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The use of lake diatoms from pro-glacial areas as climate proxy for the Northern Antarctic Peninsula since the 19th Century

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Due to their well-preserved frustules in marine and lacustrine sediment profiles, diatoms allow paleoclimatic/paleoceanographic reconstructions. The use of diatoms as micropaleontological proxy has been demonstrated essential for a wide range of eco-systems from the equatorial to the polar latitudes. This is particularly important to the Antarctic Peninsula since it is one of the most rapidly warming regions of the planet and difficulties persist to recover the past climate changes at this part of the world. Herein we present a study aiming at reconstructing regional climatic variability from the South Shetland Islands, located on the west side of the Antarctic Peninsula. We present a detailed analysis of a 50cm-sediment core retrieved at the center of Glubokoe Deep pro-glacial Lake (62°11,066'S; 058° 54,413'W), located in Fildes Peninsula, King George Island, sub-sampled at 1cm-resolution. The sediment core was dated by Pb-210 using the CRS chronological model that allowed a time span from the beginning of the 19th century to 2013. We identified 34 different taxa, of which only 19 were found frequently in the reported core. Among those, the most abundant species was the centric diatom Aulacoseira glubokoyensis, a new species discovered through this study, followed by a wide range of species of penate diatoms. Diatom relative abundances were dated for each sediment layer allowing a time series for each specific species identified and then compared with environmental parameters as air temperature, cyclone energy at 50°-70°S latitudinal band and ozone column concentrations (an indicator of UV-B radiation reaching lake surface). Air temperature data derived from the Met-READER website and is mostly related to Bellingshausen Station/Russia (1959 to 2013); Cyclones data was modeled by Ian Simmonds – personal communication/Australian Antarctic Program (1960 to 2009); and ozone concentrations are from Harley Station/British Antarctic Survey (1957 to 2013). As a calibration procedure we performed linear regression among parameters (for the above time scale) and the diatom frequency and selected the statistical significant correlations. From those correlations we constructed multiple regression models and have reconstructed the past variability of air temperature (based on the species Brachysira minor and Pinnularia sp), r=0.60; cyclones (Nitzschia cf. Kleinteichiana, Pinnularia borealis, Gomphonema sp.), r=0.92; and ozone depletion (Planothidium australe, Pinnularia borealis, Gomphonema sp. and Humidophila tabellariaeformis), r=0.92. Our reconstructions suggest that air temperatures were uniform before the 1980's decade until the end of 19th century, accompanying the same pattern of sedimentation rates observed at several shallow lakes of King George Island. Further it was found that cyclones covariated with ENSO related parameters, such as Niño 3.4, and ozone seemed to vary more intensively at Antarctica during the 20th century compared to global average as depicted by other ozone reconstruction models.