

# **ECMWF activities - a very brief summary**

**Tim Stockdale**

# Outline

- **Seasonal forecasting – System 4**
  - Nice results
  - Frontiers for development
- **Multi-model forecasting – EUROSIP**
  - Operational systems
  - Combination and calibration

# ECMWF System 4

- **IFS (atmosphere)**

- T<sub>L</sub>255 L91
- ERA interim/operational analyses

- **NEMO (ocean)**

- Global ocean model, 1x1 mid-latitude resolution, 0.3 near equator
- NEMOVAR analyses

- **HTESSSEL (land)**

- Custom initial conditions

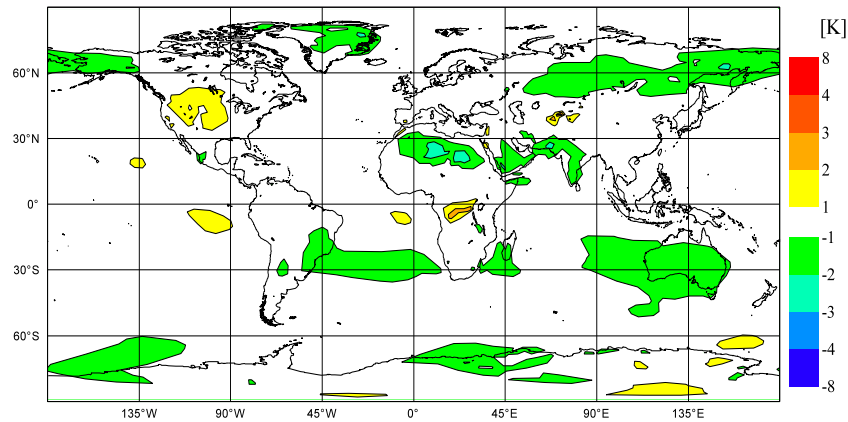
- **Forecast configuration**

- 51 member forecasts, 15 member re-forecasts
- 1981-2010 re-forecast period (30 years)

# Reduced mean state errors

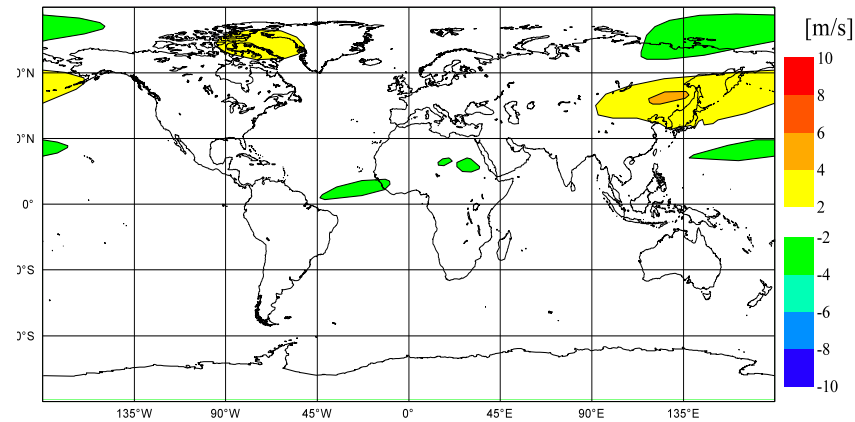
**T850**

850hPa temperature S4(15)-ERA Int 1991-2008 JJA  
Global rms error: 0.663 NH:0.669 TR:0.662 SH:0.66



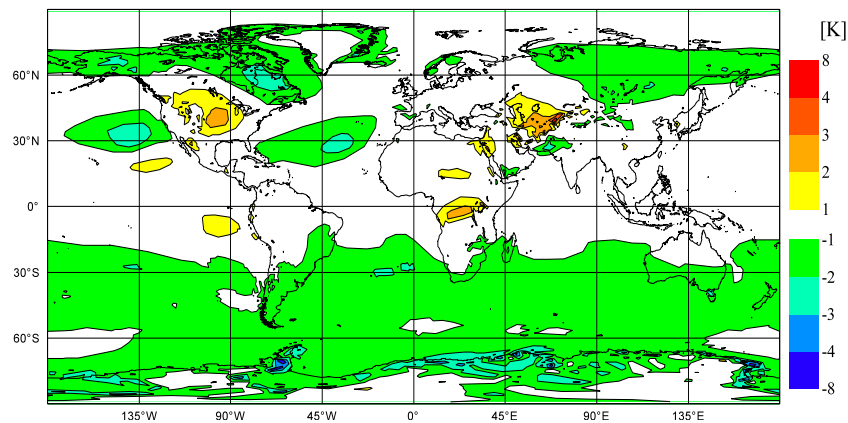
**U50**

50hPa zonal wind S4(15)-ERA Int 1991-2008 DJF  
Global rms error: 1 NH:1.43 TR:0.853 SH:0.72

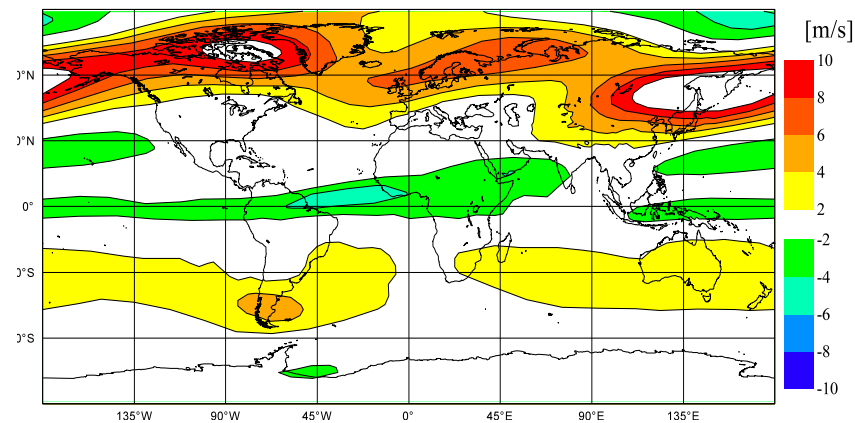


**S4**

850hPa temperature S3(11)-ERA Int 1991-2008 JJA  
Global rms error: 1.07 NH:1.06 TR:0.798 SH:1.48



50hPa zonal wind S3(11)-ERA Int 1991-2008 DJF  
Global rms error: 3.26 NH:5.53 TR:2.02 SH:2.03

