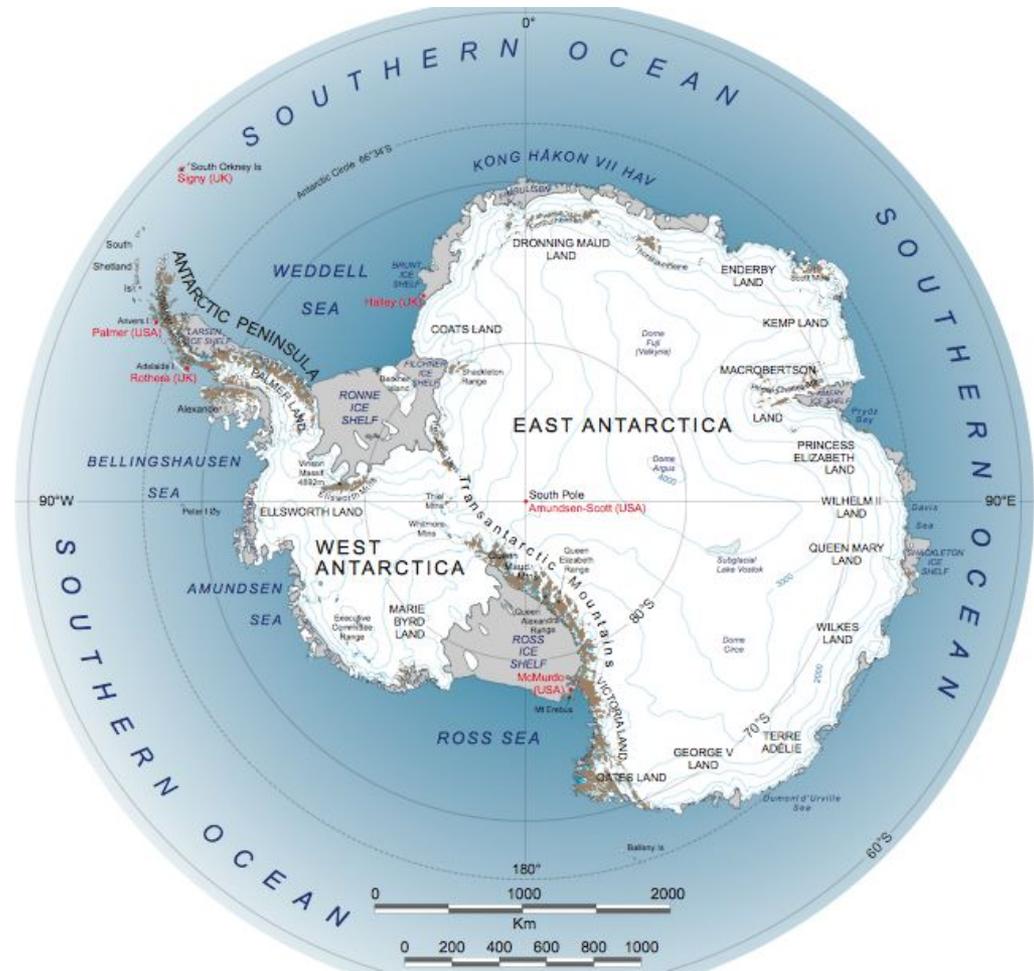
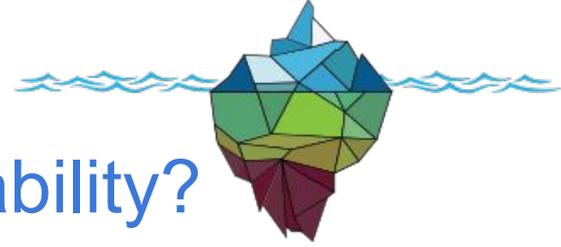


Glaciology
Marine Ice Sheet
Instability





What is Marine Ice Sheet Instability?

