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wave sensitivity to grid resolution, frequency, and pathways

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Kelvin waves transfer variability from one part of the ocean to the other. The North Atlantic Ocean acts as a source of perturbations through strong convection or ice melting events affecting the composition of water masses, thus isopycnals, and these perturbations spread over the entire ocean. Pure advection aside, wave processes represents a particular route. A reduced gravity set up, with high coastal and equatorial resolution is used to answer particular questions related to the role of bathymetry and coastlines, and the sensitivity of the wave signal to the frequency of the perturbation

Coastally trapped Kelvin waves are not resolved in high resolution ocean models. The model used here is Finite Element Ocean Model (FEOM). It differs from the other models in that its discretization is based on unstructured triangular meshes on the surface and prismatic volume elements in the volume. This variable resolution is able to resolve the localized Kelvin waves.

A Gaussian perturbation in time and space initiated at the Labrador Sea travels along the coast towards the equator as a coastally trapped Kelvin Wave, upon reaching the equator, the wave propagates eastwards along the equator till it reaches the eastern coast. Then, the signal splits up, and it propagates northwards and southwards towards the poles along the coast as a modified Kelvin wave. The interior of the basin is adjusted by westward propagating Rossby waves.

Results show that frequency of forcing is one of the major factors influencing the amplitude of the signal reaching the eastern boundaries. The results also show that Rossby waves are mainly responsible for wave adjustment from low frequency perturbations. The initial adjustment process due to Kelvin wave is completed within a few months. The amplitude of this initial Kelvin wave is dependent on the coastal grid resolution. However, the final Rossby wave adjustment is independent of mesh resolution. The experiments also show that parts of the low frequency waves originating at the Labrador sea are trapped at the Gulf of Mexico.