

Bell Ringer

1. What are the 3 categories of living things in the ocean?
2. Where would you find new ocean crust being created?
3. What month would you expect Arctic ice to be at its maximum? Antarctic?

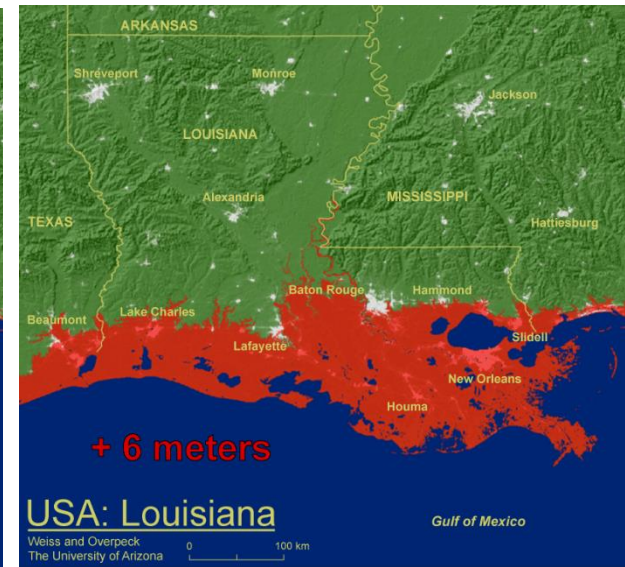
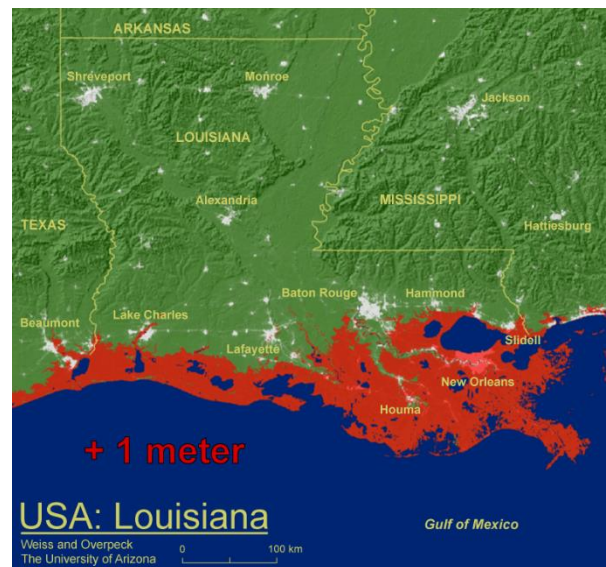
Analyzing Sea Level Rise Lab

Global Sea Level Rise



Why Measure Sea Level Rise?

Will Have a Catastrophic Impact



What's Causing Global Warming?



Heat Incoming Heat Outgoing



Top of Atmosphere

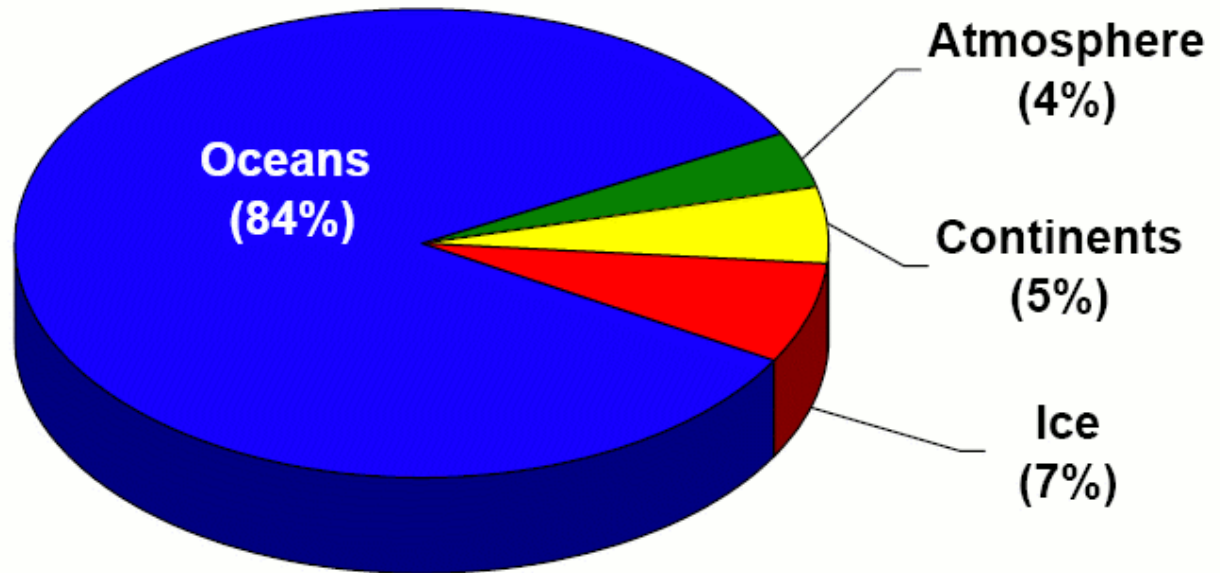
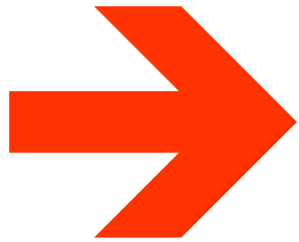


