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

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BMRC

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Overview of BoM Dynamical Seasonal Prediction System

Predictive **A**tmosphere-**O**cean **M**odel for **A**ustralia

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:

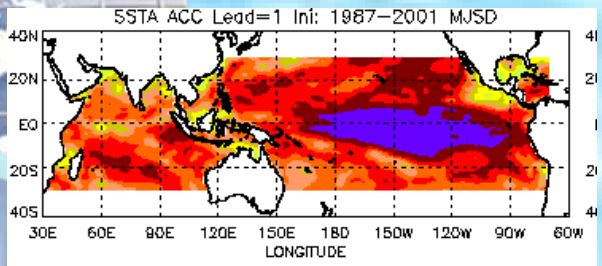
- NWP Atmos I.C.
- Assimilated Ocean I.C.
- 9 month forecast everyday (30 per month)

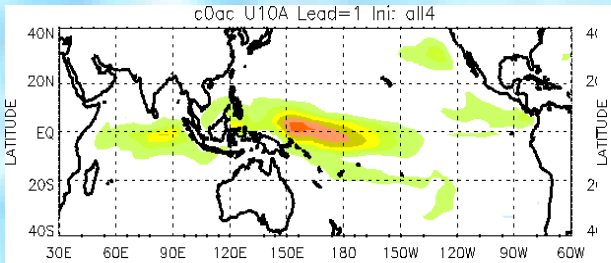
Coupled climate model

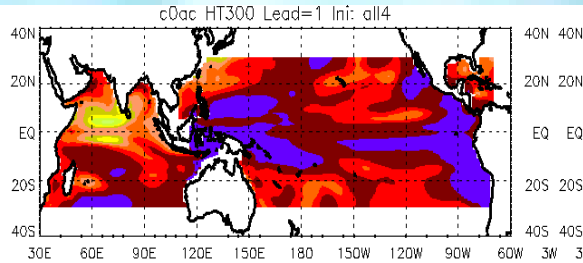
Behavior of MJO/ENSO/IOD modes, drift
sensitivity exps (e.g., decouple Indian or Pacific)

Skill (ACC) from hindcasts 1987-2001 (monthly data)

+1







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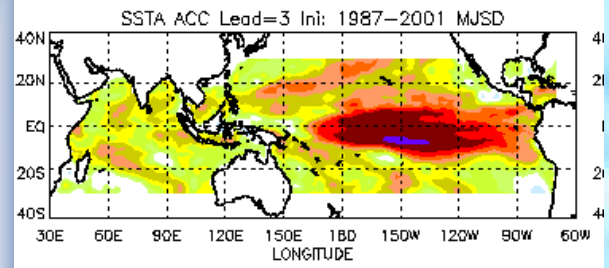

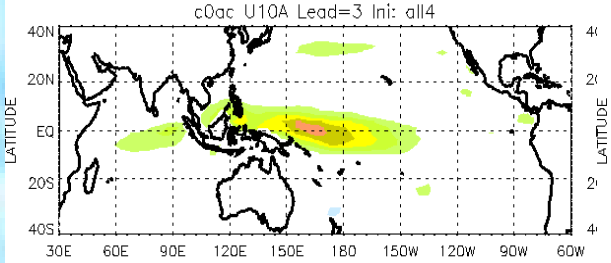

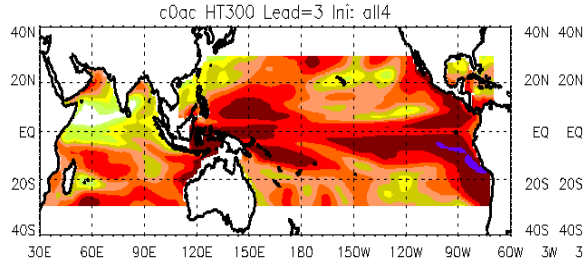

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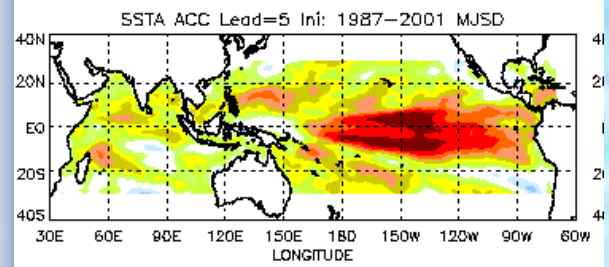

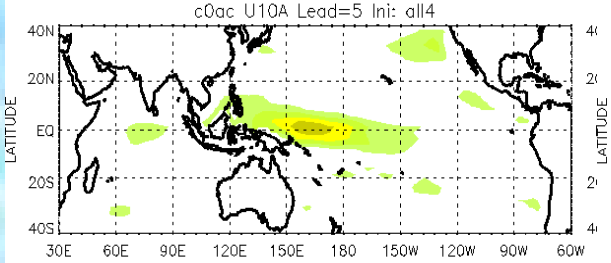

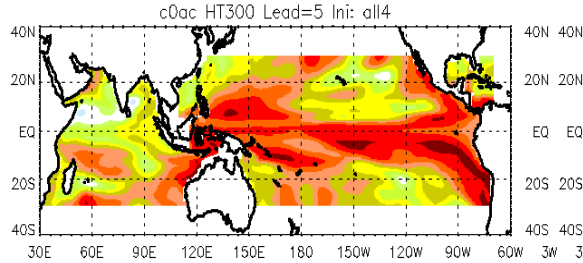

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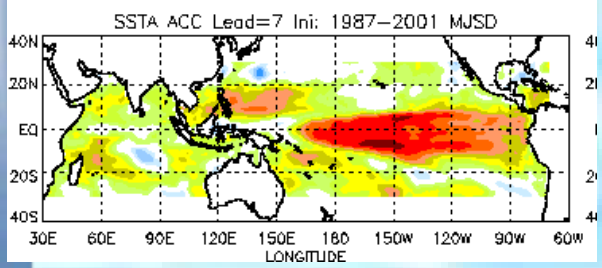

