Annales Geophysicae Discussions

Ann. Geophys. Discuss., referee comment RC1
https://doi.org/10.5194/angeo-2020-93-RC1, 2021

Comment on angeo-2020-93

Anonymous Referee #1

Referee comment on "Influence of different types of ionospheric disturbances on GPS signals at polar latitudes" by Vladimir B. Belakhovsky et al., Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2020-93-RC1, 2021

Review of "Influence of different types of ionospheric disturbances on GPS signals at polar latitudes"

The paper presents short case studies of ionospheric conditions and GPS disturbances during 5 different types of events;
dayside/cusp particle precipitation, substorm particle precipitation, daytime PCP, nighttime PCP and precipitation due to interplanetary shock arrival.
Its main conclusion is that all these event types lead to phase scintillation, but that the strongest phase scintillation is correlated with particle precipitation during substorms.
(For more detailed conclusions, see Conclusion section in the paper)

It is mentioned in the paper that 150 events have been considered, but there is only data from 5 events used in the paper.
This raises doubt about whether the conclusion in the paper is generally valid, or only valid for this set of events.
If 150 events have been analyzed, I would expect there to be at least some summary of the results included in the paper.
It should include at least some key statistics derived from the analysis of the 150 events.
It would give much more support to the conclusions if they are based on statistics from 150 events than if they are just based
on one case study for each type of event.

(This does not mean that the case studies should be removed. They are very nice as examples of the different event types.)

There are numerous language issues throughout the paper.
While the errors are not critical for the understanding of the paper, it would be significantly improved by careful proof-reading.

Lines 84-91:
You define the phase scintillation index twice.
Fortunately, the definitions are the same.
But you may want to delete one of the sentences.

Line 125: The reference [Belakhovsky et al., 2019] does not match the reference list.
The Belakhovsky et al. papers listed in the reference list are from the years 2016, 2017 and 2020.
Probably, your "2019" reference should be "2020"?
Please check and correct.

Line 147:
"Possibly it's due to the field of view of EISCAT radar not coincides with the field of view of GPS receivers."

It is clear that the radar and the GNSS observations cannot fully overlap.
But, is it possible to provide any more assessment of the degree of overlap?
(approximately how much of the GNSS observations are typically in the region of the ionosphere that is
observed by EISCAT?)
(for the case studies, have you checked which of the satellites (if any) actually passed through the
region of the ionosphere that is observed by EISCAT?)
A fully detailed description is not necessary, but please consider if there is any useful information you could include.

Lines 187-188:
"The PCP is also identified in the aurora intensity variations as forms propagating from the polar to low
latitudes in 630.0 nm (red line) emission (Figure 7) at 19.00-23.00 UT according to LYR all-

sky camera observations."

The keogram seems to show multiple patches, not just one.
Are you using the abbreviation "PCP" to refer to a multitude of patches, instead of just one patch?
(And also reinforcing the misunderstanding by using the singular "is" instead of the plural "are")
I would prefer it if you used "PCPs" when referring to multiple patches, and "PCP" when referring to a single patch.
So that sentence would start with: "The PCPs are "

Please check the usage throughout the paper, and adjust where necessary.

Lines 191-192:
"At latitudes of SKN (TRO) stations the PCP manifests itself as a long lasting substorm (more than 4
hours duration) with the amplitude 200-250 nT."

A patch is not the same as a substorm.
You need to rewrite this sentence.
For example:

"At latitudes of the SKN (TRO) stations the PCPs are observed during a long lasting substorm (more than 4
hours duration) with the amplitude 200-250 nT."

Line 195 (Daytime polar cap patches):
For a CIR event, I am interested to know the approximate solar wind properties.
In particular, what was the maximum value of the solar wind speed.
It is not required to include a plot of the solar wind data, just state the value in the text.

Lines 204-205:
"cusp precipitation has stronger
influence on GPS phase scintillation when it combined with the PCP. Our analyses also confirm this finding."

You stated that "PCPes were registered in time interval 06.00-12.00 UT".
You have not stated the presence of precipitation at any time interval for this event.
Looking at the plot, there appears to be enhanced density at 100 to 200 km from 13:00 to 15:00 UT, indicating
particle precipitation at that time. But, this does not correspond to the time period for which you state
the occurrence of PCPs, and also not with the time period of strong scintillations.

Please explain how the presented data confirms the finding.
To reach your conclusion, did you make assumptions regarding the particle precipitation also for times
when EISCAT did not directly observe precipitation?
If so, please state the assumptions clearly in the text.

Line 217:
"module of the interplanetary magnetic field"

Do you mean "magnitude of the interplanetary magnetic field"?

Line 219:
Please spell out the abbreviation "SSC" in full at its first occurrence.

Lines 243-244:
"Possibly low values of amplitude scintillations at high latitudes are caused by the low elevation angles of
GPS satellites at these regions."

Please explain how observing at low elevation decreases the amount/magnitude of amplitude scintillation.