

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC1  
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## Comment on nhess-2021-223

Anonymous Referee #1

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Referee comment on "Forecasting vegetation condition with a Bayesian auto-regressive distributed lags (BARDL) model" by Edward E. Salakpi et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-223-RC1>, 2021

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### General comments

The paper presents a study aiming at forecasting vegetation conditions in arid and semi-arid environments, with up to 10 weeks lead-time in order to improve the management of droughts and anticipate their socio-economic impacts. The study uses different satellite product (NDVI, rainfall and soil moisture) to build statistical models for the forecasting of the vegetation index. The study builds on a previous paper by the same team (Barrett et al., Remote Sensing of Environment, 2020, <https://doi.org/10.1016/j.rse.2020.111886>), that used vegetation indices only and extends it using rainfall and soil moisture remote sensing data. Furthermore, the study uses a Bayesian framework for parameter estimation, that allows the determination of uncertainty on the forecast.

The paper is well written and well structured and the results are analyzed comprehensively. The conclusions appear well founded and show that the proposed methodology provides significant improvement as compared to Barrett et al. (2020), in particular in terms of lead time. Some elements in the paper could however be improved: results are compared to a benchmark model that should be better described. Some hypotheses of the work could lead to uncertainties in the results and should be discussed (use of one image in 2016 to identify grassland and shrublands, gap filling of data). Some details about methods for non-specialists of machine-learning techniques and on how figures were built are sometimes missing, precluding the good understanding of their meaning. Provided the authors address these minor comments, the paper will be suitable for publication in Natural Hazard and Earth System Sciences.

## **Specific comments**

1/ P.2 lines 62-63: revise the sentence that is not correct.

2/ p. 5, line 91: you use sentinel 2 data from year 2016 to identify grasslands and shrublands pixels, but are you sure that this image is representative of the whole 2001-2018 study period? It is likely that land use changes over a 18 year period, so what would be the impact of errors on the grassland and shrubland pixels on the forecasting results?

3/ p.5 line 100-101: could you elaborate more about the gap filling method: how does it work and how the gap filling could impact the results of the forecasting model? What is the percentage of gap-filled data?

4/ p.7 lines 122-123: could you elaborated a little more on the method used to assess the forecast probability distribution?

5/ p. 8 line 154: incomplete sentence?

6/ p.9 line 171-172. In order to assess the validity and robustness of a forecasting model, it is recommended to use different data for model calibration and evaluation. Could you explain more in details how you proceed with the model evaluation and if the data used for the evaluation are independent from the ones used to calibrate it.

7/ p.9 lines 183: a figure explaining the computation of MPIW and PICP could be useful.

8/ p.9 lines 192-194: Could the authors provide more details about the AR benchmark model. I understood that it was built using only the vegetation index, but was a Bayesian framework also used for parameter estimation? If not, could the performance of the AR model be improved if a Bayesian framework was used for parameter estimation?

9/ p.10 lines 203-205: for non-specialists (possibly in appendix or supplementary materials) explain how the Reliability diagram and Sharpness are built.

10/ p.11 Fig. 3: explain in the figure caption how the figure is built: what are the ellipses on the figures?

11/ p.15 Fig 6: what is AUC in the caption and on the figures? The lines for the two models have the same colors and types. It is not easy to understand which curve is related to what? Could you also explain how this curve was built?

12/ p.16 Fig. 7: same remark as for Fig. 6: explain how the figures are built and what is the information they carry out.

12/ p.16 Lines 253-256: I do not understand these explanations.

13/ p. 17 lines 274-276: the result mentioned here was not shown before. It can be seen in the appendix but this should be mentioned.

14/ p.18 line 280: figure ?? – please modify.

15/ p.17-18: a discussion of the limitations and impact of the gap filling and choice of the 2016 Sentinel 2 image to identify grassland and shrubland should be added.

16/ Fig B1: Explain what is shown in these figures. They are not understandable with the current caption.