Wave Processes Along 26°N in the Atlantic

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This project analyzes the MOCHA/WBTS/RAPID mooring data along 26°N in terms of wave motion at periods of hours to years. Particular focus is given to the western boundary, which is a key location for wave transformations hypothesized by theories of general circulation or by numerical models. An observational description of these waves and their transformations requires sustained measurements over a large area, an attribute now met by the 10+ years of data collected by seven full depth moorings from the 26°N array.

The first and fundamental activity to perform at the start of this project in 2014 was to reprocess the over eight years of data records at a higher sampling rate from the raw measurements. The high frequency single instrument records were combined following methods from the MOCHA/WBTS/RAPID project. Vertical modes were calculated using previously developed techniques (Szuts et al. 2012).

With reprocessed data available, the next task was a general description of the signals in the measurements. At the most basic, if energy contained at a specific frequency and vertical shape changes from one mooring to another, then we know that the wave regime has changed. This can be seen in frequency spectra of vertically-integrated potential and kinetic energy (Figure 1). At sub-inertial frequencies, potential energy is large in the center of the western basin (WB5) and decreases towards the boundary. The same decrease is seen in the component of kinetic energy that is perpendicular to the boundary. This decrease is most noticeable at the low frequencies known to have large eddy/wave signals. In contrast, energy at intermediate frequencies (periods of 1 to 10 days) increases closer to the boundary. This intermediate frequency band is a distinct wave regime and will be a key focus for continuing research.

At supra-inertial frequencies, kinetic and potential energy diminish from the offshore (WB4) to the onshore mooring (WB1) indicating the internal wave field is modified across the western boundary. Analyses of tidal and near-inertial band motions show a weak internal wave field that is dominated by propagating waves generated at other remote locations. Semidiurnal motions are small, baroclinic tidal velocities that have a weak spring-neap cycle uncoupled with local surface tides. Near-inertial motions have a seasonal cycle peaking during the North Atlantic storm season. At the western flank of the mid-Atlantic Ridge (MarW), supra-inertial potential energy is elevated near the bottom consistent with energetic internal tides. Monthly averages of semidiurnal and near-inertial band kinetic energy from 2004-2013 shows there is large spatial and temporal variability in the strength of the local internal wave field across at 26°N.

This project also supported Z. Szuts as an advisory panel member for a graduate student at the University of Southampton, Louis Clément, who was studying the impact of westward propagating eddies on calculations of overturning circulation from the 26°N array (Clément et al. 2014).

Bibliography

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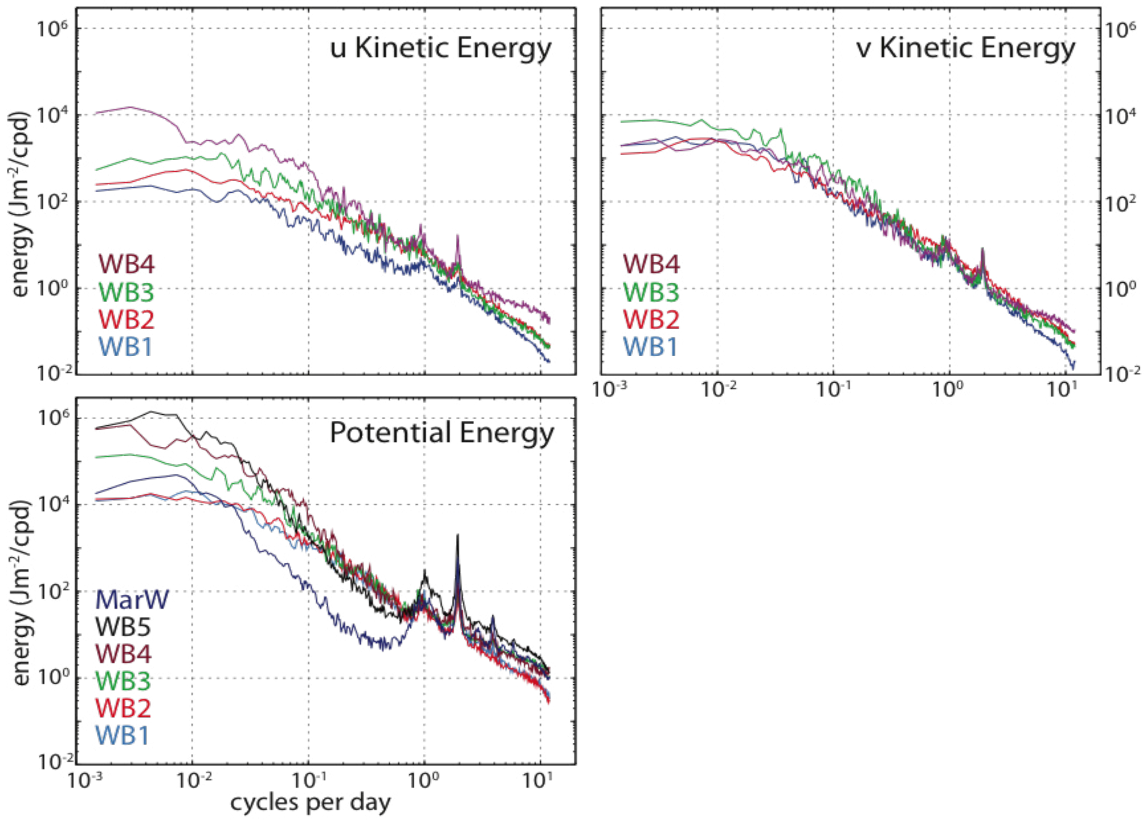

Figure 1. Frequency spectra of energy integrated through the water column from moorings along 26N, for (top left) the u component of kinetic energy, (top right) the v component of kinetic energy, and (bottom left) potential energy. The moorings are located offshore from the western boudary by: 4km for WB1, 15 km for WB2, 40 km for WB3, 90 km for WB4, and 490 km for WB5. MarW is on the western flank of the mid-Atlantic Ridge.