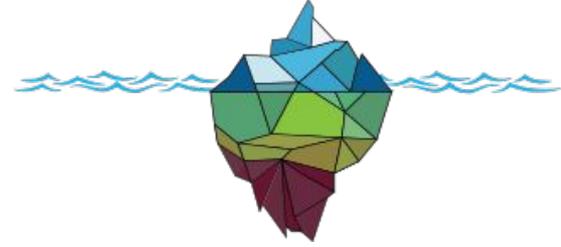


Glaciology

What Makes A Glacier Melt?

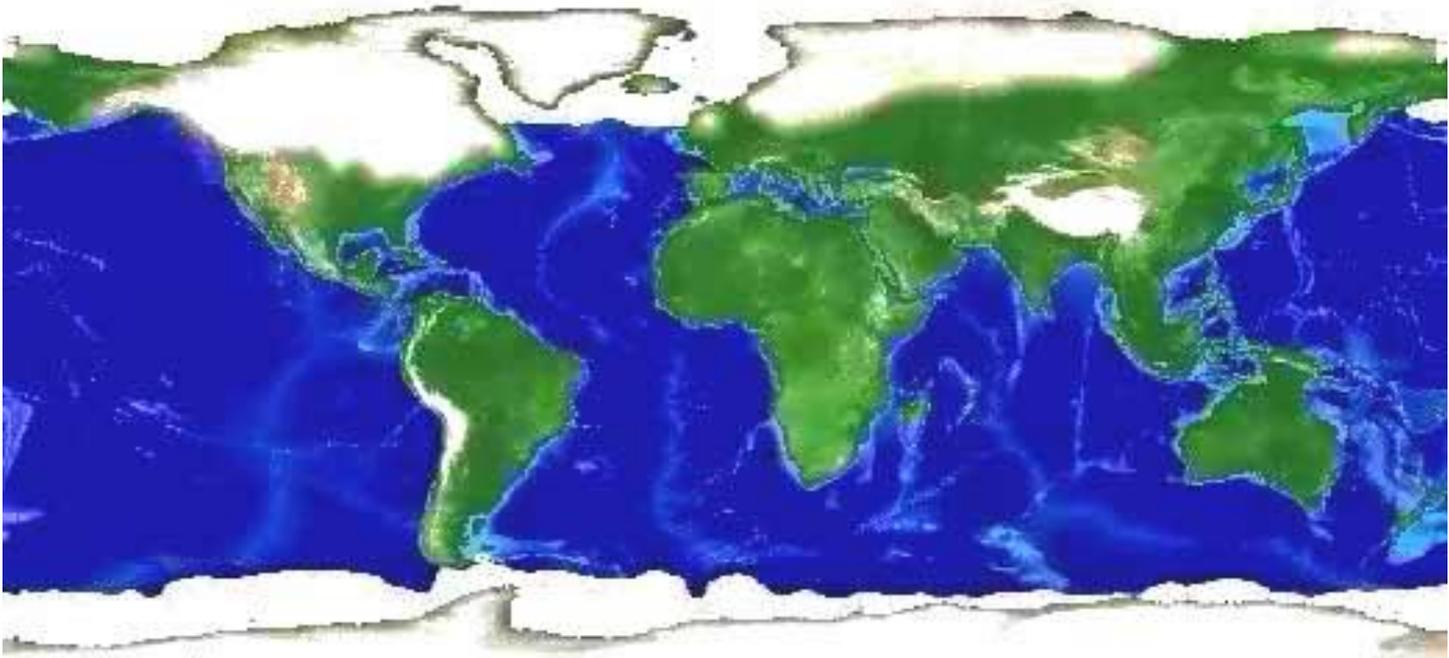




Global Ice

Over the past 2.6 million years there has been repeated **growing** and **shrinking** of glaciers and continental-scale ice sheets.

Today, glaciers cover **~10%** of the Earth's land surface.



