Extreme events in the ocean: Episodic vigorous mixing above the continental slope

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The Arctic Ocean
Turbulent mixing in the central Arctic Ocean (MOSAiC campaign)
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- strong halocline confines turbulence to surface layer
- slightly increased turbulence at deeper layers after breakdown of halocline and above complicated topography
- overall: low levels of vertical mixing and transport
Turbulent mixing at the slope (summer 2018, Laptev Sea)

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- bottom layer (shelf):
  - turbulence typically confined to boundary layers
  - turbidity confined to near bottom layer (shelf)
  - nutrients in surface depleted
  - Single high turbulence station!

- surface layer:

Questions

1. Where does this come from?
2. Does this happen often?
3. Effect on transport?
How was the mixing generated?
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- Their associated down-slope flow component displaces isopycnals downward (observed here), resulting in a trapped lee wave, as forcing period is longer than local inertial period (as in Fer et al., GRL 2020).
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Next Question
How often does this happen?
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- Strong link to low sea ice cover
- Frequency might increase in the future with further receding sea ice
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What about the transport?
Suspended sediment transport

- lateral transport at intermediate depths important factor on pan-Arctic scale, but mechanisms unclear
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- here: suspended sediment cloud of \(~500 \text{ g m}^{-2}\) originating from upper slope, contributes to basin sedimentation flux and carbon burial
Vertical nutrient transport

![Graph showing vertical nutrient transport with data points and labels for years, transects, and longitudes.]
Vertical nutrient transport

![Graph showing nutrient transport](image)
Vertical nutrient transport

Impact:

- Locally enhanced primary productivity.
- Contribution of spatially confined, episodic events at slope to overall vertical nutrient transport comparable to "background" transport contribution over whole basin.
Summary

- New energy conversion mechanism for vertical mixing above Arctic continental slopes.
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- First observation of intermediate nepheloid layer this far north, connects shelf and basin, might significantly contribute to basin sedimentation flux.
- Mixing events resupply nutrients to surface and boost late primary productivity, contribution to overall nutrient supply ~equal to basin-wide weak (summer) mixing.