TECHNICAL MEMORANDUM

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Monitoring the ASAP upper air meteorological data at ECMWF (22 December to 20 January 1984)

H. Böttger and J. Humphreys

Research Department

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European Centre for Medium-Range Weather Forecasts
Europäisches Zentrum für mittelfristige Wettervorhersage
Centre européen pour les prévisions météorologiques à moyen

1. Introduction

As a global forecasting centre, the European Centre for Medium Range Weather Forecasts (ECMWF) has the responsibility of producing high quality global analyses. Observations provide the basis for these analyses and it is well known that upper-air soundings form one of the most valuable sources of information.

Since 1982 the Canadian and U.S. meteorological services have been operating a mobile upper-air observing program which is called the Automated Shipboard Aerological Program (ASAP). Using a modified container carried on board a ship in the Pacific, upper-air soundings are produced almost automatically and are relayed via GOES-West to NCAR, Boulder and further on to the Pacific Weather Centre at Vancouver. These data, from an area otherwise almost void of radiosonde observations, are extremely valuable. However, experience so far has shown that the ASAP system suffers from deficiencies in the processing and/or transmission of the data. In cooperation with the Atmospheric Environment Service (AES), Vancouver, ECMWF has been monitoring the ASAP/TEMP reports very closely in the past.

This report gives a summary of the monitoring period 20 December 1983 to 20 January 1984. It may help to identify improvements in the system of processing and transmitting the data.

2. The ASAP Project

In winter 1983/84, the Automated Shipboard Aerological Programme started its second winter of trials on the North Pacific oceans. The project provides rawinsonde observations from the "M.V. Friendship" (call sign ELXP), which operates regularly as a commercial vessel between Vancouver and Japan.

The goal of the ASAP project is to provide a mobile system to obtain upper-air soundings in an efficient and cost effective way. This was achieved by developing a self-contained and portable device, reducing the necessary manpower to a minimum by using automatic data processing and modern communications links.

The ship-board observing system includes the balloon inflation and launcher facility, the sonde tracking and data reception unit, the data processing computer and the transmission system (Phillips, 1983). Observations are made with Vaisala radiosondes, a Vaisala PP-11 meteorological sounding processor monitors the incoming signals, and formatting is handled by an HP-85 minicomputer. The system is highly portable, being housed in a container placed on the upper aft deck of the "M.V. Friendship". The TEMP data are transmitted via satellite GOES-West to the ground station at NCAR in Boulder, Colorado. An Apple II micro computer at NCAR relays the data immediately via modems to its counterpart at Vancouver. By personal communication with AES, ECMWF was informed during the course of the monitoring project that the data transmission between the ship and Boulder/Vancouver had caused problems in the past as garbling occurred or no report was received from the ship. In order to allow manual intervention at Vancouver all messages were therefore transmitted twice and retyped manually at the Pacific Weather Centre by an operator for insertion on the Global Telecommunication System (GTS) of the World Meteorological Organisation (WMO). When attempting to fill gaps in the report or substitute for garbled parts, it was reported that further errors were introduced.

The following paragraph gives a summary of the problems experienced at ECMWF with ELXP TEMPs reports. Errors are traced back to the originating source where possible.

3. Monitoring the ELXP TEMP reports at ECMWF

3.1 The data reception

During the recent voyage, 22 December 1983 to 20 January 1984, of the "M.V. Friendship", a container ship participating in the Automated Shipboard Aerological Program (ASAP). Details of the voyage are shown in Fig. 1. The TEMP reports received via the GTS from that ship were monitored carefully at ECMWF. It was agreed with the ASAP Project Leader at AES Vancouver that ECMWF should receive by mail after the end of the voyage, copies of the TEMP reports recorded on board ship copies of the transmission via satellite from the ship to Vancouver via NCAR, Boulder and copies of the outgoing traffic from Vancouver. Any problems with the TEMPs with respect to coding errors or garbling in transmission could therefore be traced to its source.

