ABSTRACT

We analyze spatio-temporal CO2 observations that span over 26 years in the South Atlantic Bight (SAB) off the southeast United States. Various cruises and one moored time series are used to determine multi-decadal CO2 trends. We compare two statistical methods for resolving trends: 1) deseasonalization (removal of the mean seasonal harmonic) using an ensemble mean reference year with a linear least squares best-fit slope; and 2) a Generalized Additive Mixed Model (GAMM) to identify and remove the seasonal signal, with a non-linear best-fit slope. The results from the two methods are not statistically different; however, the GAMM method calculates narrower 95% confidence intervals. Both methods agree that CO2 across the SAB is increasing at a rate greater than that of the atmosphere (2±2 ppm yr-1). Thermal increases could influence outer portions of the SAB, while there is no evidence for thermal influences on the shallower inner portions of the shelf. Even though the moored CO2 time series has just less than 10 years of observations, the linear least squares best-fit slope agrees well with the slopes for only the cruise observations over 26 years. Therefore, we assume that even though the moored CO2 time series is less than a decade old, the high observational frequency (three hours averaged to one day) provides an accurate assessment of long-term CO2 trends.

OBJECTIVES

1. Estimate CO2 change in the SAB using cruise observations spanning over 25 years. Since cruises are often sporadic, we compare observations from across the SAB shelf to almost a decade of nearly-continuous moored autonomous observations.

2. Using simple linear methods, an examination of deseasonalization, and comparison to a generalized additive mixed model (GAMM), we show that simple linear techniques in the SAB agree well across regions of the slope as well as to the more complex GAMM.

CONCLUSIONS

• CO2 is increasing across the SAB, and the change in each region is greater than that of the anthropogenic-driven increase in the atmosphere. Therefore, other factors also contribute to the increase.

• The inner shelf SST trend is -0.05 °C yr-1 (Table 2), thus the resulting SST effect, assuming 350 was the partial pressure at the beginning of the time series, is: -0.05*350=4.3 °C = -0.8 ppm yr-1. The middle shelf SST trend is 0.07 °C yr-1, thus the SST effect is 1.1 ppm yr-1. Thus, there must also be a substantial non-SST contribution to the CO2 increase on the inner and middle shelves.

• The calculated trends using both the deseasonalization and GAMM methods are not statistically different, due to the large 95% CI’s.

• 95% CI’s using the deseasonalization method are likely greater than those using the GAMM because more of the seasonal signal is removed using the GAMM method, thus removing much of the extreme variability in the time series.

• The advantage of the GAMM method is that it may remove more of the variability in the seasonal signal, thus providing a narrower range in the uncertainty. If, however, the use of this method is not appropriate, linear least squares may provide reasonable results if the time series is long enough or if the frequency is high.

• Since there is far more cruise data for warm months, there is also sampling bias. Therefore, we are unable to use traditional thermal versus non-thermal decomposition methods. Future work should focus on determining the other sources of CO2 increase.

REFERENCES
