

Current status and strategy of CGCM and ocean analysis system developments in Australia

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CAWCR (Centre for Australian Weather and Climate Research)

Australian Bureau of Meteorology



Plan

Introduction

Latest system POAMA-2

- Whats new
- Ocean assimilation
- Forecast skill SST, Rainfall, etc
- Intercomparison with other models (e.g. EC, UKMO)

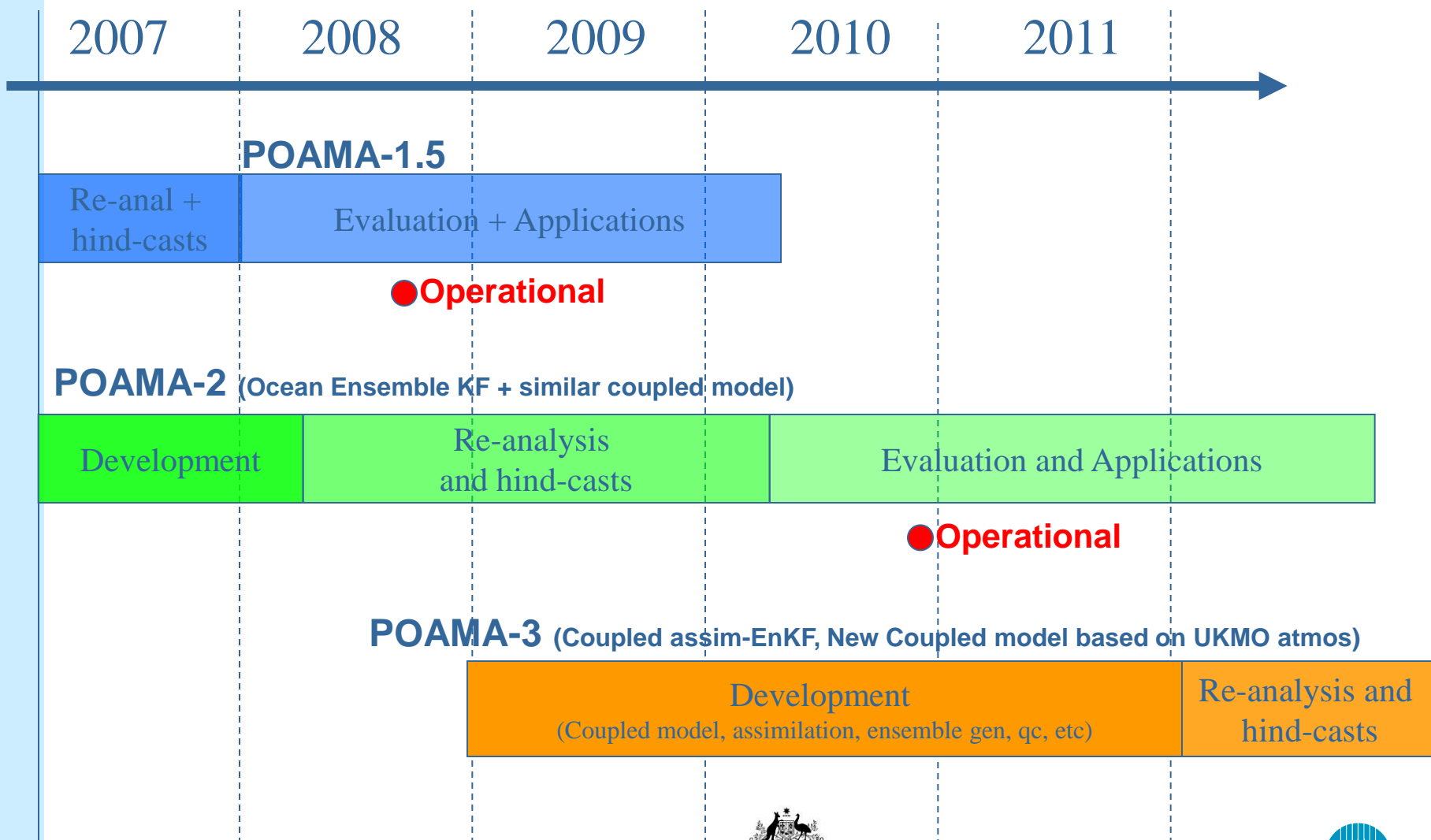
Multi-week prediction

Next system POAMA-3/ACCESS

Summary



Summary/Future



POAMA-2 - What's New

	POAMA-1.5	POAMA-2
Model	BAM-3 + ACOM2 (Dual shallow convection)	BAM-3 + ACOM2 –Pseudo Multi Model: A: standard B: with SST bias correction C: with dual shallow convection
Ocean Assimilation	Old Smith Optimum Interpolation Temperature Profiles	PEODAS – Pseudo EnKF Temperature + Salinity Profiles (Multivariate)
Atmos/Land Initialisation	ALI – nudging to ERA-40	Same
Ensemble Generation	Lagged atmospheric IC	Ocean pert from PEODAS EnKF



POAMA-2 - What's New 2

	POAMA-1.5	POAMA-2
Re-analysis (ALI & PEODAS)	1979-present NCEP forcing BMRC obs	1959-Present ERA-40 forcing UKMO ENACT obs
Hind-casts	1980 onwards 10-member per month	1960 onwards 30 member per month (3x10)
Real-time forecasts	30 member daily Lagged ensemble	30 member multi model on 1 st and 15 th of month (as hind-casts)
Ensemble Generation	Lagged atmospheric IC	Ocean pert from PEODAS EnKF (as hind-casts)

