**Introduction**

In the tropical Atlantic Ocean, Ekman transport is an important upper layer component of the meridional overturning circulation. Wind-induced Ekman divergence drives upwelling and poleward surface flow, forming the upper limb of the subtropical cell. Generally, in the absence of direct current measurement, Ekman transport and the associated heat and salt flux is derived from wind stress, SST and SSS based on the satellite observation. In this study, Ekman transport is calculated using direct velocity observation along two hydrographic sections and compared with the indirect approach.

**Ekman Theory**

Steady wind over a steady homogeneous ocean, the wind stress forcing is balanced by the effect of Earth’s rotation.

\[
\frac{1}{\rho_f} \frac{\partial u_{vort}}{\partial z} = - f v
\]

The vertical integration result in a transport perpendicular to the wind blowing direction.

\[
M'_y = -\int_0^H v_{vort}(z) \, dz = M_y
\]

Ekman transport can be calculated separately in two approaches:

- **Indirect**: using wind stress

- **Direct**: using ageostrophic velocity

**Data: Hydrographic Sections along 14.5°N and 11°S**

Underway CTD and uCTD data are applied to calculate the Ekman transport at both latitudes. Satellite based wind, SST, SSS products are used as a comparison.

**Mixed Layer Depth and Top of the Thermocline**

Mixed layer depth (MLD) is defined by a density threshold of 0.03 kg/m³. TTC is defined by a density gradient threshold of 0.01 kg/m³.

**Cumulative Transport [Sv]**

At 14.5°N, the calculation based on the uCTD data shows good consistency with the calculation based on the CTD data. The top of the thermocline appears to be a better choice for integrating the ageostrophic velocity than either the MLD or a constant depth.

**Long-term Variability of the Northward Ekman Transport**

The wind stress data from NCEP CFSR. The seasonal cycle dominates the variability.

At 14.5°N, the mean Ekman Transport is 7.9 Sv with 3.5 Sv STD.

At 11°S, the mean is -10.4 Sv with 3.3 Sv STD.

**Summary and Outlook**

The meridional Ekman transport along two transect lines is estimated using direct and indirect method, respectively. The underway CTD data provide consistent results compared with the regular CTD data in estimating the Ekman transport. At both latitudes, the Ekman transport is a balanced by the mixed layer. In the direct method, the Ekman flux is based on the choice of integral depth, the top of the thermocline appears to be a reasonable choice for the integration of the ageostrophic velocity. Though in these two cases, the Ekman fluxes using the SST and SSS are not significantly different from using a layer of temperature and salinity.

In the next step, the observed Ekman transport and fluxes will be compared with GECCO/GECO2 assimilation products. Eventually the study will be extended to the full water depth and different components related to the meridional overturning circulation will be estimated using observational data, and the variability of the MOC at 14.5°N will be analyzed with model data.

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**Reference**


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