TACE: Changes in Thermocline Ventilation Rates, Rana A. Fine, Rosenstiel School

Objectives are to**:**

- Monitor changes in ventilation rates of waters feeding the equatorial thermocline,
- Document variations in water mass pathways between the subtropics and tropics, and
- Assess the larger scale impacts of these changes-how they relate to variations in atmospheric indices and oceanic circulation and fluxes.

Methods:

- Tracer, oxygen, and hydrographic data collected along 23W annually during the R/V Ron Brown cruises will be used to calculate subduction rates. Oceanic trends will be correlated with variations in atmosphere and large scale ocean circulation.
- Oxygen sensors on several 23W Pirata and 35W,0 moorings in thermocline will be used to bridge the temporal gap between hydrographic cruises.
- The relative dynamical contributions to subduction rate variations will be examined in a model context.

Two decades (1982-2004) of tracer and hydrographic data from the subtropical/tropical North Atlantic show these data can be used to monitor decadal variability of ocean circulation. Subduction rates of SMW can be quantified using the tracer ages. Thermocline ventilation, and specifically subduction rates of Salinity Maximum Water (SMW) vary by an order of magnitude over the two decades. Subduction rates correlate with other properties: inversely with age, positive correlations with salinity and oxygen. Some of the interest in SMW comes from their equatorward subduction in subtropical circulation cells, and from their secular trends.

The North Atlantic Oscillation (NAO) is one of the dominant modes of atmospheric variability in the North Atlantic sector. Variations in the NAO index and associated wind fields imply strong changes in the surface air-sea flux fields of heat, momentum, and water. These changes impact both the local thermodynamic response of the mixed layer and the large scale circulation field. Correlation of SMW subduction rates with NAO is highest at lags of 2 and 7 years, there are correlations with AO, and to a lesser degree with tropical indices. Part of the ocean response to atmospheric forcing is local and rapid (changing wind stress curl), and part of the response seems to be longer time (waves). In addition, there probably are other influences on the two decades of subduction rates beyond the NAO, etc. including longer term secular trends like the increasing salinity and temperature. Variations in subduction rates and thus the ventilation pattern will affect the uptake of other gases, e.g., CO2.

Larger Scale Issues to address with TACE observations:

Does the whole STC speed up/slow down with changes in the NAO? How do subtropical/tropical pathways change?

Does some fraction of the decreasing subduction rate fit a longer tern pattern than the NAO index, that of global warming?

On what time scales do anomalies of T'v dominate, and on what time scales do Tv' dominate?

What will happen in 30 years, if STCs slow, will upwelling also slow/stop, and what about affect on fisheries? If upwelling changes- how will this affect the base level of the thermocline?