# THE ECMWF OPERATIONAL METEOROLOGICAL SYSTEM

by

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# THE ECMWF OPERATIONAL METEOROLOGICAL SYSTEM: Schedule, data, dissemination of products.

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## 1. The ECMWF daily operational schedule

Since 1 August 1979, the European Centre for Medium-Range Weather forecasts (ECMWF) has been carrying out numerical weather forecasts to ten days ahead operationally; five days per week until 1 August 1980, and daily since that date.

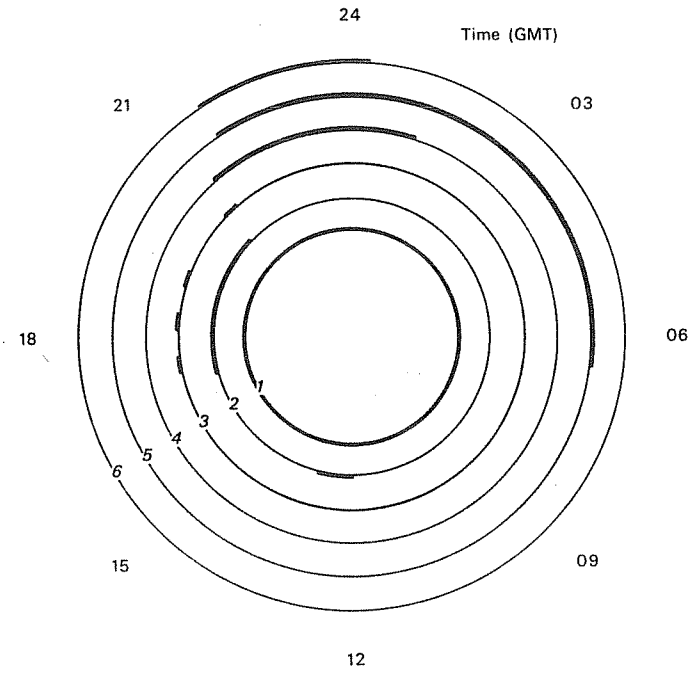
The suite of jobs which comprise the operational forecast is large, consisting on average of more than 300 Cyber jobs and 150 Cray jobs each 24 hours. The scheduling of these jobs is handled by the Supervisor, which is a continuously running Cyber job controlling the launching of all operational forecast jobs on both machines.

In principle, the operational meteorological function of ECMWF is the same as that of other large numerical forecasting centres. Figure 1 shows the daily schedule for production of the operational forecasts. Data acquisition is a process which takes place intermittently throughout the day as data become available on the Global Telecommunications System of the World Meteorological Organisation. Preprocessing of the data, including quality control and storing of the reformatted data in the Reports Data Base, is carried out at times which have minimum impact on the batch usage of the computer system, i.e. around midday and again at the end of the normal working day.

Analyses, valid for 18z the previous day, and for 00z, 06z and 12z the current day, are carried out during the evening. Each analysis uses observations made within $\pm$ 3 hours of the analysis time. The most important analysis, that for 12z, uses the data from 0901z to 1500z available on the GTS up to 2045z.

The 10-day forecast, taking about 3½ hours elapsed time of the Cray computer, starts at 2130z and is completed at around 0100z. As a measure of the reliability of the daily operation, a record is kept of the termination times of the forecast on the Cray. Approximately 45% of the forecasts terminate within 15 minutes of the scheduled time of 0100z, while 90% terminate within one hour. Less than 1 forecast in 20 is delayed more than 2 hours, the usual reason for long delays being computer malfunction.

Post-processing, including transforming the parameters from the model co-ordinate system to one more suitable for users of the forecasts, is carried out as the analysis and forecast proceed.




*1* Data acquisition
*2* Preprocessing
*3* Analysis
*4* Forecast
*5* Transmission to Member States
*6* Transmission on GTS

**Fig.1 ECMWF daily operational schedule, showing average times of data acquisition and data preprocessing, analysis and forecast production and times of dissemination of products during July-December 1981.**

## 2. Data reception and coverage

Observational meteorological data are acquired from the Global Telecommunications System (GTS) of the World Meteorological Organisation. Figure 2 shows the ECMWF has two links with the GTS, one via Bracknell, the other via Offenbach, each link acting as a backup for the other. Figure 2 also shows the ECMWF network for dissemination of its products; this will be considered further in Section 4 below.

Since ECMWF has a global analysis system, all available observational data from the entire global domain are required, including surface observations from land and sea (SYNOP), radiosonde reports from instrumented balloons (TEMP), weather reports from commercial aircraft (AIREP), atmospheric temperature measurements from polar-orbiting satellites (SATEM), wind observations from geostationary satellites (SATOB) and reports from drifting buoys or oceanographic reports (SEA).

