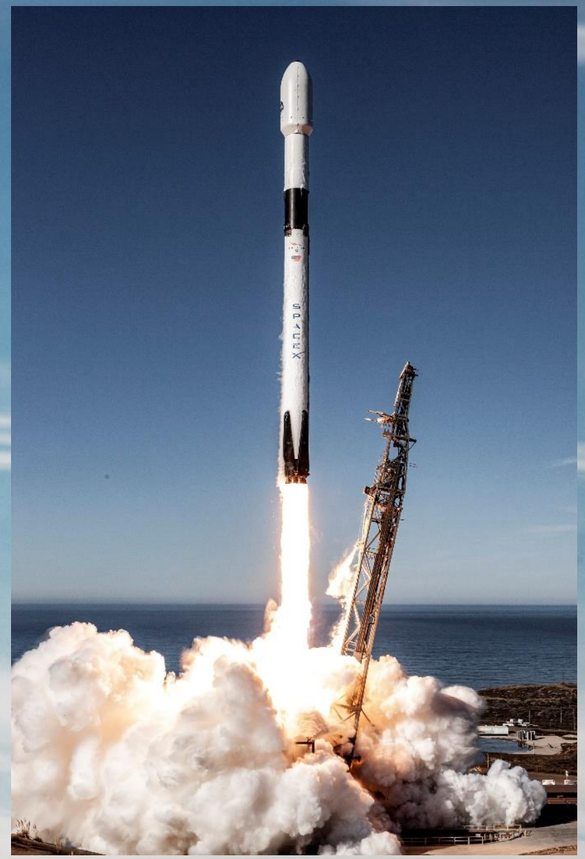
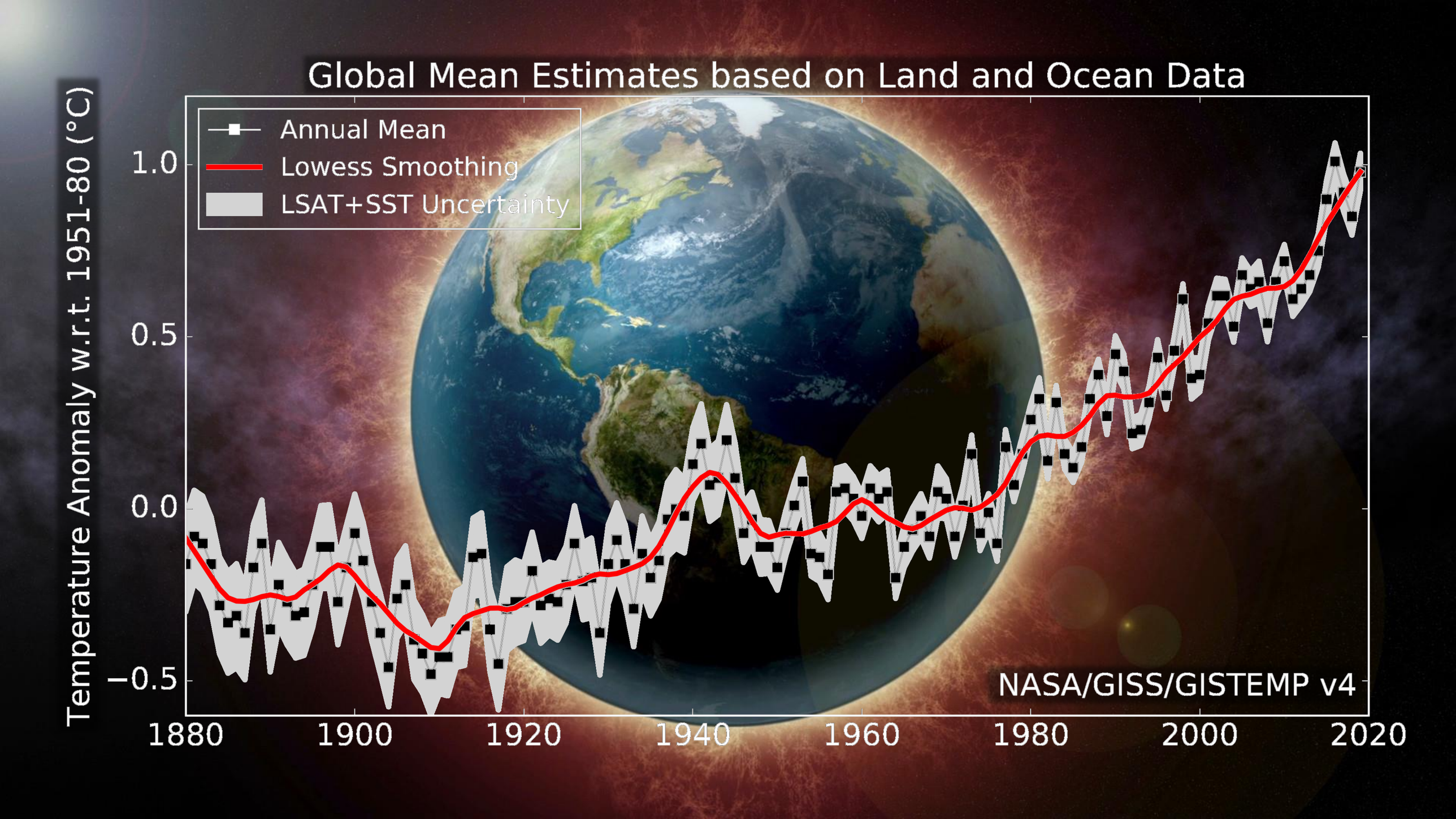

Rising Tide
Tackling Sea Level Rise from Above and Below
Josh Willis
Jet Propulsion Laboratory
Joshua.K.Willis@jpl.nasa.gov

