



# OCEAN OBSERVATIONS, THE CLIMATE AND ARGO IN THE CLASSROOM

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SCRIPPS INSTITUTION OF  
OCEANOGRAPHY



An aerial photograph of ocean waves with white foam, viewed from above. A semi-transparent blue rectangular box is overlaid on the center of the image, containing three lines of white text.

WHY DO WE NEED OCEAN OBSERVATIONS?

WHAT OBSERVATIONS ARE AVAILABLE?

HOW CAN ARGO DATA BE USED IN THE CLASSROOM?



# WHY DO WE NEED OCEAN OBSERVATIONS?

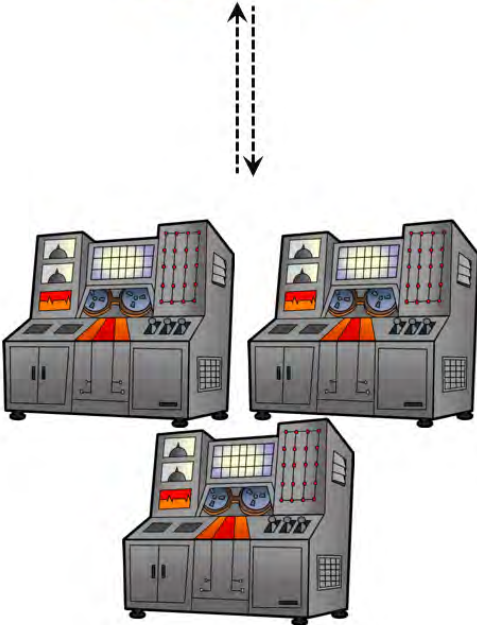
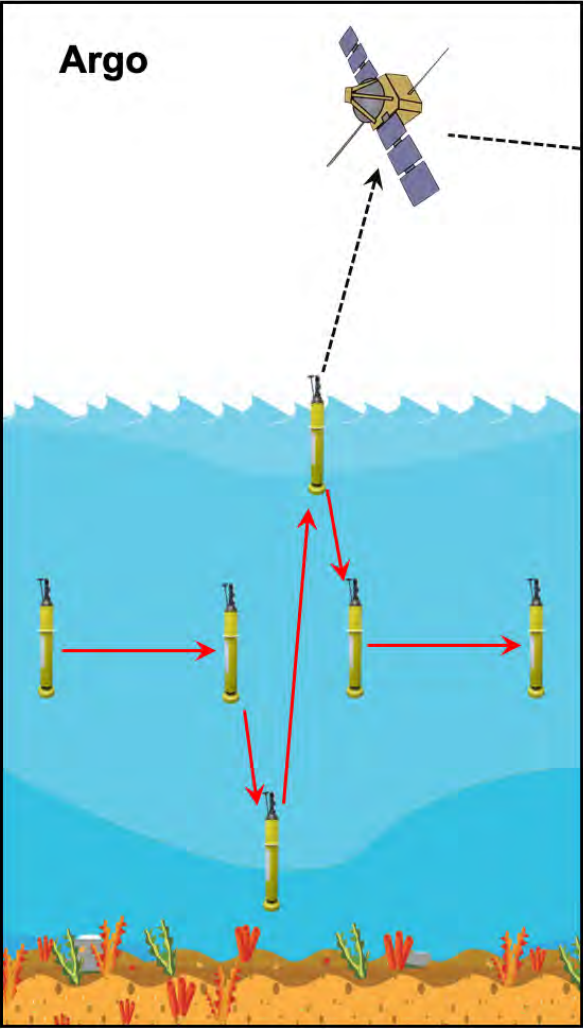
We are facing a climate crisis with more severe and more frequent events occurring.

70% of the earth is covered by the oceans.

