Results from the Met Office GloSea model

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Outline

- Features of tropical Pacific SST prediction in the GloSea model
- Real-time forecasts - Niño3 and Niño4 SST and "Interesting events" 2002

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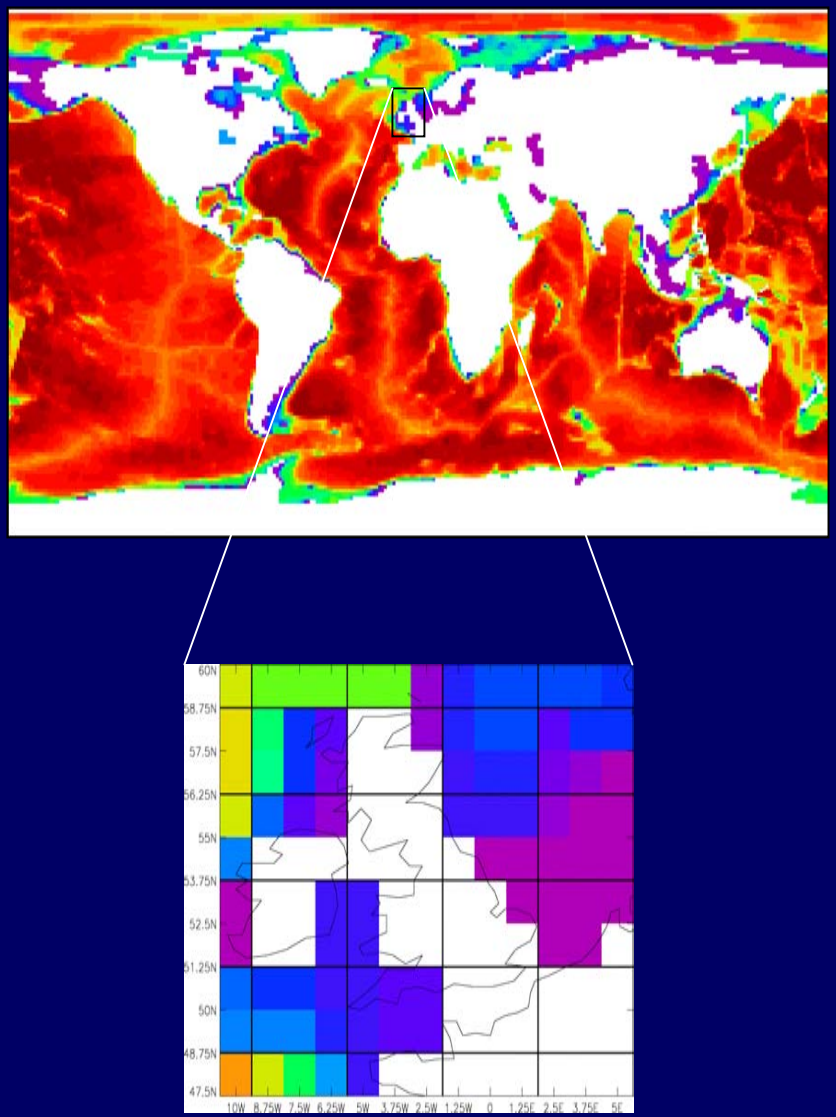
The GloSea Model

Model Design



- Hadley Centre climate model (HadCM3) physics and dynamics
- 2.5 x 3.75 x 19L AGCM
- (1.25 to 0.3) x 1.25 x 40L OGCM

- Hadley Centre coastal tiling scheme

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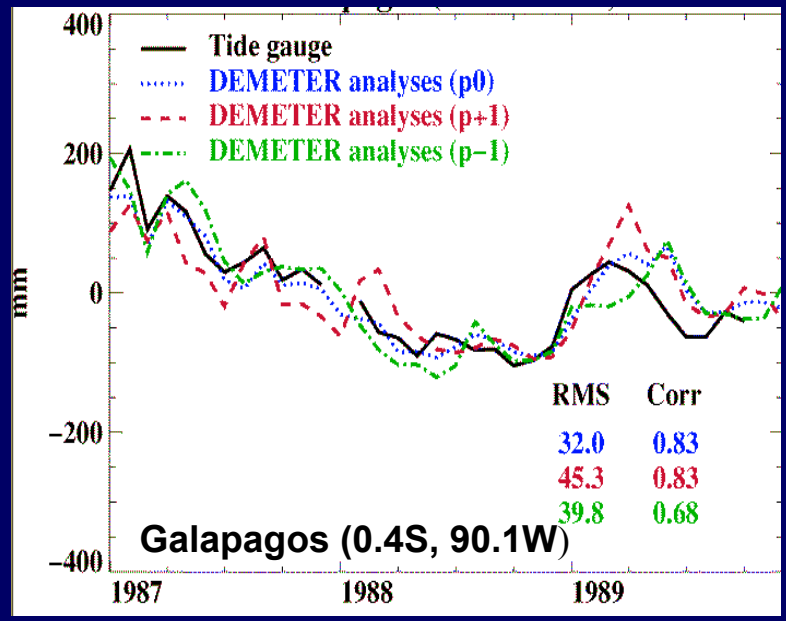
The GloSea Model

Ocean Analysis

- GloSea ocean + Met Office FOAM ocean data assimilation
- assimilation of sub-surface temperature
- NWP momentum, heat and water surface fluxes
- strong relaxation to observed sea surface temperature



Validation of ocean analyses

Ensemble Predictions

- Ensembles are generated by applying wind stress and SST perturbations that are designed to estimate the uncertainty in the observations