Sentinel-6 Michael Freilich
Nov 21, 2020

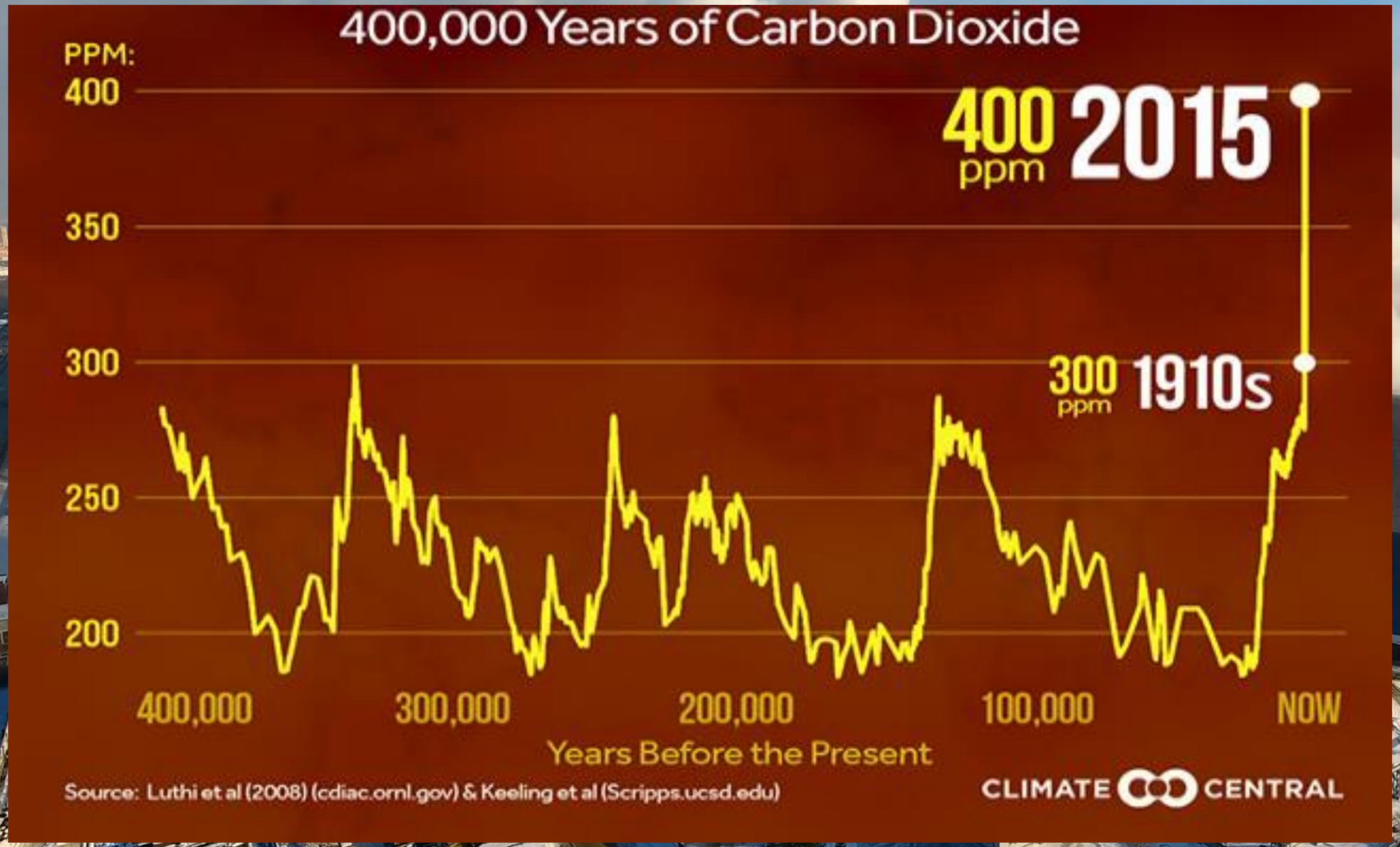
Learning Objectives

- What causes sea levels to rise?
- How do we measure the rise, *and* how do we measure the *causes*?
- Work with data sea level data from satellites and other sources, to answer these questions yourself.

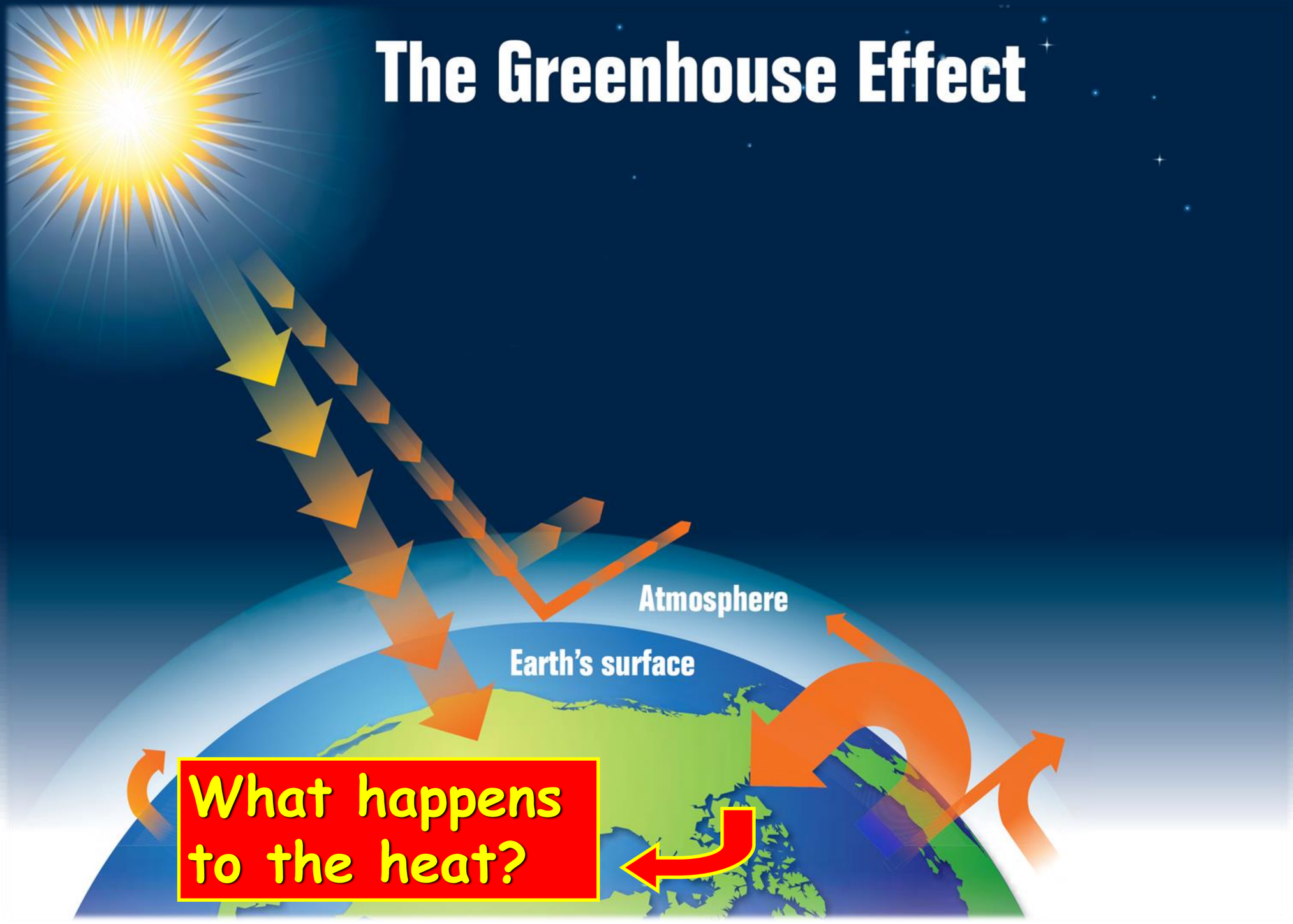



Global Mean Estimates based on Land and Ocean Data
Annual Mean
Lowess Smoothing
LSAT+SST Uncertainty
Temperature Anomaly w.r.t. 1951-80 (°C)
1.0
0.5
0.0
−0.5
1880
1900
1920
1940
1960
1980
2000
2020
NASA/GISS/GISTEMP v4

