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WITH Dr. Madhav Khandekar, *Retired Environment Canada Scientist*

Dr. Madhav L. Khandekar is a former Research Scientist from Environment Canada where he worked for about 25 years. Khandekar holds M.Sc degree in Statistics from India and M.S. and Ph.D. degrees in Meteorology from USA. Khandekar has been in the fields of atmosphere/ ocean/climate for over 50 years and has published over 125 papers, reports, book reviews, scientific commentaries etc. He has published over 40 peer-reviewed papers in various international Journals and authored a book on ocean surface wave analysis and modeling, published by Springer-Verlag in 1989. Khandekar is presently on the editorial board of the Journal Natural Hazards (Netherlands) and is a former editor of the journal Climate Research (Germany). He was an expert reviewer for the IPCC (Intergovernmental Panel on Climate Change) Climate Change Documents (AR4) published in 2007. Dr. Khandekar was interviewed in Winnipeg on June 30th, 2009.

Frontier Centre: Can you tell us a little bit about your professional background and specifically how you became interested in the climate change issue?

Madhav Khandekar: I spent my entire career in the science of weather and climate, 51 years to be exact. I did my doctorate degree in meteorology from Florida State University in the United States in 1968. I came to Canada on a post-doctorate fellowship. I worked with Environment Canada for about 25 years as a research scientist. I also taught two United Nations programs, one in Barbados in 1975 - 1977 and one in Quatar in the Middle East teaching aeronautical meteorology from 1980 – 1982. After retirement I was doing contracts here and there and the topic of climate change became hotly debated and one thing led to another and I did some contracts with the Alberta government since that government is interested in finding out how climate change impacts their oil industry, in particular. So my first report was on the uncertainties in greenhouse gas-induced climate changed. That led to another report on the extreme weather events and drought in the Canadian Prairies. In the last 10 years I have published a few papers and I have strong reservations about the science that is espoused by IPCC (Intergovernmental Panel on Climate Change). In fact two years ago the IPCC office in the UK invited me to be a reviewer for one chapter which I provided in two stages, FOD-First Order Draft and SOD-Second Order Draft, between November 2005 and July 2006. I made a comprehensive review of the IPCC Documents, but unfortunately they did not take into account all the critical points that I submitted in my review. I think the second volume of that report that I was reviewing has come out about the same way which I did not want it to be but that's the way it is. I now write and do research primarily on my own.

FC: For the record has the earth been getting warmer over the past half century?

MK: If you ask past half century then I have to answer yes. But I think you have to be careful about it. If you look at the entire 20th century, then from about 1915 till about 1945 the earth warmed rather steeply, more steeply than it has warmed in recent years. After the World War II, industrial CO2 started to increase. And interestingly the earth's temperature was going down till about 1977. The meteorologists and even the climate scientists haven't provided an exact or definite answer to why earth's climate was cooling from 1945 till about 1977. They say aerosol cooling but the aerosol data on global scale was not there at that time. So now in the last 25 years the climate has warmed but once again since about mid 1998 the temperature is slowly but surely declining. At this point I don't think it's correct to say that the planet is continuing to warm because it has essentially stayed about the same. There is no additional warming of the entire earth-atmosphere-ocean system in the last few years.

FC: So if we have rising CO2 levels and the temperatures are declining doesn't that present a problem for the theory of CO2-induced global warming?

MK: It does. I think we must first explain this discrepancy out of climate modelers' simulation. There are times that are several years when the temperature goes down and then again it's up. So right now most climate scientists are saying that what we see, the cooling, is just a part of gradual warming. But I think there are a lot of problems with that kind of explanation. More importantly so many solar scientists are now definitely saying that the sun is getting into a weaker phase. The next solar cycle, Cycle 24 as it is called is expected to be significantly weaker and it will probably be the weakest solar cycle since 1930.

FC: Which means cooler weather?

MK: Quite possibly, if the solar scientists are right. I do not see any immediate signs of sudden warming now. The ocean's heat storage for the top 700m ocean depth worldwide has declined Unless the oceans' heat storage increases rapidly I don't see any warming on the land.

FC: Does there currently exist a consensus among the scientific community surrounding the causes of the slight warming trend which has been documented over the past 50 years? Or are there competing explanations?

MK: A very intense debate is going on. Most of the skeptics like me feel that the warming that we saw during the 80's and 90's was most possibly due to the natural variability of the climate, just as there was a cooling of the earth's climate from 1945 to about 1977. More importantly many skeptics and solar scientists feel that this warming and cooling is possibly driven by the variability of the total

radiation received at the top of earth's atmosphere. So the problem is much more complex than what the IPCC has projected to us.

FC: Which of the various theories that have been put forward to explain recent changes in temperature do you find the most compelling?

MK: From my perspective I feel that the warming that we saw during the 80's and 90's is most likely the natural variability of climate. There may have been a contribution, but a very small one, from human-added CO2. But I do not see human-added CO2 causing a significant warming in the next few years to few decades.