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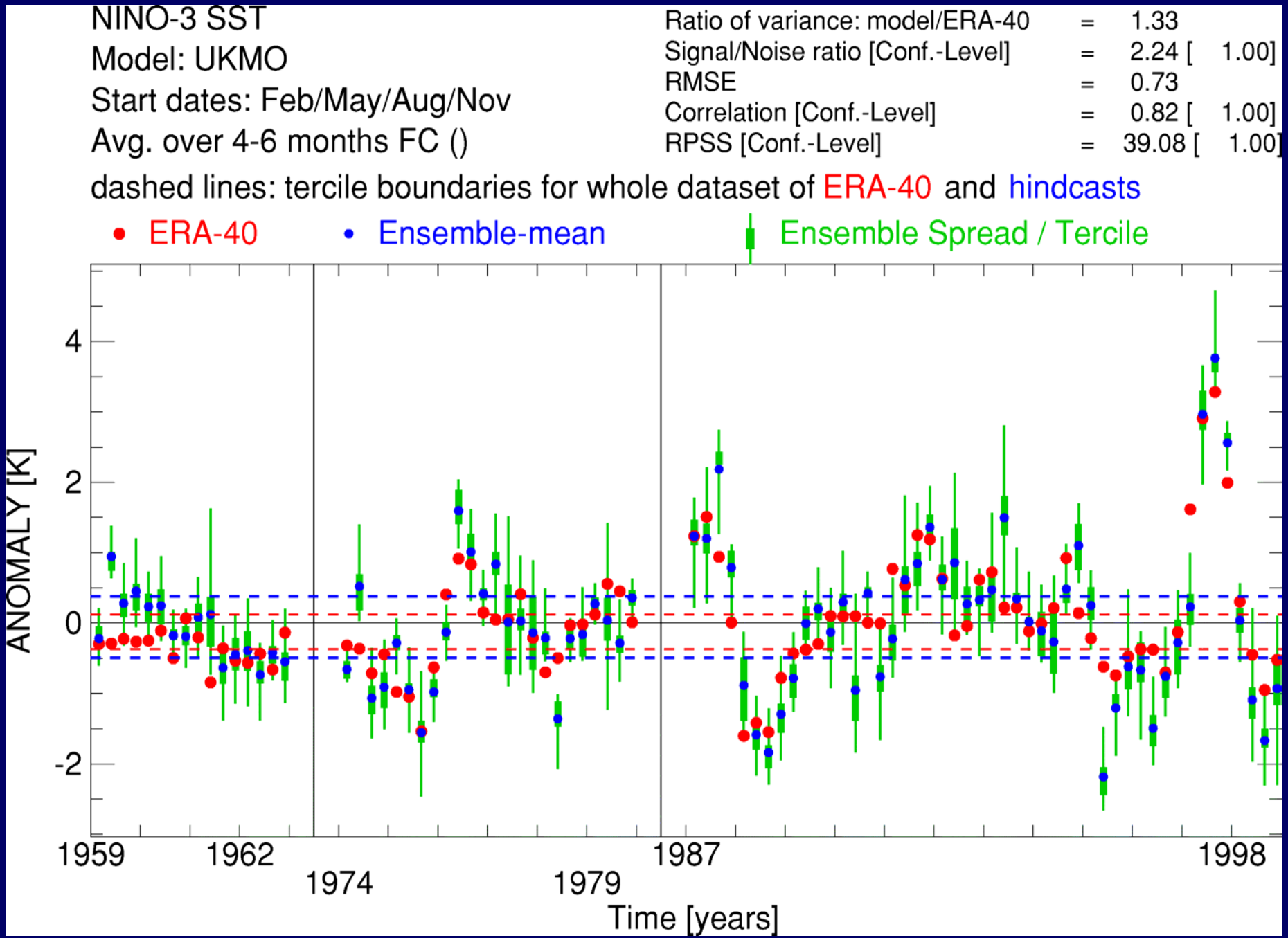
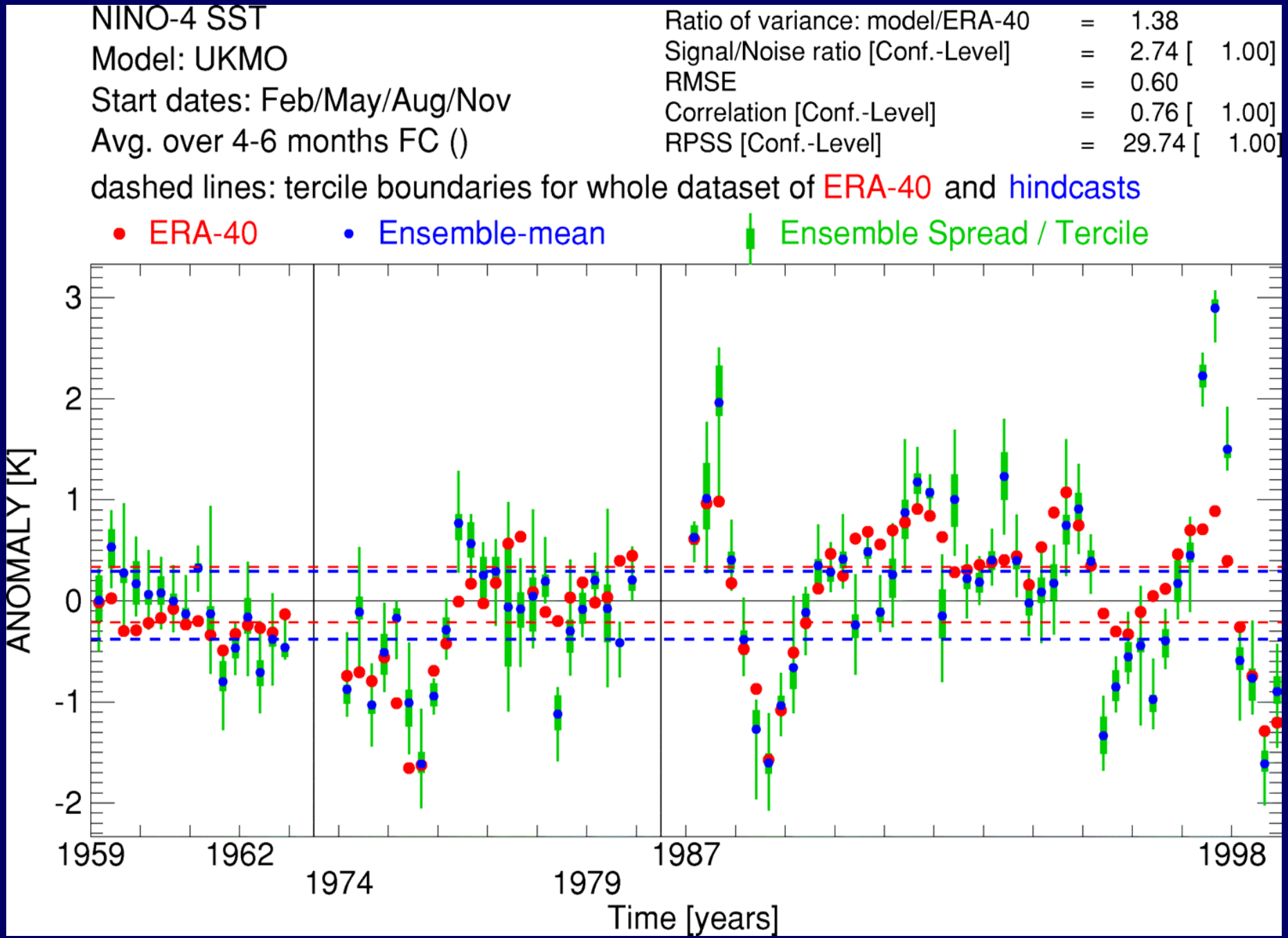
