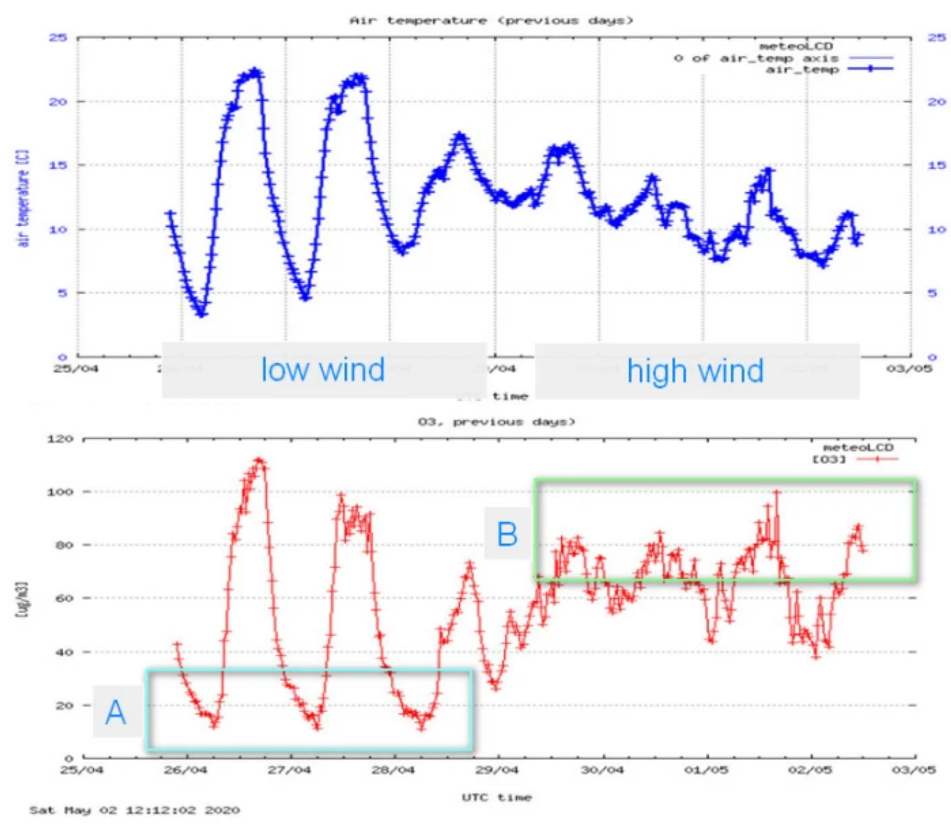
On wind, CO2 and other gases (3/3)

4. A fast recap.

This is the third and last part of my comments and observations on the influence of wind speed on near ground CO2 concentrations (mixing ratios). Let me summarize what we have seen and talked about in the first two parts:

