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Application of electrical and electromagnetic methods to delineate changes in salt content of soda lakes

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The main objective of this study is to understand salt dynamics in the soda lakes of the Austrian National Park Neusiedlersee Seewinkel and the influence of climate change in these dynamics. To achieve this, we investigated the application of electrical and electromagnetical methods to quantify spatial and temporal variations in the salt and water content. Built on the link between electrical conductivity and salt content, we mainly present results obtained with low induction number electromagnetic (EMI). EMI data were collected with the CMD Explorer and CMD Mini Explorer (from GF Instruments). Our investigations present, on the one hand, mapping of four lakes, each related to a different degree of degradation, with the aim of understanding the general patterns of electrical conductivity and their link to vegetation and surface cover. On the other hand, we conducted measurements at different time-lapses to monitor changes in the electrical conductivity along three profiles. The monitoring datasets combined EMI and time-domain induced polarization (TDIP) imaging and were repeated every two weeks between April and October 2021 near the Wörthenlacken. Monitoring measurements were conducted with both horizontal and vertical coplanar configurations with 3 separate receiver coils, for a total of 12 measurements for each point with a maximal nominal depth up to 6.7 m. Mapping measurements were collected only with horizontal configurations with both instruments, for six measurements with the same nominal depth of investigation. The initial analysis of the raw data demonstrates changes in the electrical conductivity related to changes in vegetation. In a second step, we inverted the EMI data using the open-source application EMagPy to resolve vertical variations of electrical conductivity along the monitoring profiles. Based on these results we evaluated the variation in electrical conductivity and potential salinity accompanying seasonal variations. Our interpretation incorporates non-geophysical data (temperature, water level, and precipitation) collected in observation wells near the study area. Moreover, we compared EMI monitoring results with those obtained from the inversion of TDIP datasets.