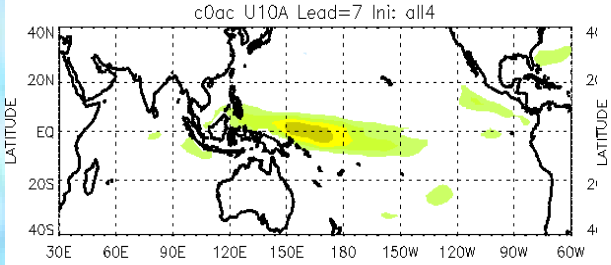

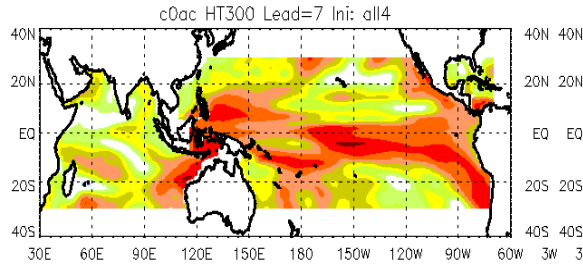

SST **Sfc Zonal wind** **Thermocline**

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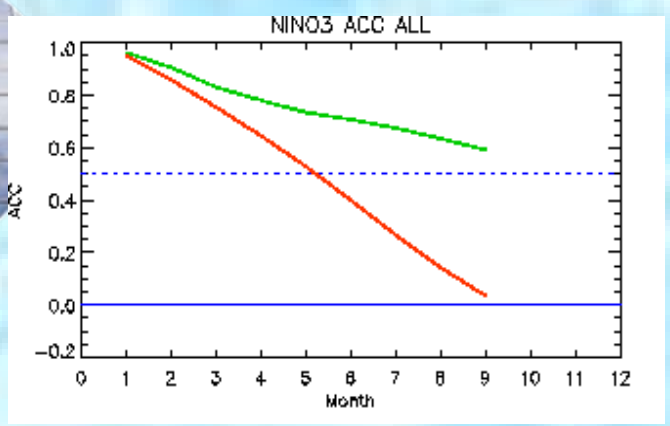
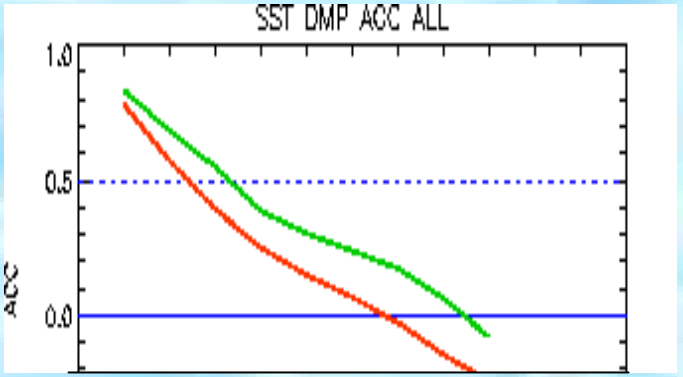
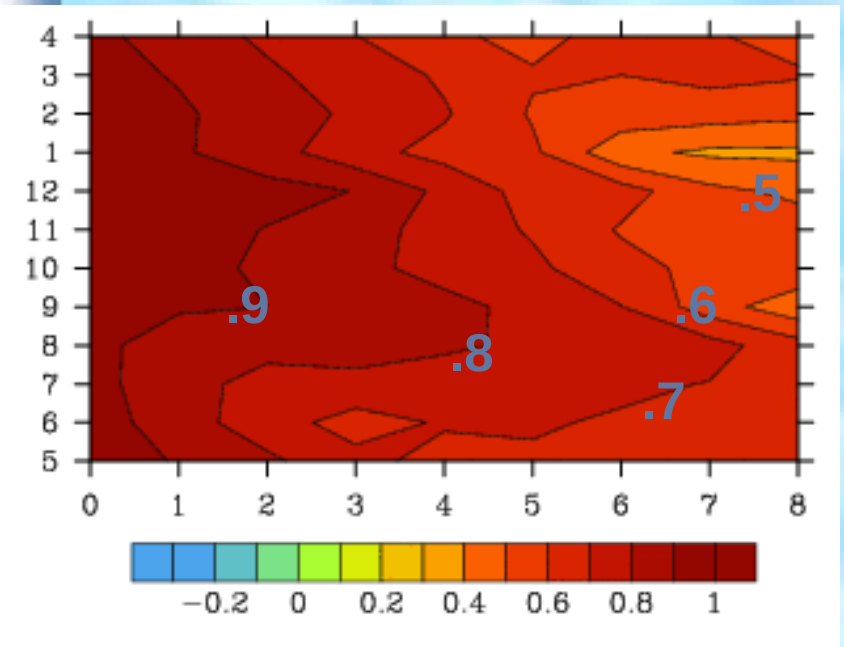
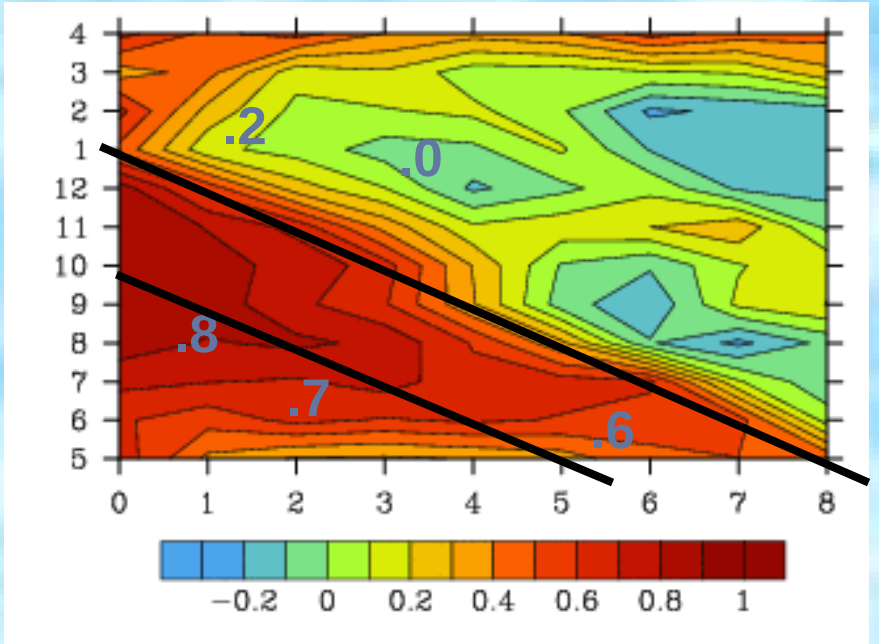




Nino3 skill



DMI skill



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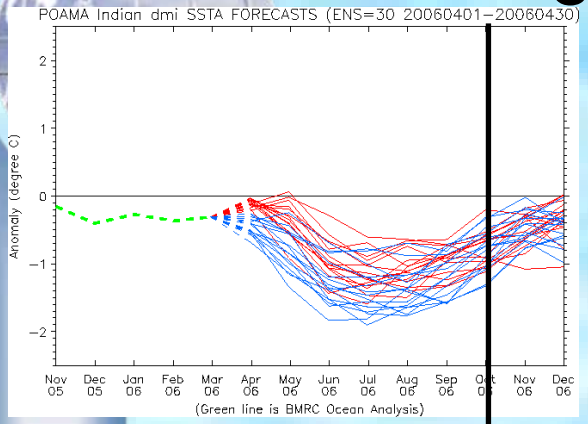
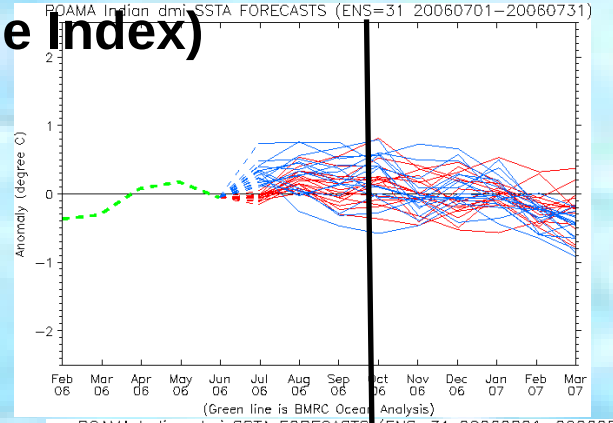
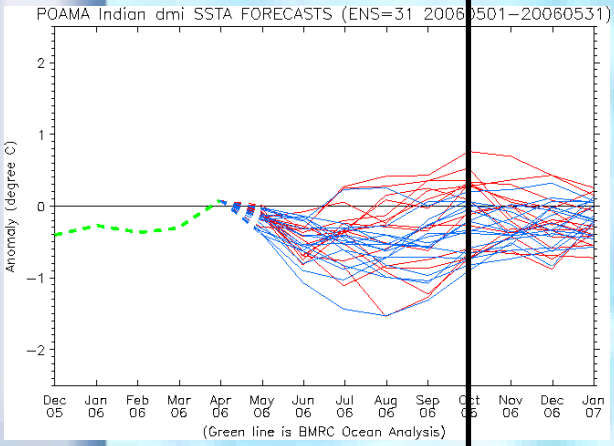
Operational Forecasts IOD 2006 (Dipole Mode Index)



