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SYMPOSIUM ON VARIATION-XI**

VARIATION AND FIXITY AS SEEN IN CLIMATOLOGY

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Abstract

The climate involves many interlocking feedback mechanisms. Their complexity raises questions about current forecasts of climate change. The case is presented that built-in design limits any major climate change.

Introduction

There has been considerable interest lately in the subject of global warming and the greenhouse theory of climatic change. Computer models called general circulation models have been written to predict the effect that an increasing concentration of carbon dioxide in the atmosphere will have on the future climate of the earth. These without exception predict that the earth's average temperature will increase, anywhere from 1 to 5°C. Climatologists are puzzled when they compare these predictions to reality. The greenhouse theory of climatic change is so believable and predictions based on it are so straightforward that scientists are hard pressed to see where the models based on it are failing. Yet a study of the weather records for the last century from all over the world suggests that most of the predictions are on the high side.

A search of the literature indicates that explanations given by climatologists as to why the predictions are high fall into five groups. One of the five groups of climatologists is, I believe, of special interest to creationists. This group believes that feedback mechanisms are built into nature so that the earth's climatic environment will not change drastically, if at all. They conclude that for every positive feedback there is also a negative feedback or set of negative feedbacks that keep the earths temperature in its present equilibrium. Therefore there will be little, if any, global warming. These climatologists do not publicly state that they are creationists nor should it be construed from this paper that they are creationists, but their research does fit into the creationist model of limited variations in a created environment that is approximated by the average conditions found on the earth today.

There are three kinds of feedbacks in the earth's atmospheric system: positive, negative, and thermostatic feedbacks. What follows is a brief description of each with an example or two taken from the study of climatology.

Feedback

Feedbacks are changes that may cause a spiraling or "vicious circle" effect. A positive temperature feedback causes the temperature to become hotter and hotter. A negative temperature feedback would cause the temperature to become colder and colder. For example, a doubling of the carbon dioxide concentration in the atmosphere increases the amount of energy incident on the earth's surface by 5 watt/meter! If it were not for two positive feedbacks, this 2% increase in energy at the earth's surface would not by itself raise the earth's temperature very much. The feedback processes which double the warming effect of the increased carbon dioxide are: (1) the ice-albedo feedback and (2) the water vapor feedback.

The first case follows: A snow and/or ice surface has a higher albedo or reflectivity than a ground or vegetation surface; thus the latter surfaces heat more than an ice or snow surface. This in turn heats the air. The snow/ground and ice/water boundary is an equilibrium position whose location depends on the mean global air temperature. If the earth experiences greenhouse warming; the snow/ground, ice/water boundary will move poleward, exposing more land and water. This will absorb more insolation, thus causing the earth to warm, causing the snow/land boundary to move further poleward causing more warming, etc. At first glance this appears to be a positive feedback mechanism which will continue to escalate until the earth warms to the point that there is no permanent snow or ice on the earth. This is, in fact, how this feedback is treated by most climatologists.

Ellsaesser (1984), however, believes the ice-albedo feedback is overestimated, if not actually of the wrong sign. In other words, he thinks the feedback may be negative rather than positive because ice and snow have a strong insulating effect. Therefore he reasons that an ice or snow cover reduces the wintertime loss of latent and sensible heat. This represents a warming for the earth. Thus global warming which would reduce the snow and ice cover would in the long run cool rather than warm the earth and be a negative feedback rather than a positive feedback.

There is a second feedback which is thought to double the warming effect of increased carbon dioxide. Water vapor in most instances is part of a positive feedback loop. The warmer the air, the more water will evaporate, This water vapor then absorbs terrestrial radiation which, through a chain of events, heats the air, which in turn causes more water to evaporate. When this positive feedback is built into general circulation models the estimated global warming is approxi-

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mately double the warming predicted when only the carbon dioxide concentration is increased and this feedback eliminated.