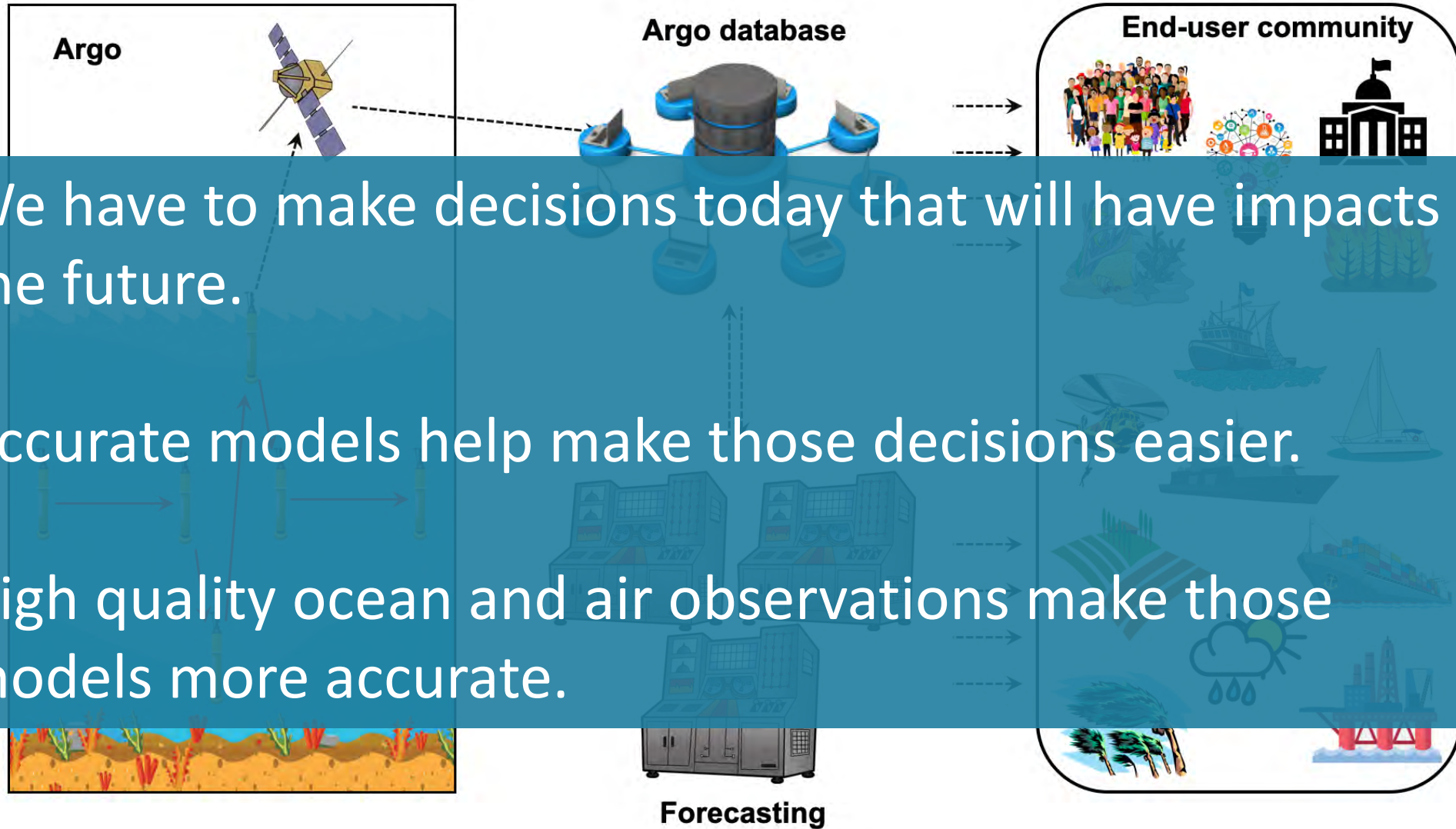
It is important to observe the state of the ocean to determine how much it is changing.

Scientists can incorporate ocean observations into models to both predict the future climate and to monitor human impact.