Rice University

Global Ice Masses. water.usgs.gov



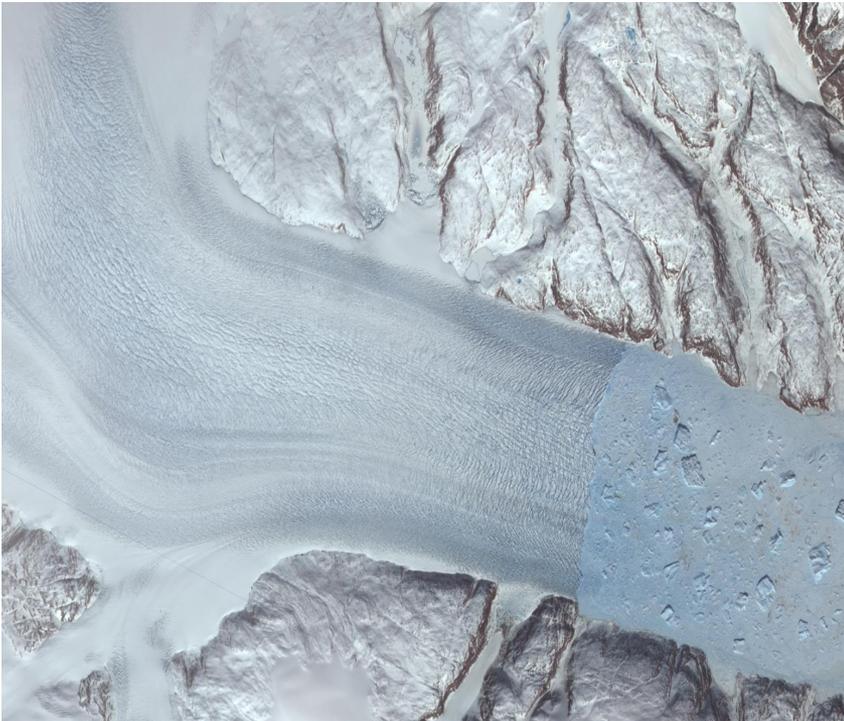
Differential Melting

- Following Climate Change, glaciers and ice sheets have been melting
- Climate Change does not affect all areas equally
- Same glaciers are melting faster than others.

