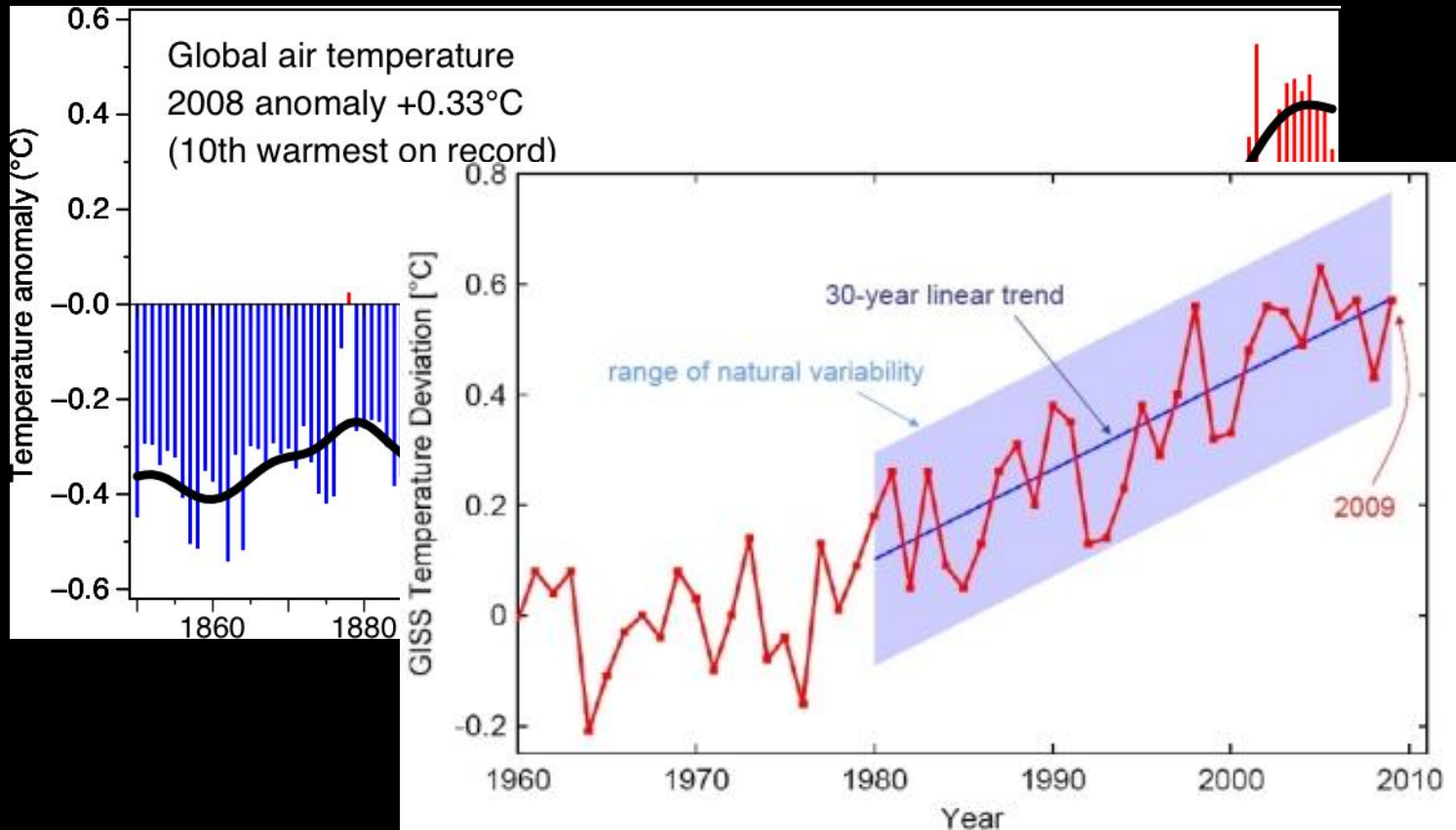


Prof. Will Steffen

**Magnitude of the risk: the science of climate
change for the coast**



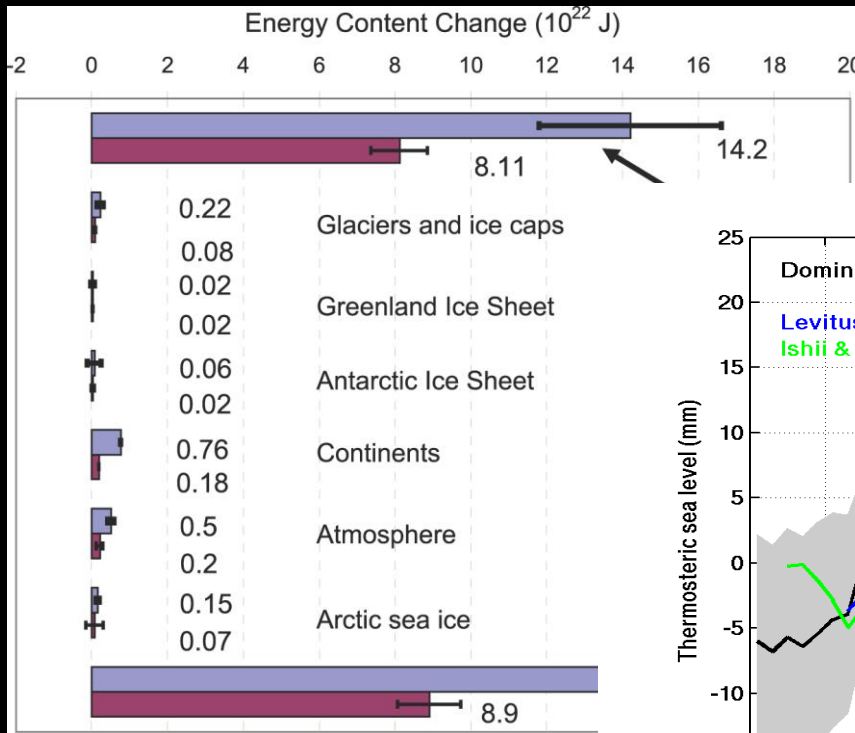
Global Air Temperature Trends



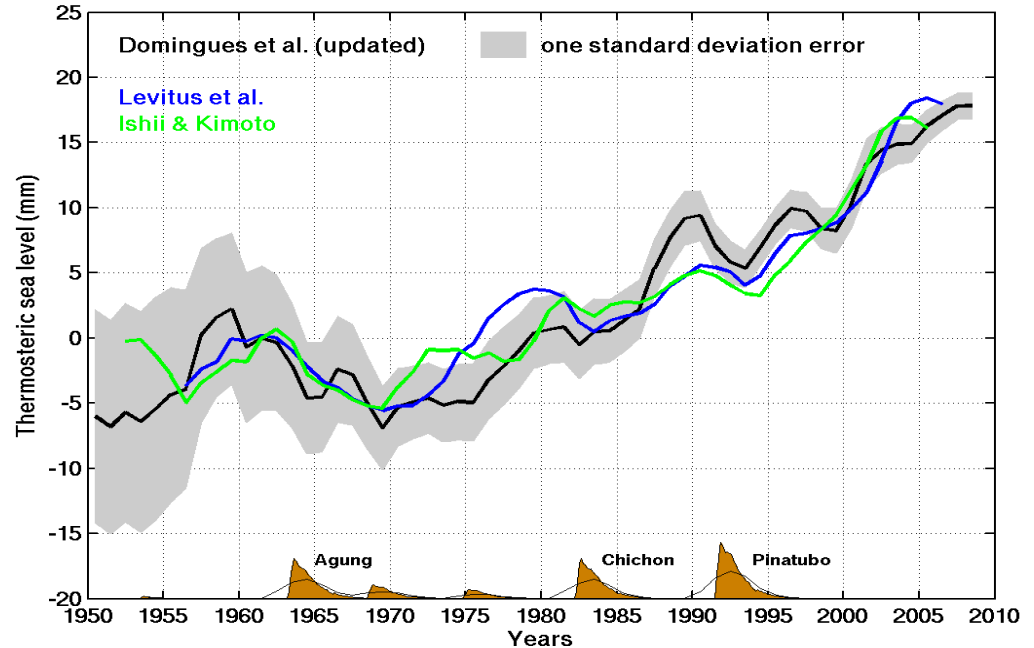
NASA GISS 2010



Ocean Heat Content



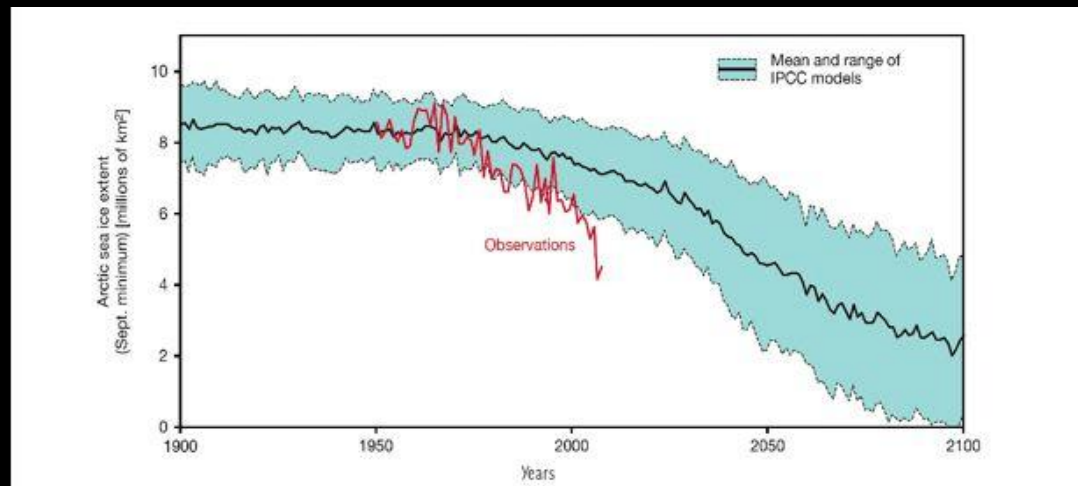
IPCC



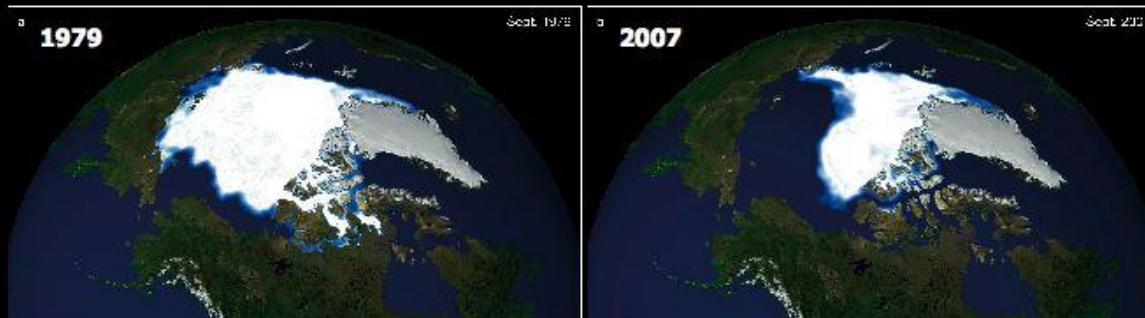
J. Church, CSIRO, 2010



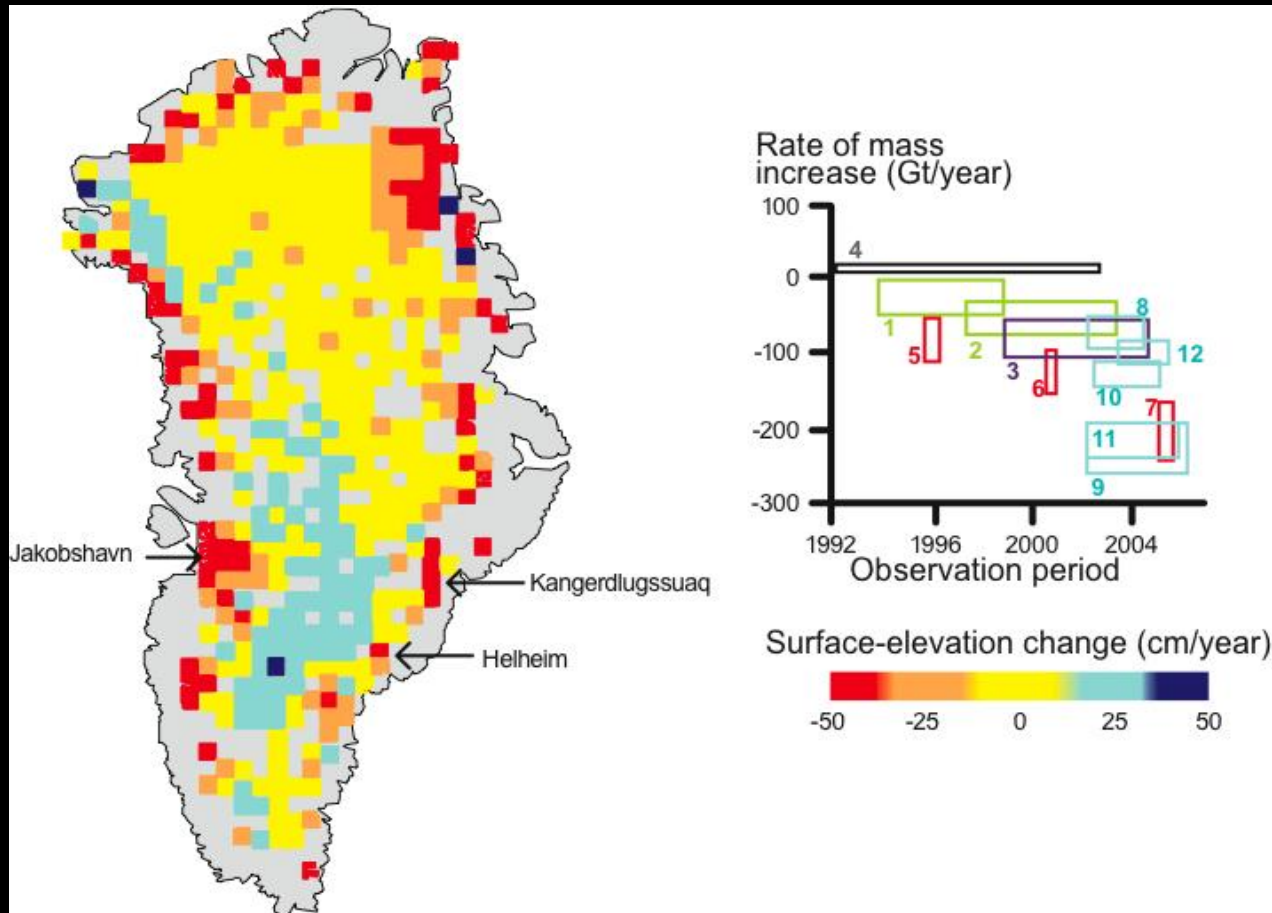
Arctic Sea Ice



