



POLAR I.C.E. (Interactive Climate Education)

WHAT IS HAPPENING TO
ANTARCTICA'S PINE ISLAND
GLACIER?

Lamont-Doherty Earth Observatory
COLUMBIA UNIVERSITY | EARTH INSTITUTE



P.I.G. ice shelf, photo M. Wolovick

<http://www.ldeo.columbia.edu/polareducation>

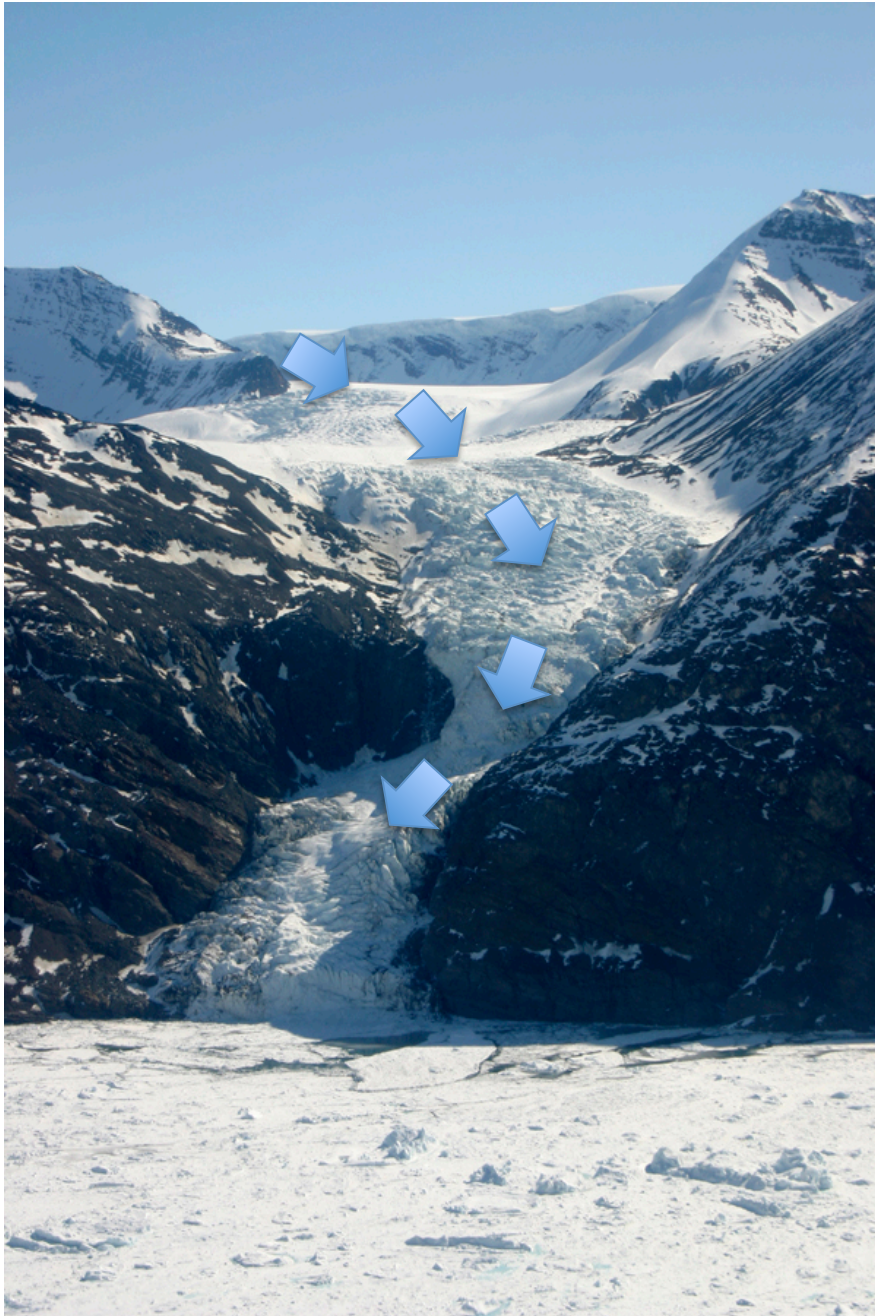
ABOUT GLACIERS...

**Glaciers are large expanses of ice.
In the polar regions they are continental sized!**



Greenland's Kangerdlugssuaq Glacier, photo by P. Spector

- Glaciers form where snow remains year-round, compressing into ice over time.
- Glacier Accounting is like a bank account:
 1. They remain balanced (equal in size) if the snow added annually equals the snow lost;
 2. They grow when more is added (snow) than removed (melt);
 3. They shrink when more is removed (melts) than added (snow).