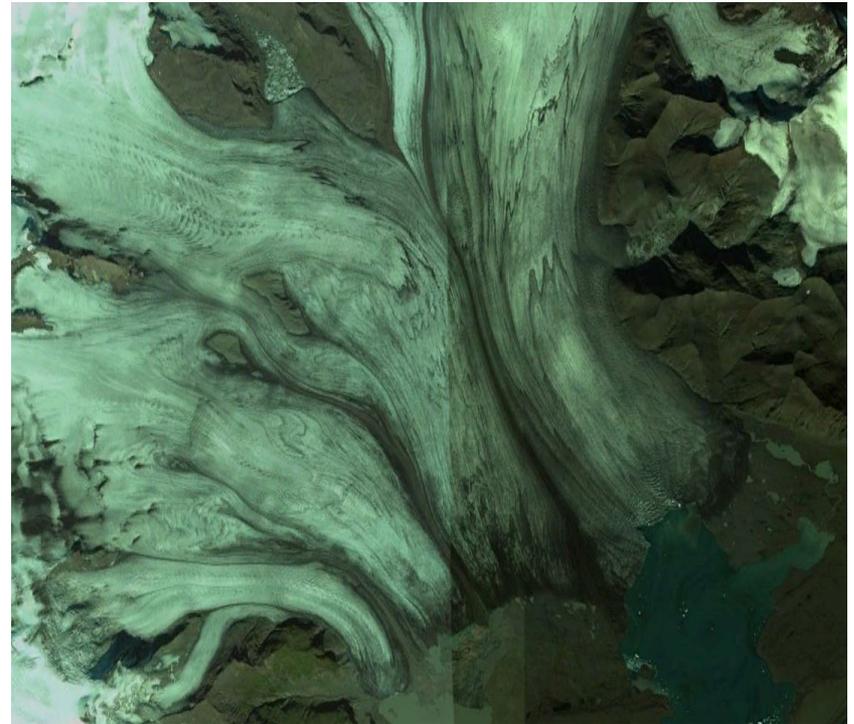




Clean vs. Dirty glaciers



Helheim glacier, Greenland visibleearth.nasa.gov

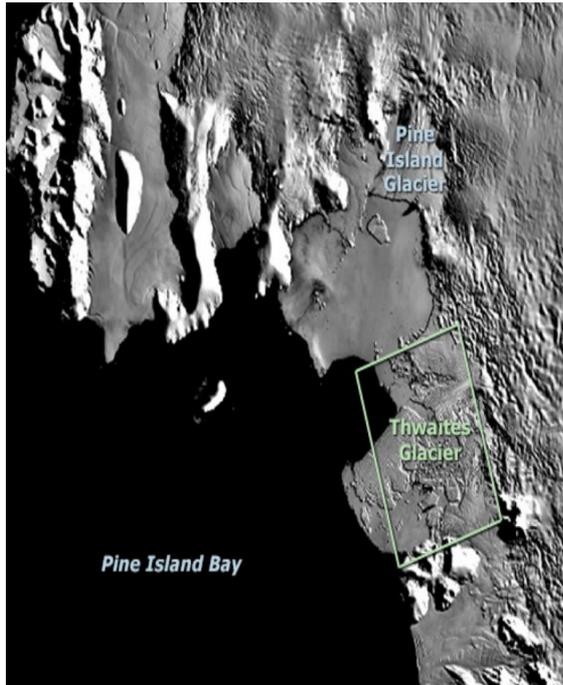


Breiðamerkurjökull glacier, [google earth pro](http://googleearth.pro)
Iceland

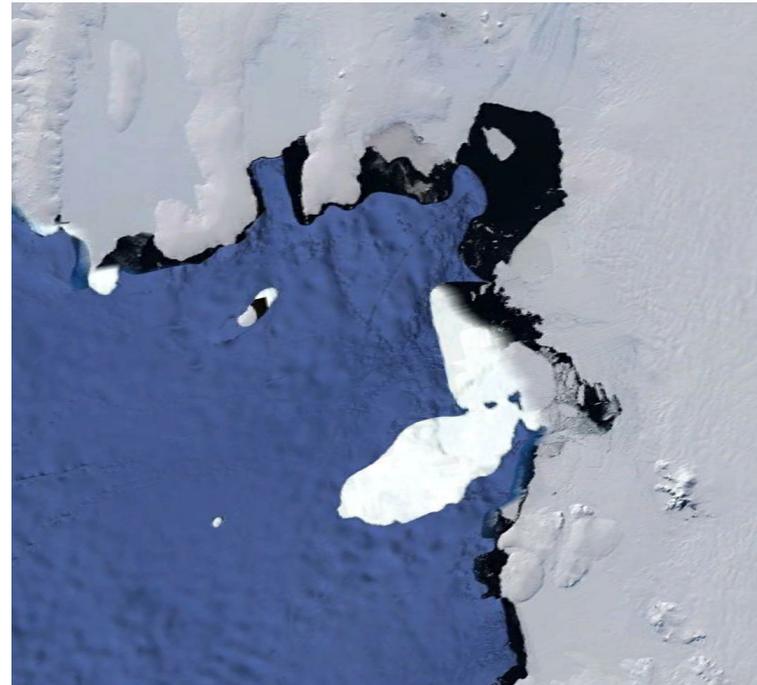
Dirt has a lower albedo than clean ice, which means the dark surface reflects less radiation back into space and absorbs the heat instead, melting the ice faster!