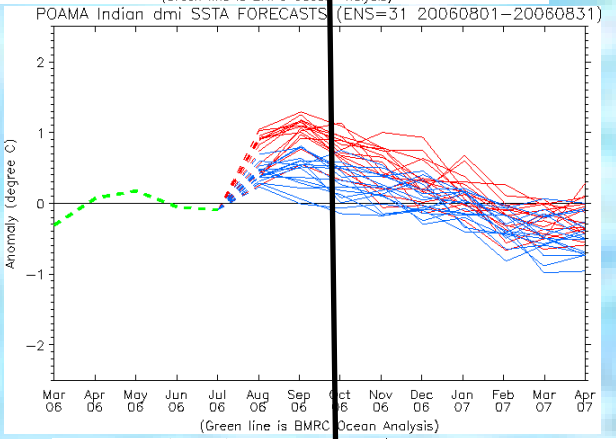
April starts



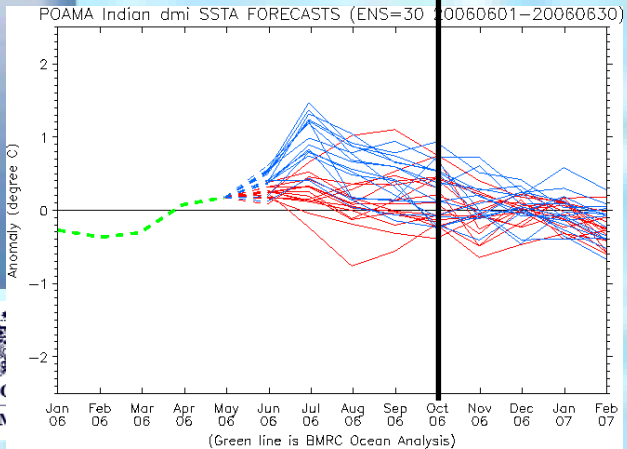
July starts



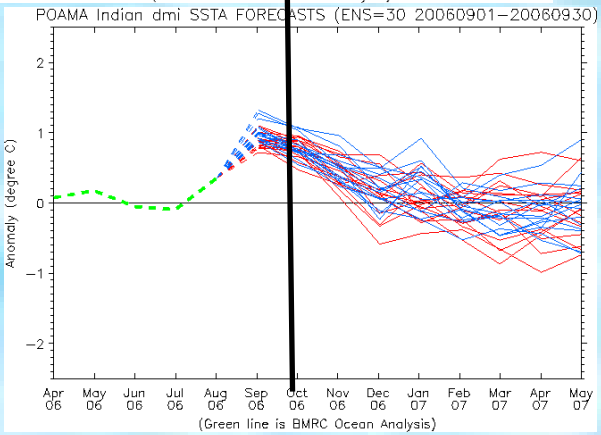
May starts



Aug starts



June starts



Sep starts

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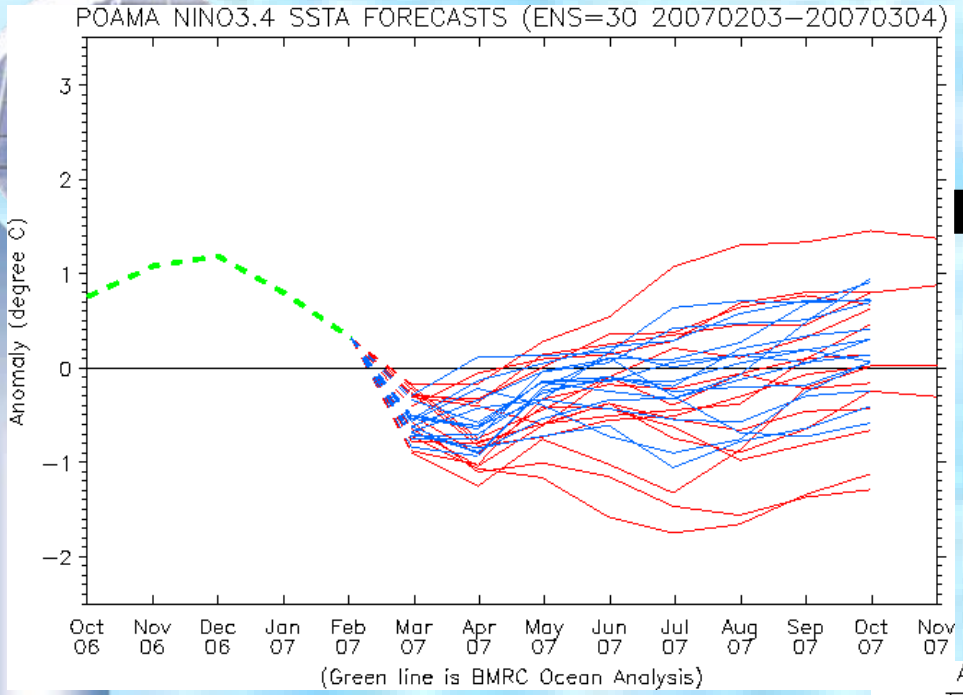
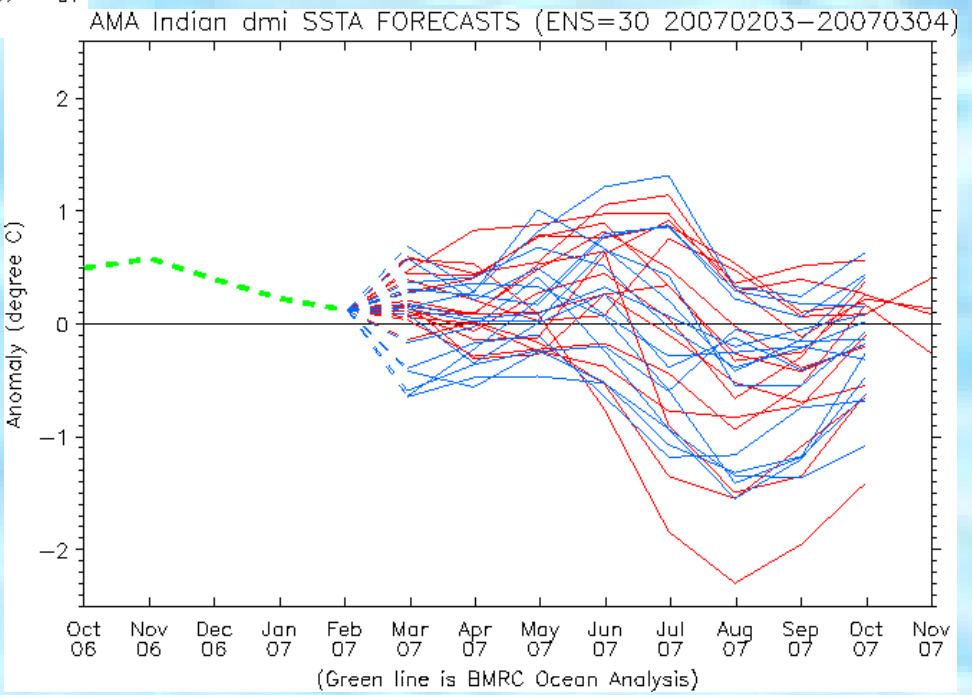
Most recent POAMA Forecasts (03/02/07-04/03/07)



weak La Niña/neg IOD?

