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About Historical CO_2 Levels

Discussion of Direct Measurements near Ground since 1826 by E.-G. Beck

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Abstract

Several comments can be made on the reconstruction of the historical CO_2 data made by the late Ernst Beck (Beck, 2010, published in SCC 2022 [21]). While most chemical methods used were fairly accurate (+/- 10 ppmv), many places where was measured were completely unsuitable for "background" CO_2 levels and in many cases too few measurements were made at high wind speed to have a sufficient convergency of the data towards a "background" CO_2 level. Moreover, the late Ernst Beck made several mistakes in the interpretation of the available data. Finally, the possibility of huge CO_2 levels around 1940 is physically impossible and contradicted by several other proxy's and contradicted by CO_2 levels as measured in high resolution ice cores.

Keywords: Historical CO_2 levels

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1. Introduction

The following is the result of many years of direct discussions with the late Ernst Beck in the years 2000-2010, until his untimely death. I am very reluctant to give this critique, as he can't defend his work anymore, but when bad data are spread around, that is at the cost of the credibility of the community for other items where climate science is on shaky grounds.

Earlier discussions with the late Ernst Beck are reflected in a web page written in 2008 and with a last update in 2010 on my web site [1]. I was aware of his latest work but did not see it at that time, because it was never published. Until now, with the publication of his work in this journal.

2. The historical methods used

In general, the methods used were fairly accurate, with some exceptions.

E.g., the apparatus used at Barrow, Alaska [2] was only accurate to +/- 150 ppmv, which was accurate enough for the intended purpose: measuring CO_2 in exhaled air of the researchers at the near polar station of around 40,000 ppmv, but by far not accurate enough to measure CO_2 in ambient air to a few tens of ppmv.

Beck still included these inaccurate data in his latest work, pointing to an accuracy of 0.015% (+/- 5 ppmv at 300 ppmv) a factor of 30 smaller than reality, as the inventor of the apparatus Scholander [3] says that the accuracy of the method was +/- 0.015 *volume* percent, which is +/- 150

ppmv in 100% gas (CO_2 or O_2 or N_2 or a mix of them), not 0.015% of the measured data.

Other critiques about the accuracy of the chemical methods were expressed by peterd at the blog of Jennifer Marohasy [4], who looked at the historical methods in detail and found errors up to 50% overestimating the CO_2 levels for some methods that the late Ernst Beck assumed "accurate" to within 3% [4].

In fact a pity that the data of Barrow were not better, as at Barrow there is currently a "background" CO_2 measuring station from NOAA [5], so that a comparison of both datasets can be made. That will be done in chapter 8.3.

Several other misinterpretations of data and methods were encountered in our discussions.

3. The interpretation of some of the data.

It is difficult to know the criteria that Beck used to include or exclude certain historical series of data and how and why he "corrected" some of the data with tens of ppmv for seasonal or other reasons.
Besides several long series that make the bulk of the 1942 "peak", several other isolated measurements support his peak value. Unfortunately there are practically no measurements over the oceans or coastal with wind from the seaside in de period of his peak value where current "background" CO2 levels are found.
Several such measurements before and after the 1942 "peak" show background levels around the ice core 300 ppmv. That makes that Beck's remark under Figure 24 in his work (Beck 2022 [20]) can't be true and conflicts with what K. Buch (see Schneider ea. 2022 [6]) found during his investigations when exploring CO2 levels over the Northern Atlantic Ocean:

„It is most remarkable that literature reveals CO2 enriched air coming from the sea at several stations when sampling at the coast (Haldane North Sea, Buch 1932–1936 Barents Sea, Northern Atlantic) or over warmer ocean currents in the Northern Atlantic (Buch1932–1936). This suggests the Northern Atlantic Ocean as the source of the enhanced CO2 levels.

The work on K. Buch's life (Schneider ea. 2022 [6]) at page 41 says just the opposite:

„Low pCO_2 and uptake of atmospheric CO_2 were observed in different regions of the North Atlantic. As a consequence of plankton growth, the pCO_2 in June 1935 on the route between Copenhagen and Boston showed in general values below the atmospheric level. Extreme low pCO_2 were observed in arctic waters close to the ice boundary during measurements on a ferry along the route Narvik – Svalbard in August 1936 (BUCH, 1936)."

Based on the NH sea surface temperatures, according to HADSST3nh [7], in the period 1935-1945 the increase of the ocean surface water temperature was about 0.2 K. That gives a maximum increase in equilibrium pCO_2 between oceans surface waters and atmosphere of not more than 5 ppmv according to Henry's law. See the formula of Takahashi (2002 [9]). Even if the North Atlantic warmed twice as fast, 10 ppmv extra from the local oceans can't give a 60 ppmv peak globally as that is fast mixed with the bulk of CO_2 in the atmosphere over the oceans…

Several other (earlier) works mentioned in Buch's life, all point to a strong uptake of CO_2 in the Nordic Arctic oceans at very low pCO_2, not much different from current pCO_2 levels, which are extremely low in the North Atlantic waters: down to 150 µatm in equilibrium, with a global CO_2 level over 415 µatm in the atmosphere. That gives that the North Atlantic waters then and now have the highest CO_2 uptake in the world, directly into the deep oceans, with the sinking waters of the thermohaline circulation (THC).

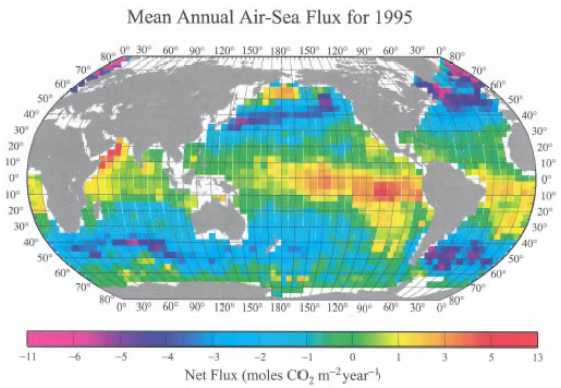

Figure 1: compilation of the releases and uptakes of CO_2 by the oceans. Source: Feely ea., 2001 [8].

