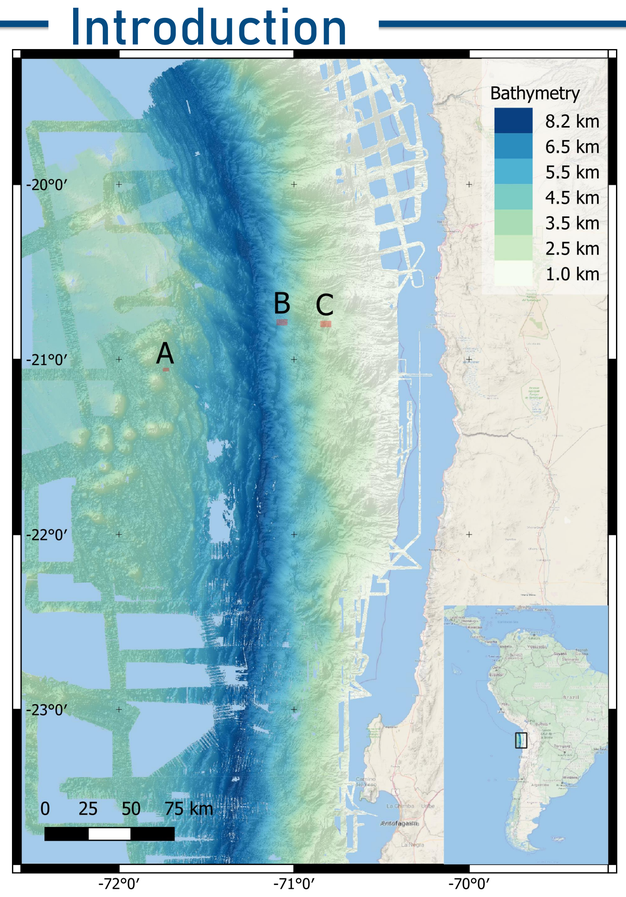
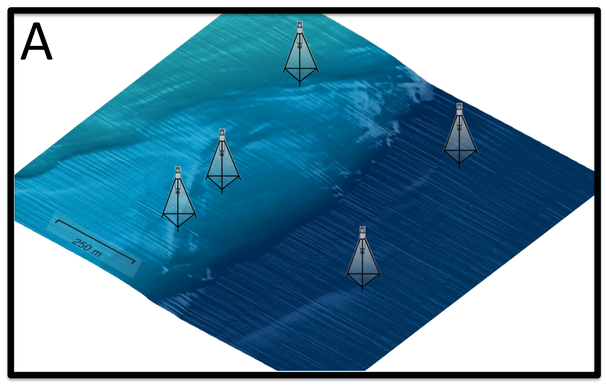
Abyssal ocean warming and decoupled circulation across the northern Chilean trench – results from a cross-beneficial seafloor direct path experiment

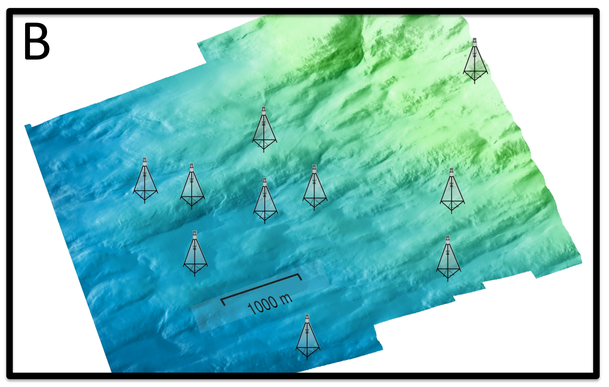
A. Jegen[1], D. Lange[1], J. Karstensen[1], H. Kopp[1]

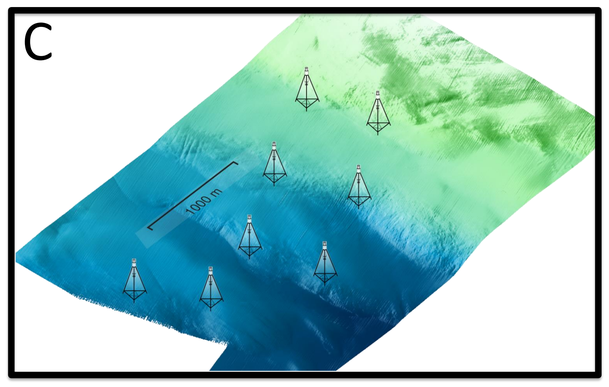
1 GEOMAR Helmholtz Centre for Ocean Research

