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Exploring the effects of climate variability on ice stream dynamics

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The narrow corridors of fast-flowing ice called ice streams are one of the most complex and less well-understood features in the dynamics of large ice sheets. They are key to paleoclimate reconstructions, predictions of sea level changes, and rapid disintegration of ice sheets during deglaciation. Ice streams also form the backbone of the flow field of ice sheets, whose dynamics are tightly coupled to the climate system. In this study we explore the links between streaming behaviour of large ice sheets and climatic forcing, which is known to exhibit a significant stochastic component. Counterintuitive and fundamental effects of stochastic forcings in dynamical systems have been recently recognized in the broad field of environmental sciences. Stemming from this research line, we investigate with a theoretical approach the interactions between stochastic climatic forcing due to climate internal variability and ice stream temporal dynamics. Our analysis shows that realistic, data-based climate fluctuations are able to (i) induce the co-existence of dynamic behaviours that would be incompatible in a purely deterministic system, and (ii) produce substantial changes in the domains of existence of the different deterministic regimes (steady streaming, sustained oscillations of ice stream velocity). Hence climate variability appears to play a significant role in the temporal dynamics of ice streams.