Applications of Transit Time Distributions (TTDs) to ^{129}I transport in the Arctic and North Atlantic Oceans

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During the 1990s, discharges of ^{129}I from European nuclear fuel reprocessing plants increased by an order of magnitude resulting in a large, well resolved, tracer spike whose passage through the Arctic and North Atlantic Oceans has been followed by time series measurements over the past 25 years. This robust and rapidly changing tracer signal has been used in conjunction with other gas (e.g. CFC-11) and radionuclide tracers (e.g. ^{137}Cs) to calculate transit time distributions and constrain water circulation and mixing time scales for a wide range of high latitude water masses. ^{129}I levels measured over the Lomonosov, Mendeleyev and Alpha Ridges in the Arctic Ocean during GEOTRACES cruises in 2015 are 10 times higher than those measured at the same locations in 1994-96 owing to the circulation of the tracer spike and they delineate in great detail the boundary current transport of tracer-rich, Atlantic Water bathymetrically steered by the ridge systems through the central Arctic. This time series analysis illustrates the strong cyclonic boundary current flow that prevailed over the Canadian continental margin in the Canada Basin in 1994-96 and its subsequent weakening under the more anticyclonic flow regime at the same locations in 2015. Parameters associated with mixing and advection have been extracted from the tracer time series using transit time distributions (TTD) that provide quantitative support for recently reported evidence of elevated levels of water mass mixing and remobilization of sediment supplied substances over the arctic continental shelves and subsequent transport into the basin interiors.