Dear referee,

We really appreciate the reviewer's efforts. Your comments definitely help us to improve our paper.

The following is a point-by-point response to the specific comments:

Major comments:

1. The authors assume a constant Doppler spectrum width of 4 m/s. It would be beneficial for readers to explain why this value is a reasonable estimate given the spacecraft speed and the beam-width of the radar. Moreover, it should be also mentioned that the Doppler spectrum width depends on the observed hydrometeors distribution, i.e., for heavy rain the width will be additionally increased.

RESPONSE:

We have omitted this explanation in this paper because we have mentioned it in detail in a previous paper. However, we admit that it would certainly be more helpful to reiterate it as follows:

The width σ_v can be considered as a sum of contributions by each. That is,

$$\sigma_v^2 = \sigma_{sm}^2 + \sigma_t^2 + \sigma_{psd}^2,$$

where σ_{sm} is the spread due to satellite motion, given by $\sigma_{sm} \sim 0.3V_{sat}\theta_{3dB}$, V_{sat} is the satellite velocity, and θ_{3dB} is the beam width (Sloss and Atlas 1968). When V_{sat} is 7738 m/s and θ_{3dB} is 0.00166 rad (0.095°), σ_{sm} becomes 3.85 m/s. The spread σ_t is due to turbulence and σ_{psd} to the distributions of hydrometeor falling velocities, respectively, which are assumed to be σ_t = 1.0 m/s (Amayenc et al., 1993), and σ_{psd} = 0.5 m/s (Gossard et al., 1997). As for the latter term, it is reported to spread to 1.0 m/s for rain (Lhermitte 1963). In this study, we assumed the σ_{psd}, = 0.5 m/s so that σ_v becomes 4.01 m/s.

We will add our explanation in the revised manuscript.

2. Although, a long integration path (10 km) seems to be a tempting approach to reduce uncertainty in the Doppler measurements, the authors do not assess the effect of a long scale signal decorrelation and non-uniform beam filling effects in such a large sampling volume. Moreover, the horizontal resolution of 10 km prevents studies on the small scale features like localized convection, the characterization of which is one of the objectives of space-borne Doppler radar missions.

RESPONSE:

We have already evaluated the change in Doppler error for 500 m, 1 km, and 10 km horizontal integrations in H22. It has been demonstrated that the Doppler error was significantly reduced by the 10-km integration. It indicated that the reduction of random errors by the integration had a larger contribution compared to the error by small-scale Doppler changes. Therefore, this paper mainly investigates the results of the 10-km integration.

3. Does the radar simulator accounts for multiple scattering? This issue has been demonstrated to have a destructive effect on the quality of the Doppler measurements.

RESPONSE:
We thank for your important remarks. However, the Doppler effect of multiple scattering was not considered in this study because of its complication, and the issue will be the subject of future research.

Minor comments:
1. The terminology "high-mode PRF" can be misleading. It would be better to use "low PRF mode" or "high tropopause mode".

RESPONSE:
We agree with your suggestion. It is indeed confusing, so we will change them in the revised manuscript as follows:
"high mode PRF" to "PRF of the high mode (lower PRF)" and
"low mode PRF" to "PRF of the low mode (higher PRF)".

2. It feels like some of the discussions can be reduced in length, e.g., when the high PRF mode is compared with the low PRF mode.

RESPONSE:
We thank you for your remarks. The main progress of this paper is that we extended the analysis to 16 orbits and also performed low mode PRF analysis and compared the results with those of high mode PRF. For the latter, we first discuss the high mode PRF results, and in the sections where we discuss the comparison with low mode PRF, we have tried to avoid redundancy and only mention what is necessary. If you feel that the discussion is redundant, it may be due to the difficulty of reading owing to the terminology problem mentioned above. We will change them in the revised manuscript in accordance with the points mentioned above, and we believe that the difficulty of reading has been improved.

Some minor comments are also included in the attached file.

Page 1,
Line 16, "mean Doppler errors for 5 dBZ_e":
Not clear what does it mean

RESPONSE:
Here, we mean the average Doppler errors with an echo intensity of 5dBZ_e.

Page 3,
Line 74 "threshold ≥20":
Is this a threshold on the reflectivity or on the cloud mask product? in the latter case, what does this number correspond to?

RESPONSE:
This is the threshold for the cloud mask product and corresponds to the "weak echo" in this product (Marchand et al., 2008). This threshold is used in many other CloudSat-based hydrometeor studies (e.g., Sassen & Wang 2008, Mace et al. 2009).