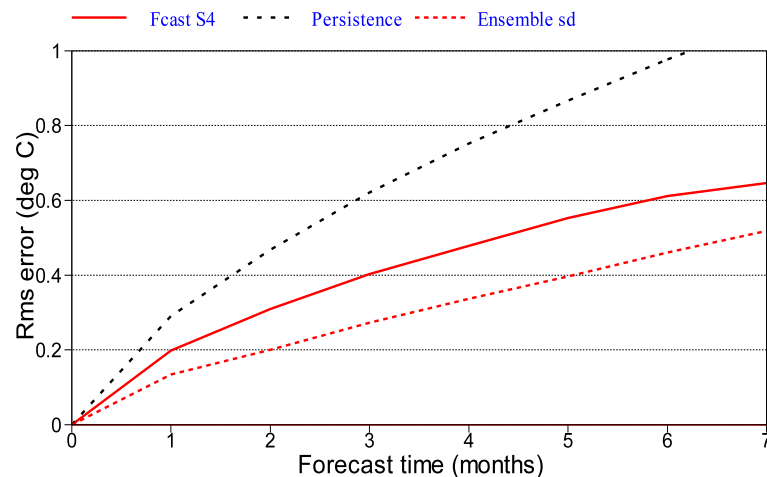


**S3**

# More recent ENSO forecasts are better ....

## NINO3.4 SST rms errors

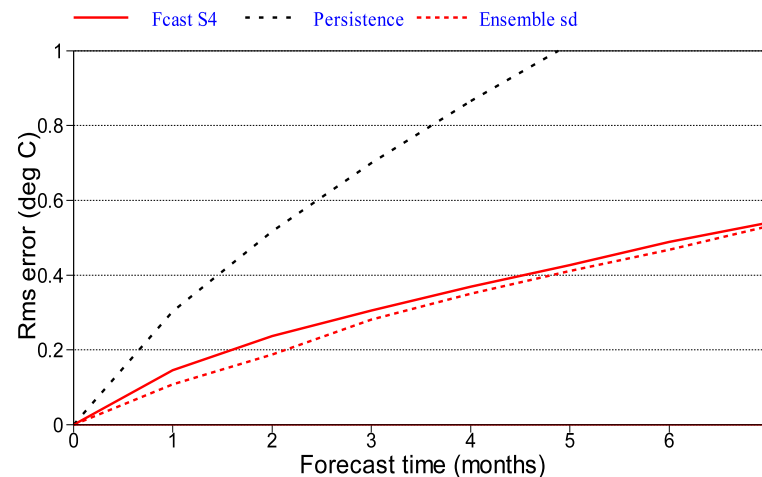
180 start dates from 19810101 to 19951201, amplitude scaled  
Ensemble size is 15  
95% confidence interval for 0001, for given set of start dates



1981-1995

## NINO3.4 SST rms errors

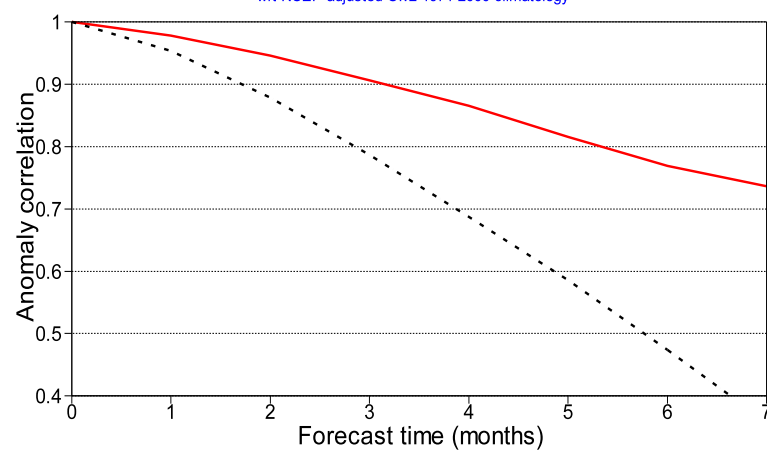
180 start dates from 19960101 to 20101201, amplitude scaled  
Ensemble size is 15  
95% confidence interval for 0001, for given set of start dates



1996-2010

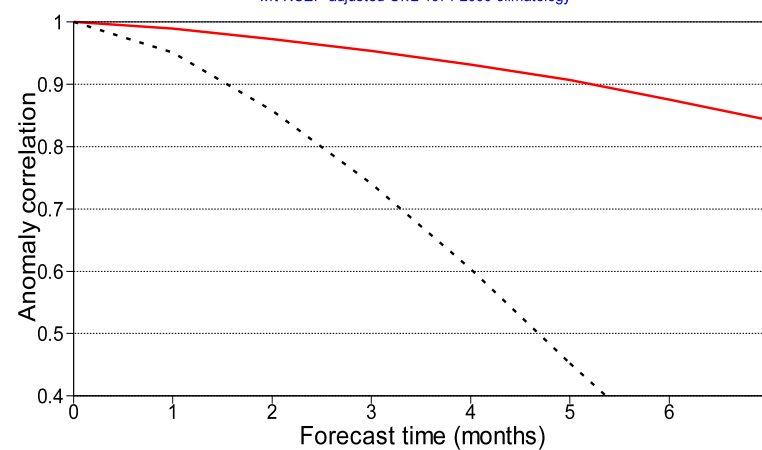
## NINO3.4 SST anomaly correlation

wrt NCEP adjusted Olv2 1971-2000 climatology



## NINO3.4 SST anomaly correlation

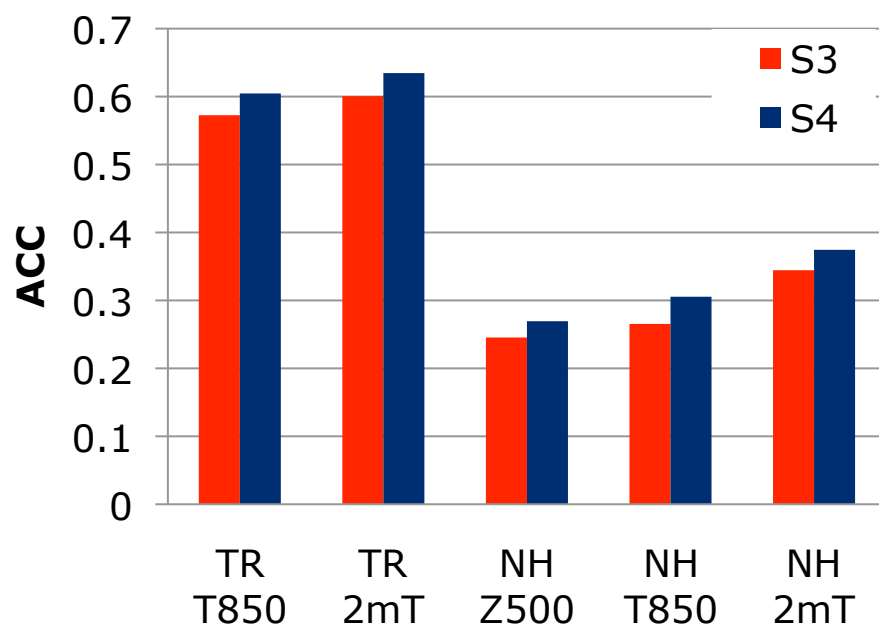
wrt NCEP adjusted Olv2 1971-2000 climatology



# Tropospheric scores

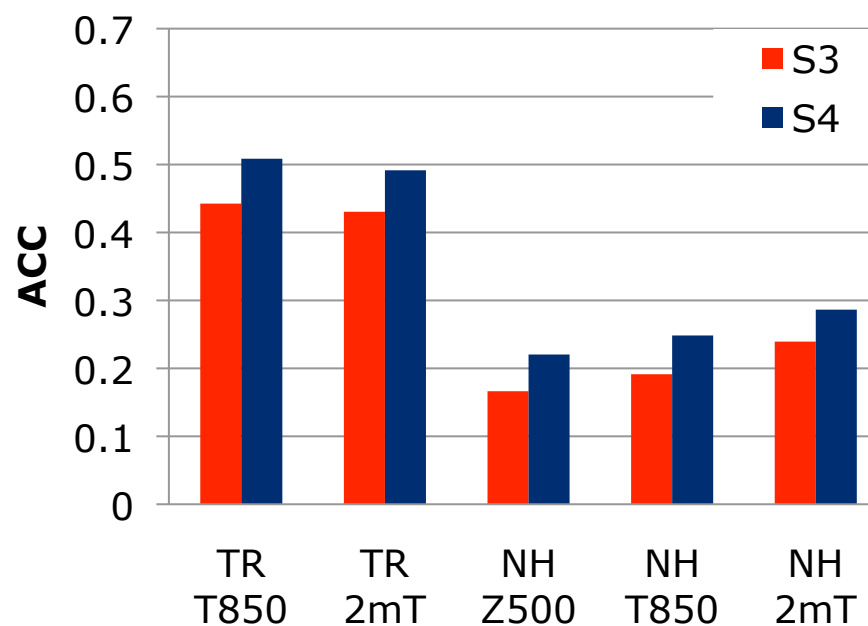
Spatially averaged grid-point temporal ACC, all 12 start months

