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Atmospheric Measurement Techniques Discussions

Interactive comment on "First Observations of the McMurdo-South Pole Ionospheric HF Channel" *by* Alex T. Chartier et al.

Anonymous Referee #2

Received and published: 30 March 2020

Referee #2

This manuscript presents demonstration oblique ionosonde observations from the Antarctic. The ionosonde is of a new low-cost design and employs advanced modern digital hardware and software defined radio signal waveform and signal processing techniques. Observations from the demonstration campaign in March 2019 were verified with a traditional ionosonde reasonably closely co-located. Propagation of the 7.2 MHz oblique ionosonde channel is compared with GPS-derived TEC observations using the MIDAS model to access if density enhancements and propagation are correlated between the two observation systems, giving moderately good agreement.

The scientific importance of this manuscript is of great interest and in need of publication as it presents a novel concept for probing the ionosphere in greater detail than

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Discussion paper

previously. However, the manuscript needs improvement. As many of my comments and concerns with the manuscript are essentially verbatim with those of Referee #1, there is no point in repeating them here. As I strongly agree with Referee #1, I will only include additional comments and suggestions and try not to repeat things.

In general, more details are needed on the new oblique ionosonde demonstration instrument and how a network, specifically a multi-static network, in the Antarctic will benefit ionospheric research.

Specific Comments

lines 1-2, title: I would suggest highlighting the oblique ionosonde aspect in the title, as ionosondes typically operate in both the MF and HF bands (however, it is recognized that no MF data was available in this demonstration experiment due to technical issues).

Section 1.1: Are there only scientific questions of interest in the Antarctic ionosphere dealing with its variability? A few other examples of the new abilities and questions which could be answered with an oblique ionosonde network in the Antarctic is needed? Contrast benefits/challenges associated with oblique versus vertical observations, etc.

Section 2.1: Much more detail on the new oblique ionosonde is needed. For example: 1) the unaliased range resolution is given, but this needs to be related to (virtual) height measurements; 2) Doppler resolution is not given, although the Doppler extent is given but at a much later point in the manuscript; 3) what is the range-gate size?; 4) what is the baud length?; 5) is there time averaging and, if so, what is it and how does this relate to the 5-seconds between frequency switches?; 6) how were the frequencies selected for this study? 7) why not use 60 frequencies for a sweep if the instrument was capable of this as stated?; and so on. A succinct and convenient method to present this instrument technical data, or at least most of it, is in a table. It makes for easy comparison to other instruments.

lines 133-134: Please include a description of the methodology used to produce the calibration factors, C_E and C_F, for the E- and F-regions. Please justify the calibration factors due to its importance relating virtual range to virtual height.

line 139: Include a reference to Dynasonde data processing if not already supplied in Bullett et al., 2016. Also, present key parameters of the VIPIR Jang Bogo ionosonde and compare to the new oblique ionosonde. If this new instrument is to complement current ionosonde networks, how it compares to them is of great interest.

Section 3.1, line 167: Is it possible to show an oblique ionogram from the new ionosonde? However, it is understandable that these ionograms may not 'look' like a typical ionogram due to the lack of sweep frequencies – only 12 were available and only 5 of those received signal.

Section 3.3 and lines 203-209 in Discussion section: I am not sure of the point of the comparison with ground-based TEC measurements and MIDAS. What is unique about TEC being greater than or less than 6 TECU and how does this related to 7.2 MHz? And how/why was 7.2 MHz selected? What is the expected outcome of this comparison?

line 225: Again, how does the "multi-static" configuration of a large network of oblique ionosondes supply new insights into the ionosphere? What would be the benefit of this?

Technical Comments

line 41: Please include, in parenthesis, the standard notation used to express drift velocity values in the ionosphere.

lines 53 and 56 (referring to Equations 1 and 2): Reference(s) is needed for equations. Equ. 2 is well know, but still should be referenced; Equ. 1 is not so well know, at least at this time.

Section 1.3: Suggest last sentence (lines 75-77) should come after sentence on line

71. A reference is needed for Digital RF.

line 105: What is a 'V8 vault'? Reference. And/or short description. What was the transmitter equipment housed in?

lines 111-112: Please include references for N210 and Motorola AN762-180 transmitter.

line 159: Virtual height and maximum Doppler velocity are parameters which should have been first presented in Section 2.1. Is a virtual height of 2500 km scientifically useful?

line 182: The VIPIR ionosonde does have higher sensitivity, but is not the reason it collects more data compared to the oblique ionosonde mostly due to the fact that fewer sweep frequencies were used by the oblique ionosonde? This is noted in the caption for Figure 4, but not in the main text.

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