

L16, replace “as well” with “also”

~~L57 replace “populations” with “population”~~ **No: there are different populations**

L72 “...listing shows...” I do not understand how I read from the table that this was the first time using Advanced Virgo. **What matters is "long": "long" -> "{em long}"**

L82 “in particular FOR the Einstein...”

L87 “earth quarry”, do you mean “mines”?

L88-9 I would rephrase with “no-fly zone have been enforced in a cylindrical volume () above each of the Virgo experimental buildings.”

L94 motions is motion

L95 positions is position

L108-109 “divided almost equally” is “almost equally divided”

~~L109 I would end the phrase with :~~

L110 “Science working point” is the “Science Mode mentioned above or something else? If different, please describe it. **to restore the working point and restart taking data in Science mode**

L122-124 I would remove the description “earthquakes ....cycle”, here we are just introducing the section.

L126 I would write “from sea activity and wind”

L134 replace “nearby” with “surrounding”

L135 add a comma after “evolution”

L137 it is not clear to which interference we are referring to. **"interference" -> "fake signals"**

L143-5 I would write “...the commissioning phase following each detector upgrade”

L145 and 148 terms “slow” and “fast” are not appropriate. The sampling rate refers to the acquisition system and to the probe itself. And these are not “kind of probes”. I would rephrase in this way: “Data acquired for EMS can be grouped in two classes depending on the sample rate used for the different probes. High-rate or “fast” includes those probes acquired at rate up to 20 kHz like seismometers, accelerometers, magnetometers, microphones, voltage and current sensors and radio-frequency antennas, while low-rate or “slow” class includes temperature, humidity, weather and lighting probes.”

L149 and Table 1, I am skeptical about using “Episensor” to distinguish FB accelerometers from the other type. This is the commercial name. For sure it cannot be used as plural. I would suggest to use, in table 1, type “accelerometer” for the two Kinematics Episensors and Wilcoxon.

L153 and others, we often use “probes” “environmental probes” “environmental monitoring probes”, I would suggest defining an acronym for these, like EP and EPs

L154 halls should be hall since I expect there is just one in each building.

L156 “contact of critical” should be “contact with critical”

Figure 1, would it make sense to add a small frame with a map of Virgo that shows where the three buildings are? **It does in order to reach out a broader audience => map added!**

L165 I would call the section “Seismic noise”

L172 I would say “spectrum variability”

L181 “dominate” please at “the spectrum” or reword as “prevail on the observed seismic spectrum”

L185 “...shallow deeps at lunch time” better to write “with small reduction during lunch break”

L187 “... is quite impressive”. How can I read it on Figure 5? There the “Christmas” and new year are not marked and the green line represents “Holiday season”. We should be more explicit eventually by directly mentioning the green line in the body of the manuscript.

L194 add “used” after “slot”

Figure 3 covers the entire 03 period. Are earthquakes included or did you remove them from the analysis? I suppose that “every 128 seconds” means “for the whole dataset recorded during O3 divided in 128 second long chunks. We write “horizontal velocity”, did you average the two horizontal components? On the Y-axis we write velocity but the unit is not a velocity one.

Figure 4, in the title and in the caption we write “sea activity” and “sea-induced” but this is the full noise that, in this frequency band is dominated by the sea effect. I would replace both with microseisms.

figure 5, as mentioned above, we must clarify what “holiday season” means and what is the time span selected for the covid-19 lockdown. We use two different names for it “Covid-19 Spring lockdown” in the figure and “spring 2020 lockdown” in the manuscript. Naming should be consistent.

Figure 3, 4, 5, 6 we use different way to write frequency bands, [1Hz; 5Hz] and 0.1-1Hz  
Figure 3, 5 and 6 on the y-axis have the same “noise level as velocity RMS”, Is not it? We use two different names and two different units.

L217 “corresponding roughly” better to swap “roughly corresponding”

L223 “environment”, I suggest to better explain what we are referring to as “surrounding environment” or “environmental noise”.

L.249-256 My idea was to rephrase the beginning of the section this way:

Earthquakes radiate energy through different types of seismic waves that are commonly divided in “body” and “surface” waves depending on the path followed from the source to the receiver. Body waves that travel through the Earth are usually detected first. The fastest are named P-waves and are compressional longitudinal waves whose speed can reach 8 km/s. Then comes S-waves, transverse shear waves whose velocity scales by a factor of  $\sqrt{2}$  with respect to P-waves. Surface waves are slower and their size dominates at large epicentral distance since their amplitude scaling factor is  $1/R$  while body waves scale with  $1/R^2$ . Most relevant surface waves are Rayleigh waves that originates....