Marine Terminating Glacier



national snow and ice data centre



Google earth pro

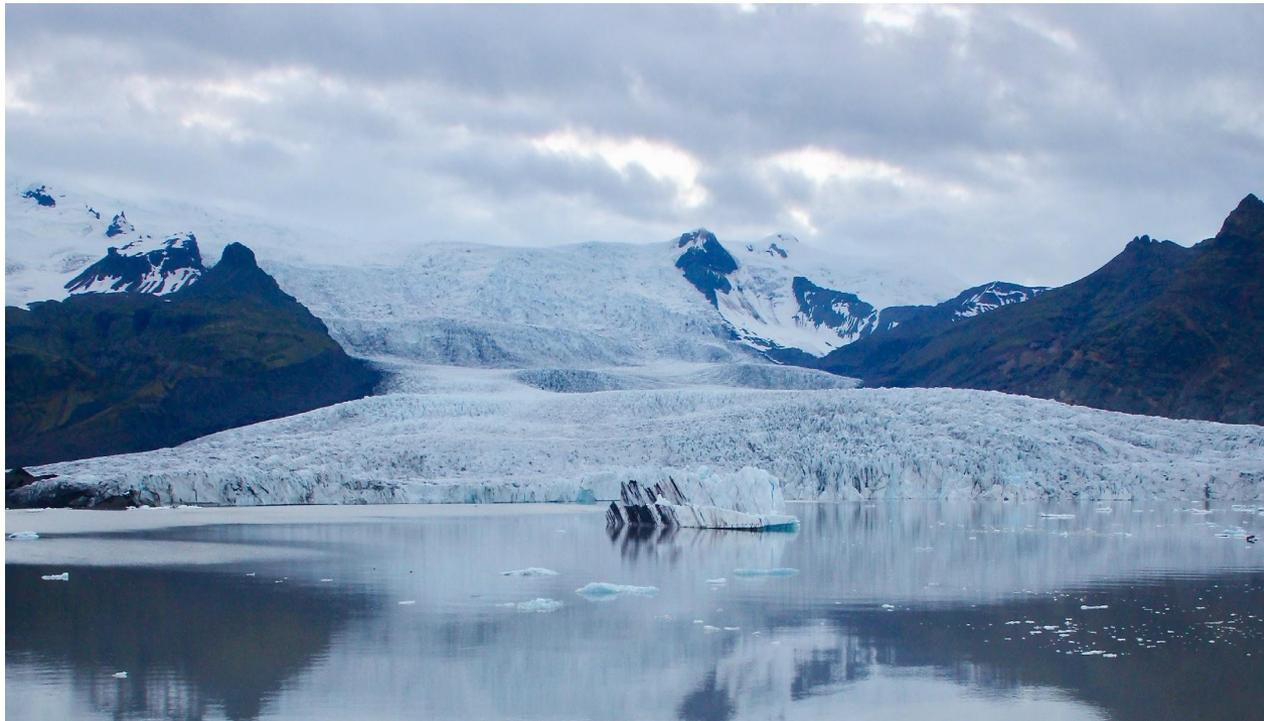
Thwaites glacier, Antarctica

Climate Change is warming the oceans, which increases melt at the front of the glaciers and promotes *Calving*



Lake Terminating Glacier

These are similar to Marine Terminating Glaciers, except it is the surface of the water that warms and undercuts the glacier.



Fjallsjökull glacier, Iceland



Land Terminating Glacier

With no water, the air temperature becomes the most important factor for ice melt. Due to climate change, the air temperature is warming!



google maps



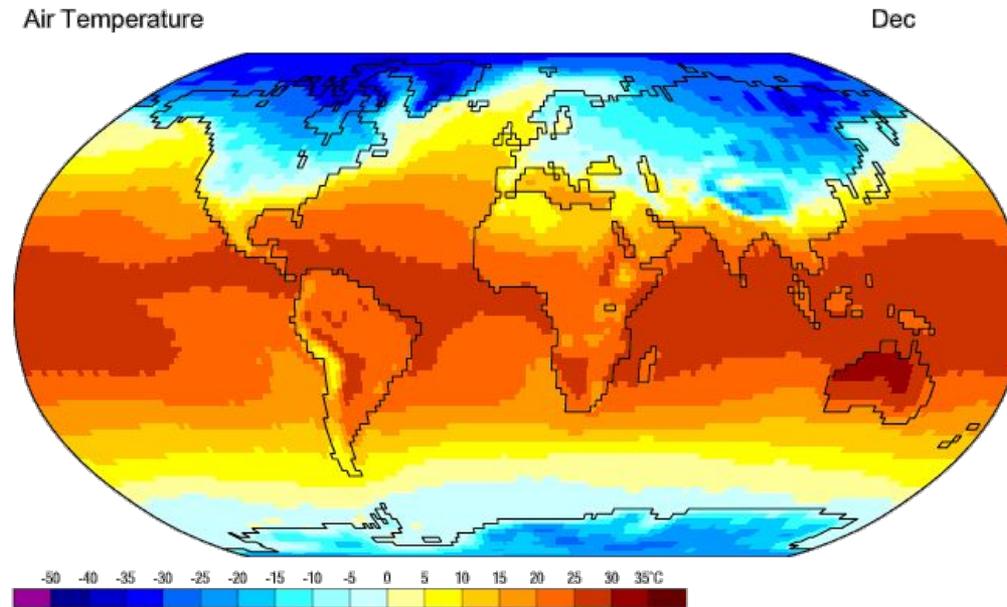
pinterest.co.uk

Russell Glacier, Greenland

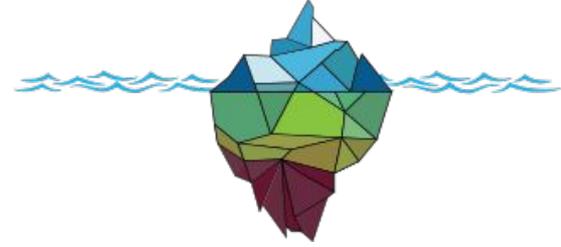


Air Temperature Changes

Warming is occurring at different amounts across the world, which leads to *Differential Melting*.

