Research interest of Tainã Marcos Lima Pinho

My name is Tainã Marcos Lima Pinho, I am a PhD student at the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI). My main research field is paleoceanography and paleoclimatology of tropical and subtropical Atlantic during the Late Quaternary. My scientific expertise spans a broad range of paleoceanographic sub-disciplines and analytical techniques. The spectrum ranges from grain size measurements, clay/total mineralogy (surface samples and sediment cores), XRF scanning/CT scanning to geochemical methods (Mg/Ca paleothermometry, water signature reconstructions using oxygen and carbon isotopes) and the establishment of stratigraphic frameworks (^{14}C dating, isotope stratigraphy).

I have 107 citations, my h-index is 5, excluding self-citations, i10-index is 4 and g-index is 9. I have published 12 papers in prestigious international journals (e.g., Nature Communications, Scientific Reports and Geophysical Research Letters), including 3 as first author. Currently, I have 8 manuscripts in preparation, 3 of them as first author. Alongside Prof. Dr. Ralf Tiedemann, I co-supervised a bachelor thesis that was recognized with the “Best Thesis Award in Marine Geosciences in 2024” by the Department of Geosciences at the University of Bremen. This thesis was developed using preliminary results from my PhD research and will be published in the near future and more thoroughly presented in my PhD thesis.

My PhD research is dedicated to reconstructing the paleoceanographic variability of the Southern Ocean and exploring its critical interactions with the East Antarctic Ice Sheet under warmer-than-present climates. This work is essential since current projections for sea level rise remain uncertain due to a limited understanding of the intricate ice–ocean feedbacks that control the dynamics of the East Antarctic Ice Sheet. Alarmingly, several studies have identified a warming threshold of only 2–3°C, beyond which the partial collapse of the ice sheet could occur—a phenomenon that has precedent in Earth’s past during warmer climatic intervals. The implications of such events would be global, considering the Southern Ocean's pivotal role in interconnected ocean basins.

Building on my strong background in Paleoceanography and Paleoclimatology at lower latitudes of the Atlantic during the Late Quaternary period, my research bridges work at high latitudes with regions reaching from the subtropics to the tropics. My previous studies have laid a robust foundation by examining the dynamic processes of ocean ventilation, water mass variability, and large-scale circulation across different ocean basins. These investigations have uncovered key mechanisms, including changes in water mass composition and shifts in meridional circulation, that are directly linked to my current research on Antarctic paleoceanography.

For instance, my research into the dynamic of the Intertropical Convergence Zone (ITCZ) (Chiessi et al., 2021; Campos et al., 2025) and the millennial-scale shifts in ocean ventilation (Nascimento et al., 2021; Campos et al., 2021) has revealed the complex interplay between atmospheric and oceanic processes. Additionally, investigations into the variations in the carbon isotopic composition of foraminifera have demonstrated a pronounced coupling between oceanic and atmospheric carbon exchanges during episodes of rising atmospheric CO_2 (Antarctic ice core), which subsequently manifest as shifts in the atmospheric $\delta^{13}C$ signature (Antarctic ice core) (Pinho et al., 2023). Notably, one of my current PhD papers directly addresses the Antarctic contribution from meltwater events and its impact on the global carbon cycle, introducing a novel hypothesis to explain the observed alterations in the atmospheric $\delta^{13}C$ signature. This paper reflects a collaborative effort between AWI research groups and our international partners.

Research into glacial productivity, and the poleward migration of subtropical gyres have provided deep insights into the drivers of ocean circulation. Our investigation of how external astronomical forcing, driven by changes in the Earth-Sun distance, reveal that it can trigger substantial meridional changes (poleward and equatorward) in both oceanic and atmospheric circulation patterns. These findings have immediate implications for unraveling the ice–ocean feedbacks that govern the stability of the East Antarctic Ice Sheet. For instance, the poleward shift of the Atlantic subtropical gyre (Pinho et al., 2025) and the reorganization of the entire southern oceanic and atmospheric circulation system (Yang, Liu and Pinho et al., 2025) during the last deglaciation (transition from the last glacial to the present interglacial period) demonstrate how heat is effectively transported poleward via atmospheric bridges (detailed in the press release on the AWI website).

Currently, I am working on a paper that examines the deglacial meltwater discharge from the East Antarctica, closely aligned in timing and processes with the aforementioned studies (i.e., Pinho et al., 2025; Yang, Liu and Pinho et al., 2025; Geophysical Research Letters). In Pinho et al. (2025) you will see that my work is built upon the classical “bipolar seesaw” theory, which is strongly linked to the Atlantic conveyor belt (AMOC). This scenario emphasizes Antarctica's central role in global ocean dynamics. Moreover, my paper in Scientific Reports (Nature Portfolio) (Pinho et al., 2021) illustrates how the poleward migration of the South Atlantic subtropical gyre has facilitated heat transfer to the Southern Ocean in response to weakenings in the AMOC during millennial-scale events, such as Heinrich Stadials over the past 70,000 years. In one of my PhD papers currently under review, we established a robust connection between the poleward shift of the gyre and local atmospheric circulation patterns at the site of my current PhD project at 70°S, near Neumayer station—changes comparable to the modern Southern Annular Modes (SAM) that modulate poleward moist transport via westerly winds (via atmospheric river) against the dry, cold air masses from katabatic wind flows off the Ice Sheet. For example, this has a substantial impact on upper water column stratification and is crucial for establishing the conditions needed for the development of the Weddell Polynya during glacial periods. The story will be fully published in a near future.

In summary, the expertise gained through my previous studies in paleoceanography and paleoclimatology uniquely equips me to unravel the intricate relationship between the Southern Ocean and Antarctic ice dynamics. Notably, my PhD represents a groundbreaking effort to present exceptionally well-dated, high-resolution records based on preserved biogenic carbonates (foraminifera species) from around Antarctica, particularly during glacial periods—a pioneering achievement unmatched since the beginning of polar expeditions, as recognized by both myself and Prof. Dr. Ralf Tiedemann (Chief Scientist of PS128 expedition, EASI-1 and my main supervisor).