Dynamical Seasonal Prediction of Indo-Pacific Climate at the Bureau of Meteorology

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BMRC
Overview of BoM Dynamical Seasonal Prediction System

Predictive Atmosphere-Ocean Model for Australia

System Components
Forecast Procedure
Hindcast skill

Drift and Intrinsic Model Behavior (MJO, ENSO and IOD)
‘06 El Niño/ Pos IOD
‘07 La Niña/Neg IOD

Beyond Niño3

Regional climate

Predictability of inter-El Niño SST (flavors, vintages, modoki)

Predictability of Leeuwin Current (proxy)
POAMA: Coupled Seasonal Forecast Model

- Atmosphere: BAM 3.1 global spectral model
  - T47, 17 Vertical levels
  - Mass Flux Convection, CAPE tendency closure

- Ocean: ACOM2, based on MOM2
  - Meridional: 0.5deg between 9S and 9N
  - Zonal: 2 deg
  - 25 Vertical levels (12 in upper 185m)
  - “tuned” Indonesian throughflow and mixing
  - Simple sea ice model (Semtner 1976)

- Ocean Atmospheric Sea Ice Soil (OASIS) coupler

- Salinity relaxed to Levitus, otherwise no flux corrections are applied.
Hindcasts 1980-2005:
- AMIP Atmos I.C.
- Assimilated (T) Ocean I.C. (piggybacks on POAMA)
- 9 mnth forecast, 3 times per month, 1 d apart

Operational forecasts:
- NWP Atmos I.C.
- Assimilated Ocean I.C.
- 9 month forecast everyday (30 per month)

Coupled climate model
Behavior of MJO/ENSO/IOD modes, drift sensitivity exps (e.g., decouple Indian or Pacific)
Skill (ACC) from hindcasts 1987-2001 (monthly data)

SST

SFC Zonal wind

Thermocline
Nino3 skill

DMI skill
Operational Forecasts IOD 2006
(Dipole Mode Index)

April starts

May starts

June starts

July starts

Aug starts

Sep starts
Most recent POAMA Forecasts (03/02/07-04/03/07)

weak La Niña/neg IOD?
Where does predictable signal in heat content (sea level) on NW shelf come from?

*Primarily ENSO oceanic teleconnection via ITF*

Is it of any practical use?

*Drives Leeuwin Current variations*
Observed heat content correlated with Nino34(DJF)

POAMA Assimilation 1982-2002

JJA (-2)

SON (-1)

DJF (0)
How do sea level variations at Fremantle relate to global heat content (sea level) variations?

Correlate Sea Level with Heat Content 1987-2001


Sea level Fremantle proxy for variations in strength of Leeuwin Current
Model supports Leeuwin Current, why not use predictions of Leeuwin Current directly?

Upper ocean currents (0-300m) from POAMA assimilation 1987-2001

Use heat content NW shelf as proxy for Fremantle SL (Leeuwin Current)
Use POAMA predictions of heat content on NW shelf (or Nino4) to predict Fremantle sea levels

\[ \text{Fremantle SL}(t) = \text{POAMA HC}(t) \times \text{reg}(0) \]

where \( \text{reg}(0) \) is cross validated simultaneous regression between observed Fremantle SL and heat content on NW shelf from POAMA 1980-2005

\[ \text{Fremantle SL}(t) = \text{Nino4}(t) \times \text{reg2}(0) \]

where \( \text{reg2}(0) \) is simultaneous regression between observed Fremantle SL and Nino4 SST index from POAMA
Un-exploited predictability in Indian Ocean, primarily ENSO related

Future improvement with improved ocean initial conditions, improved resolution, and reduction of systematic errors (mean thermocline, ENSO mode and its teleconnection)

Strong limiters of low latitude predictability

Onset of Australian summer monsoon provides a strong predictability barrier

westerly basic state →loss of positive feedbacks (Bjerknes and/or SST-windpseed)

Large noise from MJO
Heat Content & Winds regressed onto Nino34

Control

JJA

SON

DJF

MAM
Forecasts starting 1st Mar 1997

Forecasts starting 1st Dec 1997

Green: POAMA
Red: persistence