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Title: ENSO prediction in Project Minerva: Sensitivity to Ensemble Size and Atmospheric Horizontal Resolution
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Abstract:

Recently, in Project Minerva, a collaboration between the Center for Ocean-Land-Atmosphere Studies (COLA) and the European Centre for Medium-Range Weather Forecasts (ECMWF), three versions of the ECMWF coupled climate prediction system (differing by the horizontal resolutions of its atmospheric component) were used for seasonal prediction experiments. The model was used to produce 7-month hindcast experiments (some extending to 24 months), starting from May and November observed initial conditions, with either 51 or 15 ensemble members. Since atmospheric resolutions of T319 (˜ 62 km), T639 (˜31 km) and T1279 (˜16 km) were used, while keeping the oceanic resolution at 1o x 1o, these hindcasts provide useful insight into the effects of resolving fine structures of atmospheric dynamics and physical processes on climate prediction. Moreover, the relatively large ensembles give us an opportunity to find a balance between model resolution and ensemble size for climate hindcasts.

In this study we explore the effect of both the atmospheric horizontal resolution and ensemble size on ENSO prediction. Particularly, three sets of hindcasts are compared based on the hindcasts starting from May during 1982-2011: T319 atmospheric resolution with 15 ensembles, T639 with 15 ensembles, and T319 with 51 ensembles. Our analysis shows that simply increasing either ensemble size or atmospheric horizontal resolution does not necessarily lead to major improvement in the ENSO prediction skill with current climate models. For deterministic prediction skill metrics of the NINO3.4 index, the three sets of predictions do not produce a significant difference in either anomaly correlation or root-mean-square error (RMSE). For probabilistic metrics, the increased atmospheric horizontal resolution generates larger ensemble spread and thus increases the ratio between the intra-ensemble spread and RMSE. However, there is little change in the categorical distributions of predicted SST anomalies. Consequently, there is not much difference among three sets of hindcasts in terms of probabilistic metrics or prediction reliability. On the other hand, increasing the resolution to T639 reduces the RMSE in the western equatorial Pacific, possibly due to the reduced mean SST bias there.

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