Reconstructing changes to the Agulhas current using the diversity of the foraminiferal assemblages to improve the accuracy of climate models.

At present, we only have 150 years-worth of historic data about ocean temperatures and salinity, factors which directly influence water density, and as such the variations experienced in the thermohaline cycle. This data has been collected over an insufficient time period to fully understand oceans' variability beyond a few decades. This not only limits our knowledge of the past, but also limits our ability to accurately produce and test climate models that are created to help us predict changes to the future climate. These climate models are essential to allow us to successfully prepare and adapt to changes, e.g sea level changes. This lack of historic data also limits our ability to differentiate between changes to the climate that are natural, or human forced through the expulsion of excess greenhouse gases such as carbon dioxide and methane. In order to address this problem, the project I am applying to aims to extend the data concerning ocean circulation variations back further in time, especially over the Common Era.

It is essential to climate scientists to have a good understanding of the variations in the oceanic systems, as they are generally considered to be one of the most predictable elements of the Earth's climate system. This is because the oceans have such a high specific heat capacity, and hence thermal inertia, that they respond very slowly to changes in the climate, such as heating up and cooling down. This means many climate models rely on oceans remaining relatively stable in order to base climate predictions upon, meaning it is essential that we understand all causes of variability to the ocean system on longer time scales in order to successfully predict and manage future climate changes and have as accurate climate models as possible.

In order to address this problem, I will be working on reconstructing past changes to the Agulhas current off the coast of Madagascar, using shells such as planktonic foraminifera, and a range of interdisciplinary scientific methods based upon the sediment cores collected. The project will use the chemical composition in tiny zooplankton shells to estimate temperature and salinity variations at different depths over certain time periods. My work is aimed around studying the diversity of the foraminiferal (zooplankton) assemblages in order to reconstruct the changes to the Agulhas current. The results will fill a geographical gap in our current knowledge of the Common Era. In particular, I will aim to focus on the Little Ice age as well as the industrial era, in order to relate changes to the oceans and hence the climate, to changes experienced in human societies.

Knowing how the conditions of this current have changed over time is particularly important as the Agulhas current has been shown to influence the formation of deep and dense waters in the North Atlantic Ocean. Recently, the current has been observed to have increased leakage of these warm salty waters into the Atlantic Ocean due to movement of the southern hemisphere westerly winds further south, a process linked to anthropogenic greenhouse gas forced climate change.

This leakage of salty water is important for promoting deepwater formation in the North Atlantic, and hence the continued circulation of the entire thermohaline system. However, limited data currently exists on the centennial variations in the

tropical Indian Ocean and the impacts of these variations on global and regional climate through the past with important implications for future climate variations in the future. By extending the data based on centennial variations in the tropical Indian ocean, we will be helping to fill the knowledge gap in the history of the ocean in this area. This is essential to understand the role changes in the Indian Ocean played on climatic events in the Northern Atlantic, such as the Little Ice age, in order to help us understand how future climate variations in this region will affect the global climatic system in the future.

Because of the lack of oceanographic measurements spanning beyond the past 150 years, the understanding of the oceans' role in long term climatic variations, such as the impacts of increased Agulhas leakage on deepwater formation, is fairly limited. As such, my project aims to extend this data and will be of huge importance to contributing to the geographical knowledge surrounding the past, in order to more effectively predict the future climatic variations.