

# Evidence That Palmer Station Antarctica Seasonal O<sub>2</sub> and CO<sub>2</sub> Cycles Understate Regional Marine Boundary Layer Means

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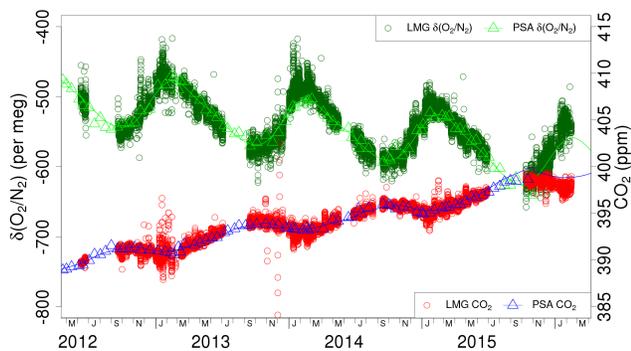
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The Scripps O<sub>2</sub> Program has collected biweekly CO<sub>2</sub> and O<sub>2</sub> flask samples from Palmer Station, Antarctica (PSA) since 1996. These data have served as an invaluable representation of regional carbon cycle signals and play an essential role in evaluating how well ocean models capture Southern Ocean dynamics and surface productivity.

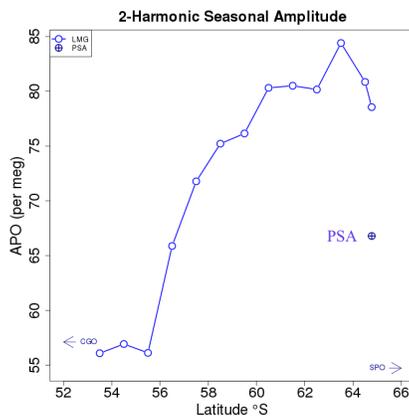
Atmospheric CO<sub>2</sub> data reflect interfering oceanic solubility, upwelling and productivity signals, and are buffered by carbonate chemistry. Because of this, atmospheric O<sub>2</sub>, and the related “atmospheric potential oxygen” (APO) quantity provide a much clearer representation of seasonal oceanic carbon cycle processes than CO<sub>2</sub> alone.

There is growing evidence in the oxygen measurement community, however, that Scripps Palmer Station APO data may not accurately represent a regional marine boundary layer (MBL) mean, possibly because of wind direction sampling selection criteria that tend to favor downslope flow from the glacier above the station, and mountains to the East. *In situ* shipboard data taken on the ASRV Laurence M. Gould between 2012 and 2016 near Palmer Station confirm this suspicion: a comparison of two-harmonic fits to station and Gould data suggests that the flasks understate the regional mean MBL seasonal cycle by at least 15%.

We present an observation- and modeling- based study of the differences in the two datasets, leveraging recent airborne data near Palmer Station from the ORCAS campaign on the NCAR Gulfstream V. We focus on addressing sampling bias, and reconciling prior measurements with current understanding so that scientists can better evaluate ocean models with representative data.



**Figure 1.** O<sub>2</sub> and CO<sub>2</sub> records from the ASRV Gould O<sub>2</sub> instrument (circles) and Palmer Station flask samples (triangles) near Palmer Station. Gould records show larger seasonal cycles than equivalent Palmer samples, with largest differences around the austral summer seasonal maximum.



**Figure 2.** 2-harmonic amplitudes of atmospheric potential oxygen (APO=O<sub>2</sub>+1.1\*CO<sub>2</sub>) between 53 and 65 South along the path of the ASRV Gould, representing seasonal air-sea O<sub>2</sub> exchange. Arrows denote the amplitudes for South Pole and Cape Grim, off plot.