

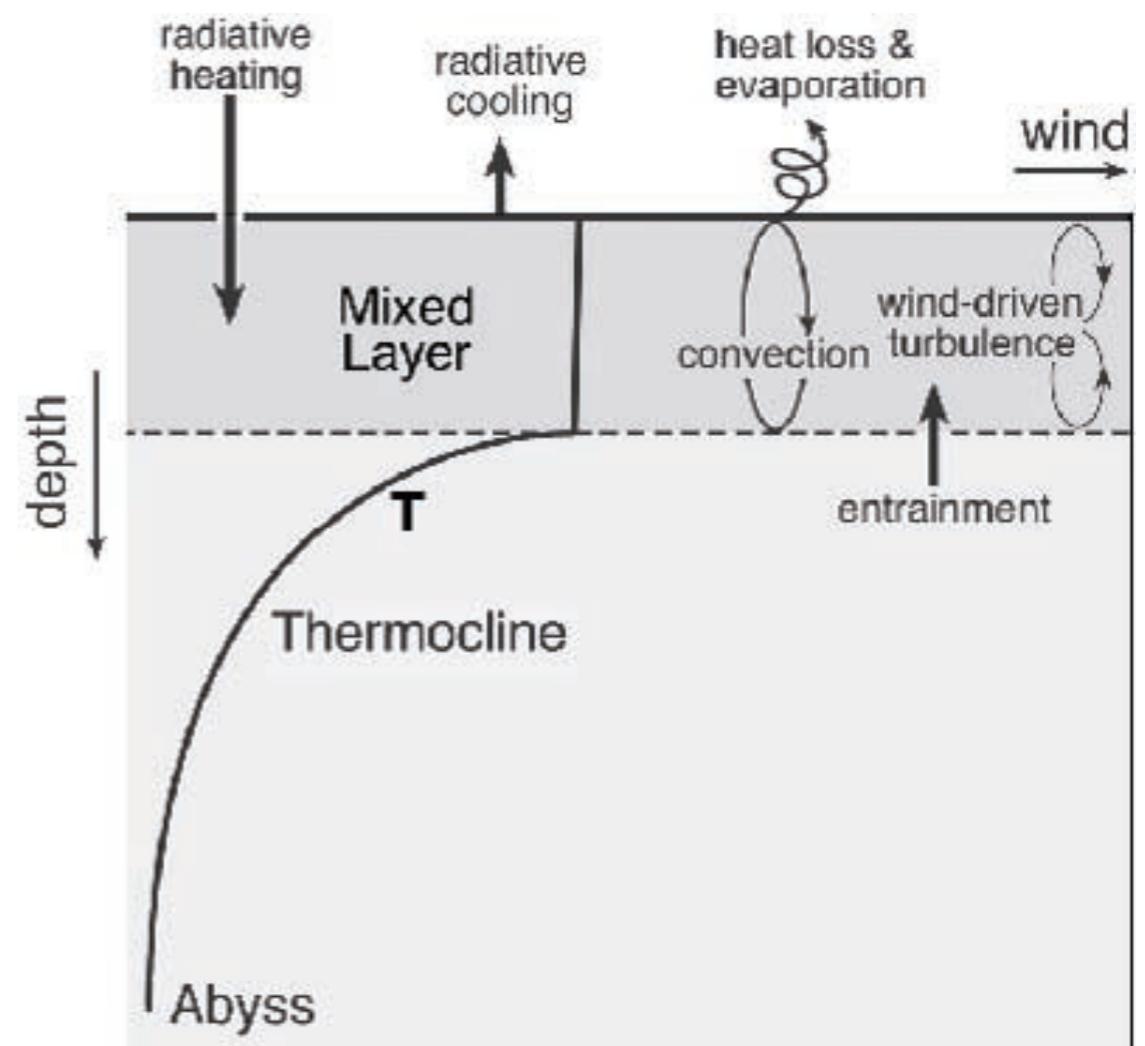
# Ocean: mixed layer

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ATM2016

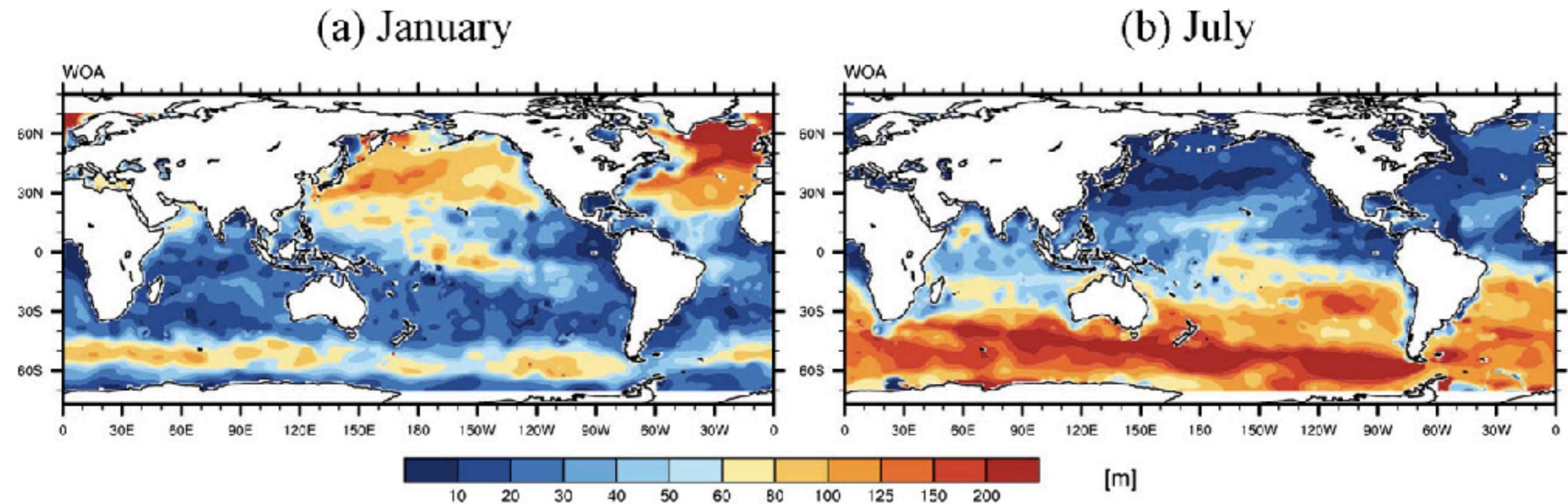
# The mixed layer

- At the surface of the ocean, there is a well-defined mixed layer.
- Properties are relatively uniform in the vertical.



