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FUTURE CLIMATIC CHANGES

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ABSTRACT

The science of climate predication has improved immensely during the past few decades. Indicating that the climate is already warming in response to anthropogenic emissions of green house gasses. Furthermore, changes in temperature and precipitation patterns will continue and accelerate during this century and possibly for centuries to come.

Keywords- *Climate change, Aerosols, Green house gases Precipitation – Temperature.*

I. GREENHOUSE GASES AND AEROSOLS

Concentrations of greenhouse gases will continue to increase during this century under virtually all scenarios. Atmospheric CO_2 will reach double preindustrial levels well before 2100. In a typical forecast, based on a number of different models and assuming an SRES A 1 B population-economic scenario, by 2100 atmospheric CO_2 will increase to more than 700 ppm (parts per million) and CH4, after peaking about the year 2050 at 2.400 ppb (part per billion), will decrease somewhat (Figure 1). Overall, a variety of model approaches and scenarios predict CO_2 concentrations of 540 to 970 ppm by 2100, compared to the 250-ppm concentration in the year 1750. However, uncertainties, especially about the feedback from the terrestrial biosphere, expand the total range of possibilities to 490 to 1.260 ppm (IPCC 2001). Predicted changes in other greenhouse gases and aerosols vary widely.

II. TEMPERATURE

Predicted temperatures from numerous transient models, incorporating several greenhouse gases as well as the effects of water vapor and sulfate aerosols, and based on 35 different SRES predict a global average warming of 1.4 to 5.8°C for the period 1990 to 2100 (IPCC 2001). However, on the basis of a more selected "ensemble" of climate models, the global average temperature increase is most likely to range between 2.0 and 4.5°C (Figure 2). Temperatures in winter and at higher latitudes may increase to more than twice the global average.

III. PRECIPITATION

Average global precipitation will increase by > 10%, but change differs both seasonally and regionally. Model experiments at the UK Hadley Centre assume a midrange economic growth and "business as usual" emission scenario in which CO_2 more than doubles over the course of this century without

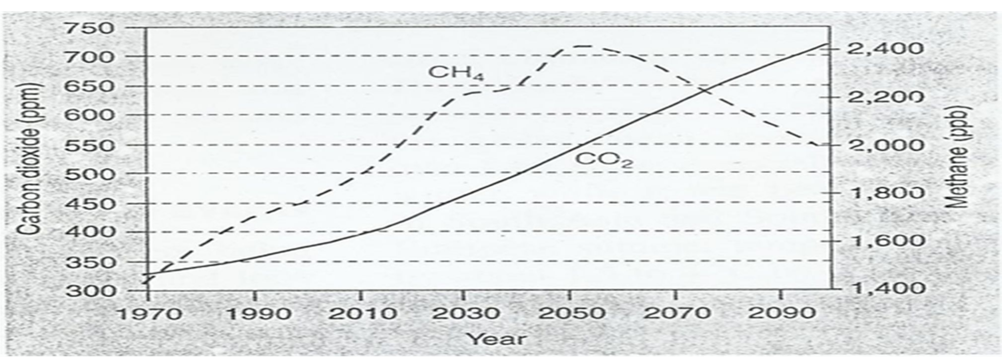

Fig.(1) Recent and future atmospheric abundances of carbon dioxide and methane. Projection based on a single example scenario SRES A1B (ased on data from IPCC 2001. Houghton JT, Ding Y, Griggs DJ, Noguer M, van der Linden PJ, Dai X, et al. eds Climate Change 2001: The Scientific Basis. Intergovernmental Panel on Climate Change, Working Group 1. Cambridge: Cambridge University Press, II. Reproduced by permission of Intergovernmental Panel on Climate Change).

IV. CLIMATE CHANGE

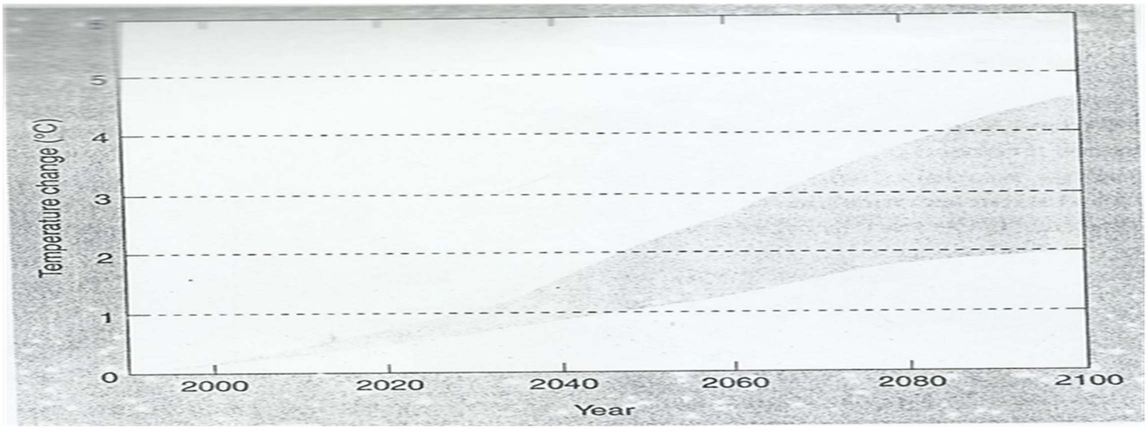

Fig.(2) Predicated global average surface air temperature increase to 2100. The shaded area represents the range of outputs for the full set of 35 SRES scenarios based on the mean results of seven different AOGCMS for a doubling of CO2. The range of the global mean temperature increase from 1990 to 2100 is 2.0 to 4.5°C (Adapted from Cubasch U and Meehl GA 2001. Proejctions of future climate change. In: Houghton JT, Ding Y, Griggs DJ, Noguer M, van der Linden PJ, Dai X et al., eds Climate Change 2001: The Scientific Basis Intergovernmental Panel on Climate Change, Working Group 1 Cambridge: Cambridge University Press, pp. 525 – 582. Reproduced by permission of Intergovernmental Panel on Climate Change).

