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A more complete Rossby wave source

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Tropical convection drives extratropical variability on subseasonal to interannual time-scales by exciting Rossby wave trains in the upper troposphere. Traditionally the relevant Rossby wave source is considered to be the sum of vortex stretching and vorticity advection by the divergent horizontal flow ($-\mathbf{u}_\chi \cdot \nabla (\zeta+f) - \mathbf{u}_\chi \cdot \nabla (\zeta+f)$). Since absolute vorticity is very small at the equator, the equatorward flanks of the upper tropospheric jets have been regarded the source region of Rossby wave trains. In these considerations vertical momentum advection is neglected, although, it is an important source for westerly momentum at the equator. The curl of vertical momentum advection is the sum of vertical vorticity advection and vortex tilting ($-\omega \zeta_p - \omega_x v_p + \omega_y u_p$). These contributions are smaller than the traditional Rossby wave source in midlatitudes by about one order of magnitude but they are of similar size in the tropics.