

Response to Referee 1 Comments

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We'd thank the referee for their thoughtful and useful comments, and for their remark that our manuscript is of highest quality and worth publishing. We agree with all the comments that the reviewer has made, and will include the suggested changes in the revision, as far as feasible with the data available. We have already implemented the proposed changes in our data analysis program, and our results have a strong agreement with the reviewer's remarks.

The following includes the reviewer's comments in italics and our detailed response. We are in the process of revising the manuscript to include the results related to these comments.

In order to assess the impacts of each of the suggested variables, we performed the following procedure:

1. Run a generalized linear model (GLM) with all eligible fixed covariates
2. Run a GLM with all eligible fixed covariates except the one we are testing
3. Do a likelihood ratio test (LRT) to compare these models and get a p-value from the asymptotic χ_1^2 distribution

These results are discussed in each of the comments responses below.

Comment 1: *Indian rainfall is associated with ENSO and onset of discharge in Nino-3.4 region leads to drought in India. The occurrences of high precipitation extremes are less in drought years and this is a well known fact. What the authors have missed, is that, the non-enso drought years are associated with Indian Ocean Dipole Moment (Saji et al.,1999, Nature 401, 360-363) and hence it is essential to consider the same as an extra covariate and I am sure the authors will get an improved results.*

Comment 1 Response: We utilized the monthly Nino 3.4 anomaly in our newly fitted models. The index was retrieved from: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/detrend.nino34.ascii.txt.

Based on the LRTs, we found this covariate significant in most years for light rainfall. Moderate rainfall indicated significance about 25% of the years studied. Extreme rainfall models only indicated significance of this variable in 12% of the years. We will include further discussion and analysis regarding these results in the final version of the manuscript.

We utilized the monthly Dipole Moment Index (1958-2010) in newly fitted models. The index was retrieved from: <http://www.jamstec.go.jp/frcgc/research/d1/iod/HTML/Dipole%20Mode%20Index.html>. Since this index was only available up to 2010, it is not present in the models for 2011-2013.

Based on the LRTs, we found this covariate significant in nearly all years for light rainfall; this corresponds to the comment above regarding drought years. Moderate rainfall indicated significance in fewer than half of the years studied. Extreme rainfall models only indicated significance of this variable in 4 of the years. We will include further discussion and analysis regarding these results in the final version of the manuscript.

Comment 2: *The other climatic fact, which the authors have missed, is the association with Indian ocean warming and del TT (tropospheric temperature difference). There is a hypothesis that Indian ocean warming leads to reduction in delTT which in turn reduces monsoon circulation and hence these indicators are very important. For details, please see, Goswami and Xavier (2007), Quarterly Journal of the Royal Meteorological Society, Volume 133, Issue 624, pages 749-764, April 2007. and also Bawiskar (2009), Journal of Earth System Science, August 2009, Volume 118, Issue 4, pp 273-280.*

Comment 2 Response:

We utilized the ΔTT covariate in newly fitted models. This was calculated based on the reference provided above. We procured data from <http://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.derived.html> for the 200 and 600 mb levels and calculated the daily average of the two.

Based on the LRTs, we found this covariate significant in many of the years for all 3 levels of rainfall. We will include further discussion and analysis regarding these results in the final version of the manuscript.

Comment 3: *One of the major hypothesis, associated with extremes, is that, local changes and local heterogeneity may lead to spatial variability of extremes, and possibly this is due to the feedback from vegetation. Is there any way, the authors may use NDVI as one of covariate along with elevation to see its importance.*

Comment 3 Response: Monthly NDVI for 1981-2001 was retrieved from: <http://jisao.washington.edu/datasets/ndvi/>. However, there was a large degree of missingness which adversely impacted the analysis. For example, in the year 1988, NDVI was missing for 3304 of the 4278 observations. Instead of using this in the models, we plan to acknowledge this covariate and it's possible use in further study.