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Aerial and in situ Measurements of Submesoscale Eddies, Fronts, and Filaments

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Submesoscale eddies, fronts, and filaments on scales of 10 m to 20 km are common features of many coastal regions of the world. Modeling results suggest that these submesoscale phenomena play an important role in local energy cascades, transferring energy from the large-scale ocean circulation to turbulence. It is also likely that submesoscale features are important for mixing, vertical transport, or biogeochemical processes.

While submesoscale features have been observed using SAR satellite imagery, only very limited in situ measurements exist that reveal the dynamically relevant internal structure. Submesoscale features have a life time of several hours to a few days and advective speeds of up to 0.5 ms-1, which makes it very hard to measure them with traditional in situ sampling. Also satellite sea surface temperature (SST) data cannot sufficiently resolve the small scales of these features. We present aerial and in situ measurements of submesoscale eddies, fronts, and filaments, and believe to have carried out the first time in situ measurements of a spiral eddy (∼2.5 km diameter) during a 5-day experiment in September 2009 off Catalina Island, CA. The observations are taken with a cost efficient and pragmatic observational approach for repeat quasi-synoptic measurements of submesoscale features in real-time and on the required small spatial and temporal scales of ∼30min and ∼20m. An IR camera mounted on a small plane is used to derive fine-resolution SST maps of this area and to guide a fast response vessel to distinct submesoscale features. A temperature/pressure array is towed in the upper 45m at speeds of 5 ms-1 through the features. The properties of the submesoscale features are examined within the context of the larger-scale circulation patterns of this highly variable coastal region combined with the analysis of satellite SST, coastal radar, and mooring data.