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Probabilistic versus deterministic skill in predicting the western North Pacific-East Asian summer monsoon variability with multimodel ensembles

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Based on historical forecasts of three quasi-operational multi-model ensemble (MME) systems, this study assesses the superiority of coupled MME over contributing single-model ensembles (SMEs) and over uncoupled atmospheric MME in predicting the Western North Pacific-East Asian summer monsoon variability. The probabilistic and deterministic forecast skills are measured by Brier skill score (BSS) and anomaly correlation (AC), respectively. A forecast-format dependent MME superiority over SMEs is found. The probabilistic forecast skill of the MME is always significantly better than that of each SME, while the deterministic forecast skill of the MME can be lower than that of some SMEs. The MME superiority arises from both the model diversity and the ensemble size increase in the tropics, and primarily from the ensemble size increase in the subtropics. The BSS is composed of reliability and resolution, two attributes characterizing probabilistic forecast skill. The probabilistic skill increase of the MME is dominated by the dramatic improvement in reliability, while resolution is not always improved, similar to AC. A monotonic resolution-AC relationship is further found and qualitatively explained, whereas little relationship can be identified between reliability and AC. It is argued that the MME's success in improving the reliability arises from an effective reduction of the overconfidence in forecast distributions. Moreover, it is examined that the seasonal predictions with coupled MME are more skillful than those with the uncoupled atmospheric MME forced by persisting sea surface temperature (SST) anomalies, since the coupled MME has better predicted the SST anomaly evolution in three key regions.