Nino34

DMI



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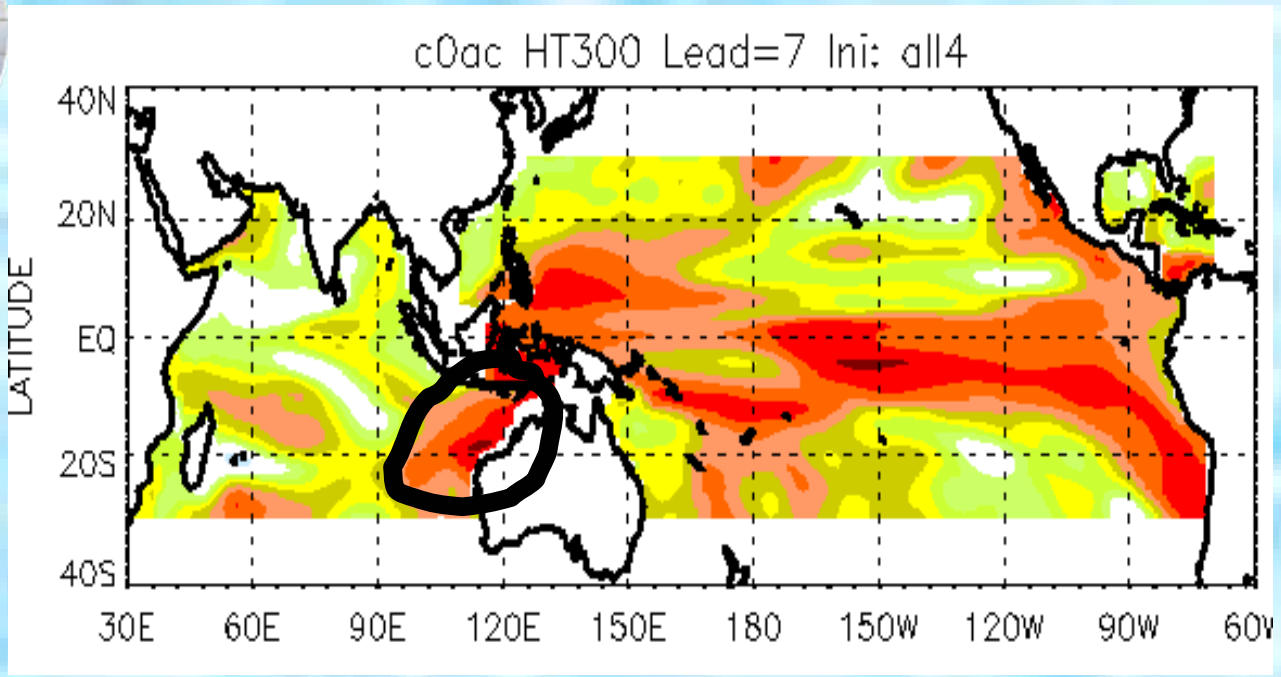
Skill (cor) Heat Content (300m) at Lead Time 7 mnth



Where does predictable signal in heat content (sea level) on NW shelf come from?

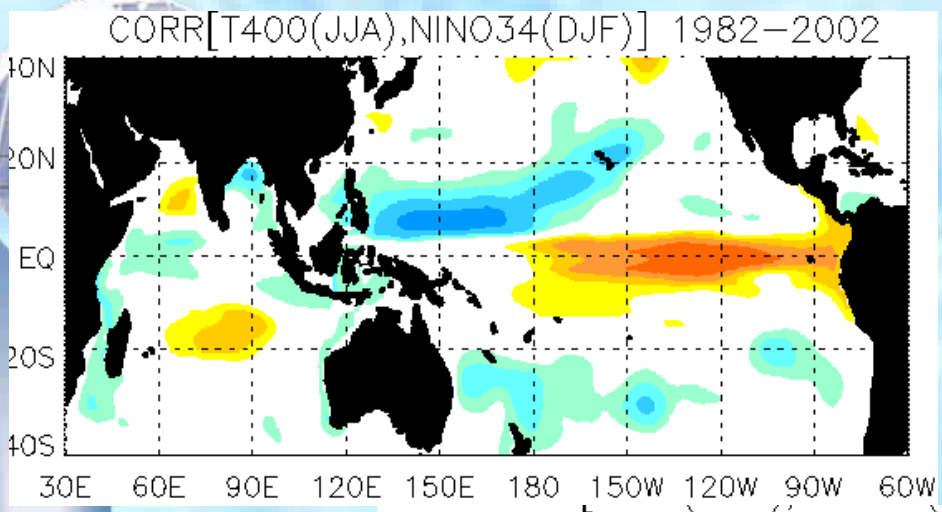
Primarily ENSO oceanic teleconnection via ITF

Is it of any practical use?

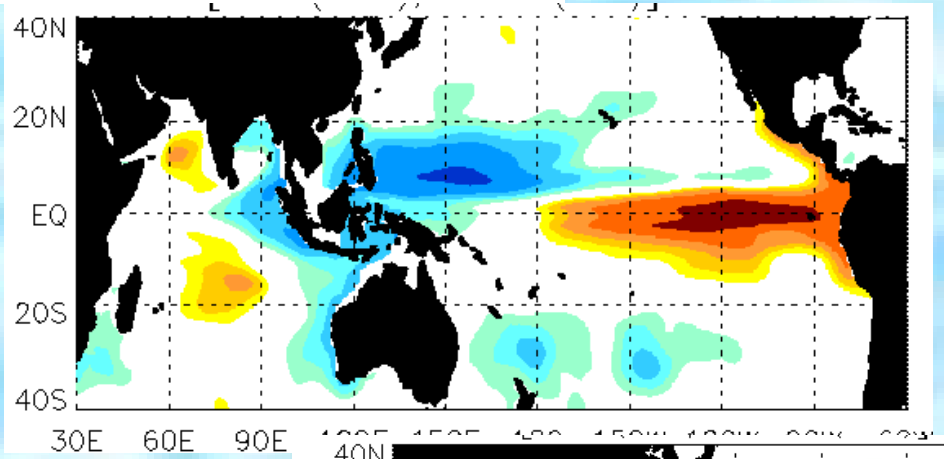
Drives Leeuwin Current variations

Observed heat content correlated with Nino34(DJF)

