Table of responses (in **bold**) to the Editor and Referees regarding "**The fastest growing and most destructive fires in the U.S. (2001-2020)**" - Article adk5737

#	Editor/Referee comment	Response
Editor Manuscript Edits		
1	OVERALL: "I have not made substantive changes to the main text, in anticipation of revisions that you will make in response to the comments of the referees or to shorten the manuscript. Further changes can be made later, if necessary."	**Thank you for your time in reviewing this manuscript. We have substantially revised and shortened the discussion based on your and the reviewer comments. We have also addressed the minor edits you have requested and look forward to addressing any main text revisions that you may have for this revised submission. The main text is less than 3500 words.**
2	'table' should be 'Table' in all places	**We have made this fix throughout the manuscript.**
3	Line 258, co-occurrence needs the second 'r'	**We have made this fix in the manuscript.**
4	Citation 26 needs space between) and 'cycle'	**We have made this fix for the Pyne citation (#27) in the manuscript.**
5	Line 522: Replace: "is" with "are"	**We have made this fix in the manuscript.**
6	Line 525: This source must be assigned a reference number and included in the list of references since it has a DOI. (All-hazards dataset mined from the US National Incident Management System 1999-2020)	**We have made this fix in the manuscript (ref #65).**
Reviewer 1		
1	The bad news: I don't work with these data sets, am not conversant with the techniques involved in remote sensing and big data, am not competent to evaluate the rigor and methodologies involved. You will have to rely on other reviewers. The good news: I am familiar with the fire issues involved and can speak to the context and significance of the article. On that: I think the piece is valuable and should be published. It can be published as is, although I recommend a few minor edits to clarify some (for me) awkward passages and perhaps make more explicit the nature of its contribution. I think the contributions are two. One is conceptual – the role of 'fast fires.' The	**Thank you so much for your overarching comments. I (JKB) especially appreciate the acknowledgement of the importance of this contribution. We cited the Wilson 1977 article in the initial submission (current ref. #18). That paper had a huge influence on my thinking around the importance of fast fires and defining them across 1,000s of events. Also, I really appreciate your comment about our novel approach being able to "parse fires into their critical components by space and time." I absolutely agree, which is why we did this study, and in fact it is why we built the FIRED database in the first place. We built FIRED to get at the spatio-temporal aspects of fire regimes from remote sensing. Thank you for this very thoughtful and spot-on review. We have addressed your major comments via a substantial revision of the discussion to better highlight the implications and suggest management strategies. We have also addressed your minor comments and suggested edits.**

	other is a metric, or suite of metrics, to support that concept. In 1977 Carl Wilson published a brief but penetrating commentary on the circumstances surrounding 'tragedy' fires that killed firefighters. The surprise was that the critical factor was the speed with which fire behavior could change; the conditions behind it were winds, light fuels (grass, shrubs), and terrain. All the multiple-fatality events involved small fires or small portions of big fires. The article changed how fire officers thought about fireline safety. The submitted article can do the same for contemporary fire concerns, with houses in place of fire crews. The second contribution is the metrics developed to support these observations. Landscape fire has long been notorious for its pathetic grab bag of measurements, which have historically consisted of number of fires, size of fires, and cost of fires. As firescapes have become more complex, fire managers literally don't know, in a quantitative sense, what they are talking about. Megafires are the one-percenters of nature's fire economy. With regard to severity, FGRs (fast fires) are the one-percenters of megafires. Analyses like this one allow us to parse fires into their critical components by space and time. This article introduces new data sets, new methods for analyzing them, and new metrics to conceptualize their meaning. This matters not just to this particular project, but to fire science and management overall because it can serve as a model for the creation of other metrics (the ecological dimension of landscape fire is more retarded). Quantified concepts can change the conversation.	
2	Its conclusions challenge some of the assumptions underpinning popular understanding about the wildland-urban fire scene. The great threat comes not from public, forested wildlands, but private lands, grasslands (amplified by invasives), and the oft-indefensible	**Thank you for this comment. We have added this conclusion, i.e., the importance of hardening the built environment, to our discussion. (In tandem, R2's last comment asked us to further discuss mitigation options.) We now emphasize this in the discussion (lines 220-223): "We need to implement building codes that incentivize use of fire-resistant materials (55), harden existing homes and remove flammable materials adjacent to structures (56), and preemptively plan for evacuation."**