Introduction









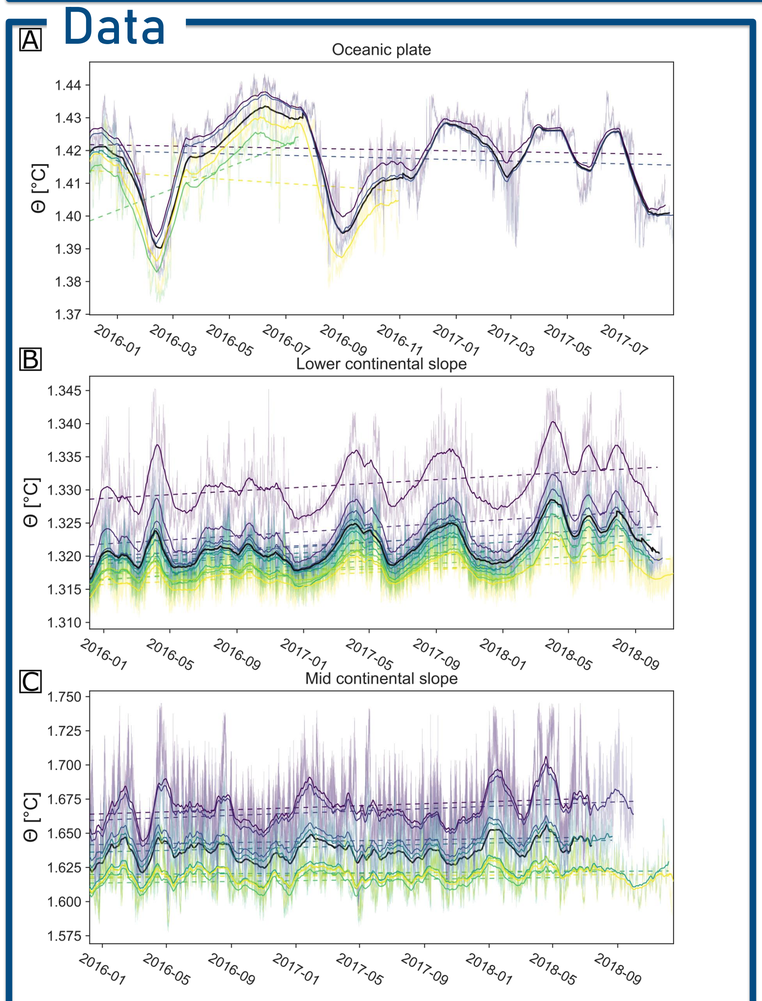
The data of three distributed seafloor sensor arrays, which were deployed for an offshore geodetic survey on a roughly E-W trending profile crossing the Chilean deep sea trench were used for hydrographic analysis.

Each network consisted of 5-10 stations that acquired high-resolution temperature, pressure and sound speed data with a sampling interval of 160 min

After calibration with reference data (GLODAPv2), salinity and density time series could be derived from the pressure, temperature and sound speed measurements, allowing a full hydrographic assessment of the study area