Another misinterpretation is that Beck shows a "calculated" atmospheric CO_2 level from data by Wattenberg from the 1925-1927 scientific expedition by the research vessel "Meteor" of around 313 ppmv in Table 9 of his work (Beck, 2022 [21]).
Wattenberg did not measure any airborne CO_2 levels: all pCO_2 measurements were done on sea-water samples from different depths, including at 0-meter depth (surface water), which Beck interpretated as air samples. Which is impossible, as the same samples had also pH values measured.
While the original work of Wattenberg is not directly available on line, the methods used are available by Wattenberg (1925, page 67 [22]) and show following explanation:

"Die Kohlensäuredruckanalysen werden mit dem von A. Krogh beschriebenen Apparat ausgeführt, der hier an Bord ausgezeichnet funktioniert. Wenn genügend Wasser zur Verfügung steht, werden jetzt auf jeder Station 6 bis 8 Bestimmungen gemacht."

Free translation:

"The pCO_2 analyses were done with the apparatus as described by A. Krogh, which here on board functions perfectly well. When enough water is available, at every station some 6 to 8 measurements were done."

Water samples, not air samples… "Station" in this case is every place where the research vessel was halted to take lots of samples for many different analyses at many depths of the ocean.

I have no idea how Beck could calculate an average CO_2 level in the atmosphere from these water pCO_2 data.

4. The presented error range.

The "error range" (the grey area as given by Beck in Fig. 24 of his work [21]) is only about the error of the methods used *not* for the range of CO_2 values measured in any of the years. If one looks at the real range of all measurements worldwide in the same year, for most of the years the error range is from the bottom to far above the ceiling of the graph. Here a compilation of the same data as Beck from the same literature for the period of interest 1930-1950 from his earlier work:

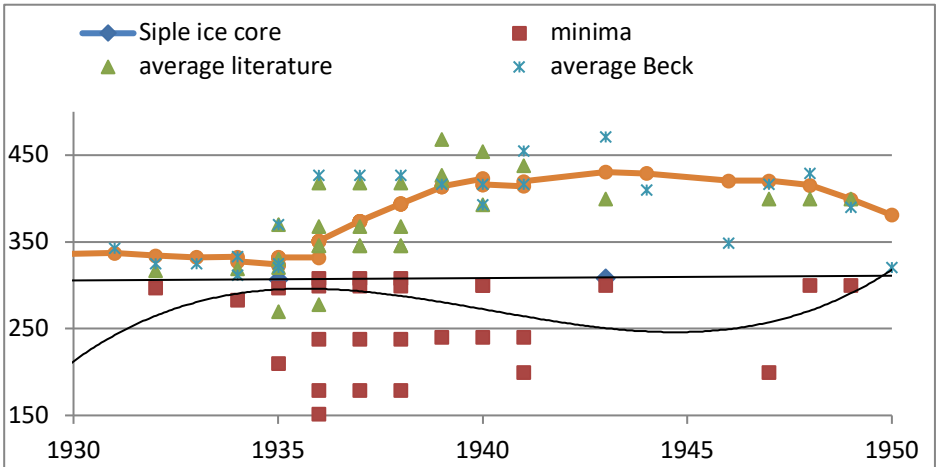

Figure 2: Minima and averages for all data of the years 1930-1950. Interesting: almost all minima are on or under the level of the Siple ice core CO_2 data, with only one exception in a series near Vienna where even the minima were above 500 ppmv.

This shows that the assumed error range of the methods had hardly any influence on the wide range caused by the CO_2 sinks and sources at the places where the measurements were done: the range of data was extremely wide, so that without further information, nobody can say what the real "background" CO_2 level in that period was, except for the data taken over the sea surface or coastal with wind from the seaside.

In most cases there were only short series or even single measurements at several places and thus no possible wind speed convergency towards an asymptote to have a clue of the real background CO_2 level.
Beck used part of the available data, based on criteria which are not very clear to give the average over the globe, but any connection with the real background CO_2 level is problematic:

The average of lots of non-background CO_2 data still is not the background CO_2 level!

Interesting point anyway is that all minima with one exception (taken in the morning at a sink of a mountain slope near Vienna) are on or below the Siple Dome ice core CO_2 levels. That means that ice core CO_2 data are within the extremely wide range of near all data over the period of interest.

5. The physical impossibility of a huge CO_2 peak around 1942.

If we take Beck's data for real, that implies that there was a 20% increase or 60 ppmv CO_2 or near 130 PgC in 15 years time from some source and that huge quantities of CO_2 were absorbed somewhere: about 50 ppmv CO_2 or 105 PgC in only 10 years time. The latter is 10.5 PgC/year or 5 ppmv/year uptake.

Compared to the total quantity of the above ground part of living biomass on land of around 500 PgC, that is about a quarter of all forests and other crops globally…
No such reduction or regrowth on such short period is known and doesn't show up in any other proxy or direct measurement. If real, that would give an enormous drop in the $^{13}C/^{12}C$ ratio together with the 1942 peak and an enormous increase in the same ratio after that. Which is totally absent in the data.

Theoretically there may have been a sudden acidification of the (deep) oceans by undersea volcanoes, but the opposite is simply not possible. There is no such a fast huge sink for CO_2 available

that can absorb 105 PgC of CO_2 in only 10 years time out of the atmosphere, not in the oceans, not in vegetation and other possible sinks are even much slower.

The seasonal CO_2 fluxes are large enough, but these are driven by seasonal temperature changes: around 14 K difference between winter and summer in the NH and somewhat less in the SH, opposite to each other. That is good for appr. 50 PgC release/absorption of the oceans and 60 PgC absorption/release by vegetation, opposite of each other in spring/summer and reverse in fall/winter. The important point is that the end result of all seasonal fluxes is near zero at the end of a year. Temperature anyway can't be the driver for the 1942 peak, as the effect of 1 K global ocean surface temperature increase is only 12-16 ppmv/K according to Henry's law. See the formula of Takahashi (2002 [9]) which exactly calculates the influence of temperature on the pCO_2 of seawater.

Neither ocean fluctuations can be the cause of such a huge variability in such a short time span: while Yndestad [10] and Keeling [11] did find some correlation between the temperature variability and ocean lunar tides, the resulting variability in the Mauna Loa record is about tenths of a ppmv, not tens!

