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Reply to Comment by Mandel et al. on "Numerically Bounded Linguistic Probability Schemes Are Unlikely to Communicate Uncertainty Effectively"

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Abstract We thank the Comment's authors for their considered critique of our paper. We respond to their main criticisms and hope that this discussion motivates further consideration of communication strategies for event attribution analyses.

We thank Mandel et al. (2020) for their comment on our recent paper (Lewis et al., 2019). Mandel et al. (2020) present an argument that Numerically Bounded Linguistic Probability Schemes (NBLPSs) are ineffective in communicating probabilistic information. We acknowledge that there are imperfections in the application of NBLPSs in public communication of scientific information characterized by a level of uncertainty. However, we believe that there are beneficial aspects to Numerically Bounded Linguistic Probability (NBLP) usage in the context of climate change communication, including extreme event attribution (EEA).

NBLP frameworks for communicating probabilistic statements are in wide use in climate science. As mentioned in Mandel et al. (2020), the Intergovernmental Panel on Climate Change (IPCC), the U.S. National Climate Assessments (US NCA), and the U.S. Environment Protection Agency (US EPA) have all adopted the approach of NBLPSs to communicate historical and projected climate change information, for example, the likelihood of historical climate changes being primarily due to anthropogenic forcings (Mastrandrea et al., 2010; Morgan et al., 2009). NBLP schemes have been selected and calibrated after careful consideration and analysis of how uncertainty and imprecision are presented and interpreted by different users of climate change information. It has been noted in previous work that there is inherent difficulty in presenting climate change information including uncertainty in a usable format for a range of policymakers (e.g., Kandlikar et al., 2005; Patt & Dessai, 2005). The NBLP framework is an imperfect compromise that allows for consistency in the presentation of probabilistic information across many statements, and this is the quality we also desired in an EEA communication framework. The familiarity of many scientists and stakeholders with the NBLP framework developed by the IPCC was also considered a benefit to the application of a similar scheme for communicating EEA results.

One criticism by Mandel et al. (2020) of the framework put forward in Lewis et al. (2019) is that it coarsens the quantitative outcomes of EEA studies. Indeed, this is part of the purpose as it prevents overinterpretation of quantitative results. Commonly, a single number from the scientific attribution assessment (usually the "best estimate" or median) is presented in media without context of the uncertainty in that outcome. Examples of overly specific EEA statements presented in media outlets are numerous (Watts, 2020; Welch, 2018), and these give a false impression of confidence in quantitative outcomes of corresponding EEA analyses (Ciavarella et al., 2020; Oliver et al., 2018). While we acknowledge that the public is composed of people with a wide range of scientific literacy and ability to interpret quantitative statements, this is somewhat irrelevant when the majority of people will only read news headlines or news articles on EEA studies. All members of the public will gain a more representative picture of the outcome of EEA analyses from NBLPSs rather than the single numbers that are currently presented. We contend that for specific stakeholders and interested readers, quantitative information presented in

scientific publications is useful and such stakeholders are more likely to read the underpinning scientific study and/or consult with experts of EEA. But for broader communication with the wider public NBLPSs—such as the framework we proposed—provide an alternative mode of delivery that better represents the overall EEA findings.

Finally, we note that Lewis et al. (2019) was published as a Commentary in *Earth's Future*. The intention of our contribution was not to provide the ultimate statement on the communication of EEA analyses. Rather, we suggested a framework for an approach meant as a useful alternative to existing techniques. As EEA is a relatively new but burgeoning field in climate science, we felt that consideration of how results of these studies are framed was warranted. We hope that the approach we proposed in Lewis et al. (2019) may be developed and improved upon as our understanding of how EEA statements are interpreted evolves. We agree with Mandel et al. (2020) that further analysis will need to be done to optimize approaches for effective presentation and communication of EEA outcomes.

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