Investigating the impact of spaceborne radar blind zone on surface snowfall statistics in polar regions

1. Motivation

CloudSat
- is the only source of global snowfall estimates derived from radar reflectivity (Ze at 94 GHz, 3.2 mm) profiles.
- cannot observe snowfall closer than 1200 m to the ground ("blind zone").

CloudSat shows the same statistics in terms of snowfall?

2. Data set

- Temporally continuous radar reflectivity profiles measured by ground-based Micro Rain Radar (MRR) at 24 GHz (12.4 mm)
- Sites in both hemispheres: Princess Elisabeth (PE) station in East-Antarctica and Ny-Alesund (NA), Svalbard. 1 year of data is analyzed.
- MRR Blind-zone: PE 400 m, NA 240 m

Do MRR and CloudSat show the same statistics?

3. Impact on reflectivity (Ze)

- 2D histograms (Fig.4 left) show only little change of Ze with height
- Detrended Quantile-Quantile plots (Fig.4, right) reveal that the distribution of Ze is shifted by up to 2.5 dB toward smaller values if measured at 1200 m.
- Reduction of blind zone by 50% leads to a reduction of the offset by more than a factor of 2 for PE, and in NA the remaining shift is negligible.

4. Impact on number of events (N)

- At 1200 m, the total number of events is underestimated by 5% to 6% (Fig.5).
- When investigating the total number of events, the better agreement due to a reduction of the blind zone cannot be seen:
  - change from underestimation to overestimation of 9% to 18%
- This change is more strongly pronounced at NA.
- The reason are most likely competing processes: virga and shallow precipitation.

5. Impact on precipitation (S)

- Change in both N and Ze contributes to the estimation of precipitation amount (Fig.6).
- For NA, the belly shape of N can be also seen in the total precipitation amount: underestimation at 1200 m, overestimation at 600 m
- For PE, such a belly shape is less clear, but still present.
- This shows that virga and shallow precipitation effects are probably partly overlapping at NA and PE.

6. Conclusions

- Blind-Zone has an impact on reflectivity, number of events and total precipitation:
  - effects differ in both hemispheres
- A lower blind-zone improves observation of reflectivity, but does not improve number of events and total precipitation.
  - Overlapping of different processes
  - Consider in future satellite missions
- More data needed to investigate spatial representativeness.

References