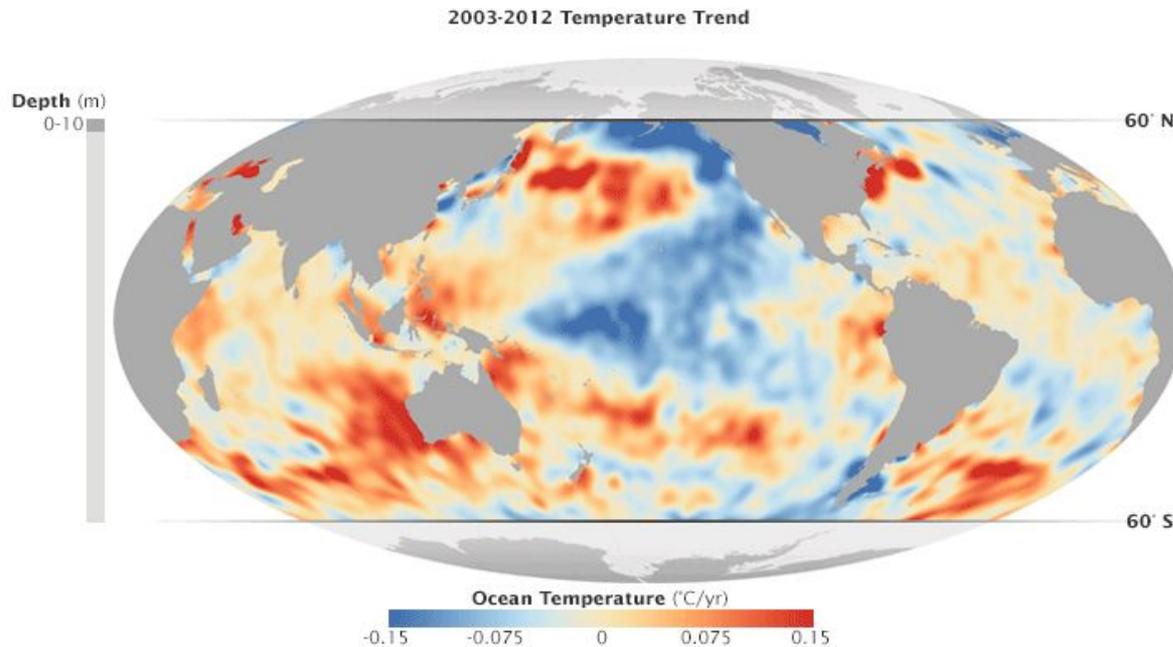


Data: NCEP/NCAR Reanalysis Project, 1959-1997 Climatologies
Animation: Department of Geography, University of Oregon, March 2000



Ocean Temperature Changes

Similar to air temperatures, ocean temperatures have changed in varying levels around the world.





Past vs. Present



usgs.gov

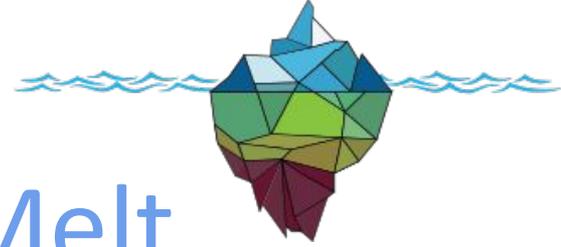
Muir Glacier - 1941



usgs.gov

Muir Glacier - 2004

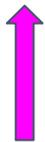
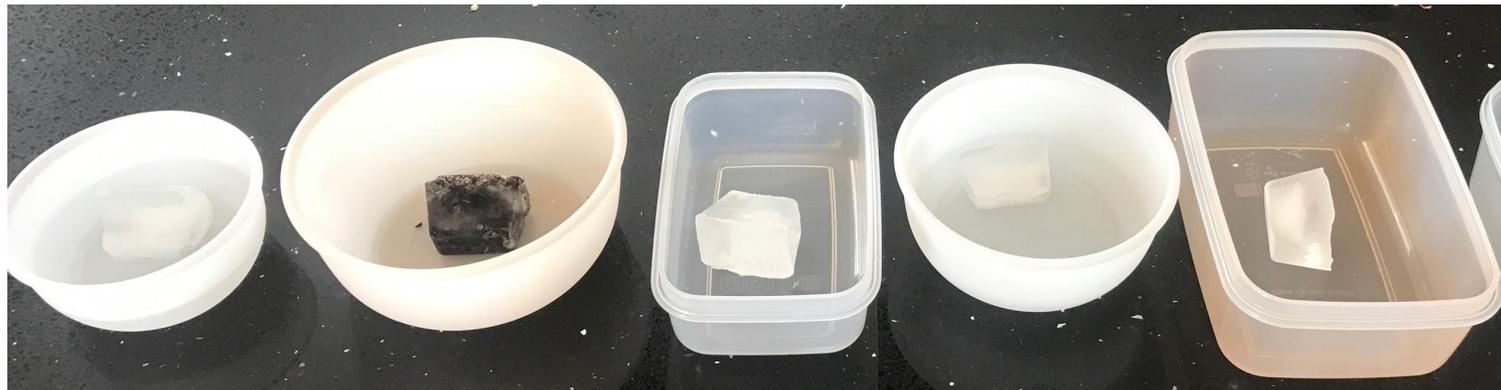
Increased Warming =
Increased Melting



