Natural Hazards
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Discussions

Interactive comment on "Spatial and seasonal responses of precipitation in the Ganges and Brahmaputra river basins to ENSO and Indian Ocean dipole modes: implications for flooding and drought" *by* M. S. Pervez and G. M. Henebry

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Major comments: This interesting MS investigates the effect of certain combinations of ENSO and DMI anomalies in rainfall and runoff anomalies in the Brahmaputra and Ganges basins. However, the definition and description of the two DMI indexes are not given, which makes the MS at parts difficult to follow. The absence of negative DMIns in the dataset should be explained in terms of the general circulation of ocean and atmosphere. One further criticism is the indiscriminate use of statistical significance.

Statistical significance is not shown in tables nor figures and the reader will believe that all results are significant, when in the text it is made clear that only part of them are. To what degree is the variation in rainfall an apparent consequence of these indexes or pure chance? Some kind of quantification of the covariation of these indexes should also be used: I suggest determining the covariance matrix in order to provide the reader (and the reviewer) with better tools of evaluating the results. In my opinion, this valuable MS should only be accepted after the DMI indexes are described and discussed (e.g. by summarizing the main findings in the literature) and after the statistical significance of the results is clearly shown in all tables and figures. Furthermore, the covariance matrix of the indexes should be determined and discussed.

Response: Thanks for providing the valuable comments and suggestions. After reviewing the comments from the both reviewers we have decided to re-do the analysis using much longer observed precipitation and SST data sets. We have identified Global Precipitation Climatology Center (GPCC) version 6.0 data set as observed precipitation to use. We have extended the analysis for the past 110 years (1901-2010). We are using conventional IOD index computed as the difference between averaged zonal western and eastern tropical Indian Ocean. We will use 50° E-70° E, 10° S-10° N as western zone and 90° E-110° E, 10° S-Equator as eastern zone defined by Saji et al., 1999 for the IOD index. Four sources of SST data (Kaplan et al., 1998; Reynolds et al., 2002; Trenberth, 1997 for Pacific Ocean, and HadISS 1.1 for the Indian Ocean) have been integrated to define ENSO and IOD indexes for the same past 110 years. We are using a Monte Carlo simulation approach with a two-tailed t test to quantitatively define statistical significance of the precipitation anomalies spatially and temporally. Finally we are rewriting the manuscript describing the results found in the re-analysis.

Minor Comments: page 1673 line 16: I strongly suggest that you dedicate at least a paragraph in Methods to explain how to derive the DMI indexes.

Response: We are revising the entire manuscript and will incorporate the suggestion.

page 1678 lines 16 to 20: It is not clear whether these changes are statistically significant. The same applies to Table 1 and 2, where the percentage of baseline is given, but not to what degree that difference is significant or not.

Response: We are quantifying statistical significance of the precipitation anomalies using Monte Carlo simulation approach and with a two-tailed t test in the re-analysis. Please refer to attached new figures for an example.

page 1680 line 11: "below average precipitation was expected", why?

Response: We are revising the statement on the basis of the re-analysis results.

table 1 and 2: add a column on the left with "El Nino", "none" and "La Nina". Add a row with "negative", "neutral" and "positive" DMI

Response: We will add that in the revised manuscript.

table 3: "neutral" is not correct. A better word would be "average" table 3: according to table 3 there is no year of negative DMIns in all time domain. Is this related to the way the index is calculated or does it have a physical meaning that should be explored?

Response: This is mostly because of the way the index is calculated. In the re-analysis we are using conventional IOD index, and are using 110 years of SST and precipitation data. In the re-analysis the year classification (Meyers et al., 2007) is significantly different. We are addressing the classification and re-analysis results in the revised manuscript.

figure 3: I suggest improving the labeling of the charts. It should be clearer that columns correspond to neg., neutral and pos. DMI and rows to El Nino, none and La Nina.

