Geophysical Research Abstracts
Vol. 21, EGU2019-13917, 2019
EGU General Assembly 2019

Bathymetry – indispensable tool for exploration of contamination in dam reservoir sediments

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Dam reservoir sediments are used as archives of contamination, eutrophication and soil erosion in the sediment source area. Numerous recently published research reports on reservoir sediments have been based on practically random sampling of single or a few cores without prior knowledge on the bottom bathymetry and reservoir deposition patterns. Such approach can produce misleading results because of uneven deposition in the reservoir bottom and reworking of the finest deposits by waves, currents and water level manipulations.
We will show an example of using bathymetry in research of contamination in bottom sediments of the Skalka Dam Reservoir, the Czech Republic, situated near the Czech-German border. The Skalka Reservoir has received mercury contamination from a historical chemical factory in Marktredwitz, Germany. We also analysed residuals of selected organic pollutants in the Skalka sediments, in particular polar as well as non-polar pesticides, polycyclic aromatic hydrocarbons and pharmaceuticals. All those contaminants are mostly present in the finest reservoir deposits. We started our research by collecting data on the reservoir depths to construct the bathymetry map. We used standard fish-finder sonar (Humminbird Helix CHIRP 7x DI GPS) attached to inflatable boat with an electric motor. A side product of the sonar measurements was a map of the relative bottom hardness, which reflected composition and cohesiveness of the bottom sediments. We also performed ground penetrating radar (GPR) measurement, which produce much better spatial resolution of bottom topography but is limited to shallow water columns in the reservoir inflow. GPR provides information about sub bottom layers which may represent pre-dam structures or some interesting events (for example flood). The results of sonar imaging and GPR measurement were then compared with historical maps of the former (pre-dam) channel position. Sampling points for our contamination studies were then selected to cover each sedimentary body in the bottom, i.e. depressions in the pre-dam channels, abandoned channels, reservoir basin in the pre-dam floodplain and former valley slopes. We found considerable scatter in the bottom sediment fineness: the lithology of bottom sediments ranges from sorted granular sand with lack of the finest (most contaminated) size fractions in sediment transition zones and fine dark muds (clayey silts with organic matter) rich in contaminants in sediment accommodation zones. The variability in lithology actually depended on the bottom topography and distance from the inflow and banks. This research can help to understand sedimentary process in the studied dam reservoir and visualise where most Hg contamination has been accumulated. The resulting knowledge may be useful for the dam reservoir managers.
Now we develop autonomous sonar RC boat to make the bathymetric analyses more efficient and accurate. We also test a small and cheap fish-finder sonar (Deeper PRO +) for its use in dam reservoir research.