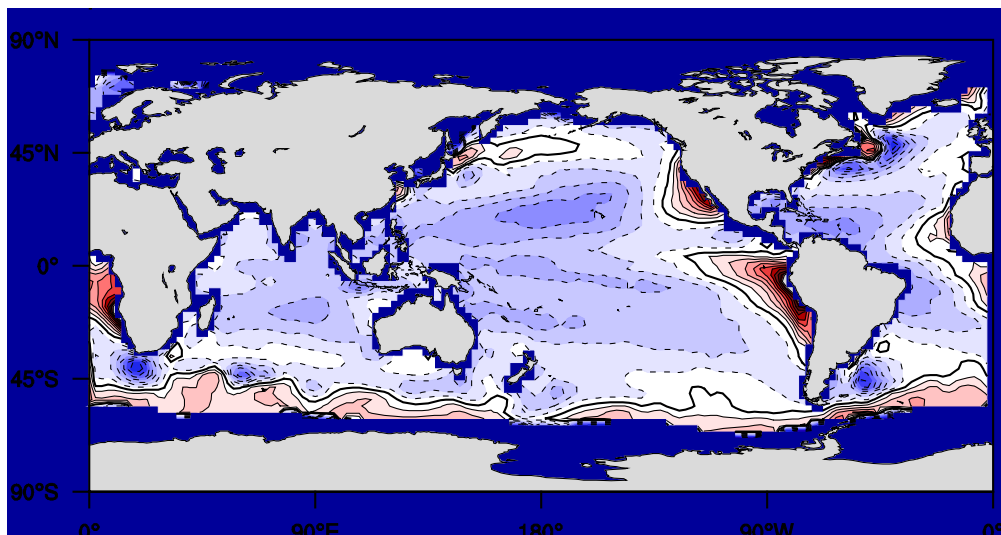


Why multi-model

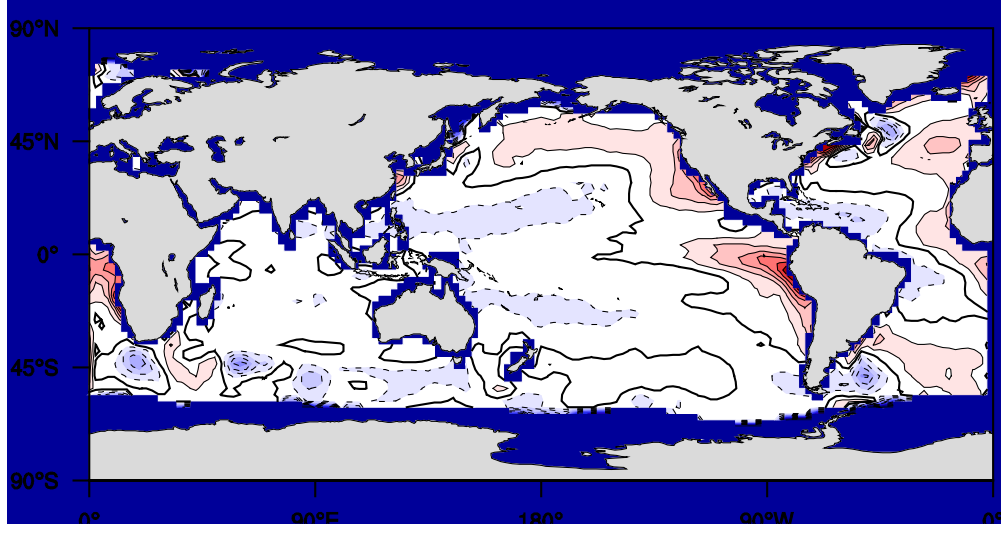
Example – impact of bias correction



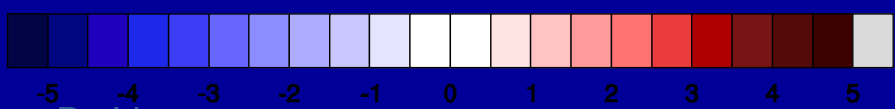
SST Bias at 4 month Lead



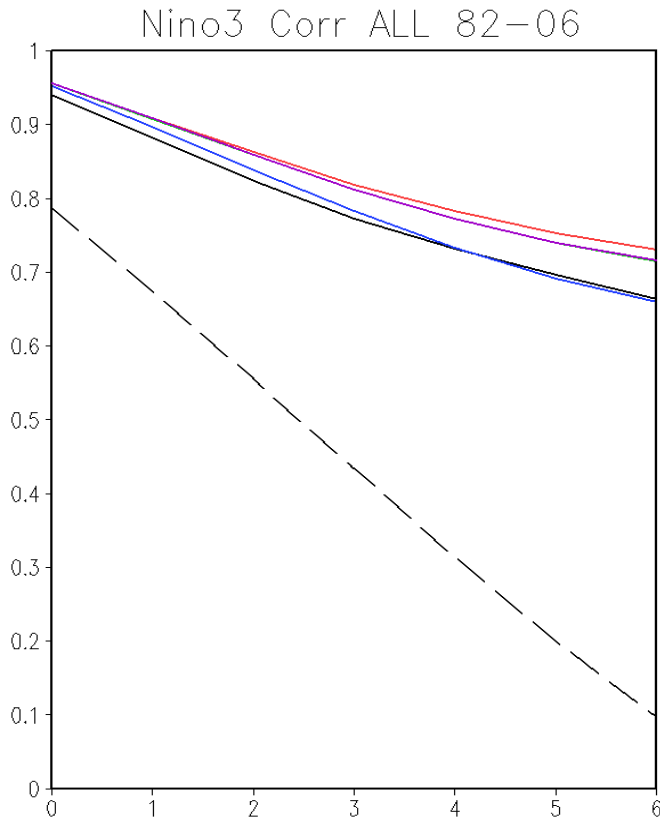
Non-bias corrected POAMA2



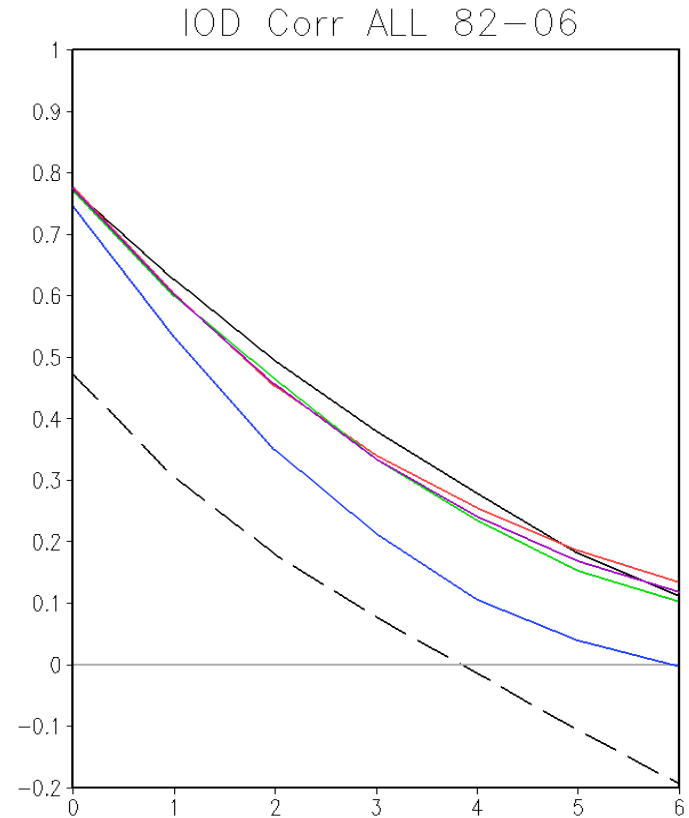
Bias corrected POAMA2



NINO-3 Anomaly Correlation



IOD Anomaly Correlation

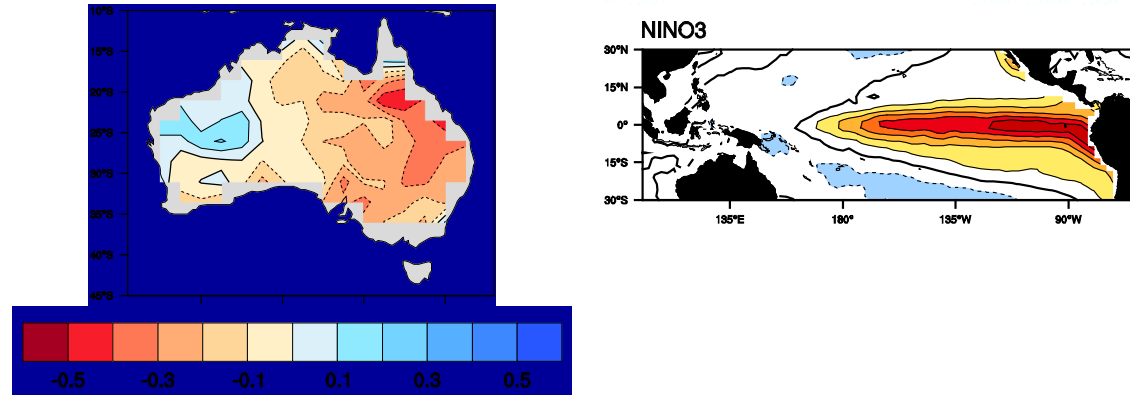


— Persistence
— P15b
— P24a
— P24b
— P24c
— Pmtmd

Bias corrected
Multi-model

a+b+c

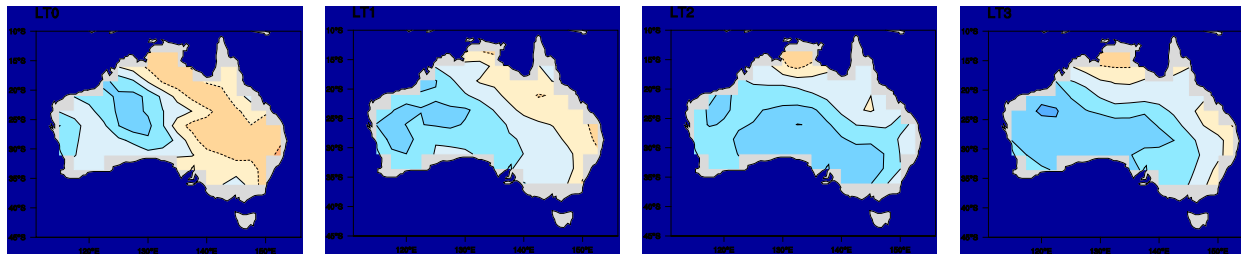
Obs JJA rainfall correlation with NINO3 index



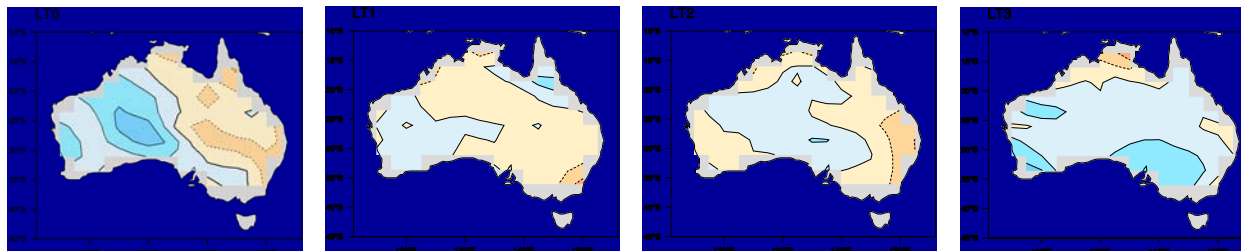
Wrong sign of the teleconnection intensifies as lead time increases



Non-bias corrected



Bias corrected

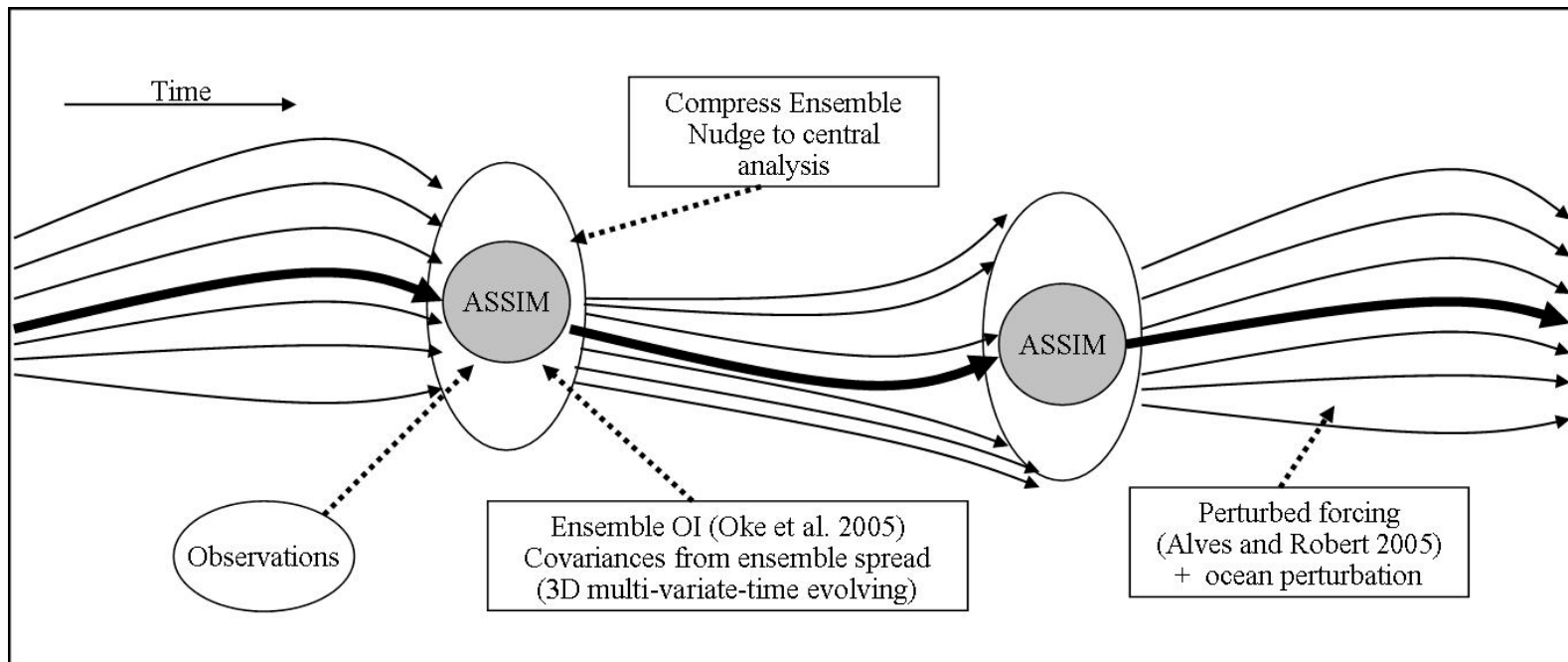


Ocean Assimilation

The new PEODAS Pseudo EnKF



PEODAS: POAMA Ensemble Ocean Data Assimilation System (Yin et al 2010)



Pseudo Ensemble Kalman Filter – (Based on extension of BLUElink system)

3D Multivariate ocean assimilation

Temperature and Salinity profiles

Re-analysis from 1960-present

Produces an ensemble of 11 states (pseudo breeding like NCEP)

