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Assessing the skill of seasonal rainfall outlooks for the Caribbean

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The Caribbean's island and low lying coastal nations make the region highly vulnerable to water-related natural hazards, many originating from seasonal rainfall variability. To help mitigate this risk, Global Producing Centres (GPCs) such as the International Research Institute for Climate and Society (IRI) publish global seasonal rainfall probability forecasts each month. However, the Caribbean's geography warrants the production of downscaled forecasts, such as done by the Caribbean Institute for Meteorology and Hydrology (CIMH). Yet, even CIMH's prediction system, which balances GPC forecasts with regional climatological expertise, is perceived to show limited reliability. To find out to what extent this results from inherently low predictability and what model improvements should be made, we compared the forecasting skills of the IRI and CIMH prediction systems from 2000 to 2012. Specifically, we calculated the commonly used Ranked Probability Skill Score (RPSS) and Heidke Skill Score (HSS) to distinguish which system, season and sub-region are more accurately forecasted.

If scores above 0.2 and 0.5 represent good and very good forecasts, respectively, the CIMH prediction system produced ∼1/3 good and ∼1/10 very good forecasts or ∼1.5 times as many as IRI's. The most accurately forecasted season was Jan-Feb-Mar by IRI (∼1/3% good or very good forecasts), compared to Sep-Oct-Nov by CIMH (∼2/3 good or very good forecasts). By contrast, Apr-May-Jun was less well predicted by both systems. Broken down by sub-region, the Lesser Antilles were best predicted with an average RPSS score of nearly 0.1 by CIMH and 0.05 by IRI whereas less skill was found for the Greater Antilles and Guianas and virtually no skill for Belize in either system. Though consistent with a greater predictability of seasonal rainfall in the Lesser Antilles, such scores point to forecasting accuracy well below a previously estimated 30% inherent predictability. Thus, there is much space for system improvement.

Currently, the main predictor in these forecasting systems is ENSO, a driver of seasonal rainfall variability in the Caribbean. Consequently, better forecasting skill should come with a larger ENSO signal. Since ENSO notoriously shows little signal and is hardest to predict during Northern Hemisphere Spring, this should explain why Apr-May-Jun rainfall was poorly predicted. However, we found only a weak correlation between RPSS scores and ENSO strength. Instead, a clearer relation between the North Atlantic Oscillation (NAO) index and seasonal rainfall forecasting skill was found, with better scores when NAO transitions from a positive to a negative phase. Since the NAO signal is only indirectly represented by the models, the latter suggests that substantial improvement in forecasting skill could reside in including additional drivers of Caribbean seasonal rainfall into the prediction systems. Finally, our results further imply that extensive use of local climate expertise could further benefit the accuracy of such forecasts.