To understand MISI, we must first define:

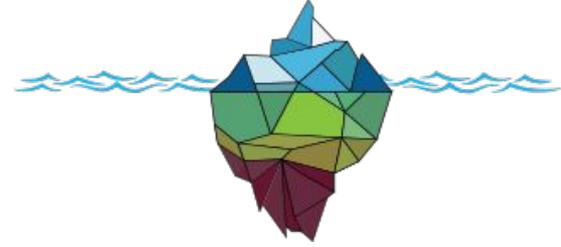
- A ‘marine ice sheet’

- *A marine ice sheet is an ice sheet that sits on bedrock below sea level*
- *E.g. the West Antarctic Ice Sheet*

AND

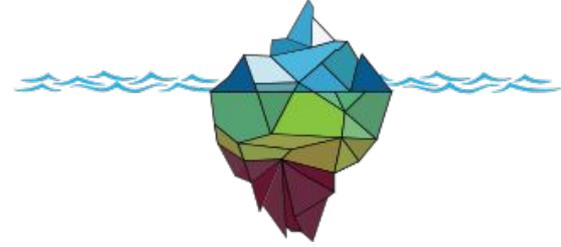
- A ‘grounding line’

- A grounding line is the point where the grounded ice sheet transitions to a floating ice shelf
- The position of this line influences the stability of a marine ice sheet

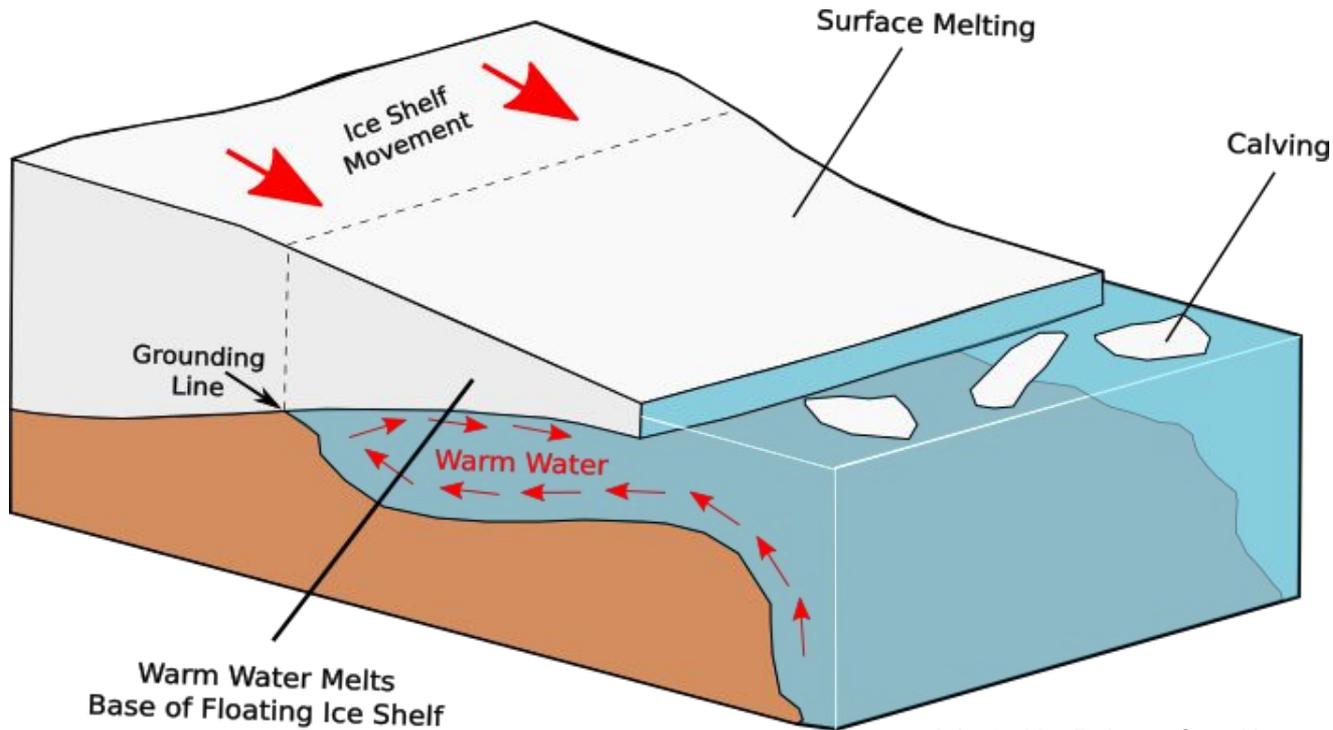


What is MISI?

