

Pacific at Risk

# OUR KNOWLEDGE, THE REALITY



## Pacific Sea-level Rise

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The Intergovernmental Panel on Climate Change (IPCC) 'best estimate' of global sea-level rise is an increase of about 50 cm by 2100. Current observational data indicate a regional (i.e. for the Pacific) average sea-level rise of 2–3 mm per year. This falls within the same range of magnitude as that produced by the global scenario. It is not currently possible to state with certainty whether a clear long-term trend exists, because detailed recording of sea level in the Pacific Ocean has only been carried out since 1991. However, it is worth noting that based on data from

the 11 tide gauges installed in 11 Pacific island countries, relative sea levels in the South Pacific have been rising by as much as 25 mm yr<sup>-1</sup> since 1994<sup>1</sup>. This is more than 10 times the global rate of sea-level rise this century. This finding is validated by satellite data which show an increase of 2–3 cm yr<sup>-1</sup>, particularly from Papua New Guinea to Fiji. The cause of this variation is not clear, but appears likely to be related to changes in ocean currents associated with El Niño events



*Rising sea-level in a number of low-lying Pacific nations has caused some residents to relocate their homes inland*

## Already Inevitable Sea-level Rise

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According to a SPREP-commissioned report from Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), human emissions of greenhouse gases up to 1995, and the consequent global warming, mean a 5–12 cm sea-level rise is already inevitable<sup>2</sup>. The oceans take some decades to fully absorb extra atmospheric warming, and the CSIRO estimates that this sea-level rise resulting from human emissions up to 1995 would peak in about 2020–2025. The CSIRO, using agreed

IPCC scenarios, also studied likely future sea-level rise if all countries met their Kyoto Protocol commitments, and if technology made it possible to cease all human emissions after 2020. This admittedly optimistic scenario would produce a sea-level rise of 14–32 cm, peaking in about 2050. Such an increase, even without the associated increased height of storm surges coming off a higher sea level, is of deep concern to the many small islands which are only one metre above mean sea level.

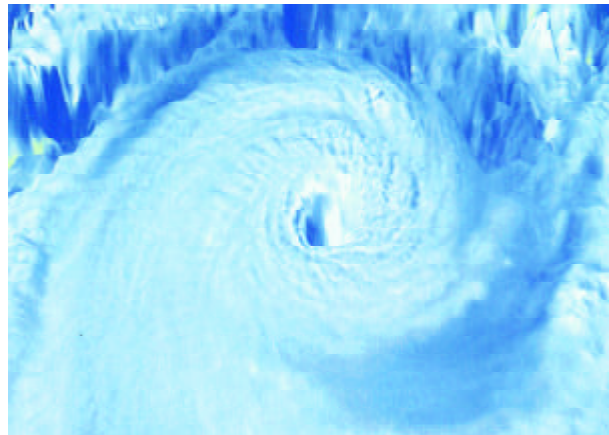


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## Tropical Cyclone Risks

A second CSIRO report, also commissioned by SPREP, shows that while there is no evidence that there might be a change in the numbers of tropical cyclones when CO<sub>2</sub> atmospheric concentrations have doubled, it is considered likely that climate change will lead to some increase (0–20 per cent) in maximum tropical cyclone wind speeds and lower central pressure<sup>3</sup>. This increase in cyclone intensity raises concerns about damage from storm surges—the dome of water forced ahead of the storm by strong winds. Many small island nations are only one or two metres above sea level, and an increase in the height of storm surges would mean greater risk that waves driven by cyclonic winds could sweep entirely over many inhabited Pacific islands.



*It is considered likely that climate change will lead to some increase (0–20 per cent) in maximum tropical cyclone wind speeds*

## Recent Weather Changes

Region-wide studies have shown recent significant changes in major weather patterns in the central and southern Pacific. The El Niño – Southern Oscillation (ENSO) weather pattern has changed its behaviour noticeably since 1976,<sup>4</sup> with more El Niños, fewer La Niñas, the two biggest El Niños on record (1982–83 and 1997–98) and the longest El Niño on record<sup>5,6,7</sup>. Statistically these changes are unusual, and some researchers have speculated that they could be connected to global warming<sup>7</sup>. These recent changes in El Niño patterns have significantly affected Pacific tuna catch volumes, resulting in substantial reductions in seasonal tuna catches for many Pacific island countries<sup>8</sup>. El Niño was also responsible, in 1997–98, for severe droughts and water shortages in many Pacific island countries, and for the extremely high sea-level rise of some 25 mm, recorded across much of the Pacific since 1994<sup>1</sup>.

Another study, by New Zealand's National Institute of Water and Atmospheric Research (NIWA), has pointed to a strong connection between El Niño events and the occurrence of tropical cyclones in the Pacific<sup>9</sup>. For the South West Pacific, the strong El Niño years of 1996–97 and 1997–98 had the highest frequencies of tropical cyclones on record, with a total of 32 tropical cyclones<sup>10</sup>.

