Radiative feedbacks and the MJO

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I will argue that radiative feedbacks are important to the Madden-Julian oscillation (MJO). I will present evidence from observations, theory, general circulation models, and cloud-resolving models to this effect. Feedbacks whereby radiative cooling of the troposphere is decreased by clouds and water vapor in the active convective phase of the MJO appear particularly important. From the point of view of the column-integrated budget of moist static energy or moist entropy, the operation of these feedbacks appears straightforward. At the same time our physical understanding of the processes involved does not appear to extend far beyond those column-integrated budgets. It is not obvious how, from the point of view of the convection itself, a reduction in radiative cooling – small by comparison to the conversion of energy from latent to sensible that accompanies condensation in the clouds, and in any case having a sign consistent with reduction in the buoyancy of updrafts – makes a critical difference. Additional persistent questions involve the role of surface fluxes (both radiative and turbulent) and, particularly, of coupling to the ocean. Surface fluxes are destabilizing to the atmospheric MJO, but disfavor its eastward propagation, at least in uncoupled atmospheric models. There is considerable evidence to suggest that ocean coupling's effect on the MJO is relatively weak, but this evidence is not conclusive and there are some persistent suggestions to the contrary.