- The MISI hypothesis suggests that when a marine ice sheet is grounded on land that **slopes downwards** from the coast to the interior of the ice sheet, the grounding line is **unstable**
- This configuration makes the ice sheet susceptible to **rapid disintegration**
- Warming of the atmosphere and the ocean could cause **increased melting** and **recession** at the grounding line on a reverse slope

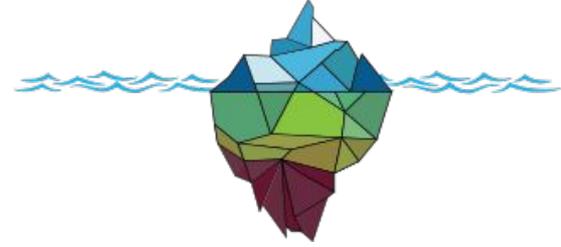


What is MISI?

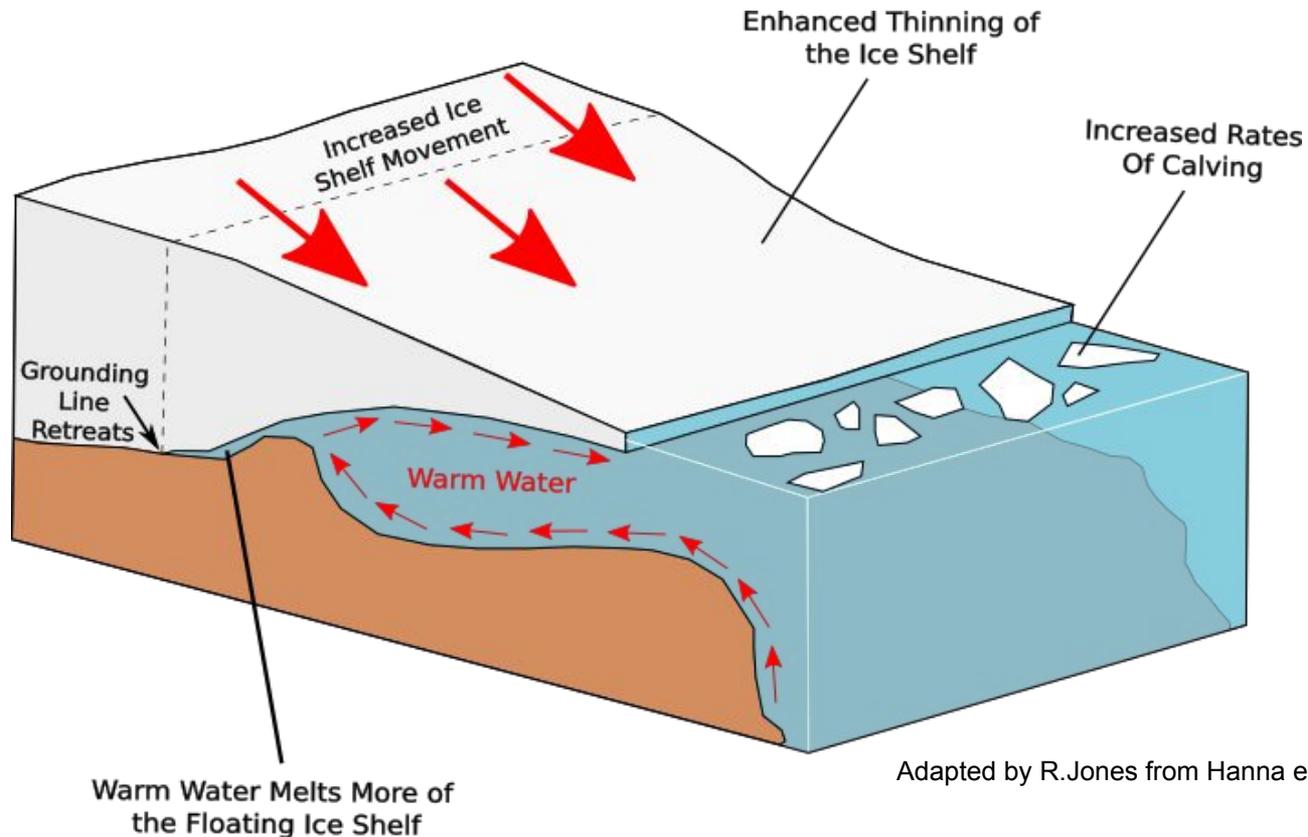


Adapted by R.Jones from Hanna et al., 2013

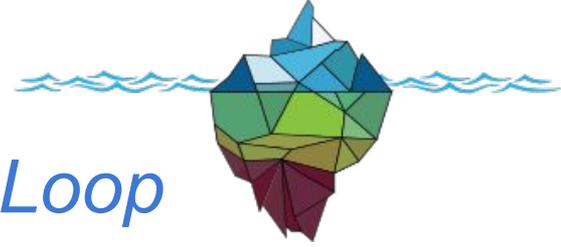
- a. Initial stable grounding line position with normal calving and surface melting.



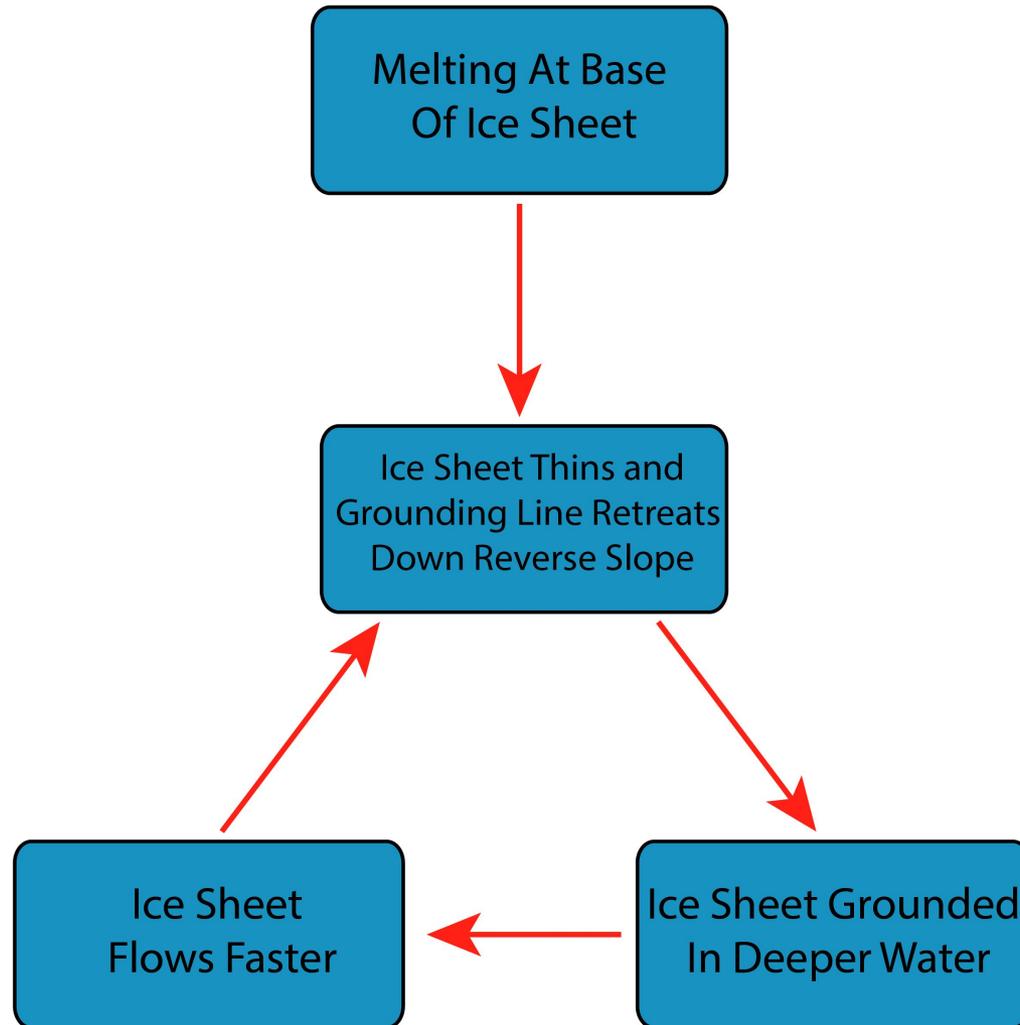
What is MISI?

