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Suppression of eddy diffusivities over a sloping seafloor in a two-layer model

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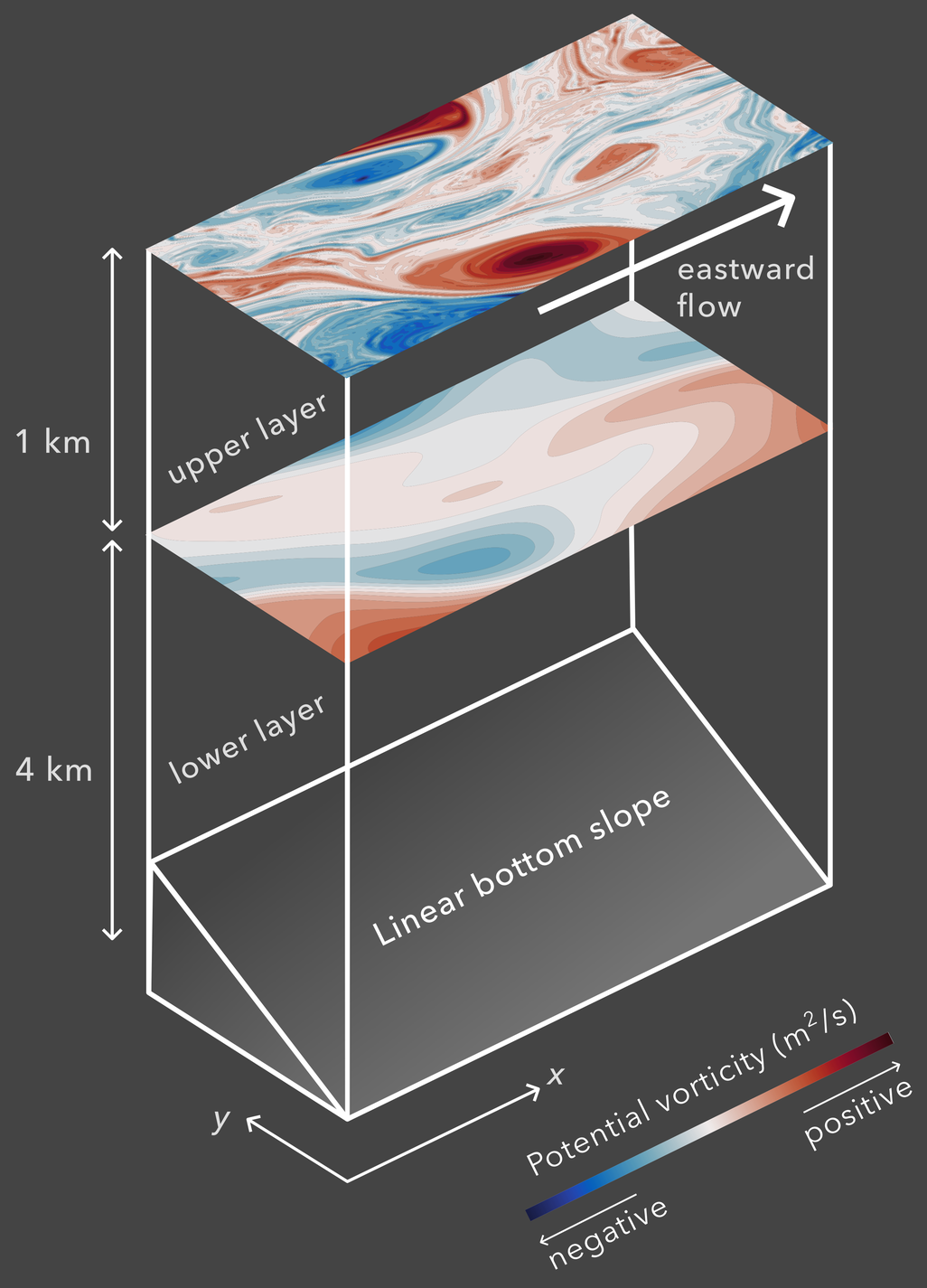


Background

Ocean eddies play a crucial role in the Earth's climate system by mixing heat, salt and carbon. In many ocean and climate models, eddy mixing is **parameterized**. However, a lot is still unknown about the physical factors influencing eddy mixing.

Recent studies found that in the presence of a **sloping seafloor**, cross-slope eddy mixing is **weakened** because the flow is steered along the slope. Here we study this effect in a numerical two-layer model.

