“OASIS—The Observatory for Air-Sea Interaction Studies” with Dr. Chris Zappa

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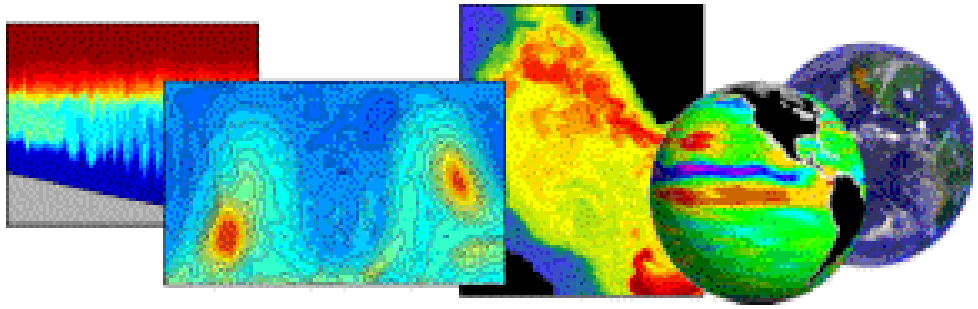
21 Apr 2018

What's "air-sea interaction"? Broadly speaking…

- Energy and matter exchanges occur on a variety of scales in the zone connecting the bottom of the atmosphere and the water surface



http://paoc.mit.edu/paoc/research/airseainteract.asp

- Heat, light, and other forms of EM energy
- Momentum (creating wavs and currents)
- O_2, CO_2, and other gases; also, H_20 (gas and liquid)
- Salt, particulate and other solids

What's OASIS (the Observatory for Air-Sea Interaction Studies)?

Observatory for Air-Sea Interaction Studies (OASIS) conducts research focused on the oceanic and atmospheric boundary layers, including

wave dynamics and wave breaking

air-sea CO_2 gas exchange

non-satellite remote sensing, and

boundary-layer processes.

Partners at LDEO, Yale, U Conn, Heidelberg, New South Wales, others

Field research, new instrumentation, lab scale studies, numerical models

Goals of OASIS Research

Quantitative understanding of ocean-atmosphere coupling

Better understanding of marine storms, ocean waves, and
upper ocean circulation

Impacts on biology, chemistry, and physics of the ocean system
(especially with respace to carbon cycling)

Contribution of these processes to climate changes

Spatial and temporal changes in surface mixed layer and waves

Methods Used by OASIS

Direct and Remote sensing of 0cean-atmosphere boundary layers

IR (infrared/heat) techniques from aircraft, towers, ships, and autonomous vehicles

New instrumentation to measure air-sea fluxes and near-surface turbulence, energy dissipation from breaking waves

Examples of problems investigated by OASIS

Boundary layer exchanges

Coastal systems (breaking waves)

Gas-exchange on many scales

Polynyas (open water surrounded by sea ice)

Rain

Sea ice)

Waves and wave breaking
More information: http://www.ldeo.columbia.edu/observatory-air-sea-interaction-studies

