Antarctic Climate & Ecosystems CRC

Sea-level Rise Program

Sea-level rise as a result of climate change may affect millions of people worldwide in coming years. A combination of higher sea level, possibly combined with stronger winds, could also cause more frequent flooding in coastal lowlands and put billions of dollars of coastal development at risk.

Scientists in the ACE CRC Sea-level Rise Program are helping Australia prepare for these possibilities by improving our ability to project and respond to future changes based on better understanding of historical sea-level change and the factors that contributed to it.

Program Leader

Dr John Church, CSIRO Marine and Atmospheric Research

Photo credit: USGS

Background

Rising sea level is one of the major impacts of climate change. More than 80 per cent of Australians currently live in the coastal fringes on the east and southwest of the continent. Around a quarter of Australia's population growth is occurring within three kilometres of the coast. Thus, a significant proportion of Australia's population may experience the impacts of a changing climate through rising sea levels, increased coastal erosion and extreme events such as cyclones, storm surges and coastal flooding. Adaptation to this growing threat requires the best scientific guidance on the impact of climate change on sea level and associated extreme events.

The ACE CRC is one of the few institutes in the world with the breadth of capability to address most aspects of sea-level change. The overall goal of the ACE CRC Sea-level Rise Program is to narrow uncertainty in projections of global and regional sea-level change, including the changing frequency of coastal flooding events, for selected cities and populated regions of the Australian coastline and Australia's neighbours in the South Pacific.

New observational tools such as satellites and improved computer models enable us to make significant progress toward reducing uncertainties in projected sea-level rise. We are using these new technologies, together with long-established methods, to improve our understanding of the various processes that contribute to sea-level change and its impacts globally and in Australia.

Program Objectives

To narrow estimates of the range of 20th century global-averaged and regional sea-level rise.

An understanding of the past is necessary to predict the future. Through analyses of historical and new data, including tide-gauge records and satellite-altimeter measurements, ACE CRC researchers are significantly enhancing our knowledge of sea-level rise over the past century. This knowledge is improving our ability to test models that project future sea levels and increasing our confidence in those projections.

To improve estimates of the different factors that contributed to 20th century sea-level rise.

Sea-level rise depends on a complex interplay of global, regional and local factors. These include the expansion of ocean water volume as it warms, melting of land-based ice (e.g., from glaciers), changes in snowfall in Antarctica and Greenland, changes in glacier flow rates, increased melting of the Greenland ice sheet, changes in the amount of water stored on land and vertical movements of land masses because of geological processes.

ACE CRC scientists are using *in situ* and satellite observations and measurements, combined with computer modelling, to unravel these complex processes. Improving our understanding of how different processes interacted to affect sea-level rise and its regional distribution during the 20th century is allowing us to reduce uncertainties in future projections, especially at regional and local scales.

To significantly reduce the range of 21st century projections of sea level rise.

The Intergovernmental Panel on Climate Change (IPCC) has predicted that global average sea level may increase anywhere from 9 to 88 cm during the period 1990 to 2100. ACE CRC research results are helping increase the precision of projections for global average and regional sea levels in the 21st century to enable society to develop appropriate responses to projected changes.

To forecast change in extreme events during the 21st century for strategic locations.

Elevated sea levels will lead to an increase in the potential impact of natural extreme events such as storm surges. In addition, the intensity of wind and waves in some regions may increase with global warming and change the frequency and intensity of extreme events. ACE CRC research has already shown that storm surges of a given height in Sydney and Fremantle occurred two to three times more frequently in the last half of the 20th century than they did in the first half. If this trend continues, coastal flooding currently expected only once every fifty years may occur as often as every three to five years by 2100.

ACE CRC researchers are assessing how climate change will affect the frequency and intensity of these events around Australia and selected South Pacific locations. This will help coastal planners assess the vulnerability of different parts of the coastline and provide guidance for adaptation and mitigation strategies to protect coastal communities and assets.

To address key uncertainties in the longer-term projections of sea-level rise.

Sea level will continue to rise after 2100, potentially by several metres, because of ongoing warming and resultant expansion of the ocean, as well as changes in the Antarctic and Greenland Ice Sheets. The rate and amount of rise are uncertain, however, and reducing that uncertainty is another focus for ACE CRC research.

Recent Achievements

In 2004-05 ACE CRC researchers completed a unique estimate of annual global averaged sea level from January 1870 to December 2004. This data indicates that the rate of sea-level rise has increased significantly during the 20th century. Previous studies had failed to detect this expected increase in the rate of sea-level rise.

ACE CRC scientists also showed that major volcanic eruptions in the late 20th century resulted in temporary decreases in ocean temperature and global mean sea level. The eruptions injected large quantities of fine particles into the upper atmosphere, reducing the amount of the solar energy reaching the Earth's surface. The effect persisted for at least a decade after each major eruption and temporarily masked the warming and consequent sea-level rise that would otherwise have occurred from increasing concentrations of atmospheric greenhouse gases.

Contact:

Dr John Church
tel +61 3 6232 5207
john.church@csiro.au
www.acecrc.org.au

Australian Government Department of the Environment and Heritage Australian Antarctic Division
UTAS
CSIRO
Australian Government Bureau of Meteorology
Established and supported under the Australian Government's Cooperative Research Centres Programme
CRC AUSTRALIA