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Pathways and transit time for Tc-99 in the North and Nordic Seas

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Spatial and temporal variability of the beta-emitting, anthropogenic radionuclide Technetium-99 (Tc-99) have been simulated using the regional (the North Atlantic and the Arctic Oceans), 20 km resolution, daily forced, Nansen Center version of the Miami Isopycnic Coordinate Ocean Model (MICOM). The sources of this soluble radionuclide origins from the reprocessing plants at Sellafield in the Irish Sea and at La Hague in the English Channel. Releases from La Hague rose to a maximum in 1985, but exceeded those from Sellafield only from 1981 to 1990. In April 1994, a new waste treatment plant, the Enhanced Actinide Removal Plant (EARP), began operation at Sellafield. The main goal of EARP was to reduce the discharges of Plutonium and Americium, but resulted in increased discharges of Tc-99, with peak releases in 1995. This peak of concentrations is observed along the west coast of Norway and in the Barents Sea several years later. The simulated temporal-spatial distribution of Tc-99 is in general agreement with the observations. The typical pathway of Tc-99 from the sources in the Irish Sea and in the English Channel is via the North Sea, along the Norwegian coast and then separating into two branches, one going eastward into the Barents Sea and the other one drifting along with the West Spitsbergen Current. To illuminate the underlying ocean circulation and mixing processes, an idealized tracer with constant value at the release point and an associated age tracer have been added to the Sellafield and La Hague sources. A detailed analysis is performed linking the atmospheric forcing to the local ocean circulation and mixing properties in the region, and subsequently to the resulting transport and dispersion of the idealized tracer. It is demonstrated that the transport and dispersion properties vary on a variety of temporal and spatial scales, making generalizations about the spreading of a tracer very

difficult.