

Referee comments for: "Halley Research Station, Antarctica: calving risks and monitoring strategies", by R. Anderson, D. H. Jones and G. H. Gudmundsson

General comments:

This is an important piece of work addressing the likelihood of changes in the Brunt Ice Shelf and the associated risks for the Halley Research Station. The potential risks mean that an understanding of the ice shelf behaviour is vital, through interpretation of existing data, analysis of past changes, further monitoring and a predictive assessment of future changes. The authors have addressed each of these in detail and present a clear assessment of the threats to the station, ranked in order of likelihood. Despite historical data being fairly limited the authors' approach has maximised the data that does exist, and combined with more plentiful recent satellite image data and an analysis of a GPS network for continued monitoring, it is a thorough review of possible risks. The paper provides an overview to improve understanding of the behaviour of the ice shelf and it presents an innovative approach to continue monitoring, essential in the event of imminent risks to the base. The paper is well written and provides full explanations of the geography and ice shelf behaviour in the region. One concern is that a reliability assessment hasn't been made for the historical ice front positions and no description of how errors may affect the projected ice front positions. Most of my specific comments are regarding methodology clarifications, small changes to the text and suggestions for additions to the figures. I would recommend this paper for publication after corrections are made.

Specific comments and technical corrections:

P.6228, line 20: "existence"

Line 21: it would be helpful to mention why it has been necessary to build Halley on the ice shelf, unlike bases that are more easily accessible

P.6229, lines 2-3: rephrase "Halley 1 through to Halley IV were each occupied for a maximum of ten years"

Line 7: underground? Perhaps misleading. Reword, e.g. "sub-surface"?

P.6230, line 9: "considerably"

Line 17: "Thomas (1973)"

P.6231, para 2: What I might suggest is that you mark the chasms on the map (Fig 2) with lines. They are not clear on the image at that scale and although the place-names show the general location they could be shown as lines to show their extent. Lines 10-11: I would say the N9 chasm is different as it's not located between Halley and the mainland and it's not upstream of the MIR.

Line 24: The SWGT chasms could also be shown on Fig 2.

P.6232, line 20: "disappearance" is not strictly true – "retreat" or "collapse" would be more accurate

Line 25: Banwell et al (2013) could also be cited here: Banwell, A. F., D. R. MacAyeal, and O. V. Sergienko (2013), Breakup of the Larsen B Ice Shelf triggered by chain reaction drainage of supraglacial lakes, *Geophys. Res. Lett.*, 40, 5872–5876, doi:10.1002/2013GL057694.

P.6233, line3: “collapse”

Line 10: no commas needed: “Each ice shelf can hence be expected to produce...”

Line 18: should be capitalised as follows - “Synthetic Aperture Radar images”

Line 19: “early 1970s”. It might be best to specify that Landsat are visible-band images rather than radar.

Line 23: “3.2” is unnecessary

P. 6233, last para and **P.6234**, para 1: the reliability of different sources must be stated and quantified in some way. Since you use the 1915 position as a benchmark, how might the error margin affect the projected ice front position? How did you assess the 1956 and 1958 maps to conclude that the 1958 position is more accurate? This position is less reliable than recent positions acquired from accurately georeferenced satellite images but this must be stated with a comparison of errors.

P.6234, Line 13-14: it would be good to see the flow line you have used, perhaps best on Figure 3

Line24-25: this sentence is repetitive

P.6235, line 4: “then” instead of “than”

Line 10: I’m not sure the reason for having the SWGT map as Fig 6 rather than Fig 5. It would be more logical to have them the other way round.

P.6236, line 5: reference?

P.6237, line 6: “A large iceberg...”

Line 11: It would be more suitable to call this Fig 7 rather than 10. This is a velocity map rather than a velocity profile. The map shows a strong difference in the velocities of the SWGT and the Brunt – this should this be pointed out here since the Brunt doesn’t have the same relationship between speed and distance from grounding line (which is very striking on the map).

Line 16: for consistency, the name should be “Riiser-Larsen Ice Shelf”

Lines 21-24: I would say you need to show Fig 9 before Figs 7 and 8, to show the location of the three rifts in SWGT. Your description of the events would then make more sense, once the reader knows what you mean by southern rift. In line 22, it would perhaps be clearer to word as follows: “The northern end of the crack has forked in the last 15 yr and has continued to widen in a north-easterly direction”.

Line 25-27: make it clear that you mean linear growth at the southern end of the crack. Line 27 – do you mean growth in the crack would accelerate? Maybe add an extra sentence to explain why you might expect this to happen?

P.6240, line4: I'm not sure you need "RTK" since you don't refer to this again. "real-time kinetic" is probably sufficient.

P.6241, line 12: I'd suggest re-wording, "SWGT is currently very active". Also line 15: "which might also destabilise the BIS."

Line 19: "advance" rather than advancement. It might be helpful to write "... the steady southerly advance of a rift in the west", just to clarify that this is the end of the rift that is of concern. Also, you mention that the rift in the south is widening, but I don't see this described in your Section 3.4 (it should be stated perhaps on P.6237, line 27).

P.6242, line 11: do you mean to say "both ice shelves" here? The GPS network doesn't detect strains in the SWGT.

P.6243, line4: "described in Humbert and Pritchard (2006)."

Other comments:

As regards current risk monitoring methods or future work, have the authors considered detecting changes in pressure ridges and surface features using digital elevation models? Adrian Fox (BAS) produced a photogrammetrically derived DEM with draped aerial photographs for the MIR region. I don't know if this was published but it would be useful for the authors to know about the result and whether it revealed anything about the activity in this region.

Figures:

It may be best to change the order of your figures. See suggestions in specific comments above.

Fig 2 – draw lines marking the three chasms on BIS.

Fig 3 – the dark green line is not very visible. It would be good to show the flow line that is used for the results in Fig 4.

Fig 5 – in the caption, do you mean 26 April rather than 28 April (as labelled on image).

Fig 6 – why is the 1955 ice front position shown here instead of the position in 1958, which was stated as being more reliable?

Fig 7 – what is the x, y reference shown here? Also, the text on the axes and the legend needs to be larger. The slivers shown for 1986 and 2011 are confusing – it implies that the gap was very small in these years. I assume the 2011 chasm outline is beneath the 2008 outline? Perhaps make one or two layers semi-transparent, or use outlines without a fill for some. The Figure caption spelling corrections are: "coloured" (or "colored") and "respectively".

Fig 9 – explain what the red dashed line is in the top map. Also, it may be helpful to label the three rifts on SWGT, perhaps with E, W and S so the reader can easily identify which ones are being described in the text. The rifts are described in Section 3.4, rather than Section 5.

Fig 10 – this is a velocity map rather than a speed profile.

Fig 11 – can you add the positions of the 2011/12 GPS units near Halley VI?

Fig 12 – The axes are rather confusing – it may be clearer simply to have a scalebar as in Fig 11.