**ACC S3 and S4 (m2-4; 30y)**



**One month lead**

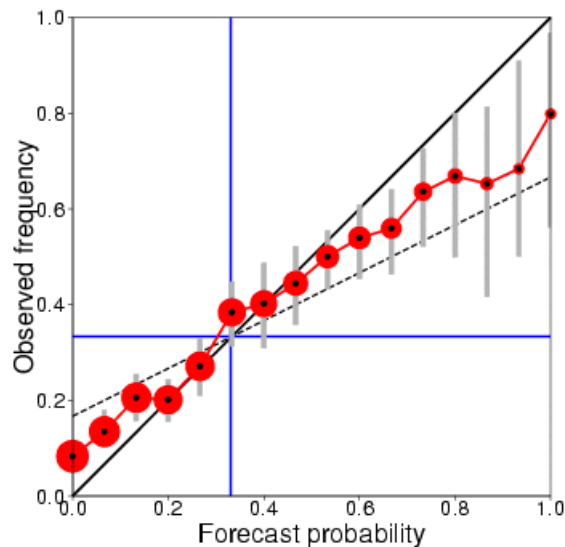
**ACC S3 and S4 (m5-7; 30y)**



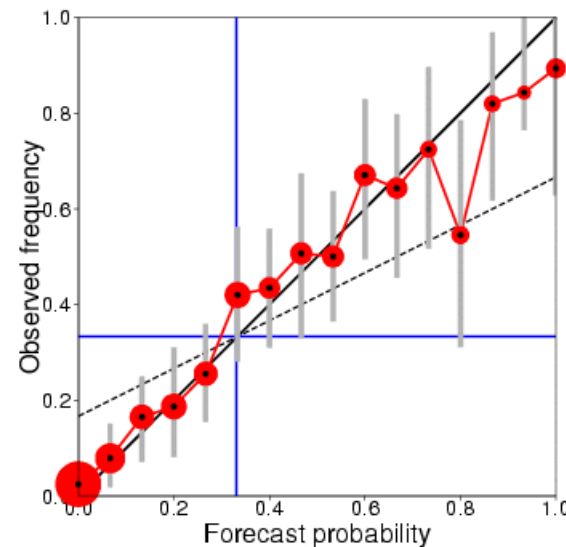
**Four month lead**

# Probabilistic scores: Tropics

**Reliability diagram for ECMWF with 15 ensemble members**  
**Near-surface air temperature anomalies above the upper tercile**  
**Accumulated over Africa (land points only)**  
**Hindcast period 1981-2010 with start in May average over months 2 to 4**  
**Skill scores and 95% conf. intervals ( 1000 samples)**  
Brier skill score: 0.129 ( 0.023, 0.202)  
Reliability skill score: 0.975 ( 0.925, 0.988)  
Resolution skill score: 0.154 ( 0.093, 0.219)



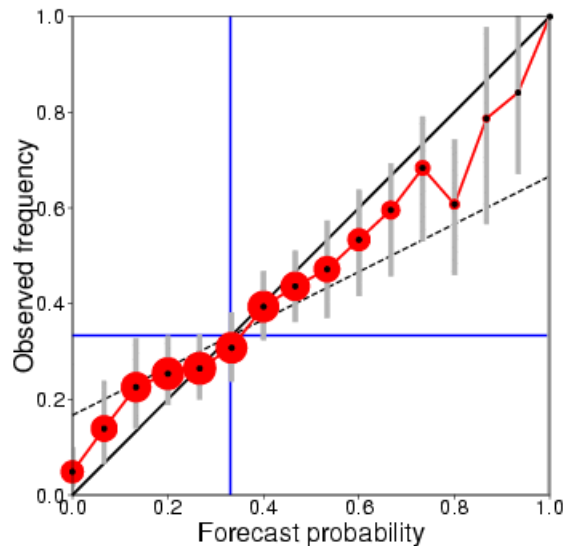
**Reliability diagram for ECMWF with 15 ensemble members**  
**Near-surface air temperature anomalies above the upper tercile**  
**Accumulated over Southeast Asia (land points only)**  
**Hindcast period 1981-2010 with start in May average over months 2 to 4**  
**Skill scores and 95% conf. intervals ( 1000 samples)**  
Brier skill score: 0.328 ( 0.158, 0.451)  
Reliability skill score: 0.982 ( 0.921, 0.987)  
Resolution skill score: 0.346 ( 0.226, 0.474)



# Probabilistic scores: Europe

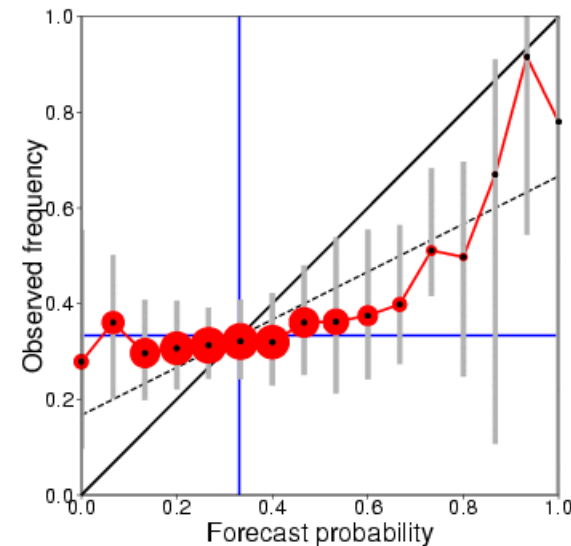
## S4: JJA 2mT from 1<sup>st</sup> May

Reliability diagram for ECMWF with 15 ensemble members  
Near-surface air temperature anomalies above the upper tercile  
Accumulated over Europe (land and sea points)  
Hindcast period 1981-2010 with start in May average over months 2 to 4  
Skill scores and 95% conf. intervals ( 1000 samples)  
Brier skill score: 0.092 ( 0.007, 0.162)  
Reliability skill score: 0.986 ( 0.950, 0.994)  
Resolution skill score: 0.106 ( 0.056, 0.173)



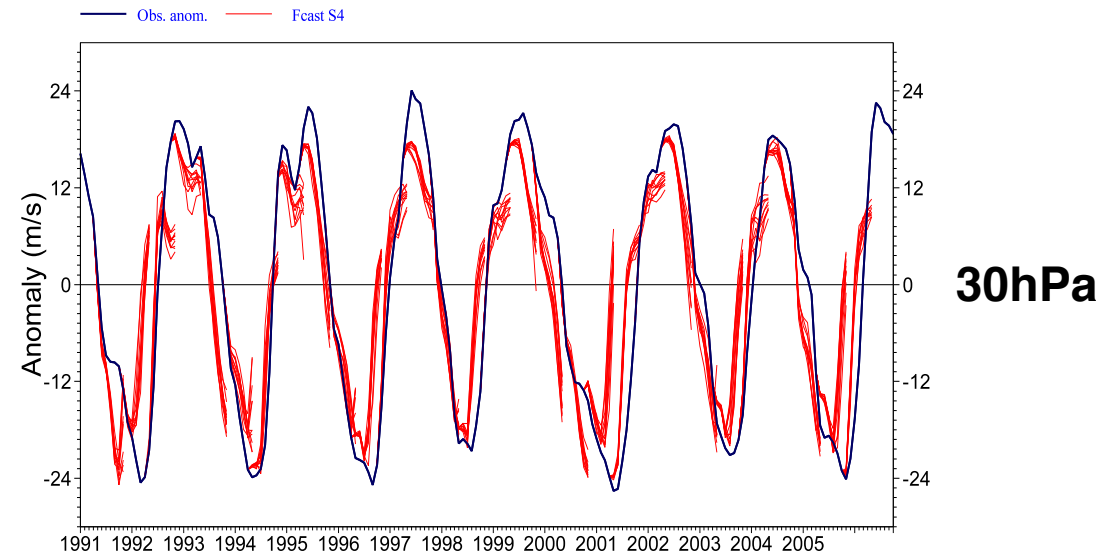
## S4: DJF 2mT from 1<sup>st</sup> Nov

Reliability diagram for ECMWF with 15 ensemble members  
Near-surface air temperature anomalies above the upper tercile  
Accumulated over Europe (land and sea points)  
Hindcast period 1981-2010 with start in November average over months 2 to 4  
Skill scores and 95% conf. intervals ( 1000 samples)  
Brier skill score: -0.081 (-0.191, 0.011)  
Reliability skill score: 0.908 ( 0.790, 0.965)  
Resolution skill score: 0.011 ( 0.006, 0.053)

