Large near-inertial oscillations of the Atlantic MOC

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The Atlantic meridional overturning circulation (AMOC) is a key contributor to Europe's mild climate. Both observations and models suggest that the AMOC strength varies on a wide range of timescales. Here we show the existence of large near inertial AMOC oscillations in a high resolution ocean model. Peak-to-peak these oscillations can exceed 50 Sv in one day. The AMOC oscillations are caused by equatorward propagating near-inertial gravity waves (NIGWs) which are forced by temporally changing wind forcing. The existence of NIGWs in the ocean is supported by observations, and a significant fraction of the ocean's kinetic energy is associated with the near inertial frequencies. We decompose the Atlantic MOC into Ekman, barotropic and geostrophic components and an ageostrophic residual, and show that the latter contains a dominant high frequency signal, with period constrained by the local inertial period. Our results also suggest that the NIGW-driven MOC variability would be near invisible to contemporary AMOC observing systems such as the RAPID MOC system at 26◦N.

In addition to the NIGW-driven MOC variability, enhanced MOC variability of up to 200 Sv, with a dominant period of 7-10 days is seen close to the Equator in all ocean basins. We find that this enhanced equatorial MOC variability is primarily forced by the local wind forcing, and not a result of interaction between the NIGW fields which propagate equatorward in both hemispheres.