



Jet Propulsion Laboratory
California Institute of Technology

Emerging Golden Age for Satellite Measurements of Sea Level and the Need for More

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Climate Summer School

8/5/24

Jet Propulsion Laboratory

Learning Objectives

- Understand the main contributions to global mean sea level rise
- Learn about the different observational techniques that have led to our current understanding of the long-term global and regional sea level change, as well as some considerations in comparing different observational techniques
- Be able to manipulate global and spatially averaged sea level data sets to assess regional trends and interannual variability

Why is sea level rising?

- Based on our understanding of the ocean, there are two main reasons that sea level is rising on global scales:

1. The ocean is warming → water expands (thermal expansion).

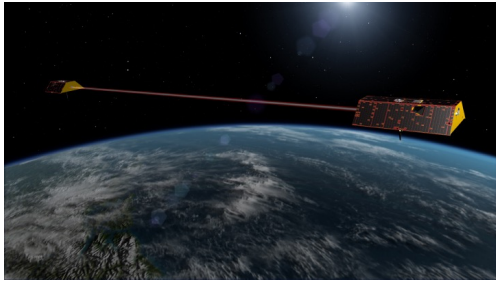
2. Ice is melting and the melt water is going into the ocean.

Both of these are due to global warming.

How do we know these are the main two causes of sea level rise?

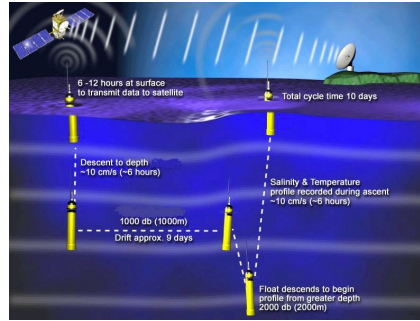
The Sea Level “Budget”

Adding Mass (GRACE-FO)



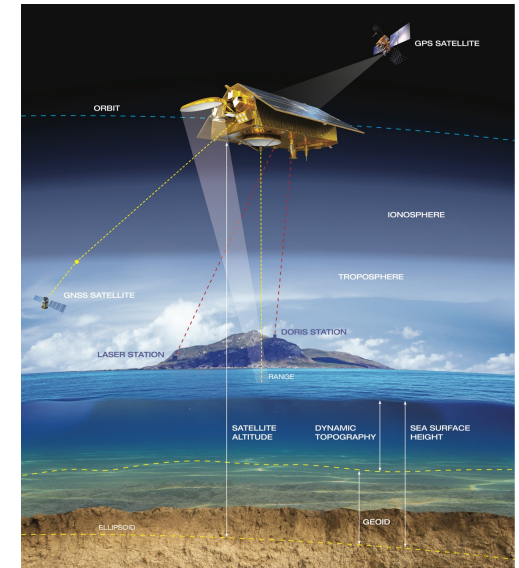
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Thermal Expansion (Argo)

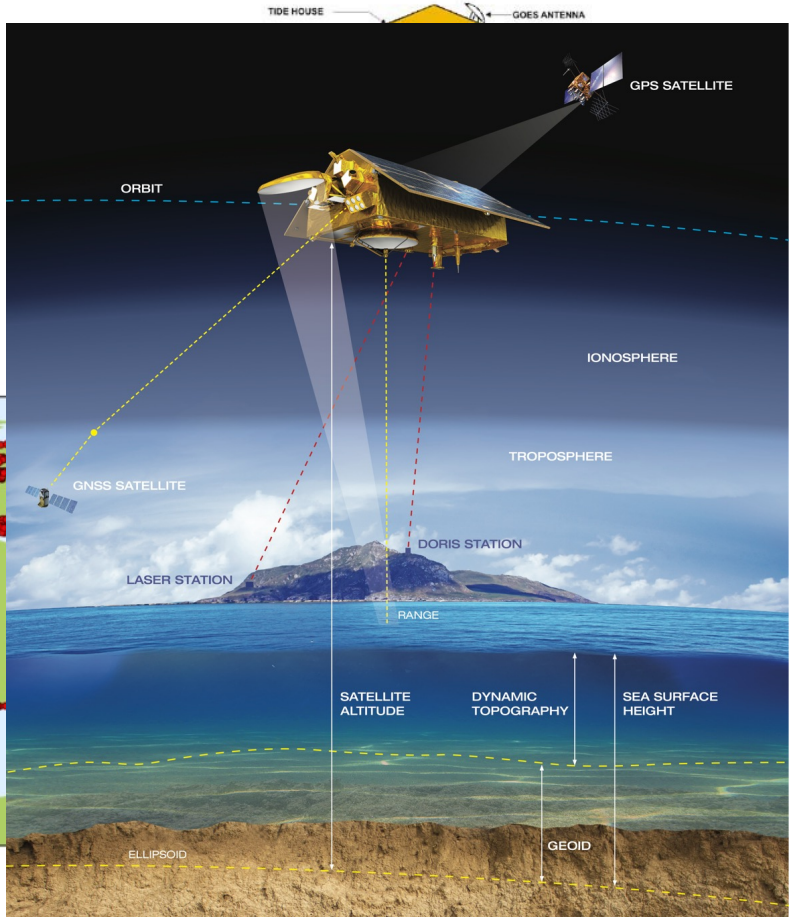
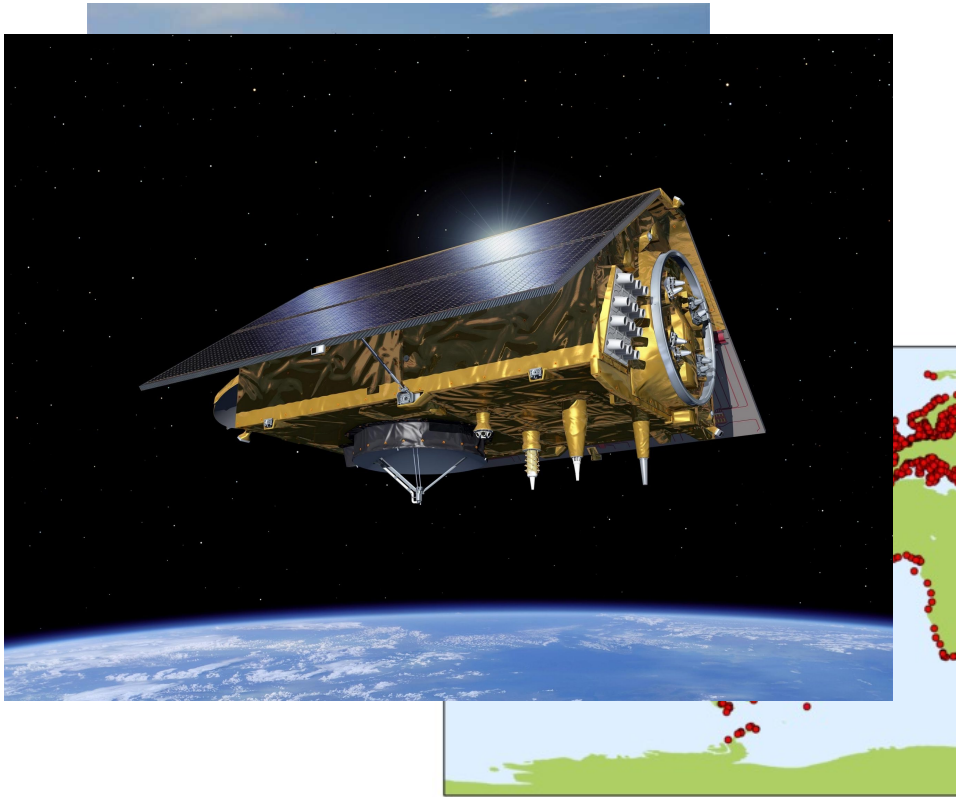


