Class 4 Global Forecasting Centre Intercomparison

A. Ryan[1], A. Sellar[1], M. Martin[1], P. Divakaran[2], G. Brassington[2], T. Spindler[3], A. Mehra[3], A. Santana[4], C. Tanajura[4], C. Regnier[5], L. Zawadzki[5], G. Smith[6], F. Davidson[7], Y. Liu[7]

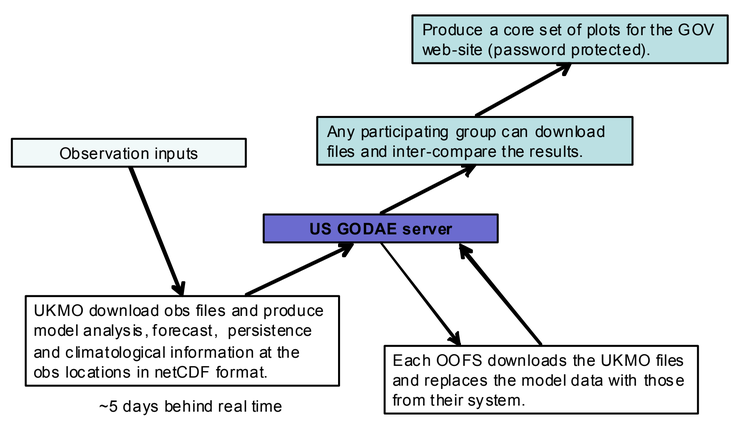
[1]UK Met Office, Exeter, UK
[2]Bureau of Meteorology, Melbourne, Australia
[3]NOAA/NCEP, Washington, USA
[4]UFBA,Brazil
[5]Mercator-Ocean, Toulouse, France
[6]Environment Canada (EC), Dorval, Canada
[7]Fisheries and Oceans Canada (DFO), St. John's Canada

Abstract

The Intercomparison and Validation Task Team (IV-TT) is initiating a routine inter-comparison of the forecast accuracy of GODAE OceanView systems. The intercomparison is based on GODAE class 4 metrics, which consist of model counterparts in observation space. Participating forecast centres are supplying model counterparts to a common set of observations, delivered within a few days of the operational forecast to enable near real time forecast accuracy monitoring. The observation data sets are: surface in-situ SST drifters supplied by USGODAE, ARGO Temperature and Salinity profiles supplied by MyOcean and Altimeter satellite data (Jason-1/2, Envisat & Cryosat). At the time of writing, participating operational oceanography forecast systems include FOAM from the UK Met Office, RTOFS-HYCOM from NOAA/NCEP, USA, OMAPS from BlueLink, Australia, ATLe0.25-HYCOM from REMO, Brazil, GIOPS-CONCEPTS from Canada Environment and PSY3 from Mercator-Ocean, France. We will present results from an investigation of summary statistics and accuracy metrics both globally and in regions of interest, which reveals interesting features of each operational forecast system.

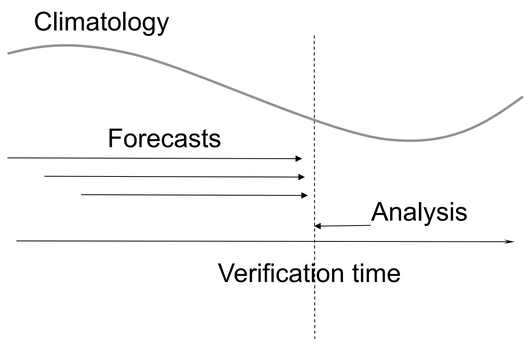
Operational implementation

1. Class 4 inter-comparison
Overview



Theoretical methodology

For each observation an offline observation operator maps the various forecast systems to observation space.



