Australian Government
Bureau of Meteorology

On Developing a Tropical Cyclone Archive, Climatology and Seasonal Prediction for the South Indian and South Pacific Oceans

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Australian Bureau of Meteorology

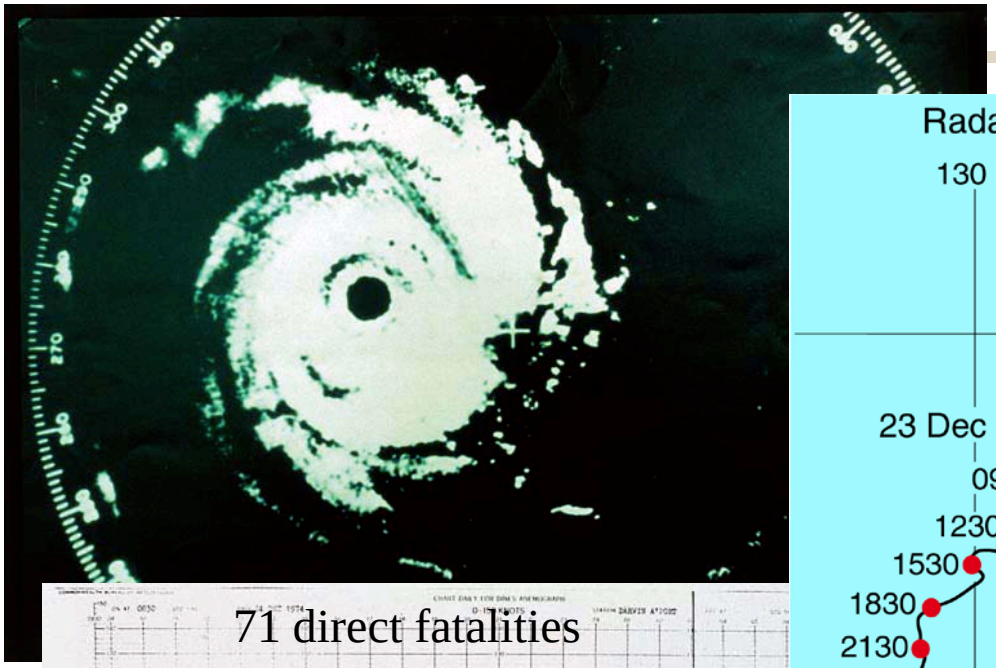
Outline

- Introduction
- Tropical cyclone archive
- Tropical cyclone web site for the Southern Hemisphere
- Cyclone climatology
- Seasonal prediction
- Summary

Introduction

- Tropical cyclones are the most dangerous and damaging weather phenomena to regularly affect countries in the South Pacific Ocean and the South Indian Ocean.
- The year-to-year impact varies, and historical records demonstrate significant interannual variability in TC frequency and spatial distribution of TC tracks.
- Additionally, the climate is changing on a global scale (IPCC 2007) and it is important to understand how a warmer climate may affect TC activity.

TC Tracy, Darwin, Australia, 1974



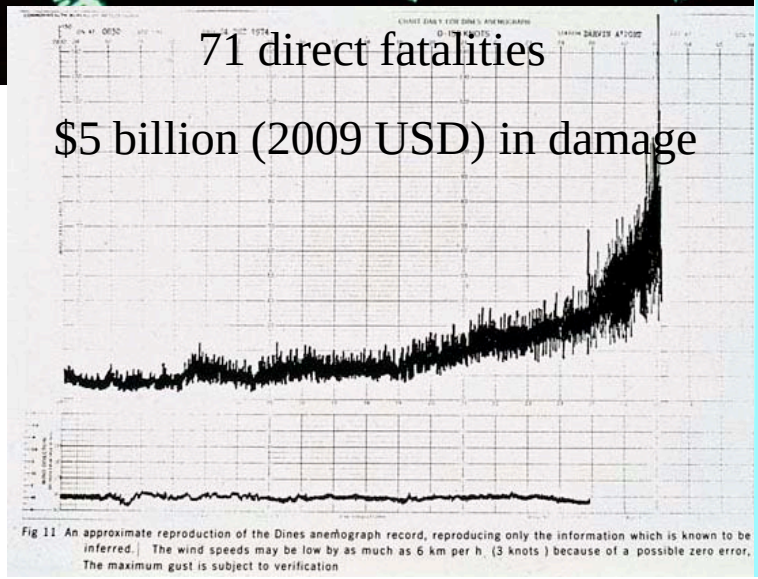
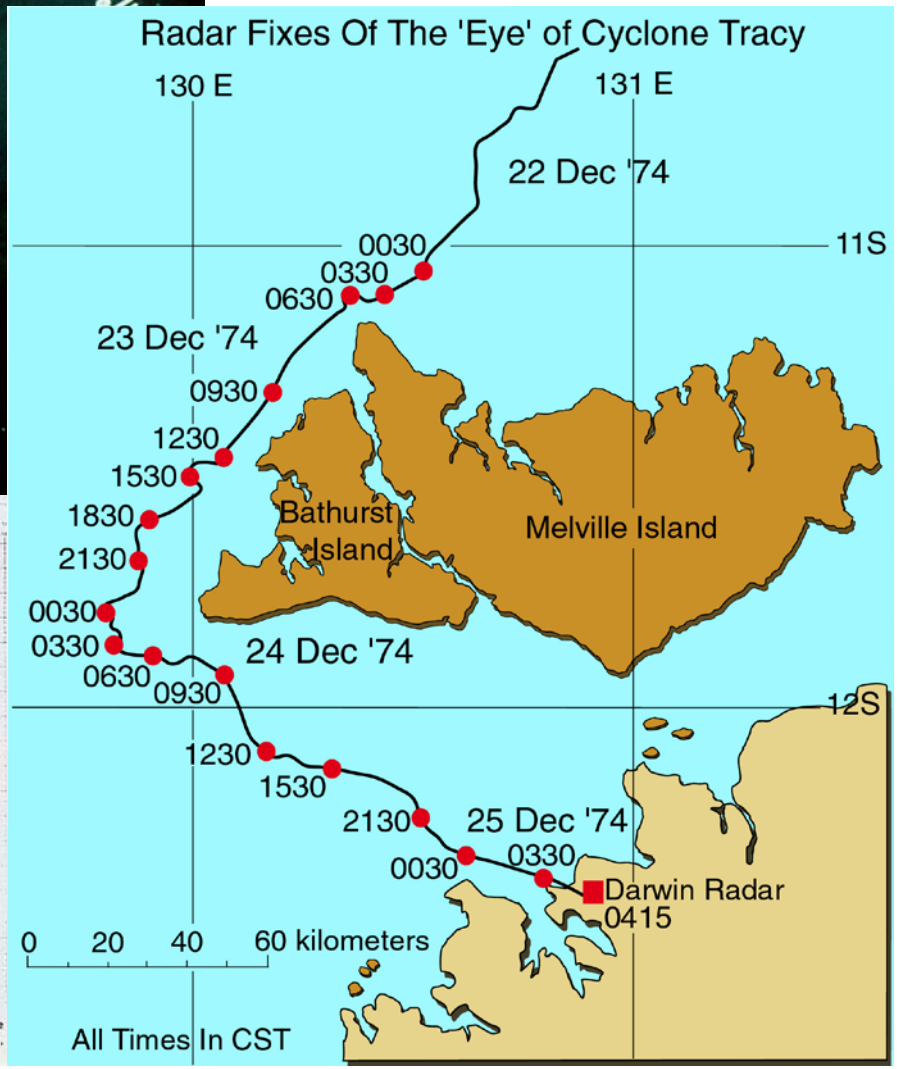