The Ocean and Atmosphere …

1

Form a “coupled system” exchanging heat, water, and momentum

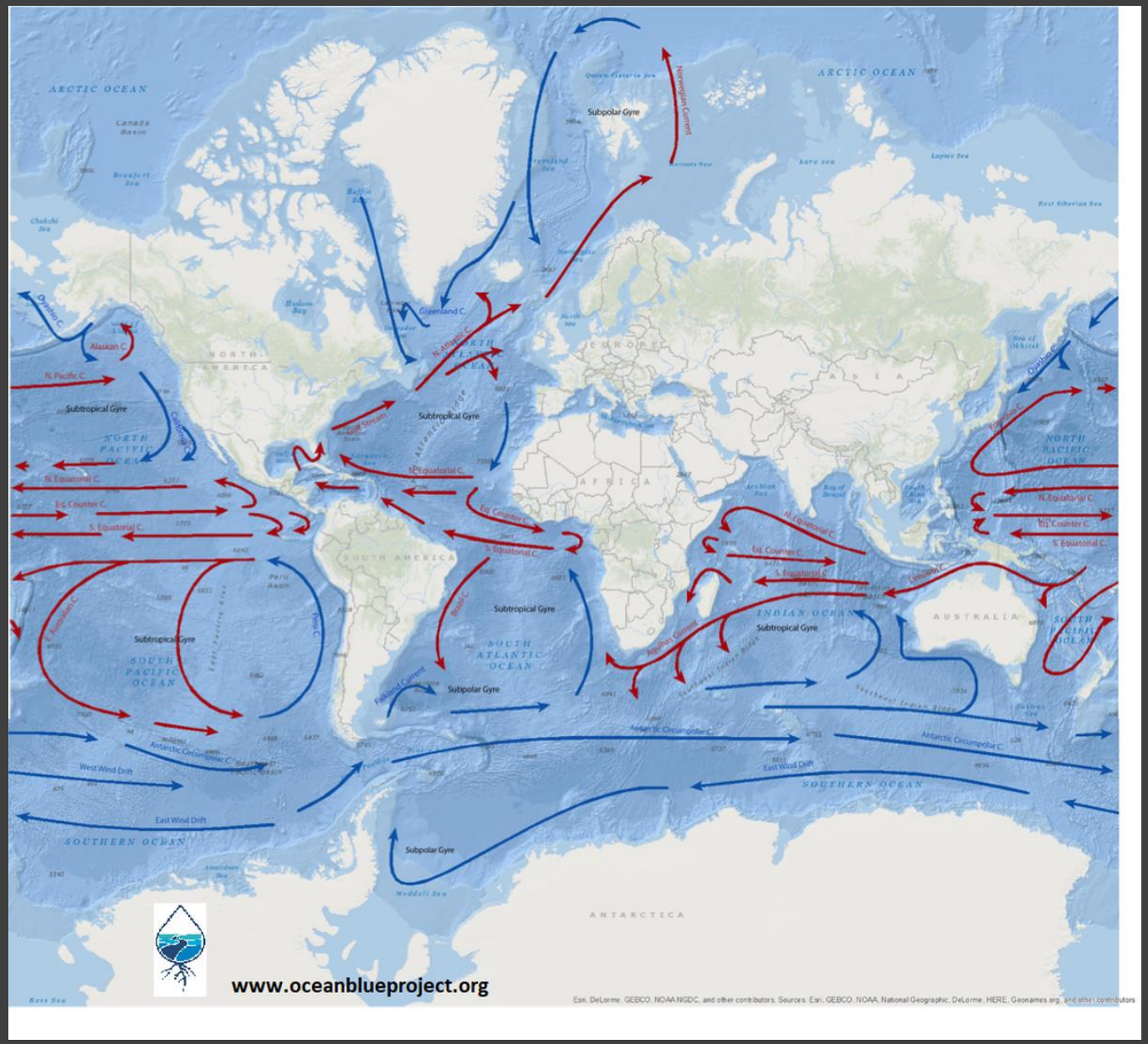
2

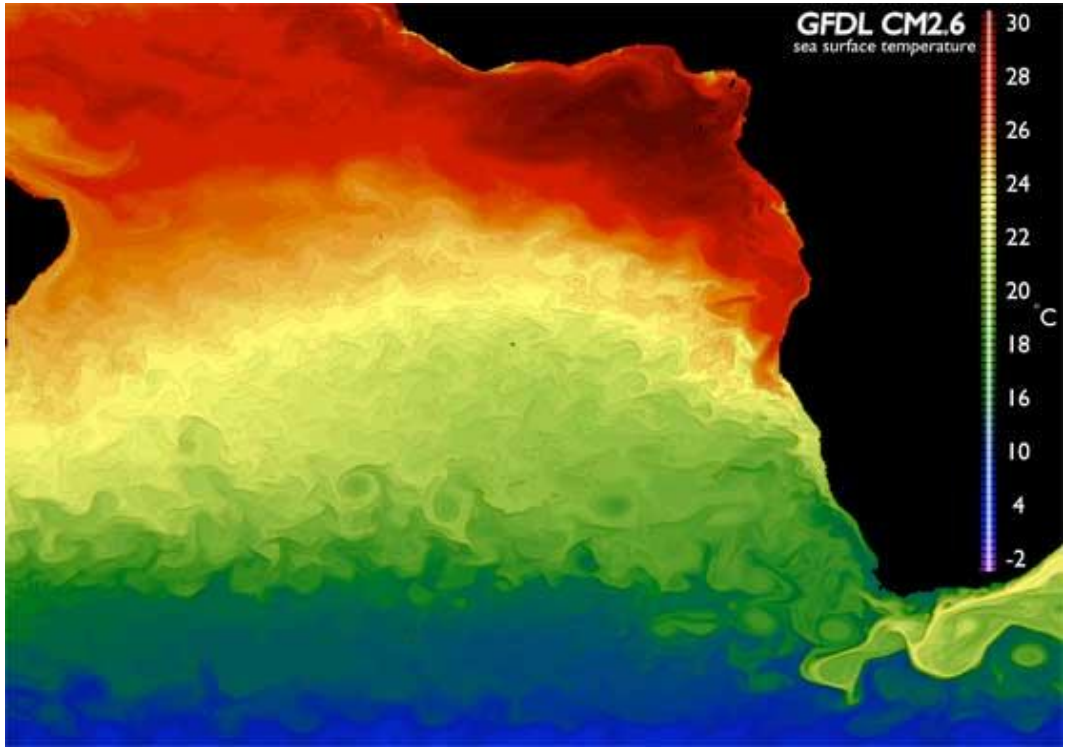
Operate on very short and very long time and space scales

3

Produce source/sinks of heat for the atmosphere, affecting climate

Broad-scale Ocean Circulation Patterns





Ocean Eddies

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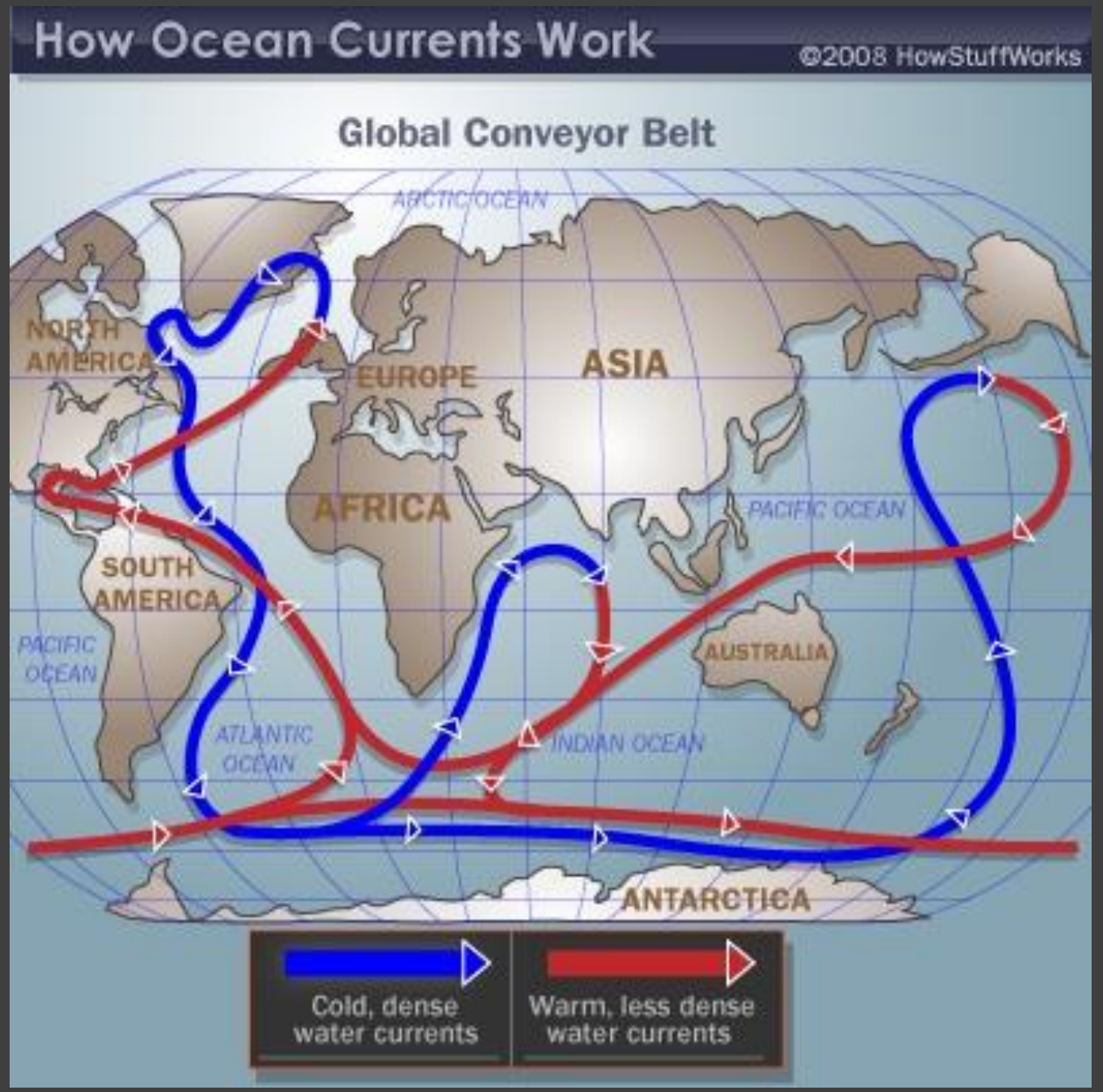
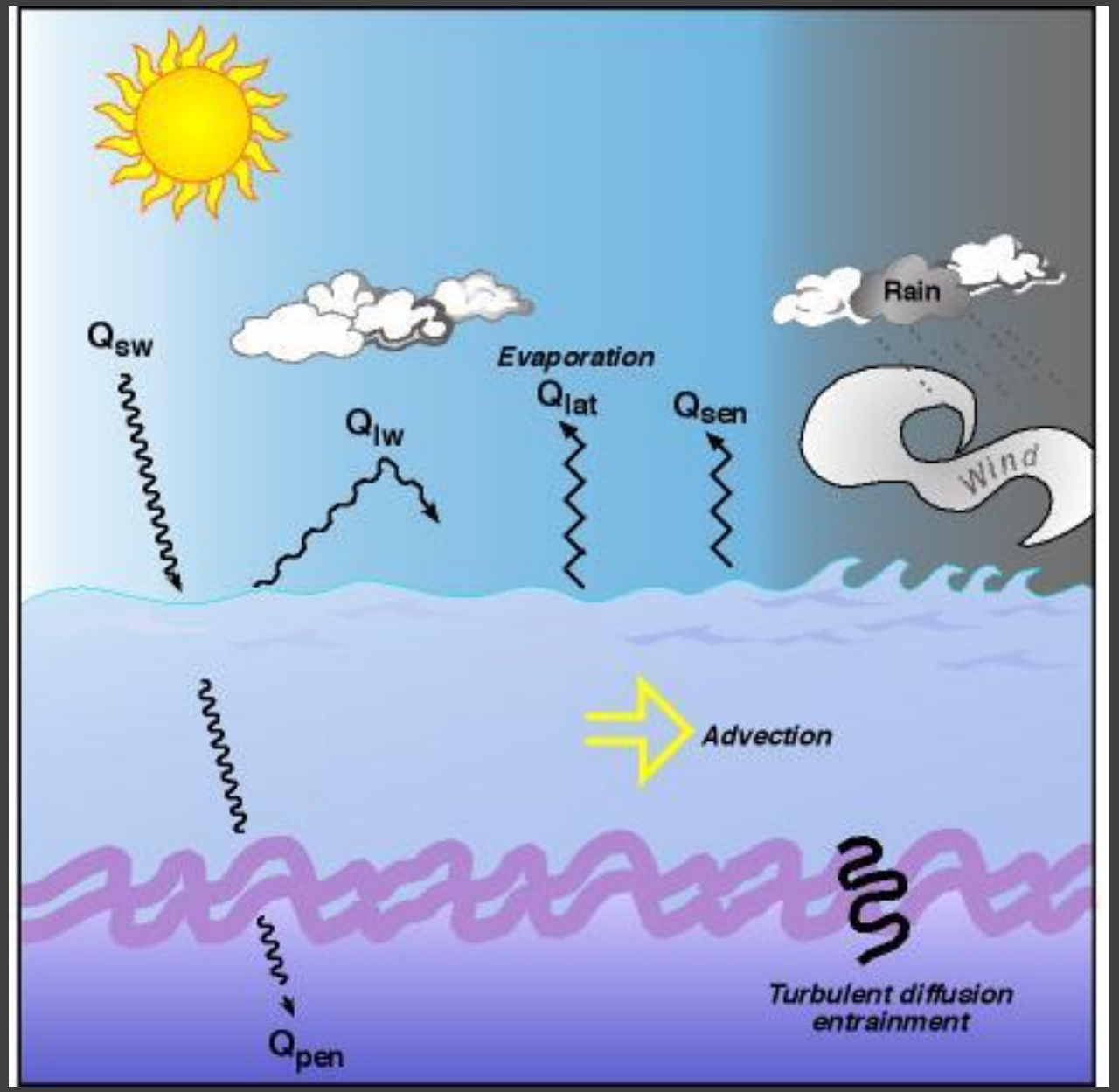
Thermohaline (heat/salinity) Circulation

