A diver in a blue wetsuit is seen from behind, swimming underwater. The water is clear and blue, with some light rays visible. The diver is wearing a watch on their left wrist and has a scuba tank on their back. The overall scene is serene and focused on the diver's movement.

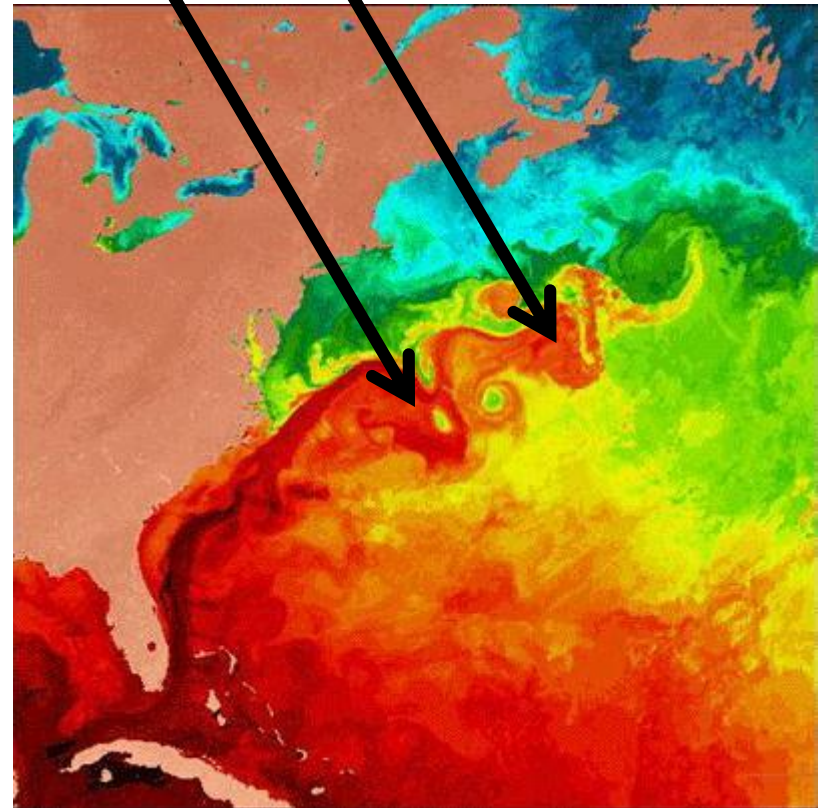
Unit 5

The Movement of Ocean Water

Currents and Climate

Current

- A **current** is a large stream of moving water that flows through oceans
- Carries water all over the world (great distances)



Red means warmer water

2 Types of Currents

1. **SURFACE Currents**

- caused by: global **winds** (and deflected by Earth's rotation)
- affect climates and transports sea plants and animals

