CLIMATE, SCIENCE, AND THE LOATHING OF THE UNPREDICTABLE

It is not only in the financial sector that mathematical models are contested. Climate predictions are also subject to criticism from those who attribute fluctuations in global temperature to misconceived equations. For the past ten years, and especially recently, the scientific community has been tearing itself apart over an apparently simple question: Is the earth getting warmer and if so, is it because of human activity? Why such a heated debate? Because, behind this "simple" question lies one that is more profound, more political, and philosophical than it is scientific: Is humankind harming the planet?

On the one hand, there are the proponents of “climate change.” They swear that the rise—quick and dangerous—in global temperatures is no doubt of human origin. On the other hand, “climate skeptics” argue that it has yet to be proved that human activity is causing the change in global climate. Each camp, which has alternately enjoyed the media’s support, has not been sparing in hurling invectives that are hardly scientific. Climate change alarmists are accused of dogmatism and intellectual terrorism, whereas skeptics are compared to negationists. Today in France, a small minority of skeptics supported by a part of the public opinion, are coming out in the open after years of hiding—considerably later than their American counterparts.

For the mathematician Benoit Rittaud, author of the Climatic Myth, the climate war has become the biggest scientific controversy since Trofim Denisovitch Lysenko’s experimental research in improved crop yields during the 1930s. A staunch Stalinist agronomist, Lysenko declared a relentless war against the findings of the Austrian monk Johann Gregor Mendel, who was earlier considered (and since then) as the founding father of

genetics and theoretician of the formation of hybrid plants. The 1930s were ripe for a pseudo scientific show of force in so much as they served the interests of the dictatorships. In 2010, we hope that such is not the case.

The reality—which is easier for scientists to accept than for politicians—is that in 2010, we still do not know many things. This is particularly true when it comes to climate behavior at the planetary scale.

Climatologists' work is very complex. At the moment, the concept of average temperature is the only option available to describe climate behavior at the global level with a single parameter. But, determining change in average temperature over a period of time is not an easy task. In France, Pierre Morel, founder of the Laboratory for Dynamic Meteorology (LMD), explains that for an increase of 0.6° C over the past 100 years across U.S. territory, 0.4° C corresponds to the corrections made to compensate for errors of the measurement equipment. Wary of the potential influence of ideological assumptions on scientific conclusions, Morel cautions: "Beware, climate is like the Rorschach tests, we find what we are looking for." Vincent Cassé, director of LMD, softens the tone: "The use of satellite data, available for 30 years, offers a global vision of the atmosphere at a given time. But to have the elements of its long-term evolution—say a few decades—calls for a minute calibration of the captors used. The slightest change in the captor on a satellite disturbs the measurements. The real challenge is to obtain a coherent series."

For a long time, the climate debate revolved around the "hockey stick" curve, an MBH98/ MBH99 reconstruction of average global temperature for the past 1,000 years. The graphic solution was proposed in 1998 then in 1999 by three scientists: Michael Mann, professor at Pennsylvania State University, Raymond Bradley, professor at the University of Massachusetts, Amherst, and

Malcolm Hughes, professor ofdendrochronology at the University of Arizona. This chart jolted minds and shattered a consensus prevalent until the late 1990s by minimizing two phenomena that were previously considered defining: the warm period corresponding to the European Middle Ages (the “optimal medieval climate”) and the Ice Age between the Renaissance and the mid-19th century, coined the “Little Ice Age”.

The hockey stick, and the implicit accusations it carried against economic growth, has quickly become the argument of choice of proponents of the catastrophic global warming theory—with its origins in the Industrial Revolution. The Intergovernmental Panel of Experts on Climate Change (IPCC), a group set up by the United Nations to gauge the risks of global warming, has in fact used this argument extensively in numerous reports and in its communications with political authorities and the media. However, this graph was quickly discredited and discarded after serious errors in its statistical methodology (false data and incorrect choice of variance) were pointed out and proved in 2004 by Richard Muller, professor of physics at the University of California, Berkeley. But curiously enough, the controversy has not died down.

The war of hypotheses is still raging on in 2010. The first question being considered is whether or not we can attribute global warming observed between the 1970s and 1990s to human activity. A large number of scientists concur that humans are indeed responsible for climate change. They rely on two proven facts: carbon dioxide (CO2) is a greenhouse gas (of human origin) and its concentration in the atmosphere is increasing. However, it remains to be proved that the observed increase in the concentration of CO2 is behind global warming. In fact, the sensitivity of climate to this type of stimulus is not known with certainty and no mathematical model is currently available to dispel the hesitation.

The two camps are in opposition but they are not equal in numbers. Even though in some countries public opinion sides with the skeptics, they are, within the scientific community, a small numerical minority. According to a recent study conducted by Stephen Schneider (climatologist, Stanford University) of the publications and citations of the 1,372 most-active researchers in the field, 97% to 98% of scientists believe that human activity is responsible for climate change.

However, there are a number of other possible explanations for the global warming observed between 1970 and 1990. They are not mutually exclusive:

- Multi-decennial oceanic variability: it can be superimposed over other causes in order to amplify them or reduce them

- The solar hypothesis: the eruptions on the surface of the sun trigger a radiation flux that can interact with the atmosphere. This "solar wind" contributes to the formation of clouds, a source of cooling. Scientists are hoping to reveal the correlations by studying variations in the eruption cycles.