# OCEAN OBSERVATIONS IMPROVE MODELING AND FORECASTING



# OCEAN OBSERVATIONS IMPROVE MODELING AND FORECASTING

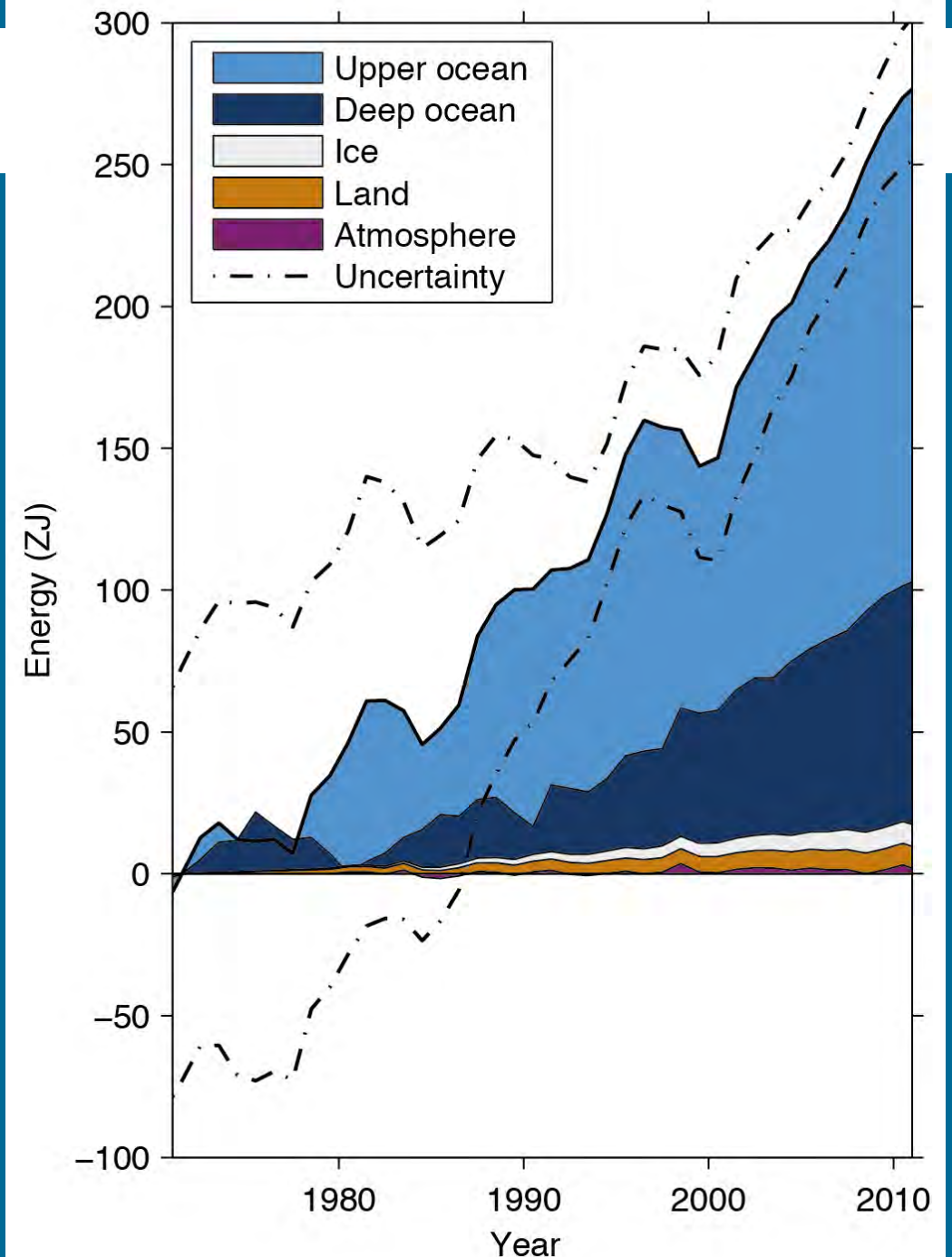




# WHERE IS ALL THE HEAT GOING?

- The oceans take up more than 90% of the energy added to the climate system by humans.
- The atmosphere takes up 2%.
- Over time, with more measurements that are more accurate, the uncertainty decreases. We are more sure of where the heat is going.
- Observing the ocean's heat content helps us monitor how well humans are able to reduce their impact.

Figure from the IPCC report in 2013



# WHERE IS ALL THE HEAT GOING?

Sea level rises due to two main reasons:

1. More water from melting glaciers and ice sheets
2. Expansion of sea water as it warms

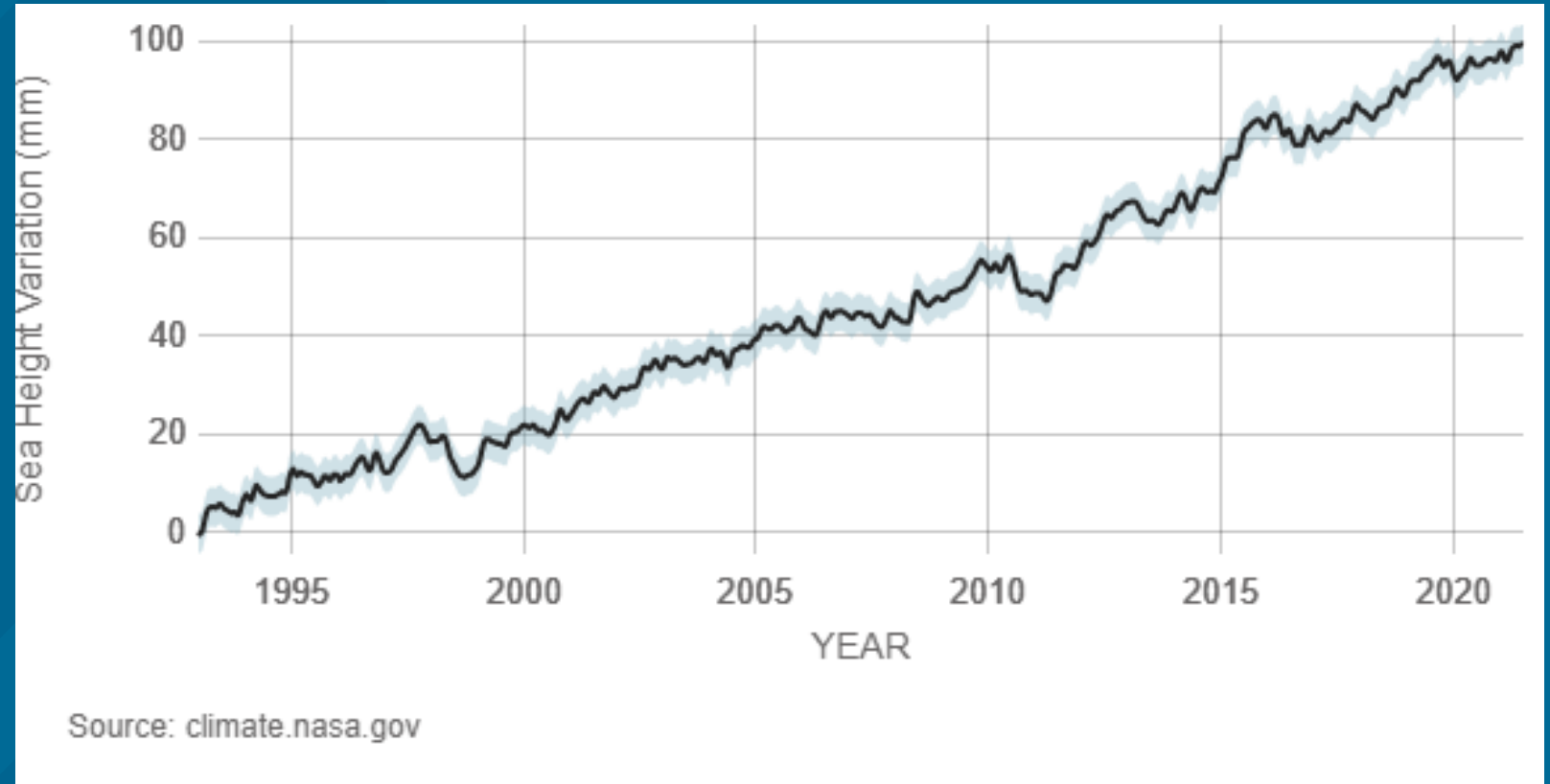
Total sea level is measured by altimetry satellites.

