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Climate change: anthropogenic or natural phenomena?

Are climate-related European policies relevant?

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Risk warnings (ecological, sanitary and so on) by academics, pressure groups and various associations, in particular those seeking visibility and/or financing, are too often media stunts. Those warnings, rapidly evolving towards crisis situations relayed by the medias which lend them a sympathetic ear, are based on studies and models, sometimes overused, which do not, or at least not sufficiently, integrate uncertainties. Such incomplete inputs and at times weak statistical powers without speaking of confusion between risk assessment and management, lead to misleading outcomes.

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The issue of climate change has been politicized decades ago and lost its purely scientific character, in the service of ideological, political and economics aims. For the last 10 or 15 years, emotions and feelings appear to progressively take precedence over science.

Debates about energy and climate policies are too often confusing and emotional due to misinformation and because people are mixing up ideological, political and factual arguments. Extreme positions have been and are sustained by both supporters of man-made climate changes, the so-called "environmentalists", and the "climate sceptics".

Could we say that "concern over global warming has cooled down" as suggested by Stefan Theil: "In übergreen Germany, only 42% of citizens worry about global warming now, down from 62% in 2006. In Britain, just 26% believe climate change is man-made, down from 41% as recently as November 2009. And Americans rank global warming last in a list of 21 problems that concern them, according to a Pew poll" (1).

What is sure is that climate is complex and its modelling is fraught with uncertainties!

On the other hand, numbers are too often chosen to impress, to score points in arguments rather to inform. Alarmists do not necessarily intend to present an objective climate situation, but rather to shock the people into taking action which serve their purpose.

The purpose of this paper is to analyse the views of "environmentalists" and climate sceptics, about the causes of temperature changes and in particular over the last century. Does it deal with a natural phenomena or is the twentieth century climate change anthropogenic? What about the changes of the last decade: warming or cooling? In this respect are mathematical models a reliable basis for predictions? What are the current policies of governments regarding climate changes?

1. Temperature changes: natural phenomena

In order to identify the causes of climate variability, a number of secular reconstructions of global temperature, total solar irradiance and climate models have been carried out. These reconstructions serve the purpose of identifying the natural versus the anthropogenic contribution of the observed global surface warming during the last century.

A number of scientists, and among them Richard Lindzen and Alfred P. Sloan, professor of Atmospheric Science at MIT and member of the National Academy of Sciences, claim that scientists are not in a position to confidently attribute past climate change to CO_2 or to forecast what the climate will be in the future.

Tim Patterson, paleoclimatologist and professor of geology at Carlton university in Canada states that "there is no meaningful correlation between CO_2 levels and earth's temperature over this geological timeframe. In fact when CO_2 levels were over 10 times higher than they are now, about 450 million years ago, the planet was in the depths of the absolute coldest period in the last half billion years.

Several studies over a wide variety of time intervals claim that the predictions of harmful climatic effects due to future increases in hydrocarbon use and greenhouse gases like CO_2 do not confirm the current experimental knowledge."

Broadly speaking there are two main opposite theories: the IPCC's view of the increase of CO_2 as the main cause of the rise in global average temperature (based inter alia on computer climate modelling) caused by man-made greenhouse gas emissions if corrective action are not implemented and on the other hand, scientists convinced of the natural fluctuation of temperature without significant impact of anthropogenic emissions.

Some explanations for climate change given by the latter category of scientists are summarized hereafter.

1. Temperature rise due to AMO?

What is AMO all about? The "Atlantic multi-decadal oscillation" is an ongoing series of long-duration changes in the sea surface temperature of the North Atlantic Ocean, with cool and warm phases that may last for several decades at a time. These changes are natural and have been occurring at least the last 1000 years.

It is important to identify the natural components in climate change during the last century in order to estimate the relevant man-made components.

