# Semidiurnal tides on the Laptev Sea shelf with implications for shear and vertical mixing


**Markus Janout**[1] & **Yueng-Djern Lenn**[2]

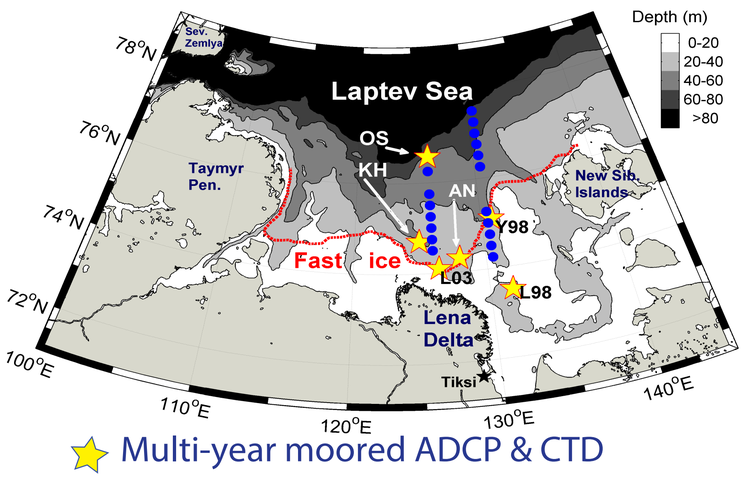
[1] Alfred-Wegener-Institute, Bremerhaven, Germany
markus.janout@awi.de

[2] School of Ocean Sciences, Bangor University, Wales
oss618@bangor.ac.uk



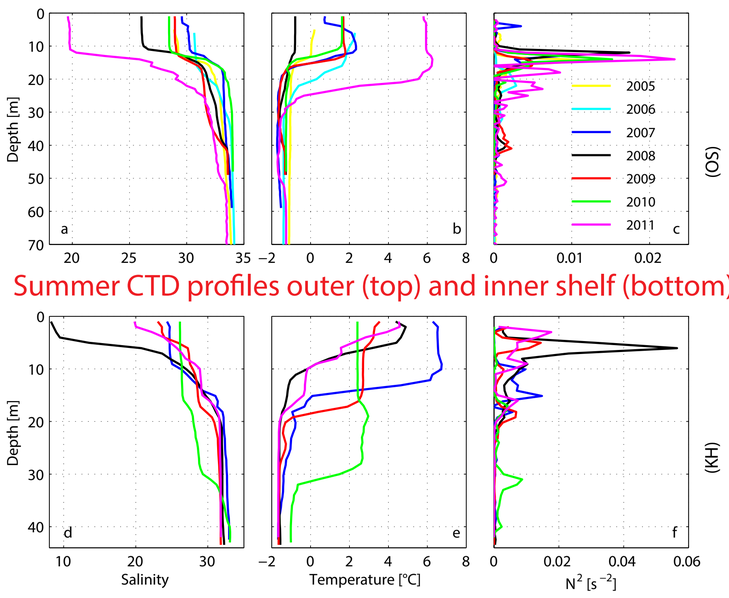
Introduction: The Arctic Ocean halocline is a globally signifcant reservior of freshwater with consequences for regional and global ocean circulation and climate. River runoff, in particular from the large Siberian Rivers, is one of the main freshwater sources available for halocline replenishment. Hence, the physical processes that control freshwater dispersion across the broad Eurasian continenal shelves impact the stratification and circulation of the Arctic basin. It can be assumed that the river runoff contribution to the polar mixed layer is primarily wind-driven. However, synoptic turbulence microstructure observations of the Laptev Sea shelf (characterized by energetic tides and the Lena River) showed episodic vertical mixing events. Therefore, in order to better understand diapycnal mixing processes and the vertical distribution of the Lena River freshwater, it is essential to understand the variability and vertical structure of tides on the Laptev Sea shelf.