Melt mass is measured by the GRACE satellites.

Expansion is measured by Argo floats.

Sea level

↑ 3.4mm/yr







✓ WHY DO WE NEED OCEAN OBSERVATIONS?

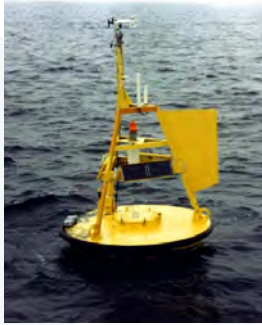
WHAT OBSERVATIONS ARE AVAILABLE?

HOW CAN ARGO DATA BE USED IN THE CLASSROOM?



# WHAT OBSERVATIONS ARE AVAILABLE?

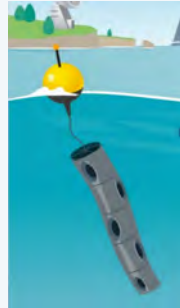
Moorings



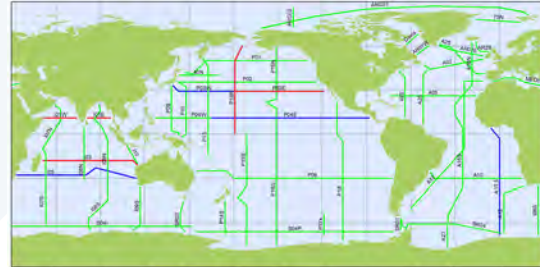
Gliders



Surface drifters



Ship data



Argo floats



Satellites



Subsurface measurements	✓	✓		✓	✓	
Near surface measurements	✓	✓	✓	✓	✓	✓
Sea level atm pressure	✓		✓	✓		
Sea ice						✓
Cost	\$\$\$	\$\$	\$	\$\$\$	\$\$	\$\$\$





✓ WHY DO WE NEED OCEAN OBSERVATIONS?

✓ WHAT OBSERVATIONS ARE AVAILABLE?

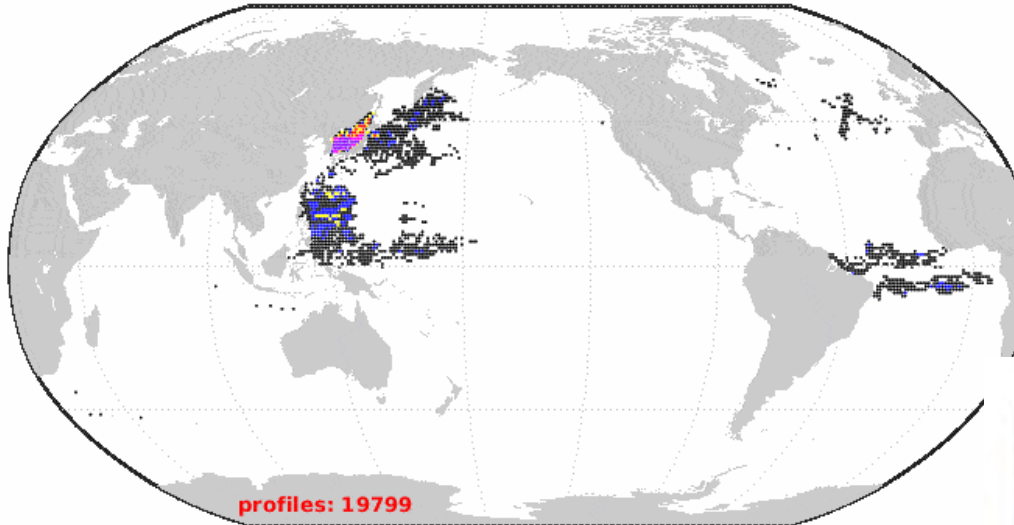
HOW CAN ARGO DATA BE USED IN THE CLASSROOM?