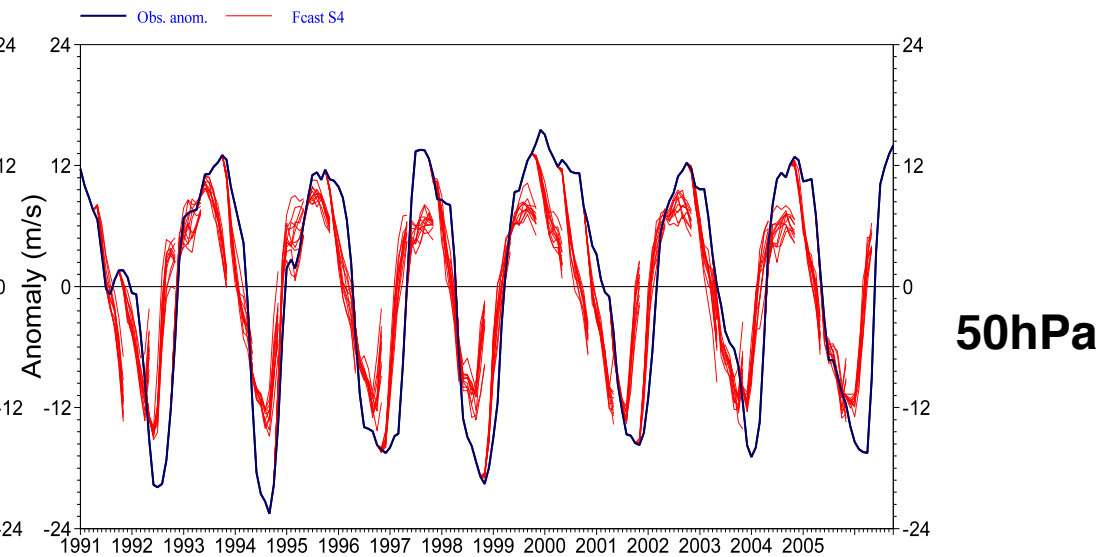
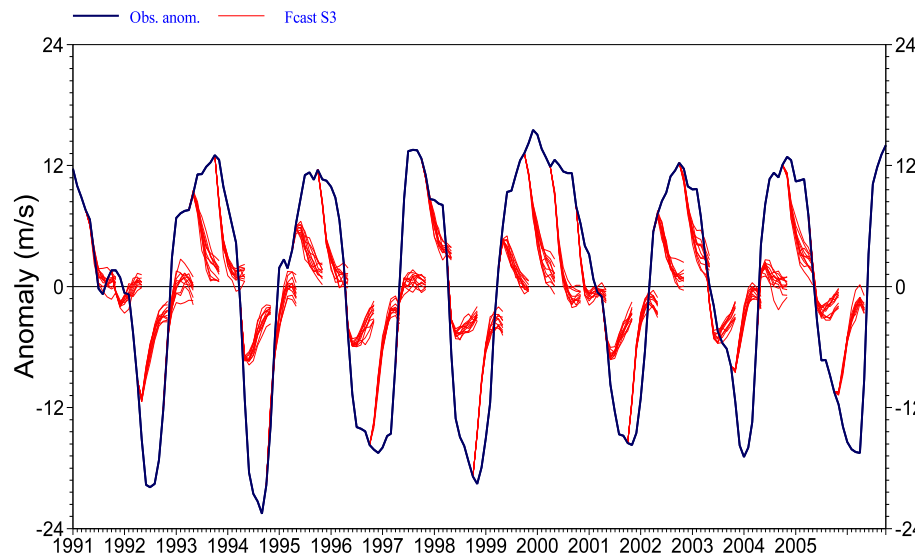