Currently there is slightly more natural uptake than release, directly in ratio to the extra 120 µatm (~ppmv) pressure of CO_2 in the atmosphere, above the current dynamic equilibrium per Henry's law (Takahashi, 2002 [9]) which is around 295 ppmv for the current average ocean surface temperature. That results in about 2.5 ppmv/year or 5 PgC/year net uptake by nature.
Still by far not enough to explain the drop of 50 ppmv in only 10 years, as the sink speed slows down with diminishing pCO_2 difference between atmosphere and ocean surface (and plant alveoli's). That also is clearly explained in Feely ea. (2001 [8]).

6. The conflict with other proxy's and measurements.

6.1 CO_2 in ice cores.

As seen before, the minima of the historical measurements are almost all on or below the ice core CO_2 data. That means that the ice core data are within the full range of measurements of all years that the historical data were taken.

Moreover, we have data from the high-resolution Law Dome ice cores with a resolution as narrow as 8 year and a repeatability of different samples at the same depth of 1.2 ppmv (1 sigma). The data even overlap with the direct measurements at the South Pole for a period of 20 years (1958-1978) (Etheridge ea., 1996 [12]):

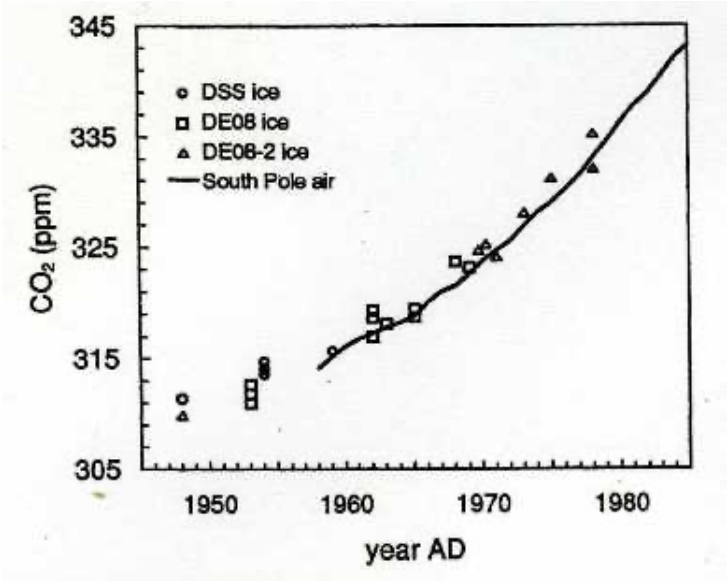

Figure 3: Overlapping of the Law Dome ice core CO_2 data with the direct CO_2 measurements at the South Pole. Source: Etheridge ea. 1996 [12].

The results of four ice cores, three at Law Dome and one at Siple Dome over the period 1900-1980 show nothing special in the period 1930-1950. Only slowly increasing CO_2 levels with even a small dip around 1942 for one the Law Dome ice cores (data from [13]):

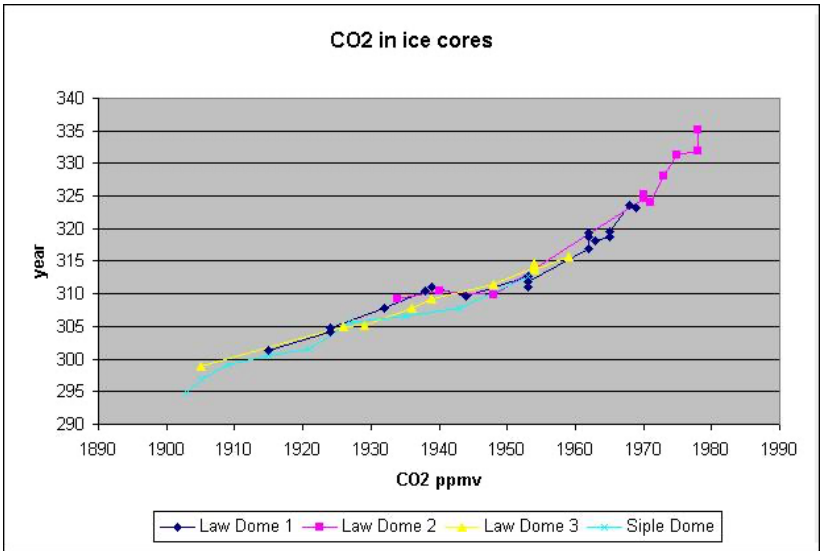

Figure 4: CO_2 levels in ice cores, Source: NOAA [13]

With a resolution of 8 years and a repeatability of 1.2 ppmv, two of the Law dome ice cores Law Dome ice cores (1 and 2) will detect a sudden 1-year wide "spike" of 20 ppmv, be it spread over 8 years or a sustained 2 ppmv increase over the full period of 8 years, thus certainly will detect a "peak" of 60 ppmv and back over a period of 25 years. They didn't.

6.2 $^{13}CO_2$ in ice cores and air CO_2 and in coralline sponges.

The $^{13}CO_2$ level of CO_2 in ice cores (reflecting the $^{13}CO_2$ level in the atmosphere) and in coralline sponges (reflecting the $^{13}CO_2$ level in the ocean surface) show no change in the period 1930-1950, except for the fast decline in $^{13}CO_2$ level, caused by fossil fuel burning which has much lower $^{13}CO_2$ levels than the atmosphere or oceans.

If there was a huge increase in CO_2 from the deep oceans, the $^{13}CO_2$ level should go up (seawater CO_2 from the deep oceans have a higher $^{13}CO_2$ level at -6.4 per mil [1]) than the current atmosphere already below -8 per mil).
If there was a huge increase in CO2 from vegetation, the $^{13}CO_2$ level should go faster down than current, as burning or decaying vegetation has about the same low $^{13}CO_2$ level as fossil fuels. Nothing special can be seen in the $^{13}CO_2$ level decline over the period 1930-1950:

