



Oceans in Motion – TIDES (“la marea”)

- Caused by gravitational forces between moon & Earth
- Also influenced by sun, tilt of Earth, topography, and other factors

DAILY TIDE CYCLE

- 2 high tides, 2 low tides per 24 hrs (due to Earth’s rotation)
- Tides get ~1 hr later each day

See Figs.

Oceans in Motion - TIDES

MONTHLY TIDE CYCLE

- Due to moon’s orbit around Earth, and gravitational pull of moon & sun
- 2 spring and 2 neap tides per month

Fig. 3.33

Oceans in Motion – WAVES (“las olas”)

SURFACE WATER MOVEMENT is wind driven

Waves = upper surface; move water only to $\approx 1/2$ wavelength (λ)

Nybakken Fig 1.10 See C&H Fig. 3.27

Oceans in Motion

Water movement is circular

But circles not closed, especially in big waves and shallow water.

Stoke's Drift = displacement of water in the direction of wave movement

Oceans in Motion

SWELLS

See C&H Fig. 3.29

Wave size determined by:

- Wind speed
- Fetch
- Duration


Longer waves move faster



Oceans in Motion – CURRENTS (“la corriente”)

NEAR-SHORE CURRENTS

- Created by wind (= waves) and shore topography
- Longshore current, undertow, rip current


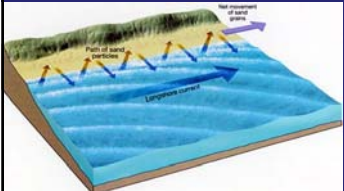


Undertow: The seaward return of water *along the bottom* underneath breaking waves

Oceans in Motion

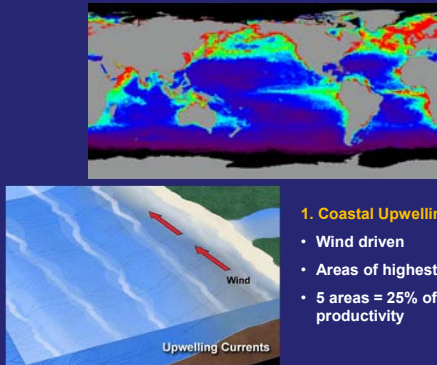
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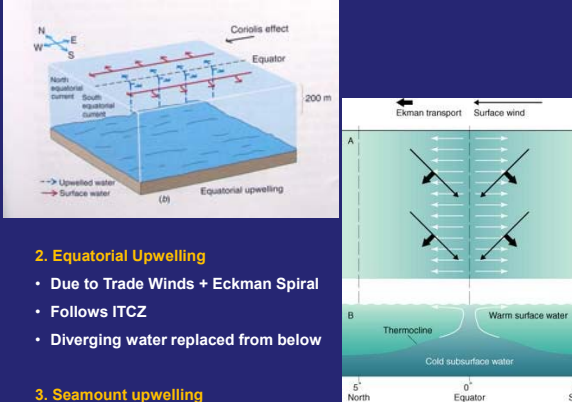
Longshore current: Results when waves hit shore at an angle, pushing water and material down the shore.

Oceans in Motion
UPWELLING – mass flow upwards of water and nutrients



1. Coastal Upwelling

- Wind driven
- Areas of highest NPP
- 5 areas = 25% of marine fishery productivity



2. Equatorial Upwelling

- Due to Trade Winds + Ekman Spiral
- Follows ITCZ
- Diverging water replaced from below

3. Seamount upwelling

The Importance of Upwelling



Oceans in Motion

DOWNWELLING = sinking water

- caused by density differences or converging currents

DEEP CURRENTS - Thermohaline circulation

- slow turnover of the world ocean (~1000 years)
- driven by temperature and salinity gradients
- "Deepwater formation" – sinking H₂O takes O₂ down and CO₂
- complex response to and effects on climate

