1 Response to Reviewer #1's comments

HESS-2019-442

Le et al. (2019): Response of global evaporation to major climate modes in historical and future CMIP5 simulations

GENERAL COMMENTS

This paper explores the historical and future impact of three major modes of internal climate variability on evaporation from oceans and land into the atmosphere based on data from CMIP5 model simulations and a Granger causality framework. Such an analysis might provide useful insights about the distribution of water resources in the near future and to help better forecast extreme hydrological events. As such, I truly see scientific value in this study; however, in my opinion, the present paper first needs to be improved in two ways: (1) the description of the method needs to be improved and more details are necessary to allow the reader to fully understand the work flow and (2) the results should be better interpreted and discussed in a physical manner to make them worth publishing. Below, I list some more specific comments and suggestions.

Response: We appreciate the valuable comments and detailed suggestions from reviewer Brecht Martens. We agree that the description of the methods is not completely clear, and we provided additional information for this section. We also provided further discussions for the results as suggested by the reviewer to improve the manuscript. The responses to the reviewer's comments are provided below in **blue text**. The reviewer's comments are shown in **black text**.

SPECIFIC COMMENTS

1. Section 2.1 needs some better motivation for some choices:

a. Why has RCP 8.5 been chosen? This needs some motivation.

Response: We added the following text to Section 2.1 to clarify this motivation:

"The RCP8.5 is a very high emission scenario with radiative forcing of 8.5 W/m^2 in 2100 relative to the preindustrial level (van Vuuren et al., 2011). Warming environment in the RCP8.5

scenario increases the frequency of extreme ENSO and IOD events (Cai et al., 2014a, 2015) and potentially modulates the impacts of these climate modes on global evaporation."

b. Why is only data from 1906–2000 used for the historical period?

Response: The original historical period in model simulations is 1850-2005. The original future period is 2006-2100. However, as we will compare the impacts of climate modes on evaporation between the historical period and future period, it is important to use the same data length for both periods. Thus, only data from 1906–2000 is used for the historical period. We modified the relative sentences in Section 2.1 to clarify this point:

"The results of the effects of climate modes on evaporation are compared between the historical period and the future period. Hence, in our analyses, we only use the data for the 1906-2000 historical period as a reference (with similar data length) for the future period 2006-2100"

c. Why is only one ensemble member per model used (r1i1p1)? I think the analysis might be more robust when an ensemble of model outputs is used.

Response: The total ensemble members are different between models (e.g., several models may provide up to ten ensemble members and others provide less), thus, it is challenging to determine the number of ensemble members (for each model) for analyses. Using one ensemble member per model is a simple way to guarantee the "one model, one vote" rule (Knutti et al., 2010). Here we use 15 different models for the analysis, this common approach is widely used and helps to reduce the uncertainties. We added the following text to Section 2.1 to clarify this point:

"As we use 15 different models for our analysis, the uncertainties related to the effects of climate modes on evaporation are reduced. The results based on multi-model mean were shown to be better and more reliable than single model results (Weigel et al., 2010)."

2. Section 2.2 needs to be improved to fully understand the workflow:

a. It needs to be clear from this section how the authors will deal with the model output from the models listed in Table S1. Will the authors average everything out or separately perform the analysis at every single model and compare the results to each other? Now, this is only clear from the figure captions.

Response: We added the following text to Section 2.2 to clarify this point:

"We apply the methods described above to all the single models. We then rescale the results of single model to 1° longitude ×1° latitude spatial resolution. We use the rescaled results to compute the multi-model mean which is shown as a map of probability for no Granger causal impact from individual climate mode to global evaporation."

b. How do the authors deal with different spatial resolutions of the model outputs?

Response: We added the following text to Section 2.2 to clarify this point:

"We apply the methods described above to all the single models. We then rescale the results of single model to 1° longitude ×1° latitude spatial resolution. We use the rescaled results to compute the multi-model mean which is shown as a map of probability for no Granger causal impact from individual climate mode to global evaporation."

c. At Line 78, the authors mention the temporal resolution of the analysis; but it is not clear when and why both annual and monthly aggregations are used. In addition, differences in the results from these two experiments are not properly addressed in the paper.

Response: We thank the reviewer for pointing this out. Here the temporal resolution of all analyses is yearly. We only change the definition of the predictand (i.e., X_t) from annual mean to seasonal mean. This change in definition does not alter the temporal resolution of the predictand (i.e. the temporal resolution is yearly for both definitions used). Regarding the difference between these two experiments, we consider the analyses using the annual mean of evaporation (i.e. the predictand X_t) are the main results (Figures 1, 2, 3) while the analyses using the seasonal mean of evaporation provide additional information (Figures S3 to S10). We add the following text to Section 2.2 to clarify this point:

"We note that the temporal resolution of all analyses is yearly. Although the definition of the predictand (i.e., X_t in equation (1)) is based on both annual mean and seasonal mean values, the change in definition does not alter the temporal resolution of the predictand (i.e., the temporal resolution is yearly for both definitions used). We report the analyses using the annual mean of evaporation (i.e., the predictand X_t) as the main results of this study while the analyses using the seasonal mean of evaporation provide additional information."

d. Line 80: how is the optimal order of the regression model determined? Is this order different for every grid cell or the same across the globe?