Fig 11 An approximate reproduction of the Dines anemograph record, reproducing only the information which is known to be inferred. The wind speeds may be low by as much as 6 km per h (3 knots) because of a possible zero error. The maximum gust is subject to verification

71 direct fatalities

$5 billion (2009 USD) in damage



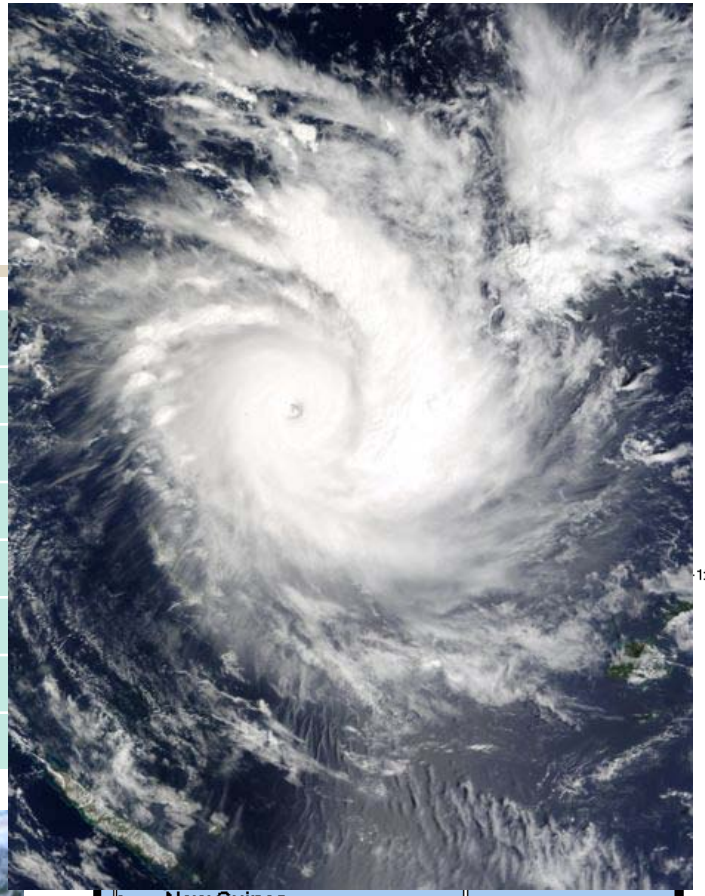
TC Tracy, Darwin, Australia, 1974

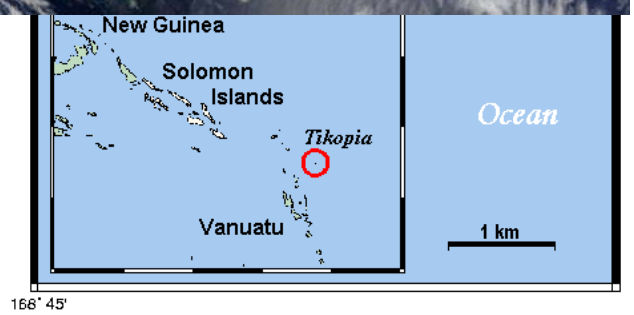
•70% of Darwin's buildings were destroyed

•*Tracy* was described as "disaster of the first magnitude … without parallel in Australia's history".

South Pacific: TC Zoe

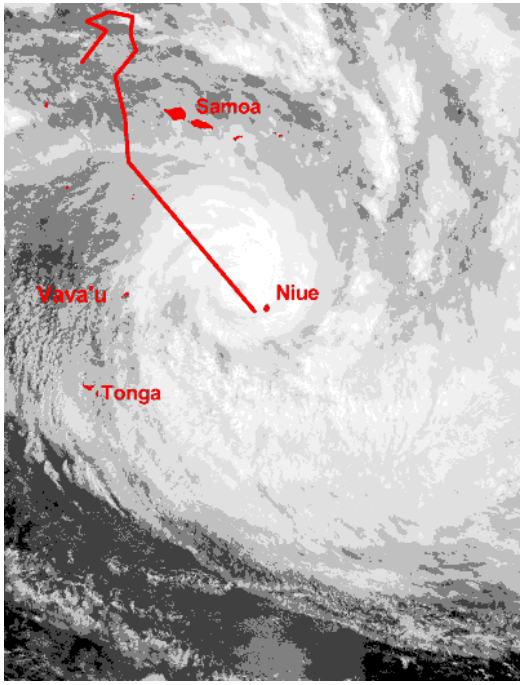
28 Dec 2002 00:00	12.3	169.8	900
28 Dec 2002 06:00	12.5	169.5	890
28 Dec 2002 12:00	12.5	169.2	900
28 Dec 2002 18:00	12.4	169.3	900
29 Dec 2002 00:00	12.6	169.4	915
29 Dec 2002 06:00	13.0	169.8	920
29 Dec 2002 12:00	13.5	170.4	925
29 Dec 2002 18:00	13.9	171.0	930





TC Zoe, 28 December 2002 06:00

South Pacific: TC Heta



TC Heta 6 January 2004

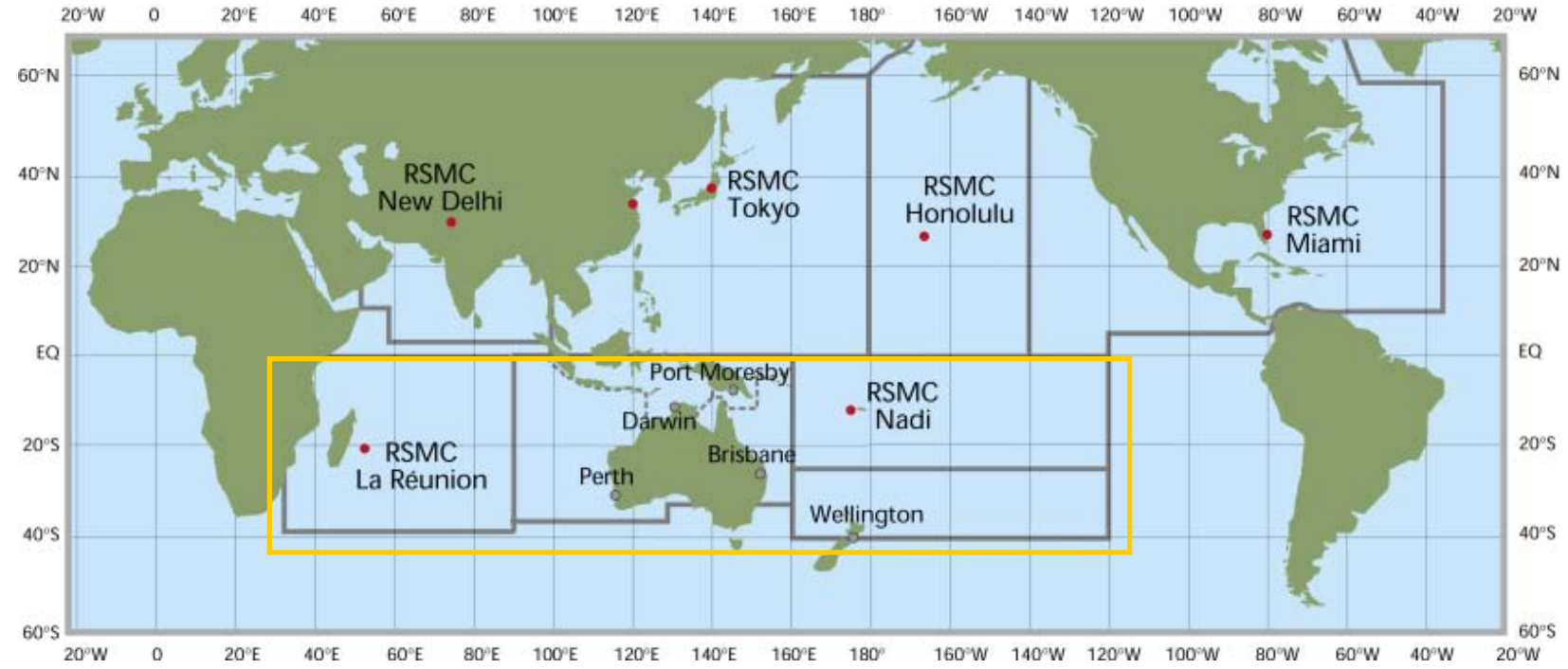
Climate Change and Tropical Cyclones

Climate is changing on a global scale and consequently it is important to monitor changes in **regional** tropical cyclone frequencies, intensities and tracks.