It was known from previous voyages of the ship that problems with the decoding of the ELXP TEMPs were encountered frequently. All detected errors were to be reported immediately via telex to the Pacific Weather Centre at Vancouver.

Table 1 gives a summary of the experience with the EXLP TEMPs parts A and B during the monitoring period 22 December 1983 to 20 January 1984. Altogether 32 TEMP observations were available from the ship for the days 24-31 December 1983 and 09-16 January 1984 both from 00Z and 12Z. It is the normal practice on board ELXP not to take any observations within a certain distance of a harbour.

Out of the 32 observations made, only 26 reached Vancouver. For one day, 28 December 1983 00Z, no copy of the report received at Vancouver was available. Communications problems were the reason for the loss of the observations in the beginning of the monitoring period.

Only in 3 out of the 26 cases was an erroneous TEMP report received at Vancouver. Once, 30 December 1983 00Z, the wrong date was encoded on board ship. The report from 11 January 1984 12Z gave two different 200 mb temperatures (the difference was 0.2 degrees) one in part A for the standard pressure level and one in the height of the tropopause which was also reported to be at exactly 200 mb. The third occasion was on 15 January 1984 00Z when a temperature group was changed in transmission via Boulder.

The majority of errors was introduced at Vancouver when the reports were retyped manually for insertion into the GTS. Nine errors were created and in only one case was the manual intervention successful. Transmission on the GTS was almost flawless. Only once a part B was garbled in transmission on the GTS.

The bulletins with TEMPs part A and B reached ECMWF in good time, usually within the first three or four hours after the time of the observation. Although the observations were complete and all four parts of the TEMPs reached Vancouver and were inserted into the GTS, the two parts for the levels above 100 mb, part C and D, were never received at ECMWF. This fact had been reported to the Pacific Weather Centre on previous occasions but the reason is still unknown.