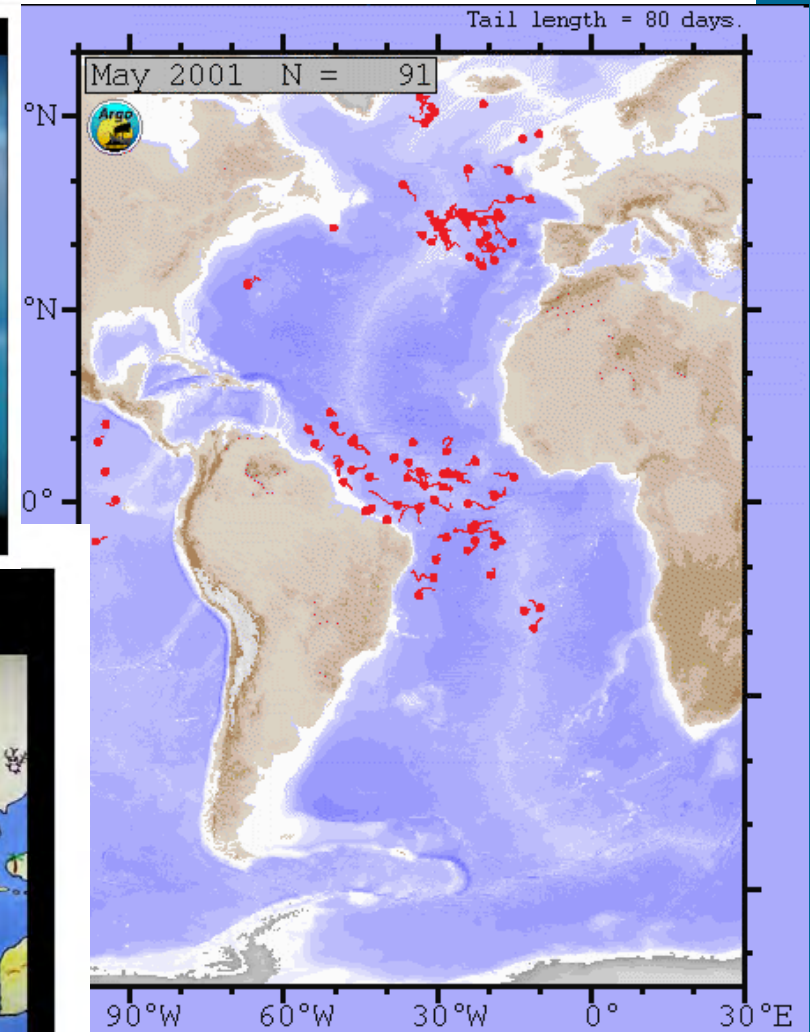
# ANIMATIONS

<https://argo.ucsd.edu/outreach/media/argo-animations/>

Argo observation density  
in profiles per 1 degree box  
11/01/1999



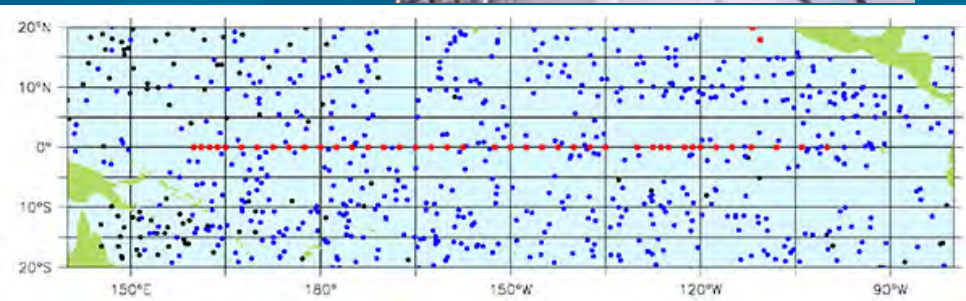
◆ 1 to 10   ◆ 11 to 25   ◆ 26 to 50   ◆ 51 to 100   ◆ 101 to 200   ◆ >200



# ARGO STORIES

<https://argo.ucsd.edu/category/float-deployment-stories/>

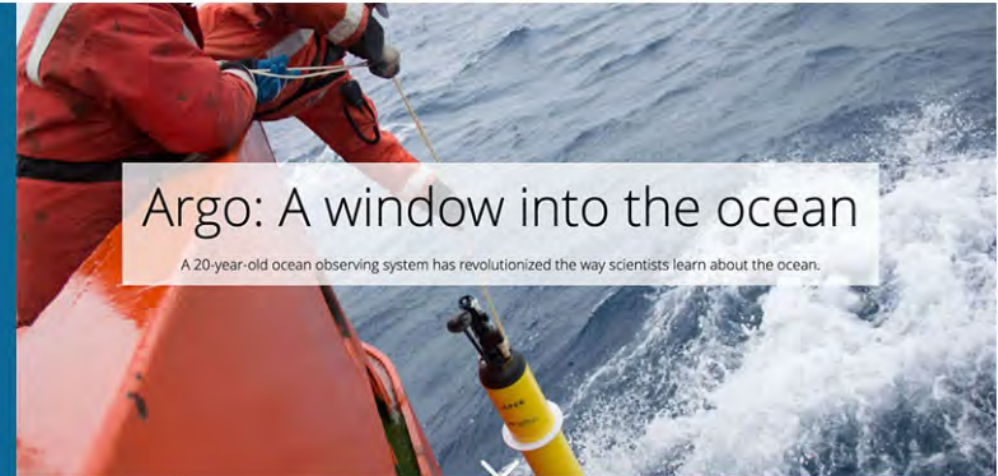
## Argo float deployments along the Equatorial Pacific from the S/V Investigator



Argo celebrates 20 years of observing the ocean

What has Argo taught us, what makes it successful, and what does it hope to accomplish in the future?

[Click to Learn More](#)



Argo: A window into the ocean

A 20-year-old ocean observing system has revolutionized the way scientists learn about the ocean.

<https://oceanops.maps.arcgis.com/apps/Cascade/index.html?appid=a170a0d522bb42f1a019e4e473cf1bdd>

