

Clim. Past Discuss., referee comment RC2
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Comment on cp-2021-159

Neil Macdonald (Referee)

Referee comment on "Changes in paleo-underground water levels revealed by water wells and their relationship with climate variations in imperial China" by Chenyao Jiang et al., Clim. Past Discuss., <https://doi.org/10.5194/cp-2021-159-RC2>, 2021

The use of wells as a proxy for groundwater availability and therefore as a climate indicator is novel and therefore I was excited to review this paper.

The use of well bottom depth is to my knowledge an innovative and interesting approach to detailing past water levels, however they require critical assessment, considering a number of factors, such as do the well bottoms reflect original construction depths, or might they have been excavated several times, as required when water levels dropped further, it also requires an assumption that the recharge in the well was consistent through time and then this was sufficient to meet supply, if demand changes (i.e. population growth) then it may have been necessary to increase the depth. I also expected some discussion of the local hydrogeology at the sites of study to determine whether conditions were similar or comparable, discussion of lag from precipitation to groundwater level and sensitivity to droughts, possibly using contemporary evidence. Unfortunately none of this was sufficiently explained, as such the principles of using wells as a water table proxy are assumed and not evidenced, as this is a 'novel' approach this is a fundamental requirement. You need to convince the reader, therefore much greater explanation and justification is required for each of the sites studied.

I was interested to see how the wells would be dated, however I am still uncertain, whether these are assigned to dynasties or dated with geo-chronological approaches, I suspect the former, if so this presents challenges in understanding the figures presented. Fig 2 presents the depth and ages of the wells, dynasties across the top, calendar years across the bottom. Therefore I assume that the order that the wells are presented in is meaningful, and that some dating is undertaken? How was this achieved, you must explain this. Similarly the use of dynasties of varying length is challenging when comparing across time, as some long dynasties appear to have trends within these periods e.g. Chengdu – Tang period with increasing depth to the wells towards the end of the period, as such presenting this with a single point is unhelpful.

Greater explanation of the methods used to date and organise the wells and potential

uncertainties in ages needs to be discussed. You need to discuss the local hydrogeological conditions in more detail, what is the lag time to drawdown/recharge of the well. You discuss historical events, but these are of limited meaning without basic site information.

You include some short or patchy series, remove these from your discussion they offer little e.g. Ezhou. You present little discussion of data/well densities, this has important implications, as new wells impact on older wells if in similar areas, drawing down local water levels. This is needed so that the reader can understand your approaches to data quality in a novel approach such as this.

I found your attempt to group the sites together disconcerting, why would Chengdu and Changsha respond or record similar trends, they are >750km away from each other and potentially driven by different climatic processes, in different hydrogeological regions? They certainly have different precipitation patterns (average precip. of ~850mma-1 at Chengdu, ~1800 at Changsha mma-1). It was unclear to me why you attempted to create artificial regions (coastal, inland and transitional).

I found that much of the discussion was unfounded and focused on attempting to assign attribution to 'trends' or 'patterns' in the data that simply were not clearly evidenced. These were not statistically or robustly presented, nor justified. I actually felt that this was beyond the scope of the paper, you need to convince the reader first of the robustness of your approach, that should be the focus of the paper.

Overall I was disappointed, I believe you fail to demonstrate and justify the use of wells as a tool for understanding past climates, however I still believe there is considerable potential here, therefore the attempt to assign attribution to these changes is unsupported. The idea is novel but is not discussed sufficiently to demonstrate with confidence that it could result in meaningful data, nor could the reader based on this paper replicate your study within another region.

An annotated copy of the manuscript is attached.

Please also note the supplement to this comment:
<https://cp.copernicus.org/preprints/cp-2021-159/cp-2021-159-RC2-supplement.pdf>