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Comment on angeo-2021-26

Anonymous Referee #3

Referee comment on "Space weather study through analysis of solar radio bursts detected by a single-station CALLISTO spectrometer" by Theogene Ndacyayisenga et al., Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2021-26-RC3>, 2021

The review of the manuscript: Space Weather Study through Analysis of Solar Radio Bursts detected by a Single Station CALLSTO Spectrometer

By Ndacyayisenga et al.

The manuscript presents the single station CALLSTO Spectrometer observations in Rwanda. The authors present different types of radio bursts but do not provide even convincing hypothesis how the radio emission can be employed in the space weather diagnostics. Further, the study presented in this manuscript is very biased regarding the event selection. The sensitivity of CALLISTO instrument is quite low, which indicates that only strong and intense radio bursts will be observed while weak events will be not detected. This effect is enhanced with strong RFI disturbances in the considered observations. As a result, in particular all the type II bursts are very intense events and therefore associated with both flares and CMEs.

Unfortunately, it seems that the authors do not fully understand the subject they are addressing. They talk about geoeffectivnes and arrival of the disturbance to Earth, but they do not even mention in situ observations. In the manuscript the question on, how the CME arrival to Earth was estimated and how the associated radio emission helps in that was not addressed. Further, the identification of jets in the presented figure in not correct. Even associations of different types of the radio bursts with eruptive events, such as CMEs and flares is not clear and is some cases incorrect. Figures are also not good, sometimes distorted, but also misinterpreted. Additionally, English language of the manuscript is also quite bad. Due to all mentioned issues, and also the point that the manuscript does not bring any new results, I cannot recommend publication of this manuscript. My suggestion is rejection.

Unfortunately, I cannot induce the authors to work on the manuscript improvements. I

support the idea of the authors to promote their observations, however then the scope of the manuscript needs to be very different. I have provided numerous detailed comments of the manuscript, hoping that will help to the authors to understand what is the problem in the manuscript and how to address it next time.

Some general comments:

- Employed data set suffers from the preselection effects. The sensitivity of CALLISTO instrument is low, which indicates that only strong and intense radio bursts will be observed while weak events will be not detected. This effect is enhanced with strong RFI disturbances in the considered observations. As a result, all studied radio bursts, all the type II bursts are very intense events. In a case of type II bursts this will result in the 100 % association with both flares and CMEs. The problem of the instrument sensitivity needs to be discussed and data should be compared with observations of some other instrument (other than CALLISTO).
- The explanation on how the association of studied radio events and CMEs/flares is not present at all. When the authors consider radio emission is associate with eruptive event? What is the time window they use?
- Further, I do not really see how presented study is related to Space Weather. There is no explanation in the manuscript which criterial are used to associate radio bursts and the possible geomagnetic impact.
- Number of definitions is incorrect, e.g. association of the type IV burst and the sock wave... Some figures are not well done and some are incorrectly interpreted.

Detailed comments:

Introduction:

Page 1, line 20: Abbreviation "CMEs" needs to be introduced.

Page 2, line 25: The authors write: "they are generated when solar flares send electron beams streaming into the heliosphere via plasma mechanism". This statement is not completely correct, the electron beams generated during the flaring process propagate along open or quasi-open magnetic filed lines and they can induce Langmuir waves which will the cause the radio emission at plasma frequency and/or its harmonic.

Page 2, line 26: The authors write that type III bursts duration is 1-3 s. However, as duration of the type IIIs depends on the observing frequency it is necessary to specify the frequency range together with the durations.

Page 2, line 27: The authors say: "The impulsive ñares in X-ray and/or H α frequencies..." It should be x-ray and Halpha wavelengths.

Page 2, line 31: The authors already used abbreviation "CME" so no need to use the full name.

Page 2, line 36: The authors should also mention very important and recently refurbished Nançay observations.

Page 2 footnote 3. The link for the "callistoQuicklooks" does not work.

Page 3, line 58: What does mean 'through a channel of 80.9 MHz to 45 MHz?

Table 1: The authors do not define when they consider the radio burst to be "associated with flares and/or CMEs". What is the time window in which two phenomena are considered to be related?