Participating centres

Institution	*System*	*Ocean Model*	*Resolution*
UK Met Office	**FOAM**	NEMO	¼ degree
Bureau of Meteorology	**OceanMAPS**	mom4p1	1 degree (1/10 around Australia)
NOAA/NWS/NCEP/EMC/MMAB	**RTOFS**	HYCOM	1/12 degree
Mercator-Ocean	**PSY3**	NEMO	¼ degree
Canadian Meteorological Centre	**CONCEPTS-GIOPS**	NEMO	¼ degree
REMO	**HYCOM**	ATLe0.25	¼ degree (Atlantic only)

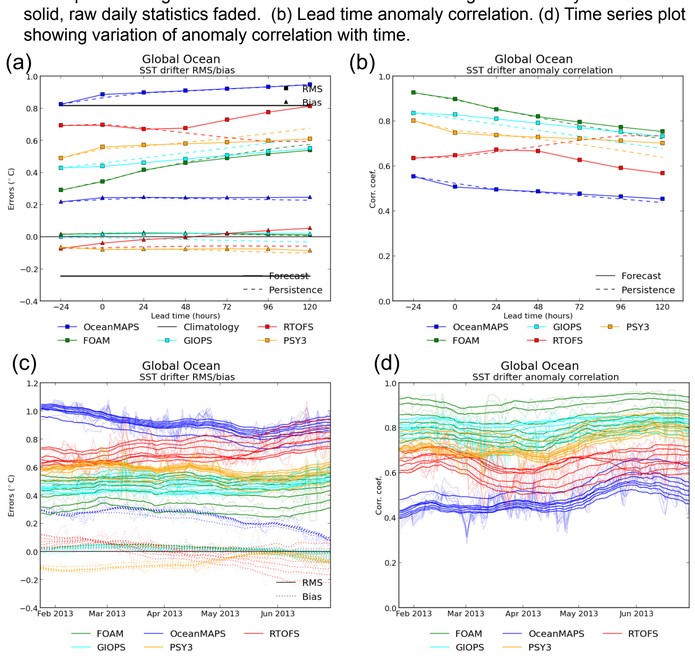
System upgrades

Institution	System	Version change	Change date
UK Met Office	FOAM	V1 → V12	15th Jan 2013
Bluelink	OceanMAPS	2.1 → 2.2	12th Feb 2013
Mercator-Ocean	PSY3V3	R1 → R3	1st May 2013

Note: The change in skill due to these upgrades has been pooled.

SST in-situ observations

Figure 1 a-d: (a) Lead time RMS/bias against USGODAE SST drifting buoys. (c) Time series plot showing variation of RMS/bias with time. Rolling mean 30-day window in solid, raw daily statistics faded. (b) Lead time anomaly correlation. (d) Time series plot showing variation of anomaly correlation with time.



-Surface temperature measurements courtesy of USGODAE

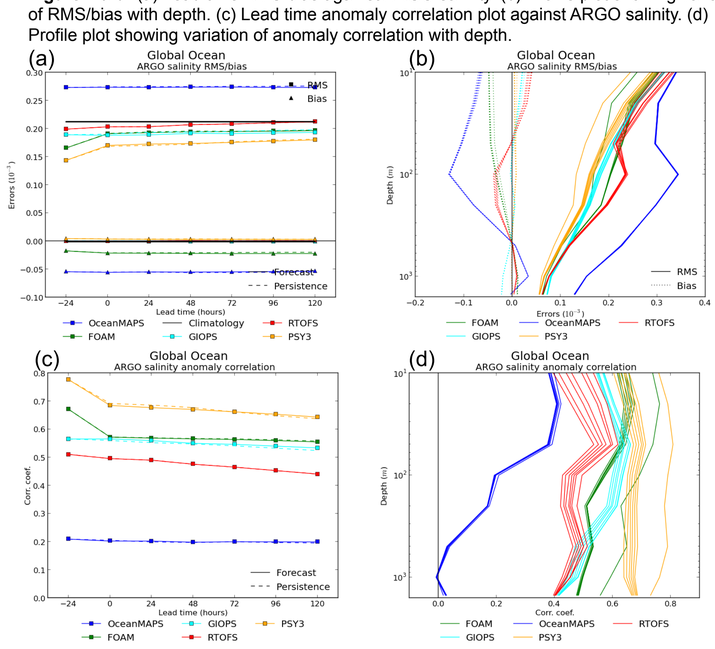
-FOAM forecasts are the most accurate global forecast system until forecast day 4 when GIOPS achieves the same forecast RMS.