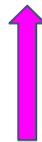
Factors Influencing Melt

- Experiment

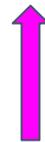
- **Aim:** to investigate how different environments influence glacier melt



Freshwater →
lake terminating
glacier



'Dirty' ice
(placed in
the sun)



'Clean' ice (also
placed in the
sun)



Saltwater →
Marine
terminating
glacier



No water →
land terminating
glacier

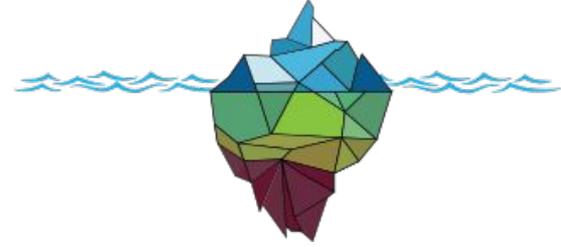


Why is this important?

- Sea level
 - Warming air and ocean temperatures impact glaciers and consequently sea level
- Most glacier melt is sad but harmless BUT others are scary and have a potentially **large impact**

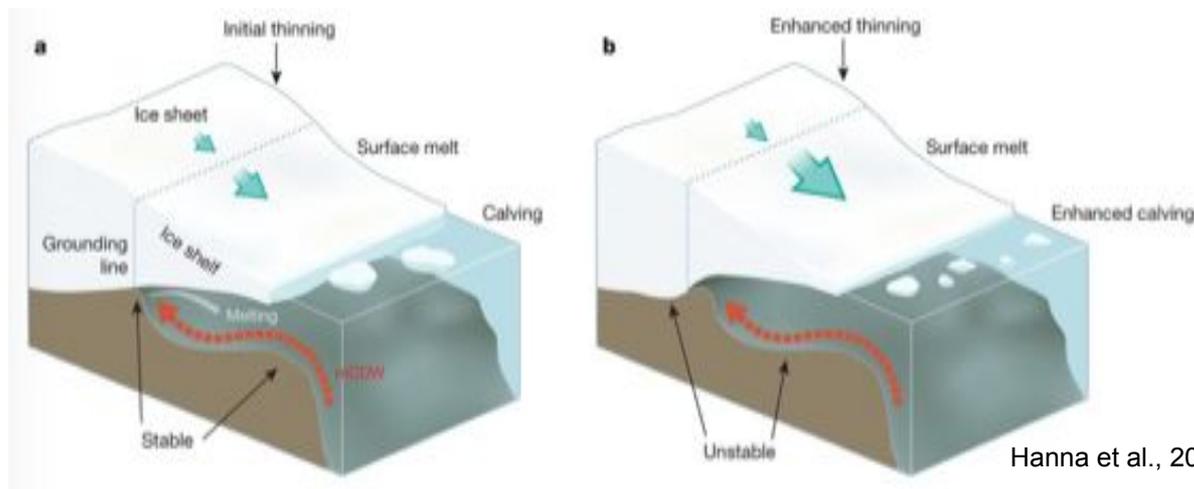


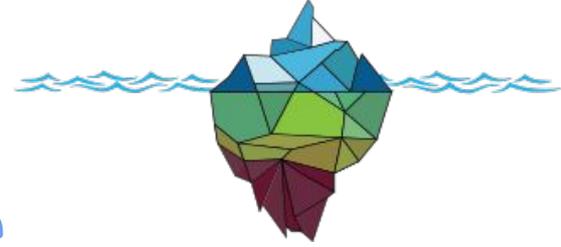
"HOW ON EARTH DO WE TURN IT OFF?"



