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Decomposing atmospheric planetary waves into standing and travelling components

A classical approach to spectral analysis of atmospheric spatio-temporal signals involves separating atmospheric disturbances into standing and travelling zonal wave components. Such a decomposition is motivated empirically by observations of the circulation being dominated by standing or propagating wave patterns, but is complicated by the fact that standing and travelling wave harmonics are not orthogonal. In a study led by O. Watt-Meyer, we have revisited classical methods of standing-travelling signal decomposition to explicitly account for the covariance between the two parts and more clearly identify when wave patterns are dominated by standing or travelling waves. When applied to wintertime Northern Hemisphere circulation, we find that standing planetary waves in the upper troposphere and stratosphere explain the largest portion of the variance at low frequencies. Standing waves tend to constructively and destructively interfere with the climatological stationary wave, suggesting that standing waves contribute to a linear interference effect in wave mean-flow interactions that has been shown to be an important part of stratosphere-troposphere coupling.