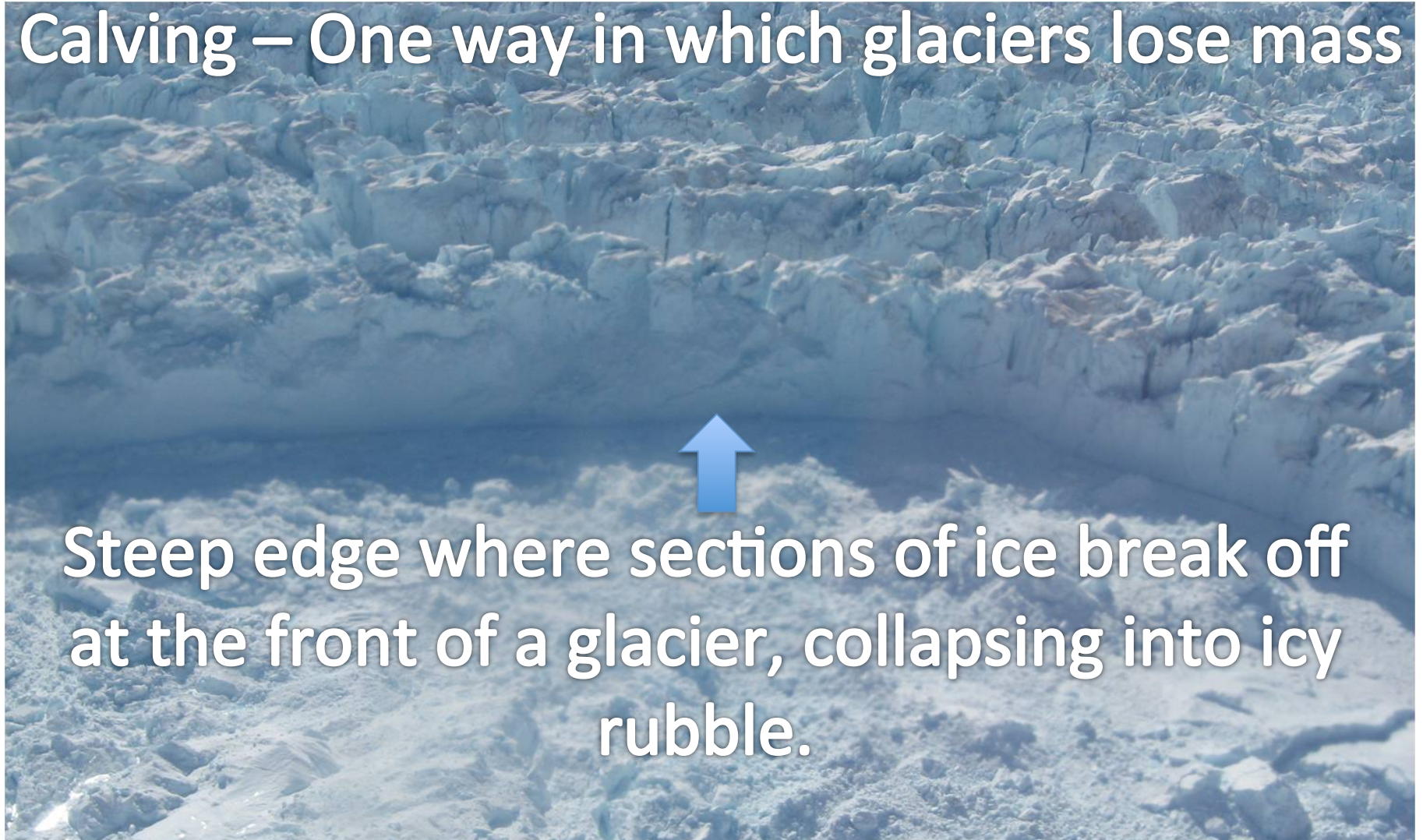


Glaciers are in constant motion.

Tugged by gravity they move under their own weight, flowing from areas of higher elevation to areas of lower elevation.

Greenland's Kangerdlugssuaq Glacier, photo by P. Spector

Calving – One way in which glaciers lose mass



Steep edge where sections of ice break off at the front of a glacier, collapsing into icy rubble.

Glaciers in the polar regions can lose ‘mass’ in several ways – calving (chunks of ice breaking off), melting, wind blow, and sublimating straight to water vapor. This loss of ice mass is called ‘ablation’.