Response: We added the following text to Section 2.2 to clarify these points:

"The optimal order p is computed by minimizing the Bayesian information criterion or Schwarz criterion (Schwarz, 1978). We note that the optimal orders might be different for each grid cell, depending on evaporation data of the selected grid cell."

e. Line 86: how are the data normalized and de-trended? Why are the data de-trended?

Response: The purpose of normalizing and detrending is only to simplify the data time series without altering the results and conclusions. We modified the related sentence in Section 2.2 to clarify this point as below:

"All climate indices and evaporation data are normalized (by using z-score) and detrended (by subtracting the trending line from given data; the trending line or the best-fit line is identified using least squares method). Detrending the data does not alter the results and conclusions."

f. Given the importance of the Granger causality framework for this work, I think it is necessary to at least summarise it in this section. At this point, the reader is simply directed to literature.

Response: We added the summary of Granger causality test in Section 2.2 as below:

"The model shown in equation (1) is defined as a complete predictive model where all variables (i.e., past data of evaporation and climate indices) are used to estimate evaporation. The null model of no causal effects from given climate mode (i.e., variable Y) to evaporation is defined by removing the terms related to Y (i.e., by setting $\beta_i = 0 \; with \; i = 1, \dots, p$) in equation (1). The complete model and the null model are then compared by using the following indicator:

$$L_{Y \to X} = n(\log\left|\Omega_{p,\beta_i=0}\right| - \log\left|\Omega_p\right|)$$

where $|\Omega_p|$ is the determinant of the covariance matrix of the noise residual, and n is the length of the data time series. We test the significance of the complete model by comparing the $L_{Y \to X}$ indicator against a χ_p^2 null distribution. This test results in a probability for no causal effect of the considered variable Y on evaporation."

g. It has been shown that modes of internal climate variability might be significantly correlated with each other and that this correlation needs to be taken into account to properly analyse their effect on other variables (see e.g. Martens et al. (2018) or Gonsamo et al. (2016)). Also IOD and

ENSO are correlated (see e.g. Figure S17 in Martens et al. (2018)). It is not clear to me how this is achieved by using the model described in Equation 1.

Response: We think the methods used in our study are not directly related to correlation analyses. More importantly, the result of Granger causality test is independent from the relationship of predictors (e.g., ENSO and the IOD) (Mosedale et al., 2006; Stern and Kaufmann, 2013). In fact, with the approach described above and below (see the responses to comments 2f and 2h), the methods used account for the characteristics of all climate indices, including the effect of cross-correlated between IOD and ENSO. Specifically, the complete predictive model shown in Equation 1 partly accounts for possible correlation between ENSO and the IOD by automatically adjusting the regression coefficients α_i, β_i and $\delta_{j,i}$ and the noise residuals ε_t, based on the characteristics of ENSO and the IOD.

We added the following sentences to Section 2.2 to clarify this point:

"Modes of climate variability might be correlated to each other and this correlation might have effects on the relationship between these modes and other variables (e.g., evaporation) (Gonsamo et al., 2016; Martens et al., 2018). However, in the approach of Granger causal analysis, the conclusion for the causal effects from variable Y (i.e., the considered climate mode) to variable X (i.e., evaporation) is independent from the relationship between Y and other factors (i.e., the relationship between climate modes) (Mosedale et al., 2006; Stern and Kaufmann, 2013)."

h. How did the authors check the validity of Equation 1? Are the fitted models tested for significance?

Response: The model shown in Equation 1 is defined as a complete model where all variables (i.e., past data of evaporation and climate indices) are used to predict evaporation. We evaluate the validity of the complete model by comparing this model with a null model. The null model of no causal effects from given climate mode (i.e. variable Y) to evaporation is defined by removing the terms related to Y (i.e., by setting $\beta_i = 0\ with\ i = 1, \dots, p$) in Equation 1. The complete model and the null model are then compared by using the following indicator:

$$L_{Y \to X} = n(\log\left|\Omega_{p,\beta_i=0}\right| - \log\left|\Omega_p\right|)$$

where $|\Omega_p|$ is the determinant of the covariance matrix of the noise residual, and n is the length of the data time series. We test the significance of the full model by comparing the $L_{Y\to X}$ indicator against a χ_p^2 null distribution. This test results in a probability for no causal effect of the considered variable Y on evaporation.