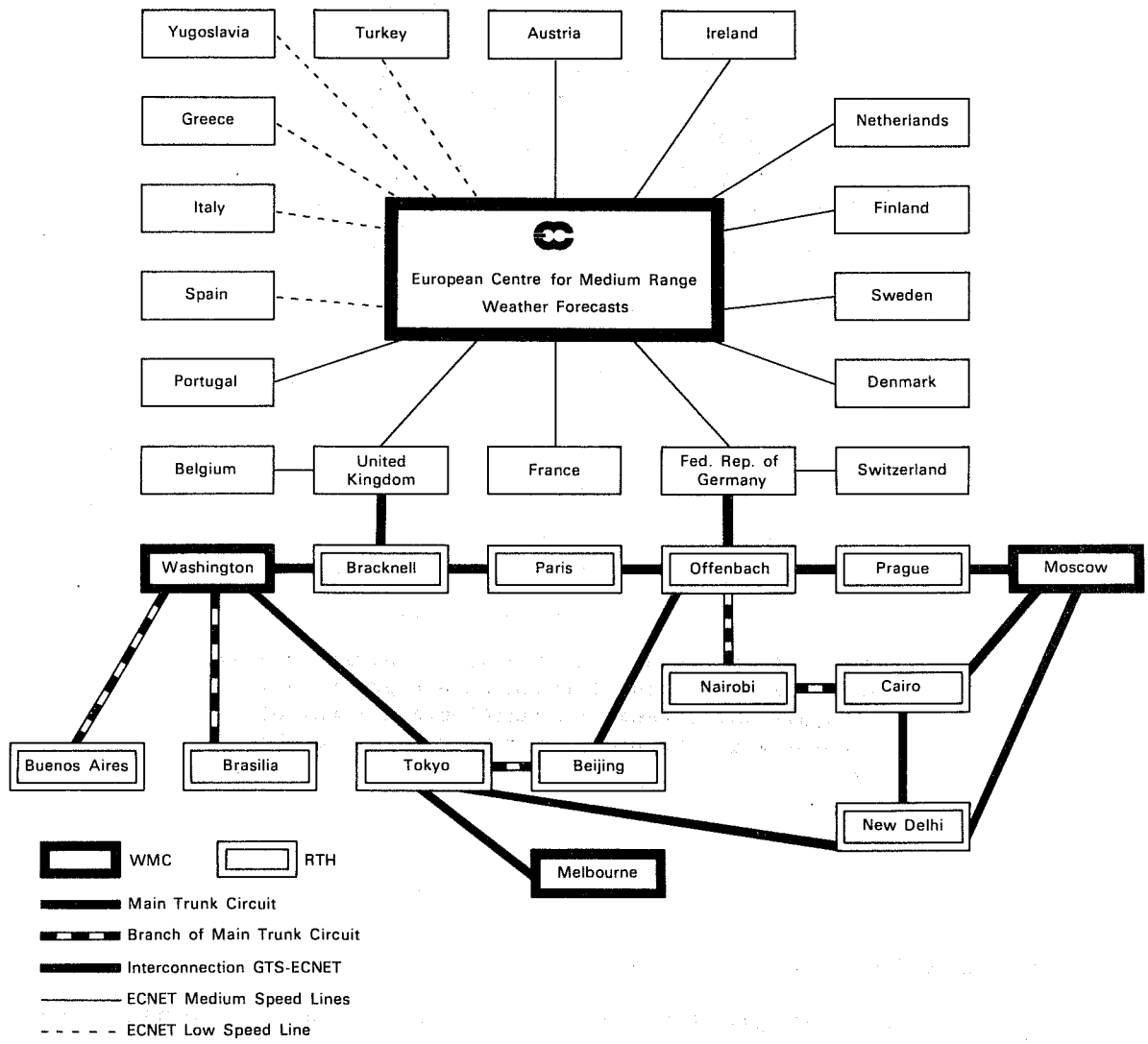



**Fig. 2 The ECMWF network (ECNET) at October 1981 and the Global Telecommunications System (GTS) of the World Meteorological Organisation.**

Figure 3 shows the coverage of observational data available for the analysis of 18 September 1981 and is an example of the data coverage available operationally for the ECMWF data assimilation system. In so far as SYNOP, TEMP and AIREP reports are concerned, it is apparent that the Southern Hemisphere has a much less dense coverage than has the Northern Hemisphere. This lack of data is partially compensated by the satellite (SATEM and SATOB) data.

Each day, around 35,000 separate weather reports are received at ECMWF. After reception, the reports are checked, some are corrected and the reports are stored in the ECMWF Reports Data Base.

## 3. Dissemination of Analyses and Forecasts

Dissemination of the results of the analyses and forecasts to the Member States is by transmission in coded digital form on medium-speed lines in the majority of cases (see Figure 2). By the end of 1981, only five Member States will still be serviced via low-speed lines.

In requesting products from ECMWF, the Member States use Meteorological Bulletins in the M3 classification "The dissemination of ECMWF results to Member States". The following Bulletins are available:

M3.1/1(1): The formats and headings of messages for the dissemination of ECMWF products.

M3.2/1 Codes used in the dissemination of ECMWF numerical products.

M3.3/1(1): The presentation of ECMWF products to Member States.

M3.4/1(2): ECMWF current product catalogue.