Water vapor under the right conditions condenses to form clouds. Thus it is also involved in a negative feedback loop. When this is taken into account along with the positive water vapor feedback mentioned above, the combination creates a thermostatic feedback chain which causes the temperature to go back and forth around an equilibrium temperature. The warmer the air, the more vapor it can hold and the more vapor the air can hold, the more cloud droplets can form. The more cloud droplets there are, the more insolation is reflected. This cools the earth, which reduces the evaporation, which reduces the cloud cover, which allows more radiant energy from the sun to warm the earth, and round and round it goes. This thermostatic feedback is complicated by the fact that clouds also reflect infrared radiation back to earth where it is reabsorbed by the earth's surface, which warms the earth. It should also be noted that instead of warming the earth this back radiation can be stored in plant material through photosynthesis or it can be stored as latent heat of vaporization, if and when it evaporates water. In these two instances the energy is taken out of the system for a longer or shorter time. In the first case the greenhouse gas carbon dioxide as well as energy is removed from the system.

Until recently it was thought that the positive and negative feedback of clouds balanced out and thus could be ignored in the climatic models. Or if the positive feedback won out, clouds could be treated as a greenhouse gas. Recent satellite radiation measurements taken as part of the Earth Radiation Budget Experiment (ERBE) now indicate that it is the negative feedback that dominates (Ramanathan, et al., 1989). This net cooling effect is greatest over the mid and high latitude oceans. This is just where the standard general circulation models predict the greatest warming. They therefore conclude that clouds have a net cooling effect on the earth and that small changes in cloud-radiative forcing fields can play a significant role as climate feedback mechanisms. It will be interesting to see if this conclusion can stand the test of time.

There is another thermostatic feedback chain. Because carbon dioxide dissolves more easily in cold water, global warming should cause more carbon dioxide to be released. This should warm the earth through the "greenhouse" process, which should release more carbon dioxide from the oceans, which should cause the temperature to spiral upwards. There is, however, some research that indicates that the starting premise is not true. Taro Takahasi (Anon., 1987) of the Lamont-Doherty Observatory of Columbia University tested samples of water taken from the North Pacific and found that most carbon dioxide is absorbed during the summer months. Present wisdom expects just the opposite to occur. Takahasi suggests two reasons for this unexpected turn of events: (1) Photosynthesis by plankton is greater in the summer consuming more carbon dioxide, and (2) during the summer months when the surface layers of the ocean warm, convection currents, which normally bring carbon dioxide to the surface are suppressed. If this explanation is verified, the assumed positive feedback will have to be treated as a thermostatic feedback which would work as follows: The warmer the earth gets, the more carbon dioxide will be consumed, which will cool the earth, which will increase carbon dioxide, which will warm the earth and will cause carbon dioxide to decrease, which causes the temperature to go up and down around some equilibrium temperature.

Certain phytoplankton excrete dimethylsulfide (DMS) into sea water. Part of this DMS enters the atmosphere and oxidizes to form sulfate aerosols which serve as condensation nuclei for cloud droplets. The clouds thus formed reflect isolation. In addition cloud droplets formed on DMS condensation nuclei are more reflective than droplets formed on other condensation nuclei. The thermostatic feedback occurs as follows. Global warming increases phytoplankton growth, which increases DMS. This increases the number of cloud droplets which increases the albedo. Warming decreases, which decreases phytoplankton growth. DMS decreases, which decreases the number of cloud droplets and decreases the albedo, which warms the earth and the temperature again goes up and down (Gribbin, 1987; Andreae, 1989).

Lindzen (1990. pp. 292-297) contends that as carbon dioxide increases it acts as a greenhouse gas warming the atmosphere. This increases convection, creating cumulo-nimbus clouds which carry warm moist air from the lower to upper troposphere. During this process the air cools to below the dew point. This removes its moisture which eventually precipitates. This combination of processes fills the upper atmosphere with dry air which allows the latent heat removed from the earth and released above most of the greenhouse gas to radiate to space, cooling the earth. This set of processes represents another thermostatic feedback.

