

How Well Can We Measure Baseline CO₂ at Cape Kumukahi?

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Weekly flasks have been routinely taken at Cape Kumukahi, Hawaii for thirty seven years, but until recently we did not know how local sources and sinks of carbon dioxide might influence these samples. This problem has been investigated by a campaign of continuous measurements of CO₂ and condensation nuclei at Cape Kumukahi between December 10, 2007 and February 25, 2008. Similar measurements were also made in the town of Hilo for four weeks in November 2007.

There is a persistent diurnal cycle of CO₂ at Cape Kumukahi with a consistent mixing ratio at night (6 PM to 7 AM) and a drop of about 2 ppm during the day, symmetrically centered at noon. This feature is present even under trade wind conditions. It may be caused by photosynthesis and respiration of CO₂ from plants growing near the building and on the 300 to 500 meter upwind fetch of land between the site and the shoreline. Local plant respiration and photosynthesis is also seen in the Barrow clean air sector in mid-summer (0.6 ppm at 10 meters) and in the non-baseline sectors at Samoa and Cape Grim (several ppm at 10 meters). At Cape Kumukahi, vegetation has been gradually recolonizing the areas covered by the 1960 lava flow, so it is possible that the diurnal CO₂ cycle has strengthened over time.

CO₂ increases of up to 25 ppm occurred at night at Cape Kumukahi. These are attributed to respired CO₂ from inland forests during periods of offshore winds. The probability of these events ranged from 20% after sunset to over 50% between 3 AM and sunrise. During the flask sample window between 9 AM and 11 AM, the probability was between 15% and 5%, and the amplitudes were only a few ppm. By comparison, excess CO₂ in Hilo at night was up to 80 ppm greater than during the day, due to the closer proximity of forests and the development of a stronger, more persistent offshore wind.

We have begun taking additional flasks from a sampling line on the top of the lighthouse tower to see if these are less affected by local vegetation CO₂ exchange than ground level flasks.

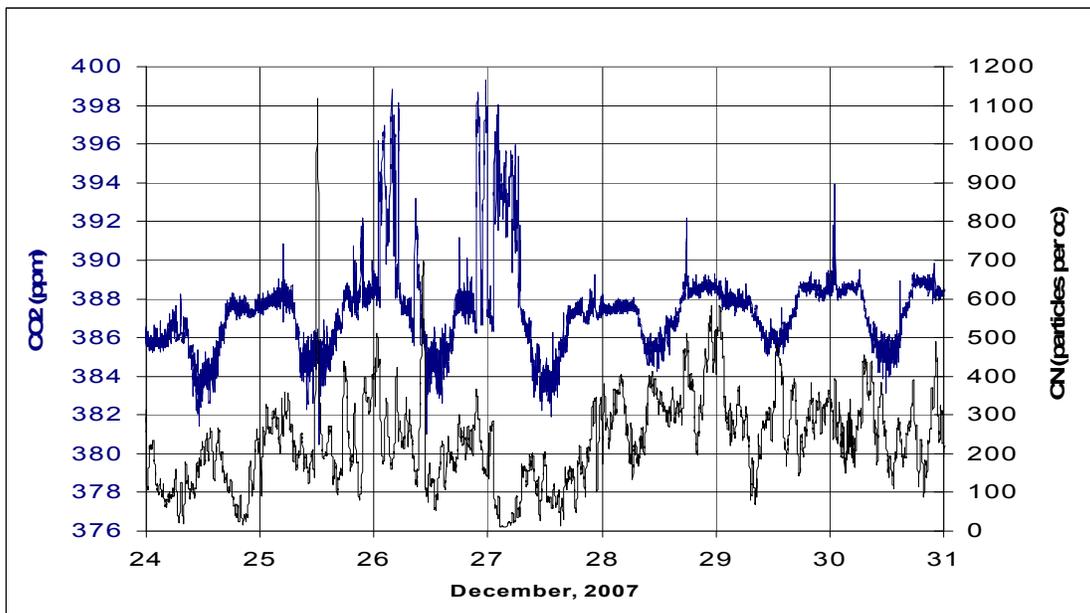


Figure 1. One week of continuous measurements of CO₂ (blue) and condensation nuclei (black) at Cape Kumukahi, Hawaii. Time grid lines are at midnight. The sampling inlet protruded from the west wall of the sampling building at a height of 3 meters. CO₂ mixing ratios are provisional pending reanalysis of two calibration gases used in the study.