The graph relating to temperature changes from 1890 until now and the amount of CO_2 released into the atmosphere "shows that the temperature changes can be approximated by a linear increase of approximately 0.5°C/100 years while the increase of CO_2 is almost quadratic. Based on this consideration and an extensive literature review, it is found that the linear change of approximately the same gradient can be extended to 1800-1850, which is 100 years before CO_2 in the atmosphere began to increase rapidly, strongly suggesting that the linear change is a natural change…

The linear increase is superposed by the multi-decadal oscillation of amplitude of about 0.2/0.3°C, with a period of 50-60 years. It caused a prominent temperature rise from 1910 to1940, which is similar to that from 1975-2000; the IPCC considers that the latter rise is mostly caused by the greenhouse effect of CO_2, or was it "a combination of the linear change and the positive trend of the multi-decadal oscillation, similar to that from 1910 to 1940"? "In 1940 and 2000, the temperature change reached a maximum". Is "the halting of the rise during the first decade of this century caused by the beginning of the negative trend of the multi-decadal oscillation, similar to that of 1940, taking over the linear rise"?... "Since the temperature changes during the last century can be reproduced approximately by the linear change and the superimposed multi-decadal oscillation, rather than the greenhouse effects of CO_2, the prediction of temperature in 2100 is more likely to be the extrapolation of the linear change (+0.5°C) to 2100 by assuming that the recovery of the LIA (little ice age) last until 2100" (2).

If the multi-decadal oscillation theory proves to be correct, then it appears that reports on climate change ignoring the combination of linear change and multi-decadal fluctuation, are predicting much too high temperature rise in 2100.

2. Solar signature in the Northern Hemisphere surface temperature

Some authors like Cliver, et al. (3), have estimated that from 50-100% of net global warming since the time of the Little Ice Age (1645-1715) was due to an increase in solar irradiance whereas Lean, et al. (4), found that changes in solar irradiance account for 74% of the variance in the northern hemisphere surface temperature from 1610 to1800, and 56% of the variance from 1800 to the present.

Global temperature records closely follow the reconstruction of the sun's brightness not only from 1940 to 1975 but also over the past 400 years whereas climate models do not capture the cooling between 1940 and 1975.

As N. Scafetta (5) and B.T. West put it:" it is reasonable to believe that solar changes might directly or indirectly alter the climate in many different ways, and it should be acknowledged that most of the sun-climate coupling mechanisms have still not been incorporated into the large scale computational climate models... These models might easily underestimate the sun-induced climate change by misidentifying the primary causes of various mechanisms. In other words: "climate is relatively insensitive to solar changes if a temperature reconstruction showing little pre-industrial variability is adopted. In this scenario, most of the global warming since 1900 has to be interpreted as anthropogenically induced."

On the other hand, if a secular temperature showing large pre-industrial variability is adopted, such as MOBERG 05 (6), the climate is found to be very sensitive to solar changes and a significant fraction of the global warming that occurred during the last century, should be solar induced."

Other effects of increased solar activity such as the impact on cloud formation and EL Nino events are not well understood.

3. Ice thickness change in the Arctic and Antarctic

Ice thickness varies considerably from year to year at a given location. Therefore sampling makes inferences regarding long-term change, difficult.

Satellite radar altimetry offers promise for future monitoring of large scale ice thickness. Lexon, et al. (7), estimated average arctic sea ice thickness over cold months (October-March) from 1993 until 2001 from satellite born radar measurements. Their data reveal a realistic variation in thickness and a significant interannual variability in winter ice thickness but no indication of trend over that time.

Various model simulations of historical arctic ice thickness indicate a marked reduction in ice thickness of 0.6 to 0.9 m starting in 1980s, but they disagree on trends earlier this century. Most models indicate a maximum in ice thickness in the mid-1960s, with local maxima around 1980 and 1990 as well.

Analyses carried out by Brown and Coté in northern Canada show positive and negative trends in ice thickness but no spatially coherent pattern. Interannual variation in ice thickness at the end of the season was determined principally by variations of snow accumulation, not by variation in air temperature. NSIDC (National Snow and Ice Data Center-USA) reports in their March 3, 2010 newsletter that Antarctic is cooling and sea ice is increasing. A recent report (Turner, et al., 2009) suggests that the ozone hole has resulted in atmospheric circulation leading to cooling and increasing sea ice extents over much of the Antarctic region.