	character of the built environment - conditions that climate change may aggravate. The vital need is to harden the built environment.	
3	OVERALL: I recommend a few minor edits (see below) to clarify some (for me) awkward passages and perhaps make more explicit the nature of its contribution.	**Thank you for these recommended edits (see changes below); we agree that these changes improve the readability and clarity of the text.**
4	Lines 187-189 – I had to read this several times to see what the numbers referred to. Maybe place the numbers with their referents directly?	**We now place the numbers with referents, as suggested. Lines 162-165 now read: "For all fires, mean FGR significantly increased in 38 and maximum FGR significantly increased in 20 of the 84 level III ecoregions (mainly in the western U.S.). Mean FGR significantly decreased in 16 and maximum FGR significantly decreased in 9 of the ecoregions (mainly in the northeast; Fig. 3 and Fig. S6)."**
5	Lines 217-230 – this seemed rushed and jumbled. Maybe add a topic sentence? Or divide the paragraph into two at line 224?	**We have substantially revised the discussion and this comment is now addressed in the new architecture. Please see lines 190-225.**
6	Lines 271-286 – Again, jumbled and harassed, and sadly lame as the conclusion for an important article. Fast fires mean suppression will lag in response, which again accents the need to focus mitigation on the structures themselves.	**Thank you for the honest feedback on the last paragraph. We agree and have strengthened the conclusions to this important article. Please see rewrite of the discussion, lines 190-255.**
Reviewer 2		
1	OVERALL: This is a timely paper that adds a unique dimension to our understand of wildfire risk to communities – building exposure and destruction in rapidly spreading fires. Most wildfire risk mitigation actions are focused on reducing fuels to influence fire behavior – reducing rate of spread and intensity in select areas to protect resources and so fire fighters can operate safely. Fire spread rates are acknowledged but not to the extent that they could be, especially for rapidly spreading fires where the best option communities and fire fighters have is to evacuate and get out of the path of the fire. This paper highlights the potential impacts fast fires have.	**Thank you so much for this thorough and constructive review. We agree that this is a timely and unique contribution and we really appreciate your acknowledgement of that.**

2	However, while I liked the paper, I think the analysis and discussion falls short in a couple of areas described in my comments (see below). Mainly, the reasons for building destruction in fast fire are blurred by the lack of spatial and temporal information on building loss in the ICS-209-PLUS data and the discussion fell short in explaining the variety of mechanisms for building loss in fast fires and mitigation options. I recommend revising the analyses to focus on the data we have the most confidence in and revising the discussion to include more about the physical aspects of fast fires and their behavior that lead to building loss and expanding discussion about mitigation options for fast fires	**Thank you for these suggestions. We added text on the mechanisms leading to building loss in both the introduction and the discussion. We address your comment about the spatial and temporal resolution of the growth and structure loss data in our response to your following comment (#3 below).** **In the introduction we added (lines 72-78): "We know that the primary mechanism for home ignition is firebrands propelled ahead of the flaming front that land on flammable materials attached to, on, or inside the structure and ultimately consume it (38). Firefighters can extinguish these building ignitions during slower fires or when structure ignition is mitigated (39), but during fast-moving events they are often overwhelmed by the higher number of homes catching fire simultaneously and the need to focus on life safety and evacuations, e.g., during the 2018 Camp Fire (17)."** **In the discussion we added (lines 204-206 & 220-223): "The speed of a fire determines first whether firefighters are more focused on evacuation than home protection (17), and second how effectively they can extinguish burning firebrands and new ignitions on structures before the home becomes fully involved (38, 39)." AND "We need to implement building codes that incentivize use of fire-resistant materials (55), harden existing homes and remove flammable materials adjacent to structures (56), and preemptively plan for evacuation."**
3	It was unclear if building destruction from the ICS-209-PLUS data were linked to the single day with fire growth rates from the FIRED data. In other words, it is not clear that buildings were destroyed on the days with the most fire spread. I don't think the authors have the data needed to look at spatial patterns of building destruction in relation to daily fire spread. The ICS-209 data do not include building destruction maps. These details are omitted from the materials and methods section. This part of the analysis should be removed – the data do not support the conclusions. The author's data also support analysis of buildings exposed to fire with the HISDAC-US data, at least where HISDAC-US data are complete (like what is presented in lines 205+). Are more buildings exposed in days with high vs. low fire spread? I imagine the authors would find similar results (more buildings are exposed in fast than slow fires) without the uncertainties the ICS-209-PLUS data introduce. It's also not clear how the ICS-209-PLUS data	**These are important observations and suggestions. We have addressed these concern in the following ways:** **First, we added additional details to the supplementary materials and methods (see paragraph starting at line 646). It is important to note that the ICS-209-PLUS dataset includes two products; the incident summary report which aggregates attributes for the entire event, and the daily situation reports which provide the daily updates for all attributes. While the ICS-209-PLUS database does not provide structure locations (i.e., building destruction maps), they do provide the daily reported estimates of structures destroyed and threatened which can be compared to the FIRED maximum daily FGR. We linked the ICS-209 wildfire events and FIRED, the MODIS-derived perimeter product, which is also published (St. Denis et al. 2023) and the workflow is available at GitHub here: https://github.com/maxwellCcook/ics209-plus-fired/blob/main/code/R/ics-fired.Rmd** **Second, we have added another analysis to the supplement and an additional figure (Fig. S4). Please see lines 658-662. This figure shows the time lag between maximum daily growth and day of structure loss report. We state: "For wildfires where daily situation reports were available and at least one structure was reported destroyed (N = 557), the mean lag-time from the day of maximum growth was 5.3 days (median = 2.8 days; mode = 0). It is important to acknowledge that the situation reports may be delayed in their reporting due to the time needed to document structure loss through overflights, remote sensing, or ground-based truthing." Despite the uncertainty in reporting date, we do find a notable**

