Pathways to extratropical skill
Climate Analysis Forecast Ensemble system

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Introduction

The extratropical continents are subject to considerable climate variability and impacts. That variability is a consequence of internal modes of variability and external forcing. Deriving forecast skill (on seasonal to multyear timescales) for the internal modes relies on capturing the long-lived sources of skill in the tropics, teleconnecting that signal through tropical-extratropical pathways, and modulating extratropical internal modes. Some results along this skill pathway are highlighted here for the CAFE system, which uses the coupled GFDL MOM5 AM2 configuration.

Tropical source & expression

The main source of memory in the climate system on seasonal to multyear scales is the tropical ocean. That region is captured here by the maximum zone of inband temperature variance in the CAFE ocean in figure 1a. CAFE forecasts are bred in this region. The dominant expression of seasonal to multyear variability is through ENSO, which is reflected in figure 1b for the CAFE forecasts.

Extratropical modes

The ENSO signal modulates the jets via the thermal wind. The jets provide a primary source of extratropical variability manifest through jetstream waveguide modes such as the PSA. The model needs a realistic simulation of waveguide modes to provide an extratropical translation of the ENSO signal. The CAFE control run provides realistic waveguide modes such as the PSA (figure 4) (Tozer et al. 2018), which is a necessary condition for extratropical skill.

Extratropical skill

The teleconnected signal is transmitted to the extratropical storm track modes, which in turn influence variability of rainfall and temperature in the extratropical regions (Risbey et al. 2018). The skill for a selected region of the extratropics is shown in figure 5. The RPSS skill score is relatively low, but still reflects some skill in either ENSO extreme. ENSO skill tends to be masked by the absence of skill in the neutral state when averaging over all ENSO states.

Conclusions

The Southern Hemisphere extratropical continental regions seem reliant on the tropical oceans for a source of skill on seasonal to multyear scales (excepting responses to external forcing). The signal that emerges in the tropics is a source of extratropical skill largely only when ENSO is in either of its extreme states (El Niño or La Niña). There seems little extratropical skill when ENSO is neutral. Extratropical skill is currently weak. To the extent that such skill is related to ENSO, it can potentially be improved when ENSO skill improves, but there are clear limits, as much of the extratropical variability is non-ENSO related. The role of poor simulation of teleconnection processes in weak extratropical skill is still unclear and will be the topic of future work.

References


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