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Leading modes of tropical-extratropical interaction at subseasonal time scales

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Forcing of deep tropical convection by extratropical Rossby wave activity is a well-known feature of regions of upper level westerly flow. These interactions are commonly observed within the South Pacific and South Atlantic Convergence Zones (SPCZ and SACZ), and in the eastern Pacific ITCZ during winter, where westerlies and equatorward wave guiding by the basic state occur at low enough latitudes to interact with tropical and subtropical moisture sources. In these regions convection is commonly initiated ahead of upper level troughs, characteristic of forcing by quasi-geostrophic dynamics. However, recent observational evidence indicates that extratropical wave activity is also associated with equatorial convection even in regions where there is a "critical line" to Rossby wave propagation at upper levels, that is, where the flow goes from westerly to easterly towards the equator. A common manifestation of this type of interaction involves the initiation of convectively coupled Kelvin waves. Kelvin waves are responsible for a large portion of the convective variability within the ITCZ over the Indian, Pacific, and Atlantic sectors, as well as within the Amazon Basin of South America. The waves originating within the western Pacific ITCZ are often triggered by Rossby wave activity propagating into the Australasian region from the South Indian Ocean extratropics. The resulting Kelvin waves frequently propagate across the entire Pacific, and continue uninhibited across the Andes into South America, the Atlantic, and Africa. At other times, Kelvin waves are seen to originate along the eastern slope of the Andes. In the latter case the initial forcing is sometimes linked to a low-level "pressure surge," initiated by wave activity propagating equatorward from the South Pacific storm track. In yet other cases, such as over Africa, the forcing appears to be related to wave activity in the extratropics which is not necessarily propagating into low latitudes, but appears to "project" onto the Kelvin structure, in line with past theoretical and modeling studies. Observational evidence for such interactions will be presented, along with a review of some recent theoretical work aimed at explaining their dynamical causes.