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www.atmos-meas-tech-discuss.net/6/C2200/2013/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Interpretation of observed microwave signatures from ground dual polarization radar and space multi frequency radiometer for the 2011 Grímsvötn volcanic eruption" *by* M. Montopoli et al.

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General:

The paper analyzes simultaneous observations of a volcanic ash plume with ground based radar and space borne passive millimeter wave sensors. The study is a significant contribution to the ongoing discussion on the development of volcanic ash monitoring systems in order to meet needs in various fields ranging from climate research to air traffic management.

» Reply: We are grateful to the reviewer for his/her useful suggestions. We modified the paper to better highlight the potentials role of polarimetry in radar volcanology as suggested by the reviewer.

Specific: In the introduction "... the role of the radar polarimetry for quantitative estimation of ash plume" is mentioned as "One of the original elements of this work....". After this announcement some more elaboration of this aspect is expected. This lack is particularly striking in the comparison between the DPX- and SPC-based estimates of ash-TCC. Differences between these estimates were attributed to various effects, but the availability (resp. not-availability) of polarimetric variables is surprisingly not mentioned in this discussion. This provokes for example the question how the SSMIS-DPX regression would be related to a SSMIS-SPX regression. "SPX" means using only the x-band reflectivity, and ignoring the polarimetric variables.

» Reply: We agree with the reviewer regarding the lack of elaboration of the role of radar polarimetry. We quantitatively compared two cases: the radar retrievals when only Zhh is used (SPX case) and when KDP and RHOHV are additionally used (DPX case). Fig. 1 of this reply shows the ash categories and concentrations in the two aforementioned cases. The main difference is due to the presence of the Large Lapilli (LL) category at the lower altitudes of the core plume when DPX case is assumed (top right panel). LL is not recognized when only Zhh is used. In terms of correlation between the SSMIS Brightness temperature (BT) and the total columnar content (TCC), it remains almost unchanged for both cases SPX and DPX (not shown). The correlation coefficient decreases to 0.67 in the case of SPX from 0.73 registered in the DPX case. Nevertheless, the distribution of the difference of TCC values between SPC and DPX ranges over -1 and 8.20 kg/m2 as shown in figure 2 of this reply. Thus, it seems that the use of the radar polarimetry has an evident impact on the radar-derived integral columnar content of ash even though this does not sensibly affect the correlation between TCC and BTH. We modified the main text including some of the points just discussed in the result section but we did not added figures in the manuscript.

At any rate, a substantiation, to which extent this study revealed the added value of polarimetry, should be provided in a final version.

» Reply: To discern if the use of polarimetry gives an added value in radar volcanology we would need of an independent reference source of information within the ash cloud in proximity of the volcano vent which is so far not available in our knowledge. What we can conclude in our study is that the use of the polarimetric variables seems to provide a better ash categorization as evidenced in figure 1 of this reply. The presence of Large lapilli below 8 km of altitude seems to be reasonable for the analyzed eruption. We further discussed this point within the main text in the result and conclusion sections.

Technical:

1. The language should be checked by a native English speaker.

» Reply: We revised the paper to improve the language.

2. p6218,l 6: "...provide information to..." should probably read "...provide information on..."

» Reply: Corrected

3. p6218, l11,12: I suggest to replace

"... thus limiting impractical or even dangerous conditions to perform in situ sampling." by "... thus avoiding impractical or even dangerous conditions of in situ sampling."

» Reply: Corrected

4. p6219, l8: thought → through

» Reply: Corrected

5. p6220, l10: "sections" → "subsections"

» Reply: Corrected 6. p6221, eq.1, l.16: KP is the dielectric factor of spherical water drops. The actual properties of the scattering particles is included in SXXb.

» Reply: Corrected

7. p 6223, l2: "....radar volumes are processed..." →"...radar signals are processed..."

» Reply: Corrected

8. p 6224, l14: "thought" →"through"âĂĺ

» Reply: Corrected

9. p 6226, l 8: "Plank's" -→"Planck's"âĂĺ

» Reply: Corrected

10. p 6231, l 17: "thought" →"though"

» Reply: Corrected

11. p 6232, l 12: "from the North" may be omitted

» Reply: we prefer to leave it to do not cause confusion even though this may lead to redundancies.

Table 1: Equations 1 to 4 are defining expectation values. Therefore, I suggest adding in table 1 the averaging time used for retrieving the variables on the left hand side of eq. 1 - 4. Particularly rho_HV is meaningful only as a time average.

» Reply: For the analyzed case study the PRF and the number of sampled pulses was 550 Hz and 23, respectively (Ronald Hannesen and Andre' Weipert, International WorkshopâĂĺon X-band Weather Radar 14th - 16th November 2011 Delft, Netherlands). Using the aforementioned values, The integration time results to be Number_of_sampled_pulses/PRF=41.8 ms. We added the number of sampled pulses in table 1 whereas in the main text we mentioned the aforementioned integration time. Table 1 has been further modified listing the actual values used for the analyzed data.

