Review

This manuscript uses a suite of remote sensing data to map changes in ice extent, structure and velocity across the wider Shackleton system. The manuscript compliments recently published work showing recent grounding line retreat and acceleration of Denman Glacier, but also includes detailed and novel observations across the wider understudied Shackleton system. The authors use these observations to conclude that there has been limited change across the Shackleton system across the observational time period. They also then simulate the response the Shackleton system to a hypothetical loss of floating ice to demonstrate the systems sensitivity to any future ice shelf loss.

Overall, I think the manuscript contains some interesting and novel observations of the Shackleton system that are worthy of publication. In particular I think the 50 year record of rifting evolution across the Shackleton Ice Shelf is a very nice contribution. The background here is while there has been some recent studies focussing on Denman Glacier, we know very little about the recent behaviour of the many other glaciers that feed the wider Shackleton system, so these results are valuable. However, at the moment I think these interesting results are somewhat lost in the manuscript. It seems like quite a jump and a distraction from discussing these detailed annual scale observations, to discussing the response of the Shackleton system to the hypothetical loss of all floating ice 400 years in the future, which then turns into a discussion as to how the deep trough of Denman may favour vigorous channelization of the subglacial meltwater system close to the grounding line. At the moment I am not sure what the main focus of the manuscript is. I think the manuscript would benefit from being more streamlined, with a greater focus on the novel observations. I have included some more detailed comments below:

Observations

The authors state that there have been no significant annual variations in ice flow speed across the Shackleton system. I would argue that the use of 'significant' is not appropriate, what is 'significant' variations greater than 50 m yr^{-1}, 100 m yr^{-1} etc?. The plots in Figure 9 give a good overview of the longer-term changes in ice flow speed across the region. However, because they are in m/day and the scales are somewhat stretched it is difficult to determine if there has or has not been any annual variations in ice flow speed. A variation of 0.3 m/day equates to around 100m yr, which would be larger than the uncertainty of the velocity products and would be an interesting result. Are there similar scale variations, particularly in the faster flowing sections of the Shackleton system, to my eyes it looks that there could be, but I could be wrong, I really cannot tell from the plot alone?

In Figure 8 the authors plot an ice speed difference map between 2019 and 2020, I think to illustrate the acceleration of parts of the Scott Glacier. I think these plots are useful in giving a broad overview of the changes in ice speed. Could they also do this over a longer time

period, maybe 2000-2010 and 2010-2020 (brackets whatever the availability of velocity data allows)? This would probably be the best visualization of the speed changes over the observational period.

One of the most striking observations is the migration of the shear margin near Chungunov Island over just a few years. This is a somewhat unique observation. The authors have collated this wide range of velocity data, while they have tended to focus of ice speed, could they also focus on the velocity directional data? Is this change in shear margin caused by the whole Denman ice tongue 'wobbling' or a more localised change to do with Scott?

Modelling

My expertise lies in remote sensing, so I am not in a position to comment on the methodological details of the modelling. But I did find the description of the modelling experiment carried out to be lacking. In the discussion it is stated that:

'The upper limit scenario of forcing in our BISICLES model runs suggests that noticeable grounding line retreat occurs in the Denman Glacier over the simulated 400-year time period'

But in the methods section there is no mention of an upper or lower limit scenario, nor any mention of the timescales of the simulation. Aside from the basic description of model, there is only a very limited description of simulation. It is essential that the details here are expanded.

In wider point, while I think it could be a useful contribution to repeat the experiment in Martin et al., but with BedMachine, I did feel the modelling appeared as somewhat left field in the manuscript and appears as a bit of a jump in the discussion from the main body of observations. The general tone of the manuscript is that very detailed remote sensing observations have shown limited changes in the floating ice in the Shackleton system… But then the manuscript jumps to.. 'now we simulate the unrealistic loss of all floating ice in the Shackleton system'… The scientific rationale for this is unclear to me? Of course, it is entirely up to the authors, but I would point out that I think the detailed observations have the potential to be a nice contribution alone.

Line 59: I would not describe the acceleration of Denman Glacier since the 1970s as a short-term fluctuation

Line 62: 'the glacier' – please clarify in the text that you are presumably referring to Denman Glacier.

Line 113: Landsat 1 was not mentioned in the above paragraph? Was it used?

Line 118-129: What software was used for the feature tracking?

Line 164: That of Rignot (2011) – Do you mean the MEASURES ice velocity mosaic?

Line 173-178: I think much more detail is needed here (see comment above)

Line 189: Not sure 'remarkable' would be the word I would use here

Line 243-245: Its nice to see the changes between 2019 and 2020, but I think you could also expand to include 2000-2010 and 2010-2020, maybe even 2000-2020

Line 250: Please use the correct citations for the Measures and ITS LIVE velocity products. I think the correct details can be found on each respective website.

Line 267: Is d Chugunov Island?

Line 269: The paragraph is discussing modelling results. Therefore I think it needs a new appropriate subsection, currently it is under 'ice flow speed'.

Line 285: 'Not changed significantly' What is 'significantly'? Observations of Denman have shown that its grounding line has been retreating and that it has been accelerating and losing mass, this is contradictory.

Line 285-302: I think you could be more detailed in this section. One of the key results here is the lack of propagation of the rifting across the Shakleton over the past 50 years, with the exception of some small activity over the past few years. This is a key result. What does this mean and how does it tie into the wider body of literature? In other regions rifting evolution has been key to ice shelf stability? How important could the melange that fills these rifts be (see recent Larour Larsen C paper in PNAS)?, etc..

Line 321-338: I struggle to see the relevance of this section to the manuscript.

Fig 1a: The scale is a little difficult to make out because of the transparency

Fig 10: The high strain rate band going across the Denman ice tongue – presume there is no evidence of any recent rifting in this location?