

# ***Interactive comment on “The Copernicus Polar Ice and Snow Topography Altimeter (CRISTAL): Expected Mission Contributions” by Michael Kern et al.***

## **Anonymous Referee #3**

Received and published: 26 March 2020

**Overview:** This paper presents the justification for and early design candidate for the CRISTAL mission. The paper also presents on the individual science applications that will be serviced by such a mission.

**Summary:** Firstly, apologies for my tardy review, I could would like to blame it on the new situation the world finds itself in with COVID-19 but I procrastinated well before that became a factor.

A thorough presentation of the need for, and technical capabilities of, the CRISTAL mission is a welcomed contribution to the community. The mission is very exciting and will provide invaluable data necessary to advance polar sciences in the coming

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decades.

Overall, I found this manuscript very difficult to review. I tried to review the manuscript multiple times but the first 4 sections were such a slog that it was unmotivating. The first 4 sections read like a cut and paste of multiple science agency white papers while the final section, section 5, provides a nice science justification for the mission but is completely decoupled from the first 4 sections. In my opinion the paper requires significant restructuring and more consideration as to what is included and why.

I would start with a section (1) that provides the motivation for the mission: that is the science justification (essentially section 5) with a dedicated subsection that summarizes the EU Arctic Policy and primary user requirements that motivate the mission. (2) I would then summarize the geophysical observables that are needed to satisfy the science and application needs (maybe as a table). There is a table for radar specification but not for the geophysical observation requirements that are more relevant to an overview paper. This could be followed by a section (3) that describes the CRISTAL mission capabilities showing that it meets the needs presented in the prior section. The current section 2 could be reduced to 1 or 2 paragraphs that get included in the new section (3), no need to review the full Copernicus program. I think nearly all of the material is in the document, it just needs to be reworked into a coherent justification and description of the mission.

I have many small comments on grammar and wording but I don't think the manuscript is at the point yet where those details would be all that useful. For that reason, I only list my major comments here: - There is a reasonable amount of redundant text between section 5 and the rest of the manuscript. This is mostly a result of organization and can be fixed by structuring and being more selective on what's included - Sections 1-4 lack references supporting statements (I believe there is only 1 reference supporting the idea that the combination of ka- and ku- band altimeter will substantially improve measurements of snow on sea ice. Also several citations are outdated (e.g. Chen 2013), DeCanto and Pollard, 2016 is highly controversial and is not a represen-

tative citation for a current best estimate of future ice sheet change. - There is virtually no justification for including a microwave radiometer and no supporting literature, this should be shored up with a clear justification as to the applications (with list of geophysical observables) and science it will support with appropriate citations - Observing mode “Land-ice and Glacier” doesn’t make a lot of sense since glaciers are Land-ice. I would suggest renaming this mode to “Land-ice” -or- glaciers and permafrost (GP) -or- glaciers, ice sheets and permafrost (GISP) - It is not clear how CRYSTAL will handle range ambiguities over complex glacier and permafrost terrain as advertised. - The colors for Figure 3 are difficult to distinguish (particularly magenta and purple). The figure should also include a colorbar and pole hole data gap.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-3>, 2020.

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