Net Heat Input Causes
Global Warming

Where Does the Heat Go?

Amount of Heat Absorbed by Parts of Earth Climate System Over Past 40 Years

Net Heat Input to Earth System

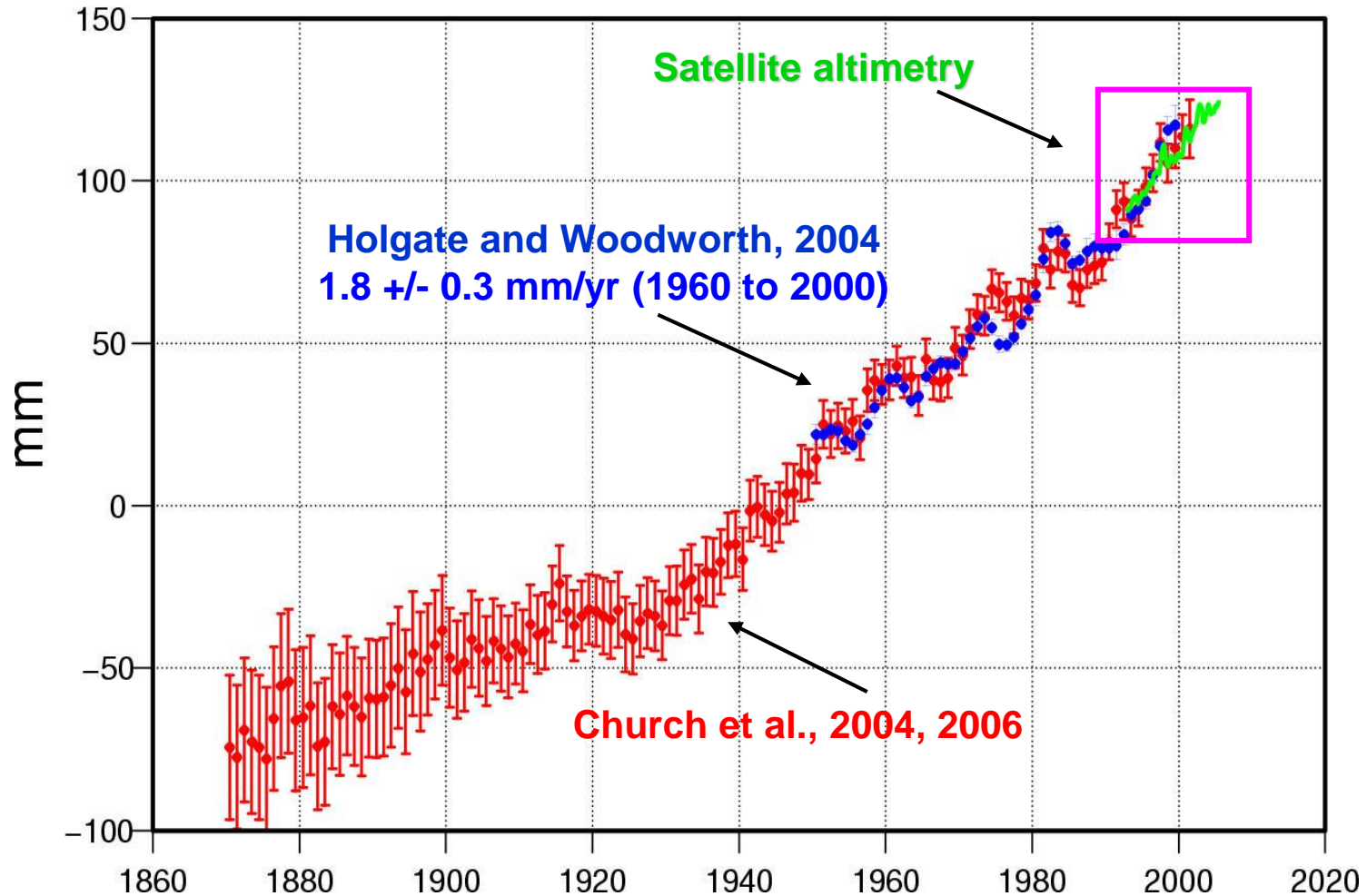


(Levitus et al., GRL, 2004)

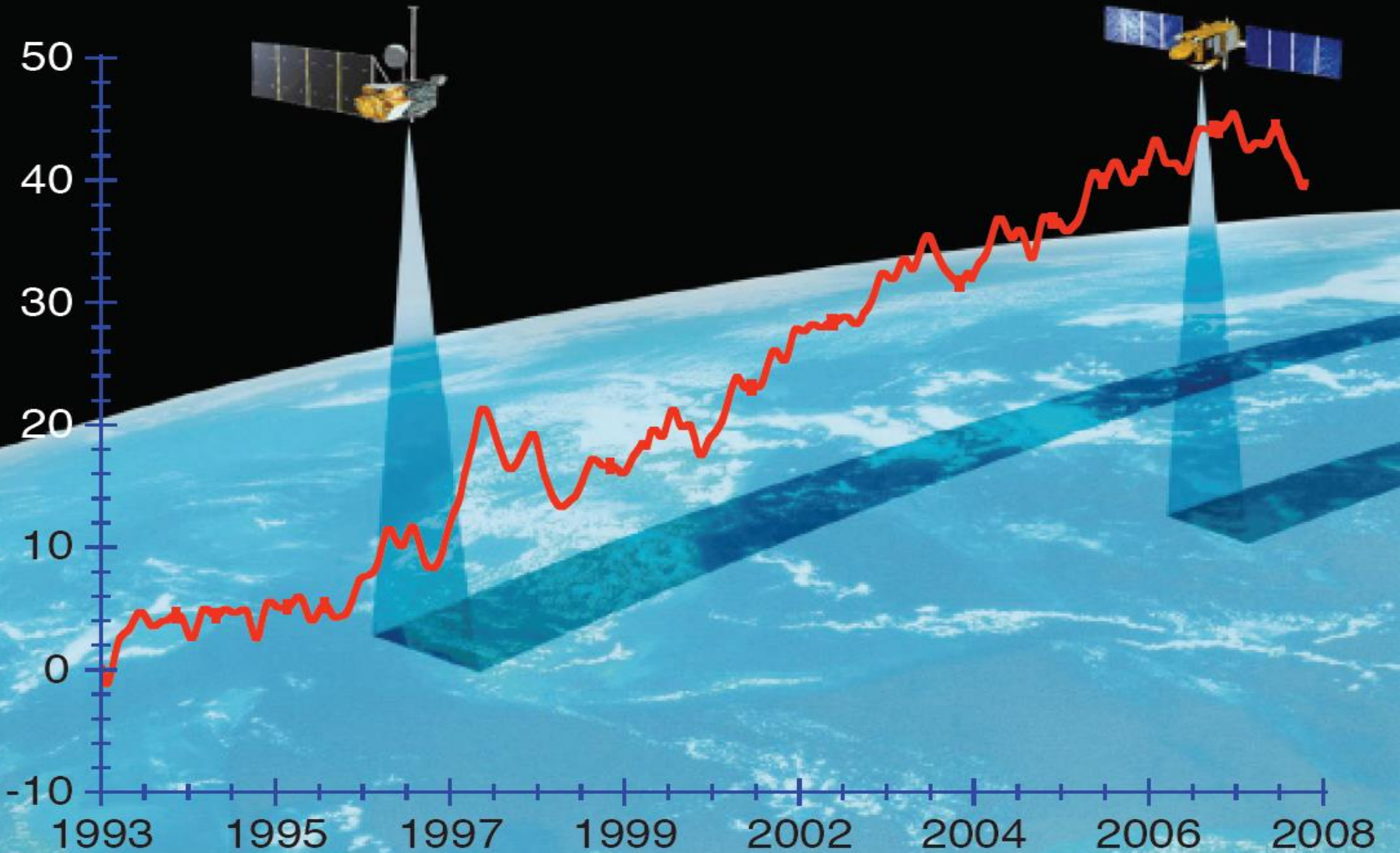
84% -- Saved By The Oceans!

