NSW DPI

Andrew Goulstone Manager, Fisheries Planning & Operations

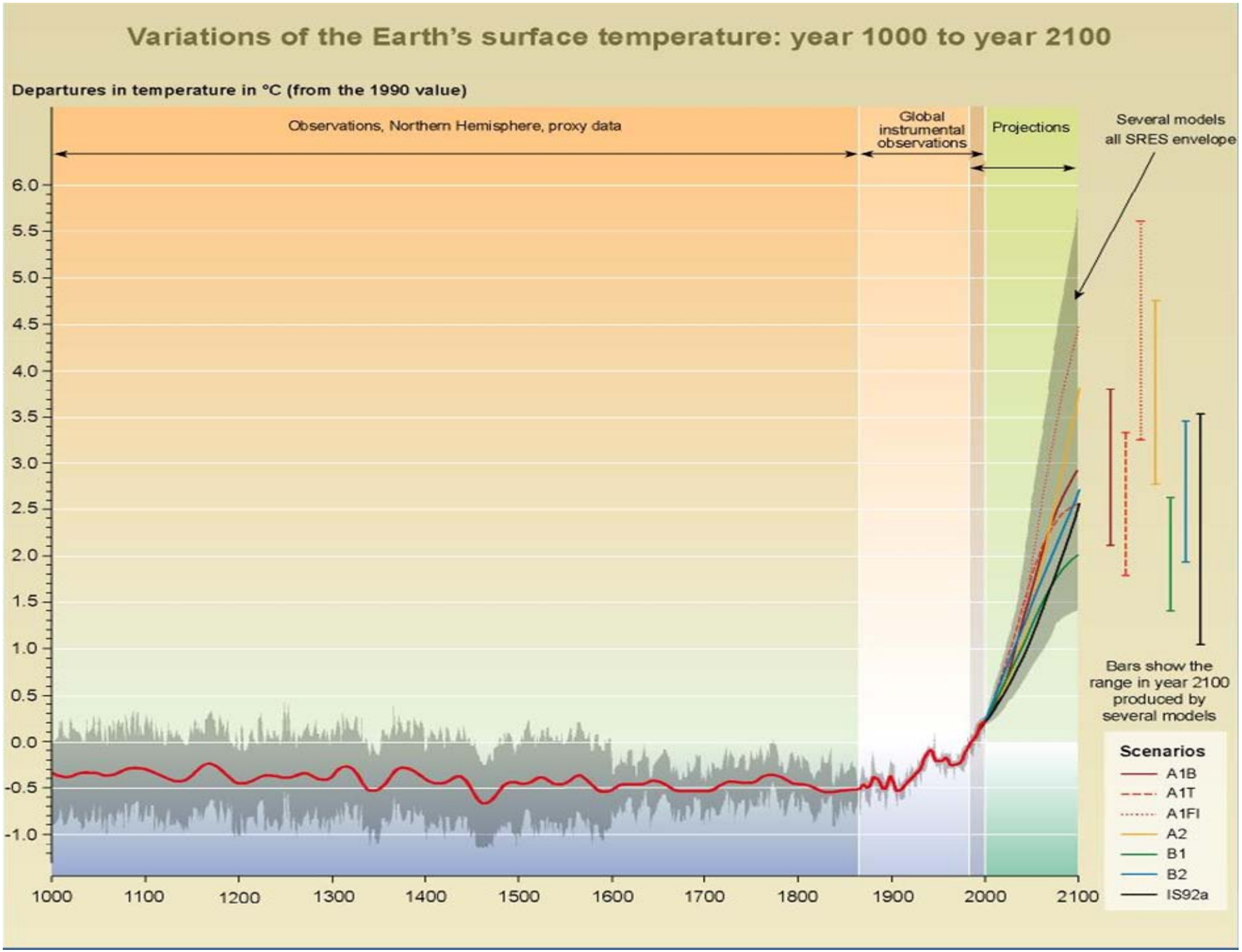
Climate change and fisheries

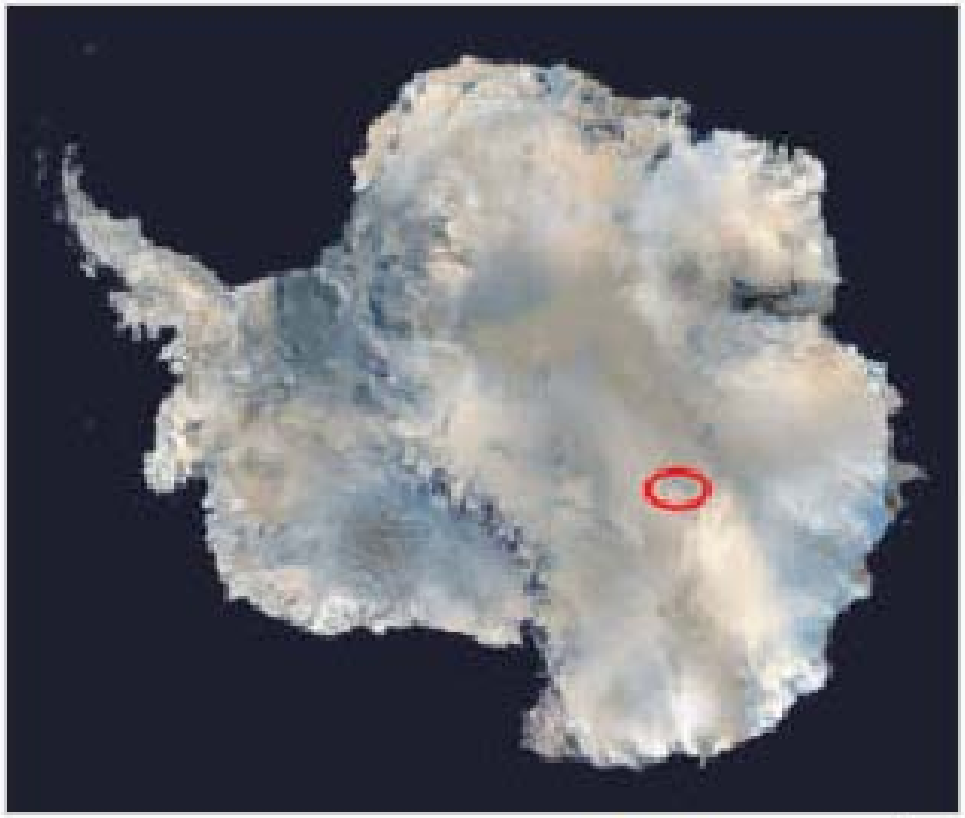
Overview

- Climate change predictions/data

  (slides courtesy of Alistair Hobday, CSIRO)

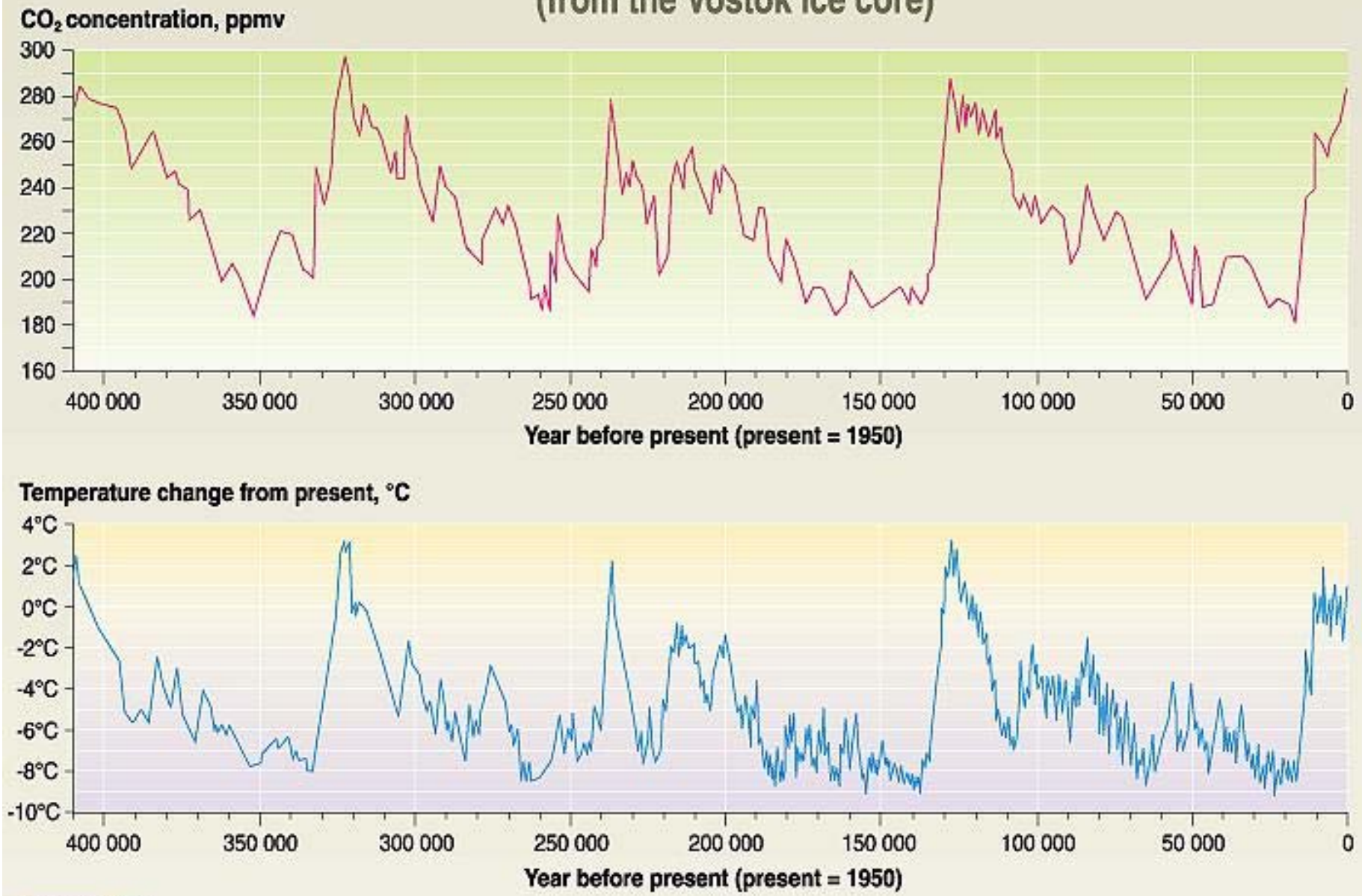
- Potential impacts on physical environment and fish stocks
- Implications for fisheries management
- SE Australia adaptation program for fisheries and aquaculture


