Nat. Hazards Earth Syst. Sci. Discuss., 2, C211–C217, 2014
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Natural Hazards and Earth System Sciences
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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

Anonymous Referee #1

Received and published: 20 March 2014

The manuscript assesses precipitation responses over two of India's major river basins in relation to ENSO and IOD. While the research is topical and has the potential to provide novel insights into Indian hydroclimate with societal implications, several major areas of concern need to be addressed before this paper may become acceptable for publication. In particular, the manuscript is overly descriptive, not very well written, with unspecific and vague language throughout. Further details for the data/methods need to be provided, statistical robustness of the results addressed, and results need to be better embedded in existing literature. More detailed comments are given below.

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The following represent major areas of concern:

(1) The introduction is very short; as such, it ignores many relevant studies and does not provide the necessary background for the present study. A selection of additional literature is provided below. The new findings throughout the text also need to be better embedded and discussed in light of existing studies.

(2) The description throughout the manuscript is vague and unspecific. Please revise the text to be more specific and scientific.

(3) The manuscript is overly descriptive and does not attempt to link the results in a dynamic/mechanistic way. Please consider including a discussion of the dynamics that might give rise to the precipitation responses you observe.

(4) Data and methods section needs to be considerably expanded to include the following:

(a) ENSO/IOD classification: more detailed description of classification method used; how does this compare to existing classifications (eg, Meyers et al 2007, Yamagata et al 2004)? What definition is used for an ENSO event?

(b) What SST data is used? What regions are chosen for the two DMI?

(c) Include a better justification for the use of the very short daily precipitation station data, when considerably longer, high-quality data exists (IITM, Rajeevan et al 2006). It is strongly recommended to redo the analyses over a longer period. In particular as all analyses shown seem to be based on monthly means, it is unclear why the AISM data set has not been used.

(d) Where does the drought/flooding information come from? Please include an additional section in data/methods that describes this data set. How is flooding/drought defined? Please show the spatial extent and duration for these flooding/drought events.

Specific comments

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- p.1, L16: Which dipole modes are meant here?

- p.1, L19: The occurrence is La Nina and positive IOD is very rare (see Meyers et al. 2007); in light of this, the results might not be representative.

- p.1, L26: “Major flooding and drought” seems a contradiction, unless a “respectively” in L27 is missing?

- p. 2, intro: Please add more recent references to ENSO’s impact on Asian climate.

- p.2, L11: Insert “sea” before “surface temperature”.

- p.2, L15: Specify that the 12% refer to interannual SST and/or what seasonal dependence this has.

- p.2, L17: One cannot ‘tune’ an IOD mode to the Ganges/Brahmaputra basin. Please reword to clarify that you are trying to define an index that is strongly associated with regional precipitation.

- p.2, L19: Please be specific what regional extent is used for these indices.

- p.2, L23: Rather than referring to the index, ie. DMI, you should refer to the mode here (as you are doing for ENSO).

- p.2, L24: Please refer to the specific IPCC chapter here that details these findings. Also refer to Cai et al. 2013.

- p.3, L2: Please refer to the specific IPCC chapter here.

- p.3, L2: The introduction is very short and does not do justice to existing literature on the topic, nor does it provide the necessary background for the study. Please expand the discussion on the following topics: projected changes in the monsoon, ENSO, IOD. While not exhaustive, some additional references are listed below.

- p.3, L3: Reword to “. . . each river basin. . .”.

- p.3, L13: Should be “India”.

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- p.3, L18: Should be “resource. . . population who rely on. . .”.

- p.3, L21: Please include “respectively” at the end of the sentence.

- p.3, L24: Actually, it is not possible to see this in Figure 1. Suggest revising the metric shown in Figure 1 to conclusively demonstrate this.

- p.3, L29: Should be “under a changing”.

- p.4, L3-5: Why choose this set of precipitation records for this study? The short period 1982-2010 severely limits the confidence in the results presented here. It is strongly recommended to redo the analysis with longer records available (eg IITM data or Rajeevan et al 2006).

