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A Comparison of Dynamical Seasonal Tropical Cyclone Predictions for the Australian and Western Pacific Regions

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The Australian Bureau of Meteorology (BoM) issues predictions of tropical cyclone (TC) activity in the Australian and South Pacific regions in the October before the TC season (November to April). Currently, these predictions utilise a statistical model based on the historical relationship between tropical cyclone activity and (i) sea surface temperature anomalies in the Equatorial Pacific ($NINO_3$.4 region) and (ii) the Southern Oscillation Index over the past few decades. Variations in the El Niño-Southern Oscillation (ENSO)-TC relationship that are not contained within the historical record can lead to deficiencies in future predictions.

The use of dynamical (physics-based) climate models (GCMs) offers an alternative to statistical TC prediction schemes. Any changes to the environment (whatever their character or cause) are incorporated in the analyses used to initialise a dynamical model. As part of the Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) Program, BoM is developing dynamically-based seasonal TC predictions for the Australian, South Pacific and North-West Pacific regions.

The seasonal TC predictions from two fully-coupled GCMs are evaluated and compared. These models are BoM's Predictive Ocean-Atmosphere Model for Australia (POAMA) and the Japan Meteorological Agency/Meteorological Research Institute Coupled GCM (JMA/MRI-CGCM). The resolution of POAMA's atmospheric component is T42 ($\sim$2.5° x 2.5°), while JMA/MRI-CGCM is T95 ($\sim$1.8° x 1.8°).

Two TC tracking methods are employed and applied to both models to evaluate the influence of model composition and tracking technique on seasonal TC predictions. In the more traditional TC detection scheme TCs are identified where 850-hPa relative vorticity is a maximum (minimum in the Southern Hemisphere) and exceeds a certain threshold. Additionally, the 500-200-hPa thickness and the difference in maximum winds at 850 and 200 hPa are used to differentiate tropical from extratropical disturbances. A second TC detection scheme, developed at BoM for use with low resolution climate models, identifies local environments that are considered favourable for TCs to form and develop. This technique utilises the Okubo-Weiss-Zeta Parameter (OWZP), which isolates regions with low-deformation flow and large amplitude vorticity. Low-level humidity and vertical wind shear thresholds are also applied to ensure that only tropical disturbances are identified as TCs.

Application of the OWZP technique to POAMA reveals TC-like disturbances with horizontal and vertical structure resembling those identified in other GCMs of similar resolution. The geographic distribution of genesis locations and the tracks of the disturbances are similar to those for observed TCs. The seasonal and interannual variability of the TC-like disturbances in POAMA is consistent with observations; however, too few disturbances are present in the Australian region. The modulation of the geographic distribution of the TC-like disturbances by ENSO is also consistent with observations.

The suitability of the system for predicting TC activity for the Australian and South Pacific regions will be reported on, including an assessment of the predictability of large-scale environmental parameters favourable to TC development.