

Tracking climate signals preserved in lake sediments from integrated process studies and ultra high-resolution analysis of annually laminated sediments

Research project objectives/ Research hypothesis

Lake sediments are very widely used and studied in the scientific literature but very little is known about the specific processes (documented with observational data) that lead to sediment formation and signal preservation in a particular lake setting. Process studies are rarely undertaken because they are costly, time-consuming and logistically demanding, thus relatively little progress has been generally achieved to understand and refine empirical climate-proxy relationships. Therefore, with this project the following three overall research questions are addressed: (1) Does regional climate and lake stratification play a major role for sedimentation processes?; (2) How climate and other environmental signals are preserved in sediments? To what extent they are interpretable?; (3) How can we use lake sediment archives to approach the temporal resolution of instrumental records? In agreement with the overall research questions, the main research objectives are:

1. Identification of meteorological, limnological and hydrochemical conditions that control sedimentation processes in the investigated lakes;
2. Documentation how seasonal and short-term variations of meteorological conditions are reflected in the structure of varves deposited during the observation period;
3. Validation of varve microstructures for reconstruction of meteorological parameters for the last approximately 100 years by linking with instrumental data available.

Research project methodology

The general strategy of the planned process study consists of three pillars: (1) on-site measurements of water column environment using multiparameter sonde, (2) particle flux measurements using sediment traps and (3) analysis of uppermost sediments from short cores using ultra high-resolution scanning and microscopic techniques. For this studies we selected 3 lakes (Lake Żabińskie, Lake Łazduny and Lake Dgał Mały) located in the Land of Great Masurian Lakes. In all of them biogenic varves are excellently preserved. The work planned in the project is divided into six major Research Tasks: (1) High-resolution monitoring of limnology, hydrochemistry and sediment flux; (2) Geochemical composition of sediment flux; (3) Biological structure of sediment flux; (4) Calibration of monitoring data with meteorological parameters; (5) Tracking climate signals in sediments and (6) Data integration and project management. The scope of field work will include in-situ limnological measurements, water and sediment sampling. Laboratory work will include chemical analyses of water samples, geochemical and biological analyses of samples collected in sediment traps as well as multi-proxy analyses of recent sediment cores.