

# ***Interactive comment on “Validation of Clyde River SuperDARN radar velocity measurements with the RISR-C incoherent scatter radar” by Alexander Koustov et al.***

## **Anonymous Referee #2**

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Review of “Validation of Clyde River SuperDARN radar velocity measurements with the RISR-C incoherent scatter radar” by Alexander Koustov, Robert Gillies and Peter Bankole

This paper is the latest of a long series of papers that compare HF and IS velocity measurements with the aim of ascertaining whether F-region HF velocity measurements are representative of the ExB drift – and if not, why not. This endeavor is both interesting and useful, and this paper makes a solid contribution to that body of work. The paper is generally clear - although slightly awkward in places - and concise. The figures are clear and attractive, and supportive of the conclusions reached. In the ref-

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eree's view, the paper is well worthy of publication, preferably once a few minor comments have been taken into consideration (just to ease readability of the manuscript).

Line 13 : "eastward plasma flow component" instead of "plasma flows eastward component" Line 14 : "effects of smaller HF velocities even at smaller velocities" is a little unwieldy Line 15 : suggest "...differences in eastward velocities between the two instruments..." Line 23 : is it worth mentioning here that echoes are not only from the F-region? Line 27 : Davies et al., 1999 (not Davis) Line 27 : Perhaps worth adding Davies et al. (2000) *Annales Geophysicae*, 2000, 18 (5), pp.589-594 Line 28 : Sentence starting "These observations...". Please clarify what is meant by the "SuperDARN principle in plasma flow measurements." You mean that F-region irregularities travel roughly with the  $E \times B$  flow? Line 32 : Collecting area was only one of a few suggestions for the discrepancy proposed by Davies et al. (1999) Line 33 : "It is accepted now that the HF velocities \*in the F-region\* are generally smaller (Gillies et al., 2018)." Line 34 : "SuperDarn measurements are interpreted under the assumption" is perhaps clearer Line 37 : "HF velocity magnitudes are" Line 44 : "Despite obvious progress" Line 49 : "Undertake validation work" Line 54 : "We take here advantage of the availability of  $E \times B$ " Line 56 : "An important aspect of the present work is that we compare CLY and ISR-based velocities in a different way as compared to the previous studies..." Line 60 : "none of these radar's beams are close enough \*in terms of their direction\*" Line 65 : "spatial domain" Line 69 : Sentence starting "These are inferred..." would benefit from clarification. Line 75: "...value from the..." Line 76 : "...The RISR method of velocity vector estimations..." Line 80 : "...both radars'..." Line 81 : remove highly Line 88 : hereafter (rather than starting from here) Line 92 : perhaps use "bin size" instead of step throughout Line 93 : "The points to which the measurements are assigned." Fig caption 1 : The black straight lines are the orientation of specific beams (4-6 for CLY), data from which are investigated. Fig caption 1 : The solid red arcs are the magnetic latitudes of 75°, 80° and 85°. Line 105 : "(along their centers) and the area \*from which\* data were considered," Line 110 : eastward Line 118 : "On the days when the radar was operational it typically worked for the

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whole 24 hours, albeit switching, once-in-a-while, its mode. . .” Line 124 : “. . .also available.” Line 125 : “. . .measurements as a function of UT. The number of intervals. . .” Line 125 : perhaps “from noon to dusk” rather than during noon-dusk time. Line 130 : perhaps it is worth clarifying the means by which ground scatter has been identified for removal. Line 131 : “. . .select a 5-min. . .” Line 132 : geographic latitudes? Line 133 : “and compute the median. . .” Line 134 : “. . ., as mentioned above.” Fig caption 2 : “for all data considered” perhaps? It may be clearer to use “data points” than “data intervals”, even though they are 5-mins long. . . Line 146 : “Although some spread is present, a significant number of points are located. . .” Line 146 : Instead of “bisector of perfect agreement”, perhaps use “line of equality” throughout(or 1:1 line). Line 148 : “. . .we binned the CLY data according to the RISR measurements, using 100-m/s bins of the latter.” Line 149 : “Data binned in this way are shown. . .” Line 149 : Median? Fig caption 3 : The standard deviations are not very clear on the plot. Why use median and standard deviation, not median and quartiles? Fig caption 3 : “. . .but the eastward flow component” Line 163 : “Good alignment with the bisector and good correspondence between the location. . .” Line 167 : “If one \*describes\* the dependence by a linear fit line between velocities of +/- 1000 m/s, the slope of the \*fitted\* line is ~0.65.” Line 172 : “We restrict consideration. . .” Line 172 : “Here the SuperDARN convection vectors are available at geomagnetic latitudes of 80.5° - 81.5° and ~ 7° of magnetic longitude.” This is the same region as for the LOS comparison, right? It is worth mentioning here what SuperDARN radars are included, just to ensure that it is clear it is not just CLY data. Line 175 : “grid node locations” Line 177 : eastward (not astward) Line 180 : “because the RISR” Line 182 : “(which is usually 2 min)” Line 184 : “the start times of RISR measurement intervals were often irregularly spaced, while the SuperDARN maps were synchronized to exactly correspond to 5-min boundaries (i.e. 0-5 min, 10-15 min, etc). ” Line 186 : “For comparison, only HF and ISR data that were less than 2 min apart were considered.” Line 189 : “For RISR, the eastward  $E \times B$  velocity component is usually available at all points shown by open circles in Fig. 1.” Line 193 : “All obtained data pairs were entered into a common dataset.” Line 201 : “Figure 3b