Comparison with POAMA-1

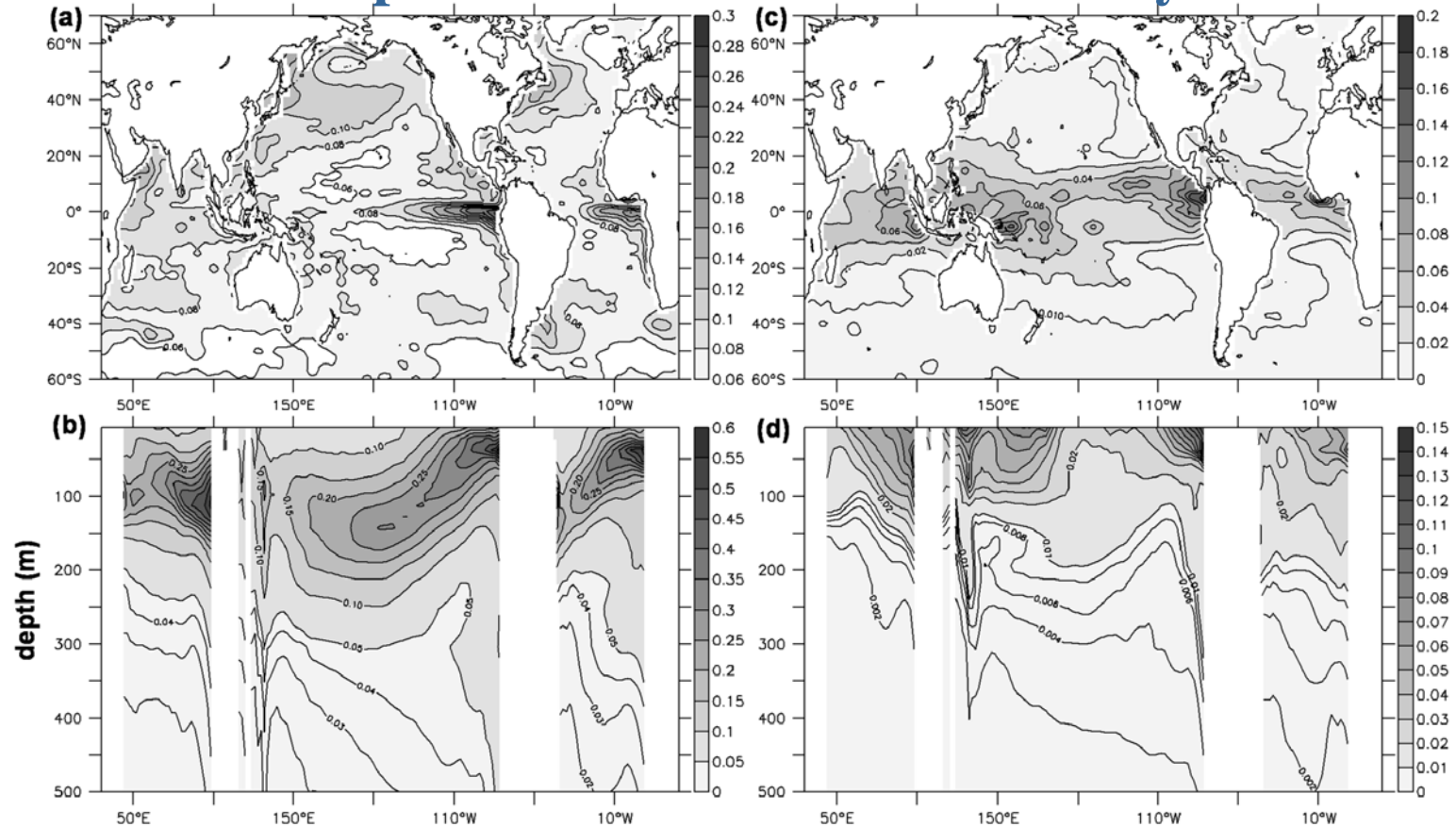
	POAMA-1	PEODAS
System	Optimum Interpolation	Pseudo EnKF
Covariances	2D Univariate Static	3D Multi-variate Time-evolving
Observations	Temperature profiles from BoM	Temperature and salinity profiles from EU ENACT
Forcing	NCEP Re-analysis	ERA-40 Re-analysis
Bias Correction	None	3D relaxation to Levitus
Re-analysis	1980-present	1960-present

Example Ensemble Spread

(Used as model perturbations)

Temperature

Salinity

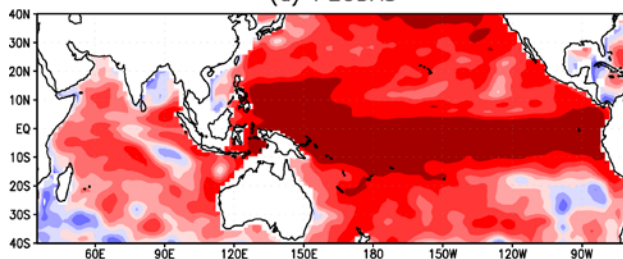


From Yin et al 2010

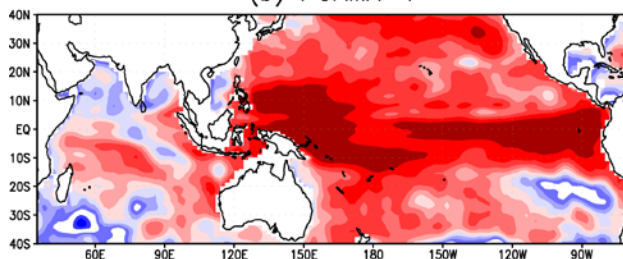
Correlation between re-analysis and UKMO EN3 dataset

Heat Content

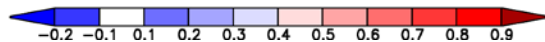
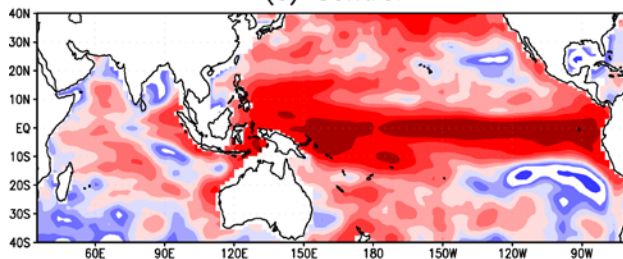
HC ACC between EN3 and
(a) PEODAS



(b) POAMA-1

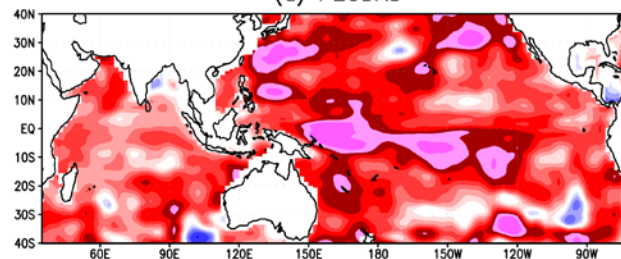


(c) Control

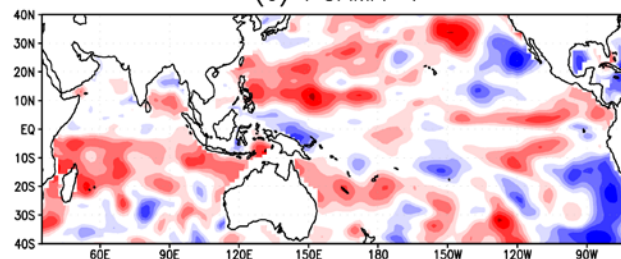


Salt Content

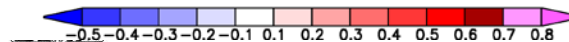
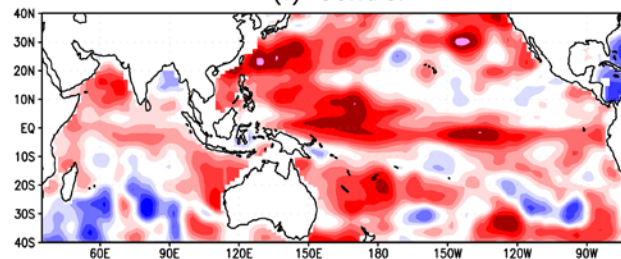
S300 ACC between EN3 and
(d) PEODAS



(e) POAMA-1



(f) Control

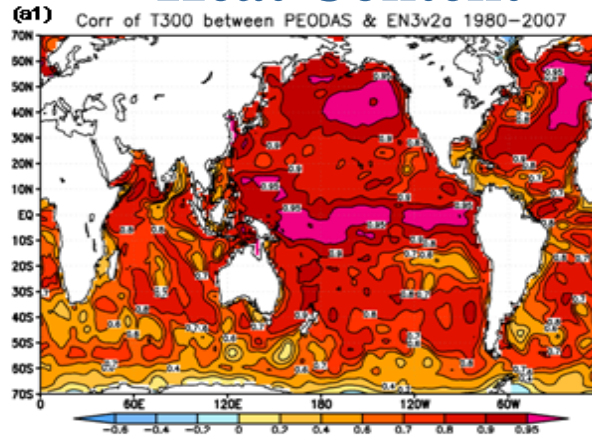


Comparison with Other Centres

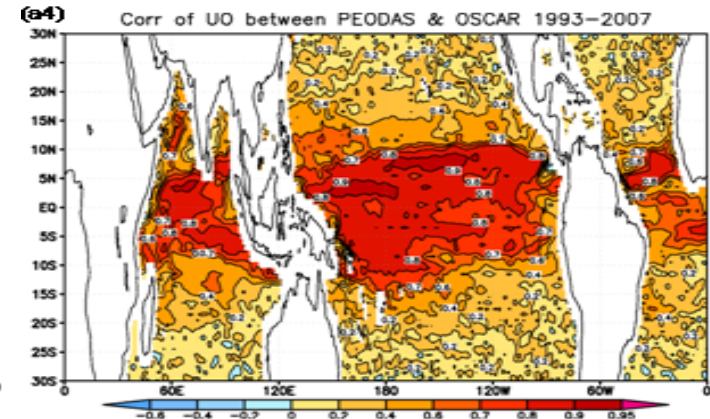
Correlation with “Observations”

