Climate
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Discussions

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Interactive comment on "Multi-proxy reconstructions of precipitation field in China over the past 500 years" *by* Feng Shi et al.

Anonymous Referee #1

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The manuscript presents a reconstruction of the seasonal mean precipitation in China over the past few centuries based on a collection of proxy records, comprising mostly tree-ring width and historical documents , but also included some oxygen isotopes record and a long Korean precipitation instrumental record. The statistical method to reconstruct the spatially resolved precipitation is a variant of Point-by-point regression, a method that has been applied for the generation of the Drought Atlases in other continental regions of the world by E. Cook and collaborators. I assume that other reviewers will comment on the quality and adequacy of the proxy records. Here I will mostly focus on the other aspects of the manuscript, like the statistical method applied, the interpretation of the results - connection of the reconstructed precipitation to large-scale variability modes, and on the clarity of the manuscript itself.

In general terms, I think this is a valuable study. The main conclusions related to the

past spatial structure of the precipitation variability, indicating the presence of spatial dipoles at decadal timescales, and the lack of a clear connection to the external forcing are interesting, although maybe to some extend to be expected, and some were already hinted at in previous studies. However, I think the manuscript itself requires some technical revisions, nt dramatic, but indeed careful. The language is sometimes not specific enough and could be misinterpreted by some readers. Also the structure of one section - the discussion-is strange. This section actually contains further results and not so much a discussion about the results. All in all, I would recommend the publication after some revisions, as specified below. Some of my points are related to language usage, but those are more recommendations to check, as I am not a native English speaker

1. The title could be more specific. The study reconstruct seasonal mean precipitation, so it should indicate the season

2. relationships with instrumental climate data (Fritts, 1976; Zhang, 1991). Other proxy records (e.g., ice core, coral, and varve sediment) have been introduced into regional climate field reconstructions (e.g., Neukom et al., 2011), but they are generally harder to use.

This is an example of what I meant by unspecific language, which can be also seen in other parts of the manuscript. Wha does 'harder to use' mean ? I guess the difficulties are related to dating and time resolution, but the authors could be more specific and do not leave the reader guessing.

3. The targets for reconstructions are primarily on temperature variables or variables related to temperature b

The targets are temperature or temperature-related variables.

4. large spatial coherency. Reconstructions of the localized precipitation field or other variables related to precipitation are seldom (Cook et al., 2004; Cook et al., 2015b;

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Seftigen et al., 2015) because they require proxy records with more extensive distributions. In particular, the Palmer Drought Severity Index (PDSI) Atlases over the past millennium in North America

I think the authors do not mean more extensive spatial distribution, but rather a more dense proxy network that it would be the case for temperature.

5. The climate field reconstruction method can be divided into the Empirical Orthogonal Function-based (EOF-based) method (Mann et al., 2009) and the point-to-point regression-based (PPR-based) method (Cook et al., 1999). The core function of the

I had real problems with this sentence. I think I understand what the authors mean, but the sentence can be really misleading. First, there are more 'families' of reconstruction methods - consider for instance the Bayesian Hierarchical Modelling Barcast, or the methods based on Canonical Correlation, or the more modern methods based on off-line data assimilation (e.g. Steiger and Hakim) or even the method based on particle filters . Also, the RegEM method used by Mann et al is not really 'EOF-based. It is correct that Mann et al used an EOF pre-filtering within the RegEM method, but this is not required by the algorithm itself. Therefore, I do not think that tis sentence is really correct. The authors may want to re-consider according with what I think they really want to say. They probably mean that statistical methods may include an EOF-prefiltering of the predictand or of the predictor or of both, or not pre-filtering at all. In the former case some small-scale information is lost - I think this is what the authors are pointing to.

