Oceanography

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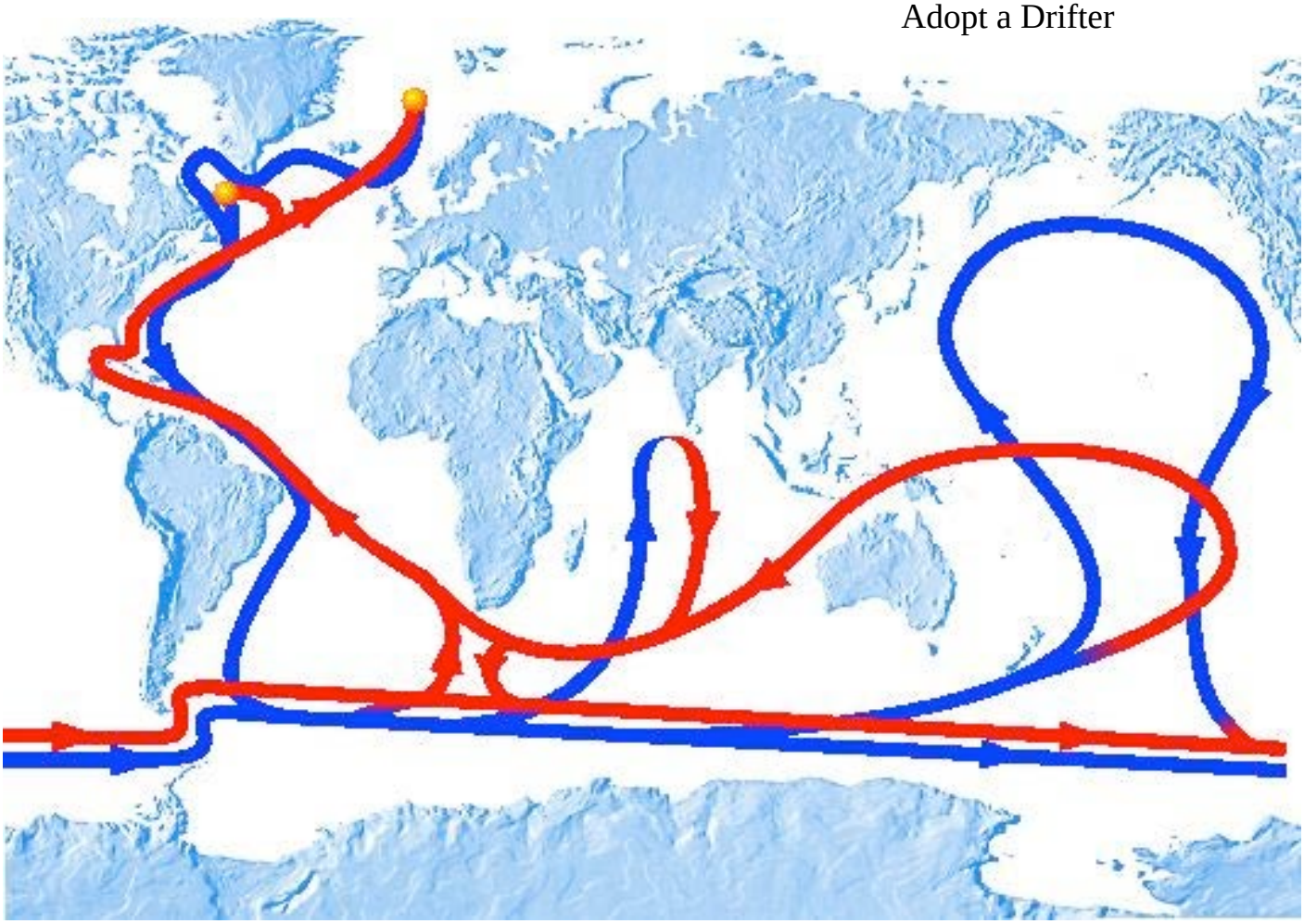
Ocean Currents

Adapted from NOAA Jetstream
Adopt a Drifter



Introduction

One cannot learn about the weather we experience without considering the ocean and its effect on our weather and the weather's effect on it. We must consider the ocean because nearly 71% of the earth's surface is covered by it and more than 97% of all our water is contained in it.

We must consider the ocean and its impact as more than one-half of the world's population lives within 60 miles (100 km) of the ocean.

