Reviewer 1 – Prof. Luterbacher

This is an important contribution in deriving a continuous very long precipitation series for an area that is strongly influenced by the Atlantic and various circulation modes. The authors do a very good job in compiling all the meta information, the way how they generate the new series and provide associated uncertainties. They also carefully compare with other series and link statistically to upstream Atlantic climate conditions. I find this is an important contribution and I support it to be published in Clim Past. Below are a couple of suggestions/comments I wish the authors can take into consideration for the revisions.

We thank Prof. Luterbacher for the time taken to provide such a constructive review and for the positive comments above.

Abstract: The abstract might be improved. In my view it is too detailed with specific information that do not reflect the major findings of the study. It might include a synthesis of the findings and what makes this series unique. Also implication of the results and potential for future applications could be stressed.

In our revisions we will rework the abstract as requested.

I suggest to provide a spatial correlation (spearman) plot between precipitation of Ireland (the representative station or country average) and Europe, separated for each season and for at least the last 50 years. That would show how the target new precipitation series is statistically linked to remote areas of the UK and European mainland.

An excellent suggestion that we hope will increase the uptake of our series in wider European work. We will include an additional figure and associated text around interpretation in the revised manuscript.

I would suggest to produce a Figure that shows the location of the precipitation series that are compared with the target Ireland series. The starting year of the stations could be separated with different colors.

This was a point raised by both reviewers and we have plotted the locations of comparison series across the UK. Reviewer 2 also asked for locations from Ireland mentioned in the text to be included so that readers not familiar with the geography of the island can get a feel for the data/locations. The revised paper will include an additional figure for this map. One challenge however is that given the number of locations now included and the multitude of start dates it is very difficult to include start year by colour. This information is given in the tables (Table 1 and Table 2) in the manuscript and we argue that this is sufficient.

Section 3.2., table 4 and fig 3: Please could you also calculate the significance for the running correlation. One way would be through bootstrapping. For the interpretation of this figure I would then only describe and interpret the significant periods.

Sure, we can do this for series in Figure 3. We will have a go at implementing the procedure in Pauling et al. (2006) for examining significance of running correlations. See additional comments on Fig. 3 below.

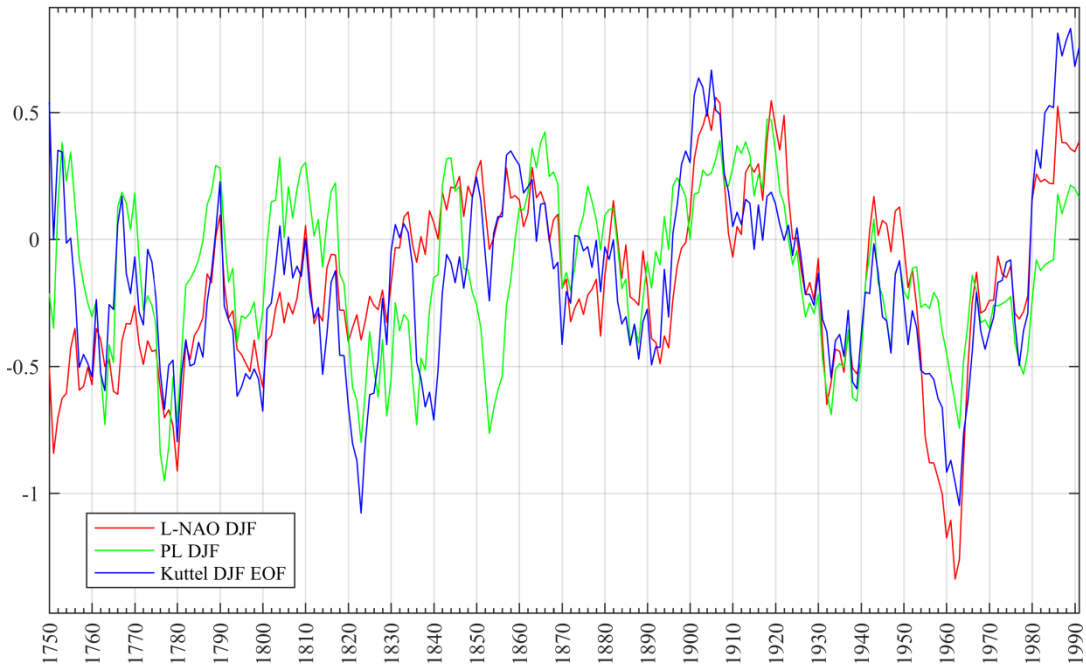
Comparison with independent circulation: The authors might use the independent gridded SLP (and derived NAO-I, first EOF of gridded SLP) reconstruction by Küttel et al. (2010). They cover the past 260 years and are fully independent.

