The background of the slide features a deep blue underwater scene. Sunlight filters down from the surface in bright, glowing rays, creating a dappled light effect on the sandy ocean floor. The water is slightly rippled, with some darker shadows in the corners.

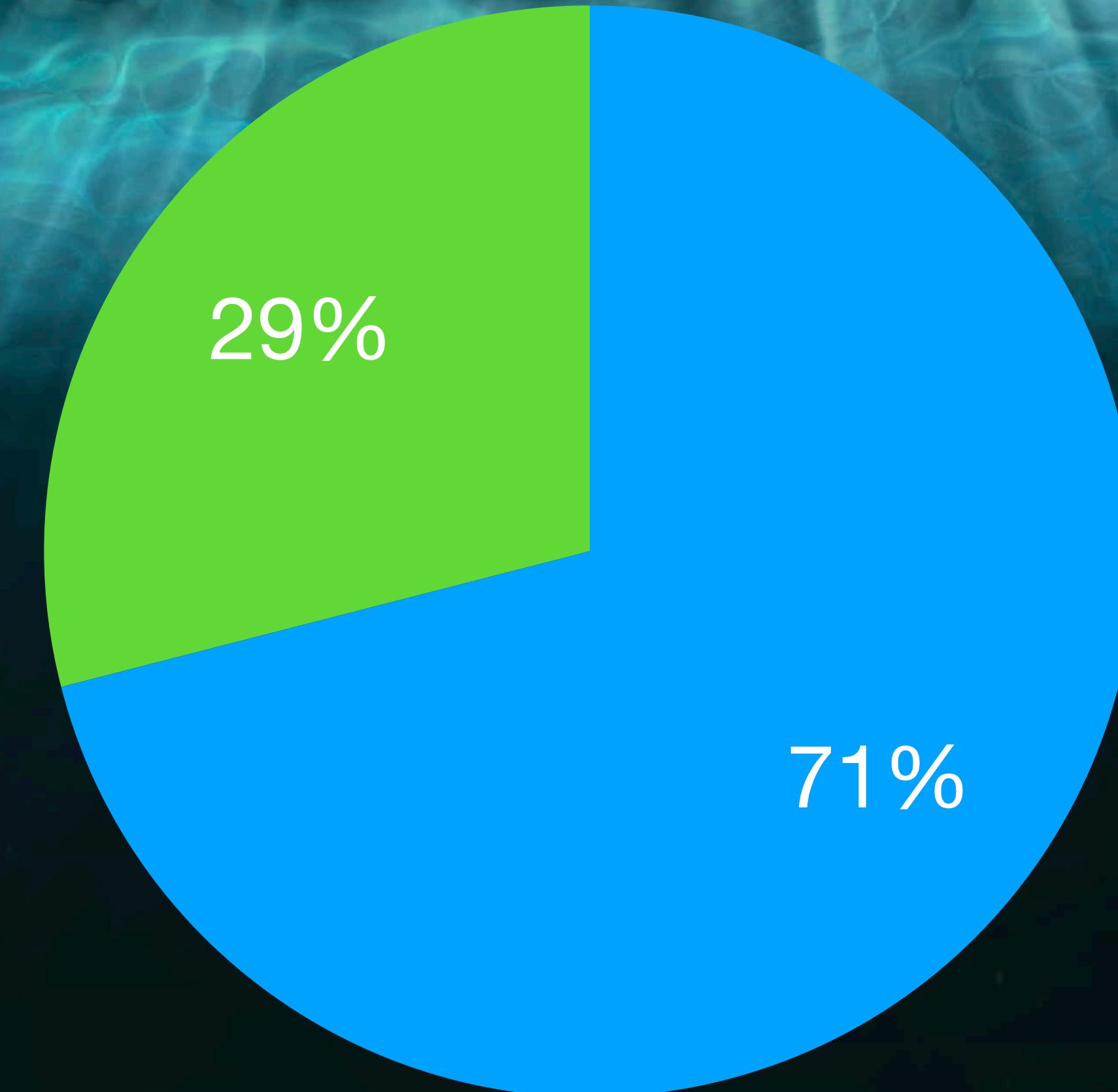
Let's look at our ocean!

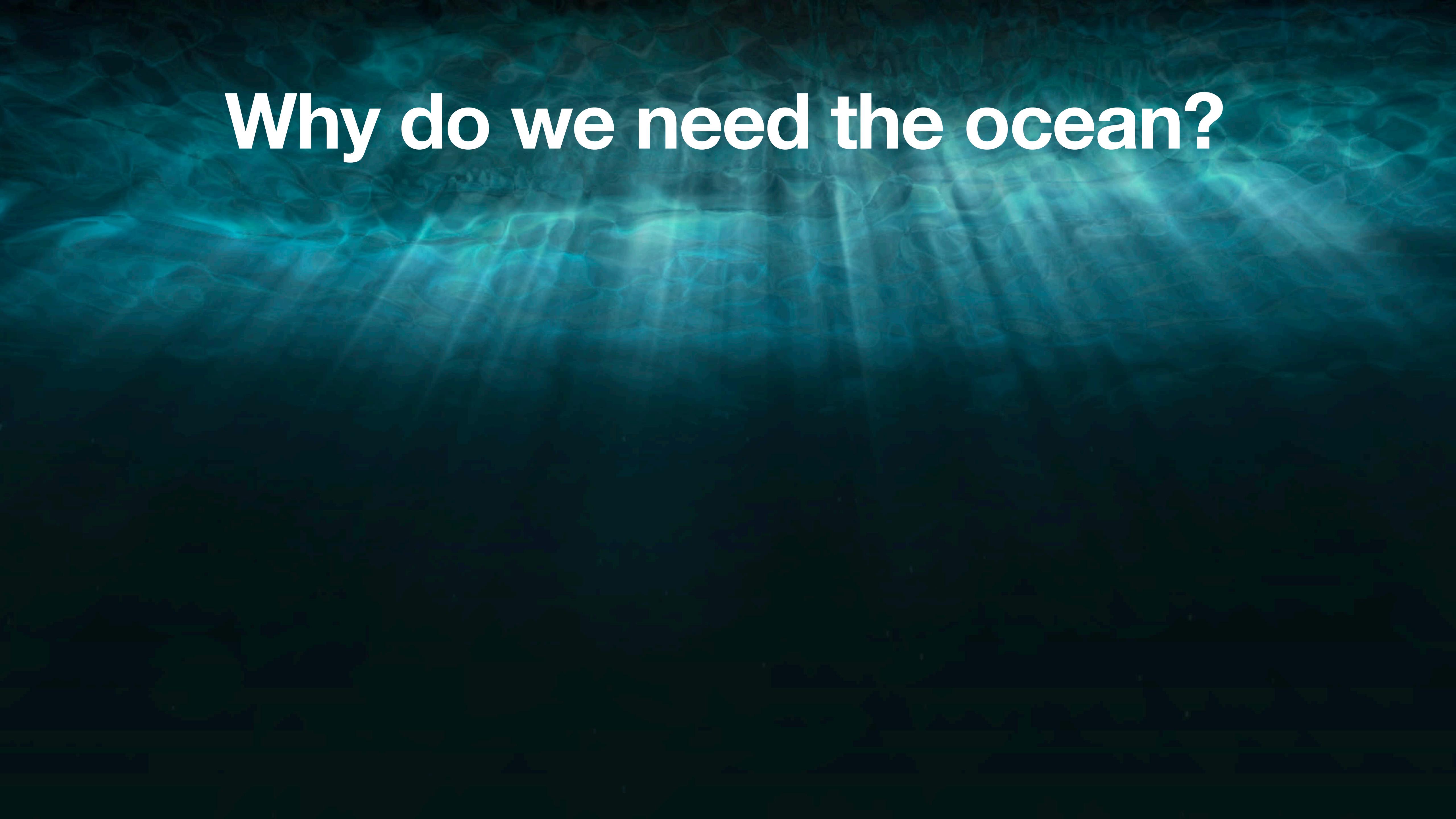


The ocean is a big place.

