Australian Government
Bureau of Meteorology

The Centre for Australian Weather and Climate Research
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Ensemble data assimilation/initialisation for intra seasonal to seasonal prediction using POAMA at the Bureau of Meteorology

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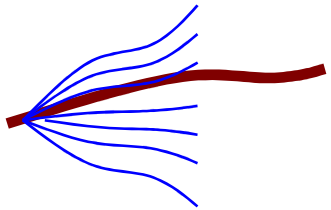
Outline

1. POAMA
2. Summary of ensemble data assimilation/initialisation scheme in POAMA
3. Characteristics of the system
4. Evaluation of the ocean component
5. Impact on forecasts
6. Summary

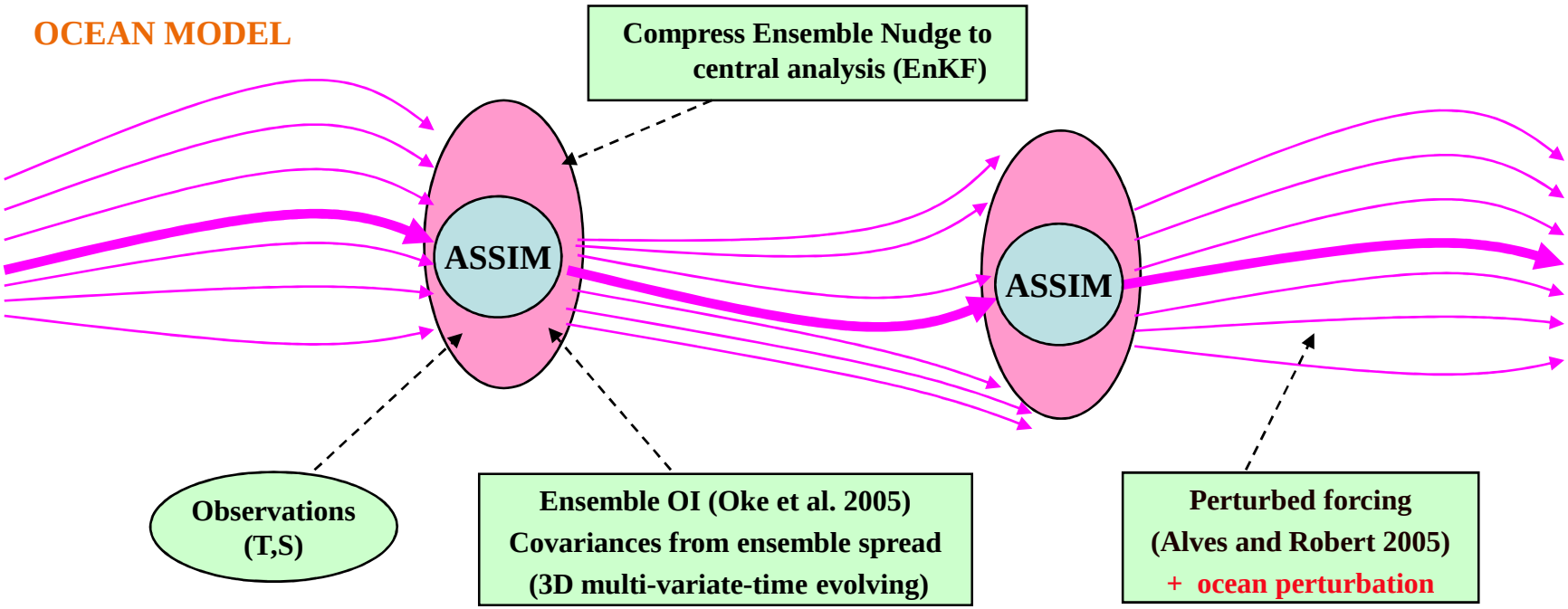
POAMA: Predictive Ocean Atmosphere Model for Australia

The Bureau's Dynamical Seasonal Ensemble Prediction System: global coupled ocean-atmosphere model and data assimilation schemes for ocean, land and atmosphere. (http://poama.bom.gov.au/)

	POAMA-2 (Seasonal)	POAMA-2 (Intraseasonal)
Atmosphere data assimilation	**ALI** (Atmosphere Land Initialisation Scheme, Hudon et al, Clim Dyn 2011). Nudge to existing analyses	**ALI**
Ocean data assimilation	**PEODAS** (Multivariate pseudo-Ensemble Kalman Filter, Yin et al MWR 2011)	**PEODAS**
Ensemble generation 	30 members Ocean perturbations from PEODAS; **no atmosphere perturbations at the initial time**	33 members **Ocean and atmosphere perturbations from Coupled Ensemble Initialisation (CEI) Scheme**

POAMA-2 Ocean Data Assimilation

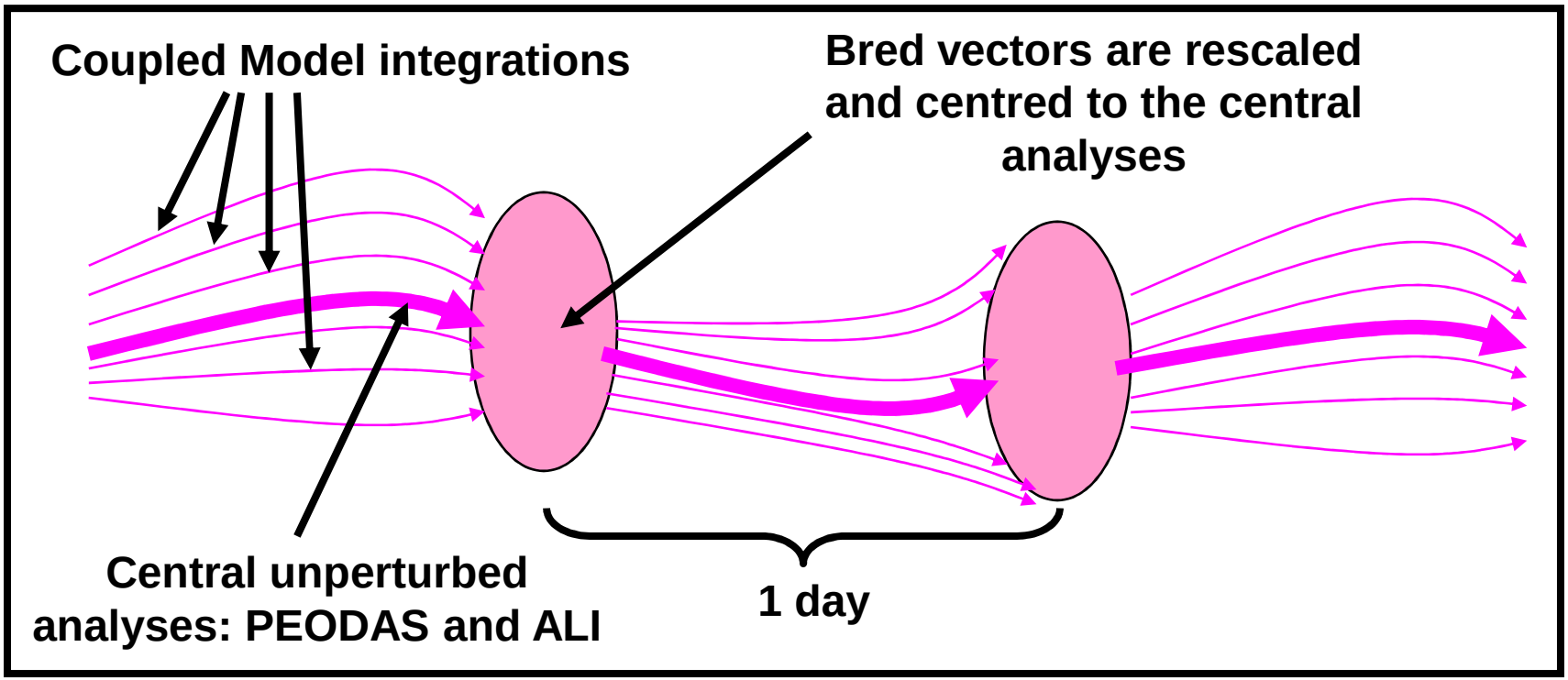
PEODAS: POAMA Ensemble Ocean Data Assimilation System (Yin et al, MWR 2011)



- An approximate form of the EnKF so as to be efficient for operational implementation by **Keeping model/obs error ratio being constant**. Flow-dependent, localisation, and additive inflation
- Provides an ensemble of initial ocean states for POAMA-2 (seas) and unperturbed central analysis for CEI.