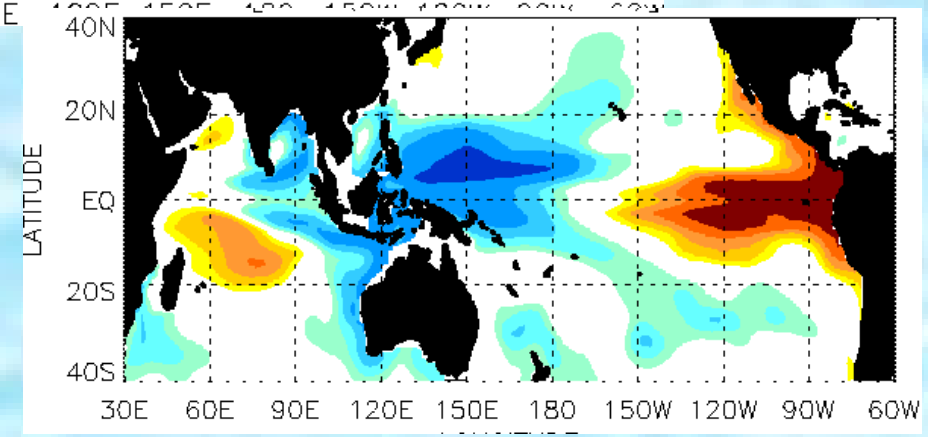
POAMA Assimilation 1982-2002



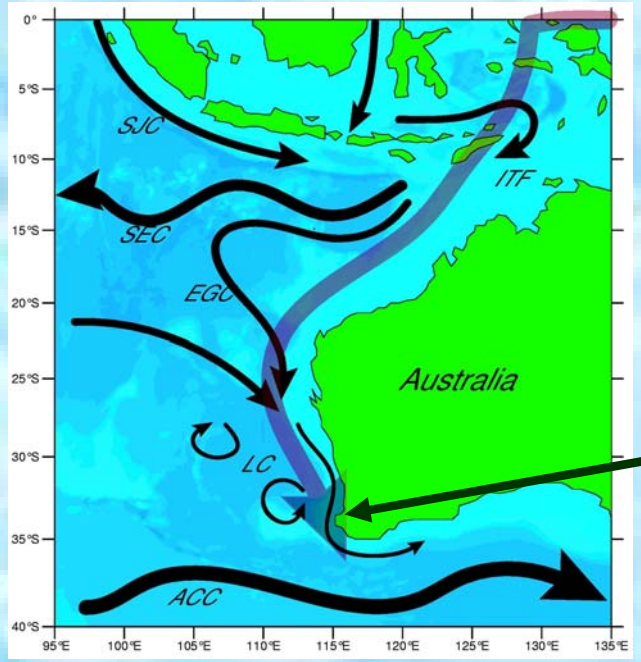
JJA (-2)



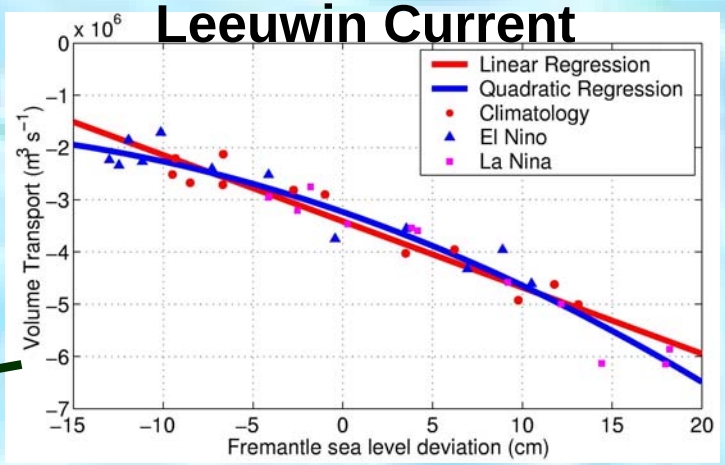
SON (-1)



DJF (0)