How much of the world is covered by the sea?

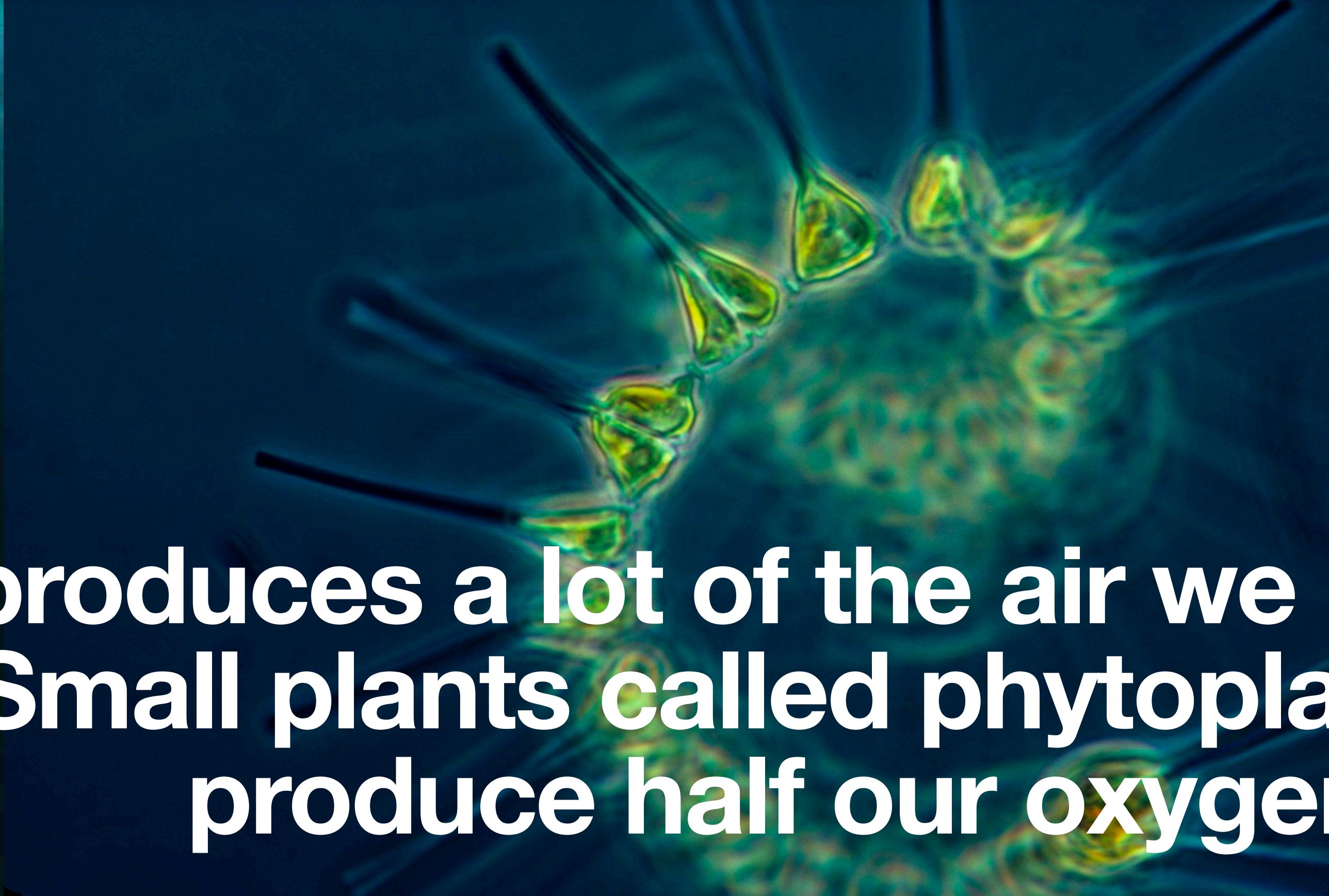
Almost three quarters!





Why do we need the ocean?

Why do we need the ocean?

A microscopic image showing a colony of phytoplankton. The individual cells are small, green, and oval-shaped, arranged in a branching, string-like pattern. They appear to be moving or swimming through a dark, watery environment.

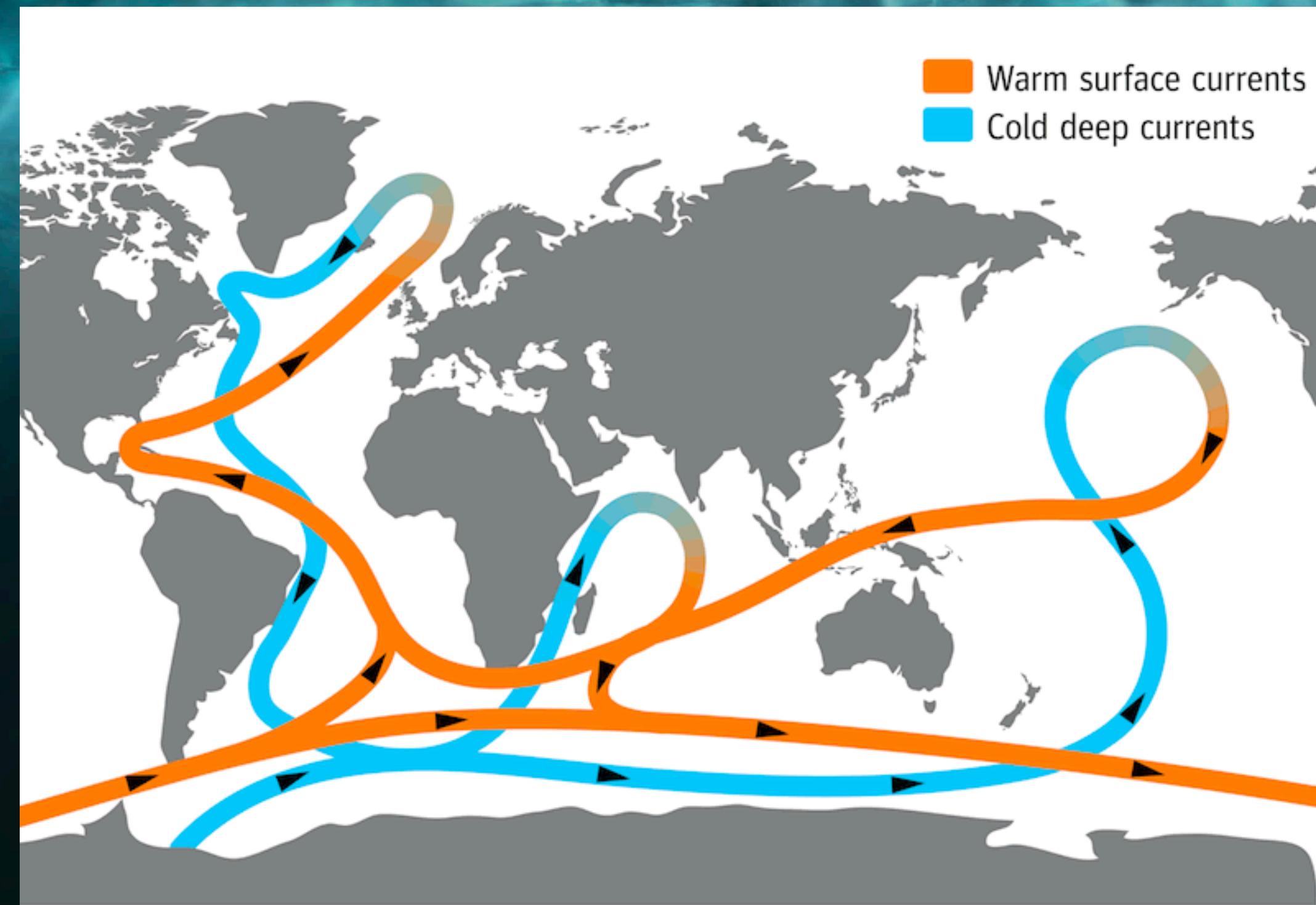
**It produces a lot of the air we breathe!
Small plants called phytoplankton
produce half our oxygen!**

Why do we need the ocean?