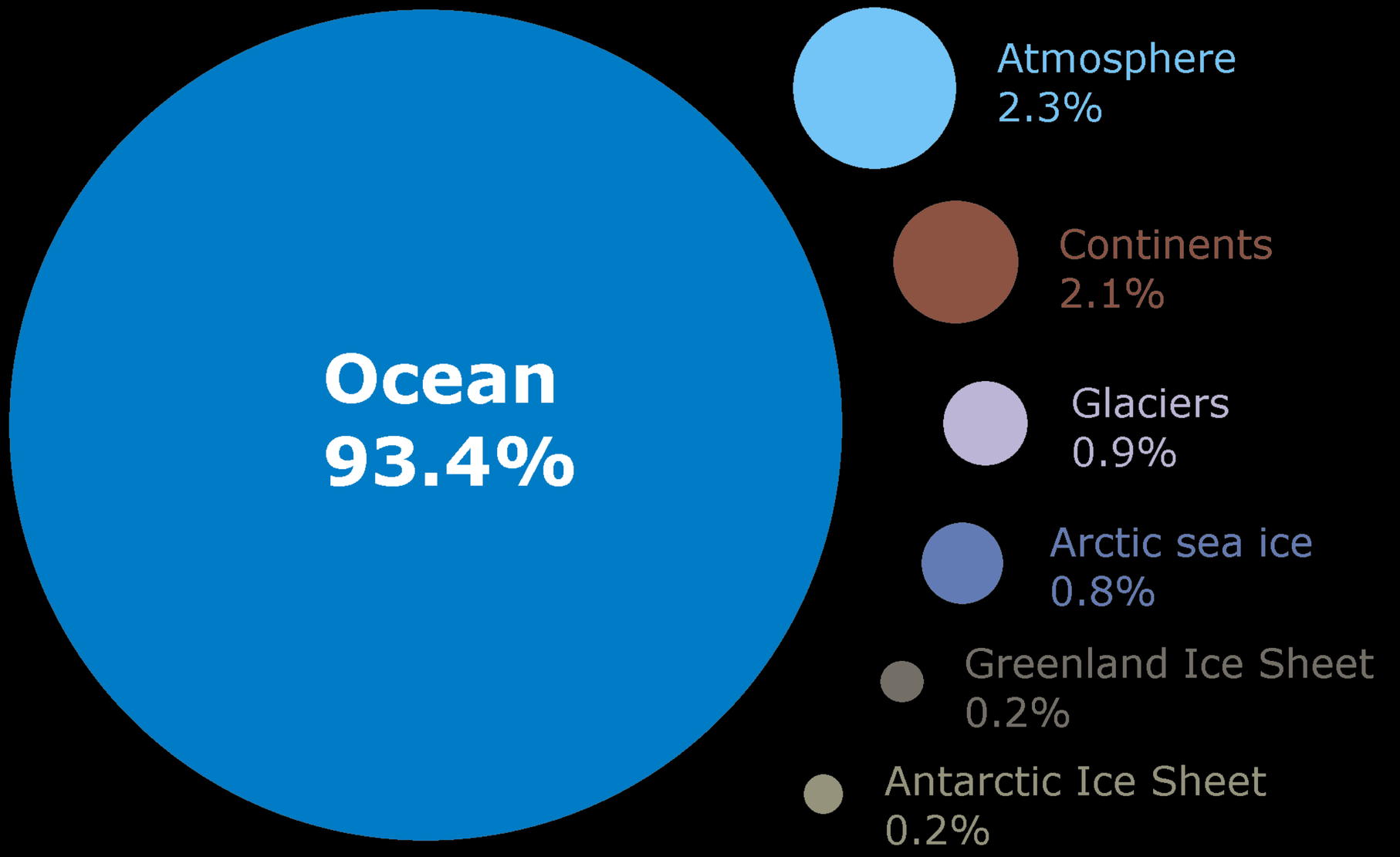
What causes global warming?