We must consider the ocean as its ability to absorb, store, and release heat into the atmosphere is huge and often directly affects us. In fact, just the top 10 feet of the ocean surface contains more heat than our entire atmosphere.

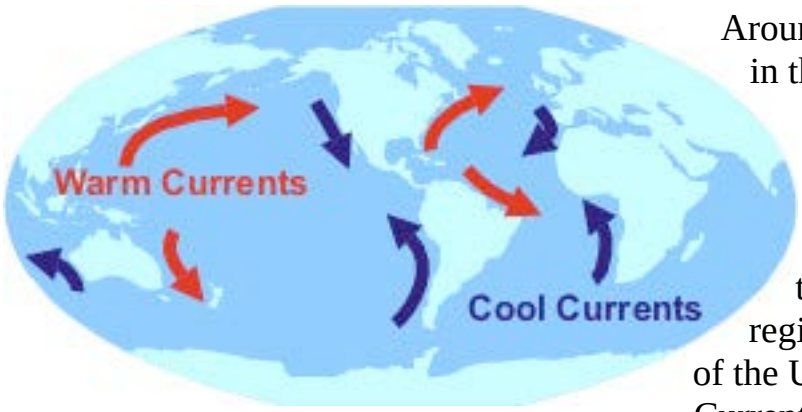
Major climate events, such as El Niño / La Nina, result from ocean temperature changes. These temperature changes then have impacts on weather events such as hurricanes, typhoons, floods and droughts that, in turn, affect the prices of fruits, vegetables and grains. It is essential that we consider "the ocean".

Ocean	Surface Area miles^2	Surface Area kilometers^2	Of all oceans
Pacific	64,000,000	166,000,000	45.0%
Atlantic	31,600,000	82,000,000	22.2%
Indian	28,400,000	73,600,000	20.0%
Southern	13,523,000	35,000,000	9.5%
Arctic	4,700,000	12,173,000	3.3%

Ocean Circulations

In January 1992, a container ship near the International Date Line, headed to Tacoma, Washington from Hong Kong, lost 12 containers during severe storm conditions. One of these containers held a shipment of 29,000 bathtub toys. Ten months later, the first of these plastic toys began to wash up onto the coast of Alaska. Driven by the wind and ocean currents, these toys continued to wash ashore during the next several years and some even drifted into the Atlantic Ocean.

The ultimate reason for the world's surface ocean currents is the sun. The heating of the earth by the sun has produced semi-permanent pressure centers near the surface. When wind blows over the ocean around these pressure centers, surface waves are generated by transferring some of the wind's energy, in the form of momentum, from the air to the water. This constant push on the surface of the ocean is the force that forms the surface currents.



Around the world, there are some similarities in the currents. For example, along the west coasts of the continents, the currents flow toward the equator in both hemispheres. These are called cold currents as they bring cool water from the polar regions into the topical regions. The cold current off the west coast of the United States is called the California Current.

Likewise, the opposite is true as well. Along the east coasts of the continents, the currents

flow from the equator toward the poles. They are called warm currents as they bring the warm tropical water north. The Gulf Stream, off the southeast United States coast, is one of the strongest currents known anywhere in the world, with water speeds up to 3 mph (5 kph).

These currents have a huge impact on the long-term weather a location experiences. The overall climate of Norway and the British Isle is about 18°F (10°C) warmer in the winter than other cities located at the same latitude due to the Gulf Stream.

While ocean currents are shallow level circulations, there is global circulation that extends to the depths of the sea called the Great Ocean Conveyor. Also called the ***thermohaline*** circulation, it is driven by differences in the density of the seawater that is controlled by **temperature** (*thermal*) and **salinity** (*haline*).