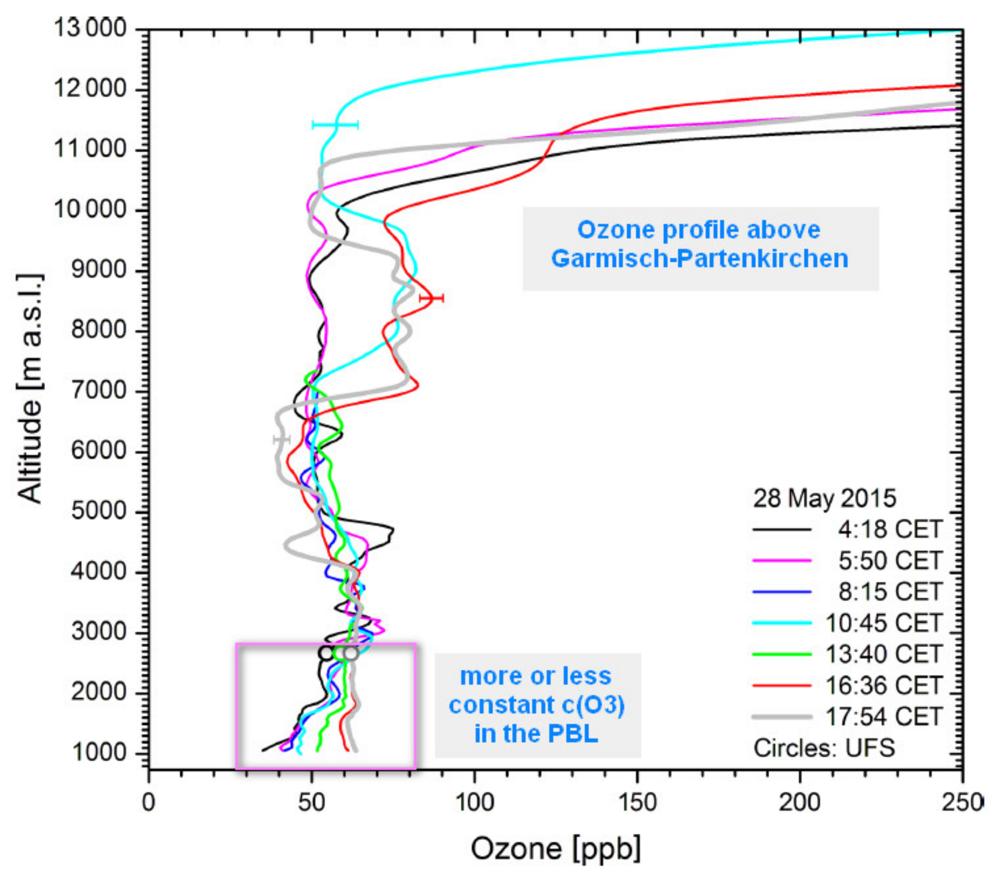
1. Observation shows that under low wind conditions, the daily CO2 concentration swings heavily from an early morning low to an afternoon high; the amplitude can reach values of 130 ppm.
2. When wind blows, and all other conditions as solar irradiance and air temperature stay more or less the same, this daily swing is dramatically dampened: the peak values can be clipped by more than 100 ppm, the minimum values remain more or less unchanged, the amplitude of the daily swing is down to about 20 ppm.
3. A similar pattern can be observed on the NO2 concentrations, as measured for instance in the Beckerich station.
4. Ground ozone concentrations do NOT follow this pattern of peak-clipping at all: the maxima remain more or less unchanged, but the minima are drastically higher. Air temperature plays a minor role, as shown by the next figure which shows the temperature and ozone date at meteoLCD for the 7 days ending in Saturday 02 May, afternoon:



The box A clearly shows constant O3 minima in spite of rising air temperature minima; the box B shows that the O3 maxima are lower: air temperature maxima are also lower by about 5°C (25%) whereas wind speed is much higher: the peak on the 26/04 is 1.8 m/s, and it is higher than 6 m/s (>300%) during the B-box days! So the wind speed is possibly the main factor increasing the daily O3 minima.