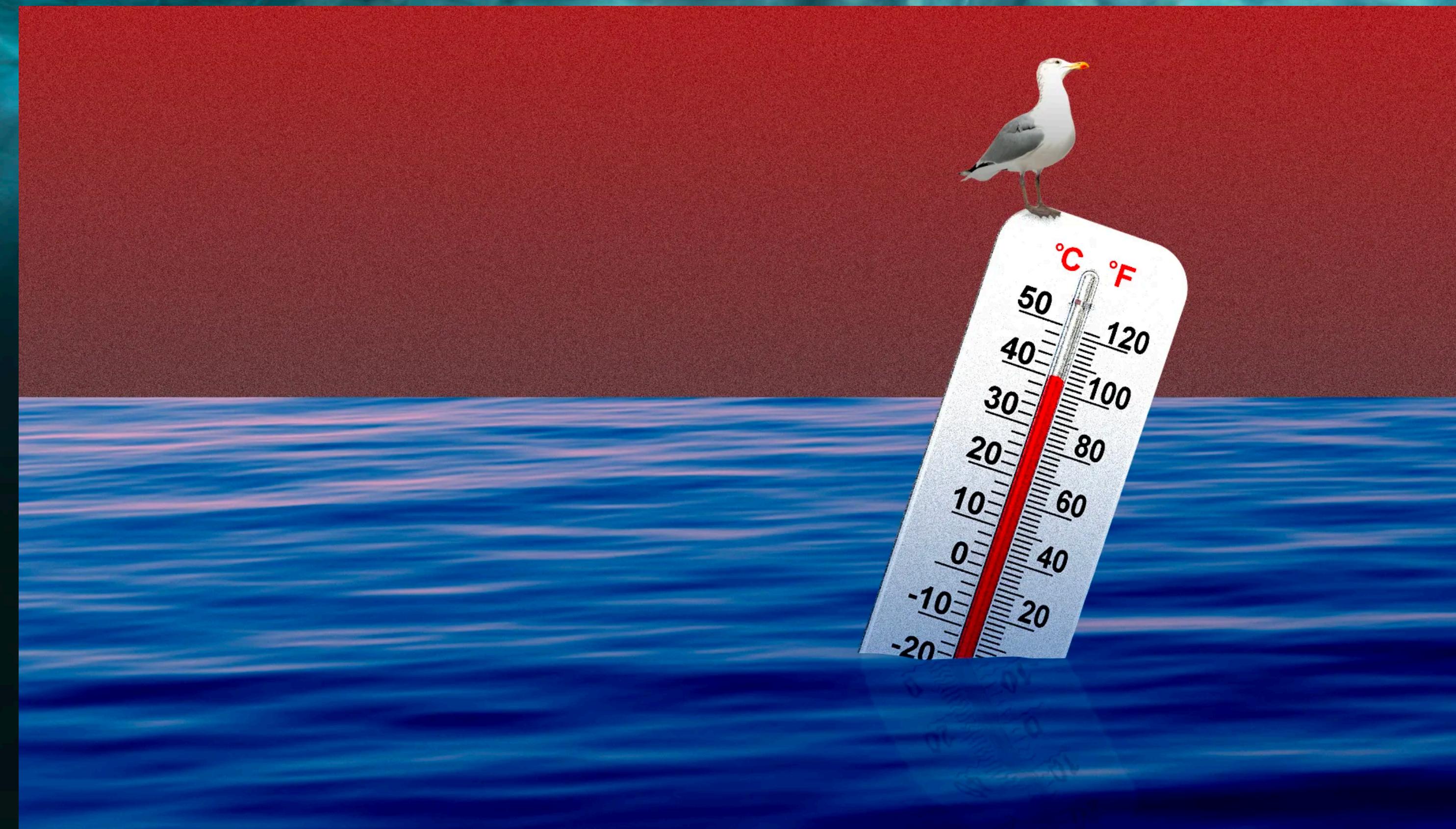
It connects us - in many ways

Why do we need the ocean?



It connects us - in many ways

Why do we need the ocean?



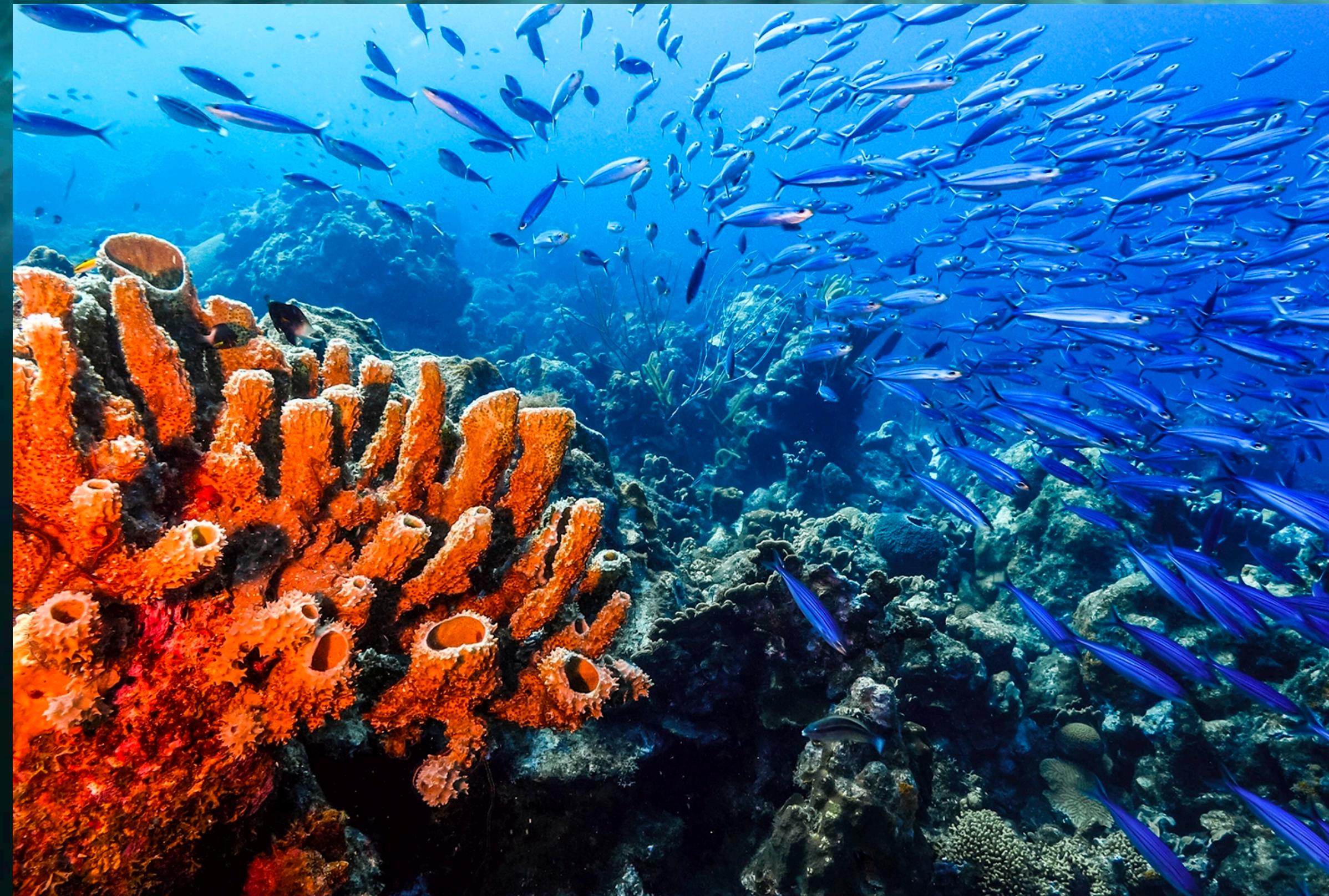
It keeps us not too warm, not too cold.

