MODELLING AND SIMULATION OF MERCURY CONCENTRATION IN WATER AND FISH FOR THE EASTMAIN 1A/RUPERT RIVER HYDROELECTRIC RESERVOIR PROJECT

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ABSTRACT

The project consists of the partial diversion of waters of the Rupert River basin into the Eastmain River basin through the creation of two successive diversion bays. The total surface area of the diversion bays is approximately 400 km^2 of which about 230 km^2 will be inundated land. As a consequence, mercury contained in the vegetation and soils is released in the water column promoting bioaccumulation of mercury in fish. The objective of the work is to assess the differential changes of the mercury concentration in water and of the mercury concentration in fish of the Eastmain 1 reservoir with and without the Rupert River diversion.

Methodology employed

A water quality model developed for Nordic hydroelectric reservoirs, a fish bioenergetics model and a fish mercury bioaccumulation model have been used to provide a quantitative assessment of the project on mercury concentration in water and fish mercury concentrations in the diversion bays and the Eastmain 1 reservoir. Inputs to the water quality model are convective inflow of chemical elements, the nature and quantity of the more labile components of vegetation and soil to be inundated, water temperature and water level fluctuations with time. Lake whitefish and Northern Pike have been chosen as representative species of non-piscivorous fish and piscivorous fish respectively.

Finding and Results

The concentration profile of mercury in the water of the diversion bays shows periodical peaks of diminishing amplitude rapidly with time. These peaks correspond to higher water temperatures the during the summer season, which promote the decomposition of the labile material with a corresponding release of mercury in the water column. Increases in the mercury concentration of water contribute to the increase the mercury concentration of the diet components of non piscivorous fish with a corresponding increase of mercury in fish. However, results show that such an increase is short lived since the highest peak in water lasts only a few months. Peaks occurring at a later time offer concentrations of mercury in water which are very nearly comparable to values reported for the Rupert River under its natural state.

General Conclusions

Increases of mercury concentrations in the water of the diversion bays are predicted immediately after flooding. However, because of the short water residence times in the bays, both the magnitude and duration of the increases are small. Also, the increases of mercury concentration in fish predicted for the downstream rivers are small both in magnitude and duration.