

Earth's Excitable Carbon Cycle

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The history of the carbon cycle is punctuated by enigmatic transient changes in the ocean's store of carbon. Mass extinction is always accompanied by such a disruption, but most disruptions are relatively benign. The less calamitous group exhibits a characteristic rate of change whereas greater surges accompany mass extinctions [1]. But why? Analysis of a two-component dynamical system suggests that disruptions are initiated by perturbation of a permanently stable steady state beyond a threshold. The ensuing excitation exhibits the characteristic surge of real disruptions. In this view, the magnitude and timescale of the disruption are properties of the carbon cycle itself rather than its perturbation. Surges associated with mass extinction, however, require additional inputs from external sources such as massive volcanism. Modern inputs from anthropogenic emissions may exceed the excitation threshold during the present century.

References

- [1] D. H. Rothman, Thresholds of catastrophe in the Earth system, *Science Advances* **3**, e1700906, 2017.

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