From Stroeve et al. (2007) updated with 2008 data



Polar Ice Sheets: Greenland



K. Steffen, Natl Snow & Ice Center, U. of Colorado, USA



Climate Change: Summary

Warming of the climate system is unequivocal, as is now evident from increases in global average air and ocean temperatures, melting of snow and ice, and rising sea level.

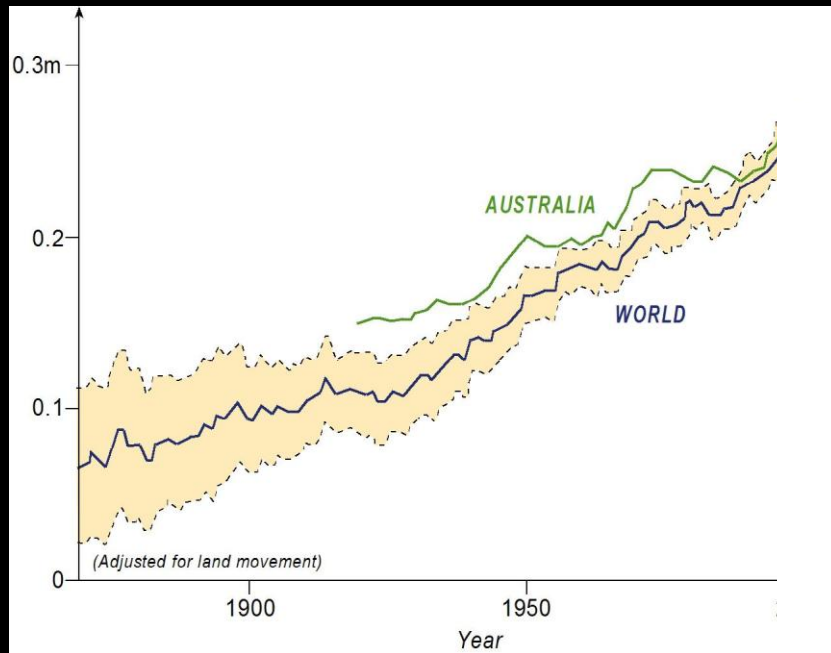
Numerous changes in climate have been observed at the scales of continents or ocean basins - wind patterns, precipitation, ocean salinity, sea ice, ice sheets, and aspects of extreme weather.

