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## The impact of glaciers on the long-term hydrology of a high-elevation Andean catchment

**Michael McCarthy**<sup>1,2</sup>, Flavia Burger<sup>3</sup>, Alvaro Ayala<sup>4</sup>, Stefan Fugger<sup>1</sup>, Thomas E Shaw<sup>5</sup>, Evan Miles<sup>1</sup>, Shelley MacDonell<sup>4</sup>, Atanu Bhattacharya<sup>6</sup>, Tobias Bolch<sup>6</sup>, James McPhee<sup>5</sup>, and Francesca Pellicciotti<sup>1,3</sup>

<sup>1</sup>Swiss Federal Institute for Forest Snow and Landscape Research, Mountain Hydrology and Mass Movements, Birmensdorf, Switzerland (michael.mccarthy@wsl.ch)

<sup>2</sup>British Antarctic Survey, Ice Dynamics and Palaeoclimate, Cambridge, UK

<sup>3</sup>Northumbria University, Department of Geography and Environmental Sciences, Newcastle upon Tyne, UK

<sup>4</sup>Centro de Estudios Avanzados en Zonas Aridas, La Serena, Chile

<sup>5</sup>Universidad de Chile, Department of Civil Engineering, Santiago, Chile

<sup>6</sup>University of St Andrews, School of Geography and Sustainable Development, St Andrews, UK

The Andean cryosphere is a vital water resource for downstream populations. In recent years, it has been in steep decline as a whole, but shown strong spatio-temporal variability due to climatic events such as the current mega drought in central Chile. Glacio-hydrological models are necessary to understand and predict changes in water availability as a result of changes to the cryosphere. However, due to a lack of data for initialisation, forcing, calibration and validation, they are rarely used, especially in the Andes, for periods longer than a few years or decades. While useful insights can be gained from short-term modelling, there is a gap in our understanding of how glaciers impact hydrology on longer timescales, which may prevent local communities and governments from achieving effective planning and mitigation. Here we use the glacio-hydrological model TOPKAPI-ETH – initialised, forced, calibrated and validated using unique and extensive field and remote sensing datasets – to investigate glacier contributions to the streamflow of the high-elevation Rio Yeso catchment, Chile, over the past 50 years. We focus in particular on: 1) fluctuations in glacier surface mass balance and runoff and associated climatic variability; 2) if peak water has already occurred and when; 3) the effect of supraglacial debris cover on seasonal and long-term hydrographs. We offer insights into some of the challenges of running glacio-hydrological models on longer timescales and discuss the implications of our findings in the context of a shrinking Andean cryosphere.