Table 1, which is extracted from Bulletin M3.3/1(1) shows the wide range of products potentially available to the users of ECMWF products.* Considering the number of parameters, levels in the atmosphere and time steps in the forecast, over 2000 global fields per day are potentially available from each forecast. Only a limited selection of these fields is made available on the Global Telecommunications System of the WMO; these include surface pressure and 1000mb geopotential height analyses and forecasts to five days for the Northern Hemisphere, analyses of wind at 850 and 200mb in the equatorial belt, and, for the Southern Hemisphere, as for the Northern Hemisphere but only to four days.

*For further information on this table, see Meteorological Bulletin M3.3/1(1).

Fig. 3 Coverage of observational data for the analysis of 18 September 1981

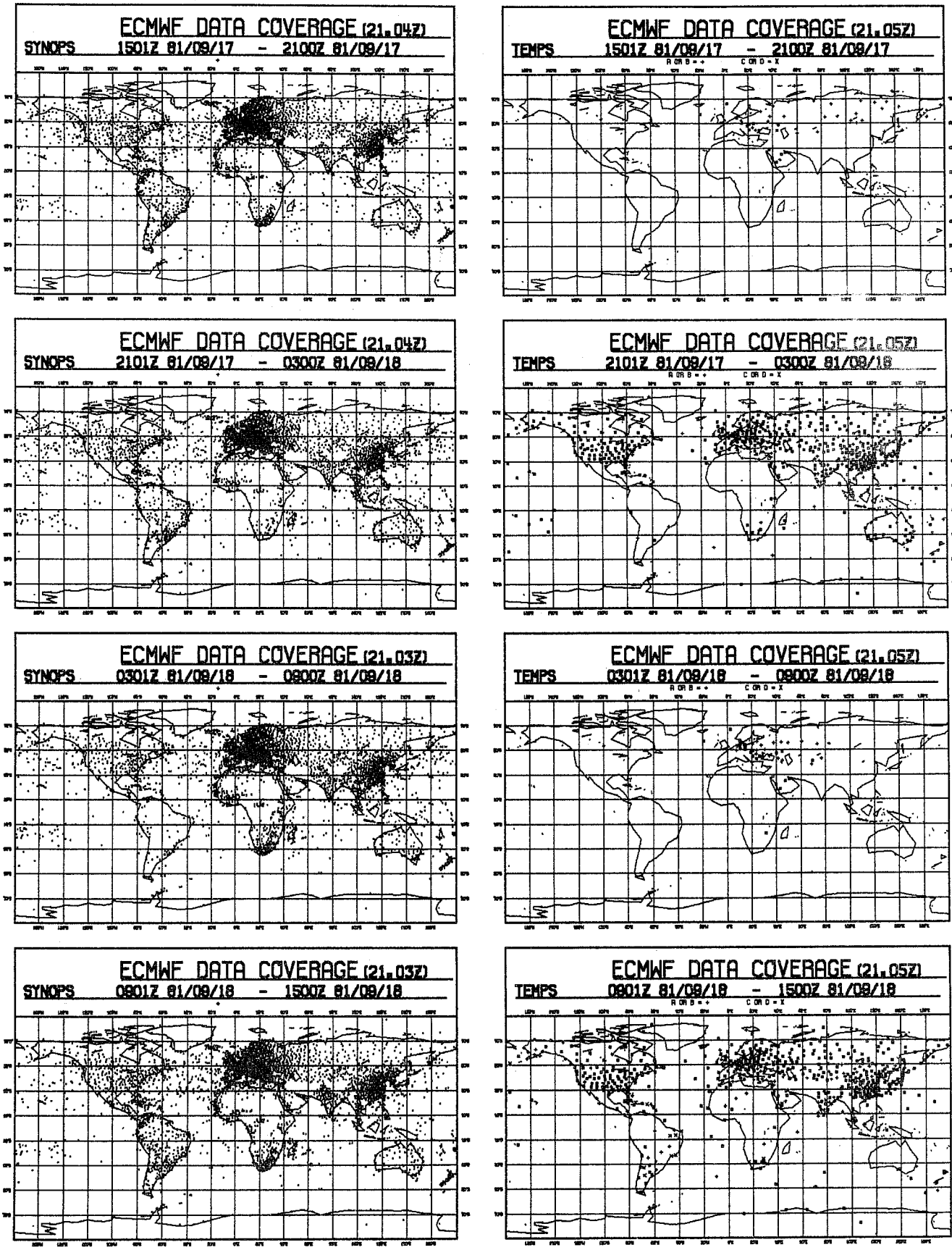
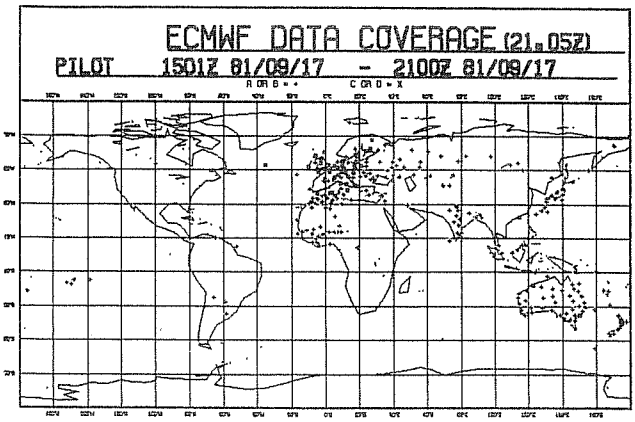
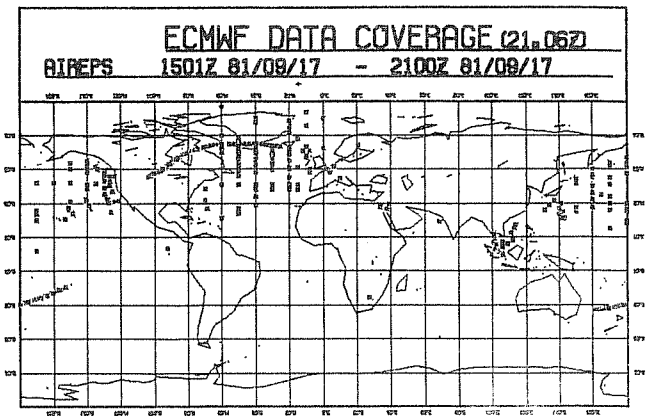
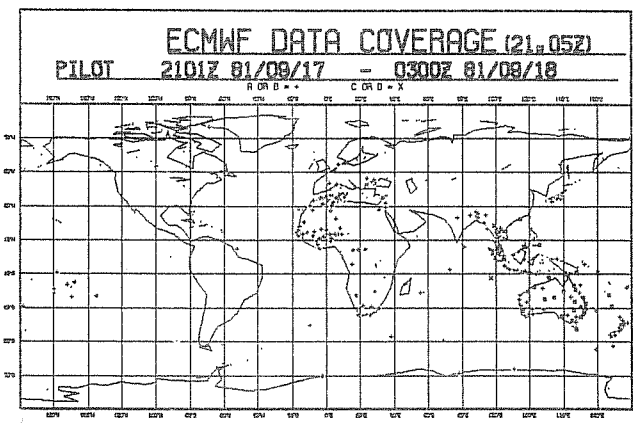
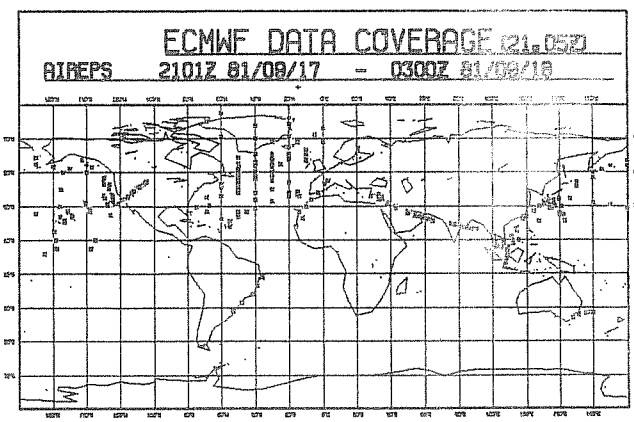