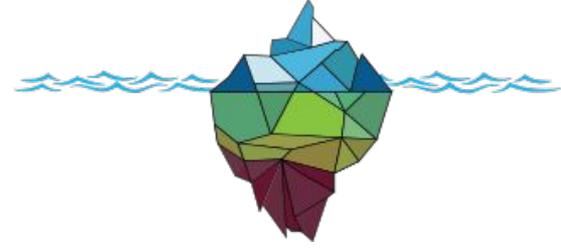


b. Warm water causes a retreat of the grounding line. As the grounding line retreats inland down the slope, an unstable position is reached and the glacier undergoes increased thinning and calving.



MISI as a *Positive Feedback Loop*





What is MISI?

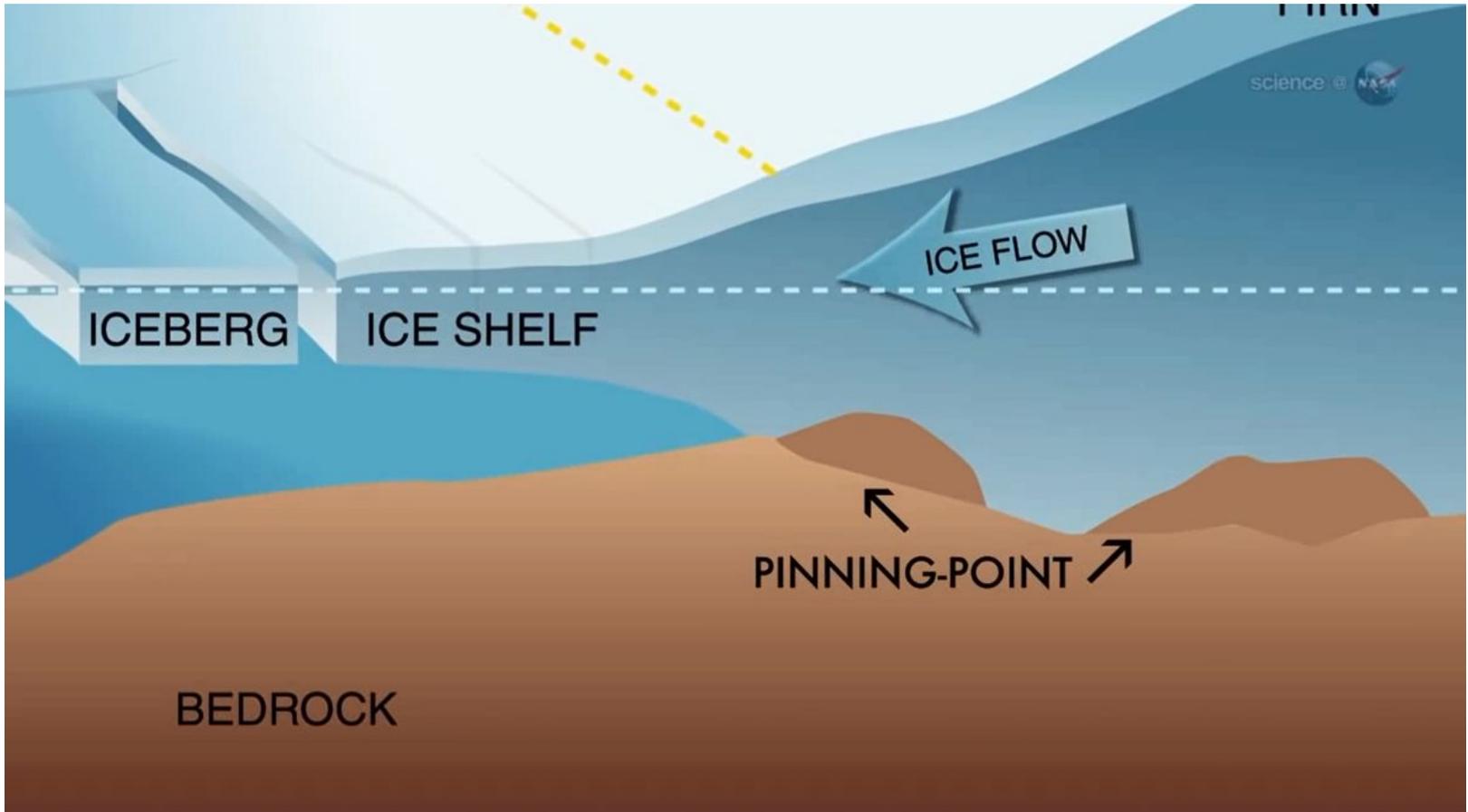
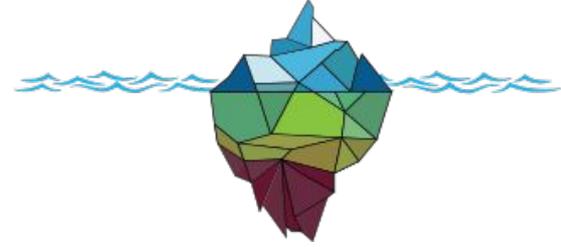