It is *very likely* that anthropogenic greenhouse gas increases caused most of the observed increase in globally averaged temperatures since the mid-20th century.

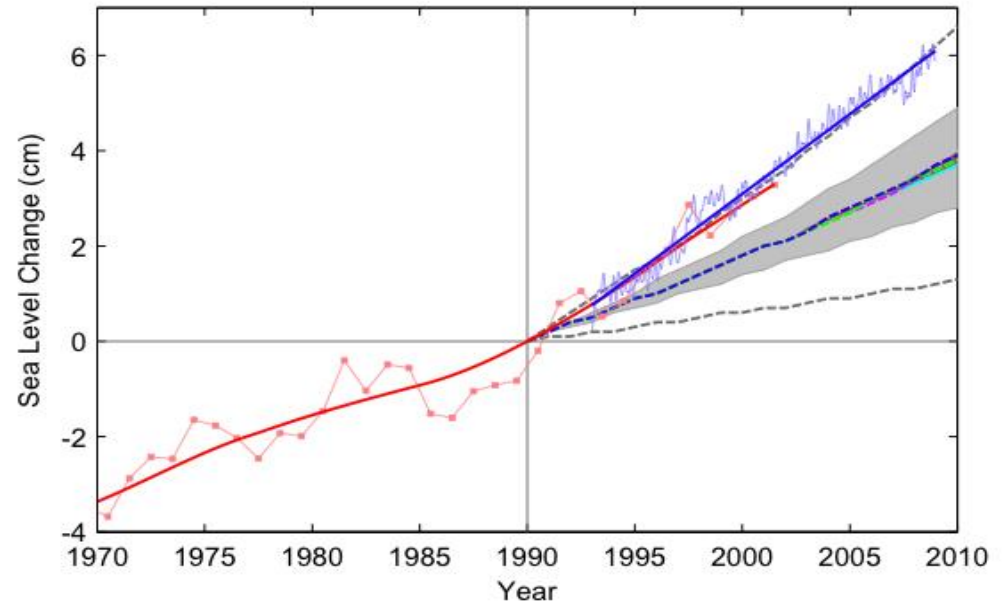
IPCC 2007



Observations of Sea-level Rise



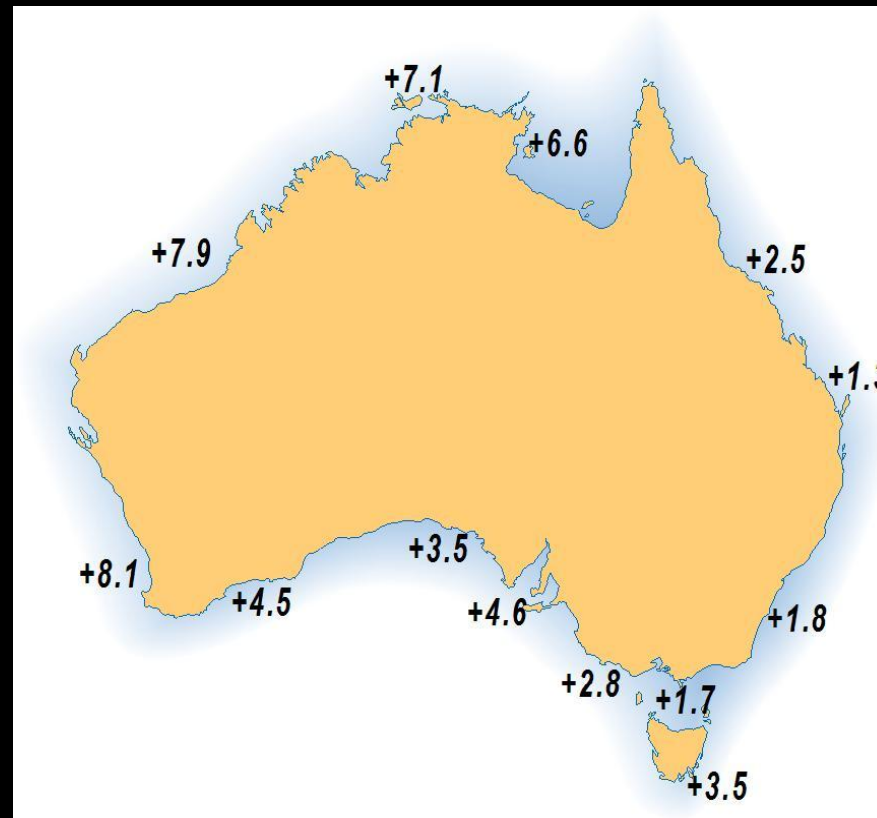
Church and White 2006



Rahmstorf et al. 2007; Cazenave and Narem 2004;
Cazenave 2006 & 2006-2008 data from A. Cazenave