CEI: Coupled Ensemble Initialisation Scheme

designed to initialise the POAMA-2 (intraseas)

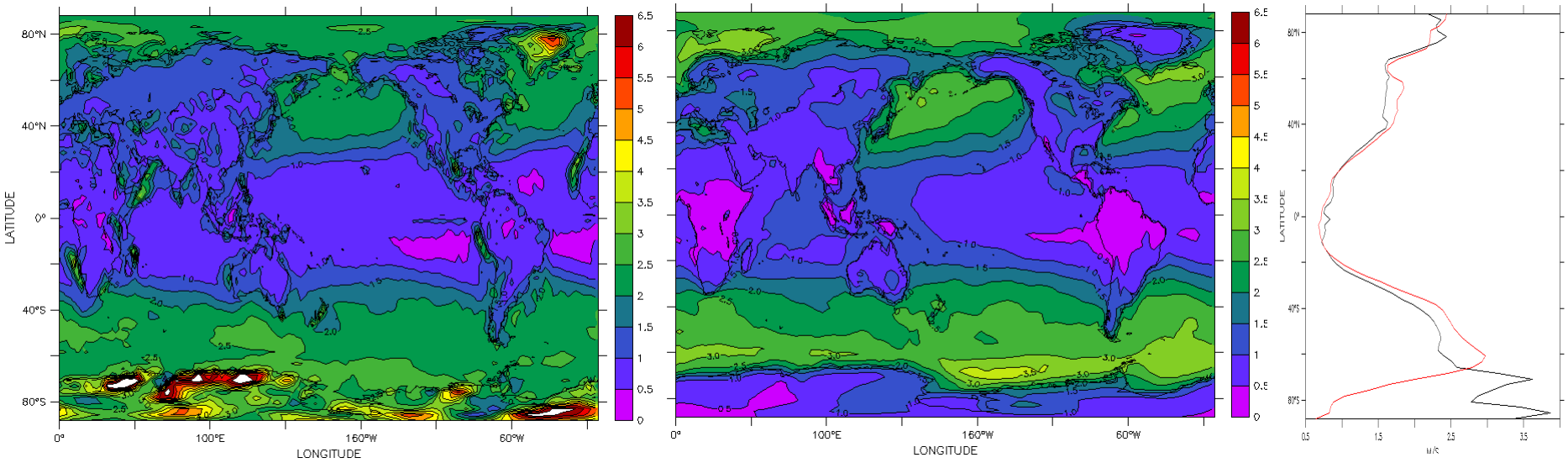


Generates coupled bred perturbations of both the atmosphere and ocean based on the breeding method in such a way that the perturbations represent the uncertainty of the analyses. Rescaling mask using zonal mean U10 for atmosphere and 3D T for ocean.

Estimated U10 analysis error

U10 ensemble spread

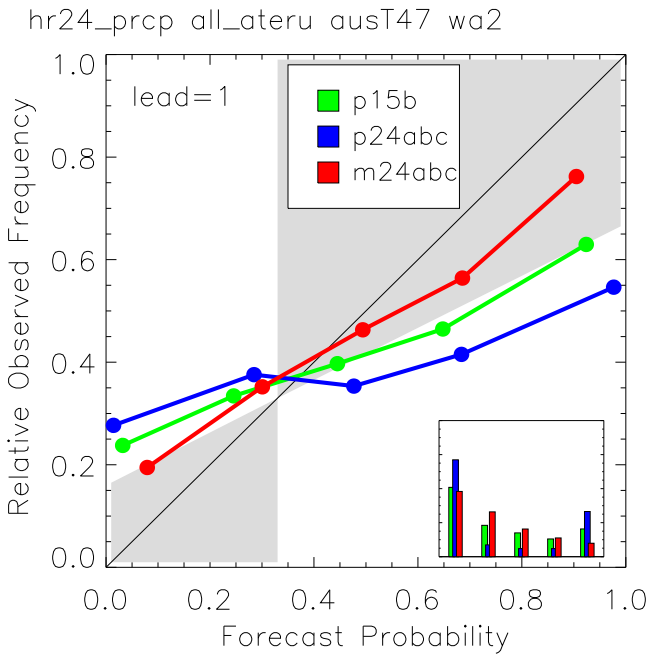
Zonal mean

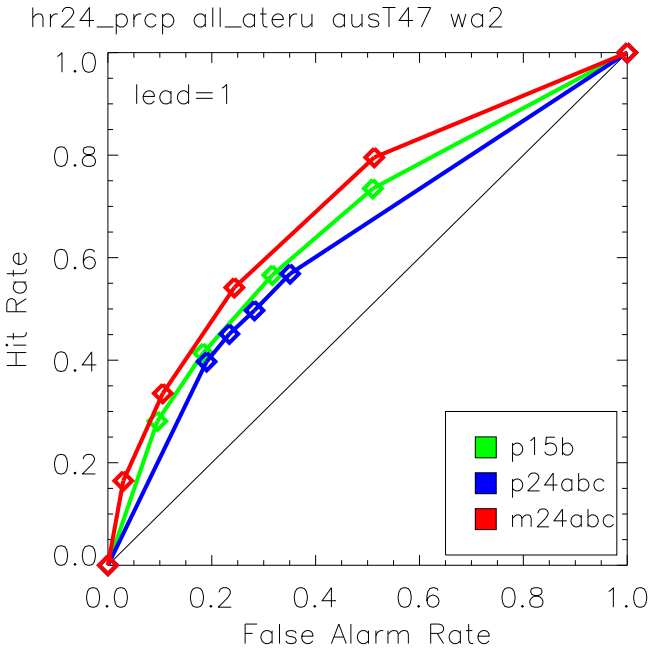


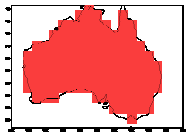
Estimated analysis error of 10 m zonal wind (m/s) from ALI, annual mean of ensemble spread from the CEI system, and zonal-average of analysis error (black) and ensemble spread (red)

Australian RAINFALL above upper tercile: all forecast start months

Fortnight 1





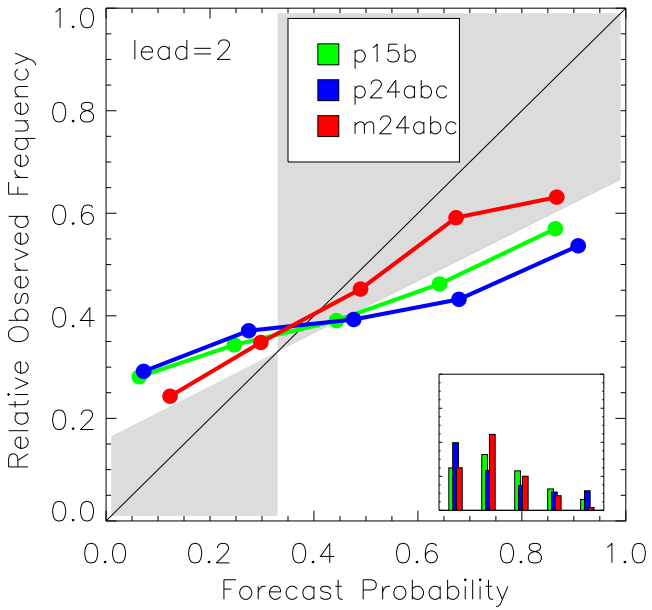


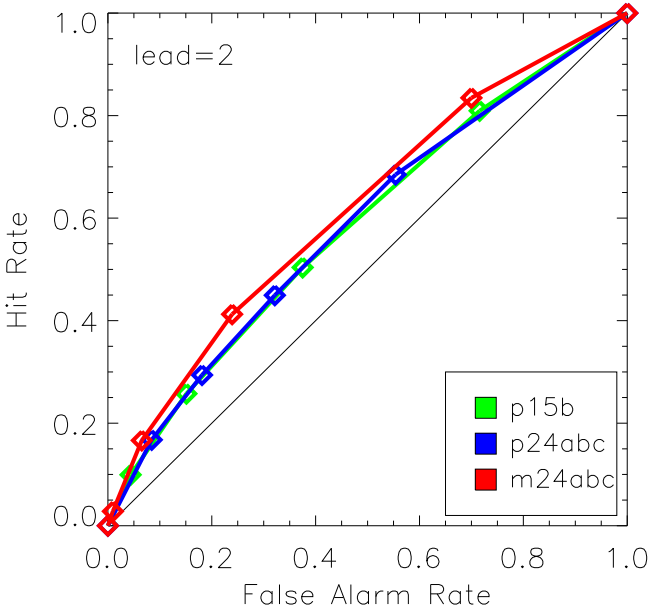
POAMA-1.5

POAMA-2 (seas)

POAMA-2 (intraseas)