Variations of the Earth's surface temperature: year 1000 to year 2100
Departures in temperature in °C (from the 1990 value)
Observations, Northern Hemisphere, proxy data
Global instrumental observations
Projections
Several models all SRES envelope
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
Bars show the range in year 2100 produced by several models
Scenarios
A1B
A1T
A1FI
A2
B1
B2
IS92a



Lake Vostok composite image (NASA)

Temperature and CO_2 concentration in the atmosphere over the past 400 000 years (from the Vostok ice core)

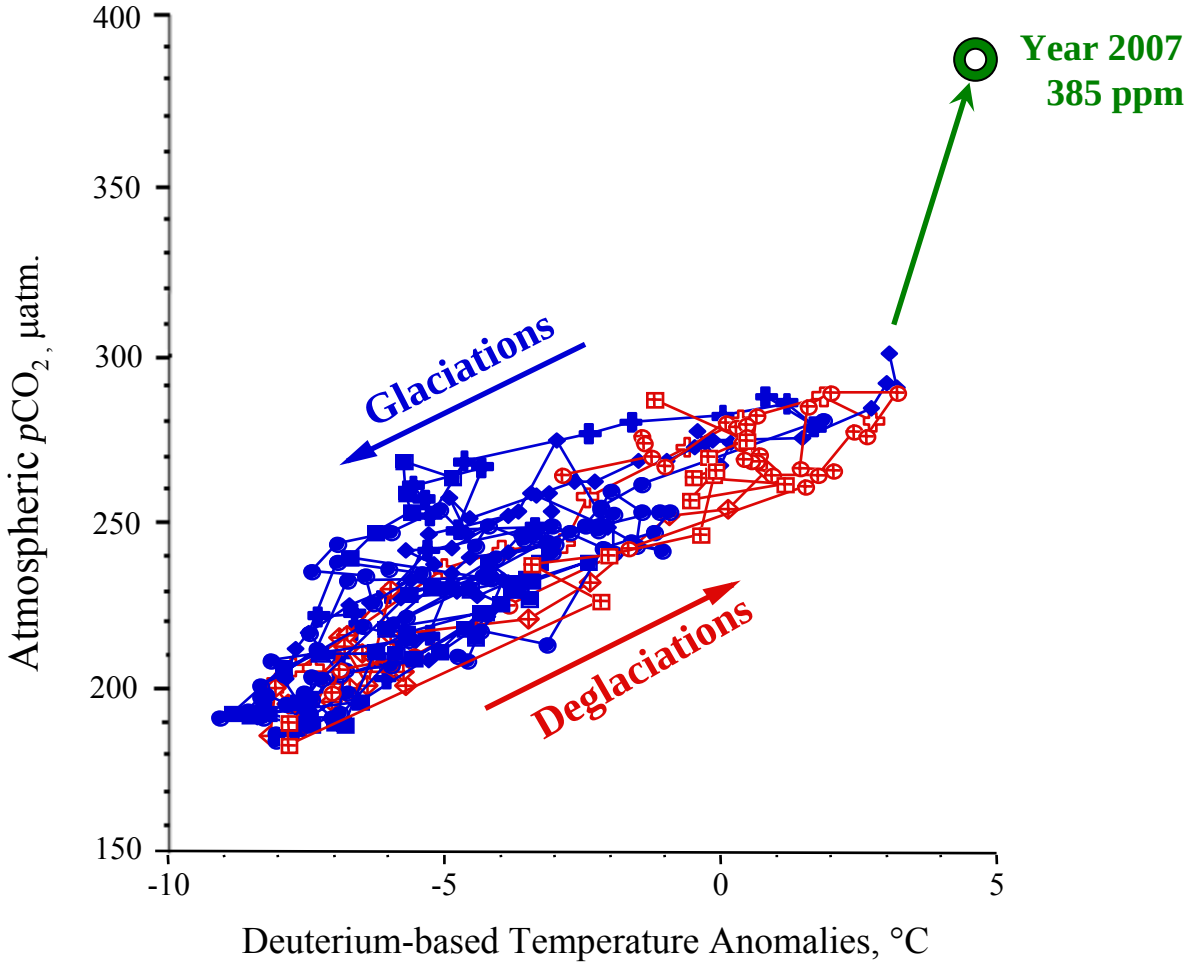


GRID Arendal UNEP

GRAPHIC DESIGN : PHILIPPE REKACEWICZ

Source: J.R. Petit, J. Jouzel, et al. Climate and atmospheric history of the past 420 000 years from the Vostok ice core in Antarctica, Nature 399 (3JUne), pp 429-436, 1999.