Climate Change 2007, AR4, IPCC:

- There has been an increase in hurricane intensity in the North Atlantic since the 1970s, and that increase correlates with increases in sea surface temperature
- There is no clear trend in the number of hurricanes
- Other regions appear to have experienced increased hurricane intensity as well

Tropical Cyclones in the Southern Hemisphere



The World Meteorological Organization (WMO) Tropical Cyclone Programme has established areas of responsibility for tropical cyclone warning which extend across the regional bodies and also extend across the ocean basins.

“Climate Change and the Southern Hemisphere Tropical Cyclones” Project

Tropical cyclone archive for the Southern Hemisphere: Current status

- Best track tropical cyclone data from the National Meteorological and Hydrological Services for 1969/70 to 2006/07 tropical cyclone seasons were obtained and verified.
- Complete records of estimated TC intensity (from the 1981/82 season): 686 identified tropical cyclones in the 26 TC seasons.
- A specialised website for disseminating results and data "Tropical Cyclones in the Southern Hemisphere" was established.

“Climate Change and the Southern Hemisphere Tropical Cyclones” Project: Tropical Cyclone Archive – cont.

- In parallel to this project, an effort called the International Best Tracks Archive for Climate Stewardship (IBTrACS) has been underway.
- The goal of IBTrACS is to provide a new standard for TC best track data in a centralised location to aid our understanding of their distribution, frequency, and intensity.

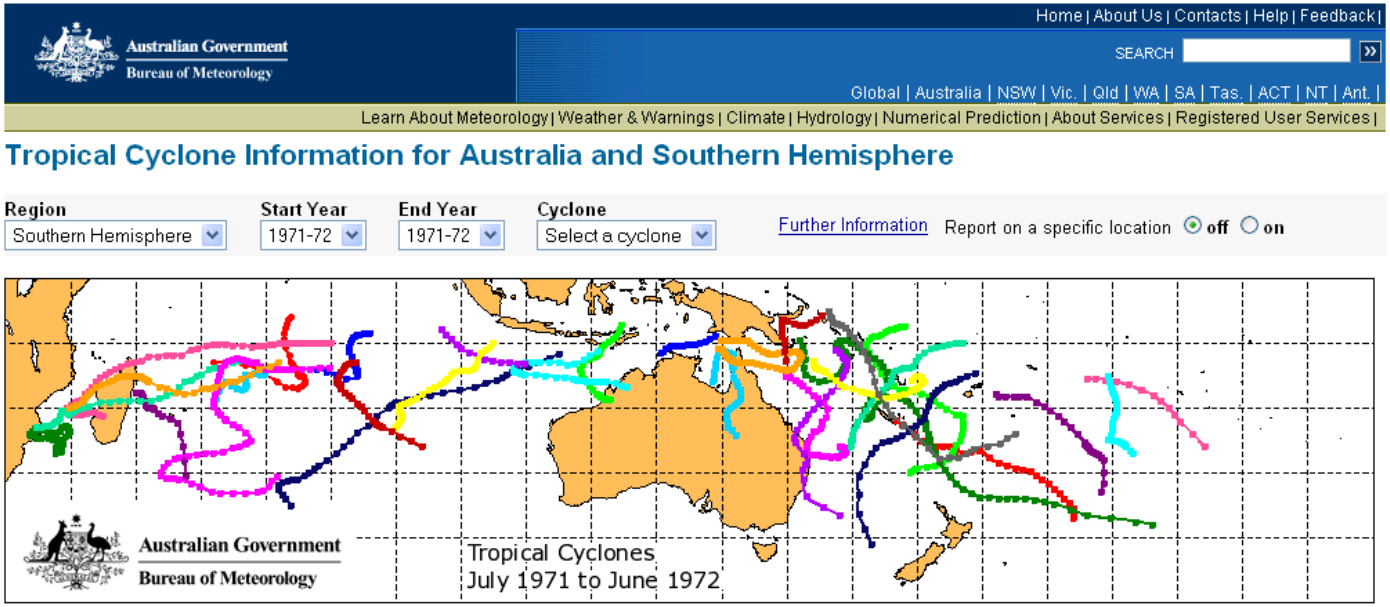
"Climate Change and the Southern Hemisphere Tropical Cyclones" Project: Tropical Cyclone Archive – cont.

- Representatives from agencies providing tropical cyclone best track data and other tropical cyclone experts met on 5-7 May 2009 in Asheville, NC to define issues to improve the known climatology of tropical cyclones.

- The SH Australian/Fiji/France/New Zealand/US effort will constitute the SH component of IBTrACS.

