An Argo Float Study of Temperature and Salinity in the Subpolar region of the Cambpell Plateau

Authors: Ana Amaral Wasielesky[1,2], Milena Menna[2], Angelo Rubino[1], Riccardo Martellucci[2], Yuri Cotroneo[3], Giuseppe Aulicino[3], Antonino Ian Ferola[3] and Elena Mauri[2]

awasielesky@ogs.it
956731@stud.unive.it

1. Introduction

The Subantarctic region of New Zealand is marked by a unique and complex bathymetry that includes an ocean ridge and a substantial submarine plateau known as the Campbell Plateau (Forcén-Vázquez et al., 2021). This plateau is located near the Pacific sector of the Southern Ocean, and plays a vital role in the export of heat, salt, and nutrients into the lower thermocline, primarily through the formation of mode waters.

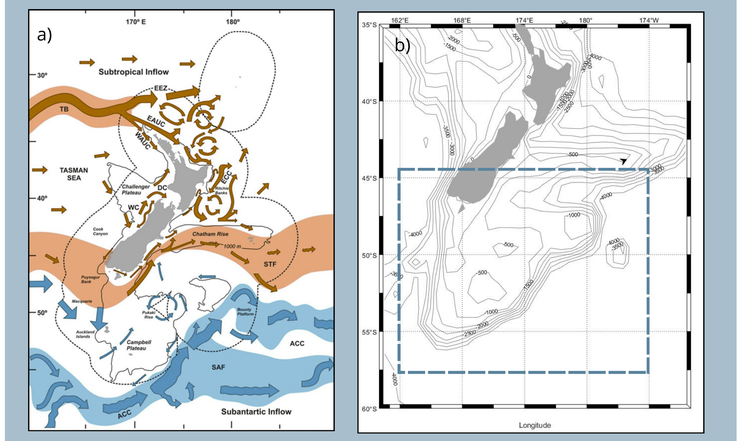

Figure 1: Oceanographic Features. 1a: Ocean Currents around New Zealand This map illustrates the ocean currents surrounding New Zealand, primarily influenced by three major water masses denoted by their respective fronts: Tasman Front (TF), Subtropical Front (STF), and Subantarctic Front (SAF). The Tasman and Subtropical fronts represent relatively warm surface currents. The eastward flow of warm water splits around New Zealand, resulting in southeastward currents along the North Island's east coast and northwestward currents along the South Island's east coast. The Subantarctic Front, is observed in the south, along with the cold Antarctic Circumpolar Current (ACC) hugging the deep ocean floor east of the Campbell Plateau and Chatham Rise. Adapted from: https://teara.govt.nz/en/map/5912/ocean-currents-around-new-zealand.
1b: Bathymetric map of the seafloor sorrounding New Zealand. Dashed blue square demarks the Campbell Plateau Region.

3. Discussion

- Larger temperature and salinity in the upper layer (0/400 m) of the second decade (STW)(Fig. 2a, Fig. 2b);
- SAW deeper in the second decade (Fig. 2a, Fig. 2b);
- UCDW warmer and saltier in the second decade (Fig. 2a, Fig. 2b);
- Colder and saltier UCDW between 1000-2000 meters of depth(Fig. 2c, Fig. 2d);
- Larger fingerprint of SAMW in the second decade (200/500 m)(Fig. 2a, Fig. 2b);
- Deep Argo floats contribute significantly to the robustness of the second decade dataset; (Fig. 2e, Fig. 2f);