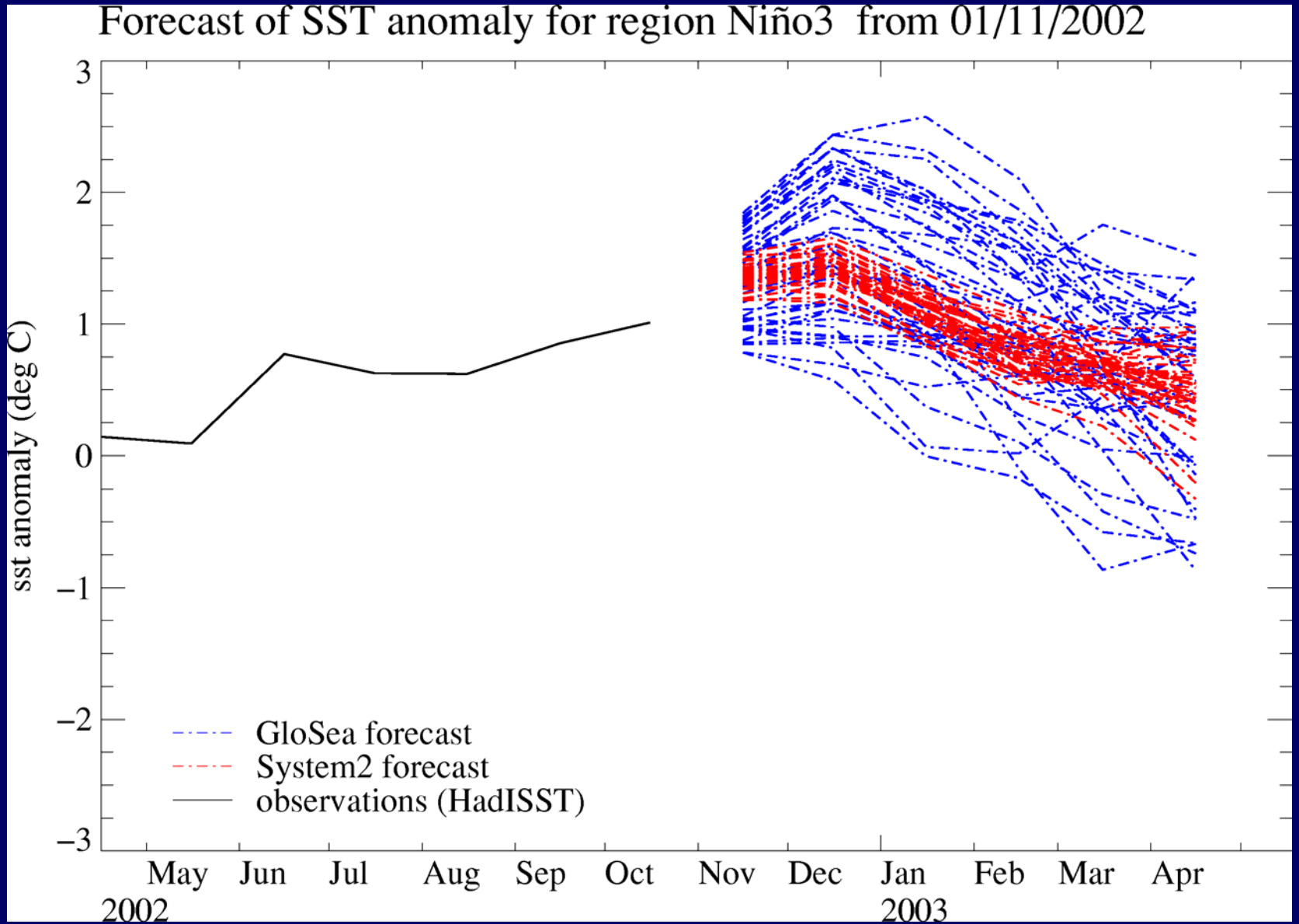
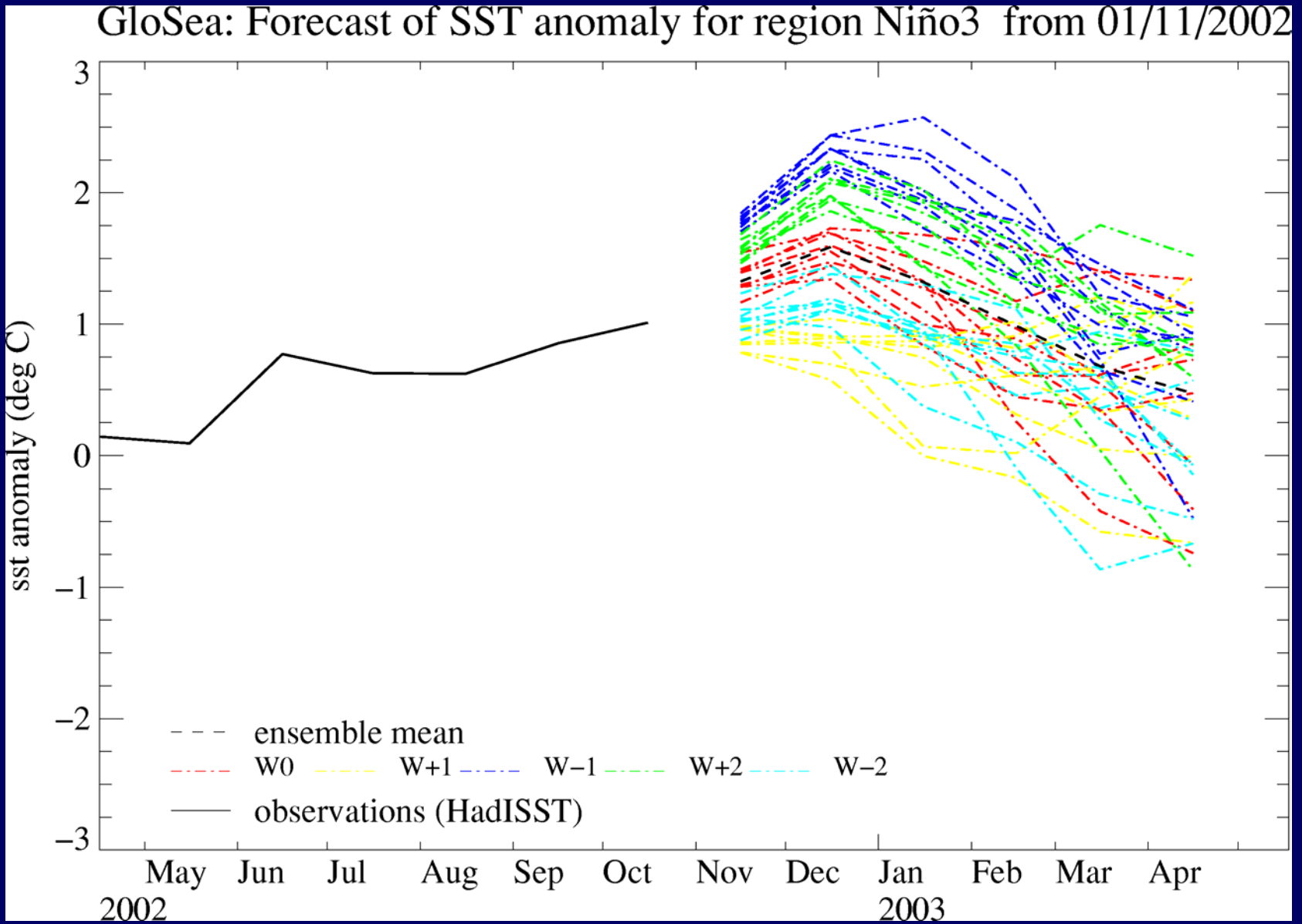
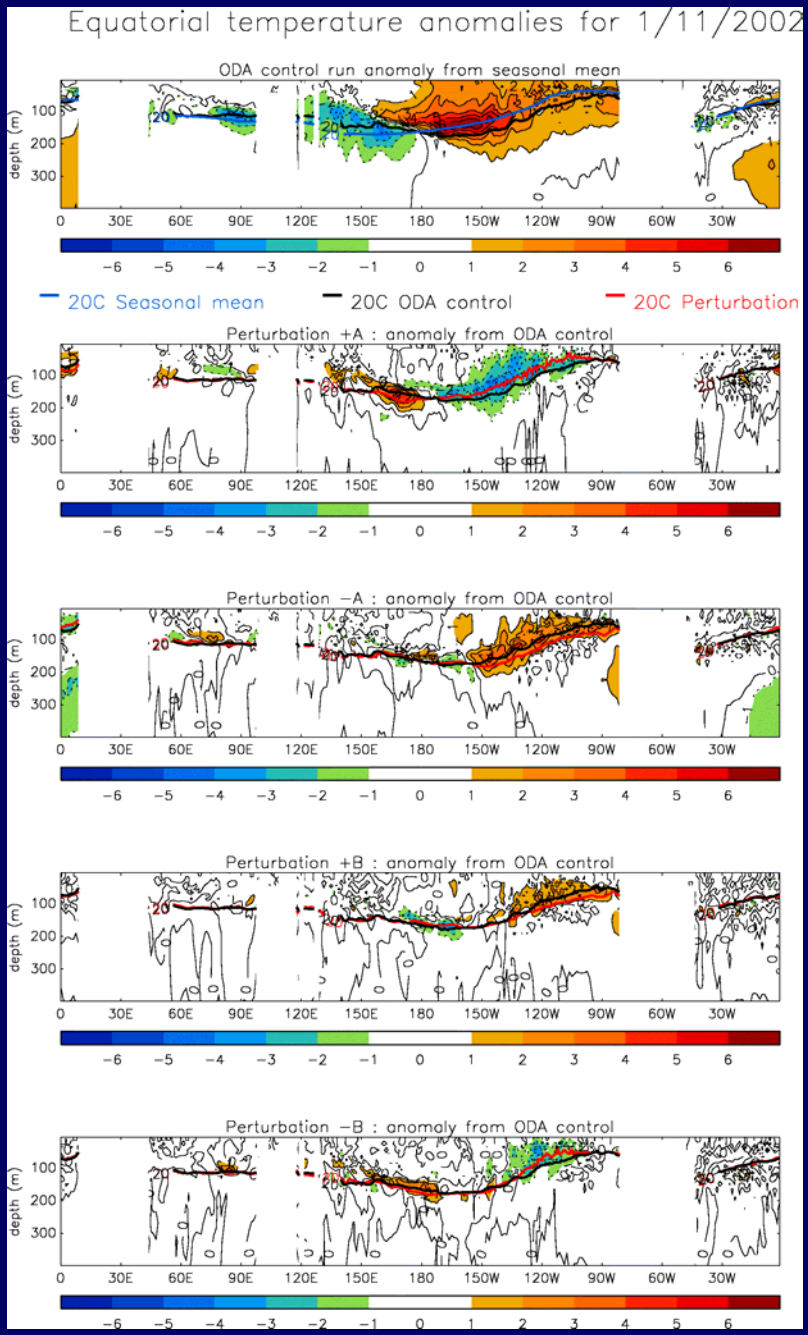

