A Tropical source of error in multi-decadal climate predictions

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Recent 50-yr trends of surface temperature and precipitation around the globe have been strongly influenced by the warming trend of the tropical oceans. The current generation of coupled IPCC models with prescribed observed changes in radiative forcing generally fail to capture the geographical variation of these trends. On the other hand, even uncoupled atmospheric models without the prescribed changes in radiative forcing, but with the observed SST changes prescribed only in the tropics, are more successful in this regard. The tropical oceanic warming pattern is poorly represented in the coupled simulations. This tropical error needs to be reduced to generate confidence in regional climate change projections around the globe for the 21st century. We provide important evidence that a primary source of this error lies in the erroneous way an SST change in one tropical region affects and is affected by a change in another region in the models. Specifically, we estimated the SST feedbacks among 8 localized regions in the tropical Pacific, Indian, and Atlantic oceans from 3 observational datasets and 76 IPCC model simulations of the 20th century. The simulated feedbacks were found to differ in several key respects from the observed feedbacks, and also to differ greatly from model to model. We argue that these SST feedback errors not only distort the patterns of simulated and predicted tropical SST trends but also cause a substantial overall warming bias in the IPCC model simulations in response to radiative forcing.