What controls fire size in the South American Gran Chaco? Exploring atmospheric, landscape, and anthropogenic drivers.

Research article is tackling an important question regarding the controls of fire size (burned area) in the two different parts (xeric and mesic) of the Gran Chaco. It is an important subject, focusing on a special and diverse region and ecosystem. In methodology, researchers use different approaches throughout their analyses, and the article is well written. However, the connection between the fires in the Gran Chaco, their impact, and the underlying human-ecosystem dynamics is poorly established. I recommend the acceptance of the manuscript following the below revisions.

major revision.

General comments:

Since fire, especially in complex ecosystems such as the Chaco, is a product of vegetation composition, and since the authors specified landscape as one of their focus areas, I expected to see more on the vegetation type in the region (not a general grouping of herbaceous, shrubland, etc, but taxa that have a fire history and/or adaptation, and how they differ between the different parts of the Gran Chaco), the interplay between vegetation/topography/fire. However, the article centers its focus on meteorological conditions leaving the human and landscape elements to the side. This, I find is quiet unfortunate and also a lost opportunity studying the fire behavior in this truly magnificent landscape from different perspectives. At this stage the title falls short of meeting the expectations. Also, the area being very special and diverse, a short history of the past human/landscape interactions resonating in its current architecture would be informative to the reader who is not familiar with the region (especially if human use of fire and how anthropogenic ignitions over time may have changed), and would fulfill the expectations raised by the title. However, the authors have meticulously attempted to resolve the meteorological parameters.

The use of FireCCI51 is unfortunate, and I urge the authors to make the absolutely necessary comparison with its updated version FireCCI511. Please see line specific comments below on this. Also, the statistical methods used should take into consideration the underlying assumptions and should be reconsidered/changed where the criteria do not meet the requirements.

The scale considered for megafires should be revisited, explained (as to why ~10,000ha is selected as opposed to a larger number (i.e. 40,000+ constituting a megafire) as different agencies have different definitions of what is a “megafire”. And also, an overall assessment of the impact of these fires is missing, and would be beneficial.

We already know from previous published research that fire severity and burned area are influenced by present meteorological conditions, climate variability (anomalies in wet/dry periods), fuel build up, wildland-urban-interface etc. However, in the analyses where I find lengthy analyses of meteorological conditions, i.e. the human influence is either weakly suggested or overall missing. Again, the researchers may wish to change the title and modify the abstract. Leaving out the anthropogenic element in such a region with such pronounced (and changing human impact) would be unfortunate however, and would certainly negatively affect the novelty of the research. Considering the largest driver of deforestation problem in the

region is anthropogenic, and there is a clear human impact on the fires in the Chaco, I expect a better-established discussion and analyses of the human drivers. In section 4.5, a weak reference to the human element is suggested but this falls short of a literature review. Also, the only reference to indigenous fire practices (or agriculture for that matter) is in the introduction, and the authors seem to have left it at that, and that is rather unfortunate. Additionally, and similarly, the landscape/vegetation connection is also very brief and weak. Again, may be a change in the title, with removal of these suggestions and a stronger connection to climate variability and anomalous fuel build up would better guide the reader and keep the expectations in check.

Finally, presentation of the results needs more structuring and if the authors wish to continue with the meteorology-vegetation-human narrative, then more detail on the later two drivers. Currently, the manuscript reads as a detailed analyses of the meteorological conditions, with a very generalized brush through the other two potential drivers. The authors train RF models, and even the results put land cover and vegetation in higher priority than wind and precipitation. I strongly suggest this to be taken into consideration.

In section **4.6** the authors list this under limitations, but if so, the study design should have been changed (along with the title). However the authors have not fully made use of the datasets which they have access to, to analyze the crossovers between wildfire and human presence.

Specific/detailed comments are listed below.

Line specific notes/corrections:

70 indigenous (not capitalized)

73 "…landscape context to assess how fire size responds to both short-term anomalies and long-term…" meteorogical extremes? Climate anomalies? Or something else?

76 FireCCI51 is an older version, now deprecated. There is now FireCCI511cds available from Copernicus Data Store (cds). I recommend you consider using the updated version, or compare both versions to see if there are important differences between the datasets for your study area: Fire burned area from 2001 to present derived from satellite observations. I understand you use FRYv2.0 which incorporates the older version. But still, it would be more sensible to incorporate the updated dataset, especially if there are important spatio-temporal differences, or compare both datasets to see if there are discrepancies which may affect your final results:

During July 2020, an error in some files in the version v5.1cds were identified, affecting the files of the grid product of January 2018, and the pixel and grid products of October, November and December 2019. These errors were fixed, and a new version, v5.1.1cds, was created for the whole time series, to replace version v5.1cds. The latter product has been deprecated, but it is temporally kept in the database for transparency and traceability reasons. Only version v5.1.1cds should be used.

193 *Also see abstract*: your reference to mega and giga-fires: it would be best if you were more explicit as to by which definition you are considering a 100+ km2 fire (which under the 40,000 ha min. for a megafire is a only large fire at ~10,000 ha) a megafire. These specifications are important as different agencies may use different scales.

226 What constitutes “very” small/large? Again, I prefer the scale is referenced properly. Alternatively, you may say smaller or larger events, since you are already giving a spatial window of 1-100 km2.

Fig 3. The x-axis legends are barely readable. Also, a clear peak can be seen in year 2020, I expect to read up about what happened on that year. And why the ignitions show a downward trend between 2003-2019, then a peak at 2020. A change in policies?

373 So the peak in 2021 is explained here by fire-weather anomalies (which I still have not seen, a show of FWI95 would be nice) but is that all? Considering roughly >80% of wildfires on a global scale originate from human ignitions, tying an anomalous year to only fire weather skips on the larger part of the narrative, the anthropogenic influence in the region.

398-399 You are using Pearson correlation here, the prerequisite for which is normal distribution, however you previously mentioned that BA is skewed, suggesting a Poisson distribution.

413 I don’t know what you mean by FWI “anomaly” (whether it is in the climatic sense, the difference from a long term mean) but why not consider FWI95, the extremes? This is often a better indicator of how FWI shapes up overtime. In either case it would be helpful if you explained what constitutes an anomaly in your analysis.

537 You have trained RF models which prioritize vegetation and topography but in your results you prioritize meteorological factors, which do not offer much novelty (there are already several studies which show FWI peaks and BA relationships, wind and BA and severity). The teleconnections are barely touched upon with no real analyses of the climatic changes in the region (is dry Chaco drying faster than before? Is wet Chaco experiencing drought episodes?). I strongly suggest you build your case (and discuss it) more strongly than you already are. If you wish to build a case around fire meteorology, then I strongly suggest you raise expectations to that effect (in the title, abstract and the main text).

620 I’m yet to see a sign of a digital elevation model showing me the different parts of the terrain. Also, since you mention you used SRTM 1km, you could have layered it in your map plots so the reader could acquaint themselves with the terrain, the BA frequency, etc. In this section you generalize the role of vegetation in fire spread in a couple of lines thrown in with landscape. Whereas your title sets the tone as if this section should discuss one of the three drivers you specify, it is short and over generalized. Were there any refugia in your terrain, created by ie. Changes in vegetation patterns, topography, soil, climate? Do pyro catchments dominate. If so have you identified any and why do those spots burn more frequently (or less frequently) and is this pattern changing, etc etc.