Why do we need the ocean?



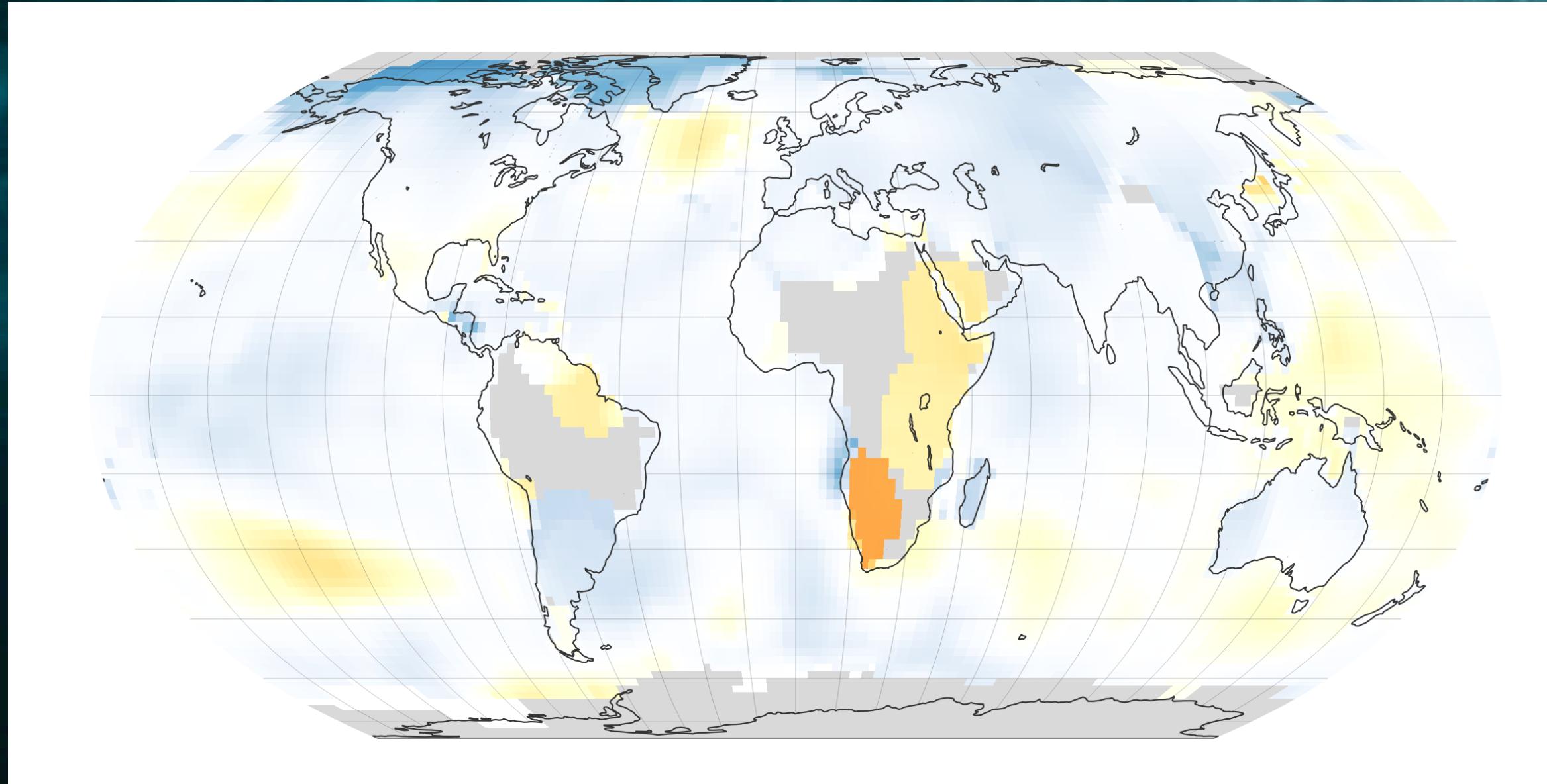
It makes our weather!

Why do we need the ocean?

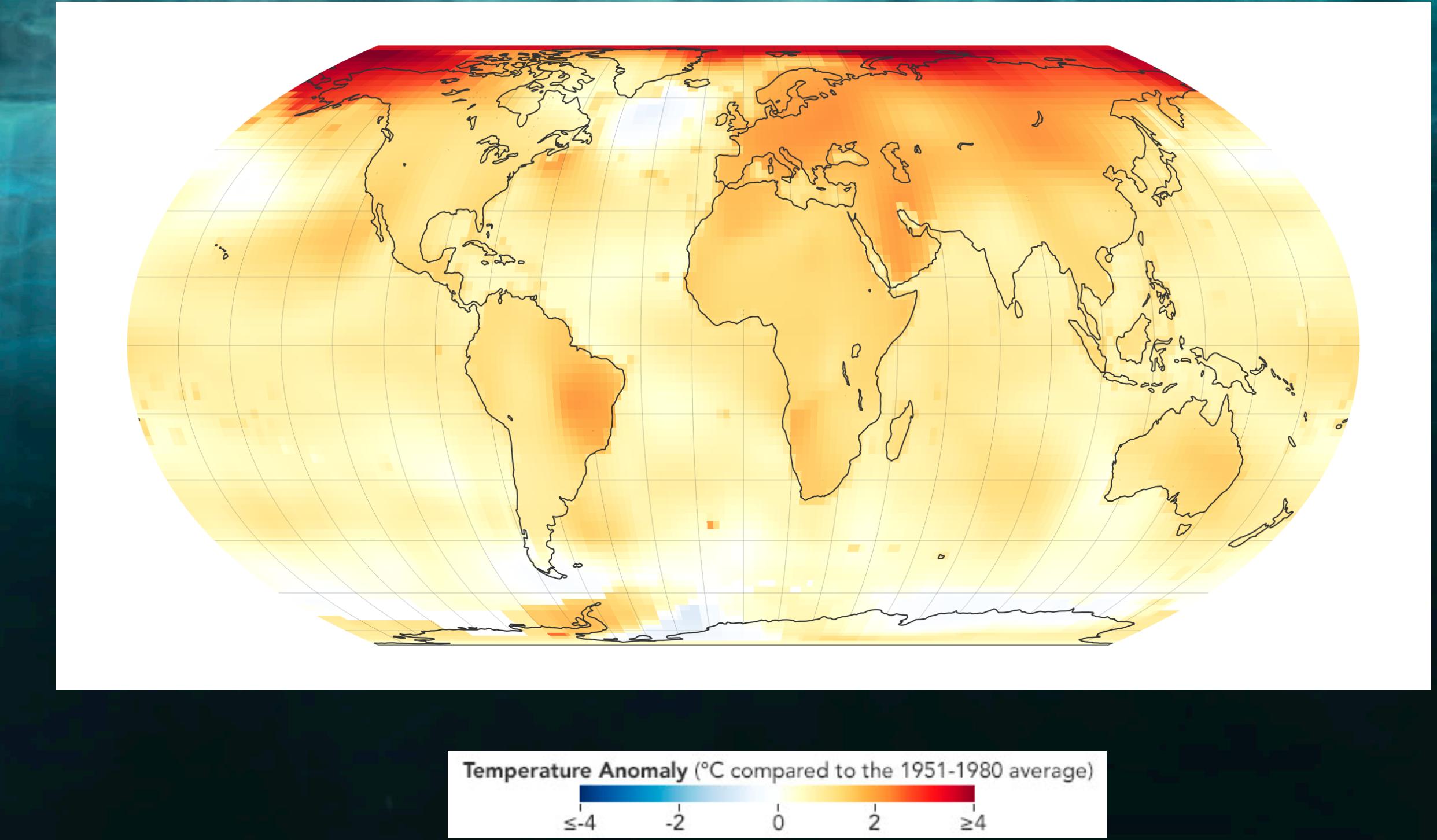


**It's home to very many of our fellow animals
- some of whom we haven't met yet!**

It's also changing, very fast, because of fossil fuel emissions.