Measures to reduce emissions. In that case, many areas between 5 and 25°C latitude, and midcontinent areas elsewhere, will become dryer.

Regional Climates and Extreme Events: Regional climate models (RCMs) are being developed to improve spatial detail and look at local and regional change. Course resolution AOGCMs simulate ocean and atmosphere general circulation features and are used for predicting global change. However, changes at finer scales can be different in magnitude or direction from the larger-scale AOGCMs. Topography, land-use patterns, and the surface hydrologic cycle strongly affect climate at the regional to local scale. These models reveal a number of differences between regions. For example, compared to the global mean, warming will be greater over land areas, especially at high latitudes in winter, while it will be less in June- August in South Asia and Southern South America. European summer temperatures will increase by about 1.5 to 4°C by 2080.

Precipitation will increase over northern mid-latitude regions in winter and over northern high-latitude region and Antarctica in both winter and summer. In December – January – February, rainfall will increase in tropical Africa and decrease in Central America. Precipitation will decrease over Australia in winter and over the Mediterranean region in summer (Giorgi and Hewitson 2001).

Models predict, in addition to warmer average temperatures, a greater frequency of extremely warm days and a lower frequency of extremely cold days. Extremes of temperature and precipitation that now occur more frequently leading, in some areas, to increased "urban heat waves" or flooding. These will be a general drying trend of the mid-continent areas during summer and an increased change of drought. The Indian monsoon variability will increase, thus increasing the chances of extreme dry and wet monsoon season (Meehl et al. 2000).

V. THE PERSISTENCE OF A WARMER EARTH

The climate may take a long time and ecosystems even longer to heal from the wounds inflicted by human-induced climate change. The Earth and the oceanic heat sink respond slowly to insult. Models suggest that the human-induced global warming may continue for centuries. The uncertainty of predicted climate change increases.

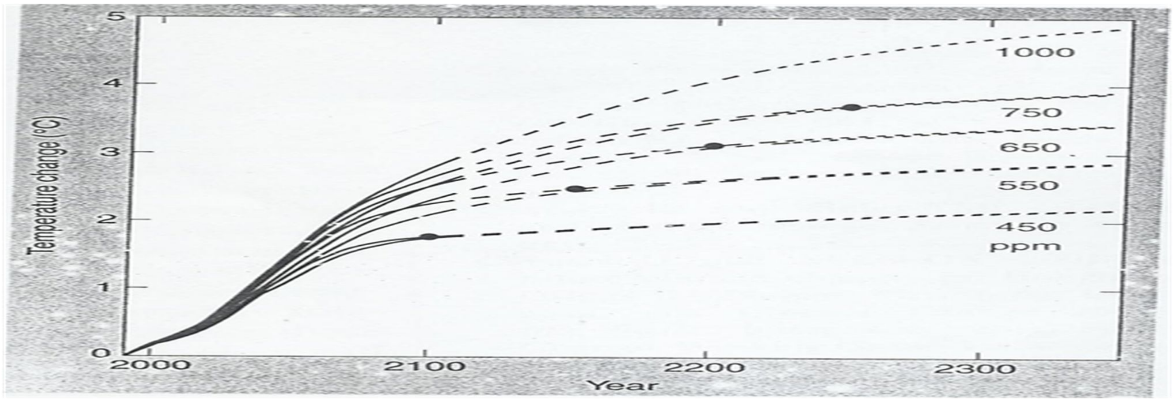

Fig. 3 Predicted global average surface temperature increase beyond 2100. The black dots represent the time and concentration of CO_2 when stabilization is achieved. Projections assume that emissions of CO_2 and non - CO_2 greenhouse gases will increase in accordance with the A1B scenario out to 2100. In 2100 sulfur dioxide emissions will stabilize. After 2100 the emissions of non- CO_2 gases will remain constant (From Cubasch and meeh1 GA 2001. Projections of future climate change. In: Juosghton JT, Ding Y, Griggs DJ, Noguer M, van der Linden PJ, Dai X et al., eds Climate Change 2001: This Scientific Basis. Intergovernmental Panel on Climate Change, Working Group 1. Cambridge: Cambridge University Press, PP. 525-582. Reproduced by permission of Intergovernmental Panel on Climate Change).

As we project beyond the twenty-first century. However, various scenarios can be examined to illustrate the range of possibilities. Long-term temperature trends will depend on when emissions are reduced enough to stabilize the atmospheric concentrations of greenhouse gases. The longer it takes to stabilize atmospheric CO_2, the greater will be its concentration and the resultant warming potential. Temperatures will continue to increase after CO_2 stabilization owing to the inertia of the climate system, which will require several centuries to come into equilibrium with a particular level of radiative forcing (Gigure 3).

Even if all emissions of greenhouse gases decline linearly to zero from 2100 to 2200, the Earth's climate will probably remain altered for centuries to come (IPCC 2001). These changes will have serious effects on the Earth's ecosystems that support human civilization. If we continue our current pattern of fossil-fuel consumption, the concentration of atmospheric CO_2 could quadruple over the next several centuries. This could lead to a 7°CCincrease in global average temperature over the next 500 years.

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