PEODAS

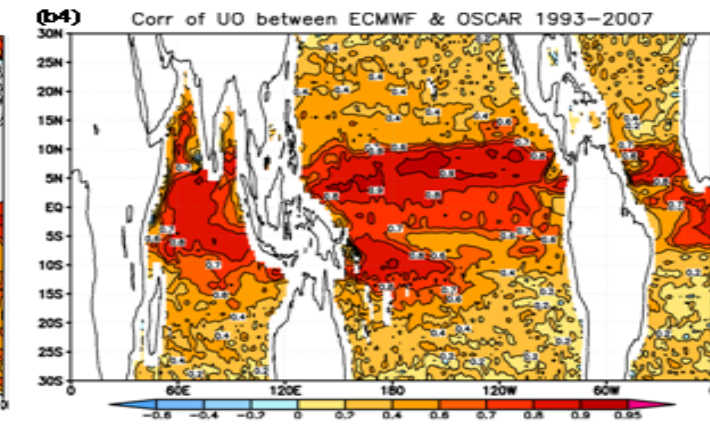
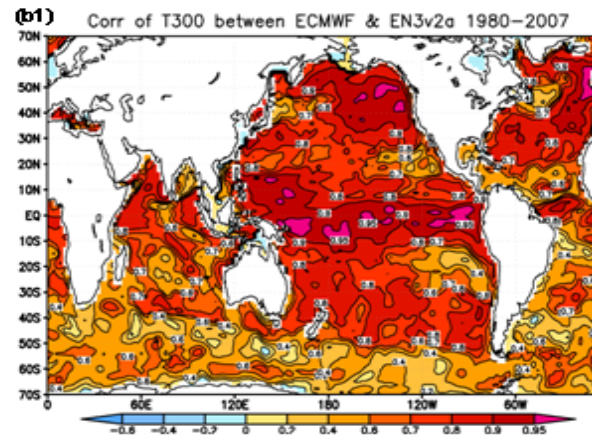
Heat Content



Surface Current



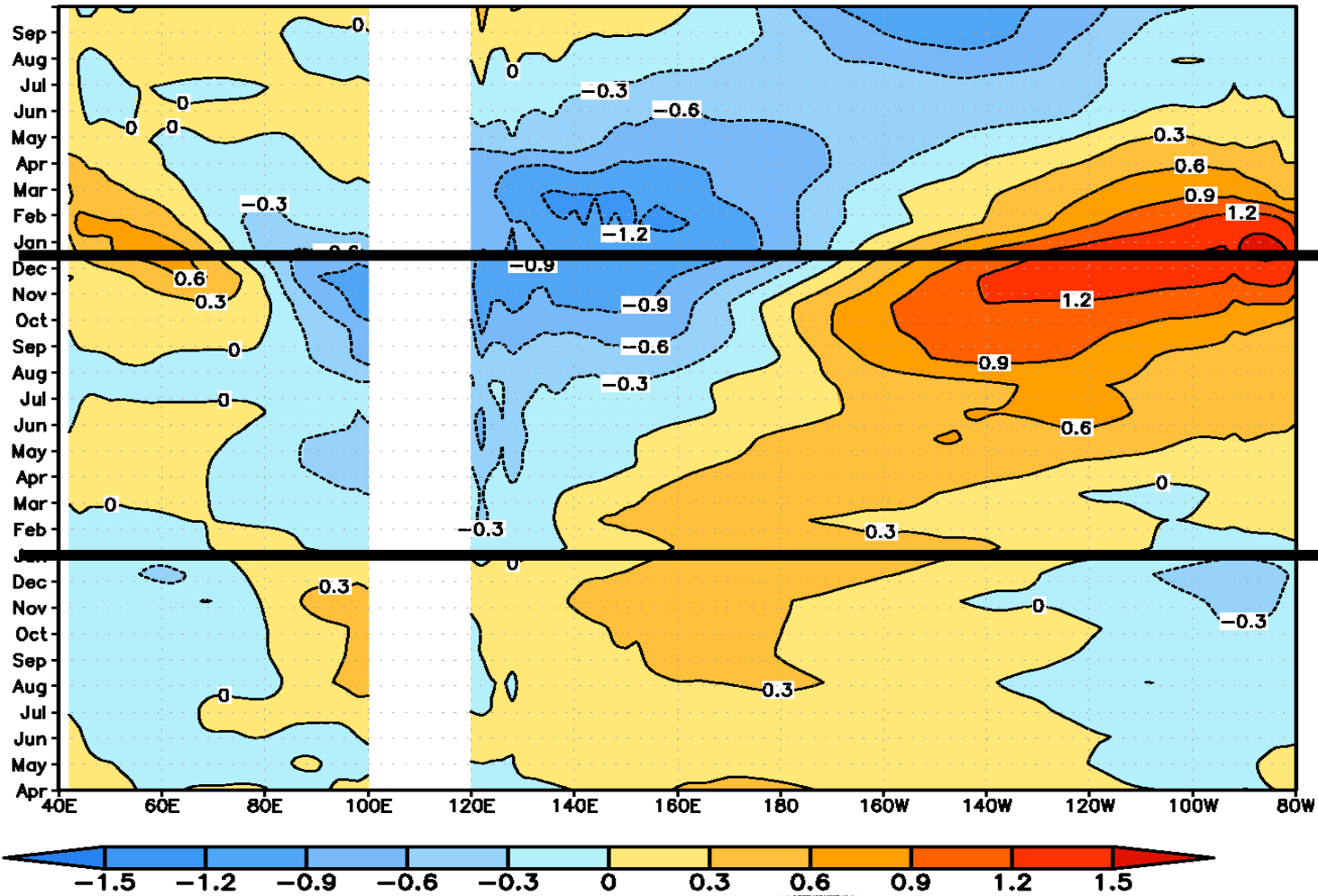
ECMWF



ENSO Composite

Heat Content

Composite T300 Anom (5S-5N) for El Niño PEODAS

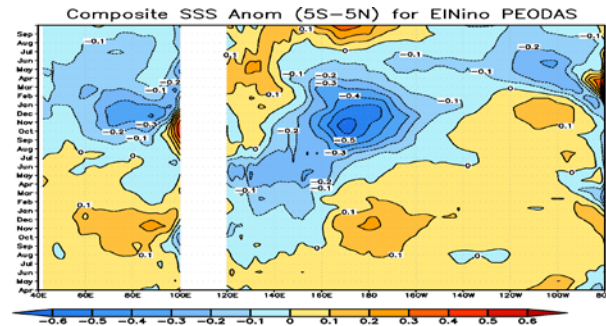
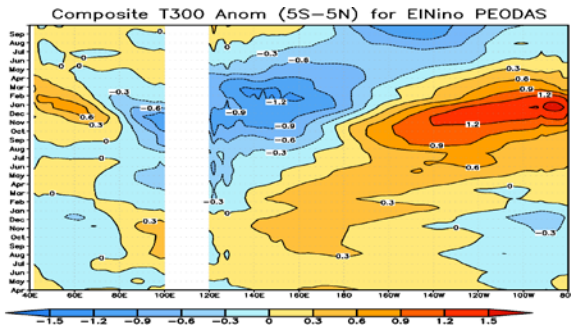


ENSO Composite

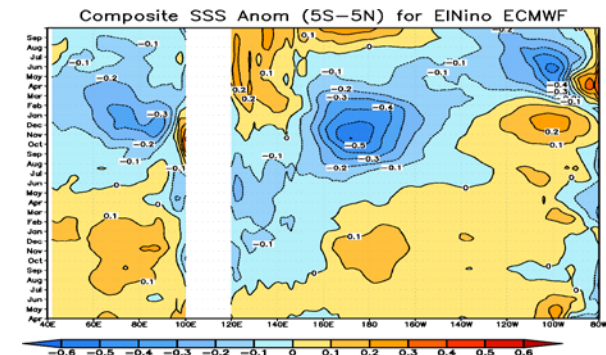
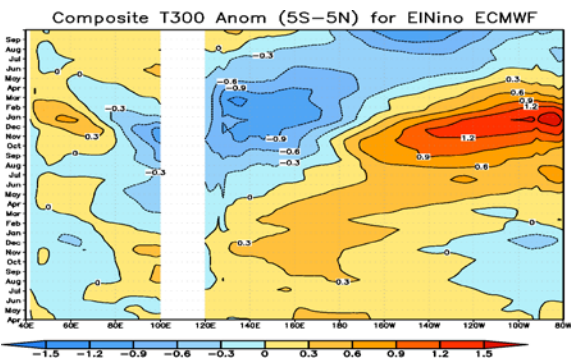
Heat Content

Surface Salinity

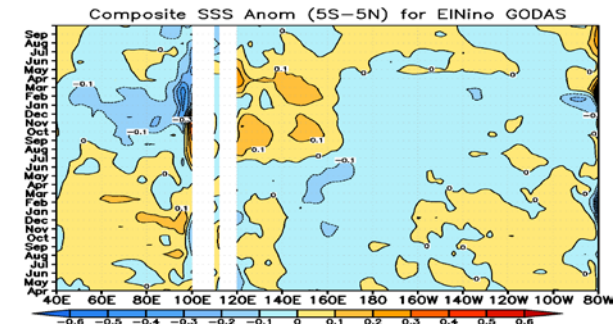
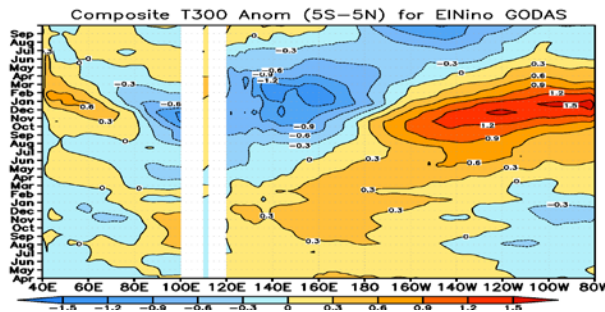
PEODAS



