This exchange of incoming and outgoing radiation that warms Earth is often referred to as the "greenhouse effect" because a greenhouse works in much the same way. Incoming UV radiation easily passes through the glass walls of a greenhouse and is absorbed by the plants and hard surfaces inside. Weaker IR radiation, however, has difficulty passing out through the glass walls and is trapped inside, warming the greenhouse.

Indirect radiative effects

The false colors in this image represent concentrations of carbon monoxide in the lower atmosphere, ranging from about 390 parts per billion (dark brown pixels), to 220 parts per billion (red pixels), to 50 parts per billion (blue pixels).

Some gases have indirect radiative effects (whether or not they are greenhouse gases themselves). This happens in two main ways. One way is that when they break down in the atmosphere they produce another greenhouse gas. For example, methane and carbon monoxide (CO) are oxidized to give carbon dioxide (and methane oxidation also produces water vapor; that will be considered below). Oxidation of CO to CO_2 directly produces an unambiguous increase in radiative forcing although the reason is subtle. The peak of the thermal IR emission from Earth's surface is very close to a strong vibrational absorption band of CO_2 (667 cm^{-1}). On the other hand, the single CO vibrational band only absorbs IR at much higher frequencies (2145 cm^{-1}), where the ~300 K thermal emission of the surface is at least a factor of ten lower. On the other hand, oxidation of methane to CO_2,which requires reactions with the OH radical, produces an instantaneous reduction, since CO_2 is a weaker greenhouse gas than methane; but it has a longer lifetime. As described below this is not the whole story, since the oxidations of CO and CH_4 are intertwined by both consuming OH radicals. In any case, the calculation of the total radiative effect needs to include both the direct and indirect forcing.

A second type of indirect effect happens when chemical reactions in the atmosphere involving these gases change the concentrations of greenhouse gases. For example, the destruction of non-methane volatile organic compounds (NMVOCs) in the atmosphere can produce ozone. The size of the indirect effect can depend strongly on where and when the gas is emitted. Methane has a number of indirect effects in addition to forming CO_2. Firstly, the main chemical that destroys methane in the atmosphere is the hydroxyl radical (OH). Methane reacts with OH and so more methane means that the concentration of OH goes down. Effectively, methane increases its own atmospheric lifetime and therefore its overall radiative effect. The second effect is that the oxidation of methane can produce ozone. Thirdly, as well as making CO_2 the oxidation of methane produces water; this is a major source of water vapor in the stratosphere , which is otherwise very dry. CO and NMVOC also produce CO_2 when they are oxidized. They remove OH from the atmosphere and this leads to higher concentrations of methane. The

CO_2e. At current rates of CO_2 emission alone, the threshold of 445 parts per million CO_2e will be reached in a mere seven years, even sooner if the accelerating output observed in the first few years of the present century continues.

Stabilising greenhouse gas concentrations can be achieved either by reducing the rate of emission, or by increasing the rate of absorption of the gases or both. Reduction in emissions from fossil fuel use is clearly of paramount importance. Carbon capture technologies that store the greenhouse gases produced at concentrated emission points such as power stations offer some hope for reducing rates of increase in emissions although their likely overall impact in the short or medium term remains uncertain.

But the management of fossil fuel use and adoption of carbon capture technologies will not in themselves be sufficient to prevent serious climate change in the next few decades. The management of carbon in living systems has a vital role to play: even with drastic cuts in fossil fuel emissions, current land-use practices would still lead to significant increases in greenhouse gas concentrations. Such management has two fundamental components: ensuring that existing carbon stocks held in natural ecosystems and in agricultural areas remain secure; and attempting to increase the rate at which carbon is sequestered in these systems.

Some aspects of the carbon cycle are at present effectively beyond direct policy control or technological intervention – notably the behaviour of the