Chapter 2
Climate Change Scenarios in the Pacific

In 1999–2000 the World Bank helped sponsor a study of vulnerability, adaptation, and economic impact of climate change in the Pacific Island region.[1] The analysis used an integrated model of climate change developed for the region, the Pacific Climate Change Impacts Model (PACCLIM), complemented by sectoral impact models, population projections, and baseline data such as historical climate records. Based on the best scientific information available for the region, the following scenarios were used by the study (table 2):

- ***Rise in sea level.*** Sea level could rise 0.2 meters (in the best-guess scenario) to 0.4 meters (in the worst-case scenario) by 2050. By 2100, the sea could rise by 0.5-1.0 meters relative to present levels. The impact would be critical for low-lying atolls in the Pacific, which rarely rise 5 meters above sea level. It could also have widespread implications for the estimated 90 percent of Pacific Islanders who live on or near the coast (Kaluwin and Smith 1997).

- ***Increase in surface air temperature***. Air temperature could increase 0.9^0-1.3^0 C by 2050 and 1.6^0-3.4^0C by 2100.[2]

- ***Changes in rainfall.*** Rainfall could either rise or fall—most models predict an increase—by 8-10 percent in 2050 and by about 20 percent in 2100, leading to more intense floods or droughts.

Table 2. Climate Change and Variability Scenarios in the Pacific Island Region

Impact	*2025*	*2050*	*2100*	*Level of Certainty*
Sea level rise (centimeters)	11—21	23—43	50—103	Moderate
Air temperature increase (degrees Centigrade)				
Fiji	0.5—0.6	0.9—1.3	1.6—3.3	High
Kiribati	0.5—0.6	0.9—1.3	1.6—3.4	High
Change in rainfall (percent)				
Fiji	-3.7—+3.7	-8.2—+8.2	-20.3—+20.3	Low
Kiribati	-4.8—+3.2	-10.7—+7.1	-26.9—+17.7	Low
Cyclones				
Frequency		Models produce conflicting results		Very Low
Intensity (percentage increase in wind speed)		0—20		Moderate
Region of formation		No change		Low
Region of occurrence		No change or increase to north and south		Low
El Niño Southern Oscillation (ENSO)		A more El Niño–like mean state		Moderate

Note: Ranges given reflect a best-guess scenario (lower value) and a worst-case scenario (higher value). Sea level rise is derived from global projections, as regional models have not yet been developed. Temperature and rainfall projections are based on the CSIRO9M2 and the DKRZ Global Circulation Models. ENSO and cyclone scenarios are based on a comprehensive review of climate variability in the South Pacific (Jones and others 1999). For details, see Annex A.

[1] See *Acknowledgments* for a list of the experts and organizations that participated in the study. Background studies to this report are cited in *References*. The assumptions used by the study are detailed in Annex A.

[2] A new report by the Intergovernmental Panel on Climate Change, scheduled to be finalized in early 2001, raises the worst case scenario for surface air temperature to 6^o C by 2100. This means that if the worst case scenario materializes, the impacts may be considerably higher than estimated here.

- ***Increased frequency of El Niño-like conditions***. The balance of evidence indicates that El Niño conditions may occur more frequently, leading to higher average rainfall in the central Pacific and northern Polynesia. The impact of El Niño Southern Oscillation (ENSO) on rainfall in Melanesia, Micronesia, and South Polynesia is less well understood (Jones and others 1999).

- ***Increased intensity of cyclones***. Cyclones may become more intense in the future (with wind speeds rising by as much as 20 percent); it is unknown, however, whether they will become more frequent. A rise in sea surface temperature and a shift to El Niño conditions could expand the cyclone path poleward, and expand cyclone occurrence east of the dateline. The combination of more intense cyclones and a higher sea level may also lead to higher storm surges (Jones and others 1999).

How certain is climate change? The Intergovernmental Panel on Climate Change (IPCC) stated in 1995 that "the balance of evidence suggests a discernible human influence on global climate change" (IPCC 1995). In a report scheduled to be finalized in early 2001, however, IPCC concluded that human influence had contributed substantially to observed warming over the past 50 years.

While there is growing consensus among experts that climate change is occurring, uncertainties remain about the magnitude and timing of the changes. For small island states, these uncertainties are magnified because the area of the countries usually falls below the levels of resolution of the general circulation models used.

Some changes are more certain than others: there is emerging consensus that global average temperature and sea levels will increase. Rainfall changes remain highly uncertain, however, as does the relationship between long-term climate change and extreme events. Uncertainties also increase with spatial resolution: there is greater confidence in model projections of global average changes than in projections of regional or local level changes. Impacts on coastal areas and water resources are generally more certain than impacts on agriculture and health. And uncertainty increases with time: projections for 2100 are less certain than projections for 2050. Despite these uncertainties, most studies consider the Pacific Islands to be at high risk from climate change and sea level rise (Kench and Cowell 1999).

Based on the results of the study, the physical and economic impacts of climate change in the Pacific Island region are illustrated here by the example of a high island—Viti Levu in Fiji—and a group of low islands—the Tarawa atoll in Kiribati. To give perspective to the analysis, all economic damages were estimated for 2050 as if the impacts had occurred under today's socio-economic conditions. Ranges provided represent a "best guess" scenario (the lower bound) and a "worst case" scenario (the upper bound). All economic costs reflect 1998 US dollars, and assume no adaptation.