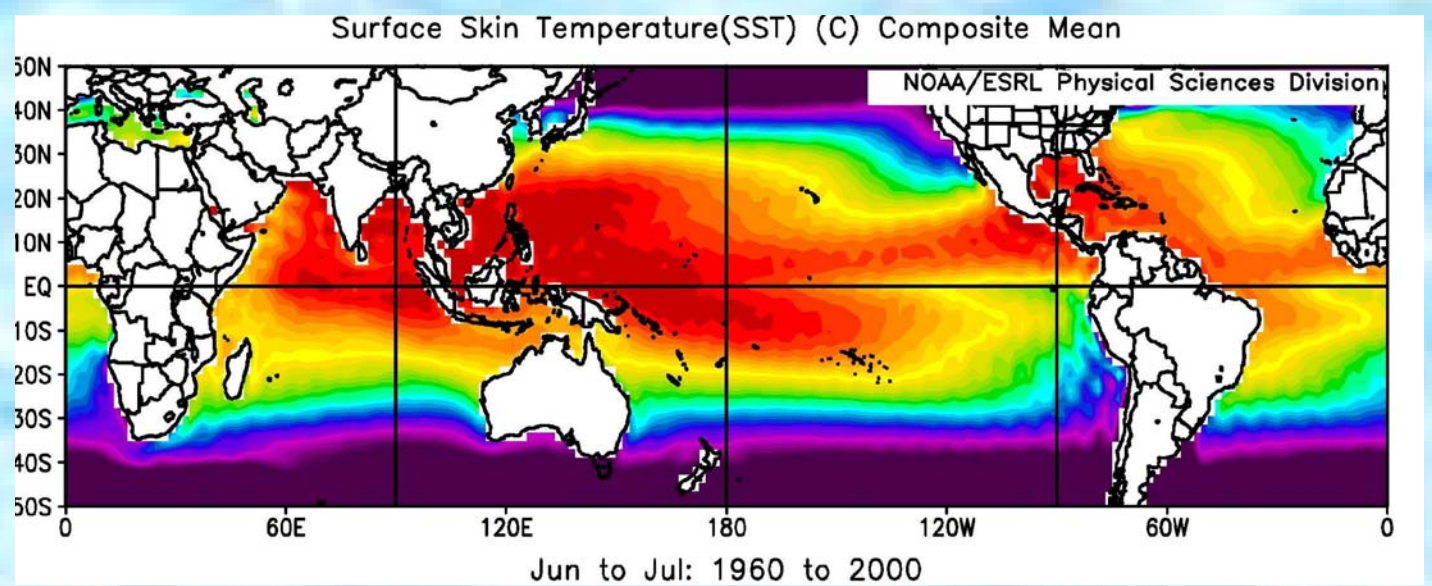


Volume transport Leeuwin Current



Fremantle Sea Level

Ming Feng



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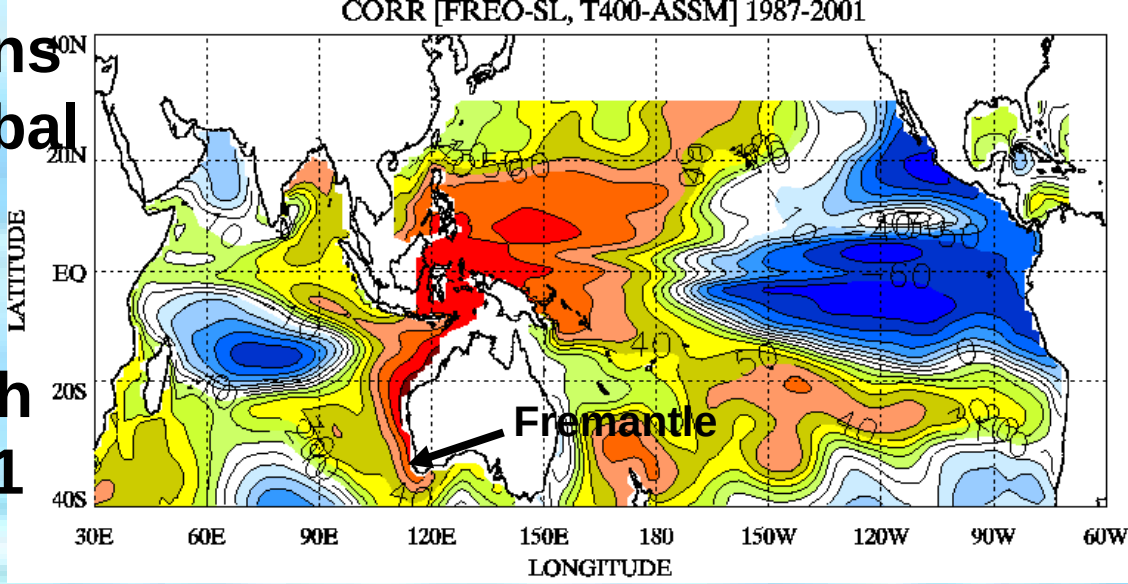
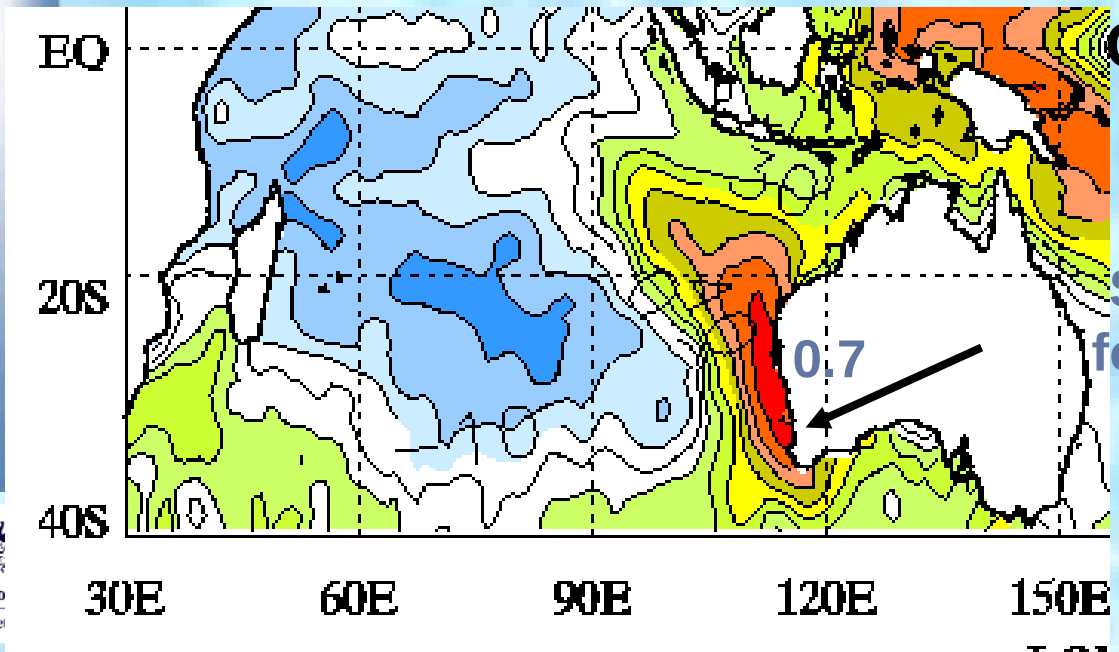
How do sea level variations at Fremantle relate to global heat content (sea level) variations?

Correlate Sea Level with Heat Content 1987-2001





Correlation Fremantle Sea Level with SST (1980-2003)

Sea level Fremantle proxy for variations in strength of Leeuwin Current

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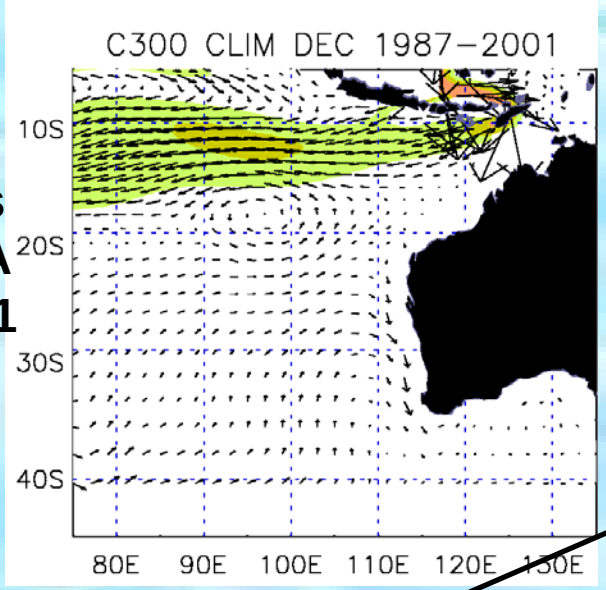
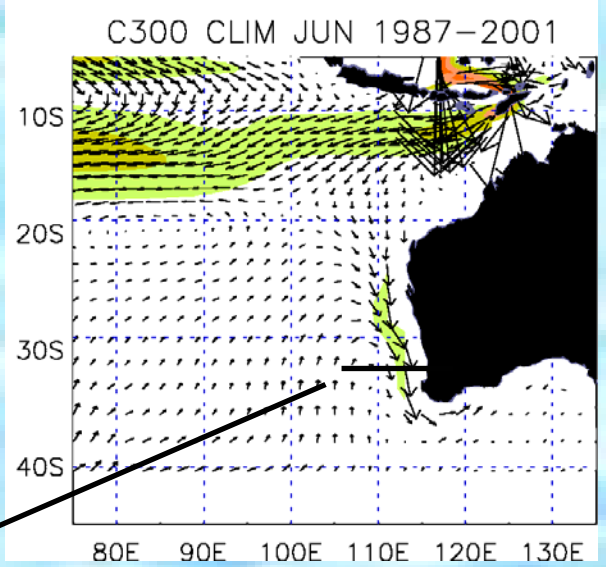
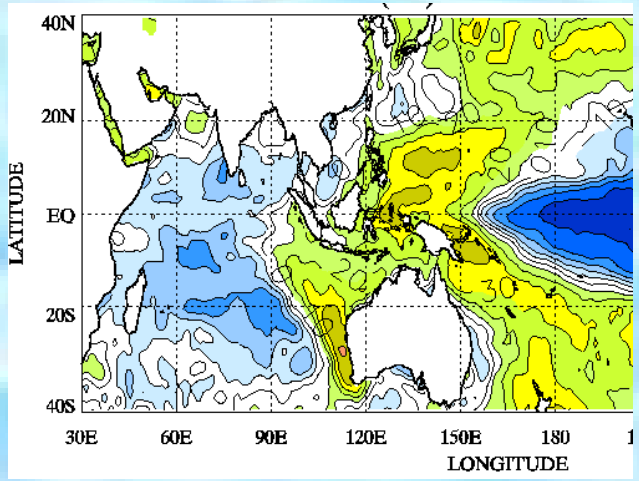
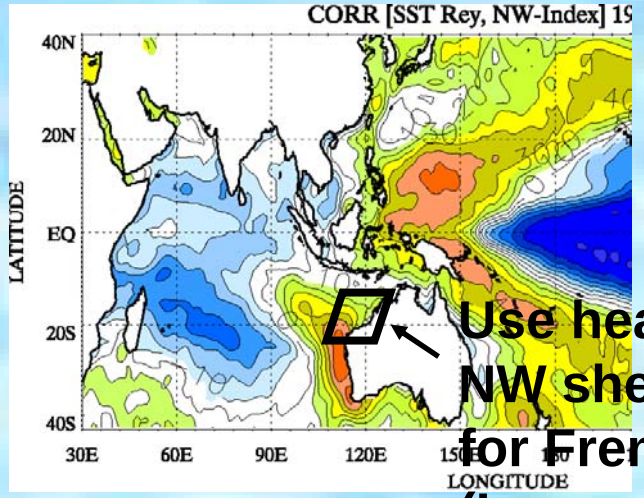
Model supports Leeuwin Current, why not use predictions of Leeuwin Current directly?