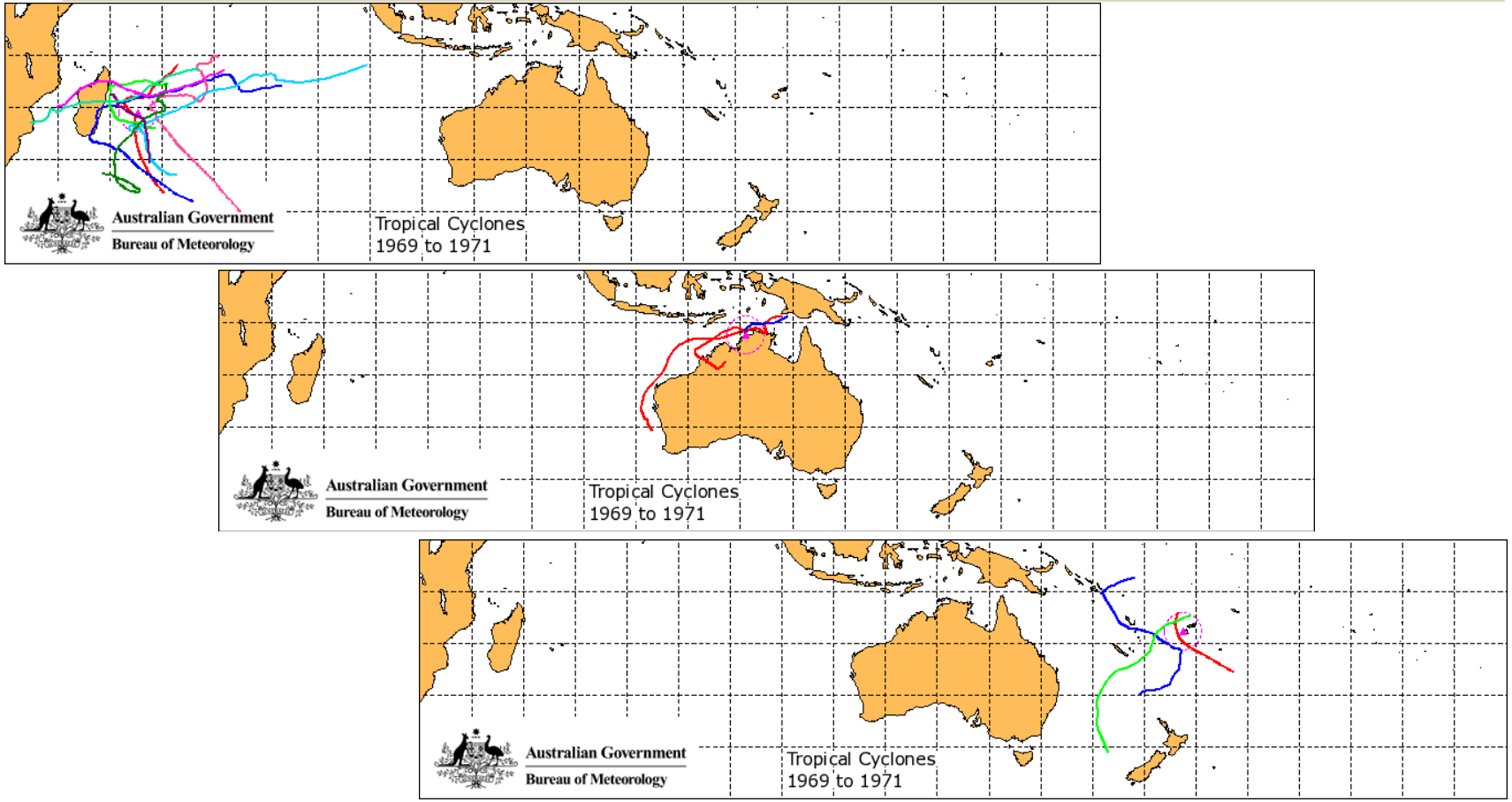
Tropical Cyclone website for the Southern Hemisphere

Specialised web page to provide user-friendly portal for historical tropical cyclone data in the Southern Hemisphere



- Regions: SH, SIO, SPO, AUS
- By season; over number of seasons
- www.bom.gov.au/weather/cyclone/tc-history.shtml

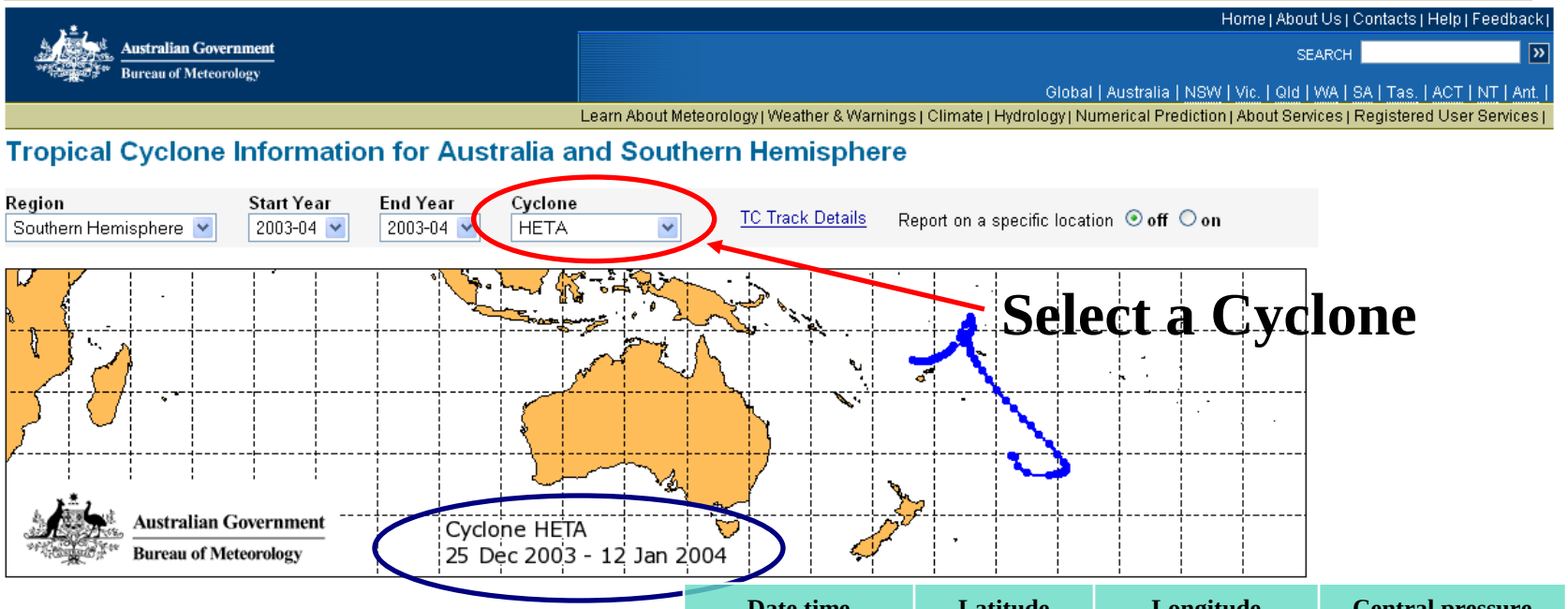
Tropical Cyclone website for the Southern Hemisphere – cont.



Report on a specific location

TCs crossing within 400 km of St-Denis, Darwin and Nadi

Tropical Cyclone website for the Southern Hemisphere– cont.



