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## ***Interactive comment on “A collection of sub-daily pressure and temperature observations for the early instrumental period with a focus on the “year without a summer” 1816” by Y. Brugnara et al.***

**Anonymous Referee #2**

Received and published: 4 June 2015

The study by Brugnara et al., “A collection of sub-daily pressure and temperature observations for the early instrumental period with a focus on the “year without a summer” 1816”, presents another important step forward in making more (sub-)daily historical data available for the scientific community. Previous studies about the climatic and social impacts caused by the Tambora eruption provided already a broad description using monthly to seasonal mean climatic data combined with some documentary evidence on extreme weather anomalies for Europe. The current study advances our knowledge by providing (sub-)daily pressure and partly temperature data to better analyse weather patterns leading to extreme events in the post eruption phase.

The paper is well written and the methods and steps taken to retrieve the historical data

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are described in a clear way including relevant equations. The analysis of some events presented in this study is still very limited due to a lack of more relevant temperature and precipitation data. Given the importance to make such historical data available, I nevertheless suggest publication in Climate of the Past with minor revisions taking into account very few points below.

## Introduction:

Page 1745, line 28f.: Please mention here also the initiative at ECMWF for ERA-20C (e.g. Poli et al., 2013) for 1901-2010.

Page 1746, line 13: Please refer here to the original source of the used data as well and not only to the secondary reference, sth. like “based on the monthly reconstruction by Casty et al. (2005, 2007)... xy shows...” (e.g. Luterbacher and Pfister, 2015). In the later part of the paper: To which extent are your results comparable/different to the previous monthly reconstruction, used pressure data and analysis by Casty et al. (2005, 2007) or Luterbacher and Pfister (2015)?

## Methods:

Page 1756, line 14ff.: I don't really agree that using a temperature climatology from 20th century reanalysis starting from 1871 is a good idea. 20CR does not assimilate any land temperatures and there is also a low coverage of assimilated SSTs in the early period. The problem is not severe here as it got only applied to few stations and the statistical correction in the final step might overcome some problems. It would be fair however to mention the potentially large uncertainty of the climatology due to the above mentioned points. Independent from using 20CR, I'm in general not sure if using such a climatology is a good idea (i.e. for continental climates and/or high altitudes). See also next point.

Page 1759, Eq (8): Using a long-term climatologic mean for daily temperatures can easily lead to  $> \pm 10\text{--}15\text{ K}$  deviations relative to the unknown daily temperature. Are you

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sure that simply using the standard lapse rate  $a$  in Eq. (8) might not be more accurate on daily basis for unknown temperatures? In both cases, large errors ( $> 5$  hPa) are easily possible for stations at high elevations (also the 20CR climatology based on a coarse grid will usually not capture the topography/elevation and a reasonable  $T_s$  here).

Page 1760, line 3: That there are no to little flags for stations at high elevation is surprising given the concerns above and my own experience to calculate their  $P_0$ . Table 1 indicates that with exception of Madrid the records from high altitudes were already corrected in previous studies. Nevertheless, did you evaluate them here again and if so, what were e.g. the neighbours for stations  $> 400$  m for estimating the differences with nearby stations and which standard errors are there for different seasons? Using Eq. (8), one degree difference for  $T_s$  leads already to an error of around 0.36 hPa for Hohenpeissenberg or 0.25 hPa for Madrid etc. when estimating  $P_0$ . Temperature uncertainties of e.g. 10 K would lead already to 3.6 and 2.5 hPa deviation in  $P_0$ . What was the specific problem with Madrid?

Results:

Page 1762, line 12: Why not use MERRA here like in section 3.3.1 instead of 20CR?

Page 1763, line 1+3: should be Fig. 7 in both cases.

Page 1763, line 5: Would remove or explain “surprisingly” here e.g. with respect to Fig. 5.

Page 1764, line 24f.: Add sth. like “...according to Eq. (8)...” and “... about 2.5 hPa at low altitude and less for higher station elevations”

Page 1767, line 17f.: A brief qualitative comparison of your reconstruction with the maps for July 1816 shown in Luterbacher and Pfister (2015) based on the Casty et al. data would be nice here.

Conclusion:



Page 1772, line 6: Although the focus is clearly on retrieving the historical data, I would suggest to add some concluding sentences here how your results/examples agree and advance earlier studies mentioned in the introduction/literature about the climatic features following Tambora.

CPD

11, C526–C530, 2015

#### Figures:

Figure 1: Although mentioned in the figure caption, a colour bar for the time would be helpful given the long time span.

Figure 4: The anomalies relative to 1801-1830 are difficult to understand from today's perspective. It would be helpful for the reader to indicate also the deviation from more recent temperatures in addition (or mention the difference of the historical mean from the recent climatologic mean somewhere in the text).

Figure 5: Lon and Lat info is much too small.

Figure 6: Numbers of the colour bar are too small. Lon and lat info might be helpful for the maps. Please use an increment of 0.5 hPa for isolines in 6a to be consistent with increments in b and c.

Figure 9+10, 12+13: The colour differences are hard to see for 5 hPa intervals. A less continuous colour bar could be useful here if possible.

#### References:

Paul Poli, Hans Hersbach, David Tan, Dick Dee, Jean-Noël Thépaut, Adrian Simmons, Carole Peubey, Patrick Laloyaux, Takuya Komori, Paul Berrisford, Rossana Dragani, Yannick Trémolet, Elias Håñlm, Massimo Bonavita, Lars Isaksen and Mike Fisher (2013): The data assimilation system and initial performance evaluation of the ECMWF pilot reanalysis of the 20th-century assimilating surface observations only (ERA-20C). ERA Report Series No. 14, available over [http://old.ecmwf.int/publications/library/ecpublications/\\_pdf/era/era\\_report\\_series/RS\\_14.pdf](http://old.ecmwf.int/publications/library/ecpublications/_pdf/era/era_report_series/RS_14.pdf)

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Casty, C, Handorf, D. and M. Sempf (2005): Combined winter climate regimes over the North Atlantic/European sector 1766–2000. *GRL*, 32, <http://onlinelibrary.wiley.com/doi/10.1029/2005GL022431/full>

Casty, C., Raible, C. C., Stocker, T.F., Wanner, H and J. Luterbacher (2007): A European pattern climatology 1766–2000. *Clim Dyn*, 29, 791–05. <http://link.springer.com/article/10.1007%2Fs00382-007-0257-6>

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Interactive comment on *Clim. Past Discuss.*, 11, 1741, 2015.

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