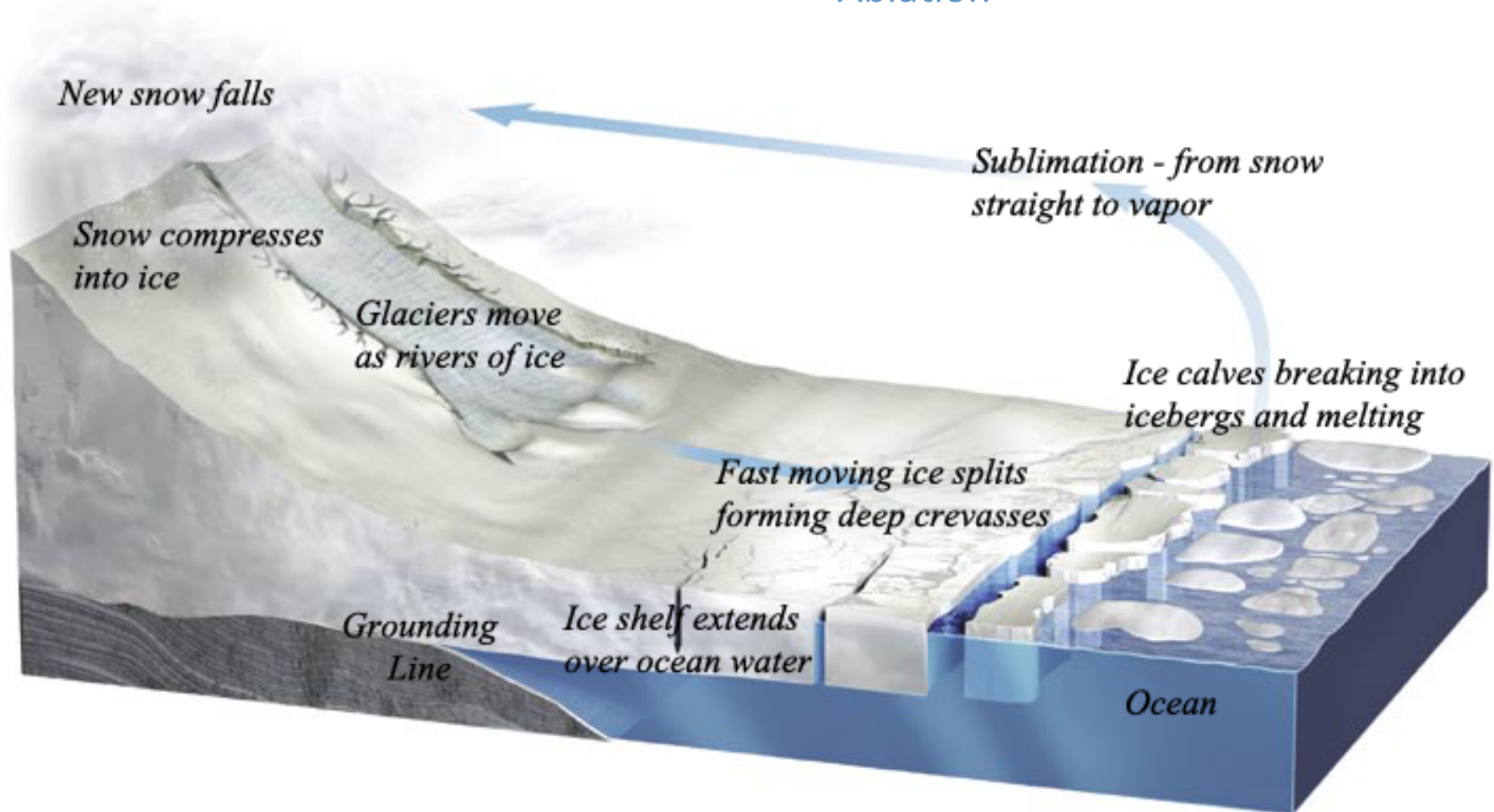
Greenland’s Jakobshavn Glacier, photo by I. Das

The Glacial System

Start with 'New snow falls' and move counter clockwise to follow the system .