selected region

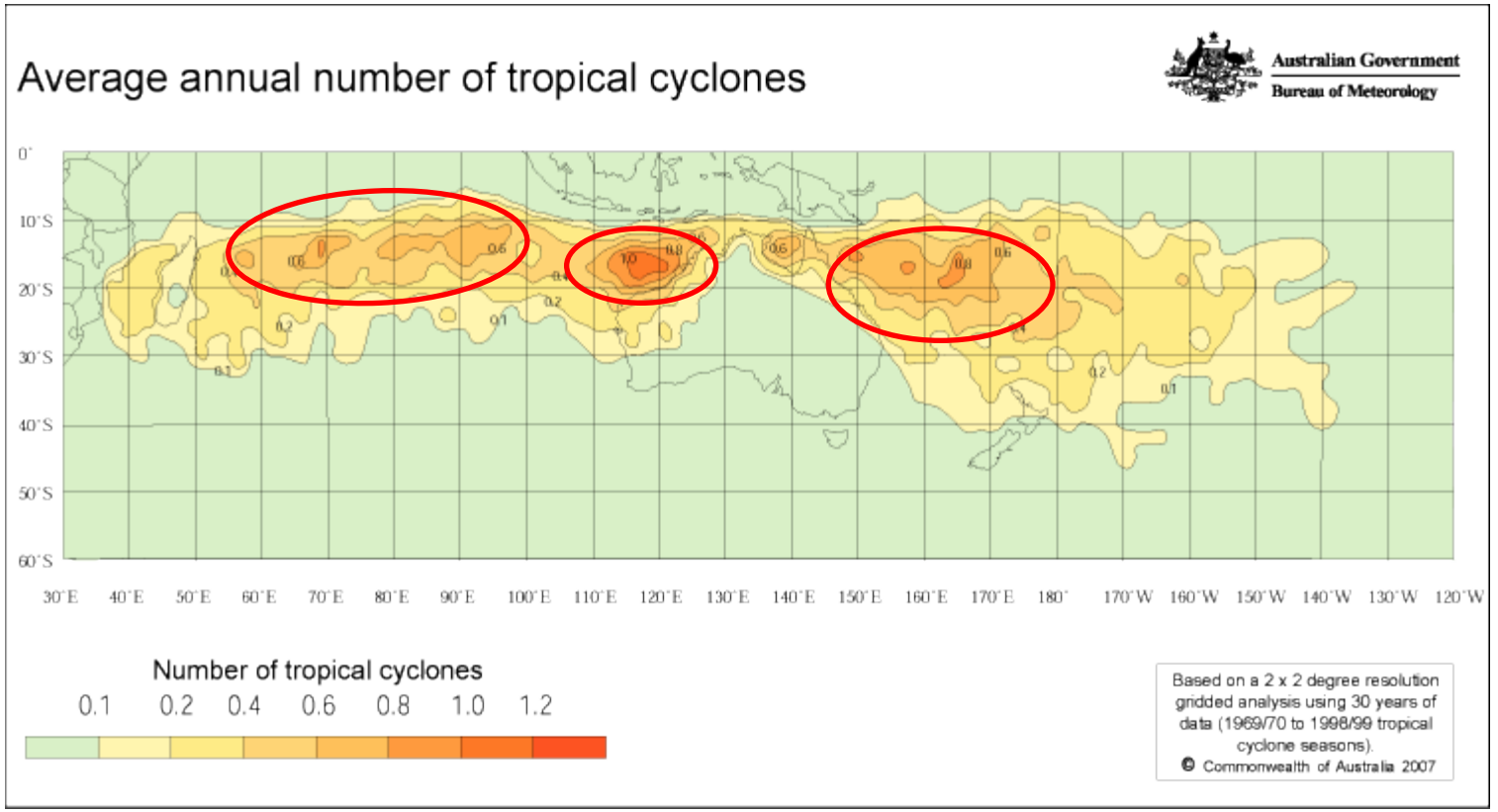
- Southern Hemisphere

selected cyclone

- HETA

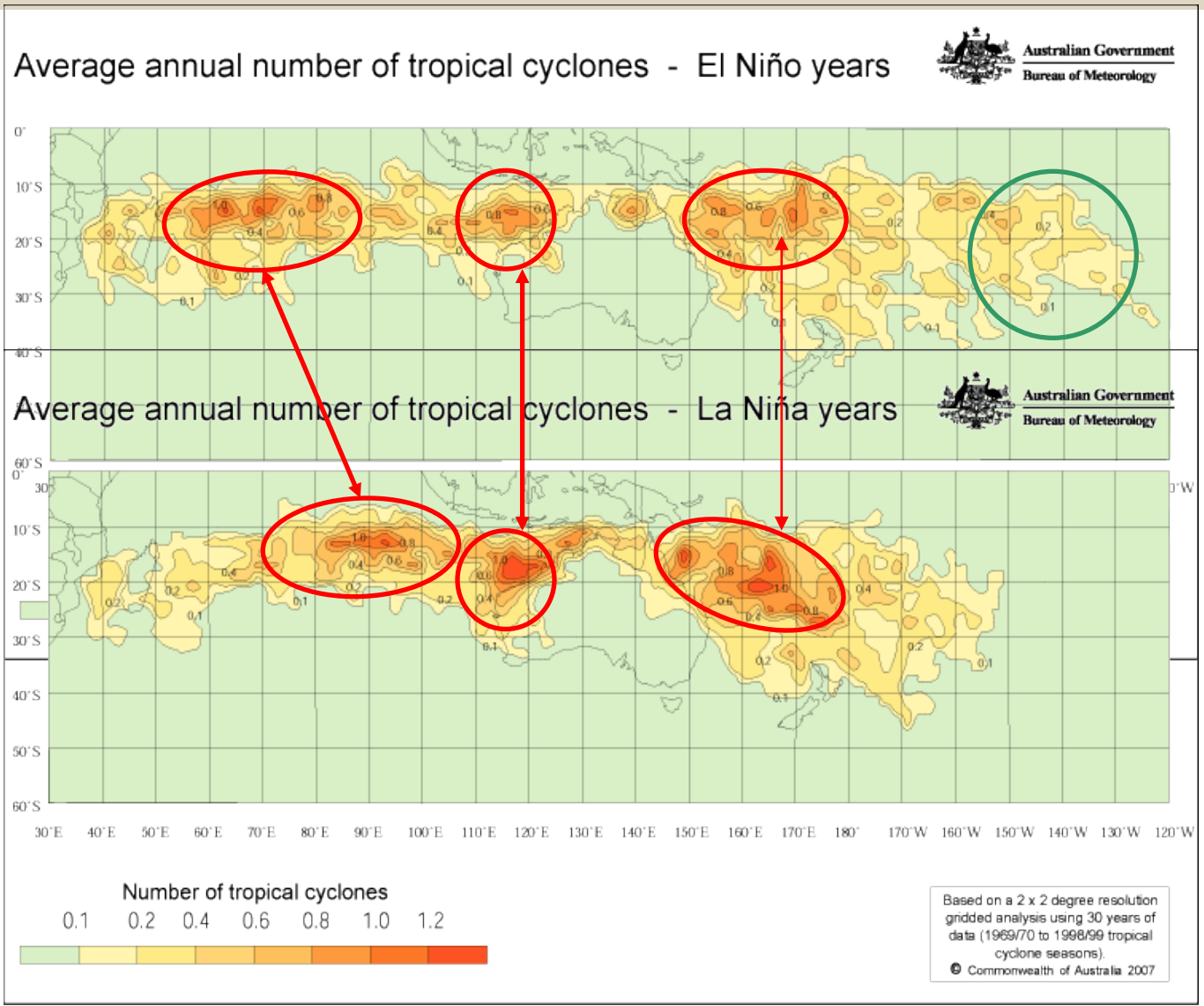
Date time (UTC)	Latitude (°S)	Longitude (°E)	Central pressure (hPa)
25 Dec 2003 06:00	15.0	176.5	1004
25 Dec 2003 12:00	15.1	177.2	1004
25 Dec 2003 18:00	15.1	178.0	1004
26 Dec 2003 00:00	15.1	178.4	1004

Southern Hemisphere Tropical Cyclone Climatology



Kuleshov, Y., L. Qi, R. Fawcett, and D. Jones (2008), On tropical cyclone activity in the Southern Hemisphere: Trends and the ENSO connection, *Geophys. Res, Lett., 35*, L14S08, doi:10.1029/2007GL032983

Southern Hemisphere Tropical Cyclone Climatology – cont.