-PSY3 forecasts exhibit sharp rise in RMS between the "best estimate" and forecast.

-RTOFS has a curious forecast trend against SST in which it's forecast error growth rate accelerates after forecast day 3.

ARGO Temperature and Salinity

Figure 2 a-d: (a) Lead time RMS/bias against ARGO salinity. (b) Profile plot showing variation of RMS/bias with depth. (c) Lead time anomaly correlation plot against ARGO salinity. (d) Profile plot showing variation of anomaly correlation with depth.



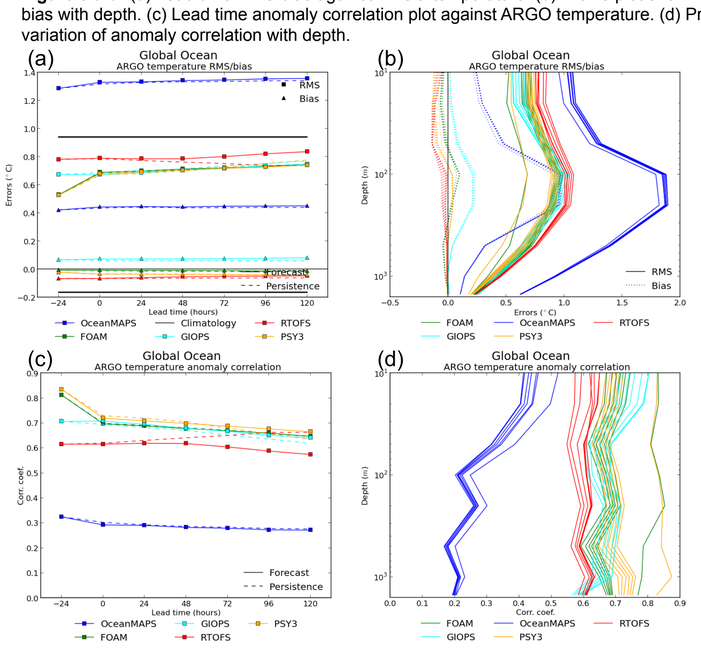
-PSY3 has the lowest RMS and highest anomaly correlation

-GIOPS and PSY3 errors decrease more rapidly with depth than FOAM.

-RTOFS and OceanMAPS RMS peaks in the calculation layer centered at 100m before decreasing with depth

-FOAM and PSY3 best estimate skill is far higher than their forecast skill

Figure 3 a-d: (a) Lead time RMS/bias against ARGO temperature. (b) Profile plot showing variation of RMS/bias with depth. (c) Lead time anomaly correlation plot against ARGO temperature. (d) Profile plot showing variation of anomaly correlation with depth.



-BLUELink's OceanMAPS temperature bias peaks between 100m-200m.

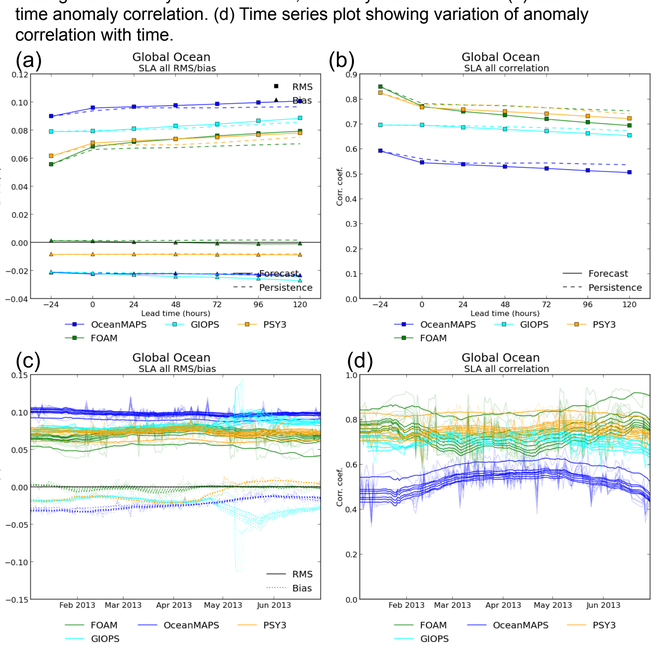
-GIOPS surface errors are lower than FOAM and PSY3 forecasts, however it's errors below 100m eliminate this gain.