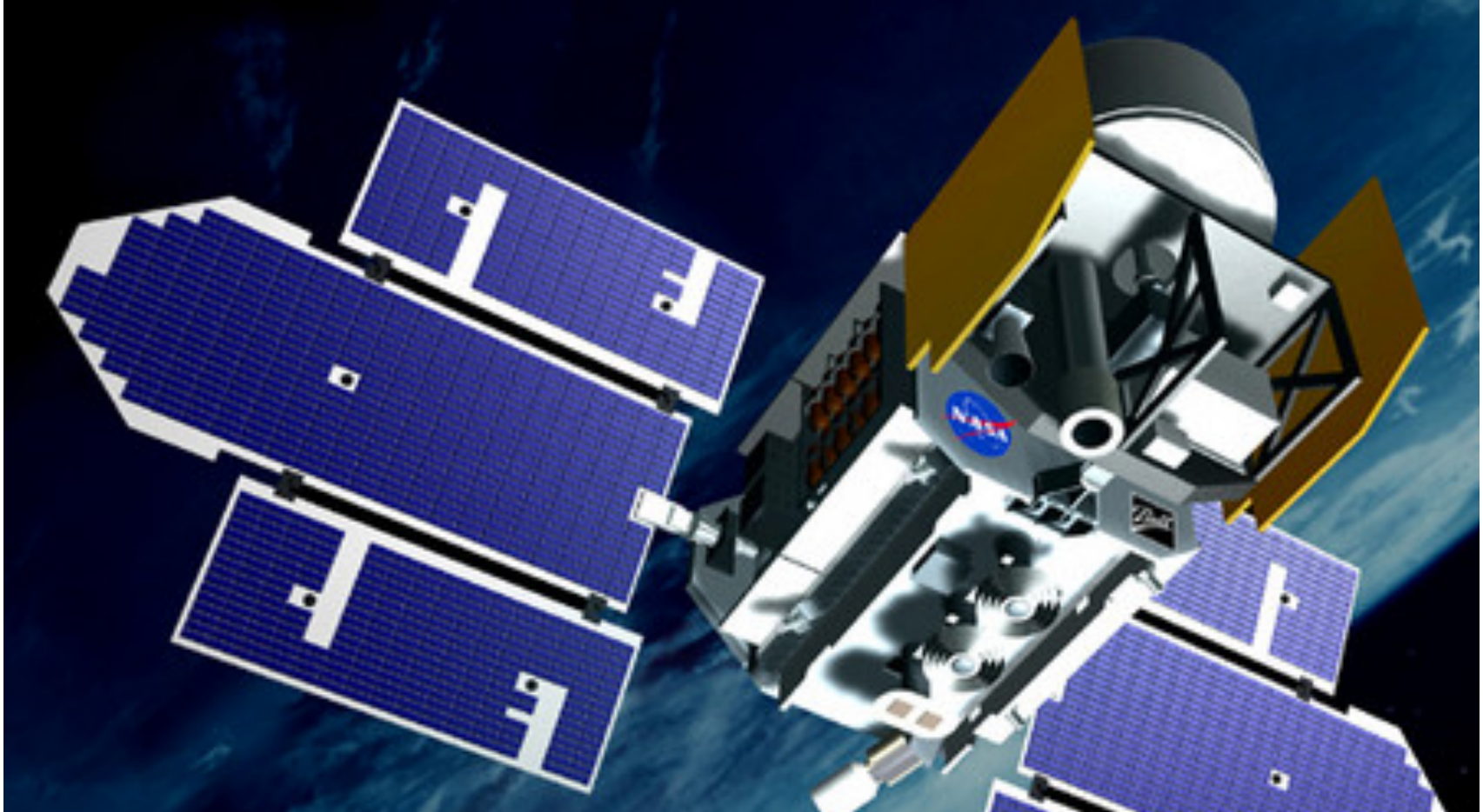
'Accumulation'

'Ablation'



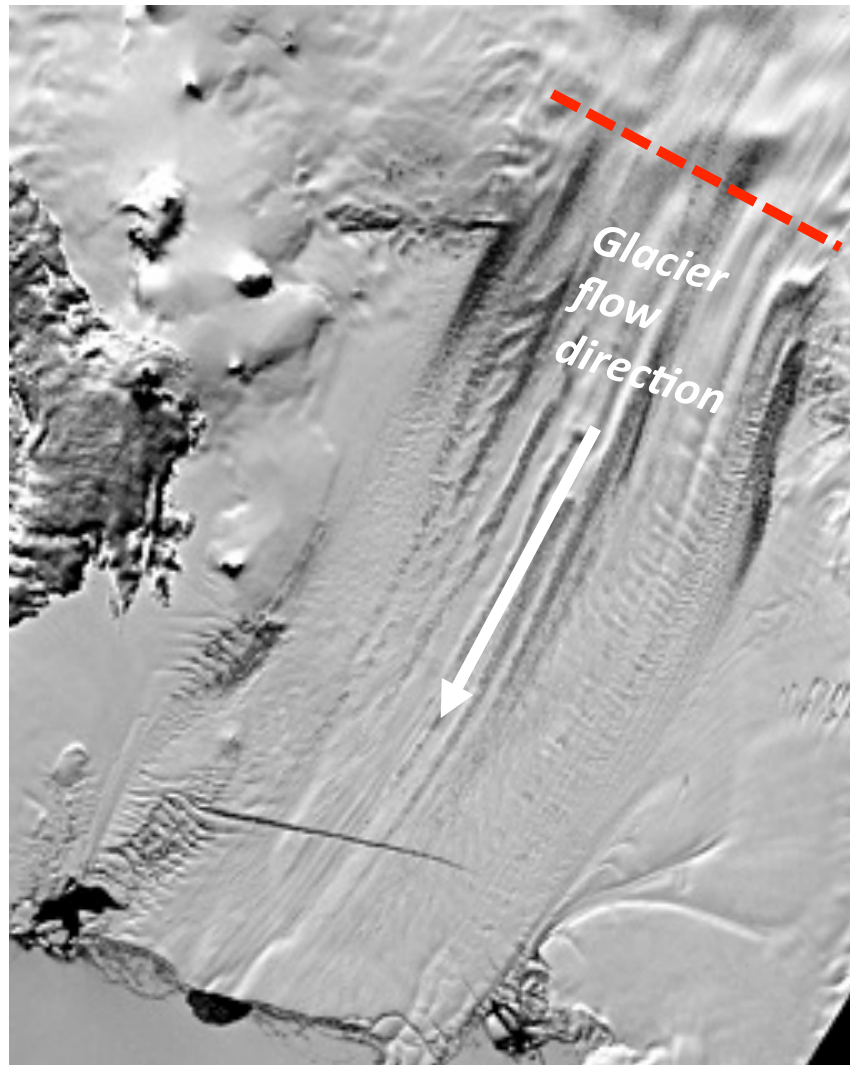
edited from R. Bell, The Unquiet Ice, Scientific American, Feb. '08)