## Observations:



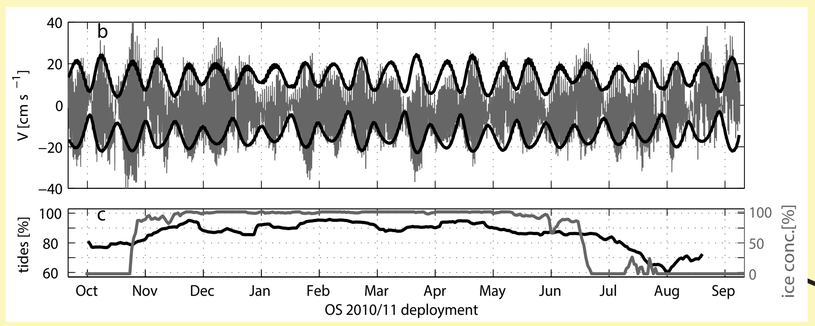

★ Multi-year moored ADCP & CTD

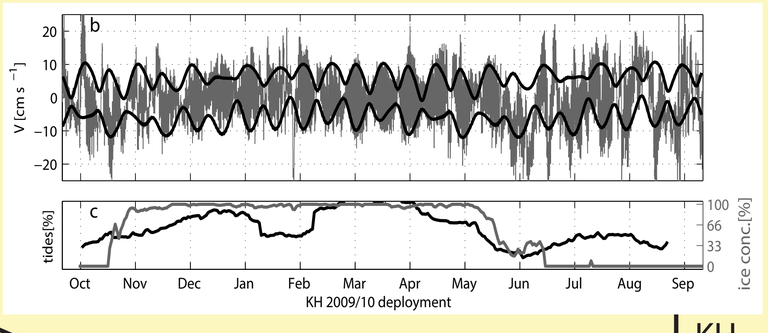
● Synoptic VMP turbulence Sep. 2007




Summer CTD profiles outer (top) and inner shelf (bottom)

Tides dominate Laptev Sea currents from outer shelf (OS) to inner shelf (KH), less so when ice-free:



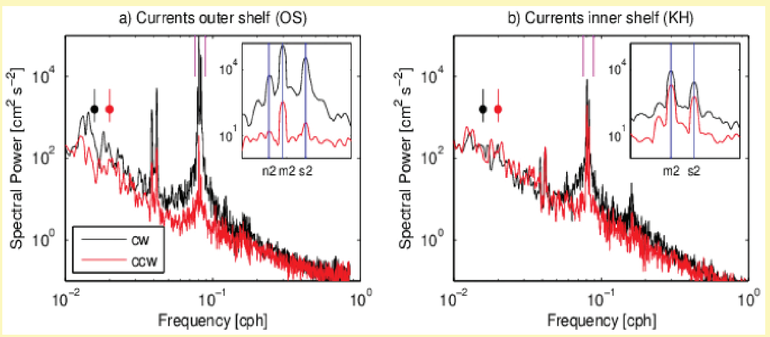




OS → KH

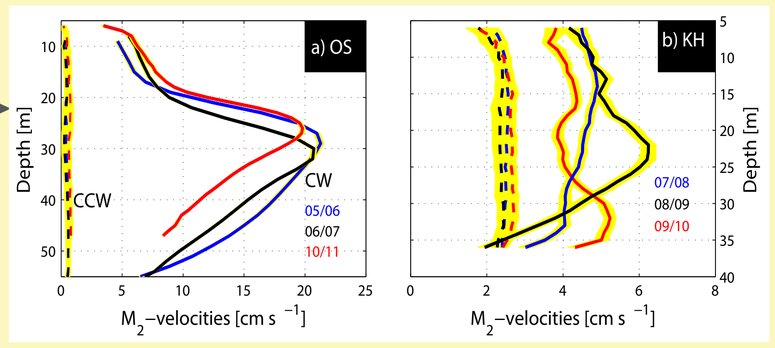
Semidiurnal tides dominate variability.

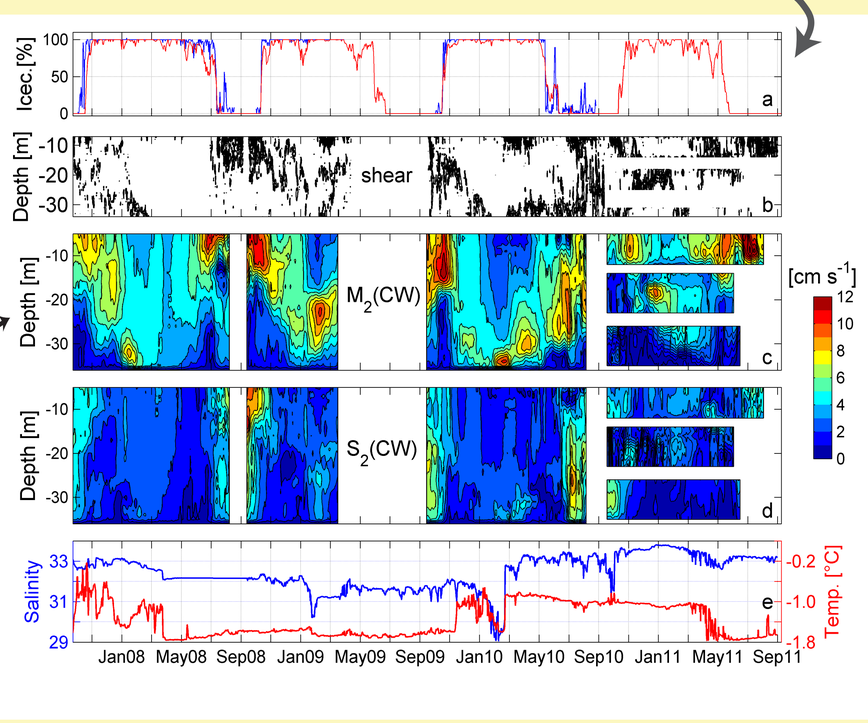
M2 critical latitude runs through the Laptev Sea, so M2 is very close to local inertial frequency (insets)

➡ ***this leads to high dependence of M2 tidal structure on local stratification and clockwise polarization.***




Persistent fresh surface mixed layer results in the markedly sheared M2 tidal current ellipses that are strongly clockwise polarized.