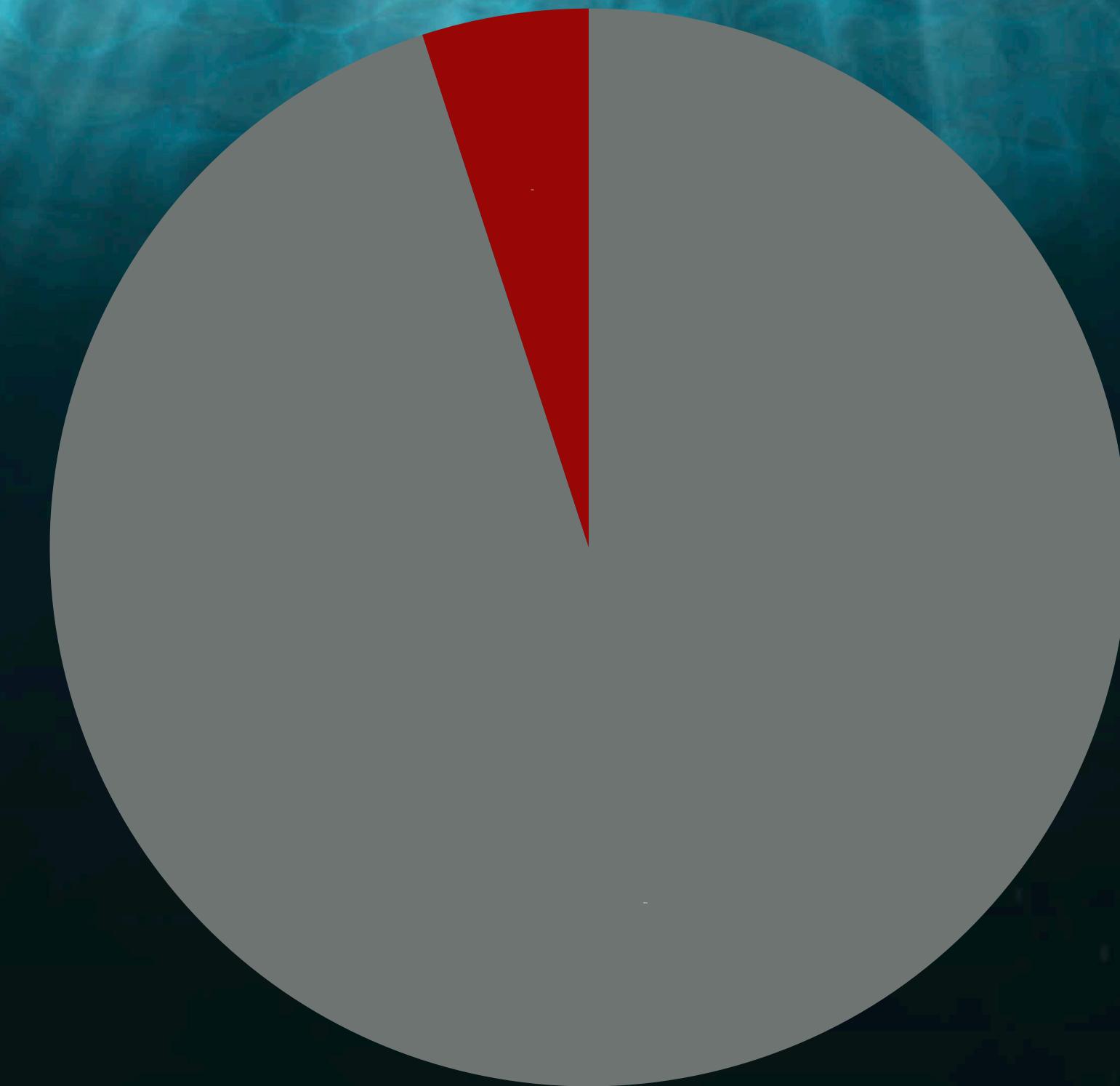


1895-1900
(Anomaly from 1951-1980)



2015-2019
(Anomaly from 1951-1980)

**But - it's complicated,
and we still don't know that much about it!**



Oceanographers try to find out about the ocean!



We have two main ways of doing that.



We can visit the ocean with boats or robots



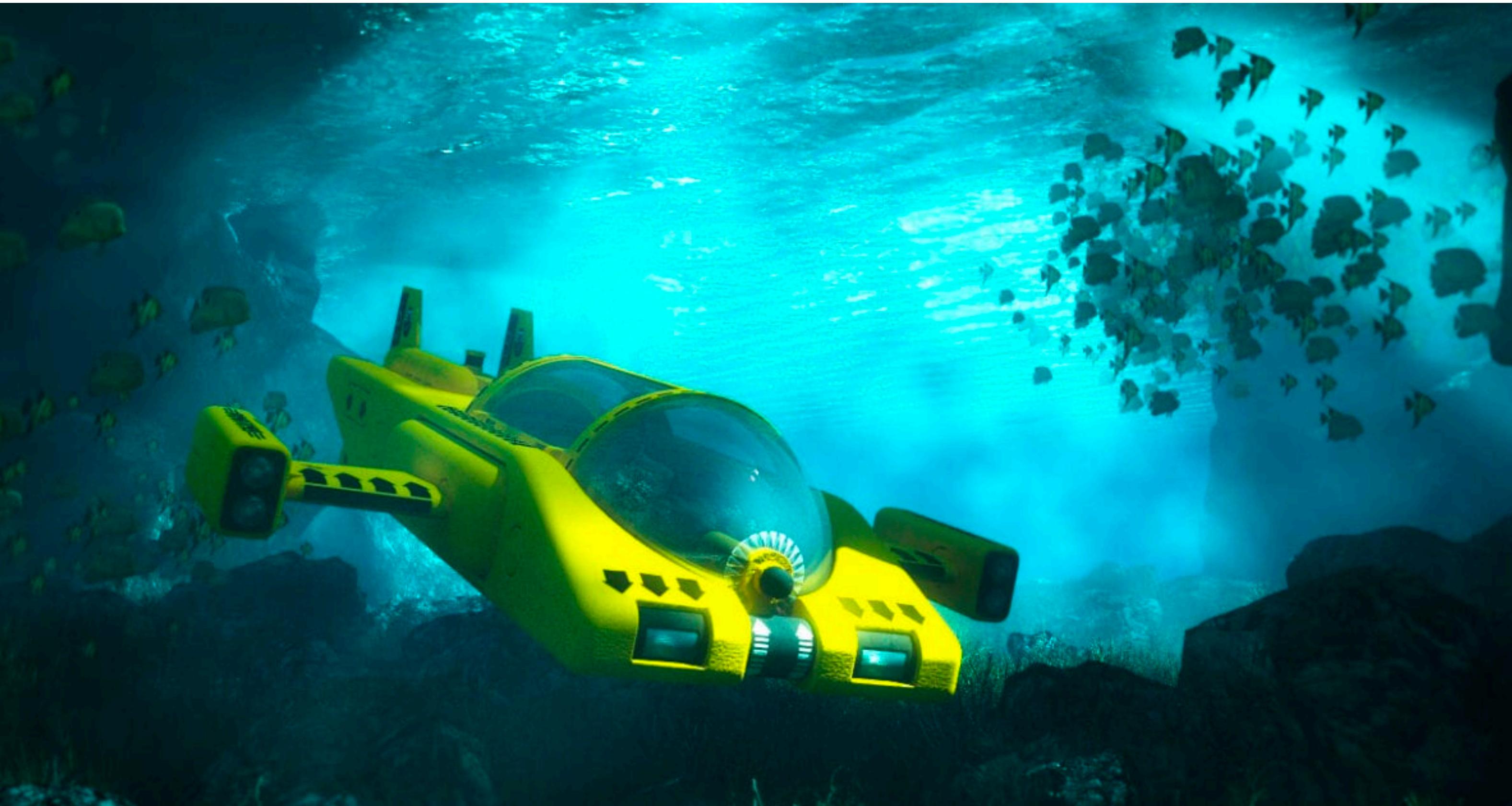
A sail-robot!



