

B43F-2583 Vertical distribution of Chernobyl-derived ^{137}Cs in bottom sediments

represents long-term dynamics of water contamination

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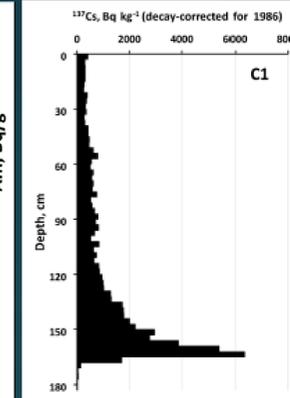
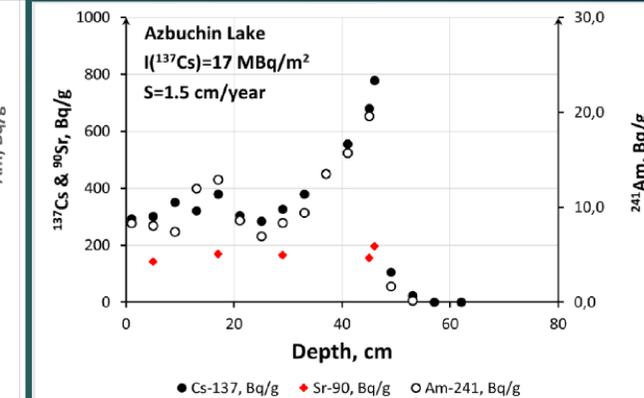
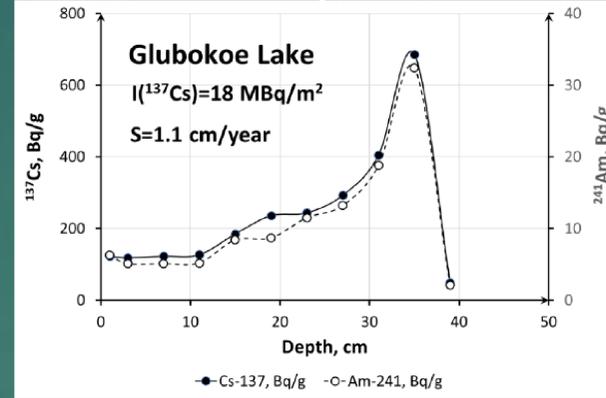
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Long-term dynamics of radionuclides in the environment has become particularly relevant today, 33 years after the Chernobyl accident. Bottom sediments of lakes and reservoirs provide insight in understanding time changes of radionuclides strongly bound to sediment particles such as ^{137}Cs . A number of cores of bottom sediments were collected in 2018 in deep parts of **Lake Glubokoe, Lake Azbuchin and Cooling Pond (CP) in close vicinity of the Chernobyl NPP** and in **Schekino reservoir (Upa River) in Tula region of Russia**.

Results

The obtained ^{137}Cs vertical distributions in sediments suggest that no vertical mixing of sediments has occurred, and the ^{137}Cs peaks are well-defined and not diffuse ones. Assuming that sedimentation rates after the accident were more or less uniform, layers of bottom sediments can be attributed to certain time. We obtained the dynamics of particulate ^{137}Cs activity concentrations from 1986 to 2018. Using experimental values of the distribution coefficient K_d , changes in the dissolved ^{137}Cs activity concentrations in the above water bodies have been estimated for the period of 32 years after the accident. The estimates of dissolved ^{137}Cs concentrations are in reasonable agreement with monitoring data. The general trend of the particulate and dissolved ^{137}Cs and ^{241}Am activity concentrations in all water bodies apparently can be described by the semi-empirical "diffusional" model.



