

***Interactive comment on* “Comparison of airborne radar altimeter and ground-based Ku-band radar measurements on the ice cap Austfonna, Svalbard” by O. Brandt et al.**

Anonymous Referee #1

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Summary

This study compares ground-based GPR data and in-situ snow properties measurements with Airborne Radar altimeter data (ASIRAS) collected over the same sites to validate the data received from the airborne radar. They find that the waveforms of the ground-based radar and ASIRAS agrees well, but due to the lower bandwidth of the ASIRAS system, the surface response is integrated with near surface and off-nadir scattering from the upper ~30 cm of the subsurface. This interference with the surface return could potentially cause problems in picking the surface response. However, they suggest that the surface interface return should be located in the leading edge

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of the returned waveform and by using a simple 20% threshold re-tracker they get a good agreement with the ground-based radar measurements. They also show that the strongest reflections occur from a combination of a layer of larger crystals together with a thin ice layer and that the last summer surface gives rise to pronounced scattering.

General comments

I think it is an interesting study and can be to some use in validation of the airborne radar altimeters. They show that the returned waveform of the ground-based radar are similar to the airborne radar returns and "sees" the same thing, which is of course an important prerequisite for using ground-based radar in validating or calibrating the air- and satellite borne radars. However besides this, I do not find that the manuscript present much novel thoughts or discussion. Many of the conclusions are already established and are just shown in a different angle.

Furthermore, I think the authors needs to focus the manuscript. As it is now it tries to verify the agreement between ground and air radar waveforms, give explanations to the causes of the scattering horizons in the data and discuss problems with re-tracking, all in rather shallow analyses.

In general, I think the manuscript well written and the figures are easy to read and well presented. Although I think the manuscript could benefit from shortening considering that the scientific outcome is limited. Some parts of the manuscript could easily be shortened, especially paragraphs explaining established techniques and methods that could just be shortly described with relevant references.

Specific comments

Your manuscript aims at trying to verify that ground-based radar can be used as a validation tool for satellite and airborne altimeter radars. However, you include a comparison of snow-pit data with the radar data to be able to explain the origin of the scattering horizons in the radar data. This is of course is interesting and desirable for

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future interpretations, but I do not see the direct need for it for just verifying that the two waveforms are similar. Or do I miss something? The important thing to compare the two radar data sets is to have a common time base. I see of course that might be interesting in knowing more about the causes of the scattering horizons. But if you want to investigate the causes for the scattering horizons in a more satisfactory way I think you need complementary in-situ measurements, such as dielectric profiling, conductivity etc. and a more through analysis, but that would take the manuscript in another direction. I also do not see the need for a common depth scale (and the need of estimating wave velocities) for the same reason. Of course you need it if you want to compare the data with snow pit observations.

You state that the greater bandwidth of the ground based radar (8GHz) show that the first peak in the airborne data is a composite of the return from the surface and within ~ 30 cm below the surface and that the peak position in the airborne data is not necessarily a good proxy for the surface. As I understand, this has already been studied and reported (Scott et al, 2006b reference in your paper). Although in their paper, they were just using ground-based radar, but I do not see that the physics behind this phenomenon should differ much and make your conclusion unique. It would be good if you could clarify in the manuscript how your findings differ from those of Scott et al. (2006b). Also, that off-nadir scattering can interfere and degrade resolution is fairly well known and something you should expect. However, I think it very good that the authors point to this as it is often overlooked.

Interactive comment on The Cryosphere Discuss., 2, 777, 2008.

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