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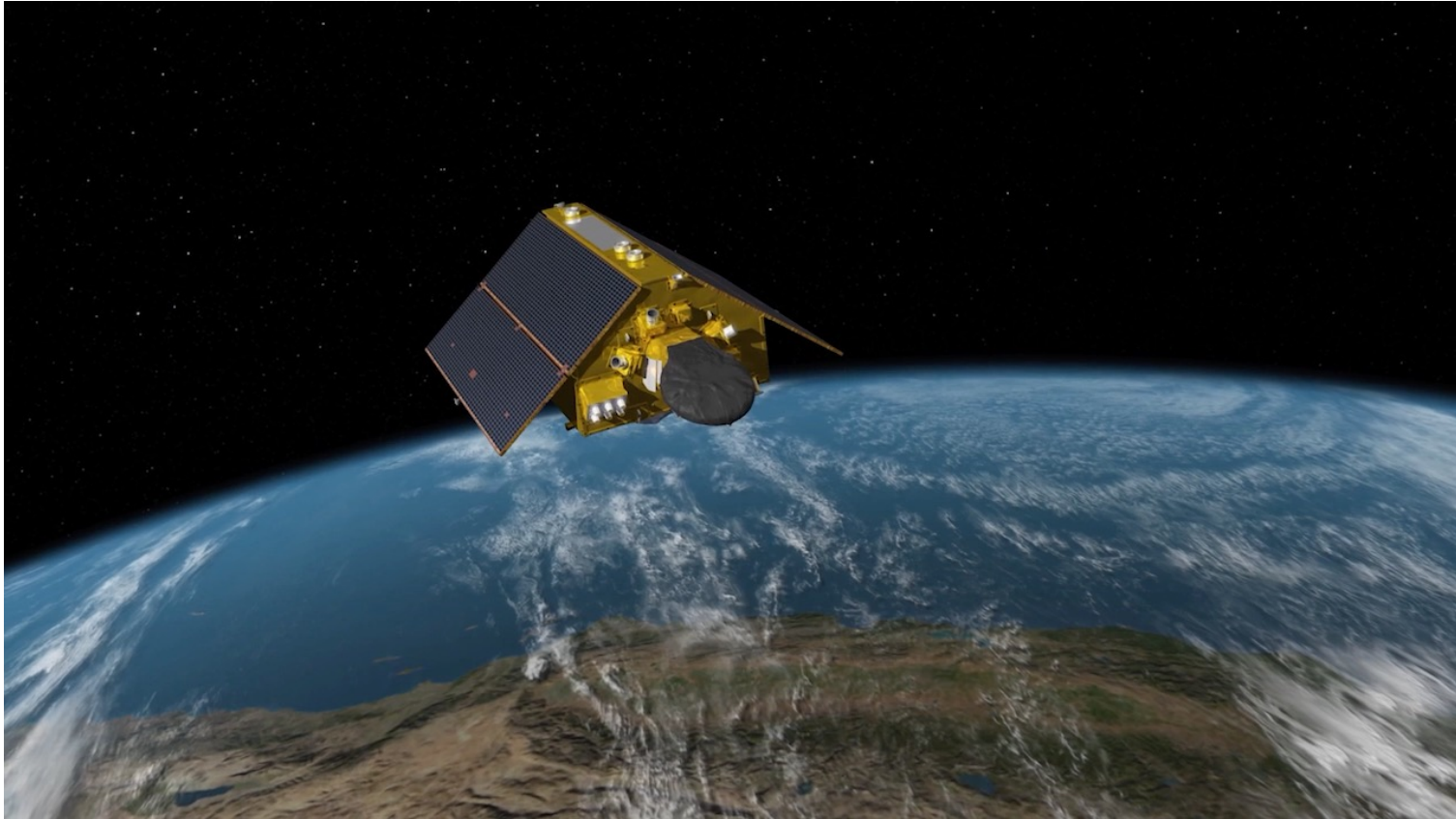
Total Sea Level (altimetry)



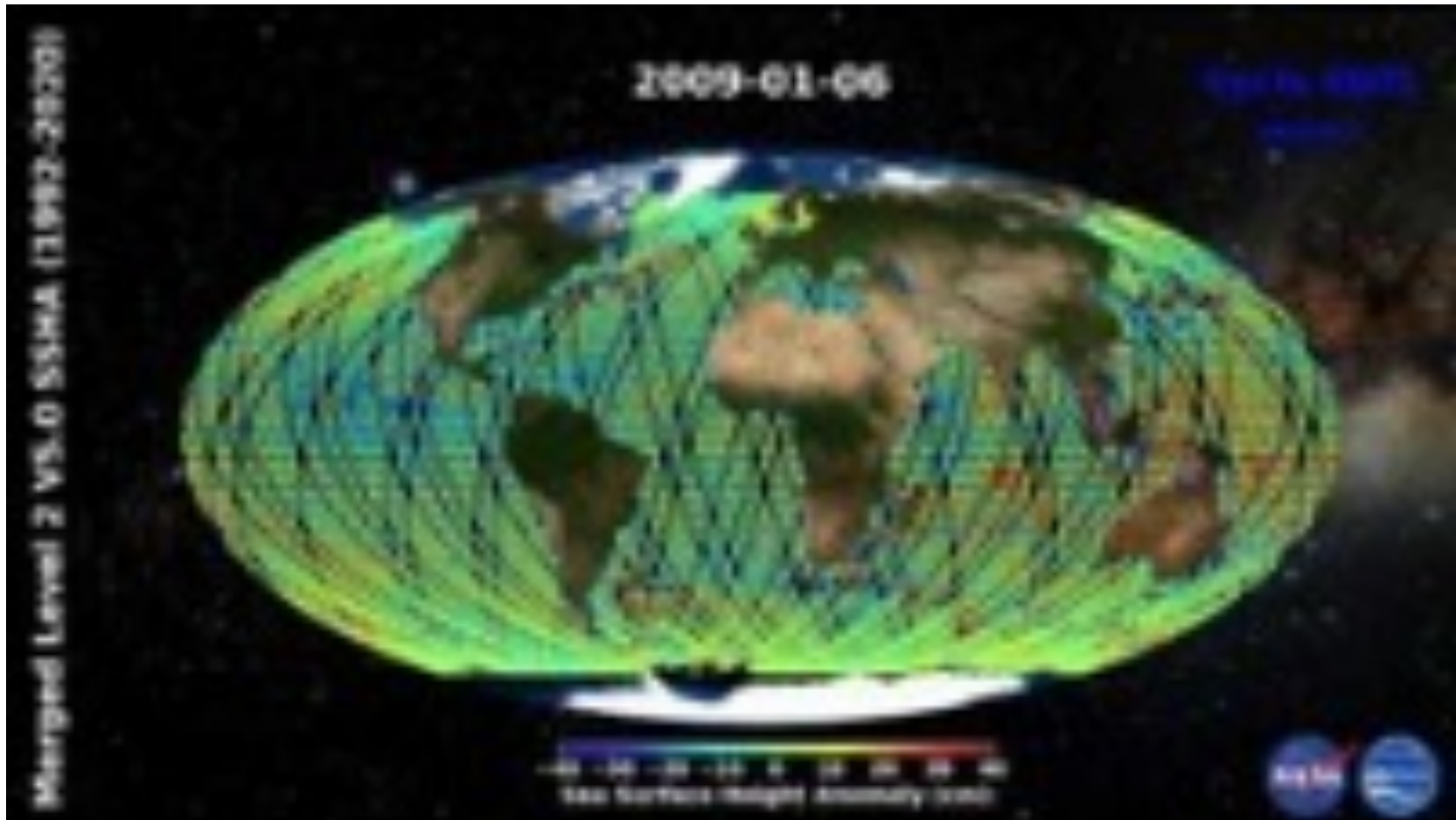
How do we measure sea level change?