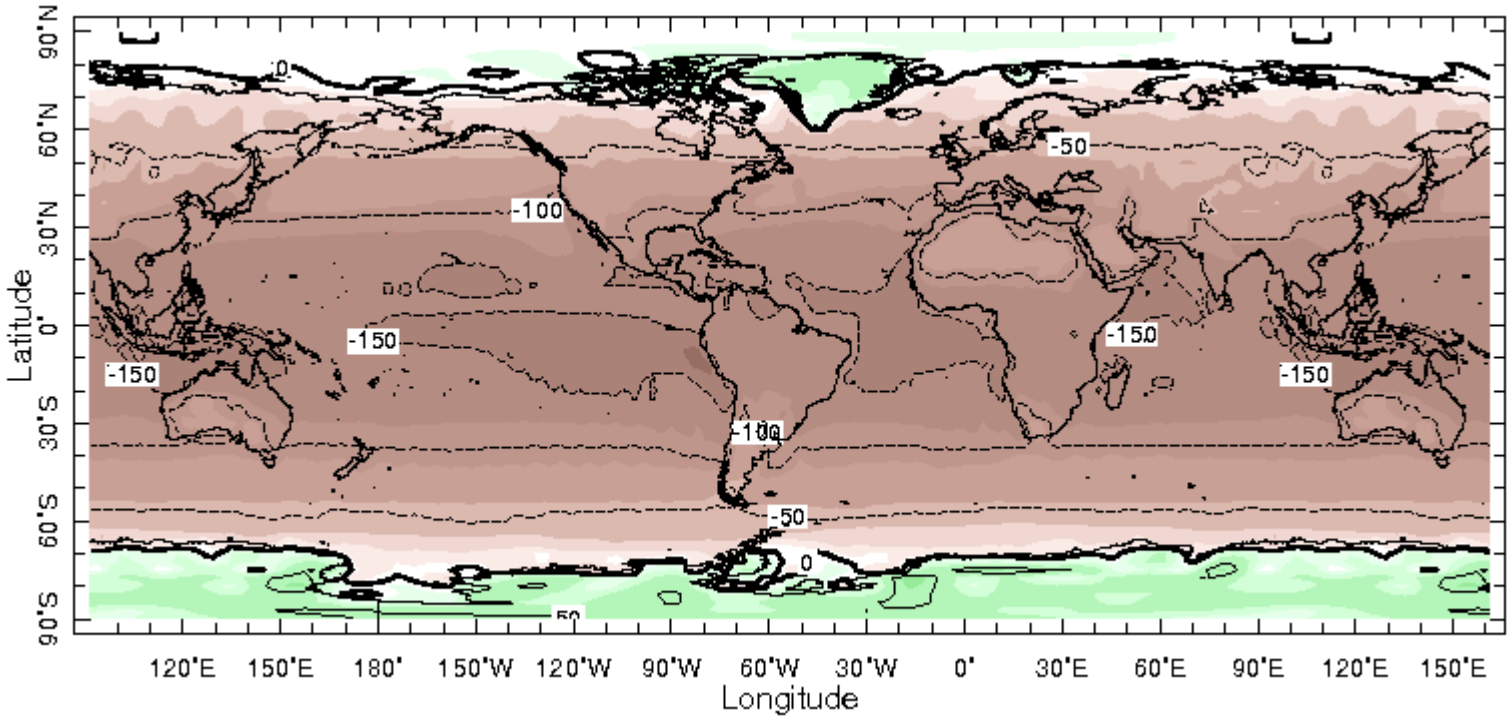


Representing air-sea fluxes



https://www.pmel.noaa.gov/ocs/sites/default/files/thumbnails/image/5R_AirSeaFluxes_RSidebar.jpg