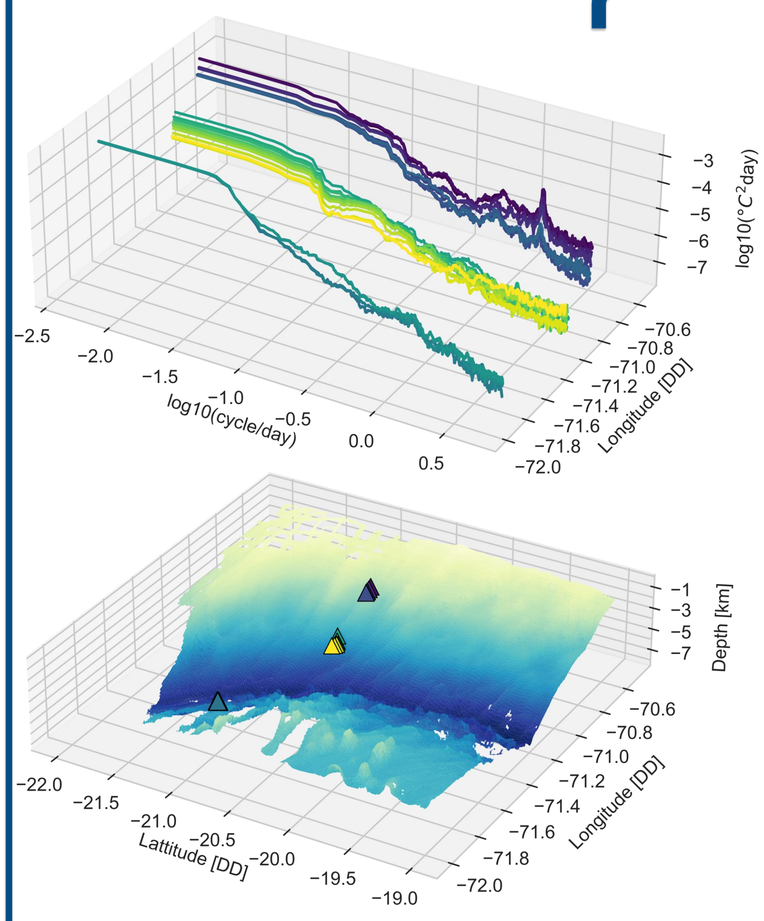
Average potential temperatures recorded at sites A-C are 1.42 °C, 1.32 °C and 1.64 °C.

Data



Calibrated temperature data coloured according to relative station depth (purple, shallow to yellow, deep)

Temporal variations



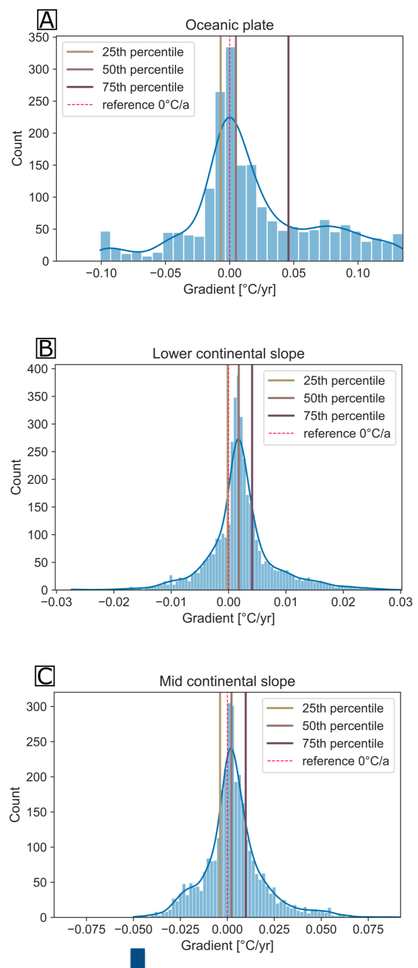
No diurnal and semidiurnal tides at lower slope
→weak bottom boundary layer stratification close to trench

Slope sites show 0.1-0.125 cpd peak
→topographic vorticity waves trapped against the coast

Multi-year warming trend over oceanic plate and continental slope appear decoupled

Multi-year warming trend of 0.002 °Cyr^{-1} - 0.003 °C yr^{-1} detected in bottom water layer over continental slope

Warming likely related to changes in source water or changes in source water formation regions

