Unimodality of Wave Amplitude in the Northern Hemisphere

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A novel statistic for local wave amplitude of the 500hPa geopotential height field is introduced. The statistic uses a Hilbert transform to define a longitudinal wave envelope and dynamical latitude weighting to define the latitudes of interest. Here it is used to detect the existence, or otherwise, of multimodality in its distribution function. The empirical distribution function for the full 1960–2000 period is close to a Weibull distribution with shape parameters between 2 and 3. There is substantial interdecadal variability, but no apparent local multimodality or bimodality.

The zonally averaged wave amplitude, akin to the more usual wave amplitude index, is close to normally distributed. This is consistent with the central limit theorem which applies to the construction of the wave amplitude index. For the period 1960–1970 we do find apparent bimodality in this index. However, the different amplitudes are realized at different longitudes, so there is no bimodality at any single longitude.

As a corollary, it is found that many commonly used statistics to detect multimodality in atmospheric fields potentially satisfy the assumptions underlying the central limit theorem and therefore can only show approximately normal distributions. We conclude that these techniques may therefore be suboptimal to detect any multimodality.