FC: Does CO2, or the more politically correct term greenhouse gas emissions, have any impact whatsoever on global temperatures or are they entirely irrelevant?

MK: They are entirely irrelevant. I don't see that CO2 is inducing any climate change. CO2 may have induced a small amount of warming that we saw in the 80's and 90's but more importantly CO2 is an inert gas, it is not a pollutant. That's a misleading misconception. It is a very healthy ingredient for the world's agriculture and forestry. We have shown definitely through satellite data that world forestry has been enriched in the last 10 years because of increased CO2. I think it is incorrect to say that CO2 is a pollutant and a dangerous gas and it's a misleading concept.

FC: Some who are skeptical about global warming alarmism have argued that the earth was much warmer at other points in recorded history than it is today say during the Medieval Warm Period about 1000 years ago. Is this true or is the earth today actually hotter than it has been during other recorded time periods of human history?

MK: No, it is not true at all. What you said is right. During the Medieval Warm Period from about the 8 – 12th century the earth was almost certainly as warm, or possibly even slightly warmer. There is a debate going on but I think it is now proven more or less beyond a shadow of a doubt based on a lot of ice core and other data that during the Medieval Period that the earth was at least as warm. Not only that, but around 1000 AD , most of the Arctic Ocean was free of ice. A lot of anecdotal data and stories suggesting that the Vikings were actually sailing in the Arctic Ocean where there is permanent ice pack now are correct. If the Arctic ice pack starts to melt a little bit as it is now I don't think it a matter of great concern to us. It shouldn't be.

FC: There have been many highly publicized computer models which suggest that global temperatures are likely to skyrocket in the years ahead as a result of the greenhouse gas emissions. Do these computer models worry you?

MK: No they don't worry me at all. In my lifetime I have worked with a large number of atmospheric models, ocean wave models, small scale models, regional models, what have you. I know the limitations of these models. My work, primarily in my career of more than 50 years, was with short-term weather forecasting, 12 hours, 24 hours, 1 – 3 days, never forecasting beyond a week. Now I am interested in seasonal predictions but sort of in a different technique than a computer model. I think computer models have a lot of inherent difficulties in simulating precisely the large-scale circulations of the atmosphere.

FC: In addition to the models, some who are alarmed about climate change say that recent history and in particular the data shown in the hockey stick graph provides conclusive evidence that global temperatures are rising quickly. Can you tell us a bit about the hockey stick graph and if it really is a smoking gun that proves the alarmists right?

MK: The hockey stick was a graph constructed by some scientists about 10 years ago. What it was meant to show was that the earth's temperature from about 1080 till about 1850 remained essentially constant and then it started to shoot up. Lots of problems have been found out in the graph. The most glaring error in the hockey stick was that it did not show the Little Ice Age, which was significant. It did not show the Medieval Warm Period from the 8th – 12th century, which was also significant. There were errors in the use of the tree-ring data and also other errors. So today, most scientists dismiss the hockey stick. They do not consider the hockey stick graph to be a correct representation of the global mean temperature. Having said that, yes, we did see the mean temperature of the earth warming but in an erratic way, not steadily. For a few years it will go up and then it will come down and again it goes up and so on. Part of the explanation is that after the 200 years of the Little Ice Age from about 1600 – 1850 the earth was quite cool, almost 1.5 degrees in the mean temperature to about 1 degree for sure, There area lot of historical stories are available how in the UK, for example, the River Thames would be frozen solid during winter which it doesn't freeze now. Most of Europe was under a blanket of snow for long periods of time. So while the earth was coming out of the Little Ice Age to warm and so it warmed in more or less in a natural fashion. Now I think, most skeptics, think that the earth's mean temperature has steadied again. There is no more warming of the earth right now and if the solar scientists are right we might see even a significant decline in the earth's main temperature in the next 10 – 20 years.

FC: In recent years, people have stopped talking about global warming and instead have started to use the term climate change. Is there a reason for this change in language?

MK: Very interesting question. Scientists who have been advocating the science of global warming induced climate change are realizing that there is no more global warming to talk about so they are now talking about climate change. But when you analyze carefully earth's climate history you find that earth's climate was never constant, it was constantly changing. The only the thing constant about earth's climate was that it was always changing. If we go back into geological times, there were periods where the earth was very warm. During the Cretaceous for example, 120 – 140 million years ago the earth was so warm that it is speculated that there was not even a speck of ice on either of the poles. The forest extended all the way to the North Pole and perhaps part of the Antarctica. The climate has

always been changing. Even in the past 100 years of the 20th century we have excellent data and we see that the climate warmed in the first half of the century, then it cooled for about 25 years and then it warmed for the 80's and 90's and now we are probably seeing a sort of tapering off or even a cooling of the climate. Climate change is nothing to be worried about. It is something that the earth is going through and the best way to deal with this climate change is to slowly but surely add up to a slightly different climate change that we experience worldwide. No big deal.

