

17 MAY 2000: SYMONS MEMORIAL LECTURE

Dr R Sutton, Centre for Global Atmospheric Modelling, University of Reading - Decadal variability and predictability of Atlantic-European climate - rowan@met.rdg.ac.uk

Decadal timescale fluctuations in Atlantic-European climate have attracted considerable recent attention in the research literature. The prominent trend in the North Atlantic Oscillation index from low values in the 1960's to much higher values in the 1990's, and the identification of related coherent fluctuations in the North Atlantic Ocean have provoked great interest in the mechanisms responsible, and in the possibility that decadal climate fluctuations may be to some extent predictable.

This talk will review key features of the observed decadal fluctuations in the Atlantic sector and discuss present understanding of the mechanisms involved, including the influence of the ocean on the atmosphere over the North Atlantic/European region. The important problem of decadal-timescale climate forecasting, which has received little attention by comparison both with shorter timescale seasonal forecasting and with longer timescale climate change forecasting, will also be considered.

Mr D Parker, Hadley Centre, The Met. Office - The instrumental record of climate since the mid-19th century - deparker@meto.gov.uk

Changes in climate since the mid 19th century are reviewed with emphases on temperatures worldwide, and on atmospheric circulation, temperature and precipitation in the North Atlantic - European region. In the global survey, temperatures at the surface, aloft, and in the ocean are included. However, the instrumental record of climate is affected by numerous uncertainties as a result of incomplete coverage, random errors, and changing biases in the data.

So, some of these are discussed, and statistical and other methods of compensation are presented. The presentation concludes with future needs and opportunities for the Global Climate Observing System.

Dr K Shine and Dr S Rosier, University of Reading - Modelling climate changes in the stratosphere - k.p.shine@rdg.ac.uk and s.m.rosier@rdg.ac.uk

In the 1960s, Manabe and colleagues presented calculations using a radiative convective model which are a landmark in our subject. These included extensive calculations of the impact of changes in radiatively active gases within the stratosphere; these remain points of reference even today. In this talk the background to the developments in this area in the following decades will be presented. It is an era in which speculation about how the atmosphere might

change has begun to be replaced by observations as to how it has changed. Our most recent work has explored the impacts of ozone loss on stratospheric temperature. This work indicates that much of the cooling in the lower stratosphere can be explained by ozone change. However, we have also shown that stratospheric water vapour changes may have "compete" with ozone as an explanation, although our understanding of stratospheric water vapour changes is shrouded in uncertainty and controversy.

Mr P Cox, Hadley Centre. The Met. Office - The role of the biosphere in climate change - pmcox@meto.gov.uk

The biosphere influences weather and climate over a massive range of timescales. Stomatal pores on plant leaves respond to the environment with a characteristic timescale of minutes, modifying evapotranspiration and producing detectable impacts on the diurnal evolution of the boundary layer and near-surface variables. At the other extreme, deep-rooted plants and soil microbes together amplify the concentration of carbon dioxide in the soil, possibly accelerating the weathering of silicate rocks which is believed to control the concentration of atmospheric CO₂ on geological timescales. In between are processes operating over decades to centuries which have great relevance to the issue of anthropogenic climate change.

Key amongst these is the uptake of CO₂ by the oceans and by land ecosystems, which are currently responsible for absorbing more than half of the human CO₂ emissions. Marine biota modify oceanic uptake by producing carbonate shells which sink to depth, producing a biological carbon pump. The photosynthetic rates of land plants are enhanced under high CO₂, which acts to increase carbon storage in vegetation and soils.

However, the atmosphere-ocean and atmosphere-land exchanges of carbon are also known to be sensitive to climate. Warming reduces the solubility of carbon dioxide in sea-water, and increases soil and plant respiration. As a result, climate warming alone may result in a reduction of carbon storage. There is therefore a competition between the direct effects of increasing CO₂ (which tends to increase carbon storage in the ocean and on land), and the effects of any associated climate warming (which may reduce carbon storage, especially on land). Currently this competition seems to favour CO₂ uptake, but how might this change in the future?

To address this question we have included dynamic vegetation and an interactive carbon cycle in the Hadley Centre GCM. The structure of the coupled climate-carbon cycle model will be described, with a particular focus on feedback mechanisms. Results from the first transient climate change simulations will be presented to demonstrate the potential importance of these feedbacks over the next century.

Professor S Manabe, Earth Frontier Research System, Tokyo - The Symons Memorial Lecture - Exploring natural and anthropogenic variation of climate - yasukawam@frontier.esto.or.jp

Using a coupled atmosphere-ocean-land surface model developed at the Geophysical Fluid Dynamics Laboratory of NOAA, this lecture investigates the physics responsible for the internally generated and thermally forced variation of surface temperature. The first part of this lecture, based mainly on Manabe and Stouffer (1996), explores the physical mechanism responsible for local and global temperature fluctuation. The second part assesses the observed trend of local surface temperature during the last half century. Based upon diagnostic analysis of observed and simulated trend and variability, we explore and assess the mechanism involved.

Currently, coupled models of increasing complexity are used for the study of climate change. This talk will conclude with a discussion of a future strategy for modelling studies of climate variability