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Supplementary Table S1. Riverine discharge area ($\text{m}^3 \text{s}^{-1}$) for the seven regions and large basins that contribute to the Arctic riverine input, and present-day river discharge and total suspended matter (SPM), summarized from Gordeev (2006). Holocene river runoff has been estimated from modern-day data and changes in runoff given by Wagner et al. (2011). Values are given for discharge until 1800 AD (pre-industrial estimates) and for the present day. The present-day total organic carbon (OC) fluxes include both dissolved and particulate OC based on data from Rachold et al. (2004) and Striegl et al. (2007). These dates are corrected for more recent dissolved OC estimates for the six largest Arctic Rivers (Holmes et al. 2012).

Major oceanic seas	Major inflowing river	Area (km^2)	Present-day discharge ($\text{m}^3 \text{s}^{-1}$)	Holocene discharge to 1800 AD ($\text{m}^3 \text{s}^{-1}$)	Holocene discharge to present-day ($\text{m}^3 \text{s}^{-1}$)	Present-day total SPM (Tg y^{-1})	Holocene total SPM to 1800 AD (Tg y^{-1})	Holocene total SPM to present-day (Tg y^{-1})	Present-day total OC (Tg y^{-1})
Barents and White seas	Divina and Pechora	1386	14 600	14 339	13 513	17.9	34.2	31.5	6.35
Kara Sea	Ob and Yenisei	6589	46 830	45 514	43 084	30.9	32.0	31.9	10.8
Laptev Sea	Lena	3592	23 330	22 618	19 569	28.6	16.4	16.0	8.88
East Siberian Sea	Kolyma	1327	7380	7886	6604	25.2	34.0	24.9	2.24
Chukchi and Beaufort seas ^a	Mackenzie	2546	11 600	12 099	11 346	125.1 ^a	74.1	72.8	4.44 (12.10 ^b)
Total Arctic		15 440	103 740	102 456	94 116	227.7	190.7	177.1	32.7 (40.40 ^b)

^a Estimate does not include data for the Kobuk and Kuparuk rivers. ^b Including Yukon River.

Supplementary Table S2. Modern sediment and organic carbon (OC) contribution from coastal erosion into the Arctic Ocean. Length of coastline, erosion rate and OC content are from Lantuit et al. (2012).

Sea sector	Length of coastline (km)	Weighted mean coastal erosion rate (m y ⁻¹)	Modern sediment release (Tg y ⁻¹)	Weighted mean organic carbon content (weight %)	Modern organic carbon release (Tg y ⁻¹)	Reference
Chukchi Sea	7398	0.41	70	2.79	0.8	Rachold et al. 2004
American Beaufort Sea	3376	1.15	2.1-3.3	5.7	0.15-0.18	Jorgenson & Brown 2005; Ping et al. 2011
Canadian Beaufort Sea	5672	1.12	5.6	2.43	0.06-0.19	Hill et al. 1991; Couture 2010
Barents Sea (incl. White Sea)	17 965	0.42	119	0.92	0.8	Rachold et al. 2004
Kara Sea	25 959	0.68	109	1.51	0.35-1	Rachold et al. 2004; Vasiliev et al. 2005; Streletskaya et al. 2009
Laptev Sea	16 927	0.73	58.4	1.63	0.66-3.7 ^a	Rachold et al. 2004; Vonk et al. 2012; Günther et al. 2013
East Siberian Sea	8942	0.87	66.5	1.64	2.2-7.3 ^a	Rachold et al. 2004; Vonk et al. 2012
Total	86 239 ^b	0.68	430.6-431.8	1.76	4.9-14.0	

^a Vonk et al. (2012) report for the Laptev and East Siberian seas together. We have corrected their OC flux to the marine system (22 Tg y⁻¹) for the estimated input of OC from subsea erosion (11 Tg y⁻¹) and subsequently corrected for shelf area (East Siberian Sea 987 000 km², Laptev Sea 500 000 km²) in order to obtain a value of 3.7 Tg y⁻¹ for the Laptev Sea, and 7.3 Tg y⁻¹ for the East Siberian Sea.^b From the total classified coast length in Lantuit et al. (2012) of 101 447 km 15 208 km account for bedrock coasts (i.e., without erosion) of northern Greenland, Svalbard, and the northern fringe of the Canadian Arctic Archipelago directly facing the Arctic Ocean are missing here.

Supplementary Table S3. The total sediment accumulation (0-11 Kya; Holocene average; after Stein & Macdonald 2004).

Area	Area (x10 ³ km ²)	Sediment accumulation	
		(Tg y ⁻¹)	(10 ³ Tg)
Continental shelves:			
Beaufort Sea	178	123	1353
Chukchi Sea	620	19	209
East Siberian Sea	987	109	1199
Laptev Sea	498	67	737
Kara Sea	926	194	2134
Barents Sea (incl. White Sea)	1597	259	2849
Continental shelves	5052	771	8481
Continental slopes	541	107	1177
Continental rises	1095	79	869
Abyssal plains	1367	30	330
Ridges	1506	21	231
Total Arctic	9555	1008	11088

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