## Argo floats deployed from I8S & I9N cruises near Antarctica

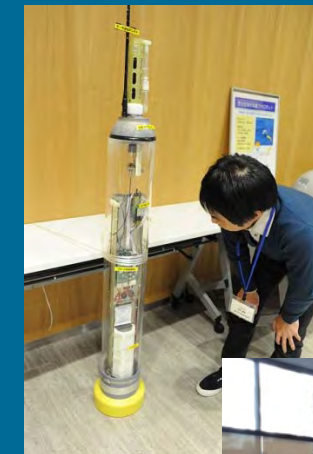




# ARGO CURRICULUM

<https://argo.ucsd.edu/outreach/education-materials/>

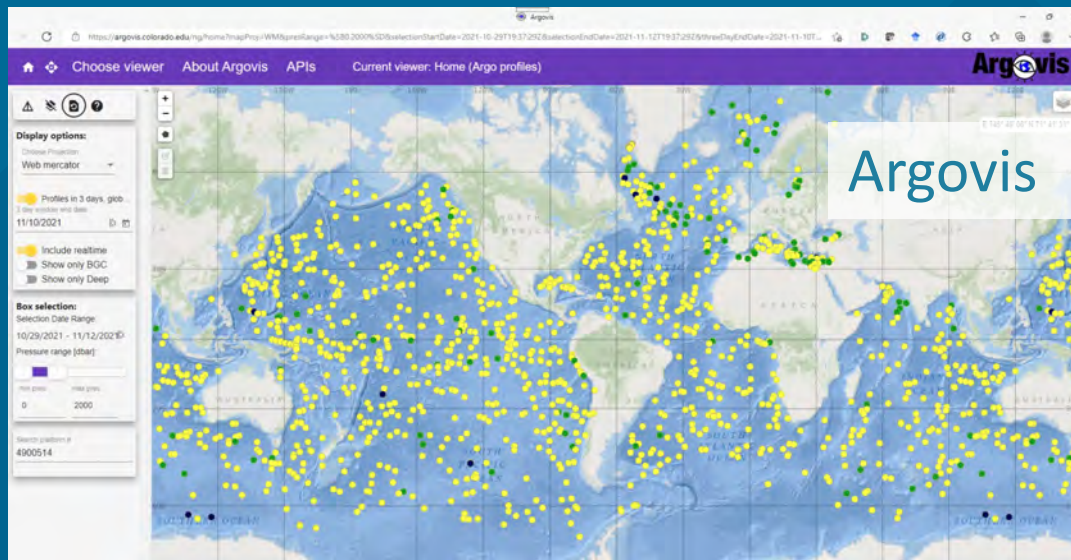
Curriculum	Target Audience	Themes
Carole Brieseman's website	Grades K - 12	Density, currents, float technological advancements
LEARNZ field trip on R/V Tangaroa	Grades 1 - 5	Ocean observation, ocean currents, relationship between humans and the environment
EuroArgo website	Grades K - 6	Ocean observation, Density, currents, Argo implementation
Mon Ocean et moi	Grades 6 - 12	Ocean observations, marine phytoplankton, marine zooplankton, ocean seasons and ocean properties
SERREAD	Grades 3 - 12	Weather, climate, rising sea level
SOCCOM	Grades 6 - 12	How floats work, carbon cycle, Southern Ocean's role in Earth's climate