NINO-3 SST
Model: UKMO
Start dates: Feb/May/Aug/Nov
Avg. over 4-6 months FC ()
Ratio of variance: model/ERA-40 = 1.33
Signal/Noise ratio [Conf.-Level] = 2.24 [1.00]
RMSE = 0.73
Correlation [Conf.-Level] = 0.82 [1.00]
RPSS [Conf.-Level] = 39.08 [1.00]
dashed lines: tercile boundaries for whole dataset of ERA-40 and hindcasts
ERA-40
Ensemble-mean
Ensemble Spread / Tercile
ANOMALY [K]
4
2
0
-2
1959
1962
1974
1979
1987
1998
Time [years]


NINO-4 SST
Model: UKMO
Start dates: Feb/May/Aug/Nov
Avg. over 4-6 months FC ()
Ratio of variance: model/ERA-40 = 1.38
Signal/Noise ratio [Conf.-Level] = 2.74 [1.00]
RMSE = 0.60
Correlation [Conf.-Level] = 0.76 [1.00]
RPSS [Conf.-Level] = 29.74 [1.00]
dashed lines: tercile boundaries for whole dataset of ERA-40 and hindcasts
ERA-40
Ensemble-mean
Ensemble Spread / Tercile
ANOMALY [K]
3
2
1
0
-1
-2
1959
1962
1974
1979
1987
1998
Time [years]


Forecast of SST anomaly for region Niño3 from 01/11/2002
sst anomaly (deg C)
3
2
1
0
−1
−2
−3
GloSea forecast
System2 forecast
observations (HadISST)
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
2002
2003


GloSea: Forecast of SST anomaly for region Niño3 from 01/11/2002
sst anomaly (deg C)
3
2
1
0
−1
−2
−3
ensemble mean
W0
W+1
W−1
W+2
W−2
observations (HadISST)
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
2002
2003



Instantaneous equatorial temperature anomalies for 01/11/2002

Perturbation +A minus control

Perturbation -A minus control

Perturbation +B minus control

Perturbation -B minus control

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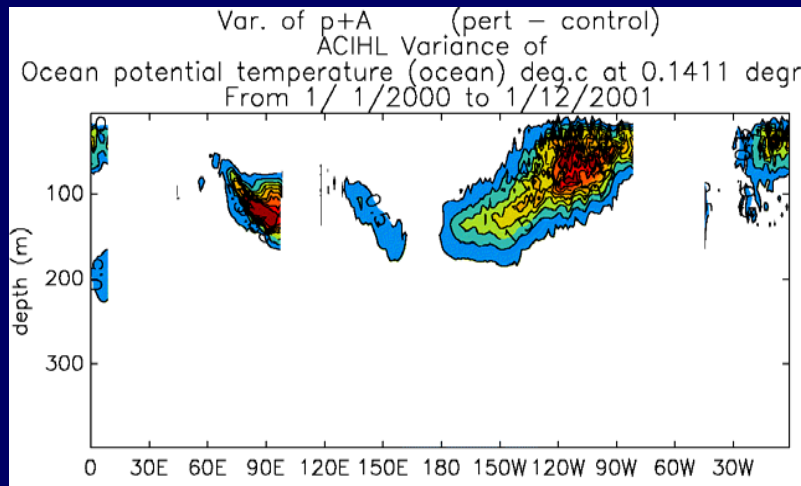
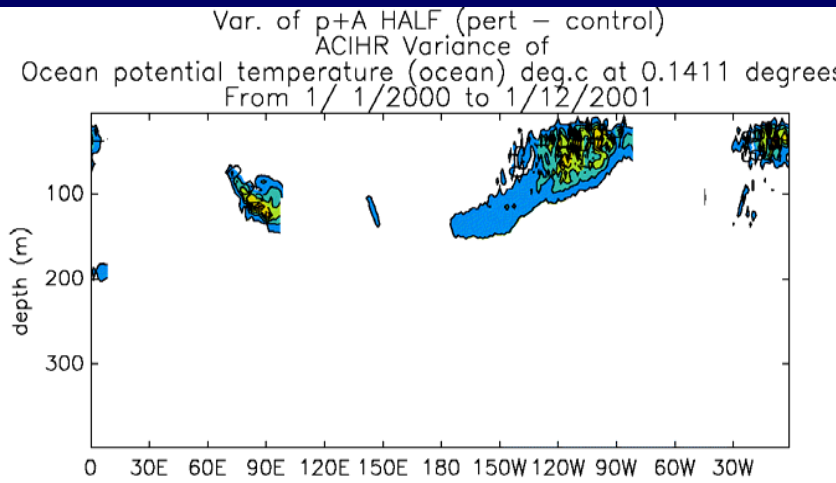
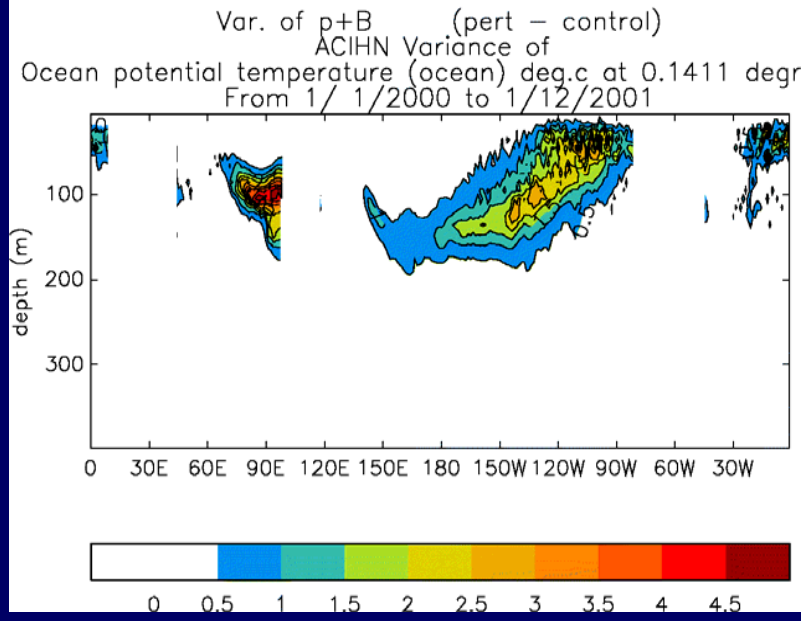
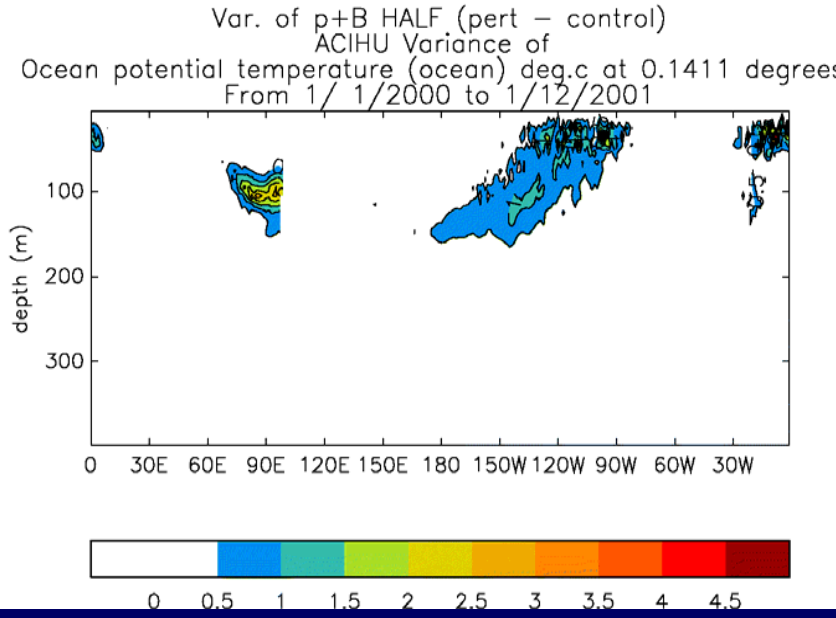
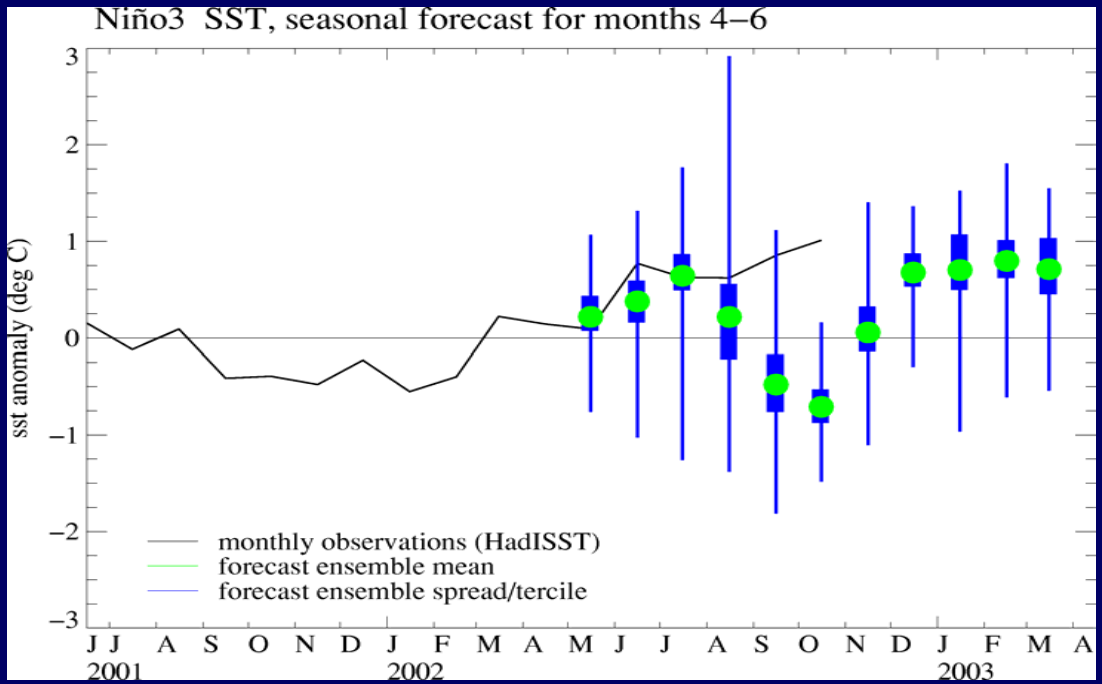