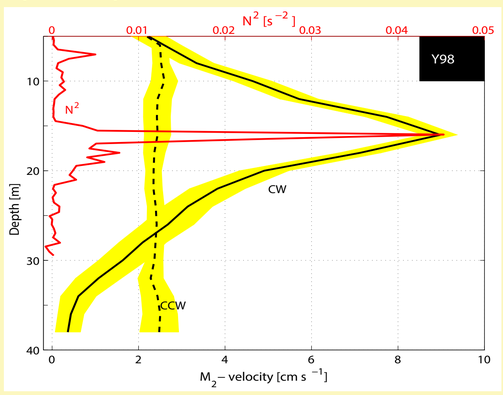


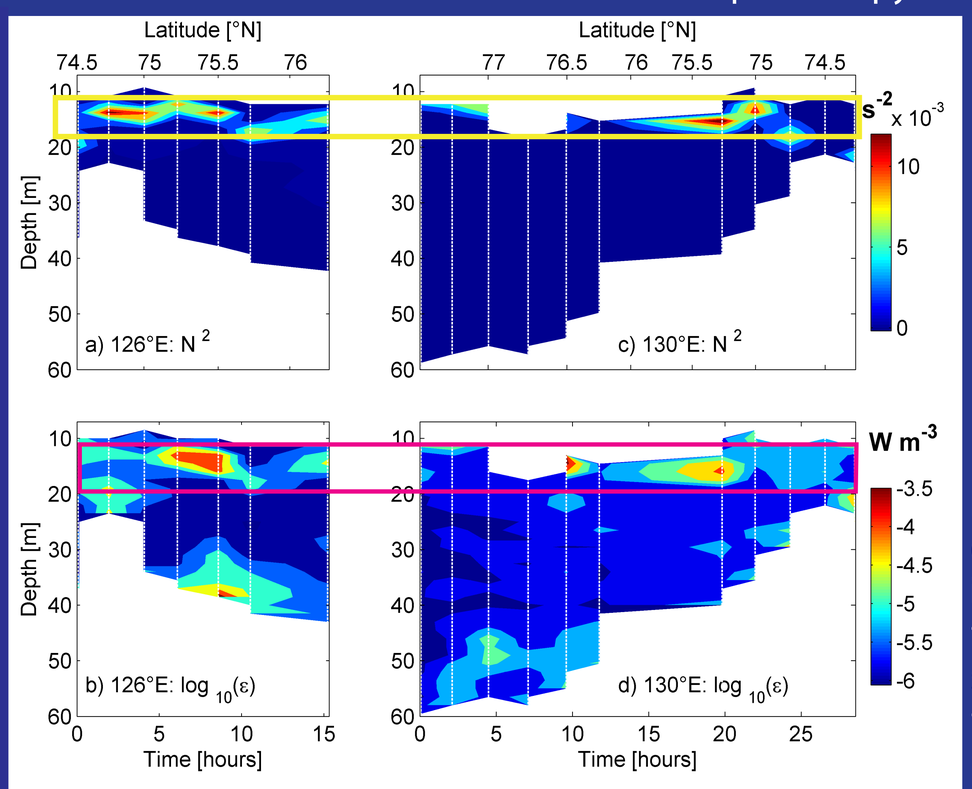

High M2 shear marks deepening surface mixed layer that persists through much of winter under the sea ice.
The S2 component is smaller but exhibits similar patterns.

***Can the semidiurnal tidal shear lead to turbulent mixing?***

Example: dependence of tides on stratification




Turbulence microstructure observations show peaks in pycnocline dissipation:




Pycnocline marked by high N2

Episodic tke dissipation peaks imply injection of freshwater from the surface mixed layer to shelf halocline

## Summary of the main results:

- Tidal currents are polarized and dependent on stratification throughout the shelf
- Tides play the biggest role in the currents' variability on the outer shelf, less so near-shore where tides are weaker
- "Shear-spike"-mechanism by Burchard and Rippeth (JPO, 2009), i.e. alignment of winds with tidally rotating shear vector, explains high dissipation events on the Laptev Sea shelf
- Distribution of Lena River freshwater determines many of the Laptev Sea's physical and biogeochemical conditions including the vertical structure of tides and vertical mixing
- Please find more details in Janout & Lenn (JPO, accepted)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