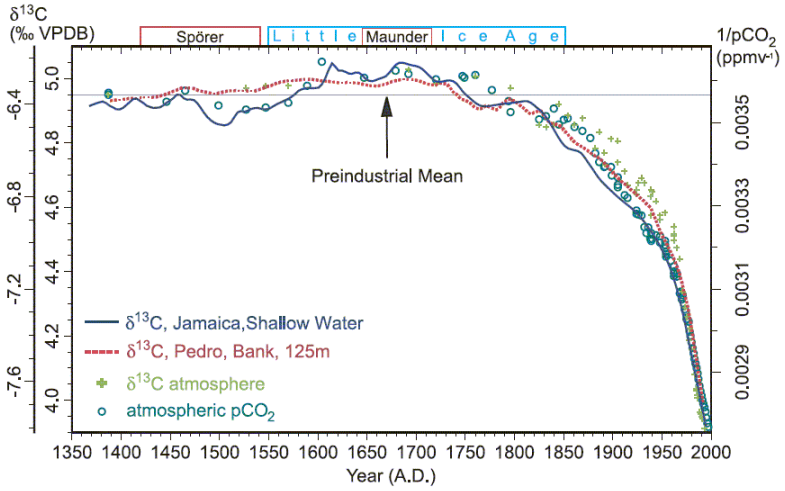

Figure 5: $^{13}CO_2$ decline in atmosphere and in coralline sponges. Source: Böhm ea., 2002 [14]

The resolution of the data in the coralline sponges is 2-4 years, the mixing ratio between ocean surface waters and the atmosphere is less than a year. Changes of 1 PgC CO_2 in the atmosphere by vegetation or 4 PgC from the deep oceans would be detected as a change in the $^{13}CO_2$ level of the coralline sponges. No changes caused by an over 100 PgC "peak" around 1942 can be found.

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[1]) There is a huge discrimination in stable isotopes at the sea-air border and back. The net equilibrium between oceans (at zero per mil in the deep oceans, +1 to +5 per mil in the ocean surface) resulted in a relative stable level of -6.4 +/- 0.2 per mil in the atmosphere over the whole Holocene and started to drop from 1850 on down to below -8 per mil nowadays. See Böhm ea., 2002 [14].

6.3 Stomata data

Ernst Beck did mention stomata data as supporting his ideas, but as far as I can see, they don't. Stomata data are from plants growing on land and each place has its own (positive) CO_2 bias compared to global CO_2 levels. Therefore, they are calibrated against… ice cores and direct measurements over the past century.
The main advantage of stomata data is the high resolution over time, the drawback is that they mainly reflect local CO2 levels and local variability, depending of land use in the main wind direction, even the main wind direction may have changed over time (MWP vs. LIA).

Here the calibration of a series of European tree birch leaf stomata data in The Netherlands (Wagner ea., 2002 [15]):

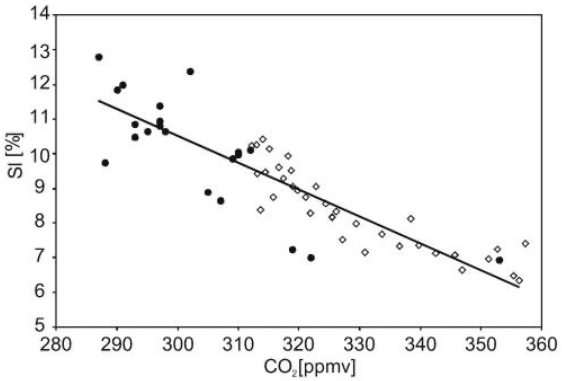

Figure 6: European tree birch leaf stomata index calibration data. Source: Wagner ea., 2002 [15]

According to high resolution ice cores, the CO_2 levels in 1942 were around 310 ppmv. If there was a real peak value of 370 ppmv in the same year as the 310 ppmv mark in the graph, according to Beck, the SI [%] would be near the bottom of the graph.

The same problem for the stomata data at Jay Bath (Kouwenberg ea., 2005 [16]) which are interpretated by Beck as high in the year 1950, but the authors didn't see anything special in that period. The error margin of the stomata CO_2 level estimates again includes the ice core CO_2 level.

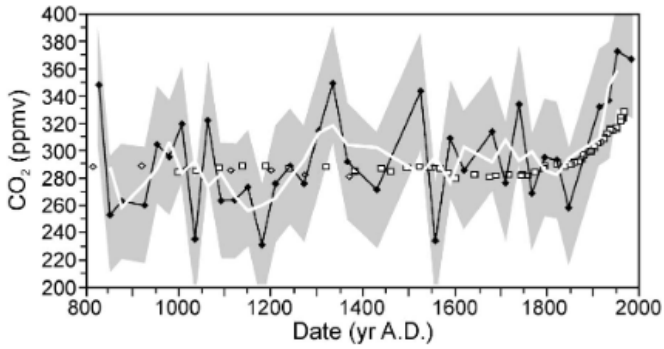

Figure 7. According to Ernst Beck, there was a high CO_2 value of 370 ppmv around 1950, but the wide error margins of the method includes the ice core results of around 310 ppmv in the same year. Kouwenberg ea., 2005 [16].

The authors of the reconstruction at Jay Bath even warn against the interpretation of the data:

"However, the large amplitude of the CO_2 signal in the Jay Bath record, compared to the ice cores and other stomatal reconstructions, may be influenced by the relatively low amount of needles in the low-CO_2 part of the calibration data set."

7. The influence of wind and rain on the CO_2 levels found.

7.1 The influence of wind speed.

Francis Massen has done a tremendous job by collecting and analysing a lot of meteorologic and other data, including CO_2 data, on top of a school building at Diekirch, Luxembourg.

With the data collected, he could show that with high wind speed, the wide spread of the collected data was narrowing into an asymptote that resembles the background CO_2 levels of the same period in time. That is reflected in the work he made together with Ernst Beck and presented these results at the online KLIMA2009 conference of the University of Hamburg (Massen and Beck, 2009 [17]).

The results for Diekirch are plotted here:

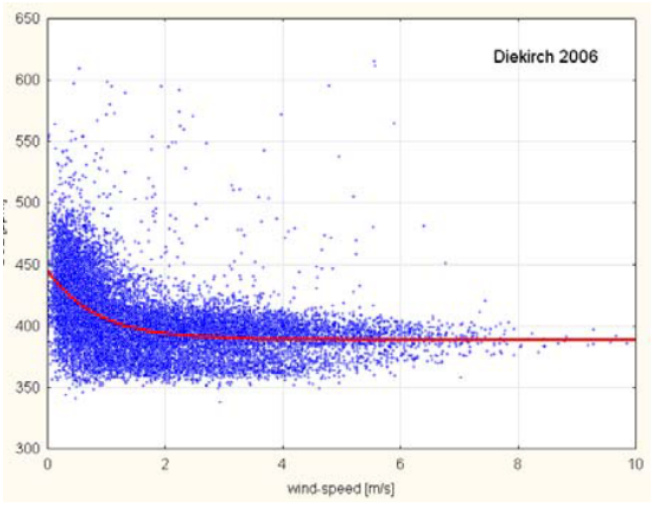

Figure 8: Asymptote caused by wind speed vs. CO_2 levels. Source: Massen and Beck, 2009 [17]

There is a clear influence of wind speed on the measurements and with higher wind speeds, the measurements approach the real "background" CO_2 levels as measured at Mauna Loa and other baseline stations.

