Improved sub-seasonal meteorological forecast skill using weighted multi-model ensemble simulations

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Supplementary Information

Table S1 North American Multi Model Ensemble phase 2 data availability and required reprocessing

| Institute              | CanCM3       | CanCM4       | FLOR-B01    | CCSM4        |
|------------------------|--------------|--------------|-------------|--------------|
| Environment Canada     | Environment Canada | GFDL          | NCAR/University of Miami |
| Temperature data availability | 100% | 100% | 100% | 71.4% |
| Precipitation data availability | 100% | 100% | 100% | 76.5% |
| Resampling             | None         | None         | Bicubic     | Bicubic      |
| Ensemble members       | 10           | 10           | 12          | 10           |

Figure S1 The normalized mean relative difference between the parameters obtained with years of data and the parameters obtained in a bootstrapping procedure. Low values indicate identical parameters, while high values indicate large differences. The analysis is done for the constrained and unconstrained weighted mean, for all regions used in this study.
**Figure S2** Sub-seasonal forecasts issued on 1st of March 2000 for temperature anomalies for the following year, including the November 2000 drought in Western Africa (lead 8 months). Top rows indicate the individual sub-seasonal model forecasts (ensemble mean, bold colour lines), individual ensemble members (grey lines) and the observed anomalies (bold black line). Bottom row indicates optimal weights applied to the individual models and the resulting multi-model forecast (dashed line) and observations (solid line.) Grey lines indicate confidence intervals at 10% increments. The total of the ensemble weights equals 1, and negative weights indicate that the original forecast anomaly is multiplied by a negative weight in the forecasted weighted ensemble. For all forecasts, anomaly correlation between the forecasts and observed anomalies are provided in the bottom left of each panel. The target year (in this case 2000) is not used in estimating the model weights.
Figure S3 Anomaly correlation between seasonal forecasted and observed precipitation anomalies. Forecasted anomalies are aggregated for specific lag times.

Figure S4 Anomaly correlation between seasonal forecasted and observed temperature anomalies. Forecasted anomalies are aggregated for specific lag times.
Figure S5 Anomaly correlation between sub-seasonal forecasted and observed precipitation anomalies. Forecasted anomalies are aggregated for specific lag times.

Figure S6 Anomaly correlation between sub-seasonal forecasted and observed temperature anomalies. Forecasted anomalies are aggregated for specific lag times.
Figure S7  Accumulated precipitation anomalies for the January 2011 Brazil floods (issued on July 2010). Top rows indicate the individual sub-seasonal model forecasts (ensemble mean, bold colour lines), individual ensemble members (grey lines) and the observed anomalies (bold black line). Bottom row indicates optimal weights applied to the individual models and the resulting multi-model forecast (dashed line) and observations (solid line.) Grey lines indicate confidence intervals at 10% increments. The total of the ensemble weights equals 1, and negative weights indicate that the original forecast anomaly is multiplied by a negative weight in the forecasted weighted ensemble. For all forecasts, anomaly correlation between the forecasts and observed anomalies are provided in the bottom left of each panel. The target year (in this case 2010) is not used in estimating the model weights.

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