We added the following text to Section 2.2 to clarify these points:

"The model shown in equation (1) is defined as a complete predictive model where all variables (i.e., past data of evaporation and climate indices) are used to estimate evaporation. The null model of no causal effects from given climate mode (i.e., variable *Y*) to evaporation is defined by removing the terms related to Y (i.e., by setting $\beta_i = 0 \; with \; i = 1, \ldots, p$) in equation (1). The complete model and the null model are then compared by using the following indicator:

$$L_{Y \rightarrow X} = n(\log\left|\Omega_{p,\beta_i=0}\right| - \log\left|\Omega_p\right|)$$

where $|\Omega_p|$ is the determinant of the covariance matrix of the noise residual, and n is the length of the data time series. We test the significance of the complete model by comparing the $L_{Y \rightarrow X}$ indicator against a χ_p^2 null distribution. This test results in a probability for no causal effect of the considered variable *Y* on evaporation."

3. As the authors correctly point out near the end of Section 2.1, several issues arise when using output from climate models. Both the modelled evaporation and the calculated climate indices are uncertain, and it is unclear to which extent this affects the analysis in the paper. I understand that the authors somehow try to tackle this by relying on the output from different models; but I think too little attention is given to this issue in the paper. I would at least expect a brief discussion about the possible uncertainties in the analysis: how reliable are the derived climate indices used to describe the IOD, ENSO, and NAO? The authors could for instance benchmark them against observed indices. How reliable is the evaporation in the models? Again, this can be done by benchmarking against in situ observations. Alternatively, the authors could discuss the uncertainties based on existing literature to put their results in context: e.g. in which regions are the results presumably less reliable due to uncertainties in evaporation or internal climate variability?

Response: We thank the reviewer for these suggestions. The uncertainties related to the simulations of climate indices and evaporation are discussed in previous works and we cited as below:

"There might exist model biases in simulating ENSO (e.g. Taschetto et al., 2014), the IOD (Chu et al., 2014; Weller and Cai, 2013), NAO (Gong et al., 2017; Lee et al., 2018) and there is uncertainty in capability of land surface models in modeling evaporation (Mueller & Seneviratne, 2014; Wang & Dickinson, 2012)."

Despite these uncertainties, the CMIP5 simulations are still very helpful and these datasets are widely used (e.g., Cai et al., 2014b, 2015). As noted by the reviewer the approach of multi-model mean partly address the issue of uncertainties related to both evaporation and internal climate variability as simulated by climate models. The results described in our study also consider these uncertainties (i.e., by using significance level and agreement level between models). We noted that the high uncertainties for the ENSO effects are only shown for several regions (e.g. South Asia, Africa and Southern South America).

The following sentences in Section 3 (Discussions) discuss the uncertainties in simulating climate modes and evaporation:

"There are different factors that might contribute to the ambiguity of climate mode impacts on evaporation of several regions (e.g. South Asia, Africa and Southern South America). Specifically, these factors include the large discrepancies of current estimations of land evaporation for recent decades (Dong & Dai, 2017; Miralles et al., 2016), the limitations of climate models in simulating climate modes (Gong et al., 2017; Lee et al., 2018; Taschetto et al., 2014; Weller and Cai, 2013) and the overestimation of simulated evaporation in most regions (Mueller and Seneviratne, 2014)."

We also added the following sentences to Section 3 (Discussions) to further clarify the uncertainties related to model simulations:

"Specifically, there are systematic biases in simulating yearly average evaporation in Australia, China, Western North America, Europe, Africa and part of Amazonia (Mueller and Seneviratne, 2014). Thus, these biases contribute to the uncertainties in the effects of climate modes on evaporation. Nevertheless, the methods based on multi-model mean and Granger causality tests (see Section 2.2) help to reduce the uncertainties and provide robust results and conclusions."

4. The impact of IOD on evaporation over land is surprisingly very low; although it has been shown in several publications that the IOD is significantly affecting the surface hydrology; e.g. in Australia. How do the authors explain this low impact found in their study?

Response: We think these differences might come from different approaches in previous works and our study. For example, the impacts of the IOD might not be assessed with the contributions of confounding factors (e.g., ENSO and NAO). We think for several specific IOD events (e.g., extreme IOD or the IOD events associated with weak ENSO events), the IOD may significantly influence evaporation and surface hydrology in Australia. However, the results of our study imply that the multi-year impacts of the IOD on evaporation of Australia is not significant. Thus, we think this is not completely a contradiction.

5. One of the main advantages of using output from climate models is the availability of surface and atmospheric variables driving evaporation, all linked by the model in a physical manner. As such, the observed patterns described in Section 3 can be better explained from a physical point of view in my opinion. Why are certain links between evaporation and the climate modes found (or not found) in specific regions? Most of the discussion is relatively speculative at the moment, while I think it should be feasible to explain the observed patterns by some additional analyses. Speculative sentences like "… the influence of ENSO on evaporation might be associated with Wind-Evaporation SST" (P4-L108), "In the Northern Hemisphere, this result might be due to decrease in solar radiation. " (P6-L165), "This increase in ENSO impacts might be related to the increase …" (P6-L177), or "There are different factors that might contribute to the ambiguity of climate mode impacts on evaporation …" (P7-L204) could be better answered, by also analysing the effect of the modes on other model variables.

Response: We thank the reviewer for these suggestions.