Var. of p+A (pert – control)
ACIHL Variance of
Ocean potential temperature (ocean) deg.c at 0.1411 degrees
From 1/ 1/2000 to 1/12/2001
depth (m)
100
200
300
0 30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W


Var. of p+A HALF (pert – control)
ACIHR Variance of
Ocean potential temperature (ocean) deg.c at 0.1411 degrees
From 1/ 1/2000 to 1/12/2001
depth (m)
100
200
300
0 30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W

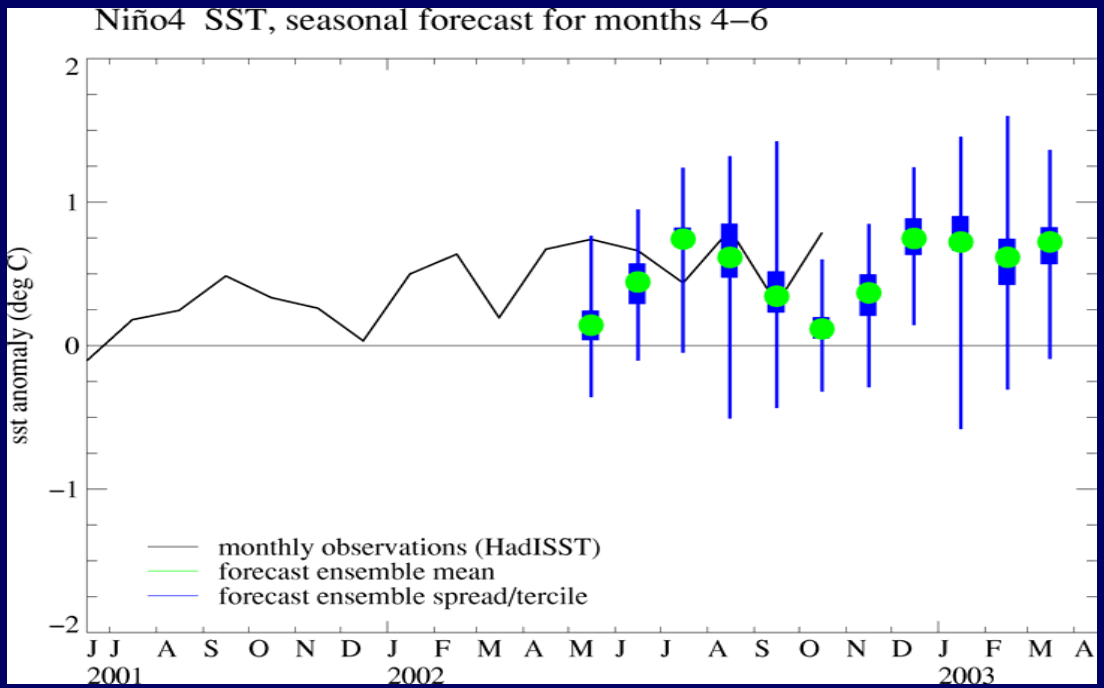

Var. of p+B (pert – control)
ACIHN Variance of
Ocean potential temperature (ocean) deg.c at 0.1411 degrees
From 1/ 1/2000 to 1/12/2001
depth (m)
100
200
300
0 30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5


Var. of p+B HALF (pert – control)
ACIHU Variance of
Ocean potential temperature (ocean) deg.c at 0.1411 degrees
From 1/ 1/2000 to 1/12/2001
depth (m)
100
200
300
0 30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5

Real-time SST forecast months 4-6



Niño 3



Niño 4

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“Interesting events” 2002

		~1 month lead seasonal forecast
Australia	Dry Apr-Oct	
Indonesian region	Dry	
India monsoon	Dry JJA	 ?
Western Sahel	Dry JAS	
Southern Africa	Dry Jan-Apr	
SE South America	Wet JJA	
Asia	Warm JFM	 (initialisation ?)
U.S. West, E. Seaboard	Dry Jan-Oct	

