Operational Issues with BLUElink> Ocean Model, Analysis and Prediction System (OceanMAPS)

Graham Warren[1], Gary Brassington[1,2], Mikhail Entel[1], Xinmei Huang[1], Leon Majewski[1], Tim Pugh[1,2], and Claire Spillman[1,2]

[1]Bureau of Meteorology

[2]Centre for Australian Weather and Climate Research

The BLUElink> Ocean Model, Analysis and Prediction System version 1.0b[1] (OceanMAPS) is Australia's first generation ocean forecasting system that has been operational at the Bureau of Meteorology since August 2007[2]. OceanMAPS consists of a sequential procedure analogous to that employed in Numerical Weather Prediction (NWP).

- Collection of observations from both *in situ* and remotely sensed sources
- Preparation of surface forcing fields from the NWP output
- A data assimilation system to provide the best estimate of the initial ocean state
- A numerical ocean circulation model solving the three dimensional equations of motion for a fluid.
- Procedures for managing and serving the data and products from the system

A complete technical specification of the system is available online[3]. The operational system produces a seven day forecast twice per week.

Observation input

The observational input to the system come from *in-situ* data collected under the ship-of-opportunity program (SOOP), the Argo project and moored buoys; and remotely sensed altimetry and sea surface temperature from a series of orbiting satellites.

Some data is automatically generated and transmitted by satellite and distributed on the World Meteorological Organisation (WMO) Global Telecommunications System (GTS) in BATHY and TESAC codes. These messages from around the globe are decoded and stored in the Bureau's Real-time data base (rtdb).

More detailed data from the ARGO program in NetCDF format is obtained by ftp from two Global Data Assembly Centres (GDAC) that were set up as part of GODAE. It has been found that the data obtained from the two GDACs (one in Monterey, CA, USA and the other in Brest, France) are not identical.

All data which is obtained from the GTS (which also includes profiles from moored buoys) is extracted from the rtdb, converted to the ARGO NetCDF format, combined with the Argo data obtained from the two GDACs, and processed by a duplicate checking routine to provide a file of the day's "best observations". The best daily observation files preserve all of the available quality control messages from the automatic quality control performed at the GDACs.

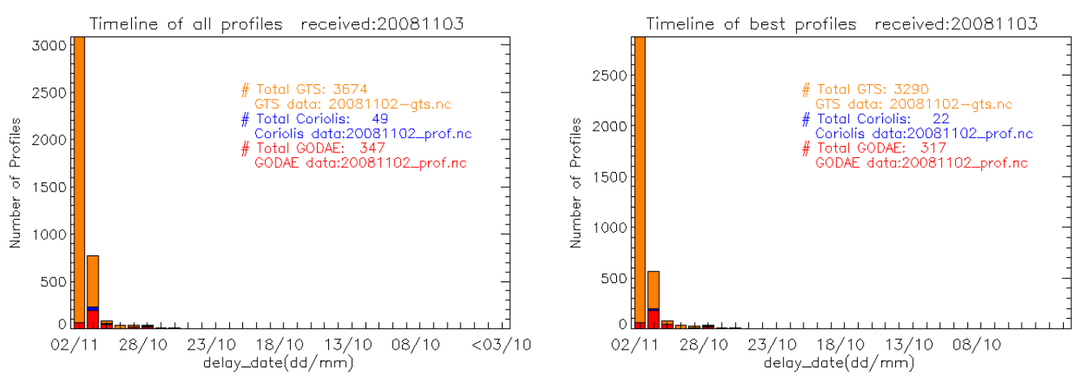

Figure 1: *In situ data as received from all sources and the contributions to the "best" observation of the day file*

Each best daily observation file is further processed using an internal set of quality control checks including standard checks for monotonicity, stability and others[4] plus comparisons with climatology before being used in the assimilation.

At present OceanMAPS makes use of two satellite altimeters available for operational oceanography, Jason and Envisat. Each data stream has its own unique file format which is processed and passed through a series of quality control checks before use in the analysis. Plans are being developed to receive and use Jason-2 operational data and the Jason-2 NetCDF format is proposed as a common format for all altimeter data.