- p.4. methods/data: considerably expand the description of this section, as detailed in main comments above.

- p.4, L25-26: Why distinguish between two different types of IOD when lumping results together afterward? Please show results separately for the different types.

- p.5, L4-7: This sentence does not make sense and is contradictory.

- p.5, L7: Should this not be “intensive”, rather than extensive?

- p.5, L15-17: Wrong cause-and-effect: changes in OLR do not cause variations in convection; reword; similar applies to Walker circulation changes.

- p.5, L16: How these results are linked to the Hadley circulation here are unclear.

- p.5, L18-19: Again, why distinguish two different types of IOD when lumping results together? Show separately.

- p.5, L22-23: “. . . increased precipitation was relatively less. . .” – reword to clarify meaning.

- p.5, L28: Again, OLR does not cause changes in clouds – it is a metric to measure presence of clouds.

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- p.6, L8-10: The results seem to indicate average conditions. Please indicate significance.

- p.7, first para: This section is very hard to follow, as it is unclear when Figure 3 and Figure 4 are discussed. Please restructure to be more coherent. Consider also to only discuss significant results. The majority of ENSO/IOD combinations do not indicate significant deviations in precipitation from average conditions for the two ocean basins.

- p.7, L7-8: What is a “cycle of dry conditions” and “below the expected mean of dry conditions”?

- p.7, L17: Reword to “for neutral ENSO conditions”.

- p.7, L29: Figure 4 does show significant precipitation changes. Please correct text.

- p.8, Section 4.3: This whole section needs to be more quantitative; in its present state it is very anecdotal and arbitrary. Please conduct a detailed statistical analysis that demonstrates that there are indeed significant changes in drought and flood incidence.

- p.9, L10: Provide specific chapter.

Table/Figures

- Table 3: Where does the drought/flooding information come from? Please include an additional section in data/methods that describes this data set. How is flooding/drought defined? Please show the spatial extent and duration for these flooding/drought events.

- Figure 1: The metric mm/day is not helpful, given the large seasonality. Only show monsoon precipitation or standard deviation of precipitation to indicate key regions. 1982-2010 is an odd period to choose for climatology.

- Figure 2: Which DMI is shown, E-W or N-S? Why introduce separate types, if the results are not shown separately?

- Figure 2: Indicate where precipitation anomalies are significant. Without significance

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levels, anomalies are not useful.

- Figure 2: What months do the precipitation anomalies refer to?

- Figures 2-4: Please indicate for each subplot how many years each entails.

Additional references to be included

- Cai et al. 2013: Projected response of the Indian Ocean Dipole to greenhouse warming. Nature Geoscience, 6, 999-1007.

- Du et al. 2013: A New Type of the Indian Ocean Dipole since the Mid-1970s. J. Climate, 26, 959-972.

- Meyers et al. 2007: The Years of El Niño, La Niña, and Interactions with the Tropical Indian Ocean. J. Climate, 20, 2872–2880.

- Rajeevan et al 2006: High resolution daily gridded rainfall data for the Indian region: Analysis of break and active monsoon spells. Current Science, 91

- Saji & Yamagata 2003: Possible impacts of Indian Ocean Dipole mode events on global climate. Climate Res, 25, 151-169.

- Schott et al. 2009: Indian Ocean variability and climate variability. Rev. Geophys., 47, RG1002, doi:10.1029/2007RG000245.

- Ummenhofer et al. 2011: Multi-decadal modulation of the El Niño-Indian monsoon relationship by Indian Ocean variability. Environmental Research Letters, 6, 034006

- Weller & Cai 2014: Meridional variability of atmospheric convection associated with the Indian Ocean Dipole Mode. Scientific Reports, 4, DOI:10.1038/srep03590

- Yamagata et al 2004: Coupled ocean–atmosphere variability in the tropical Indian Ocean. Ocean–Atmosphere Interaction and Climate Variability. Geophys. Monogr., Vol. 147, Amer. Geophys. Union, 189–212.

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