2. **DEEP Currents—**

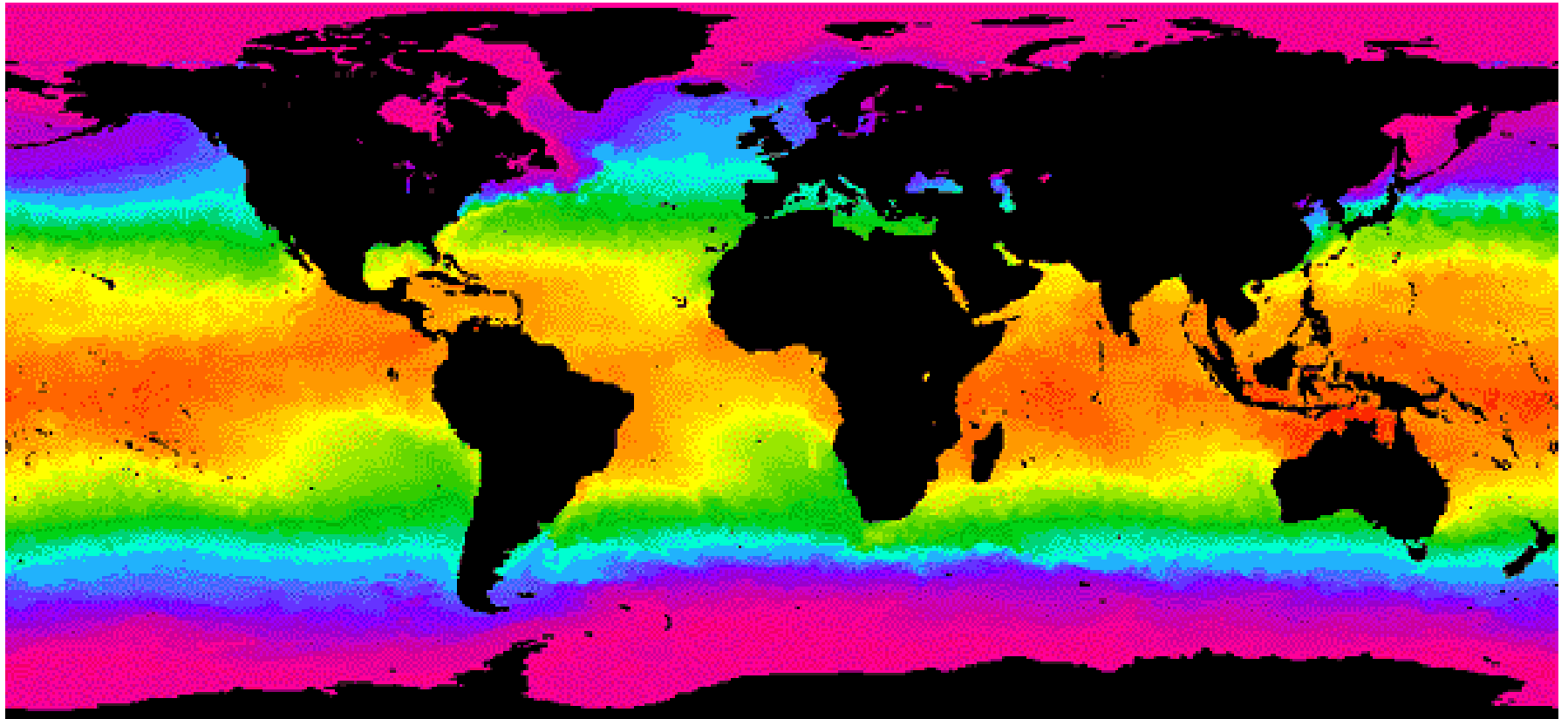
- caused by density differences (temperature and salinity)

Two surface current you must know...

- **Gulf Stream**
 - Atlantic Ocean
 - brings **warm** water from equator
- **California Current**
 - Pacific Ocean
 - brings **cold** water from Alaska

