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Atmospheric drivers of Greenland ice sheet surface energy and mass balance changes as a function of elevation and circulation patterns

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Recent Greenland Ice Sheet (GrIS) surface mass loss has been attributed to the expansion of the bare ice area following the upward migration of the snowline along with persistent blocking systems. Given the temporal fluctuations and spatial heterogeneity of the ablation zone, the local impacts of atmospheric drivers on the GrIS surface energy and mass balance at different elevations and under various atmospheric circulation patterns remain poorly known.

Based on the 1959-2020 period, we present a new indicator of the North Atlantic influence over Greenland (NAG) as the combination of the North Atlantic Oscillation Index (NAO), the Greenland Blocking Index (GBI) and the vertically integrated water vapor over the GrIS. We explore the NAG monthly frequency and the inter-annual evolution along with large-scale spatial anomalies. With the support of a high-resolution regional climate model (RACMO2.3p2), we investigate the influence of spatio-temporal NAG fluctuations on atmospheric drivers, surface energy and mass balance fluxes, that triggered the expansion of the ablation zone to higher elevations. Finally, we assess NAG performance by comparing its results with NAO and GBI alone.