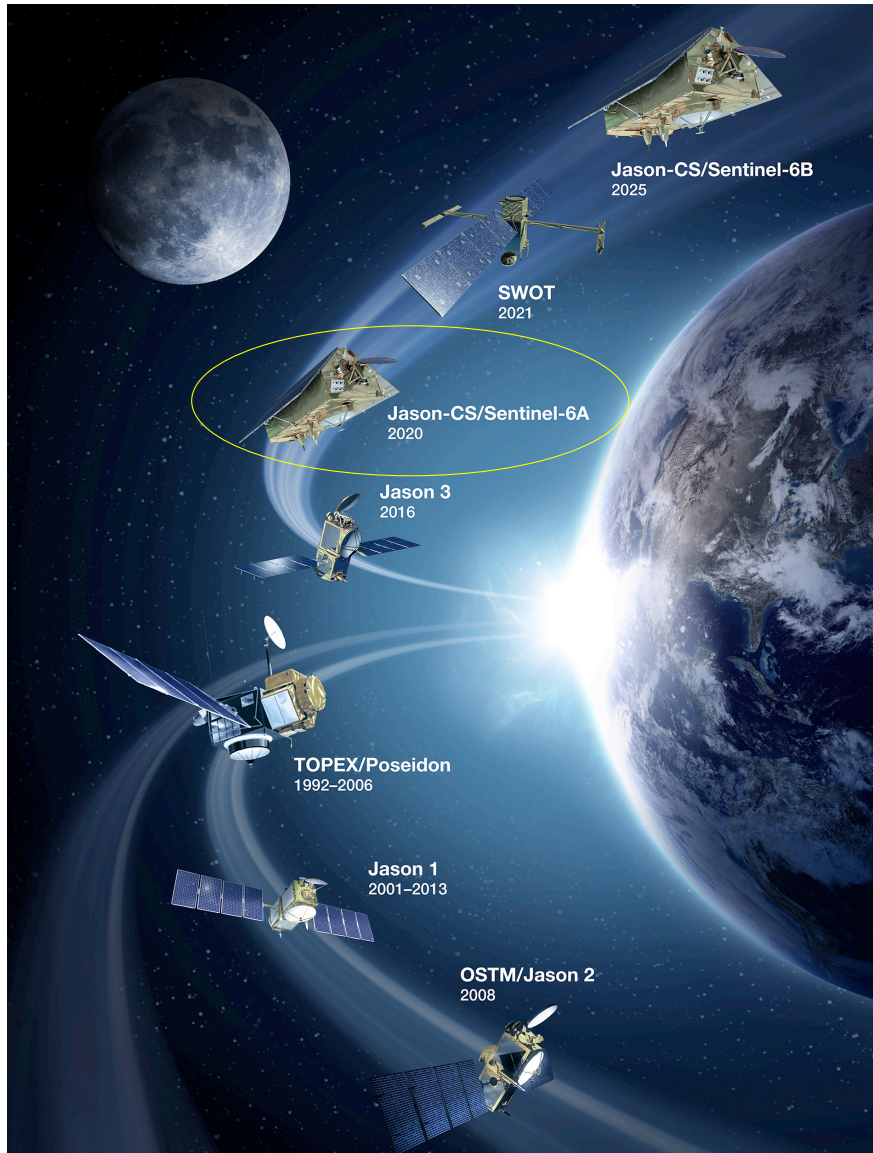


Satellite Altimetry



Satellite Altimetry



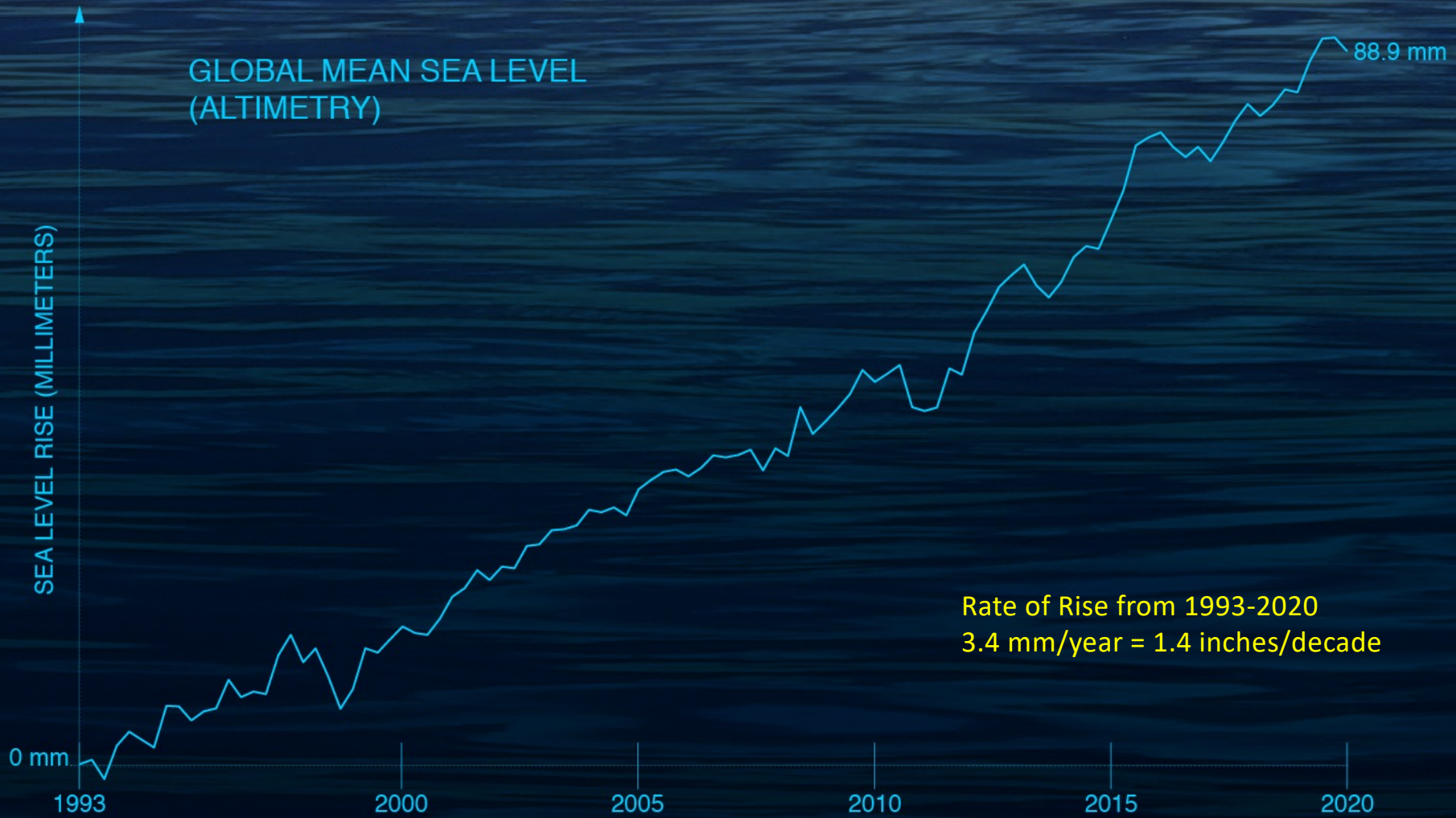


Sentinel-6 continues 30+ years of sea level measurement from space

With the launch of Sentinel-6A/Michael Freilich and Sentinel-6B in 2025, this record will surpass 40 years in length.

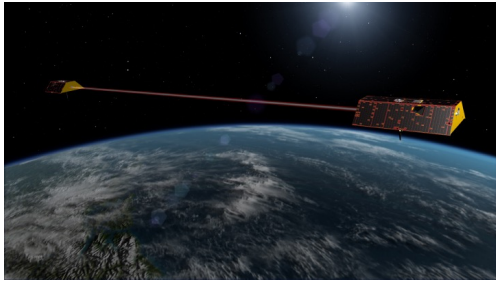


GLOBAL MEAN SEA LEVEL (ALTIMETRY)