	were linked to the FIRED data. How did you account for differences in reported ignition dates and locations in the ICS-209-PLUS data compared to the MODIS data?	**association between maximum FGR and reported structure loss. We believe this association justifies our analysis of the maximum daily growth rate and the structures loss across the entire wildfire event. There are several groups and companies working on near real-time assessment of structure loss post-hazard, but currently the ICS-209s still provide the best available dataset on structure loss across events and for the length of period that we are exploring in the analysis.** **Third, we do use the HISDAC-US data to account for spatial locations of structures threatened or exposed. This is a different metric than actual structures damaged or destroyed. We use this geospatial dataset (at 250-m resolution) to assess exposure (rather than actual home loss). We highlight that we are using multiple data sources to get the best answer we can to both exposure to wildfires and actual structure loss. The introduction now describes this in more detail (see lines 92-96): "The aggregation of ICS-209 reports provides the best available information on the high costs of U.S. wildfires at a national scale. Importantly, the combination of these latter two datasets, HISDAC-US on the spatio-temporal distribution of residential structures and the ICS-209-PLUS on actual structure loss, allows us to explore both potential exposure and documented impact."**
4	There should be more discussion about the physical characteristics of fast fires that lead to building destruction. Is it the speed that makes buildings more likely to ignite and burn, or do fast fires have greater heat production than slow fires of the fire, or is it because people and fire fighters have evacuated and there is no firefighting happening? Some of this is mentioned in the last paragraph, but more information could be added about fire behavior unique to fast fires. This is important, as it determines mitigation actions to reduce building loss in fast fires.	**Please see our response to your comment #2 above.**
5	One sentence summary – Your results suggest the most destructive fires are the fastest growing fires, not megafires. Remove the word 'megafires'.	**Thank you for the suggestion. 'Megafires' has been changed to 'wildfires.'**
6	Line 35+ Please provide some statistics about how quickly the Camp and Marshall and Lahaina fires grew to support the main point of this paper – that the fastest growing fires are the most destructive. Or pick examples from Table 1.	**We now provide growth or speed statistics on the Camp, Marshall, and Lahaina wildfires. Please see edits to the first paragraph (lines 35-40).**