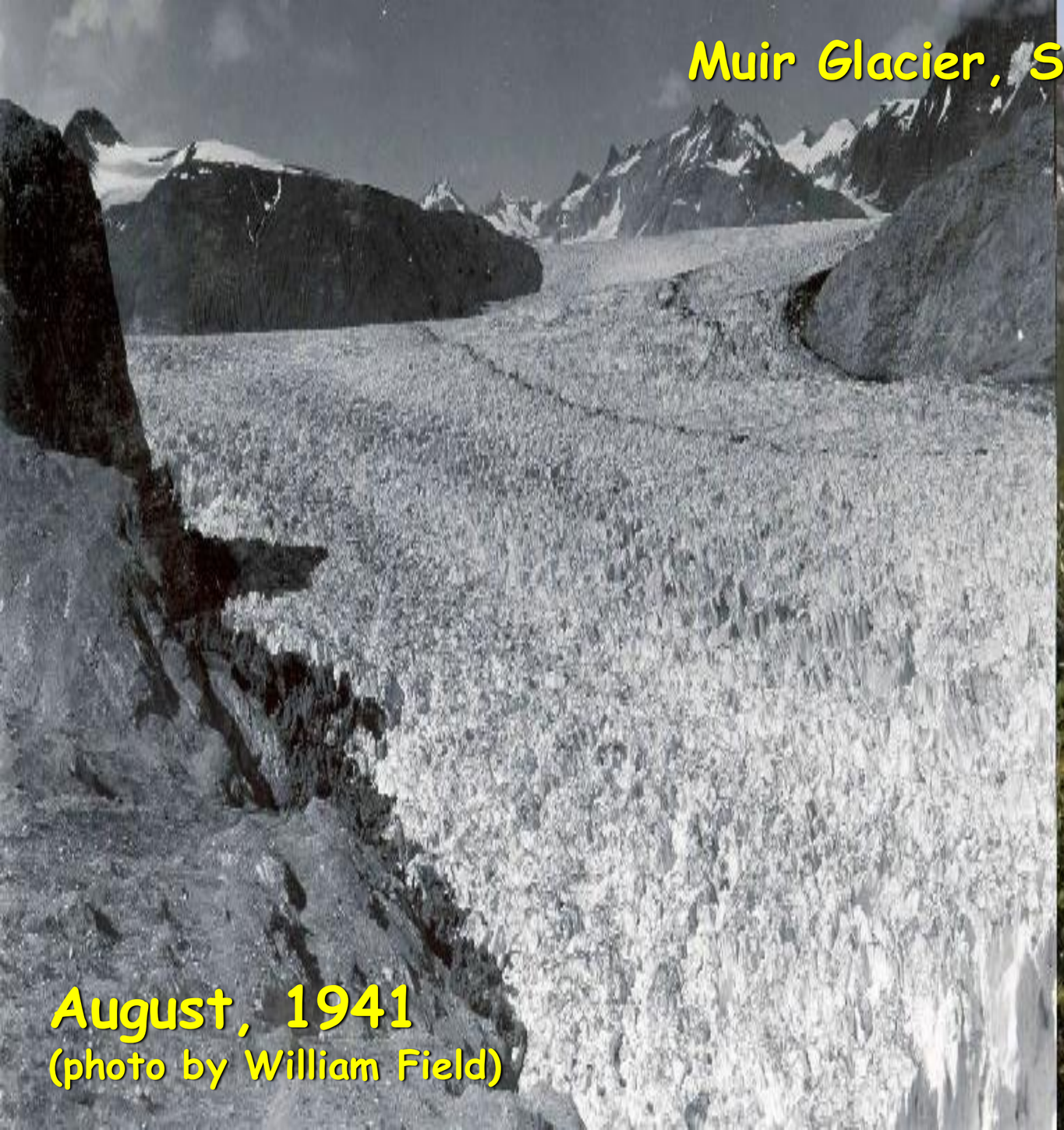
The Greenhouse Effect



Where is global warming going?

