

WEDNESDAY 15 OCTOBER 2003: EL NIÑO: FRONTIERS IN RESEARCH AND PREDICTION

David Anderson (ECMWF): An overview of El Niño and the southern oscillation

In this lecture some key aspects of El Niño and the southern oscillation will be summarised. Several processes of thought to be involved in El Niño will be reviewed, including the role of equatorial waves. The basis of and prospects for prediction will be considered. Some recent results suggest increased predictability horizons whereas others suggest only limited predictability.

Axel Timmermann (University of Kiel): Theories of El Niño

The ENSO phenomenon has been studied extensively for more than 20 years. Despite great advances in understanding the underlying physical processes and in predicting ENSO-anomalies several months ahead, important questions remain, such as “What determines the amplitude of ENSO? Why is ENSO irregular? Is ENSO a cycle or a series of events? Why are there very strong El Nino events, but no equivalently strong La Nina events? Why do large El Nino events occur only once in a while (10-20) years? What processes limit the predictability of ENSO? How does ENSO respond to an anticipated greenhouse warming and how did it respond to past climate changes?”

After an outline of the major theoretical advances of the last 20 years, the recent frontiers of ENSO theory will be discussed.

Hilary Spencer (University of Reading): El Niño teleconnections and the role of the Indian Ocean

Regional, seasonal forecasts based on El Niño may lack skill for a number of reasons. For example, due to a dominance of atmospheric variability unrelated to El Niño, atmospheric model errors and due to the impacts of sea surface temperature (SST) anomalies remote from the tropical Pacific but remotely connected to El Niño (described as SST teleconnections). SST teleconnections may enhance or reduce a regional atmospheric response to El Niño and may also lead to a delayed response due to the memory of the remote ocean basins, hence extending predictability. The impacts of these SST teleconnections are investigated using models and observations.

The SST anomalies in the Indian Ocean are found to be crucial for accurate prediction of global El Niño teleconnections, especially after the peak of El Niño . Some of the delayed signal over Africa, the Atlantic and Europe is forced by the Indian Ocean as well as the Pacific. However, El Niño and La Nina may not be the only climate phenomena that lead to predictable SST anomalies in the Indian Ocean. For example, a recently described coupled ocean-atmosphere mode, the Indian Ocean dipole, is investigated. Although this dipole is weakly correlated with El Niño, it can occur independently and may be predictable.

Sandy Tudhope (University of Edinburgh): El Niño past, present and future

One obstacle to progress in predicting the likely future behaviour of El Niño in a Greenhouse warming world is the lack of instrumental data of sufficient length to characterise the range of natural variability in the system. To help resolve this issue, natural archives of past ENSO variability may be exploited. Living and 'fossil' annually-banded corals from the Pacific are proving to be particularly useful in this respect, giving new insights into ENSO variability, both 'within climate regimes' (e.g., the past few thousand years when global climate boundary conditions were broadly similar to present), and 'between climate regimes' (e.g., during past glacial times). Of particular significance is the interpretation that ENSO variability appears to have been weak, or possibly even absent, in the period from ~10,000 – 5,000 years before present. This was most likely a strongly non-linear response to relatively subtle changes in seasonality driven by the precession cycle of orbital variation. This presents an opportunity to test the ability of the current generation of ENSO models to capture such variations, and may ultimately help reduce uncertainty in future ENSO prediction.

Magdalena Balmaseda (ECMWF): El Niño Prediction

Nowadays real time predictions of ENSO (El Niño-Southern Oscillation) are routinely made by different institutions around the world, using a wide variety of forecast models that range from simple linear regression to fully coupled general circulation models (CGCMs). The relative merits of the different approaches are the subject of much debate. From a CGCM perspective, the skill of statistical forecast set a lower limit for the skill of a perfect CGCM. In practice, deficiencies in the formulation of CGCMs can lead to forecast errors. However, the opposition between dynamical and statistical models may lack perspective. Ultimately, the adequate combination of forecasts from different models should produce more accurate and reliable forecasts than any of the models alone.

Edward Clay: The use and abuse of El Niño forecasts: climate forecasting in Southern Africa

Since the early 1990s advances in climatic modelling and information technology have given rise to publicly available seasonal climatic forecasts on a regional basis for Africa. The first part of the paper provides a case study of how economic decision makers have responded to the growing scientific understanding of the relationships between global atmospheric processes (El Niño), weather patterns in Southern Africa and economic performance. It looks selectively at the experiences of public institutions including the World Bank, regional and national bodies during the drought crisis of 1991-92 and how this affected behaviour in the next regional drought crisis of 1994-95. There was internationally financed investment in strengthening climatic forecasting within Southern Africa. Climatic forecasts and media coverage of climatic events were influences on both public and private actions and attitudes during the 1997/98 El Niño event. Possibly unrealistic expectations were created of the potential contribution that state of the art climatic forecasting could make at that time to economic and social actions - and that had negative consequences. The Southern African humanitarian crisis of 2001-3 has in turn

exposed considerable weaknesses in the understanding of economic decision makers about how climatic variability interacts with highly dynamic and hazard vulnerable socio-economic systems. Drawing on evidence from these experiences, the second part of the paper looks at the interface between climatologists investigating natural processes and social scientists investigating socio-economic vulnerability. There are possible lessons for both disciplinary groups in working in areas where their investigations overlap in seeking to reduce the socio-economic risks posed by natural hazards