4. Correlation of glacial decadal oscillations, Pacific Decadal Oscillations (PDO) (8) and earth's climate changes

Based on previous natural climate warm and cool cycles, Professor Easterbrook (9) derived a temperature curve for the 20th and 21st centuries. This curve predicts an earth cooling starting in about 2005 to about 2030 followed by another warming period from about 2030 to about 2060 (no link with CO_2) and another cooling from about 2060 to 2090. Those projections are very different from IPCC predictions.

A decade after Prof. Easterbrook's projection, the earth's temperature did not increase and on the contrary has diminished. In 2008, the NASA's satellite imagery confirmed that the Pacific ocean went from warming (since 1977) to cooling comparable to the earth's cooling from 1945 to 1977. Nasa's imagery suggests that PDO started its cooling phase exactly at the time foreseen by the previous PDOs (Easterbrook 2001,2006,2007).

The US Environmental Protection Agency's (EPA) National Centre for Environmental Economics (NCEE) is concerned about the tendency to accept the findings reached by groups outside EPA, particularly the IPCC and CCSP (Climate Change Science Program) without a careful and critical examination of their conclusions and documents. Their comments are as follows:

- ✓ Global temperatures have declined over the last years with a more rapid decline in 2007 and 2008 whereas PDO went negative in September 2007 and the AMO in January 2009 respectively. At the same time atmospheric CO_2 levels have continued to increase and their emissions have accelerated. They conclude that there is a correlation of temperature fluctuations and variation in the PDO and ENSO (EL NINO oscillation).
- ✓ Moreover, it appears to be a strong association between solar sunspots/irradiance and global temperature fluctuations. It is unclear how this exactly operates but it may be through indirect solar variability on cloud formation. A 2009 paper by Scafetta and West suggests that solar variability could account for up to 68% of the increase in earth's global temperatures.
- ✓ The crucial assumption in the GCM models used by the IPCC concerning strongly positive feedbacks from water vapour is not supported by empirical evidence. The surface measurements are more ambiguous than the satellite ones in that the increasing temperatures shown since the mid 1970s could either be due to the rapid growth of urbanization and the heat island (UHI: urban heat island) effect or by the increase of GHG levels.

If Professor Easterbrook and NCEE prove to be right, the cooling phase of the next 30 years would lead to a decrease of crop yields, increase of energy demand, dwelling modifications and so on.

5. Correlation of CO_2 concentration and earth's temperature

On the one hand, IPCC (2007) argues that anthropogenic GHG emissions have largely determined in the past decades temperature changes and will do so in the future. On the other hand, a number of scientists dispute this view and claim that there is no compelling evidence that the rise in temperature of the last decades was caused by CO_2 emissions and that for instance, when CO_2 concentrations were 10 times higher than they are now, the earth was in a major ice age. They also emphasize that data from ice cores indicate that, during ancient climate changes, increase in temperature preceded increases in CO_2 by hundreds of years (10).

Fisher, et al. (1999), examined records of atmospheric CO_2 and air temperature derived from Antarctic Vostok ice cores. According to those measurements, at the end of the Ice Age actual data show that Earth's temperature rose well before there was any increase in atmospheric CO_2 .In fact, the air's CO_2 content began to rise 400 to 1000 years after the planet began to warm. Similarly, a study by Caillon, et al. (2003), finds that the CO_2 increase lagged Antarctic warming by around 800 years.

Changes in the CO_2 concentration are not well correlated with the 0.6°C increase exhibited by the surface thermometer global average temperature estimates during the 20th century:

- ✓ First, the phase of temperature increase between 1905 and 1940 occurred before any significant increase in industrial GHG emissions.
- ✓ Second, the rapid post-1940 increase in CO_2 emissions (hydrocarbon use has risen 6-old) was accompanied by a falling temperature between 1945 and 1965 (11).