## System 4



## System 3



# Volcanic winters

Difference: f2v - System 3

Mean 2m temperature anomaly

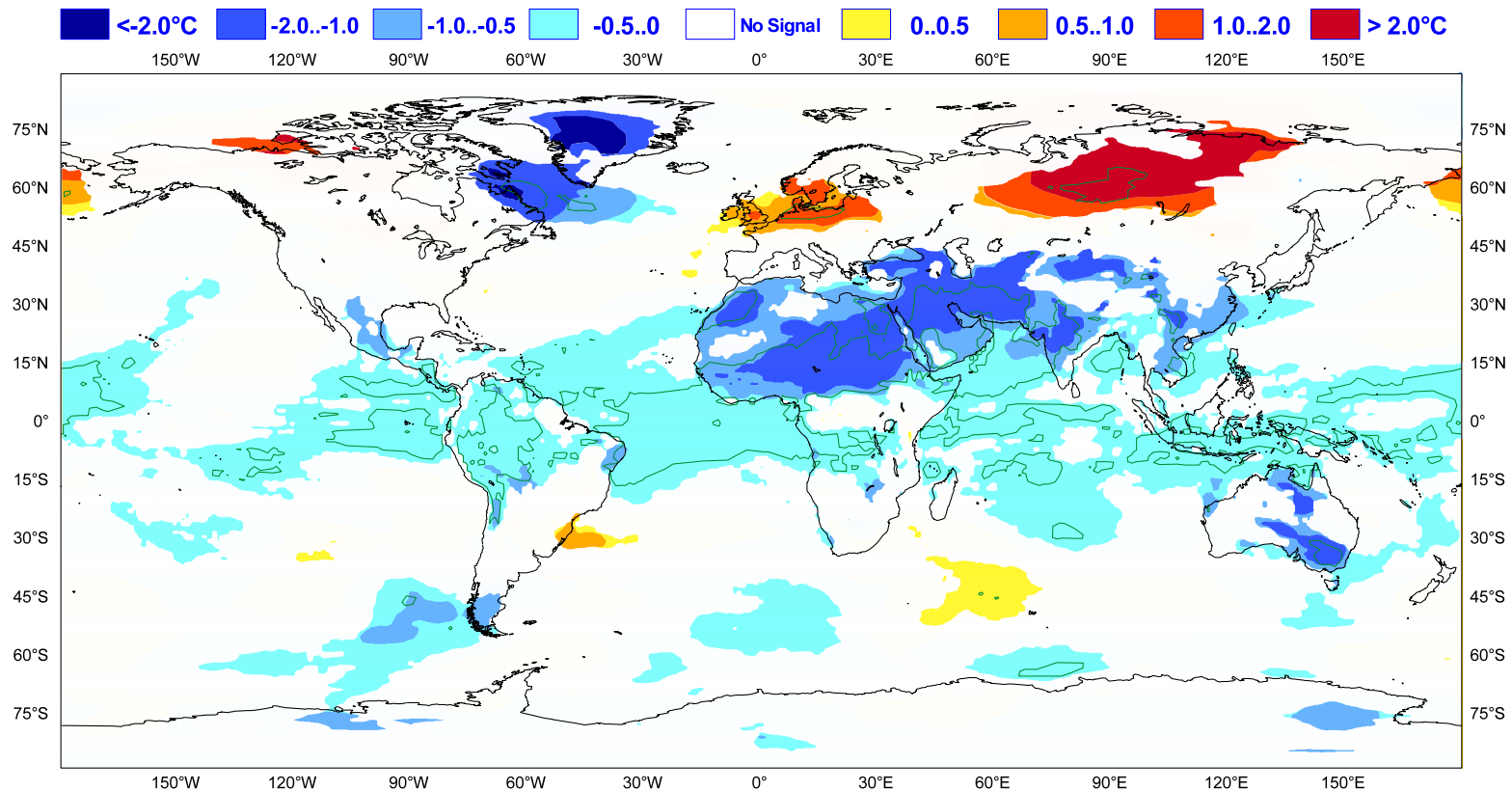
Forecast start reference is 01/11/91

Ensemble size = 11, climate size = 11

DJF 1991/92

Shaded areas significant at 10% level

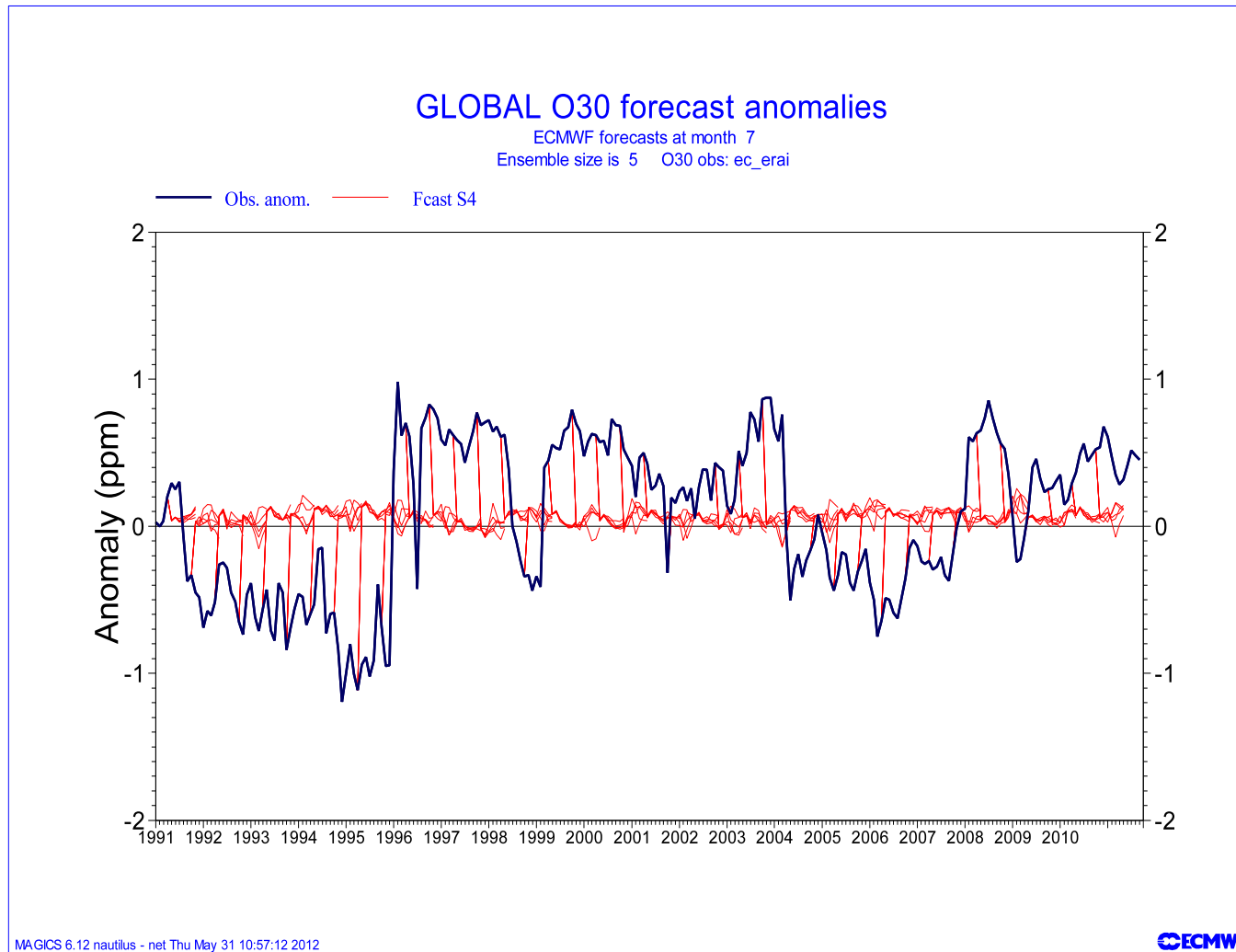
Solid contour at 1% level



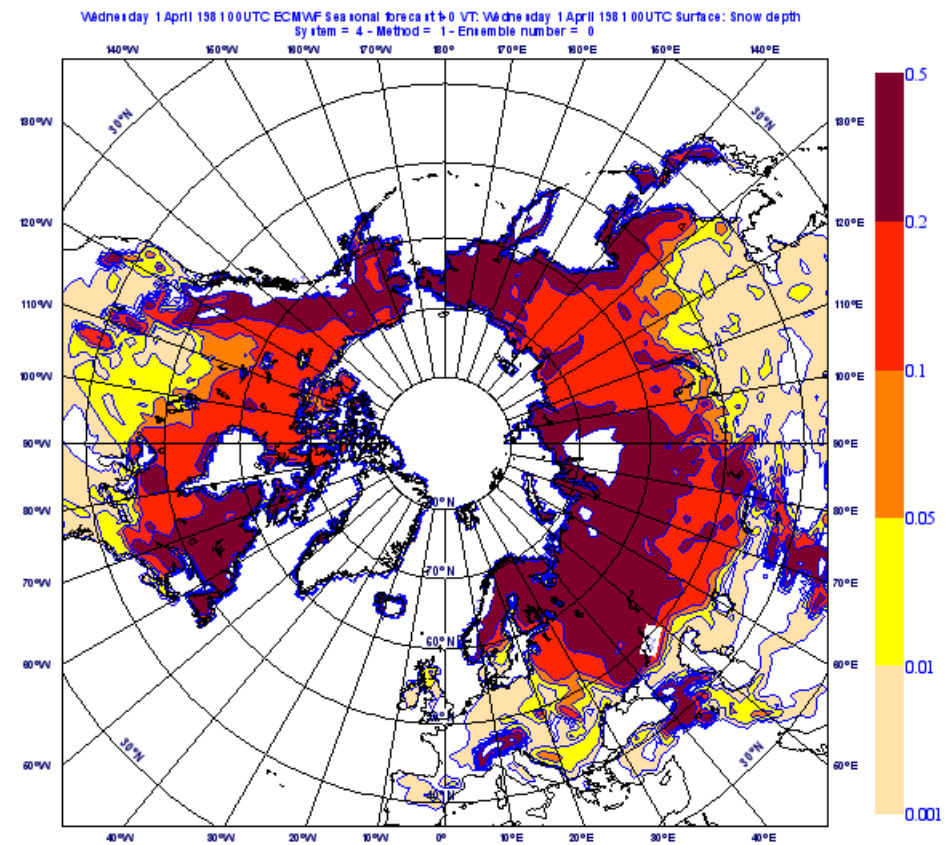
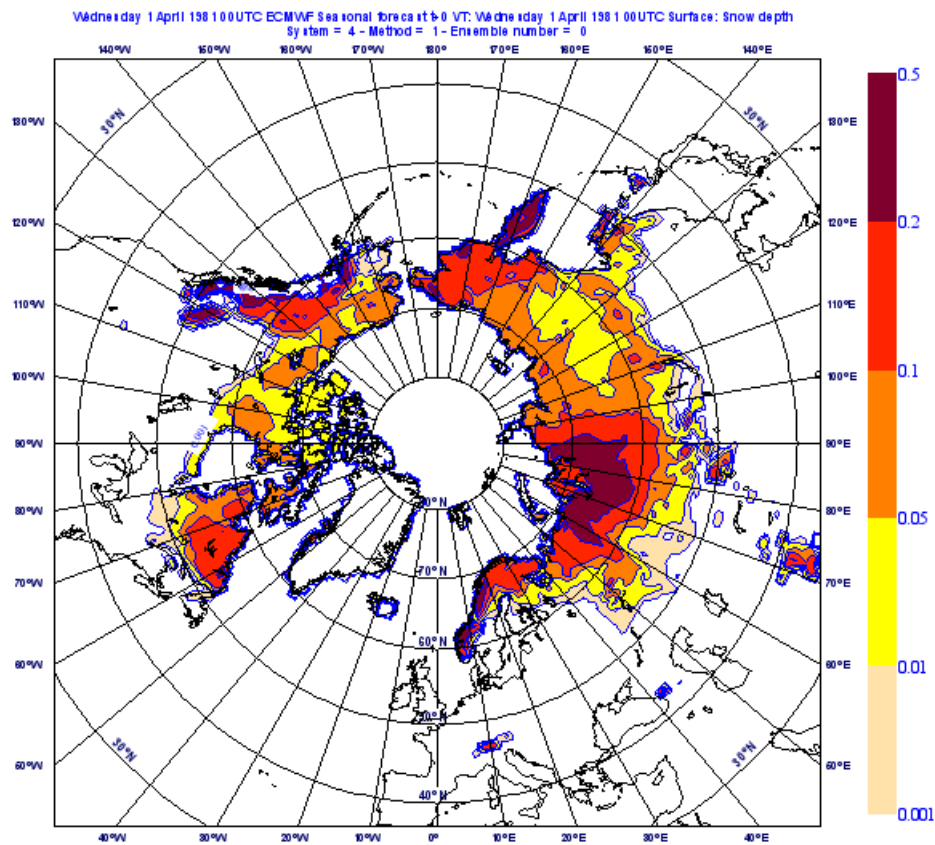
Produced from hindcast data