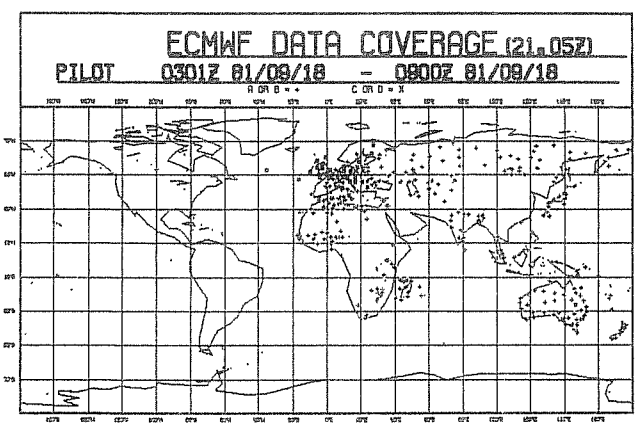
Fig. 3 (continued)

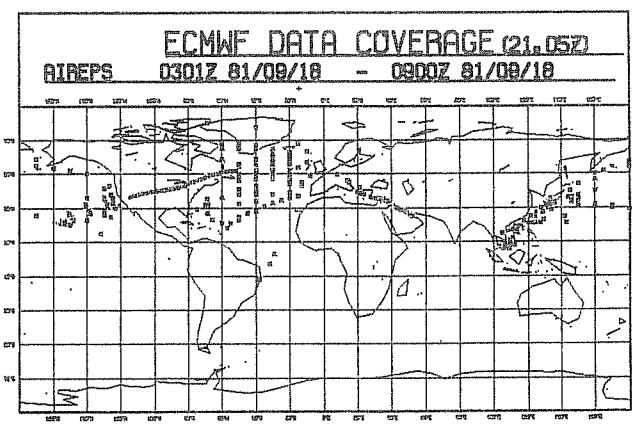


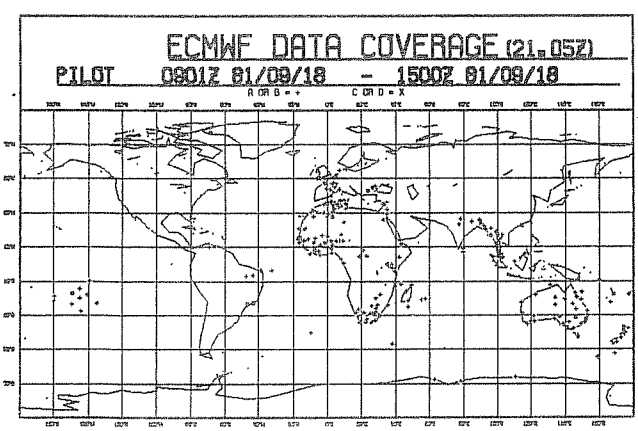



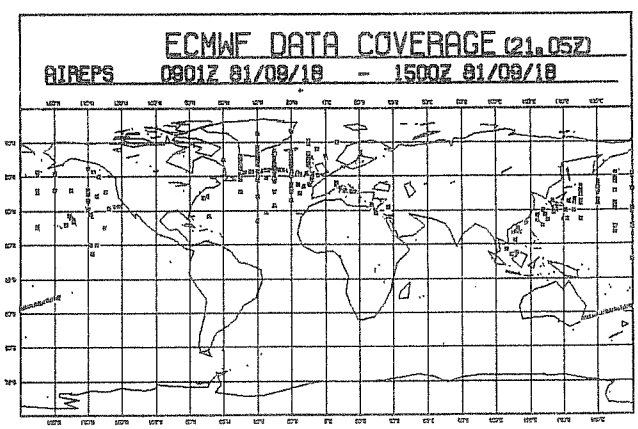



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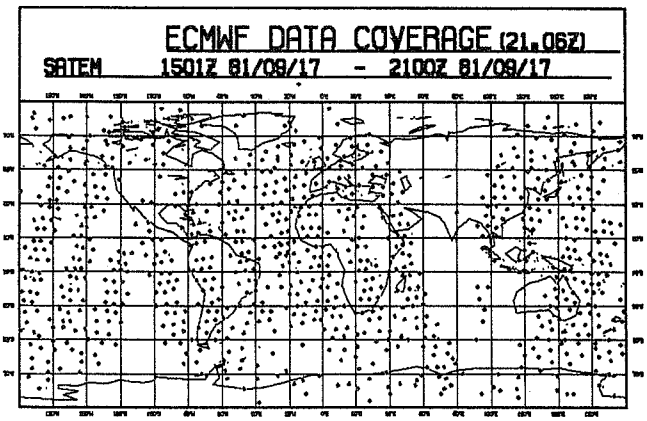