Thank you for this recommendation. The London SLP series, the Paris London Index and the Westerly Index also provide independent insights into SLP and the NAO-I. Given the number of series we already incorporate we examined the Küttel et al. (2010) dataset to determine if it was consistent with the aforementioned series and the extent to which it could add value to the paper (given the series already included). We focus attention on the derived NAO-I (leading EOF of the gridded Küttel et al. SLP data).

Agreement between the leading EOF for each season and the Hurrel PC based NAO-I is very strong for winter and spring (r>0.9), but less so for summer and autumn. This is most likely because the domain used in the Küttel et al. SLP series extends further east (to 50 deg) and includes the Arabian heat low (which will be very prominent in summer/autumn).

Comparison of the winter (DJF) leading EOF shows a strong correlation with other modes of westerly flow already analysed in the paper. The table below shows Spearman's rank correlation matrix from 1760 – 2000 for winter (DJF) IoI rainfall and indices of westerly flow from our manuscript.

	IoI 1711	WI	PL Index	L-NAO	Küttel et al. EOF
IoI_1711	1.00	0.50	0.31	0.46	0.32
WI	0.50	1.00	0.52	0.43	0.56
PL Index	0.31	0.52	1.00	0.52	0.67
L-NAO	0.46	0.43	0.52	1.00	0.71
Küttel et al. EOF	0.32	0.56	0.67	0.71	1.00



Evident is the strong correlation between Küttel et al. and the PL-index and L-NAO index. Comparison of decadal means (standardised to period 1900-1950, as in our manuscript) also shows the strong coherence between the leading winter EOF from Küttel et al. and the PL Index and L-NAO index. We therefore conclude that integrating the Küttel et al. data into the paper adds little value above the series already included. Given the number of series being plotted already we would therefore rather not include it to maintain legibility of the plots. In addition, the other series, including an, independent, homogenised SLP series for London, together with three estimates of westerly flow and the NAO-I, extend further back into the 1700s.

We will however mention in the discussion that this is a source that could have been used or may be useful in other similar work and highlight the consistency with other series as above.

Apart from the NAO, the East Atlantic/Western Russia pattern (Eurasia-2 pattern EU2 (Barnston and Livezey, 1987) is one of the most important modes for western Eurasia and shows also significant correlation with precipitation over Ireland. For instance, the EU2 index measures the pressure difference across central Europe and thus is important in describing the variability of Eurasian climate, especially during wintertime. Therefore the authors might also consider the EU index that has been reconstructed back to AD 1675 (Luterbacher et al. 1999) and calculate the correlation and running correlation.

This is an excellent suggestion. The EU2 index is indeed highly correlated with our 1711 series in all seasons, especially in winter. This is a valuable index to our study and we will integrate it into the paper in our revisions. Specifically this will now be included as one of our independent comparison series and integrated into the assessment of running correlations (Fig 3), the correlations in table 2 and each of the panel plots for the seasonal comparisons. Thanks for bringing this to our attention.

It would also be interesting to compare your new reconstruction with those of Pauling et al. (2006) and Casty et al. (2007). The authors provide 0.5◦x0.5◦ resolved gridded precipitation back to the mid 17th century (Pauling et al. 2006) and 1766 (Casty et al. 2007) including Ireland. The period could be analysed where there is no overlap of predictors. That would be another benchmark test for the various datasets.

Again, an excellent suggestion. We have used the 1766 (Casty et al. 2007) series in previous work exploring historical droughts in Ireland and have found it particularly useful (Noone et al. 2017) However for this study, both in terms of length of record and independence of the early series the seasonal reconstructions by Pauling et al. (2006) are likely to be most useful. Stations in Ireland are used as predictors in this series, however, the earliest Irish precipitation source seems to be Armagh Observatory which extends to the 1830s. Prior to this the Pauling et al. data would provide a useful additional comparison series, though there remain issues of circularity which are impossible to avoid. In particular the Jenkinson data was calibrated to EWR by the original authors, with some of the UK series that comprise Pauling et al., also likely to be used for this purpose. Nonetheless we will include the Pauling et al. data as a series in our plots comparing running decadal totals with other precipitation series (Fig 4- Fig 8).