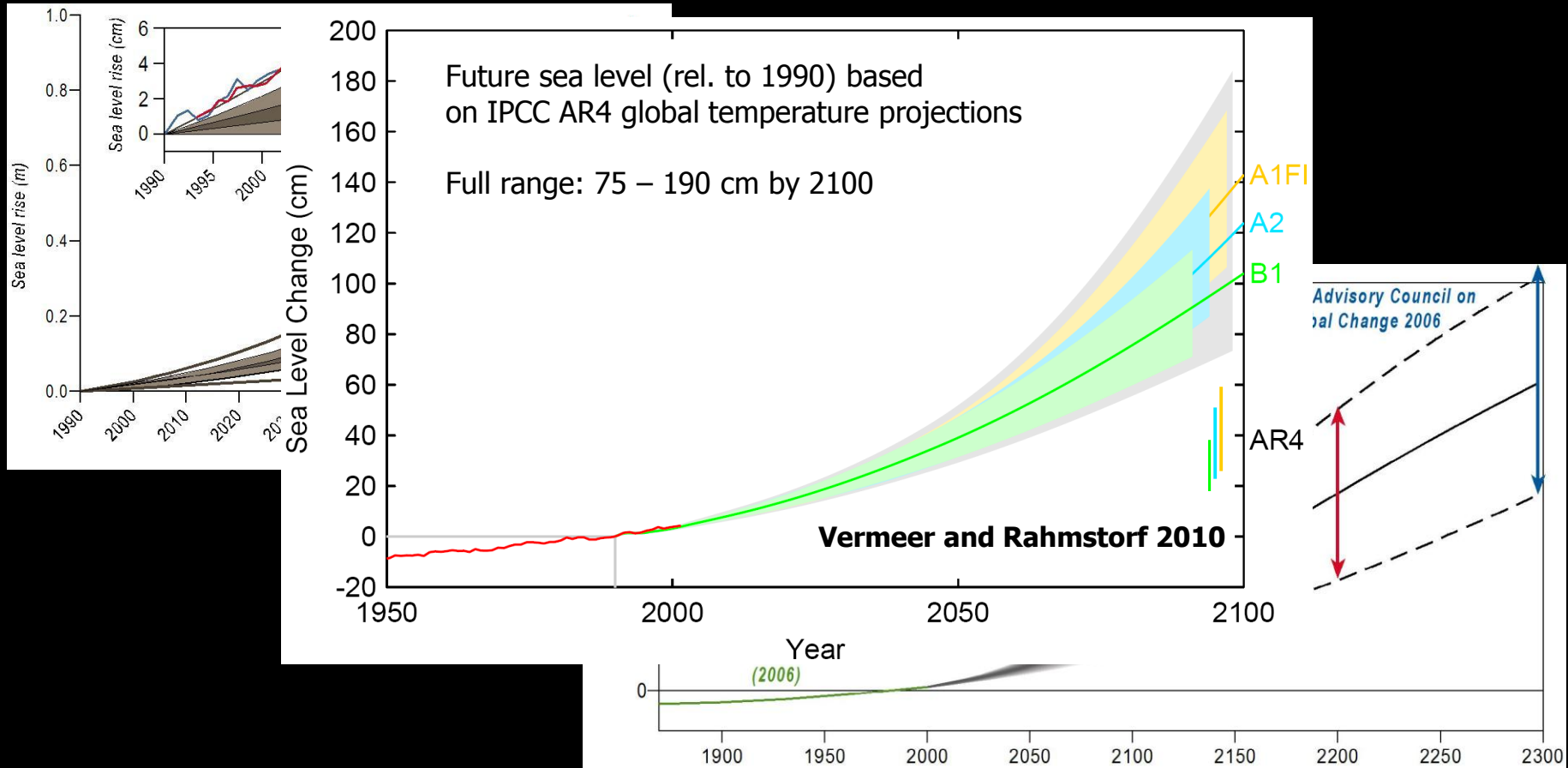
Local Sea-level Rise (mm/yr)



NTC 2008



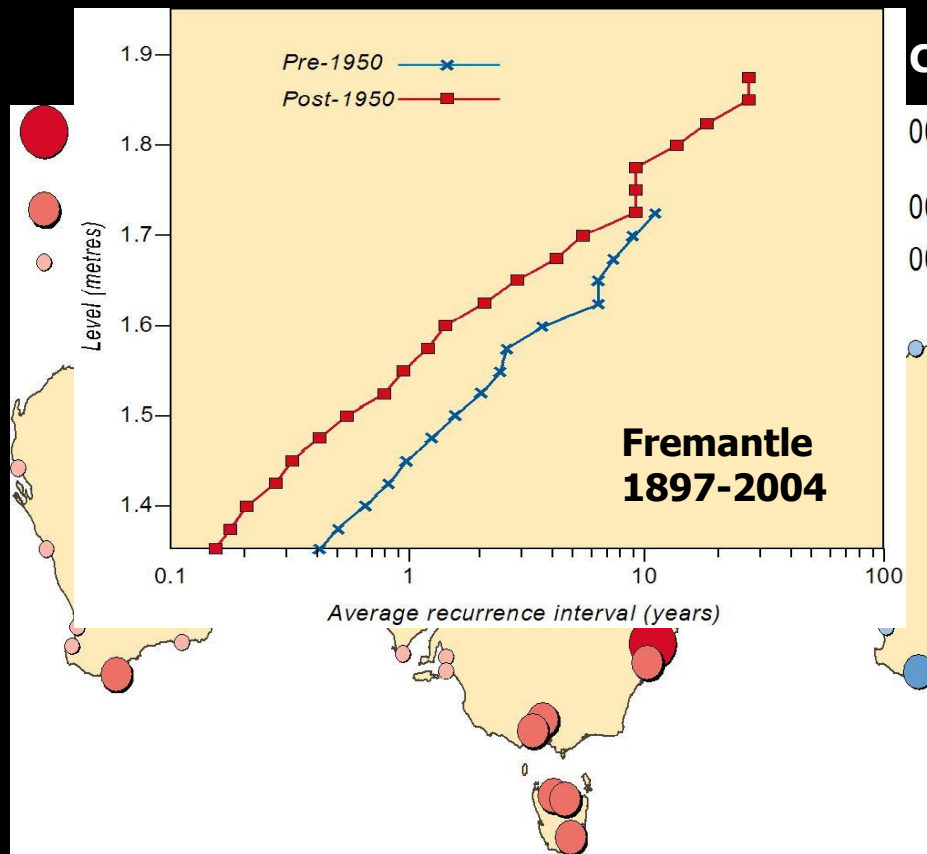
Projections of Sea-level Rise



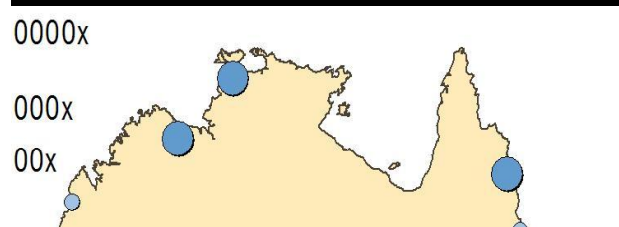
German Advisory Council on Global Change 2009



