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The Characteristics and Significance of Hydrodynamical Internal Variability in Modelling Dynamics in Marginal Seas

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Internal variability, unprovoked by external forcing, emerges in the hydrodynamics of the marginal seas. Ensemble ocean simulations are used to analyze the characteristics, scales, and intensities of such variability in the Bohai, Yellow Sea, and South China Sea. With the signal defined as the covariation in the ensemble, and the noises as the independent variations, a scale dependency of the Signal-to-Noise Ratio (S/N ratio) is found in the Bohai, Yellow Sea, and South China Sea. The external forcing and related signal are dominant for large scales, while most of the internal variability is generated for small scales. The intensities of internal variability of the Bohai and Yellow sea are about half of the intensities of South China Sea, likely because eddies are less energetic in the Bohai and Yellow Sea, which likely is the main source of noise in South China Sea.

In addition, we investigate the effect of tides on internal variability in the Bohai and Yellow Sea by three ensembles of numerical experiments with tidal forcing, with half tidal forcing, and without tidal forcing. When the tides are weakened or turned off, the S/N ratios are reduced in large and medium scales, more so in the Yellow Sea than in the Bohai. The increase in the S/N ratio is largest for large scales and for depth-averaged velocity. The reduction in tidal forcing results in an approximately 30% increase in S/N ratios in the Bohai at large scales. Thus, the absence of tidal forcing favours the emergence of unprovoked variability at large and medium scales but not at small scales. We suggest that the main mechanism for the increase of covarying variability when tides are active, is the additional mixing induced by the tides.