Fortnight 2





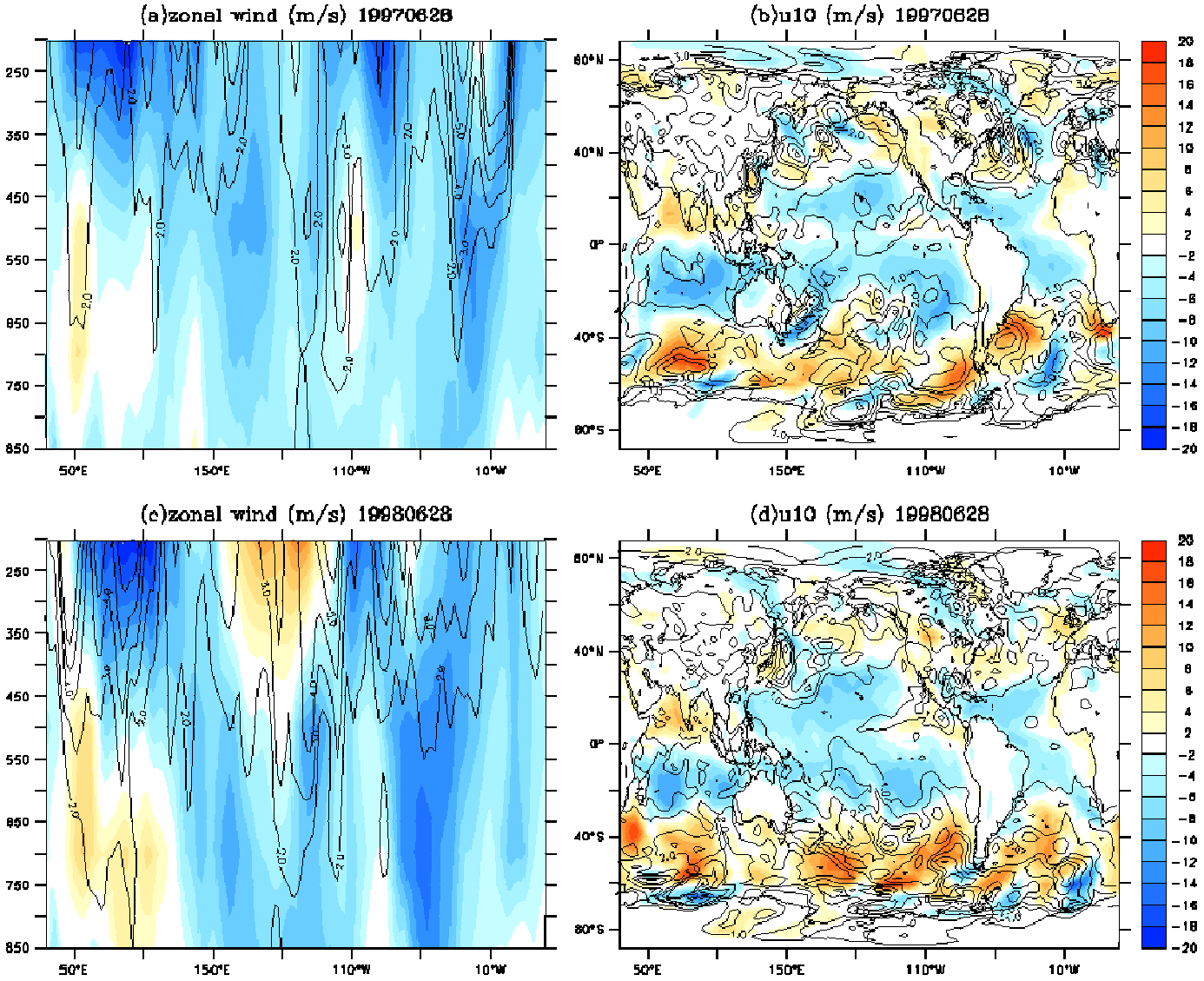
Zonal wind (shaded) and ensemble spread (contour) from CEI

EQ

10 m

El Nino

La Nina



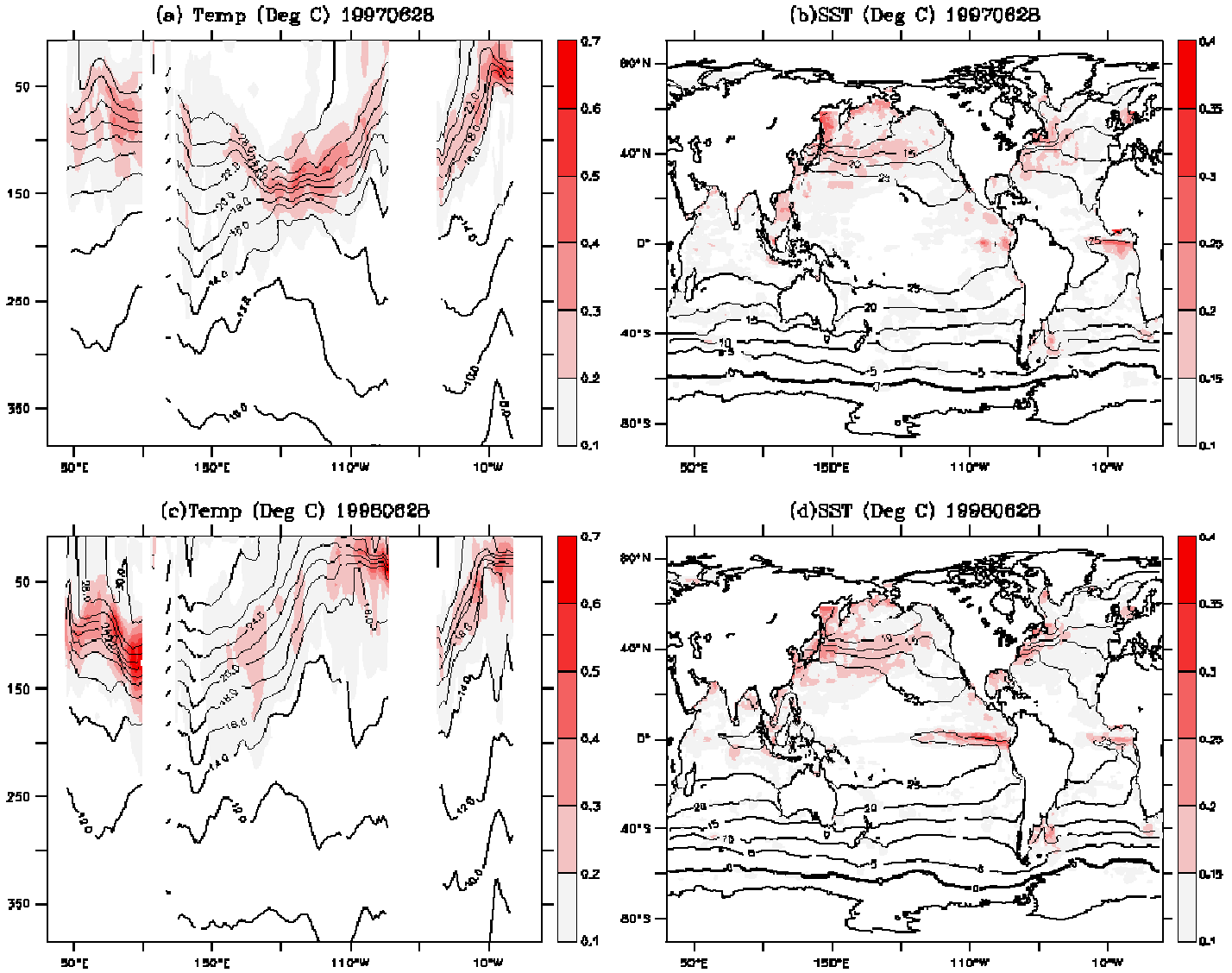
Ocean Temperature (contour) and ensemble spread (shaded) from CEI

