Representing Arctic coastal erosion in the Max Planck Institute Earth System Model (MPI-ESM)

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The Arctic has warmed twice as fast as the globe and sea-ice extent has decreased, causing permafrost to thaw and the duration of the open-water period to extend. This combined effect increases the vulnerability of the Arctic coast to erosion, which in turn releases substantial amounts of carbon to both the ocean and the atmosphere, potentially contributing to further warming due to a positive climate-carbon cycle feedback. Therefore, Arctic coastal erosion is an important process of the global carbon cycle.

Comprehensive modelling studies exploring Arctic coastal erosion within the Earth system are still in their infancy. Here, we describe the development of a semi-empirical Arctic coastal erosion model and its coupling with the Max Planck Institute Earth System Model (MPI-ESM). We also present preliminary results for historical and future climate projections of coastal erosion rates in the Arctic. The coupling consists on the exchange of a combination of driving forcings from the atmosphere and the ocean, such as surface air temperature, winds and sea-ice concentration, which result in annual coastal erosion rates. In a further setp, organic matter from the eroded permafrost is provided to the ocean biogeochemistry model and, consequently, to the global carbon cycle including atmospheric CO₂.