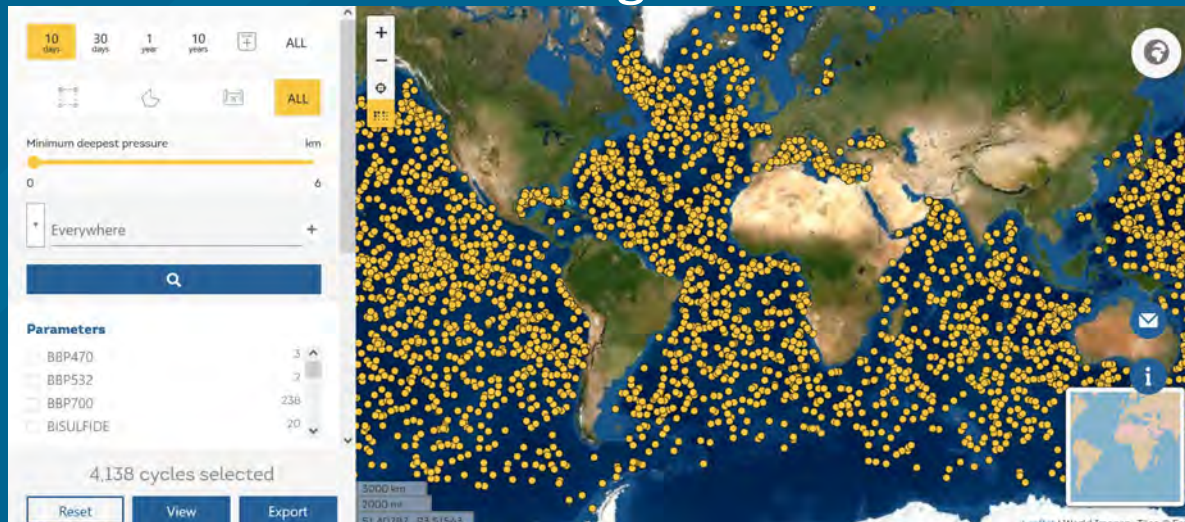


# ARGO VISUALIZATIONS

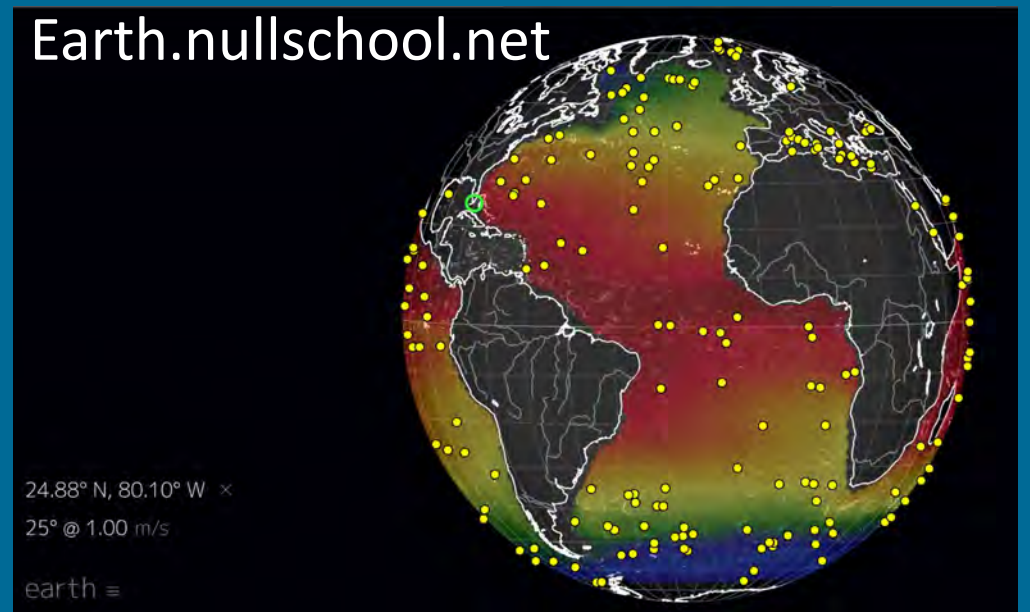
<https://argo.ucsd.edu/data/data-visualizations/>



Euro-Argo data selection tool



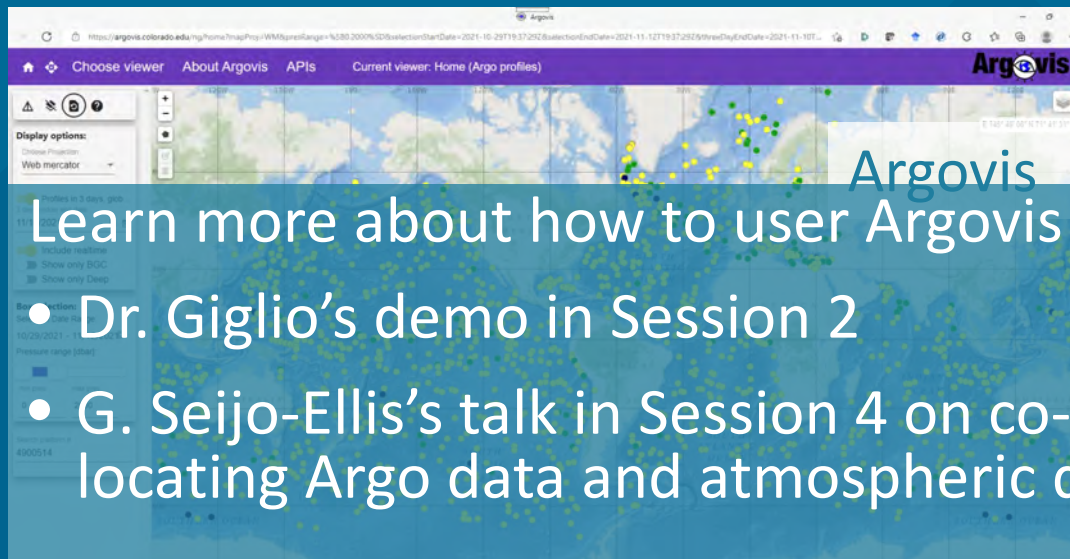
Earth.nullschool.net





# ARGO VISUALIZATIONS

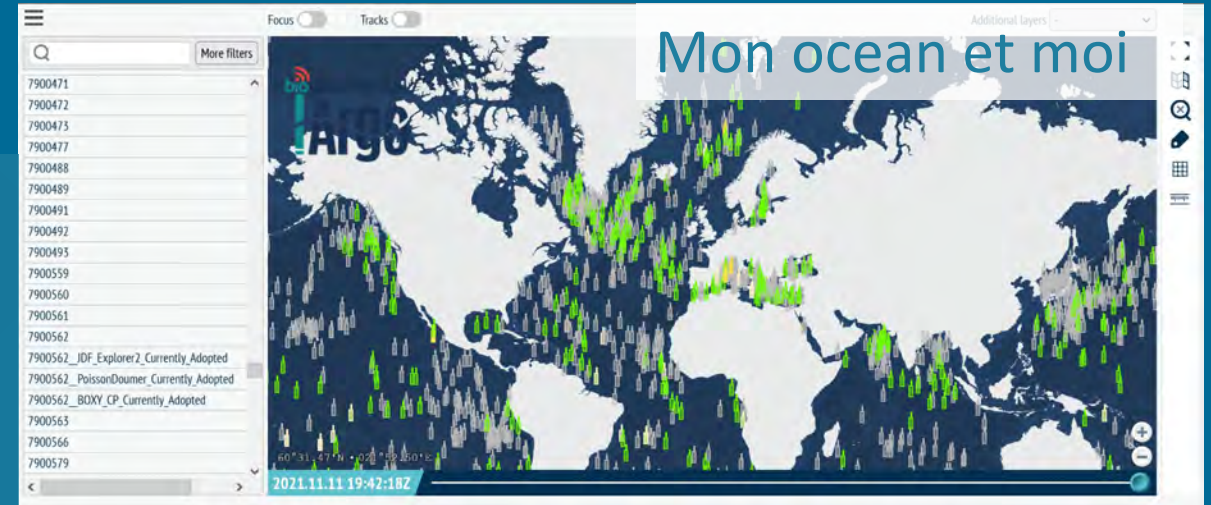
<https://argo.ucsd.edu/data/data-visualizations/>