EQ

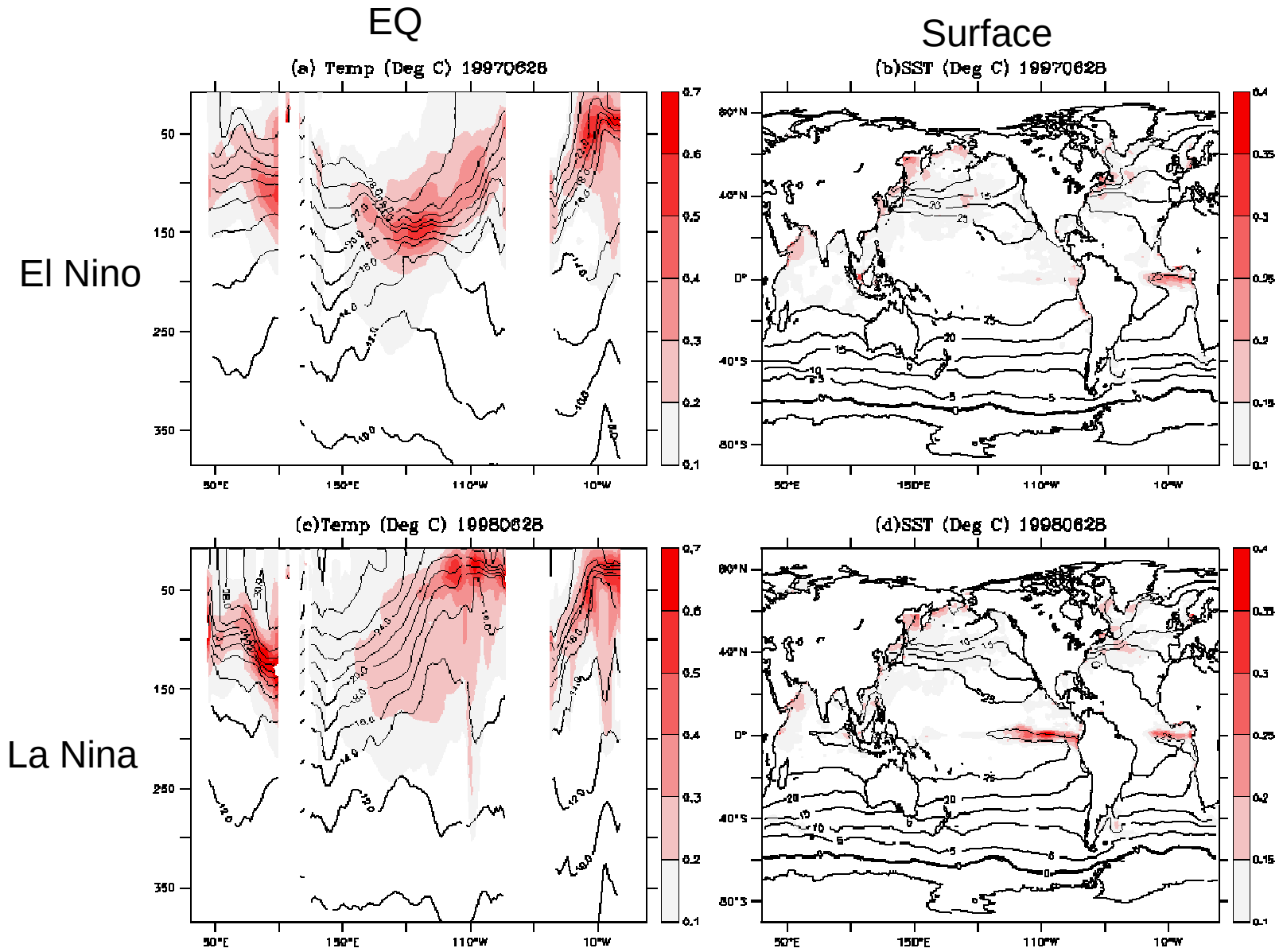
Surface

El Nino

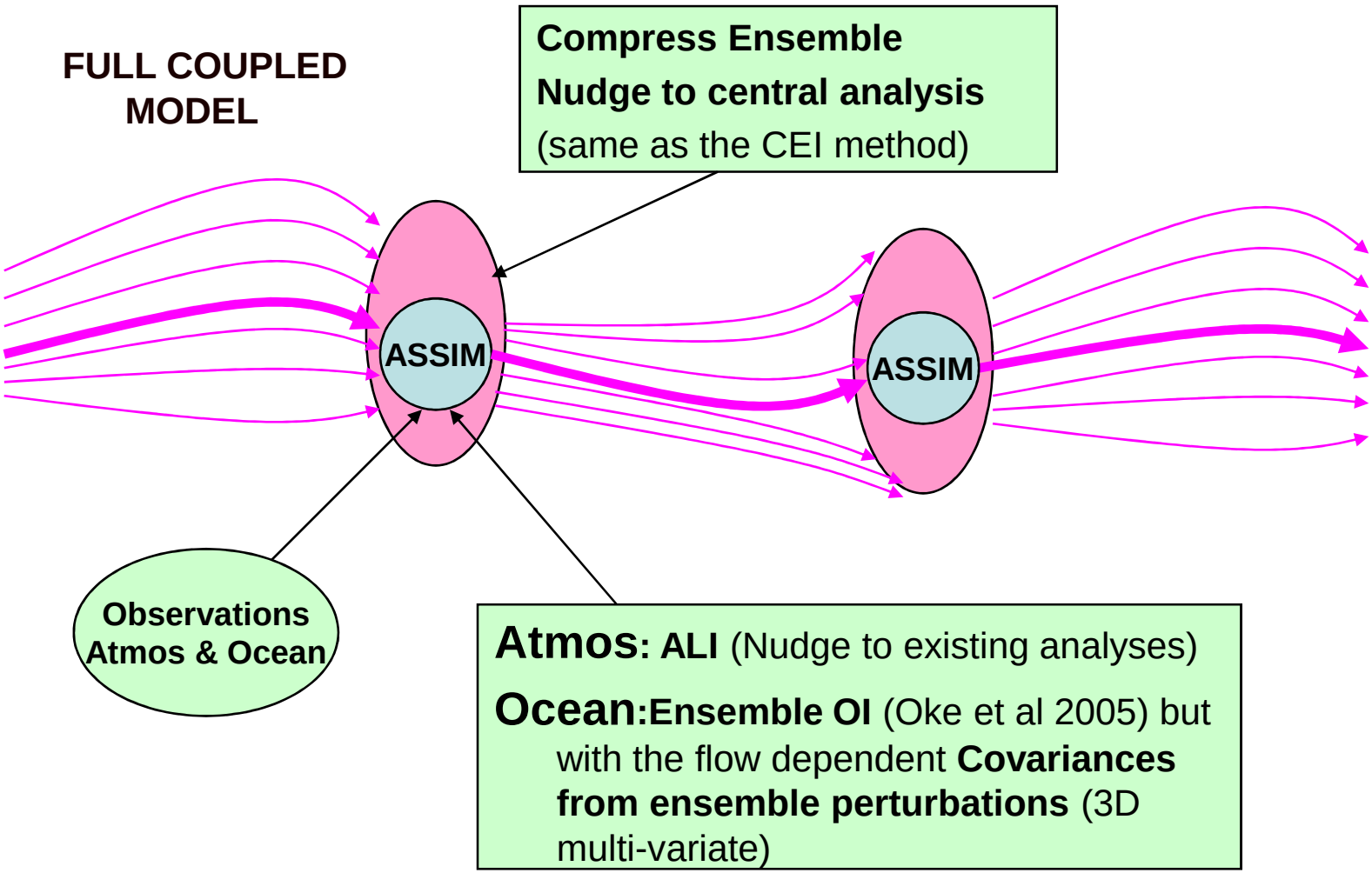
La Nina



Ocean Temperature (contour) and ensemble spread (shaded) from PEODAS



PECDAS: POAMA Ensemble Coupled Data Assim System
Version 1: Weakly coupled



Preliminary version: PECDAS

Atmosphere: ALI nudging towards ERA-Interim

Ocean: PEODAS scheme (ensemble multivariate OI)

Perturbation generation: 30 mem coupled breeding method rather than EnKF in PEODAS

Assim: every 1 day with 1 day time window

Obs: EN3 Temp. & Sali. profiles, including CTD, XBT, Argo

Model: POAMA-2, T47L17 BAM and ACOM2 (MOM2)

Observation errors: uncorrelated in space

Covariance Localization: horizontally & vertically

Keep error ratio being constant: σ(model) / σ(obs)= 0.47

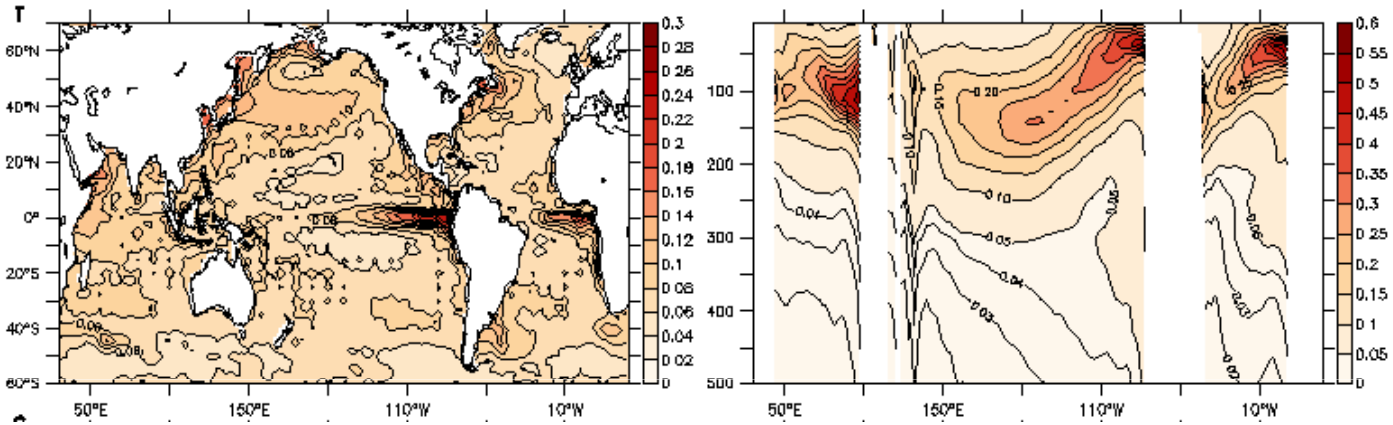
30 years reanalysis done (1980-2009)

