Understanding the contrast of Australian springtime rainfall of 1997 and 2002 in the frame of two flavors of El Nino

Eun-Pa Lim and Harry H. Hendon

Research & Development Branch, Bureau of Meteorology, Melbourne, Australia

e.lim@bom.gov.au

Sponsored by the Victorian Climate Initiative

Australian Government Bureau of Meteorology · CSIRO · State Government Victoria Department of Environment and Primary Industries

Why was it not so dry in 1997 but so dry in 2002?

Australian spring rainfall variation is strongly associated with the occurrence of El Nino/La Nina

- 1997 - Strongest El Nino of the 20thC, but AUS wasn't as dry as expected
- 2002 - Weak El Nino with its max. SST warming over the dateline, but AUS experienced severe drought in the east

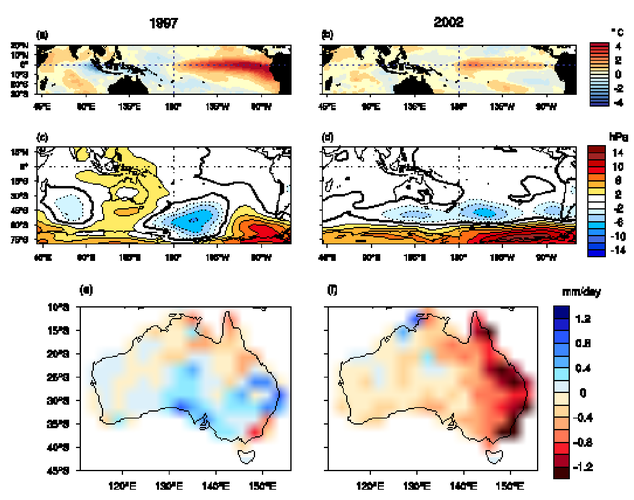
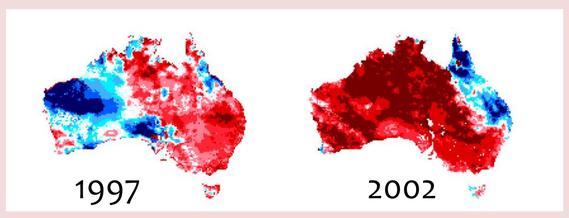


FIG 1. Observed anomalies of (a,b) SSTs, (c,d) MSLP and (e,f) Australian rainfall in 1997 (left) and 2002 (right) austral spring (September-October-November; SON) based on the climatology of 1982-2005. The color shading interval is 0.5°C for SST anomalies, 2 hPa for MSLP anomalies, and 0.2 mm/day for rainfall anomalies.

Was it because of

- SST - different spatial patterns (flavors) of tropical Pacific SST anomalies associated with El Nino in 1997 and 2002?
- Land - drier upper layer soil condition in 2002 winter than that in 1997?



- Atmosphere - massive sudden stratospheric warming in 2002 winter that caused a record strength negative Southern Annular Mode (SAM) in 2002?

AIM of this study is to understand the causes and predictability of the different springtime rainfall responses over Australia for El Niño in 1997 and 2002

Summary

1997 spring wasn't as dry as expected because

- ***maximum SST*** warming of this El Nino was far shifted to ***the east***
- Atmospheric noise amplified the wet condition

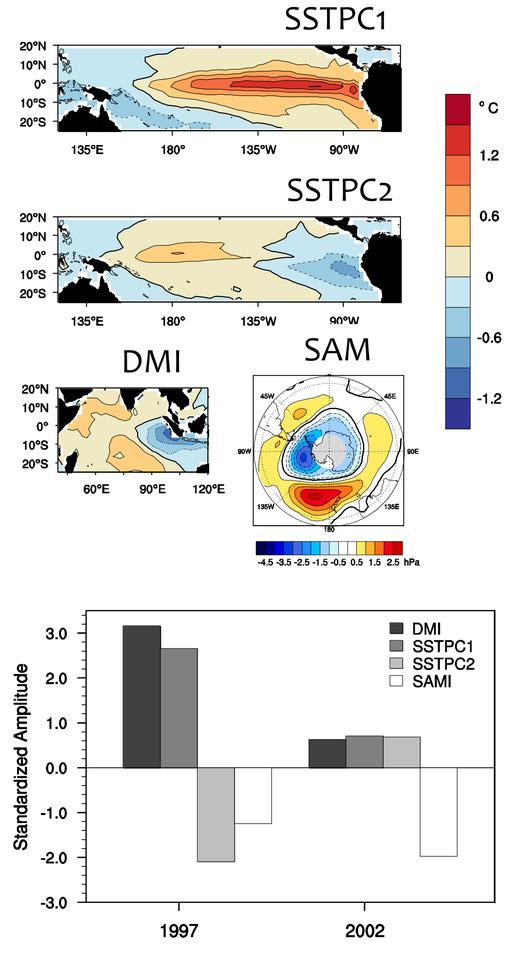
2002 spring was drier than expected because