About Measuring Glaciers...



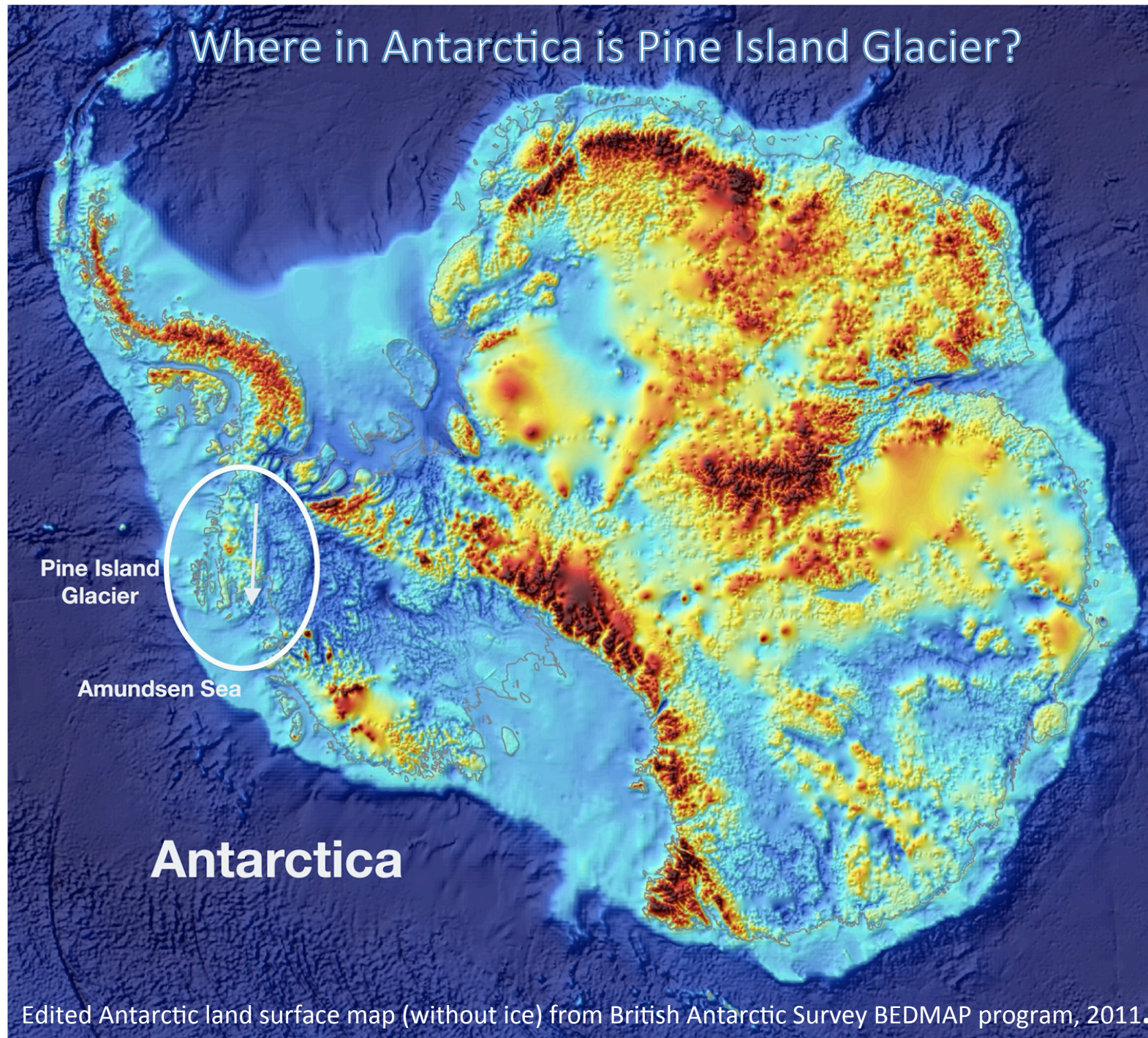
- Satellites have been collecting information about the Earth since the 1990's.
- NASA ICESat I used a laser to measure ice surface elevation from 2003 to 2009. These measurements are accurate to ~15 cm (6 inches) of elevation!
- Today's activity uses ICESat data to measure changes to ice elevation of Pine Island Glacier.