An important point is that one need many data at high wind speed to get the best performance of the algorithm. In this case, the bulk of all data is between 350 and 500 ppmv at near zero wind, but rapidly goes down to 350-420 ppmv already at 2 m/s wind speed and results in around 390 ppmv for the asymptote. The asymptote lays at around 25% of the original range with near zero wind.

Ernst Beck used this method to look at the historical data of Giessen (Germany). We will come back on that point when we discuss the data as interpretated by Beck in chapter 8.2.

7.2 The influence of rain.

In his latest work, Beck also used precipitation as a tool to estimate the real background CO_2 levels. In fact, rain itself has not much influence on CO_2 levels, as fresh water doesn't dissolve much CO_2.

Where the rain drops are formed (out of several m^3 air for one litre rain), the drop in CO_2 level in the surrounding air is not even measurable: its solubility is only 3.4 g CO_2 in one litre fresh water of 0°C at a pressure of 1 bar of 100% CO_2 [18]. At 0.0004 bar only 1.3 mg/l CO_2 is dissolved in rainwater.

My impression is that the results of more rain have more to do with the turbulence of the air masses that are moving together with (heavy) rain, not with the precipitation itself.
It can be a useful tool if rain data are available and wind data are not available and enough data with heavy rain are available.

Anyway, in most cases there are too few historical datapoints on precipitation from the same site to give a good impression of the performance of rain on the CO_2 data to give the background CO2 level.

8. The interpretation of the data from longer series

The whole "peak" value around 1942 by Ernst Beck is mainly based on two longer series of data: Poona, India and Giessen, Germany.

8.1 The CO_2 series of Poona, India.

The station at Poona, India did collect only a few ambient air CO_2 measurements. Most measurements done were under, in between, and just above growing crops, as that was the purpose of the measurements: following the CO_2 use by growing crops.
Thus, completely out of order to know anything about "background" CO_2 levels.
Here the plot of all the measurements:

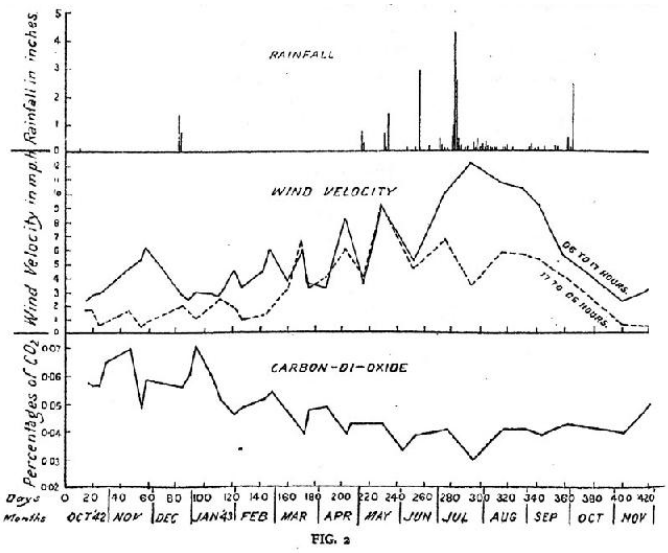

Figure 9: CO_2 measurements (1-2 per month) at Poona, India (Misra, 1942-1943 [19]).

There are far too few datapoints available and most of them were around crop leaves, to get even a clue of the real background CO_2 levels of that time… The range from 300 to 700 ppmv within a year shows that one can obtain about any level one (doesn't) want from following crops on land.

8.2 The CO_2 data from Giessen, Germany.

The second and most important place where a long series of CO2 data was taken was in Giessen, mid-west Germany. Here the "finger plot" of the historical data as calculated by Massen and Beck [17]:

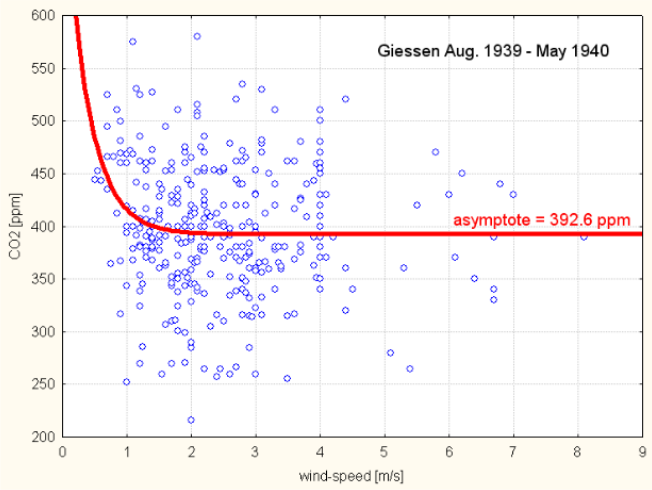

Fig.10 The CO_2 versus wind speed plot of the Giessen measurements by W. Kreutz (average = 398, stdev = 62)

Figure 10: finger plot of the historical CO_2 data from Giessen, Massen and Beck, 2009 [17].

The "finger plot" of the data is rather questionable, as there are only some 20 datapoints at wind speeds over 4 m/s, compared to the hundreds of data points at Diekirch in Figure 8 or the modern data from the modern station at Linden/Giessen (see Figure 11).
Moreover, there is a huge spread from 250 to 530 ppmv for the bulk of the data up to 2 m/s and even over 4 m/s, the spread still is from 270 to 470 ppmv.

The interesting point is that there is a modern CO_2 measuring station, at a few km from the site of the historical station, which takes air samples every half hour over a GC for CO_2 and other ambient gases of interest. Linden/Giessen still is rural in modern times, thus some comparison is possible.

