The authors should make clear the limitations of the bias calculations from the sun scan measurements. From the sun one can establish the overall gain bias, but the antenna effects although included are not equivalent to the antenna effects that are present in the two way measurements. There are some key assumptions that underpin bias measurements with the sun scan. These are not articulated in the paper. Here I list the constraints.

The measurement of sun flux for calibrating Zdr implies that in the ratios of powers at the two polarizations due sole to the antenna effects

$$\frac{P_h(antenna\ one\ way)}{P_v(antenna\ one\ way)} = \frac{g_h \int_\Omega s_h(\theta,\phi)\, f_h^2(\theta,\phi) d\Omega}{g_v \int_\Omega s_v(\theta,\phi)\, f_v^2(\theta,\phi) d\Omega}\ , \qquad (1)$$

can be estimated precisely. Ω is the solid angle centered on the sum (on which the beam is centered too), integration is mainly over the main beam, the $s_h(\theta,\phi)$ is the distribution of sun flux within the beam for the H polarization, $s_v(\theta,\phi)$ is for the V polarization; on the average these are equal; g_h and g_v are gains, and $f_h^2(\theta,\phi)$, $f_v^2(\theta,\phi)$ are one way power pattern functions. Equation 1 is part of the computation of the differential reflectivity (hence bias) in the proposed method. The actual antenna bias is due to the two way antenna effect. The pertinent equation is

$$\frac{P_h(antenna\ two\ \mathrm{way})}{P_v(antenna\ two\ \mathrm{way})} = \frac{g_h^2 \int_\Omega f_h^4(\theta,\phi) d\Omega}{g_v^2 \int_\Omega f_v^4(\theta,\phi) d\Omega} \qquad (2)$$

The bias on receive $Z_{dr}^{(R)}$ can be conveniently written as

$$Z_{dr}^{(R)} = C_r \frac{g_h \int_\Omega s(\theta,\phi)\, f_h^2(\theta,\phi) d\Omega}{g_v \int_\Omega s(\theta,\phi)\, f_v^2(\theta,\phi) d\Omega} = C_r \frac{g_h K_{h1} B_{h1}}{g_v K_{v1} B_{v1}} \qquad (3)$$

The C_r is receiver bias and B_{h1}, B_{v1} are beam cross sections, say at the 6 dB levels below the peak. Note that the assumption behind (3) is that the main lobe of the beam is well represented with a two dimensional Gaussian function such that the beam cross sections at the horizontal and vertical polarizations are related to the integrals via

$$K_{h1} B_{h1} = \int_\Omega s(\theta,\phi)\, f_h^2(\theta,\phi) d\Omega, \ \text{ and } \ K_{h2} B_{v1} = \int_\Omega s(\theta,\phi)\, f_v^2(\theta,\phi) d\Omega\ ; \qquad (4)$$

K_{h1}, K_{h2} are constants of proportionality that relate the integrals to the beam cross sections, and the beam is centered on the sun.
From the radar equation the measured Z_{dr} assuming homogenous isotropic scatterers is

$$Z_{dr} = C_t \frac{g_h^2 \int_\Omega f_h^4(\theta,\phi) d\Omega}{g_v^2 \int_\Omega f_v^4(\theta,\phi) d\Omega} C_r = C_t \frac{g_h^2 K_{h2} B_{h2}}{g_v^2 K_{v2} B_{v2}} C_r = C_t \frac{g_h^2 K_{h2} a_h B_{h1}}{g_v^2 K_{v2} a_v B_{v1}} C_r\ . \qquad (5)$$

Here C_t is the bias on transmission and it excludes the antenna effect. It is assumed that the beam is filled with uniformly distributed scatterers. B_{h2}, B_{v2} are the cross sections of the two way antenna patterns and K_{h2}, K_{v2}, are the proportionality constants relating the beam cross sections to the integrals of the two way patterns. For Gaussian patterns it follows that $B_{h2}= a_h B_{h2}$, where a_h is a constant; similarly $B_{v2}= a_v B_{v2}$. For convenience write (5) as

$$Z_{dr} = C_t \frac{g_h K_{h2} a_h}{g_v K_{v2} a_v} \frac{g_h B_{h1}}{g_v B_{v1}} C_r \ . \qquad (6)$$

The bias due to the receiving path $\frac{g_h B_{h1}}{g_v B_{v1}} C_r$ lacks the proportionality constants K_{h1}, K_{v1} which are in (3) and are estimated from the sun scan. But these two should be very close. On the transmission side the antenna part $\frac{g_h K_{h2} a_h}{g_v K_{v2} a_v}$ is not known. This ratio should be very close to 1. The constants of proportionality for the H and V parts should be equal. And if the gains g_h, g_v are close, the sun calibration can indeed provide a good estimate of the bias. Note that the beam cross sections used in the assumptions need to be equal but need not be completely overlapping. For example two elliptical cross sections could have major axis not aligned, for example orthogonal. One can quantify (or set limits) on how well can the sun scan be used for calibration by comparing the $g_h B_{h1}$ to $g_v B_{v1}$ (take the ratio in dB). That is done next for the five radars.

Going back to the paper I examined the values from table 1. So I compute the G_h-G_v + 10*log[H(el,H) H(az,E)]-10*log[V(el,E) V(az,H)]; that is ($g_h B_{h1}$/ $g_v B_{v1}$) in dB scale and obtained: -0.045, -0.03, -0.182, 0.12, -0.015 for the five radars respectively. Thus I conclude that for the radars No 1, 2, and 5 the sun scan could provide bias to within ± 0.1 dB.

Some other comments:

If the radar is scanning the sun the position is wider in azimuth because the effective beamwidth is larger.

You state “uncorrected”. It is clearer to indicate that “Ground clutter had not been applied to the data, and noise power has not (or has?) been removed.” Uncorrected is confusing and strictly would mean that you had correct data and then you “uncorrected it”.

Page 14, line 5: Remove “because”
Page 16, line 5: “one months of data”

Fig. 5 not clear – Caption states “Probability” whereas on the axis I see “Power fraction”.

Caption Fig. 2 end sentence you repeat the.

Sentence on page 5 “In addition solar hits with standard deviation much larger than that expected for a solar hit (e.g. three times larger) have been rejected.” Is this really what you are doing? If so how are you computing the standard deviation, local running average in azimuth at a constant altitude, or else? Or, do you really mean the data that deviate by thee standard deviations from the mean are discarded?