PCCSP 1.3 Improving the Understanding of Tropical Cyclone climatology

Key tasks:

- Develop a comprehensive TC climatology
- Investigate the role of the broadscale controls on variability of TCs
- Undertake analysis of relationship between trends and large-scale environmental factors
- Further develop specialised website for Tropical Cyclones in the Southern Hemisphere

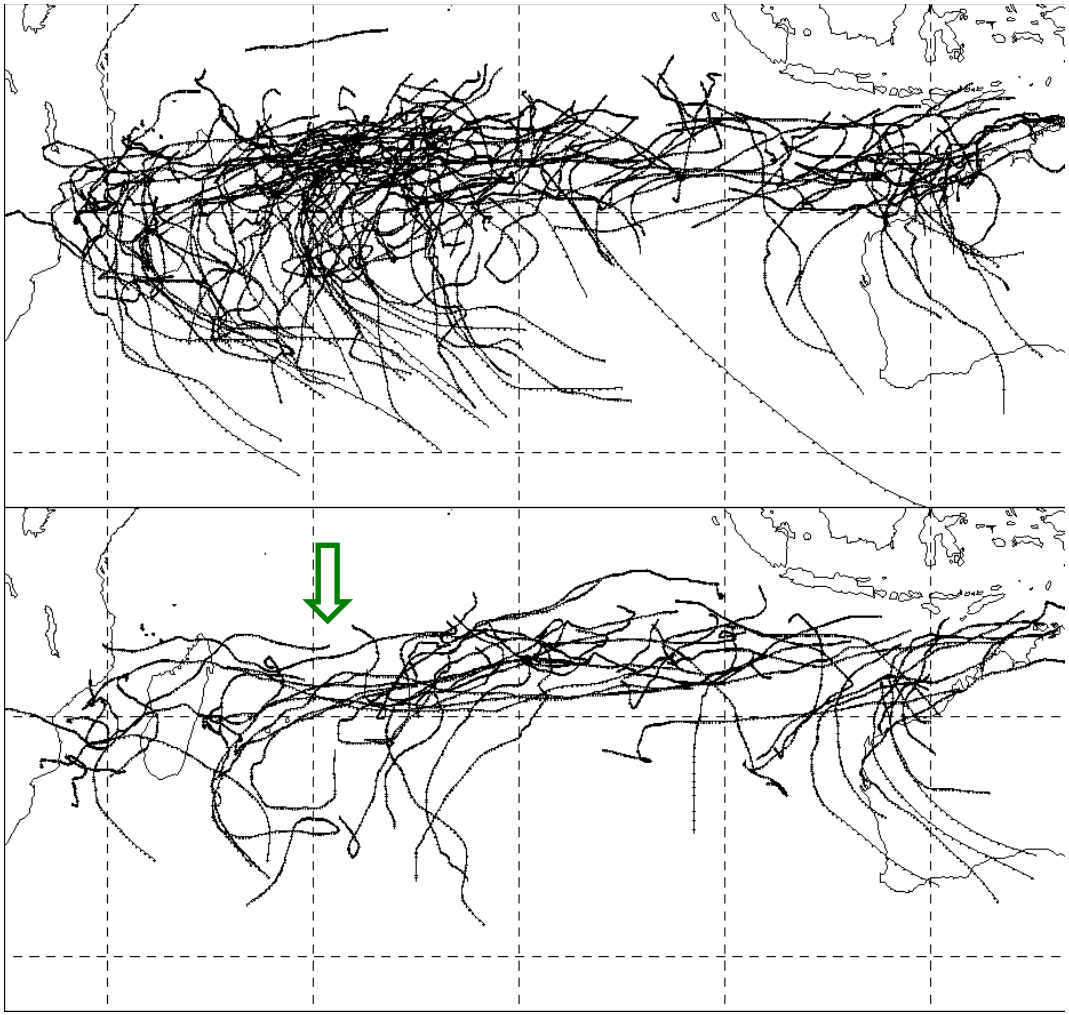
PCCSP 1.3 Improving the Understanding of Tropical Cyclone climatology – cont.

- To analyse the climatological characteristics of the TC, the NCC's vortex tracking computer package will be employed
- A set of FORTRAN programs that generates a wide range of statistics (Murray and Simmonds 1991; Jones 1994)
- TC characteristics such as cyclone hours, system intensity, intensity tendency, system density and system flux will be computed

Murray, R. J. and I. Simmonds, 1991. A numerical scheme for tracking cyclone centres from digital data. Part I: development and operation of the scheme. *Aust. Meteor. Mag.*, **39**, 155-166.

Jones, D. A., 1994. A numerical vortex finding, tracking, and statistics package. *BMRC Research Report*, **41**, 35pp.

PCCSP 1.3 Improving the Understanding of Tropical Cyclone climatology – cont.

