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Ekman Pumping Mechanism Driving Precipitation Anomalies in Response to Equatorial Heating

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In this paper some basic mechanisms for rainfall teleconnections to a localized tropical sea surface temperature anomaly are re-visited using idealized AGCM aqua-planet simulations. The dynamical response is generally in good agreement with the Gill-Matsuno theory. The mechanisms analyzed are i) the stabilization of the tropical troposphere outside the heating region, ii) the Walker circulation modification and iii) Ekman pumping induced by the low-level circulation responses. It is demonstrated that all three mechanisms, and in particular ii) and iii), contribute to the remote rainfall teleconnections. However, mechanism iii) best coincides with the overall horizontal structure of rainfall responses. It is shown by using the models boundary layer parameter- ization that low-level vertical velocities are indeed caused by Ekman pumping and that this induces vertical velocities in the whole tropospheric column through convective feedbacks. Also the modification of the responses due to the presence of idealized warm pools is investigated. It is shown that warm pools modify the speed of the tropical waves, consistent with Doppler shifts and are thus able to modify the Walker circulation adjustments and remote rainfall responses. The sensitivity of the responses, and in particular the im- portance of the Ekman pumping mechanism, to large variations in the drag coefficient is also tested, and it is shown that the Ekman pumping mechanism is robust for a wide range of values.