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On the variability of the Mediterranean Outflow Water in the Atlantic Ocean: Observations and Model analysis

A. BOZEC (1), E.P. CHASSIGNET (1), and M.S. LOZIER (2)

(1) COAPS/Florida State University, Tallahassee, FL, USA , (2) Division of Earth and Ocean Sciences, Duke University, Duke, NC, USA

Several questions remain unanswered about the role and importance of the Mediterranean Overflow Water (MOW) for the Atlantic Ocean circulation and the global thermohaline circulation. Of particular interest is the temporal variability of the MOW and the mechanism(s) responsible for such variability on interannual and decadal scales. Specifically, we seek to determine the extent to which MOW variability is 1) driven by buoyancy forcing changes within the Mediterranean Sea, 2) driven by the variability of the properties of the entrained waters or 3) due to circulation change in the Atlantic Ocean.
In a first step, using HYDROBASE, we show that variability of the entrained water between 1955 and 1995 is similar but weaker than the variability described by Potter and Lozier (2004) for the MOW in the Atlantic Ocean. In a second step, we use a 1/3° North Atlantic configuration of the HYbrid Coordinate Ocean Model (HYCOM). The Mediterranean overflow is parameterized using the Price and Yang (1998) boundary condition, which allows for an accurate representation of the outflow properties. Two experiments of 59 years are performed: one forced by the interannual NCEP atmospheric fields from 1948 to 2006 and the second forced with the ERA15 climatology. In these two experiments, no variability from the Mediterranean Sea is introduced in the system. In the climatological run, the properties of the MOW and of the entrained water stays constant through the simulation, while in the interannual run, the variability of the MOW and of the entrained water are similar to the observations. In a third step, we explore the possible mechanisms responsible for the MOW trend in the Atlantic Ocean, such as changes in the circulation pattern at 1000m in the vicinity of the Gulf of Cadiz.