Vostok Ice Core Data



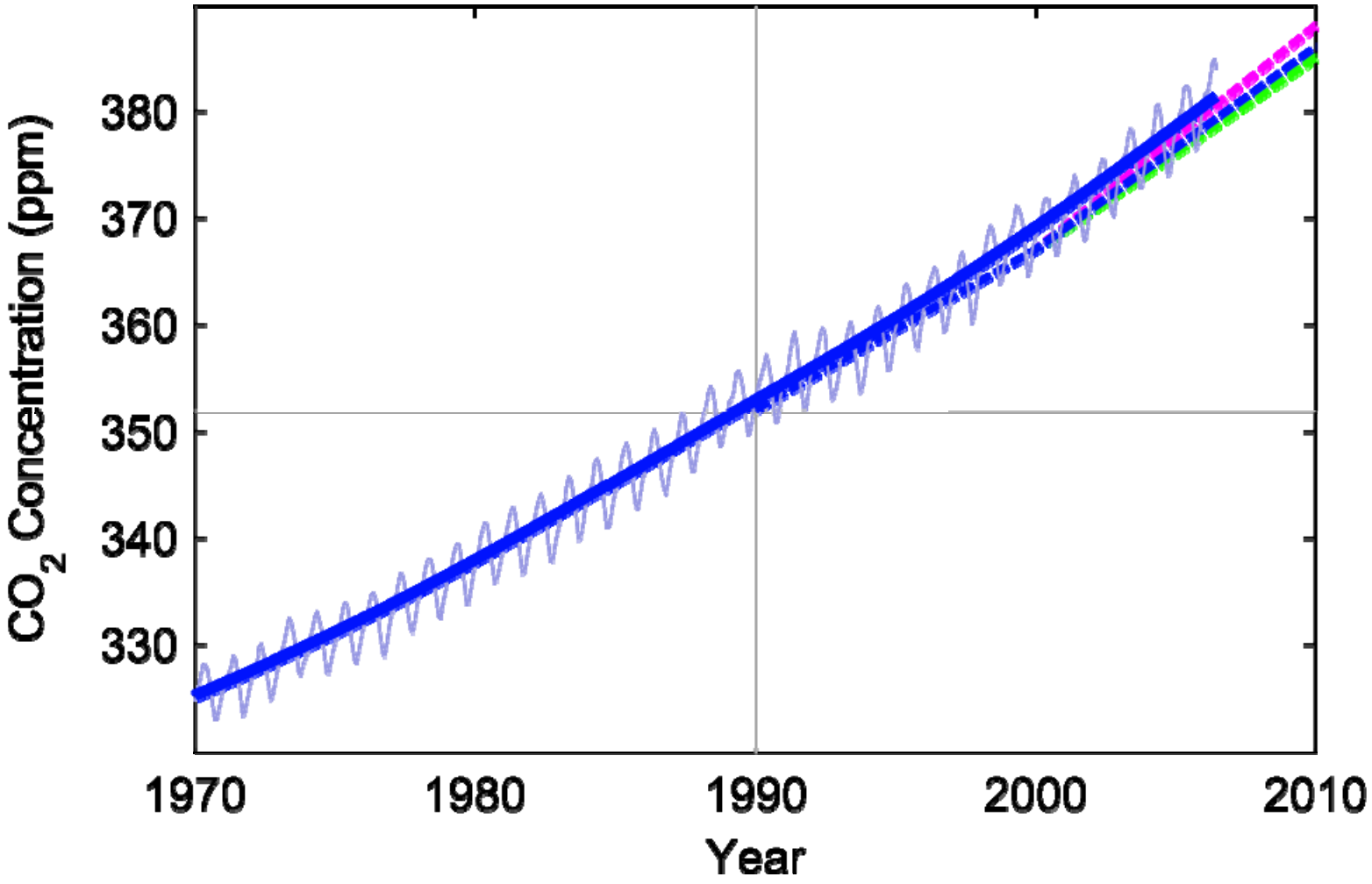
IGBP 2000

Courtesy David Ugalde, DCC

How well are the IPCC projections standing up to the test of time?

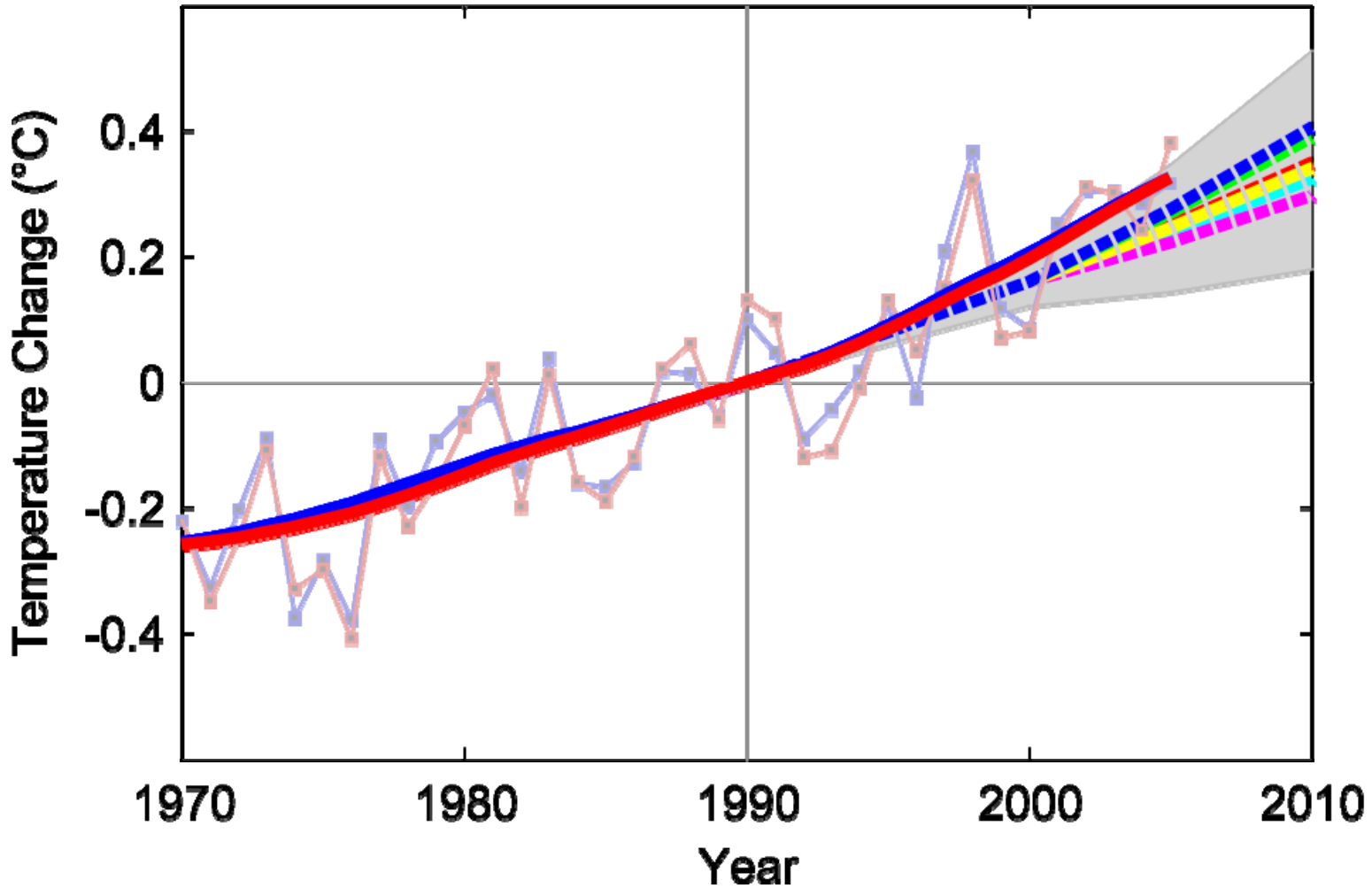
Rahmstorf et al., Science 2007

- CO_2 projections match the observations.



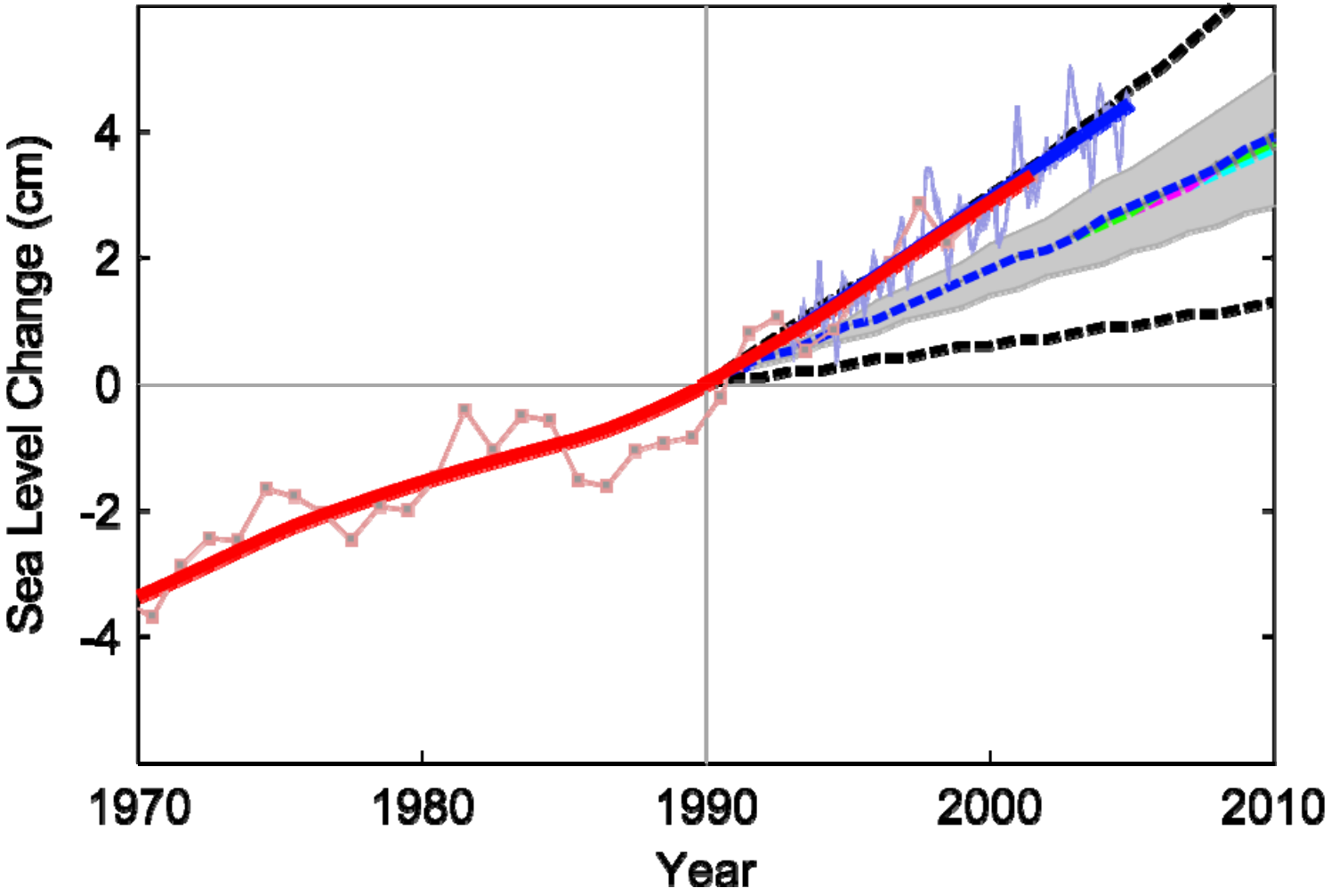
Rahmstorf et al., Science 2007

- Temperature rise near upper limit of the projections



Rahmstorf et al., Science 2007

• Sea level rising at the very upper limit of the IPCC projections (i.e. 88 cm rise by 2100)