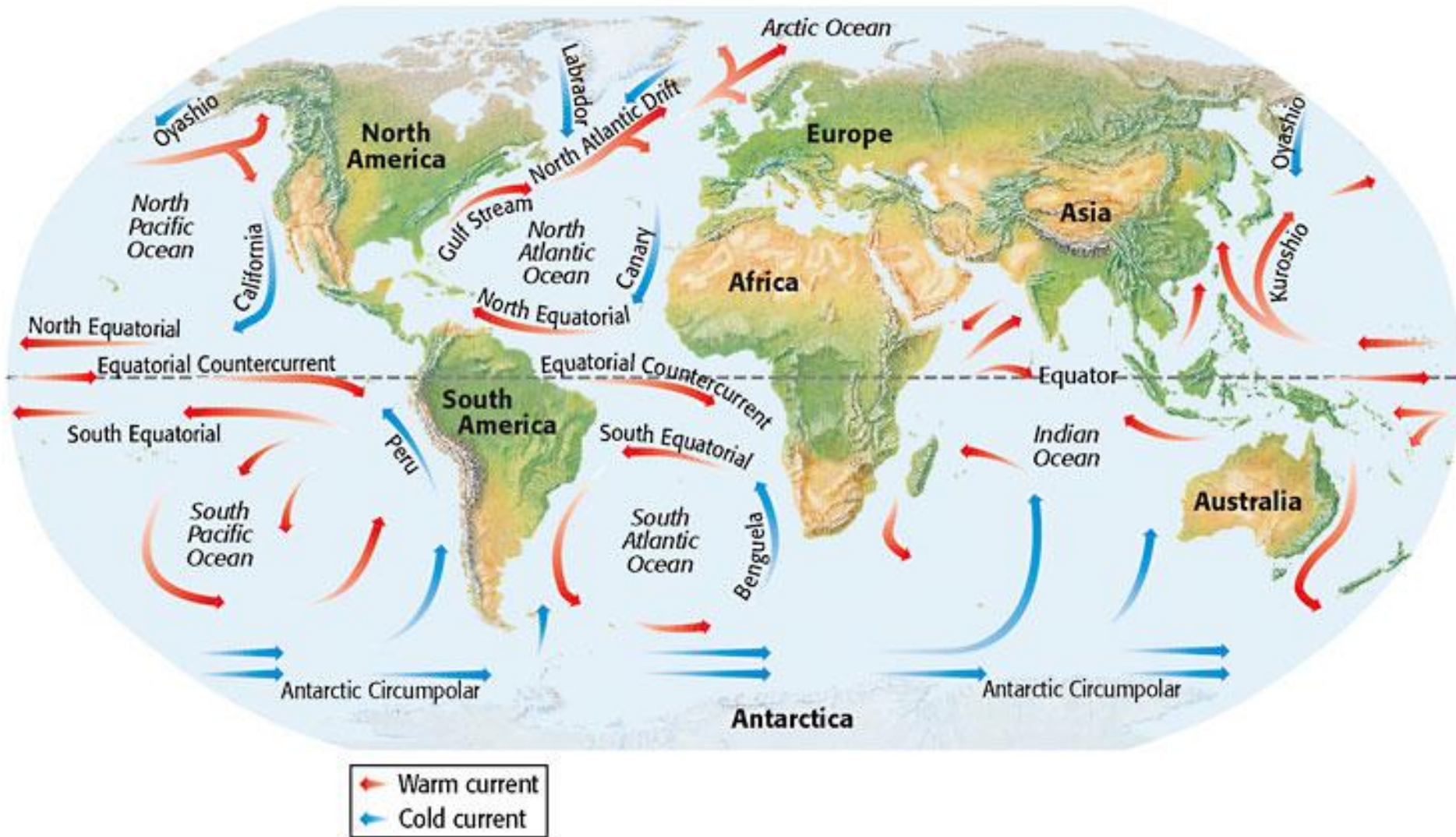


Sea Surface Temperature



Surface Currents

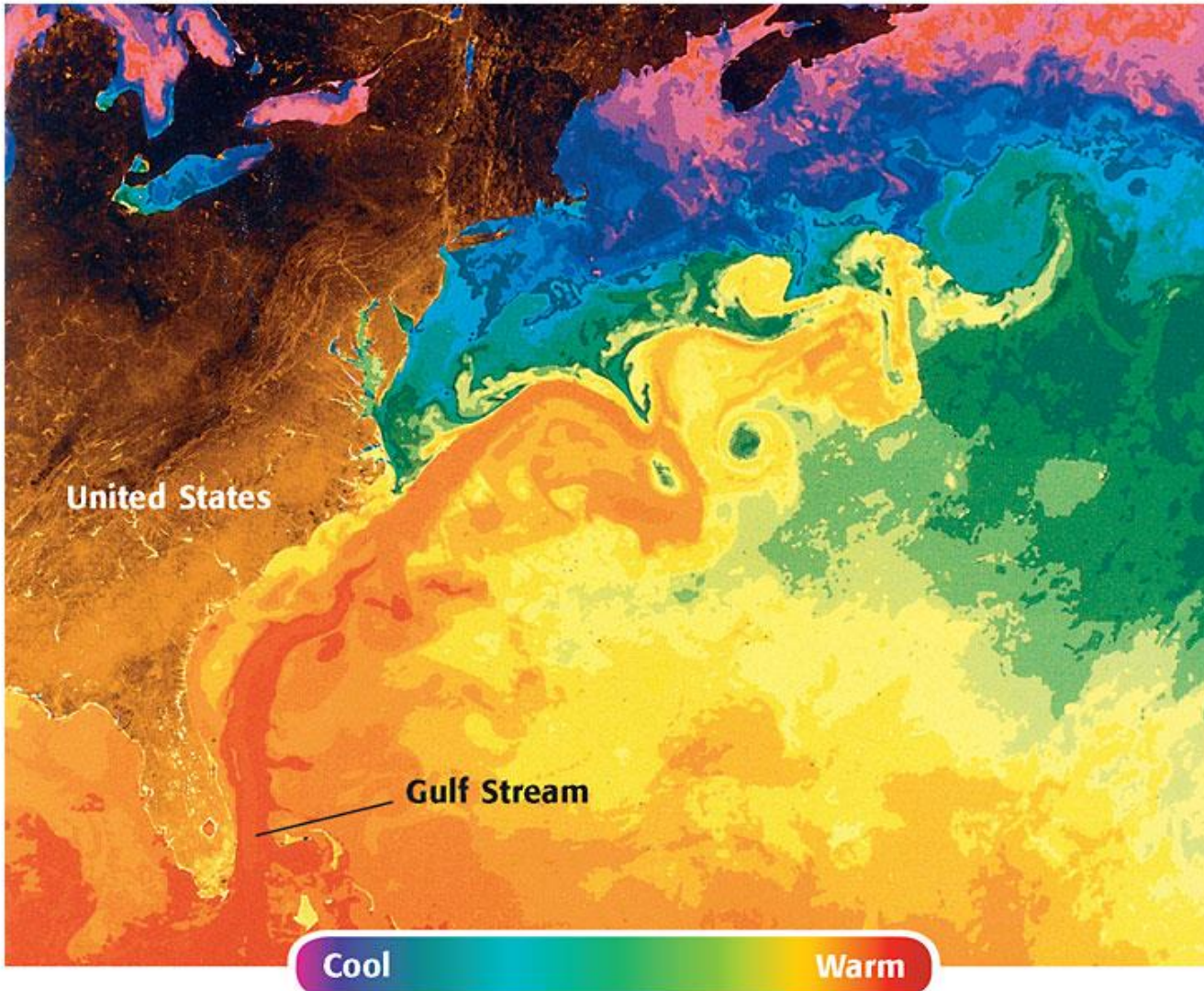
(notice deflection/changes direction when hits land)



Coriolis Effect –water (and air) appears to go to the right in the northern hemisphere because the earth spins

- <https://www.khanacademy.org/partner-content/nova/clouds/v/hurricanes>

Gulf Stream Current (warm surface current—affects climate)



Notice
the Gulf
Stream veers
to the right

The Gulf Stream Current— brings warm water from equator

Warm-water currents, such as the Gulf Stream, can affect the climate of coastal regions.

