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The portion of the total near-inertial energy flux propagating out of the mixed layer

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The Near-Inertial (NI) motions that are excited by winds are believed to be an important source for deep-ocean mixing. About 2 TW of energy, mainly supplied by winds and tides, are required to create mixing to sustain the global general circulation in the ocean. The global energy rate from the surface to internal tides was estimated to be 0.9 TW. In contrast, the quantitative assessment of the NI energy available for deep-ocean mixing and the portion of the total NI energy flux propagating out of the mixed layer remains to be clarified.

The portion of the total NI energy flux propagating out of the mixed layer has so far been studied using realistic ocean models, but with leveled upper ocean of a constant depth (the Mixed Layer Depth (MLD) was assumed to have the depth of e.g., 150 m). This assumption cannot give a realistic distribution the MLD because of it's spatial and temporal variability. To overcome this difficulty we use spatial structure of the MLD diagnosed from temperature and salinity fields, using a potential density criterion defined by Levitus (1982). We analize the oceanic state from January and July 2005 at 1-hourly temporal resolution.

In our analysis, we use the Max Planck Institute Ocean Model at 10 km horizontal resolution and 80 vertical levels. We calculate the total NI energy flux propagating out of the mixed layer as a sum of a vertical energy flux and a projection of a horizontal energy flux at the MLD. We address these questions: How big is the portion of the total wind-induced NI energy flux that propagates out of the mixed layer? Can we connect the portion of the total NI energy flux propagating out of the mixed layer and the wind-power input to NI motions?

Our results show that the total NI energy flux propagating out of the mixed layer shows a pronounced maximum in the mid-latitude storm track regions during the winter season for both months. About 12.9% of the total NI energy flux for January and 8.2% for July propagates out of the mixed layer. We attribute the lower portion of the NI energy flux propagating out of the mixed layer during July to MLD deepening (up to 800 m) between 30°-60° S. This strong spatial vertical variability of the MLD at the Southern Hemisphere is not seen in the Northern Hemisphere during January. Higher wind-power input to NI motions leads to higher dissipation of the total NI energy flux, meaning that the vertical shear influences the propagation of the total NI energy.