

Space-time spectral analysis is a useful tool for quantification of the degree of organization of tropical convection and its interaction with the large-scale circulation. Previous work has highlighted the tendency of tropical convection to be organized by the Madden-Julian oscillation (MJO) and into equatorial wave modes that are anticipated by theory. Here we explore three aspects of space-time spectral analysis pertinent to the MJO and these equatorial wave modes: definition of the background spectrum, display of the spectrum, and the space-time coherence spectrum. Statistical significance of the spectral peaks associated with the MJO and the equatorial wave modes depends on definition of a background spectrum. Here we define the background spectrum at each zonal wavenumber as resulting from a first order autoregressive process (red noise). The associated decorrelation time for this red noise process for convection are found to be half as long as for zonal wind, reflecting the different physical process controlling each field. Spectral peaks in outgoing longwave radiation (a proxy for deep convection) and zonal wind that stand out above the red background spectrum are similar to those that are identified using a background spectrum resulting from ad-hoc smoothing of the original spectrum. Variance-preserving display of the power spectrum with a logarithmic frequency axis is shown to be useful for emphasizing the prominence of the Kelvin waves and their distinction from the Madden-Julian Oscillation. The space-time coherence spectrum of OLR and zonal wind indicates that the interaction between convection and large-scale circulation occurs solely by the MJO and the equatorial wave modes. The coherence is quantifiable and is thus suggested as a useful metric for diagnosis of the MJO and the equatorial wave modes in observations and simulations.