There are other feedback loops involved in global warming which involve the atmosphere/ocean system and the atmosphere/vegetation system. One is described by Bakun (1990): Global warming takes place, which increases coastal ocean upwelling. Fogs increase near desert coastal areas, which increases aridity inland and may promote sedimentation of unoxidized organic matter. This would decrease the atmospheric carbon dioxide concentration causing cooling because the greenhouse effect would be reduced.

The presence of these thermostatic feedback loops in nature lend broad support to the creationist view that the environmental variability found today in nature is limited. That this limit to variability lies within a range that is suitable for human existence supports the view that the earth was created as the home environment for man.

Conclusion

One ought not draw the conclusion that, since the world has these self-regulatory cycles, we need not be concerned about the increasing concentrations of greenhouse gases in the atmosphere. One should indeed be concerned about this and make every effort to decrease the level of greenhouse gases or at least keep the level from rising. This is especially true of those greenhouse gases that are not part of the created, natural order. There are much more pressing reasons than

the possibility of global warming to limit the production of carbon dioxide. The foremost is that fossil fuels, the primary source of carbon dioxide, are non-renewable resources which are vital to modern Western civilization.

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SYMPOSIUM ON VARIATION—XII

THE LIMITS TO VARIATION

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Abstract

Variation can be readily observed within species and can be shown to be involved in speciation through mechanisms such as random change occurring in the genome, and selection pressure acting on populations. However, there is no evidence that "missing links" occur and punctuated equilibrium theory, while providing an explanation for this, does not provide proof that "evolution" has caused the changes required to create new phyla.

Variation

There can be no doubt that considerable variation occurs within species. Variation in morphology is apparent in man (e.g., color, fingerprints, eyeshape) and selective breeding of pets and livestock has been practiced since before records began. Perhaps the most obvious example is provided by the many varieties of domestic dog which are all one species (whether Great Dane or Chihuahua) and which can often interbreed now only with the intervention of man. Yet from the time of Aristotle western scientists have generally perceived that the living world is highly ordered in a hierarchical system despite the variation. Nearly all the great biologists who founded comparative anatomy, taxonomy and paleontology, such as C. Lyell, R. Owen, G. Cuvier, C. Linnaeus and L. Agassiz, adhered strictly to a discontinuous topological model of nature. However, from the 1860's evolutionary biologists, building on Darwin's ideas, have been claiming that the same pattern provides support for organic evolution. This is the concept of species change by the natural selection of heritable differences which arise at random in each generation.

With the development of genetics and more recently molecular biology, the complex changes in genes and DNA sequences that drive genetic and thus phenotypic variation have been revealed. This has provided the mechanism upon which the concept of gradualistic non-random evolution has become firmly established. The theory, perhaps better described as a metaphysical dogma is now known to its followers as "Neo-Darwinism" or the "Synthetic theory."

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Although there has been much debate about Darwinism as a philosophy, even within the scientific community (e.g. Halstead, 1980, p. 215; 1981, p. 403; Eldridge, 1986, p. 54; Perutz, 1986, p. 36)), there is no doubt that at the species level at least "micro-evolution," in the sense of change, has occurred. Clear and unambiguous sequential arrangements of DNA can be reconstructed to show the process by which new genes arise. Because of their much faster generation times, change is best seen in micro-organisms and in smaller invertebrates such as copepods where, for example, studies of the segmentation and setation of the limbs has enabled extensive lineages of species to be traced to taxonomic levels above that of Order. Comparison of genera and species of fish and their parasitic Copepoda from New Zealand and Australia led Jones (1988) to strongly suggest that the New Zealand copepod parasite fauna was derived from the Australian with subsequent speciation. Among vertebrate groups, an example of species formation among birds is provided by the phenomenon known as circular overlap. The following example is provided by Denton (1986, p. 81). In Europe there are two species of gull, *Larus argentatus* (the herring gull) and *L. fuscus* (the black backed gull). These distinct species co-occur but do not interbreed. Further to the east, in Russia, the herring gull does not occur. The black backed gull becomes increasingly unlike the European type but resembles the herring gull until in the United States the herring gull only is found.

Mechanism of Variation

Given that variation does occur and can lead to differentiation at the species level, what is the mech-