L259-260 remove this sentence.

L261. I would rephrase like this:

“Since seismic waves excite manufacts even at great distance, at EGO-Virgo the monitoring include local, regional and teleseismic earthquakes since it was observed that all of the can induce large motion.....

L267-271, rephrase:

~~“However, it was observed that the time lost could be even longer (one hour of more) when large teleseismic earthquakes excite the normal modes of the suspensions. A counter action exist, damping the high quality factor modes, but this must be taken in advance of the relevant ground shaking.~~

L274 start with way:

Likely, large earthquakes at local and regional scale do not happen very often , so the type of earthquakes on which this analysis is focused is large earthquakes that....

----- Second step -----

L.278 “waves arrival”

I would keep the original text.

L.279 "to avoid" better "of avoiding"

L.280 "and relying" better "that relies"

~~L.280 When we say "the strategy implemented at Virgo, can we name it our create and acronym? Then it will be simpler to refer to it in the following.~~

Comment  
deferred  
for now.

L.283 I would rephrase the incipit of this paragraph this way:

Highlighted information added.

In the following we will also face the case of local moderate earthquakes. These events, the majority of which occur on the Italian Apennines, are not detected by "NAME of the SYSTEM" although.....

L.299, "Namely, for each earthquake SEISMON predicts the arrival time of the different seismic waves (P-, S- and surface), their amplitude at site and the probability of losing control in consequence of that earthquake.

L.303 remove one "system"

L.309 move back the indentation.

L.323. "EQ mode", we missed to explain what it is? Yes => paragraph reworded to fix that.

better to write "from nominal model to earthquake mode" without arrows.

L331. I would write "gusts shake the buildings structure () and those ...."

L333. I would rephrase "During..." with "However, since EQ mode was not validated for ...., this was used parsimoniously because corresponding data had to be discarded. A few week before..."

~~L.342 This sentence is more attinent to the introduction section.~~

(as they should include  
all such earthquakes)

L.344 "...are sufficient" This assertion needs to be justified in some way.

L.345 "some close..." better "moderate earthquakes occurring at local and regional distance (from few...away from EGO), too weak to generate a USGS alert and then being processed by SEISMON, could cause losses of control of Virgo.

L.347 "to also investigate these other cases" better "to check if any of these control losses was caused by this type of earthquakes, we queried the INGV () earthquake catalogue to download the list of events occurred during O3 in the Mediterranean region. This list partly overlaps with the USGS one and duplicates were removed.

See  
comment  
on page 5

NAMINGS: Virgo and Virgo Detector are the same thing? if so, we need to harmonize the text, same for EGO, EGO site, Virgo site and for O3 and O3 run. same for "control loss" and "loss of control"

L.360 delete "by chance"

~~L.368 here we introduce the "post run analysis", it would ease the comprehension to use it also in other parts (e.g. Mediterranean events analysis) to distinguish what was done in realtime.~~

Relevant but  
too time  
consuming  
at this stage.

~~L.342-368, we switch from earthquake to Virgo and then back to earthquakes. This could be confusing for the reader.~~

L371-372 Better to write "Applying a minimum cut at ranking = 0.02 allows to safely remove..."

L374-375 "meaning that Virgo status is fully controlled.

I (Nicolas)  
may be  
biased as I  
wrote that  
text but I  
feel like it  
reads well.

FIGURES:

- Figure title sometimes explains the figure content, sometimes gives information about the epoch of used data. We should be consistent and, if necessary use the title always for the same reason. My preference is "no title" and move those information in

Almost completely done -- regenerating all plots did take a while...

the caption. Time span of the O3 run is always unnecessary unless we use a portion of O3.

- ~~The font used for labels is different for different figures~~ Too complicated, sorry!
- ~~ticks are sometimes "inside" and sometimes "outside" of the figure.~~

Figure 10, left "entries" is "earthquake" ? right "ration" is called fraction in the caption and in the manuscript. In the caption we write "all earthquakes" are we referring to all earthquakes from the merge of the two lists (INGV and USGS)? We never mention it.

L.378 and following, "epicenter distance" is "epicentral distance"

L379 "delock" I do not see where we call it delock. Consistently removed

L.382-388 better to write ".....the control loss with the ratio becoming not null for magnitude 6 and above. This saturates to 1, all events causes a control loss, when magnitude exceeds 7.2. We also note that the ratio is not null around magnitude 3 and this reflects the control loss consequence of some small local earthquakes recognizable also in the left side histogram of Figure 10.