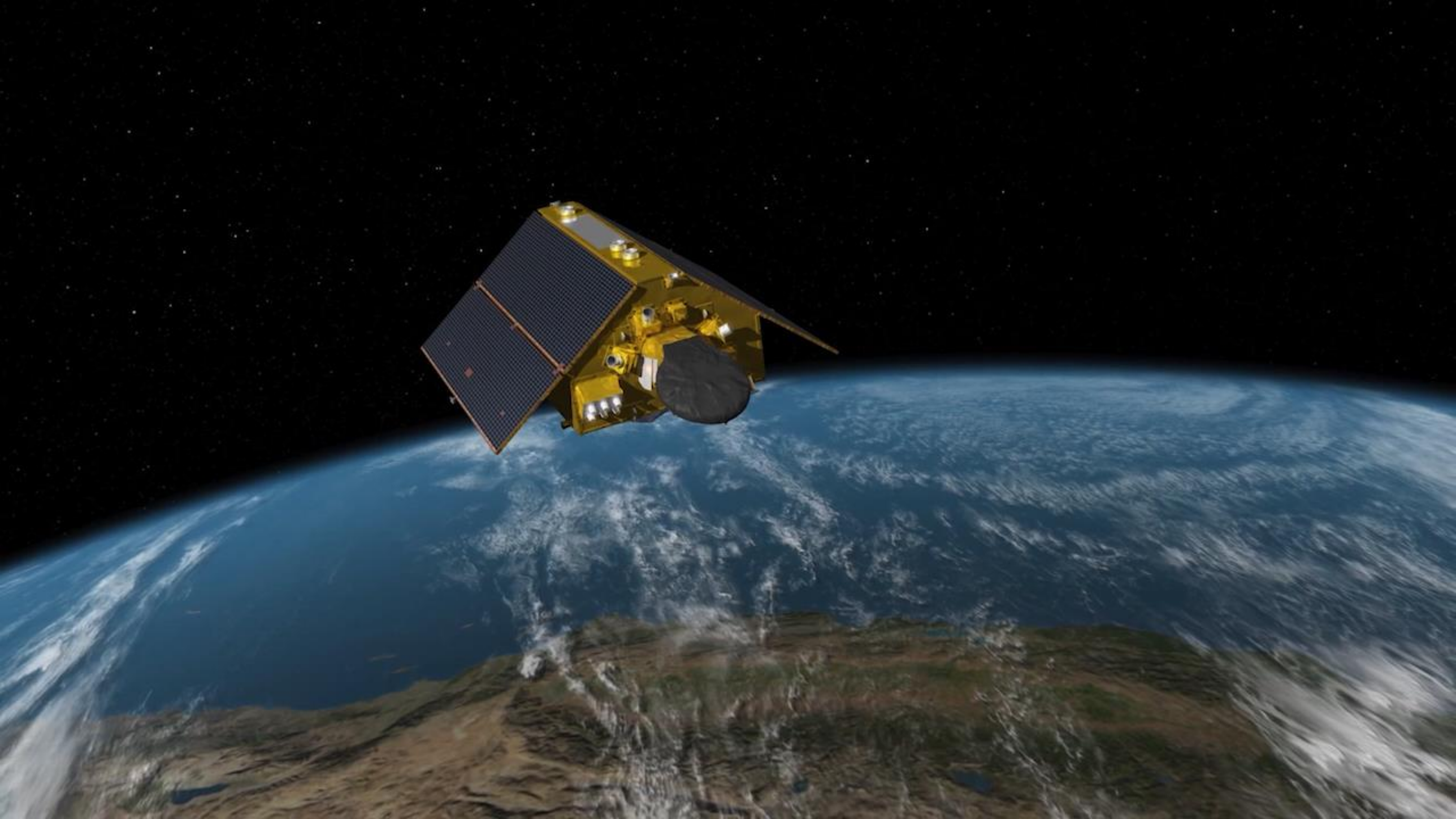


Muir Glacier, SE Alaska

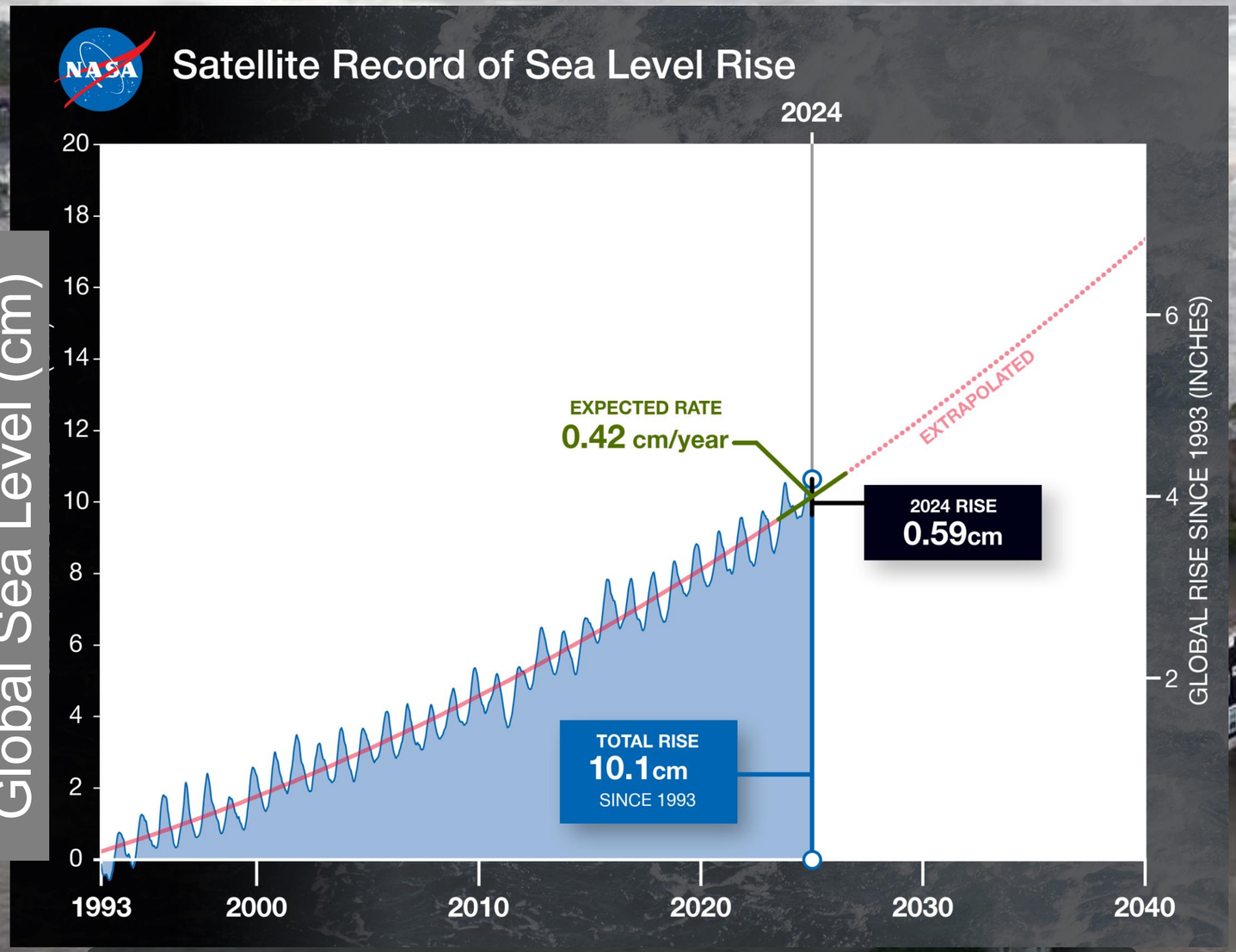


August, 1941
(photo by William Field)

August, 2004
(photo by Bruce Molnia)

