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Modelling the marine advance of the last Cordilleran ice sheet

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Marine advance of the last Cordilleran ice sheet onto the north-eastern Pacific continental shelf may have caused rapid fluctuations of sea level and potentially impacted upon human migration into North America. However the position of the former ice front was critically controlled by a process that remains poorly understood: glacier calving. Geomorphological reconstructions show that part of the presently oceanic areas were ice-covered, allowing for downstream formation of the well-studied Puget and Juan de Fuca lobes. Here we use a numerical glacier model (PISM) to reconstruct the former marine front of the Cordilleran ice sheet and its impact on upstream ice dynamics. Our simulations show that the use of a thickness-based calving law leads to a strong deficit of marine ice cover in the areas where existing reconstructions suggest its advance. In contrast, a physically-based parametrization of glacier calving using the main components of the strain rate tensor (eigencalving; A. Levermann, T. Albrecht, R. Winkelmann, M. A. Martin, M. Haseloff, and I. Joughin, The Cryosphere, 6, 273-286, 2012) reproduces the geomorphologically inferred ice extent.