Institution: Swansea University

Unit of Assessment: 14

Title of case study: Massive iceberg stimulates public interest in Antarctic ice shelf research

Period when the underpinning research was undertaken: 2008-2018

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Adrian Luckman	Professor	1997 - present
Daniela Jansen	Research Officer	2013 - 2016
Bernd Kulessa	Professor	2004 - present
Suzanne Bevan	Research Officer	2010 - present

Period when the claimed impact occurred: 2017-2018

Is this case study continued from a case study submitted in 2014? No

1. Summary of the impact

Research by the Glaciology group at Swansea University predicted the 2017 calving of Iceberg A-68, one of the largest icebergs ever recorded. We proactively engaged with the media, developed a sustained social media campaign and a dedicated interactive website to highlight the impact of our research, which culminated in an unprecedented global reach (>50,000,000 people). Our online survey, looking at people's interest in polar science before and after their interaction with our campaign, demonstrated a significant impact on awareness, understanding and behaviour among nearly 1,600 respondents. As a result of our research and engagement, Iceberg A-68 became globally famous, and a more widespread understanding of the significance of massive icebergs in the Earth's system was gained.

2. Underpinning research

Supported by a series of RCUK research grants, *Stability of Larsen Ice Shelf* [**G1**], *Marine ice in Larsen C ice shelf* [**G2**] and *Impact of melt on ice shelf dynamics and stability* [**G3**], Swansea University glaciologists (Luckman, Kulessa, Jansen and Bevan) have been investigating Antarctic ice shelves and their present and future stability for over a decade. Our main geographic focus has been the Larsen C Ice Shelf, Antarctic's 4th biggest ice shelf and we have used field geophysics, satellite remote sensing and numerical modelling to investigate ice shelf processes in this region. Specifically, we investigated the surface structure of the Larsen C ice shelf and highlighted that rift zones (large fractures) within Larsen C Ice Shelf represent weaknesses that warrant careful monitoring [**R1**]. Jansen et al. [**R2**] established the present stability of this ice shelf and demonstrated that the mechanics of suture zones needed further study. This paper also pointed out for the first time that the Larsen C Ice Shelf rift had the potential to develop into a significant iceberg, while what remained of Larsen C after iceberg calving could develop dynamic conditions akin to those that led to disintegration of the Larsen B Ice Shelf.

In related work Luckman et al. [**R3**], investigated the prevalence and formation of basal fractures, and Kulessa et al. [**R4**], identified a mechanism for arresting fractures and postulated that Larsen C could have the same principal stress distribution that led to collapse of Larsen B in 2002. Our research on Larsen C led us to an awareness of the risk to stability from rifts in specific locations and encouraged us to closely monitor the part of the ice shelf where rift development would have the most impact [**R2**]. Using satellite data and our own computer models, we were the first to detect and report on a potentially significant rift in early 2015 [**R5**]. We provided the first evidence that the rift would soon develop into an iceberg of significantly large size and described the potential impact that this calving might have on the remaining ice shelf [**R5**]. We also described how surface melt can influence bulk ice shelf structure and therefore resilience to fracture [**R6**]. Luckman (an expert in satellite data analysis) continued to closely monitor the development of the

rift using highly specialised techniques such as SAR interferometry and feature tracking. Because of the scarcity of conventional, visible-light satellite imagery of the ice shelf due to the predominant cloud cover and polar night-time, these techniques were crucial in allowing us to monitor the progression of the rift [**R5**]. In 2017, the largest calving event since the 1980s occurred as predicted [**R5**], giving birth to A-68, a 5,800 km^2 iceberg.

3. References to the research

All papers were peer-reviewed (**SU authors in bold**). All papers published in Q1/Q2 Journals (JCR 2019). Papers were supported by funding from NERC.

[R1]. Glasser, N. F., **Kulessa, B.**, **Luckman, A.**, **Jansen, D.**, King, E. C., Sammonds, P. R., Scambos, T. A., Jezek, K. C. (2009) Surface structure and stability of the Larsen C ice shelf, Antarctic Peninsula. Journal of Glaciology 55:400-410. http://dx.doi.org/10.3189/002214309788816597

[R2]. Jansen, D., Kulessa, B., Sammonds, P. R., **Luckman, A.**, King, E. C., Glasser, N. F. (2010) Present stability of the Larsen C ice shelf, Antarctic Peninsula. Journal of Glaciology 56:593-600. http://dx.doi.org/10.3189/002214310793146223

[R3]. Luckman, A., Jansen, D., Kulessa, B., King, E. C., Sammonds, P., Benn, D. I. (2012) Basal crevasses in Larsen C Ice Shelf and implications for their global abundance. The Cryosphere 6:113-123. http://dx.doi.org/10.5194/tc-6-113-2012

[R4]. Kulessa, B., Jansen, D., Luckman, A. J., King, E. C., Sammonds, P. R. (2014) Marine ice regulates the future stability of a large Antarctic ice shelf. Nature Communications 5: 3707. http://dx.doi.org/10.1038/ncomms4707

