

**Title:** Methods for Estimation of Ionospheric Layer Height Characteristics from Doppler Frequency and Time of Flight Measurements on HF Skywave Signals, (Collins et al., forthcoming)

**Summary:**

The paper demonstrated a methodology to estimate ionospheric virtual layer height characteristics using Doppler measurements from frequency locked time standard stations in conjunction with ionosonde measurements and ray-tracing models. The study showed observations are consistent with a model in which mode splitting originates from different path length velocities associated with single and multiple hop modes as the virtual layer height changes. The study took the support of complementary processes of 1) calculating Doppler shifts from virtual layer height changes and virtual layer height changes from Doppler shifts, and 2) the analysis of intermittent low-Doppler shift modes including correlation with ionosonde observations to help identify multihop propagation modes to justify authors claim.

**Overall remarks:**

The work is significant and covers a timely topic that aids the analysis to understand various space weather effects on the ionosphere using path length estimates from distributed HF stations when integrated with other ionospheric measurements. The major drawback of the manuscript is its organization and readability. The figures are not described in the text properly, and neither they are justified. The chronology of the figure number is awkward, Figure 11-13 is mentioned before Figure 10 in the text. Also, not all the figures are labeled and some of the figures are not of publication quality. Finally, the reviewer was not able to find a proper justification or necessity of the methodology in the manuscript, in the introduction, discussion, and conclusion sections.

I recommend addressing the following points before proceeding with the publication.

1. Line 5-6: 'mode splitting ... layer height changes' – not clear, please rewrite the sentence.
2. Line 8-9: '2) the analysis ... propagation modes.' – not clear, please rewrite the sentence.
3. Line 19: '... condition change, time-dependent changes...' – can it be related to spatial change also?
4. Line 23: '... studies of ionospheric conditions ()' – provide at least one citation.
5. Line 39: '... and layer width ...' – change to 'thickness'.
6. Line 41: '... in order to stabilize the solution.' – What solution? Why does the author need to stabilize the solution?
7. Line 42-43: 'In this study, ... to ionospheric height.' – complex idea, please break down into two sentences.
8. Line 79: 'The composition ...' – not sure what composition.
9. Line 81: '... distributed density ...' – not clear.
10. Line 89: '... ionospheric electron content ()' – provide citations.
11. Line 101: '... a suitable ....' How does the author know what is suitable?
12. Figure 2 and the parameters used in there are not described in detail in the text.
13. An additional figure is required to describe the working principle of the method that is described in Figure 3.

14. The reviewer is not able to understand step 3 of the methodology.
15. Line 122: Equation 3 should be replaced by numerical integration, such as the Trapezoidal rule.
16. The reviewer is not sure about step 5 of the methodology.
17. It is better to describe HF RT (section 2.3) before section 2.2, as it is referenced in Figure 3 and methodology.
18. Most of the figures (7-15) lack motivation (Why is it needed in the paper? What question does it answer?), location in the manuscript (text mentioned in Figures 11-13 before 10), and labels (x, and y scales), which make them very difficult to interpret and justify their needs.
19. Line 247-249: '... give comparable ...', not sure authors presented this comparison anywhere in the manuscript. Please provide additional details of this comparison.
20. Provide a clear objective and findings of the study in the introduction and conclusion section of the paper.
21. The discussion section should compare the results in the context of previous research, but here authors discussed the figures and observations in the figures.

Considering all these comments together, I would strongly recommend restructuring the paper by rearranging the sections (sub-sections), figures, and discussion sections.