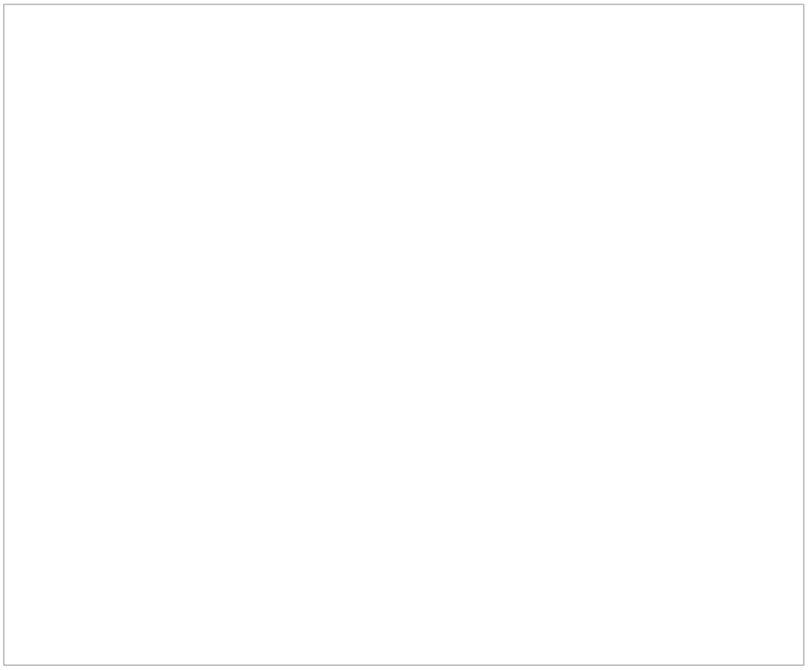
Stomatal data vs ice core measurements to measure CO2 levels

What The Science Says:
Stomatal data is not as direct as ice core measurements and hence not as precise.

Climate Myth: Plant stomata show higher and more variable CO2 levels
"When stomata-derived CO2 (red) is compared to ice core-derived CO2 (blue), the stomata generally show much more variability in the atmospheric CO2 level and often show levels much higher than the ice cores." (David Middleton)

Shortly after F. Wagner published his stomatal results (here), a response appeared in Science. The key difference in the result can be seen in the figure:



This figure shows that Wagner's data shows a sharp increase to 330ppm at 11,260 years BP (years before 1950), staying there for 500 years, in disagreement with the Taylor Dome and Vostok ice-core records.

In deciding between these results, several items should be noted:

Firstly, ice-core CO2 measurements are direct measurements on air that has been enclosed in bubbles. On the other hand, stomatal density is an indirect measure. Experiments on stomata density showed that "the stomatal response to increasing atmospheric CO2 was identical to that induced by removing water from the plant roots" (Idso et al 1984). In other words, stomatal index data may not be the able to measure the atmospheric concentration as precisely as its proponents would like.

Secondly, several different ice-core data sets are essentially consistent. Artifacts do appear in earlier ice core records - mainly the Greenland drill sites where CO2 was depleted through a chemical reaction - but

there are no such indications of this in the Taylor Dome ice core. In any event, this is a known phenomena, and one that can be accounted for. These records all indicate the CO2 concentration from 260 to 280 ppmv during the preindustrial Holocene.

Stomata data, on the other hand, do not show such agreement. For example Beerling et al (D. J. Beerling, H. H. Birks, F. I. Woodward, J. Quat. Sci. 10, 379 (1995)) report largely scattering proxy CO2 values from 225 to 310 ppmv between 9940 and 9600 14C-yr, in disagreement with the data presented by Wagner et al.

In summary, the skeptics claim that stomatal data falsify the concept of a relatively stable Holocene CO2 concentration of 270-280 ppmv until the Industrial Revolution. This claim is not justified.

Skeptical Science explains the science of global warming and examines climate misinformation through the lens of peer-reviewed research. The website won the Australian Museum 2011 Eureka Prize for the Advancement of Climate Change Knowledge. Members of the Skeptical Science team have authored peer-reviewed papers, a college textbook on climate change and the book Climate Change Denial: Heads in the Sand. Skeptical Science content has been used in university courses, textbooks, government reports on climate change, television documentaries and numerous books.