

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-221

Anonymous Referee #1

Referee comment on "Training a supermodel with noisy and sparse observations: a case study with CPT and the synch rule on SPEEDO – v.1" by Francine Schevenhoven and Alberto Carrassi, Geosci. Model Dev. Discuss.,
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The paper applied two approaches, CPT and synchronization based, to “combine” multiple imperfect models to form a so called supermodel to noisy and sparse observations. The general concept is quite interesting and potentially could be very valuable to multi-model forecasting. The authors inherited previous works on CPT and synch rule, and relaxed noise-free assumption, proposed adaptations and demonstrated in SPEEDO experiments. Overall I think this paper is publishable with some revisions. Please find my concerns listed below.

- 1) It seems that the “imperfect” scenario described in the paper (for example section 2) are limited in perfect model class with imperfect model parameters. Is the proposed methodology applicable to a more general scenario where the model class is imperfect, i.e. there is no parameter value would lead to a perfect model.
- 2) I am strongly against the idea (Line 28,44) that the benefit of using MME is due to “errors tend to cancel each other”, this misinterpretation is a result of only considering the ensemble mean. Note that the purpose of using the ensemble forecasts (Leutbecher and Palmer (2008)) is to account for uncertainty.
- 3) The authors proposed the possibility of negative weights when form the supermodel. Personally I am a little concern about this approach, especially how would one interpret the negative weights? Can we first bias correct the models (for example Line 158, models 1 and before combine them?
- 4) It is a little unclear what exactly is a supermodel. is the sentence at (Line 35) a formal definition of the “supermodel”?
- 5) Line 98-99, it seems that achieving a synchronized state is a good thing, please define what is a synchronized supermodel state and clarify why it is desirable.
- 6) Line 87, “observations were available”, this statement needs to be clarified as the observations were not mention early or in the equations 1a-c.
- 7) Section 3.3, please give more details about how the CPT trajectories are generated.
- 8) Paragraph at Line 240, It seems that the authors suggest that when the models are linear, the CPT approach works well. Why it doesn't if the model is highly nonlinear?
- 9) Table 4 and Figure 3 shows the weights for supermodel trained by CPT and synch rule, it would be interesting to see the forecast performance of CPT compared with synch rule.