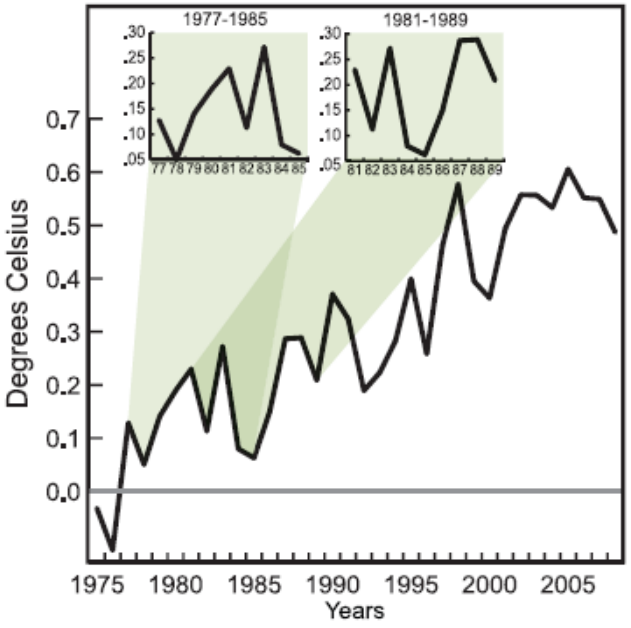
Rahmstorf et al., Science 2007

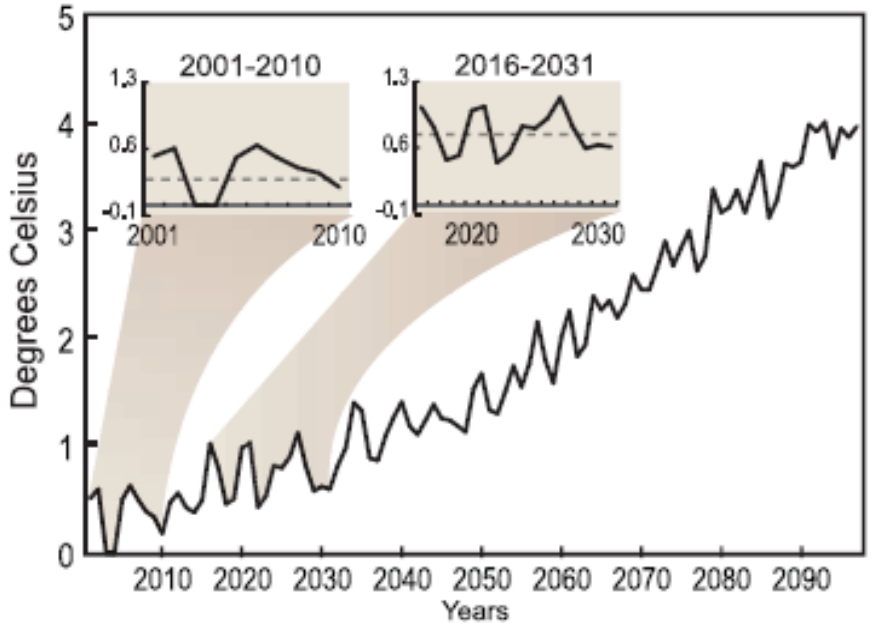
Climate change is not linear!

Is the climate warming or cooling?

David R. Easterling[1] and Michael F. Wehner[2]

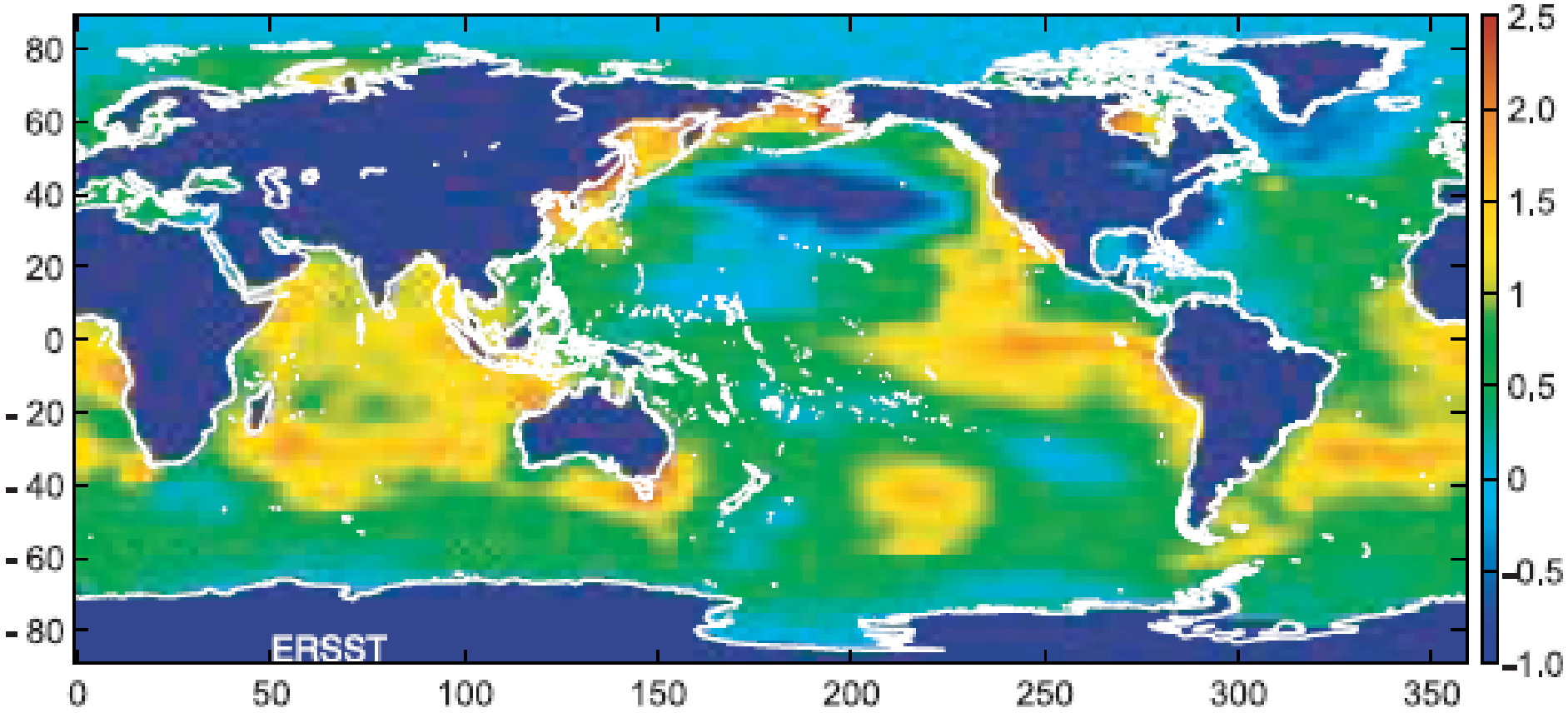
Received 18 February 2009; revised 25 March 2009; accepted 30 March 2009; published 25 April 2009.





