Studying ocean circulation and biogeochemical processes during the Last Glacial Maximum (~21 ka)

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Motivation

- Exposed shelves in the LGM may have caused significant tidal energy shifts to the open ocean and changed the thermohaline circulation and biogeochemical cycles in the ocean interior.
- We want to test the hypothesis that the deep ocean was less ventilated despite increased deep ocean mixing due to **internal *wave breaking.***

Methodology

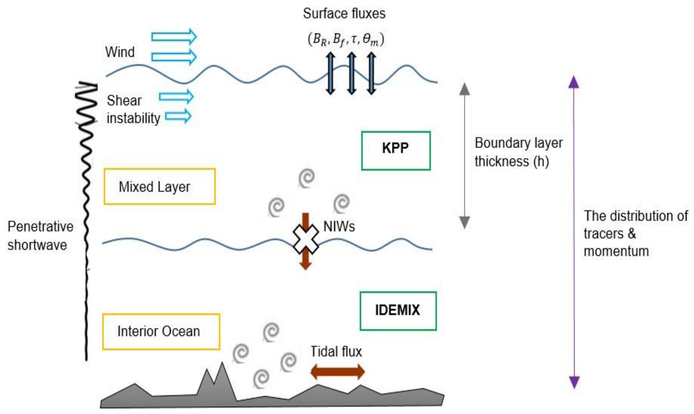

Figure 1. KPP + IDEMIX mixing scheme

Tidal forcing is ***the only source*** to generate internal waves.

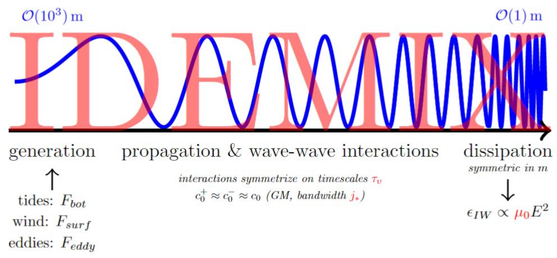

Figure 2. Schematic illustration of internal gravity wave model IDEMIX

Preliminary Results

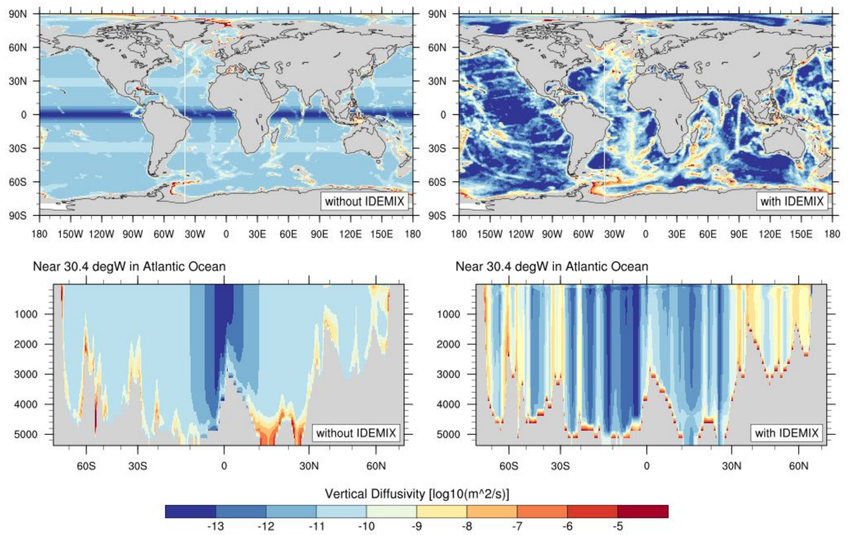

Figure 3. Global maps at 1500 km and sectional profiles at 30.4°W for 500 years of LGM simulation with and without IDEMIX