What is the most obvious consequence?

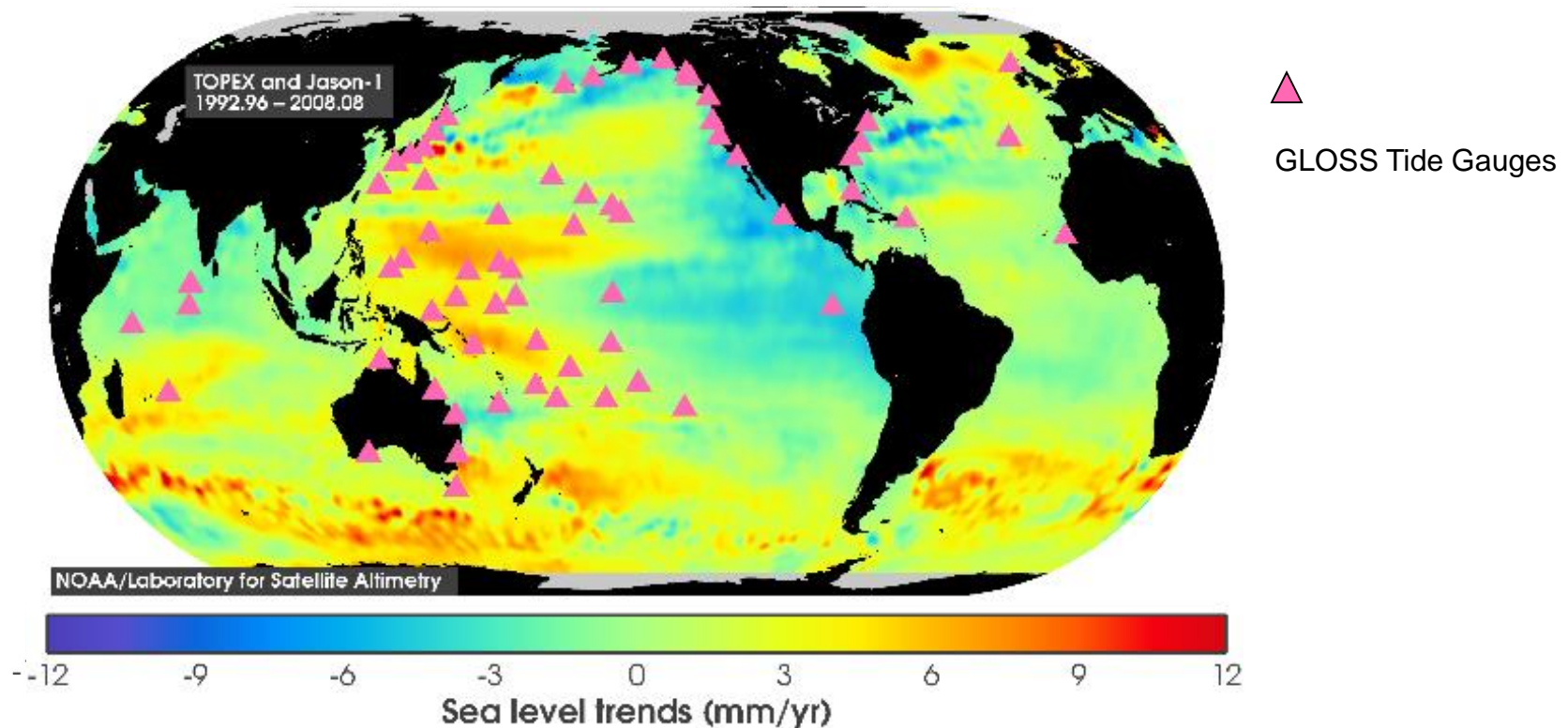
Mean Sea Level Rise, 1870-2000: ~ 1.7 mm/yr,
with an increase in the rate of rise



Altimeter Record of Sea Level Rise Over Past 15 Years



Sea Level Rise From Topex & Jason-1: 1993-2007



- *Sea Level Rise is spatially, highly non-uniform*
- *Tide gauges are important, but primarily for altimeter calibration*

What's Causing Sea Level Rise?