Ensemble Spread: SST and Temperature (averaged over 1980-2006)

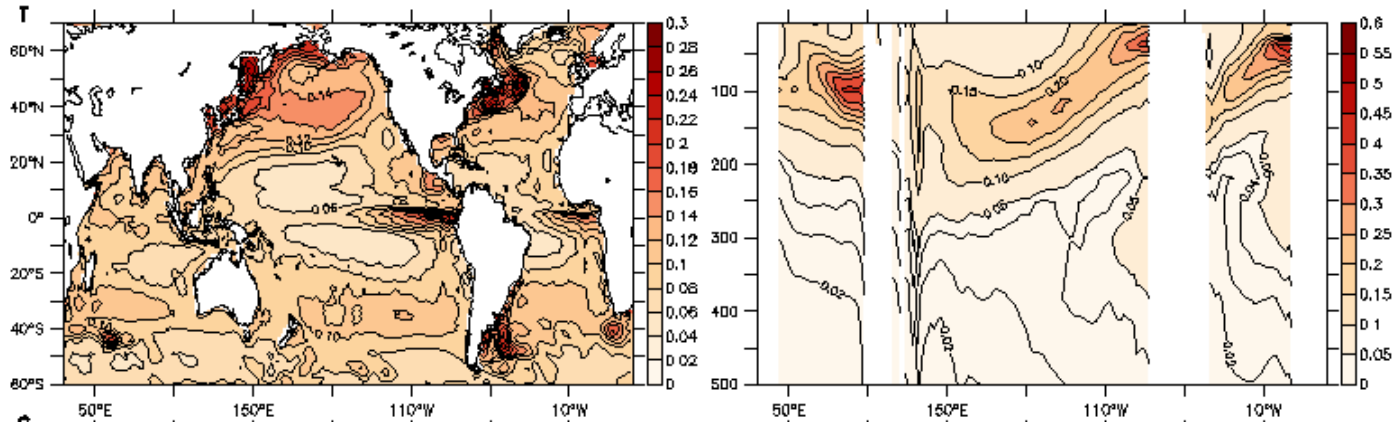
surface

equator

PEODAS



PECDAS

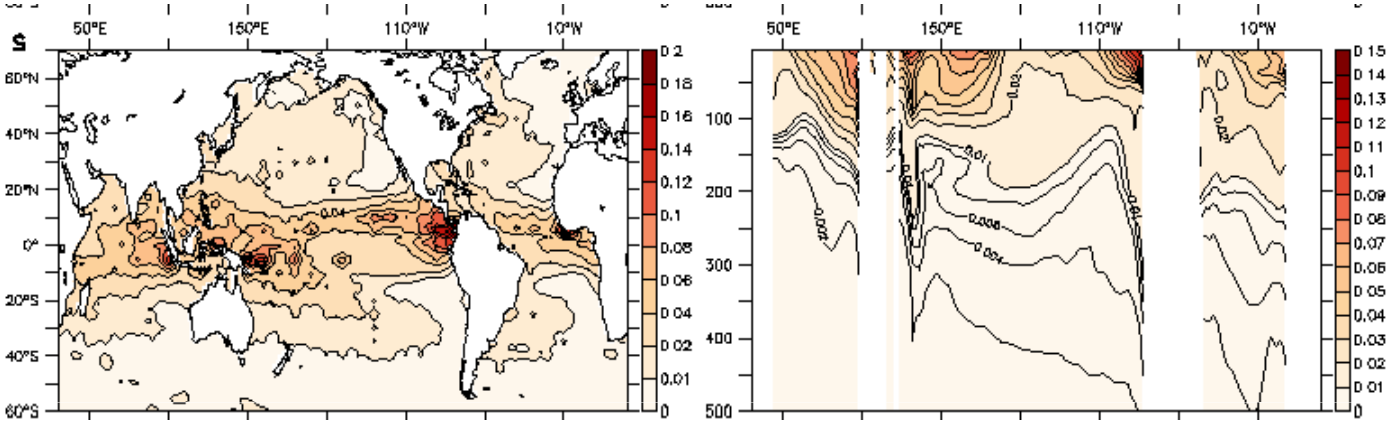


Ensemble Spread: Salinity

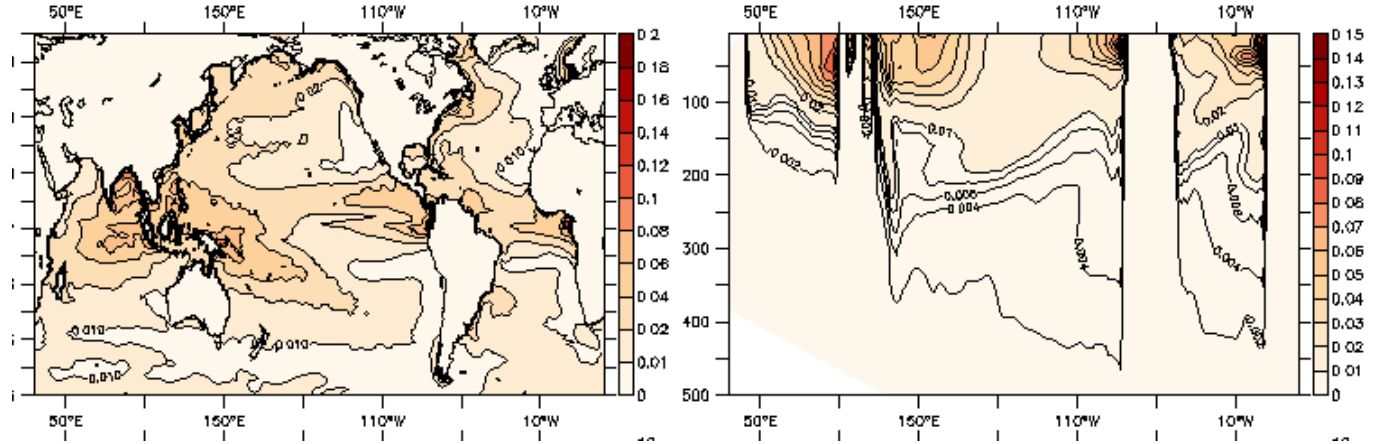
surface

equator

PEODAS

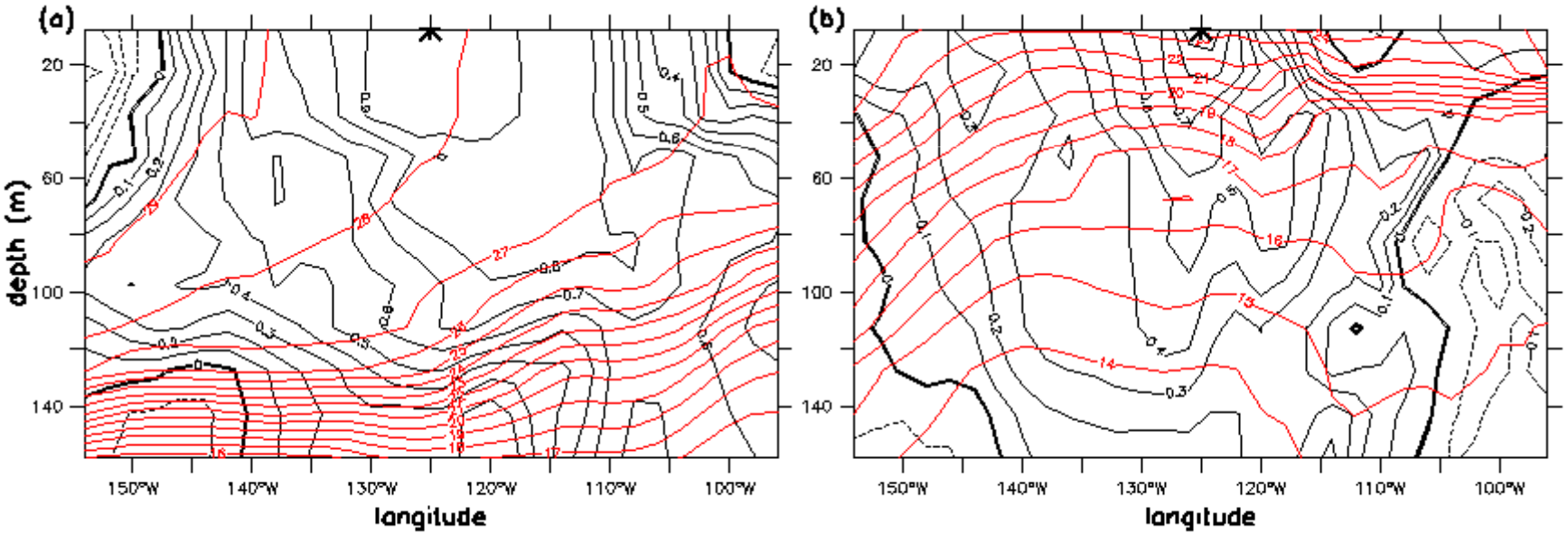


PECDAS



