Earth Syst. Sci. Data Discuss., referee comment RC1
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Comment on essd-2022-303

Anonymous Referee #1

Referee comment on "Crowdsourced Doppler measurements of time standard stations demonstrating ionospheric variability" by Kristina Collins et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2022-303-RC1, 2022

In this paper, the authors describe a new experimental framework, still in development, based on the crowdsourcing paradigm for the measurement of ionospheric phenomena using radio waves. The authors focus on describing the data produced by this system and not much on the physics. Nevertheless, they outline some possible scientific questions that can be addressed as this experimental framework continues evolving.

Before going into the specific comments, I want to point out two general issues I see with the paper's current approach. First, I found it challenging to infer the paper's primary goal. It was not explicit in either the abstract or the introduction. Second, the authors might be underestimating the potential impact of this work. As I see it, this is the first step in building a system to systematically assess the accuracy of the bottom-side estimates from almost all ionospheric models. These measurements can be compared to the oblique paths obtained with each ionospheric simulation if coupled with accurate ray-tracing solvers. If the authors agree that this is a viable application, they should mention it in the paper.

The following is a list of specific comments. I will use "l." to refer to "line."
l.1: It is unclear what you mean by "atmospheric coupling." If it is being used as an umbrella term for neutral atmosphere, solar activity, particle precipitation, etc., it might be better to say "ionospheric variability."

l.12: My understanding is that Doppler shifts can be caused not only by changes in ionospheric height. I do not think you have to make this assumption, but if you want to focus on height, you should be very specific about this being an essential assumption of the paper.

l.23: Considering that one of the main contributions of this experimental framework is the

role of citizen science, you should elaborate further on what it is and its advantages and limitations for this work.

l.32: "Long-term ionospheric trends" is a whole area of research studying time series, often covering several solar cycles. Maybe you can use "seasonal variability."

l.45: AGWs are ubiquitous and are not restricted to the mechanisms you listed.

Figure 1: Should elaborate on what multi hops and Pederson modes are.

l.57: Consider using a simple algebraic expression to illustrate the dependency between phase, wavelength, and local ionospheric parameters.

l.77: What does "cleaning" imply?

Figure 3: The image is too big, considering the information it is displaying. I suggest making it smaller or just listing these files' information.

l.118: Instead of displaying the frequency response of the Butterworth filter, you should limit it to summarize its features. The details shown in Figures 7 and 10 are unnecessary for the explanations presented.

l.124: Instead of "line of pixels from bottom to top," you might want to use "columns."

l127: You should elaborate on the mechanism responsible for this seasonal movement considering this is one of the main outputs of the measurements.

Figure 6: Give more details on the location of the sunrise peak.

Figures 8 and 10: What are the sources of variability in Doppler shift and power? Is it just experimental uncertainty, or are there other ionospheric mechanisms involved?

Figure 9: The caption needs more details. Using a smaller marker size would facilitate visualization.

l.149: There might be better choices for a time series with such a finite perturbation than a band-pass filter. Have you considered calculating the high-frequency oscillation from the difference between the original time series and its smoothed form?

Figure B1: The colormap is different from Figure 9.