Ice Melt

+

Heat

=

Sea Level Rise



+



=



More Water,
More Mass

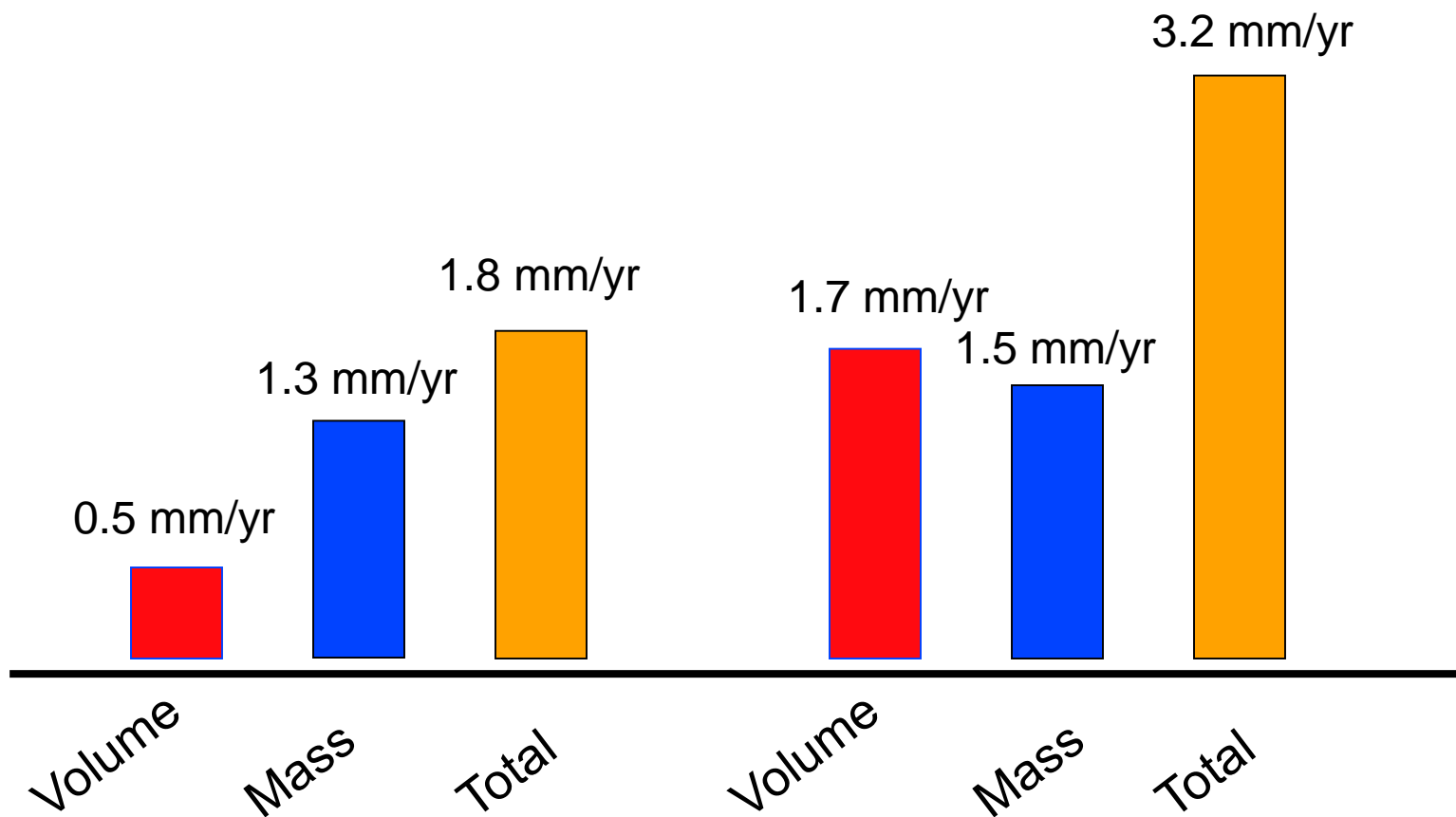
More expansion,
More Volume

