Response to Referee 2

We thank R2 for this helpful review. Enclosed please find a detailed explanation of the revisions we made based on R2's comments. For convenience, comments are in bold and our responses are in italic. Revisions made in the manuscript are presented in italic with grey background..

Review report for manuscript "The method ADAMONT v1.0 for statistical adjustment of climate projections applicable to energy balance land surface models" by Verfaillie et al. (2017) This study introduces the method ADAMONT v1.0 to adjust and disaggregate daily climate projections from a regional climate model against an observational dataset at hourly time resolution. The method makes use of a refined quantile mapping approach for statistical adjustment and an analogous method for sub-daily disaggregation. The method is capable of producing adjusted hourly time series of temperature, precipitation, wind speed, humidity, and short- and longwave radiation, which can in turn be used to drive any energy balance land surface model (e.g. a fully distributed energy and water balance hydrologic model). The observational dataset used here is the SAFRAN meteorological reanalysis, which covers the entire French Alps split into 23 massifs, within which meteorological conditions are provided for several 300 m elevation bands. In order to evaluate the skills of the method itself, it is applied to the ALADIN-Climate v5 RCM using the ERA-Interim reanalysis as boundary conditions, for the time period from 1980 to 2010. The authors find the disaggregation method to preserve inter-variable dependency structures although it performed well for temperature compared to precipitation. The manuscript is well organized and the analyses methods are well thought out, except a few points. Please find below a few comments which could help you to improve your manuscript on the way to publication.

We thank the reviewer for this review, please see our specific responses to each point below.

Major comment: Line 1 – 64: The authors introduce the need for bias-correction of RCM outputs but completely fail to address the many flaws of bias-adjustment which have been well detailed in Ehret at al 2012: "Should we apply bias correction to global and regional climate model data?" Most impact studies are now utilizing convection permitting models at <4km resolution to overcome some of these limitations. Also, the authors have to specifically state that the results of the quantile mapping are sensitive to data sets used and adjustment method as well. Thus, there is a wide array of uncertainties associated with these kinds of studies.

The reviewer is correct that bias-correction is not a perfect solution, but it is still a necessary step when using regional climate model data for impact studies (Maraun 2016), be it convection permitting or not. In addition, while a few studies have recently emerged using non-hydrostatic high-resolution model approaches targeting summertime processes such as convection-driven events (e.g. Ban et al., 2015, Giorgi et al., 2016, https://www.hymex.org/cordexfps-convection/wiki/doku.php?id=modellist), in some areas impact studies have only marginally employed such models and most existing studies extensively rely on 10-km resolution regional climate models such as those employed in EURO-CORDEX. For example, studies addressing snow in mountainous areas have only in a few cases employed high resolution non-hydrostastic models (e.g. Musselmann et al., 2017), mostly for upstream research and process studies rather than for impact studies, which require very low biases because of the threshold effects at play in snowpack processes. We therefore believe that, even though future studies will increasingly

employ high resolution convection permitting regional climate models, many impact studies will be carried out using hydrostatic models as part of large-scale projects such as EURO-CORDEX and beyond. Furthermore, as indicated above, convection-permitting models are not immune of biases (Prein et al., 2015) and will require appropriate adjustment for being used in impact assessments.
Concerning the sensitivity of quantile mapping to the data sets used and adjustment method, we have now added the following sentence to account for this (Line 64-66) : « Furthermore, the performance level of quantile mapping methods is sensitive to the observation data set used and the detailed characteristics of their implementation, which requires specific attention. »

Ban, N., J. Schmidli and C. Schär, 2015: Heavy precipitation in a changing climate: Does short-term summer precipitation increase faster?. Geophys. Res. Lett., 42, 1165-1172.

Giorgi F., C. Torma, E. Coppola, N. Ban, C. Schär and S. Somot, 2016: Enhanced summer convective rainfall at Alpine high elevations in response to climate warming, Nature Geoscience, 9, 584-590.

Musselman, K.N, M.P. Clark, C. Liu, K. Ikeda, and R. Rasmussen, 2017: Slower snowmelt in a warmer world, Nature Climate Change, 7, 214-219.

Prein, A.F., W. Langhans, G. Fosser, A. Ferrone, N. Ban, K. Goergen, M. Keller, M. Tölle, O. Gutjahr, F. Feser, E. Brisson, S. Kollet, J. Schmidli, N.P.M. van Lipzig, and R. Leung, 2015: A review on regional convection-permitting climate modeling: Demonstrations, prospects, and challenges, Rev. Geophys., 53, 323-361.

Minor Comments:

Abstract: I could not tell for which RCP(s) the adjustment was made just by reading the abstract. Please make the abstract a standalone section.

No RCP was used. In this article, we only focus on the evaluation for the recent period 1980-2010, as indicated in the abstract (Line 11-13) : « In order to evaluate the skills of the method itself, it is applied to the ALADIN-Climate v5 RCM using the ERA-Interim reanalysis as boundary conditions, for the time period from 1980 to 2010. »

What is "ADAMONT"?

ADAMONT is the name of one of the projects which funded this study. There is no meaningful definition beyond this name.

Line 145 – 160: what do you mean by integration? Just use something like "aggregation" for easy understanding. Tmax/Tmin is taken from 6am to 6am? This is not clear at all. When did you take the max and min specifically?

We thank R2 for this remark.
We changed the word « integration » to « aggregation » and « integrated » to « aggregated » (Line 155 and caption of Table 1). Maximum and minimum values are calculated from 6 am to 6 am, and only for temperature. For other variables, the daily mean (from 6 am to 6 am, this information has now been included) or the last value of each day is used.
We have slightly changed this paragraph to make it clearer (Line 156-161) : « for temperature, the daily minimum and maximum values (from 6:00 UTC to 6:00 UTC the next day) are selected (RCMs generally offer daily minimum and maximum temperature). For wind speed and humidity, the last value of each day (at 6:00 UTC) is selected (in order to be comparable to an instantaneous value), and for precipitation and radiation, the daily mean (6:00 UTC to 6:00 UTC) is used. »

Line 335: The authors should clearly state that the RMSE and mean bias were used to evaluate model performance in terms of reproducing amounts while FAR, POD etc. for occurrence.

OK, even though we don't evaluate model performances, but rather the performances of the ADAMONT method.
This is now stated (Line 359-362) : « – the root mean square error (RMSE) and the mean bias over the evaluation period, computed over seasonal integration periods based on the SAFRAN and the adjusted RCM datasets (to evaluate the method performance in terms of reproducing amounts);
– scores specific to the detection of occurrence of precipitation events (...) »