About Pine Island Glacier (P.I.G.)...



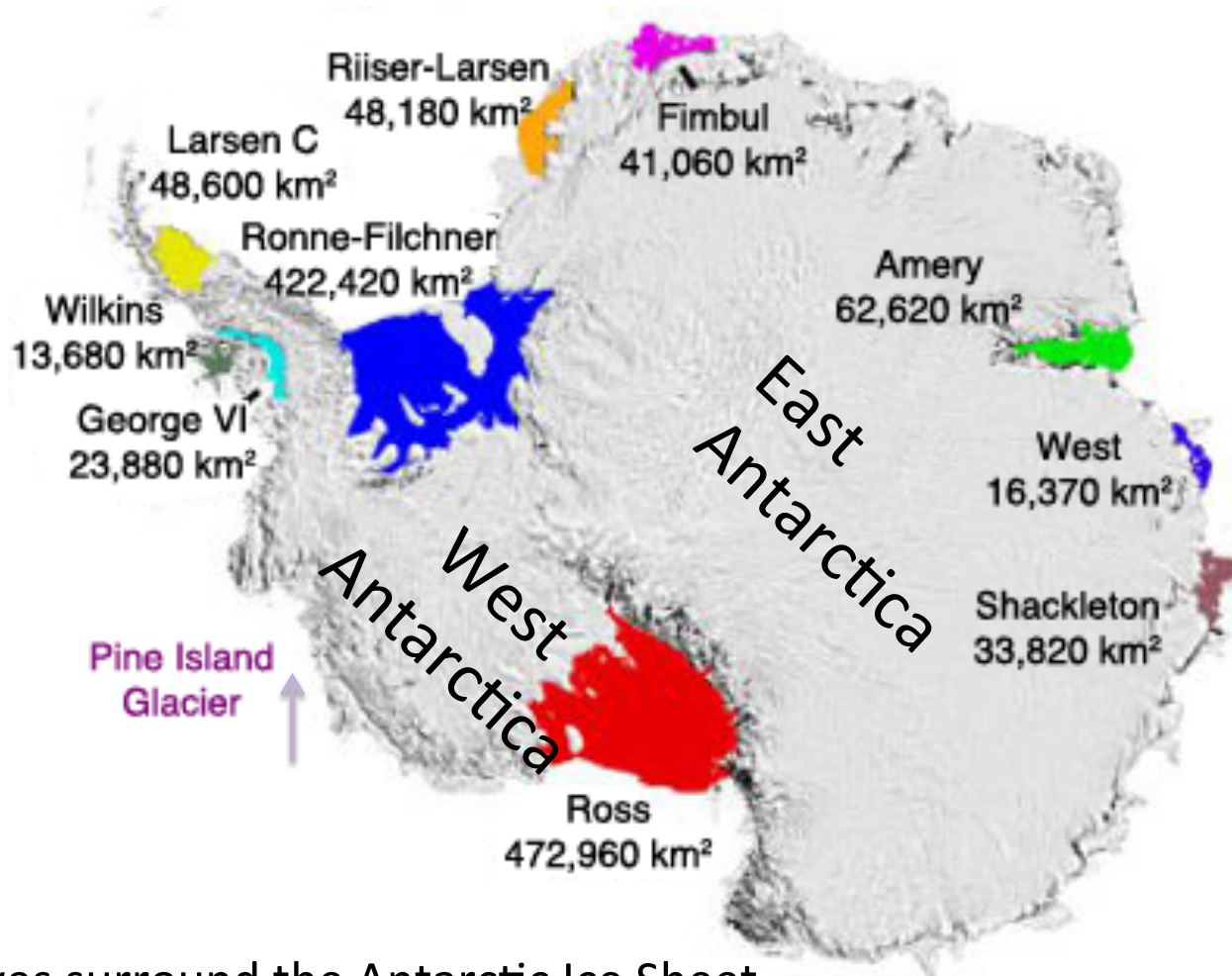
This activity focuses on ice surface elevation on P.I.G. The red line shows where the ICESat ice surface data used in this activity was collected.

Where in Antarctica is Pine Island Glacier?



Edited Antarctic land surface map (without ice) from British Antarctic Survey BEDMAP program, 2011.

About Antarctica's Ice Shelves...



- Ice Shelves surround the Antarctic Ice Sheet.
- Like barricades they block the glaciers, slowing the ice flow off the landmass.
- The larger the ice shelf, the larger the barricade.
- Pine Island Glacier has a very small ice shelf – too small to show in this graphic.

Is P.I.G. a 'climate canary'*?

Let's do the activity! Working with Ice Elevation Data from P.I.G. you can answer this important question!