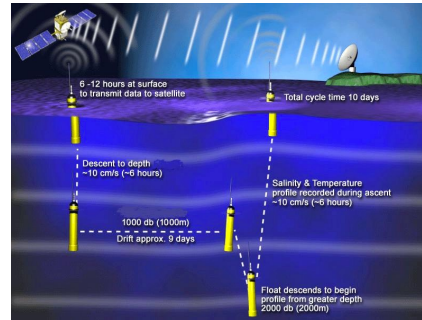
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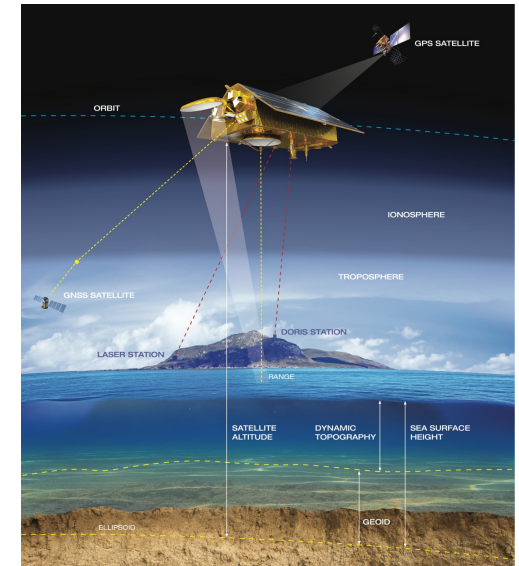
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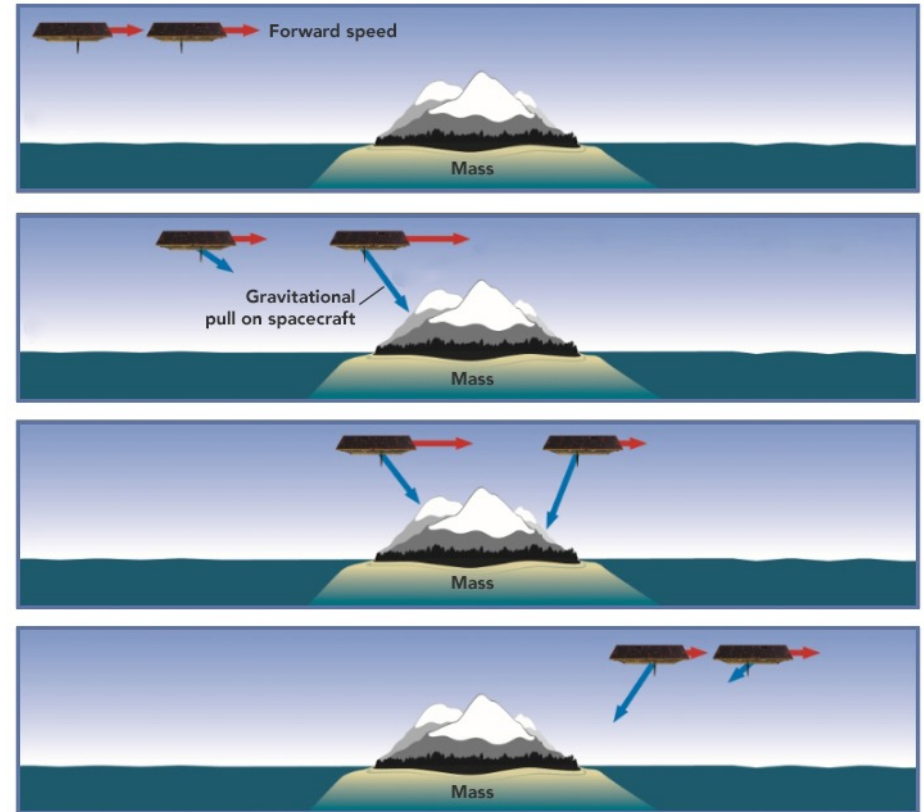
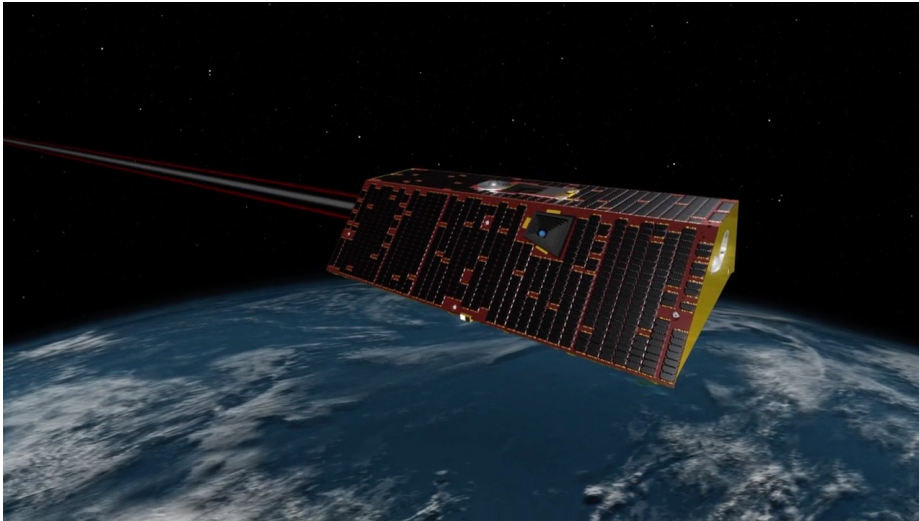
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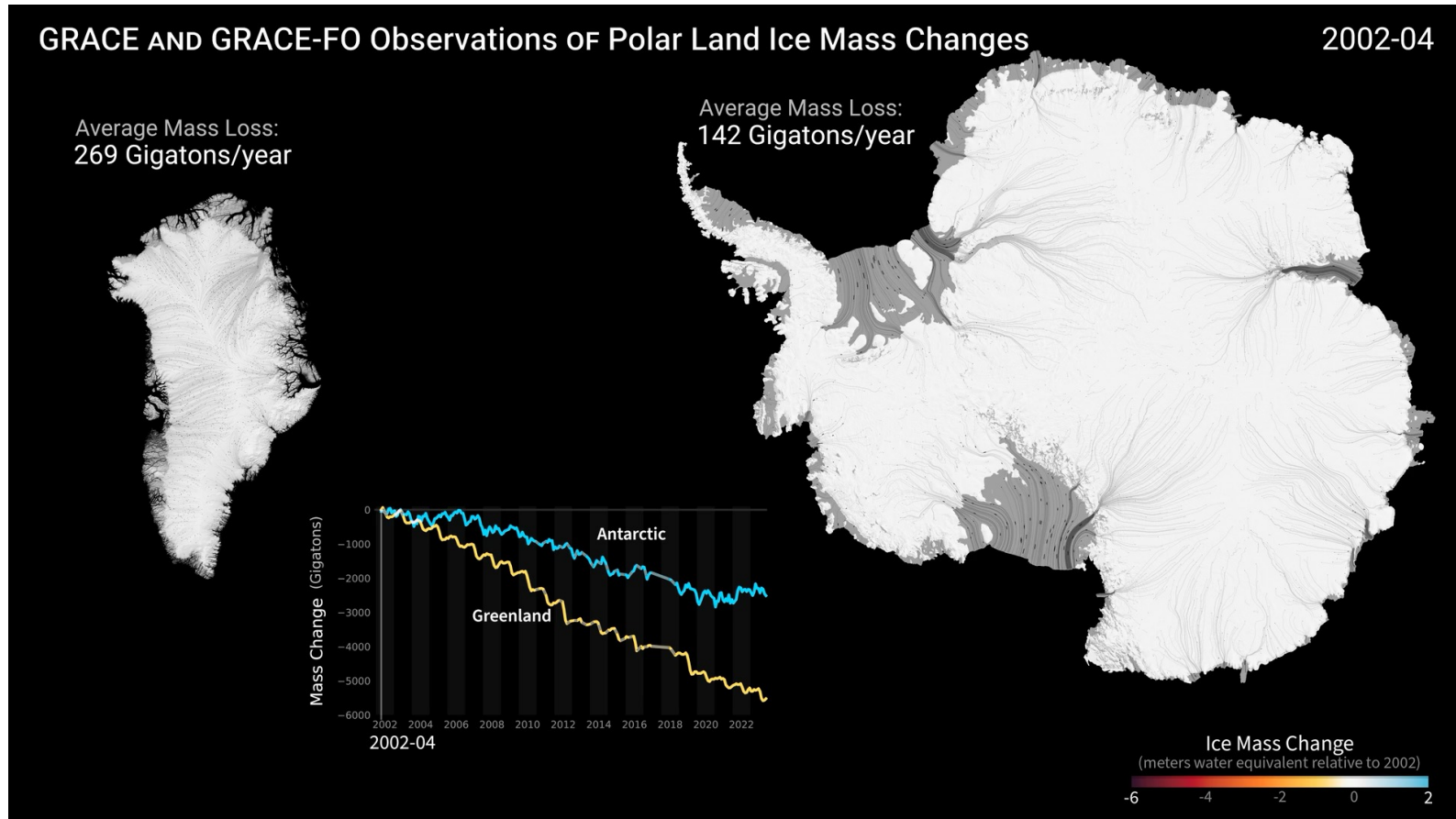
GRACE and GRACE-FO

- Gravity Recovery & Climate Experiment (GRACE; 2002-2016) and GRACE Follow-On (GRACE-FO; 2018-pres.) measure gravity changes on Earth.