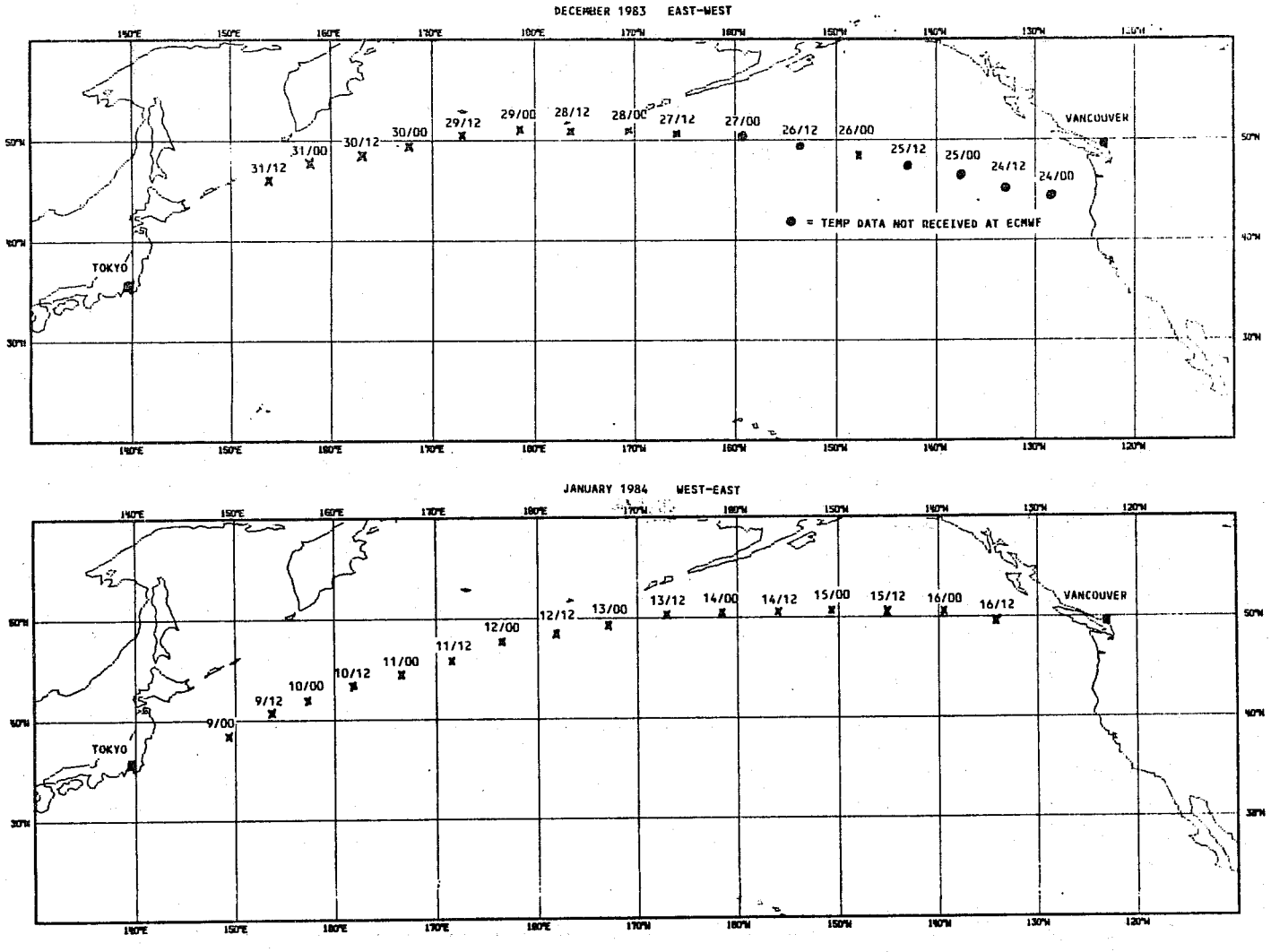

Fig. 1 Voyage of the "MV Friendship" between Vancouver and Tokyo, 22 December 1983 to 20 January 1984. Dates and location of the vessel for the days when TEMP reports were produced are shown.

TABLE 1

Date/Time	Sent from ELXP	Received at Vancouver		Sent from Vancouver		Received at ECMWF		Comments (Note that TEMPs parts C and D have never been received at ECMWF)
		correct	error	correct	error	correct	error	
December								
24 0000	x							)
1200	x							) not received at Vancouver
25 0000	x							)
1200	x							)
26 0000	x	x			x		x	error in part B
1200	x							) not received at Vancouver
27 0000	x							)
1200	x	x			x		x	error in part A
28 0000	x	no copy			x		x	error in part B
1200	x	x			x		x	error in part B
29 0000	x	x			x		x	error in part A
1200	x	x		x		x		
30 0000	x		x		x		x	error in date and in part B
1200	x	x		x		x		
31 0000	x	x			x		x	error in part A
1200	x	x		x		x		
January								
09 0000	x	x		x		x		
1200	x	x		x		x		corrected version sent from Vancouver
10 0000	x	x		x		x		
1200	x	x		x		x		
11 0000	x	x		x		x		
1200	x		x		x		x	temperature at 200 mb and tropopause incompatible
12 0000	x	x		x		x		
1200	x	x		x		x		
13 0000	x	x			x		x	error in part A
1200	x	x		x			x	part B garbled on GTS
14 0000	x	x		x		x		
1200	x	x		x		x		
15 0000	x		x	x		x		corrected at Vancouver
1200	x	x			x		x	error in Date/time group part B
16 0000	x	x		x		x		
1200	x	x			x		x	error in part B
TOTALS	32	22	3	15	11	14	12	

Table 1: Details of the GTS reception of TEMP reports at ECMWF from ship ELXP ("MV Friendship") during the voyage across the Pacific 22 December 1983 to 20 January 1984. No observations were taken when the ship was in port or within the vicinity of the coast.

The statistics are for bulletins including TEMP parts A and B which were always received together at ECMWF. Parts C and D never reached the Centre via the GTS.