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









Use heat content NW shelf as proxy for Fremantle SL (Leeuwin Current)

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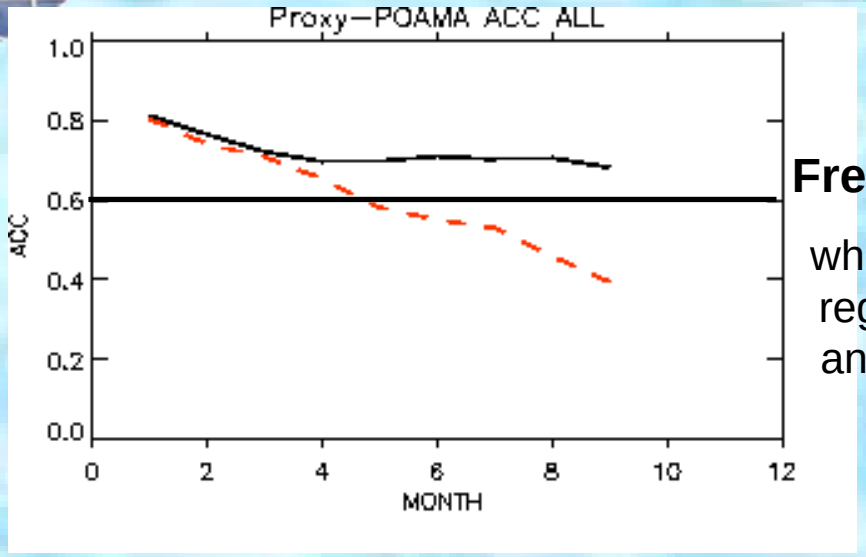
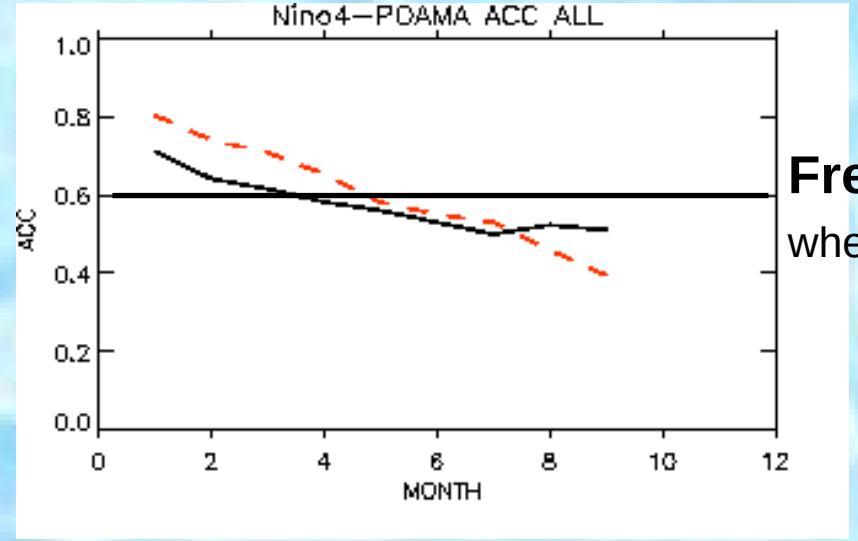
Use POAMA predictions of heat content on NW shelf (or Nino4) to predict Fremantle sea



Fremantle SL(t)=POAMA HC(t) * reg (0)

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



Fremantle SL(t)=Nino4(t) *reg2 (0)