ECMWF

# Problematic ozone analyses

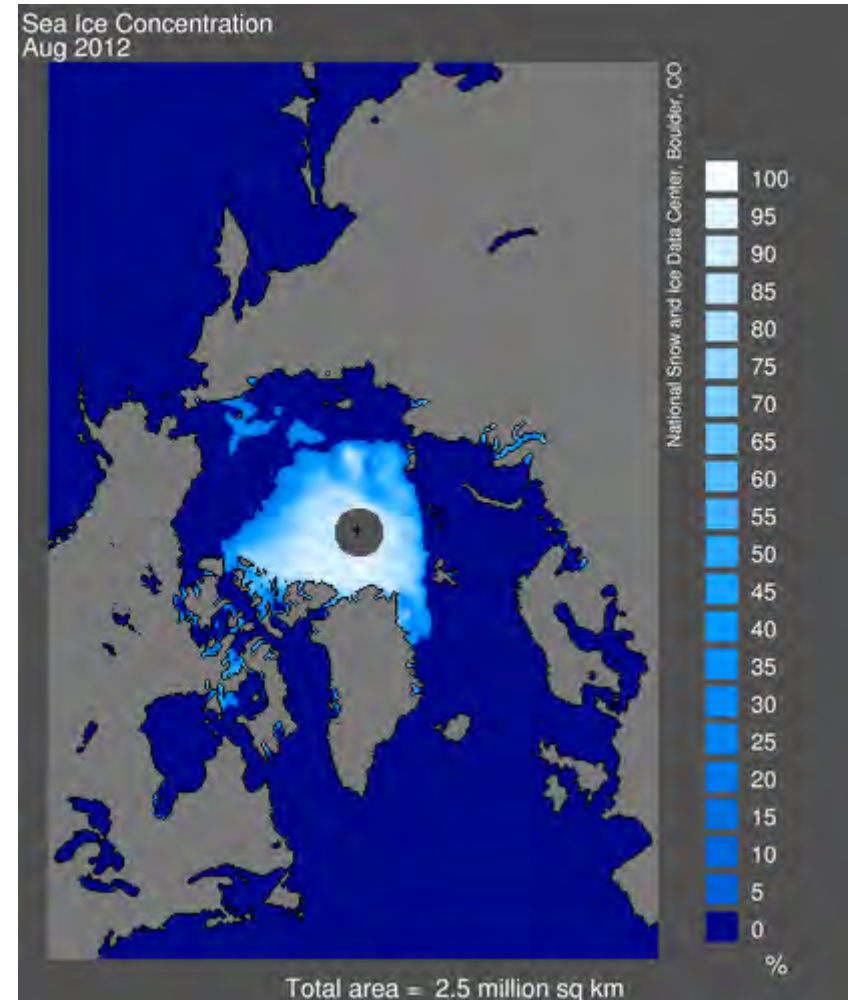
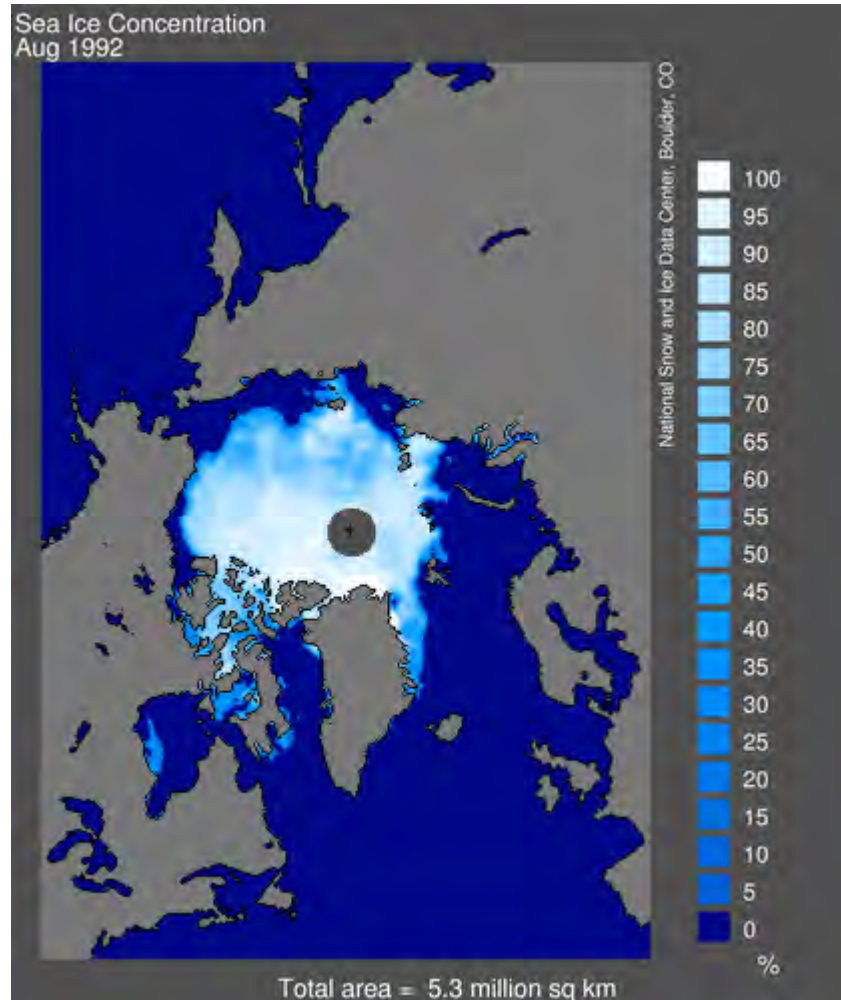