A review of 23 quantitative records has demonstrated that world temperatures in 2006 were, in average, approximately 1°C cooler than in the medieval period (12).

Models established to evaluate climate using both the instrumental records and long term geological evidence are not only successful in predicting the recent warming phase, but also suggest cooling over the next few decades. This conclusion has also recently been strengthened in a more analytical basis by NASA and the Russian Academy of Sciences, both of which have issued predictions that cooling will occur early in the 21st century as solar activities decrease.

A map given in the "21st Century Science and Technology" shows an increasing cooling of the near surface atmosphere in January to July 2005, 2007 and 2008 in the Arctic, Antarctic, north America, Australia, Africa, South Asia and the Pacific and Indian oceans. This figure also shows the global temperature trends for the whole year, which in most of this period was lower than in 1998.

It should also be noted that there are discrepancies between temperature measurements made at the surface of the earth and from satellites.

Post, et al. (1982, 1985), state that "since the ranges of predicted and observed increases in atmospheric carbon do not overlap, many scientists remain sceptical that we can analyze the impact of fossil fuel burning on the global carbon cycle."

"The only genuinely global records of measured temperature come from balloon radio-probe measurements (since 1958) and satellite microwave sounding units (since 1978). These data for what they are worth over such short time periods indicate a gentle 0.1-0.2 °C/decade until 2000."

2. Models versus established data and findings

Climate models presume that a number of climate forcings and feedback mechanisms operate. Because those mechanisms are often only partially known, they might be poorly modelled for all that they are included in the modelling.

On the other hand, it should be noted that apparently the "sun-climate coupling mechanisms have still not been incorporated into the large scale climate computational models" (13) and therefore the sun induced climate change might easily been underestimated by misidentifying the primary causes of various mechanisms.

Using models requires caution especially when they cover 50, 100 years or more.

In spite of serious uncertainties inherent to climate modelling, some reports like the "Stern Review" give exaggerated confidence to model projections and outputs.

Is that really scientific? Indeed the hypotheses generated by the science must be validated by experience, real data. On the other hand science evolves over time as new discoveries are made and new hypotheses are formulated and others discarded. There is no such thing as settled science!

IPCC recognises that: "in climate research and modelling… We are dealing with a coupled non-linear chaotic system and therefore the long-term prediction of climate change states is not possible." (14).

"The process whereby uncertainty accumulates throughout the process of climate change prediction and impact assessment has been variously described as a cascade of uncertainty (Schneider, 1983) or the uncertainty explosion (Handerson-Sellers,1993) (15).

The IPCC rated the "level of scientific understanding of nine out of twelve identified climate forcings as "low" or "very low" highlighting the limitations and short history of climate models and recognizing large uncertainties about how clouds react to climate forcings" (15).

In particular, can we trust the GCM (General Circulation Model) climate forecasts 50 and 100 years into the future (which in any case cannot be verified in our lifetime) when those models are not able to demonstrate shorter range forecast skill? (16).

A case in point to illustrate above comments, is the Stern Review. It estimates that if we don't act, the overall costs and risks of climate change will be equivalent to losing 5% of global GDP each year, now and for ever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more!!

Doubts can be entertained about the inputs which in this case form the point of departure of the model. And a model is no better than the inputs and assumptions it is based on.

"The Review largely underestimates or takes no account at all of adaptations of people, enterprises or institutions conducts in response to both the experience and the prospect of global warming… It also downplays the possibility of adaptations arising from future technical progress… The model includes very speculative non-economic costs with little empirical guidance... From 80 to 90% of the impacts of climate change estimated by the Review comprise novel and conjectural cost categories that are not used by the large majority of experts who have studied this issue; that rely on arbitrary amplifications to regular climate model processes; and which have not received proper critical attention in the peer reviewed economics literature… Since the treatment of projected damages and disasters is so flawed, these final results cannot be taken at face value: they reflect a bias towards speculative alarmism" (15).

In spite of the above, the Stern Review is largely cited and referred to by environmentalists!