FC: There are some scientists, in particular some Russian scientists, who are predicting several decades of cooler weather. Do you have any thoughts on that?

MK: I'm not an expert on solar physics so I cannot definitively make any points but the more literature I sift through, and I have come across a large number of papers, on solar impacts on earth's climate and based on the observations. I am more of an observational guy I like to see the data before making any definitive conclusion, and the temperature data and the extreme weather data does not suggest to me that the earth's climate is going through some dangerous period or some unusual climate situation. I think what we see is part of natural variability and earth's climate is a very robust entity I don't see that this climate is getting destabilized because of human activity. It is more a perception that was created by somewhat of an alarmist view.

FC: Some have asserted that a number of extreme weather events that have occurred in recent years such as Hurricane Katrina can be attributed to global warming and in particular greenhouse gas emissions. Is this a reasonable argument?

MK: No, not at all. In fact one of the areas I tried to do some extensive research is in the area of extreme weather events. One of my contracts with the Alberta government was to study the extreme weather events particularly on the Canadian Prairie provinces but as an extension I also looked at weather events worldwide particularly studying the Indian monsoon for a long time. I have analyzed 150 years of Indian monsoon data and I have found that major droughts and floods have occurred in the Indian monsoon data in an irregular manner. It has nothing to do with climate change. Also I have analyzed extreme weather events during the 1945 – 1977 period when the earth's temperature was slightly declining and I have found that there were just as many extreme weather events during that period as there were during the 1980's and 90's. So the argument that warming would increase extreme weather events is without any merit.

FC: Canada and the United States are both considering enacting cap-and-trade policies to lower our national greenhouse gas emissions. Are these policies likely to have any impact on global temperatures in the coming decades?

MK: No, not at all. In fact it would have very little impact, if any. Before we go to these cap-and-trade policy I think the climate scientists and even the UNFCC, which is holding its next meeting in Copenhagen in December, should first explain why the mean temperature is not rising despite about 100 billion tons of human-added carbon dioxide released into the atmosphere in the last 10 years. So I think that unless we thoroughly examine the present state of the climate change science there is very little point in trying to cap-and-trade CO2. It may be a good idea in terms of monitoring if CO2 really becomes a problem but at this point in time I do not see CO2 as a problem at all.

FC: Do you see any issue with increasing coal consumption because the anti-CO2 people generally oppose this?

MK: I think this is more of an economic and political problem. The major problem with coal use is environmental pollution which is definitely a problem but not still a major problem as it is in some third world countries where I have lived. I think a judicious use of coal can be a good source of energy to future generations. (A major problem with coal is the atmospheric pollution thru particulate matter its produces. But a clean-coal technology can be developed and coal use in developing countries like India & China may be on the increase in future. A judicious use of coal would be very useful for many developing countries in particular, where coal is plentiful).

FC: It seems that more and more scientists seem to be publishing papers and making statements questioning the belief that man-man climate change is a serious problem. Can you explain this increase in the number of scientists who are expressing scepticism about human-caused global warming?

MK: I do not see man-made climate change as a serious problem at all. In fact, I do not subscribe to the view that the climate is changing due to human activities. As I have mentioned in my earlier explanation, the climate is always changing. Yes, the climate has changed in Canada, in parts of Europe but if you carefully analyze the tropical area, the equatorial region where a large population lives today I have studied the tropical and equatorial climate in my career for a long time and I think that the climate change there is minimal. The equator or the tropical region or the South Asian countries live in perpetually hot climate. They rarely have minimum temperatures going below 22 degrees. Their maximum temperature in the afternoon is always between 32 – 35 degrees, give or take a couple of degrees, and despite this perpetually hot climate most of these countries have made good economic progress. To give one example from my original country, India has increased their grain growing productivity almost 4 – 5 times in the last 50 years using just about the same amount of agricultural land. I think technological advances have helped India and countries like China, Thailand and Indonesia grow and improve grain production and provide adequate food and possibly shelter to the large number of humanity that lives there today. So I do not see climate change as a serious problem for humanity at all.

FC: How do we turn around the vast amount of ignorance on this topic?

MK: I wouldn't call it ignorance. I call it some kind of a belief, religion or an ideology that seems to pervade particularly in North America and European counties. Based on my experience, having lived in various parts of the world during my career as visiting or working for example in the Middle East in Qatar or the Caribbean, in

Barbados I do not see such concerns in many of the equatorial countries. I think most people in tropical countries and African countries have many other serious problems like AIDS, improper healthcare, inadequate water supply. They have no time to worry about global warming at all. I think if their political management does a good job with their economies and if they are provided with ways to improve their agricultural product they will be much better off than trying to follow this hypothesis of climate change and divert their scarce resources on that. I do not see, honestly, any adverse impact at all. Most of these countries can conveniently deal with possible extreme weather events including any rising of sea level. Actually I am working on a paper on rising sea level and how it is maybe no more than 25cm at most for the next 100 years which is not at all a serious sea level rise in my opinion.