Interactive comment on "Seasonal predictions of agro-meteorological drought indicators for the Limpopo basin" by F. Wetterhall et al.

Anonymous Referee #1
Received and published: 17 March 2014

General comments
This manuscript investigates the potential of seasonal forecasts of rainfall indices relevant for agriculture in the Limpopo catchment in Southern Africa. It is generally well written, with some exceptions for some sections which would require clarification (cf. specific comments below). The topic is of particular interest and the manuscript shows the interest of doing seasonal forecasts for such latitudes. In order to make it even more convincing, it would have been good to translate skill score results into indices directly usable by decision-makers or stakeholders. Following the discussion part of the paper (Section 4.2), and without going as far as monetization, it would be interesting to have results in terms of hits, false alarms et al. for relevant thresholds taken for example from the literature already referenced in Section 1 of the manuscript (e.g., Baron et al., 2003; Nyakudya and Stroosnijder, 2011).

We thank the reviewer for the comments. The detailed comments are answered below.

We agree that it would be very useful to be able to convert the forecast into something which is very useful in terms of indices, in this paper we are using short dry periods as an indicator of droughts rather than the raw precipitation. In order to fully take this last step we would need to have detailed information on the last chain in decision making progress, i e information from farmers and agricultural planners exactly what is needed. Within the DEWFORA project there has been case studies to show that, for example as described in the paper by Mwangi et al., 2013 where detailed drought forecasts were produced using ECMWF's seasonal forecasts. This paper has more the form of a proof-of-concept showing he use of bias-correction when dealing with precipitation forecasts. We will however in the revised paper add scores based on a contingency table with a theoretical threshold to further show the quality if the forecasts for the different aggregations.

Specific comments
1. P865 L2-4: This statement is unclear.

This has been rephrased to "It has to be noted that probabilistic seasonal forecast systems have significantly more skill than deterministic forecasts (Molteni et al., 2011).

2. P869 L3-6: The description of the quantile mapping approach is incomplete and/or unclear: For example, I don't understand why considering steps in mm when looking at quantiles? Moreover, the last sentence is quite unclear.

The description of the quantile mapping was substantially expanded and clarified and put into a new section. The text on quantiles is not correct, it should read that the increment step in the quantile matching is 0.02, ranging from 0 to 1.

3. P869 L7-13: This paragraph is also not quite clear to me (probably as a consequence of the previous comment).

This section was rewritten and clarified.

4. Table 1: I'm confused here about several things: (1) what is the exact relation between number of dry spell and the frequency of dry spells? Please specify what is your variable of interest and stick to it throughout the paper.

Dry spells were defined as a sequence of days (minimum 3 days) where rainfall is below a certain threshold (see the red bars in Fig. 3). Number of dry spells and frequency of dry spells is interchangeable, and we will stick to frequency of dry spells throughout the paper.

(2) What are the numbers in this table? Are they the median values of the forecasts averaged over all locations? Why not using (as well) the CRPSS values, given that you mentioned earlier that you will use this performance score?

Yes, this shows the average frequency of dry spells over the entire region (all points, and all ensembles for the forecasts). The length of dryspells are not correctly depicted in the table, the numbers have been wrongly averaged. The table was corrected and now shows anomalies in percent from the observed values as well as complemented with CRPSS as well.

5. Figure 5: Again I'm confused here by what is exactly the spread shown here. How do you define a spread for CRPSS? Is it a confidence interval from a bootstrap resampling (looks like very wide if yes)? Or is it a spatial spread? Please make it clearer. A similar comment applies to Figure 6.

The spread shown is indeed a spatial spread over all points and all years in the area. This was made clearer in both figures

6. Could you comment on the possible specificities of the hindcast period considered here (1981-2010)? Is it representative of a longer historical period?

We understand the question as to mean whether the climate over the period was wetter or drier than normal? Since we have very little other data we can only but speculate on the effects of the long-term climate on the results. We are hesitant to do this, but added a comment in the paper regarding this.

Technical corrections

1. P863 L9: "vulnerability rainfall variability"?

Corrected to "vulnerability due to rainfall variability"

2. P864 L10-12: Please briefly define and give a reference for readers not familiar with this index

To give a full explanation of Nino 3.4 would not be possible within this paper, but a reference to Trenberth (1997) was added.