High Sea-level Events: Increase in Frequency



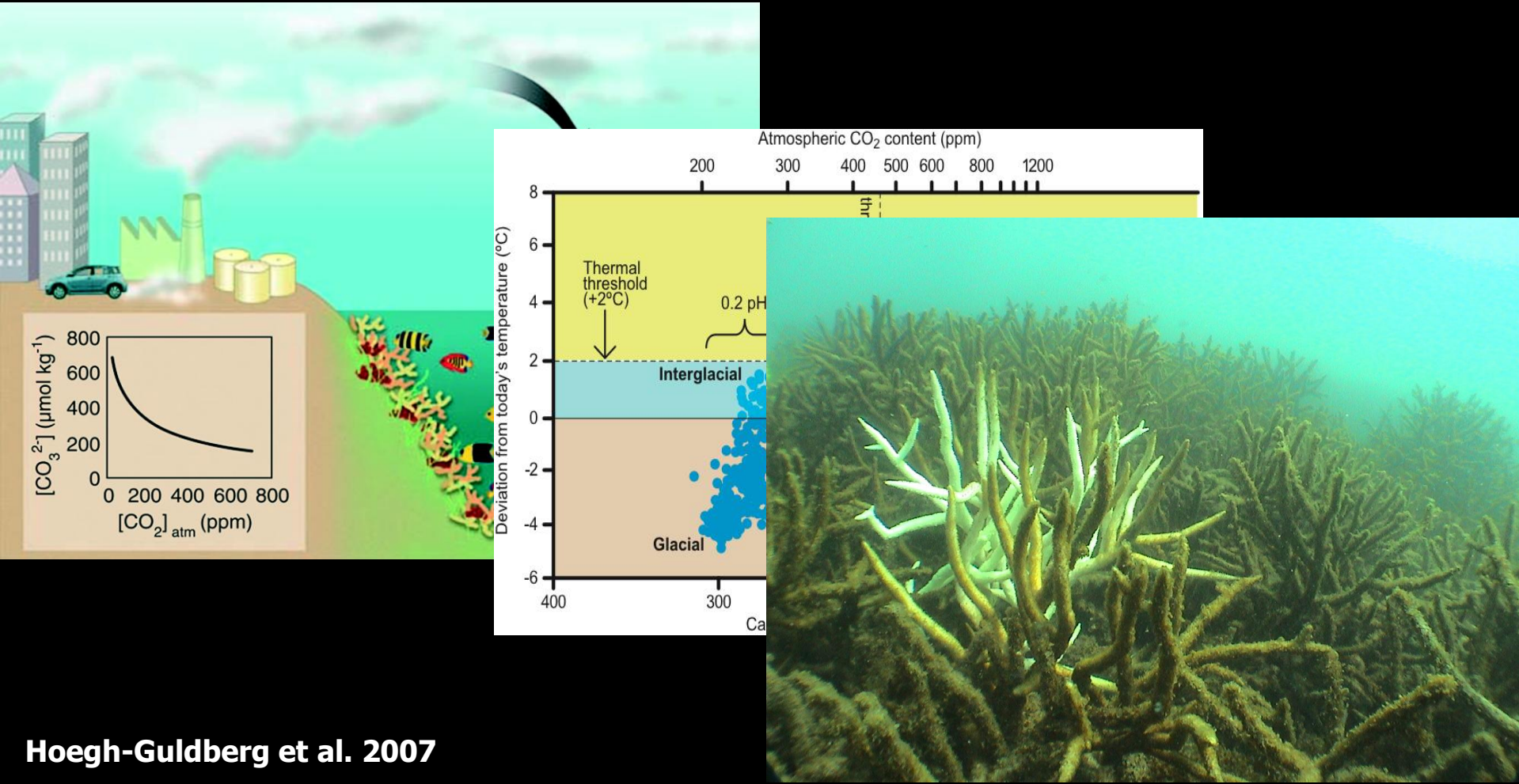
Church et al. 2006



David Hanslow, TSRA



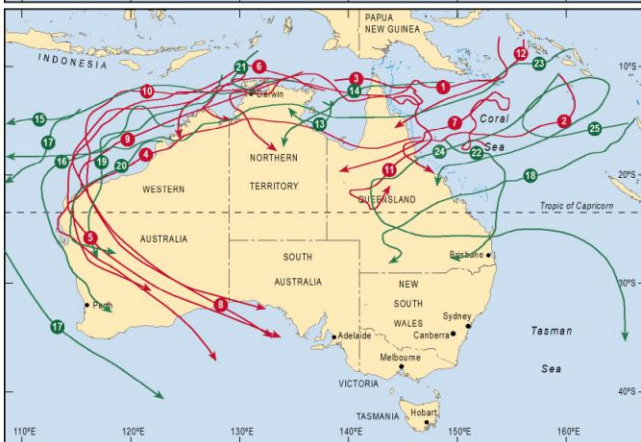
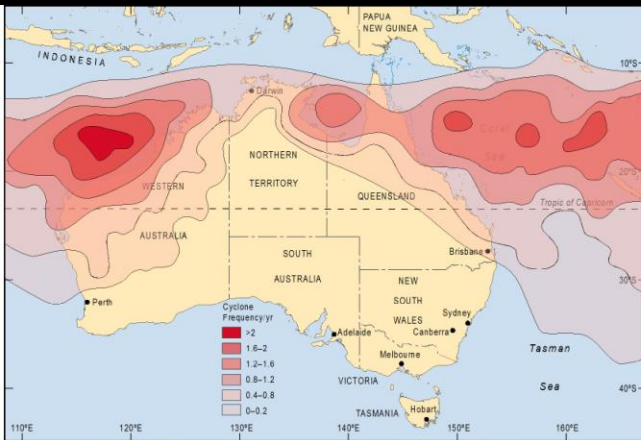
Ocean Acidity & Coral Reefs