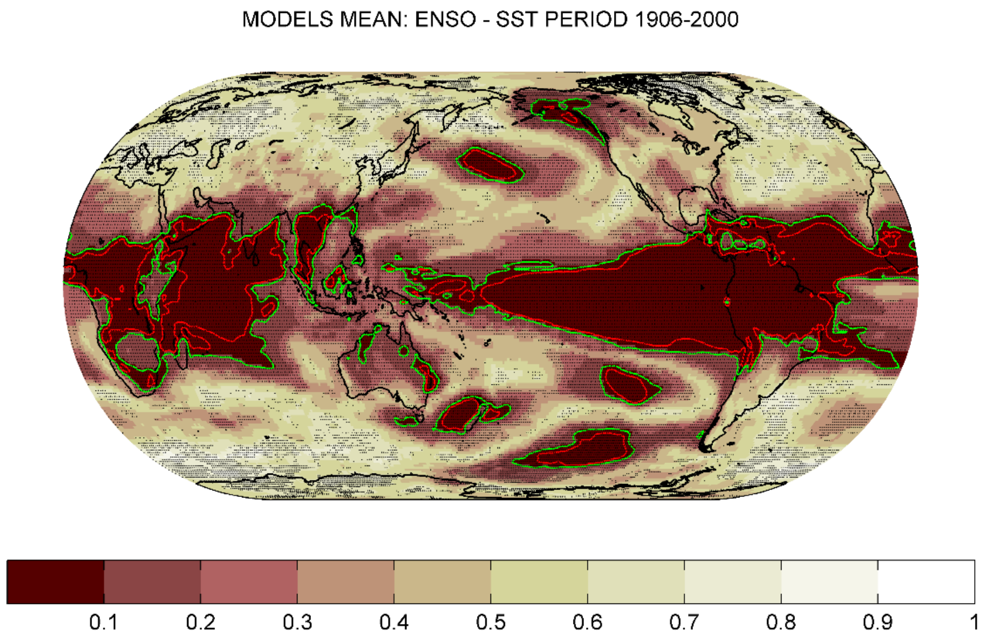
- Regarding the sentence "… the influence of ENSO on evaporation might be associated with Wind-Evaporation SST" (P4-L108), we added supporting Figure S2 and rewrote this sentence as below:

"Further analyses reveal that ENSO has significant impacts on SST (Figure S2a) and zonal winds (Figure S2b) over the tropical Pacific for the 1906-2000 period (similar patterns are observed for the 2006-2100 period, not shown). Hence, the influence of ENSO on evaporation might be associated with Wind-Evaporation SST (WES) effect (Cai et al., 2019). The WES effect occurs when warm (cold) water becomes warmer (colder) due to decrease (increase) in evaporation and weakened (strengthened) surface winds."

We also added the following sentence to the Section "ENSO influence on evaporation":

“ENSO causal effects on global precipitation are shown in Figure S2c which indicates the close connection between precipitation and evaporation process in several regions (e.g., tropical Pacific, Australia, Amazonia and regions closed to Caspian Sea).”

a)


