The Impact of Automated Shipboard Aerological Program (ASAP) Data upon Australian Analyses

Bob Seaman
Principal Research Scientist
Bureau of Meteorology
Research Centre
Melbourne
Australia

The Automated Shipboard Aerological Program (ASAP) of the World Meteorological Organization and the Intergovernmental Oceanographic Commission of UNESCO is based upon upper air observation stations that are operated on board cargo ships. The Australian Bureau of Meteorology ("the Bureau") has contributed towards a component of ASAP called the Worldwide Recurring ASAP Project (WRAP). The WRAP provides the opportunity for routine upper air soundings en route from Europe - the Cape of Good Hope - Australia - New Zealand - Brazil - Europe. Such a route includes areas of the southern hemisphere where other upper air soundings are few.

MV P&O Palliser Bay, the first vessel in the Worldwide Recurring ASAP Projects (WRAP) for the World Meteorological Organization, supported by the MetOffice (UK), NOAA (USA) and the Commonwealth Bureau of Meteorology.

The Bureau sponsored two soundings daily from the MV Palliser Bay, operating out of the United Kingdom, for the section of its route from 60 to 160 degrees east between South Africa and Australia. Between April 2001 and March 2002, five such crossings were made. As part of the Bureau's evaluation of the usefulness of the soundings from Palliser Bay, an assessment was made of their impacts upon analyses from the Bureau's global data assimilation and prediction system (GASP).

How to assess impact?

Ideally, one might wish to define the incremental benefit of additional sounding data by some measure of forecast improvement. However, statistically reliable results on forecast improvement are very difficult to obtain with small sample sizes and large case-to-case variation. Therefore, a more indirect, but simple to calculate, measure of impact was used. This measure is based upon the assumption that, in the long run, observations that change the analysis the most from what it would have been otherwise are likely to be the most valuable. In the case of a sounding, the impact is defined as the difference between (i) the analysis in the vicinity of the sounding using the sounding and all other available data, and (ii) the analysis not using the sounding but still using all other available data. The Bureau already routinely calculates the impact of all Australian and New Zealand upper air soundings in this way. So it was easy to calculate the impact of the Palliser Bay soundings in the same way.

Results and discussion

Table 1 sets out the root mean square (rms) and maximum impacts of the Palliser Bay soundings, upon geopotential and wind analyses at several levels, on each of the Indian Ocean crossings. To provide a reference against other soundings, table 2 summarizes the impacts of the Palliser Bay relative to fixed upper air stations in the Australian sector. The fixed stations include not only Australian and New Zealand mainland stations, but also island stations like Macquarie Island and Chatham Island. The median rank of the Palliser Bay is aggregated over levels from 1000 hPa to 100 hPa. Its rank is almost always in the top quartile, and often close to the top. The corresponding rank of Macquarie Island, located at 55 degrees south,

Table 1. Impact of the Palliser Bay soundings

(a) 20-29/4/01 (Indian Ocean - 14 cases)					
Level (hPa)	1000	850	500	200	100
Geopotential impact (m) rms	4.4	4.6	3.1	4.2	2.1
Geopotential impact (m) max	9.5	11.1	6.5	6.7	3.8
Wind impact (m/s) rms	1.4	1.7	2.5	3.1	2.6
Wind impact (m/s) max	3.4	4.4	5.3	6.5	4.4
(b) 12-21/7/01 (Indian Ocean - 13 cases)					
Level (hPa)	1000	850	500	200	100
Geopotential impact (m) rms	5.7	5.9	9.5	4.5	3.8
Geopotential impact (m) max	11.8	14.2	20.9	11.5	7.2
Wind impact (m/s) rms	1.1	1.2	2.1	3.5	4.1
Wind impact (m/s) max	2.8	2.7	4.6	7.1	9.5
(c) 5-13/10/01 (Indian Ocean - 15 cases)					
Level (hPa)	1000	850	500	200	100
Geopotential impact (m) rms	10.2	8.0	8.3	2.9	5.8
Geopotential impact (m) max	15.4	13.4	12.3	5.5	4.4
Wind impact (m/s) rms	1.3	1.5	3.3	3.3	3.1
Wind impact (m/s) max	1.9	2.4	8.3	6.8	5.3
(d) 29/12/01 - 7/01/02 (Indian Ocean - 16 cases)					
Level (hPa)	1000	850	500	200	100
Geopotential impact (m) rms	3.4	3.5	5.9	1.6	3.0
Geopotential impact (m) max	8.6	8.6	10.7	3.9	5.3
Wind impact (m/s) rms	1.3	1.2	1.5	2.1	2.7
Wind impact (m/s) max	2.2	2.5	3.3	3.6	5.2
(e) 22/3/02 - 31/3/02 (Indian Ocean - 16 cases)					
Level (hPa)	1000	850	500	200	100
Geopotential impact (m) rms	11.9	10.3	8.4	5.8	8.3
Geopotential impact (m) max	23.6	21.2	15.3	11.0	12.9
Wind impact (m/s) rms	0.8	0.8	1.6	3.8	4.2
Wind impact (m/s) max	2.0	1.7	3.1	7.3	8.5

and one of the top remote stations, is shown in brackets for comparison. The notation 5/38, in the top row of table 2 for example, denotes that the Palliser Bay ranked 5th out of 38 stations. In the same period, as denoted by the (1), Macquarie Island was the top-ranking station.

In general, the impacts of Palliser Bay upon GASP analyses were similar to those of rawinsondes at isolated island stations, and greater than those of rawinsondes at mainland Australian stations. The Palliser Bay impacts for geopotential ranked particularly highly, perhaps because cloud drift winds from the satellite images provide some redundancy with the Palliser Bay winds. However, remote radiometric sounding data from satellites, which are related to thickness rather than geopotential, provide a lesser redundancy with the Palliser Bay geopotentials.

Concluding remarks

Taking into account both the preceding results and other factors, the Bureau concluded that it received good value from its initial investment in the WRAP project. Palliser Bay was decommissioned soon after the March 2002 voyage. However, another vessel, the MV Nuria, has been recruited. ●

References

Seaman, R.S., 1994: Monitoring a data assimilation system for the impact of observations. Australian Met. Mag. 43, 41-48.

Table 2 Median rank of Palliser Bay relative to fixed upper air stations

(Rank of Macquarie Island in brackets)

	Geopotential	Wind
April 2001	5/38 (1)	5/56 (4)
July 2001	3/39 (1)	15/56 (4)
October 2001	2/39 (3)	10/54 (7)
January 2002	5/39 (6)	22/56 (10)
March 2002	2/40 (1)	16/56 (5)

The Bureau of Meteorology Research Centre (BMRC) is the research division of the National Meteorological Service of Australia. The objectives of the BMRC can be summarized as:

- to advance the science of meteorology with particular emphasis on the southern hemisphere and the Australian region,
- to support the operations and services of the Bureau of Meteorology through the development of major systems and the provision of scientific advice, and
- to advance national interest through meteorological and oceanographical research.

Research in BMRC is carried out by six groups covering the areas of model development, data assimilation, model evaluation, weather forecasting, climate forecasting, and ocean and marine forecasting. ●

Further information can be found at http://www.bom.gov.au/bmrc.