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Equatorial Variability in Warm Climate Simulations

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The Madden-Julian oscillation (MJO) has long been an unresolved question in tropical meteorology. The challenge to understand the MJO is partly due to the multi-scale nature of the problem, ranging from convection to planetary wave patterns. A possible interaction between synoptic-scale eddies and the MJO have been shown previously in observations, models and theoretical work. In addition, little is known about the MJO in warm climates.
Using the NCAR CAM3 model we preform simulations of very warm climates. In these simulations a transition to superrotation, i.e. westerly winds in the troposphere above the equator, is observed. The convergence of momentum leading to superrotation is driven by increased equatorial intraseasonal variability (ISV); with increasing temperature the ISV is increasingly similar to the MJO. Moreover, in a superrotating regime there is an increased modulation of extratropical eddies by the ISV. Two main reasons are proposed to explain the changes: critical lines for barotropic Rossby waves shift toward the equator as the mean wind is increasingly westerly, increased ISV amplitude will lead to increased modulation. In addition, geometrical factors such as weaker storm tracks and a weaker humidity gradient could change the intensity and effect of the eddies. The results from the model indicate that modulation of extratropical eddies could act as a feedback between the MJO and the general circulation in warmer climates.