*Years ago miners used canaries as an ***early warning signal*** to alert them to toxic changes in the air inside the mines. Canaries have become a symbol of an early alert to approaching danger.



Our canary wears shades as protection from the reflectivity of the glacial snow (known as albedo). Ice albedo is a key ingredient in the ongoing cooling of our Earth system.

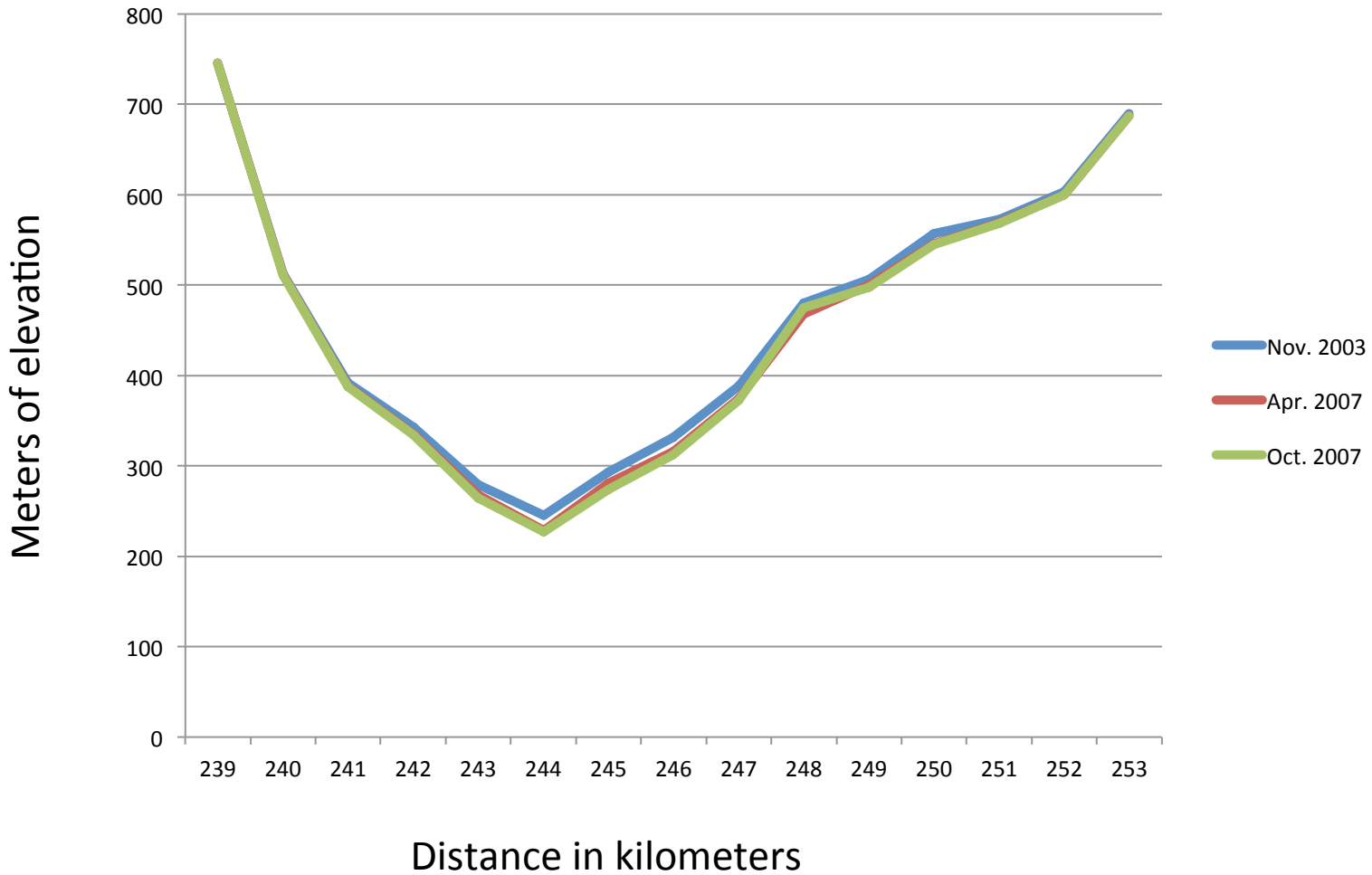
GRAPHING P.I.G. DATA FOR LINE #279

LOCATION RECORDED BY KM	ELEVATION IN METERS NOV. 2003	ELEVATION IN METERS APR. 2007	ELEVATION IN METERS OCT. 2007	
239	746	746	746	
240	512	511	511	
241	392	389	387	
242	343	335	334	
243	279	267	264	
244	245	229	227	
245	293	281	274	
246	332	316	312	
247	389	374	372	
248	480	468	475	
249	507	500	497	
250	557	545	545	
251	573	569	569	
252	604	600	600	
253	690	687	687	



Complete Part I... the first graphing activity.