Response: Agreed, we will make them clearer.

figure 4: same as in figure 3

Response: Response: Agreed, we will make them clearer.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 1671, 2014.

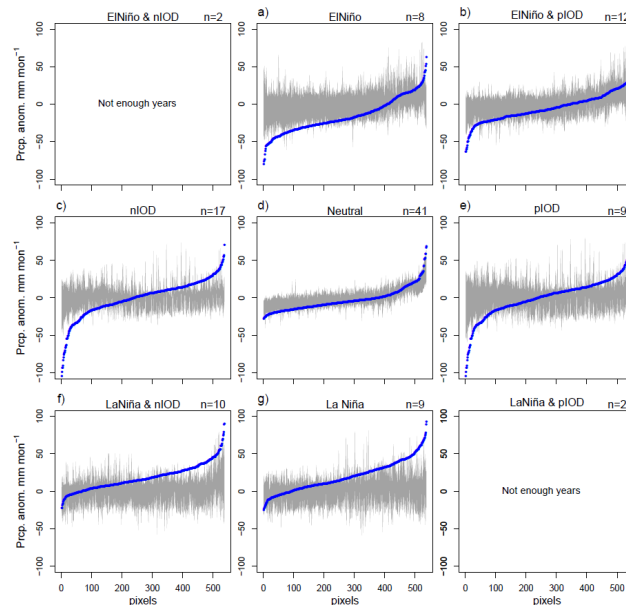Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 1671, 2014.

Figure 2: Composite of the mean precipitation anomaly for June through October for each pixel in the basins when El Niño, La Niña, and positive or negative IOD occurred, co-occurred, or did not develop. The number of observed years for each ENSO-IOD combination is indicated with *n*. Combination specific precipitation anomalies (mm mon-1) are shown with blue dots; long-term mean anomalies are shown with a black line and its 10% and 80% lower and upper bounds as determined by Monte Carlo testing, and a two-tailed t test at 80% confidence level is shown with gray shading. Where the blue dots lie outside the gray shaded area, the values are significantly different from the long-term variance.
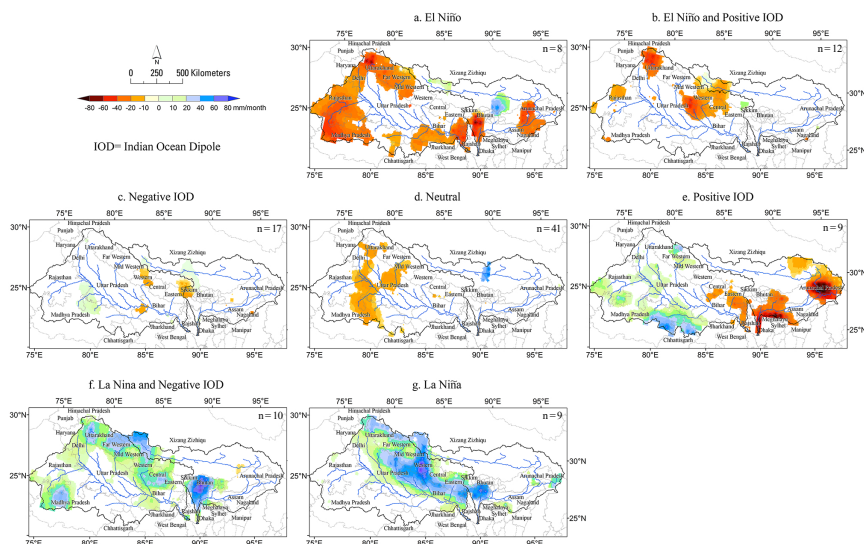
Fig. 1.