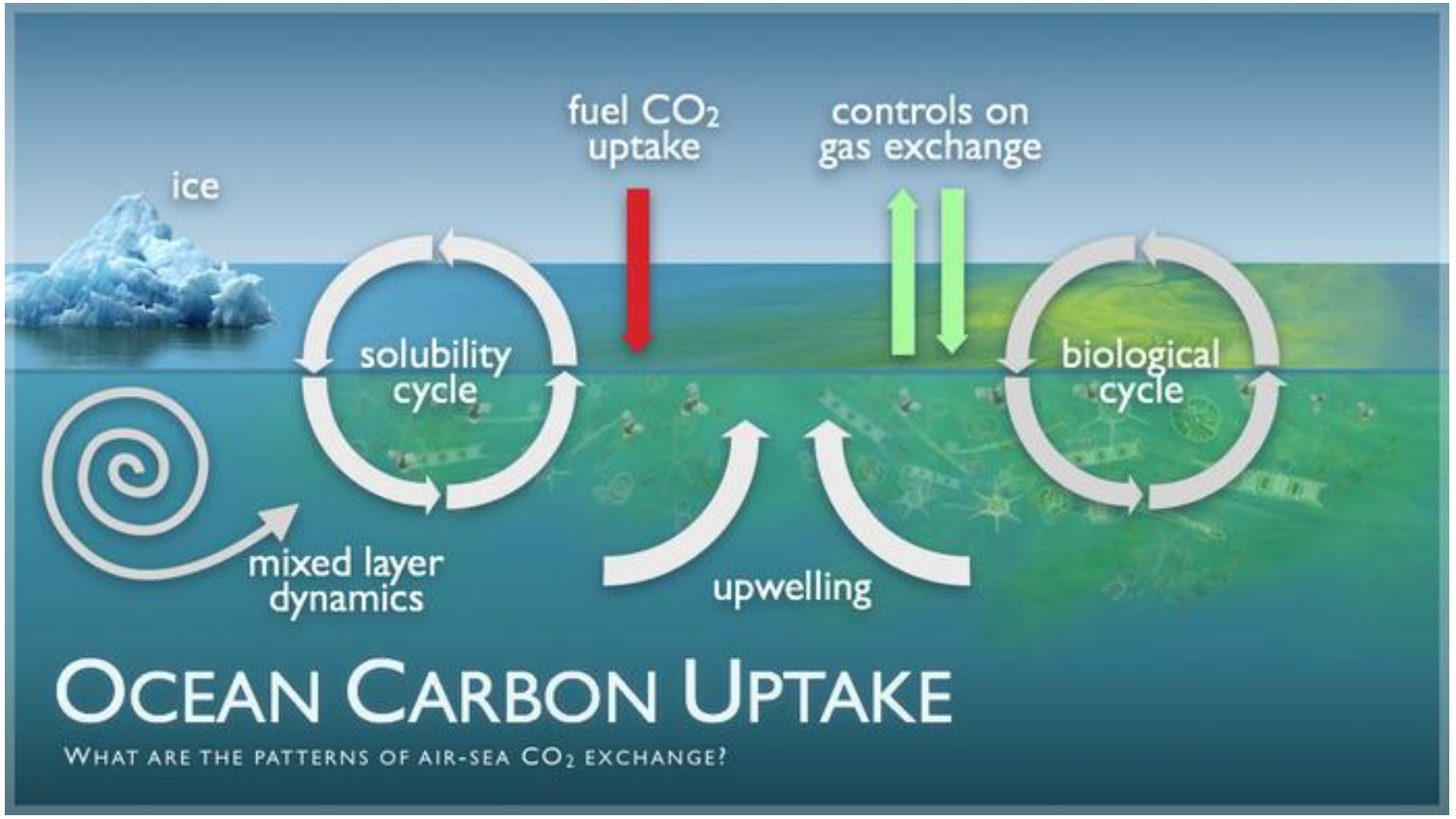
Example of Air-Sea Heat Flux Measurements



http://paoc.mit.edu/labweb/images/net_heat_flux.htm

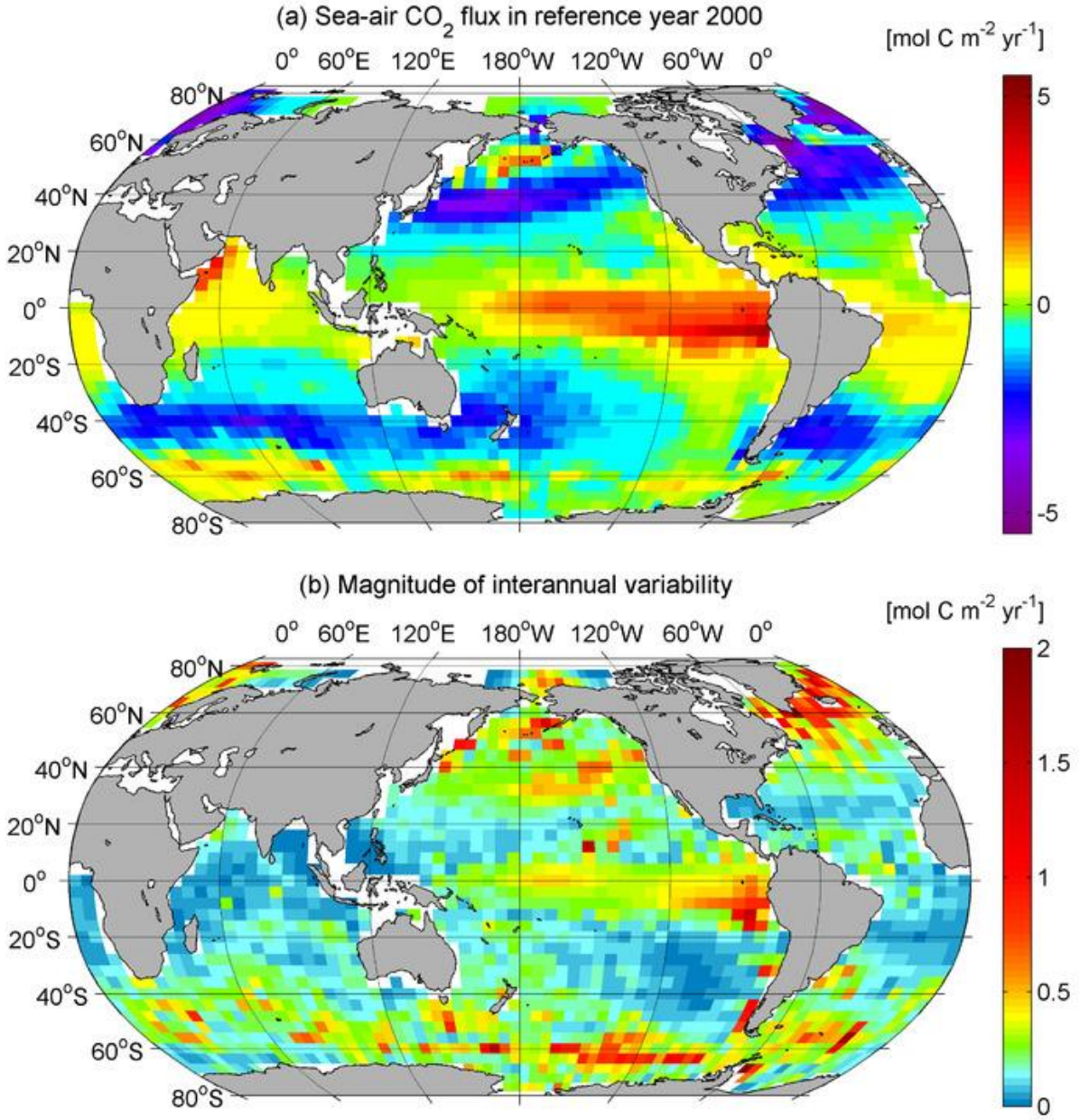
Positive values are out of the ocean/negatuive values are into the ocean

