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Reply on RC1

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Author comment on "Exploring TikTok as a promising platform for geoscience communication" by Emily E. Zawacki et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-494-AC1, 2022

We thank the reviewer for their time and helpful comments regarding our manuscript. We believe that with the described additions below to better explain our study, particularly for those that are unfamiliar with TikTok or similar social media analyses, our manuscript will be suitable for publication and of significant value to the science communication community.

Given the total opacity of the TikTok algorithm, our study seeks to elucidate patterns and trends related to reach and engagement of geoscience content on TikTok so that science communicators can find the most success there. More so than any other social media platform, content discovery on TikTok is algorithmically-driven, and our study uses all analytical data metrics available on TikTok to provide insight relevant for science communicators. We specifically analyze (1) reach [video views], (2) video view duration, and (3) video engagement in assessing the impact of each video. We seek to maximize all three factors: (1) videos seen by more people increase the audience impacted by the content, (2) the longer people view a video indicates greater interest in the video and subject, and (3) engaging with the video (like, comment, share) demonstrates additional interest in the video and subject, all reflective of successful science communication.

The videos we created for the Terra Explore TikTok were part of a pilot project to test producing geoscience video content on TikTok. As such, we aimed to produce videos of various topics/styles, durations, with different hashtags used, and different posting times/dates in order to sample parameter space. Although there was not a systematic design to every video, these videos still provide important insight and much needed data for science communication efforts on TikTok. As it is difficult to isolate singular variables, we use the similarity of content and format in GMV (ground motion visualization) videos to more clearly evaluate individual factors. We acknowledge that algorithms may change over time as platforms evolve, but we are not aware of evidence that TikTok is changing its algorithm so rapidly as to invalidate attempts at analysis.

- We survey all available data metrics from TikTok to discern any notable trends in video reach and engagement, as is common with research examining content on social media platforms (see Habibi and Salim, 2021 and Wang et al., 2022 (*Geoscience Communication)*). We will more specifically describe the purpose of each parameter that we are looking at and what it indicates, as well as our associated hypothesis with how it relates to algorithmic discovery. As an example, social media algorithms are

generally believed to reward videos that have a high viewer retention (how long someone watches the video) and high engagement rate by showing the video to more people (as these videos keep users engaged and on the app/platform for longer) (Klug et al., 2021). However, short videos on TikTok (~15s) can very easily yield high viewer retention rates, which doesn't necessarily translate to high views or engagement. Understanding the data related to each metric is thus important in deciphering what characteristics are likely to make a successful video. Beyond understanding the algorithm itself, a high average view duration and a high engagement rate indicates that the audience is interested and invested in the video content and are extremely useful metrics for evaluating how engaging and successful the video content is.

We will remove the figure depicting gender of followers over time, as a text explanation will suffice.

- We strongly agree that statistical analysis is needed in this study and will greatly strengthen our analyses. We are working on performing correlation analyses for all the relationships we evaluate (including r, r^2, and p values to determine statistical significance).
- TikTok provides information about the top territories of an account's followers and individual video views by region. ~85% of the Terra Explore account's followers and views are from the United States, which is why we defaulted to a more US-centric view. However, we will include this information related to viewer/follower region and will analyze any videos that have a significant proportion of views from outside the US. We hypothesize that TikTok heavily mines data based on a user's location and often shows video content local to that viewer. Post time optimization is typically linked to the location where the majority of your audience is, and hence would apply to 'local morning' vs 'local evening.'
- While our videos posted were part of a pilot, we believe that they provide useful information for science communicators, especially given how limited any existing studies of science communication on TikTok are and how untapped the potential of TikTok is.

We will adjust the title of the manuscript so that it more accurately reflects the content.

Line 16: "Viewer retention" (also 'audience retention') is a standard metric in social media for the average percentage of a video people watch. However, to keep this term consistent with our figures, we will refer to it as the 'average video view duration (%)' throughout.

Line 20: The "For You" page is the Proper Noun name for this feed on TikTok. In the abstract, we define it as "TikTok's algorithmic recommendation feed."

Line 22: We will qualify 'viral' as high views and engagement.

Lines 53-55: As described in point 1, we will more thoroughly outline our methodology and describe the importance of each metric we analyze. We analyze engagement, as videos with high engagement are hypothesized to be rewarded by the algorithm and will continue to be shown to more people. This cycle of increased engagement and reach thus increases the impact potential of the science content. High engagement rates also indicate an increased interest from the viewer in the video, demonstrating the impact and 'success' of the video.

Lines 58-77: We can include additional context regarding the global distribution of TikTok users.

Line 67-68: TikTok provides no information regarding their AI algorithm or how it works,

hence why studies like this are important. The information we provide in this section is essentially the extent of all information TikTok publicly makes available. Users can indicate they are 'not interested' in a video, but there is no way to choose topics of interest other than watching videos on the app (or skipping them) and liking videos that they enjoy.

Line 77: We recommend downloading TikTok for a brief user experience. Sounds are background audio clips that can be re-used by multiple users and are separate from hashtags.

Lines 85-93: The lifetime of a TikTok hashtag is essentially infinite. You can click on a hashtag and see all videos that have ever been created that use that hashtag. Any person can use any hashtag at any time. As we discuss later in the paper, hashtags on TikTok have a fundamentally different 'function' than they do on platforms like Twitter. People generally do not 'search' for hashtags on TikTok like they do on Twitter. We hypothesize that hashtags are primarily used in TikTok's AI to provide additional information and context for the video when deciding who to show it to with the algorithm.

