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Argo floats detect long Rossby waves and rapid current reversals in the North Atlantic

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We develop a new mathematical technique for the analysis of sparse and noisy data. The technique is effective for observation coverage with large spatial gaps and data with large noise/signal ratio. This allowed us to have higher temporal resolution for signals extracted from the Argo data and to detect “coherent” structures and rapid processes: long Rossby waves and reversals for the mid-depth currents.

Subsurface tracks and temperature profiles collected from March 04 through May 06 were used to detect signatures of long Rossby waves in velocity of the currents at 1000m and temperature, between the ocean surface and 950m, in the zonal band of 4N-24N. Long Rossby waves with the characteristic scales of 1000-2500 km are identified in the western (west of the Mid-Atlantic Ridge [MAR]) and eastern (east of the MAR) sub-basins. Along-shore wind fluctuations and an equatorially-forced coastal Kelvin wave were found to be responsible for the excitation of annual and semi-annual propagating Rossby waves in the eastern sub-basin. These waves are transmitted along a wave guide formed by the African shelf and the MAR. Unstable standing Rossby waves with annual and semi-annual periods are shown in both the sub-basins.

Subsurface tracks between April 03 through May 06 were used to detect rapid mid-depth current reversals at basin scale. We have reconstructed current snapshots averaged over a three month time period and detected two current reversals in November 05 and May 04. This dynamical regime is characterized by dissipation of the Southern Re-circulation Gyre, formation of a cyclonic gyre with the centre located approximately at 30N, 50W; preferably cyclonic circulation in the Subpolar Gyre. Each current reversal did not exceed 3 months.