Vertical distributions of radionuclides in Glubokoe, Azbuchin lakes and Schekino Dam reservoir

Semiempirical "diffusional" model of radionuclide long-term dynamics in lakes and rivers

- In case of closed lake (Bulgakov et al., 2002):

$$C_p^{bottom}(t) \sim \frac{\sigma}{\rho \sqrt{\pi D_{eff}^{bottom} t}} e^{-\lambda t} = C_b^0 \frac{e^{-\lambda t}}{\sqrt{t}}$$

- In case of surface runoff (Konoplev et al., 2018):

$$C_p^{soil}(t) \sim \frac{\sigma}{\rho \sqrt{\pi D_{eff}^{soil} t}} e^{-\lambda t} = C_s^0 \frac{e^{-\lambda t}}{\sqrt{t}}$$

- In lake for general case:

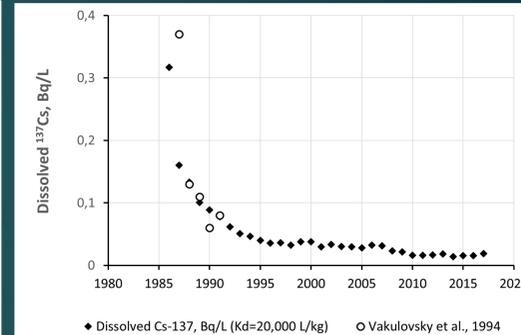
$$C_p^{lake}(t) = \alpha C_p^{bottom}(t) + (1 - \alpha) C_p^{soil}(t) = C_p^0 \frac{e^{-\lambda t}}{\sqrt{t}}$$

- Time dependence of dissolved radionuclide in lake should follow equation:

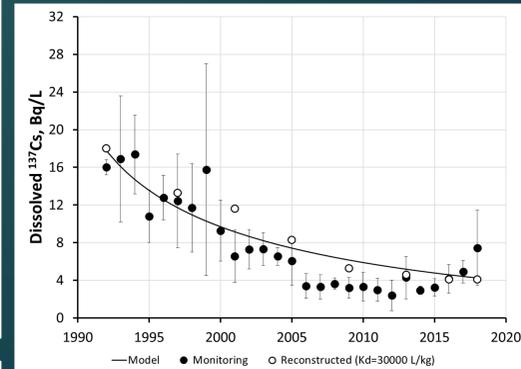
$$C_w(t) \sim \frac{C_p^0}{K_d \sqrt{t}} e^{-\lambda t} = C_w^0 \frac{e^{-\lambda t}}{\sqrt{t}}$$

Acknowledgement

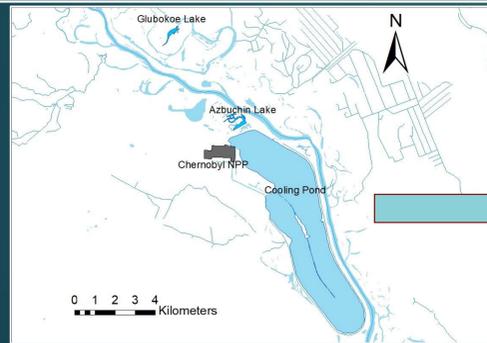
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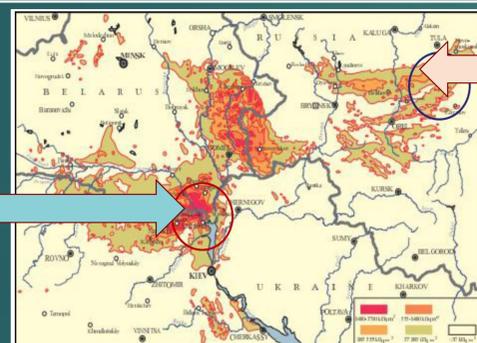
Reconstructed dissolved ^{137}Cs in Upa River against monitoring data



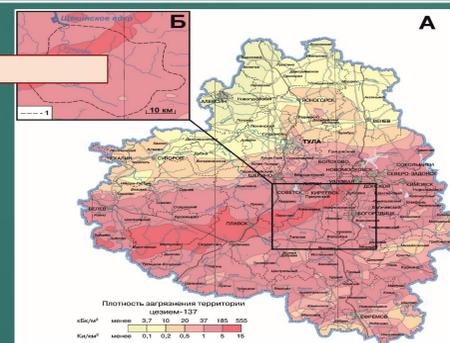
Reconstructed dynamics of dissolved ^{137}Cs in lake Glubokoe against data of monitoring and diffusional model



Water bodies under study in Chernobyl Exclusion Zone (Ukraine)



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



Upa River Catchment in Tula region (Russia)



Bottom sediments core sampling at Glubokoe, Azbuchin lakes, Cooling Pond and Schekino Dam reservoir