1 The Gulf Stream carries warm water from the Tropics to the North Atlantic Ocean.

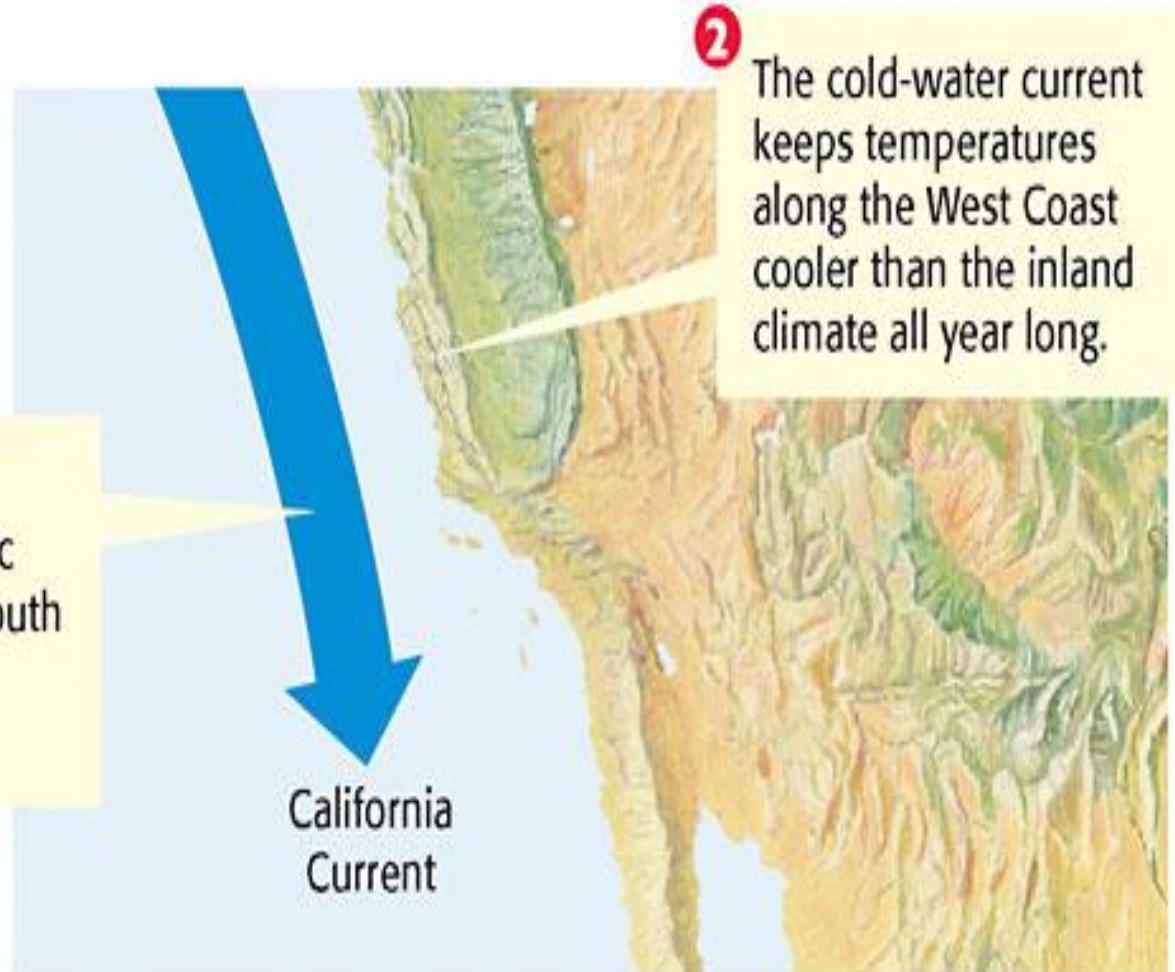


2 The Gulf Stream flows to the British Isles and creates a relatively mild climate for land at such a high latitude.

The California Current –brings cold (polar waters)

Cold-water currents, such as the California Current, can affect the climate of coastal regions.

1 Cold water from the northern Pacific Ocean is carried south to Mexico by the California Current.



2 The cold-water current keeps temperatures along the West Coast cooler than the inland climate all year long.

Surface Currents and CLIMATE

- **Climate** is an area's average temperature & precipitation and is affected by latitude, elevation, and surface currents
- ex: British Islands are warmer than you might expect due to the Gulf Stream
- Why has a hurricane NEVER hit California?