# The mixed layer

- The typical depth of the mixed layer is 50-100 m.
- At high latitudes, mixed layer depth can be a few hundred meters, even up to 1 km.



# The mixed layer

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- The mixed layer communicates with the underlying thermocline (except high latitude regions).
- Wind and convection can result in vertical mixing at the surface ocean.
  - Wind stress at the surface drives turbulent motions.
  - Buoyancy loss drives convection motions
- Buoyancy??

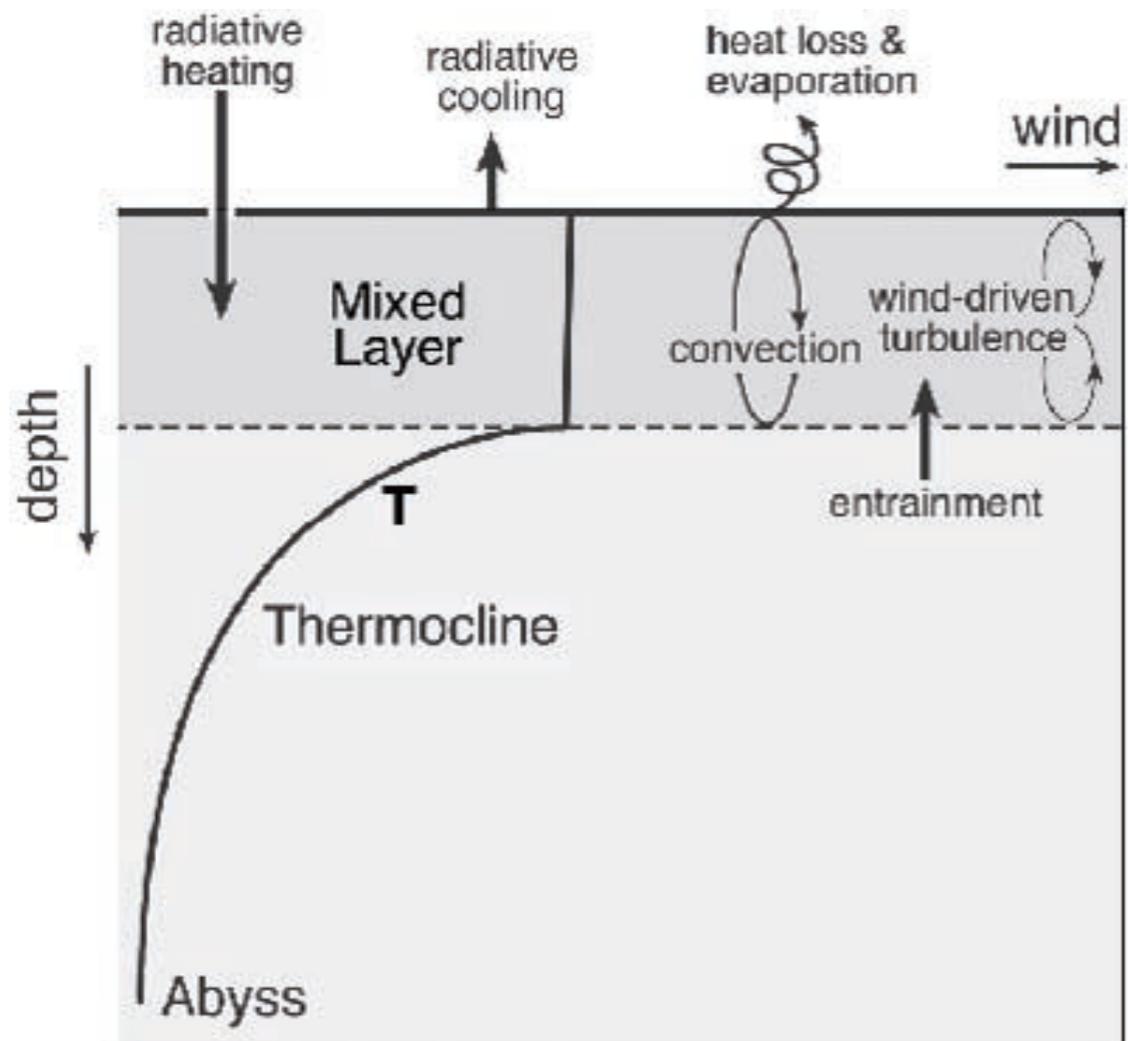
# Buoyancy

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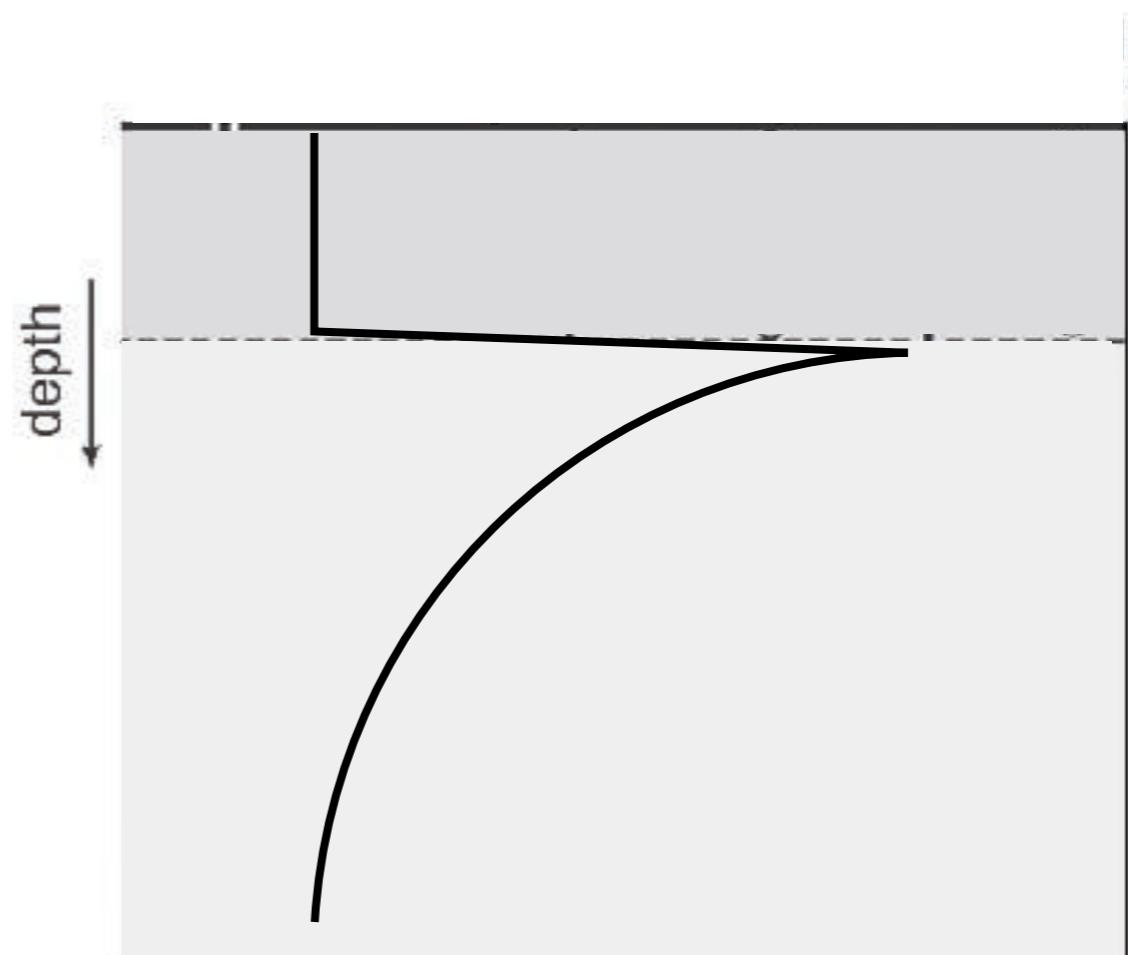
- An upward force
- $b = -g \frac{(\rho_p - \rho_e)}{\rho_p}$
- Buoyancy loss  $\rightarrow$  sink
- Buoyancy gain  $\rightarrow$  float
- Buoyancy frequency :

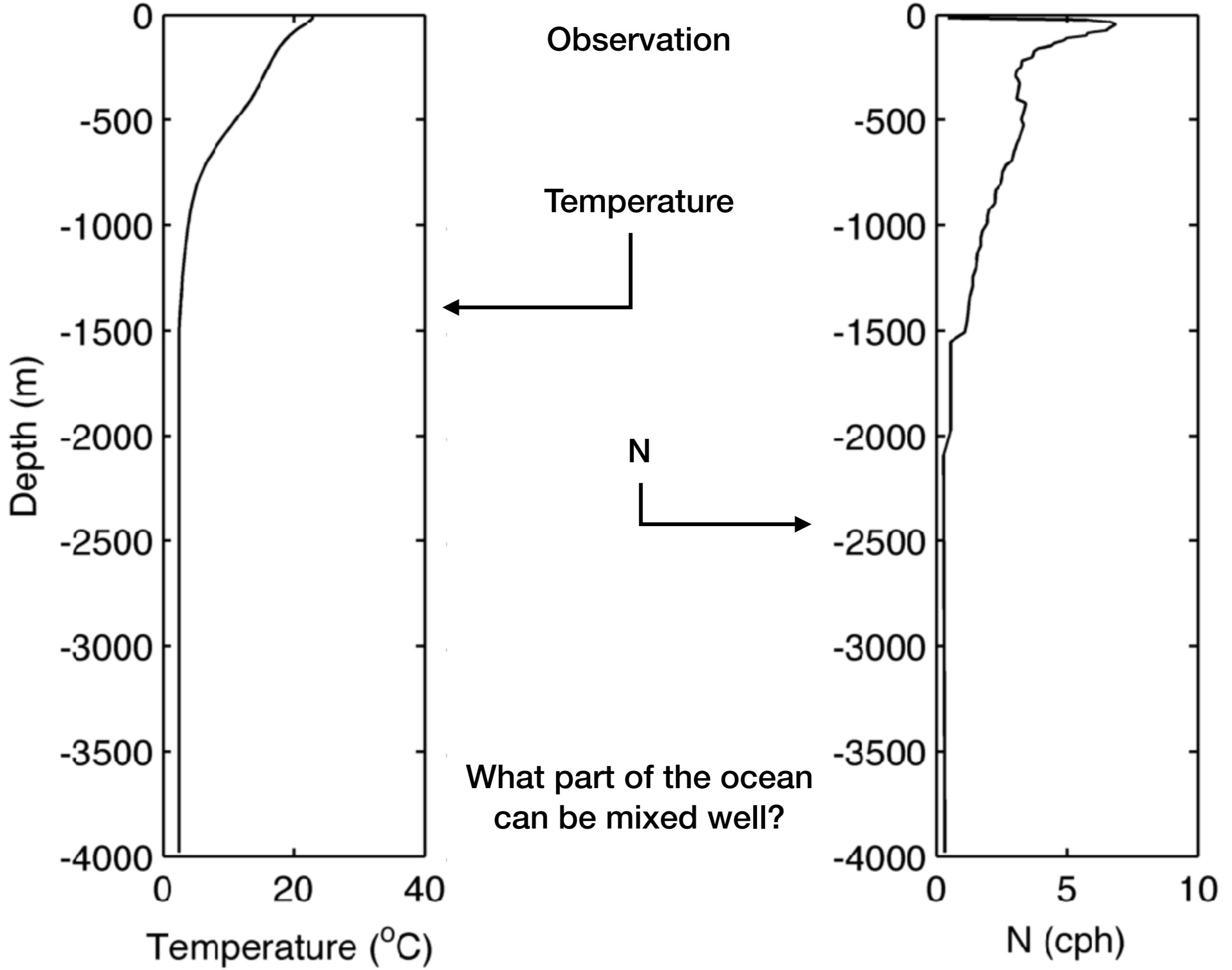
$$N^2 = -\frac{g}{\rho_{ref}} \frac{\partial \rho_e}{\partial z} \approx g \alpha_T \frac{\partial T}{\partial z}$$