3.2 The quality control

ECMWF monitors all the incoming reports with respect to timeliness and quality. Data which fails the decoding stage can be inspected and an attempt is made to correct bulletin headers or miscoded and garbled reports whenever feasible. All incoming reports undergo quality control checks primarily against climatological limits before they are entered into the reports data base. TEMPs will in addition be checked with respect to their vertical consistency and part A which gives the heights at standard pressure levels is reconstructed from part B, which gives a detailed approximation of the observed vertical temperature, humidity and wind profile. The height of the footpoint of the radiosonde ascent is taken from the station index in the WMO Handbook, Vol. A. If the geopotential heights reported in part A of the TEMP do not agree with those calculated from part B within a predescribed accuracy, which is a function of height, the reported height will be flagged in the reports data base. If the datum does not meet the Centre's quality control criteria, it will not be presented to the analysis and an attempt will be made to substitute an estimated value for the reported value.

From the December 1983/January 1984 voyage of the "M.V. Friendship" ECMWF received a total of 26 temp reports and in 19 cases quality control flags were set, normally resulting in a rejection of the data. This does not indicate a poor quality of the observations themselves. Evaluations carried out within the ASAP project have indicated that the data from the ASAP upper-air ascents appears to be of good quality (McBean, 1983). Also in a recently published intercomparison of the ASAP system, using the Vaisala RS-80 sondes and the V12 1680, no serious deficiencies in the quality of the observations were found (McBean and Smith, 1984). As indicated in table 1, very often errors are introduced into the coded report at Vancouver and occasionally the bulletin will be garbled on the GTS between Vancouver and ECMWF. These errors are obviously spotted in the internal consistency check of the quality control at ECMWF. More serious is the fact that perfectly valid reports do not pass the check without flags being set and even substitutions being introduced. The reason is the discrepancy in the assumed height of the platform from which the balloon is launched and the actual height used for measuring the geopotential in part A on board ship. According to the WMO Handbook Vol. A, no such height is given therefore zero is assumed for all ships and for the Atlantic weather ship this seems to be a valid assumption. According to the UKMO at Bracknell, which operates OWS Lima, no barometer height is added in the calculation of TEMP part A.

For the ELXP ship, differences in height for the 1000 mb level are found at around 20 metres, leading to quality control flags being set for the lower pressure levels in most cases and often the heights get rejected and are not presented to the analysis. In the long term, there seems to be a need for including the station height into the TEMP code in order to make full use of the information given in all four parts of a TEMP.

4. Summary

The ASAP upper-air data from the ELXP ship in the Pacific have been monitored at ECMWF during the period 22 December 1983 to 20 January 1984. Of 32 observations which were made on board ship, only 26 bulletins reached the Centre, and in 12 cases errors were detected in the code either in part A or part B of the TEMP. Although they were regularly sent from the ship, no ELXP TEMPs part C or D have ever reached ECMWF. The majority of errors in the code were introduced at Vancouver on input of the bulletin into the Global Telecommunication System of the WMO. The observations were of good quality and the transmission from the ship to Vancouver via satellite and onwards on the GTS to ECMWF was satisfactory.

Problems were encountered at ECMWF with the quality control of the TEMPs; for ships the height of the launching platform of a radiosonde is assumed to be at sea level, whereas in the reported heights an elevation at launch of approximately 20 metres was used.

Full automation, including automatic insertion of the data onto the GTS, will help to overcome the present deficiencies and will provide extremely useful observations beneficial to the meteorological community for global data analysis.

The ASAP programme will continue in 1984 (ASAP Newsletter, January 1984) and additional ships will be involved in the project providing upper-air soundings from the Pacific and the Atlantic. ECMWF will continue monitoring these observations carefully and give feedback as to its usefulness and quality.

References

McBean, G.A., 1983, Storm Sections from Mobil-Ship, Upper-air observations, AES Pacific Region Techn. Note.

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Phillips, D.J., 1983, Report on the Operations of a mobile upper-air system (ASAP) in the North Pacific, AES Pacific Region Tech. Note.