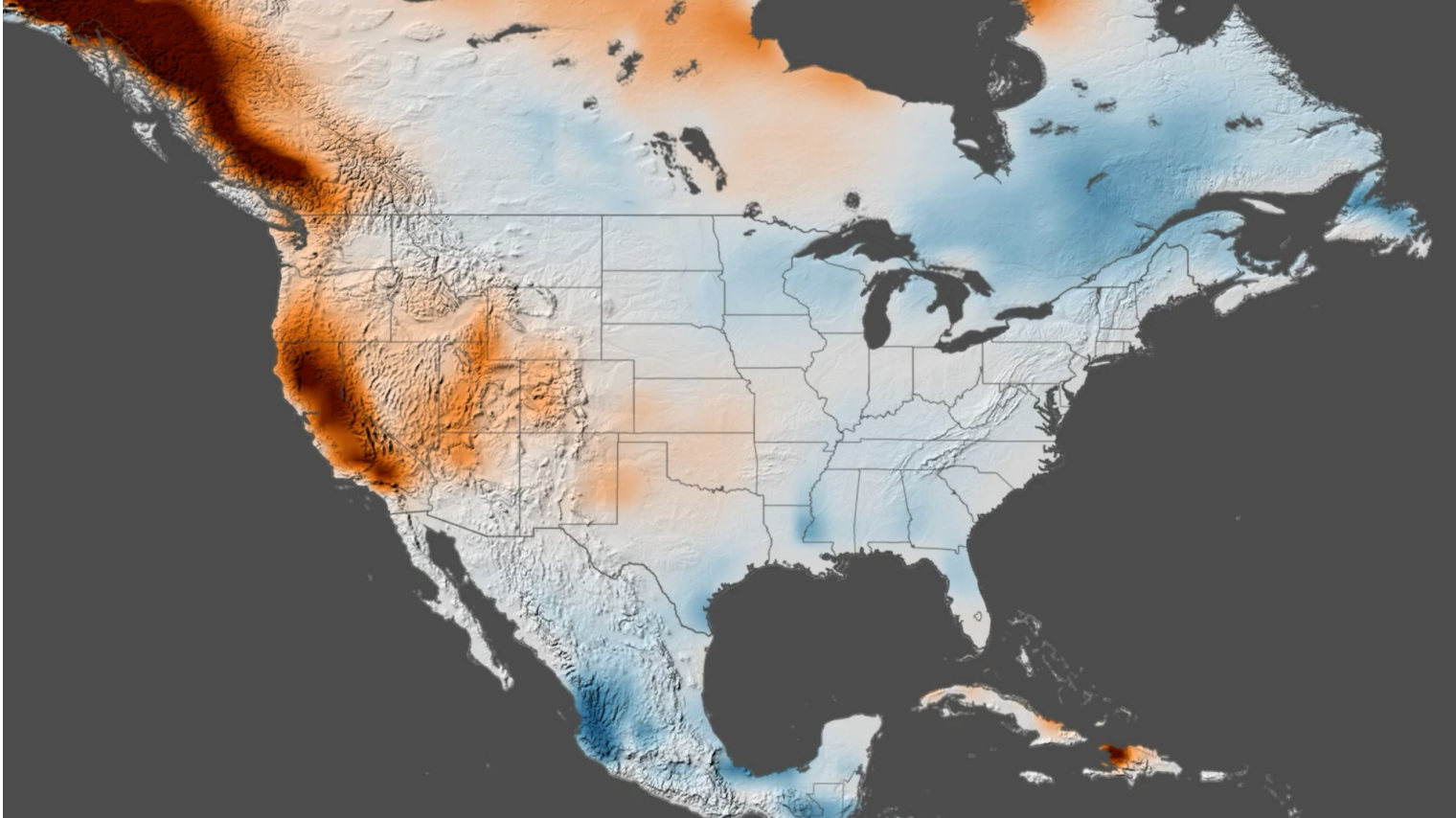


<https://earthobservatory.nasa.gov/>

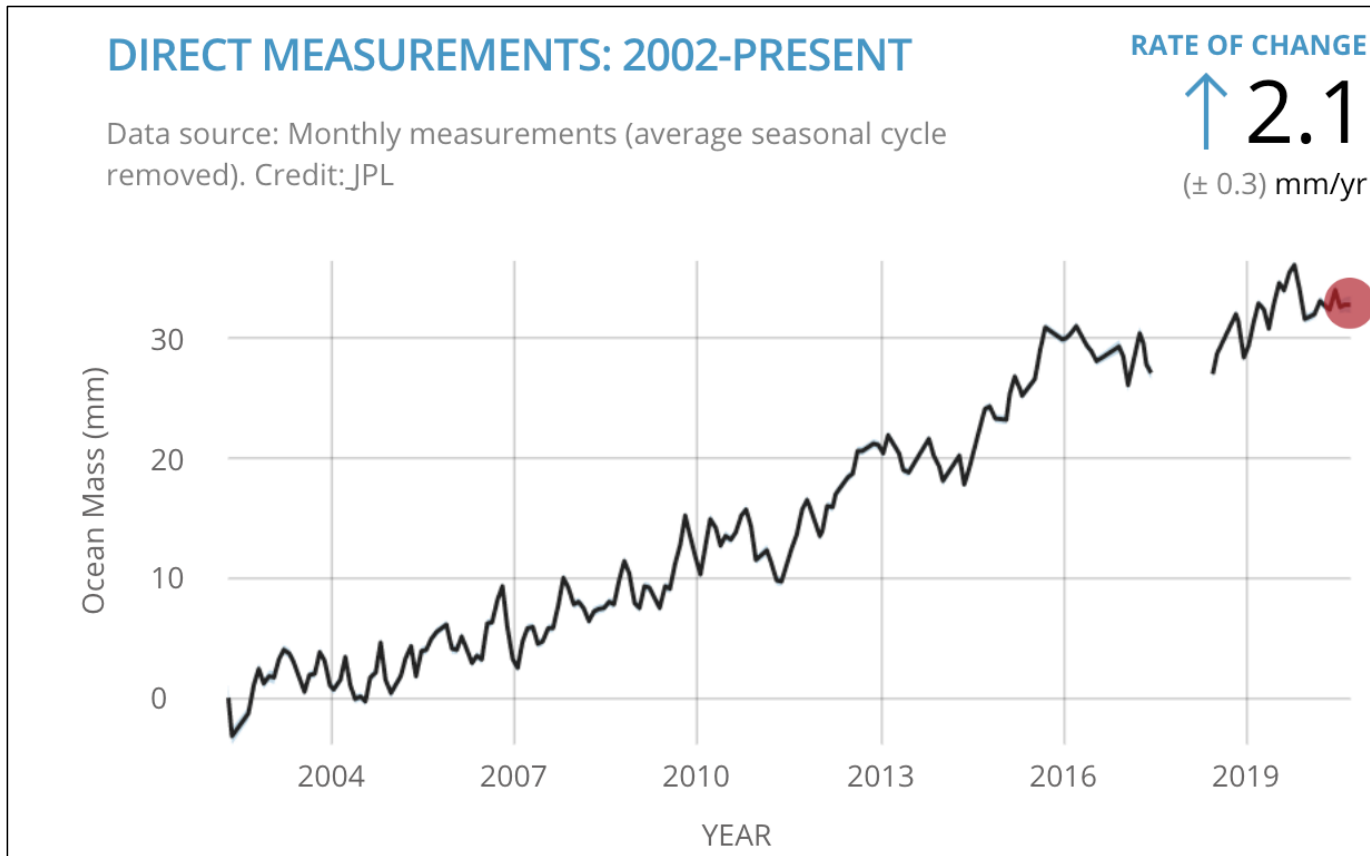
Greenland and Antarctica Ice Sheet Mass Loss



