

Sea-level variability and rise: understanding the past, implications for the future

John A. Church

Centre for Australian Weather and Climate Research – A partnership between CSIRO and the Bureau of Meteorology, CSIRO Wealth from Oceans Flagship And Antarctic Climate and Ecosystems Cooperative Research Centre GPO Box 1538, Hobart Tasmania 7001

Geological data indicate sea level was several metres higher than current values at the time of the last interglacial and then fell to more than 120 m below present day values during the last ice age. Sea level then rose over 120 m at peak rates of about 40 mm yr⁻¹ (4 m century⁻¹). Geological data and coastal sea-level measurement indicate sea levels rose by about 20 cm from 1870 to the present, with a significant increase in the rate of rise. Both satellite data and coastal sea-level measurements indicate the rate of rise is over 3 mm yr⁻¹ since 1993.

The largest contributions to 20th century sea-level rise are ocean thermal expansion and the melting of glaciers and ice caps. Sea level will continue to rise through the 21st century and beyond. The ice sheets of Greenland and Antarctica have the potential for significant contributions. After stabilization of greenhouse gas concentrations, sea levels will continue to rise for decades to centuries. There is a surface warming value above which melting of the Greenland Ice Sheet exceeds precipitation, leading to ongoing wastage of the ice sheet and a sea-level rise of metres. We could cross this critical value in the 21st century. There is increasing concern that the Greenland and Antarctic Ice Sheets might contribute more rapidly to sea-level rise through dynamic ice-sheet responses.

The 20th century sea-level rise has already led to more frequent flooding events of a given level. By 2100, tens of millions of people may be vulnerable each year to coastal flooding events associated with sea-level rise and extreme events. Appropriate mitigation measures and planning and adaptation actions can significantly reduce the number of people affected.