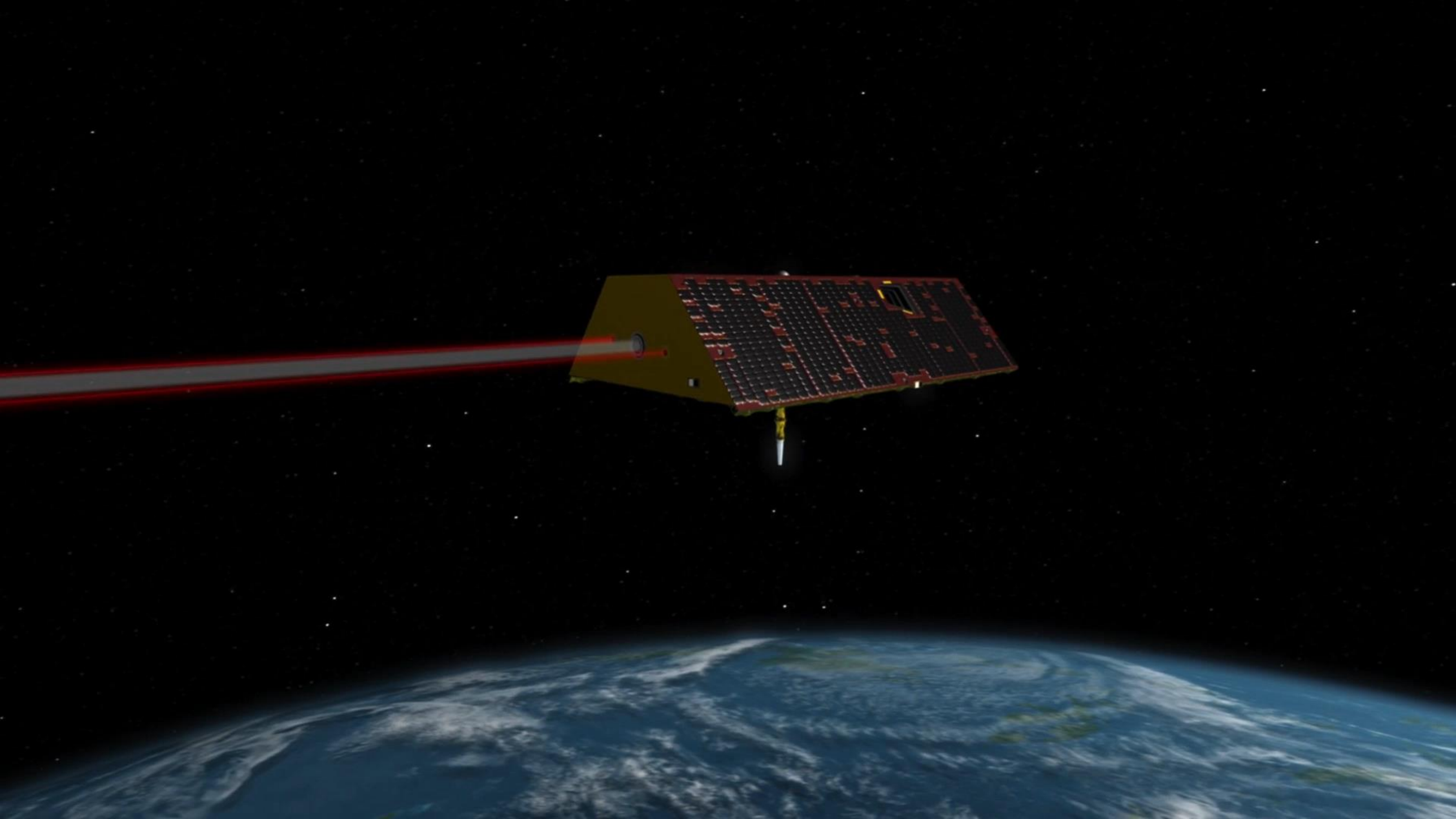


Satellites measure the rising ocean



3 million extra people at flooding risk for every cm of sea level rise

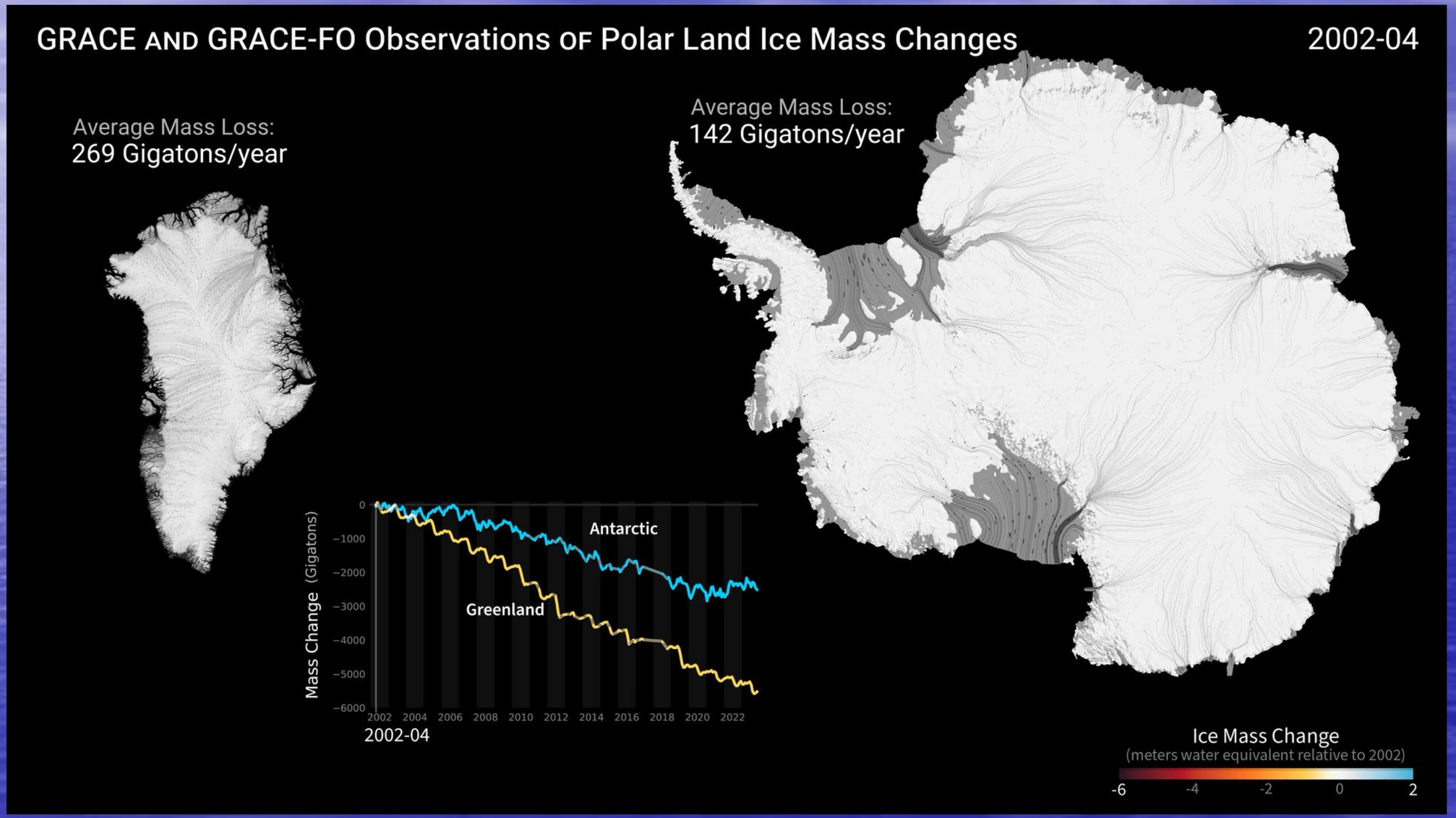
Photo of New Jersey shoreline after Superstorm Sandy in 2012



National Aeronautics and Space Administration

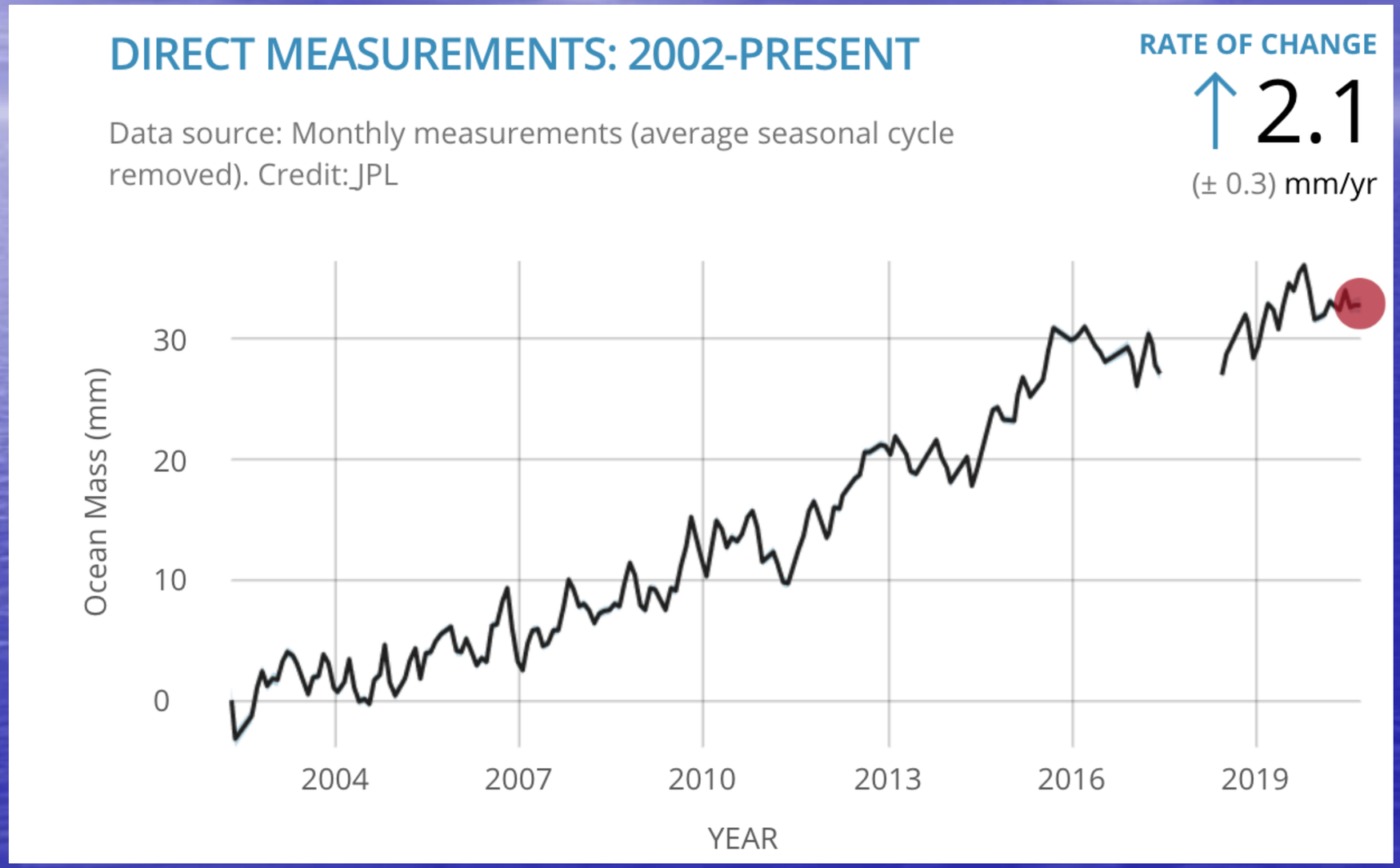
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Greenland and Antarctica Ice Sheet Mass Loss