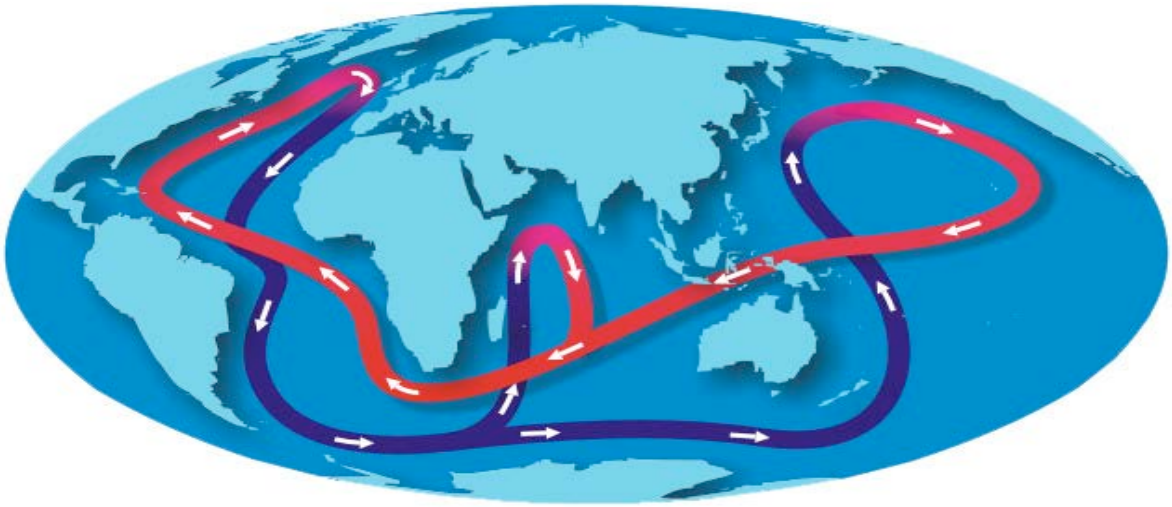
In the northern Atlantic Ocean, as water flows north it cools considerably increasing its density. As it cools to the freezing point, sea ice forms with the "salts" extracted from the frozen water making the water below more dense. The very salty water sinks to the ocean floor.

It is not static, but a slowly southward flowing current. The route of the deep-water flow is through the Atlantic Basin around South Africa and into the Indian Ocean and on past Australia into the Pacific Ocean Basin.

If the water is sinking in the North Atlantic Ocean then it must rise somewhere else. This upwelling is relatively widespread. However, water samples taken around the world indicate that most of the upwelling takes place in the North Pacific Ocean.

It is estimated that once the water sinks in the North Atlantic Ocean it takes 1,000-1,200 years before that deep, salty bottom water rises to the upper levels of the ocean.

The Great Ocean Conveyor



The Story

Sunday, October 21, 2007

Weather from the bridge of
The RONALD H. BROWN

Temperature- 15.1ºC
Humidity- 74.54%
Pressure- 1016.82 mb
Wind Speed- 3.19
Swell Height- 4-6 feet

SCIENCE LOG: Today's focus will be on the **Adopt a Drifter Program**.

On Sunday Morning at 8:20, crew members deployed a drifter buoy that was adopted by Ana Maria Varela's classes at St. Matthew's College in Argentina, and Todd Toth's class at Waynesboro High School, Waynesboro, PA. Ana Maria was a South American Low Level Jet Experiment (SALLJEX) NOAA Teacher in the Field. Please visit her logs at: http://www.ogp.noaa.gov/salljex/anamaria/index.htm Todd Toth was a NOAA Teacher in the Air in 2006. You can visit his logs at: http://teacheratsea.noaa.gov/tia/toth/index.html. The Adopt a Drifter program allows schools to follow these drifters as they track on the currents in our oceans worldwide! The Adopt a Drifter program was launched in December of 2004 when Mary Cook was the Teacher At Sea aboard the RONALD H BROWN. The goal of the program is to give students and teachers the opportunity to observe, collect, and interpret real time data from oceans all over the world. Typically, a school from the United States is teamed up with an international school, and together, they adopt a buoy. The data from the buoys is also used by the World Meteorological Organization to track ocean currents, build weather models, and track potentially damaging land falling hurricanes.

The Website

Please visit the following URL: http://www.adoptadrifter.noaa.gov and explore.

First – double click on the Waynesboro High School/ St. Matthew's College link near the bottom left of this web page. Check out the pictures of our buoy.

Second – click inside the radio button near the Waynesboro High School/ St. Matthew's College link and proceed to the top right of webpage. Again click inside radio buttons - *Map showing measurements* and *Sea Surface Temperature*.

