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Interannual variability in temperature and precipitation alone cannot explain Holocene glacier fluctuations in the Southern Alps of New Zealand

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Several glacial modeling studies suggest that interannual climate variability within an unchanged mean climate state can cause large fluctuations in glacier length (∼1 km), which would complicate interpretations of moraine records as proxy evidence of past climatic change. We modeled glacier fluctuations forced by stochastic variability in mean annual temperature and total annual precipitation and compared them to the mapped and dated Holocene moraine sequence in the Cameron valley, New Zealand. Using a 2D coupled mass balance - ice flow model, we simulated interannual mass balance, ice volume, and glacier length changes and show that stochastic variability does not cause large advances (>300 m) of the Cameron Glacier. We suggest that the glacier has been responding to shifts in the mean climate, and thus its moraine record is a valuable indicator of past climate.