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Dear Editor,

Please consider our manuscript entitled: "*Poleward shift of subtropical highs drives Patagonian glacier mass loss*" by Brice Noël, Stef Lhermitte, Bert Wouters and Xavier Fettweis submitted to Nature Climate Change.

We present novel, long-term reconstructions (1940-2023) of Patagonian glacier surface mass balance (SMB), i.e., the difference between precipitation accumulation, sublimation and meltwater runoff, from two state-of-the-art regional climate models, statistically downscaled to 500 m spatial resolution. These high-resolution SMB products agree with point in-situ measurements, and combined with published solid ice discharge estimates, can for the first time accurately capture glacier mass loss recorded by GRACE/GRACE-FO satellites in the last two decades.

We identify a strong link between Patagonian glacier mass loss and a long-term poleward shift of subtropical highs, favouring warm air advection towards the Southern Andes. The resulting atmospheric warming is 17% larger than the global average, and drives enhanced meltwater runoff while maintaining steady precipitation, hence triggering long-term SMB decline and subsequent increased mass loss. Since the 1940s, we estimate that Patagonian glacier mass loss has contributed  $4.1 \pm 0.6$  mm to global mean sea-level rise.

The manuscript (MS) contains:

**Title:** 72 characters  
**Abstract:** 150 words  
**Article:** 3,060 words  
**Methods:** 2,540 words  
**Captions:** 670 words  
**Figures:** 5  
**References:** 70

The Supplementary Information (SI) contains:

**Captions:** 1,070 words.  
**Figures:** 9  
**Tables:** 2  
**References:** 15

We suggest the following reviewers:

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We are looking forward to your response,  
Best regards,

Brice Noël and co-authors