Look at the climate for two cities in the U.S. (same latitude)



Santa Cruz,
California



Cape Hatteras,
North Carolina

Deep Currents

- Caused by **density** differences
- Water density depends on:
 - 1. temperature (cold sinks)
 - 2. salinity (saltier water sinks)

I  Density

Questions

- What is the MAIN cause of surface currents, like the Gulf Stream?
- ...**winds** that blow in regular directions (prevailing winds)
- Deep currents are caused by differences in _____.
- **density (temperature or salinity)**

- During which of the following situations is water likely to sink to form a deep-ocean current?
 - **A.**Water evaporates and salinity decreases in water near Florida.
 - **B.**Winds form huge waves in the open waters of the Atlantic Ocean.
 - **C.**Water freezes and leaves behind saltier water near Antarctica.
 - **D.**Winds near Alaska blow cool water toward the North American coast.

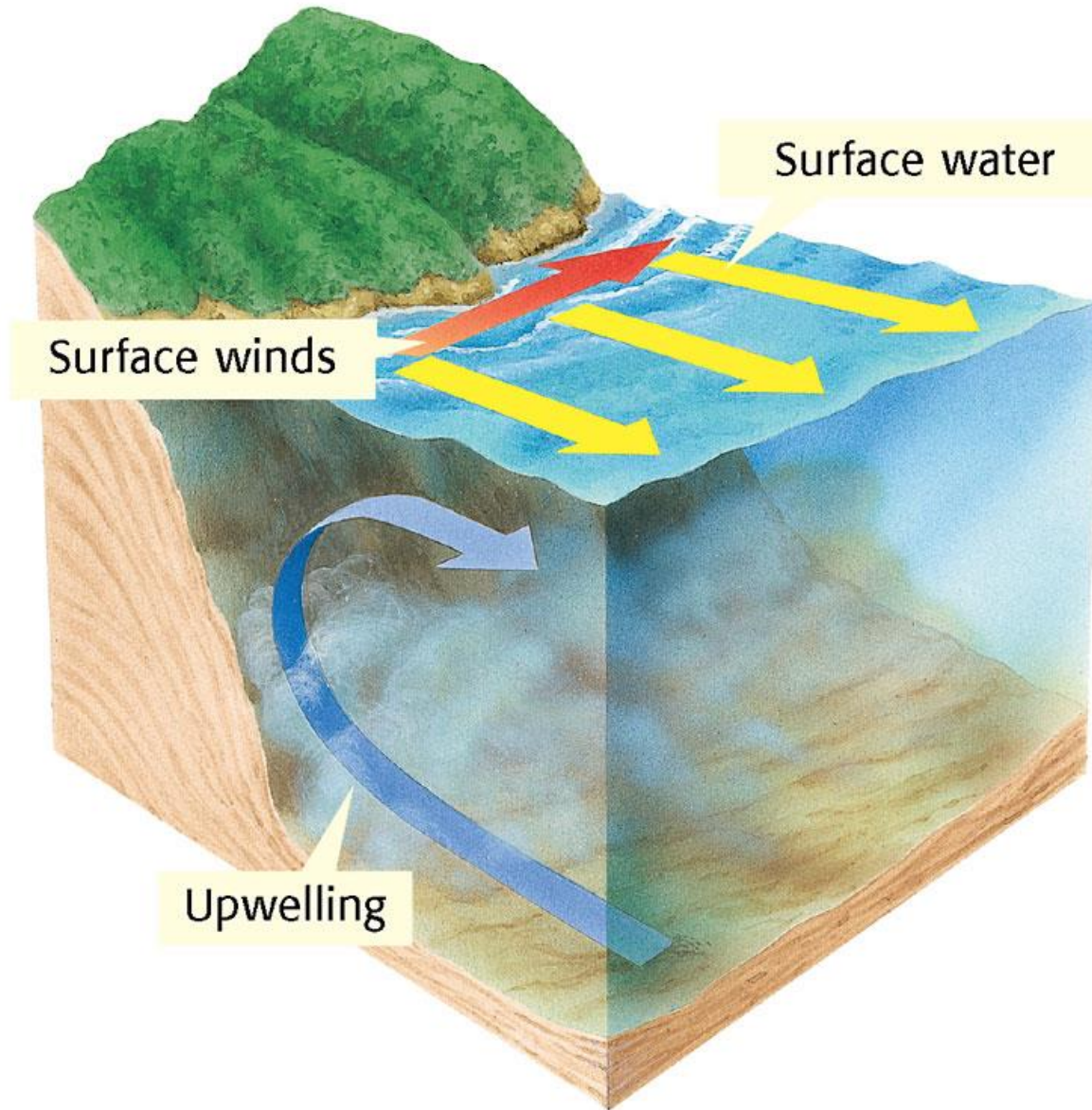
- The Gulf Stream carries warm water to the North Atlantic Ocean, which contributes to
- A. A harsh (cold) winter in the British Isles.
- B. A cold water surface current that flows to the British Isles.
- C. A mild (warm) climate for the British Isles
- D. A warm-water surface current that flows along the coast of California



