REPLY TO REVIEWER 1

Below you find a point to point response with the **reviewers points in bold**, *italic texts* are excerpts from the new version of the manuscript.

The simulations and results are interesting, however the largest differences result from mostly unrealistic values of the radiometric specifications/operations. Radiometers with larger beamwidth (> 6 degrees) can't be expected to scan low elevation angles because of the risk of spurious intrusions in the field of view. Therefore only radiometers with narrow beamwidth should be considered for operations at low elevation angles. In addition radars have very narrow beamwidth making the interpretation of coincident measurements difficult unless the characteristics of the instruments are reasonably close. If we consider ground-based radiometers whose beamwidth allows scanning at low elevations (FBHW<3.5 degrees) and that could be used in conjunction with radar operations the differences in the simulations are of the order of fractions of degrees.

Among the instruments listed in Table 1 the ASMUWARA has the largest beamwidth. However, with a 10-degree beamwidth, the ASMUWARA wasn't probably designed for scanning at low elevation angles. Usually radiometers with large beamwidth employ algorithms that correct for the beam approximation (E.g. [1], [2]). But even with corrections the interpretation of the data in relation to the radar narrow beamwidth would be difficult.

The beamwidth of V-band channels is generally less than 2.5 degree in all currently available ground-based radiometers. Based on Fig. 13 the effect would then be in the noise level at all elevation angles. So the 8 K overestimation mentioned in the summary refers to a channel at 50 GHz with a 10 degree beamwidth. I don't think any of the radiometers currently built meets that specification.

Similarly the 11 K bias mentioned in the summary for the W-band channels corresponds to a radiometer with 10-degree beamwidth. This is unrealistic in the W-band. Actually most of the W-band receivers have beamwidth of less than 2 degrees, which again would not cause a large effect based on Fig. 13.

We appreciate the point of the reviewer. Indeed the radiometer specifications in Table 1 indicate that K-band beam width can have very large beam width but most are below 6°, while the V-band and W-band are generally below 3°. Therefore we modified Table 3 and the in text descriptions to reflect limitations of real radiometer systems. The Table now reads as:

Table 3. Summary of the range of biases in clear air for elevation angles above 4° in TB (in K) associated to each effect (bandwidth (100 – 1000 MHz), beam width (0.5 - 10°), refractivity, and earth curvature) for each set of frequencies and each sounding. Entries with long dashes represent values that are below any instrument measurement capability.

	Mid-latitude summer		*Mid-latitude winter*		*Subarctic summer*		*Tropical summer*	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
Bandwidth K-band	*1.5*	*-0.8*	*1.4*	*-0.6*	*1.4*	*-0.7*	*1.5*	*-0.7*
Bandwidth V-Band (peaks)	*8*	*-2*	*7*	*-2*	*8.5*	*-2.5*	*7*	*-2*
Bandwidth W-Band	–	–	–	–	–	–	–	–
Beam width K-band (4°HPFW)	*0.5*	*-5*	*0*	*-4.5*	*0.5*	*-5*	*2*	*-2*
Beam width V-band (3°HPFW)	*1.1*	*-0.2*	*1.2*	*-0.2*	*1.2*	*-0.2*	*1*	*-0.2*
Beam width W-band (3°HPFW)	*1.5*	*-0.5*	*0.6*	*-1.5*	*1.6*	*-0.6*	*0.7*	*-0.2*
Refractivity K-band	*0.5*	*0*	*0*	*-1*	*0.25*	*-0.4*	*0.9*	*0*
Refractivity V-band	–	–	–	–	–	–	–	–
Refractivity W-band	–	–	–	–	–	–	–	–
Curvature K-band	_	*-5.4*	_	*-6.1*	_	*-5.9*	_	*-4.6*
Curvature V-band	_	*-1.1*	_	*-1.3*	_	*-1.2*	_	*-0.9*
Curvature W-band	_	*-0.7*	_	*-5.4*	_	*-1.6*	_	*-0.9*

(P. 33, L. 1 - 6)

I have also re-done the beam width analysis to include only beam width of 3° half-power Full width (HPFW) for V-band and W-band and 4° HPFW for K-band or smaller beam widths.

“*In the previous section, all bandwidths could reasonably be considered for all elevation angles and all frequencies. This is not necessarily the case for the beam width effects. At K-band, there are radiometers that have a 10° beam width, but these radiometers are generally not used to scan at low elevation angles. In other cases, such as V-band and W-band, radiometers seldom have beam width larger than 3°. The results shown in this section will reflect these considerations: the errors only will be mentioned for beam width smaller than 4° HPFW in K-band and 3° HPFW in V-band and W-band.*” (P. 17, L. 5 - 10)

<u>On the addition of a set of requirements</u>

In my opinion the study would be more valuable if, to summarize the simulation exercise, the authors could determine a set of requirements (for example frequencies, desired noise level, optimal bandwidth/integration time, beamwidth and lowest scanning elevation) necessary to achieve a meaningful synchronized coordination of operations between a radiometer and a radar, then work out the uncertainties and biases and then come up with a possible optimal design.

For example the choice of narrow non-overlapping bandwidth in most profiling radiome- ters is due to the fact that they sample high-resolution channels on the shoulder of the absorption line to obtain a vertical profile. For a radar-radiometer coordinated opera- tions if profiling is necessary then one can’t enlarge the bandwidth arbitrarily. If profiling is not necessary then there could be a set of optimal frequencies that allow the opti- mization of the design (i.e. larger bandwidth, choice of appropriate beamwidth, noise optimization, etc.).

This study is not meant to say anything about the choice of frequencies (for that Scheve and Swift (1999) have did some work) nor does it say any thing about the radiometer noise figure and lowest scanning angle. However, a summary paragraph was added for the beam width and bandwidth results:

“*The errors of beam width and bandwidth found in this paper are the bias errors caused by using the zero beam width and bandwidth approximation in the radiometric forward model. These biases indicate by how much this approximation is no longer valid and must be compensated for by using corrections. A good estimate of the accuracy of brightness temperature measurements from microwave radiometers is 0.5 K. Therefore, the largest bias errors caused by omitting either the beam width or the bandwidth that could be acceptable without the need to correct for or take into account these characteristics should ideally be less than half of the accuracy of brightness temperature measurements. For existing commercial radiometers, this occurs at elevation angles smaller than 25° for all frequencies for the beam width effect (3° HPFW) and at all elevation angles for bandwidth effect (400 MHz).*” (P.26, L. 11 - 20)

Scheve, T.M. and Swift, C.T.: Profiling atmospheric water vapor with a K-band spectral radiometer, IEEE Trans. Geosci. Rem., 37, 1999.