Vertical distribution of ^{137}Cs in bottom sediments represents time changes of water contamination: Chernobyl and Fukushima

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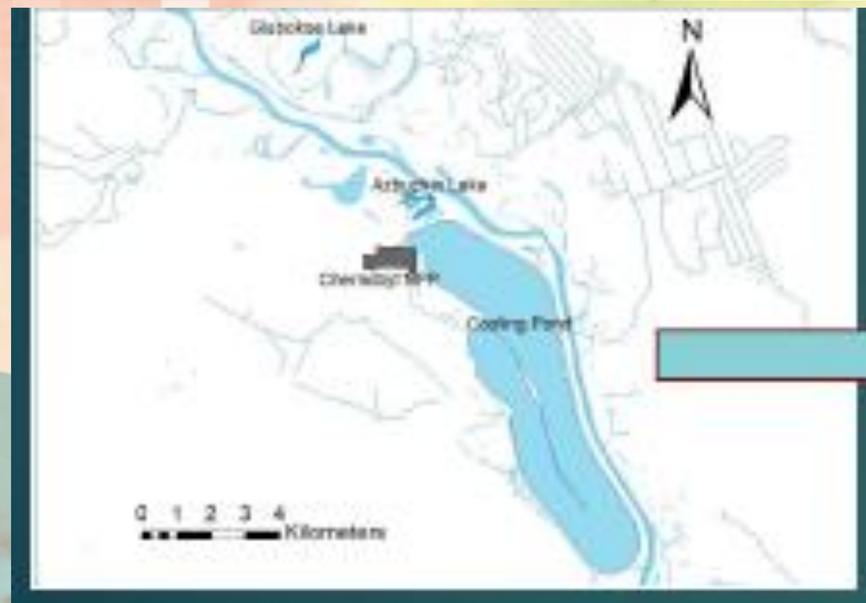
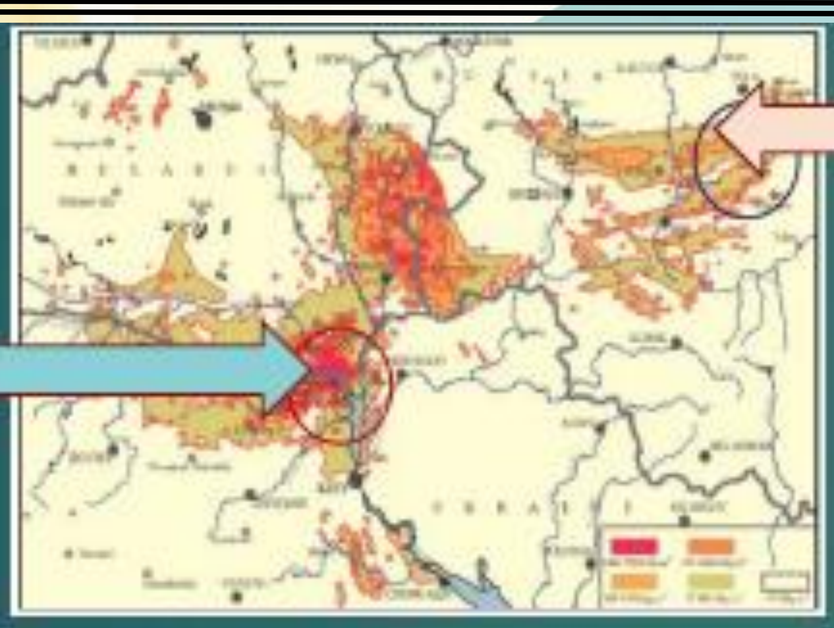
Introduction: Bottom sediments of lakes and dam reservoirs can provide an insight in understanding the dynamics of ^{137}Cs strongly bound to sediment particles. On this premise, a number of cores of bottom sediments were collected in deep parts of lakes Glubokoe, Azbuchin and Cooling Pond in close vicinity of the Chernobyl NPP in Ukraine, in Schekino reservoir (Upa River) in Tula region of Russia (2018) and in Ogaki reservoir (Ukedo River) in Fukushima contaminated area (2019).

