

Four-Dimensional Glider fleet survey reveals small mesoscale eddy merging and splitting
dynamics.

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ABSTRACT

A four-dimensional, three-month-long survey by eight gliders at the Balearic Sea in the western Mediterranean Sea was used to examine the evolution and variability of mesoscale eddies and related physical processes, including frontogenesis, and subduction. The combined glider fleet covered nearly 15978 km over the ground, performing 704 glider days while doing over 4837 dives to as deep as 700 m, measuring temperature, salinity, velocity, chlorophyll fluorescence, oxygen, and acoustic backscatter. The data was objectively mapped on 10 m vertical levels in space and time. Vertical and ageostrophic horizontal velocities were estimated using the omega equation. Uplift of the isopycnal surface, 28.9 kg/m³, ~70 m in 10 km, was observed in an asymmetric cyclonic eddy (CE) on April 29, 2022, with ~25 km width and ~35 km length. Downward velocities of ~20 m/day developed, with the CE axis shifted westward. After the first CE decay, the 28.9 isopycnal shoaled again in the east as another CE formed, where relative vorticity reached ~0.5f. The eddy axis shifted westward during CE growth, and the downward velocities were ~25 m/day during the eddy intensification. Then, the new cyclonic feature spread over before splitting again into two 15 km CEs on May 2. The two smaller CEs proceeded north and west until they vanished. An anticyclonic structure (20 km) developed within their separation. The glider observations reveal horizontal density gradients up to 0.5 kg/m³ over ~10 km. Both upwelling and downwelling were observed near the frontal interface by biochemical tracers.