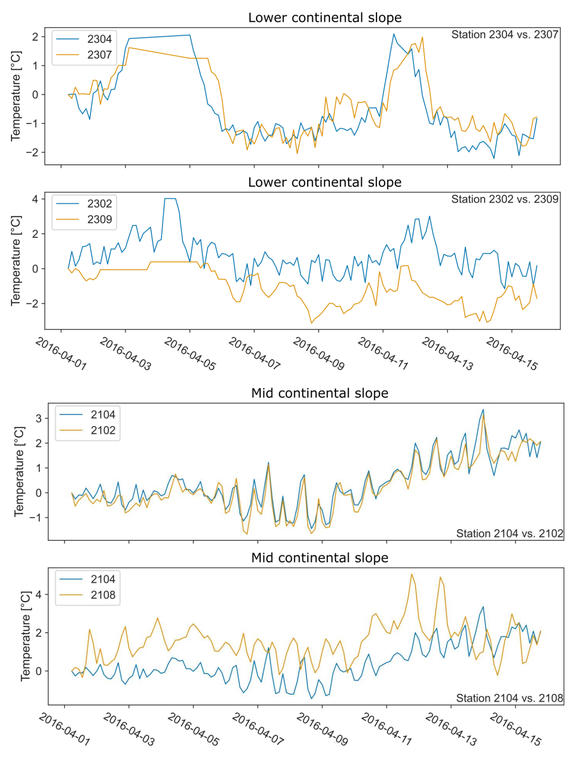


Conclusions

1. Periodic and sporadic temperature oscillations, related to cross-diapycnal motion, were detected over oceanic plate and continental slope
2. While the anomalies and their spatio-temporal variations coincide at the two continental slope sites, they deviate from those detected at the oceanic plate site
3. The deep sea trench outlines the seaward extent of the abyssal eastern boundary current system off Chile
4. In the studied area of the abyssal eastern boundary current system, anomalies propagate southwards, are most pronounced closest to the trench and weaken with increasing distance to the trench

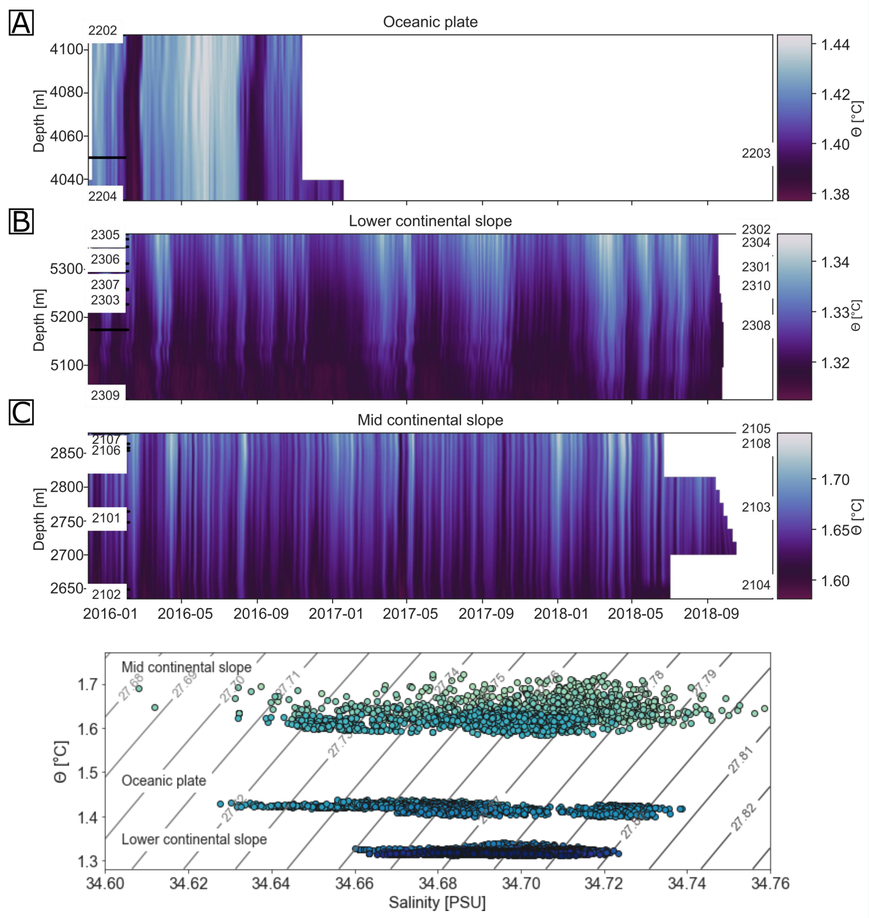
Data of offshore geodetic experiments can be utilised for regional hydrographic studies

Spatial variations



Continental slope stations show coincident temperature anomalies that appear increasingly stretched with distance to the trench

Southern stations show later anomaly onset
→ Anomalies propagate southwards over continental slope



Temperature Oscillations stretch through the entire depth of the experiment, but weaken with depth
Fluctuations are cross-diapycnal motion (e.g. tides or turbulence)

Acknowledgements

We are grateful to the captain and the crew of RV SONNE for their support during expedition SO244 (GeoSEA) and SO288 (COMBO). Both cruises would not have been possible without the excellent shore-based administrative and logistical support of the Leitstelle Deutsche Forschungsschiffe, Briese Research and the Projektträger Jülich, as well as the help of the Foreign Office in Berlin.