Ensemble-based covariance structures from PECDAS for equatorial eastern Pacific

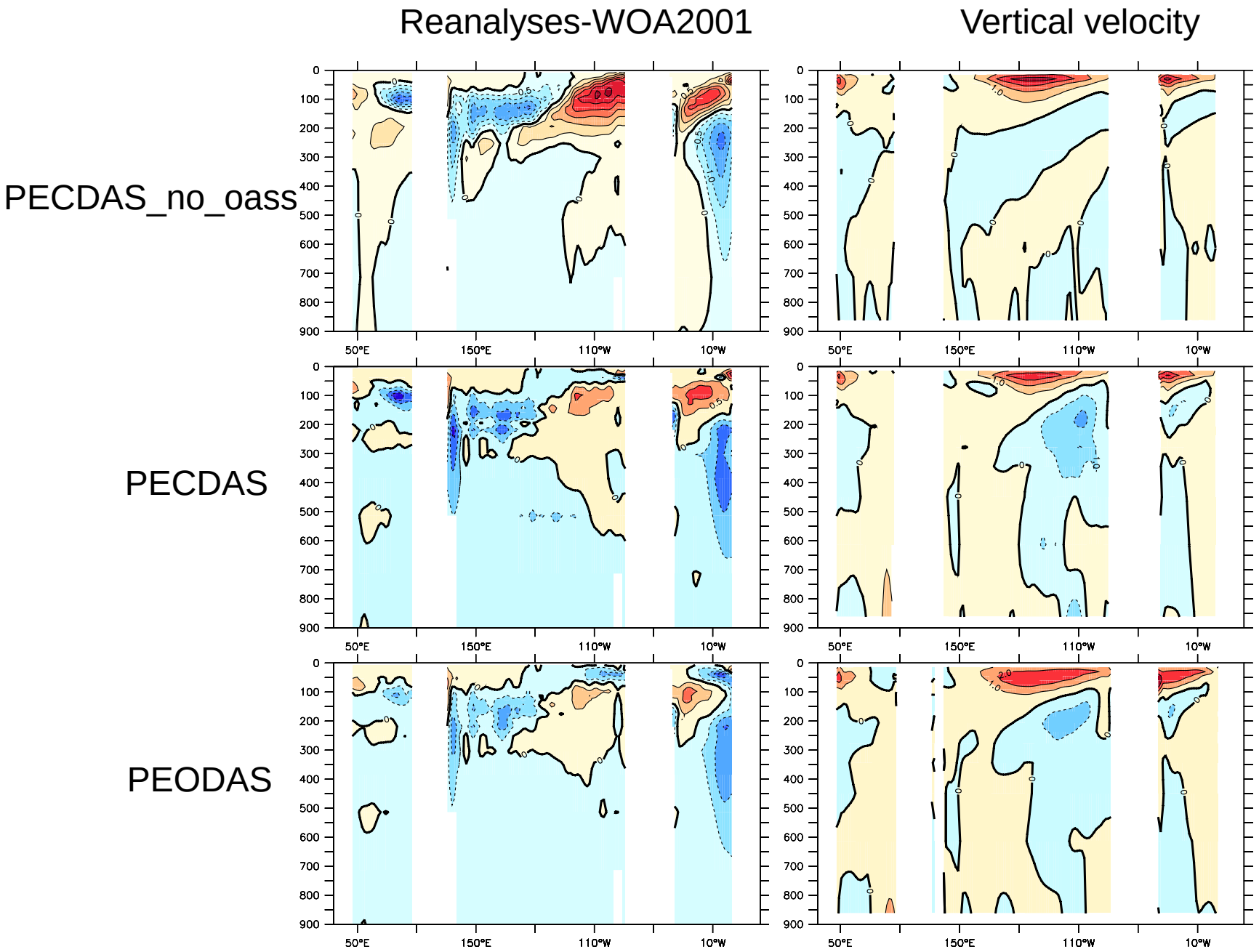
Correlation
isotherms



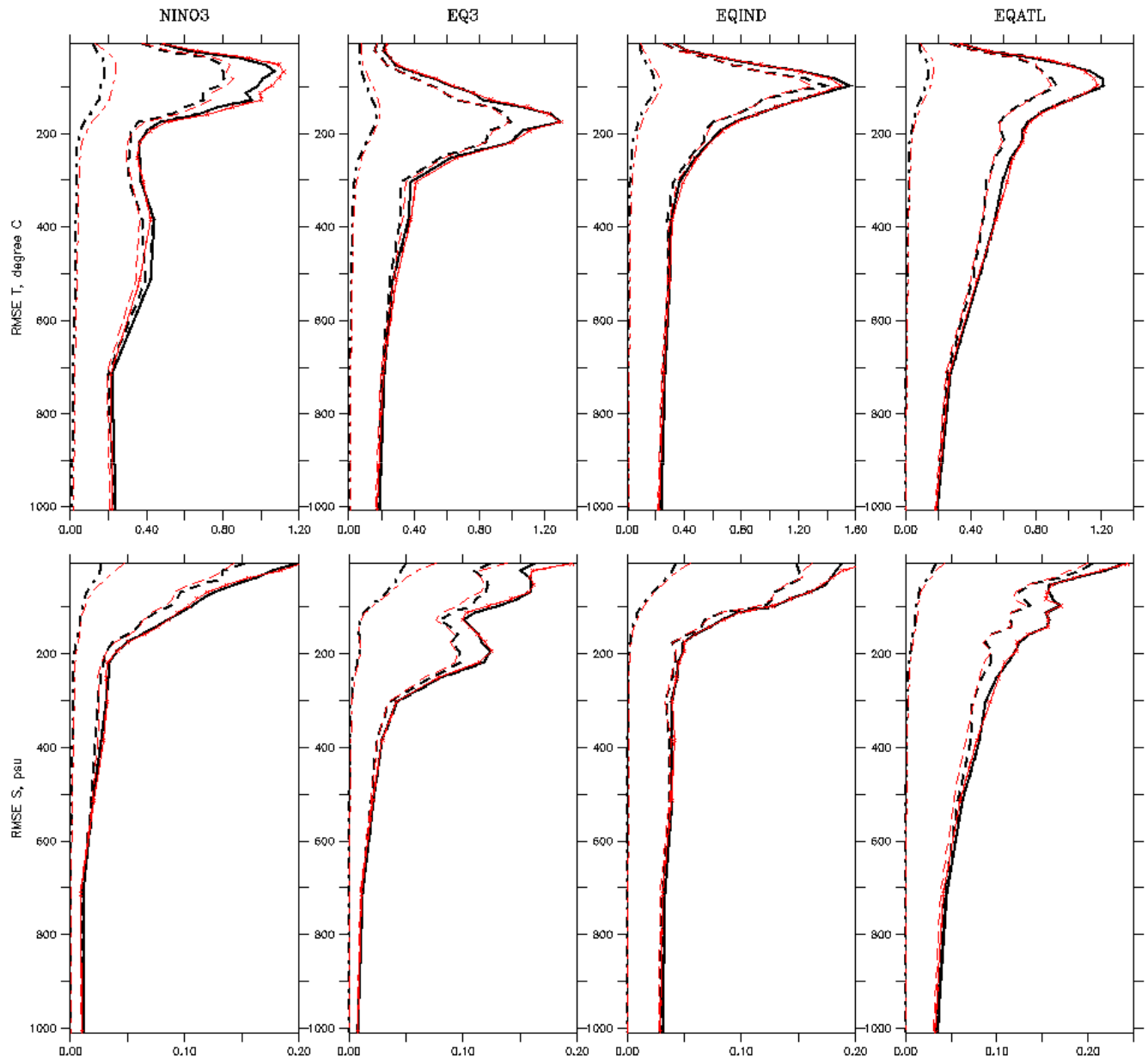
El Nino (28 June 1997)

La Nina (29 June 1998)

Mean temperature differences with WOA2001 (left panel) and W (right panel) along the equator

