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Skillful climate forecasts of the tropical Indo-Pacific using model-analogs

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Seasonal forecasts made by coupled general circulation models (CGCMs) undergo strong climate drift and initialization shock, driving the model state away from its long-term attractor. Here we explore initializing directly on a model's own attractor, using an analog approach in which model states close to the observed initial state are drawn from a "library" obtained from prior uninitialized CGCM simulations. The subsequent evolution of those "model-analogs" yields an ensemble forecast, without additional model integration. This technique is applied to four of the eight CGCMs comprising the North American Multimodel Ensemble (NMME), by selecting from prior long control runs those model states whose monthly tropical IndoPacific SST and SSH anomalies best resemble the observations at initialization time. Hindcasts are then made for leads of 1-12 months during 1982-2009. Skill of these model-analog hindcasts is comparable to initialized NMME hindcasts, for both the individual model ensemble means and (when the analog hindcasts are averaged together) the grand NMME mean. In some regions, such as the eastern equatorial Pacific, the model-analog hindcast skill exceeds that of the NMME. Despite initializing with a relatively large ensemble spread, model-analogs also reproduce each CGCM's perfect-model skill, consistent with a coarse-grained view of tropical Indo-Pacific predictability. This study suggests that with little additional effort, sufficiently realistic and long CGCM simulations may offer skillful seasonal forecasts of tropical IndoPacific SST anomalies, even without sophisticated data assimilation or additional ensemble forecast integrations. The model-analog method could provide a baseline for forecast skill when developing future models and forecast systems.