# Temperature



# Buoyancy frequency



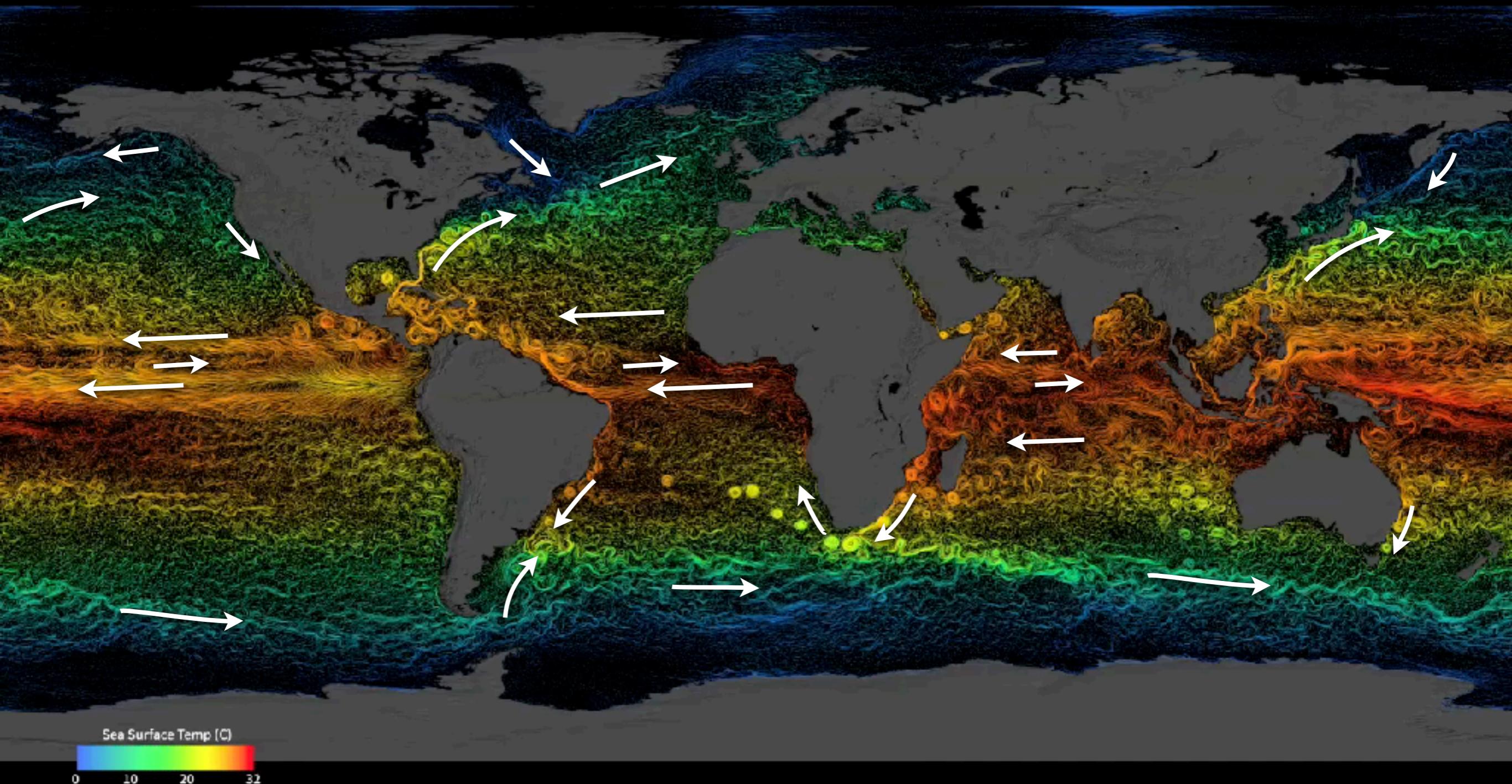


# Ocean: Mean circulation