Sea Surface Temperature (SST) is obtained from satellite observation by the Advanced Microwave Scanning Radiometer (AMSR-E). The advantages of AMSR-E are that it provides daily global coverage with an uninterrupted view of SST as the microwave sensor has the capability to see through clouds but has coarse horizontal resolution. Plans are in place to include other SST sensor data in future upgrades.

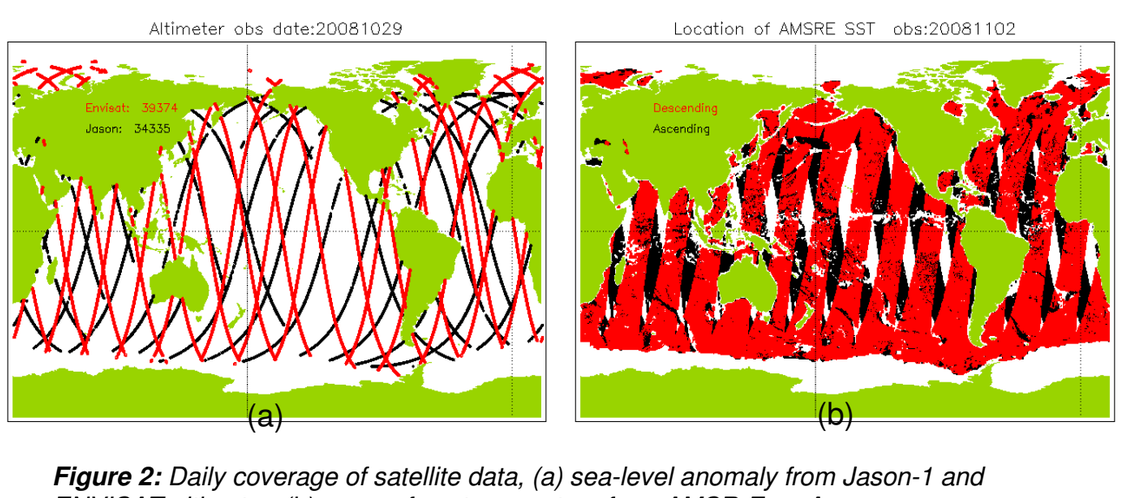

Figure 2: *Daily coverage of satellite data, (a) sea-level anomaly from Jason-1 and ENVISAT altimeter, (b) sea surface temperature from AMSR-E on Aqua*

Scheduling

The forecast system is designed to perform two analysis cycles prior to each forecast cycle with a data window for altimetry of plus or minus 5 days which is approximately the period for a complete cycle of Jason1 . The first is an analysis cycle to provide a "best analysis" delayed by 8-9 days to maximise the coverage of altimetry and have a symmetric distribution of observations about the analysis time. A near real-time analysis is performed 5 days prior to the forecast start which ensures altimetry at the analysis time is included. The forecast cycle is initiated following a 5 day catch-up model integration to real-time. Although both SST and in situ profile observations are available at real-time, the multi-variate, ensemble-based analysis has been found to perform best when good coverage is available from altimetry.

The initial operational implementation will produce a 7 day forecast, performed twice per week on Monday and Thursday, schematically shown in Figure 3. This ensures an overlap of 3 or 4 days in the forecasts. The forecasts are triggered after the fluxes from the latest run of the Bureau's global atmospheric model (GASP)[5]