Image illustrating a pinning point, from the arctic sea ice forum



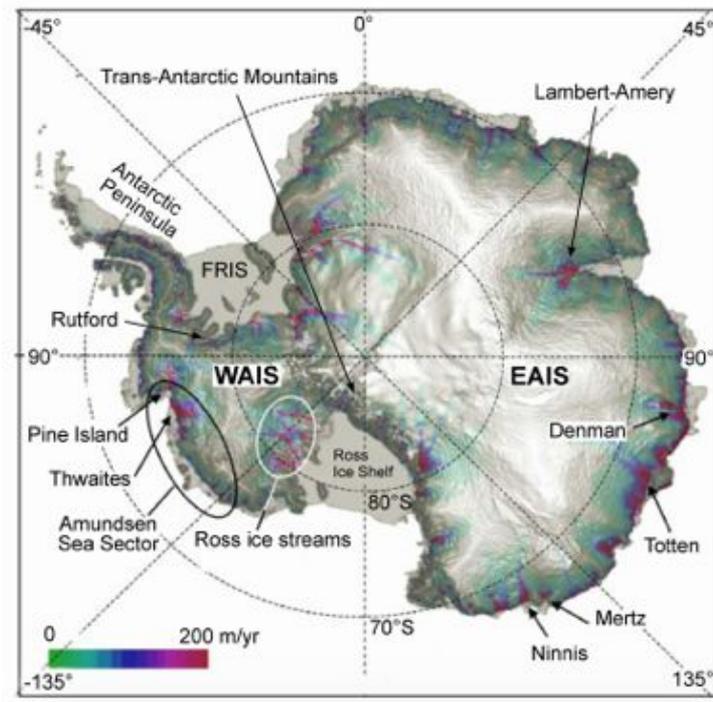
Why does it matter?