How can we enter this scientific debate—given that it is contaminated by ideology—without getting obscurantist or becoming obsessed with models? The path is narrow. And IPCC's method of functioning is a disturbing element. Political powers detest the unpredictable nature of scientific work and are dubious about leaving the choice to the men and women of science. For them, the IPCC is first of all a think-tank that enables them to make decisions. This is a big mistake, says Sir David King, professor at the University of Oxford and former scientific advisor to the British government, in the Daily Telegraph: "The IPCC was set up as a means of arriving at a consensus, which contradicts the very spirit of scientific research. Scientists are supposed to defy received ideas and consensus, so that only the most sound ideas

among them can survive." The late Sir Karl Popper, philosopher and professor at the London School of Economics, put it differently: "Refutability is the fundamental property of any scientific proposal".

King is nonetheless resolute: "It is ridiculous to deny the reality that global warming is linked to human activities and absurd to pretend that we do not know the reason why." André Berger, professor at the Catholic university of Louvain, tries to put his finger on the most deleterious human activities. In regards to CO2 emissions, he says: Industry is not the main culprit, but deforestation and transportation are. Between 1990 and 2005, industries world over reduced their emissions by 10% whereas those related to transportation increased by 26%." He also notes that China emits less than the U.S., the European Union, and Russia combined, whereas its population is much greater.

Fabian Leurant, professor at the Institute of Ponts ParisTech and assistant director of the French Laboratory of City, Mobility, and Transportation (Laboratoire Ville Mobilité Transport), also cautions against hasty simplifications. "Concentration and industrial specialization have their virtues in terms of efficiency, but they often imply, paradoxically, more transportation and more emissions," he says. "Similarly, the shift in the means of transportation from airplanes to light goods vehicle (LGV) or electrical vehicles will not benefit climate change unless the electricity used to run them is produced from renewable resources."

The question of desertification is also under debate. Majority opinion finds that more areas will become deserts. This reality is translated, for example, by the ascent towards northern Europe of plant species that are traditionally confined to the Mediterranean. According to a study published in December 2009 by Scott Loarie (Stanford University) and David Ackerly (University of California,

Berkeley) in *Nature* magazine, a large number of animal and plant species will migrate towards the North or to higher altitudes, but a third of them will not be able to make the shift quickly enough and will perish. The two researchers calculated that the average displacement speed of natural environments from the surface of the earth will be 0.42 km/year during the 21st century. This average was established on the basis of the IPCC's "A1B" scenario. The IPCC foresees a significant increase in greenhouse gas emissions until the middle of the century, despite low population growth and the rapid introduction of more efficient new technologies.

On the other side of the debate, a few dissidents believe that the desert will become green again. Among them is Farouk El Baz, director of the Center for Remote Sensing, University of Boston, who uses satellite images to evaluate the origin and evolution of desert landform. In July 2009, he explained to the BBC: "Global warming of the earth will trigger more evaporation of the oceans and thus more rain [leading to more vegetation]." This theory has found favor with Martin Claussen, researcher at the Max Planck Institute of Meteorology in Hamburg, Germany. Claussen confirms that North Africa is one of the most controversial regions in the world as regards to global warming. An explosion in the growth of plants in the region was predicted by certain climatologists. In 2005, Reindert Haarsma's team at the Royal Meteorological Institute of De Bilt, the Netherlands, predicted a major increase in future rainfall in the Sahel. The team's study, published in *Geophysical Research Letters*, says that rainfall in July and September (the monsoon season) will increase by two millimeters per day by 2080.

So, will we ever be able to describe and predict the climate? Will math and physics offer a reliable instrument for this purpose? Climatologists have been working on the matter for the last few decades, but the biologist Henri Atlan almost denies the very

possibility of the existence of a prediction tool: “In matters of climatic models, the amount of data available is much less compared to the number of variables that are taken into account while constructing them. Thus, there are a large number of good models, capable of taking into consideration the observations available, even though they are based on different explanatory theories and lead to distinctive or even opposing predictions. This is because we are in a situation where we underdetermine theories by facts, when the amount of data cannot be multiplied as much as necessary during repeated and reproducible experiments.” His conclusion: the models on climate change are just theories full of uncertainties as regards to their connection with reality. The same goes for the predictions inferred from them.

Hervé Le Treut, professor at the Ecole Polytechnique ParisTech and director of the Pierre-Simon Laplace Institute, challenges this analysis: “The current models correctly take into account the climatic structures organized at the global level and their modes of variation. However, it is true that they remain deficient in their regional or local approach to climate change.” Will technologies help in making any progress? Le Treut is confident that they will: “There are two promising sources of progress: a better physical representation and an increased resolution thanks to faster computers. The models of the 1990s had a resolution of 500 km (i.e., the atmosphere was broken up by the model into blocks of 500 km squares). In 2010, it is 100 km. As and when we gain in resolution, the empirical theories necessary for representing the different phenomenon can be replaced by real observations. Japan possesses computers capable of carrying out climatic simulations with a resolution of 3 km. This will enable us to reproduce the diversity of the atmospheric scales, mainly those prevailing in a cloud.”

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