[R5]. Jansen, D., Luckman, A. J., Cook, A., **Bevan, S., Kulessa, B.**, Hubbard, B., Holland, P. R. (2015) Brief Communication: Newly developing rift in Larsen C Ice Shelf presents significant risk to stability. The Cryosphere 9:1223-1227. http://dx.doi.org/10.5194/tc-9-1223-2015

[R6]. Hubbard, B., **Luckman, A.**, Ashmore, D. W., **Bevan, S., Kulessa, B.**, Kuipers Munneke, P., Philippe, M., **Jansen, D.**, Booth, A., Sevestre, H., Tison, J.-L., O'Leary, M., Rutt, I. (2016) Massive subsurface ice formed by refreezing of ice-shelf melt ponds. Nature Communications 7:11897. http://dx.doi.org/10.1038/ncomms11897

Grants

[G1]. Kulessa, B (PI), Luckman, A. (CoI), Jansen, D as PDRA (2008-2011) Present and future stability of Larsen Ice Shelf (SOLIS), NERC standard grant, [NE/E012914/1], GBP374,389

[G2]. Luckman, A. (PI), Kulessa, B. (CoI), Jansen, D as PDRA (2011-2012) Quantifying the role of marine ice in Larsen ice shelf. NERC Small Grant, NE/I016678/1, GBP49,219

[G3]. Luckman, A. (PI), Kulessa, B. (CoI), Bevan, S as PDRA (2014-2017) Impact of surface melt and ponding on ice shelf dynamics and stability, NERC Standard Grant, [NE/L005409/1] GBP507,532.

4. Details of the impact

We attracted media and attention to the imminent calving of a very large iceberg from Larsen C Ice Shelf by rapidly publishing a short paper [**R5**], creating the MIDAS website [**C5**] to provide updates of events, and using Social Media to draw attention to them [**C6**]. Once we had exercised this approach to establish a relationship with Jonathan Amos of the BBC, we used direct communication with him to generate further media interest.

We were able to sustain media and public interest in the story (and thus in ice shelf research) because the rift propagation occurred in several stages, each of which we were uniquely positioned to both rapidly detect and directly communicate to the BBC. The subsequent iceberg calving was of equal media interest and we maintained our careful scientific reporting of the events

as they unfolded. We were diligent in addressing media interest, giving several radio and TV interviews [**C4**] and answering email queries with as much factual information as we could provide.

Reach is evidenced by geographical coverage and audience volume. The 2017 calving event was featured on the home pages of three of the world's largest online news outlets: the BBC (tweeted to 6,500,000 followers, with 429 comments) [**C1**], the Guardian (shared ~11,000 times with 1667 comments; [**C2**], and the New York Times (NYT) (tweeted to 38,000,000 followers) [**C3**]. Each of these articles featured interviews with Luckman and utilized graphics provided by the *MIDAS* team. Between January 2017 and February 2018, the Larsen C story received ~6,500 items of coverage in 98 countries (Fig. 1, data obtained from Swansea Press office, [**C6**]), online, in print, on TV, and in radio articles. Through follow-up interviews with BBC Science Correspondent Jonathon Amos, the team at Swansea University generated 9 articles of BBC Online coverage, following the progression of the rift, the calving event and the progress of iceberg A-68 [**C4**] (most recently in February 2020). One of these articles was the second most read piece of the news outlet on 31 May 2017 (Swansea Press Office, [**C6**]). Luckman's article for *The Conversation* had ~147,000 reads [**C6**] and 2,097 social media shares. Luckman also gave a Royal Geographical Society (RGS) lecture in May 2017 (audience ~400).

Figure 1: Media Reach

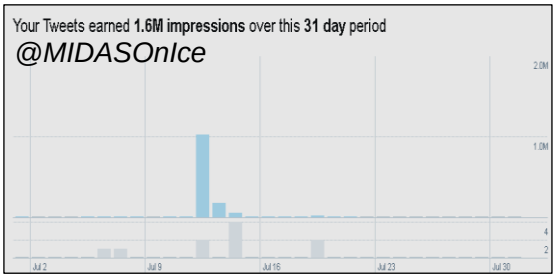

Figure 2: Social Media Reach

Alongside these media activities, via Twitter we shaped how the public narrative evolved by directing journalists to the *MIDAS* project website, where we posted regular blog updates [**C5**]. Many journalists guided their readers to this website – "*As a journalist based in Cape Town, our readers have great interest in this kind of news. I was able to use the links and embed it in my news article for further reading*" (Quote 737, [**C9**]) and "*I think the information you provide is extremely valuable. I am a member of the media and I came to your site to get information directly from the source instead of using CNN's story/content/info*" (Quote 397, [**C9**]). Consequently, we saw page visits spike from 22 page views before we broke the story to 50,000 views two days later. Similarly, the *@MIDASOnIce* Twitter account received a 14-fold increase in followers between 2017 and 2018 (Fig. 2). Tweets from *@MIDASOnIce* and *@Adrian_Luckman* announcing the calving event earned ~2,000,000 impressions. We estimate that overall, our engagement reached as much as 50,000,000 people; see [**C6**] for a breakdown of social media engagements.

