Impact of Balanced and Unbalanced motions on the Seasonality of Energy Cascade in the North Atlantic

Ajayi A. O., J. Le Sommer, J.M. Molines, G. Serazin,
B. Arbic and P. Klein

Abstract

The ocean kinetic energy combines balanced motions and high frequency unbalanced motions. Ocean kinetic energy has to be transferred from large scale motions to centimetre scale for dissipation to equilibrate kinetic energy injection at large scales. Recent literatures suggest that the spontaneous and stimulated generation of unbalanced motions are playing an active role in kinetic energy cascade toward dissipative scales. While balanced motions at small scales are argued to be source of kinetic energy for large scale motion via inverse cascade of ocean kinetic energy. Quantifying the net effect of submesoscale balanced motions and high frequency unbalanced motions (in terms of energy transfer) at basin and global scale is thus imperative towards having a better knowledge of ocean energy budget. In this study, using the NEMO based sub-mesoscale permitting ocean model of the North Atlantic with horizontal resolution of $1/60^{o}$, we quantify at basin scale, the seasonal change in energy transfer due to submesoscale balanced motions and high frequency unbalanced motions in the North Atlantic. Our result shows that (i) submesoscale balanced motions are more energetic in winter compare to summer and they represent a source of energy for large scale flows through inverse cascade; (ii) high frequency unbalanced motions enhance forward cascade of energy towards dissipative scales in winter time; (iii) at high wavenumber, there is a well defined scale separation across all frequency band at which energy is transferred to dissipative scales, such a scale separation is almost absent in summer time.