

## Mid-year Project Review for Research Theme Area #5: Environment

### Fate and transport and food web models of radionuclides in the Laurentian Great Lakes system: parameter and model development

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#### Radionuclides in the water of the Laurentian Great Lakes and tributaries

We have sampled water from 41 major tributaries of the Great Lakes; 26 in Canada (spring and fall) and 15 in the USA (summer). We have also sampled water and suspended particles from 12 major basins of the Great Lakes (summer( and all 6 outlets (spring and fall). Analyses are underway for radionuclides and stable analogues. These data will be used to parameterize fate and transport models, including in situ suspended particle and surface sediment  $k_d$ , as well as bioaccumulation factors for zooplankton that drive biokinetics food web models.

- $^{137}\text{Cs}$  in water of the Laurentian Great Lakes Basin is very low, reflecting the occurrence of glacial lake clay throughout the basin. Only a few rivers approach or exceed 1 mBq L<sup>-1</sup> on shield geology, with levels often less than 0.1 mBq L<sup>-1</sup> on sedimentary geology and in Lakes Erie and Ontario.
- HTO in the Laurentian Great Lakes basin reflects proximity to CANDU NGSs with highest levels around Bruce NGS and southern Lake Huron, and in Lake Ontario. Lake Erie is lower than Lake Huron due to dilution by less contaminated tributary water. Elevated levels of HTO are found to the east and northeast of Bruce NGS, with essentially background levels in southern Ontario rivers. Tributaries at the east end of Lake Ontario are also near background.

#### Radionuclides in soil and plants of the Laurentian Great Lakes basin

We have sampled soil and plants from 51 sites in the Laurentian Great Lakes basin. Soil samples include the organic layer, and the underlying 0- 20 cm of mineral sediment in 5 cm intervals. Plants typically sampled at each site (3 species per site) include spruce or fir, maple and ferns. These samples will be used to parameterize terrestrial processes in atmospheric fate and transport models. These include soil to plant transfer factors and soil  $k_d$ , as well as using weapon test fallout to validate models.

Anthropogenic radionuclides from weapon test fallout and CANDU NGS emissions ( $^{137}\text{Cs}$ ,  $^{90}\text{Sr}$ ,  $^{129}\text{I}$ ,  $^{14}\text{C}$ , OBT) will be used to develop mass balance models for the Great Lakes basin.

#### Historical data on radionuclides the Laurentian Great Lakes basin

We have compiled a time series of historical data on radionuclides in the Laurentian Great Lakes basin fallout, soil, sediment, water and biota from journal publications, gray literature and monitoring data. We have also reconstructed missing values for Great Lakes water using dated cores with  $^{137}\text{Cs}$  profiles and sediment  $k_d$  from our in situ measurements and published values. These data will be either used to validate our fate and transport models.

#### Radionuclides and stable analogues in Laurentian Great Lakes biota

By measuring radionuclides and stable analogues in water and zooplankton, and sediment and benthic invertebrates, we will determine transfer factors for primary consumers that can be used as input (food) for fish in foodweb biokinetic models.

- We have collected biological samples from a total of 11 unique basins in Lakes Superior, Huron and Erie thus far. From each of these basins, samples of water, suspended particles, bottom sediment, periphyton, macrophytes, phytoplankton, zooplankton, benthic invertebrates, prey fish and predator fish were collected. To date, over 1,500 fish from 12 different species have been collected from three Great Lakes. These samples have been collected in cooperation with the Ontario Ministry of Natural Resources and Forestry as part of their monitoring programs, an efficiency gained for the FST program.
- The foodweb model will focus on species important for commercial and recreational fishing (e.g., the zooplankton > rainbow smelt > lake trout pelagic-driven foodweb and the invertebrate > lake whitefish benthic-driven foodweb). Length-weight data and fish age will be used to determine fish growth rates, a key biokinetic parameter.