

## ***Interactive comment on “The 1816 ‘year without a summer’ in an atmospheric reanalysis” by Philip Brohan et al.***

### **Anonymous Referee #4**

Received and published: 2 September 2016

The manuscript describes the reconstruction of the weather in Europe for summer 1816 based on the well-established 20CR reanalysis system using a very small set of (surface) pressure observations. The result is , according to the authors, able to reproduce the sequence and location of individual weather events with confidence over Europe. Verification of the resulting reanalysis surface temperature with independent station data provides a good correlation. It is shown that better results are obtained when the model includes a radiative forcing that could be representative for the Mount Tombora eruption in 1815.

I would like to congratulate the authors with the exciting result of a likely accurate reconstruction, given the very low amount of synoptic input data. It demonstrates the power of atmospheric reanalysis. I do have some queries though, and I recommend publication of the manuscript subject to a minor revision that addresses this comment.

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General comments: 1) I think the authors should elaborate a bit more on the improvement achieved when including the volcanic forcing, rather than the phrase 'and it is', increased temperature correlations (figure 4) and reduced pressure increments (figure 5).

2) It is implicitly assumed that the model bias in the 20CR reanalysis system plays a minor role. In principle the model could be biased warm. For instance, the imposed SST could be too warm. That by itself could explain a reduced temperature correlation with respect to the unbiased system. And the apparent improvement of adding volcanic forcing to the biased system could actually lead to a deterioration of the 'true' unbiased system. How can the authors rule out such a possibility? What is known about the model error and what is known about the magnitude of the systematic error in the imposed SST and sea-ice products? I would strongly recommend that the authors address this point.

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Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2016-78, 2016.

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