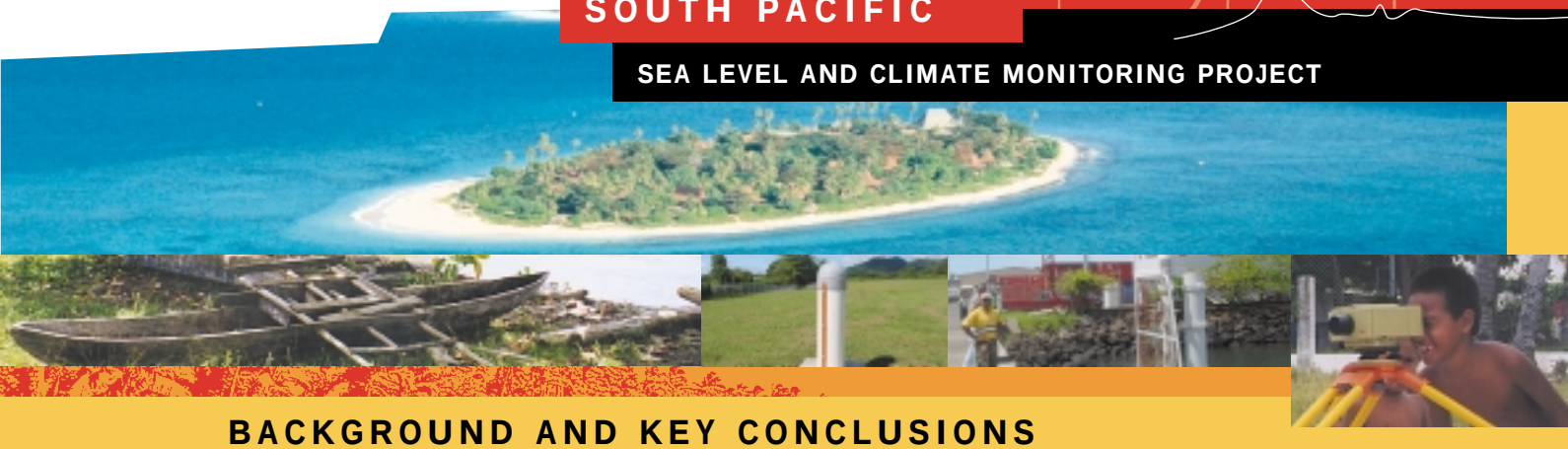
SOUTH PACIFIC

SEA LEVEL AND CLIMATE MONITORING PROJECT



BACKGROUND AND KEY CONCLUSIONS ON THE SCIENCE OF CLIMATE CHANGE

THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

INTRODUCTION

To address the concern that human activities were changing the composition of the atmosphere and that this could have far reaching impacts on the earth's climate, the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988. The task of the IPCC was to prepare authoritative assessments in order to advise governments, industry and the broader community of the current state on science and whether or not there were well-grounded concerns for the future of the earth's climate. The IPCC scientific assessments are based on the information available in the peer reviewed literature. The reports deal with observations of the climate system, the significance of these observations, the ability of models to adequately represent the climate system, projections of future changes using the best available models, impacts of present and projected changes and possible mitigation responses.

The IPCC's periodic assessments of causes, impacts and possible response measures to climate change are the most comprehensive and up-to-date report on the subject.

The IPCC is a formal intergovernmental body under the control of the member governments of the WMO and UNEP. The role of governments is *not* to decide the scientific conclusions but rather to ensure that the views of the entire scientific community are considered and assessed in a rigorous and balanced way.

The First Assessment Report consisted of three volumes was published in 1990. An update was produced in 1992 and the Second Assessment Report was completed in 1995. The IPCC also produced a series of Technical Reports and Special Reports. (See www.ipcc.ch for publications details).

THE TAR

The Third Assessment Report (TAR) consists of three volumes, Climate Change 2001: The Scientific Basis (Working Group 1), Climate Change 2001: Impacts Adaptation and Vulnerability (Working Group 2), Climate Change 2001: Mitigation (Working Group 3), and a consolidation of key findings in Climate Change 2001: Synthesis Report. The reports were thoroughly reviewed by the international scientific community and by Governments, with the PIC representatives involved in the review process. Each volume contains a Summary for Policy Makers (SPM), a Technical Summary and the individual chapters. All of the chapters as well as the SPM and Technical Reports for each of the three volumes of the TAR and the Synthesis Report were distributed to governments and are also available at www.ipcc.ch