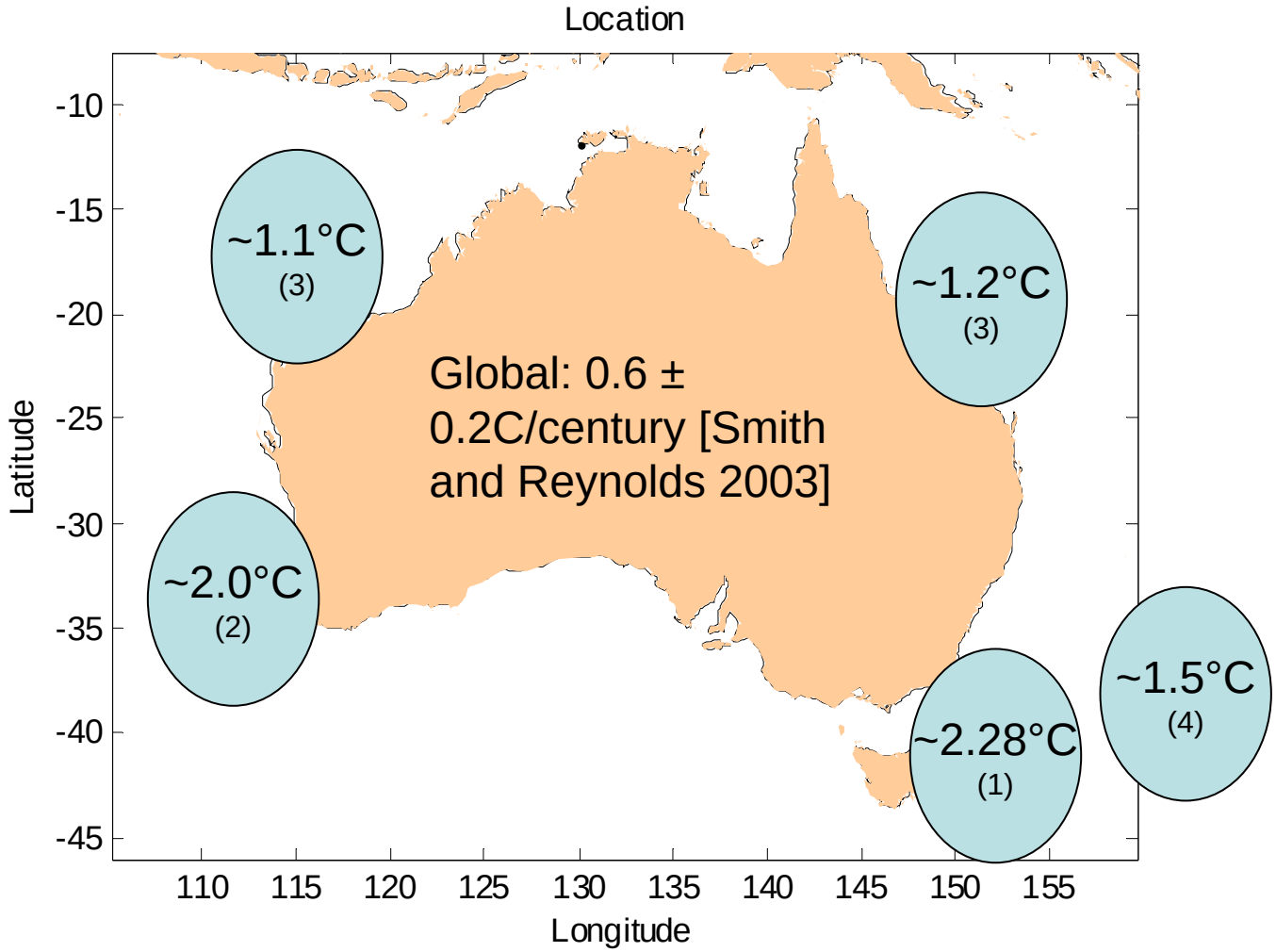
Trend in Sea Surface Temperature: 1944-2005

- It's not getting hotter everywhere….