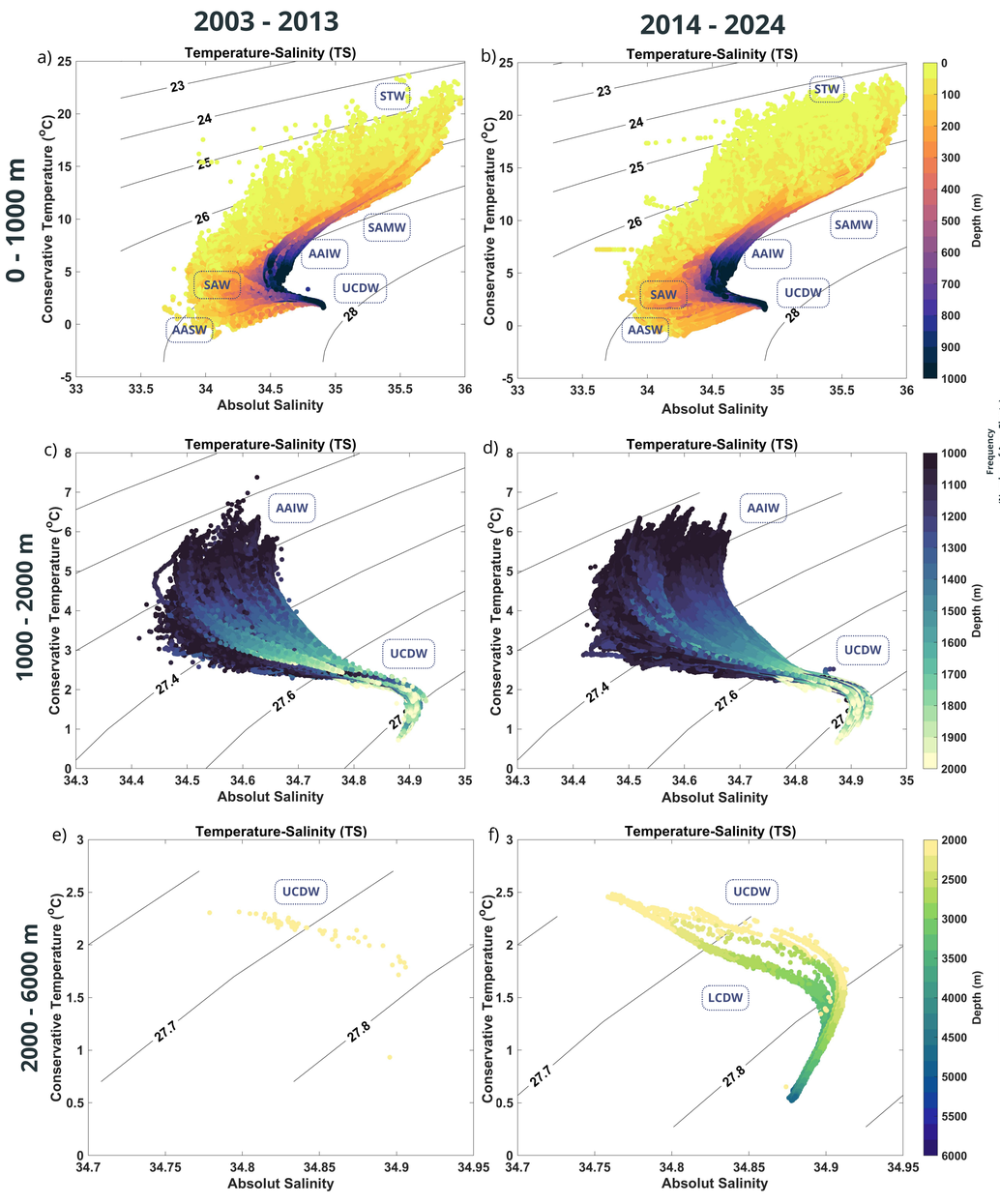

Figure 2: Temperature-Salinity Plots for the Campbell Plateau as described by existing literature (Forcén-Vázquez et al., 2021). 2a: 0-1000 m, 2003-2013. 2b: 0-1000 m, 2014-Feb 2024. 2c: 1000-2000 m, 2003-2013. 2d: 1000-2000 m, 2014-Feb 2024. 2e: 2000-6000 m, 2003-2013. 2f: 2000-6000 m, 2014-Feb 2024. Acronyms: AAIW - Antarctic Intermediate Water; AASW - Antarctic Surface Water; SAMW - Subantarctic Mode Water; SAW - Subantarctic Water; STW - Subtropical Waters; UCDW - Upper Circumpolar Deep Water; LCDW - Lower Circumpolar Deep Water;

2. Data and Methods

Argo float data from 2003 to 2023 were used to identify the water masses in the Campbell Plateau and understand the differences between the two decades in this region. All the profiles used in the present analysis were flagged as high quality control data. The first decade contained 8320 profiles, while the second decade contained 12095 profiles(Fig. 3b)

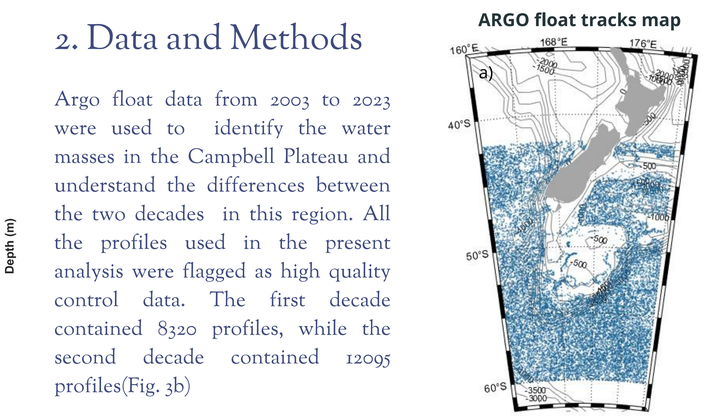

Figure 3a: Argo Float Tracks Map. Figure 3b: Histogram of Argo float count in the past 20 years . Blue bars represent the data in the first decade. Orange bars represent the data in the second decade.

4. Future Steps

- Verify distinct patterns using TS plots intrannually to gain deeper insights into their characteristics;
- Plot TS diagrams for the subtropical and subantarctic areas (north and south of 54°S), eastern and western sectors (east and west of 172.5°E);
- Plot Hovmoller diagrams with the trend of T and S in the period 2003-2023;
- Verify distinct patterns using TS plots between cyclonic eddies and anticyclonic eddies to gain deeper insights into their characteristics;
- Understand how eddies influence the water mass variability;
- Understanding the role of the Campbell Plateau in the deep upwelling of the global conveyor belt.

Awknowlegments

These data were collected and made freely available by the International Argo Program and the national programs that contribute to it. (https://argo.ucsd.edu, https://www.ocean-ops.org). The Argo Program is part of the Global Ocean Observing System.

Affiliations

1 Ca' Foscari University of Venice, Department of Environmental Sciences, Informatics and Statistics, Venice, Italy
2National Institute of Oceanography and Applied Geophysics (OGS)
3University of Napoli Parthenope, Department of Science and Technology