In another significant and substantial change in weather patterns, the South Pacific Convergence Zone (SPCZ)—a vast belt of storms and winds—abruptly shifted eastwards in 1977<sup>11</sup>, changing patterns of rainfall and sunshine in every South Pacific island country<sup>12,13</sup>. A NIWA-led study found that the northern Cook Islands, Tokelau and parts of French Polynesia have become substantially wetter since the late 1970s, while Fiji, Tonga, Vanuatu and New Caledonia have become drier. Central and western Kiribati, Tokelau and north-eastern French Polynesia became 0.3°C warmer between 1977 and 1994. Over the same period these countries became wetter and cloudier, with a 30 per cent increase in rainfall compared with pre-1977 averages. For

New Caledonia, Vanuatu, Fiji, Tonga, Samoa and the southern Cook Islands, average rainfall decreased by 15 per cent after 1977



*Rising sea level in Majuro, Marshall Islands is damaging the sea walls erected to protect the islanders*



*One of the many effects of Cyclone Val which hit Samoa in the early 90s*

## Pacific Temperature Rise

A joint New Zealand-Australian analysis of Pacific island weather records<sup>13</sup> has revealed that since 1920 the surface air temperature rose by 0.6 – 0.7°C in Noumea (New Caledonia) and Rarotonga (Cook Islands). This is greater than the mean global increase. Based on data from 34 stations in the Pacific Ocean region, from about 160°E and mostly south of the equator, surface air temperatures have increased by 0.3 – 0.8°C this century, with the greatest increase in the zone south-west of the South Pacific Convergence Zone (SPCZ). This is also well in excess of global rates of warming. A joint NIWA/Hadley Centre study has corroborated the warming in the Pacific, confirming similar increases in surface ocean temperatures throughout the South Pacific<sup>1</sup>



*The last sunrise of the millennium, Apia, Samoa.*

## Observed Recent Changes

There is a growing body of strong anecdotal evidence across the Pacific. Until recently scientific research in the region has been sparsely scattered, making it difficult to definitively establish long-term trends. However, the inhabitants of every Pacific island atoll and island insist that what they are observing today is in many cases very different from what they knew one or more decades ago<sup>15</sup>.

These disruptive changes are consistent with many of the anticipated impacts of global climate change. They include extensive coastal erosion, persistent alteration of regional weather patterns and decreased productivity in fisheries and agriculture. Higher sea levels are making some soils too saline for cultivation of crops such as taro, pulaka and yams. Coastal roads, bridges, foreshores and plantations are suffering increased erosion, even on islands that have not experienced inappropriate coastal development.

Recent devastating droughts have hit export crops and caused serious water shortages in many Pacific island countries, including the Federated States of Micronesia, Fiji, the Marshall Islands, Papua New Guinea, Samoa and Tonga.

There are increasing reports indicating the more widespread and frequent occurrence of mosquito-borne diseases such as malaria. Malaria is even being reported in the highlands of Papua New Guinea and the Solomon Islands where previously it was too cold for mosquitoes to survive.

It is too early to say if these observed changes are the beginning of long-term climate change rather than further manifestations of the natural variability of climate that characterizes the Pacific islands region. However, they are the sorts of changes which can be expected as global warming sparks climate change. Moreover, Pacific island policymakers are aware of the warning from the IPCC that

future climate changes may also involve “surprises”. These arise from the non-linear nature of the climate system. As the IPCC has said, by their very nature, future unexpected, large and rapid climate system changes, as have occurred in the past, are difficult to predict.

Climate change, once started, continues to intensify for decades if not centuries. If the observed changes noted above are indeed precursors of global climate change impacts, then the Pacific’s many small island countries and territories face serious, wide-reaching and long-term consequences of human emissions of greenhouse gases.

*Persistent alteration of regional weather patterns explain migration of common fish species from Pacific coasts, reducing productivity in fisheries*





## Pacific Island Countries Research

### Sea-level Monitoring

A joint venture between SPREP and Australia's National Tidal Facility has seen the installation of Sea Level Fine Resolution Acoustic Measuring Equipment (SEAFRAME) in 11 Pacific island countries: Cook Islands, Fiji, Kiribati, Marshall Islands, Nauru, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.



*Sea Level  
Fine  
Resolution  
Acoustic  
Measuring  
Equipment  
(SEAFRAME)*

### Greenhouse Gas Inventories and Mitigation Analysis

Thirteen Pacific island countries—Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Papua New Guinea, the Republic of the Marshall Islands, Samoa, the Solomon Islands, Tonga, Tuvalu and Vanuatu—have ratified the UNFCCC. With assistance from the Pacific Islands Climate Change Assistance Programme (PICCAP), a SPREP project, ten have compiled inventories<sup>16</sup> showing each country's greenhouse gas emissions<sup>17</sup>; assessment of how to reduce those emissions<sup>18</sup>; assessment of each country's likely vulnerability to climate change and sea-level rise; and evaluation of adaptation options available to each country<sup>19</sup>.

The greenhouse gas emissions inventories prove that the Pacific islands region's contribution to global warming is minuscule. The region contains 0.12 per cent of the world's population and produces approximately 0.03 per cent of global CO<sub>2</sub> emissions. Per capita emissions from the Pacific islands region are approximately 0.96 tonnes per year—well below the global per capita emissions in 1996 of 4.02 tonnes.