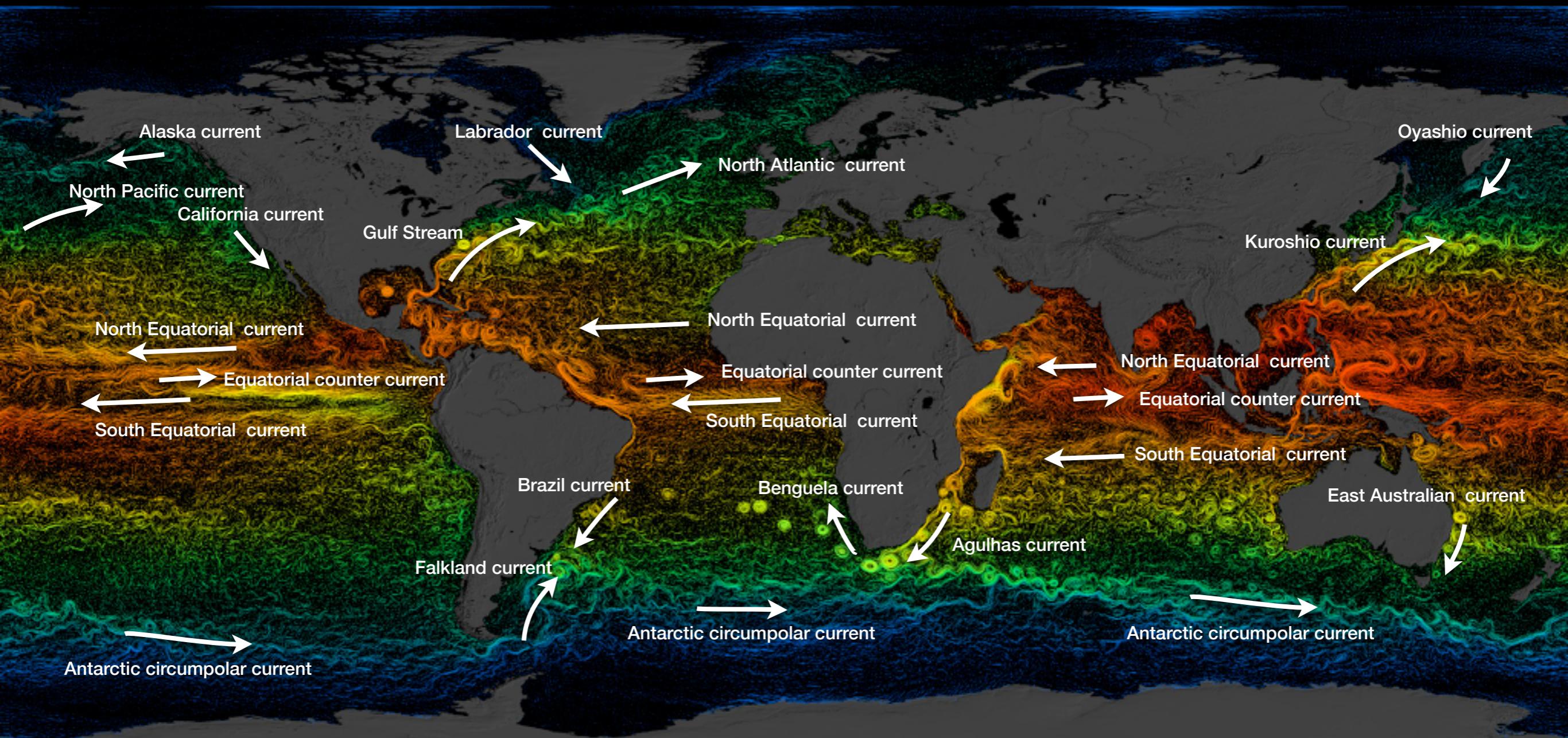
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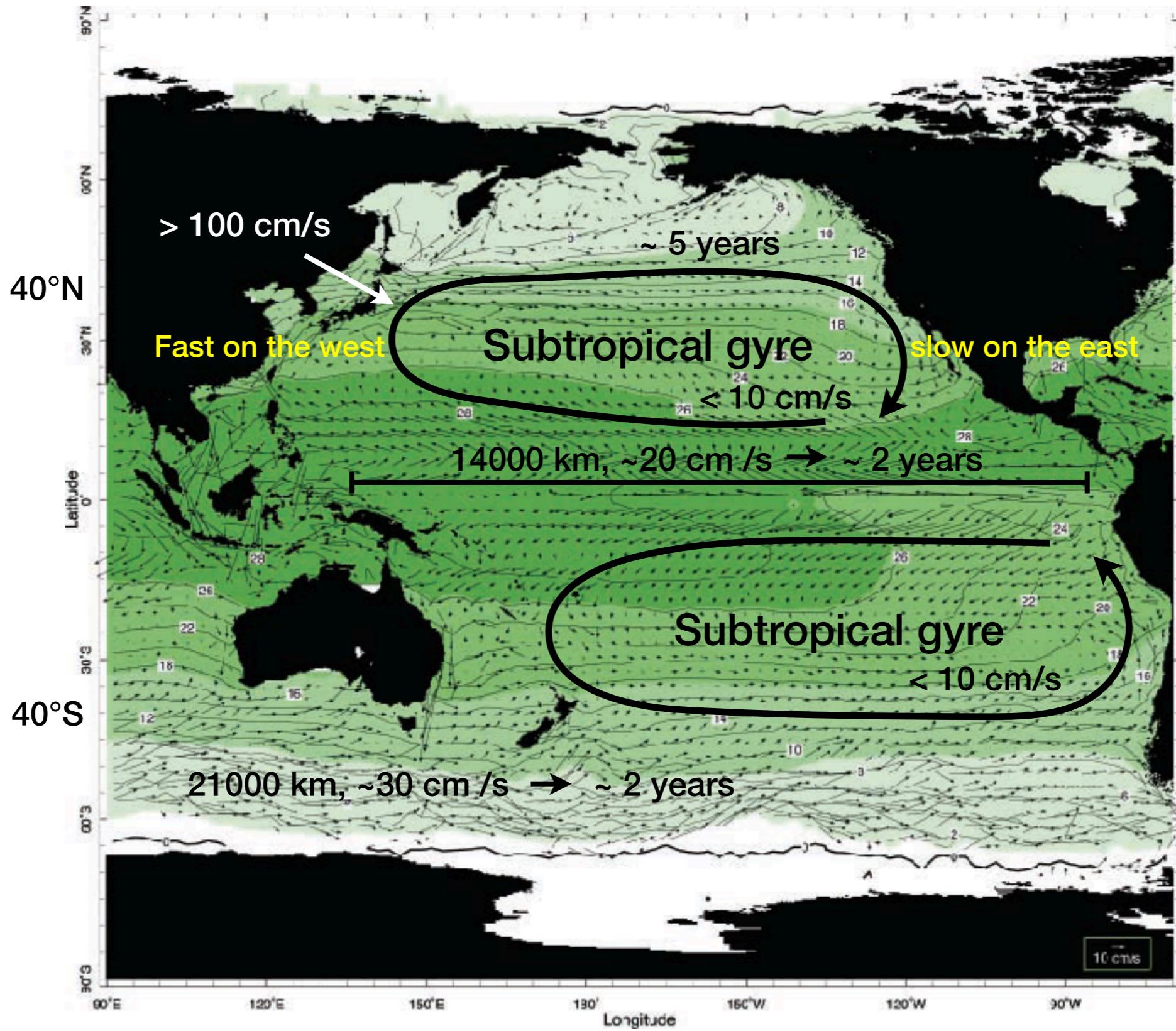
ATM2016