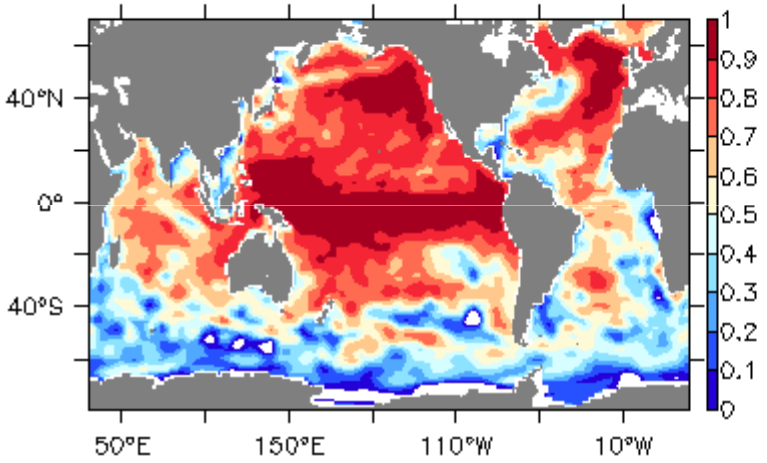


Ensemble spread (dot-dash), RMS O-A (dash) and RMS O-B (solid) for PECDAS (black) and PEODAS (red) (1980-2006)

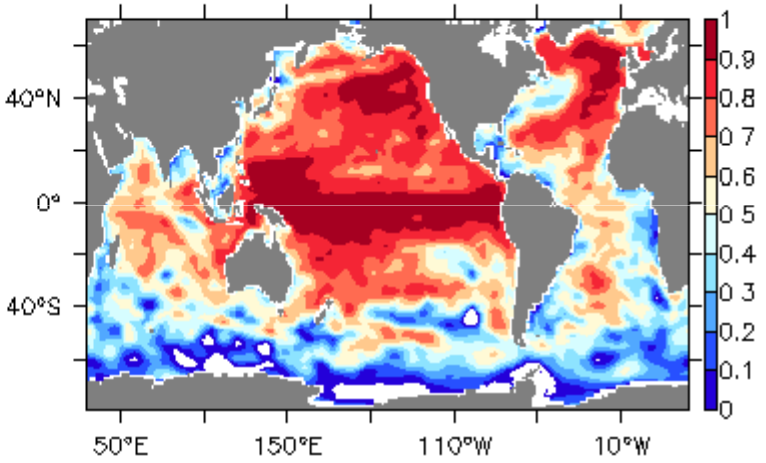


T300 correlations between EN3 and the reanalyses

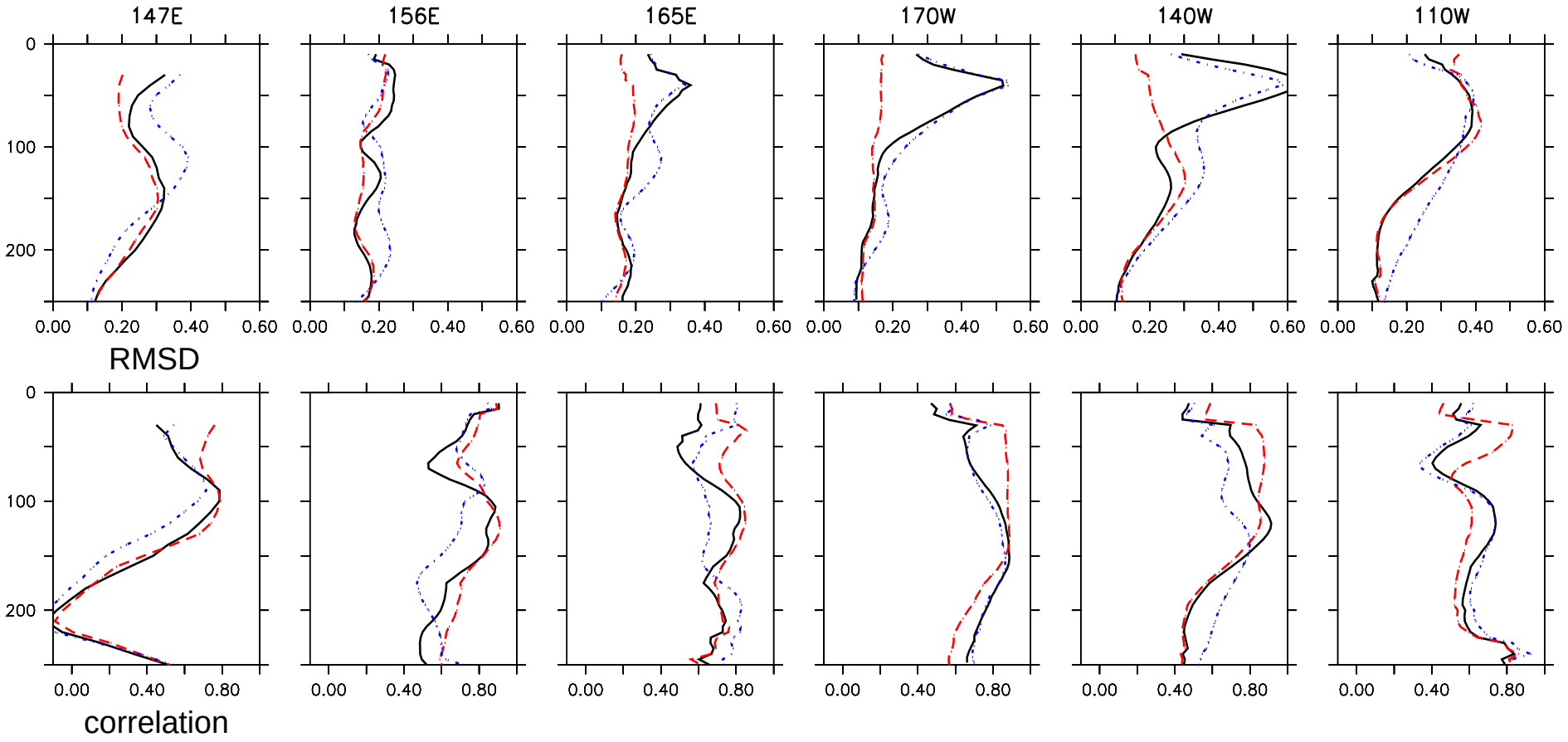
PECDAS



PEODAS

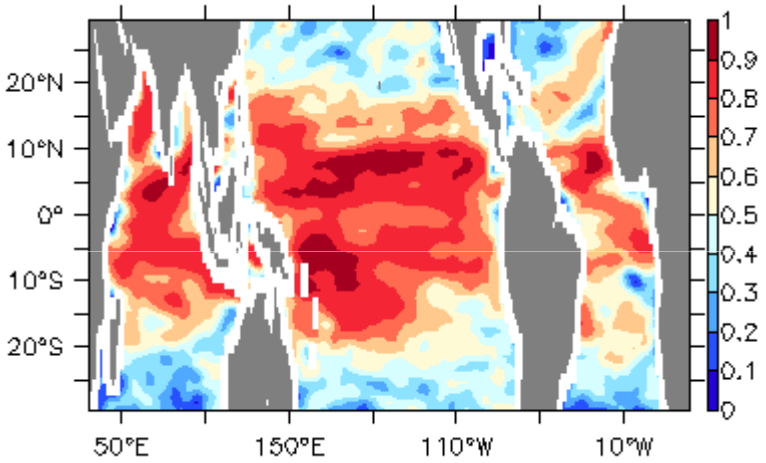


Profiles of RMSD (top) and correlation (bottom) between zonal currents from TAO ADCP and from PECDAS (black), PEODAS (red), and PECDAS_no_oass (blue)