L.391 "RIngs of Fire" better to explain what it is?

a region covering much of the rim of the Pacific Ocean that is seismically very active

NOTE: I recently learned from a referee that in English we never use two plurals as for "earthquakes magnitudes" but the correct form is "earthquakes magnitude" or "earthquake magnitudes".

L.394-396 ".....earthquakes with largest magnitude for any distance."

L405 and following, I would write "...show the location of the significant earthquakes that occurred during O3 with the same color coding used in Figure 111. Their distribution depicts the boundaries of the main tectonic plates and, as discussed above, we can observe that the most harmful..."

L411-414 I would remark that this statistics has not an absolute meaning, it was a quite period for Italy, if O3 took place in 2009 or 2016 we would have had a different partition.

See next page

L416 "example of the impact"

L417 "...and how the early warning information was used to change..."

Figure 12 better to write "Location of the earthquakes used in this study.

L.419 "~~correction force~~" I do not recall we never mentioned it. what is it?

Lines 315-317: control <=> correction. Info reminded though.

I would rather keep it.

~~I suggest to remove the sentence beginning with "Should ..." this is unnecessary.~~

~~L422 and following, I suggest to move all the details in the caption and summarize in the body only what we can read from it.~~ See next page

L426, to me is not that clear at this stage of the description. We have not mentioned when waves arrive. Parenthesis added to make a link with the bottom plot

L434 "Virgo kilometric arms" is another name for the "Virgo arms"

L436 "9.5 V" not clear what it is See next page

L440 "telesism frequency range" is "the dominant frequency range for earthquake recorded at teleseismic distance"

Both used in the article =>

~~L443 "warning" is what we previously called "alert" ? harmonize.~~ defer that comment for now

L444 and following "... S-waves and Rayleigh waves. For the latter we three different arrival times stem from the different used velocities (...)."

Figure 14, bottom frame what BLRMS is ?

That is described in the bottom plot bullet is that not!?

L449 "First, the plan" better "The plan"

L451 "Then we are" better "We are also"

L.461 "difficulty" is "difficulties"

The text I see includes "often" in between "high winds and rough sea" and "occur together".

L.465 we write ~~"high winds and rough sea occur together"~~ but wind is local at EGO, sea generated microseism originates in the Tirrenian but also in West Med and in the Atlantic. So the sentence is not always true, in my opinion.

L.468 "the intensity of microseism" is "microseism amplitude"

Virgo site is EGO? **Yes. Substitution "Virgo site" -> "EGO" everywhere.**

L474 "we investigated" better "require further analysis"

L477 I suggest to use two different names for the two BLRMS (e.g. BLRMS\_strain and BLRMS\_microseism), with would ease the writing in the following and the reading as well.

L478-9 "The correlation between the two curves is apparent"

L.480 "former" not clear to what we are referring to.

L485 "Winter" how can I see winter in figure 15?

**Footnote added: That calendar season starts around day 50 of O3b and lasts almost until the end of the data taking.**

L.487 RMS is BLRMS?

L488 "microseisms induce"

Figure 15 label, this is not Virgo strain RMS, it is BLRMS for the two "strain" and "seismic", [strain] is not the measure unit. Top left frames "strain in" and "microseism in" is called BLRMS in the manuscript. Bottom right label "microseismic noise RMS is seismic BLRMS? Caption, the color coding for the right panels is not described.

L497 delete "due to sea activity"

Figure 16 color coding for right panels is not described. caption, wht 6.5 ?

Figure 17 and 18 are displaying the same time spans? In figure 8 we give the absolute time in 17 we do not. In figure 17 the two frames have different length in seconds. What is gps = 126...

L.548 "SL" what is it? **Acronym defined in line 506.**

L602-603 We already said it few times....

L. 411-414

We remark that this statistics has not an absolute meaning: the O3 run took place during a quiet seismic period for Italy, compared to e.g. 2009 or 2016.

#### NAMINGS:

For "Virgo" vs. "Virgo detector" and "EGO" vs. "EGO site" I wouldn't change anything for now as there can be different things. For "O3" vs. "O3 run", that's more a misuse of language => I suggest to wait for the journal referee's report.

L422 and following

If I'm not mistaken, that was the case in a previous version but it was decided to move info from the caption to the text...

=> I would wait for the journal's referee report to make that change (again).

L436

I added "voltage" after "correction" plus the following footnote:

The mirror control is done by varying the amount of current applied to actuators (pairs of coil-magnet): see Ref.~\cite{ACERNESE2020102386} for details.