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Study of Antarctic ice cores reveals atmospheric CO2 history over past thousand years

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Credit: Newcastle University

(Phys.org)—A small team of researchers with affiliations to institutions in the U.S., Switzerland and Korea has found links between atmospheric carbon dioxide levels, the land carbon reservoir and climate over the past thousand years, by examining ice cores taken from the West Antarctic Ice Sheet Divide. In their paper published in *Nature Geoscience*, the team describes the levels of CO_2 they found and why they believe that most of the level changes they observed were likely due to terrestrial sources. Jed Kaplan, with the University of Lausanne offers a News & Views piece on the work done by the team in the same journal issue, comparing CO_2 level changes found by the researchers with historical human events putting the ice core data into perspective.

To learn more about atmospheric carbon levels over the past millennium the researchers analyzed ice core samples taken by workers on the Antarctic WAIST Divide Ice Core project—looking for both CO_2 concentrations and their isotopic composition. In so doing they were able to see levels rise and fall at both decadal and centurial level of detail, for the years 760 to 1850. The data showed two main "events" during that period, the first was a slow decline running from the start of the twelfth century to the start of the nineteenth century—the other was decadal level ups and downs of levels attributable to unknown, but speculative causes. The researchers also believe that most of the level changes came about due to terrestrial sinks and sources, not activity in the oceans.

Kaplan suggests some of the ups and downs could be traced back to natural causes, such as increases or decreases in peat deposits due to temperature variations, though they could just as easily be blamed on human activities such as soil erosion in Eastern Europe due to agricultural activities. He also points out that the sharp drop in CO_2 levels that occurred around 900, almost undoubtedly came about due to population drops in Mesoamerican cultures after the introduction of European diseases. Likewise the sharp increase in carbon levels from 975 to 1080, can almost certainly be attributed to events in both Europe and Asia. He also notes a dip right around the time shortly after the onset of the Black Plague, which happened to coincide with widespread draughts in Asia. He concludes by suggesting that studies of ice cores such as that done by this new team not only help reveal trends in the past, but will likely prove useful for helping to predict trends in the future.

More information: Links between atmospheric carbon dioxide, the land carbon reservoir and climate over the past millennium, *Nature Geoscience* 8, 383–387 (2015) DOI: 10.1038/ngeo2422

The stability of terrestrial carbon reservoirs is thought to be closely linked to variations in climate, but the magnitude of carbon–climate feedbacks has proved difficult to constrain for both modern and millennial timescales. Reconstructions of atmospheric CO2 concentrations for the past thousand years have shown fluctuations on multidecadal to centennial timescales, but the causes of these fluctuations are unclear. Here we report high-resolution carbon isotope measurements of CO2 trapped within the ice of the West Antarctic Ice Sheet Divide ice core for the past 1,000 years. We use a deconvolution approach to show that changes in terrestrial organic carbon stores best explain the observed multidecadal variations in the δ13C of CO2 and in CO2 concentrations from 755 to 1850 CE. If significant long-term carbon emissions came from pre-industrial anthropogenic land-use changes over this interval, the emissions must have been offset by a natural terrestrial sink for 13C-depleted carbon, such as peatlands. We find that on multidecadal timescales, carbon cycle changes seem to vary with reconstructed regional climate changes. We conclude that climate variability could be an important control of fluctuations in land carbon storage on these timescales.