Ocean Carbon Exchanges



https://www.pmel.noaa.gov/co2/file/Ocean+Carbon+Uptake+Image

CO2 flux images



https://www.pmel.noaa.gov/co2/file/CO2+Flux+Map

Sea-surface microlayer (SSM)

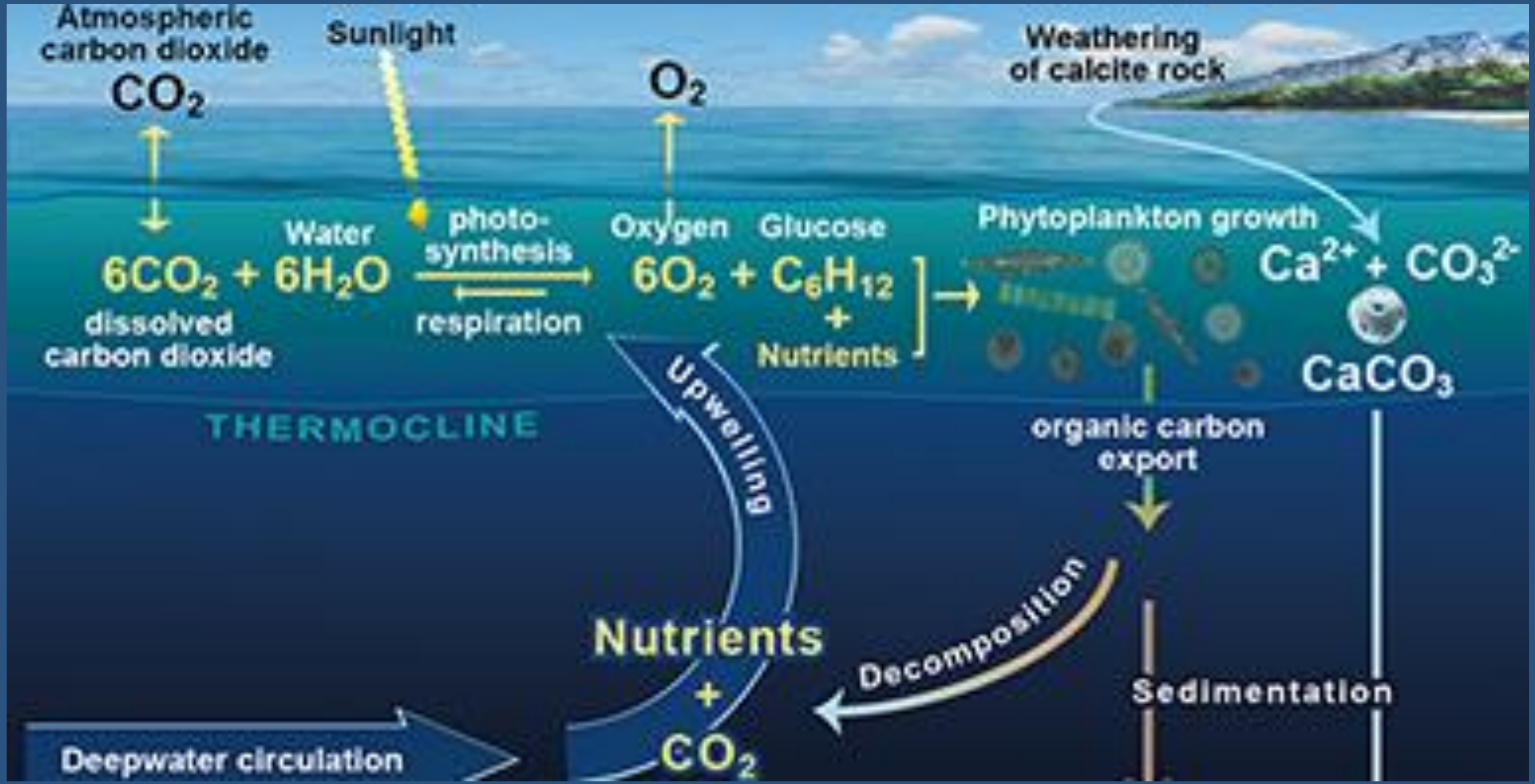
Narrow uppermost zone at air-sea boundary

Distinctive physico-chemical characteristics from underlying water

Metabolic contributions of microorganisms in gas exchange

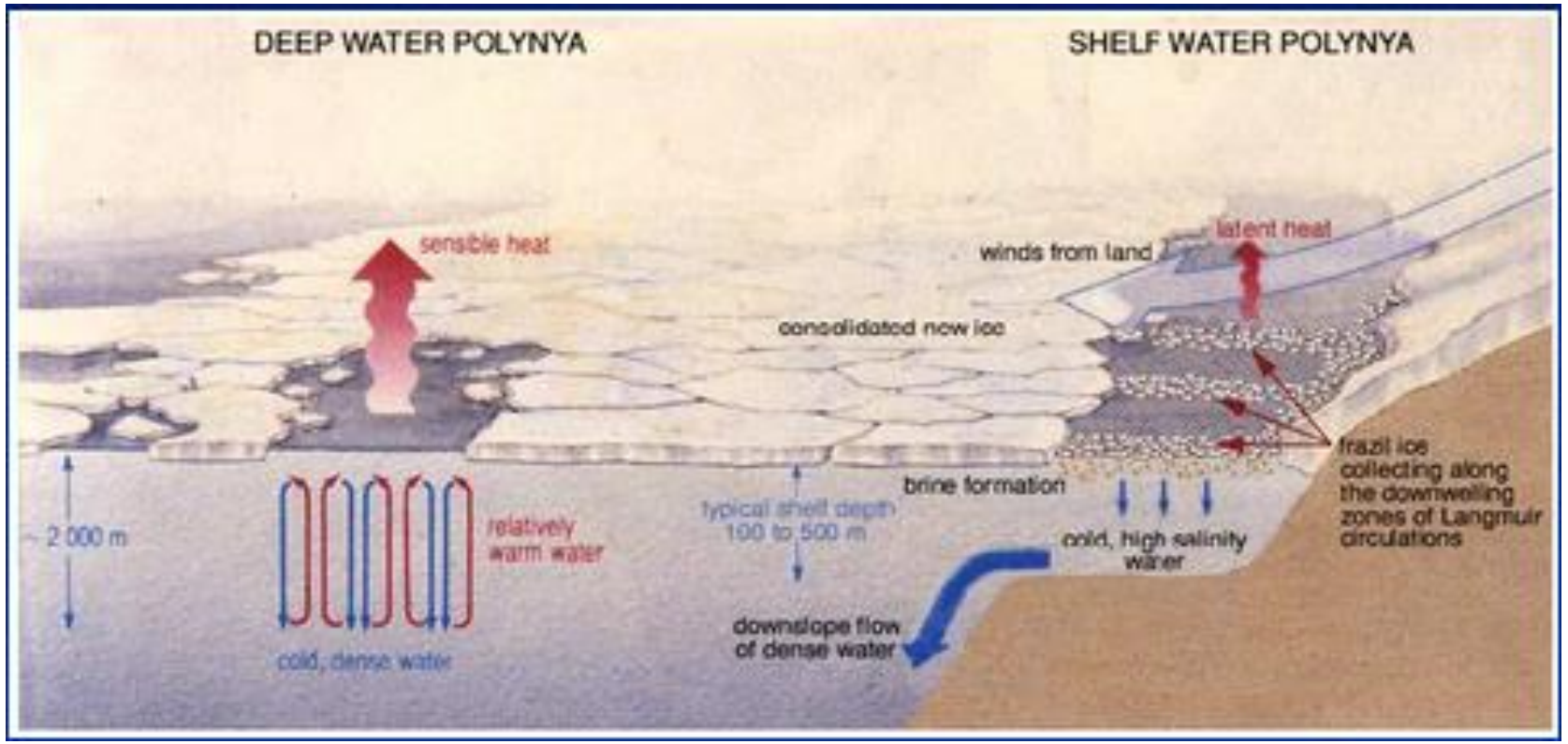
Surface In Situ Incubator (SISI) studies plankton-oxygen turnover