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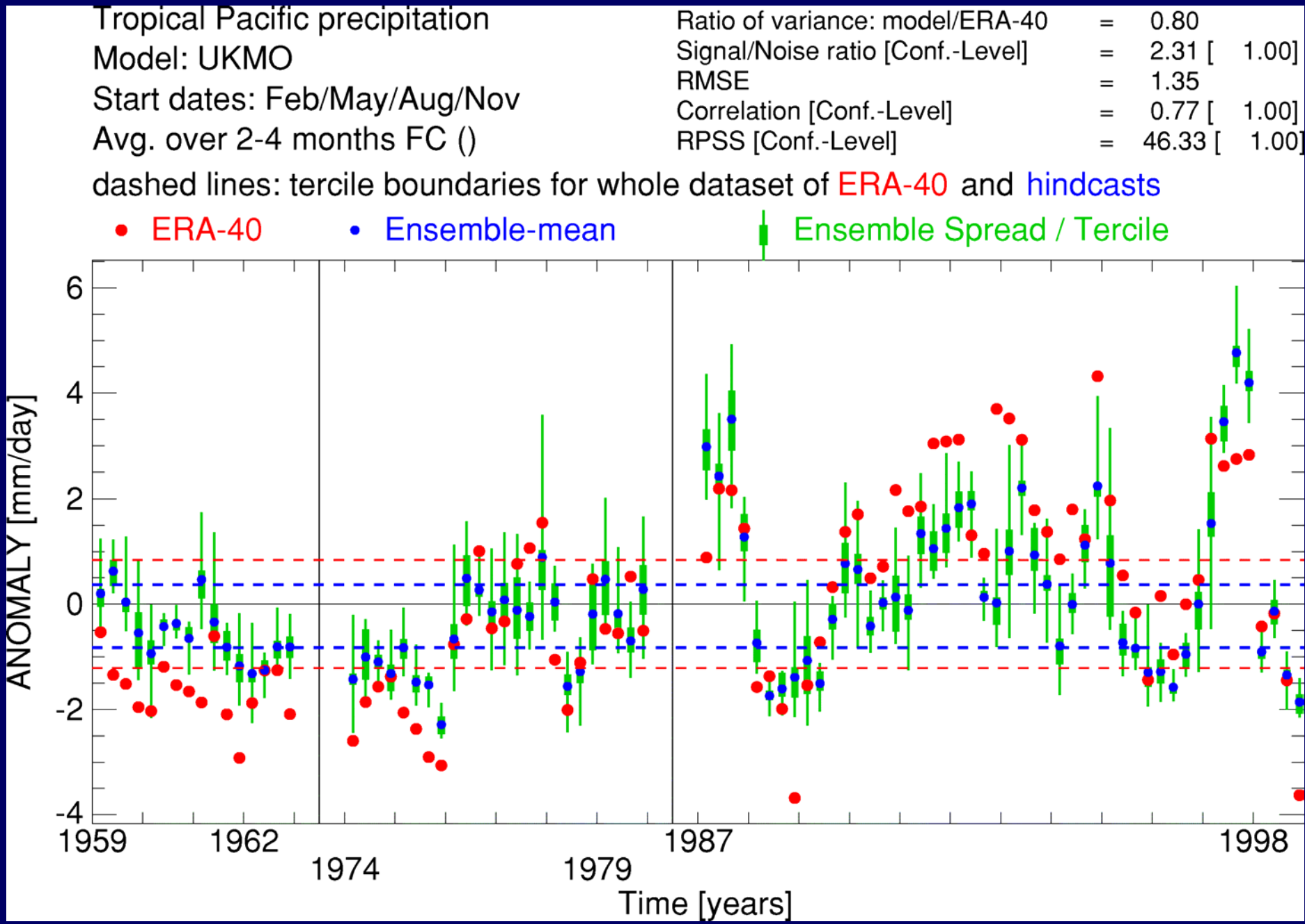
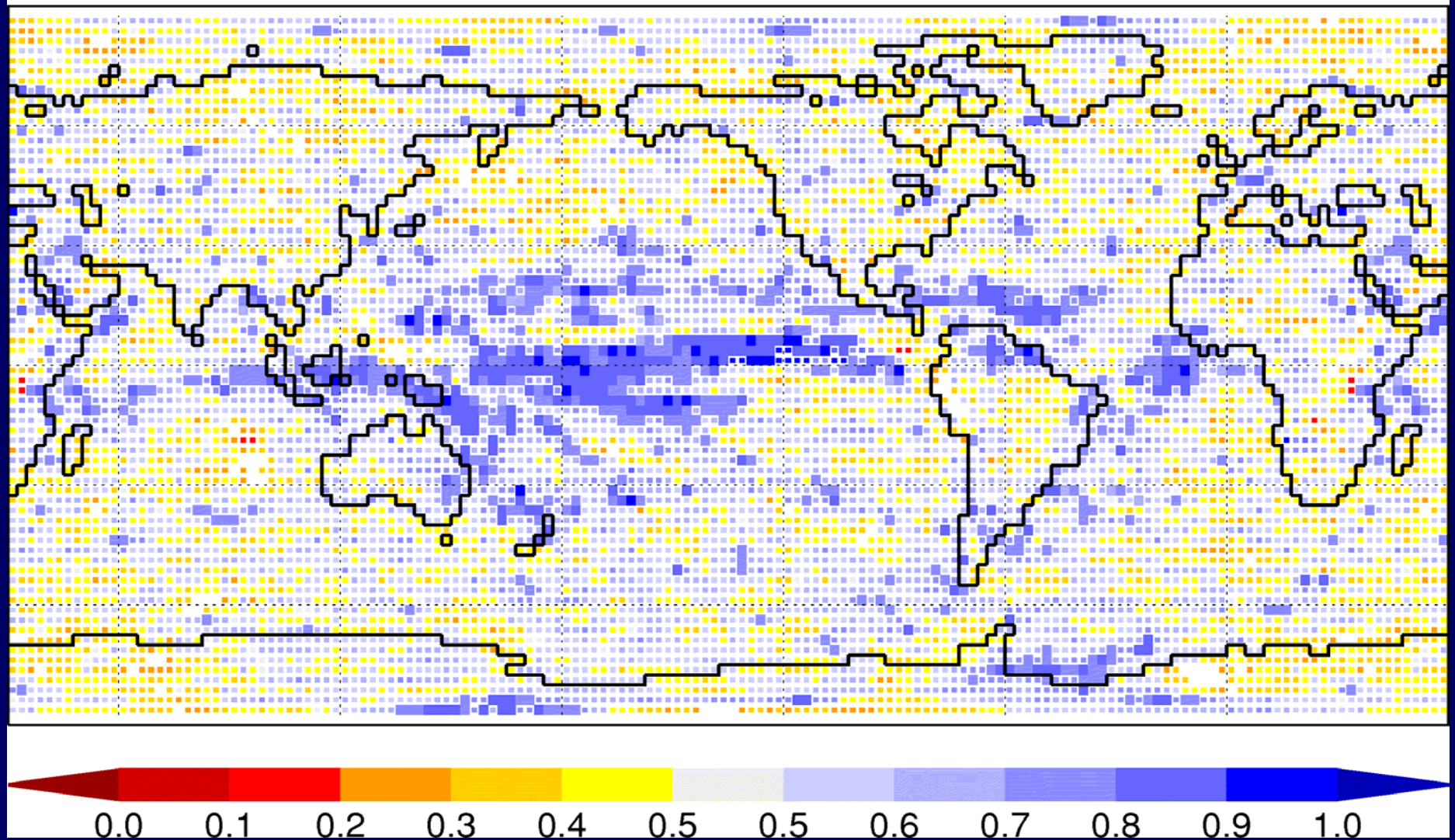

Tropical Pacific precipitation
Model: UKMO
Start dates: Feb/May/Aug/Nov
Avg. over 2-4 months FC ()
Ratio of variance: model/ERA-40 = 0.80
Signal/Noise ratio [Conf.-Level] = 2.31 [1.00]
RMSE = 1.35
Correlation [Conf.-Level] = 0.77 [1.00]
RPSS [Conf.-Level] = 46.33 [1.00]
dashed lines: tercile boundaries for whole dataset of ERA-40 and hindcasts
ERA-40
Ensemble-mean
Ensemble Spread / Tercile
ANOMALY [mm/day]
6
4
2
0
-2
-4
1959
1962
1974
1979
1987
1998
Time [years]

ROC Score: EXP(UKMO) regarding ERA-40 reanalysis

Event: Total Precipitation Anomaly > 0

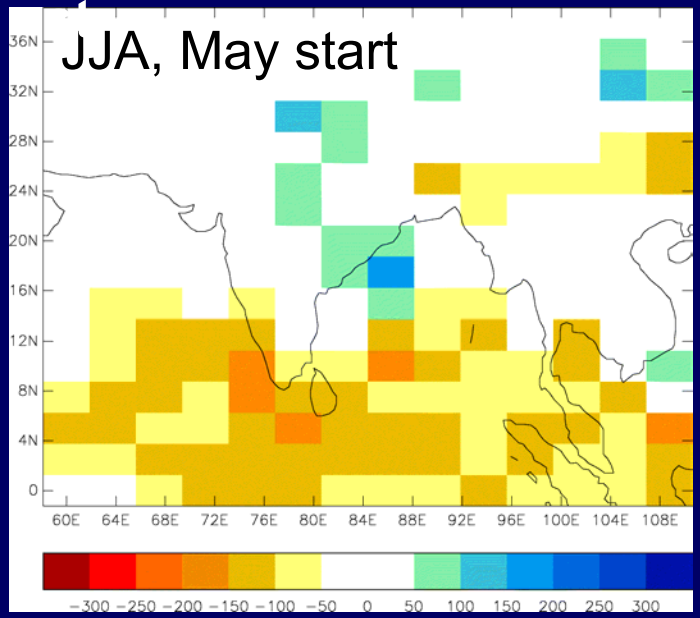
Forecast start month and years: May / 1959-1963, 1974-1979, 1987-1999