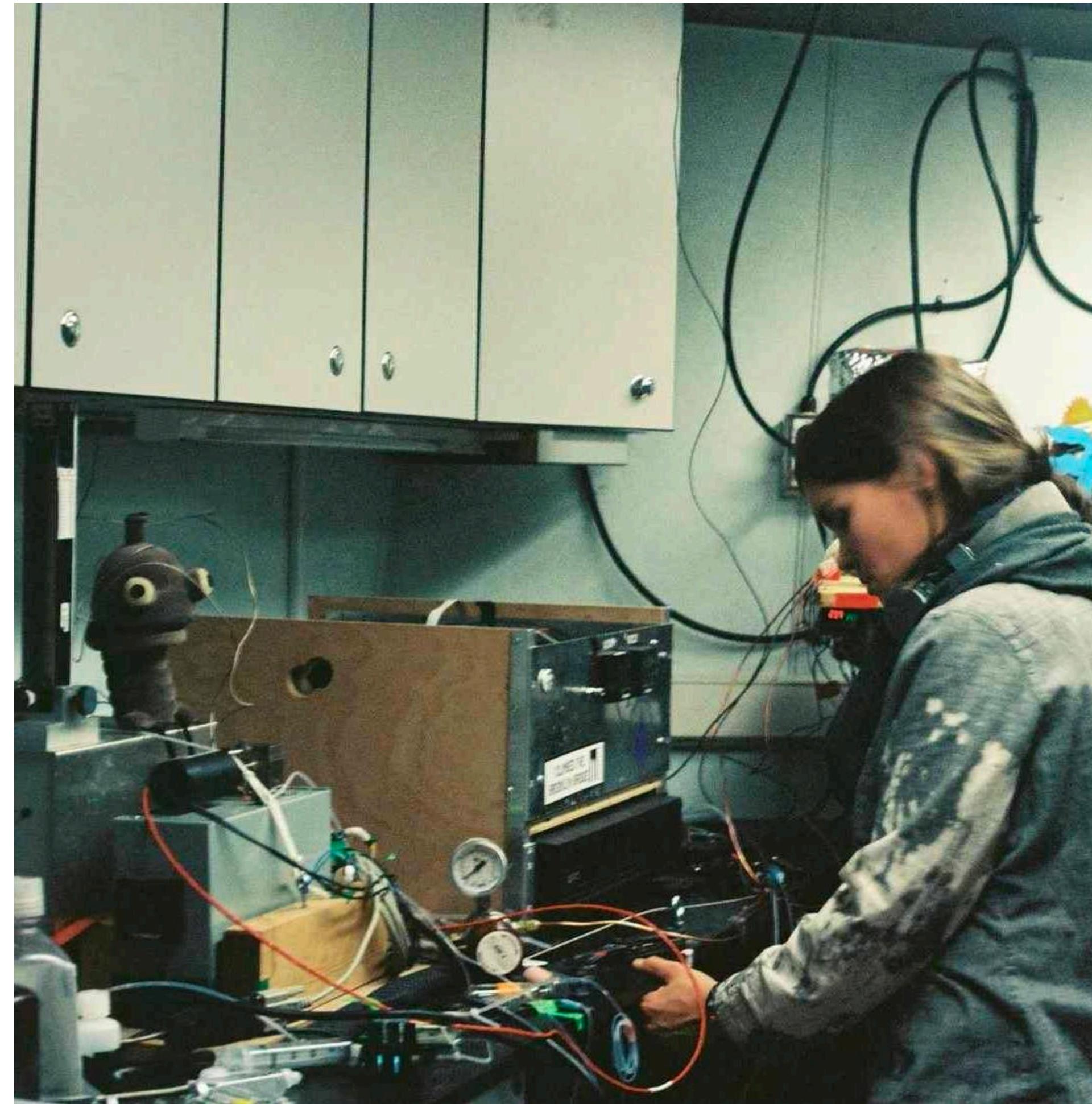
An underwater robot



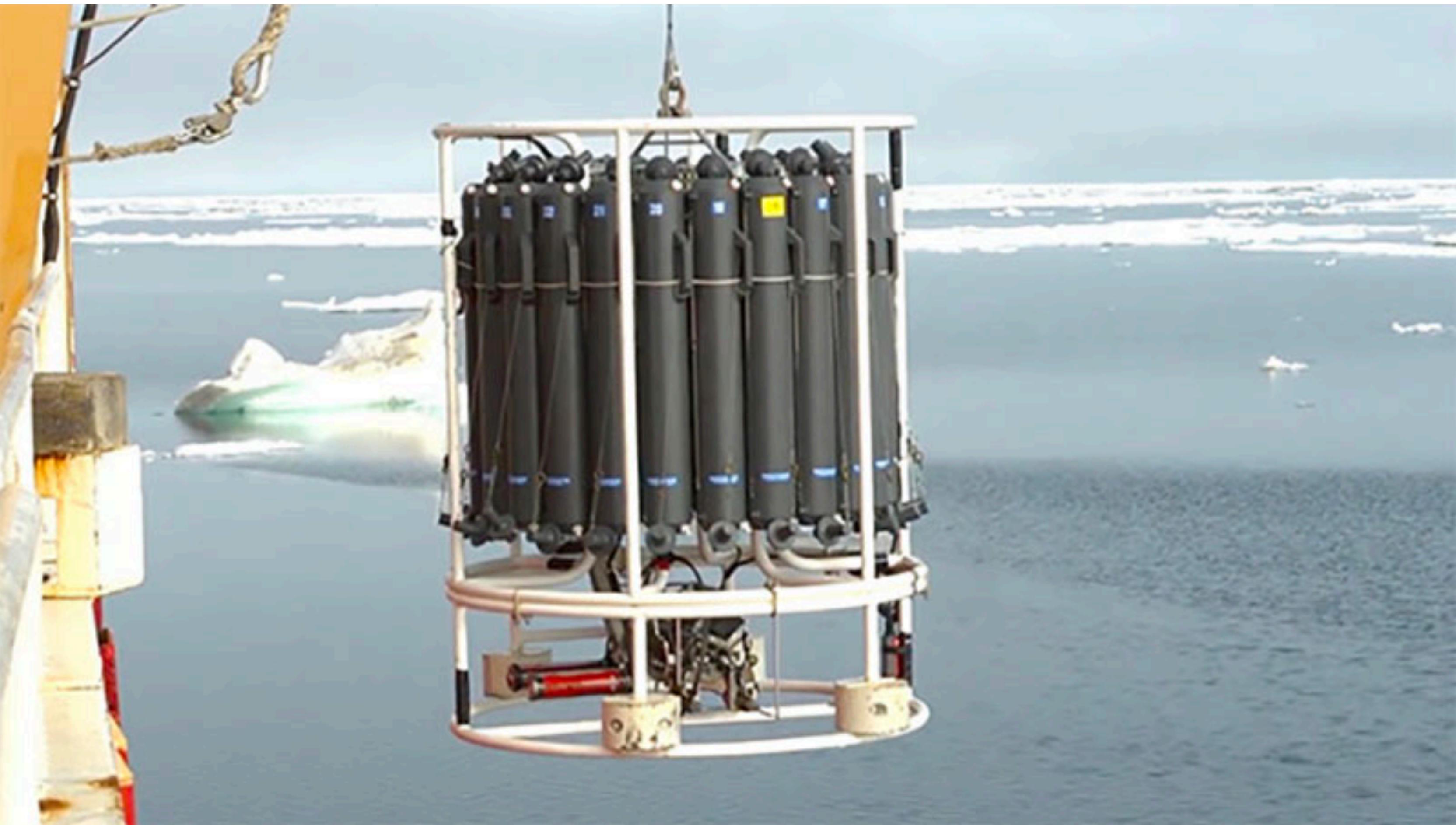
A very deep underwater robot



My robot - for measuring trace gasses



A fancy bucket (we use buckets a lot)