Changes in Water Storage

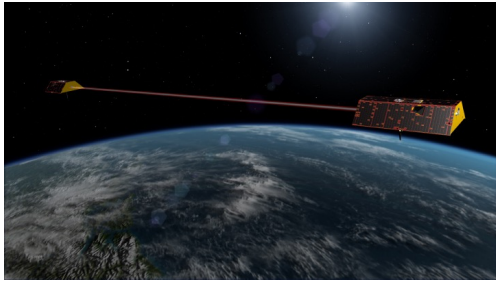


Sea Level Change from Ice Loss



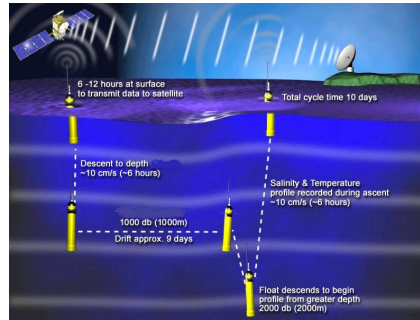
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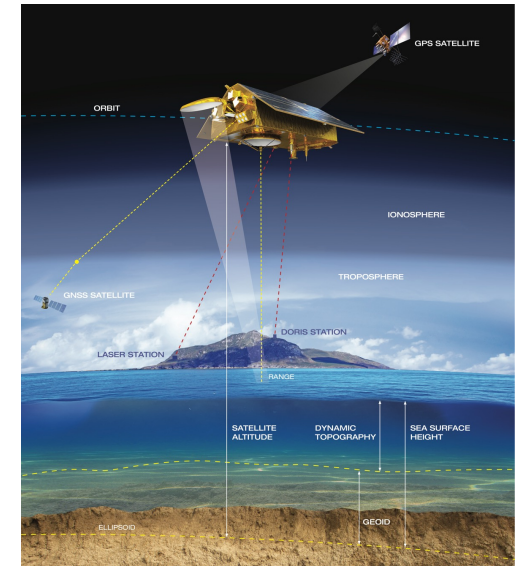
