Atmospheric Carbonic Acid

Raining CO_2[1]

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Robert A. Beatty BE (Minerals) FAusIMM
BobBeatty@bosmin.com

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One aspect of the "Global Warming" discussion, which is not covered adequately, is what happened to CO_2 in the atmosphere?

Some chemical fundamentals are important:

- Carbonic acid has a molar mass of 62.03 g/mol and a pH of 4.18
- Pure water vapour has a molar mass of 18 g/mol and a pH of 7.0
- Atmospheric CO_2 is very soluble in atmospheric water vapour, and forms a solution with a molar mass of around 46.3 g/mol at a pH between 5.0 and 5.6
- Water evaporating from the surface of the sea is essentially pure water vapour.

This highly soluble gas ensures it gets rapidly absorbed into the atmospheric moisture which starts out at a pH of 7.0, but reduces to between 5 and 5.5 pH as rainfall which is the CO_2 absorption limit.

The resulting water vapour is 2.57 times heavier than pure water vapour, and gravitates to Earth, rapidly removing CO2 from the atmosphere. These drops have less buoyancy than pure water vapour which causes them to fall more rapidly. Rain drops have now become drops of carbonic acid, and are described as "wet deposition".[2]

[1] https://bosmin.com/PSL/RainingCO2.pdf

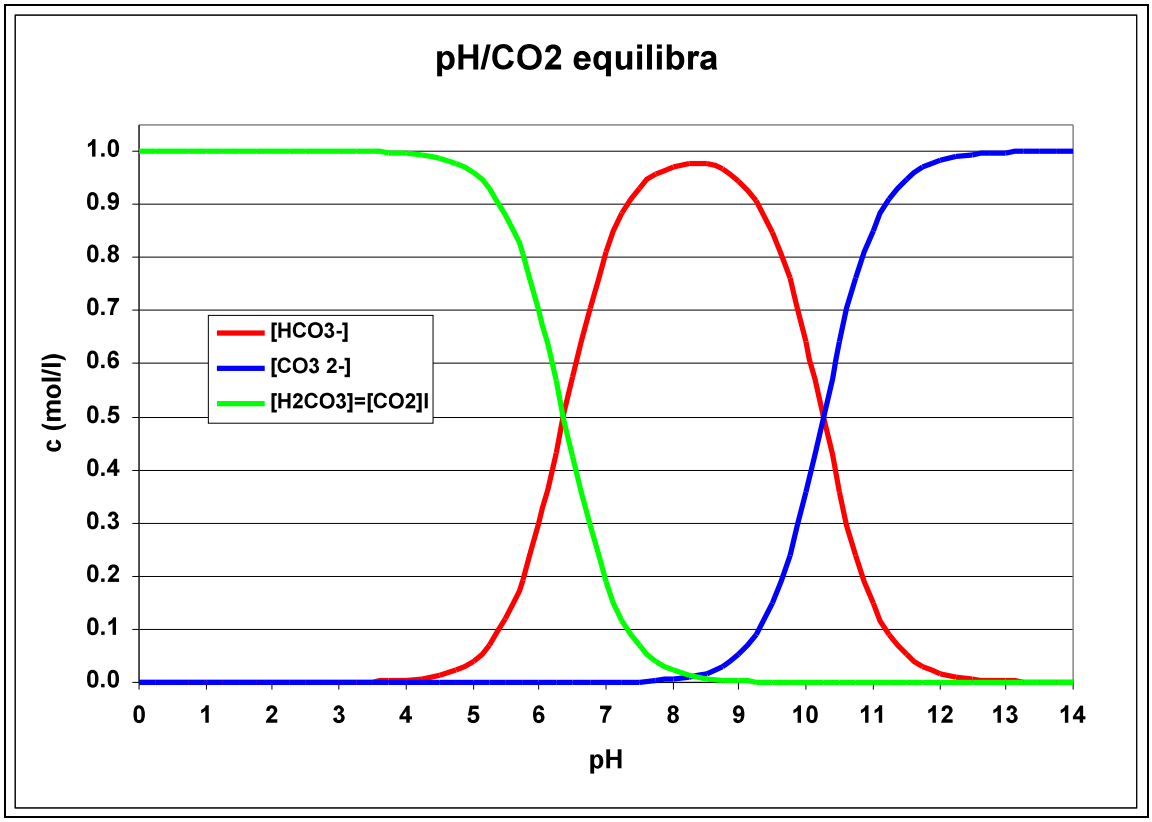
[2] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0161105

As rain, CO_2 parachutes out of the atmosphere in large quantities, much of it falls directly onto the ocean, where the pH is around 8.2 Other rain falls on the land where it can oxidise rock surfaces, before entering rivers leading to the sea.

Here the sea water immediately neutralises the more acid rain. This ensures CO_2 occupies a unique position relative to the other atmospheric gasses, and explains why there will always be a limit to the quantity of CO_2 present in the atmosphere, but not in sea water.

The following graph shows why the sea water readily dissolves CO_2 at a pH of 8.2:[1]

[1] https://bosmin.com//SeaChange.pdf



At a pH of 8.2 CO_2 gas is largely absorbed into the sea as the bicarbonate radical HCO3- which combines with Na^+ and Ca^{++} cations to form dissolved sodium and calcium bicarbonates.

When water vapour evaporates from the surface of the sea, it does so as substantially pure water vapour, not as carbonic acid. This occurs because the CO_2 which landed as an integral part of acid rain cannot reform during the evaporation cycle due to the CO_2 having transformed into the bicarbonate radical. This ensure CO_2 only has a one way trip into the ocean as rain, but can re-emerge as CO_2 if the Sea Surface Temperature (SST) rises above the temperature/particial pressure balance defined by Henry's Gas Law.

CO_2 solubility highlights the importance of Henry's Law, and the SST. Sea temperature controls the concentration of CO_2 in the atmosphere immediately above the ocean, as reported by Emeritus Professor Lance Endersbee.[1] The results are based on recorded quantities, and show a straight line relationship between SST and atmospheric CO_2. Sea temperatures are mostly controlled by tectonic activity on the sea floor.

These fundamentals are germane to the whole 'Green House' debate, and show there is no connection between burning coal, LNG, bush fires, GM, BMW or Tesla, and the concentration of CO_2 in the atmosphere. Planting trees and reducing 'emissions' will do nothing to alter the basics of atmospheric CO_2 science.

[1] http://icecap.us/images/uploads/Focus_0808_endersbee.pdf