Significance is evidenced by the scale of the direct and follow-on media coverage and social media shares, as well as the resulting stimulation of public debate. For example, the BBC, Guardian, and NYT home page articles generated a total of 2,339 reader comments, and the NYT article triggered an Op-Ed that same day [**C7**]. A Google Trends analysis shows that the popularity of the search terms '*Larsen C*', '*Larsen C crack*', '*Antarctica*', and '*Iceberg*' (Fig. 3) increased by as much as 1000% during 2017 [**C8**].

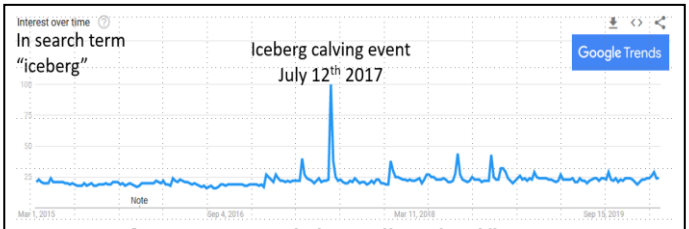

Figure 3: Social Media Significance

These factors demonstrate that we generated **awareness, inspiration and curiosity** in the general public which is further evidenced by the worldwide responses to our online survey on the *MIDAS* website. Ninety percent of the 1,596 respondents (geographic spread seen in Fig. 4)

agreed that being made aware of the Larsen C rift made them want to learn more about the cryosphere and polar science [**C9**].

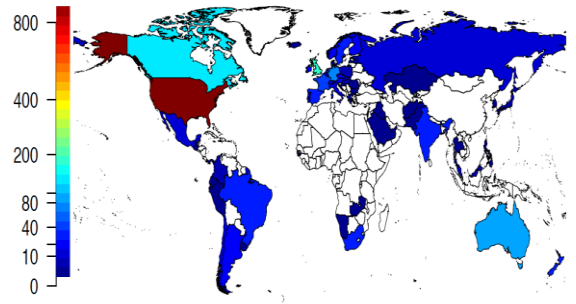

Figure 4: Public Reach

Respondent comments also provide evidence that our coverage of the iceberg story impacted their lives, in the following ways: **i) Increasing understanding:** "*As someone who is not a scientist, I very much appreciate sites like this that give me a better feel of how our world is changing."* (Quote 285 [**C9**])**; ii) Stimulating curiosity**: "*Wow, thanks. You have my whole family talking about ice!"* (Quote 269 [**C9**]); **iii) Generating concern and behavioural change:** "*Added to my growing concerns about climate change and motivated me more to think and act on what can be done at a personal and community level to mitigate it."* (Quote 101 [**C9**]); **iv) Stimulating a desire to learn more:** "*This article has piqued my curiosity to learn more about climate change, and particularly the changes within Antarctica and its c change, and particularly the changes within Antarctica and its composition"* (Quote 692, [**C9**])**;** and **v) Improving the capacity to inform others:** *"Your information and related Twitter feeds have been a great source of material. I give presentations to my local U3A several times a year on Climate Change."* (Quote 25, [**C9**]) and "*I use your blog to help me design climate change lessons for my college classes."* (Quote 285 [**C9**]). This last category was wide-ranging, including school teachers, college lecturers, the University of the Third Age (U3A), and journalists, all reporting to have used our MIDAS website and twitter feeds material (such as time lapse videos of the rift and iceberg) to aid in the engagement of their various audiences.

Our research and coverage of the rifting process also **influenced strategic and logistics decisions** made by the British Antarctic Survey (BAS), who responded to our alert of the propagating rift in late 2016 by cancelling planned fieldwork on the Larsen C Ice Shelf [**C10**].

5. Sources to corroborate the impact

[C1]. BBC News Online article '*Giant Iceberg Splits from Antarctic*', 12 July 2017: https://www.bbc.co.uk/news/science-environment-40321674

[C2]. The Guardian Online '*Iceberg twice size of Luxembourg breaks off Antarctic ice shelf*', 12 July 2017: https://www.theguardian.com/world/2017/jul/12/giant-antarctic-iceberg-breaks-free-of-larsen-c-ice-shelf

[C3]. The New York Times Online '*An Iceberg the Size of Delaware Just Broke Away From Antarctica*', 12 July 2017: https://nyti.ms/2s5jZ5V

[C4]. Comprehensive summary of media coverage linked to Swansea University including links to many articles beyond those above. Available as a PDF document.

[C5]. Natural Environment Research Council (NERC) *MIDAS* Project website: https://web.archive.org/web/20180211112120/http://www.projectmidas.org/

[C6]. Summary of social media engagements. Available as a PDF document.

[C7]. The New York Times Op-Ed '*Warnings from Antarctica*', 12 July 2017: https://www.nytimes.com/2017/07/12/opinion/antarctica-larsen-ice-shelf.html?searchResultPosition=1

[C8]. Trends in Google search terms. Available as a PDF document.

[C9]. NERC *MIDAS* Project online survey results. Available as a PDF document.

[C10]. Email from the Director of Science, British Antarctic Survey. Provided upon request.