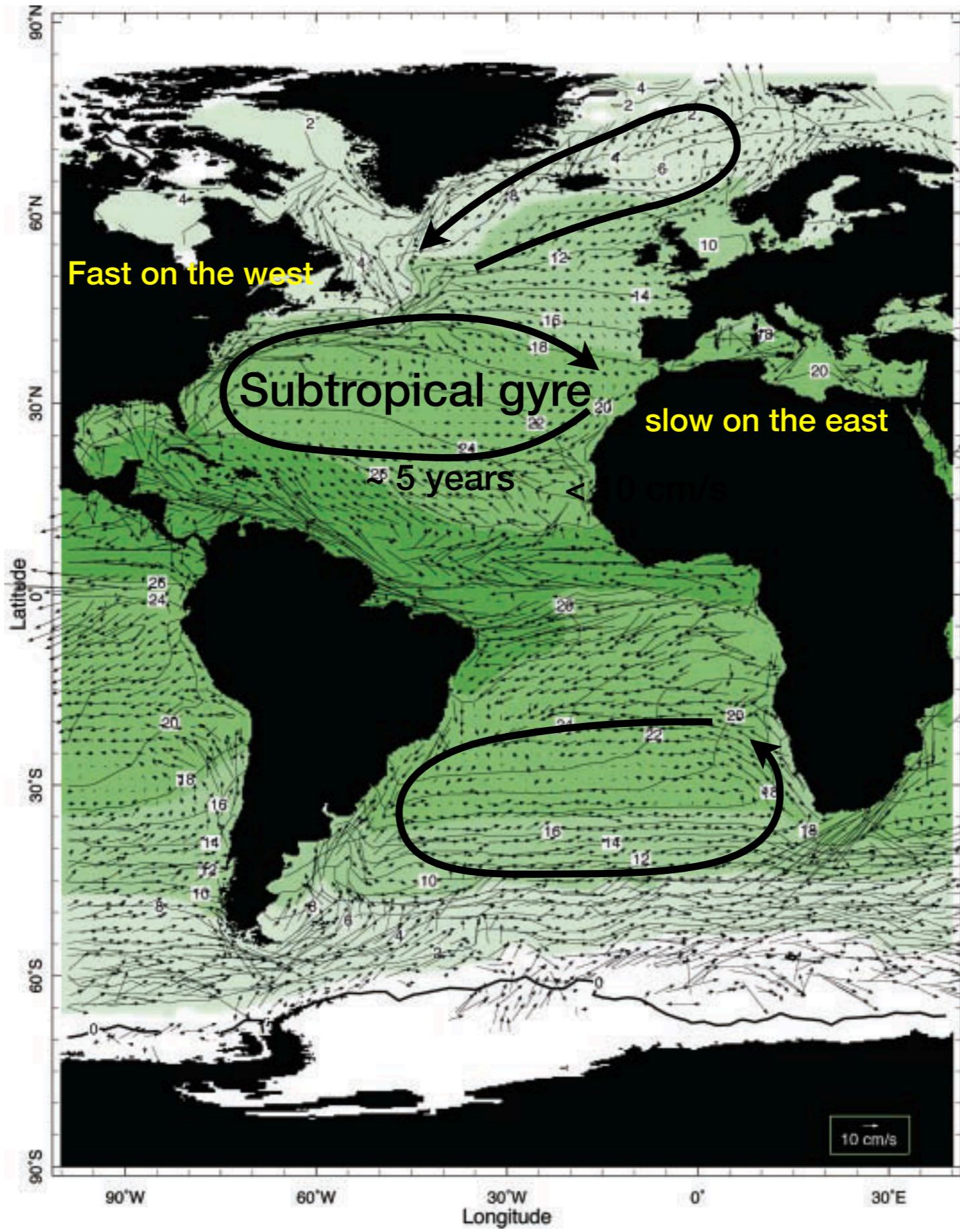
# Global Sea Surface Currents and Temperature