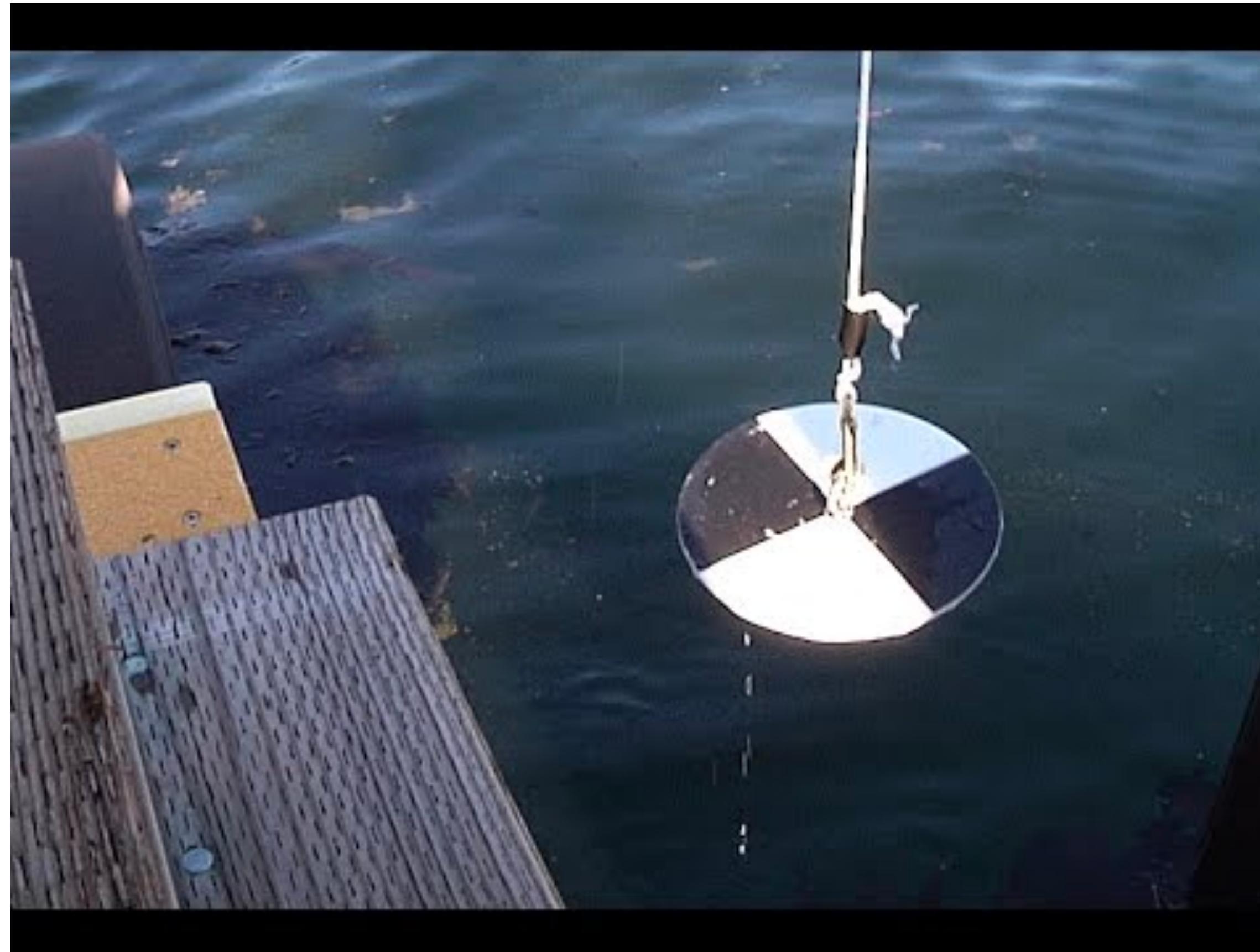
A space robot



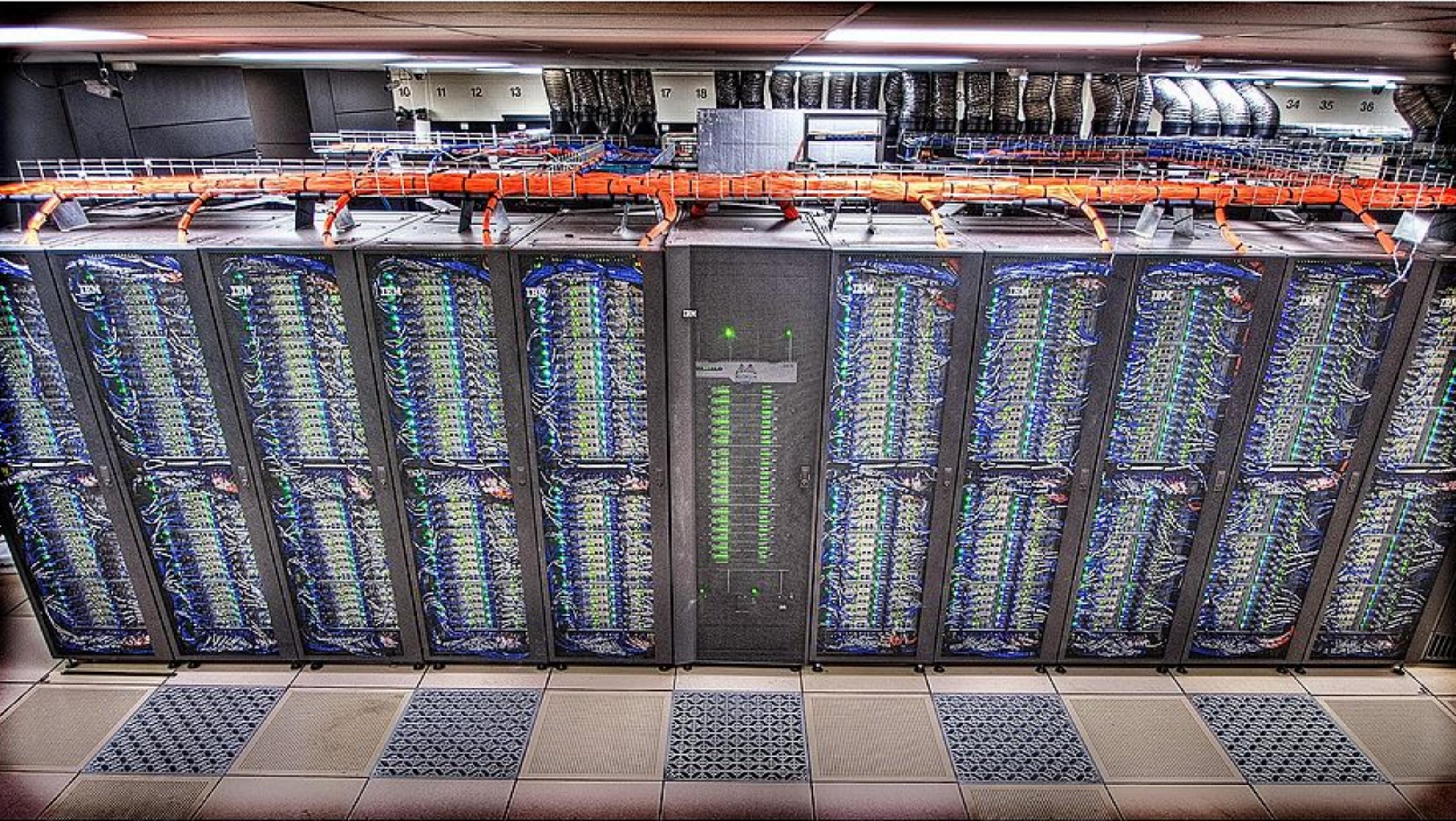
A water-speed measuring robot



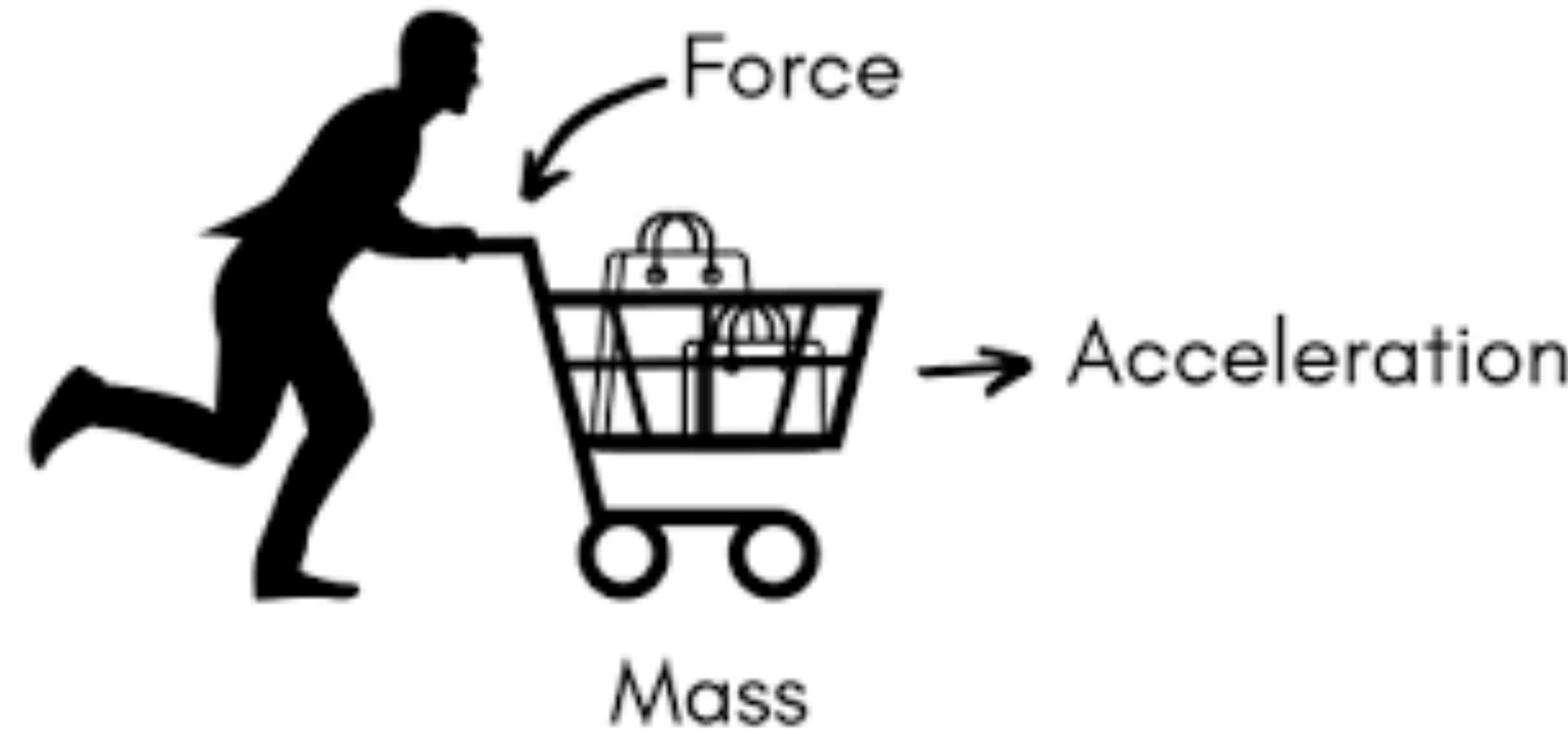
A piece of metal on a string



Or we can use computers



Computers take basic physical principles



Computers take basic physical principles



Navier-Stokes Equations

Continuity Equation

$$\nabla \cdot \vec{V} = 0$$

Momentum Equations

$$\rho \frac{D\vec{V}}{Dt} = -\nabla p + \rho \vec{g} + \mu \nabla^2 \vec{V}$$

Total derivative

=

Pressure gradient

Body force term

Diffusion term

$$\rho \left[\frac{\partial V}{\partial t} + (V \cdot \nabla) V \right]$$