6. The left EOF patterns may retain some useful regional spatial information, which would have been partially lost in the EOF- based method. For instance, the global temperature field reconstruction using the EOF-based method (Mann et al., 2009) was

The 'left patterns' is unfortunate. It my be be misinterpreted as 'left and right vectors' in SVD. I would rather used 'the discarded EOF patterns after EOF-truncation'

7. (Shi et al., 2015a) and the optimal information extraction (OIE) method (Yang et al., 2016). In theory, the PPR-based method maximizes the retention of spatial information, but this method requires a sufficient number of suitable proxy

I also had problems with the description of the OIE method, and also to figure out to what extent this method is different from the PPR method. This manuscript does not give enough details and refers to other previous manuscript by Shi et al. I have quickly looked into those papers and I cannot tell the difference between OIE and PPR. This may be my probable, or the problem in previous manuscripts, but I really would recommend to be much more specific here, and at least indicate the basic difference between OIE and PPR, and what are the advantages, if any, of OIE over PPR in this setting.

8 The precipitation (or the variable sensitive to precipitation) field reconstruction for a large-scale region using the PPR-based method is difficult when only one type of proxy records did not cover all reconstruction areas. For example, the tree-ring

This sentence is too cumbersome. I tink I understand what it means, but the authors may consider rephrasing.

9. regression and inverse regression. The LOC regression method has already been verified to efficiently retain low-frequency climate signals (Christiansen, 2011; Shi et al., 2012).

However, the LOC method has been shown to potentially overestimate the past variability. There is a comment and reply exchange on the Christiansen et al manuscript, and my interpretation of it is that Christian et al. also acknowledge that this could be a problem in certain circumstances.

10 2.2 Tree-ring record

Please, be more specific here : three-ring width, isotopes, density, eraly woood density, etc.

11 To maximize the overlap lengths of the instrument data and proxy records, all tree-ring records were extrapolated to AD 2000 using the RegEM algorithm (Schneider, 2001). Here, the truncation parameters for the RegEM algorithm were set to

Extrapolation does not include new information and therefore it cannot increase the skill of the reconstructions. Was this step necessary for the OIE algorithm ? if not, an explanation is required as to why the records were extrapolated.

12 Discussion section. As I indicated in the preamble, this section actually contains further results, such as the superposed epoch analysis. It also contains the analysis of the link between the reconstructed precipitation and ENSO and the PDO. As it stands, it is a classical results section. The title' discussion' is misleading .

13. The superposed epoch analysis (SEA) between the precipitation, its PC1, and 35 large eruption events during AD 1470-1849 shows that volcanic activity as one important external forcing may affect the MJJAS precipitation anomalies variability for China (Fig. 8). Nevertheless, the signals are barely significant and there are similar averaged scores before and after the

These results are too cryptic. The SEA has not been mentioned before, so the reader is left wondering where this comes from: which eruptions have been included, how were they dated (the reconstructed volcanic forcing of Gao et al and of Crowley and Untermann doe not always agree on the dating of the forcing maximum), how was the SEA itself conducted, for instance how many years prior to the eruptions were considered to define the pre-eruption mean, how was the statistical significance established, etc.

14.

Our results indicate thus that the south-north mode variability of precipitation anomalies in China carries very likely the fingerprint of ENSO evolution over the past 500 years, but the origin of the EOF1 and EOF3 patterns are not clearly established yet. This

implies that the other factors such as North Atlantic Oscillation (NAO) (Wu et al., 2009; Zheng et al., 2016), interdecadal Pacific oscillation (IPO) (Song and Zhou, 2015), North Atlantic triple SST pattern (Ruan and Li, 2016) through the North Atlantic–Eurasia Teleconnection (AEAT) (Li et al., 2013a), the snow cover change of the Tibetan Plateau (Ding et al., 2009; Wu et al., 2012), and changes aerosol concentration (Li et al., 2016) may contribute to the reconstructed precipitation field modes during the pre-industrial period.

This conclusion is rather speculative. Why shoud EOF1 and EOF3 be related to the large-scale climate ? they coud be originated by regional processes in China.

15. Caption Figure 1. Please indicate what RSQ, RE, CE and uncertainty mean

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