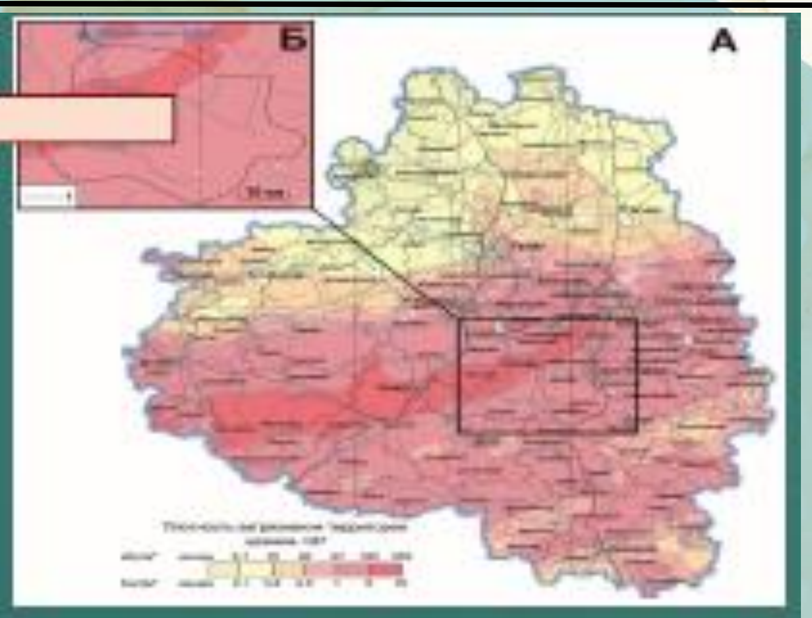
Approach: The sediment profile formed since the accident shows how the particulate concentration of radiocesium in the water body was changing with time; The highest concentration of ^{137}Cs in the depth profile corresponds to its particulate concentration in the initial time period after the accident, and ^{137}Cs concentration in the top layer of bottom sediments shows the current particulate ^{137}Cs concentration.



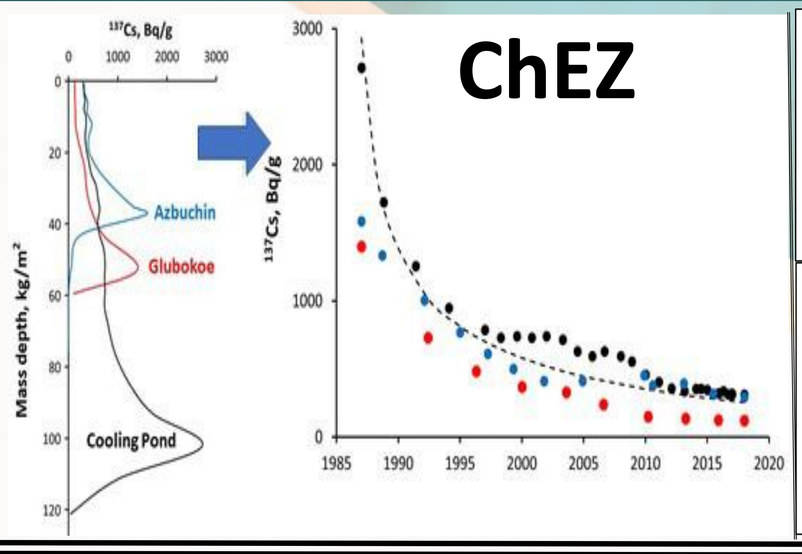
Water bodies under study in Chernobyl Exclusion Zone (Ukraine)