# Land surface



Snow depth limits, 1<sup>st</sup> April

# Sea ice

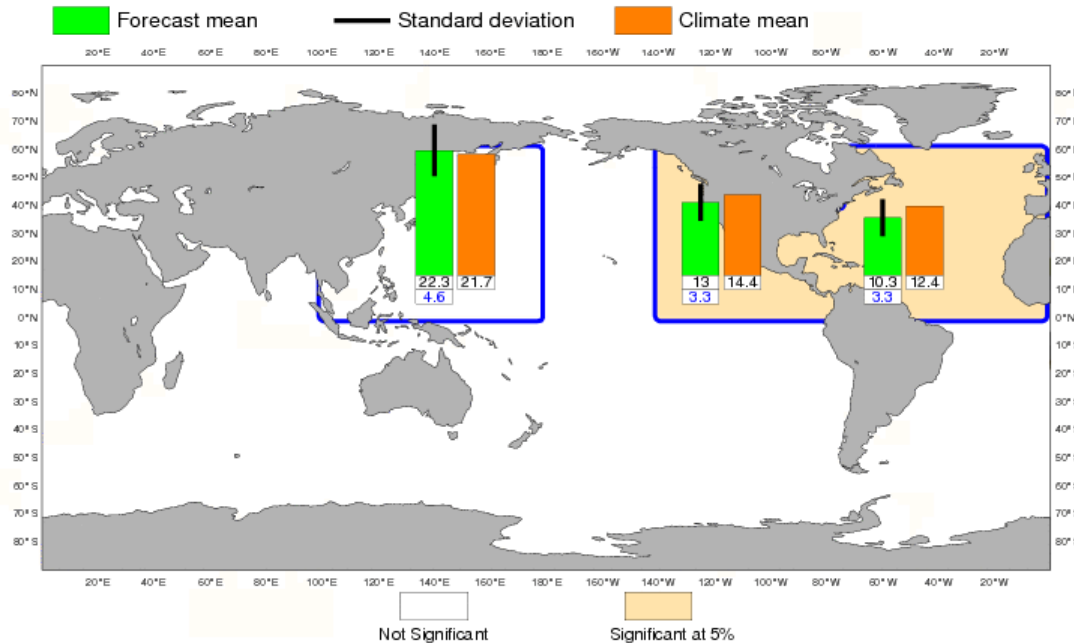




# Tropical storm forecasts

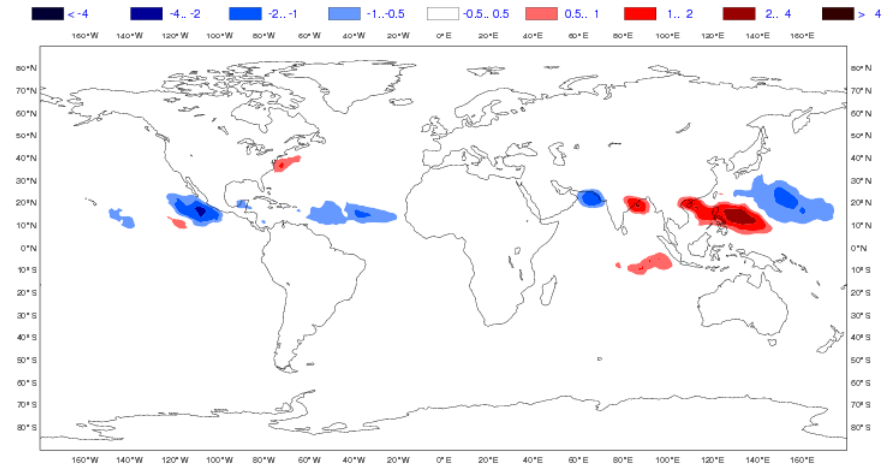
ECMWF Seasonal Forecast  
Tropical Storm Frequency  
Forecast start reference is 01/05/2012  
Ensemble size = 51, climate size = 300

System 4  
JJASON 2012  
Climate (initial dates) = 1990-2009



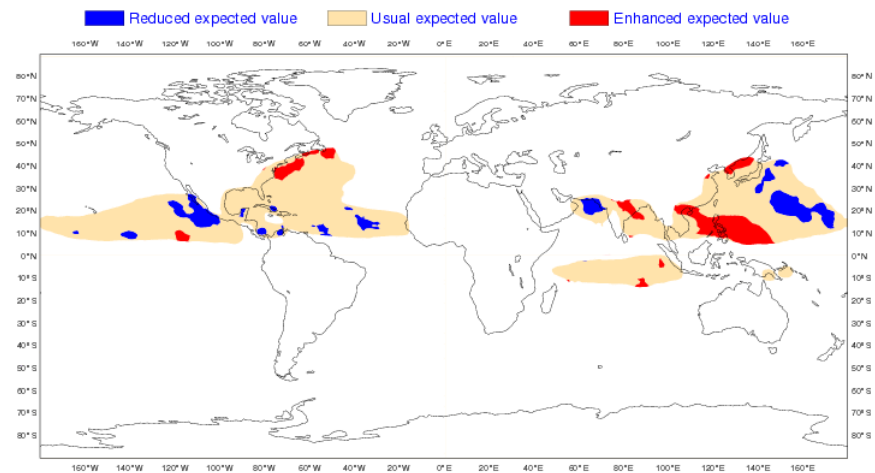
ECMWF Seasonal Forecast  
Tropical Storm Density Anomaly  
Forecast start reference is 01/05/2012  
Ensemble size = 51, climate size = 300

System 4  
JJASON 2012  
Climate (initial dates) = 1990-2009



ECMWF Seasonal Forecast  
Standardized Tropical Storm Density  
Forecast start reference is 01/05/2012  
Ensemble size = 51, climate size = 300

System 4  
JJASON 2012  
Climate (initial dates) = 1990-2009



# EUROSIP multi-model ensemble

- **ECMWF S4**

- **Met Office S7**

- Major upgrade expected in November, including high resolution ocean
- Still have limited re-forecast set (14 years)

- **Météo-France S3**

- System 4 is ready, but last minute problem with land initial conditions has delayed implementation.

