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Multiproxy climate and sea ice reconstruction of the industrial era at the Western Antarctic Peninsula

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Recent changes and variability in climate conditions leave a significant footprint on the distribution and properties of sea ice, as it is sensitive to environmental variations. We investigate the rapidly transforming region of the Western Antarctic Peninsula (WAP) focusing on the conditions and development of sea ice in the pre-satellite era. For this study on past sea ice cover we apply the novel proxy $IPSO_{25}$ (Ice Proxy for the Southern Ocean with 25 carbon atoms; Belt et al., 2016). Three sampling sites were selected to cover areas near the Antarctic mainland, in the Bransfield Basin (2000 m depth) and the deeper shelf under an oceanographic frontal system. Analysis of short cores (multicores) resolving the last 200 years (based on $^{210}Pb_{ex}$ dating) focused on geochemical bulk parameters, biomarkers (highly branched isoprenoids, GDGTs, sterols) and diatoms. These results are compared to multiple climate archives and modelled data. This multiproxy based approach provides insights on changes in spring sea ice cover, primary production regimes, subsurface ocean temperature (SOT based on TEX^{L}_{86}) and oceanographic as well as atmospheric circulation patterns. While environmental proxies preserved in two cores near the coast and in the Bransfield Basin reflect the properties of water masses from the Bellingshausen Sea and Weddell Sea, respectively, data from the third core at the deeper shelf depict mixed signals of both water masses. Our study reveals clear evidence for warm and cold periods matching with ice core records and other marine sediment data at the WAP. We observe a general decrease in SOT and an increase in sea ice cover overprinted by high decadal fluctuations. Trends in SOT seem to be decoupled from atmospheric temperatures in the 20th century, and this is supported by previous studies (e.g. Barbara et al., 2013), and may be related to the Southern Annual Mode. We consider numerical modelling of sea ice conditions, sea surface temperature

and SOT for further support of our findings.

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