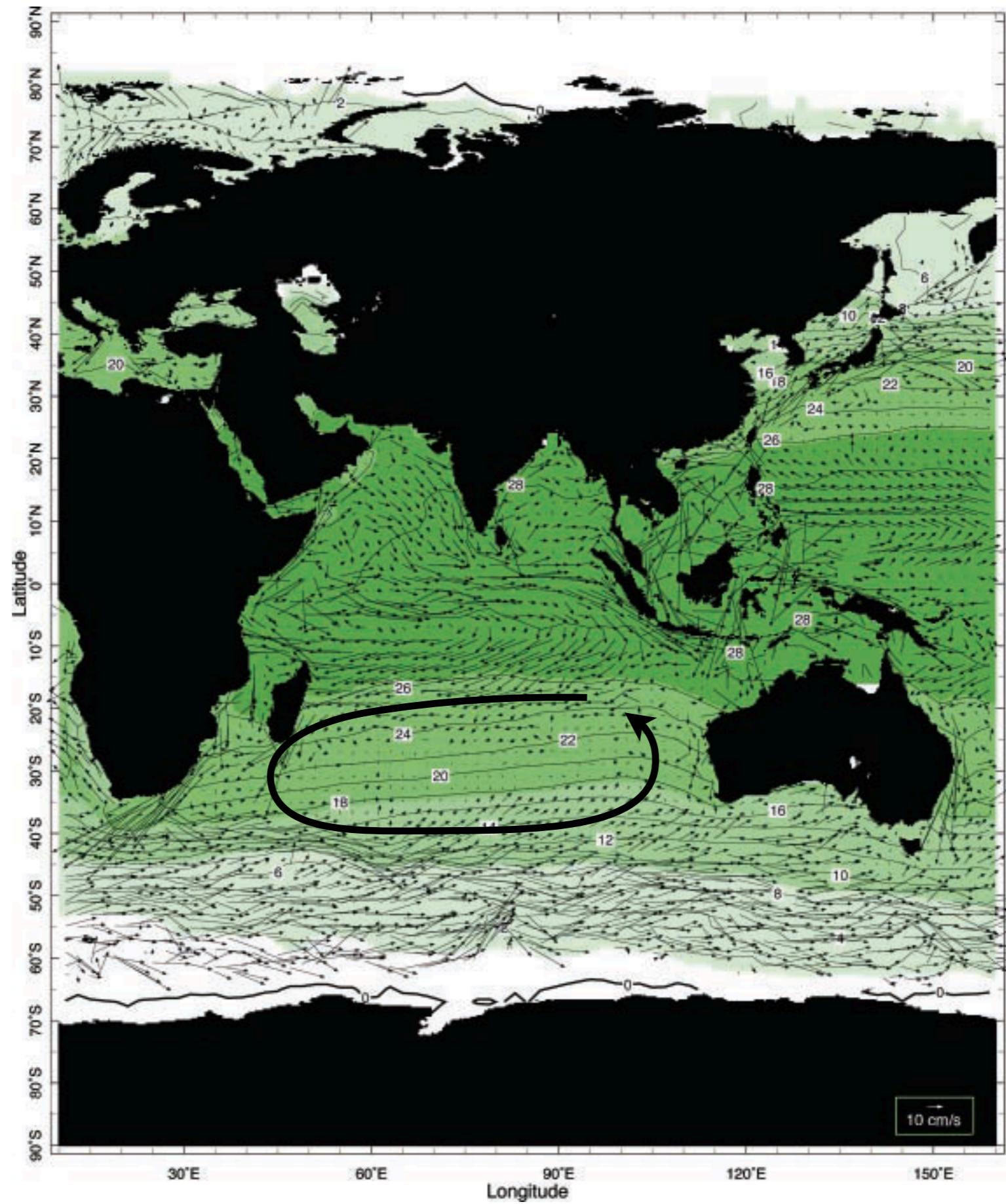


<https://svs.gsfc.nasa.gov/3912>

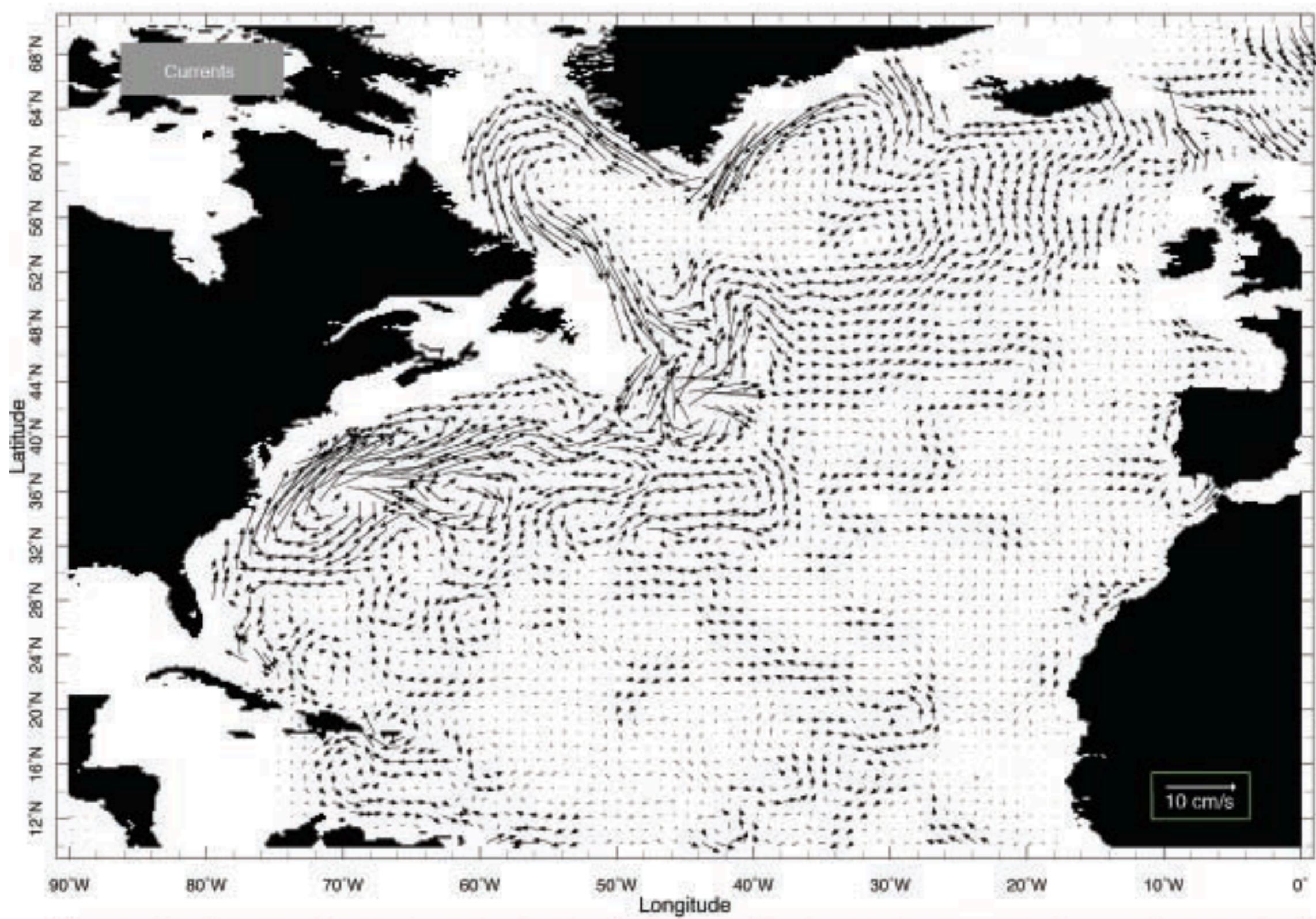




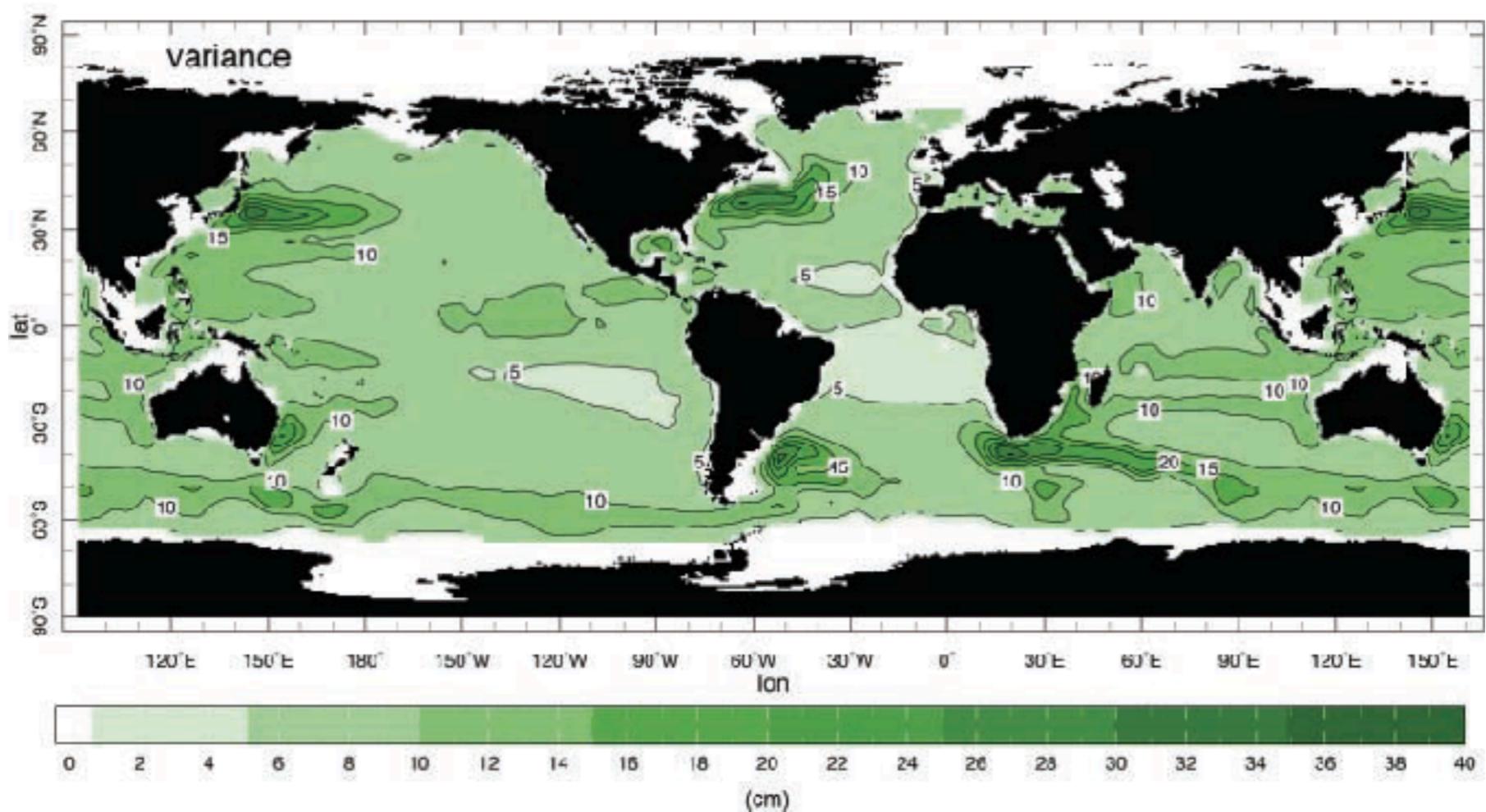