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Figure 3. Composite of the spatially distributed June through October total precipitation anomalies (mm) in occurrence, co-occurrence, or absence of El Niño, La Niña, and positive or negative IOD categories with the number of observed years (n) in each category indicated. Only anomalies are shown that are significantly different from the long-term variance as determined by Monte Carlo testing and two-tailed t test at 80% confidence level.
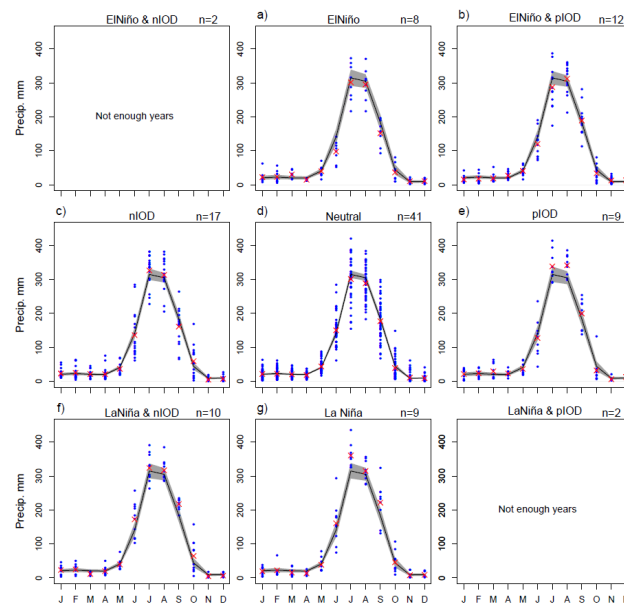
Fig. 2.

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Figure 4. Composite of the Ganges basin precipitation (mm) by month when El Niño, La Niña, and negative IOD occurred, co-occurred, or did not develop. The number of observed years for each ENSO-IOD combination is indicated with n. The seasonal cycle from January to December is shown for the period 1901–2010. The black line is the mean of all years (1901–2010). Within each combination, observed years (n) are shown with blue dots; the red x is the mean of the observed years, and its confidence levels are shown with gray shading as determined by Monte Carlo testing and a two-tailed t test at 80% confidence interval. Where the read x lies outside the gray shaded area, the values are significantly different from the long-term variance of that month.
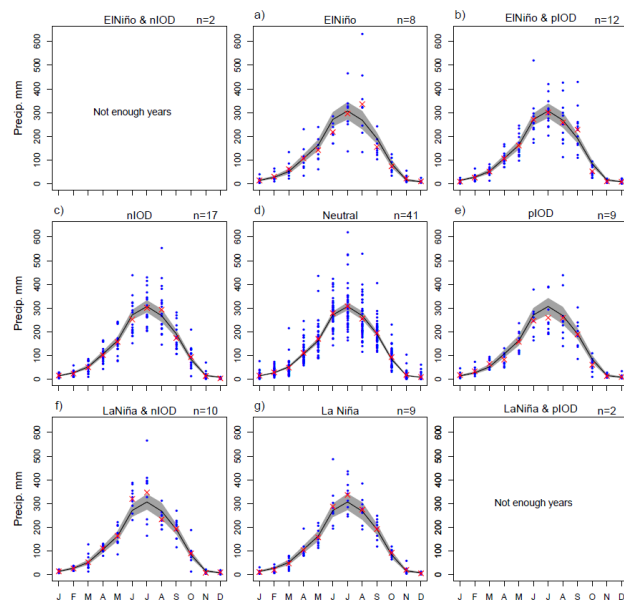
Fig. 3.

Figure 5. Composite of the Brahmaputra basin precipitation (mm) by month when El Niño, La Niña, and positive or negative IOD occurred, co-occurred, or did not develop. The number of observed years for each ENSO-IOD combination is indicated with . The seasonal cycle from January to December is shown for the period 1901–2010. The black line is the mean of all years (1901–2010). Within each combination, observed years (n) are shown with blue dots; the red x is the mean of the observed years, and its confidence levels are shown with gray shading as determined by Monte Carlo testing and a two-tailed t test at 80% confidence interval. Where the read x lies outside the gray shaded area, the values are significantly different from the long-term variance of that month.

Fig. 4.