Generation of high-energy flow events in a deep depositional area – The Norwegian Trench

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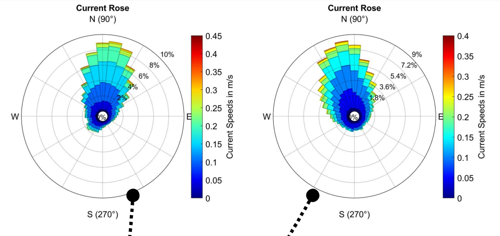
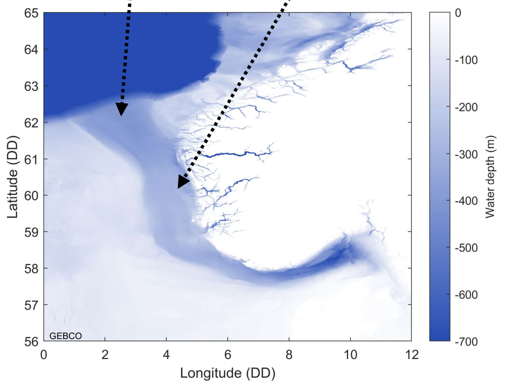
1. Introduction

In the Norwegian Trench deep currents highly contribute to transport into and out of the North Sea. However, knowledge about the forcing of deep currents is limited. High-resolution data of near-bed velocities, temperature and salinity reveal never seen dynamics at high depths in this depositional area. We present insights into the dynamics of the deep currents to understand what processes near the bed drive the exchange across the shelf. This knowledge contributes to a better understanding of transport processes in the Norwegian Trench.

L1: Cross-shelf exchange flows **L2** : Outflows of the North Sea





2. Methods and Material

Data (observation + model data):

- 1-year Acoustic Doppler Current Profiler (ADCP) and Conductivity – Temperature (CT) sensor data
- Two instruments (at L1/M1 & L2/M2) attached 20 m above the bed in 250-350 m depth
- CMEMS current velocity data (CMEMS[1])
- CMEMS wind data (CMEMS[2])

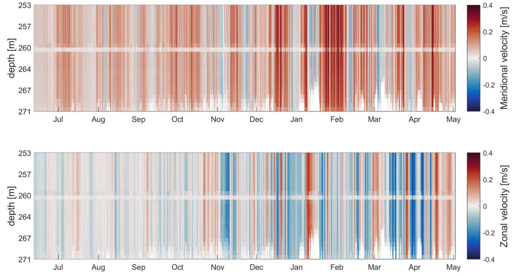
Parameters:

- u and v (m/s), temperature, pressure, (salinity)

Analysis tools:

- Utide for tidal analysis in MATLAB

Time series at L2



3. Results

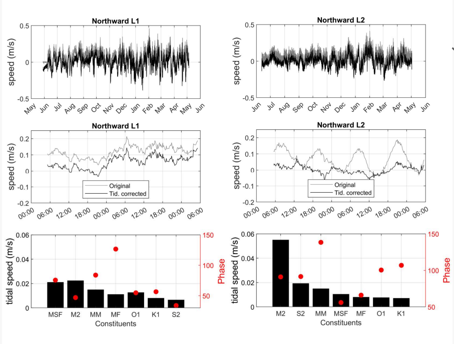
Currents and Tides (A)

Tidal contribution explains
-> 3 % of the variability at L1
-> 15 % of the variability at L2

Currents are strongest over winter at both locations and mostly in northward (alongshore) direction.

M2 is highly variable because of the Spring-Neap tidal cycle

→ Tidal currents, mainly M2 induced, are low but variable in the Spring-Neap tidal cycle.



Non-tidal periodic motions detected in PSD (Frequency domain)

Non-tidal signals (B)

- 13.55 h = Inertial Oscillations at L1
- 2-3 days = Eddies, baroclinic instabilities (Mysak & Schott 1977)
- 3-16 d = CTW (NCC) (Skagseth et al. 2011)

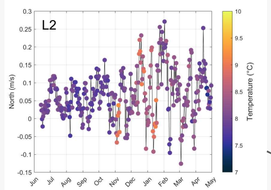
→ Surface eddies of the wind-regulated Norwegian Coastal Current (NCC) impact deep flows.

Atlantic Water (AW) inflows (C)

- Density is temperature driven (water masses identified by temperature)
- PTAs show new AW inflow or convection both causing warmer water temperatures in winter
- AW inflows are strongest in winter and during strong northerly winds

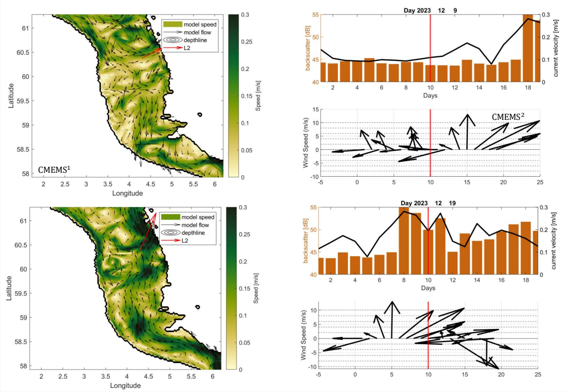
Inflows at L1 look different and might also be related to canyon dynamics, not wind!

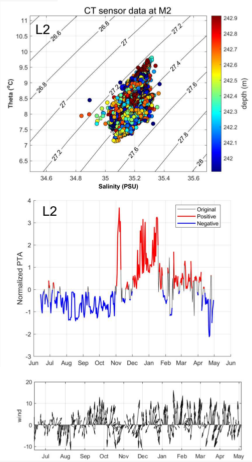
→ AW inflows bring warmer water into the trench and are driven by northerly winter storms



Canyon dynamics (D)

- The Norwegian Trench is a productive canyon where upweling takes place.
- BBL dynamics are influenced by wind events ("benthic storms"?)





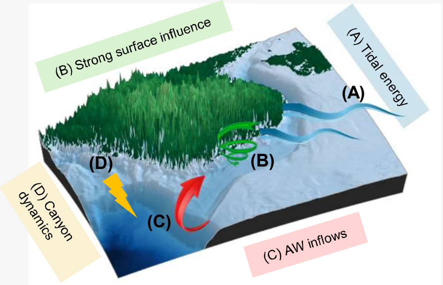
AW water mass

> T in winter

Link to wind?

4. Key findings

Our results show that **deep currents are highly sensitive to meteorological forcing** and much more dynamic than previously expected. These new insights allow better prediction and understanding of transport processes in the North Sea, especially of the wind-driven deep-water transport.



5. Acknowledgements and References

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Skagseth et al. (2011) Wind- and buoyancy-induced transport of the Norwegian Coastal Current in the Barents Sea, J. Geophys. Res., 116, C08007, doi:10.1029/2011JC006996.
CMEMS[1]: https://doi.org/10.48670/moi-00054; CMEMS[2]: https://doi.org/10.48670/moi-00305
GEBCO: General Bathymetry Chart of the Ocean, https://www.gebco.net/
Mysak, L.A. and Schott, F. (1977) Evidence for Baroclinic Instability of the Norwegian Coastal Current, J. Geophys. Res., 82-15