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plots eastward component of the plasma flow from the two systems. The spread of the data. . ." Line 202 : "We assessed Fig. 3b by binning the data in the same way as for Fig. 3a, see open circles." Line 202 : "Several results from Fig. 3b are consistent with the data of Fig. 3a. Line 207 : "If one describes the dependence by a linear fit to the velocity medians in bins (open circles) between +/- 1000 m/s, the slope of the fitted line is 0.54." Line 208 : "Secondly, the tendency for the SuperDARN velocity being smaller is greater for larger RISR magnitudes." Line 208 : "show opposite velocity polarity" – "show oppositely directed flows", perhaps? Line 212 : "Although Fig. 3 shows good consistency of the data provided by the two radar systems, the differences can be as large as a factor of 2 in individual measurements." Line 214 : delete "highly" Line 219 : "broader area over which the SuperDARN data are averaged for the 2-D comparison" Line 220 : "In this case, there is more chance for SuperDARN to include ground-scatter. . ." Line 227 : One popular opinion about SuperDARN velocity measurements is that the systematic "underestimation" of the velocity by the HF radars is due to the index of refraction being assumed to be unity." Line 227 : "A plot similar to Fig. 3a" Line 232 : "The plot looked very similar to Fig. 3a." Line 234 : what does "except the slope is not quite close to 1" mean? Other studies has a slope closer to 1? Line 236 : ". . .plotted R from the RKN SuperDARN radar against UT" Line 239 : ". . .observed near local solar noon and during the afternoon hours. . ." Line 240 : "It is therefore expected that the velocity ratio R would be smallest during these times. . ." Line 240 : " (but not as strong as they were near noon)" Line 246 : "incorrectly" not "not correctly" perhaps Line 250 : "It is lower during daytime (noon is at about 19:00 UT) than during dawn/prenoon (12-18 UT). . ." Line 264: Please clarify the comment about lateral deviations of CLY beams giving both smaller and larger deviations. Line 275 : "in THE case of A" Line 276 : ". . .smaller than in the case of a uniform. . ." Line 278 : "The RISR radar would average the velocity in patches of enhanced. . ." Line 278 : Do you mean average the velocity in those patches together (not equally)? Line 283 : "decreased, so that they would show" Line 285 : "the opposite" Line 288 : "Such points are occasionally seen. . ." Line 290 : "Figure 3 also shows such points but, in general,

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the data agree fairly well” Line 290 : “Although the work of Kustov. . .” Line 291 : clarify what is meant by “the effect” Line 292 : “. . .it could partially be due to the aforementioned effect of ionospheric. . .” Line 296 : “mixed ionospheric and ground scatter” Line 300 : “have to remind the reader that. . .” Line 300 : obvious period of ground scatter have been removed : again, what thresholds are used. Line 300 : presumably obvious ground scatter is removed from all figs. . . Fig 5: Are the diamonds really red? Line 314 : “one CLY scan” Line 315 : “during the above event.” Line 315 : perhaps in the poleward and equatorward portion of the FOV, rather than high and low number beams. Line 319 : originating instead of originated Line 319 : “as well as those from CLY. . .” ? Line 320 : “near noon”, rather than “at near noon hours” Fig 6 : convection map (not maps) Line 326 : “. . .are sunward, roughly along the magnetic meridian, near noon, signifying. . .” Line 327 : remove highly Line 330 : “the extent that” Line 331 : “We can see that the centres. . .” Line 331 : many cases? Many maps, do you mean? Line 335 : “To investigate this further. . .” Line 337 : “velocity scan maps” : maybe LOS velocity map (as used before) Line 339 : “the CRB inferred from SuperDARN maps is located almost 2 degrees higher in MLAT than that determined from both CLY velocity maps and RISR data at the. . .” Line 340 : “The fact that the CRB from CLY velocity maps is closer to that inferred from RISR data hints that the SuperDARN. . .” Fig 7: in various beams? Which ones? Line 353 : “Resolute Bay incoherent scatter radar (RISR).” Line 360 : “approach. Namely, we considered the eastward component of the ExB. . .” Line 364 : “draw several conclusions” Line 266 : Conclusion 1 should be combined with conclusion 6 as the “final conclusion”. Line 279 : “nighttime, but not daytime.” Line 384 : Could the RISR electron density measurements be used to test if this is true on a statistical basis? Line 386 : “compared to”

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