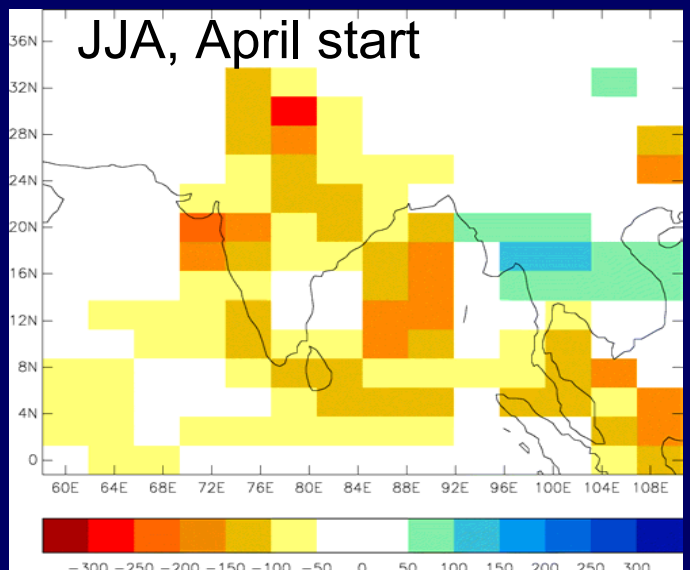
FC period: months 2-4 (JJA), ens: 0-8



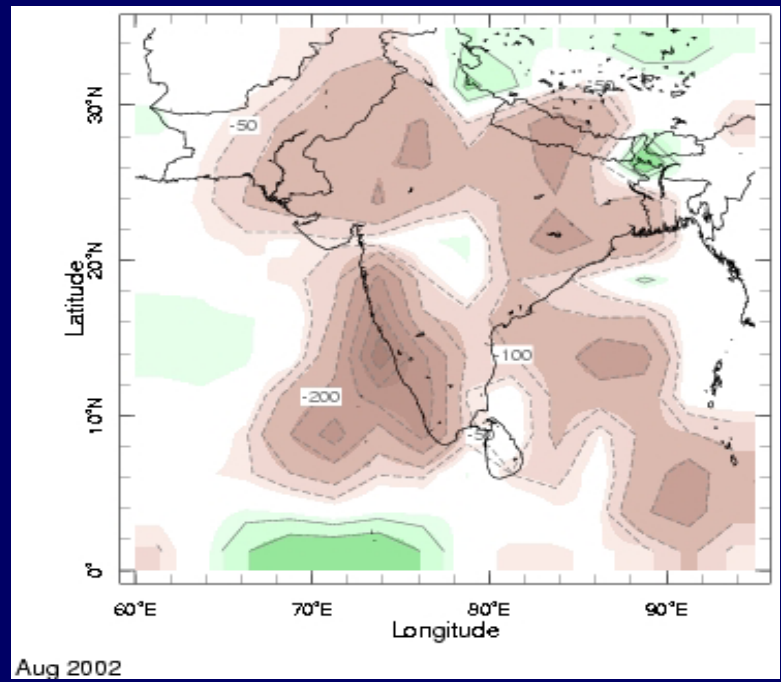
Accumulated rainfall anomaly (mm), Jul-Aug 2002

Foreca





Observed



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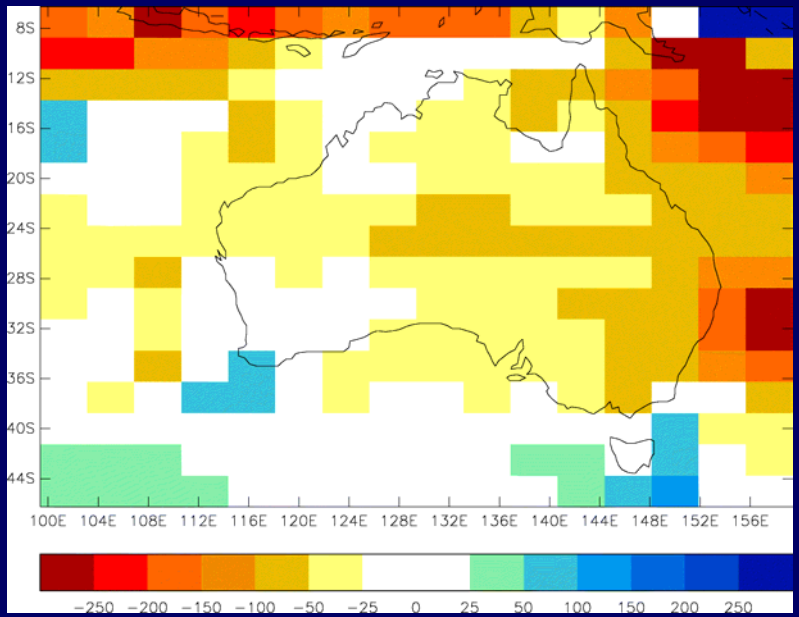
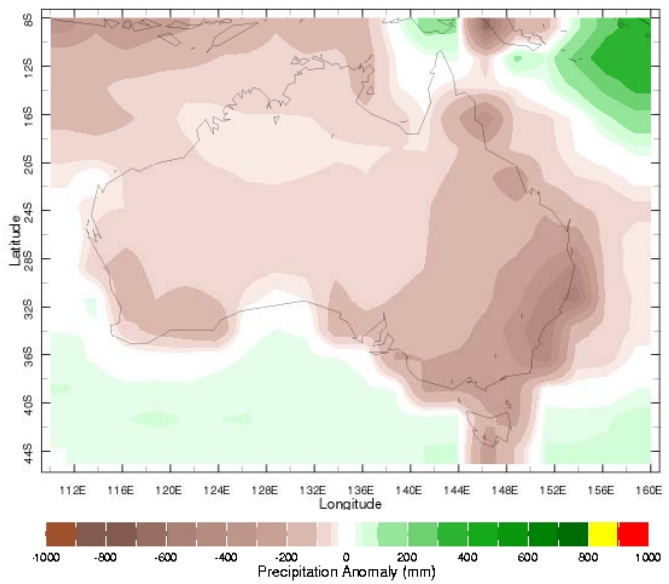
Accumulated rainfall anomaly (mm), Apr - Oct 2002

Forecast
monthly data at 2-month lead



Observed



Australian Drought

Nearly 70% of Australia experienced April-October 2002 rainfall in the lowest 5% to 10% of the historical record for the period. In terms of extent and mean percentile, it was the **driest 7-month period** observed for the country as a whole. The areas most seriously affected are in the southern half of the country. (Australian BOM)