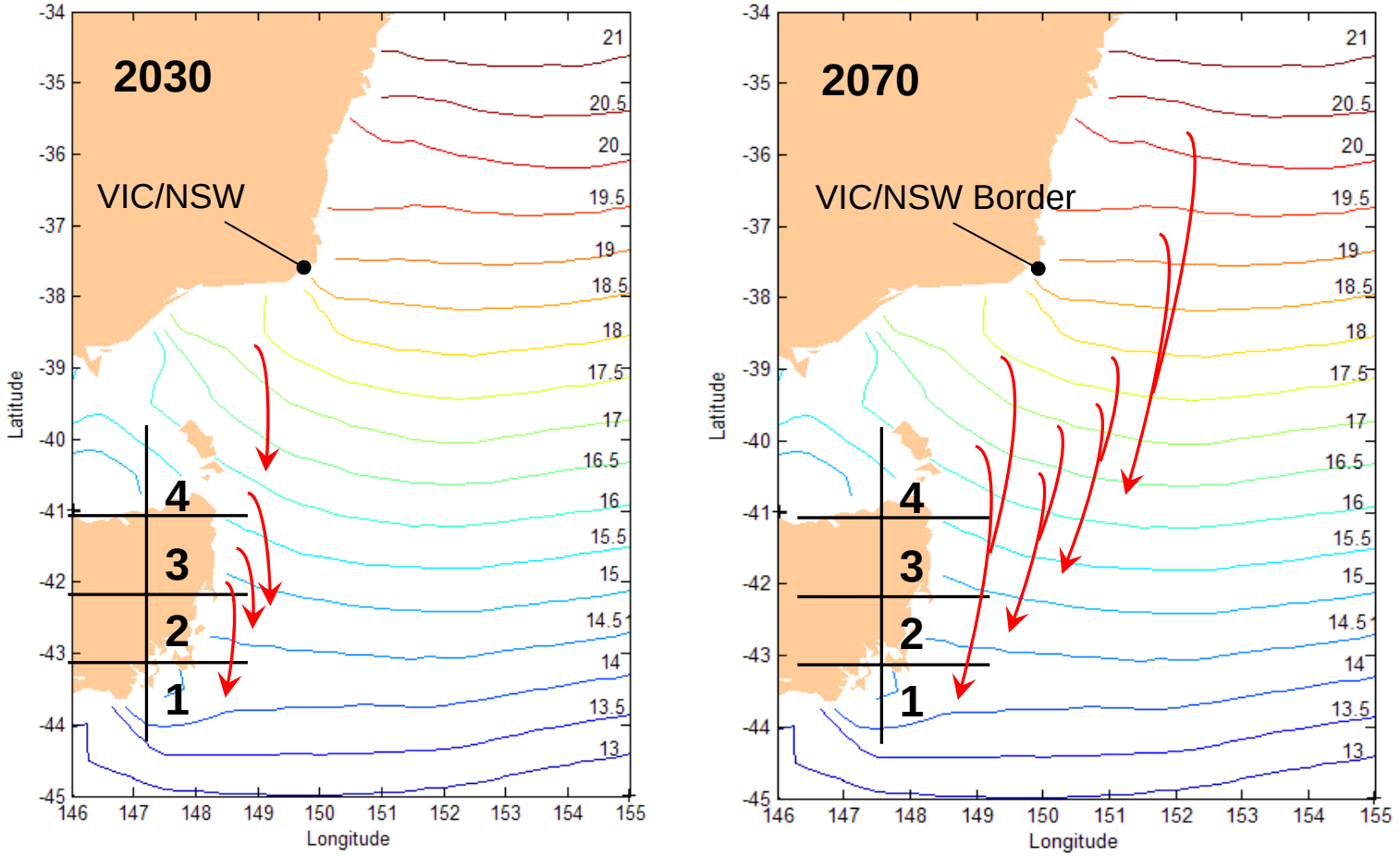


Ridgway 2007

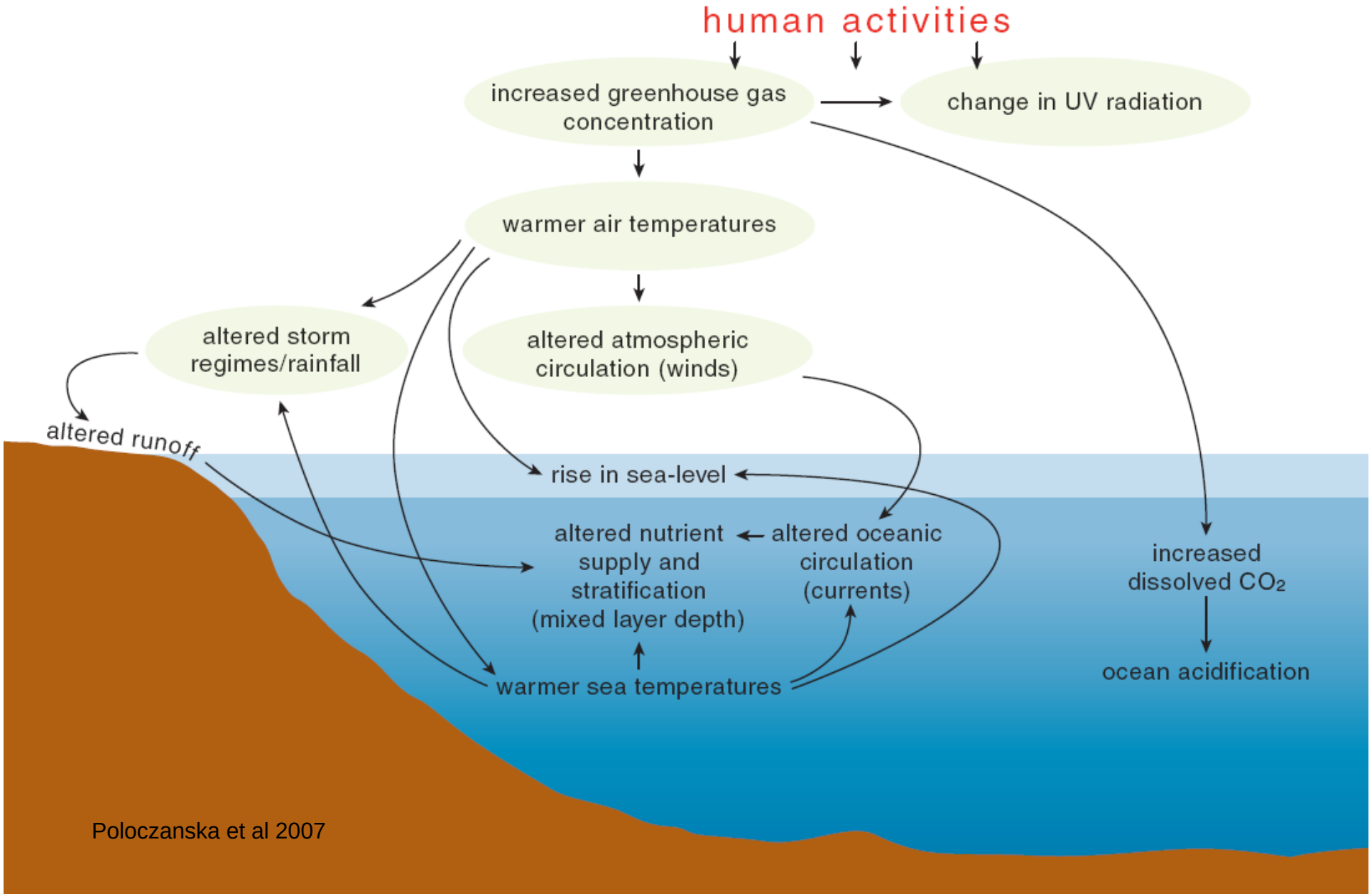
Evidence for Sea Surface Temperature changes (per century)



Increased penetration of East Australian Current



Physical Impacts on the Ocean



Poloczanska et al 2007

Australian changes – physical – MARINE

- Sea Surface Temperature – general increase
- Ocean currents – EAC increase, Leeuwin (?)
- Winds – increase
- Ocean acidification – pH decline
- Stratification – ‘mixed layer depth’ shallower
- Local changes due to current induced upwellings
- Sea level – rise >0.5 m

Hobday et al 2008

Australian changes – physical – FRESHWATER

- Decreased rainfall and increasing severity of drought caused by higher air temperature & evaporation levels
- Increased river temperatures & reduced water flows → reduced DO levels & increased salinity
- More ‘lake’ type environments instead of ‘flowing’ waterways – changing habitats

Gibbs 2007

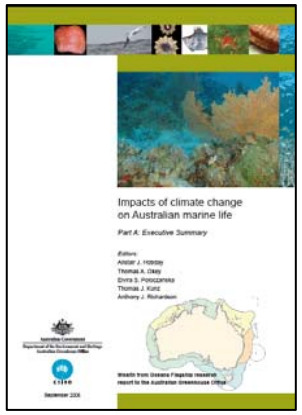
Climate change impacts on fish

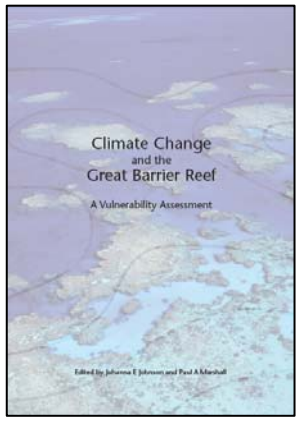
Species

- Abundance & distribution
  - Increased or decreased production
  - Range shifts (SBT, spanner crabs, wrasses)
- Reproduction
  - Timing of migration (sea mullet, Aust bass)
  - Reproductive period
- Physiology
  - Growth rates
  - Organisms relying on calcification (phytoplankyton, corals, molluscs)

Communities

- Community shifts
  - Habitat modification
- Productivity changes
  - Carrying capacity of environment





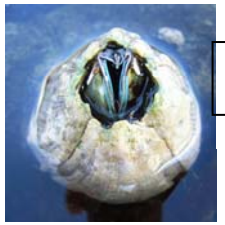
Hobday A.J., Okey T.A., Poloczanska E.S., Kunz T.J. & Richardson A.J. (eds.) 2007. Impacts of Climate Change on Australian Marine Life.

Hobday A.J., E. Poloczanska, R. Matear (eds.) 2008. Review of Climate Impacts on Australian Fisheries and Aquaculture

http://www.cmar.csiro.au/climateimpacts

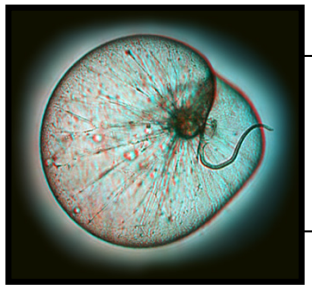
Johnson, J. E. & Marshall, P. A. (eds) (2007). Climate Change and the Great Barrier Reef.

Observed changes in south-east Australia



Giant rock barnacle moved to Tasmania *(Pitt and Poloczanska)*

Expansion of sea urchins native to NSW causing loss of kelp forests in off eastern Tasmania *(Johnson, Ling)*

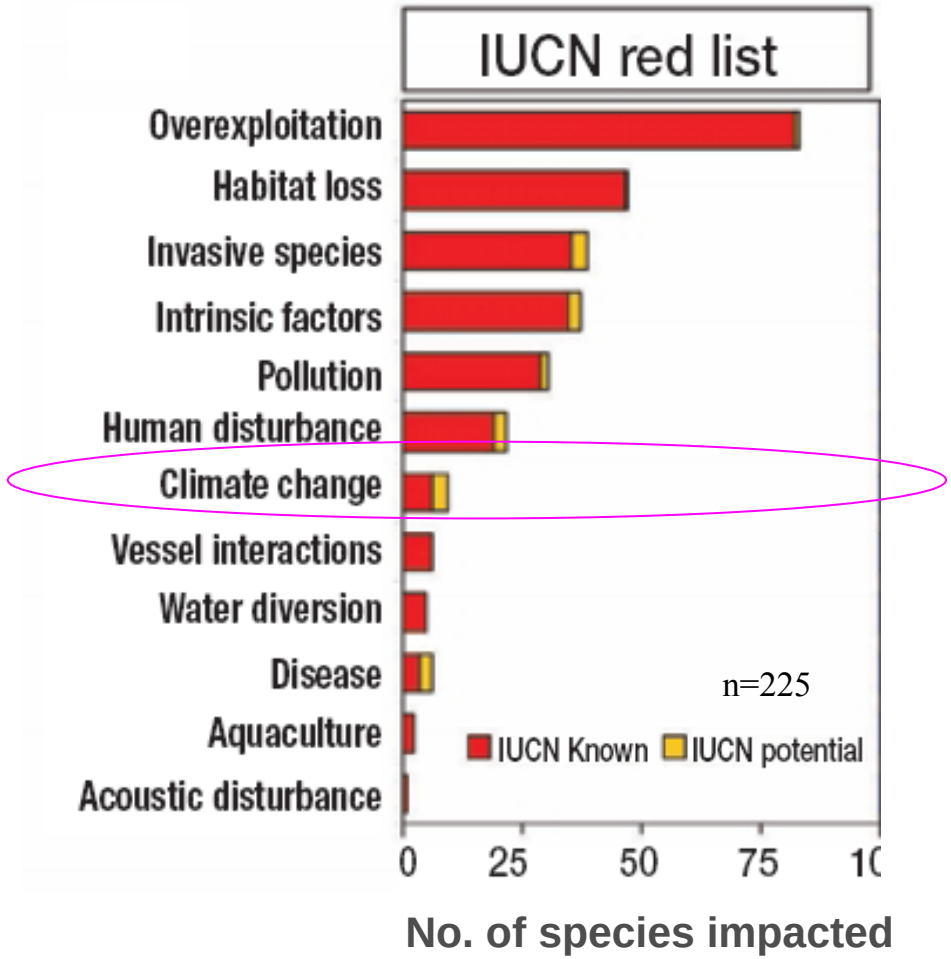


Changing composition of phytoplankton blooms off Tasmania– increased tropical species and red tides *(Blackburn et al)*