Line 75: insert "of cloud occurrence"

RESPONSE:
We will change our statement in the revised manuscript accordingly.

Page 7,
Line 145: "Incidentally, we added black dashed and solid lines to Fig. 3 to show the results":
Not clear. These figures have 4 lines that were described before. Please, rephrase this sentence.

RESPONSE:
We will correct in the revised manuscript as follows:
(before)
Incidentally, we added black dashed and solid lines to Fig. 3 to show the results.

(after)
Note the black dashed and solid lines in Fig. 3.

Line 146: insert "in H22"?

RESPONSE:
We will also change our statement in the revised manuscript as follows:
(before)
In both Figs. 3a and 3b, the results are in good agreement with those of this study.
(after)
In both Figs. 3a and 3b, the results in H22 are in good agreement with those of this study.

Line 148: "The PRF varies from 7156 to 7500 Hz, with a corresponding SD_{random} of 1.5 to 3.4 for 0 to –19 dBZ_{e} (see Fig. 2 in H22). On the other hand, in the high mode, the PRF varies from

6106 to 6464 Hz, with a corresponding SD_{random} of 0.8 to 1.5 for 0 to –19 dBZ_e":
SD_random is lower for higher PRF.

RESPONSE:
We will correct in the revised manuscript as follows:
(before)
The PRF varies from 7156 to 7500 Hz, with a corresponding SD_{random} of 1.5 to 3.4 for 0 to –19 dBZ_e (see Fig. 2 in H22). On the other hand, in the high mode, the PRF varies from 6106 to 6464 Hz, with a corresponding SDrandom of 0.8 to 1.5 for 0 to –19 dBZ_e.

(after)
The PRF varies from 7156 to 7500 Hz, with a corresponding SD_{random} of 0.8 to 1.5 for 0 to –19 dBZ_e (see Fig. 2 in H22). On the other hand, in the high mode, the PRF varies from 6106 to 6464 Hz, with a corresponding SDrandom of 1.5 to 3.4 for 0 to –19 dBZ_e.

Page 8,
Line 167: "the Doppler accuracy should be higher in the tropics and lower toward the poles.":
In the tropics, high mode will be used (according to your description in line 89) that is characterized by lower PRF thus higher SD_random which contradicts what is written here.

RESONSE:
The statement in line 89 merely states what mode is used in nominal operation. However, for clarity, we will change our statement in the revised manuscript as follows:
(before)
From the PRF variation shown in Fig. 2, the Doppler accuracy should be higher in the tropics and lower toward the poles.

(after)
From the PRF variation shown in Fig. 2, in the PRF of the high mode (lower PRF), the Doppler accuracy should be higher in the tropics and lower toward the poles.

Line 169: "the frequency of precipitation echoes is considered to be the highest in the tropics, and the resulting folding Doppler error may have resulted in the largest SD_{diff} being in the tropics.":
please rephrase.

RESPONSE:
We will correct our statement in the revised manuscript as follows:
(before)
the frequency of precipitation echoes is considered to be the highest in the tropics, and the resulting folding Doppler error may have resulted in the largest SD_{diff} being in the tropics.

(after)
the frequency of precipitation echoes is considered to be the highest in the tropics, and the folding Doppler error may have resulted in the largest SD_{diff} in the tropics.

Line 174: "This may be related to the frequency of precipitation echoes":
Rather than the frequency, it is the intensity of the precipitation that matters. The strongest radar signal is expected to be observed for the most intense rain events that are characterized by the largest raindrops thus the largest terminal and Doppler velocities. Of course, the attenuation due to rain will result in a steep reflectivity decrease toward the ground but this does not change the fact that velocity folding occurs for the most intense rain.

RESPONSE:
In H22, Fig. 9(d) shows a 2D-histogram of the Doppler velocities after 10 km integration as a function of the Z_e. The velocity folding occurs even for 0 dBZ_e, indicating that the heavy rain with large Z_e does not make a significant contribution. Therefore, we consider the frequency of precipitation to be more important statistically.

Line 177 & 179: "for 5 dBZ_e":
Not clear what do you mean by 5 dBZe. Does it correspond to the reflectivity that exceeds 5dBZ?

RESPONSE:
Here, we mean the SD_{diff} with an echo intensity of 5 dBZ_e.