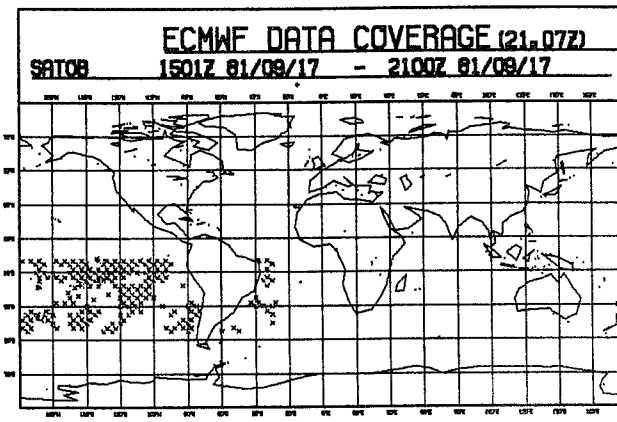


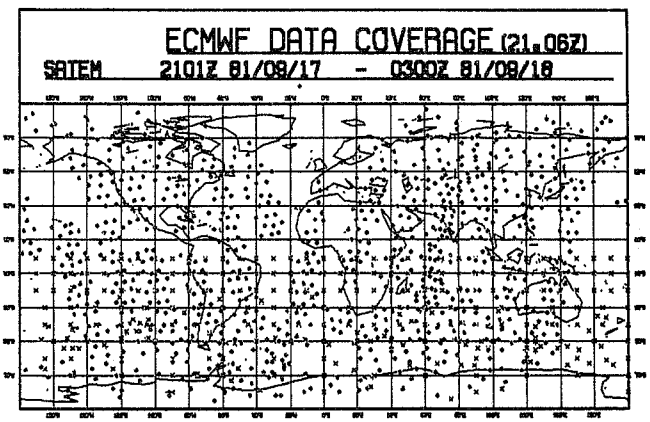


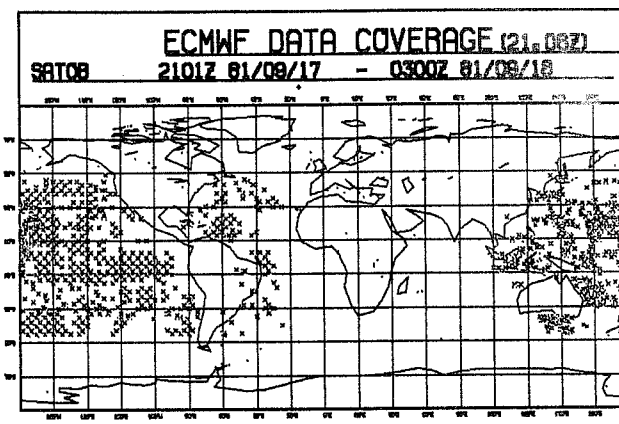


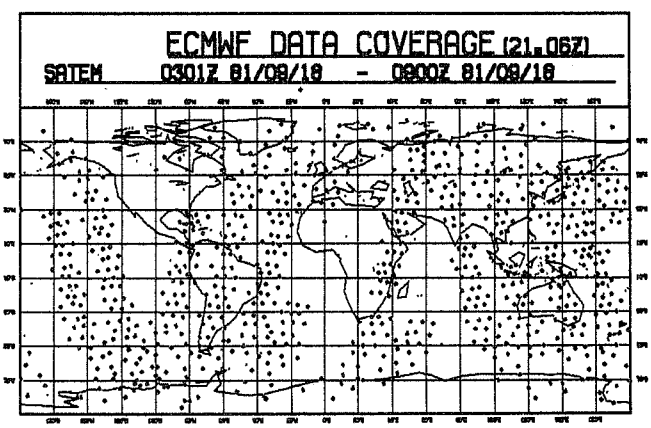


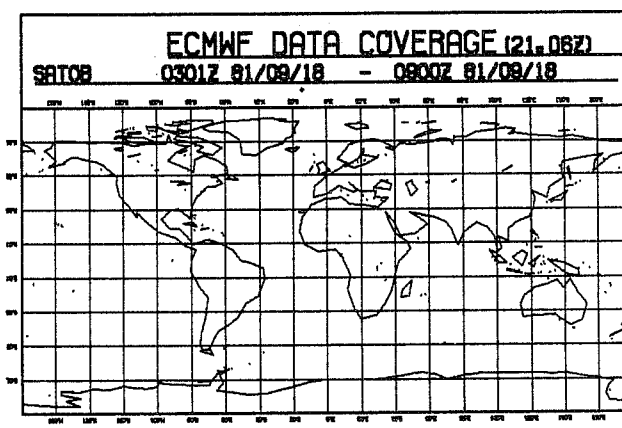


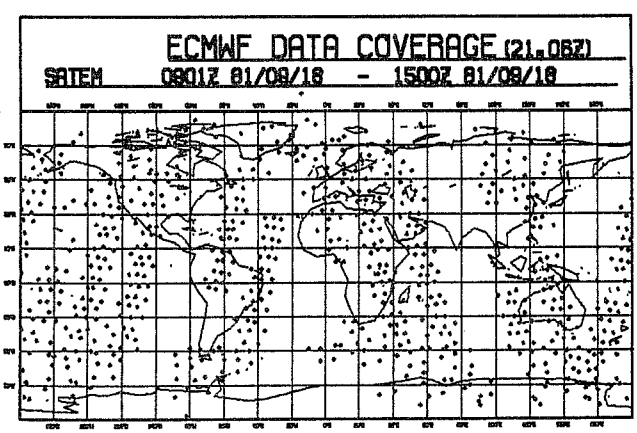


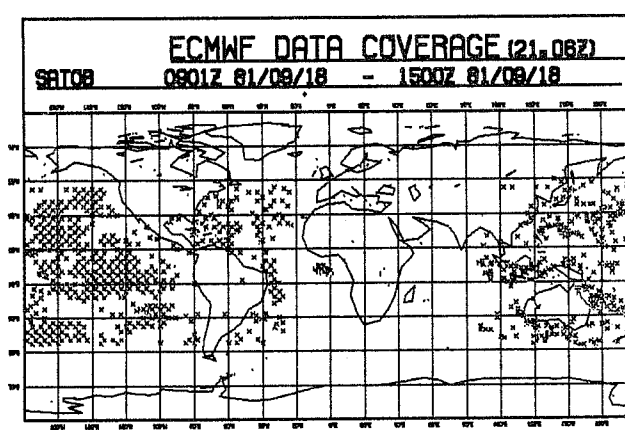

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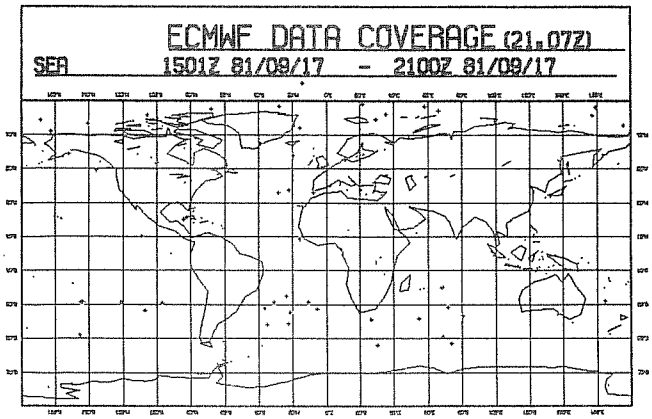