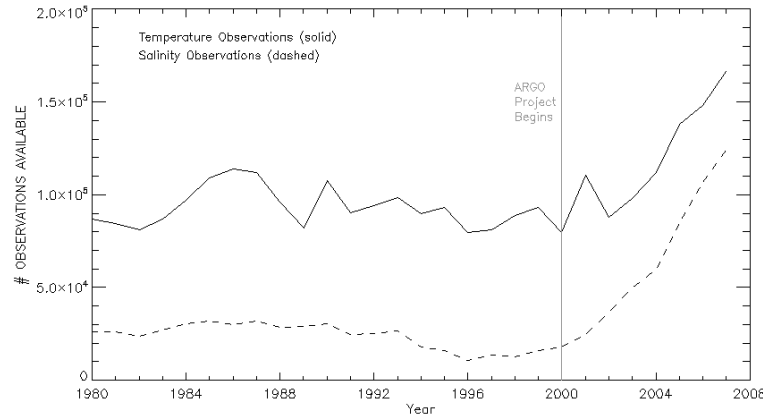
ECMWF



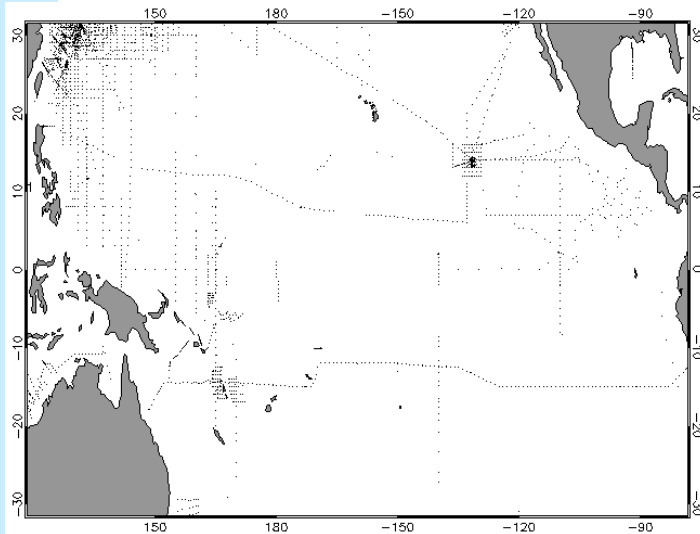
NCEP



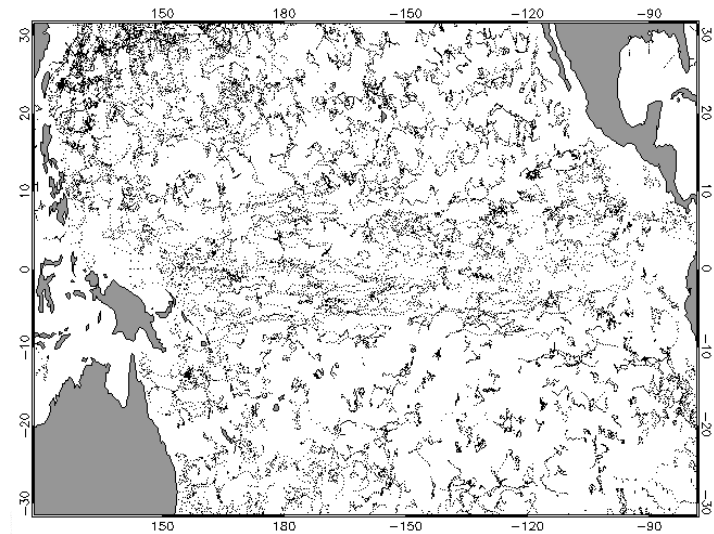
Observation distribution



Pre-Argo



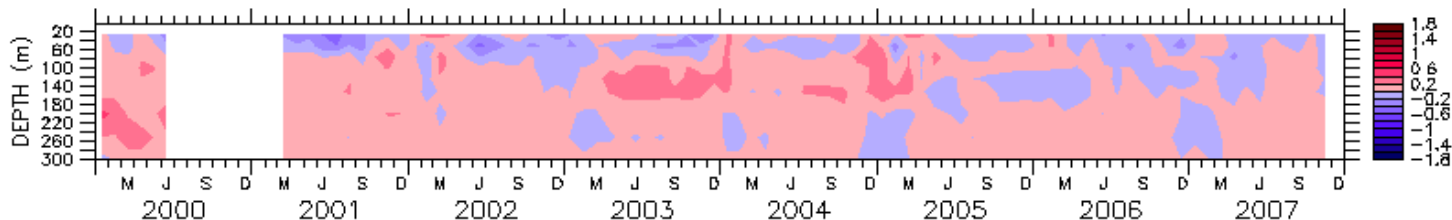
During-Argo



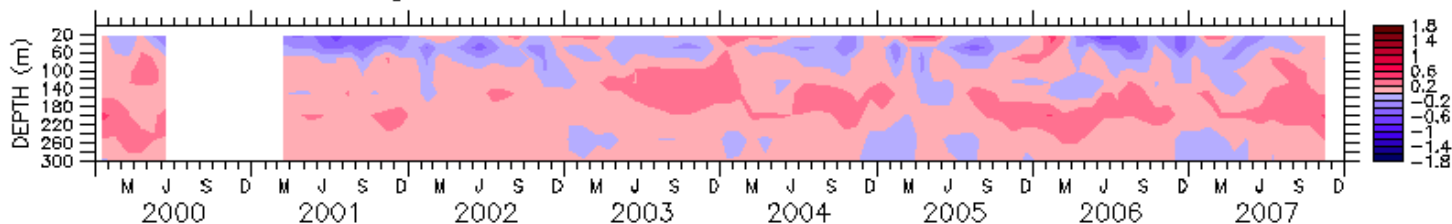
Produced by Yonghong Yin

Salinity pre-Argo: impact cross-covariances

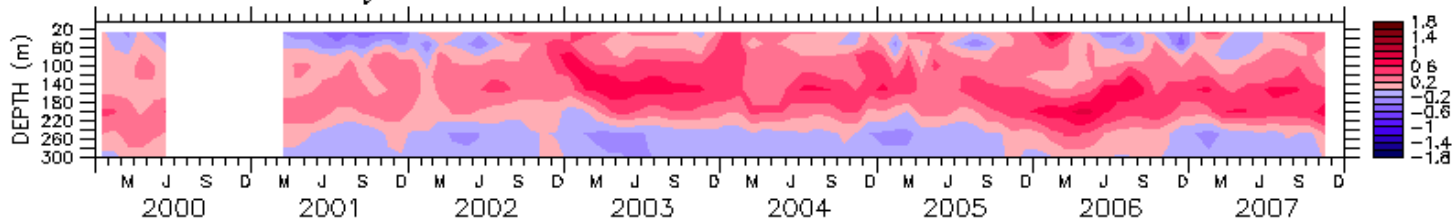
LONGITUDE : 156E
LATTITUDE : 5S



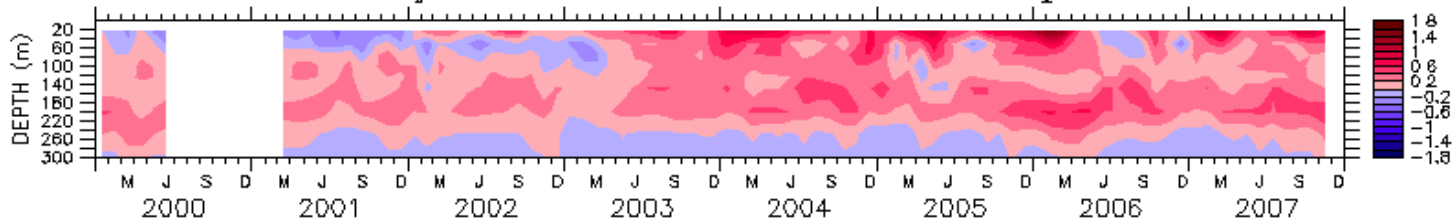
Salinity Difference: Obs minus Full Assimilation



