

Interactive comment on “A multi-year short-range hindcast experiment for evaluating climate model moist processes from diurnal to interannual time scales” by Hsi-Yen Ma et al.

Anonymous Referee #1

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This study presents an innovative approach by conducting a series of short-range hindcasts based on a climate model that can be used to expose deficiencies in model parameterizations that are responsible for biases in climate simulations from the same model. Justification of this approach includes that model biases in climate mean and variability in long-term simulations start to emerge in the first several days of hindcasts by this model, which is thought to result from model parameterized processes since the large-scale state is still very close to the observations specified in the hindcast initial conditions. This study also proposed to conduct these short-range hindcasts for multiple years to achieve stable statistics when examining model deficiencies and associated processes, although it is shown that a systematic association between model

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biases in short-range hindcasts and long-term simulations do not significantly change in different individual years. Three examples are further illustrated for applications of this approach to understand model biases in simulating the diurnal cycle of warm season precipitation over central U.S., the tropical MJO, and the local and remote influences by ENSO on the interannual time-scale. This approach along with the long-term hindcast datasets based on CAM5 produced from this project, can be used in many other studies for both tropical and extratropical climate phenomena, thus are valuable for the climate research community. In addition to identify model parameterization deficiencies as mentioned in this study, this approach can also provide a very useful avenue to diagnose and understand critical processes regulating various climate and weather phenomena by taking advantage of detailed model output with largely realistic representation of these phenomena in hindcasts at day-2. This can also be stressed in the manuscript. The paper is generally very clearly written although there is room for further improvement. I recommend this paper for publication after some minor revisions as listed below.

Minor comments: Line 12: suggest to change “3-day long hindcasts every day” to “3-day hindcasts initialized every day . . .”. Also many grammatical errors need to be corrected throughout the manuscript, which I may not list all of them in the following. Line 14: suggest to delete “propagation”, since MJO amplitude is also involved. Line 14: also not sure about “the responses of moist processes to sea surface temperature anomalies . . .” here. Why “moist processes” since net heat fluxes and wind stresses are also shown in Fig. 7? Line 21: again, in addition to “parameterized moist processes”, could other parameterizations also related, for example, boundary layer and radiation parameterizations? Line 52: “AMIP” first appears here, but is defined in Line 99. Also, suggest to remove “of years”. Line 57: CAM5 is mentioned here, but CESMv1 is mentioned in abstract and other places. Better be consistent. Line 66: suggest to delete “from diurnal to interannual time scales” in this line. Line 75: variation(s) Line 79: present(s) Line 96: of the 16-year duration Line 120-125: would be better if how these regimes are defined can be briefly explained. Line 135: cloud regime(s) Line

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147: parameterization deficiencies Line 150: suggest change “scheme developer” to “model developer” Line 153: the intraseasonal variability Line 166: present(s) Line 170-171: “the intensity of OLR decreases” is a little confusing since active convection corresponds to smaller OLR. Not sure if this means convection is enhanced or weakened. Figure captions 3,6: CAPT are used but not defined. The presentation of Figures 4,5 can be improved, particularly Fig. 5. It may be not needed to use both precipitation and OLR since both of them represent MJO convection. At their present forms, these figures look very busy and a little difficult to see some detailed features particularly in wind vectors. Lines 179-180: Seems to me, the wet biases are largely evident over regions around the Maritime Continent, which may also relate to model biases in representing the regional diurnal cycle. Line 220: the circulation anomalies are discussed here, but temperature and moisture fields are also used to constrain model in the initial conditions. “the response SST anomalies is” needs to be fixed Line 231: “larger” root mean square errors? Line 254: Possibly to briefly mention these “cloud measures”. Line 284-285: “Indeed, GCMs usually perform more poorly for”. Not quite follow the purpose of this statement. Line 297: suggest change to “to understand the processes that control the diurnal and sub-diurnal variations of . . .” Line 301: CESM1 is mentioned here, and CAM5 in the model introduction part.

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