Lines 104-105: We do not say that it is impossible to have experiment videos related to geosciences, merely that they are generally less common and/or easy to produce compared to videos of chemistry and physics experiments. A survey of educational science content on TikTok demonstrates an abundance of videos of chemistry and physics experiments and near total absence of geology-related experiments (which we find is more so related to the ease with which at home or classroom chemistry/physics experiments can be filmed and shared on the app).

Lines 123-124: The video presenters are the existing communications staff at our respective organizations. The male presenter was only able to create two videos during this duration, hence we are unable to analyze video metrics based on the gender of presenter, although this is work we would like to do in the future.

Section 4 (general): As it is very difficult to vary just a singular variable when creating TikTok videos, we use the GMV (ground motion visualization) videos as a way to most clearly isolate variable trends with posting. All the Terra Explore videos were created during a pilot project, in which the goal was to test and produce different types of geoscience content on TikTok (different topics, durations, hashtags used, time and day posted, etc.). Although there was not a systematic design behind every single video posted, that does not make the analyses of these videos any less meaningful.

Line 175: We will include UTC with our time zones.

Fig.2: We will delete this figure.

Fig 3: ~85% of viewers of Terra Explore are within the United States, hence the majority of views come from 'local' time zones. The concept of post time upload is related to optimizing the upload of your content for when the majority of users/followers will be active on the app so that it is seen by the highest number of people. All our most highly viewed videos (>90,000 views) were posted between 7 am - 2 pm MST (UTC-7), which allows more time for the content to be live and assessed by the algorithm before the number of active users drops off overnight. However, the lack of a distinct trend in this plot indicates that post time is but one of many factors that may impact the success of a video. This concept is also not to indicate that the morning MST is the most ideal time to upload, rather that it is the local time of the majority of the audience.

Fig. 6: We will delete this figure.

Lines 215: "Viewer retention" is the common terminology in social media. However, to

keep this term consistent with our figures, we will refer to it as the 'average video view duration (%)' throughout.

Fig. 7: We will add a more thorough explanation in the text for those that are unfamiliar with metrics used in social media analyses. Traditionally, yes, you would expect to see a relationship between video views and average view duration, as videos with a high avg. view duration are hypothesized to be rewarded within the algorithm and shown to more viewers, thus yielding higher views (particularly on platforms like YouTube). A high average view duration also indicates that the audience is more interested in the video content and that it holds their attention rather than scrolling to the next video, thus providing a useful gauge in how effective the science communication video is. However, because TikTok can support such short videos (~15 s), those videos can very easily yield a high avg. view duration, but that doesn't necessarily mean they will also have a high number of views. We see videos with the highest number of views (>90,000) have avg. view durations of >40%, indicating that this is the value creators should aim for.

Fig. 8: The higher the engagement rate, the more people are interacting with a piece of content, thus showing higher interest on the side of the viewer (see Habibi and Salim, 2021, another study that measures user engagement of educational science content on TikTok). As is hypothesized with how algorithms work, content that is interacted with more will be shown to more people, thus yielding higher views. What is interesting on this plot is that even videos that did not yield a high number of views still yielded high engagement rates. Here we see no observable trend between number of views and the engagement rate on the content. It could be that a video needs both a high engagement rate and a high avg. view duration to be shown more in the algorithm and receive more views (see Figure 9).

Fig. 9: We find that there is no clear relationship between the average view duration and engagement (two factors that are likely to increase video reach in the algorithm). Thus, just because a person views more of a video does not necessarily mean they are more likely to interact with the content. However, the average view duration here is also linked to the length of the video, as ~15 s videos can much more easily yield a high avg. view duration than can a ~150 s video (Fig. 10–the longest videos actually have consistently high engagement rates, especially for shares).

Section 6.4: Explained in reply to Fig. 7.

Section 7: There is essentially zero transparency to TikTok's algorithm, hence the importance of this study and others like it. The existing literature related to analyzing content on TikTok and the algorithm is very limited (see Klug et al., 2021, which we will discuss and add a citation for). This study is thus important because it provides additional data and insight for the very little that has been analyzed of science communication on TikTok. We will address in the text that algorithms can change over time, and thus it will be useful to conduct future surveys over time. However, algorithmic changes that fundamentally impact how the app functions are unlikely to occur over short periods of time. 95% of teens in the United States say that they have access to a smartphone (Pew Research Center). Thus there is almost no exclusion to the technology, demonstrating that TikTok has nearly unlimited reach potential. We have addressed audience demographics in previous comments.

Lines 405-412:

- We have addressed these concerns all in previous comments (see comments to Figure 3).
- We do not intend to suggest that every topic be related to a newsworthy event or place-based geology, rather that these are ways in which to maximize the algorithmic impact

of the video content, thus reaching the highest amount of viewers and sharing the science with a broad audience. These are also tools to make the topic communicated relevant and relatable to the audience. As we demonstrated, even videos that had lower views yielded high engagement rates, which indicates that the content was still impactful, even if it was received by a smaller audience. We find that demonstration videos < 30 s are an impactful way to communicate topics, as are lecture-style videos ~40 - 120 s in duration. We include this discussion of gender and this recommendation as we hypothesize that there may be inherent sexism baked into the TikTok algorithm, where accounts that are identified as female are shown less or are not shown science-related content on their "For You" page. "*The recommendation would be merited if the strategy is to include more gender-related topics to gain more female followers, who then view videos of other topics* is precisely what we suggest and recommend. A nuance to note is that videos from an account a person is following are also often shown on the 'For You' page. Hence, even if the video is viewed by an account follower, the view will still be counted as coming from the 'For You' page.

- We re-emphasize here that views on TikTok generally do not come directly from hashtags (like one might look up a hashtag on Twitter), rather that hashtags are tools to provide additional algorithmic context for the video (especially beneficial if highlighting a location, e.g., #california).