where 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

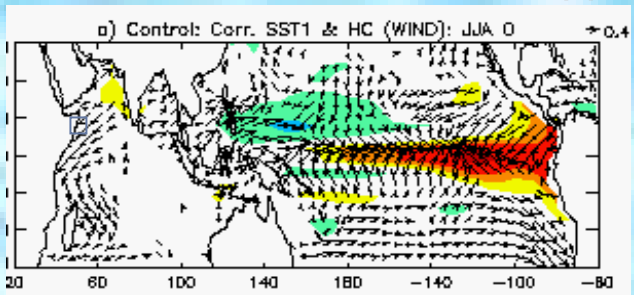
IndClim

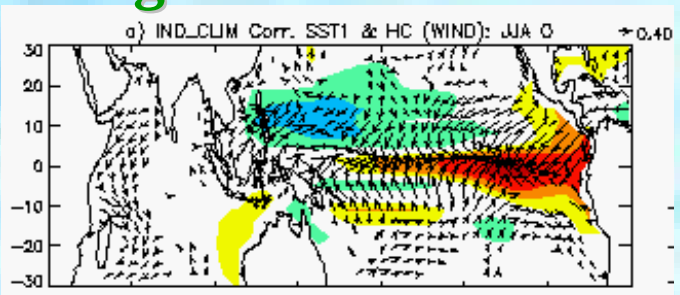
JJA

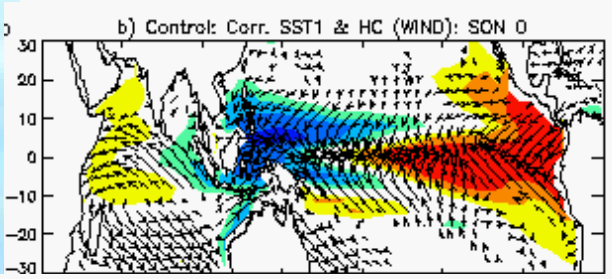
SON

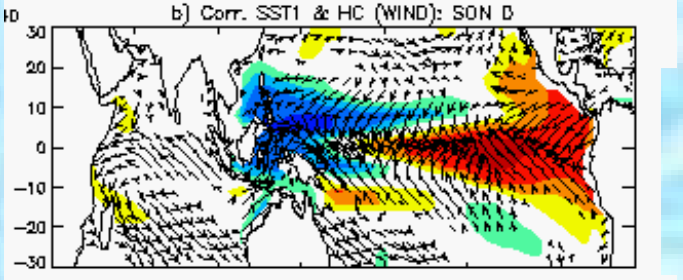
DJF

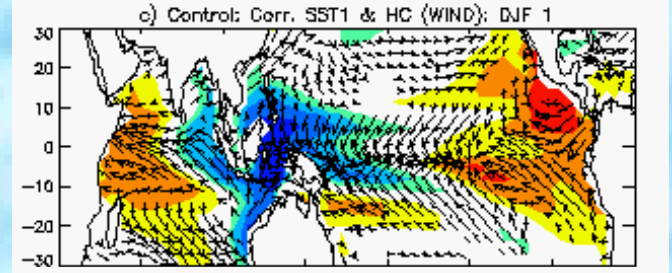
MAM

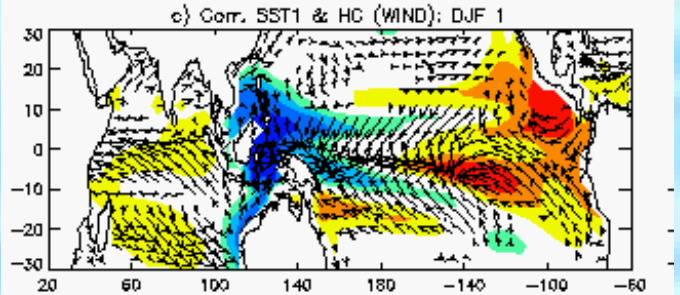


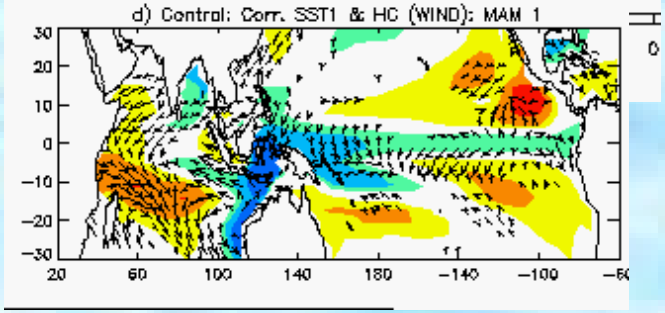


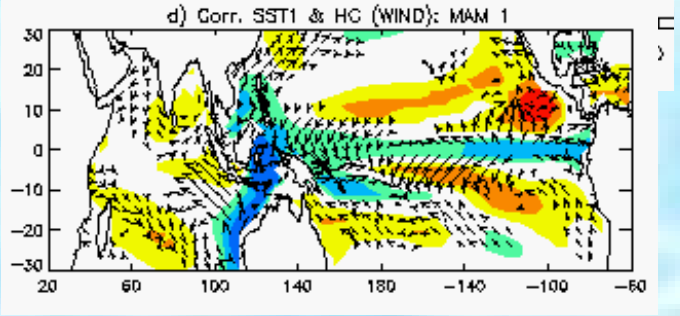












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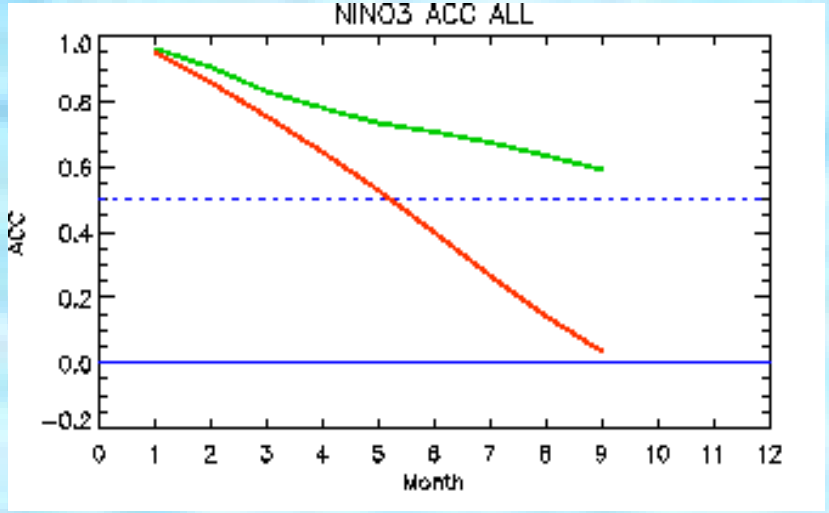
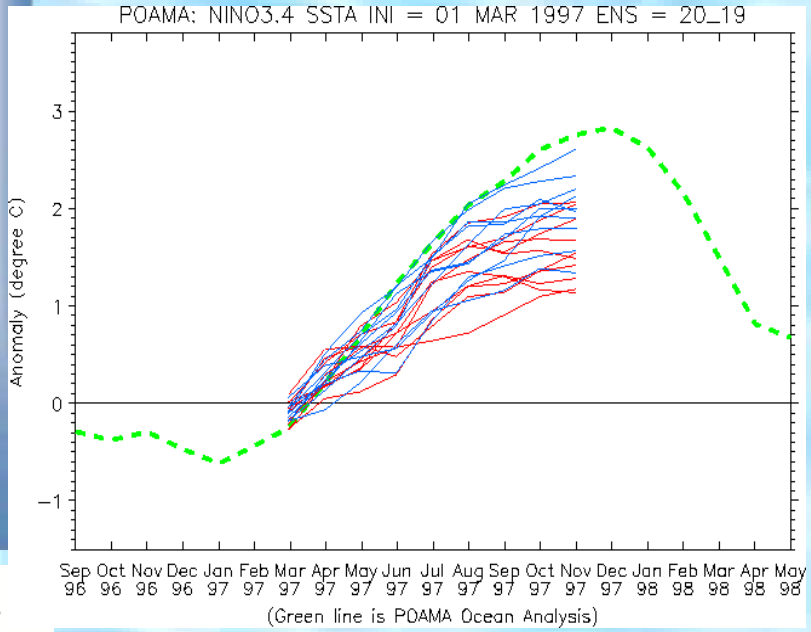


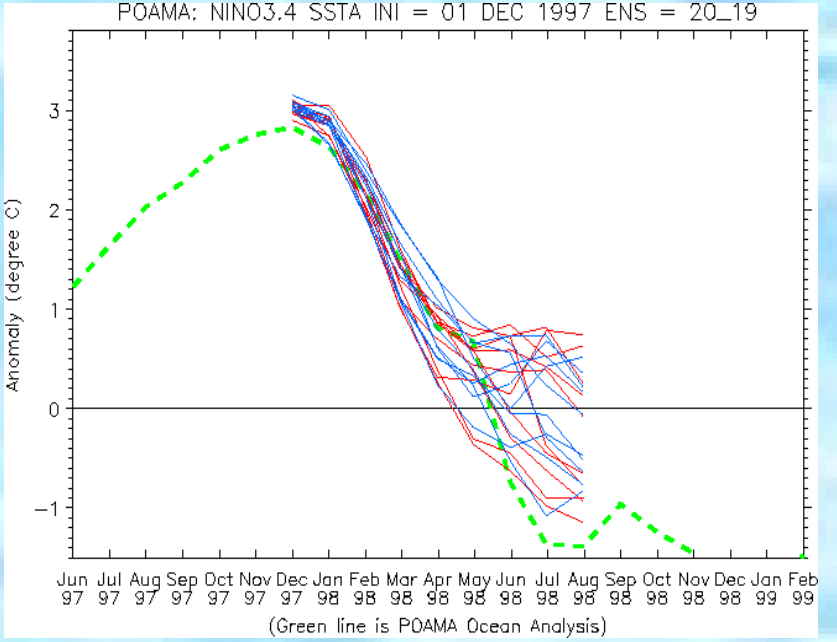
green: POAMA

red: persistence

Forecasts starting 1st Mar 1997



Forecasts starting 1st Dec 1997



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