http://www.mdpi.com/2077-1312/5/4/46/pdf



http://www.euroargo-edu.org/argoeu_2a.php

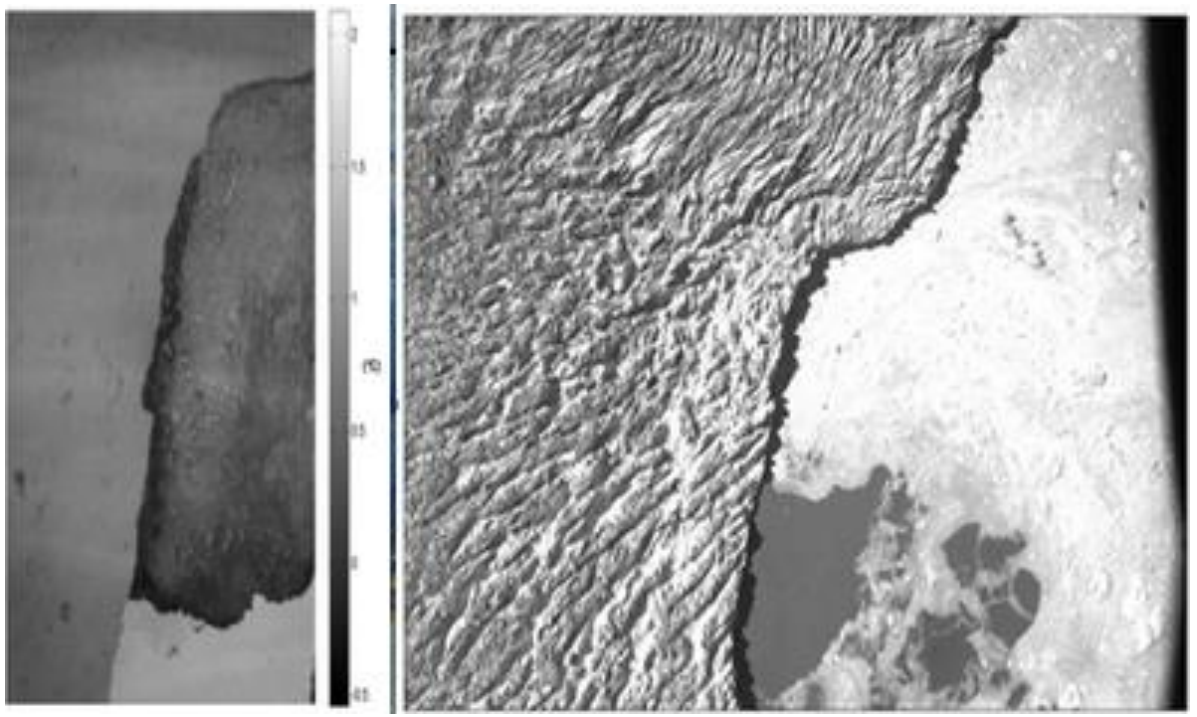
Polynyas in Terra Nova Bay, Antarctica



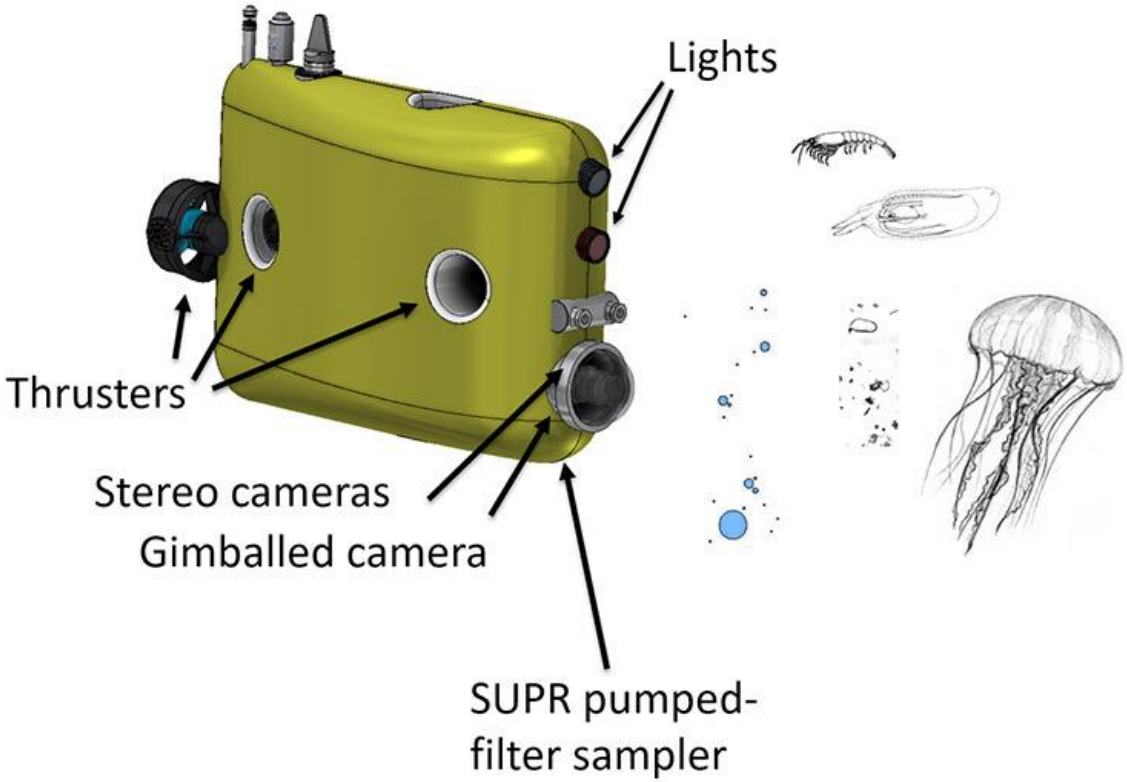
http://www.ldeo.columbia.edu/observatory-air-sea-interaction-studies/projects-oasis/terra-nova-bay

