

Evidence of variability of atmospheric CO₂ concentration during the 20th century

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Summary of the presentation

In 1958 the modern NDIR spectroscopic method was introduced to measure CO₂ concentrations in the atmosphere [Beck 2007]. In the preceding period, these measurements were taken with the old wet chemical method. From this period, starting from 1857, more than 90,000 reliable CO₂ measurements are available, with an accuracy within $\pm 3\%$. They had been taken near ground level, sea surface and as high as the stratosphere, mostly in the northern hemisphere. Comparison of these measurements on the basis of old wet chemical methods with the new physical method (NDIR) on sea and land reveals a systematic analysis difference of about minus 10 ppm.

Wet chemical analyses indicate three atmospheric CO₂ maxima in the northern hemisphere up to approx. 400 ppm over land and sea since about 1812. The measured atmospheric CO₂ concentrations since 1920 –1950 prove to be strongly correlated (more than 80 %) with the arctic sea surface temperature (SST).

A detailed analysis of the Atlantic Ocean water during the arctic warming since 1918 – 1939 by Wattenberg (southern Atlantic ocean) and Buch (northern Atlantic ocean) indicates a very similar state of the Atlantic Ocean (pH, salinity, CO₂ in water and air over sea etc.) These data show the characteristics of the warm ocean currents (part of global conveyor belt) at that time, indicating a strong CO₂ degassing from the Atlantic Sea, especially in the area of Greenland/Iceland and Spitsbergen. More than 360 ppm had been measured over the sea surface.

In 2004 Polyakov published evidence for a multi-decadal oscillation of the ocean currents in the arctic circle, showing a warm phase (strong arctic warming during 1918 –1940 with high temperatures in the Iceland/Spitsbergen area) similar to the current situation, and a cold phase (around 1900 and 1960). Today the Iceland/Spitsbergen area is known for a strong absorption of CO₂.

This multi-decadal heating of the oceanic CO₂ absorption area and larger parts of the Northern Atlantic Ocean was followed by an increase of the atmospheric carbon dioxide concentration to approx. 400 ppm during the 30s and approx. 390 ppm today. The abundance of plankton (13C) and other biota supports this view.

Conclusion: Atmospheric CO₂ concentration varies with climate, the sea is the dominant CO₂ store, releasing the gas depending on multi-decadal changes of temperature.