-RTOFS, PSY3 and FOAM are cold biased throughout the water column

-GIOPS and OceanMAPS have significant warm biases.

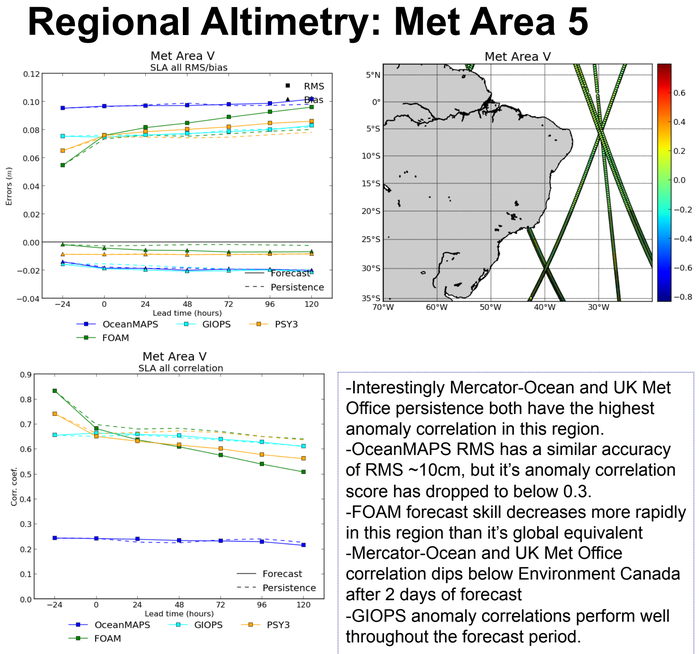
Global Altimetry

Figure 4 a-d: (a) Lead time RMS/bias against AVISO Altimeters. Jason-1,2 and Cryosat (c) Time series plot showing variation of RMS/bias with time. Rolling mean 30-day window in solid, raw daily statistics faded. (b) Lead time anomaly correlation. (d) Time series plot showing variation of anomaly correlation with time.



-Altimeter measurements from Jason-1, Jason-2 and Cryosat between January and June 2013.
-Mercator and UK Met Office compare most favourably;
-PSY3 exhibits higher forecast correlation
-FOAM has highest correlation and lowest RMS in January and June.
-GIOPS has a 8cm RMS globally and a correlation between 0.6 and 0.7 throughout the forecast period.
-All systems show a seasonal signal in both correlation and RMS.

Regional Altimetry: Met Area 5



-Interestingly Mercator-Ocean and UK Met Office persistence both have the highest anomaly correlation in this region.
-OceanMAPS RMS has a similar accuracy of RMS ~10cm, but it's anomaly correlation score has dropped to below 0.3.
-FOAM forecast skill decreases more rapidly in this region than it's global equivalent
-Mercator-Ocean and UK Met Office correlation dips below Environment Canada after 2 days of forecast
-GIOPS anomaly correlations perform well throughout the forecast period.

Conclusions

Global forecast centres now routinely inter-compare their results against a common set of observations. With the exception of the Australian Bureau of Meteorology (OceanMAPS) system which has been optimised to be most accurate in a region around Australia, all global forecasting systems consistently out perform climatology for SST against in-situ observations and 3D temperature and salinity against ARGO. Sea level anomaly correlations are consistently above 0.6 throughout the forecast cycle. Comparisons against persistence are also quite promising, with the exception of sea level anomaly RMS and anomaly correlations are more accurate than persistence.

These results derived from the first 6 months of this year show significant seasonal trends. A robust inter-comparison requires at least a full year of data. It is also desirable to decompose the results by region and by operational system change to fully understand the utility of each global forecast system.

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Met Office FitzRoy Road, Exeter, Devon, EX1 3PB United Kingdom
Tel: 01392 885680 Fax: 01392 885681
Email: name.name@metoffice.gov.uk