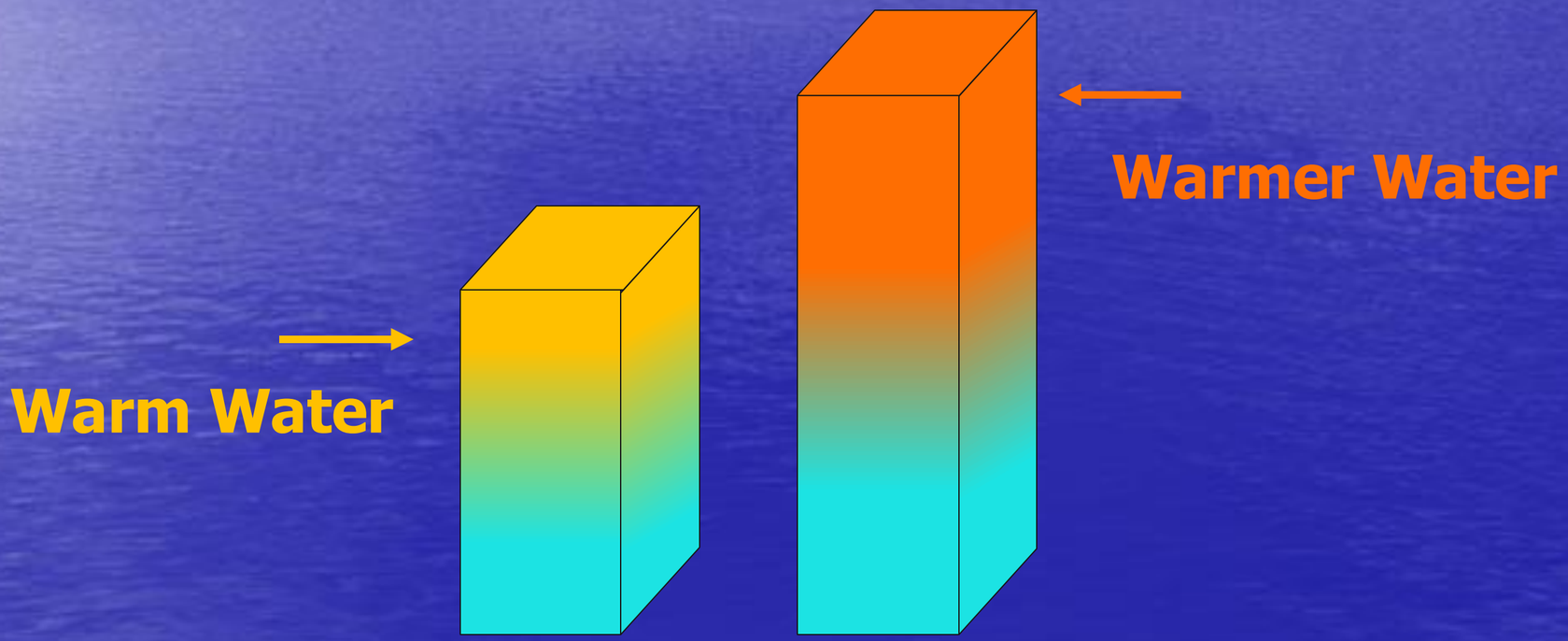


National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Sea Level Change from Ice Loss



Sea surface height shows where the ocean stores heat

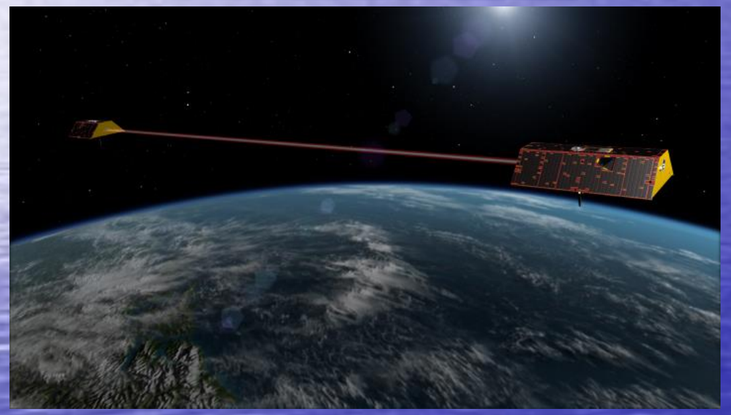


National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

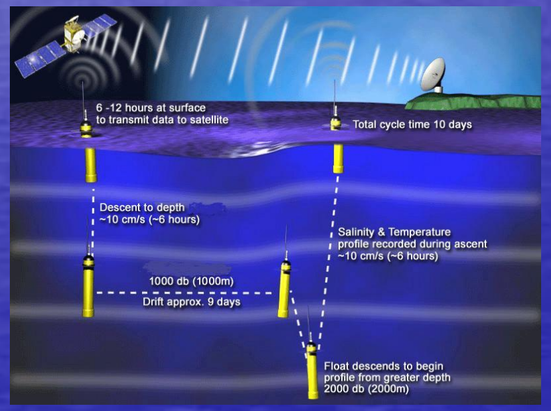
The Sea Level "Budget"

Adding Mass (GRACE)



