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The Circum-Arctic Shelf Sediment CArbon DatabasE (CASSCADE): first analysis of spatial patterns and fluxes of terrestrial carbon input to the Arctic Ocean

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The circum-Arctic shelves are the main receptors of sediments and organic carbon (OC) from the surrounding Arctic permafrost region. Arctic rivers discharge about 33 Tg OC to the Arctic Ocean every year. Substantial amounts of terrigenous OC (14 Tg) are also annually released from Arctic permafrost by coastal erosion, yet with much larger uncertainties. While a large fraction of terrigenous OC in the Arctic Ocean is degraded to CO_2 and CH4, a yet poorly constrained amount is re-buried in shelf sediments.

The first Circum-Arctic Shelf Sediment CArbon DatabasE (CASSCADE) – an international collaboration compiling data on OC concentrations, isotopes (δ13C, Δ14C) and sediment fluxes from the published literature as well as from yet unpublished records – permits to quantify the patterns of large-scale terrigenous OC releases to the Arctic Ocean. The current CASSCADE version includes $\sim$4,300 values of OC concentrations, $\sim$1,500 δ13C values and 52 stations with known sediment accumulation rates. A preliminary estimate is that the Circum-Arctic shelf sediments of the Beaufort, Chukchi, East Siberian, Laptev, Kara and Barents Seas sequester about 30 Tg terrigenous OC per year. An overwhelming part (83%) of this input occurs on the East Siberian Arctic Shelf (ESAS), likely reflecting a combination of input from its large rivers and erosion along the coastlines of the Laptev and East Siberian Seas. Other areas with more stable coasts yield significantly lower shares (e.g. Kara Sea only 3%) despite large river discharges.

Compared to estimates of the influx from Arctic rivers and coastal erosion, this inverse receptor approach implies that about 57% of the terrigenous OC is re-buried and 43% of that OC is degraded, which translates into an atmospheric flux of 20 Tg per year. Climate change is expected to cause large-scale permafrost thaw and increase the release of OC to the Arctic Ocean in the near future, a feedback that could amplify both land-ocean transfer of OC and the emission of climate-susceptible greenhouse gases