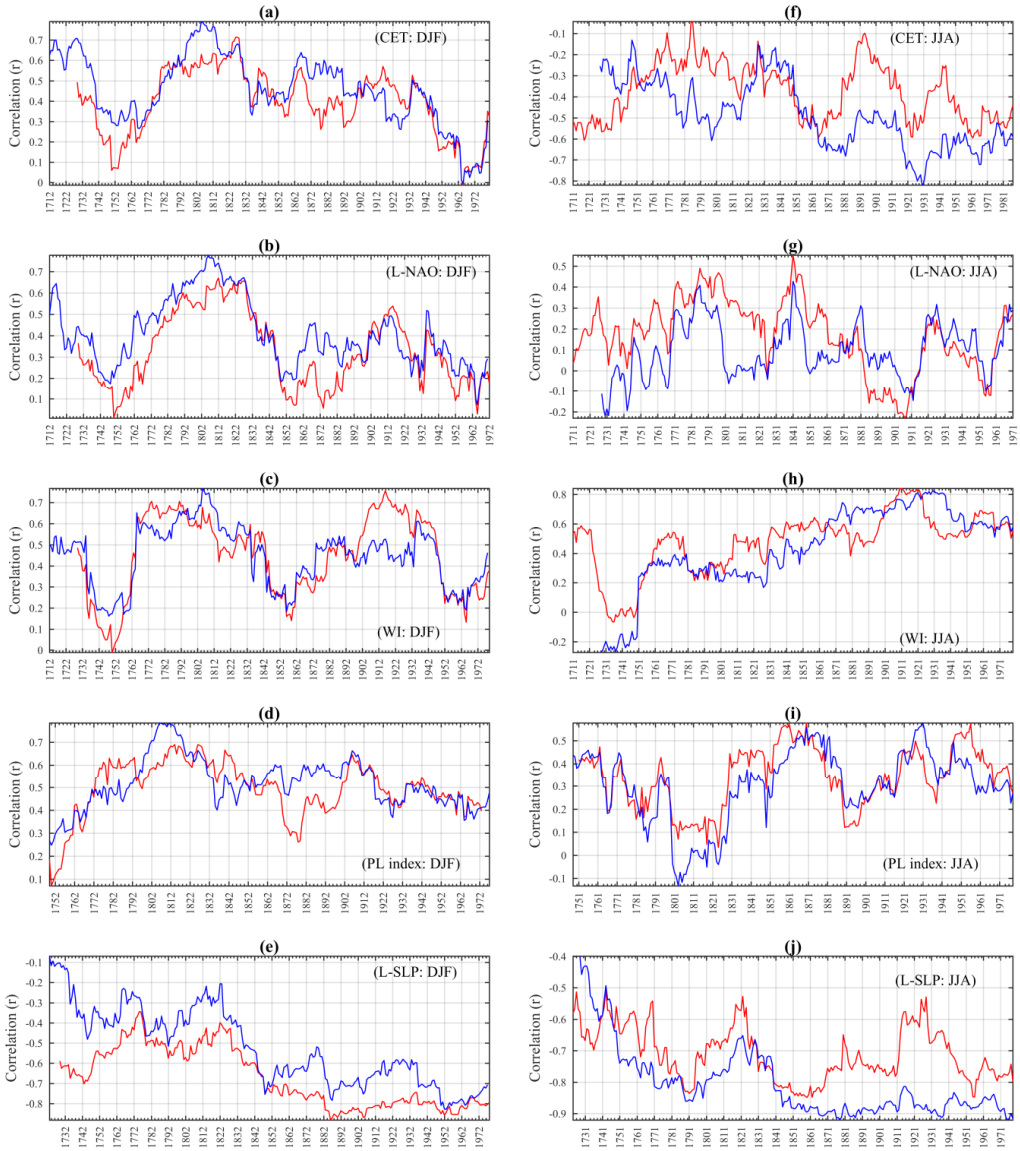
Different studies have shown, that the AMO/AMV are significantly correlated with precipitation/temperature downstream over the UK and Europe. It would be interesting to see whether the positive correlation within the instrumental period is also valid during the

reconstruction period. There is new annual AMO/AMV reconstruction available that could be used (Wang et al. 2017). The data can be downloaded from this link https://www1.ncdc.noaa.gov/pub/data/paleo/reconstructions/wang2017/wang2017amvamo.txt

Thanks for this suggestion. We will examine and explore this as part of our revisions.

