EMS Annual Meeting Abstracts
Vol. 8, EMS2011-653, 2011
11th EMS / 10th ECAM

Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

A diagnostic of the vertical velocity for the equatorial Atlantic

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Estimating the vertical velocity (w) in the oceanic upper-layers is a key issue for understanding the cold tongue development in the eastern equatorial Atlantic. For that, we have developed an expanded and general formulation of the vertical velocity based on the primitive equation (PE) system, in order to gain new insight into the physical processes responsible for the development of the equatorial and Angola upwellings. This approach is more accurate for describing the real ocean than simpler considerations based on just the wind-driven patterns of surface layer divergence.

The w-sources are derived from the PE w-equation and diagnosed from a realistic ocean simulation of the equatorial Atlantic. Sources of w are numerous and express the high complexity of terms related to the turbulent momentum flux, to the circulation and to the mass fields, some of them depending on w and others not. With this formalism, the equatorial upwelling is found to be mainly induced by 1. the zonal wind stress, 2. the stress-curl and 3. the imbalance between the circulation and the pressure fields. On the other hand, the Angola upwelling in the eastern part of the basin is mainly controlled by strong stress-curl.

A strong cross-regulation is evidenced between the forcing terms dependent on w and those independent of w. This cross-regulation suggests the existence of an equatorial balanced-dynamics. The forcing terms depending on w represent the negative feedback of the ocean to the w-forcing terms independent of w. We finally show that in the equatorial band, this adjustment is led by non-linear processes and by vortex stretching outside.