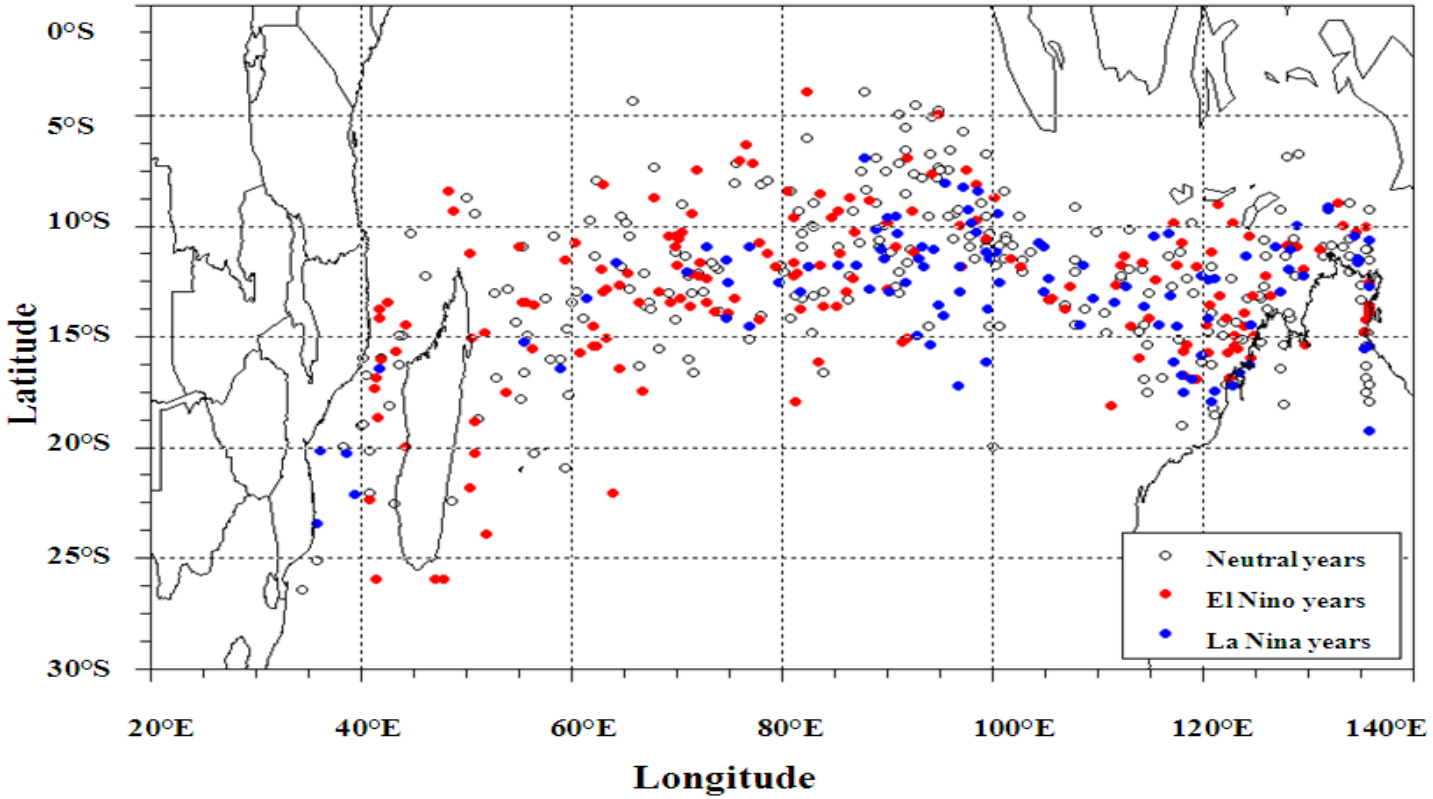


El Niño

La Niña

TC tracks in the South Indian Ocean from 1969/70 to 2005/06 TC seasons

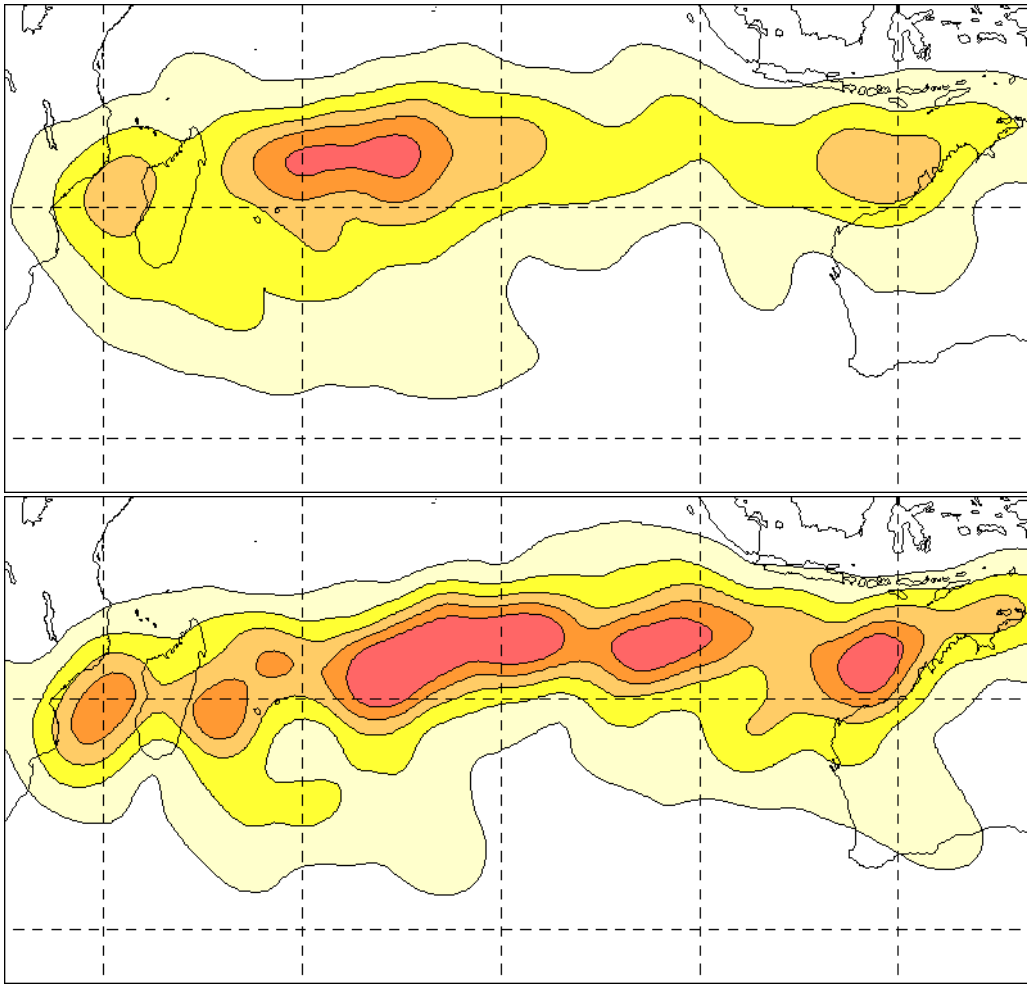
PCCSP 1.3 Improving the Understanding of Tropical Cyclone climatology – cont.



Geographical distribution of tropical cyclogenesis events over the South Indian Ocean for the period 1969-2006

Kuleshov, Y., F. Chane-Ming, L. Qi, I. Chouaibou, C. Hoareau, and F. Roux (2009), Tropical cyclone genesis in the Southern Hemisphere and its relationship with the ENSO, *Ann. Geophys*., *27*, 2523-2538.

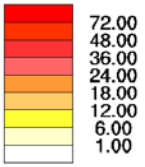
PCCSP 1.3 Improving the Understanding of Tropical Cyclone climatology – cont.