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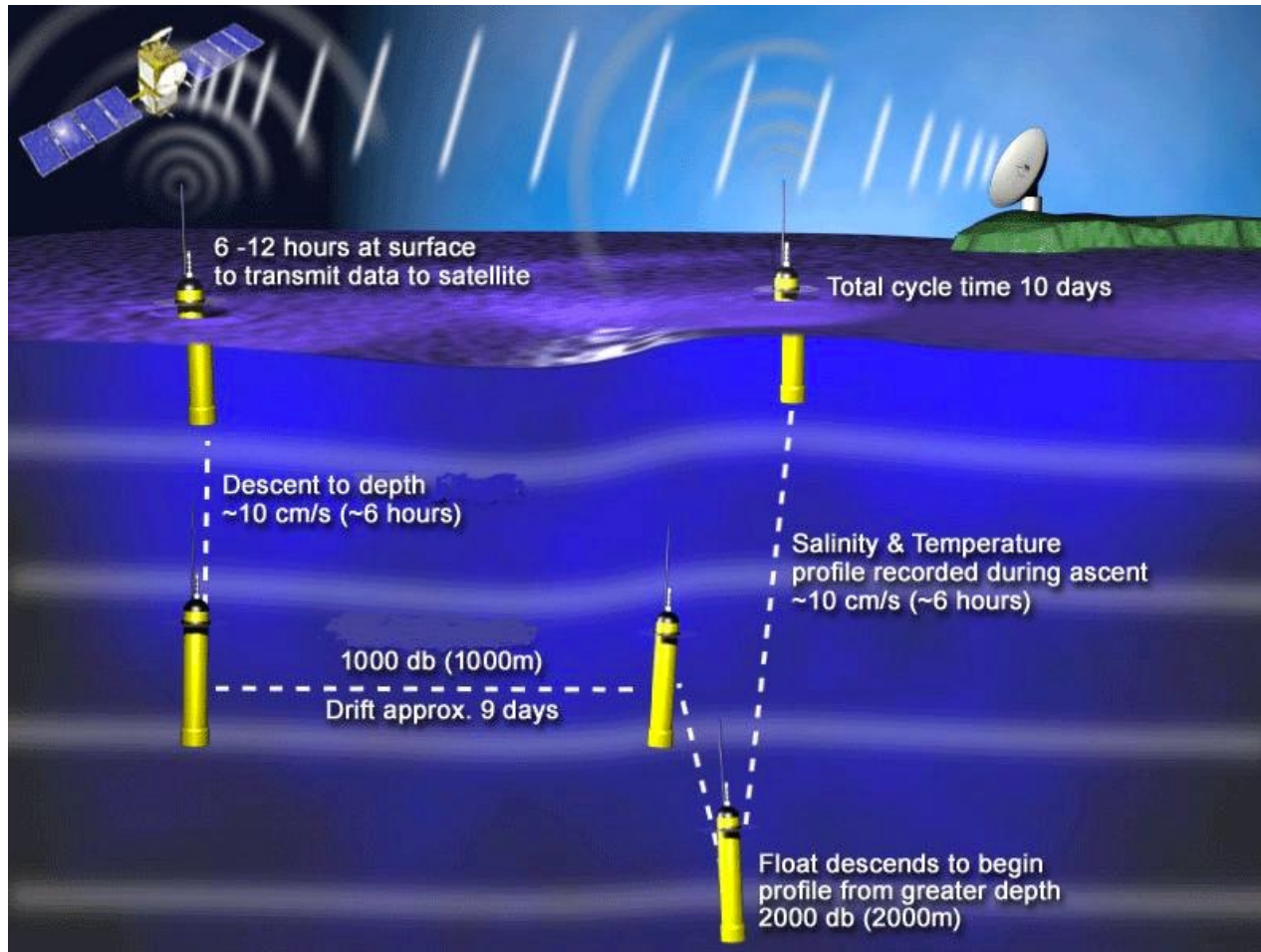


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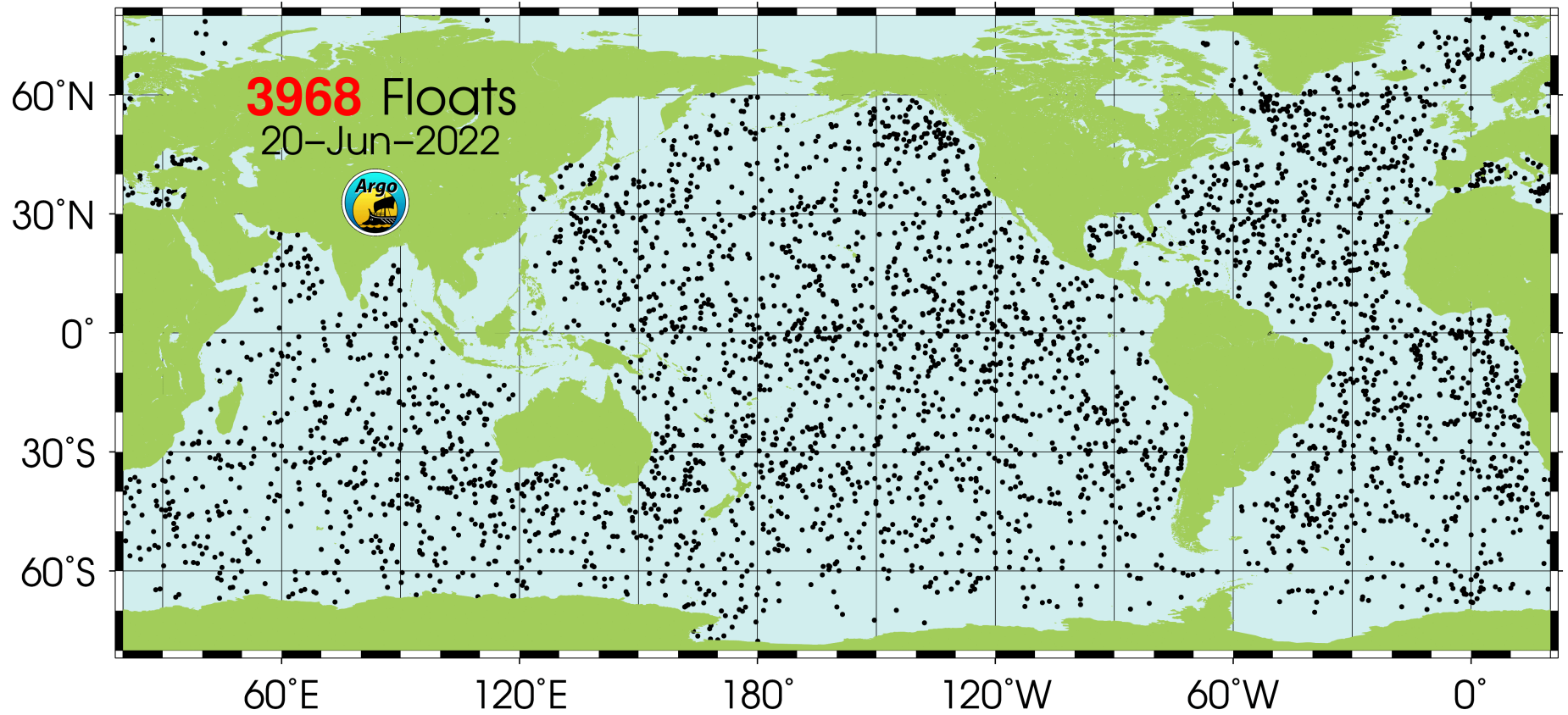