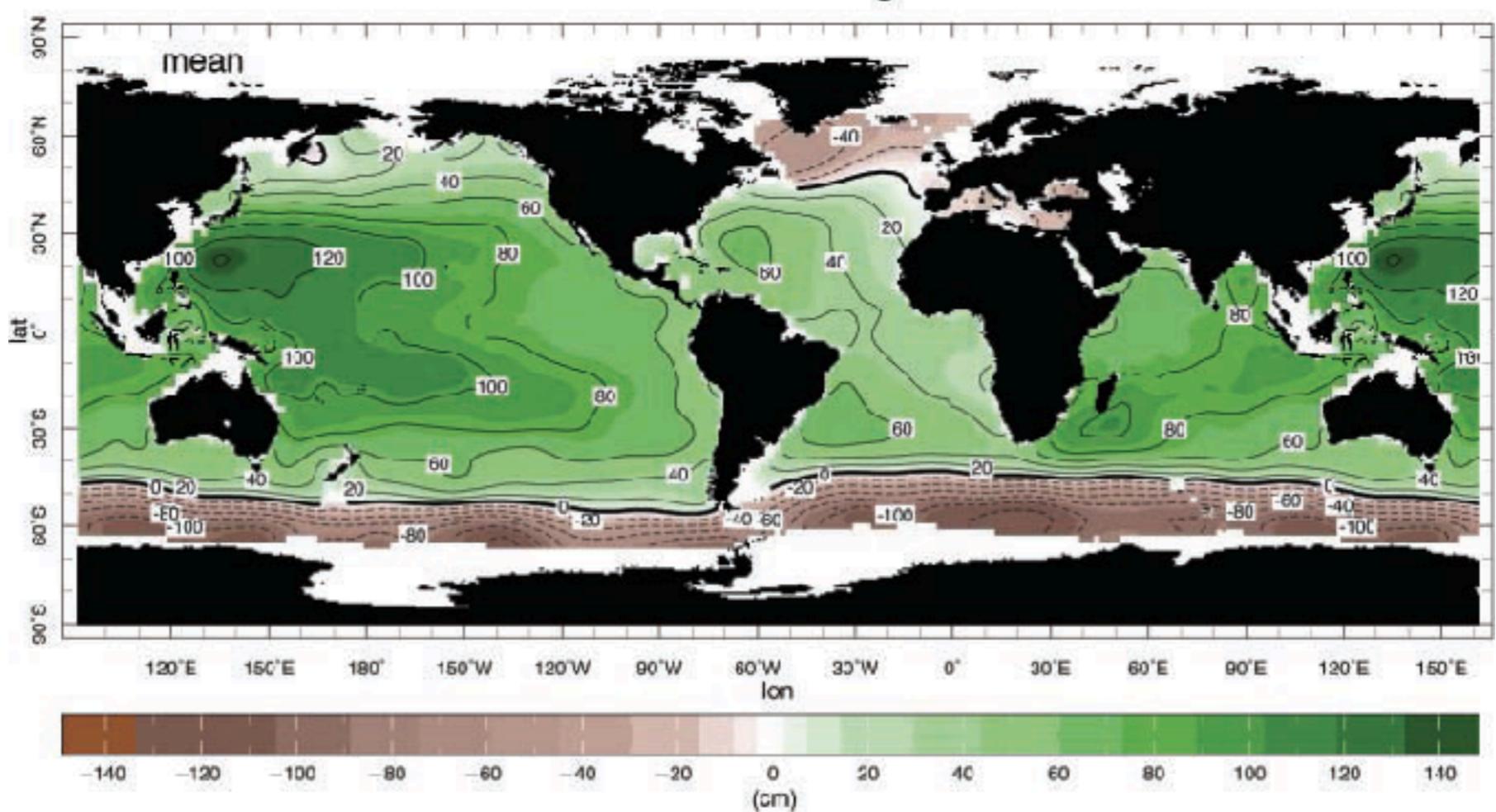




## Currents And Pressure at 700m in The Atlantic



# Sea Surface Height



### Zonal-Average, Annual-Mean, Potential Density ( $\text{kg/m}^3$ )

