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Spotlight on Agriculture

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IS GLOBAL WARMING A REALITY?

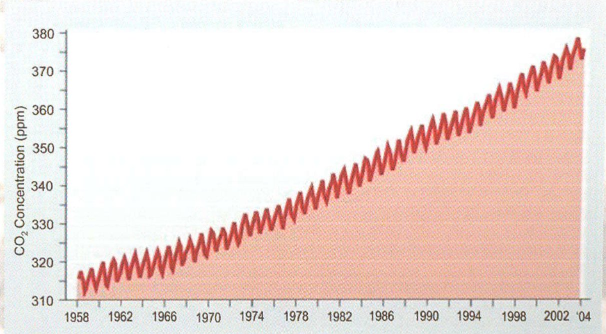
Is the global climate really becoming warmer? Is it natural or man-made? How much hotter will it get? These are some of the most significant scientific questions facing humankind at the start of the 21st century.

While the world's climate has always varied naturally, the vast majority of climate scientists now believe that humans are changing the earth's atmosphere, leading to potentially irreversible climate change. Rising concentrations of atmospheric "greenhouse gases" beyond levels of natural variation are the result of economic and demographic growth over the last two centuries since the Industrial Revolution. Our burning of fossil fuels and changes in land use are the main culprits.

Although the details are still being vigorously debated, there is a surprising degree of consensus about the basic science of global warming. Some gases in the atmosphere, notably water vapour, carbon dioxide and methane, trap infrared radiation emitted by the earth's surface – creating a situation similar to that inside a glass greenhouse, like a thermal blanket. This greenhouse effect is inherently good for life on Earth, as we would all freeze to death without it. However, if the balance between incoming and outgoing heat is disturbed, as is happening right now, the result is global warming – with detrimental knock-on effects.

Human activity is pumping carbon dioxide (CO_2) into the atmosphere, and this has caused a sustained annual rise in CO_2 concentrations. Measurements at the Mauna Loa Observatory in Hawaii have charted this rise for almost half a century, and today's concentrations are about 35% above pre-industrial levels.

The effect this increase in CO_2 concentrations has on the planet is measurable. British scientists have examined satellite data from 1970 to 1997 to plot changes in the amount of infrared radiation escaping from the atmosphere into space. Measuring these changes is an indirect way of determining how much heat is being trapped. The scientists found that not only was less and less radiation escaping, but also that increasing quantities of atmospheric CO_2 and methane were now trapping energy that used to escape. This trapped energy was being stored in the atmosphere as heat.



Atmospheric CO_2 levels (parts per million), measured at Mauna Loa, Hawaii, between 1958 and 2004

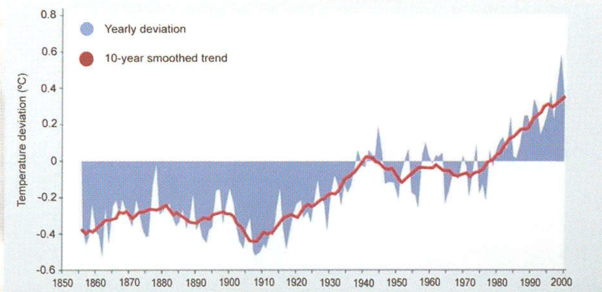
There is currently little doubt that the climate is changing. Plants have already been observed to be flowering much earlier, and birds lay their eggs sooner too. Also, as temperature records from around the world going back 150 years suggest, 19 of the 20 warmest years – measured in terms of average global temperature, which takes account of all available thermometer data – have occurred since 1980.

It is generally believed that up to 40% of the variation in climate since 1890 is due to two natural phenomena: solar cycles (which influence the amount of radiation reaching Earth), and the changing frequency of volcanic eruptions (which produce airborne particles that can shade and, hence, cool the planet for a year or more). However, no known natural effects can explain the remaining 60% of the variation, manifested by a temperature increase of 0.5 ºC over the past 30 years. Natural changes alone would actually have caused a marginal global cooling.

At present, the consensus among climate scientists is that the global temperature has risen and will continue to rise during this century. Furthermore, there is an unambiguous human (anthropogenic) influence on the global warming process, mainly through industrial greenhouse gas emissions.

SO, HOW HOT WILL IT GET?

The concentration of CO_2 in the atmosphere now stands at around 375 parts per million, compared with 280 parts per million in pre-industrial times. On its own, a doubling of CO_2 from pre-industrial levels – which could happen as early as 2050 – will add only about 1 ºC to average global temperatures, other factors being equal. However, the world never behaves so predictably. Mother Earth possesses several positive and negative feedback mechanisms that would respectively amplify or dampen atmospheric warming, and the main debate among climate scientists today is on the relative significance of these mechanisms.



Mean global temperature deviation (in degrees Centigrade) for the period 1855–2000, compared with the 1960–1990 average

Is Global Warming a reality?