Salinity Difference: Obs minus No Sal. Assimilation

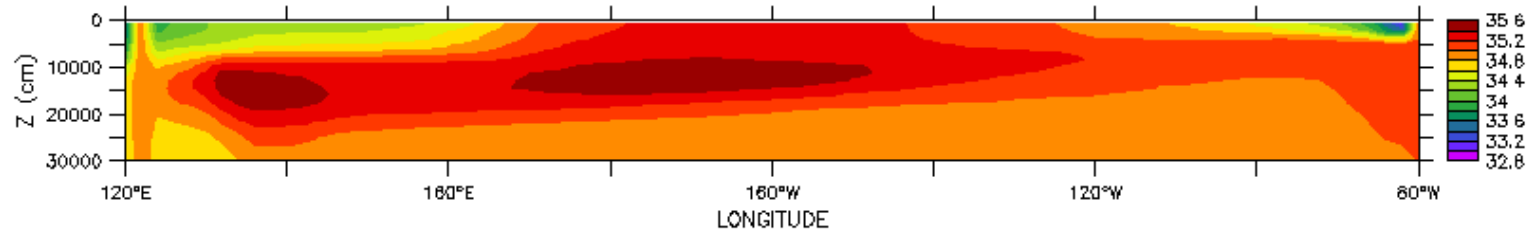


Salinity Difference: Obs minus No Sal Update

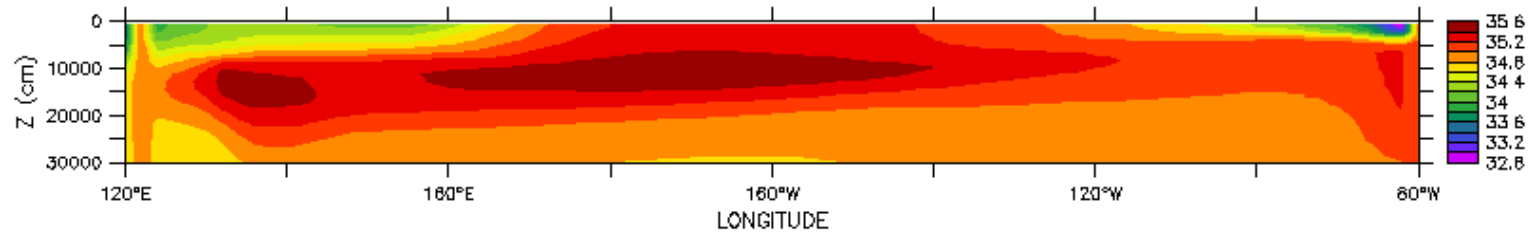


Salinity Difference: Obs minus No Assimilation

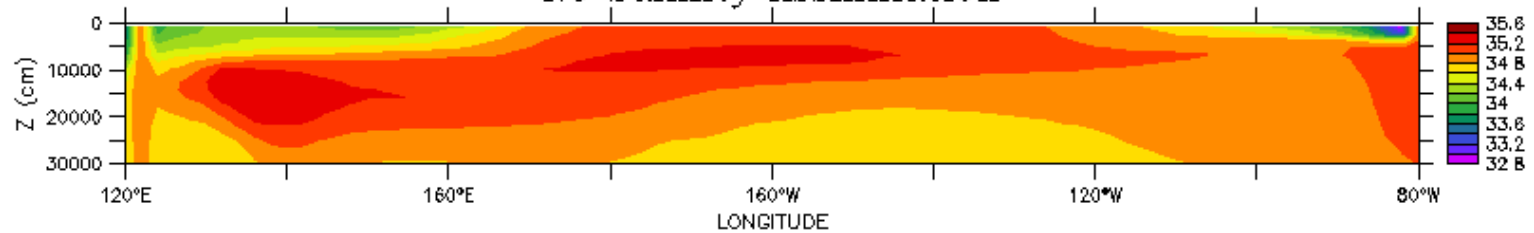
Salinity pre-Argo: impact on mean state



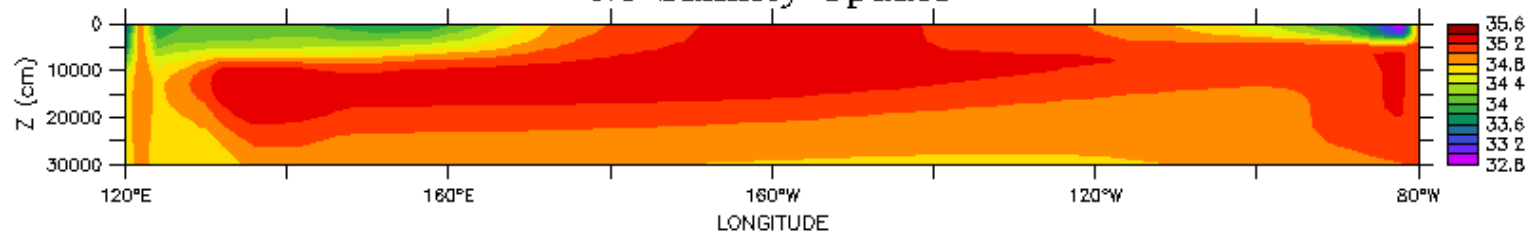
Full Assimilation



No Salinity Assimilation



No Salinity Update

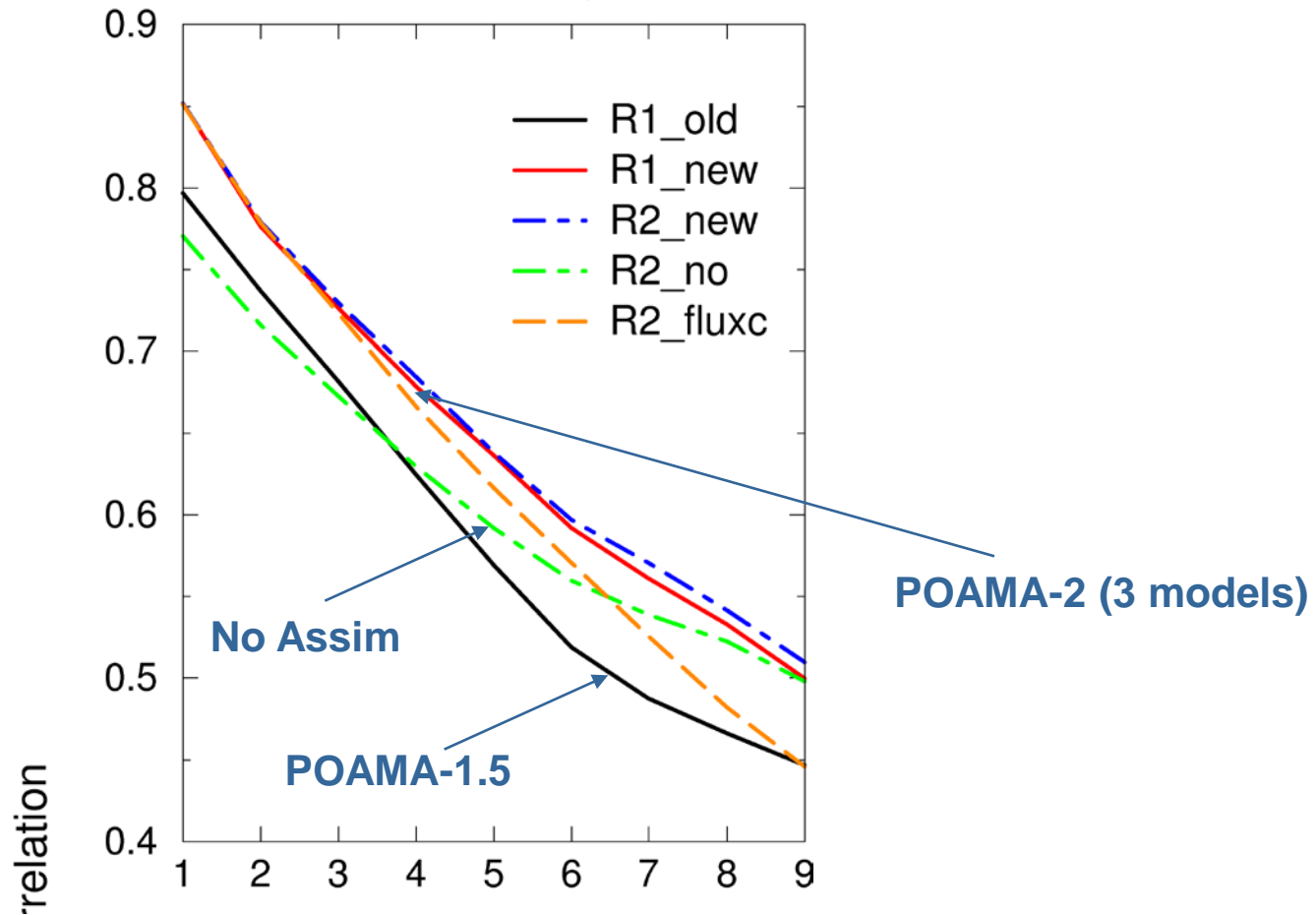


No Assimilation

Impact of Assimilation on Heat Skill

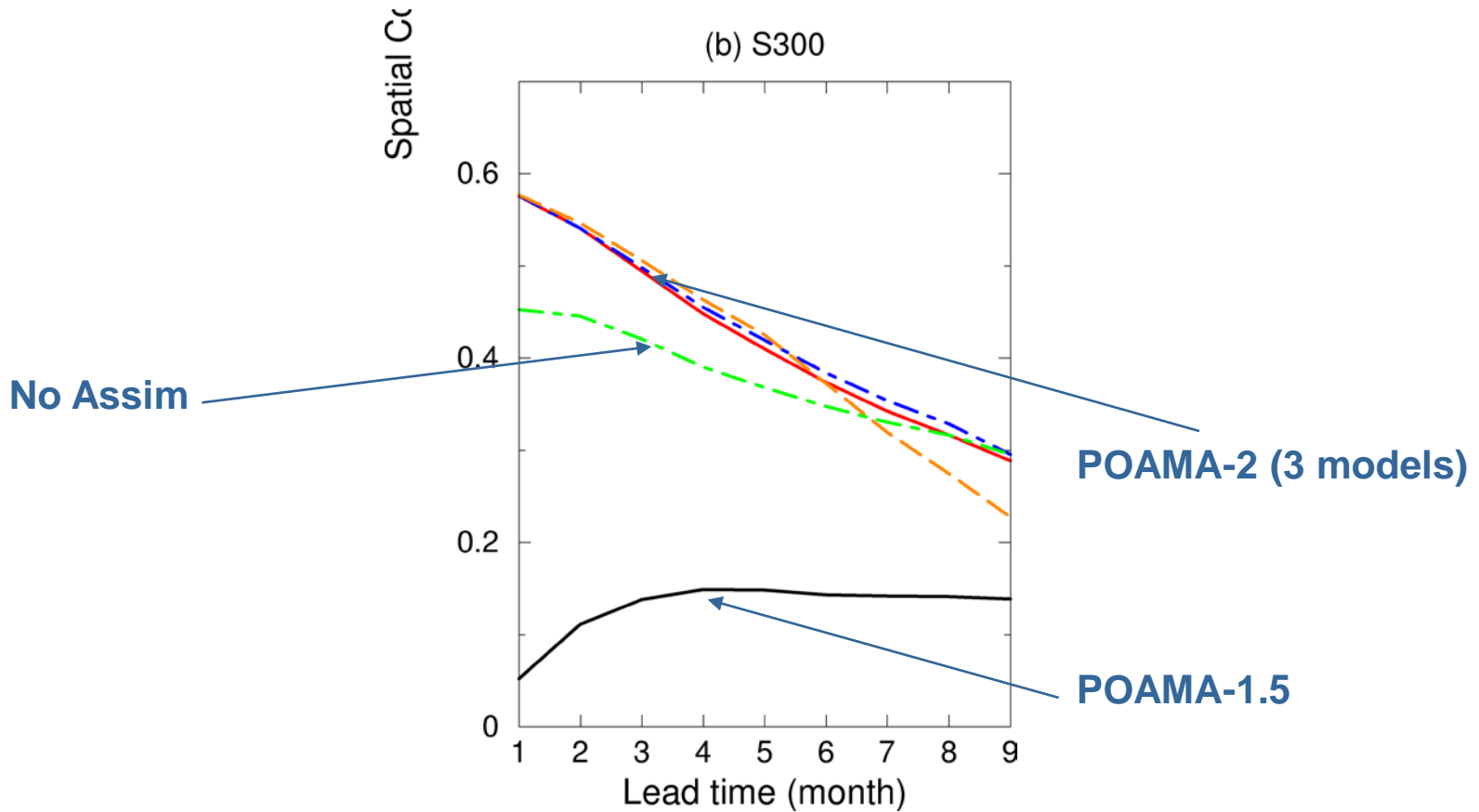
Correlation in Tropics

(a) HC, PO region



Impact of Assimilation on Salt Content Skill

Correlation in Tropics

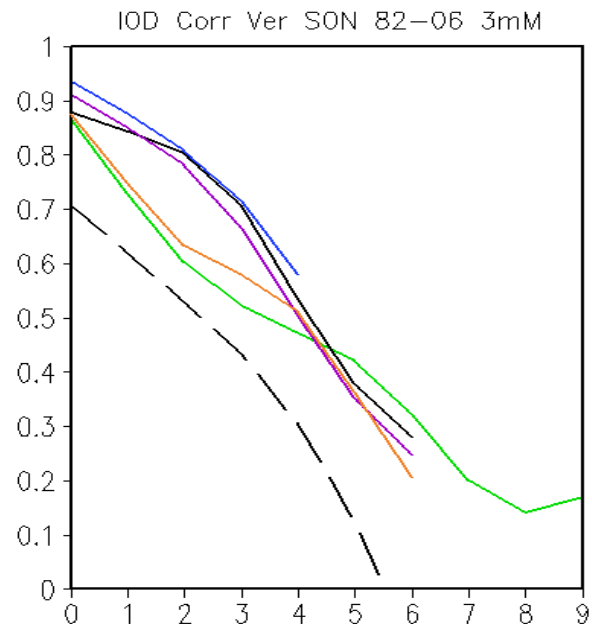
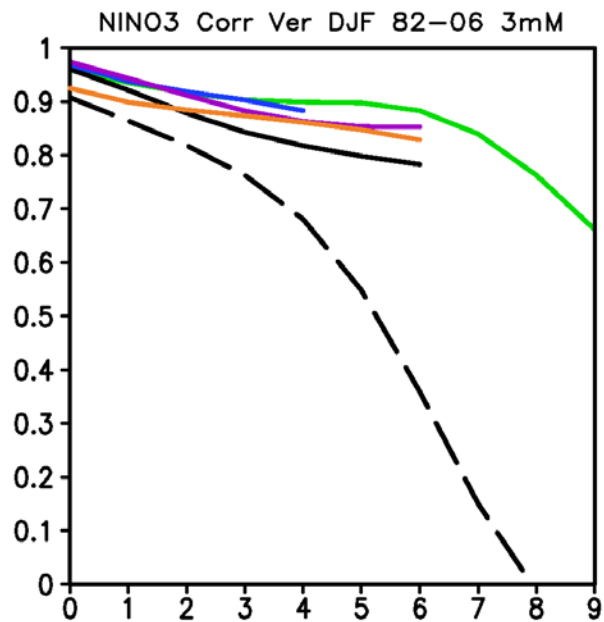