MODELS MEAN: ENSO - SST PERIOD 1906-2000
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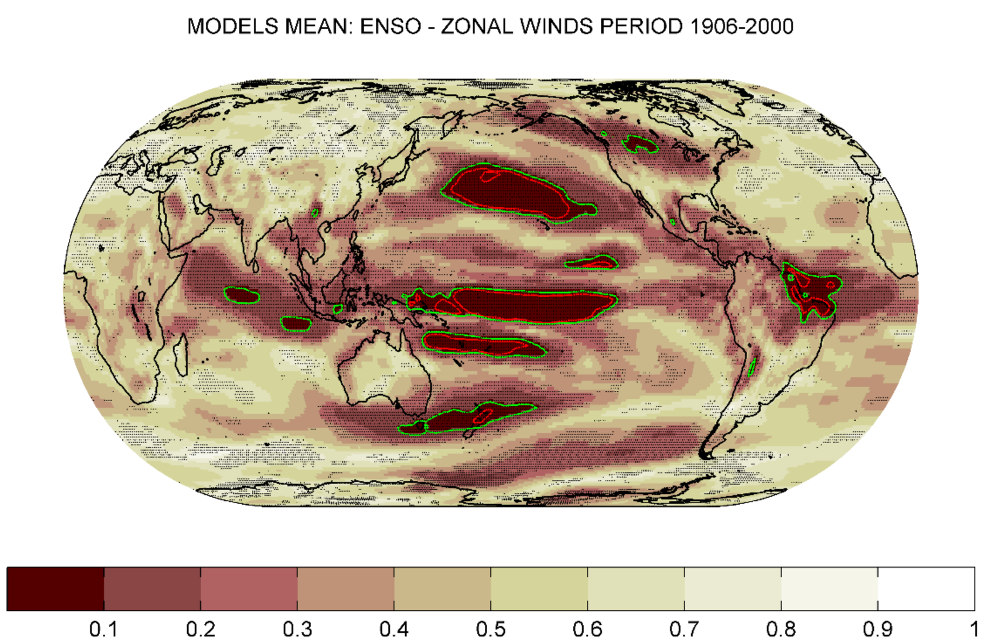
b)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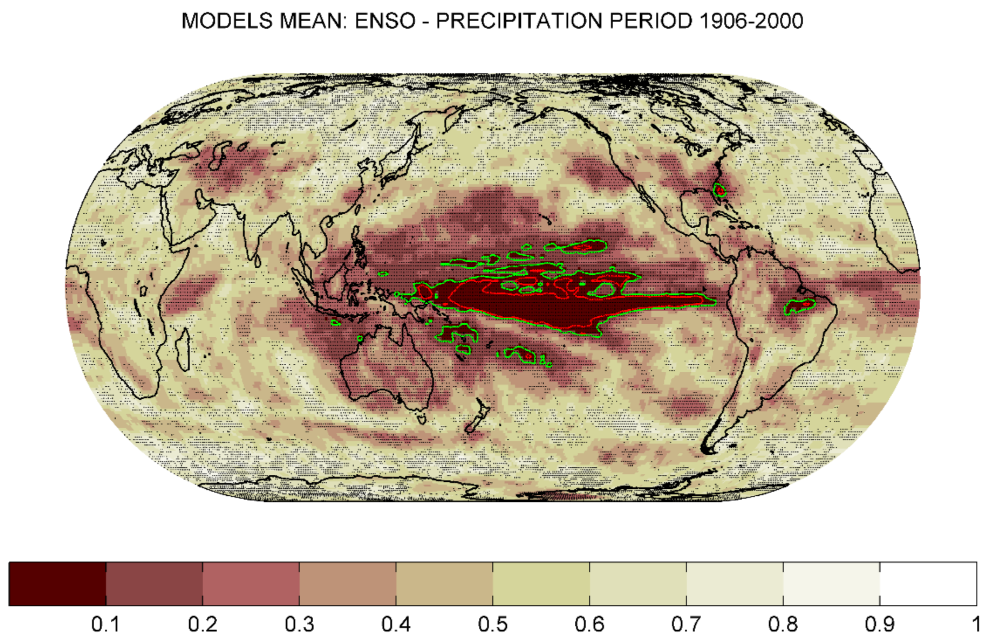

Figure S2. Multi-model mean probability map for the absence of Granger causality between ENSO and annual mean SST (a), zonal winds (b) and precipitation (c) for the period 1906-2000. Stippling demonstrates that at least 70% of models show agreement on the mean probability of all models at given grid point. An individual model's agreement is determined when the difference between the multi-model mean probability and the selected model's probability is less than one standard deviation of multi-model mean probability. The green (red) contour line designates *p* value = 0.1 (0.05). Brown shades indicate low probability for the absence of Granger causality. ENSO = El Niño–Southern Oscillation. SST = sea surface temperature.

- Regarding the sentence "In the Northern Hemisphere, this result might be due to decrease in solar radiation. " (P6-L165)", we added a reference as below:

"In the Northern Hemisphere, this result might be due to decrease in seasonal solar radiation (Martens et al., 2018)."

- Regarding the sentence "This increase in ENSO impacts might be related to the increase …" (P6-L177), we removed this sentence to avoid confusing the readers.

- Regarding the sentence "There are different factors that might contribute to the ambiguity of climate mode impacts on evaporation …" (P7-L204), we removed the word "might" in this sentence. We noted that in the next sentence, we provided some references for clarification.

Overall, we think the effects of climate modes on a single driver of evaporation do not imply the effects of climate modes on evaporation. This result points to the complexity of evaporation processes which are influenced by different factors.

6. The statements at P8-L237-238 and P9-L258-260 are confusing. Modes of climate variability affect surface meteorological variables that drive the evaporation process like precipitation, wind, and air temperature, which, in turn, affect evaporation. The fact that no clear link can be found between evaporation dynamics and the modes of climate variability does not necessarily mean that these drivers are more important to explain variability in evaporation, but rather indicates that the drivers are not affected by the modes of climate variability in the models.

Response: We thank the reviewer for raising this point. We re-structure these statements as below:

"These results suggest that, for several regions of declining impacts of climate modes (highlighted in blue shades, Figure 6), the important drivers of evaporation processes in the 21st century (e.g., precipitation, near-surface air temperature, wind speed, soil moisture) tend to be not affected by the modes of climate variability in the models."

"Land evaporation is shown to have weak connection with teleconnection indices in several regions, suggesting the weak effects of climate modes on important drivers of land evaporation, such as local wind speed (Stephens et al., 2018), surface temperature (Laîné et al., 2014; Miralles et al., 2013), moisture supply (Jung et al., 2010) and amount of precipitation (Parr et al., 2016)."

7. I am a bit surprised that there is generally little difference between the results for the future and historical periods. Several studies have shown that the modes of climate variability analysed in this paper are affected by climate change, and that (e.g.) more extreme states of these modes are expected (this is also acknowledged in the paper several times). How do the authors explain this small difference?

