however, the basic physics relating Green functions to noise is similar to that in the earlier work on stochastic electrodynamics and optics.

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Some fine points on radiative forcing

On the basis of radiation transfer theory, Raymond Pierrehumbert (PHYSICS TODAY, January 2011, page 33) claims that as the ditch in emission spectra seen from space widens, increased atmospheric carbon dioxide renders Earth's cooling less efficient. Across the ditch, emission by CO_2 varies with the temperatures of the strata from which the emission occurs. As the concentration of CO_2 increases, its emission to space takes place from progressively higher levels. Near the edge of the ditch, where the emission is from the troposphere, the levels become colder. However, across the 14.5- to 15.5-µm (650–690 cm^{-1}) band they become warmer.

From 1970 to 1997, CO_2 increased by about half of its glacial–interglacial range. The clear-sky ditch became wider[1] but also shallower,[2] and Earth's cooling became slightly more efficient. When the effects of clouds are included, the brightness temperature across the atmospheric window is some 30 °C colder than seen in Pierrehumbert's figure 3a. Clouds partly obscure emissions by CO_2 from the troposphere, rendering the widening of the ditch less important than the figure would suggest. Above broadband emitters colder than around –55 °C, the ditch becomes a dike[3] and CO_2 cools rather than warms the planet.

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Pierrehumbert replies: Because the stratosphere is warmer than the tropopause, emission near the center of the CO_2 band increases as CO_2 concentration is increased with temperature held fixed. However, the increased emission in that spike is far outweighed by the decreased emission in the wings, as is verified by all detailed calculations of radiative forcing.[1] The increased emission near the center of the CO_2 band primarily acts to cool the stratosphere, not the surface, and once the stratosphere comes into equilibrium, the effect of ditch-shallowing becomes even less pronounced.

The papers Hardy Granberg refers to are attempts to detect the signature of recent CO_2 increase in the observed trend in spectra between 1970 and 1997. That is a formidable task, given interannual variability, observational errors, the small signal over such a short time period, and the problem of intercomparison between measurements taken with different satellites. The spectra discussed in those papers incorporate the influence of temperature changes over the time period and do not in any way imply that the CO_2 increase has made cooling to space more efficient. One doesn't need to be able to accurately observe the short-term trend in order to confirm that radiative transfer is being done correctly. The comparisons of present-day spectra shown in my article already amply demonstrate that.

Insofar as a thick cloud acts nearly like a blackbody in the IR, the radiation to space from a region containing such a cloud indeed becomes essentially insensitive to the CO_2 concentration beneath the cloud. The reason that cloud effects do not negate the basic picture I gave in my article is that high cloud coverage is sparse in Earth's present climate, so the CO_2 radiative forcing in regions clear of high clouds still exerts a dominant warming influence. What's more, the presence of high clouds reduces the local radiating temperature, thus making the emission to space less sensitive to tropospheric temperature. This effect increases climate sensitivity. Because cloudy regions are coupled to clear sky regions by dynamical heat transports, the presence of high clouds actually means the atmosphere has to warm more in order to accommodate a given radiative forcing than it would in the absence of high clouds. These effects are fully taken into account in climate models and in comprehensive diagnostics of radiative forcing and climate sensitivity.[2]

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Clarifying Dirac and Majorana distinctions

In our article "The neutrino's elusive helicity reversal" (PHYSICS TODAY, May 2011, page 40), we wrongly suggested that new, as yet unknown forces might induce neutrinoless double beta decay even if neutrinos are Dirac particles. What we should have said was the following:

Even for practically massless Majorana neutrinos, physics associated with very high mass scales could lead to neutrinoless double beta decay. In that case, new forces that do not connect electrons to neutrinos would lead two neutrons to disintegrate into two protons and two electrons inside a nucleus, exactly as would happen in the case of ordinary weak interactions with massive Majorana neutrinos. Thus new heavy physics could allow neutrinoless double beta decay, and yet neutrinos still could be almost Dirac-like.

We thank Rabindra Mohapatra for pointing this out.

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[Editor's note: With sadness we inform our readers that Maurice Goldhaber died on 11 May 2011.]

Correction

June 2011, page 49—The scan for figure 4 is courtesy of L-3 Communications Security and Detection Systems. ■