Rock lobster catch and distribution correlated with regional SST changes around Tasman Sea *(Frusher et al)*

Some coastal fish species have exhibited major distributional changes *(Last, Edgar, Barrett)*

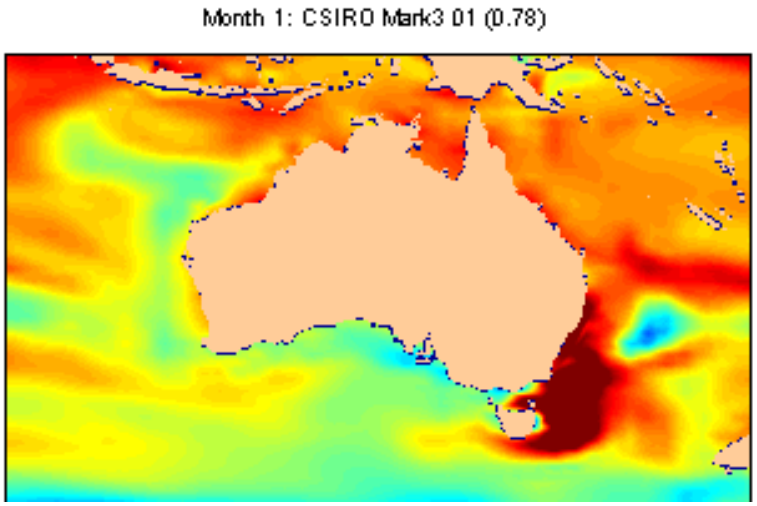
Implications for recreational fisheries management

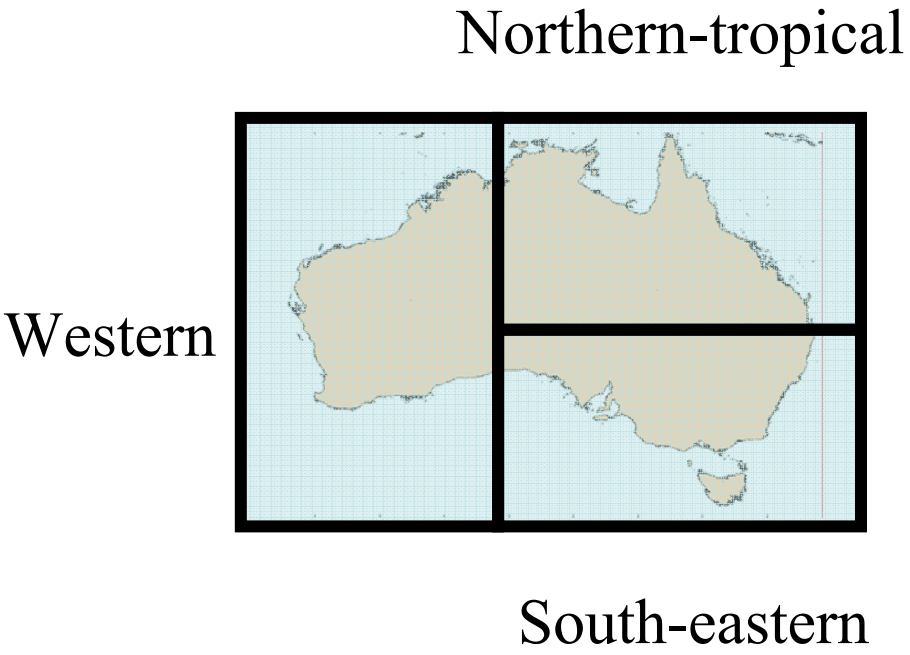


Kappel 2005

South Eastern Australia Program

Adaptation of fisheries, aquaculture and fisheries management to climate change





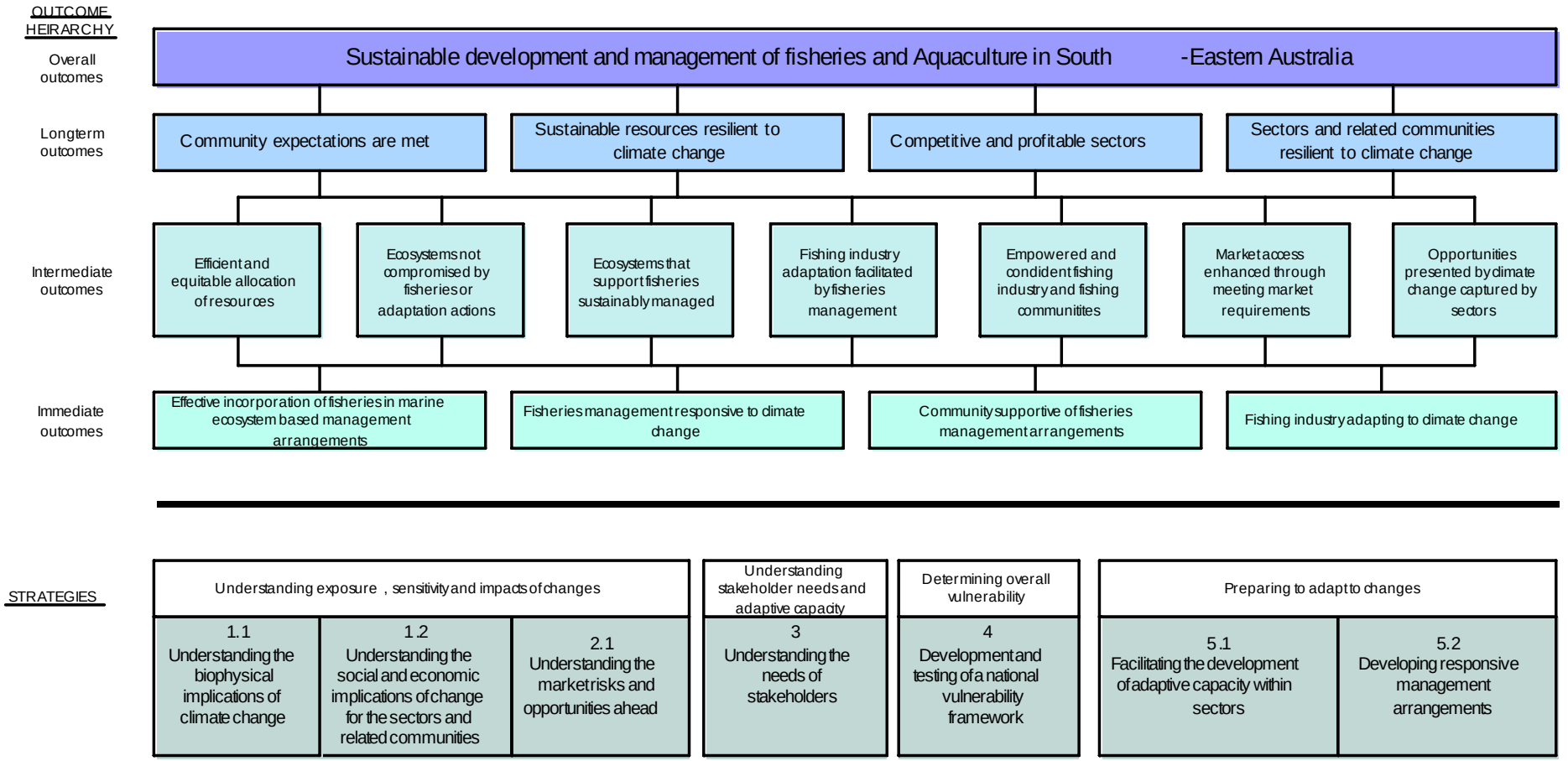
- Consortium of program partners
  - Vic DPI (leading)
  - Commonwealth – CSIRO, FRDC, AFMA
  - NSW – DPI *(in-kind only)*
  - SA – PIRSA & SARDI
  - TAS – DPIWE & TAFI
- Provides for:
  - implementation of the National Climate Change Action Plan for Fisheries & Aquaculture (NCCAPFA) and National Adaptation Research Plan (NARP);
  - coordination of biophysical, social, economic, policy and industry adaptation research & investment within the region;
  - prioritisation and setting of regional directions for fisheries management/policy & research.
- 8 month scoping phase using formal program logic – currently establishing governance arrangements (MOU)