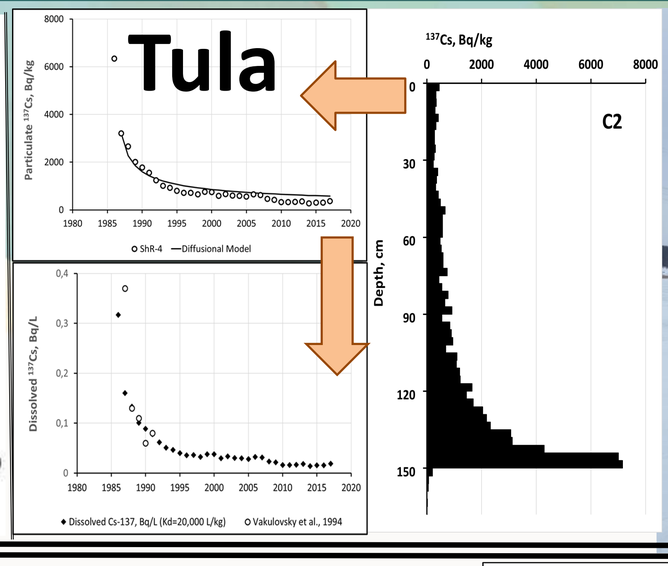


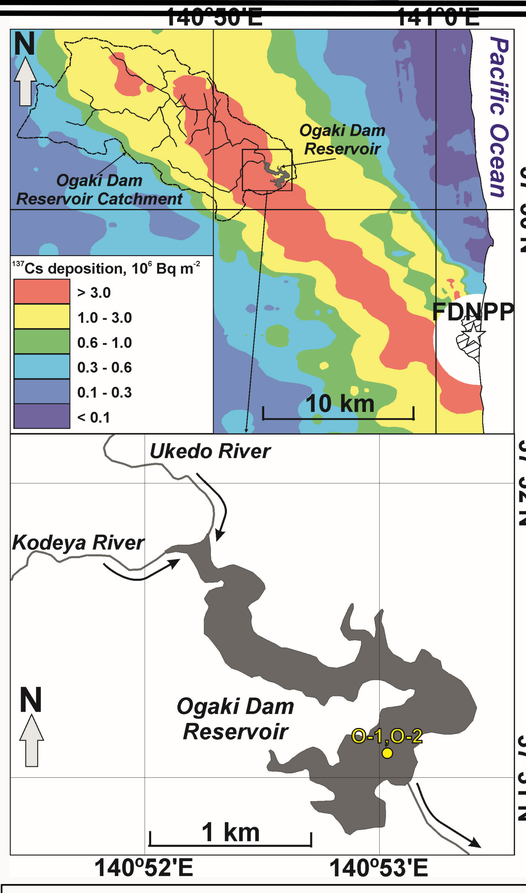
^{137}Cs deposition in Belarus, Russia and Ukraine

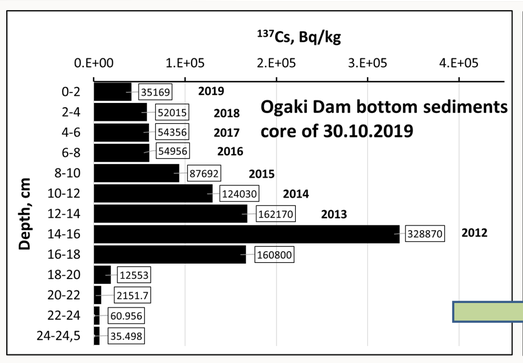


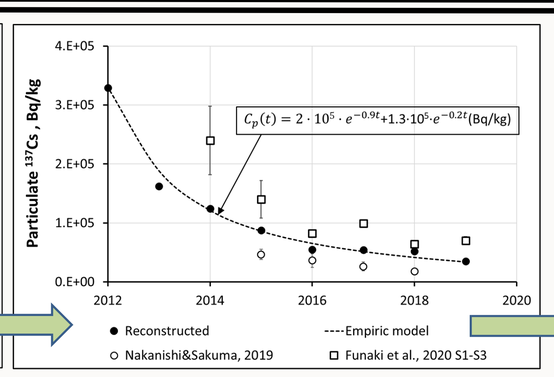
Upa River Catchment in Tula region (Russia)

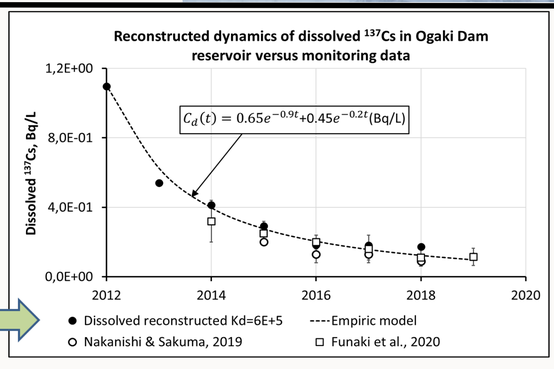












Conditions and assumptions: 1. Vertical mixing of sediments in the bottom is insignificant; 2. Radionuclide is strongly bound to sediments (Kd ≥ 104 L/kg); 3. The maximum radionuclide concentration in its depth profile is well marked with a sharp front below; 4. The position of the radionuclide concentration peak in the sediment depth profile can be taken as a time marker of the accident; 5. Changes in particulate concentration with time are reconstructed from the profile above the peak, given data on annual average sedimentation rate is available or, as a first approximation, assuming this parameter to be constant over the time after the accident.

Conclusions: 1. The proposed and tested method allows to reconstruct long-term dependence of ^{137}Cs particulate and dissolved concentrations in rivers and lakes using its vertical distribution in bottom sediments;

2. The obtained estimates of ^{137}Cs activity concentrations in the studied water bodies of Chernobyl and Fukushima contaminated areas seem to be in agreement with available monitoring data and modeling results.

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