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Tracer filamentation at an unstable ocean front[1] YEN CHIA FENG, Cooper Union, AMALA MAHADEVAN, Woods Hole Oceanographic Institute, JEAN-LUC THIFFEAULT, University of Wisconsin Madison, PHILIP YECKO, Cooper Union — A front, where two bodies of ocean water with different physical properties meet, can become unstable and lead to a flow with high strain rate and vorticity. Phytoplankton and other oceanic tracers are stirred into filaments by such flow fields, as can often be seen in satellite imagery. The stretching and folding of a tracer by a two-dimensional flow field has been well studied. In the ocean, however, the vertical shear of horizontal velocity is typically two orders of magnitude larger than the horizontal velocity gradient. Theoretical calculations show that vertical shear alters the way in which horizontal strain affects the tracer, resulting in thin, sloping structures in the tracer field. Using a non-hydrostatic ocean model of an unstable ocean front, we simulate tracer filamentation to identify the effect of vertical shear on the deformation of the tracer. In a complementary laboratory experiment, we generate a simple, vertically sheared strain flow and use dye and particle image velocimetry to quantify the filamentary structures in terms of the strain and shear. We identify how vertical shear alters the tracer filaments and infer how the evolution of tracers in the ocean will differ from the idealized two-dimensional paradigm.

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