Change of velocity
with time

Conective term

Fluid flows in the
direction of largest
change in pressure.

External forces, that
act on the fluid
(gravitational force
or electromagnetic).

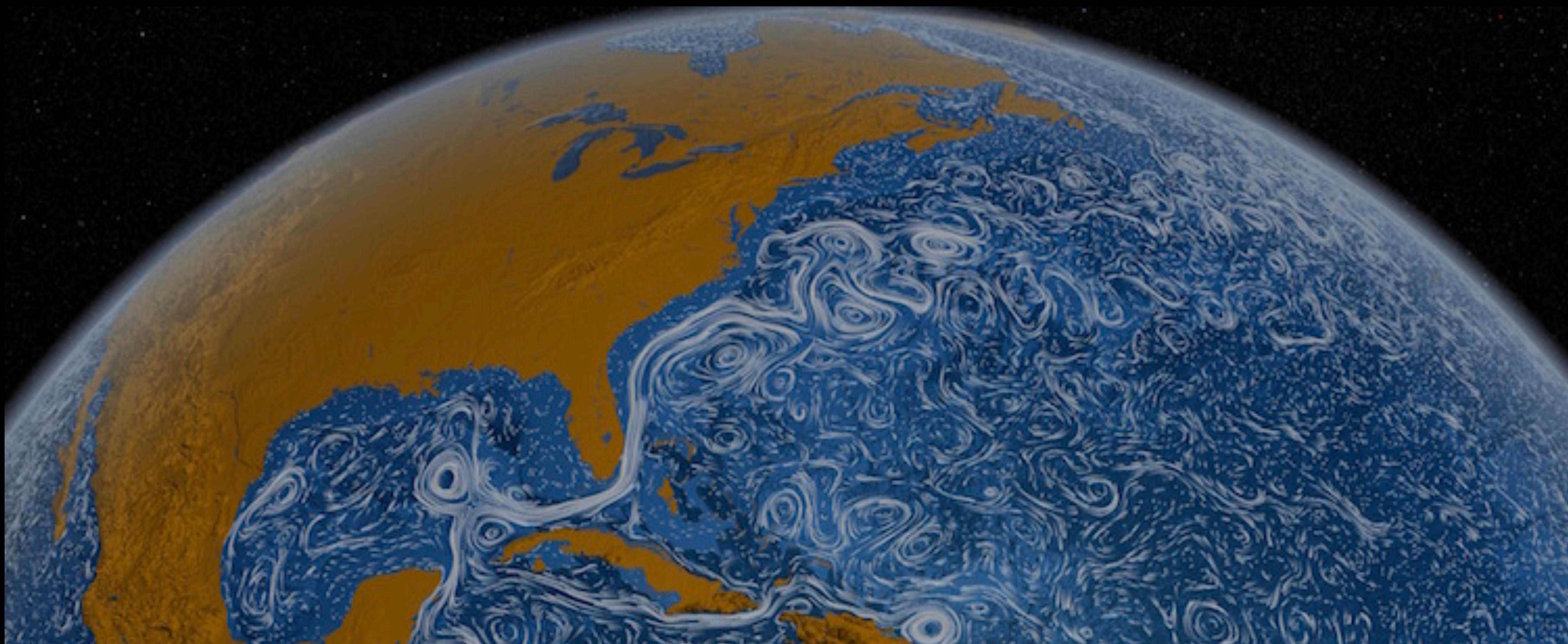
For a Newtonian
fluid, viscosity
operates as a
diffusion of
momentum.

and write them so we use them to guess how fast the ocean is moving

We use this idea to make weather forecasts



And also estimates of the big picture



**The more we learn about the ocean, the more important we realize it is.
And the more interesting. Never stop exploring!**

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