Upwelling

- occurs off the western coast of South America
- warm surface waters move offshore (due to offshore winds), then deep, cold (nutrient rich) water rises up to replace it
- creates a great environment for ocean life

Upwelling



El Nino

- means *little boy* because it starts in Peru around Christmas time
- happens when eastern Pacific Ocean (near Ecuador and Peru) warms to 83°F
- occurs every 3-7 years (can last a year or two)
- Currently experiencing El Nino
- some say it's due to sunspot activities; others say underwater volcanoes (scientists aren't sure)

- Scientists (NOAA) now have ocean **buoys** that record sea-surface temperatures, air temperatures, winds, and currents (to predict El Nino, scientists look for slower South Pacific trade winds and/or rising sea-surface temperatures)



- South Pacific trade winds slow down (or even reverse), which **stops the upwelling** and alters worldwide weather patterns (jet stream altered)
 - flashfloods, landslides/mudslides in normally dry areas (Peru, California, Gulf coast of U.S.)—therefore lots of erosion and insect infestation. Also more tornadoes and thunderstorms in southern U.S.
 - droughts in areas that usually get a lot of rain (Seattle, Indonesia, Central America, South Africa and Australia)—can lead to forest fires and collapse of agricultural industry
 - more tornadoes and thunderstorms in southern US

	<u># of hurricanes</u>
1990	8
1991	4
1992	4
1993	4
1994	3
1995	11
1996	9
1997	3
1998	10
1999	8
2000	8
2001	9
2002	4
2003	7
2004	9
2005	15
2006	5
2007	6
2008	8
2009	3
2010	12
2011	7
2012	10

Usually less
hurricanes in U.S.
during El Nino
years...

- Recent El Nino years:
 - 1991
 - 1994
 - 1997
 - 2002
 - 2009

Did you know...

- It is estimated that the 1997-98 El Nino killed about 2,100 people and caused at least 33 billion dollars in property damage from droughts and flooding. Many natural disasters.

Math

- A fisherman usually catches 540 kg of anchovies off the coast of Peru. During El Nino, the fisher caught 85% less fish. How many kilograms of fish did the fisher catch during El Nino?
- **81 kg**



La Nina (means “*little girl*”)

--ex: winter of 2012--

- often occurs after an El Nino year
- caused with the waters in the eastern Pacific Ocean get **cooler** than usual
- **affects weather patterns**
- --wetter on west coast of U.S. (snow & rain)
- --unusually cold weather in Alaska
- --unusually warmer weather in the rest of USA (warm winter in SE)
- --drought in SW

Usually MORE hurricanes during La Nina years...

1990	8
1991	4
1992	4
1993	4
1994	3
1995	11
1996	9
1997	3
1998	10
1999	8
2000	8
2001	9
2002	4
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2007	6
2008	8
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2012	10

- Recent La Nina years:
 - 1995
 - 1998
 - 1999
 - 2007
 - 2010
 - 2012

When does upwelling occur?

Monthly Sea Surface Temperature °C

