

Implications of the semigeostrophic nature of Rossby waves for Rossby wave packet detection

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Upper tropospheric Rossby wave packets have received increased attention recently. Many previous studies detect wave packets by computing the envelope of the meridional wind field using either complex demodulation or a Hilbert transform. The latter requires fewer choices to be made and appears, therefore, preferable. However, the Hilbert transform is fraught with a significant problem, namely a tendency which fragments a single wave packet into several parts. The problem arises because Rossby wave packets show substantial deviations from the almost-plane wave paradigm, a feature which is well represented by semigeostrophic dynamics. As a consequence, higher harmonics interfere with the reconstruction of the wave envelope leading to undesirable wiggles. A possible cure lies in additional smoothing, e.g. by means of a filter, or resorting to complex demodulation (which implies smoothing, too). Another possibility, which does not imply any smoothing, lies in applying the Hilbert transform in semigeostrophic coordinate space. This device also turns out beneficial for computing formulations of a wave activity flux which are meant to be phase independent.