Thwaites Glacier

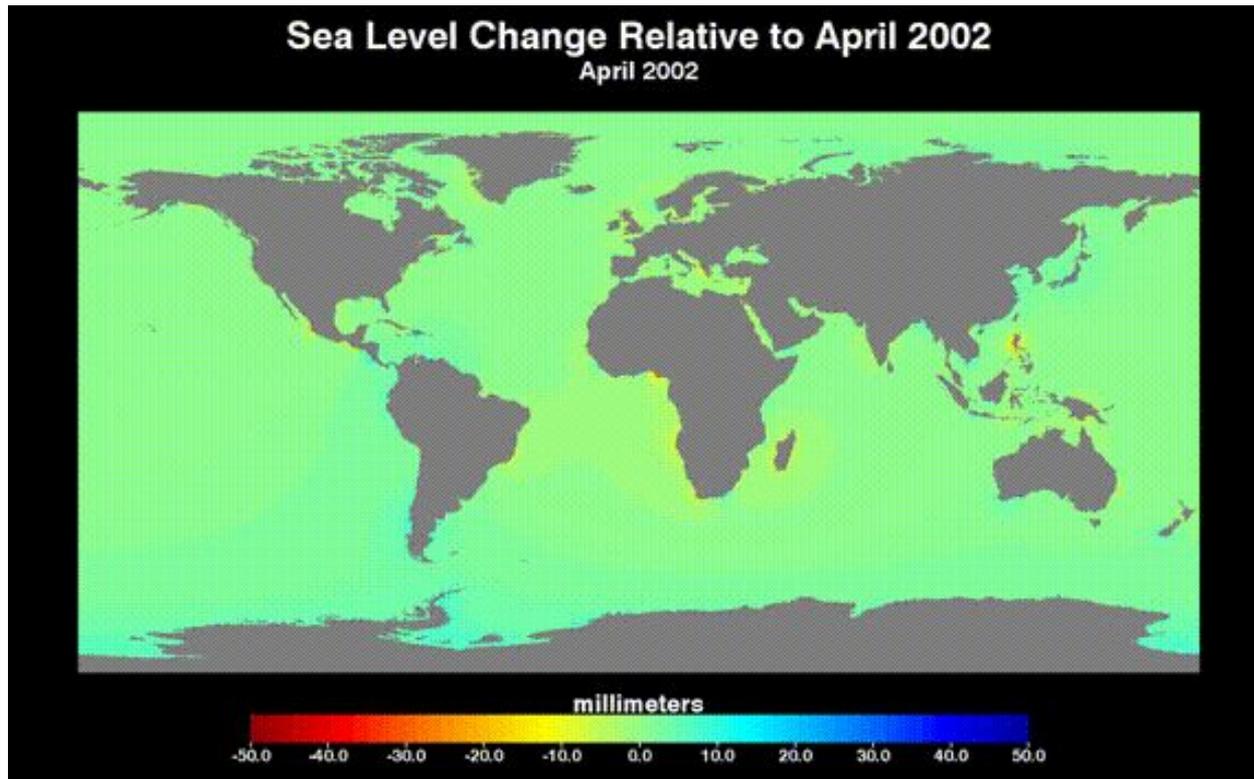
- Thwaites Glacier alone has limited Sea Level Rise potential ($\sim <1\text{m}$) BUT
- Considered the *'plug'* of Antarctica
 - warming oceans \rightarrow melt undercutting
 - if ice mass is removed = potential for the West Antarctic Ice Sheet to collapse rapidly





Sea Level Change

Due to human-induced Climate Change, drastic sea level changes could occur



Impacts of Sea Level Rise



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Asia | China | India

Deadly South Asia floods affect 16m people

18 August 2017



About 11 million people in India have been hit by flooding

More than 16 million people have now been affected across a swathe of South Asia, say aid officials.

The floods in Nepal, Bangladesh and India are threatening lives and are expected to worsen.

The International Federation of Red Cross and Red Crescent Societies says it is becoming one of the worst regional humanitarian crises.

bbc.co.uk

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Where will the deadly floods strike next?

By Mark Smith
Technology of Business reporter

26 September 2017



Flooding in the Dominican Republic continues long after Hurricane Maria has passed

With hundreds dead and millions either left homeless, or facing huge damage to their properties, catastrophic flooding has devastated many parts of the world. Nature's fury may seem unstoppable, but can technology at least help us to cope better?

Savage hurricanes and record rains have struck around the world, bringing chaos to many countries and regions, including Bangladesh, India, the Caribbean, China and Texas in the US.

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Cornwall floods: Clear-up follows flood 'devastation'

f | | | | | Share



A 4ft torrent of water through a Cornwall village has left a fire chief said.

damaged and several people had to be rescued in the Peninsula, as storms hit on Tuesday afternoon.

village, leaving roads in and out impassable. A school bus

bbc.co.uk

bbc.co.uk

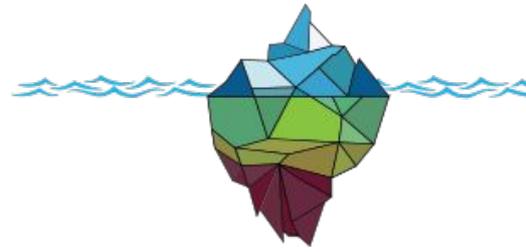


What Can You Do?

