Review of “Dynamic MJO forecasts using an ensemble subseasonal-to-seasonal forecast system of IAP-CAS model”

For publication in *Geoscientific Model Development*

Recommendation: Major revisions

This manuscript describes a new subseasonal ensemble prediction system at IAP-CAS. The development and analysis are sound. The system itself isn’t distinguished from existing S2S systems, although the error analysis is interesting and there is a nice simple method to initialize the model. In particular the analysis of convective heating in Figure 9 is a unique and very nice contribution. I have a few questions about the analyses that I would like the authors to answer before the paper is published, and so I am giving a recommendation of “major revisions”.

Breaking down the MJO into different types is a useful way to determine model biases. One thing I note from Figure 5 is that the simulated “jumping” MJOs look much more like the simulated slow MJOs than the observed jumping structure. Is part of the difficulty simulating these modes that the model lacks the ability to correctly simulate the distinct jumping and slow modes? Related, the composite simulated MJO structures shown in Figure 6 appear to be significantly disrupted; most notably, the fast mode has a strange equatorial dry anomaly and enhanced westerlies at day 20 extending all the way to nearly 180 longitude. This appears to be something like an anomalous westerly wind burst which could in turn have impacts on ENSO prediction. Could the authors comment on what this physically might represent, or is it a model anomaly that is challenging to explain?

The authors’ attribution of the MJO propagation errors and over-convection to a moist bias is certainly plausible and supported by the evidence. What I find strange is that the moisture bias is smallest near the Maritime Continent but the MC barrier is still a challenge for these simulations. Is the MC barrier a separate problem for the model not directly related to the propagation biases? Also the authors believe that a positive bias in evaporative fluxes could be causing the positive moisture bias; is it possible to check this?

The target analysis in Figure 4b is a nice alternate way of assessing the predictive skill of the system. Can this be interpreted as a prediction of the *development* of the MJO and/or even of the genesis of MJO events?

Minor comments

- There is too much detail in the tables. I think tables 2–5 are unnecessary for the body of the paper and can be moved into the supplemental data.
- Lines 49–51: I didn’t understand the statement “models that exhibited lower forecast skills in [CMIP5] have demonstrated noteworthy improvements in the simulation of MJO”. Did you mean that models with poor MJOs in CMIP5 had significantly improved MJOs in

CMIP6? Note that these should not be the skill of MJO forecasts since CMIP simulations are long uninitialized simulations.

- Section 2.1: FV3 only needs the semi-implicit sound wave solver if run nonhydrostatic; I believe these simulations are hydrostatic as are most FV3-based climate models.
- Section 2.2: That the S2S forecasts are nudged to GFS forecasts for the first ten days is interesting. Is this to avoid coupling shock at initialization?
- Section 2.4: Am I correct that there are 4 ensemble members initialized each day over a 20-year period? This would then be a very large dataset.
- Section 3.3: What is “silhouette clustering”?
- Equation 11: Is this calculation used to compute condensational heating in both the model and observations? Why was the condensational heating output by ERA5 and the model not used? (I understand if this was not output from the model, and ERA’s condensational heating estimate may be skewed by the data assimilation used by the reanalysis.)
- Figure 14: Is this the same as Figure 6, but the shading is Q850 instead of precipitation?
- Figure A2: I see FGOALS-f2 is the model shown in this paper. Are the other models shown here earlier versions of FGOALS, and in what order were they developed?

For the most part, the article is well-written. I do see some English usage that could be improved. Here are some examples:

- Title “Dynamic” → “Dynamical” and “of IAP-CAS” → “of the IAP-CAS”
- Line 66: “low” → “lower”
- Lines 78–82: recommend using future or present tense instead of past tese in this paragraph.
- Line 234: “inconsecutive movement”; do you mean discontinuous propagation/movement?
- Line 235: “coupling” → “coupled.

Lucas Harris