3. Current government policies

Gro Harlem Brundtland, chair of a Commission convened by the United Nations in 1983 to address growing concerns about deterioration of human environment and natural resources, suggested that " sustainable development must meet the current needs without jeopardizing the capacity of future generation to meet theirs".

The problem is that the meaning and interpretation by governments of such a definition are plural and vary over time. The reasons for changing policies relating to sustainable development and in particular to climate change are manifold:

- ✓ The financial and economic crisis of 2008/2009 has moved green policies down the political agenda. Saving the economy and creating jobs take priority. To face such crisis, some governments are lured by protectionism. A point in case is bio-fuel.
- ✓ The European Centre for International Political Economy (ECIPE) has calculated that, in many instances, the effective rate of assistance to European producers of ethanol and biodiesel exceeds 250%. Furthermore, the renewable energy directive discriminates against non-European products through dubious and highly bureaucratic standards dressed up as "sustainable requirements".

"Production in many third countries is more environmentally friendly and sustainable than in the EU" (17). But growing rapeseed and other similar products sustain the agriculture and jobs which is politically a major driver.

- ✓ The failure of the Copenhagen conference has turned utopian thinking into more realistic goals. Most of Kyoto signatories failed to reduce their CO_2 emissions during the last 10 years.
- ✓ A number of countries have experienced a political backlash over their renewable energy schemes.

As the *Wall Street Journal* put it: "Tens of billions of Euros taxpayers' money have been pumped into projects that depend on endless government handouts. Each of the 35,000 solar jobs in Germany, for instance, is subsidized to the tune of EUR 30,000" (18).

According to estimates by the Rhine-Westphalia Institute for Economic Research, green subsidies will cost Germany electricity consumers nearly EUR 27 billion for 2009/2010. Perhaps even more important is the growing realization that the warming trend of the late 20th century has for the last 10 years or so essentially come to a temporary halt. The data collected by international meteorological offices confirm this.

As a result of a campaign by Germany's heavy industry, as well as growing opposition from within her Christian Democratic Party, Mrs Merkel has been forced to abandon her green principles and image.

In December 2008, more than 10,000 angry metal workers and trade unionists- most of them from Germany- protested outside the European parliament in Brussels against the EU's climate policy which they fear will increase unemployment. At the forefront of the left-wing opposition to the EU's climate policy has been EU industry Commissioner Günther Verheugen. The German Social Democrat has been arguing throughout the year 2008 that the climate targets should only be accepted if "truly cost effective solutions could be found".

President Obama also faced a political backlash with his bill addressing climate change. Senate majority leader Harry Reid concedes in July 2010 that the comprehensive Kerry-Lieberman cap and trade climate change bill is dead.

An American poll reports that American voters are unwilling to pay more than they currently pay for electricity to combat climate change. The Obama Treasury Department reports that cap and trade legislation would cost the average US household nearly USD 3,000 per year.

Pragmatism often overrides theoretical or idealistic approaches. China is set to overtake Japan as the world's largest importer of thermal coal. Traders and policy makers said they expected China's thermal coal net imports to hit 105-110 million tons in 2010. China was a net exporter until 2007. The surge in coal imports is

a consequence of rising power demand. China relies on coal to produce more than 3/4 of its electricity and could add 500 GW of new coal fired electricity generation capacity between now and 2020 because of coal's stability of supply and because China is pretty rich in coal resources.

The US is adopting a similar policy. Indeed coal is also largely available in the American territory which is essential to ensure supply security. Moreover with coal there is no risk of scarcity at least for another two centuries. About half of US power is generated in coal fired power stations. This is not going to change, the American moto being "decarbonize and maintain affordable electricity". While continuing power production from coal, USA will provide power plants with carbon capture and storage installations when the technology will be commercially available.