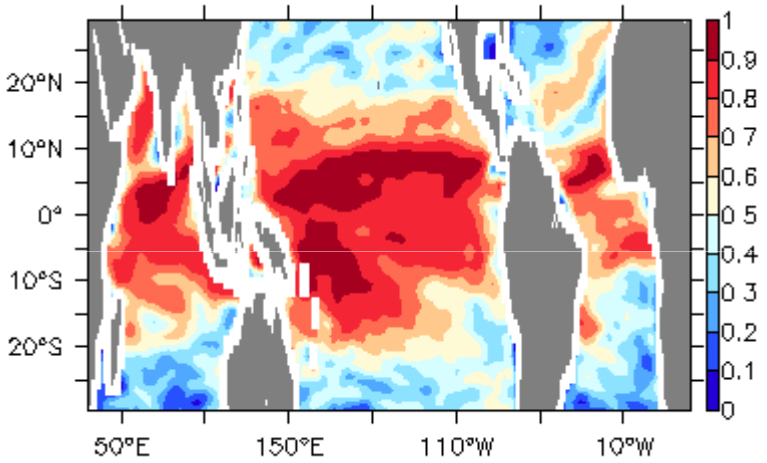


Zonal current correlations between OSCAR and reanalyses

PECDAS



PEODAS



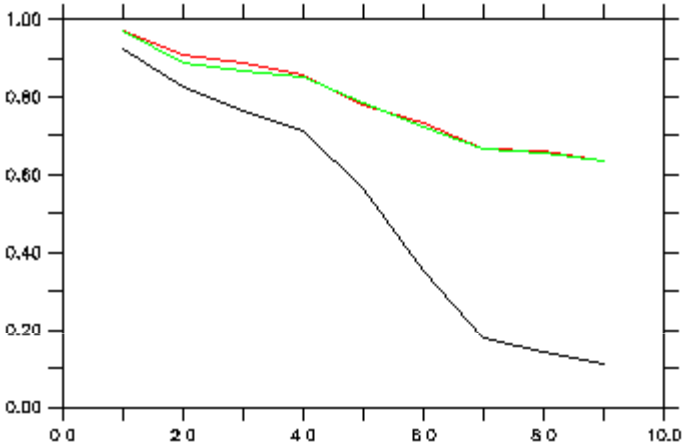
POAMA-2 (PECDAS)
POAMA-2 (seas)
persistent

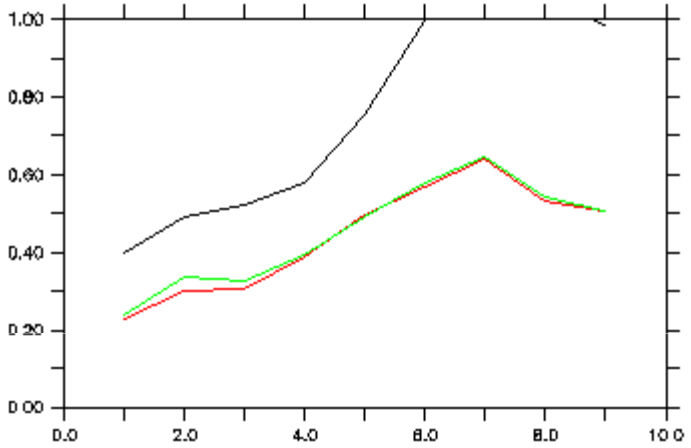
SSTA forecast skill

ACC

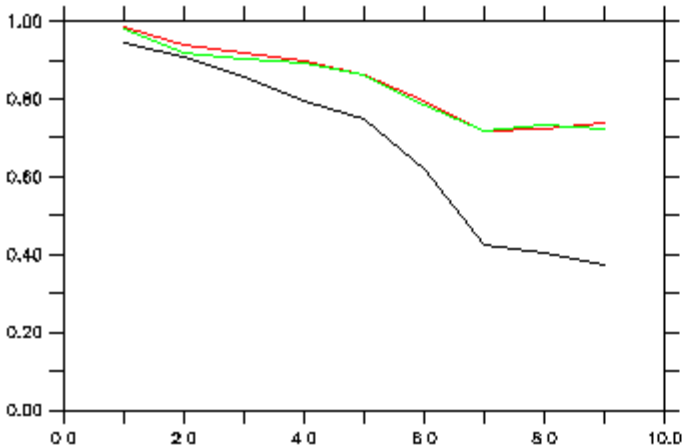
RMSE

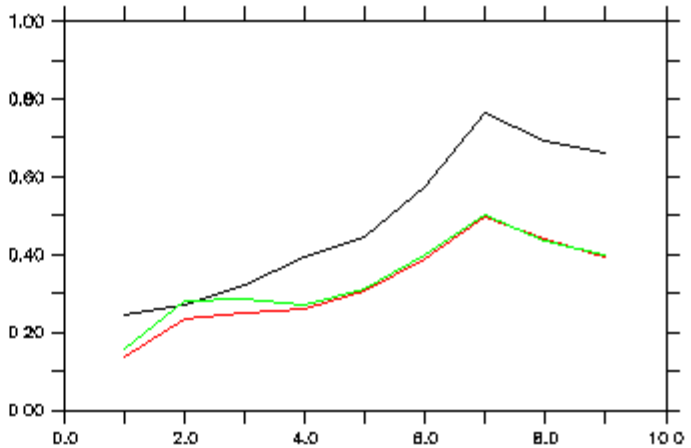
Nino3





Nino4





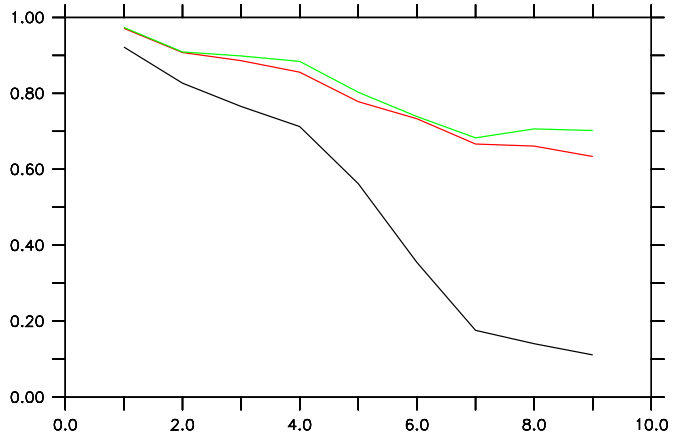
POAMA-2 (PECDAS)
POAMA-2 (intraseas)
persistent

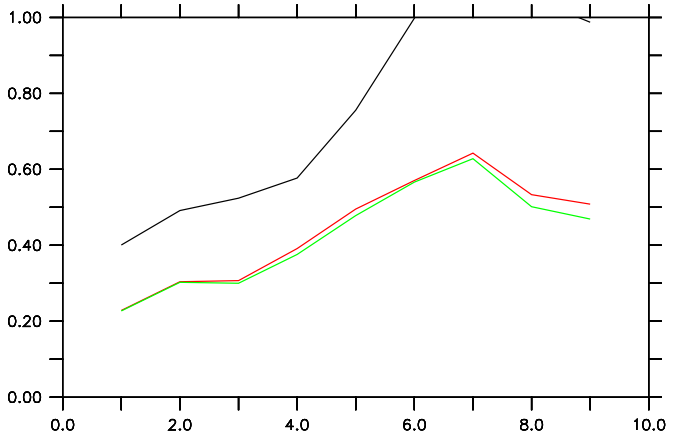
SSTA forecast skill

ACC

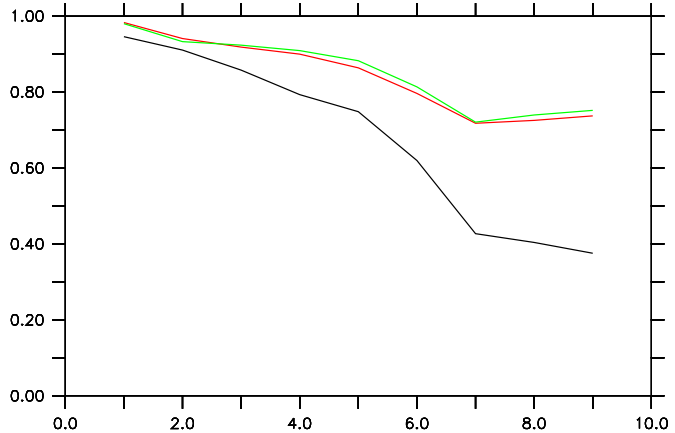
RMSE

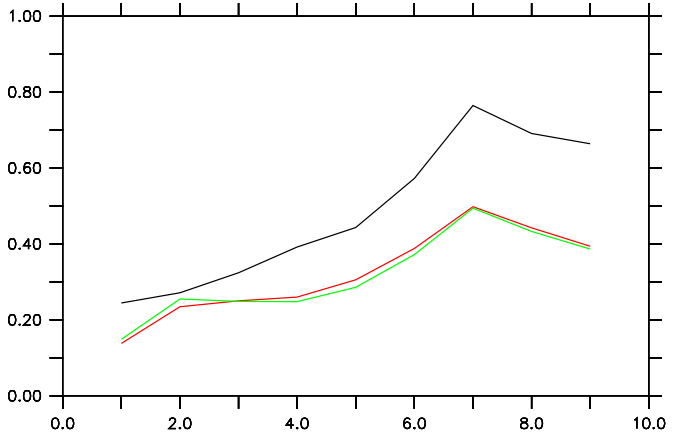
Nino3





Nino4





Summary and future work

- Results of PECDAS are promising, The reanalysis and the forecast skills are comparable with that of the PEODAS, except the equatorial current which seems to be related with the model issue.
- Need to refine the assimilation scheme to solve the ocean current problems
- More sophisticated ensemble generation techniques will be considered to implement in the future
- PECDAS will implement in the new high-resolution ACCESS model (POAMA-3)