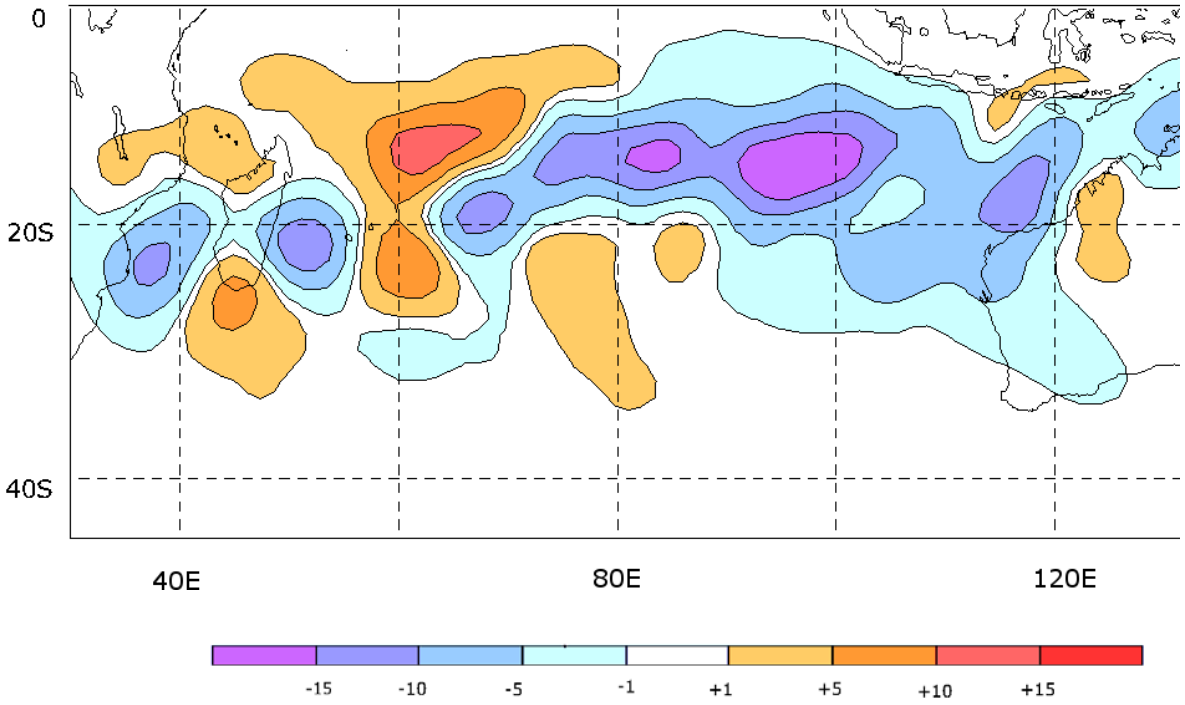
El Niño

La Niña

TC hours



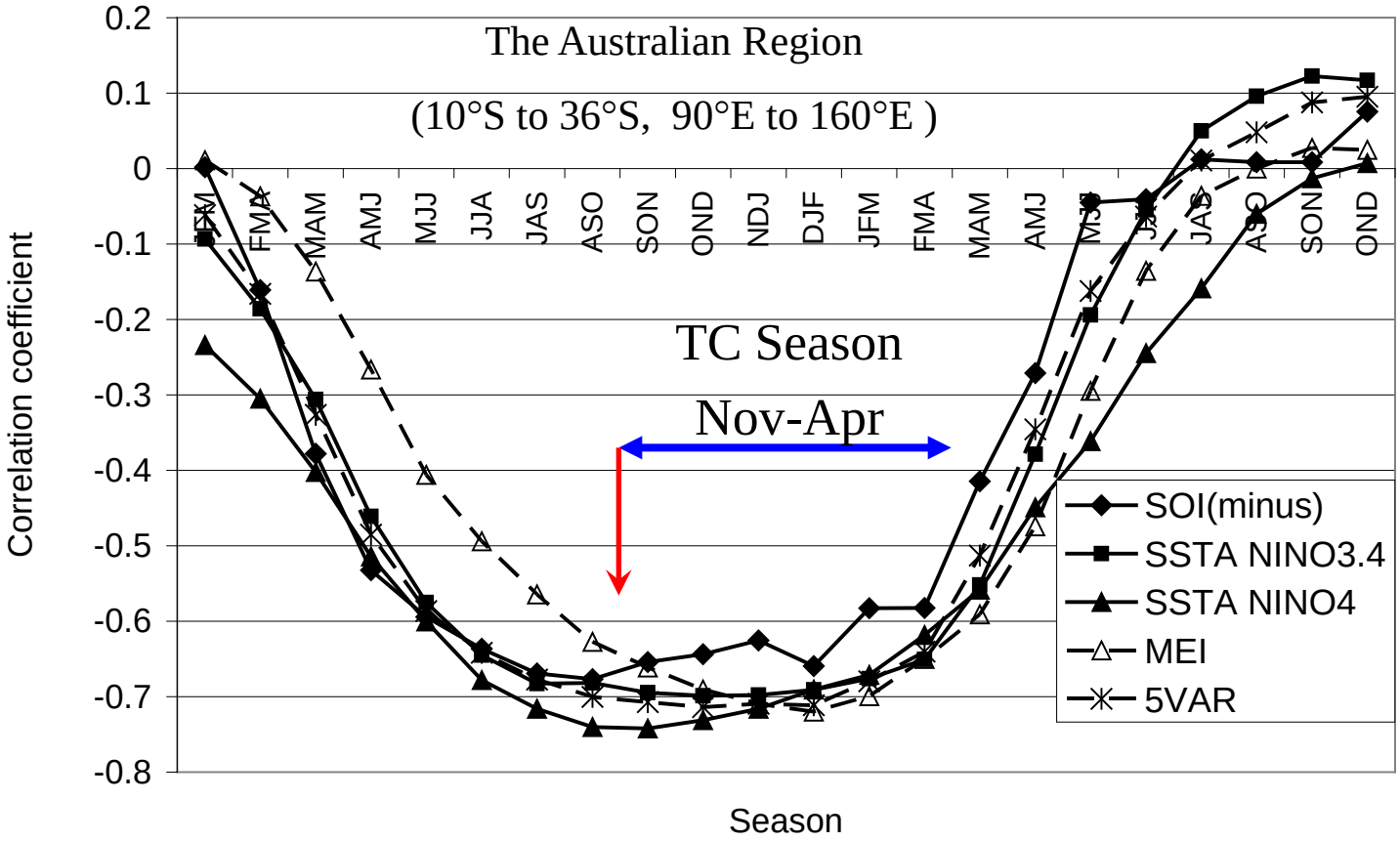
PCCSP 1.3 Improving the Understanding of Tropical Cyclone climatology – cont.



TC hours: Differences between El Niño seasons and La Niña seasons

“Climate Change and the Southern Hemisphere Tropical Cyclones” Project: Seasonal Forecasting

The correlation between TC numbers and the ENSO indices



Kuleshov, Y., Qi, L., Fawcett, R., and Jones, D. (2009): Improving preparedness to natural hazards: Tropical cyclone prediction for the Southern Hemisphere, in *Adv. Geosci.*, *12 Ocean Science* (ed. Gan, J.), World Scientific Publishing, Singapore, 127–143.

Seasonal Climate Outlooks: Tropical Cyclones

- To develop operational seasonal climate outlooks for Australian tropical cyclones in order to achieve consistent useful and skilful tropical cyclone outlook by regions.

- To develop experimental seasonal climate outlooks for tropical cyclones using dynamical climate models such as the Bureau's Predictive Ocean Atmosphere Model for Australia (POAMA).

Seasonal Climate Outlooks: Tropical Cyclones – cont.

- Currently based on large scale indicators of climate (Sea Surface Temperature)
- Moving to POAMA: considerable skill in predicting the variations in the tropical climate, particularly in predictions of the El Niño-Southern Oscillation.
- Dynamical models are now challenging statistical methods for predicting seasonal TC activity. For example, the UK Met Office uses a dynamical numerical model called *GloSea*. For the 2008 North Atlantic hurricane season (July to November period) 15 tropical storms was predicted and there were 16 tropical storms recorded.

Seasonal Climate Outlooks: Tropical Cyclones – cont.

Seasonal Outlook for Tropical Cyclones

Contents

2008/09 (issued October 2008)[1]

Summary: Above average tropical cyclone season expected for Australia

Based on the current broad-scale climate indicators, the tropical cyclone outlook for the 2008/09 season shows moderate shift in the odds favouring above average tropical cyclone activity in the Australian region as a whole and in the Eastern and Western Australian regions. For the Eastern and Northern Australian regions, the outlook suggests that close to or slightly above average tropical cyclone activity is likely.

Top

Related links

- ENSO Wrap-up
- Seasonal Climate Outlooks
- ENSO Forecasts
- Further POAMA forecasts (experimental)
- Background Info

Definitions

- ENSO
- El Niño
- La Niña
- NINO1/2/3/4/3.4
- Warm/Cool

Seasonal Climate Outlooks: Tropical Cyclones – cont.

- Future Work (2009/10 and beyond)
  Shift to a dynamical model based seasonal climate outlook service (POAMA2.1); collaboration with APCC

- Exploratory analysis of the relationship between POAMA-based outlooks of broad-scale climate drivers (such as NINO indices) and observed tropical cyclone activity.

Summary

- Tropical cyclone database for the Southern Hemisphere was developed.
- A specialised website for disseminating results and data "Tropical Cyclones in the Southern Hemisphere" was established.
- Future work (IBTrACS, PCCSP etc)

- Improving quality of the SH TC archive

- Develop a comprehensive TC climatology (SIO and SPO)

- Investigate the role of the broadscale controls on variability of TCs

- Develop TC seasonal prediction in the Australian region, South Pacific and South Indian Oceans

Acknowledgement

Australian Government Department of Climate Change and NOAA's National Climatic Data Center for financial support of the project

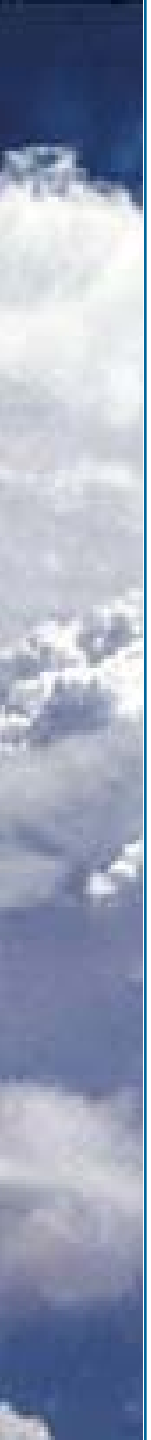
"*Climate change and the Southern Hemisphere tropical cyclones*"

Australian Government Department of Climate Change for financial support of the project

"*Improving the Understanding of Tropical Cyclone Climatology*"

Acknowledgement

Météo-France (La Réunion), the Meteorological Services of Fiji and New Zealand for providing regional TC data



Thank you