From the modern station, here the "finger plot" of a lot of CO_2 data collected by HLNUG [20]:

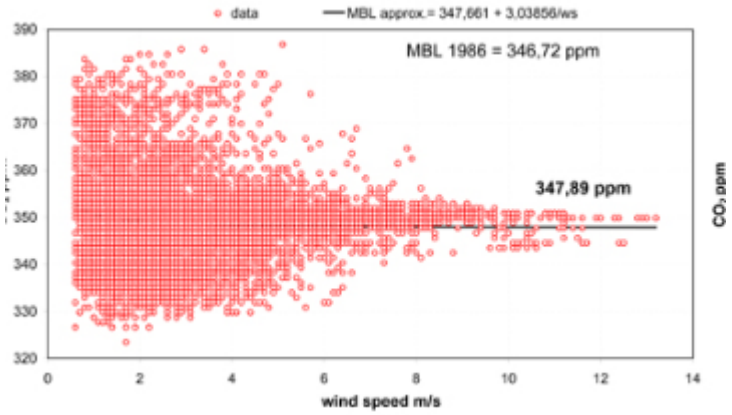

Figure 11: finger plot of the modern CO_2 monitoring station at Linden/Giessen [21]

Compared to the historical data, the bulk of the modern data have a much smaller range of measurements: about 330-380 ppmv, while 250-530 ppmv for the historical data. That is a difference in range of over five times in width. That doesn't give much confidence in the historical measurements, as one can expect more disturbances from traffic in modern times than around 1939-1941. Moreover, there is a clear finger plot for values at wind speed above 6 m/s, which is questionable for the historical data by lack of sufficient observations at high wind speed.

To show the problems which the historical measurements, here a plot of the modern station CO_2 data of Linden/Giessen over a few days with little wind and a strong inversion layer:

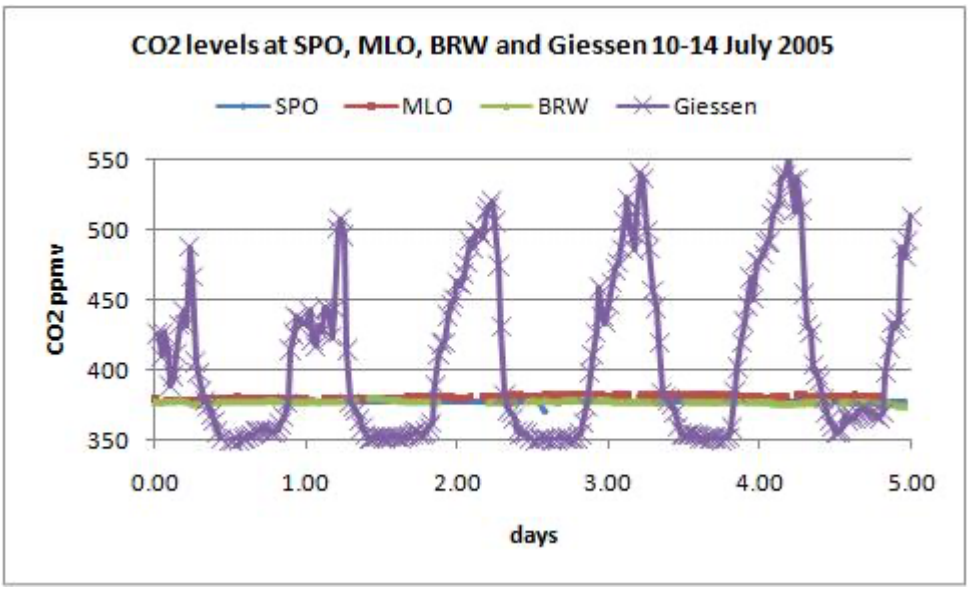

Figure 12: CO_2 data from the South Pole (SPO), Mauna Loa (MLO), Barrow (BRW) and Giessen Data from the period 10-14 July 2005. All data are raw(half) hourly measurements and include outliers. Data from Giessen from [20] other station data from NOAA [23].

The historical measurements at Giessen were taken three times a day at 7 A.M., 2 P.M. and 9 P.M. That makes that one measurement was below "background" (due to photosynthesis) and two were at the flanks of the decreasing and rising CO_2 levels under inversion. Over a full year of data, that gives already in average a local bias of around 40 ppmv in the modern station data, compared to Mauna Loa.

As an aside, Beck in his latest work says that the samples were taken every 90 minutes, but that was only during an extra campaign over 5 days, not over the full period:

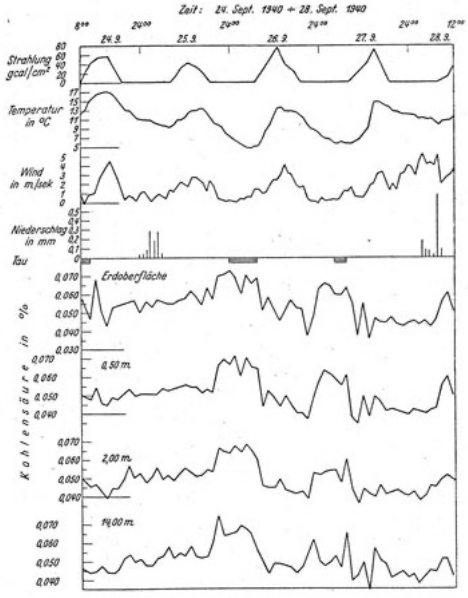

Abb. 1. Tagesverlauf der Kohlensäure und Witterungsfaktoren.

Figure 13: CO_2 samples taken every 90 minutes in the period 24-28 September 1940 (Kreutz, 1941 [24])

Another strange mistake in Beck's text is that he says that the standard deviation of the historical measurements was +/- 6.47 ppm, while the table from Kreutz shows a sigma between 61.1 and 65.9 ppmv, as at that time everything was expressed in tenths of a percent in air. Also clear is that only three samples per day were taken at different heights over the full period, except the above 5 days:

Tabelle 1 a und b.
Mittlere CO_2-Werte.
a) vom 1. August 1939 bis 31. Januar 1941.