Graph of 3 sets of P.I.G. elevation data



GRAPHING P.I.G. DATA FOR LINE #279

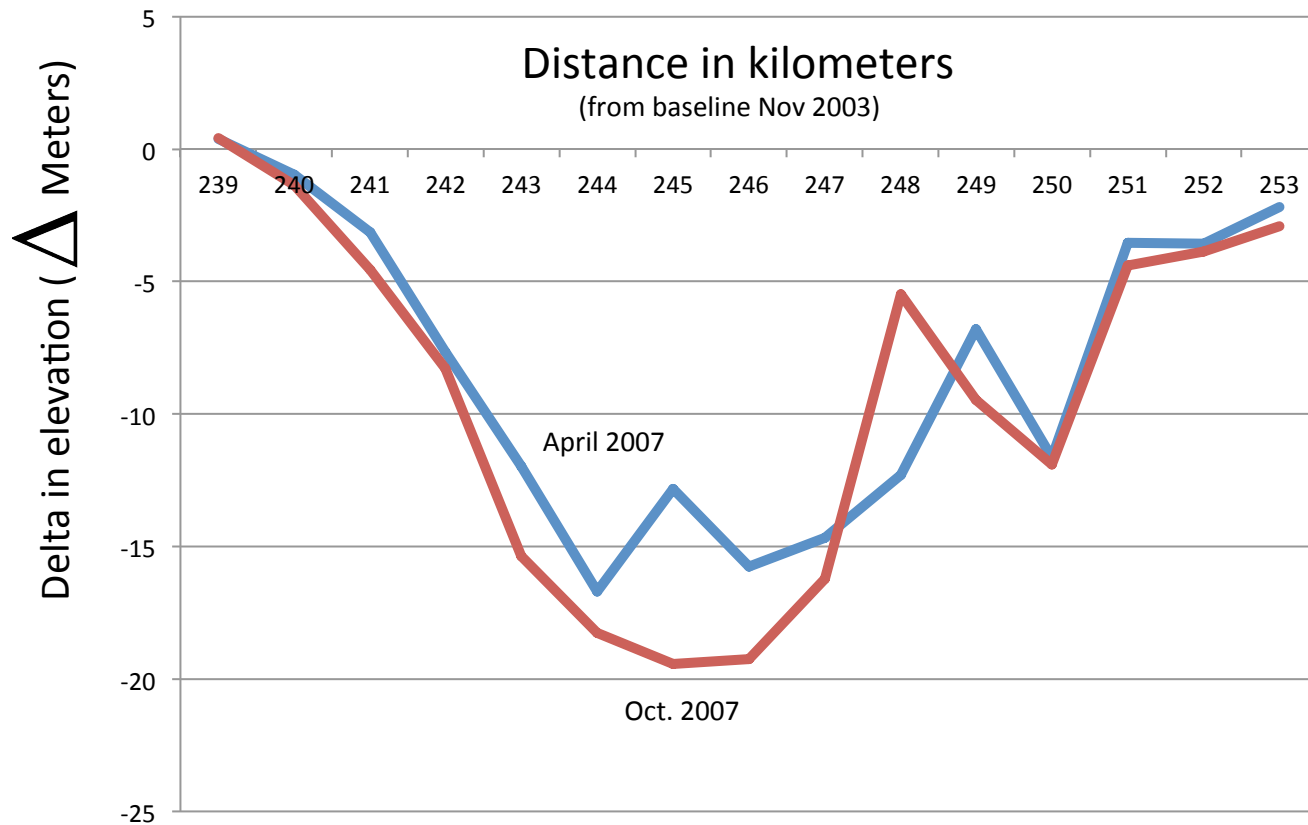
LOCATION RECORDED BY KM	ELEVATION IN METERS NOV. 2003	ELEVATION IN METERS APR. 2007	ELEVATION IN METERS OCT. 2007	DELTA IN METERS NOV. 2003 TO APRIL 2007	DELTA IN METERS NOV. 2003 TO OCT. 2007
239	746	746	746	0	0
240	512	511	511	-1	-1
241	392	389	387	-3	
242	343	335	334		
243	279	267	264		-15
244	245	229	227	-16	-18
245	293	281	274	-12	
246	332	316	312	-16	
247	389	374	372		-17
248	480	468	475	-12	
249	507	500	497	-7	-10
250	557	545	545	-12	
251	573	569	569	-4	
252	604	600	600		-4
253	690	687	687	-3	-3

For each dataset in 2007 you will calculate the change (delta Δ) from 2003, completing the last two columns in this chart. Then graph the Δ in Part II, using 2003 as your zero line and the Δ for April and October 2007.



Complete Part II... the second graphing activity.

Graph of delta-comparison to 2003





Project website: <http://www.ldeo.columbia.edu/icepod/>
Education website: <http://www.ldeo.columbia.edu/polareducation/>