Water- and land-borne geophysical measurements before and after the sudden drainage of large karst lakes in southern Mexico

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The karst lakes of the sparsely-populated Lacandon Forest in Chiapas, southern Mexico, and their associated sediment infill are attracting increasing attention as high-resolution and continuous environmental and climate archives. To evaluate the information stored in the sediments, paleolimnologists retrieve sediment cores and analyze multiple biological and non-biological indicators. Our geophysical measurements presented here were motivated by the need to determine coring locations providing continuous sediments records from a total of four lakes of the Lacandon Forest. Therefore, we mapped the sediment thickness on the lake floor by applying seismic, electrical, and electromagnetic methods. The measurements were carried out with floating devices – and, after the sudden drainage of two of the studied lakes, complemented by measurements on the exposed lake floor.

During a first campaign in March 2018 when lakes were filled, we collected seismic data with a sub-bottom profiler (SBP). Furthermore, we collected transient electromagnetic (TEM) data with a floating measuring device to investigate the potential of the method for the determination of sediment thicknesses as an alternative to seismic methods. After the lake-level maximum that coincided with the first campaign, the water levels of two of the studied lakes dropped dramatically by July 2019, leaving lake Metzabok (maximum depth ~15 m) dry and lake Tzibaná (~70 m) with a water level decreased by approx. 30 m. In October 2019, when lake levels were still low, we conducted a second survey covering the dry lake floor of lake Metzabok and some dry parts of lake Tzibaná. During this second campaign, we collected electrical resistivity tomography (ERT), induced polarization (IP), and seismic refraction tomography (SRT) data along selected lines of the 2018 survey.

Our 2018 results from the water-borne survey show that sediment thickness estimates from seismic (SBP) and electrical (TEM) data agree well for water depths up to 20 m and sediment thicknesses ranging from 2 m to 10 m. The 2019 data collected on the dry lake floor confirms the
findings of the first campaign and – due to the smaller distance between measuring devices and target – results in a more detailed picture of sediments and the underlying limestone bedrock.