- Ways of doing your part to help prevent climate change

PROTECTING OUR PLANET STARTS WITH YOU 

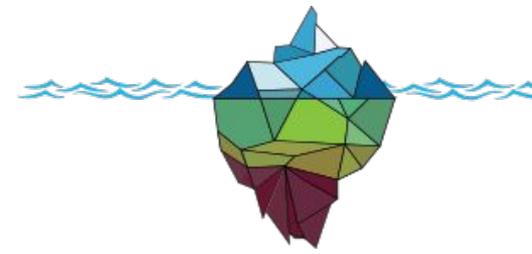
<p>BIKE MORE DRIVE LESS</p> 	<p> reduce REUSE recycle</p> <p>Cut down on what you throw away. Follow the three "R's" to conserve natural resources and landfill space.</p>	<p>choose sustainable</p>  seafood <p>Learn how to make smart seafood choices at www.FishWatch.gov.</p>	<p>Trees provide food and oxygen. They help save energy, clean the air, and help combat climate change.</p>  PLANT A TREE
<p> EDUCATE</p> <p>When you further your own education, you can help others understand the importance and value of our natural resources.</p>	<p>CONSERVE WATER</p>  <p>The less water you use, the less runoff and wastewater that eventually end up in the ocean.</p>	<p> -SHOP- WISELY</p> <p>Buy less plastic and bring a reusable shopping bag.</p>	<p> Don't send chemicals into our waterways.</p> <p>Choose nontoxic chemicals in the home and office.</p>
<p> Volunteer!</p> <p>Volunteer for cleanups in your community. You can get involved in protecting your watershed too!</p>		<p> Long-lasting light bulbs - ARE A - BRIGHT IDEA</p> <p>Energy efficient light bulbs reduce greenhouse gas emissions. Also flip the light switch off when you leave the room!</p>	



True or False

'Dirty' glaciers melt more slowly than 'clean' glaciers.

TRUE OR FALSE

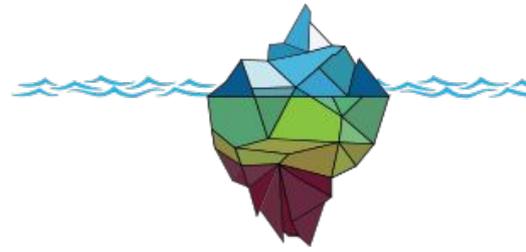


True or False

'Dirty' glaciers melt more slowly than 'clean' glaciers.

~~TRUE~~ OR **FALSE**

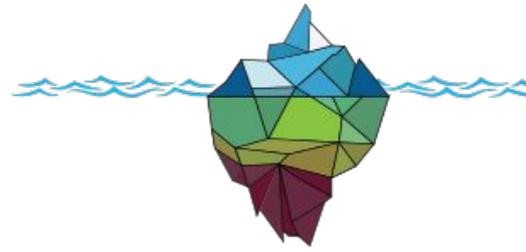
False! Clean glaciers have a high "Albedo", and so reflect more of the sun's radiation back into space. Therefore, dark surfaces warm more quickly.



True or False

If a lake formed in front of a glacier it would melt more quickly.

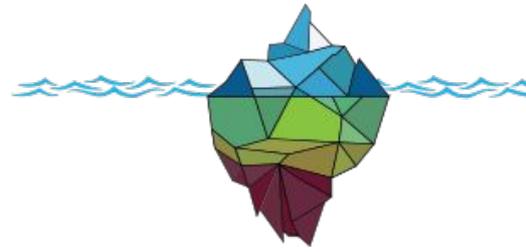
TRUE OR FALSE



True or False

If a lake formed in front of a glacier it would melt more quickly.

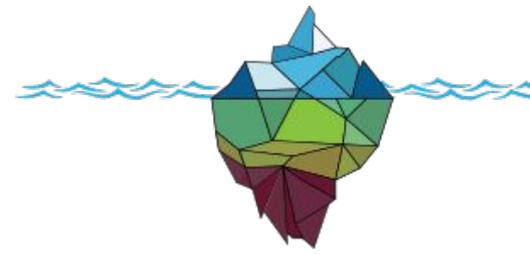
TRUE OR ~~FALSE~~



True or False

Ocean warming is less important than rising air temperatures.

TRUE OR FALSE



True or False

Ocean warming is less important than rising air temperatures.

~~TRUE~~ OR **FALSE**

False! Both are very important, but warming oceans may rapidly melt Thwaites Glacier, leading to the whole of West Antarctica flowing into the sea!