Page 9,
According to your description, high-PRF mode will be used for latitudes beyond 60 degrees and low-PRF mode for altitudes below 60 deg. Therefore, half of the presented panels are not necessary. Please consider removing them or make a note in the figure caption which mode is expected to be used in which zone.

RESPONSE:
As already mentioned, the description in line 89 only states what mode is used in nominal operation.

Page 10, "for 5 dBZ_e":
Figure 6, caption & Line 196: Not clear what do you mean by 5 dBZe. Does it correspond to the reflectivity that exceeds 5dBZ?

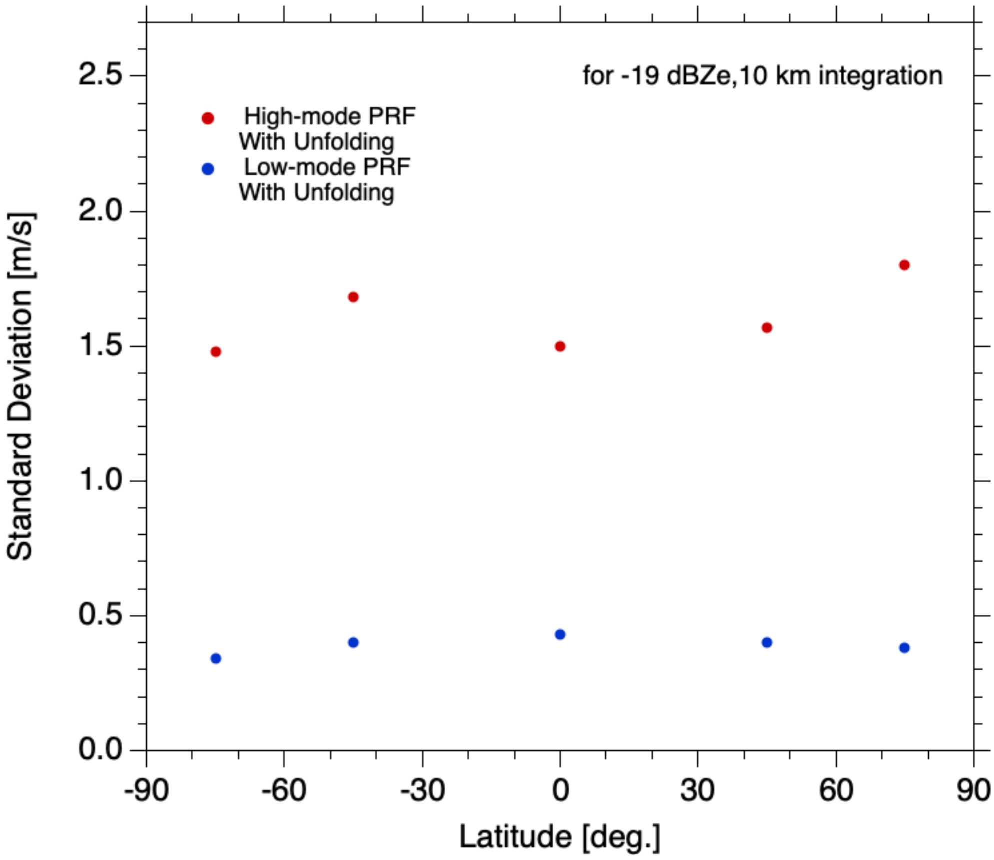
RESPONSE:
Here, we mean the values with an echo intensity of 5 dBZ_e.

Line 201: "due to the frequency of precipitation echoes":
As previously, I don't think it is the frequency of occurrence that matters but the rainfall intensity.

RESPONSE:
As stated in the reply to Line 174, we consider the frequency of precipitation to be more important statistically.

Line 201: "there would be no relationship between the latitudinal variation of SD_{diff} with unfolding correction and the frequency of precipitation echoes":
That is true only if only high SNR data are considered. The SD_diff depends on the SNR, thus the regions where weak radar echoes are observed often are characterized by higher SD_diff.

RESPONSE:
The latitudinal variation of SD_{diff} with unfolding correction for -19dBZ_e with relatively low SNR is shown below. As in fig. 6, there is no significant variation in latitude.



Line 242: "for 5 dBZ_e":
Not clear what do you mean by 5 dBZe. Does it correspond to the reflectivity that exceeds 5dBZ?

RESPONSE:
Here, we mean the SD_{diff} with an echo intensity of 5 dBZ_e.

Thank you very much.