Response: We think this small difference is due to the nature of methods used in this study. Here we assess the multi-year effects of climate modes on evaporation rather than the effects of single event. Thus, the effects on evaporation of the extreme states of these modes do not persist long enough to be significant. Moreover, in the climate system, the effects of these extreme IOD events might be compensated by the extreme events of other climate modes (e.g., ENSO).

We added the following sentence to Section 4 to clarify this point:
"These results imply that the effects on evaporation of the extreme states of the IOD do not persist long enough to be significant. Moreover, in the climate system, the effects of these extreme IOD events might be compensated by the extreme events of other climate modes (e.g., ENSO)."

TECHNICAL CORRECTIONS

1. *P1-L28-29: "… and are likely to have impacts on global evaporation and transpiration …": it should be explained why this is expected, or the statement should be backed-up with references.*

Response: We thank the reviewer for this suggestion. We rewrote these sentences as below to clarify this point:
"These climate modes may have influence on important drivers of evaporation such as surface temperature (e.g., Arora et al., 2016; Leung & Zhou, 2016; Sun et al., 2016; Thirumalai et al., 2017; Wang et al., 2017), precipitation (Dai and Wigley, 2000), soil moisture (Nicolai-Shaw et al., 2016), humidity (Hegerl et al., 2015) and wind speed (Hurrell et al., 2003; Yeh et al., 2018). Hence, these climate modes are likely to have impacts on global evaporation and transpiration (hereafter simply referred as 'evaporation')."

2. P2-L31-32: It is unclear what is meant by this statement. I think "indicator" is simply the wrong choice of word here; else, the authors need to add which aspect of e.g. the global water cycle is "indicated" by evaporation.

Response: We modified "indicator" to "variable contributing to"

3. P2-L40: References should be given here to make clear about which "previous works" the authors are talking.

Response: We corrected this sentence as follows:
"Moreover, most of previous works (e.g., Shinoda and Han, 2005; Xing et al., 2016; Zveryaev and Hannachi, 2011) mainly address the connection between individual climate mode and evaporation, however, the role of other climate modes might not be included in the analyses."

4. P2-L36-48: Please note that Martens et al. (2018) preformed a comprehensive analysis of the impact of 16 major modes (including the ones tested here) of climate variability on terrestrial evaporation. Although the paper is cited in the results section, I think it is fair to cite it here as well.

Response: We thank the reviewer for this suggestion. We rewrote the sentences in the Introduction as below to include the results shown in the study of Martens et al. (2018):

"While previous studies emphasize the importance of ENSO (Martens et al., 2018; Miralles et al., 2013), the Atlantic Multidecadal Oscillation, the Tropical Northern Atlantic Dipole, Tropical Southern Atlantic Dipole and the IOD (Martens et al., 2018) on global land evaporation, the role of the NAO remains elusive."

5. P3-L61-62: The importance of this statement for the paper is not clear.

Response: We added the following sentence to this statement to clarify its purpose:

"Hence, the term 'evaporation' used in this study is referred to both transpiration and evaporation."

6. P4-L98: Indian Oceans → Indian Ocean

Response: We modified the text

7. Why do the authors use the probability of the absence of Granger causality, rather than the presence? To me this is rather confusing, especially when looking at figures. Also the discussion of Figure 5 at page 7 is complicated by this, I think.

Response: We use the probability of the absence of Granger causality because the test of Granger causality is based on the null hypothesis of <u>no</u> Granger causal effects from climate modes to evaporation (see also the responses in section 2f and 2h of SPECIFIC COMMENTS). The probability is computed and shown for <u>no</u> causal effects. The presence of Granger causality is not directly tested, but it is an inference. We rewrote the first sentence of this paragraph as below to clarify this point:

"Figure 5 shows the fraction area of Earth surface for land and ocean with probability for the absence of Granger causality between climate modes and evaporation less than 0.1 (i.e., p value < 0.1; here, the null hypothesis of no Granger causality from climate modes to evaporation is rejected at 10% significance level, hence, we conclude that there is significant causal effects; we note that the fraction area is substantially smaller if p value < 0.05).”

8. Regarding Figures 1–4 and Figure 6:

a. I would like to advice to use a different color map. The use of a “rainbow” color map is misleading and should be avoided (I encourage the authors to google this and find out the reasons).

Response: We thank the reviewer for this advice. We changed the color map of Figures 1-3 to a more perceptually-uniform one (brown-to-white color scale).

Regarding Figures 4 and 6, we changed the color map to blue-white-brown color scale. The map represents both negative and positive p-value.

We showed here Figures 1 and 4.

