Response of the South Pacific Convergence Zone to imposed circulation and moisture perturbations in an intermediate level complexity model

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Previous research has identified a connection between the strength of low-level trade wind inflow from the relatively dry southeastern Pacific basin and the position of the South Pacific Convergence Zone (SPCZ). This circulation-precipitation relationship has been noted in composite analysis applied to reanalysis data as well as to output from current generation climate models, although the causality is ambiguous. Additionally, given that prior studies exhibit deep vertical structures associated with changes to low-level inflow east of the SPCZ, the relationship between low-level inflow variability and the propagation of upper level mid-latitude synoptic disturbances into the SPCZ remains unclear. Thus, forcing models with prescribed circulation and moisture anomalies may be instructive for untangling the dynamic and thermodynamic contributions to such interactions, as well as their potential causality. To that end, we use the Quasi-equilibrium Tropical Circulation Model 2 (QTCM2), an intermediate complexity model with a separate boundary layer of fixed height imposed at the base of the free troposphere, to explore the response of the SPCZ, and more broadly convection across the South Pacific, to perturbed low- and upper-level circulation and moisture fields east of its climatological position. Preliminary results suggest a strong precipitation response to strengthened low-level trade wind inflow, hypothesized to be the result of increased convergence in the climatological SPCZ, with an associated decrease in Intertropical Convergence Zone (ITCZ) precipitation. Conversely, there is a limited precipitation response to weakened low-level trade wind inflow despite a notable (2-3 g kg^{-1}) increase in specific humidity, suggesting the climatological low-level inflow is already associated with the necessary moisture threshold for deep convection. Ultimately, these results suggest dynamics play a stronger role than thermodynamics in the interaction as modeled by QTCM2.