A few things you might not know about
The Greenhouse Effect & Global Warming

1. The Greenhouse Effect and Global Warming are not new phenomena!

- The French mathematician Fourier (who lived through the French Revolution) first proposed the importance of both atmospheric and oceanic currents in redistributing heat around the planet. Incidentally, it is Fourier's mathematics which underlies the speed with which our GPS and Sat Nav systems work.
- The basic science behind the Greenhouse part was actually made public in 1896 by the Swedish scientist Svante Arrhenius. Essentially, energy from the sun, largely in the form of visible light, passes through the atmosphere without much absorption (largely because the air is mainly N_2 and O_2). This incoming radiation warms the surface. Like all things which have temperatures above absolute zero the surface re-emits radiation but at a frequency determined by the temperature; this is in the infrared region of the spectrum so we do not see it. Some of this outgoing radiation has exactly the right frequency to match the vibrational frequency of the C-O bonds in CO_2, so the energy is absorbed by the molecules as they enter a vibrationally excited state. Then almost immediately they 'relax' and the molecules end up moving a bit faster, i.e. they are a bit hotter. This is the Greenhouse Effect.

2. Water is also a major Greenhouse gas. Water molecules are present in the atmosphere and they behave in a similar way to CO_2 but at a slightly different frequency. So why do we bother so much about CO_2 and ignore H_2O? As we all know, the higher up we go the colder it is; in the case of water this leads to cloud formation, rain, hail or snow. This is a very efficient, natural way of removing H_2O from the atmosphere. Without the water contribution to global temperatures the temperatures on the planet would all be well below zero day and night. Life as we know it would cease to exist.

3. Are there natural mechanisms for removing CO_2? Well nothing like that of water. The two vital natural mechanisms are photosynthesis by plants and eventual dissolution in the oceans. As Hardy Planters we know about the first, probably less about the second. In fact, nearly half of the emitted CO_2 ends up in the sea and the shells of sea animals. However, there are two big problems with this air-sea interface:

- Worry number one is that if the temperature of the seas **increases** it becomes **less efficient** at absorbing CO_2. In fact the oceans can start releasing carbon dioxide back to the atmosphere. When the impact of an action reinforces the original action it's called positive feedback, but in this case it's far from an environmentally positive result!
- The second worry is what the professionals call the 'residence time'. In a rough and ready way, this is the average time one might expect a molecule to remain in the air before getting swallowed up by the sea. This time runs out at about 2 years or so for CO_2, plenty of time for emissions to travel thousands of miles from their place of origin. The effect is truly trans-boundary – unlike the problems of say SO_2 and NO_2, which are water soluble and remain 'local' problems, some of the CO_2 which we emit will find its way to China, and some of what China emits will find its way to us.

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