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Cyclone-track based seasonal prediction for South Pacific tropical cyclone activity using APCC multi-model ensemble prediction

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This study aims to predict the seasonal TC track density over the South Pacific by combining the APCC (Asia-Pacific Climate Center) multi-model ensemble (MME) dynamical prediction system with a statistical model. The hybrid model uses the statistical relationship between the TCs during the austral tropical cyclone season (November–April) and the large-scale key predictors forecasted by the APCC MME for the same season. For successful establishment of the model, we focus on answering three questions: 1) How well do the APCC MME forecasts explain the key large-scale atmospheric and/or oceanic variability related to the observed seasonal TC activity in the South Pacific? 2) How do we build the empirical model in each TC track based on the relationship between the seasonal TC activity and the large-scale variability from the APCC MME forecasts? 3) How do we build and produce the seasonal TC activity map from a prediction of the APCC MME-empirical model?
The cross validation result from the MME hybrid model demonstrates reasonable prediction skill, with a correlation of 0.24 to 0.78 across all TC clusters in predicting the TC number between the hindcasts and observations for 1982/1983 to 2008/2009. The cross validation of the forecasted TC numbers from the hybrid model is higher in regions where the ENSO modulation effect is dominant. In the hybrid TC forecast for 2008/2009 seasons, a general distribution of TC track probability and its anomaly compared to the climatological TC track probability is well predicted, while the prediction is poor in other years, for example, the 2007/2008 seasons. The prediction is limited to the performance of the dynamical seasonal prediction. For the 2015/2016 seasons, the TC track probability prediction from the APCC MME is well matched with the forecasts from other agencies that disseminate the seasonal TC activity outlook. In the 2015/16 seasons, the TC track density anomaly presents higher TC track probability east of the dateline compared to the climatological TC track distribution, but much lower TC track probability west of the dateline. This is due to El Niño. Thus, for countries near and east of the dateline, there would be a greater chance of exceeding the climatological average.