A combination of impact of the financial and economic crisis and pragmatism lead the Spanish government to trim down renewable energy subsidies through feed-in tariff cut-backs, delayed incentives implementation and other measures. The Spanish Ministry of Industry will put on hold certain wind and solar thermal projects to help address losses incurred from what analysts see as excessive support. The recession hit government wants to cap the number of hours when both wind power and PV generation can receive tariff premiums on top of the market prices. Spain is trying to put under control a ballooning tariff deficit estimated to have accumulated to EUR 16 billions.

Same development in Australia. The Prime Minister climbed down from his climate change policy. Instead of getting the parliament adopt in 2010 an emission trading scheme that would put a price on carbon pollution, the Australian government decided to delay action until 2013 at least. It offered two reasons for that decision: the need for more time to decide on any global action on climate change and the opposition's backflip in parliament.

4. Conclusions

When it deals with global warming and with the relating political decisions , it is essential to know whether it has been caused over the last century and will be in the future, by human greenhouse gas emissions and in that case to what extent, or, to a large degree, by natural phenomena.

Scientists and Academics supporting this latter view are funding their position on a number of arguments like the correlations of natural phenomena (Atlantic Multidecadal Oscillations- AMO -, Pacific Decadal Oscillations- PDO-, solar signature and so on) and temperature fluctuations.

As far as supporters of man-made climate change are concerned, they are faced with questioning about correlation of CO_2 concentration and a fortiori of anthropogenic CO_2 emissions and earth's temperature change. They have to reconcile their positions with, among others, data from ice cores indicating that, during ancient climate changes, increase in temperature preceded increase in CO_2 by hundreds of years as detailed in this paper, and with the fact that over the last 130 years, ambient CO_2 levels are believed to have risen whether or not global temperatures have increased.

If, as hypothesized, global temperatures are essentially a function of CO_2 levels, it is difficult to understand why temperatures fell from 1940 to 1975 and after 1998 at the same time that CO_2 levels increased.

A traditional approach makes use of mathematical models which are no better than their structure and their inputs. The problem is that there is a temptation to have model projections override firmly established data and findings, dismissing that model outcomes must be validated by experiments/measurements.

Emotions and feelings appear to progressively take precedence over science. The resulting clash of influence jeopardizes rational risk management.

Can supporters of man-made climate changes claim that there is a consensus about anthropogenic global warming whereas there are many reputable scientists challenging their views? This is the case of a large mobilization contesting the IPCC conclusions, "the Global Warming Petition Project" launched by Art Robinson of Oregon State University, that gathered about 31,500 signatures of scientists and academics convinced that the hypothesis of man-made global warming is not scientifically valid and that governmental

action based on IPCC conclusions would be counterproductive for the human well-being as well for the earth.

Some "Environmentalists'" icons have been contested by scientists.

A case in point is the famous "hockey stick graph" showing reconstructed estimates of the temperature records over the past centuries and suggesting that recent warming is exceptional. In 2003, Stephen McIntyre and Ron McKritich published a paper questioning the statistical methods used by Mann, et al.

Another one is Al Gore's movie *An inconvenient truth*. In spite of the fact that serious mistakes (19) have been evidenced and confirmed by a UK ruling: "Guidance notes to Teachers", and that dramatic pictures have been heavily challenged like natural catastrophes due to rising temperatures (20), "Environmentalists" are still referring to that movie.

As Ottmar Edenhofer, deputy director of the Potsdam Institute for Climate Research, emphasizes, IPCC's procedures have to be thought about. In particular, IPCC reports have to be more careful about noting the uncertainties surrounding information that has not been subjected to peer review among scientists to avoid blunders like the disappearance of Himalayan glaciers by 2035 or reduction of north African agriculture by up to 50%.

As a rule, when a risky situation could occur, the risks must be evaluated before acting and all the more so when it deals with climate. Because of its complexity, the outcome of its modelling, necessarily fraught with uncertainties, cannot be taken for granted. Therefore, is it well reasonable to draw from such models political decisions without an objective cost/benefit analysis identifying the required resources (with the associated " willingness to pay") for decreasing the risks and without the assessment of the perception of risks, taking into account that cost/benefit and perception evolve over time thanks to information and acquired knowledge reducing uncertainty?