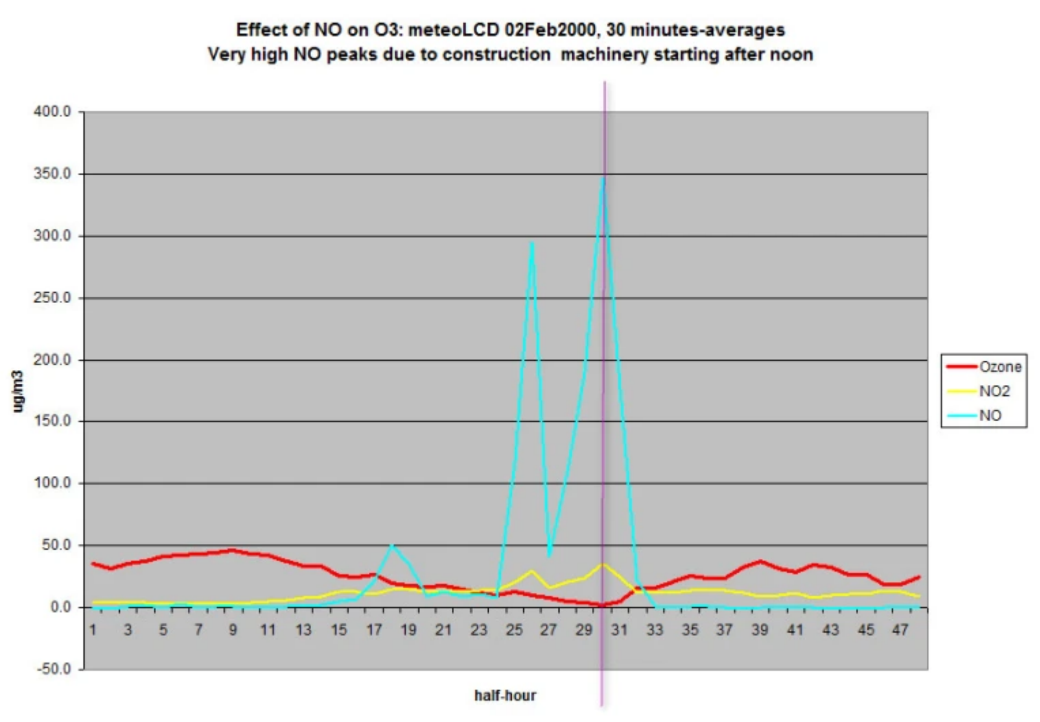
5. How can we explain the different O3 pattern?

Luckily, I found a recent paper by Thomas Trick et al. published in January 2020 in "Atmospheric Chemistry and Physics", titled: "Very high stratospheric influence observed in the free troposphere over the northern Alps – just a local phenomenon?" (link). This paper shows that incursions of stratospheric ozone are much more important than what the consensus science says. Usually it is assumed, that these incursions (known since many years) do not upper the local concentrations by much more than 10 ppb (20 ug/m3). In this paper it is shown from observations that this is not the case: the incursions can be much higher, something that activist scientists who see high ozone levels being caused exclusively by human activity are eager to ignore. The very high O3 concentrations in the stratosphere can increase the O3 concentrations at mid-troposphere heights (and possibly lower) by quite a lot. Balloon observations and LIDAR soundings (by laser) give us a good picture of how the O3 concentration varies with altitude. The next picture (from the paper) shows the situation at Garmisch-Partenkirchen:



For us the lower part in the fuchsia colored box is important: we see that O3 concentration does vary with the time of the day, that it is highest during late afternoon (grey curve) as we know well, but most important, that the **overall O3 values are more or less constant**! This means that higher wind speeds do increase the mixing of air layers, but as the O3 concentration is about the same, that mixing does not cause a dilution! The low morning values during wind-poor days are the result of O3 destruction caused by NO (we may assume that NO concentrations are well correlated to NO2, the only gas of which we have observational values).

The following picture shows an extreme situation at meteoLCD, 2-Feb-2000; this was a period where our NO and NO2 sensors (by Environnement SA) were still in action. The year 2000 was a year where parts of our buildings were re-constructed, and heavy machinery as compressors and excavators were often operational at ground-level. This day they started after noon, and the extraordinary high NO levels are mainly caused by starting up the Diesel engines. The result is a near complete destruction of O3, this at a time where the O3 concentrations are normally rising:



6. In conclusion.

Once more, we have shown that near-ground CO2 concentrations are heavily influenced by wind speed; this CO2 lowering influence certainly is much more important than that of photosynthesis which works in the same direction. Ground ozone concentrations are not impacted in a similar manner, whereas those of NO2 are. So, and this may come as a surprise, the concentrations at ground level of different atmospheric gases does not respond to increasing wind speeds in the same manner!

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