Hoegh-Guldberg et al. 2007



Changes to Tropical Cyclones



- | | | |
|----|----------|--------------|
| 1 | Monica | Apr 2006 |
| 2 | Larry | Mar 2006 |
| 3 | Ingrid | Mar 2005 |
| 4 | Steve | Feb-Mar 2000 |
| 5 | Vance | Mar 1999 |
| 6 | Thelma | Nov-Dec 1998 |
| 7 | Justin | Mar 1997 |
| 8 | Olivia | Apr 1996 |
| 9 | Bobby | Feb 1995 |
| 10 | Orson | Apr 1989 |
| 11 | Winifred | Feb 1988 |
| 12 | Manu | April 1986 |
| 13 | Sandy | Mar 1985 |
| 14 | Kathy | Mar 1984 |
| 15 | Max | Mar 1981 |
| 16 | Hazel | Mar 1979 |
| 17 | Alby | Mar-Apr 1978 |
| 18 | David | Jan 1976 |
| 19 | Joan | Nov-Dec 1975 |
| 20 | Trixie | Feb 1975 |
| 21 | Tracy | Dec 1974 |
| 22 | Wanda | Jan 1974 |
| 23 | Madge | Feb-Mar 1973 |
| 24 | Ailthea | Dec 1971 |
| 25 | Ada | Jan 1970 |

Climate change could affect frequency, intensity and positions of cyclones and other storms, but there is much uncertainty surrounding projections.

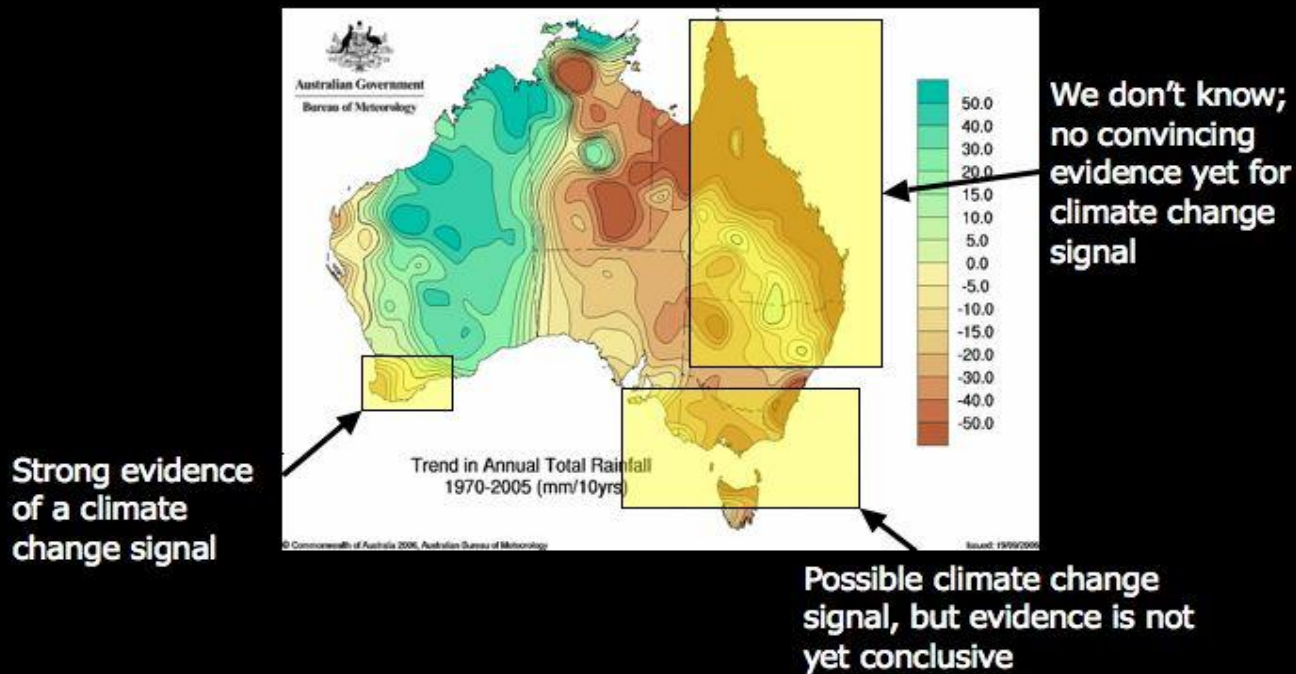
Possible decrease in total number of cyclones but increase in number of most intense cyclones.

Cyclones could track further south along east and west coasts.

