

## ***Interactive comment on “A global empirical system for probabilistic seasonal climate prediction” by J. M. Eden et al.***

**Anonymous Referee #2**

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Review of “A global empirical system for probabilistic seasonal climate prediction”

By J. M. Eden, G. J. van Oldenborgh, E. Hawkins, and E. B. Suckling

The manuscript describes and assesses the skill of a global empirical system for probabilistic seasonal climate prediction. The manuscript is well organized and provides an original and novel contribution for the field of seasonal prediction, being a valuable benchmark for future assessment of dynamical seasonal prediction systems. The development of empirical systems is an important and complementary contribution to dynamical prediction systems. However, I feel a number of improvements are required in order to make the manuscript ready for publication. Please see below a list of major remarks and additional remarks that I recommend to be addressed prior to publication of this manuscript.

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### **Major remarks:**

- 1) Lack of methodological information to allow repeatability: The presented methodology in the manuscript is mainly descriptive. To allow repeatability of the described empirical model it is necessary to include in the manuscript the equations used to define the model, including a description of model parameters, predictor and predictand variables, and explain how model parameters were estimated. Currently the methodological description is limited to indicate that the developed global empirical system is based on multiple linear regression. A substantially improved description of the developed empirical model with the inclusion of the required equations for the production of probabilistic prediction is needed.
- 2) More precise methodological description needed: In the current model description it is unclear which seasons are included in the lagged analysis. Additionally, the procedure of removing the impact of CO<sub>2</sub> equivalent signal from modeled time series needs to be explained in details because this procedure is currently unclear. Including the equation used to perform this procedure will help this clarification.
- 3) Improved figures are required: All multiple panel figures are currently excessively small in size. For this reason it is not possible to clearly see the results, particularly for the described statistical significance. All multiple panel figures need to be improved (i.e. enlarge all individual panels) to allow the reader to clearly appreciate the presented evidences.
- 4) Text requires clarity improvement: The text needs to be carefully revised in order to improve clarity. Please see below a number of additional remarks indicating where clarification is required.

### **Additional remarks:**

Abstract: The acronyms NGOs and ENSO are not defined. All acronyms need to be defined when first used. Please revise the entire manuscript to make sure all acronyms

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are defined when first used.

Abstract, line 17: using correlation and skill scores. Please be more precise. Correlation of what with what? Which skill scores?

Page 3944, line 4: by limiting the effects of model biases. What do you mean here? Do you mean empirical forecasts produced with empirical models do not have biases by construction? Please clarify.

Page, 3948, line 18: during the predictor period. What is the predictor period? Please be more precise.

Page 3949, line 12: using data since 1901. A comment on data availability in the early 1900 is needed here.

Page 3949, lines 18-20: Please provide equation to explain precisely what was the procedure implemented here to make the described removal.

Page 3949, lines 21-26: The described procedure is unclear. Is each predictor tested separately/independently? Please provide equations to show more precisely what has been done.

Page 3949, lines 25-26: Predictor inclusion is determined independently for each hindcast. What does this precisely mean? Please rephrase and better explain.

Page 3950, line 20: We parameterize this trend... The described procedure is unclear. Please provide equations to show more precisely what has been done.

Page 3951, line 1: previous year CO2EQV. Why previous year if you are considering seasonal averages? Shouldn't it be previous season?

Page 3951, lines 4-5: when natural variability is small compared to the forced signal. Please further expand and explain precisely what you mean by this sentence.

Page 3951, line 24: PDO, IOD and AMO indices. At this point it is unclear how pre-

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dictors are selected. Please further explain and provide precise information on the selection procedure.

Page 3952, lines 21-23: The correlation is also strong... Unfortunately it is not possible to see these described features. Figure panels are too small. Please enlarge figure panels.

Page 3952, line 25: Lagged correlation between PREC and the predictors is shown in Fig. 2. What type of lag are you considering? Previous season predictor with next season PREC? Please be more precise.

Page 3954, line 10: causal hindcast estimates. What do you mean by causal? Please rephrase of further explain.

Page 3954, lines 18-19: the incremental correlation attained by including additional predictors (second to eight lines). It is unclear if panels on lines 2-8 of Fig. 3 are for individual predictors or for a sequential cumulative addition of predictors. Please explain more precisely what is shown here.

Page 3955, line 3: full correlation. What does this mean? Does it mean the correlation for the model that incorporate all predictions (i.e. bottom row in Fig. 3)? Please be more precise.

Pages 3965 and 3966, Figure 1 and 2: Figure panels are too small. It is currently difficult to appreciate the evidences presented in these figures. Please enlarge figure panels. The caption indicates one month lead time. Please be more precise in defining what is meant by one month lead time here. Does this mean the previous season predictor values are used to predict next season SAT and PREC?

Pages 3967 and 3968, Figures 3 and 4: For which period has this correlation been computed? Please provide this information in the figure caption. It is also unclear if the first 8 rows of this figure show the correlation skill considering only one predictor (i.e. the individual predictors indicated on the left side of each row). Please make sure the

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correct description is provided in the text and figure caption. Likewise, it is unclear if the last row of this figure shows the correlation skill considering all 8 predictors indicated in lines 1 to 8 above in the multiple linear regression model. Please make sure the correct description is provided in the text and figure caption. And unfortunately, because figure panels are too small, it is not possible to see the stippling indicated in the figure caption. Please enlarge figure panels to allow identification of statistically significant results. Make sure to provide references and or equations for the RMSESS and CRPSS shown in Figure 4.

Pages 3969 and 3970, Figure 5 and 6: Figure panels are too small. It is currently difficult to appreciate the evidences presented in these figures. Please enlarge figure panels. Figure 5 is apparently for SAT but caption indicates PREC. Please correct.

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Interactive comment on Geosci. Model Dev. Discuss., 8, 3941, 2015.

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