	0 m	0,5 m	2,0 m	14,0 m	Mittel
Vormittag	42,8	41,7	40,5	43,2	42,1
Nachmittag . . .	52,9	45,0	43,0	46,4	46,8
Abend	42,5	42,5	41,6	44,0	42,7
Tagesmittel . . .	46,1	43,1	41,7	44,4	43,85

b) für das Jahr 1940

	0 m	0,5 m	2,0 m	14,0 m
Mittel	46,8	45,1	43,4	46,2
Maximum	64	62	62	68
Minimum	27	28	24	24
Streuung σ (abs.) .	± 6,42	± 6,11	± 6,12	± 6,59
Streuung σ (%) . .	13,7	13,6	14,1	14,3

Figure 14: Averages and standard deviations of samples at different heights over time in Giessen (Kreutz 1941 [24]). Vormittag = morning, Nachmittag = afternoon, Abend = evening. Streuung = standard deviation

In comparison, the full chart of all measurements can be shown:

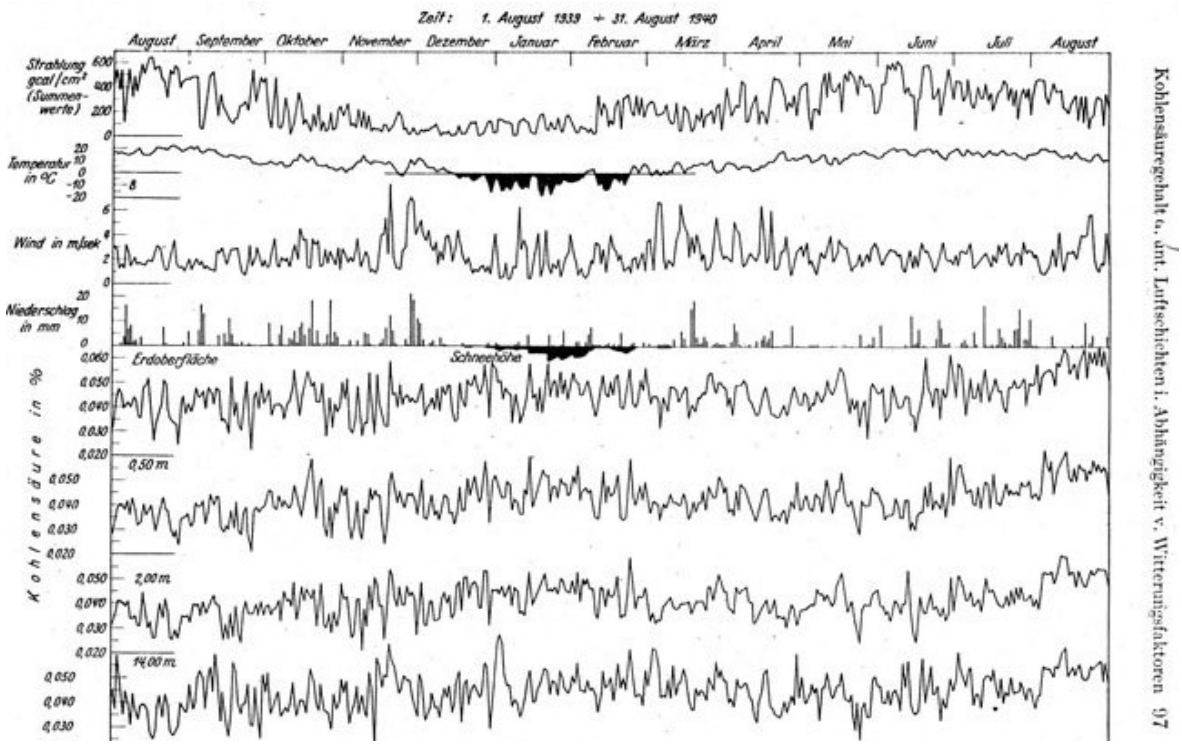

Figure 15: Chart of all historical CO_2 measurements at Giessen with weather factors (Kreutz, 1941 [24])

8.3 The CO_2 data from Point Barrow, Alaska, USA.

The difference between the historical and modern data is striking:

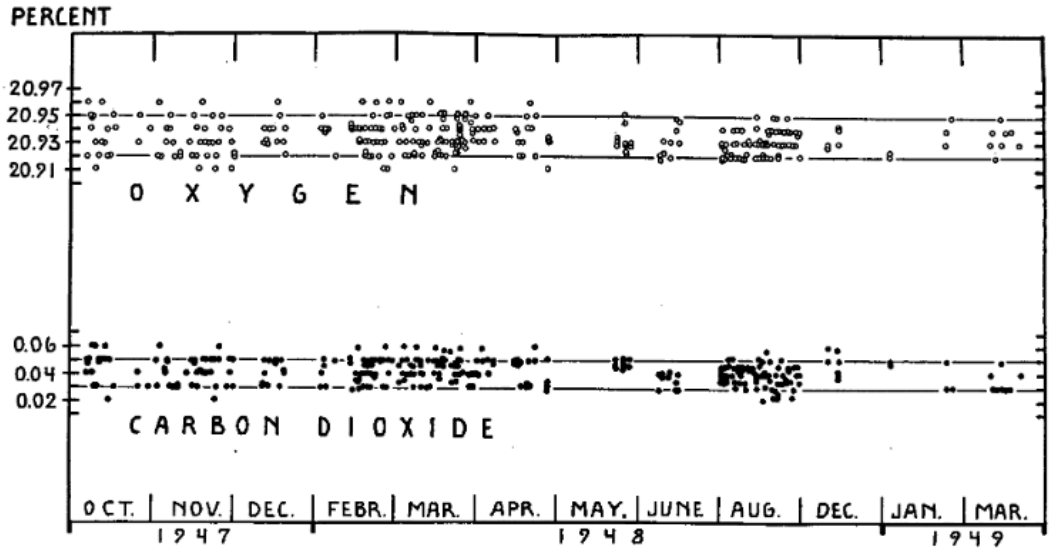

Figure 16: historical CO_2 measurements taken at Point Barrow, range: 200-600 ppmv [2].