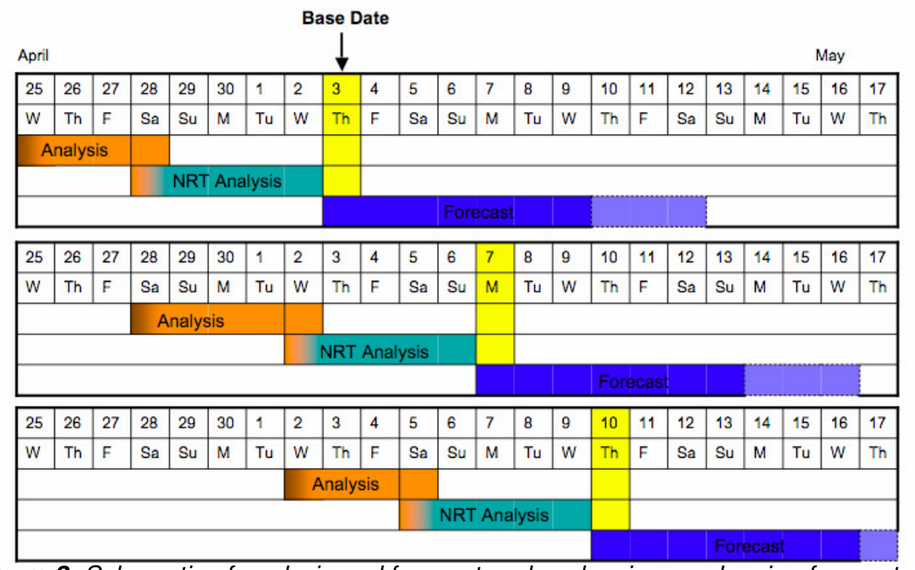

Figure 3: *Schematic of analysis and forecast cycles showing overlapping forecasts produced each Monday and Thursday, preceded by a near-real-time analysis 5 days behind and the analysis 8-9 days behind*

Product Servicing

The initial suite of products provided as a free on-line graphical service on the Bureau's public web page[6] are daily averages of forecasts out to 7 days of sea surface temperature (SST), sea surface salinity (SSS), sea level anomaly (SLA), SST plus currents and SLA plus currents for regions of interest within the Australian region. An example of sea surface temperature for the region off Queensland is shown in Fig 4(b).

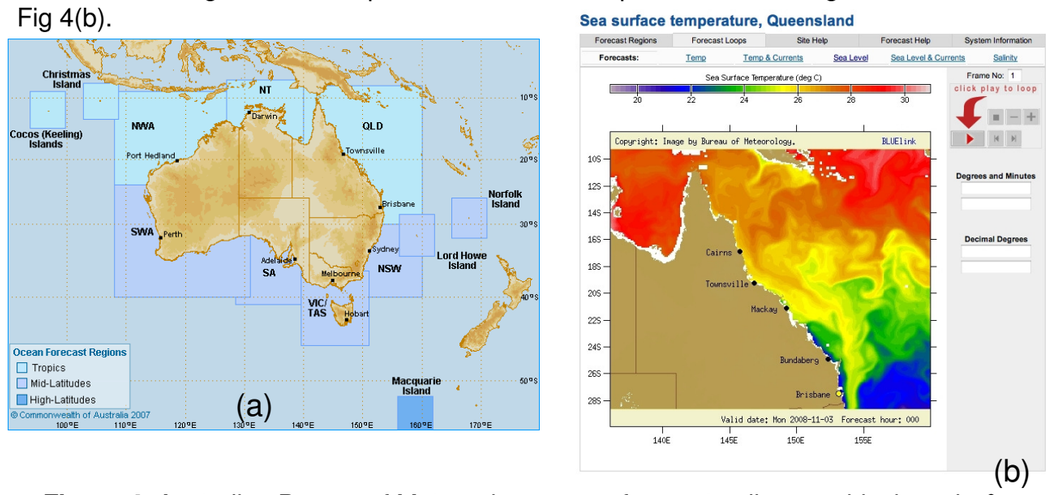

Figure 4*: Australian Bureau of Meteorology ocean forecast online graphical service[6], (a) region selection page, (b) graphical animation interface showing sea surface temperature off Queensland.*

Gridded files from each of these regions plus the whole Australian region domain can be obtained by subscription from the Bureau's ftp server. Products are being made available to the research community through OpenDAP[7]. There are plans to extend this to more general users of the data once maintenance and authentication issues are resolved.

References

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7. Bureau of Meteorology Research Data Access Service (http://opendap.bom.gov.au/index.shtml)

Acknowledgements

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Correspondence

Mr Graham Warren
National Meteorological and Oceanographic Centre
Bureau of Meteorology
700 Collins Street, Melbourne, Australia
g.warren@bom.gov.au