Argovis

Learn more about how to user Argovis in:

- Dr. Giglio's demo in Session 2
- G. Seijo-Ellis's talk in Session 4 on co-locating Argo data and atmospheric data



Mon ocean et moi

7900471  
7900472  
7900473  
7900477  
7900488  
7900489  
7900491  
7900492  
7900493  
7900559  
7900560  
7900561  
7900562  
7900562\_IDF\_Explorer2\_Currently\_Adopted  
7900562\_PoissonDoumer\_Currently\_Adopted  
7900562\_BOXY\_CP\_Currently\_Adopted  
7900563  
7900566  
7900579

## Euro-Argo data selection tool



Learn more from R. Cancouet in Session 2

10 days 30 days 1 year 10 years ALL

Minimum deepest pressure: km

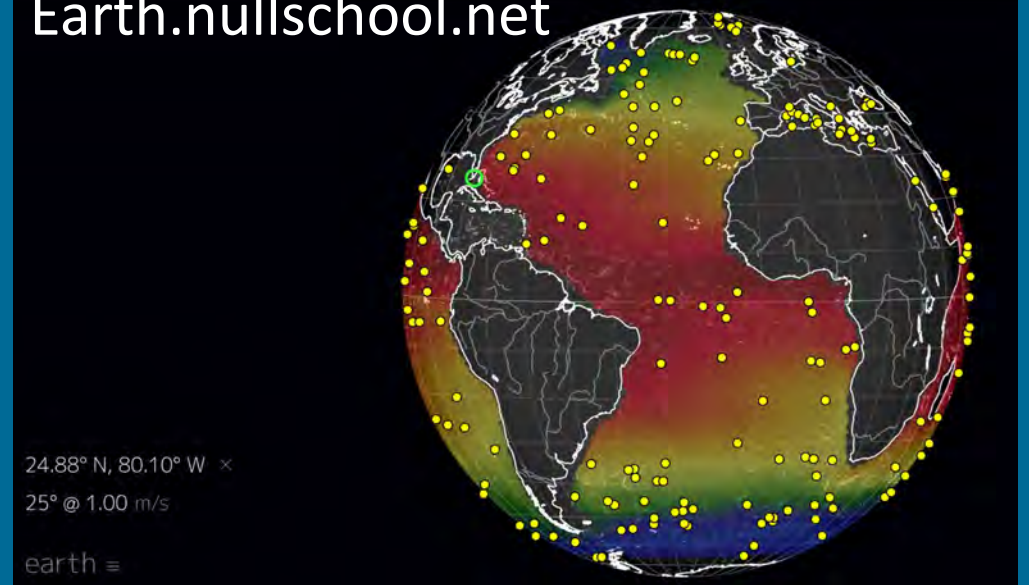
Parameters

- BBP470 3
- BBP532 3
- BBP700 236
- BISULFIDE 20

4,138 cycles selected

Reset View Export

## Earth.nullschool.net

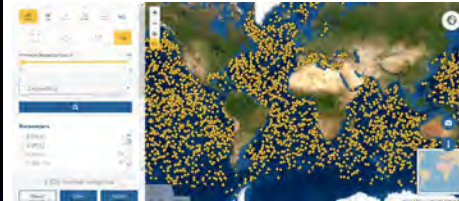
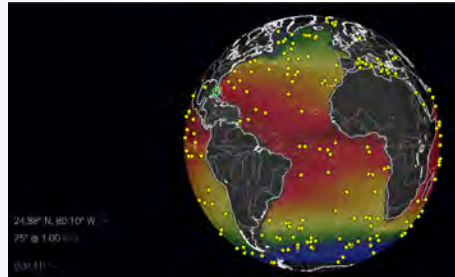
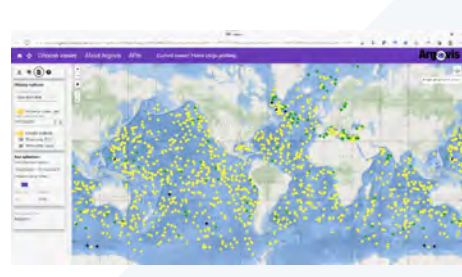


24.88° N, 80.10° W ×  
25° @ 1.00 m/s

earth =

# WHICH VISUALIZATION TOOL SHOULD I USE?

<https://argo.ucsd.edu/data/data-visualizations/data-visualization-comparisons/>



	Argovis	Earth nullschool.net	EuroArgo data selection tool	Mon Ocean et moi (focus: BGC Argo)
Visualize profiles	✓		✓	✓
Visualize trajectories	✓		✓	✓
Visualize gridded data	✓	✓		✓
Download data as text	✓		✓	
API capabilities	✓			





# THANK YOU QUESTIONS AND COMMENTS WELCOME

<https://argovis.colorado.edu>

<https://argo.ucsd.edu/category/float-deployment-stories/>

<https://argo.ucsd.edu/outreach/media/argo-animations/>

<https://argo.ucsd.edu/outreach/education-materials/>

<https://argo.ucsd.edu/data/data-visualizations/data-visualization-comparisons/>