IcePod – Open Ocean Imaging

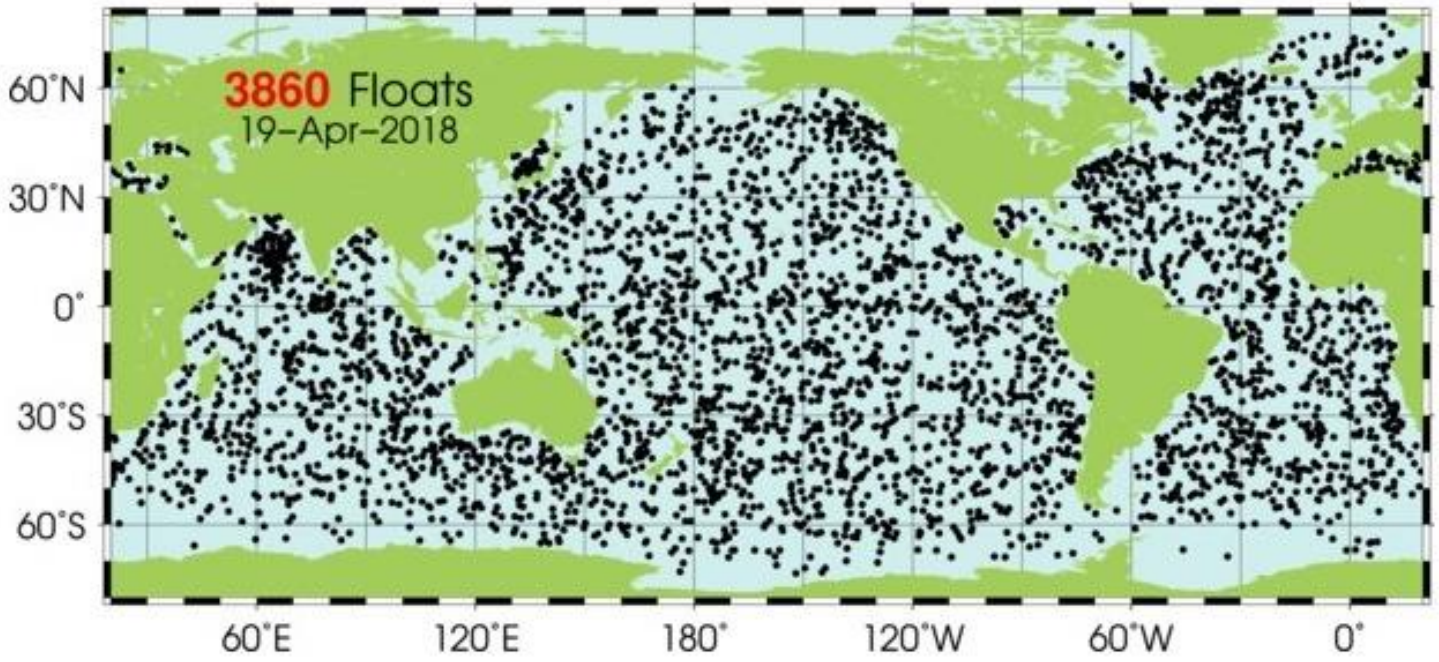
http://www.ldeo.columbia.edu/observatory-air-sea-interaction-studies/projects-oasis/icepod

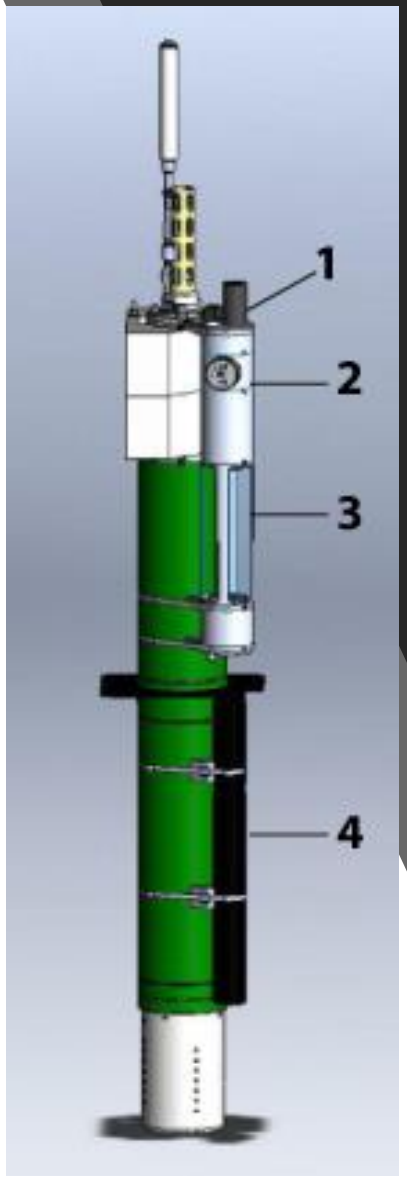


http://www.whoi.edu/main/auvs



Argo Floats


3860 Floats
19–Apr–2018
60°N
30°N
0°
30°S
60°S
60°E
120°E
180°
120°W
60°W
0°



Biological Argo Floats

http://www.euroargo-edu.org/argoeu_2a.php

This French float contains several bio-optical sensors:

