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1. INTRODUCTION

The urgent need to improve public understanding about climate change motivated the author to initiate a program of public education two years ago. Shortly before retirement the author spent a sabbatical on writing, *Introduction to Climate Change: Lecture Notes for Meteorologists*, a climate change textbook for the World Meteorological Organization (Houghton, 2002). This required study of the Intergovernmental Panel on Climate Change (IPCC) reports as well as several basic scientific texts on physical climatology, the climate system, and climate monitoring. This background plus the author's research career in climate dynamics provides useful background for the public talks.

A description of the program is presented here with the hope of encouraging others to similarly engage the public. Climate change is more than just an ordinary research topic. Scientists need to truly mingle and engage in discussion with the general public on the subject. Climate change issues involve our world community, our global environment, and our personal quality of life.

2. SCOPE OF MATERIAL PRESENTED

Material for this program is drawn from a wide assortment of resources covering many aspects of the climate change issue. The scientific aspects, of course, are a major part. The human component is included in a variety of ways. These include news media reporting, details on how humans affect the environment, future climate prediction, impacts of climate change on human activity, and thoughts about what humans individually and collectively can do about climate change.

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It is important to include some of the complex interrelationships in the science of climate change starting with the fact that the entire climate system (atmosphere, ocean, land surface, biosphere, and cryosphere) is involved, not just the atmosphere. The scientific relationships are conveyed in a descriptive manner. The "greenhouse effect" is explained and portrayed as a key connection between what humans add to the atmosphere and changes in the atmospheric and earth-surface temperature. Uncertainties in quantitative values of changes related to climate change are highlighted especially as related to predictions for the future.

3. STRATEGY FOR PRESENTATION

Questions and discussion are encouraged throughout the presentation to promote a two-way connection with the audience. As noted before, the scientific aspects are kept to a descriptive level. Generally, key material is covered in the first two thirds of the time and additional material is included as time and questions permit.

Presentations begin by acknowledging that there is debate on whether or not climate change is occurring or is important. The intent is to not have audiences think the talk is merely one for the "pro" side but rather the purpose of the talk is to give general objective information. Examples of flaws in articles in the news media are given to emphasize how the general public may be misled or confused by the public discussion.

The presentation varies according to whether or not the audience has a scientific background. If the audience does not have a scientific background, every attempt is made to invite questions as they come up. In either case, the presentation remains descriptive for the scientific components. The physical settings for the presentations have ranged from auditoriums to classrooms to restaurant space. Visual materials are always used. These may include PowerPoint slides, overhead transparencies, or simple handouts

depending on the situation. Thus, it is possible to present in virtually any setting.

4. CONTENT

All presentations include the following elements:

- A. Introduction
- B. What skeptics are saying
- C. Facts
- D. Uncertainties
- E. Challenges
- F. Human activities that cause climate change
- G. Climate change impacts on humans and the environment
- H. What can we do about climate change
- I. Concluding remarks

(Time allotted to the last four points is abbreviated as needed)

Under what the skeptics are saying, attention is drawn to biases in reporting terminology as well as errors in newspaper reports. For instance, the published statement “one-in-three chance its multitude of experts are wrong” could just as well be written “two-in-three chances its multitude of experts are right”. A useful introduction to the distinction between weather and climate is made by commenting on the press statement “If the weather folk can’t figure out what’s happening for the rest of the week, how can they tell us what the climate will be for the next 50 years?”

“Facts” include a number of statements which are not debated even by skeptics. This helps to provide common ground with the audience even if there are climate change skeptics present. Facts include:

--Global mean temperature generally has been going up over the last 140 years.

--Range of this variation or even that considered for the next 100 years does not exceed natural variability.

--Concentration of carbon dioxide has been going up as well as that of other greenhouse gases.

--Radiative theory of atmospheric gases and aerosols is important.

--Climate change involves the entire “earth system”, not just the atmosphere.

--Future projections face uncertainties in emission production, model prediction, and impacts expected from climate change

--Several thousand scientists from more than 40 countries have been involved in climate change studies, and most of them believe that climate change is occurring.

Many kinds of uncertainties are discussed beginning with human-induced radiative forcing changes of the atmosphere that have already occurred then extending to the large uncertainty for future emission scenarios. The key uncertainty is predicting the future actions of people themselves. Uncertainty about computer climate model predictions is noted by the comparison of results from a large number of climate models. The uncertainty gets even larger for model predictions of local conditions. Finally, a few examples of the large uncertainties for the impacts of climate change on agriculture, sea level, and human health are discussed.

Challenges are mentioned briefly. Key points are that the entire climate system must be considered in dealing with climate change and that predictions for the future must include predicting the course of humanity itself. Other points include the extensive natural variability, global connections for climate forcing and response, and how small changes in global means are accompanied by larger changes in local conditions. Some examples of research challenges are mentioned.

The extent of the discussion about the impacts of human activity on climate depends on the audience and questions that have been asked up to that point. Human effects are described as being more than just increasing greenhouse gases. It is noted that many factors will influence the level of human impact: population, economy, technology, energy, agriculture, land-use, environmental concerns, personal attitudes and lifestyles, and the extent to which the world works together.

Possible climate change impacts are discussed for terrestrial ecosystems, the ocean, humans, and weather systems. Some examples include crop yields, sea level rise, and human vector-borne diseases.

The discussion on what we can do about climate change provides an opportunity to get to the personal level if it has not already been

reached by this time in the talk. From here on, responding to questions becomes the focus of the presentation. Frequently, differences of opinion among the audience become apparent.

5. ACCOMPLISHMENTS TO DATE

My first invitation to present a talk came in 2001 from the Madison chapter of the United Nations Association. Since then I have made presentations to more than a dozen other groups including churches, civic organizations, universities, a high school, and research groups. Several of these were in foreign countries. The most extensive opportunity was at the University of Wisconsin-Superior where I gave a campus-wide presentation and then met with a number of classes over a two-day period. The most challenging presentation was at a high school in Russia where I had to deal with the language issue as well as the younger age of the audience. There were radio and TV interviews associated with two of my presentations.

Talks have been arranged in a number of ways. In the first year, the primary method was informal suggestion of interest from me, or my wife, to members of community and church groups. The visit to the University of Wisconsin-Superior resulted from conversations of my son, who works there, with his colleagues. I specifically proposed such presentations when planning trips to China and Russia. There are more proactive options available such as participating in

Wisconsin education programs sponsored by the Office of Space Science Education at the Space Science and Engineering Center, University of Wisconsin-Madison or working through the American Meteorological Society.

6. FUTURE

I hope that more scientists will become involved in similar public outreach. I, myself, hope to be able to continue this activity at a level consistent with "retirement" life. I recognize that I could quickly become overbooked if I spread the word too much. I am also aware of the need to keep up with the latest advances in climate change research and thinking by scanning appropriate publications on a regular basis.

7. REFERENCES

Houghton, D.D., 2002: *Introduction to Climate Change: Lecture Notes for Meteorologists*. WMO Technical Publication No. 926, World Meteorological Organization, Geneva, 131 pp.