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## The tipping points of Pine Island Glacier, West Antarctica

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**Mass loss from the Antarctic Ice Sheet is the main source of uncertainty in projections of future sea-level rise, with important implications for coastal regions worldwide. Central to this is the marine ice sheet instability: once a critical threshold, or tipping point, is crossed, ice-internal dynamics can drive a self-amplifying retreat committing a glacier to substantial ice loss that is irreversible at time scales most relevant to human societies. This process might have already been triggered in the Amundsen Sea region, where Pine Island and Thwaites glaciers dominate the current mass loss from Antarctica. However, current modelling and observational techniques have not been able to establish this rigorously, leading to divergent views on the future mass loss of the West Antarctic Ice Sheet. Here we aim at closing this knowledge gap by conducting a systematic investigation of the tipping points of Pine Island Glacier using established early warning indicators that detect critical slowing as a system approaches a tipping point. We are thereby able to identify three distinct tipping points in response to increases in ocean-induced melt. The third and final event, triggered for less than a tripling of melt rates, leads to a retreat of the entire glacier that could initiate a collapse of the West Antarctic Ice Sheet.**