Note: See supplement file for the modified manuscript.

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/6/C2200/2013/amtd-6-C2200-2013-supplement.pdf

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Interactive comment on Atmos. Meas. Tech. Discuss., 6, 6215, 2013.

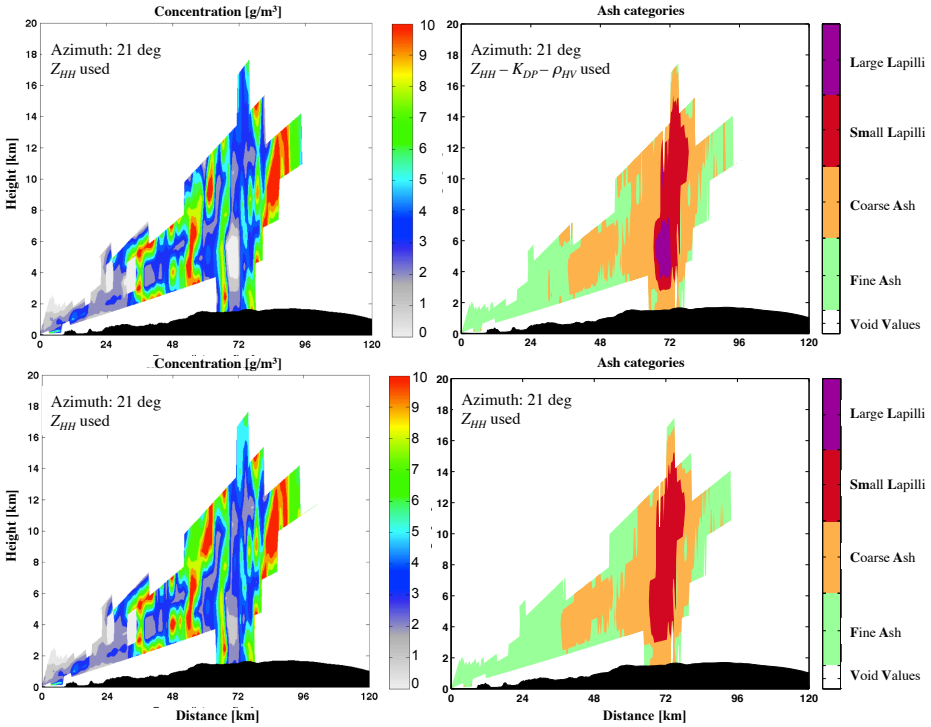

Fig. 1. Top panels: radar retrieval of ash concentration (left) Ca (g/m3) and ash category retrieval (right) when polarimetry is used. Bottom panels: the same as in the top panels but when polarimetry is igno

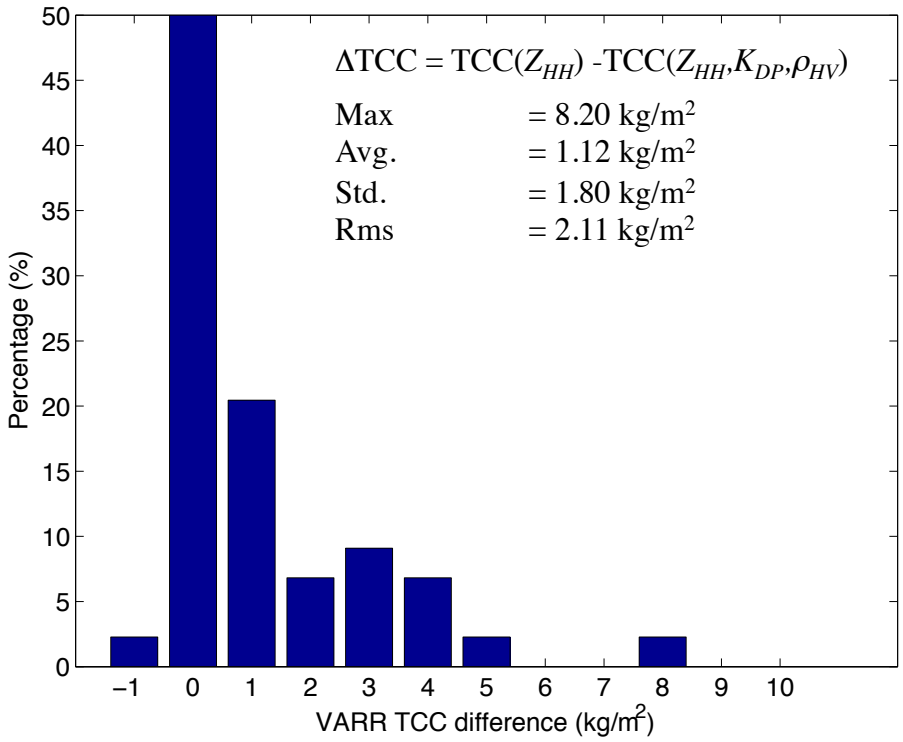

Fig. 2. Distribution of TCC difference as in the figure legend.