SST Skill

El Nino and IOD

(& Comparison with other models)

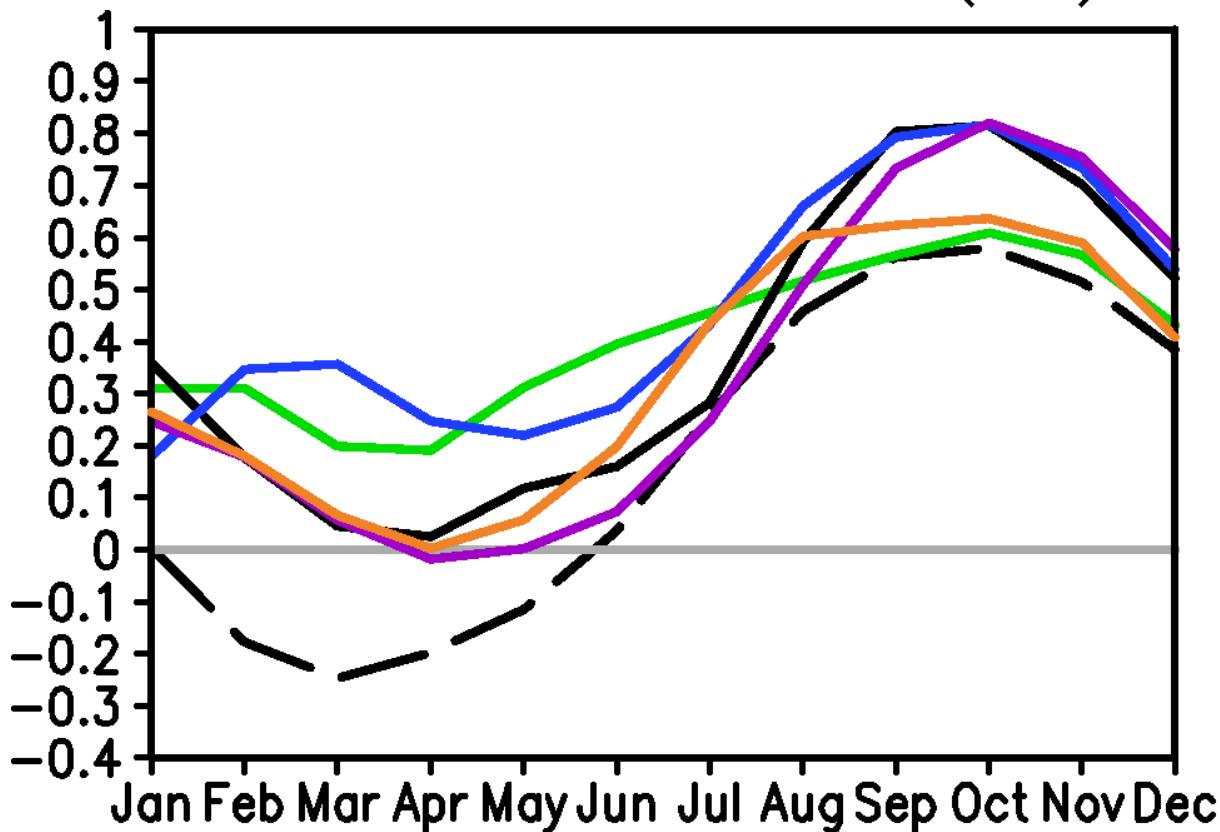
Mostly Based on hind-casts from ~1982-
2006



— SINTEX
 — P15b
 — ECMWF
 — PMTMD
 — NCEP
 - - - Persistence

IOD Skill at 2 Month Lead

IOD Corr all verf mon 82-06 LT=2 (3mM)



— SINTEX
 — P15b
 — ECMWF
 — PMTMD
 — NCEP
 - - Persistence

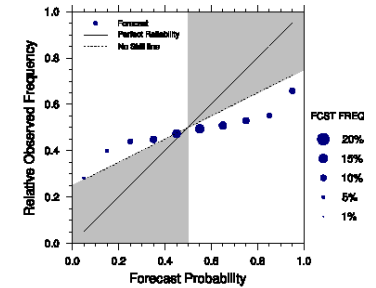
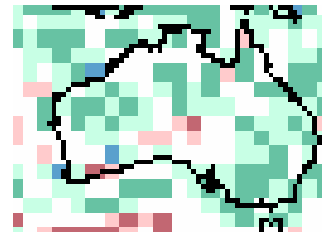
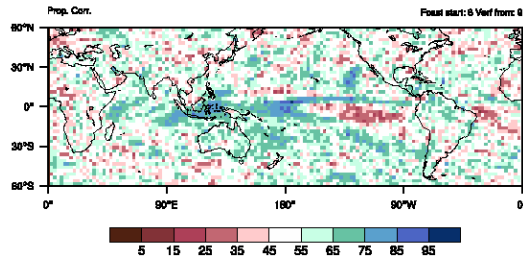
Rainfall Skill



SON Skill lead 1

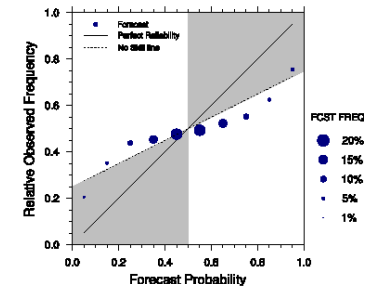
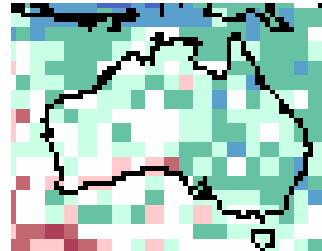
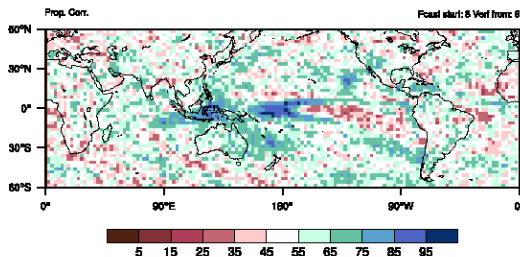
POAMA-1.5

poama1.5b at LT1



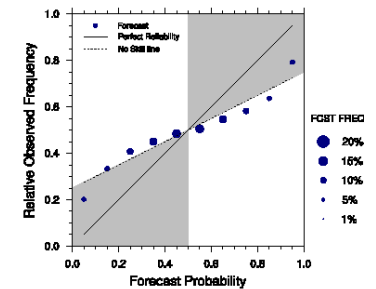
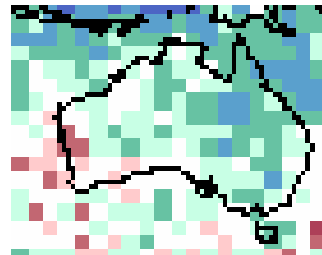
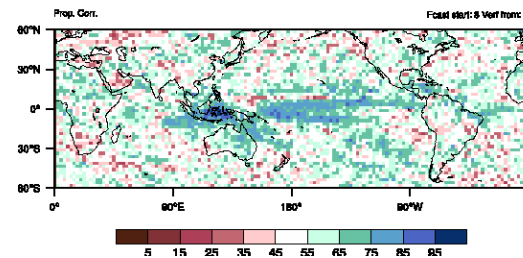
**POAMA-2
MME**

POAMA2 MME at LT1



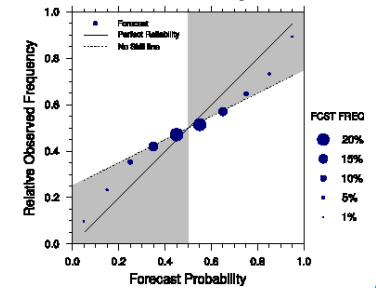
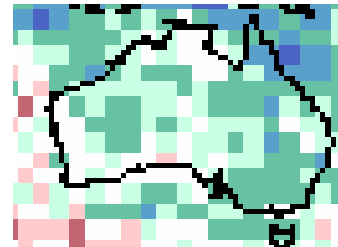
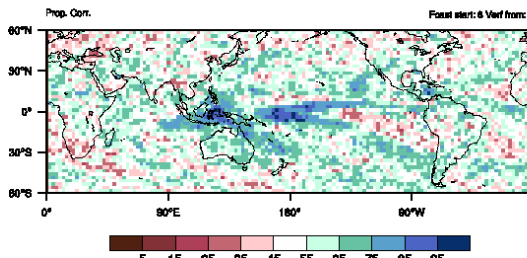
ECMWF