Would it not be more rational and more efficient to promote energy saving and *mature* alternative solutions for transportation and power generation on objective and not disputed grounds (fuel reserve depletion, fuel security of supply and air/water/soil pollutions) instead of rushing to subsidizing (at prohibitive costs) non-mature technologies principally justified by a misused and astray precautionary principle?

At this point maybe would it be advisable to consider the views of an industrialist: if Europe still wants to pursue its climate change policy, then it should "lower the temperature of its policy to a level that enables it to embrace a more predictable, sustainable climate change approach that sets ambitious but achievable objectives that do not jeopardize European industry. After the Copenhagen failure, there is currently no justification to move the EU's Climate-change target from -20 to -30%. Political credibility is involved. Indeed the conditions under which the -30% target was proposed have not been met... Sofar Europe is alone in the developed world to stick to its commitments: US emissions have grown by 17% (Kyoto target: -4%), Japan's by 14% (-6%), Canada by 26% (-6%) and Australia by 30% (+8%)... the plans of the leading emerging economies do not suggest that they will follow the EU's example… China, which is already responsible for about 20% of global emissions, could increase emissions by 75-90% compared to its 2005 yardstick. Moreover, in 2020, China's per capita emissions (10-11 tons of CO_2) would be higher than those of the EU (8-9 tons) based on a 20% reduction target... The EU strategy of leading by example has failed. The EU must now renew its strategy of unilateral commitments" (21).

Notes

(1) Stefan Theil, "Uncertain Science", *News Week European*, May 28, 2010.

(2) Syun-Ichi-Akasofu, "Global temperature changes during the last millennium and the prediction for 2100", International Arctic Research Center, University of Alaska Fairbanks, May 18, 2009.

(3) E.W. Cliver, et al., *Geophysiscal Research Letters*, Vol. 25, No. 7, pp. 1035-1038, 1998.

(4) J. Lean, et al., *Geophysiscal Research Letters*, Vol. 22, No. 23, pp. 3195-3198, 1995.

(5) N. Scafetta, Physics Department, Duke University, Durham, North Carolina, USA.

(6) Anders Moberg, Department of Meteorology, Stockolm University, Sweden.

(7) Seymour Lexon, Mullard, Space Science Laboratory, University College, London, United Kingdom.

(8) The PDO is a long-lived pattern of Pacific climate variability (oscillations). "cool" PDO regimes prevailed from 1890-1924 and again from 1947-1976, while "warm" PDO regimes dominated from 1925-1946 and from 1977 through the mid-1990s. Its climatic fingerprints are most visible in the North Pacific/North America sector while secondary signatures exist in the tropics.

(9) Don Easterbrook, Geology Professor Emeritus, Western Washington University, USA.

(10) Mundelsee (2001), *Science Review*, 20, pp. 583-589 and Siegenthaler, et al. (2005), *Science Review*, 310, pp. 1313-1317.

(11) *World Economics*, Vol 7, n°4, October-December 2006.

(12) Arthur B. Robinson, et al., "Environmental effects of increased atmospheric carbon dioxide", Oregon Institute of Science and Medicine, see on http://www.oism.org/pproject/s33p36.htm.

(13) N. Scafetta and B.J. West, "Phenomenological reconstructions of the solar signature in the Northern Hemisphere surface temperature records since 1600", *Journal of Geophysical Research*, Vol. 112, 2007.

(14) *Third Assessment Report* (TAR), 2001.

(15) Ian Byatt, et al., "The Stern Review : A Dual Critique", *World Economics*, Vol. 7, n°4, October-December 2006.

(16) William Gray, Emeritus Professor Atmospheric Science, Colorado University, USA, 2009.

(17) Frederik Segerfeldt, European Enterprise Institute, Stockolm, Sweden.

(18) December 15, 2008.

(19) Vincent Benard, Hayek Institute, Brussels, 2007.

(20) Muir-Wood,et al.

(21) Gordon Moffart, director general of Eurofer

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