Sea Level Budget Changes With Time

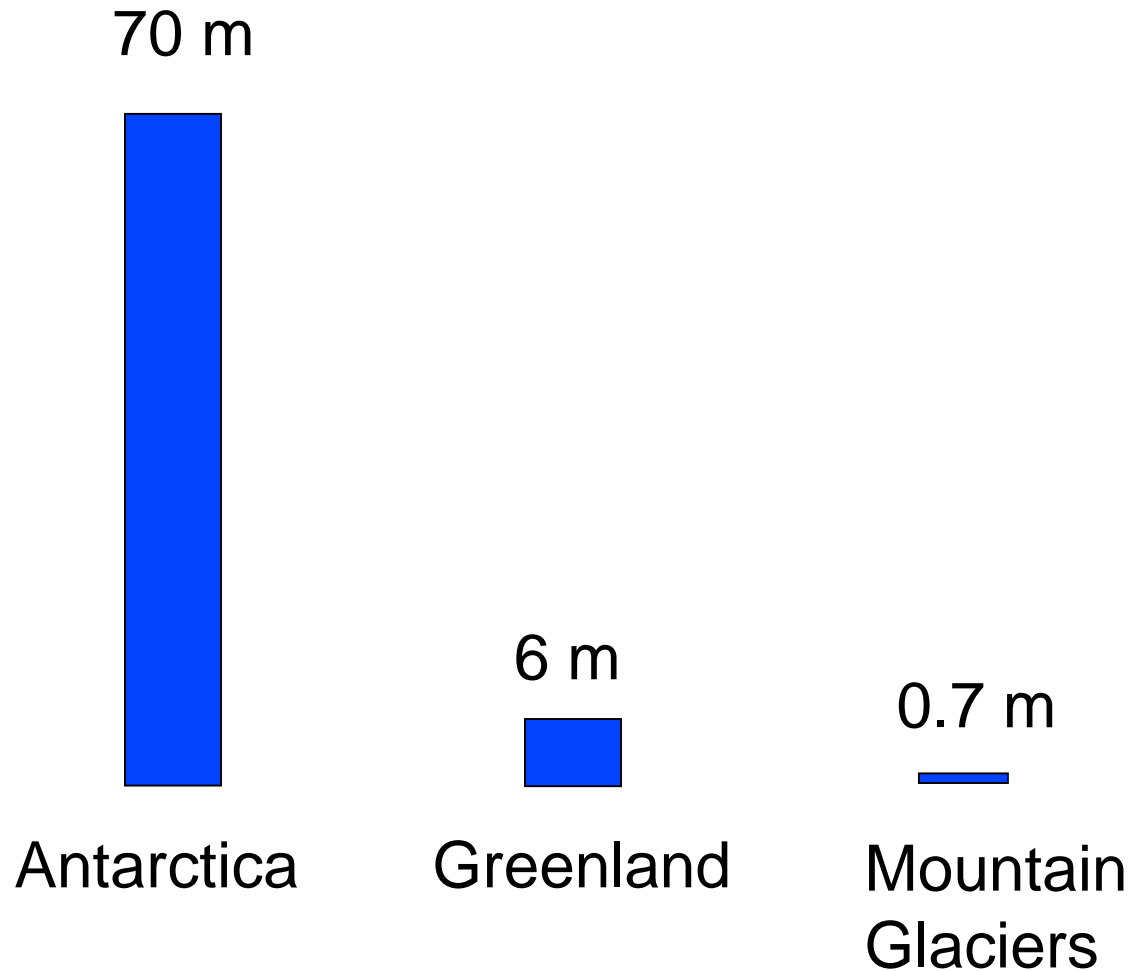
*Current Rate Nearly Twice the 20th Century Rate
Largely Due to Volume Changes*