It is striking, that the L-SLP is the only index that shows a significant negative correlation. Why is this?

In examining this comment we noticed that the running correlation plot (Fig 3) was wrong in our original manuscript. It repeats each plot for the same series and some other small issues. The correct plot is below, which we will of course update in our revisions (with the addition of the EU2 index). Significant negative correlations are evident between CET and IoI/EWR rainfall in summer and with L-SLP in both seasons. In relation to SLP, this is due to blocking – high SLP over London is associated with dry conditions over the islands. This is as expected. We would also expect the other indices to be positively correlated.



Corrected Fig3 Moving 30-year correlations between IoI_1711 (blue) and EWR/EWP (red) for winter (left) with a) CET; b) L-NAO; c) WI; d) PL index; e) L-SLP and for summer (right) with f) CET; g) L-NAO; h) WI; i) PL index; j) L-SLP.

Decadal interpretations I suggest you also consider the Casty et al. (2007) and Küttel et al. (2011) papers with respect to linkages between the large scale atmospheric circulation and precipitation in Europe back to the mid-18th century.

We will do so in our revised manuscript.

It would help the reader if the seasonal aspects and the comparison with other series could be shortly summarized, that would help the reader keeping the major features from the many numbers. This could be also in the form of a table that synthesis the results.

We will do this through either providing a short recap paragraph at the start of the discussion or a synthesis table in the results section.

Minor comments

Page 6, top: Jenkinson et al. (1979) applied a graded scaling system, similar to Brázdil et al. (2010), to both diaries. In this context, please also cite Gimmi et al. (2007)

We will do so

Please note that Luterbacher et al. 2002 was published in 2001 and the publication date should be changed accordingly.

We will do so

All records were standardised (by mean and standard deviation) to the period 1900-1950 for visual comparison. Could you please specify why this period and if another more recent period would be chosen, if the results would be stable? Why only visually? What is the intention?

We choose this period given the availability of data across all series, together with the good quality of observations from the period. The results do remain valid for different periods for standardisation. We will remove the reference to 'visually', this was included given we are plotting multiple series on the same axis.

Concerning the precipitation conditions in 1816 in Ireland, please have a look at Veale and Endfield (2016) with additional information

Thanks, we will integrate.

Concerning the post precipitation conditions in Ireland after the Laki eruption, please have also a look at Brazdil et al. 2010

Thanks, we will integrate.

Potentially the following paper is of relevance and could be included/cited Evaluating the Dendrochronological Potential of Taxus Baccata (Yew) in southwest Ireland (Galvin et al. 2014)

Thanks, we will integrate.

The authors use Maunder Minimum as a key word but only mention it once. I would thus remove it.

Will remove as a key word.

References in responses

Casty, C., Raible, C.C., Stocker, T.F., Wanner, H., and Luterbacher, J., 2007: European climate pattern variability since 1766, Clim. Dyn., 29, 791-805.

Küttel, M., Xoplaki, E., Gallego, D., Luterbacher, J., Garcia-Herrera R., Allan, R., Barriendos, M., Jones, P.D., Wheeler, D., and Wanner, H., 2010: The importance of ship log data: reconstructing North Atlantic, European and Mediterranean sea level pressure fields back to 1750. Clim. Dyn. 34, 1115–1128.

Noone, S., Broderick, C., Duffy, C., Matthews, T., Wilby, R.L. and Murphy, C.: A 250-year drought catalogue for the island of Ireland (1765–2015), Int. J. Climatol., 37 (Suppl.1), doi: 10.1002/joc.4999, 2017.

Pauling, A., Luterbacher, J., Casty, C., and Wanner, H., 2006: 500 years of gridded high-resolution precipitation reconstructions over Europe and the connection to largescale circulation, Clim. Dyn. 26, 387-405.