

## **In which direction does mixing occur in the ocean?**

Imagine a slightly-tilted pile of Dutch pancakes sweetened with Canadian maple syrup. As the maple syrup is poured onto the top pancake, it may easily spill over the sides but only slowly penetrates through to the interior. Due to enhanced resistance to movement through a pancake, it is easier for the syrup to move along the pancake than through the pancake. We make use of this pancake analogy to conceptualize the stratification of ocean buoyancy and its influence on the associated transport of matter and heat. Buoyancy measures the gravitational acceleration on a fluid element relative to the surrounding fluid. Two fluid elements are neutrally buoyant when buoyancy forces neither to move above nor below one or the other. From this it may be possible to conceptualize the neutral surface: i.e. a surface (like a pancake) along which fluid can move, without changing its buoyancy. As with the pancakes, it is easier for fluid in the ocean to move along such a neutral surface, than it is to move through such a surface.

This paper both conceptually and mathematically defines the neutral direction and argues empirically, why we believe this to be true. As motion and mixing in the ocean is believed to be in this neutral direction, accurately representing this direction is extremely important. This is because this direction lies at the very fundament of numerical ocean modeling and our understanding of the ocean, but has only few times been discussed in length.