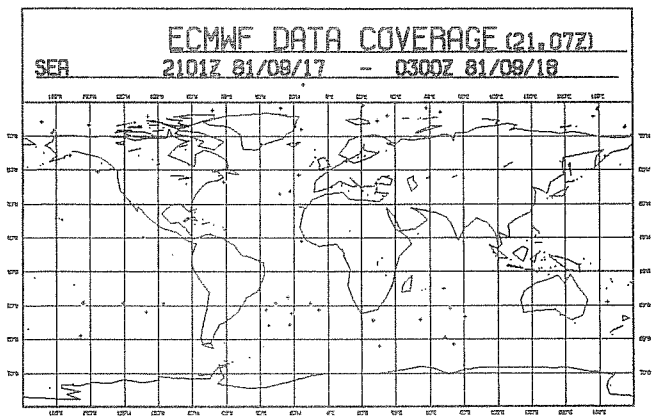


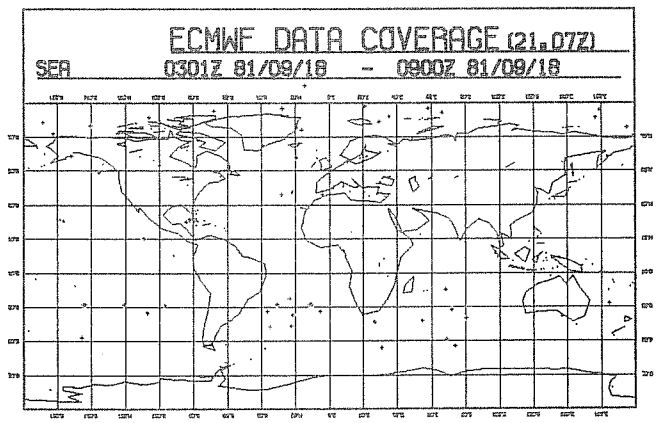


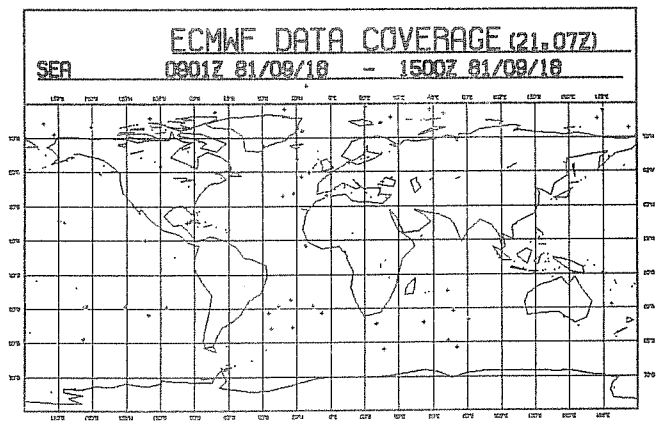

Table 1: Range of parameters potentially available from the ECMWF system, and characteristics of parameter

| Parameter | '$n_2n_2$' | 'Pii' | Units | Scaling factor u | Ref. value (rrrrrr) | Sign bit | No. of bits ($n_bn_b$) | Bit Map |
|---|---|---|---|---|---|---|---|---|
| Z1000 | 00 | H99 | decametres | 1 | 0 | Yes | 11 | No |
| Z850 | 01 | H85 | " | 1 | 150 | " | 11 | " |
| Z700 | 02 | H70 | " | 1 | 300 | " | 11 | " |
| Z500 | 03 | H50 | " | 1 | 500 | " | 11 | " |
| Z400 | 04 | H40 | " | 0 | 700 | " | 8 | " |
| Z300 | 05 | H30 | " | 0 | 900 | " | 8 | " |
| Z250 | 06 | H25 | " | 0 | 1000 | " | 9 | " |
| Z200 | 07 | H20 | " | 0 | 1200 | " | 9 | " |
| Z150 | 08 | H15 | " | 0 | 1300 | " | 9 | " |
| Z100 | 09 | H10 | " | 0 | 1600 | " | 9 | " |
| Z70 | 10 | H07 | " | 0 | 1800 | " | 9 | " |
| Z50 | 11 | H05 | " | 0 | 2100 | " | 10 | " |
| | 12 | | | | | | | |
| | 13 | | | | | | | |
| | 14 | | | | | | | |
| T1000 | 15 | E99 | $^oK$ | 1 | 250 | Yes | 11 | No |
| T850 | 16 | E85 | " | " | " | " | " | " |
| T700 | 17 | E70 | " | " | " | " | " | " |
| T500 | 18 | E50 | " | " | " | " | " | " |
| T400 | 19 | E40 | " | " | " | " | " | " |
| T300 | 20 | E30 | " | " | " | " | " | " |
| T250 | 21 | E25 | " | " | " | " | " | " |
| T200 | 22 | E20 | " | " | " | " | " | " |
| T150 | 23 | E15 | " | " | " | " | " | " |
| T100 | 24 | E10 | " | " | " | " | " | " |
| T70 | 25 | E07 | " | " | " | " | " | " |
| T50 | 26 | E05 | " | " | " | " | " | " |
| | 27 | | | | | | | |
| | 28 | | | | | | | |
| | 29 | | | | | | | |
| V1000 | 30 | D99 | $ddd^{(o)}/fff^{1/}10 m.sec^{-1}$ | N/A | 0/0 | No | 9/11 | No |
| V850 | 31 | D85 | " | " | " | " | " | " |
| V700 | 32 | D70 | " | " | " | " | " | " |
| V500 | 33 | D50 | " | " | " | " | " | " |
| V400 | 34 | D40 | " | " | " | " | " | " |
| V300 | 35 | D30 | " | " | " | " | " | " |
| V250 | 36 | D25 | " | " | " | " | " | " |
| V200 | 37 | D20 | " | " | " | " | " | " |
| V150 | 38 | D15 | " | " | " | " | " | " |
| V100 | 39 | D10 | " | " | " | " | " | " |
| V70 | 40 | D07 | " | " | " | " | " | " |
| V50 | 41 | D05 | " | " | " | " | " | " |
| | 42 | | | | | | | |
| | 43 | | | | | | | |
| | 44 | | | | | | | |