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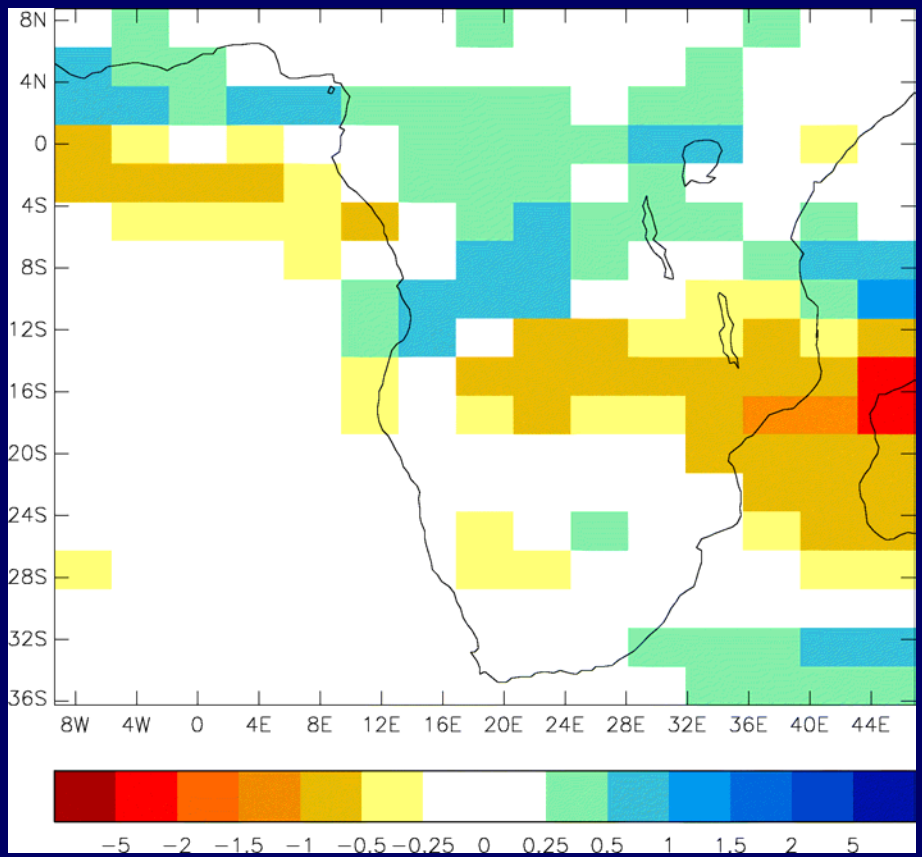
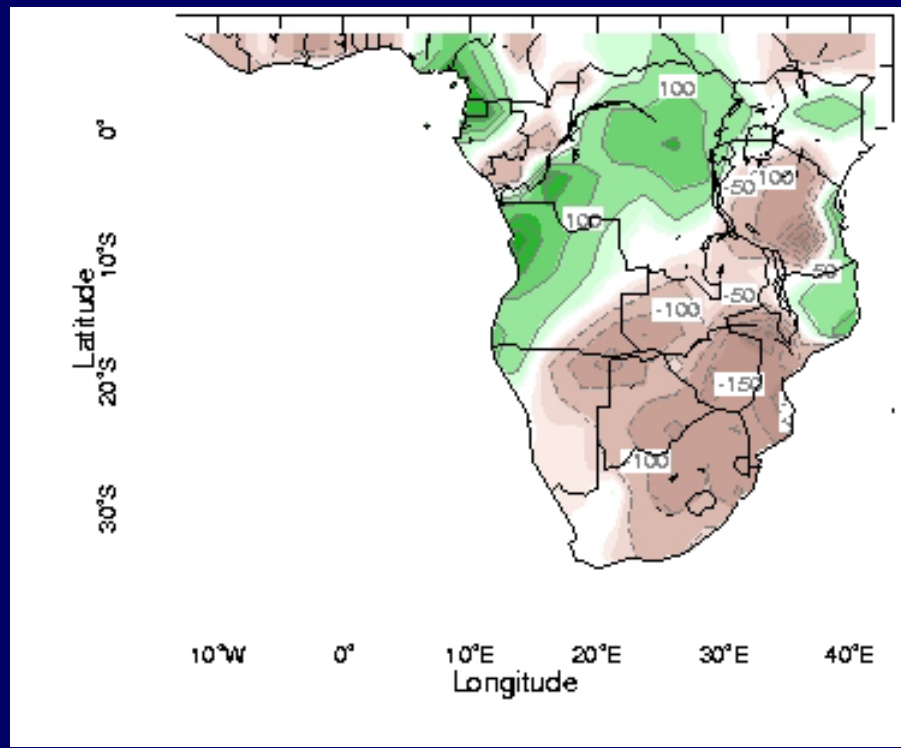
Accumulated rainfall anomaly, Jan-Apr 2002

Forecast: Jan - Apr, Jan start



Observed



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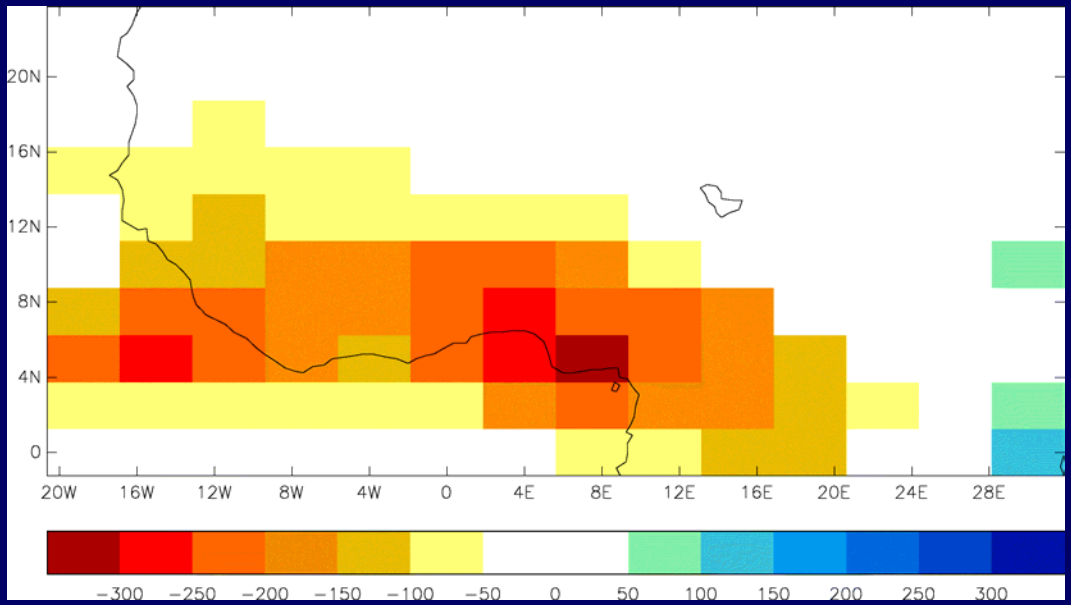
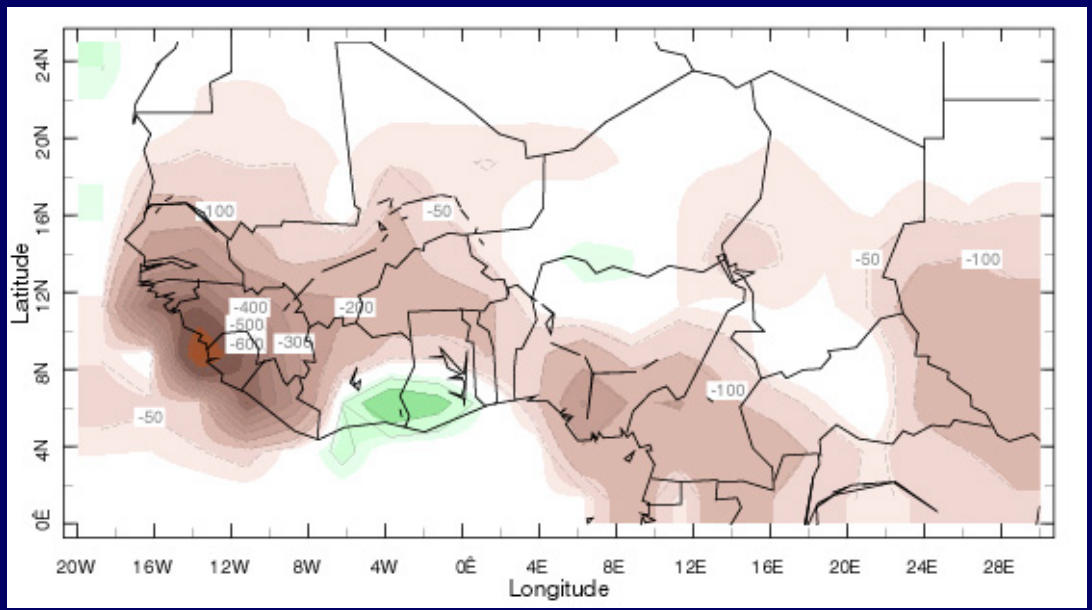
Accumulated rainfall anomaly (mm), Jul - Sep 2002



Forecast
JAA, June start



Observed

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Summary

- Currently keeping close to production of ERA 40
- Large variance of SST in regions Nino3 and Nino4
- Large ensemble spread in forecasts of tropical Pacific SST
- Real-time forecast model has performed well in west Pacific, the central and east Pacific SST was too cool in late summer/early autumn
- Some success with real-time forecasts of climate events in 2002

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