Methods

1. We use **GeophysicalFlows** *(Constantinou et al., 2021)* to create eddying flow fields in a two-layer model.

2. We then use **Parcels** (*Delandmeter and Van Sebille, 2019)* to release and track particles in the flow fields.

3. From the particle trajectories, we can compute the **eddy diffusivity**, which measures the eddy mixing strength:

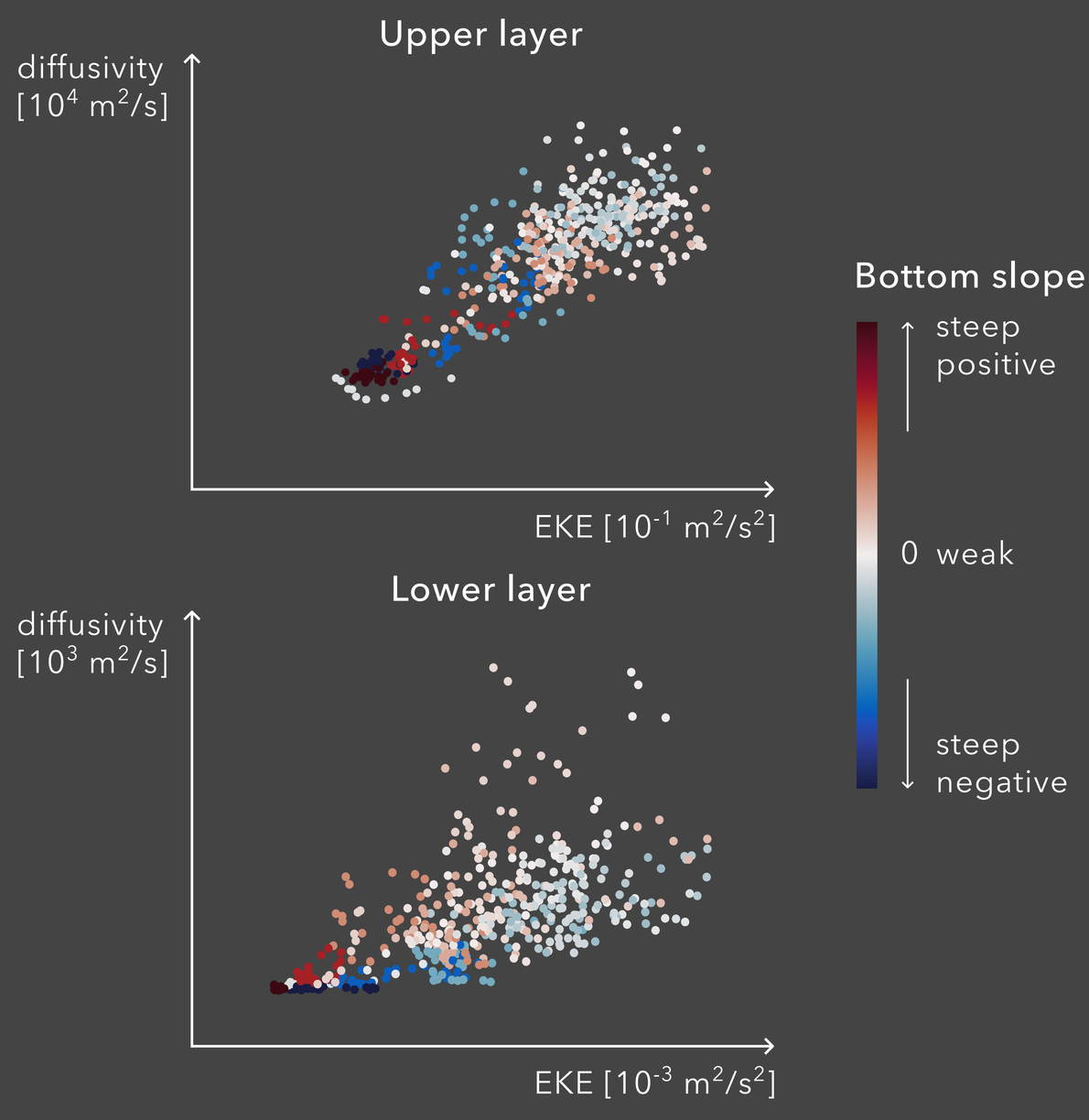
$$d = \lim_{t\to\infty} \frac{\left\langle (y - y_0)^2 \right\rangle}{2t}.$$

For each slope, we make an **ensemble** of multiple flow field realizations and multiple particle releases.

Results

Eddy diffusivity is **weaker** for **steeper slopes**, in both the upper and lower layer.

There is a significant correlation between the **eddy diffusivity** and the **eddy kinetic energy** *(upper layer: 0.84, lower layer: 0.65)*.



Outlook

The next step is to understand the flow field dynamics based on **linear instability theory**.

Then, we will create a **parameterization** for the eddy diffusivity as a function of the EKE and bottom slope.

These results will help to better understand the physical processes affecting eddy mixing and to develop improved parameterizations of eddy mixing for ocean and climate models.

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