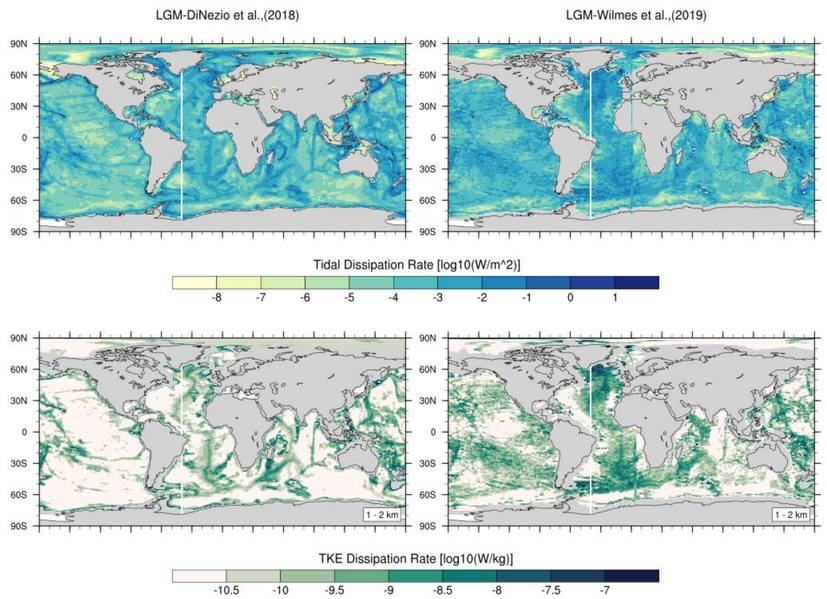

Figure 4. Tidal forcing datasets and the TKE dissipation rates of 100 years of LGM simulations

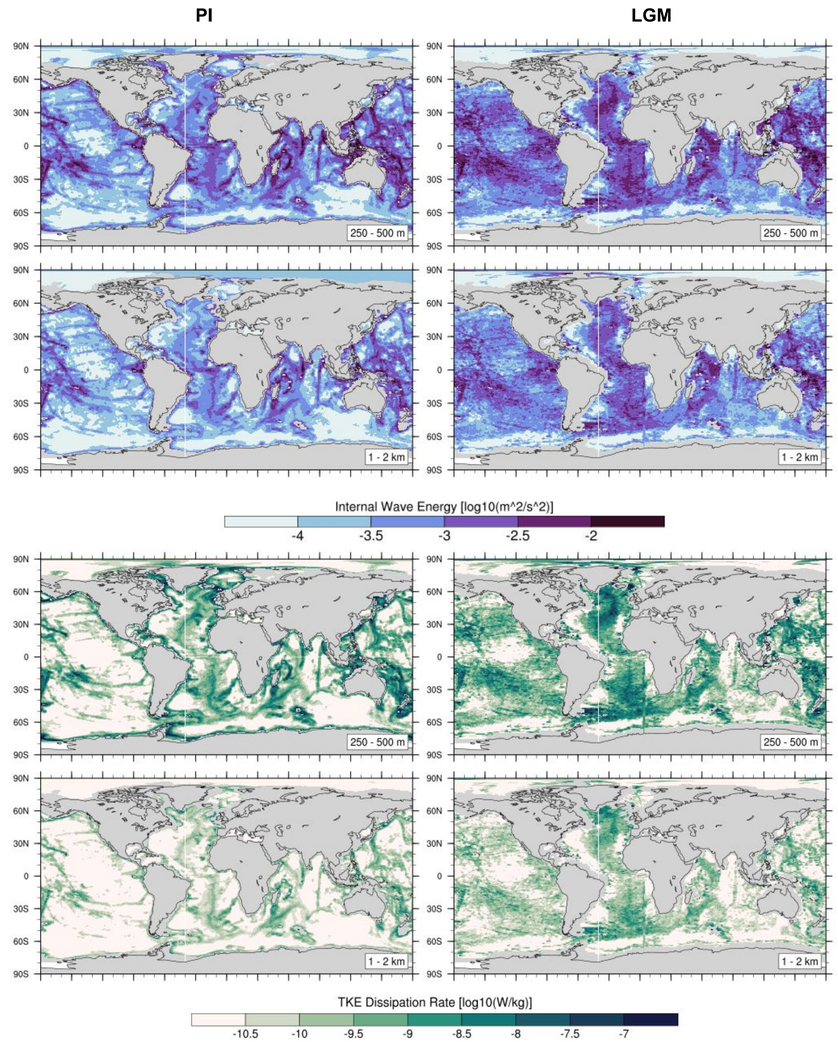

Figure 5. Mean of internal wave energy and the TKE dissipation rates of 100 years of PI and LGM simulations over different depth ranges

Summary

- The strength of turbulence and its vertical extent is significantly increased near steep deep-bottom topography with IDEMIX coupling.
- In general, the TKE dissipation rates are an order of magnitude (even two orders of magnitude at the mid-Atlantic Ridge and the Drake Passage) higher by using tidal forcing from Wilmes et al.,(2019) compared to DiNezio et al.,(2018).
- LGM ocean is more turbulent than PI. Both internal wave energy and TKE dissipation rates decrease from surface to deeper levels.