Publication of Ernst-Georg Beck´s Atmospheric CO_2 Time series from 1826-1960

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A surprise e-mail

On Christmas Day 2008, I received an e-mail from the German researcher Ernst-Georg Beck. He asked me to analyze an atmospheric CO_2 time-series from 1820 to 1960. A CO_2 time-series from 1820 was something special. Next day I went to work, analyzed the time-series, wrote a short note and e-mailed back a comment. It was all done in an hour. I wrote that there was nothing special about this time-series. The CO_2 variations coincided with North Atlantic water surface temperature from 1900 to 1960 (Yndestad et al. 2008) [1].

In August 2009 he came from Germany and visited me in Ålesund, Norway. He wanted to know more about the CO_2 time-series signature. In a golden moment, the wavelet spectrum analysis revealed a coincidence between the CO_2 signature, the Atlantic Water temperature, and the lunar nodal tide spectrum (Yndestad et al. 2008) [1]. Beck found what he was looking for. After the CO_2 signature was estimated, I started to ask him about possible errors in the time-series. Slowly I began to understand, the magnitude of the job he had done. This was a life's work, which should have been presented as a PhD thesis.

Summary of the work

The estimated Marin Boundary Layer (MBL) CO_2 time-series was derived from around 90,000 measurements associated with meteorological data selected from a basis of around 200,000 recorded measurements. The data had been presented in 979 technical papers. Among the authors were two Nobel Laureates. The standard analytical procedures of the time had been employed, including intercalibration between some laboratories. The uncertainty was quite large the first decades but narrowed over time to a level within 3 % (Beck 2007) [2]. For measurements over time in the same laboratory, the relative uncertainty would be reduced. That should give adequate comparisons with modern data including a fairly good overlap with the Mauna Loa data from 1958 the last 5 years. Thus, the data set should be considered at least partly adequate which would justify further detailed studies by the international scientific community. After all, the resolution of these in situ data is far beyond the ice core data being widely accepted.

Becks last manuscript

Beck started to work a revised paper and the first update came in October 2009. In the new paper he explained how Francis Massen had found an empirical relation between the CO_2 level and wind speed (where meteorological data were available), demonstrating that high winds mixed the atmosphere gases so the ground measurements near the sea showed almost the same (level) concentration as the Mauna Loa reference stationat elevation near 4000 m. (Massen and Beck, 2011) [3] He also showed that a similar empirical relation existed between CO_2 level and precipitation, and that estimates based on measurement on certain times of the day or at certain times of the year gave values close to Mauna Loa observations (Beck 2022) [4].

The challenge was to summarize his extensive material. Late in the autumn 2009, I received a message that he had been reduced due to disease. In January 2010, I was informed that he had got cancer. It was urgent to get the manuscript published. In spring 2010, he worked in good periods. During the spring, he received help from his own university. In August, the manuscript was submitted to Journal of Climate for publication. He died September 21, 2010. A rejection came November 15, 2010. The last comment from the second reviewer was: "*I must categorically recommend the rejection of this article without the possibility of a new submission or revision*". The atmospheric CO_2 from 1820 did not coincide with published CO_2 variations from Antarctic ice core samples, over the past 1,000 years. After Beck, the manuscript was no longer publishable or transferable.

Becks vs Keeling

The discussion about the time-series coincidences was not new. Beck had published a first version of his data series in 2007 (Beck 2007) [2]. In this publication, Beck allowed himself to comment that the Mauna Loa data series lacked data for the period before 1959. This comment led to a reaction from Ralph F. Keeling [(Keeling 2007) [5]. Beck's data series had an unexpected CO_2 growth from 1930 to 1945 and a subsequent relaxation over the next 10 years. The credibility of the data series now was dependent on Beck being able to clarify the source of CO_2 growth in this period. Beck believed the source was variations in the sea temperature. In a new article, he showed that the CO_2 variation was correlated with measured temperature variations in Antarctica (Beck, 2008a) [6], (Beck 2008b) [7]. In the autumn 2008, a new publication appeared (Yndestad et al. 2008) [1] which confirmed that the Atlantic Ocean had a temperature increase from 1930 to 1945. This increased sea surface temperature coincided with the CO_2 increase from1930 to 1945 in Beck's data. Beck's article was handed over to the journal *Science of Climate Change* in 2021. They took the responsibility to publish the Beck February 2010 paper, as (Beck 2022) [3].

Atmospheric CO_2 signatures

There are no other known atmospheric CO_2 data series, that goes back to 1820. The question remained. What is the reference that may verify an atmospheric CO_2 time-series from 1820 to 1960. The solution was to estimate spectrum signature coincidences. Global sea surface temperature signature from 1850 to 2022 was known (Yndestad 2022a) [8]. The next step was to estimate atmospheric CO_2 at Mauna Loa signature 1959-2020 and the Atlantic CO_2 spectrum signature 1826-1960. It turned out that atmospheric CO_2 signatures coincides with the lunar nodal tide. Atmospheric CO_2 is controlled by sea temperature variations. Global sea surface temperature variations are controlled by the lunar nodal tide (Yndestad 2022b) [9]. The lunar nodal tides are controlled by the moon. Beck's extensive work was not in vain. The CO_2 time-series, estimated by Beck, is confirmed by the lunar nodal signature. The atmospheric CO_2 time-series 1820-1960 then should be published and made available for the scientific community and further studies.

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