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Enhancement of prediction skills of multi-model ensemble seasonal prediction for the boreal winter seasons using a climate filter concept

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Using the APCC operational multi-model ensemble (MME) hindcasts of precipitation and temperature at 850 hPa for boreal winters for the period 1981-2003, along with those of the individual models as well as corresponding observed and reanalyzed data, we propose the use of a 'climate' filter to diagnose, and improve the MME prediction skills. The 'filter' is based on the observed strong association between the ENSO-associated Walker circulation and the tropical Pacific rainfall. The reproducibility of this relationship is utilized to evaluate the fidelity of the models. We also explore the possible use of the above filter to devise an improved MME suite for seasonal prediction. It is found the retrospective forecast skill of a newer type of MME that contains only the 'more skillful' models is superior to that of the all-inclusive operational MME. It can be also seen that prediction skills of our sample MME, involving all the available 10 models, only comes from the five better models that successfully reproduce the tropical Pacific ENSO-rainfall relationship. Further, the distribution of the prediction for the MMEs with 'more skillful' and 'less skillful' models is region-sensitive. It can be discerned that the gap between skills of MMEs comprising of only the 'more skillful' models and those with only the 'less skillful' models significantly widens over the extra-tropics, and consequently drags down the skills of a comprehensive MME which contains all the available models. The possible reason is that the 'more skillful' models which clear through the climate filter may provide appropriate heat sources in the tropics which facilitate better teleconnection to the extra-tropics and beyond, though detailed diagnosis to verify this hypothesis is beyond the scope of the current study. There is very little difference in the prediction skills for the MME carried out with all the models as well as those carried out with the 'more skillful' models in the regions such as tropical South America that are adjacent to the eastern tropical Pacific, where almost all the models perform relatively well. Our pilot forecast with the proposed MME for two boreal winter seasons indicates that the method generally works better than the all inclusive MME in many of the target regions. The study, however, is subject to the limitations of data length, which is unavoidable due to the lack of longer hindcasts. The fact that the ENSO alone is not a major climate driver for the climate everywhere is also an issue. Nonetheless, our work shows that selection of the models that represent realistic climate features and associated responses enhance the chances of better prediction.