Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-72-RC1, 2016

Atmospheric Measurement Techniques Discussions

Interactive comment on "Differential Absorption Radar Techniques: Water Vapor Retrievals" *by* Luis Millan et al.

Anonymous Referee #1

Received and published: 6 April 2016

The paper is an extension of work by Lebsock et al (2015). In the present paper, a much more detailed error model is used to evaluate the method. The authors also consider different wavelength combinations to optimize the retrievals under clear, cloudy and rainy conditions. I found the paper to be informative and well written. I was interested to find that the 'most persistent potential bias is due to the water vapor line width uncertainty' (p. 6).

I recommend publication. There are, however, several issues below that the authors should address.

For the Ku- and Ka-band DPR radar aboard the GPM satellite, the standard deviation of the normalized surface cross section, NRCS, is quite high over land at nadir and near-nadir incidence at both frequencies – greater than 5 dB in many cases. Over ocean

and off-nadir incidence over land, the standard deviation is much smaller, usually on the order of 1-2 dB. I'm less familiar with this variability for CloudSat but the authors should know these data well; I'm surprised not to see this as part of the uncertainties listed in Table 2.

On the other hand, since the measurement is differential, I would expect the errors caused by variations in the NRCS to be much less since the quantity of interest is the variance of the difference rather than the variance of either NRCS alone. This suggests that the quantities that need to be specified are the variances of the NRCS and the correlation coefficient, p, of the NRCS at the two frequencies. Although I would expect p to be close to 1, this value, as well as the variance, will be a function of incidence angle, surface type and frequency separation and could be important parameters to be considered in the radar design.

For range profiling, the analogous assumption to constant or known variation in the NRCS is that the radar reflectivity factors be constant at the two frequencies (Z(f1)=Z(f2)). Although for most clouds, this assumption is reasonable, under raining conditions, I would guess that the assumption is problematic and that this is the main reason for choosing the frequencies to be close together (169, 172 GHz). Is this correct? A plot of the difference Z(f1)-Z(f2) versus f2-f1 (for a center frequency of, say, 170 GHz), using one of the rain or snow PSD's in the table, would be useful.

Is the focus around 183 GHz rather than around 22 GHz because of the larger dynamic range available at 183 GHz or is it because of an interest in cloud profiling rather than rain profiling? Or is it because there are more cloudy regions than raining regions? Although the issues of cloud detection and estimation are not discussed, I assume that the objective is to retrieve cloud parameters as well as water vapor.

p. 2, line 27: 'dielectric factor' rather than 'dielectric constant' – dielectric factor is a function of the dielectric constant but not identical to it.

p. 4, line 9: 'close to the 183 GHz . . .'

p. 5, lines 17-18: ‘The strength of the surface reflection ..’ But this strength depends on surface type and incidence angle that will affect the dynamic range.

p. 6, line 4: ‘used’ rather than ‘use’.

p. 8, line 28: ‘to develop’; ‘to characterize’.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-72, 2016.