PHYSICAL MATHEMATICS SEMINAR

Spectral Analysis of Tropical Atmospheric Dynamical Variables using a Linear Shallow Water Modal Decomposition

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ABSTRACT:

Space-time spectral analysis has been used frequently in studying observational evidence of convectively coupled equatorial waves. Here 23 years of brightness temperature (T_b) data and dynamical reanalysis data are analyzed by an appropriate projection onto the meridional basis functions of the β-plane linear shallow water equations. Evidence of peaks in power along linear equatorial mode dispersion curves in T_b, zonal and meridional wind, divergence and geopotential spectra are presented.

Another feature of all space-time spectra considered is the redness in frequency, zonal wavenumber and meridional mode number. It is found that spectral peaks in the dynamical variables spectra are largely consistent with baroclinic linear shallow water waves, but peaks related to barotropic waves and extratropical storm track activity are also apparent. The convectively coupled wave signals are seen to be confined to the first few meridional basis functions suggesting a filtering method to reduce noise for these signals. This result also has implications for future modeling and theoretical work. A comparison of our results for two different reanalysis products shows only minor differences adding confidence in the robustness of the results presented. This work implies that any comprehensive theory of tropical convection should explain the ubiquity of moist linear waves as well as the spectral redness with respect to all temporal and horizontal scales.

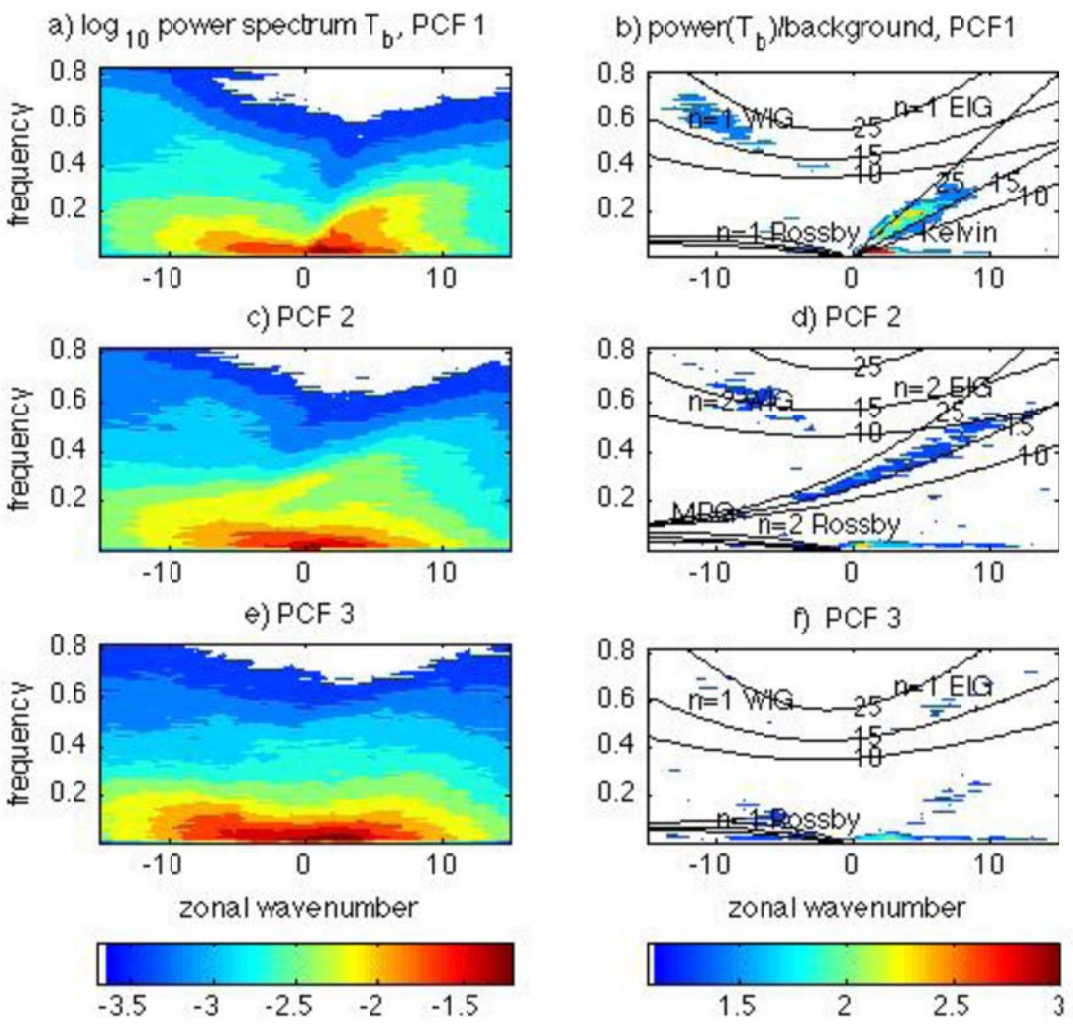

Figure 1: Zonal wavenumber-frequency T_b log power spectra for single PCFs. The left panels show PCF 1 to 3 spectra and the right panels show the same with the background removed. Top and bottom PCFs are symmetric across the equator, PCF 2 is anti-symmetric. Superimposed are the dispersion curves for theoretical linear shallow water waves.

TUESDAY, FEBRUARY 28, 2012
2:30 PM
Building 2, Room 105

Reception at 3:30 PM in Building 2, Room 290
(Math Dept. Common Room)

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