Argo Profiling Floats



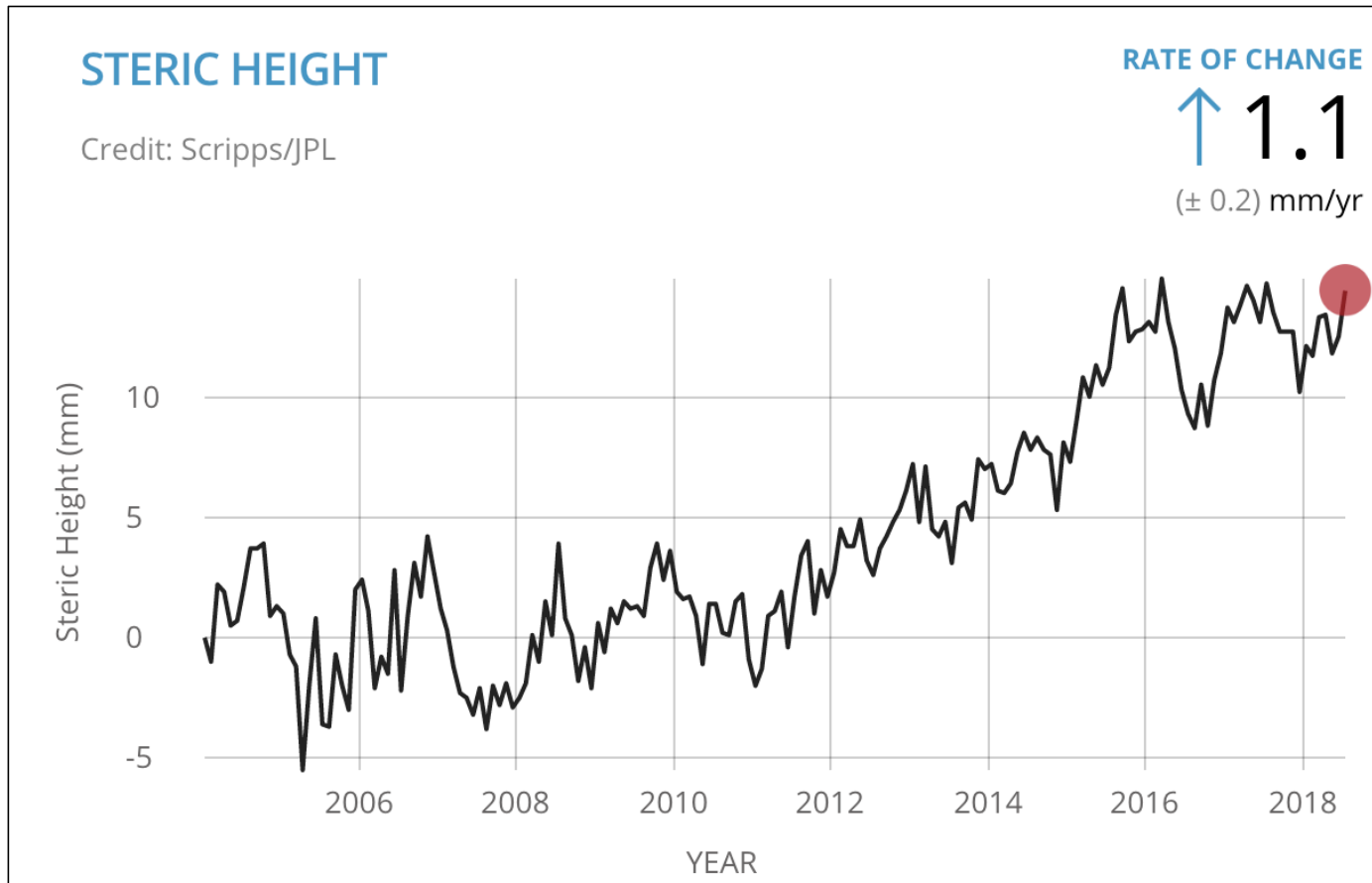
<https://argo.ucsd.edu/>

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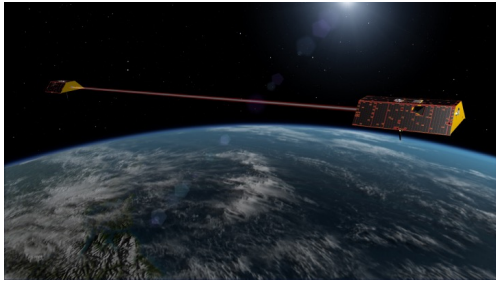
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Sea Level Change from Thermal Expansion



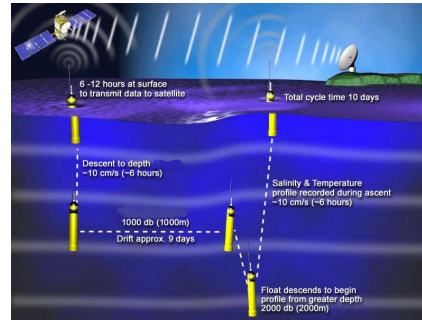
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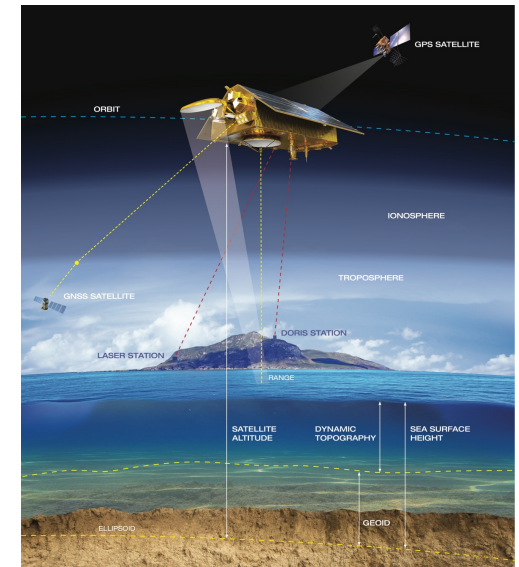
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Total Sea Level (altimetry)



Closing the Sea Level “Budget”