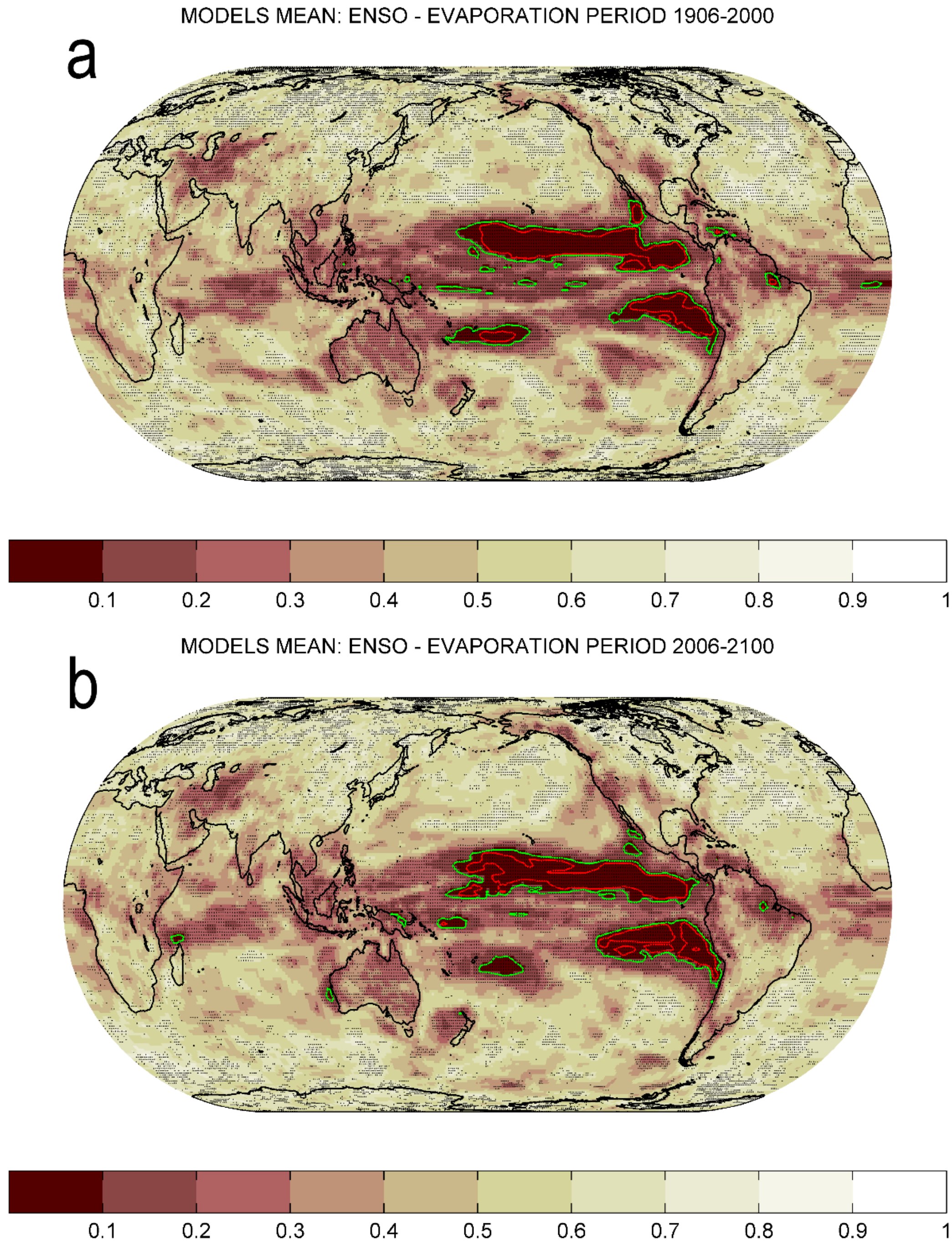

Figure 1. Multi-model mean probability map for the absence of Granger causality between ENSO and annual mean evaporation for the periods 1906-2000 (a) and 2006-2100 (b). Stippling demonstrates that at least 70% of models show agreement on the mean probability of all models at given grid point. An individual model's agreement is determined when the difference between the multi-model mean probability and the selected model's probability is less than one standard deviation of multi-model mean probability. The green (red) contour line designates p value = 0.1 (0.05). Brown shades indicate low probability for the absence of Granger causality. ENSO = El Niño–Southern Oscillation.