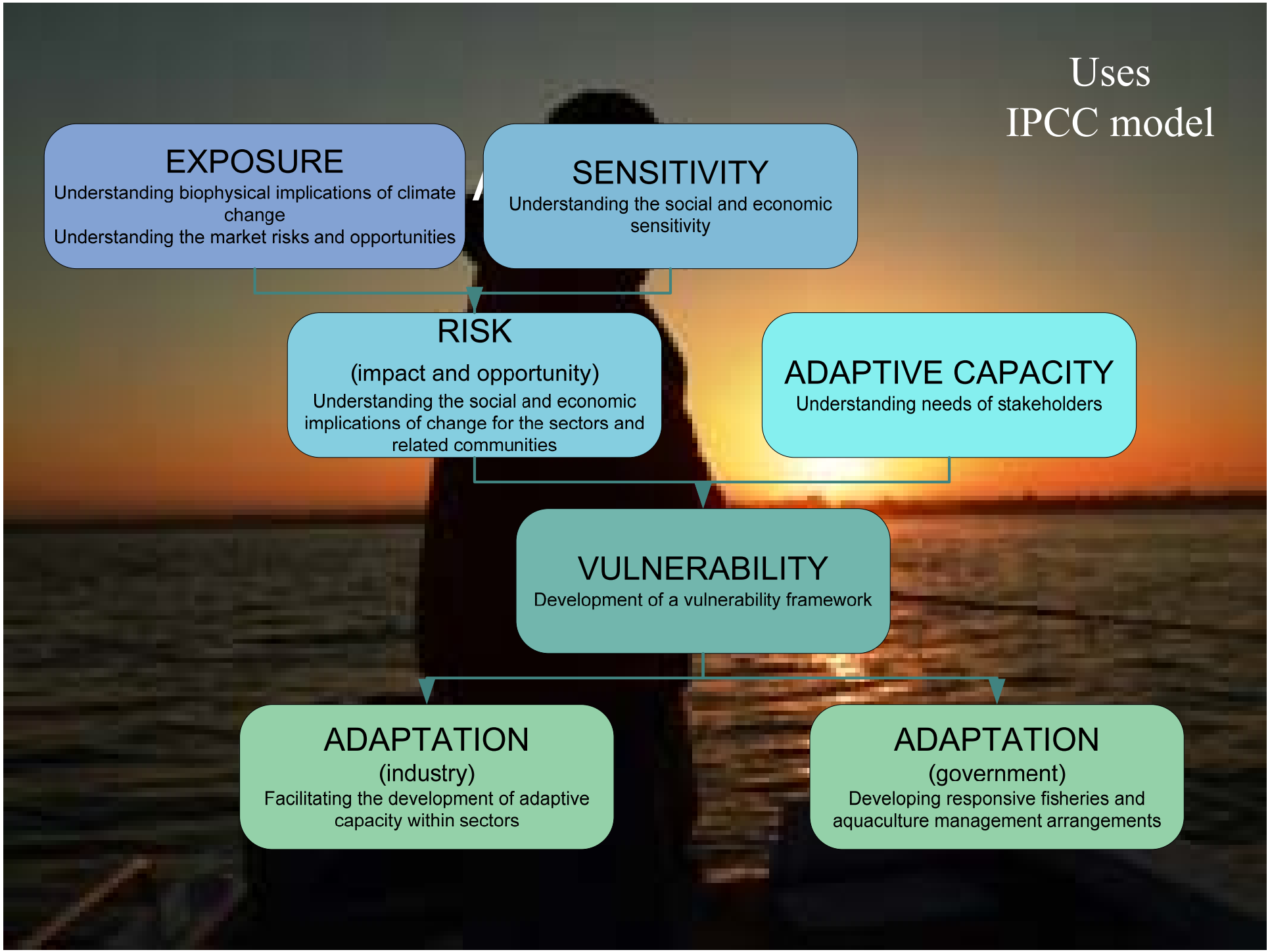
South Eastern Australia Program

Adaptation of fisheries, auaculture and fisheries management to climate change

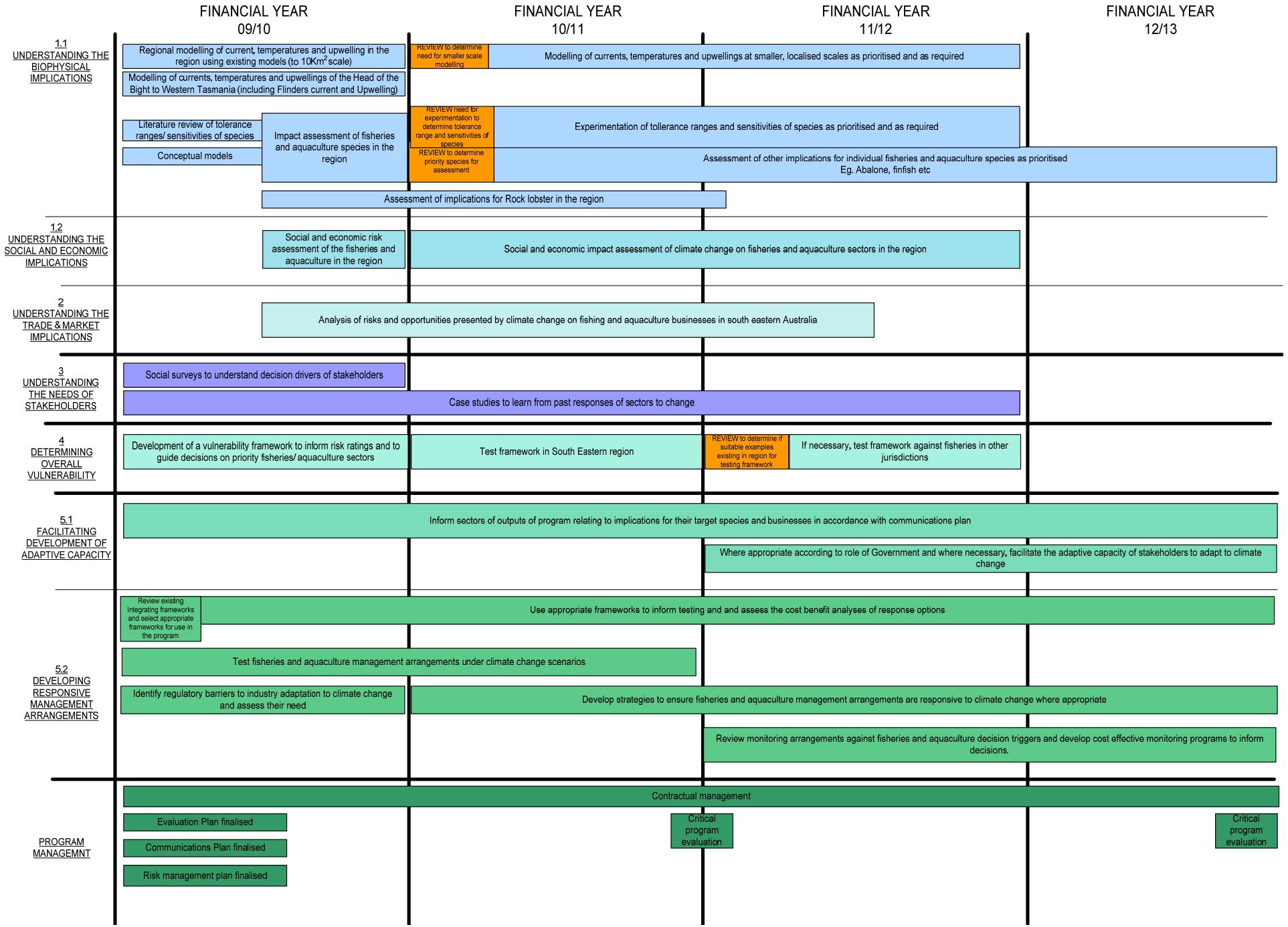
PROGRAM LOGIC

Adaptation of fisheries , aquaculture and fisheries management to climate change in South -Eastern Australia Program




Uses
IPCC model
EXPOSURE
Understanding biophysical implications of climate change
Understanding the market risks and opportunities
SENSITIVITY
Understanding the social and economic sensitivity
RISK
(impact and opportunity)
Understanding the social and economic implications of change for the sectors and related communities
ADAPTIVE CAPACITY
Understanding needs of stakeholders
VULNERABILITY
Development of a vulnerability framework
ADAPTATION
(industry)
Facilitating the development of adaptive capacity within sectors
ADAPTATION
(government)
Developing responsive fisheries and aquaculture management arrangements

ADAPTATION OF FISHERIES AND FISHERIES MANAGEMENT IN SOUTH EASTERN AUSTRALIA PROGRAM SCHEDULE



Further information

- Marine climate impacts & adaptation
  - www.cmar.csiro.au/climateimpacts
- SE Australia program (NSW component)
  - Andrew.Goulstone@dpi.nsw.gov.au
  - Ph. (02) 6648 3925
- National climate change issues and projects
  - National CC Adaptation Research Facility – Marine Network
  - Neil.Holbrook@utas.edu.au