Short and Woodroffe 2009



Changes in Rainfall



Steffen 2009



Other Climate-related Changes

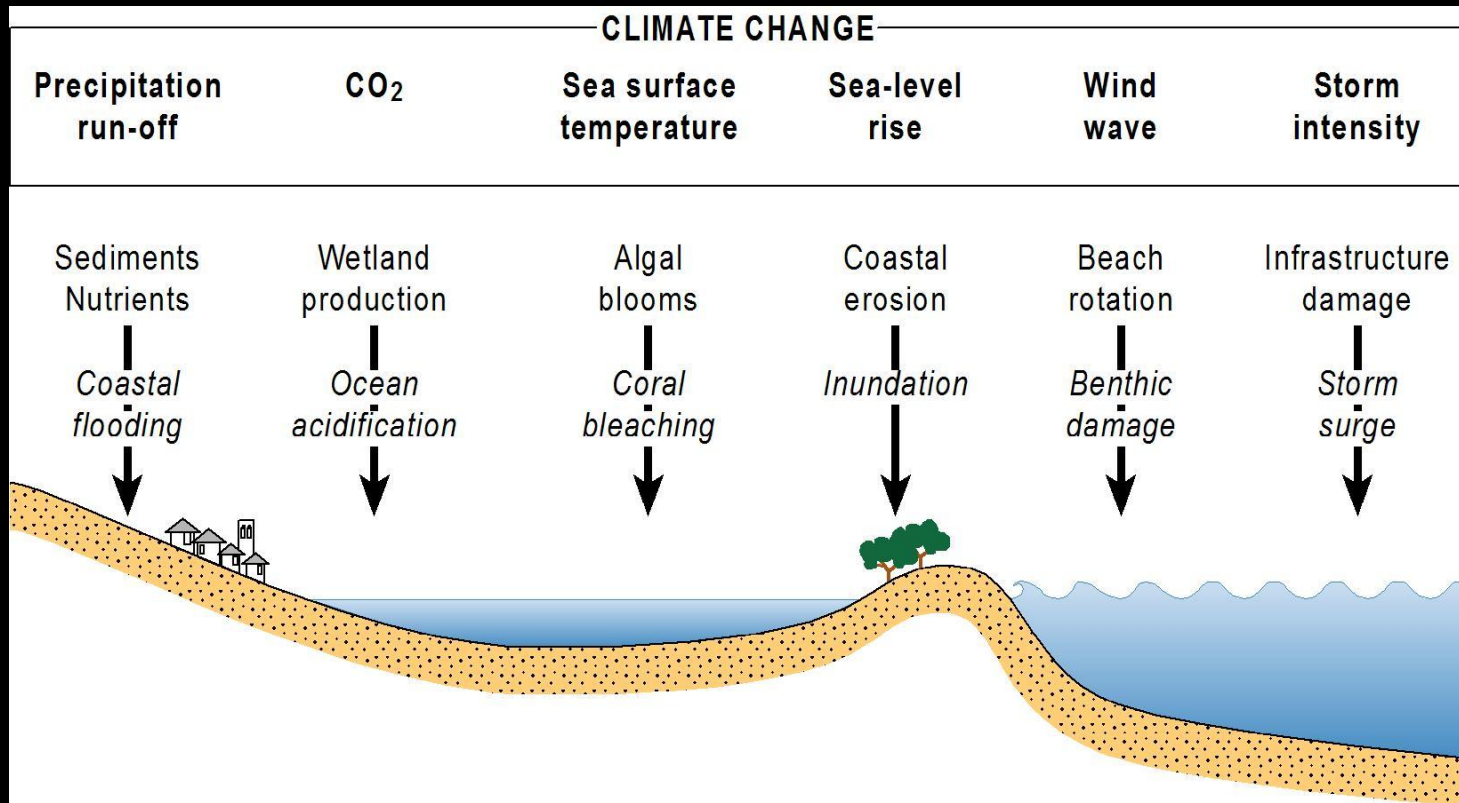
Wave climates

Storm surge and wind

Extreme events - intense rainfall (leading to riverine flooding), heatwaves, hail storms



