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CENTRAL FORECASTING MONITORING NOTE NO. 10

MONITORING STATISTICS FOR SATEMs and SATOBs

June-August 1992

by

S. G. Smith

October 1992

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June - August 1992

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1. Introduction

This Monitoring Note is the fourth in a series that has presented monitoring results for SATEMs and SATOBs for different three-monthly periods :

- Number 3 - September - November 1989
- Number 5 - December 1989 - February 1990 and June - August 1990
- Number 8 - December 1991 - February 1992 (referred to as P1)

Results for SATEMs (500 km resolution) and SATOBs have again been compared here with similar statistics for TEMPs/PILOTs, AIREPs and LASS (Local Area Sounding System) observations. The background field used to infer the quality of the observations is a T+6 hour background field from the operational NWP global model.

Only significant features are commented upon for each chart.

2. Temperatures

During the June - August period, SATEM temperatures at 1000-850 hPa north of 30 S were not used in the assimilation, nor temperatures over land below 100 hPA. LASS temperatures were not used at any level over land but at all levels below 30 hPa over sea. AIREPs were permanently rejected over mainland United States until 9th June, then replaced by a scheme permanently rejecting reports from selected airlines.

On 11th August, a model change inadvertently caused model output temperatures to be too cold and these are used in this study. The effect would be negligible at low levels but at the 50-30 hPa band could cause a positive shift in the O-B quantities of a few degrees Celcius. Whatever the impact, it only affected about 1/6 of the three month period.

2.1 SATEMs (figs 1 - 7)

(1) Neglecting values over land, there are large positive mean differences for the 1000-850 hPa band in the N. Atlantic, central southern Atlantic and NE Pacific (fig 1) and corresponding high rms differences (fig 2). For P1, there were large positive differences over the NW Atlantic, north Norwegian Sea, central southern Atlantic and NW Pacific.

(2) Significant positive mean differences occur over the N. Atlantic and Norwegian Sea for the 300-100 hPa band (fig 3) again with corresponding high rms differences (fig 4). Similar features were evident for the same areas in P1 though not quite as marked.

(3) Mean differences over most of the globe are positive for the 50-30 hPa band (fig 5). For P1, there was a only a slight positive bias. The change evident between the two periods may be due to the change to the model radiation scheme implemented in April 1992 and/or the model output problem mentioned above.

2.2 TEMPs (figs 8 - 13)

Note that the bands for the TEMPs are not exactly the same as for SATEMs due to the form in which the data are archived. Over the NE Atlantic, mean differences are positive for the TEMPs at both 1000-801 hPa and 300-101 hPa (figs 8 and 10), as they are for SATEMs at corresponding bands. Above 100 hPa, (fig 12), most of the mean differences above 100 hPa are negative. This is consistent with results for P1 but contrasts with results for the SATEMs in the band 50-30 hPa.

2.3 AIREPs (figs 14 - 15)

Again a positive difference is observed over the NE Atlantic (fig 14), though differences across the whole globe are generally above zero.

2.4 LASS (figs 16 - 18)

LASS (O-B) differences are shown for 850 hPa (fig 16), 250, 200 and 150 hPa combined (fig 17) and 50 and 30 hPa combined (fig 18). Most grid box values are within 0.5 deg C of zero, the exception being in the top band over the Mediterranean. These results are in contrast to the significant positive bias observed over parts of the NE Atlantic at the two lower bands for TEMPs and all three bands for SATEMs. Concern has recently been expressed about the impact of LASS data on the model which, since they use the model backgroound as a first guess in the retrieval process, may be feeding back model biases into the assimilation.

3. Winds

During the period of this study, SATOBs from GOES were permanently rejected north of 20 N above 500 hPa as were those from GMS that were outside 20 N - 20 S above 500 hPa. No SATOBS from INSAT were used. The same rejection procedure for AIREP temperatures (see section 2) applied to AIREP winds.

3.1 SATOBs (figs 19 - 28)

(1) Positive mean speed differences (observations stronger than background) are evident for the 701-1000 hPa band over the METEOSAT area of coverage (figs 20 and 21), particularly in the Gulf of Guinea area. An area of positive differences has been evident before, either in the Gulf of Guinea or further south. There is another area of positive biases over NW Africa. These findings are consistent with those of other Met. centres, suggesting an observation bias is more likely than a model bias, though a model bias cannot be ruled out (see below). The large biases give rise to high rms vector differences (fig 22).

(2) Although speed differences are generally negative in mid-latitudes at the 101-400 hPa band (fig 26), they are smaller than a few years ago. In fact for GMS winds in the northern (summer) hemisphere the mean difference is positive.

(3) There has been a significant reduction in the bias for GOES high level mid-latitude winds compared to earlier periods since their retrieval scheme changed in February 1992. The quality of their low level winds also has improved as gauged by rms vector wind differences.

(4) There are some large positive speed differences at the 101-400 hPa

band, notably to the west of S Africa and between 10-20 S in the western hemisphere.

(5) There is convergence of the O-B vectors at the equator (fig 20) for the 701-1000 hPa band corresponding to a divergence at the 101-400 hPa band (fig 25) ie the observations have the effect of enhancing the model's Hadley circulation. This feature has been noted in previous monitoring notes. However it is not consistent with forecast verification results (admittedly over longer forecast period times than six hours) which suggest that the model over-develops the Hadley circulation.

(6) The quality of the INSAT observations continues to be poor.