1) Downwelling irradiance sensor

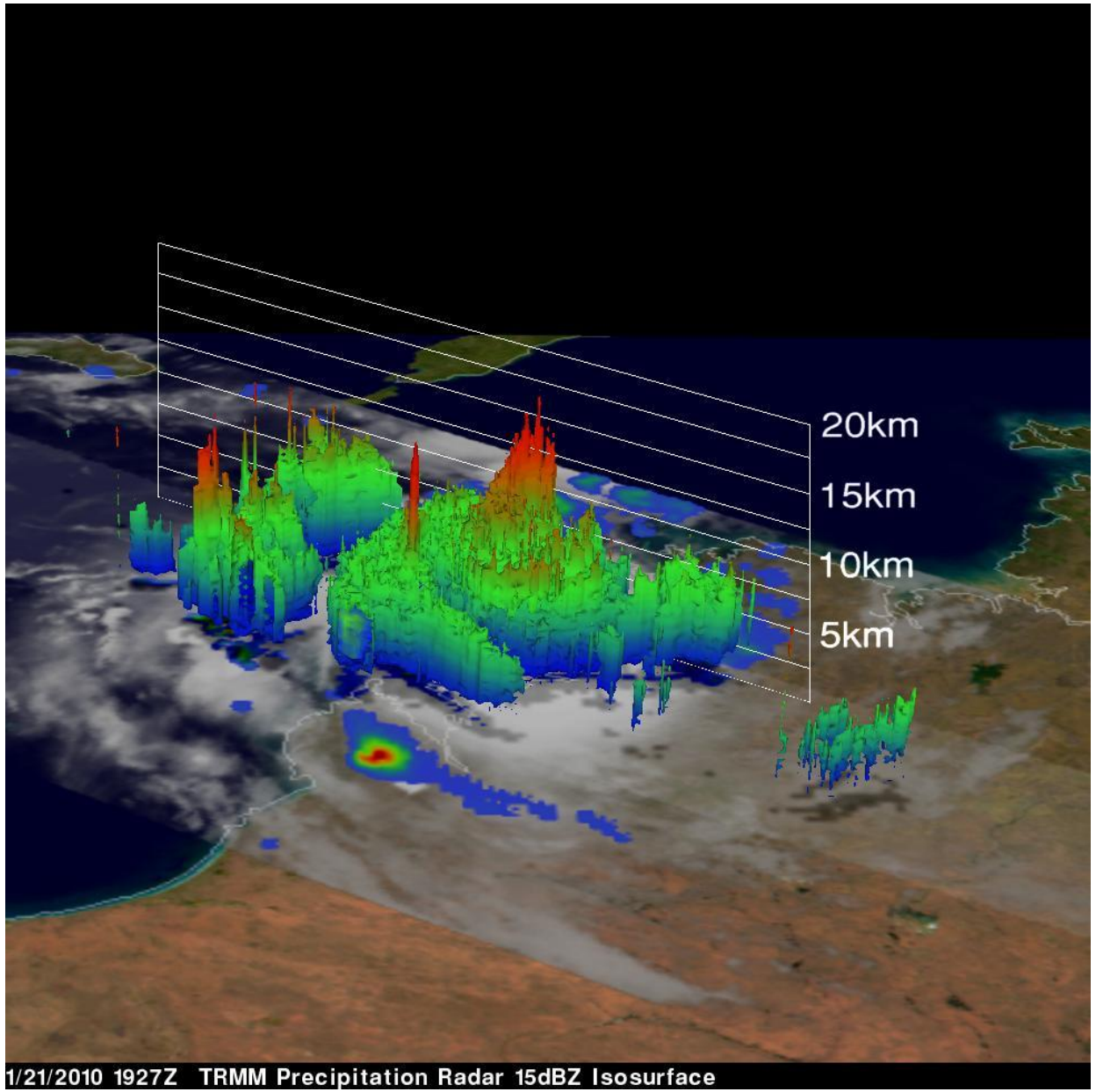
2) Chlorophyll fluorescence
CDOM fluorescence
back-scatter sensor

3) Sensor measuring light beam attenuation at 660 nm

4) Nitrate (NO_3) sensor

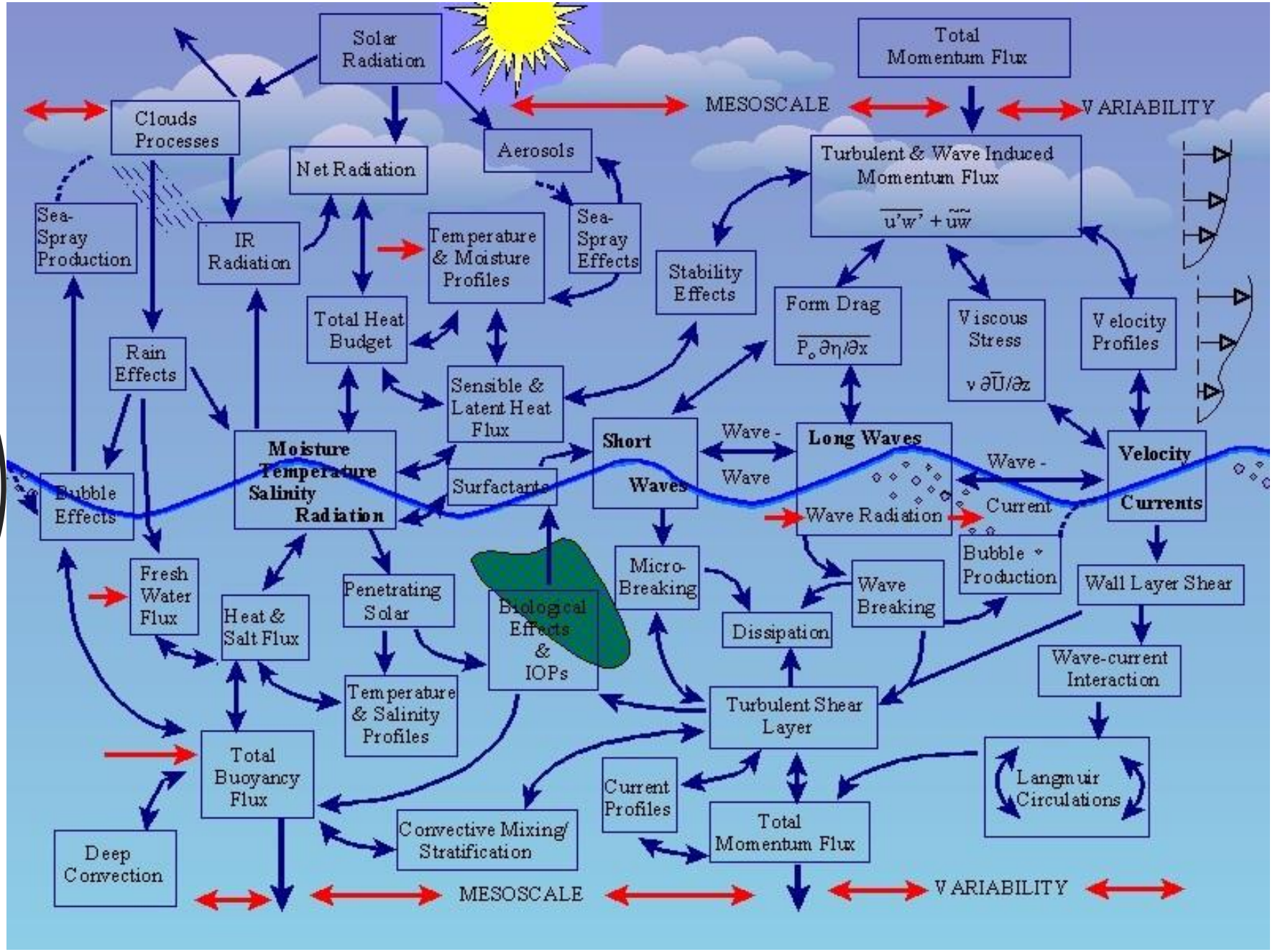
The float also has a sensor for oxygen and the temperature, salinity and pressure sensors found on all Argo floats.

TRMM (Tropical Rainfall Measurement Mission) USED SENSORS TO DETECT VARIATIONS IN PRECIPITATION DENSITY ACROSS STORMS. Combined with surface measurements, scientists learn much more about air-sea processes



https://pmm.nasa.gov/image-gallery/trmm-precipitation-radar-image-magda

Putting it altogether



http://www.ldeo.columbia.edu/sites/default/files/cblastpic2.html