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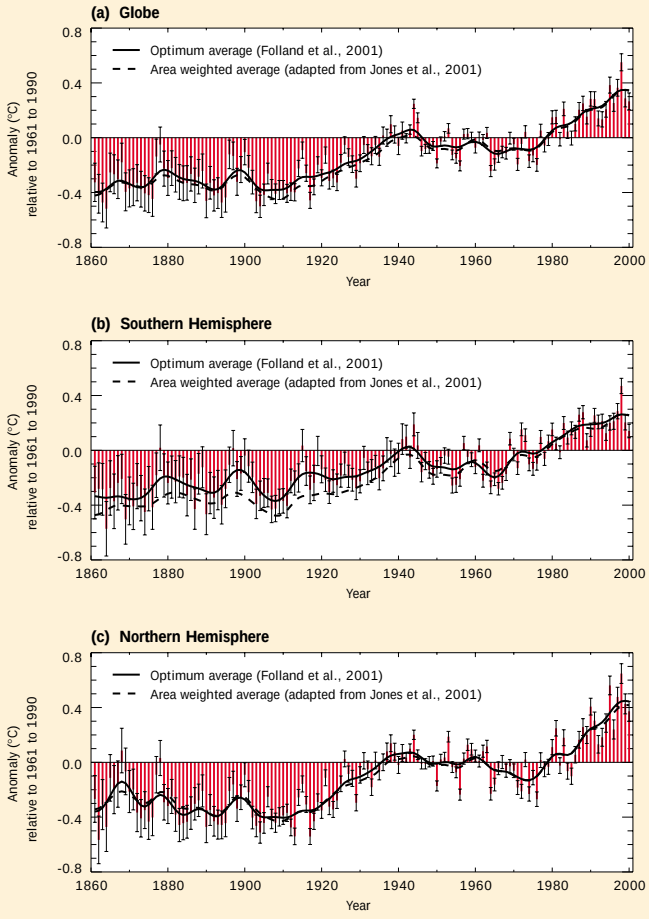
A Project supported by the Australian Government

KEY CONCLUSIONS ON THE SCIENCE OF CLIMATE CHANGE FROM THE TAR (WG1)

Documented in the Summary for Policy Makers for each of the three volumes of the TAR, the key conclusions on changes in the physical climate system include:

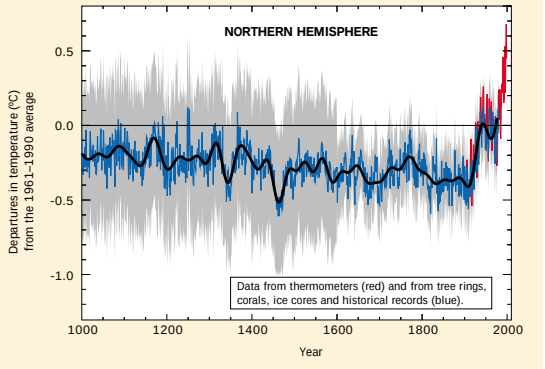
- **An increasing body of observations gives a collective picture of a warming world and other changes in the climate system.** The global average surface temperature has increased over the 20th century by about 0.6ºC, with the 1990s the warmest decade and 1998 the warmest year (Figure 1). Proxy temperature data (tree rings, corals, ice cores, historical records) for the northern hemisphere indicate that the 20th century increase in temperature is likely to be the largest in any century for the last millennium (Figure 2). (At this time, insufficient data is available for a similar analysis for the southern hemisphere.) There has been a decrease in snow and ice cover and a global average sea-level rise of between 0.1 and 0.2 m during the 20th century.
- **Emissions of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate.** The present CO2 concentration has not been exceeded during the past 420,000 years and likely not during the past 20 million years.
- **Confidence in the ability of models to project future climate has increased.**
- **There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.** Also, both observations and models indicate it is very likely that 20th century warming has contributed significantly to sea-level rise through ocean thermal expansion and the melting of glaciers.
- **Human influences will continue to change atmosphere composition throughout the 21st century.**