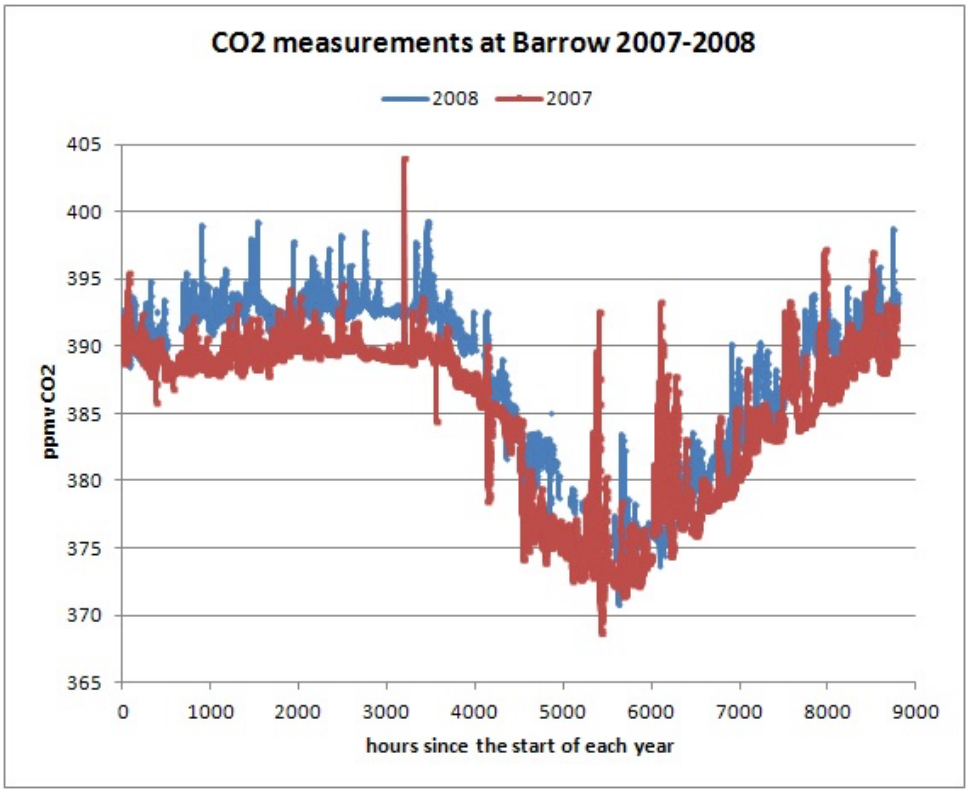

Figure 17: Modern hourly averaged CO_2 measurements at Point Barrow, range: 370-405 ppmv, including all local outliers and a 18 ppmv seasonal amplitude (NOAA [23])

Not only is there a 100 ppmv bias in the historical data, which the authors accept as acceptable for the accuracy of the apparatus that was used, but the spread of the data is also enormous:

between 200 and 600 ppmv for the historical data compared to 370-400 ppmv (with 2 outliers on 17,500 hourly datapoints) for the modern station, including a seasonal amplitude of 18 ppmv. A difference of 13 times in range… For still a very pristine area…

9. The inclusion and exclusion of series

Beck was not the first to make a compilation of the available CO_2 measurements in certain periods of the past. Callendar did that already in the 1930's [25], based on very stringent a-priori criteria. One can agree or disagree about the criteria used by Callendar, but I still have the impression that Beck didn't use any criteria at all and just lumped everything together: the good, the bad and the ugly…

One of the criteria by Callendar was to exclude series that were taken for agricultural purposes, which would have excluded the series of Poona, India by Misra. Which is fully warranted as such data have not the slightest resemblance of background CO_2 data of that time…

Even so, there are strange omissions in his choice to include some series and exclude others.

If one looks at the description of the data collected at Point Barrow [2], several other investigations were mentioned by the researchers that may be of interest. Only one is retained by Beck for his compilation: the Scholander tests of the new equipment that was intended to measure CO_2 in exhaled air [3]. Here the full list of investigations that were mentioned by the researchers at Point Barrow:

Author	Year	CO_2 ppmv	O_2 %	Technique
Nansen and Petterson	1880	300-320		
Krogh	1904	250-700	20.92-21.02	Haldane
Benedict	1912	300	20.95	
Krogh	1919	300	20.95	
Fieser	1924	300	20.94	different absorber
Müller	1928	240-300		
Peters and Van Slyke	1932		20.93	Haldane
Haldane and Graham	1935		20.93	Haldane
Carpenter	1937	310	20.94	
Lockhart and Court	1942	300-1700	20.48-20.76	Haldane
Scholander	1947	330	20.94	for exhaled air
Hock ea.	1952	400	20.94	same as Scholander 1947

Table 1: list of different CO_2 and O_2 measurements mentioned by the Point Barrow researchers [2].

Hock ea. (1952 [2]) of the Barrow test accepted the around 300 ppmv CO2 levels as the "background" data of that time and their 400 ppmv average as within the margins of the method used…

Of particular interest is the Carpenter investigation (1937 [26]), also mentioned by Callendar (1928 [25]):
It is the first and only one that I know which mentioned the use of a "calibration gas" to test the CO_2 measuring device before using it for its real purpose (physiological tests in different research facilities).
The calibration gas was a simple cylinder with compressed air that was used to test the apparatus and check if it did show the same values over the full period of use.

After that check, CO_2 and O_2 in ambient air were measured at the three locations where the research was established.

The results are very interesting:
With only one outlier (at 600 ppmv) on 1266 samples, the three locations did show an average of 310 ppmv CO_2 in ambient air with a standard deviation of only 15-17 ppmv, method and results together.
Compare that to the figures of Giessen a few years later that show an average of 417-461 ppmv and a standard deviation of 61.1-65.9 ppmv, causing the "peak" in Beck's compilation.
Carpenter's data and several other series were not included in Beck's work.

In his latest work, Beck (2022, [21]), the SI shows 875 stations with data, but in his text, he mentions that only 87 data series were used in his compilation. I didn't find which stations exactly were retained and which not, neither the criteria he used for inclusion of exclusion, except a vague sentence that:

"The selection process was characterized by using only data sampled by known methods and from locations which allow a validation of local influences and air masses"

Allow me to have some doubts that anyone can know the local influences at the historical places and air masses (like the influence of all the land use changes in the main wind direction).

Conclusion

While I admire the enormous amount of work that the late Ernst Beck has done in recovering lots of historical CO_2 measurements, his estimation of the accuracy of these measurements seems very optimistic and the problems with the local contamination of the data seems highly underestimated. The criteria he used to exclude or include certain series are far from clear.
Moreover, the historical "peak" around 1942 is physically impossible and conflicts with other proxies over the same period and with CO_2 data from high resolution ice cores.

Still, it was a monumental work that he has done, to support the words of Jan-Erik Solheim. Together with Francis Massen I can only hope that others will recover even more historical data and give them back to the scientific world.

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