IFS at LT1

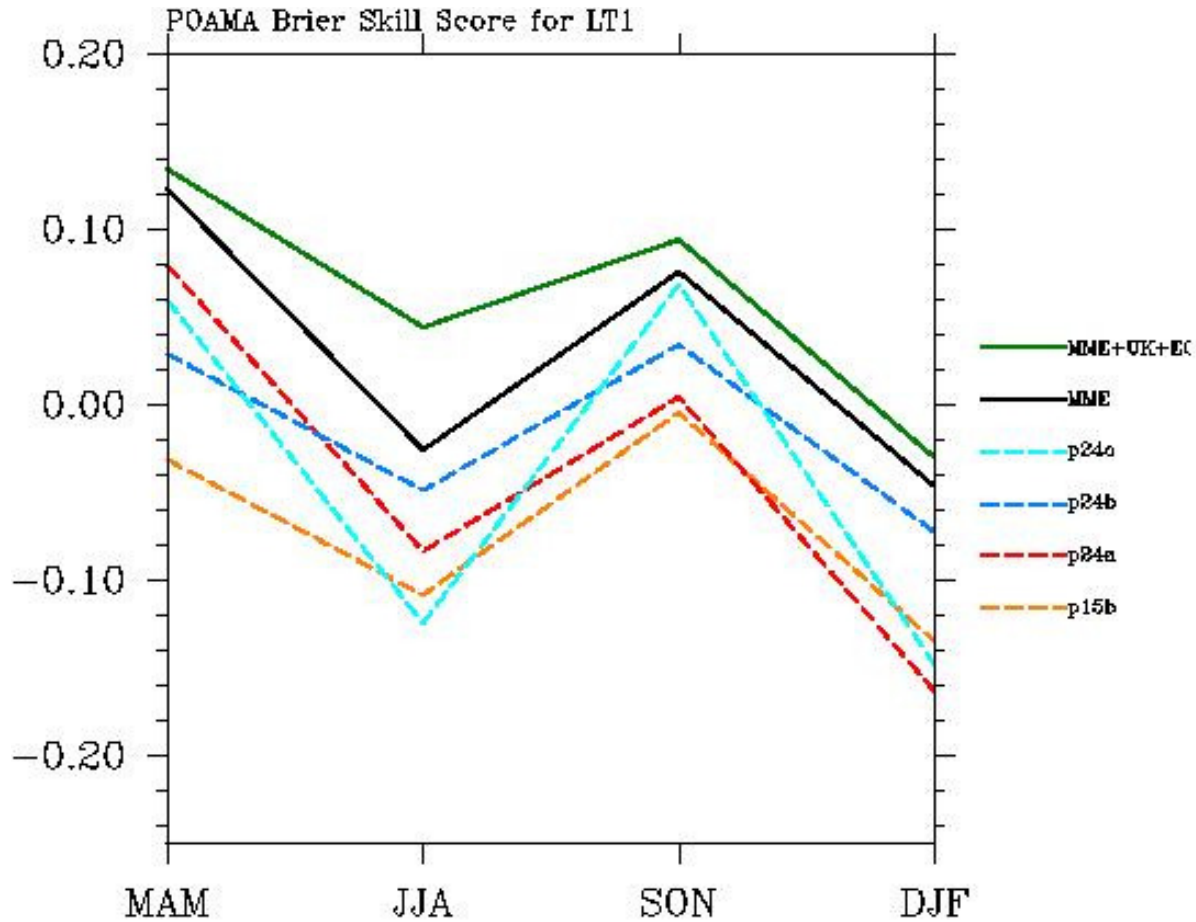


**POAMA-2
+EC+UKMO**

POAMA2 MME + IFS + HadGEM2 at LT1

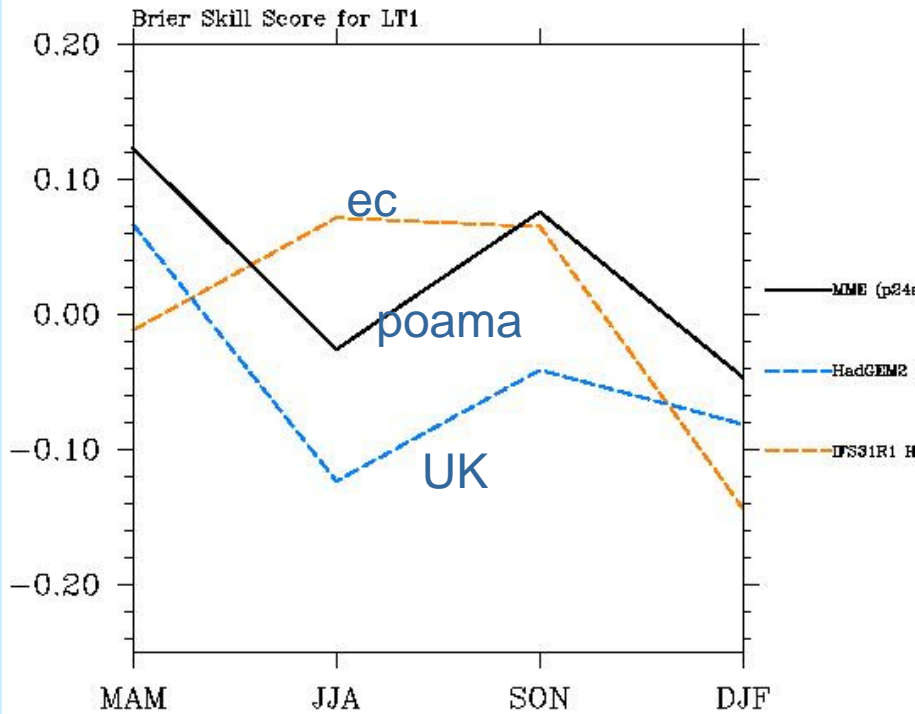


Brier Skill Score for SE (lead 1 month)

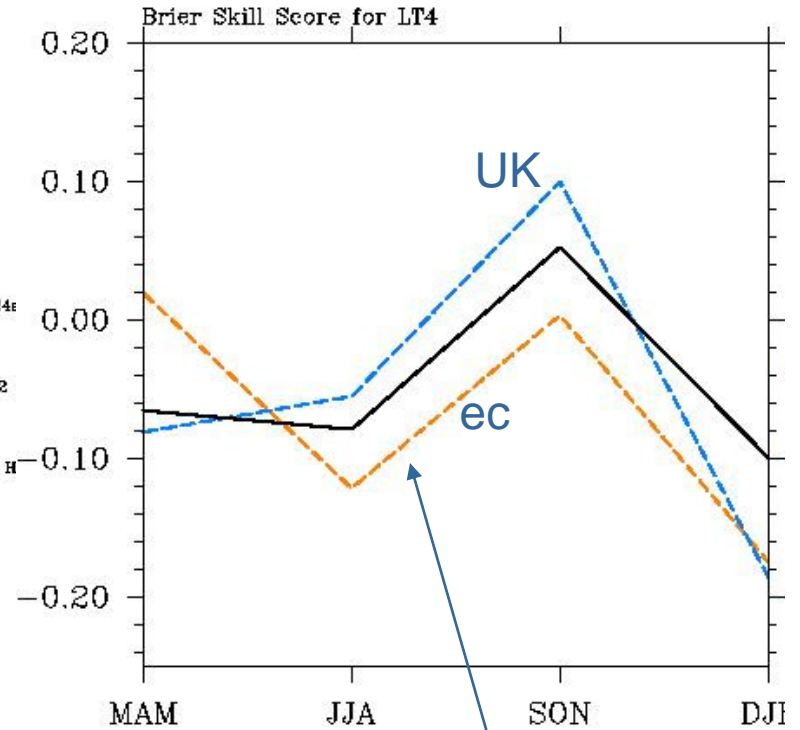


Brier Skill Score for SE

Lead 1 month



Lead 4 month



EC teleconnections not so good



POAMA-2 Multi-Week

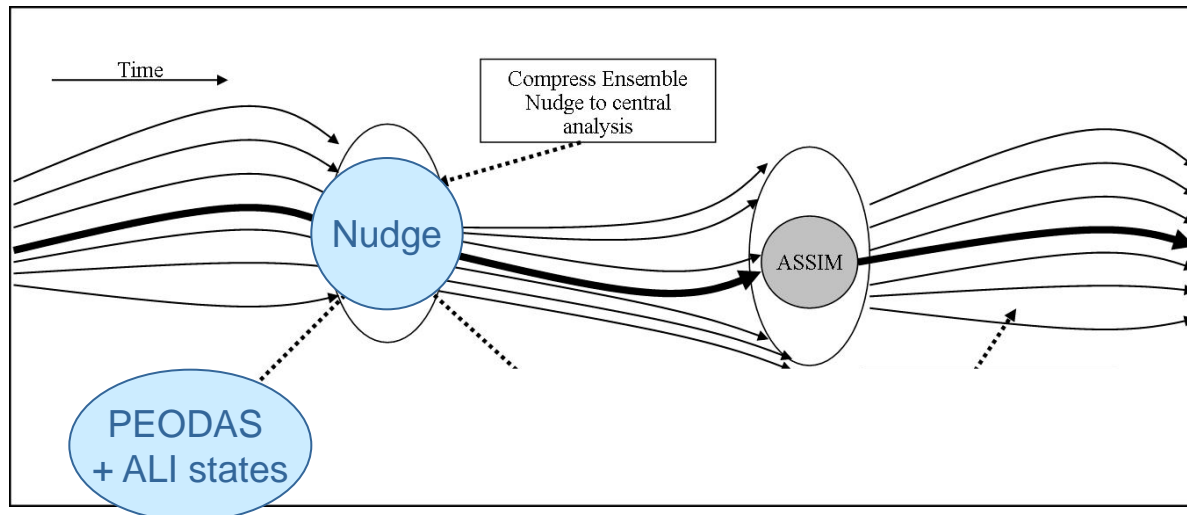
Need – generate atmospheric perturbed initial conditions

Coupled breeding scheme about POAMA-2 Initial Conditions

30-member forecast every Sunday using POAMA-2 model

Operational first half of 2011

Coupled breeding – using coupled model



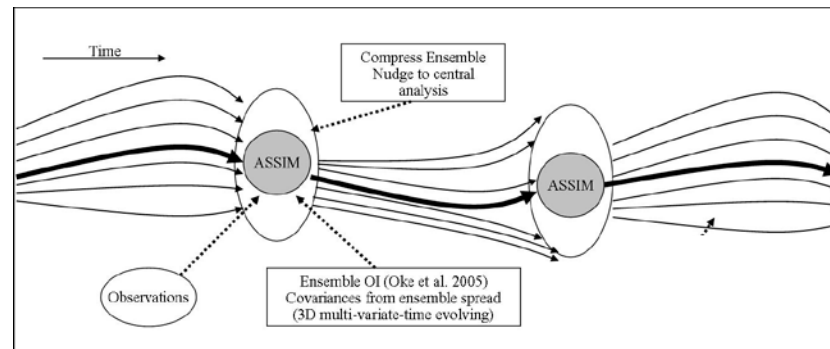
POAMA-3/ACCESS

Model Features

- Based on the New ACCESS coupled model (UKMO UM + MOM4 + CICE+CABLE)
- Resolution tbd between N96 and N144, L~38-80, depending on supercomputing
- Preliminary version in 2011 with limited hind-casts (N96L38, not CABLE, not tuned, simple initialisation e.g. SST nudging)
- Challenge – improve model simulation (physics)

Initialisation Features

- Full coupled initialisation (coupled PEODAS) with cross-covariances and implicit breeding
- Progress through a series of incremental stages starting with coupled SST nudging in 2011
- First system will be for multi-week (cheaper)



Summary

- POAMA-2 Based on Pseudo-multi model
- New real-time strategy – 30 members on 1st and 15th of month
- Assimilation significant improvement - PEODAS
- Modest improvement in skill and reliability (more complete evaluation to be done)
- Internationally competitive – (especially due to assimilation system)
- Potentially modest improvement in skill from incorporating EC & UK models into multi model ensemble
- Intercomparison with other models suggest all models have issues – potential for significant skill enhancement through model improvement
- Dedicated multi-week component first half of 2011
- Focus now on dev. of POAMA-3 based on ACCESS/UKMO UM & Coupled EnKF

