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Interactive comment on "Dominant patterns of interaction between the tropics and mid-latitudes in boreal summer: Causal relationships and the role of time-scales" *by* Giorgia Di Capua et al.

Anonymous Referee #2

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General comments

The paper addresses relevant scientific questions of teleconnections between tropical convection related to monsoon activity and midlatitude circulation on subseasonal timescale, particularly authors focus on the boreal summer time. The paper presents a method for causal link visualization in the form of a 2D-map of regression coefficients describing linear relationship between the cause (monsoon activity and circulation patterns represented by maximum covariance analysis (MCA)) and response processes (2m air temperature and outgoing longwave radiation). The causal effect network (CEN) approach was tested previously on 1D reanalysis data in a number of

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climate studies. Here the authors expanded the method to a grid-wise CEN analysis. They find that both-ways links exist in summer, which act on a 4-week timescale between the South Asian monsoon and the Northern Hemisphere circulation and on a 1-week timescale in the opposite direction. In addition, authors analyze causal links in the presence of different ENSO phases, however not in the mature state of ENSO phases but in summers before El-Ninos and La-Ninas reach a peak, which makes it somewhat difficult to compare with other studies that analyze monsoon-ENSO coupling mostly during the developed ENSO phases (e.g, Kawamura 1998,Kumar et al1999, Goswani and Xavier 2005, etc). This analysis suggests that the La Nina phase has a dominant effect on the summer link between the South Asian monsoon activity and the mid-latitude circulation as compared to the El Nino phase. Whereas the western North Pacific monsoon effect on the North Pacific High is stronger during the El Nino phase. In general, the scientific methods and assumptions are sufficiently described; however the methodology could still be improved by putting it into the context of studied teleconnections and for the traceability of the method and results. Also the result and discussion parts need further clarification. The language in general is fairly clear, however overloaded with abbreviations, which makes the paper somewhat difficult to follow.

Specific comments

1) Clarification on methodology: - Section 2.2: The choice of MCA is not clear as compared to other methods of dimension reduction. It would be helpful to describe what will happen with MCA modes after section 2.2. In Figure 2, the legend suggests four time series but one can only recognize two time series. - Section 2.4 is very generic; it would also be useful to know at some point what “A, B, C” are in the current analysis. Adding a table describing indexes and abbreviations separated in cause and response actors used for the causal effect analysis would be helpful. A discussion on the sensitivity of results to data-length would also be useful. - L219-223 and L310-315 should be in Methods because this text describes methodology and not the results.

2) Clarification on results and discussion: - L250-259: It is not clear what the purpose of this paragraph is. - L266-268: Mentioned patterns do not look “similar” at all to me. I would suggest to specify regions where similarities are seen by authors. - Explaining some of the results, authors interpret patches of beta-values on causal maps that look like noise. E.g., L280: "Although the CGT influence is mostly concentrated in the mid-latitude regions, one can see a negative causal effect of the CGT pattern on OLR values over the Bay of Bengal (Fig. 3f).“ It looks like the effect that authors describe is a small dash over the Bay of Bengal, I cannot even see the color of the region, just the black contour color. Does the method behind causal maps take care of spatial noise? - L282: "Asia and North America are strongly affected by the CGT.“ It would be useful to support the qualitative judgment of the link-strength by providing beta-coefficient values in parentheses for this particular example and throughout the text, where link’s strength from causal maps is described. - L455: “apparent paradox”: I am not sure there is any paradox. Studies cited by the authors describe a trend in current observations and future climate change projections, which cover two different time periods, thus such comparison is not consistent. - L435-440: A comparison of teleconnections acting on subseasonal timescales from this study with those from other studies on interannual and decadal timescales is odd. - L56 and L496: A statement about paving the way to better predictions without further explanation is a bit bold. The CEN method has a potential to improve our understanding of climate processes but authors need to explain better how exactly this method can improve climate predictions.

3) Inaccurate region description: - L295: “Russia/Scandinavia”: I would say “northern and eastern Europe“ because this where non-zero beta values actually are. On the other hand, what does “non-corrected p values” from the caption mean, I do not find it explained. - L323: “over Kazakhstan” I would say “north of Kazakhstan” if the region enclosed by the contour is meant. Moreover, Kazakhstan is located north-east of the Caspian Sea not north-west of the Caspian Sea. - L319: “a few areas”: Indeed these are three regions which can be named. - L412: “European Russia”. I would rather say “northern and eastern Europe”.

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4) Figure 5: - During El Nino years, there is a link between SAM and Z200 in the tropical Pacific, which is not present during the La Nina years, therefore the concluding statement in the results, conclusions and abstract about strong effect of El-Nino only for the second MCA mode is confusing. - NPH and mode 2 results are not described in the text. - L417: “the pattern identified in Fig 5f with a low over central Europe and high over western Russia”. I do not see a low-high dipole, the figure shows beta-coefficients not geopotential. - L419: “. . .wave-trains initiated by La Nina. . .” I do not follow this explanation. Figure 5f is about El Nino effects. Similarly, L456-458: “. . . if La Nina conditions would become. . .(Fig. 5f)”. Figure 5f is about El Nino effects.

5) An extensive use of abbreviations makes the paper a bit difficult to follow. - Adding a table describing CEN actors abbreviations would be very helpful. - Abbreviation is introduced but never used in the manuscript such as EASM (L92) and SRP (L439). - BSISO abbreviation in L138 is not introduced.

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