7	Line 39+ If we should define the modern era of megafires on speed instead of size, what do you suggest for the definition? Is there a catchy name for a speed threshold along the lines of the size threshold (megafires or those >= 100,000 acres in size)?	**Thank you for this comment. We feel that 'fast fires' is the equivalent for speed that 'mega-fire' is for size. We have emphasized this definition in the conclusion text (lines 194-197): "First, we delineate a new class of the fastest growing and most destructive fires, or 'fast fires.' This class is akin to 'mega-fires,' but is defined based on a maximum daily growth rate of more than 1,620 ha/day where we document the majority of structures destroyed (78%) and suppression costs (61%)."**
8	Line 45+ '…we know relatively little about when and why fast fires occur at regional or national scales.' Really? These fires occur under hot, dry, and windy conditions.	**Good point. We clarified that we are talking more about the lack of knowledge at regional to national scales. The sentence now reads (lines 47-49): "Further, we know that fast fires occur when it is hot, dry and windy, but relatively little research exists about when and why they occur across regional or national scales."**
9	Line 60+ 'expansion of the urban footprint has placed tens of millions of homes squarely into this contemporary fuel matrix' – this is the wildland-urban interface.	**We have added reference to the wildland-urban interface at this point in the paragraph. The sentence now reads (lines 62-64): "Moreover, the expansion of the urban footprint (29) has placed tens of millions of homes squarely into this contemporary fuel matrix, termed the wildland-urban interface (WUI) (30)."**
10	Line 112+ 'Many modeling efforts at regional to national scales model fire activity at monthly to yearly timescales (5, 43). These results highlight the need for regional models based on fire behavior that use predictions at daily to hourly time scales, rather than burned area estimates based on topography and spatiotemporally coarse climate data. This is particularly important in the context of modeling the occurrence of extreme meteorological events and their ability to drive rapid fire growth (20).' These models do exist and are being used at large scales related to work cited earlier in this paper (14, 15, and 16). Finney et al. 2011's FSIM model is a notable example (https://doi.org/10.1007/s00477-011-0462-z). Acknowledge that these models do exist or remove this section of text. However, it remains to be seen if models like FSIM and the weather data they use capture spread rates in the extreme events reported in this paper.	**Thank you for this comment. We added the following clarification and the suggested reference. Please see lines 123-125: "Such models exist (13-15) and are being further advanced (33) but it remains to be tested whether they can replicate the remotely-sensed spread rates in extreme events as reported here."**
11	Line 117+ 'We also found that mean and maximum FGR vary by land cover…' I don't doubt this but am unclear how FGR was partitioned across different land covers. Did you use the majority of	**We added a sentence clarifying this in the methods on line 589-591: "For each event, and daily subset, the modal International Geosphere-Biosphere Programme (IGBP) landcover classification was extracted from the MOD12c1 product."**

	land cover burned in each day or some other approach. Please add a sentence or two in the materials and methods to explain.	
12	Line 230+ 'Future work should explore how wildfires spread quickly even before amassing a large footprint.' I think we understand how wildfires spread but we don't understand if we can simulate fast fires well and represent the potential exposure/damages they may cause in risk assessments (e.g. Wildfire Risk to Communities). My guess is that fast fires are not well represented, and we are underestimating risk in many areas.	**Thank you for this excellent point. We agree. We have deleted this sentence and have better highlighted the gap you identify. Please see lines 200-202 where we state: "Current national fire risk models and planning efforts tend to focus on fire probability, intensity, or area burned (50), rather than fire speed and consequent settlement exposure or potential damage." We cite Scott et al. 2013, which provides methods and data layers that underpin the Wildfire Risk to Communities platform.**
13	Line 265+ '… in areas of rugged terrain …', yes rugged terrain might matter, but figure 1 shows a lot of fast fires in the Great Plains where remoteness and limited emergency response is probably a larger factor	**Thank you for this comment. We deleted this sentence to better streamline the discussion. Please see rewrite of the discussion (starting at line 190).**
14	Line 269+ 'This result reinforces the need to identify and suppress potentially dangerous wildfires before they threaten lives or property' Is this the best solution you can offer? We've been trying to suppress fires for years. What other mitigation options do communities have to mitigate the risk of fast fires?	**Thank you for flagging this. We offer more concrete solutions that need to be adopted in light of fast fires, and faster fires. Please see our response to Reviewer #1, comment #2. And please see rewrite of the discussion (starting at line 190).**