- MISI is a major concern amongst scientists today
- Historically, the Antarctic Ice Sheet (AIS) was deemed *stable*, with a positive mass balance and an entirely cold interior and slow rates of flow
- However, recent work on MISI and improvements in mass balance estimates reveal that the AIS is *not stable* at all

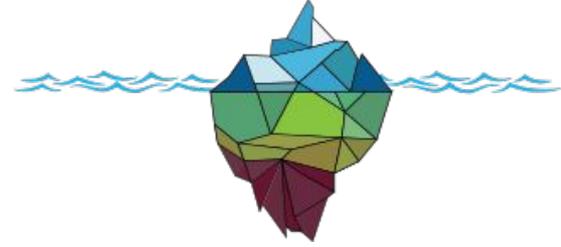


Why does it matter?

- The AIS is divided into the East (EAIS) and West Antarctic Ice Sheet (WAIS) by the Transantarctic Mountains



Relief map of the AIS highlighting the larger EAIS and the smaller WAIS. These two sections are divided by the Transantarctic Mountains (Bamber and Aspinal, 2013: 424)



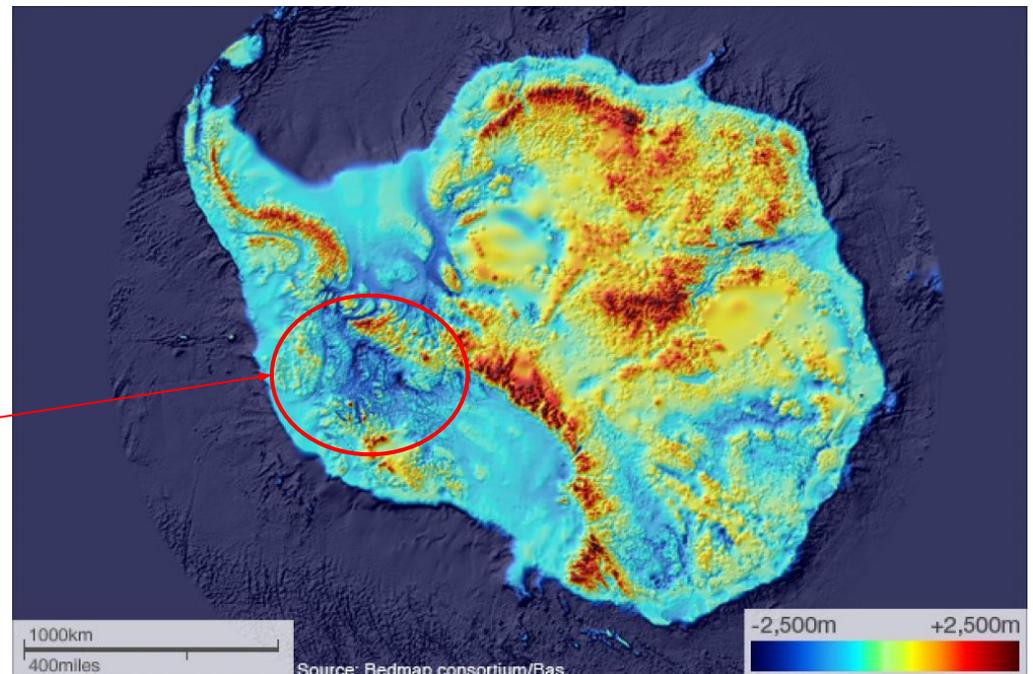
Why does it matter?

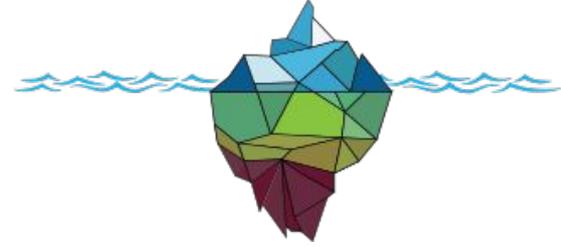
- The EAIS rests mainly on land, so it is more stable
- BUT, the WAIS is thought to be unstable as it rests on beds below sea level with retrograde slopes

Land cover of the Antarctic Ice Sheet, showing upland areas in red and lowland in blue.