Table 1 continued

| Parameter | $'n_2n_2'$ | 'Pii' | Units | Scaling factor u | Ref. value (rrrrrr) | Sign bit | No. of bits ($n_bn_b$) | Bit Map |
|---|---|---|---|---|---|---|---|---|
| w850 | 45 | V85 | $mb.hr^{-1}$ | 2 | 0 | Yes | 13 | No |
| w700 | 46 | V70 | " | 2 | | " | 13 | " |
| w500 | 47 | V50 | " | 2 | | " | 13 | " |
| | 48 | | | | | | | |
| | 49 | | | | | | | |
| r1000 | 50 | K99 | 1 per cent | 0 | 0 | No | 7 | No |
| r 850 | 51 | K85 | " | " | " | " | " | " |
| r 700 | 52 | K70 | " | " | " | " | " | " |
| r 500 | 53 | K50 | " | " | " | " | " | " |
| r 400 | 54 | K40 | " | " | " | " | " | " |
| r 300 | 55 | K30 | " | " | " | " | " | " |
| q1000 | 60 | Q99 | $g.kg^{-1}$ | 2 | 0 | No | 12 | No |
| q850 | 61 | Q85 | " | 2 | " | " | 12 | " |
| q700 | 62 | Q70 | " | 2 | " | " | 12 | " |
| q500 | 63 | Q50 | " | 2 | " | " | 11 | " |
| q400 | 64 | Q40 | " | 2 | " | " | 10 | " |
| q300 | 65 | Q30 | " | 2 | " | " | 10 | " |
| $p_s$ | 70 | X01 | mb | 1 | 1000 | Yes | 11 | No |
| $T_s$ | 71 | X02 | $^oK$ | 1 | 250 | Yes | 11 | No |
| P | 72 | X03 | mm | 1 | 0 | No | 10 | Yes |
| T(2m) | 73 | X04 | $^oK$ | 1 | 250 | Yes | 11 | No |
| $P_S$ | 74 | X05 | mm | 1 | 0 | No | 10 | Yes |
| S | 75 | X06 | cm | 0 | 0 | No | 10 | Yes |
| $V_s$ | 76 | X07 | ddd(°)fff($^1$/$_{10}$) $msec^{-1}$ | N/A | 0/0 | No | 9/11 | No |
| N | 77 | X08 | centiles | 0 | 0 | No | 7 | No |
| C | 78 | X09 | see note below | | | | | |

Notes to Table 1

(i) Explanation of mnemonics

Z = geopotential height (i.e. parameter 02 in WMO Code Table 0291)
T = temperature (i.e. " 04 " " " " " " )
V = wind speed & direction (i.e. " 22 " " " " " " )
w = vertical velocity (i.e. " 42 " " " " " " )
r = relative humidity (i.e. " 13 " " " " " " )
q = humidity mixing ratio (i.e. " 14 " " " " " " )
$p_s$ = m.s.l. pressure (i.e. " 01 " " " " " " )
$T_s$ = surface temperature (i.e. " 04 " " " " " " )
P = total rainfall (i.e. " 50 " " " " " " )
T(2m) = temperature at 2m above model surface (i.e. " 04 " " " " " " )
$P_S$ = snowfall (Not defined in WMO Code Table 0291)
S = snowcover (i.e. parameter 51 in WMO Code Table 0291)
$V_s$ = wind at 10m (i.e. " 22 " " " " " " )
N = cloud cover in centiles
C = special parameter used to disseminate cloud information in form of "pseudo satellite" picture, see note (xii)

The number following the parameters Z,T,V,w,r,q indicatesthe pressure level for these parameters.