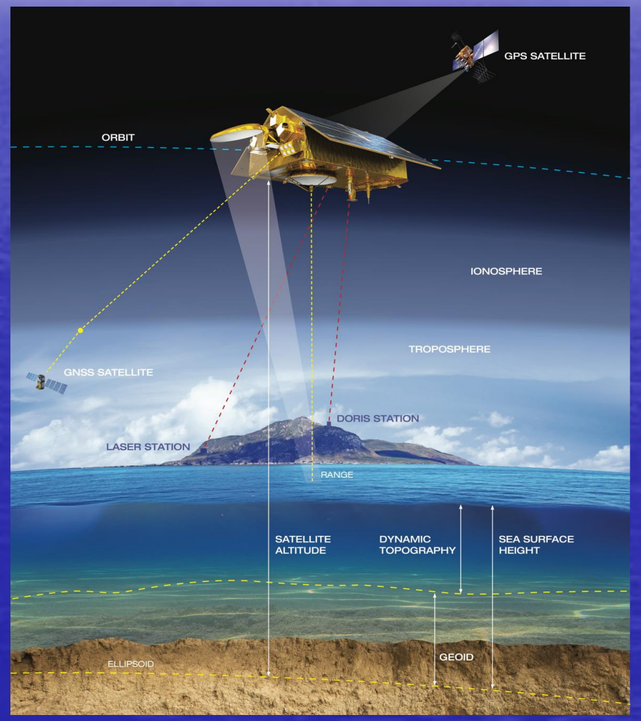
+

Thermal Expansion (Argo)



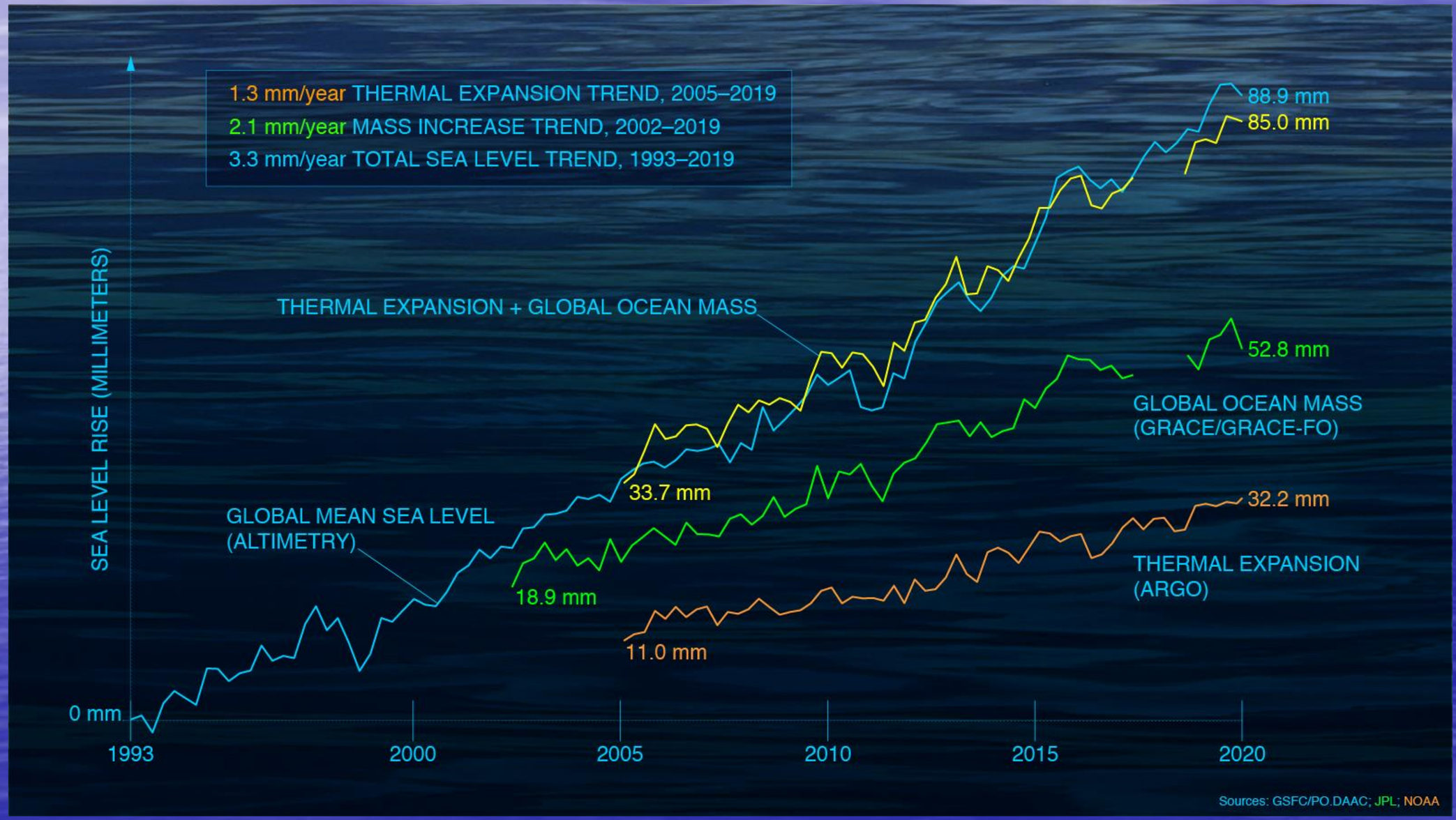
=

Total Sea Level (altimetry)



National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Closing the Sea Level "Budget"



National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Project Questions

Contact Scientists:
Josh Willis: joshua.k.willis@jpl.nasa.gov
Severine Fournier: severine.fournier@jpl.nasa.gov

- Topic: Sea Level Rise & Its Causes
- Geographic focus: Global, US East and West Coast
- Datasets:
  - MEaSUREs-SSH (from satellite altimeters)
  - GRACE water storage
  - NOAA Steric Height (from Argo and other sensors)
- Tools:
  - CMDA tools (https://hub.jpl-cmda.org)
  - Sea Level Explorer (https://earth.gov/sealevel/sea-level-explorer/?view=map)
- Questions:
  - Use MEASURES-SSH global mean sea level to calculate the trend and acceleration in global mean sea level. If you project these trends forward, how much will sea level rise by 2100? What might go wrong with this kind of projection? What could it be missing?
  - For the overlap period, compare ocean mass increase from GRACE and steric change from NOAA with the total sea level rise from altimetry (the MEASURES product). Do they agree? How well, and what does this imply? Do the mass and steric contributions add up to give the total global mean? Why might they differ?
  - Explore the sea level data regionally using the Sea Level Explorer (https://earth.gov/sealevel/sea-level-explorer/?view=map). Consider points along the US East and West Coast. Does sea level rise faster or slower than the global mean? Why might they differ?