The West Antarctic Ice Sheet is seen to be a deep hollow, meaning it is unstable.

antarctica.gov.au

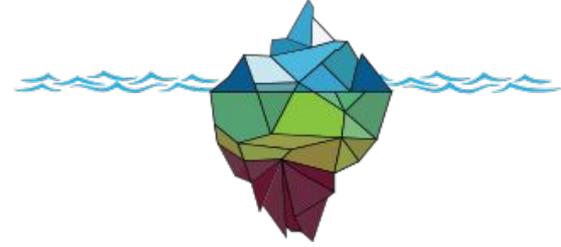




Why does it matter?

- The bed of the WAIS gets deeper further inland, creating a vulnerable situation
- This instability is occurring at Thwaites glacier, generating concerns regarding sea level rise
 - Limited SLR potential from Thwaites (<1m)
 - BUT, is generating concern given that Thwaites is deemed the '*plug*' of the WAIS and thus the AIS (total of ~57m SLR potential)

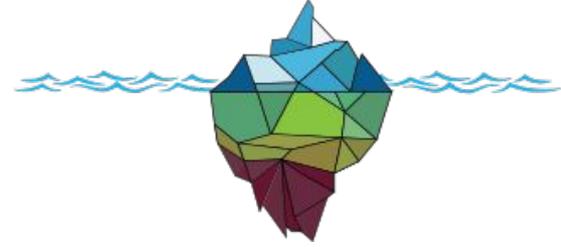




True or False

The position of a grounding line plays a key role in determining the stability of an ice sheet.

True or False



True or False

The position of a grounding line plays a key role in determining the stability of an ice sheet.

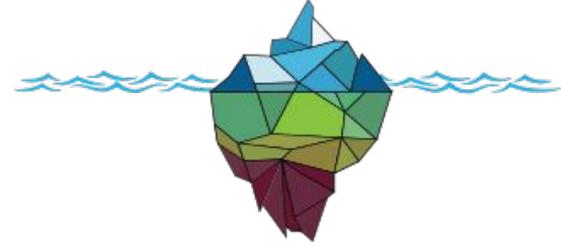
True or ~~False~~



True or False

The Marine Ice Sheet Instability hypothesis suggests that when a marine ice sheet is grounded on land that slopes downwards from the interior of the ice sheet to the coast, the grounding line is unstable.

True or False



True or False

The Marine Ice Sheet Instability hypothesis suggests that when a marine ice sheet is grounded on land that slopes downwards from the interior of the ice sheet to the coast, the grounding line is unstable.

~~True~~ or **False**

False! It is when the marine ice sheet is grounded on land that slopes downwards from the coast to the interior of the ice sheet that the grounding line is unstable.



True or False

Scientists are concerned that Marine Ice Sheet Instability may occur at the *East* Antarctic Ice Sheet.

True or False

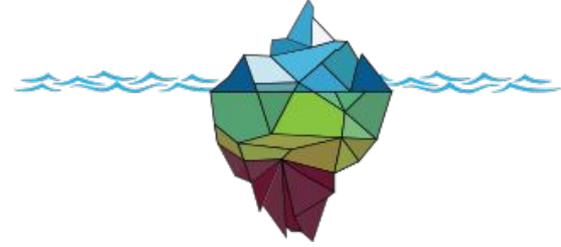


True or False

Scientists are concerned that Marine Ice Sheet Instability may occur at the *East* Antarctic Ice Sheet.

~~True~~ or **False**

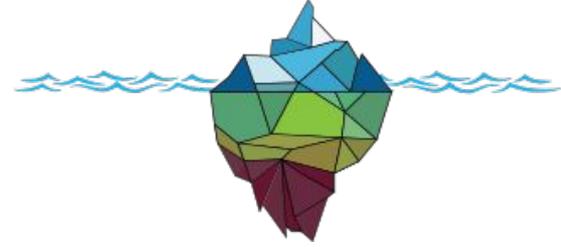
False! It is the West Antarctic Ice Sheet that scientists are concerned about.



True or False

Marine Ice Sheet Instability at the West Antarctic Ice Sheet has the potential to significantly raise global sea level.

True or False



True or False

Marine Ice Sheet Instability at the West Antarctic Ice Sheet has the potential to significantly raise global sea level.

True or ~~False~~