FIGURE 1



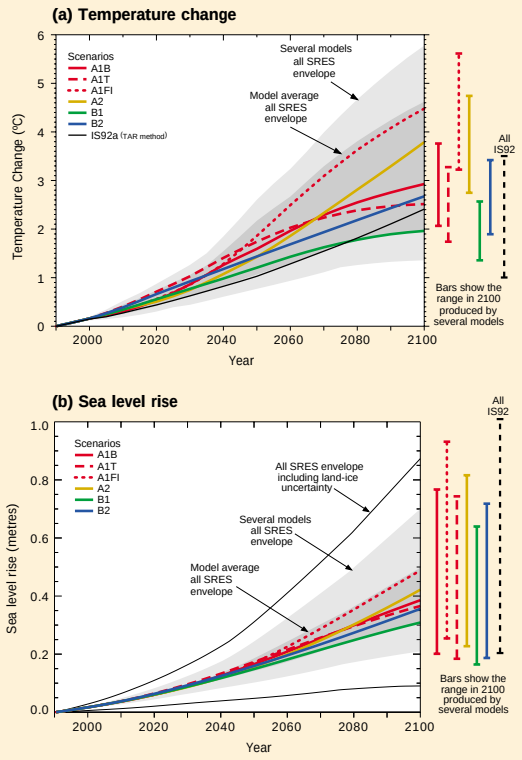
Smoothed annual anomalies of combined land-surface air and sea surface temperatures (ºC), from 1861 to 2000, relative to 1961 to 1990, for (a) Globe; (b) Southern Hemisphere and (c) Northern Hemisphere. (From IPCC, 2001).

FIGURE 2



Variation of the average northern hemisphere surface temperature data over the past 1000 years from proxy data. The grey region is the 95% confidence range. (From IPCC, 2001).

FIGURE 3



Projected temperature (a) and sea level (b) changes for the 21st century. (From IPCC, 2001).

- **Global average temperature and sea level are projected to continue to rise under all IPCC likely emission scenarios.** Projections of globally averaged temperature increases range from 1.4ºC to 5.8ºC over the period 1990 to 2100 (Figure 3a), with greater warming over the land than the oceans. The projected rate of warming is larger than the observed change during the 20th century and is very likely to be without precedent in the last 10 000 years. Changes in the frequency and intensity of extreme events are also expected.
- **Anthropogenic climate change will persist for many centuries.** After greenhouse gas concentrations have stabilized, average temperatures would rise at a rate of a few tenths of a degree per century and sea levels will continue to rise for hundreds of years.
- **Further action is required to address remaining gaps in information and understanding.** High priority areas for action include the need for systematic and sustained observations and modeling and process studies.

IMPLICATIONS FOR THE PACIFIC REGION

Sea-level change

One of the key challenges for Pacific nations is sea-level change. During the 20th century, tide gauge observations indicate sea level has risen at the rate of 1 to 2 mm yr^{-1}, which is faster than the rate during the 19th century. However, no acceleration in sea-level rise has been detected during the 20th century.

For the period 1990 to 2100, sea-level rise as a result of climate change is projected to be between 9 and 88 cm (Figure 3b). The increase in mean sea level will lead to more frequent extreme events of a given level. To date there is little confidence in any regional pattern of projected or historical sea-level rise.

As the oceans warm they expand. Observations and models indicate this ocean thermal expansion (principally from the upper kilometre of the ocean), the melting of non-polar glaciers and a smaller component from the Greenland ice sheet are thought to be the main contributions to recent and future sea-level rise. For east Antarctica, current temperatures are so cold that the projected warming for the 21st century is not likely to result in significant surface melting. Current models of the West Antarctic Ice Sheet indicate that it is unlikely to make a significant contribution to sea level in the 21st century but its dynamics are inadequately understood, especially for projections on a longer time scale. For a sustained warming above 3ºC, the Greenland ice sheet is projected to melt, leading to a sea-level rise of up to 7 m over millennia.

Other impacts

The El Nino–Southern Oscillation affects regional variations of precipitation, temperature and sea level. Recent trends for surface temperatures to become more El Nino like in the tropical Pacific, with the eastern tropical Pacific warming more than the western tropical Pacific, with a corresponding eastward shift of precipitation, are projected to continue in many models. Current projections show little change or a small increase in amplitude for El Nino events over the next 100 years.

Economic and environmental sectors in the Pacific such as agriculture, forestry, water, marine (coral reefs) and fisheries are likely to be impacted by climate change.

THE SOUTH PACIFIC CLIMATE AND SEA LEVEL MONITORING PROJECT

Whilst actions to reduce greenhouse gas emissions may limit the magnitude and the rate of change, some change is inevitable and adaptation strategies will be required. However, determining the timing and the regional impact of change requires further observation and research. Sea-level monitoring undertaken in the South Pacific Sea Level and Climate Monitoring Project is not only important for understanding present change and for improving projections for the future but it is also essential for developing appropriate adaptation and response strategies and policies across a broad spectrum of sectors.

FURTHER READING

IPCC (2001). *Climate Change 2001: The Scientific Basis*. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Eds. Houghton, JT, Ding Y, Griggs DJ, Noguer M, van der Linden P, Dai X, Maskell K and Johnson CI, eds.]. Cambridge University Press, 881pp.

See also www.ipcc.ch

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