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Submesoscale transport in the ocean and shape distortion from surface drifter triplets in the Gulf of Mexico

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Understanding the shape evolution of a tracer patch advected by ocean currents is relevant in many applications such as mitigation response in case of dispersion of hydrocarbons. Aspects of the geometry of the two dimensional surface dispersion can be quantified by simultaneous observations of at least three Lagrangian drifters. Drifter triplets are also the minimal configuration required for directly estimating kinematic properties of the underlying velocity gradient field.

Traditional data constraints on drifter triad availability have been overcome by a particular launch strategy used during the Grand Lagrangian Deployment Experiment (GLAD) in the northern Gulf of Mexico in 2012.
Triangle shape metrics are analyzed to quantify the evolution of submesoscale (100–500 m initial separation) surface drifter triplets released in a quasi-eqilateral configuration. The observations are compared to synthetic drifters advected by geostrophic velocity fields derived from satellite altimetry. Observed submesoscale triads evolve rapidly, reaching highly elongated configurations on timescales of 6 h to 2 days, in contrast to 6 days or longer for altimetry-derived synthetic data. Estimates of horizontal divergence and strain rate from the drifter triplets indicate the relative importance of divergence in the evolution of triangle shape. Horizontal divergence is scale dependent, on the order of the local Coriolis parameter, and 2 to 3 times larger for initial 100 m scales compared to initial 500 m scales.