The mitigation analyses carried out by national officials in 13 Pacific island countries have identified a wide range of options for reducing the region's greenhouse gas emissions, in the areas of reducing dependency on imported fossil fuels, enhancing renewable energy supply and improving energy efficiencies.

### Vulnerability and Adaptation Assessments

In a six-month certificate training programme run first by the University of Waikato (New Zealand) International Global Change Institute (IGCI) and now transferred to the University of the South Pacific in Suva, Fiji, two national officials from each of 11 countries studied how to scientifically assess likely vulnerability and adaptation options. These national assessments of climate change vulnerability and adaptation now form the basis of needs and priorities for adaptation within the framework of sustainable development.

Pacific island countries identified the following areas as priorities that need urgent action: coastal zone, agriculture, water resources, human health, biodiversity and marine resources, tourism, food security, capacity building, institutional strengthening, governance, management and planning.

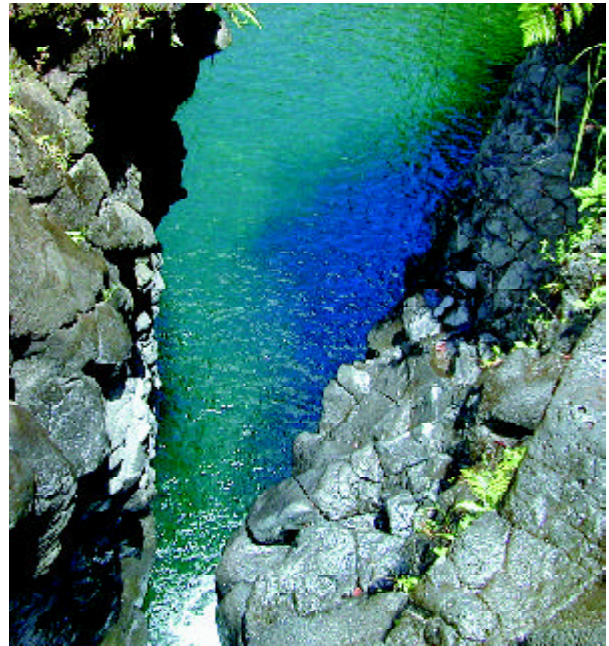
### Regional Computer Model

Global computer models do not have enough detail to adequately inform Pacific island planners. The vulnerability assessments carried out by Pacific islands officials are being fed into a regional computer model (PACCLIM) being developed by the IGCI in Hamilton, New Zealand. The PACCLIM model will provide essential details by sector, allowing Pacific island Governments to assess what they have the capacity to do, and what they can afford to do, as climate and sea levels continue to change.

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### **Pacific Islands Meteorological Service Coordination and Collaboration**

The South Pacific Regional Environment Programme (SPREP), the Australian, French, New Zealand and United States meteorological services, the United States National Oceanic and Atmospheric Administration (NOAA) and the World Meteorological Organization (WMO) work together to support continued strengthening of the capability of the Pacific region's national meteorological services, to meet the growing demand for improved weather and climate services and products<sup>20,21</sup>. SPREP also collaborates with the EU funded Cyclone Warning System Upgrade Project (CWSUP), implemented by the South Pacific Forum Secretariat to improve rapid dissemination of information, resources and communications for tropical cyclone warning services in the region. SPREP, in collaboration with NOAA, the US National Weather Service and CWSUP provides the Emergency Managers Weather Information Network (EMWIN), a satellite based communication system for rapid dissemination of warnings and other weather products and services to meteorological services in the Pacific islands region



*Pacific island countries identified water resources as one of the priority areas that need urgent action*

### **Collaboration with Global Climate Research**

Improved climate predictions will assist the region mitigate the impacts of climate change. The United States Department of Energy (US DoE), the University of California, Los Alamos, and SPREP are implementing a climate research studies project: the Atmospheric Radiation Measurement Program (ARM)<sup>22</sup>. This research aims to improve understanding of the roles of clouds and radiation (solar and terrestrial) in the climate system, and to reduce the uncertainties that plague atmospheric general circulation models (GCMs). Two research Atmospheric Radiation and Cloud Stations (ARCS) have already been installed in Manus, Papua New Guinea, and in Nauru. A third site is being considered for implementation in the year 2001 at a yet undetermined location.



*The array of instruments which measure surface radiation balance on Manus Island, Papua New Guinea*



*Atmospheric and Cloud Station (ARCS) on Manus Island, Papua New Guinea*

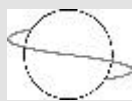
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Design and layout by Michael von Reiche for SPREP's Publications Unit

Photos by: Stefan and Michael von Reiche, Colin Woodard, Penehuro Lefale, Chalapan Kaluwin and Fatu Tauafiafi.

Printed by Quality Print Ltd, Suva, Fiji.

Produced by SPREP's Climate Change and Integrated Coastal Management Programme through the Pacific Islands Climate Change Assistance Programme (PICCAP) with funding assistance from the Global Environment Facility (GEF) through the United Nations Development Programme (UNDP).



