THE USE OF OCEAN OBSERVATIONS IN BUREAU OF METEOROLOGY OPERATIONAL PRODUCTS

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ABSTRACT *- The Bureau of Meteorology has an expanding range of operational systems and services that have direct dependencies on ocean and marine data. The operational systems fall into four main groupings;*

1.) Surface wind and sea state forecasts in support of marine forecasts,
2.) Sea surface temperature analyses for use by operational atmospheric models and in the production of climate forecasts and seasonal outlooks,
3.) Sub-surface ocean analysis system for use in the production of seasonal outlook and for climate forecasting,
4.) Coupled models used for climate assessments and outlooks.

The functions of these systems will be described and examples of ocean data utilisation presented.

1 - MARINE METEOROLOGY

For many years high-seas weather and sea state forecasts have been issued as a component of the Bureau's operational services. Until recently, these were solely dependent on analysed and forecast surface winds with isolated wave-rider buoy sites providing validation. Recent adaptions to the atmospheric forecast model now enable direct assimilation of surface wind data; there is also an indirect dependence on (and assimilation of) other surface marine data such as sea level pressure and SST. The wave model has also been recently adapted to assimilate remotely-sensed significant wave height data [Gree 99]. An example of improvements made to the significant wave height (SWH) field by the assimilation is shown in Fig. 1. Here the SWH is increased to the east of Tasmania and along much of the Western Australian coast.

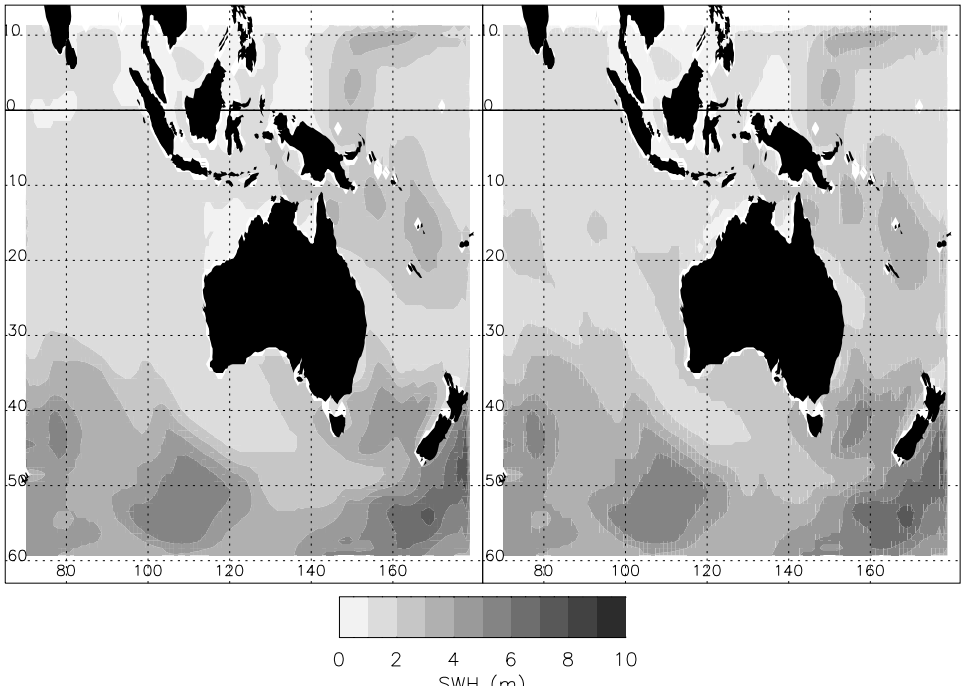

Fig. 1: SWH at September 15 12Z for the hindcast without assimilation (left) and with assimilation of ERS-2 altimeter SWH (right)

2 - SEA SURFACE TEMPERATURE ANALYSIS

Since the early 1990's the Bureau has also been operating an SST analysis system. For the global product, an optimal interpolation system is used to blend in situ and remote measurements of SST with forecasts based on previous analyses. The in situ data are principally used for the removal of bias from the remotely sensed data. The key sources are polar orbiting AVHRR data and in situ data from ships, moorings and buoys. This product is updated weekly and has an effective resolution of around 150 km. It is used by both the operational atmospheric models and in the production of climate forecasts and seasonal outlooks. A finer resolution product that ingests locally received AVHRR data is also produced daily with an effective resolution of around 50 km.

3 - SUB SURFACE OCEAN ANALYSIS

For the last decade the Bureau has been operating a sub-surface ocean analysis system, nominally global but with greatest attention given to the tropics and waters around Australia [Smit 95]. The data are drawn from the GTS and from various other sources including TAO and the GTSPP. The ship-of-opportunity program and TAO are the key relevant elements of the observing system. As a contribution to the ocean observing system th Bureau has undertaken to provide long-term support for the ship-of-opportunity lines formerly supported through research funding. These products are updated twice a week and include estimates of monthly temperature down to 500 m, depth of key isothermal surfaces, and heat storage over the upper 150 and 400 m. These products are used for seasonal outlooks and for climate forecasting.

4 - COUPLED MODELS

The Bureau also runs an operational coupled ENSO forecast model. This is an intermediate class model which uses sub-surface ocean data and surface wind data (the FSU product) to initialise the model. Experiments have indicated that sub-surface data are critical to the performance of this model [Klee 95]. The forecasts from this system are used operationally in climate assessments and outlooks and are a component of the international suite of models used to assess the likelihood of seasonal-to-interannual climate variations. A fully coupled general circulation model is currently being trialled. Fig. 2 shows the hindcast skill of this model verified over the period 1980-1995.

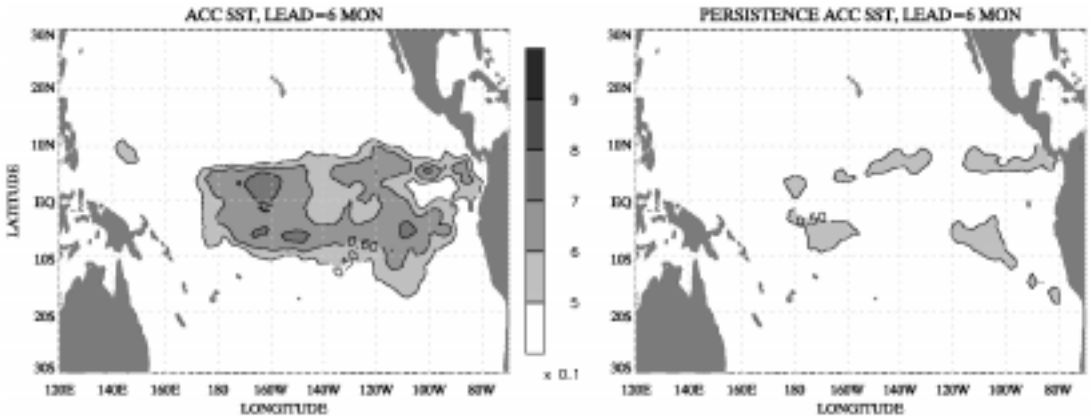

Fig. 2: SST skill over the Pacific at 6 months lead time for the (left) and persistence (right), with skill > 0.5 shaded.

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