicos, Valdivia, Chile

[3]Department of Meteorology, University of Valparaíso, Valparaíso, Chile and Center for Climate and Resilience Research (CR)2, Santiago, Chile

[4]School of Earth and Environment, University of Leeds, Leeds, United Kingdom

Patagonia (40°S-55°S) includes two large icefields, the Northern and Southern Patagonian Icefields (NPI and SPI). Most of the glaciers within these icefields are shrinking rapidly, raising concerns about their contribution to sea-level rise in the face of ongoing climatic change. This ice volume loss has led to rapid changes that remain imprinted on the Patagonia landscapes. In view of the local, regional and worldwide impacts of glacier retreat in Patagonia, an assessment of the potential future surface mass balance (SMB) and ice loss of the icefields, is critical. We seek to provide this assessment by modelling the SMB between 1976 and 2050 for both icefields, using regional climate model data (RegCM4.6) and a range of emission scenarios at a spatial resolution of 10 km. Additionally, using meteorological observations during strong drought conditions which occurred in Patagonia in 2016, key meteorological and glaciological characteristics are described, quantified and analysed in order to assess possible future conditions.

For the NPI, a reduction between 1.51 m w.e. (RCP2.6) and 1.88 m w.e. (RCP8.5) was projected, suggesting that negative SMB will prevail well into future decades. For the SPI the projected reduction was within the range of 1.12 m w.e. (RCP2.6) to 1.45 m w.e. (RCP8.5), which implies positive SMB will dominate, albeit at a lower rate than the current observed. However, if it is assumed that the recent frontal ablation rates tend to continue into future decades, ice loss and sea-level contributions will increase for both Icefields. The trend towards lower SMB is explained by an increase in melt, and to a lesser extent by a reduction in snow accumulation.

Several mechanisms not accounted for our modelling approach could act as positive feedbacks in the magnitude of the ice loss. We summarise these feedbacks in a conceptual framework based on a combination of our own meteorological observations as well as on the recent research findings. This framework highlights the diversity of meteorological and glaciological conditions that can prevail even between nearby glaciers. Importantly, more frequent thermal inversion events and increased meltwater availability are likely to trigger ice dynamics changes and potential increases in ablation. Together, these plus other factors make the prediction of future glacier response and evolution in Patagonia a very complex and challenging task.