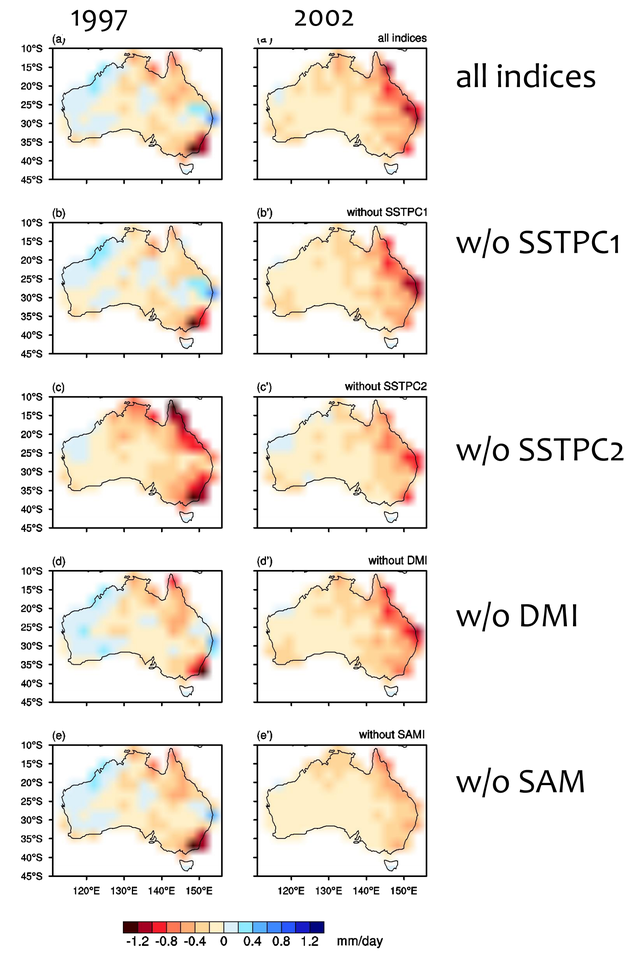
- ***maximum SST*** warming of this El Nino was shifted to ***the west***
- record strength of ***-ve SAM*** amplified the dry condition
  - * -ve SAM could be predicted by POAMA due to the realistic atmospheric initial conditions
  - * Good representation of air-sea interaction is important for skilful forecasts for SAM and associated Australian climate

Data

- Australian Water Availability Project (AWAP) analysis
- Reynolds OI v2 SST
- ERA-Interim reanalysis

Statistical analysis – multiple linear regression





all indices

w/o SSTPC1

w/o SSTPC2

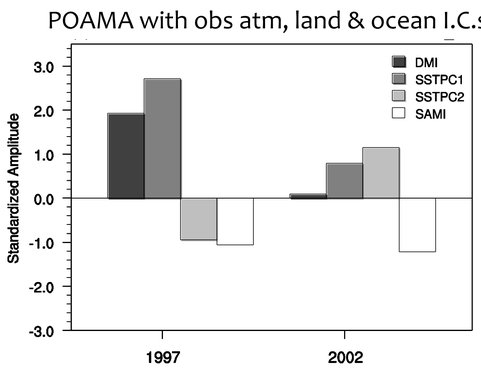
w/o DMI

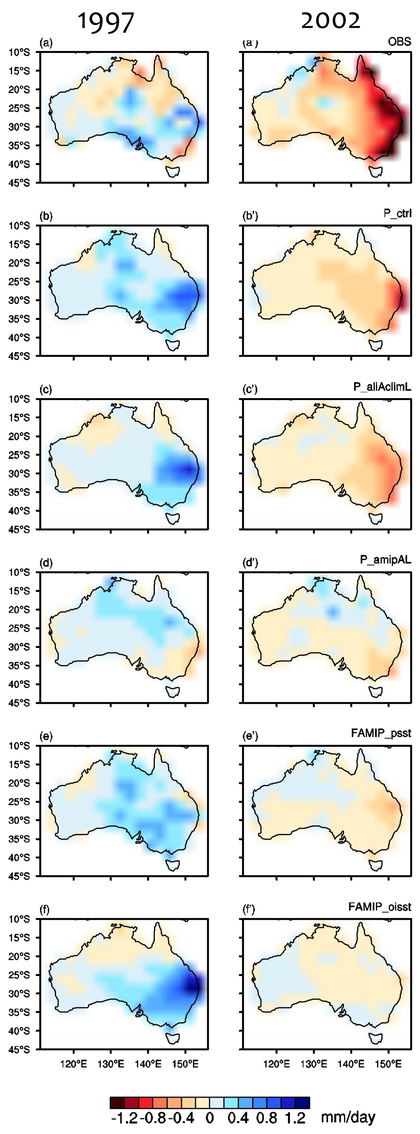
w/o SAM

- Reconstruction of 1997 rainfall anomaly - SSTPC1 & SSTPC2
- Reconstruction of 2002 rainfall anomaly - SSTPC2 & SAM

POAMA forecast sensitivity experiments

POAMA with obs atm, land & ocean I.C.s





obs

obs atm, land & ocean I.C.s

climatological land I.C.s

Atm & land I.C.s in balance with obs SSTs (Atm/land not observed)

Atm forced by forecast SSTs

Atm forced by observed SSTs

- POAMA skilfully predicted different flavored El Nino, the SAM and the rainfall anomaly in 1997 and 2002 spring
- In all experiments, 2002 was drier than 1997: different SSTs were key to this rainfall contrast
- Prediction of strong negative SAM was important to predict 2002 drought
- Land I.C.s mattered for the inland & South Australia
- Atm I.C.s was important in getting 1997 spring wetter in South Australia & New South Wales

For further details:
Lim, E.-P. and H. H. Hendon 2015: Understanding the contrast of Australian springtime rainfall of 1997 and 2002 in the frame of two flavors of El Nino. J. Climate, 28, 2804-2822