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EUREC4A-OA/ATOMIC experiment : Themohaline and dynamical descriptions of mesoscale and submesoscale structures of the Northwest Tropical Atlantic Ocean

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In January-February 2020, the EUREC4A-OA/ATOMIC experiment took place in the Northwest Tropical Atlantic Ocean with the overall objective of understanding the role of fine scale processes in the internal ocean dynamics and air-sea interaction. Four oceanographic vessels, the French Atalante, German Maria S Merian and Meteor, and the American Ron Brown, closely coordinated with air-borne observations and autonomous ocean platforms (gliders, saildrones, and drifters) to simultaneously measure the ocean and atmosphere east of the island of Barbados and the coast of Guyana in the western Tropical Atlantic. A whole battery of instruments measuring the thermohaline and dynamic characteristics of the region was launched. The fixed CTD stations, reaching great depths while measuring salinity, temperature, and oxygen concentrations, serve as a reference to calibrate and validate other devices, in particular, shallower uCTD, TSG, and MVP, acquired during ship transits, and autonomous gliders and saidrones. Combined, these datasets increase the horizontal resolution and thus the description of structures ranging from mesoscale to fine scale.

The Northwest Tropical Atlantic Ocean is a dynamical region filled with mesoscale eddies of different origins and transporting various water masses across the region. These eddies have rich and diverse characteristics ranging from shallow cyclonic and anticyclonic eddies to the deep reaching North Brazil Current (NBC) Rings. On the surface, down to 200 m depth, the signatures of shallow cyclones and anticyclones (NBC rings) were measured. The shallow mesoscale eddies, with core centered around a density of 25.5 kg m-3, advect highly saline and warm waters, with low oxygen concentrations compared to the surrounding water masses. Below, evolving at density around 26.7 kg m-3, thick anticyclones were observed, characterized by low temperature and

salinity but with high values of oxygen, indicative of a South Atlantic origin. One was observed drifting slowly northward and another one at the NBC retroflection. Similarly, mesoscale cyclonic eddies were also observed both at the surface and at depth. Surface and subsurface eddies are not aligned vertically and they seem to evolve independently.

The large number and diversity (ship-mounted or autonomous) of observing platforms implemented in the project made made it possible to innovatively sample the upper-ocean frontal scales and stratification. It has been found that the interaction between the particularly fresh waters from the Amazon River, flowing northward along the shelf-break, and NBC rings create a rich variety of submesoscale fronts and a strong barrier layer, leading to interleaving. With the high vertical and horizontal resolutions, we quantify the layering and mixing processes at play.