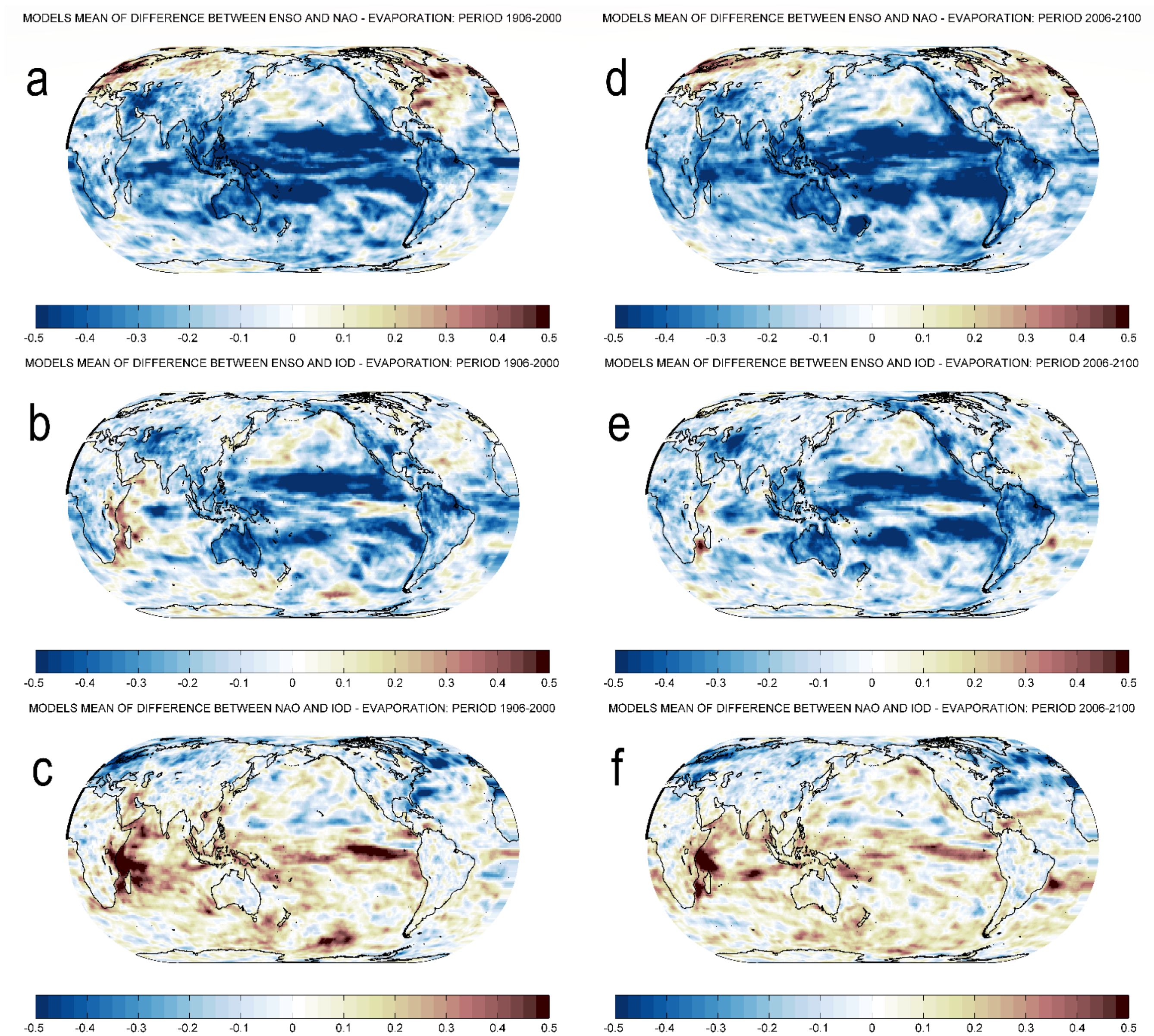

Figure 4. Difference in multi-model mean probability for the absence of Granger causality between a pair of climate modes and annual mean evaporation. The results are shown for the periods 1906-2000 (a, b, c) and 2006-2100 (d, e, f). ENSO minus NAO (a, d). ENSO minus IOD (b, e). NAO minus IOD (c, f). Blue shades indicate lower probability for the absence of Granger causality. ENSO = El Niño–Southern Oscillation. NAO = North Atlantic Oscillation. IOD = Indian Ocean Dipole.

b. The labels indicating 60 and 90 degrees latitude (both south and north) overlap with the map.

Response: We thank the reviewer for this suggestion. We removed all the longitude and latitude labels in the figures.

c. For the contours, I would use a color not used in the color map.

Response: We thank the reviewer for this suggestion. We changed the color of the contours.

d. The symbols used to indicate the lines of equal latitude and longitude should be different from the dot used to indicate the agreement between models. I would simply not plot the parallels and meridians to make the figures less busy.

Response: We thank the reviewer for this advice. We removed the latitudinal and longitudinal grids to make the figures easier to read.

9. Regarding Figure 5: this figure is currently useless in providing information on differences between IOD and NAO. Would it be possible to plot these on the right y-axis with a different scale?

Response: We agree with the reviewer that it is difficult to distinguish the difference between the IOD and NAO. This is because the fraction area influenced by these 2 modes is very small and close to zero. In fact, the fraction areas of NAO are zeros in Figures 5a, c and d. The fraction area for the effects of the IOD and NAO is much smaller compared to the fraction area of ENSO. Thus, it is difficult to plot all these information. We added the following text in the Figure 5 caption to clarify this point:

"Several fraction areas are close to zero"

We should note that we have additional Figure S11 with similar information, but the fraction areas are computed for p value < 0.25 (i.e. climate modes are unlikely to have no causal effects on evaporation). This Figure might be used as an alternative to compare the difference between the IOD and NAO. We added the following text to the Discussions Section:

"Figure S11 indicates that the land and ocean area influenced by the IOD is slightly higher compared to NAO."

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Brecht Martens

Ghent University

Laboratory of Hydrology and Water Management

2 References

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