Now, click – ***Get Measurements***

Questions:

1. Our buoy was released at a latitude and a longitude of?
2. Our buoy is currently at a latitude and longitude of?
3. When first released, the water temperature was _____ ˚C
4. The buoy is currently in water that is _____ ˚C.
5. The buoy has moved approximately _____ degrees (North / South)
   Circle answer
6. The buoy has moved approximately _____ degrees (East / West)
   Circle answer

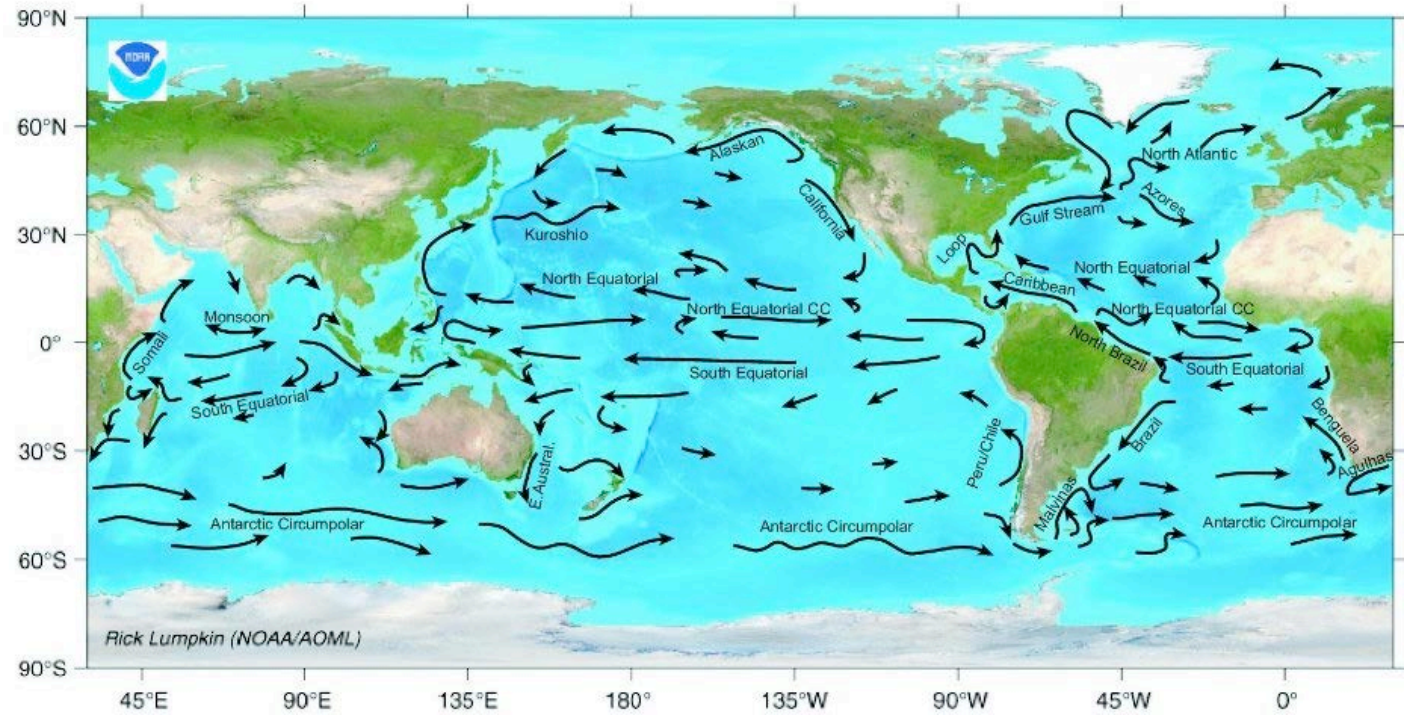
Now, click the *Table of measurements* radio button and again click on – ***Get Measurements***
A raw data page should come up – review type of data shown.

7. Again, our buoy was released at a latitude and a longitude of?
8. Our buoy is currently at a latitude and longitude of?

Check back over your answers to questions 1 & 2. How close were you?

9. When first released – the water temperature was _____ ˚C
10. The temperature of the water where the buoy is currently located is _____ ˚C
11. What ocean is our buoy in?
12. **Tough one**: What is the average speed of our drifter buoy? ***Think!***
13. What is the name of the ocean current that our buoy is currently drifting in?
14. Which ocean is the largest? The smallest?
15. What is the ultimate source of energy for the ocean currents?
16. Explain the term: ***thermohaline***

17. How long does it take for cold, dense water to finally rise? Where does most of this upwelling occur?



Extended Lesson

1. Go to the following site: http://www.ndbc.noaa.gov
2. Choose a location along the east coast – closest to Waynesboro, Pennsylvania.
3. Collect data (temperature) from 10 locations and record. Are any patterns visible?
4. Relate time of year (season) to water temperatures.
5. What other influences may affect water temperature?

In a follow-up lesson we will look at how the oceans affect the weather and climate.