3. Fig. 1, legend: Please add the definition and reference for IGBP

Reference and definition was added.

4. Fig. 2, legend: “from from”

Corrected

5. Fig. 2, legend: SYS4 has not been defined yet

Definition was added before the first occurrence

6. P867 L7: The reference is actually Balsamo et al. (2010)

Reference was corrected

7. P867 L17: Please add a reference for SAFRAN, e.g. Vidal et al. (2010)

Reference added

8. P868 L12: Please define and give a reference for ORCA1

Reference added

9. P869 L1: the quantile mapping approach has not been used in Maraun et al. (2010), as this is a review paper; Please rephrase.

The reference to Maraun et al was deleted

10. P869 L21-22: “assume” “assumed”, please rephrase

Changed to “Let us assume that the predictability of the occurrence of dry spells and dry spell length are dependent on the following factors:”

11. P869 L22&23: please remove “Eq.”

Eq removed

12. P871 L6: I believe N = 30 here (number of years). Am I right?

N incorporates both the number of years and grid points. This was changed to denote years and grid points explicitly

13. P871 L13: Please recall that 15 is also the size of the hindcast ensemble.

Yes, that is why it was chosen. Was added to the text

14. Section 3.1 & 3.2: Specify the (non) area filtering

The area filtering was described in Section2.4 but since the area filtering did not have any effect on the results, Figure 5 will be removed and will instead show ROC scores calculated from the contingency table.

15. Table 1: please repeat the observed value across columns

We do not agree with this point, since it should be an unnecessary repetition of identical values

16. Figure 5, y axis: "length of dry season"? "longest dry spell". Please be consistent over the paper. More generally, if what is shown here is the CRPSS, it should appear as such on the y-axis.

The figure was corrected to state "longest dry spell"and CRPSS was added to the y axis

17. P873 L4-5: Please rephrase.

The text was rephrased to "The forecasts has the lowest skill over area 4, which also is the area least sensitive to droughts, but after the bias correction the skill scores are comparable to the other areas."

References

Balsamo, G., Boussetta, S., Lopez, P., Ferranti, L. (2010) Evaluation of ERAInterim and ERA-Interim-GPCP-rescaled precipitation over the U.S.A. ERA Report Series, 5, pp10

Barron, J., Rockström, J., Gichuki, F., Hatibu, N. (2003) Dry spell analysis and maize yields for two semi-arid locations in east Africa. Agricultural and Forest Meteorology, 117, 23-37, doi:10.1016/S0168-1923(03)00037-6, 2003

Huffman G. J., Adler, R. F., Bolvin, D. T., Gu, G. (2009), Improving the global precipitation record: GPCP Version 2.1, Geophysical Research Letters, 36, L17808, doi:10.1029/2009GL040000

Maraun, D., Wetterhall, F., Ireson, A. M., Chandler, R. E., Kendon, E. J., Widmann, M., Brienen, S., Rust, H. W., Sauter, T., Themessl, M., Venema, V. K. C., Chun, K. P., Goodess, C. M., Jones, R. G., Onof, C., Vrac, M., Thiele-Eich, I. (2010) Precipitation downscaling under climate change. Recent developments to bridge the gap between dynamical models and the end user. Reviews of Geophysics, 48, RG3003. doi: 10.1029/2009RG000314

Nyakudya, I. W., Stroosnijder, L. (2011) Water management options based on rainfall analysis for rainfed maize (Zea mays L.) production in Rushinga district, Zimbabwe, Agricultural Water Management, 98, 1649-1659. doi:10.1016/j.agwat.2011.06.002

Vidal, J.-P., Martin, E., Franchistéguy, L., Baillon, M., Soubeyroux, J.-M. (2010) A 50-year high-resolution atmospheric reanalysis over France with the Safran system. International Journal of Climatology, 2010, 30, 1627–1644. doi: 10.1002/joc.2003

References

Mwangi, E., Wetterhall, F., Dutra, E., Di Giuseppe F. and Pappenberger, F., (2014), Forecasting droughts in East Africa, Hydrology and Earth System Sciences, doi:10.5194/hess-18-611-2014, 18, 611-620

Trenberth, K. E. (1997) The Definition of El Niño. Bulletin of the American Meteorological Society, 78, 2771-2777" was added.