Impacts on the Coastal Zone



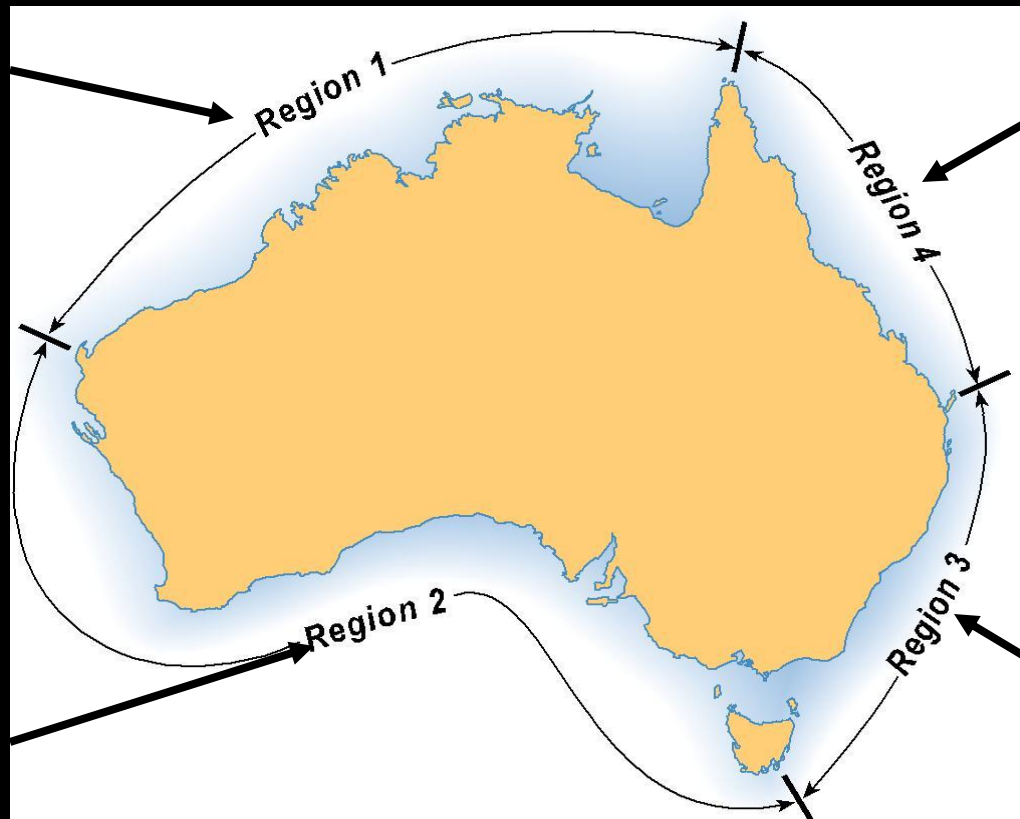
Short and Woodroffe 2009



Australia's coastal regions

The Muddy North

The Barrier Reef

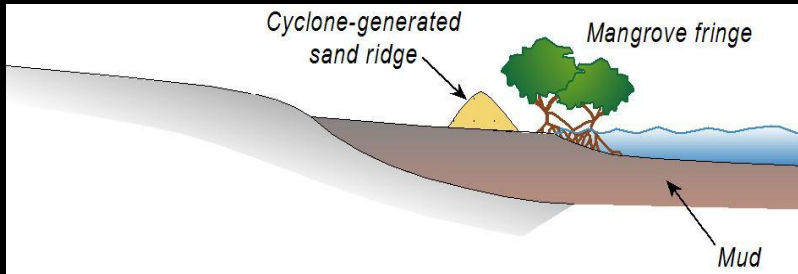


The Limestone South & West

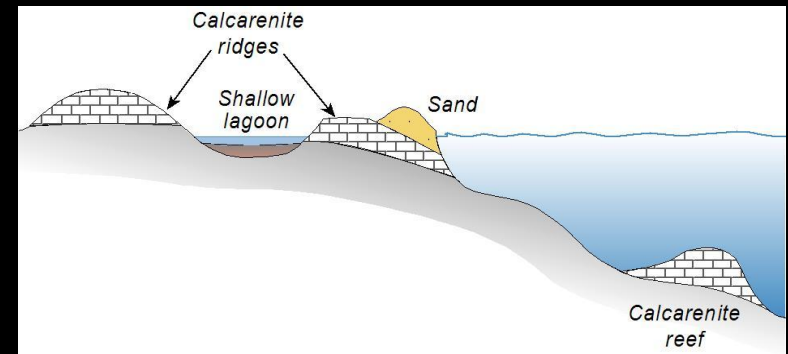
Eastern Headlands & Bays



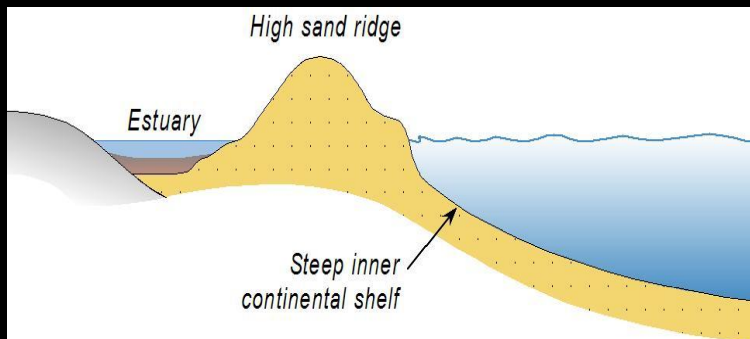
The Coastal Regions



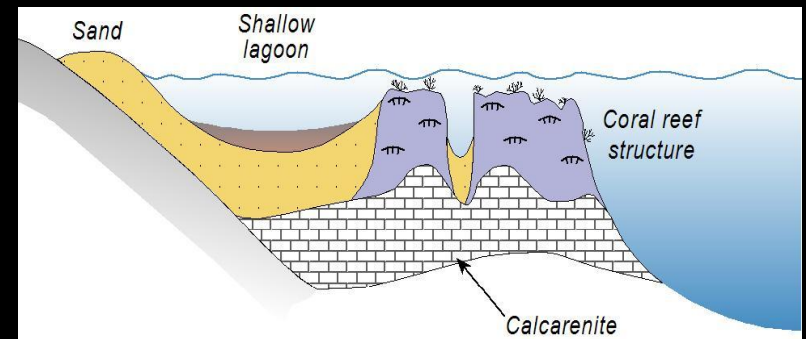
1. The Muddy North



2. The Limestone South & West



3. Eastern Headlands & Bay



4. The Barrier Reef



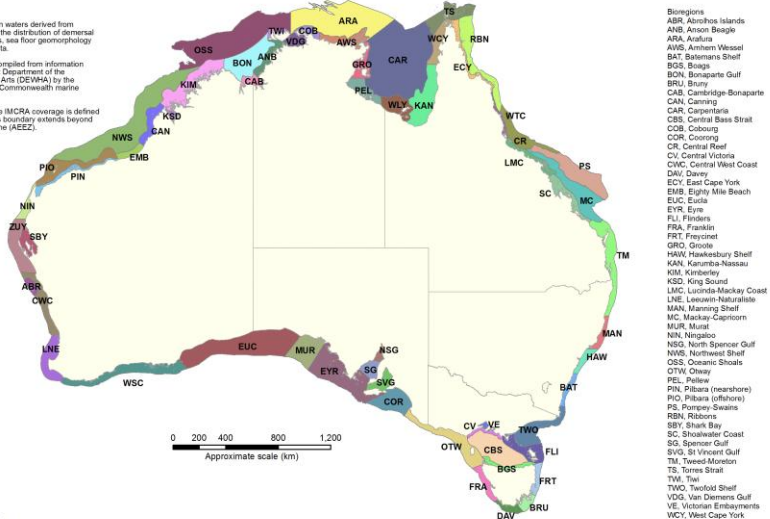
Bioregions along the Coast

Integrated Marine and Coastal Regionalisation of Australia (IMCRA) v4.0 - Meso-scale Bioregions

An inshore regionalisation of Australian waters derived from biological and physical data, including the distribution of demersal fish, marine plants and invertebrates, sea floor geomorphology and sediments, and oceanographic data.

The meso-scale regionalisation was compiled from information supplied to the Australian Government Department of the Environment, Water, Heritage and the Arts (DEWHA) by the relevant State, Northern Territory and Commonwealth marine research and management agencies.

The seaward extent for the meso-scale IMCRA coverage is defined by the 200m isobath except where this boundary extends beyond the Australian Exclusive Economic Zone (AEEZ).

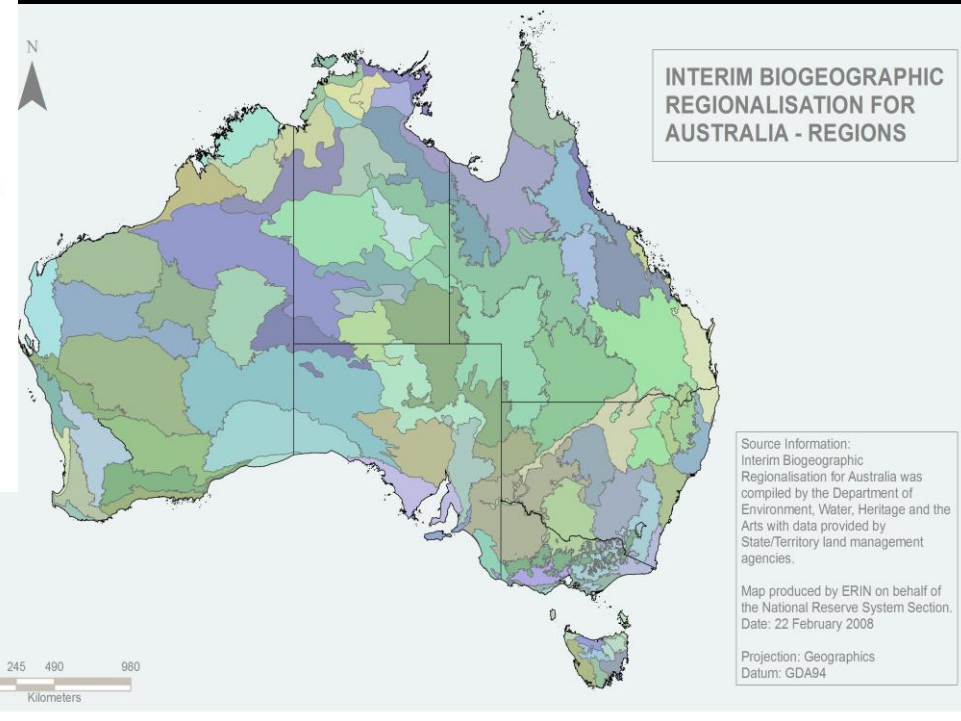


- Bioregions
- ABR, Abrolhos Islands
 - ANB, Anson Beagle
 - ARA, Arlsey
 - AVS, Amhem Vessel
 - BAT, Batmans Shelf
 - BOS, Boaps
 - BON, Bonaparte Gulf
 - BRU, Bruy
 - CAB, Cambridge-Bonaparte
 - CAN, Canring
 - CAR, Carpentaria
 - CBS, Central Bass Strait
 - COB, Coboung
 - COR, Corong
 - CR, Central Reef
 - CV, Central Victoria
 - CWC, Central West Coast
 - DAV, Dary
 - ECY, East Cape York
 - EMB, Eighty Mile Beach
 - EUC, Eula
 - EYR, Eyr
 - FLI, Finders
 - FRA, Franklin
 - FRT, Freycinet
 - GRO, Groote
 - HAW, Hawkesbury Shelf
 - KAN, Kambumba-Nassau
 - KIM, Kimberley
 - KSD, King Sound
 - LMC, Lurinda-Mackay Coast
 - LNE, Lesueur-Naturaliste
 - MAN, Manning Shelf
 - MC, Mackay-Capricorn
 - MUR, Murud
 - NIN, Ningaloo
 - NSS, North Spencer Gulf
 - NWS, Northwest Shelf
 - OSS, Oceanic Shoals
 - OTW, Otway
 - PEL, Pelaw
 - PID, Pilbara (nearshore)
 - PIL, Pilbara (offshore)
 - PS, Porosey Seals
 - RBN, Rabsons
 - SBF, Shark Bay
 - SG, Spencer Gulf
 - SVS, St Vincent Gulf
 - TM, Tweed Moreton
 - TS, Torres Strait
 - TW, Tai
 - TWO, Tweed Shelf
 - VGD, Van Diemens Gulf
 - VE, Victorian Embayments
 - WCV, West Cape York
 - WLY, Wallester
 - WSC, WA South Coast
 - WTC, Wet Tropic Coast
 - ZUY, Zuytdorp

Projection: Geographics
Datum: GDA94

Australian Government Data Sources:
DEWHA (2006) IMCRA v4.0 - Meso-scale Bioregions
Geoscience Australia (2001) Australia, Coastline and State Borders 1:100,000

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DEWHA