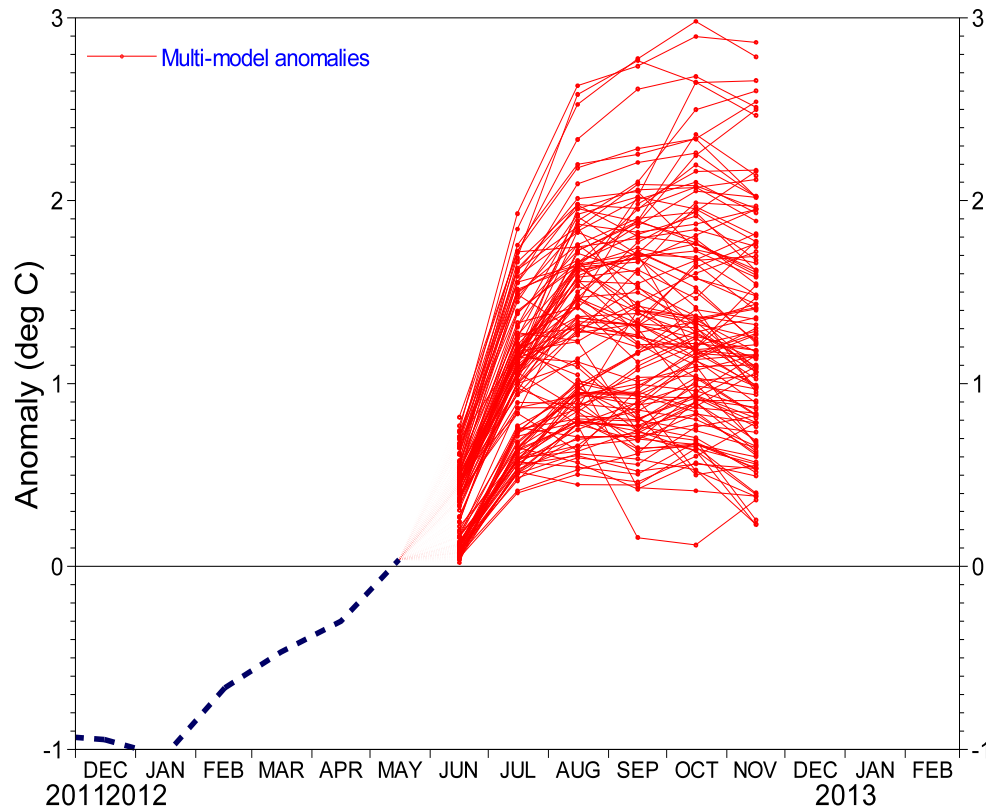
- **NCEP S2 (CFSv2)**

- Now included in operational multi-model system
- Issues with re-forecasts – Nino plumes only use data from 1999 onwards for calibration (NCEP recommend “split climatology”).

# Revised Nino plumes

NINO3.4 SST anomaly plume  
EUROSIP multi-model forecast from 1 Jun 2012

ECMWF, Met Office, Météo-France  
Monthly mean anomalies relative to NCEP adjusted Olv2 1971-2000 climatology

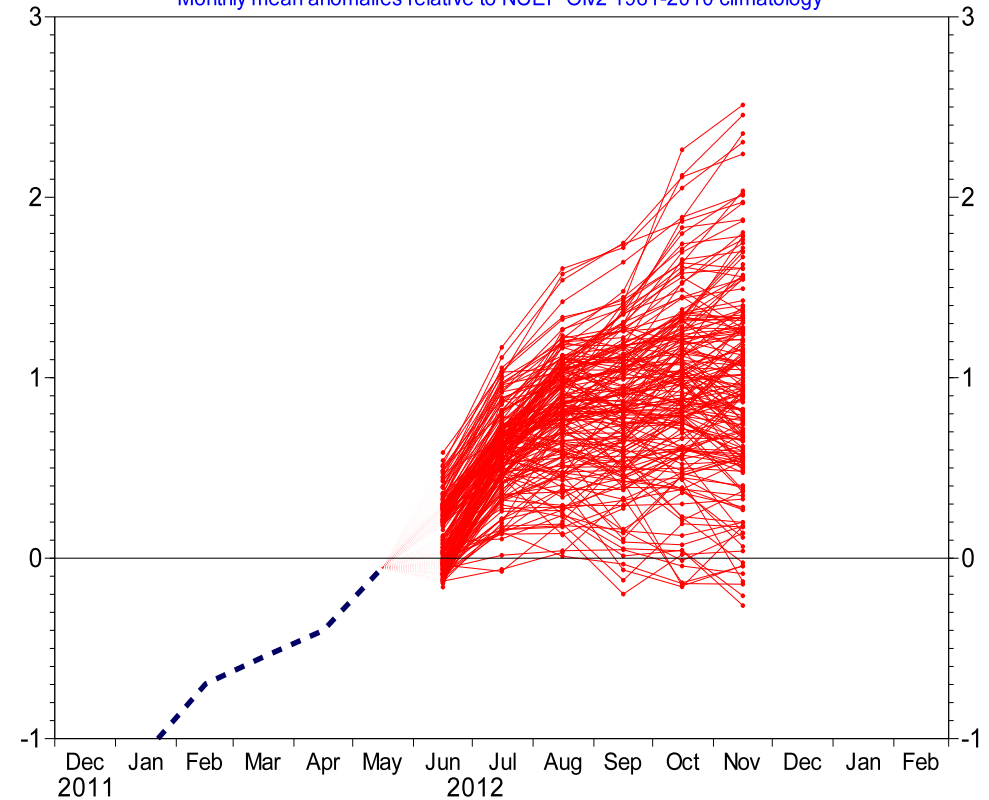


Forecast issue date: 15 Jun 2012



NINO3.4 SST anomaly plume  
EUROSIP multi-model forecast from 1 Jun 2012

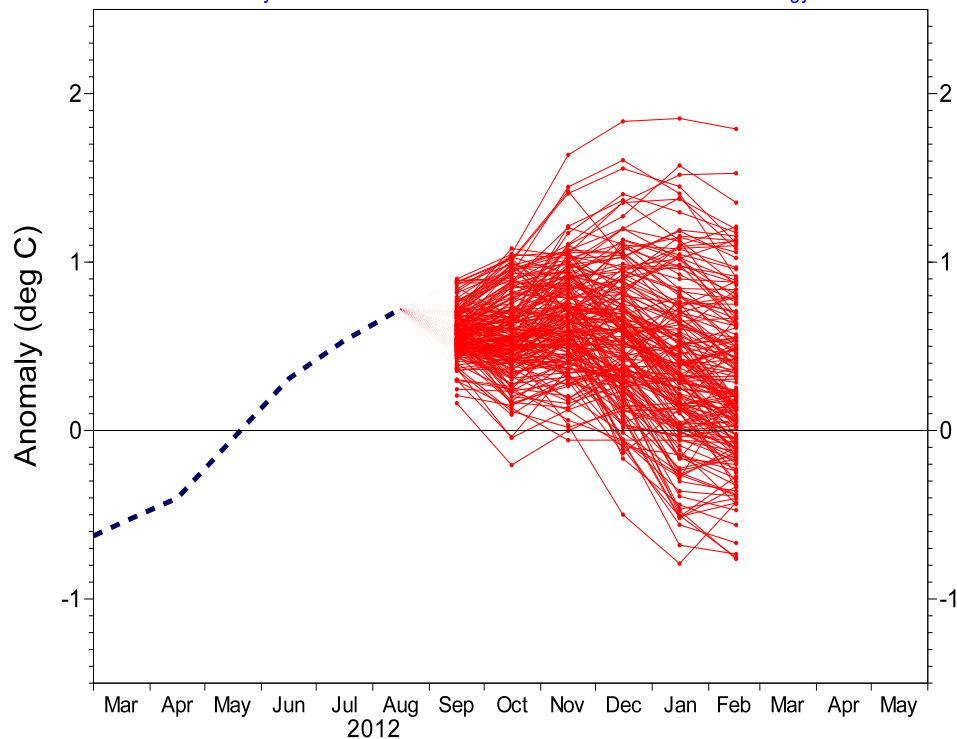
ECMWF, Met Office, Météo-France, NCEP  
Monthly mean anomalies relative to NCEP Olv2 1981-2010 climatology





# Calibrated p.d.f.

NINO3.4 SST anomaly plume  
EUROSIP multi-model forecast from 1 Sep 2012  
ECMWF, Met Office, Météo-France, NCEP  
Monthly mean anomalies relative to NCEP Olv2 1981-2010 climatology



NINO3.4 SST calibrated pdf  
EUROSIP multi-model forecast from 1 Sep 2012  
ECMWF, Met Office, Météo-France, NCEP  
Percentiles at 2%, 10%, 25%, 50%, 75%, 90% and 98%

