



Cascading transitions in the climate system

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A number of tipping elements in the Earth system have been identified among which the oceanic meridional overturning circulation. Here, we focus on the impact of the threshold behaviour of this large-scale subsystem on other coupled climate subsystems. We introduce a framework of (directionally) coupled tipping elements exhibiting *cascading tipping*, i.e. a sequence of abrupt transitions as tipping in one subsystem changes the background conditions for another subsystem. A mathematical framework of elementary deterministic cascading tipping points in autonomous dynamical systems is presented containing the double-fold, fold-Hopf, Hopf-fold and double-Hopf as the most generic cases. The potential of cascading tipping in the climate system is illustrated through conceptual models of the ocean circulation coupled to (i) the El Niño–Southern Oscillation (ENSO) system and (ii) the Antarctic land ice sheet.

Reference

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