The United Nations Intergovernmental Panel on Climate Change (IPCC) was set up in 1988 to assess the impact of these feedback mechanisms. The IPCC has drawn from the work of thousands of scientists and countless hours of supercomputer time, creating and refining models to simulate Earth's climate system. The IPCC recently concluded that the feedback would be overwhelmingly positive; that is, they would amplify the warming effect caused by greenhouse gas emissions. The only remaining question is this: Just how big will these positive feedbacks be?

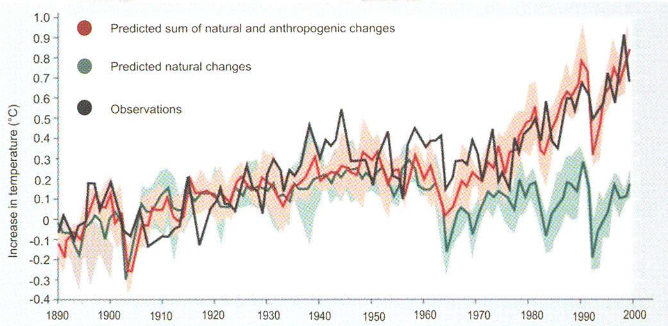
According to the latest IPCC assessment, the doubling of CO_2 levels will warm the world by anything between 1.4 and 5.8 ºC. This would predict a rise in the mean global temperature from around 14.8 ºC to between 16.2 and 20.6 ºC. However, some climate models developed by respected scientists predict that a doubling of CO_2 levels will cause the world to warm up to around 11 ºC – rather than the IPCC assessment of around 5.8 ºC – and remember that we are likely to reach those CO_2 levels by 2050 at the present rate of emission! Overall, the climate is expected to become more variable, with a greater threat of extreme weather events such as intense storms and heatwaves.

Some uncertainties within the IPCC models remain, however. The first of these is the melting of polar ice. Where the ice melts, the new, darker surface absorbs more heat from the sun, which warms the planet. This is in fact already happening.

Secondly, water vapour is a major source of positive feedback. Indeed, it is the main greenhouse gas, overshadowing even the effect of CO_2, but it usually receives less attention in the media. Any change in the amount of moisture in the atmosphere is critical. A warmer world will evaporate more water from the oceans, giving extra impetus to global warming. Some of the water vapour will turn into cloud, which reflects energy from the sun back into space – cooling the Earth. However, clouds also trap heat radiated from the surface, especially at night; this warms the Earth. Whether warming or cooling predominates depends on the type and height of clouds. Thus, the IPCC recognises that clouds are the biggest source of uncertainty in the models.

There could also be other surprise positive feedback mechanisms that are not yet well understood. For instance, the release of huge amounts of methane – a potent greenhouse gas – would have a catastrophic warming effect. The volumes currently frozen into the ocean floor and Siberian permafrost serve as a potential hazard in this respect. Moreover, if ice formation in the Arctic came to an end or the gigantic ice sheets covering Greenland and the West Antarctic melted, it could upset ocean currents. These events could even shut down the Gulf Stream, which warms Europe to a more clement climate than equivalent localities on the same latitude in North America and Canada.

Nonetheless, there are counterbalancing negative feedback mechanisms, some of which are already provided for in the models. These include the ability of the oceans to absorb heat from the atmosphere, and the capacity of some pollutants – such as the sulphate particles emitted by volcanoes – to shade the planet. Increasing temperature should boost plant growth and, hence, CO_2 absorption by green plants – but only up to a point. Thereafter, physiological damage to plants caused by temperatures that are too high may turn this negative feedback to a positive one, compounding the problem.



The relative magnitudes of natural and human contributions to global warming. The broader, lighter shadings in the graph are statistical expressions of uncertainty in the predicted values.

NAMIBIA AND GLOBAL WARMING

For now, Namibians should accept that global warming and climate change are a reality, and should take note of how they are likely to affect us. One middle-of-the-range model, the Global IS92a Climate Change Scenario, projects that the mean annual temperature as well as the minimum and maximum monthly temperatures in Namibia will increase by between 2 and 6 ºC by the year 2100. Predictions of rainfall are highly uncertain, ranging from a small increase of 30 mm per year to severe decreases of 200 mm below the current annual average at any particular place in Namibia.

The greatest impact is predicted for the central inland areas. Evaporation is anticipated to rise by 5% per degree of warming. So, even if rainfall remains unchanged, the availability of water is likely to decrease. Sea levels are expected to rise by between 30 and 100 cm by 2100, which will definitely adversely affect Walvis Bay and, albeit to a lesser extent, Swakopmund and Henties Bay. Water is already a scarce resource in Namibia, so decreases in rainfall and increases in evaporation will have an unfavourable effect on our economic growth.

As is widely known, Namibia is vulnerable in sectors such as human health, crop and livestock production, coastal flooding, and impacts on biodiversity and ecosystems. It is crucial that we start adapting our activities now already, and prepare for the inevitable. In all our agricultural planning, therefore, we should always bear in mind the consequences of climate change.

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