Page 4, line 75: The authors state wrongly: "type IV bursts may be due to small-scale feature events present in the solar corona. First, the type IV bursts are generally associated with CMEs, so they cannot be put in the same category as type III bursts that are not flare associated. Second what are 'small-scale feature events'? Do the authors refer to nanoflares, small scale reconnection events or something else?

Page 4, line 78: The authors write incorrect, type II bursts and not type IV radio bursts are triggered by CME-driven shocks. The type IV emission is considered to be associated with CMEs, but not CME-driven shocks.

Page 4, line 79: On figure 2 there is absolutely no information that would indicate that studied event was geoeffective. So, the following statement has no ground: "the one of August 22, 2015 is chosen based on its geoeffectiveness as displayed in Figure 2."

Figure 2 (Page 7): Panel c) does not show the CME itself but it shows the associated EUV wave, one of the on disc signatures of CME. Considering blue circle as a CME-driven shock is very provisional consideration, and needs to be better justified and with some references.

Page 4, line 81: What means "The event has a band split fundamental structure with the corresponding frequencies ranging between 46-56 MHz and 46-75 MHz,"? I believe it should be written something like: the fundamental band of the type II burst shows the band split. It should be also explained what is band split, and what are the listed frequencies? References need to be added describing the band split, eg. Vrsnak et al., 2001 and some recent work like Mahrous et al., 2018.

Page 4, line84: The authors state that the CME occurred at 07:12 UT. Where did he occurred, in the EUV images or in coronagraph images, and which one SOHO/LASCO C2? All this needs to be specified.

Page 4, line 85-86: I am wondering how the CME with the speed of about 640 km/s arrived from the Sun to Earth in less then 24 hours?! This is surly not possible. The authors should check the association of the solar event and the one observed in situ. The disturbance propagating with the speed of about 700 km/s will need about 2.5 days to come to Earth. Further, the way shock height is estimated is not scientifically justified.

Page 5, line 88: What does mean that flare occurred at 06:49 UT? Was that the flare start of the maximum? All this needs to be specified.

Page 5, line 89-90: The simultaneous occurrence of the flare and CME is not the point which makes difficult understanding which one of them is generating coronal shock. It is the simultaneous flare impulsive phase and the CME acceleration phase that does not allow us to clearly understand if the shock is flare-generated or CME-driven.

Figure 3 (page 8): In the presented images no clear jets are observed. What the authors call bright 'nods' are the brightenings observed when the closed loop system moves. Usually, jets are observed propagating along the open filed lines, and I see nothing like this in the presented figure. And in particular, that should be the case when jets are associated with type III radio bursts – signatures of fast electron beam propagating along open field lines. We can observe open field lines in the figure but none of them shows brightening indicating jet propagation.

Page 5, line 102-103: This sentence has no sense. Where the authors see propagating waves?

Page 5, line 104-105: This sentence is not justified. In order to associate type III bursts with CME at least the source positions of type III bursts need to be checked and compared with the source region of CMEs. The authors should study literature a bit better. Namely, numerous type III bursts can appear during the so called type III storms that can last for days. And, it is generally considered that they are associated with the complex active regions observed on the visible side of the solar disc.

Page 5, line 113: What does this sentence mean?

Page 5, line 114: What is 'backbone of the CME-driven shocks'? Why the authors think type IV bursts are 'poorly associated with flares? This statement needs to be justified and references provided.

Page 6, line 117 – 118: Figure 6 does not show any type IV radio bursts, but it shows somehow distorted images of CMEs in the SOHO/LASCO C2 field of view. The running difference images of SDO, 171 A are also very bad. It is not completely clear where is the solar limb and the Sun seems distorted.

Page 6, line 118-119: How is this visible?

Page 6, line 122-124: The authors first state that some type IV radio bursts may be not associated with flares and CMEs. And in the following sentence they state that this kind of type IV bursts coincide with the decaying phase of flares or post eruption loops. These two sentences are in contradiction.

Page 6, line 124: This is very general sentence, not related at all to presented study. It cannot be considered as conclusion.

Page 7, line: By e-CALLISTO we can be continuously monitor radio emission and not Space Weather.

Page 9, line 141: Which radio bursts may be used as a precursor for space weather diagnostics? And how? The authors did not really provide convincing evidence, actually any evidence how we can use radio observations for space weather diagnostics.