1920 - 1990

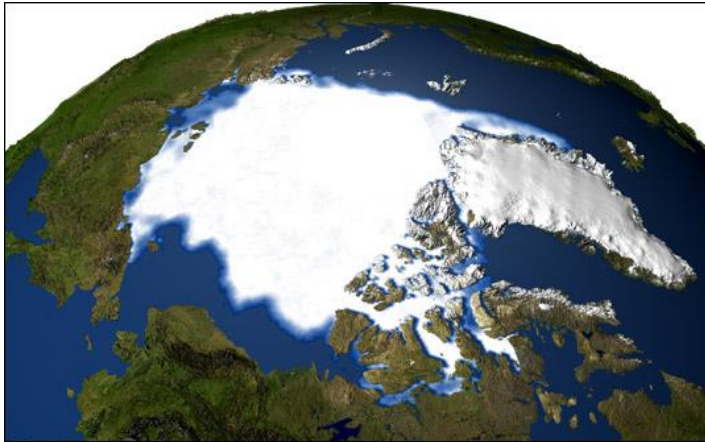
1992 - 2003



Sources of Ice Melt & Potential Impact on Sea Level

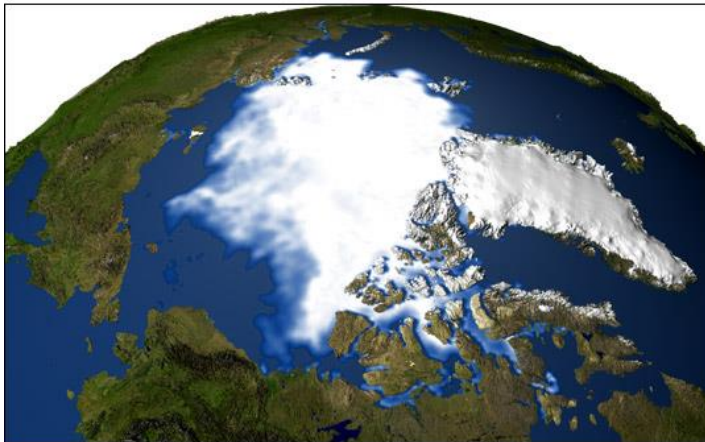


Arctic Sea Ice Is Disappearing At Record Rate



1979 SSMI Composite Data

Summer 1979



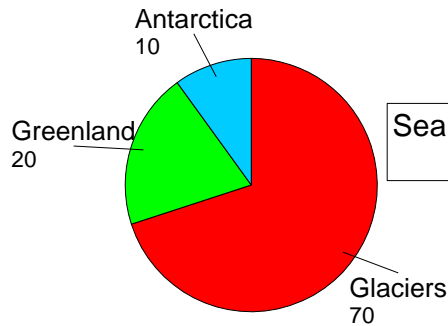
2003 SSMI Composite Data

Summer 2003

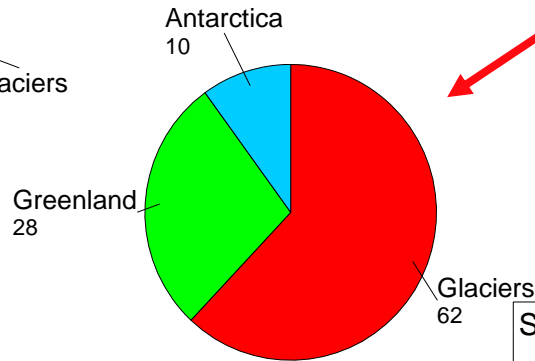
The loss poses grave environmental dangers ...
but not Sea Level Rise ... *(Archimedes Principle)*

Ice Melt Contributions to Sea Level Rise: Glaciers & Ice Sheets

Sea Level Rise (%) [IPCC, 2006]]
100% = 1.28 mm a⁻¹

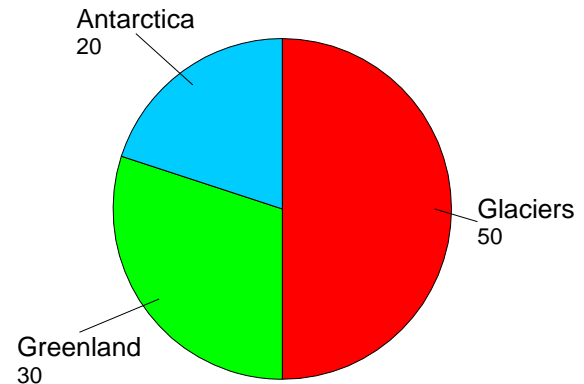


Sea Level Rise (%) [Meier et al., 2007]
100% = 1.8 mm a⁻¹



Mountain Glaciers
Are Currently the
Biggest Source, But
Probably Not For
Long.

Sea Level Rise (%) [latest GRACE data]]
100% = 2.2 mm a⁻¹





Greenland Is a Growing Worry

Its ice sheets are flowing faster towards the ocean during summer.

Possibly due to surface melt water cascading down crevasses and providing a slick surface at the ice/rock interface.

Planet Earth: Shallow Seas