3.2 TEMPs/PILOTs (figs 29 - 32)

(1) There are significant positive speed differences for 701-1000 hPa over central west Africa (fig 29) where the SATOBs showed a similar difference. RMS vector differences (fig 30) are about 5 m per s in this area compared to 4-9 m per s for the SATOBs.

(2) There is also evidence of positive speed differences at 101-400 hPa (fig 31) over and to the west of W. Africa, again similar to the SATOB results. However speed differences are positive over most of the globe, more particularly in the southern hemisphere and are especially marked over Australasia. Note that SATOBs from GMS, whose coverage includes Australasia, are not used south of 30 S above 500 hPa, hence the SATOBs cannot be the cause of any model under-prediction of high level speeds at these southern mid-latitudes.

3.3 AIREPs (figs 33 - 35)

(1) Mean speed differences are positive almost everywhere.

4. Implications for the operational suite

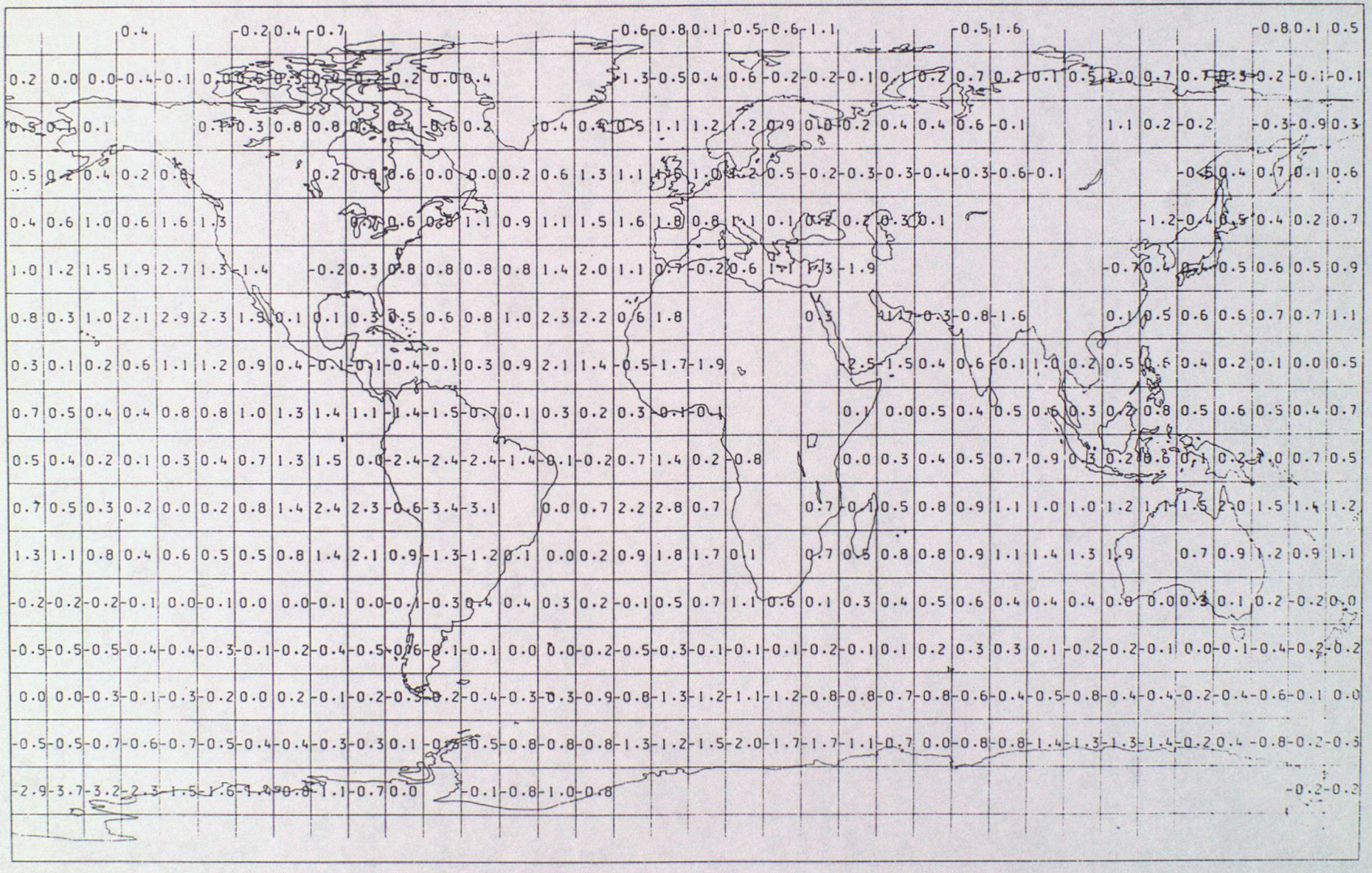
• concern over the possible harmful impact of LASS observations on the assimilation has been expressed. With effect from October 14th, LASS data have been rejected from the model although this was done more as a temporary measure until the cold bias in high level model output fields (present since August 11th) is corrected. Investigations into the general impact of LASS data continue.

• the quality of GOES low and high level winds has improved since the change to their retrieval scheme in February. A proposal to remove the permanent rejection of the GOES high level winds north of 20 N has been approved and will be implemented in December.

• the positive speed differences observed for SATOBs at low and high levels in the Tropics and particularly over W. Africa is of concern. It is not clear whether this is primarily an observation or model problem or a combination of both. Monitoring results from other centres (using their own models) give similar results but sonde minus model speeds also show a positive bias.

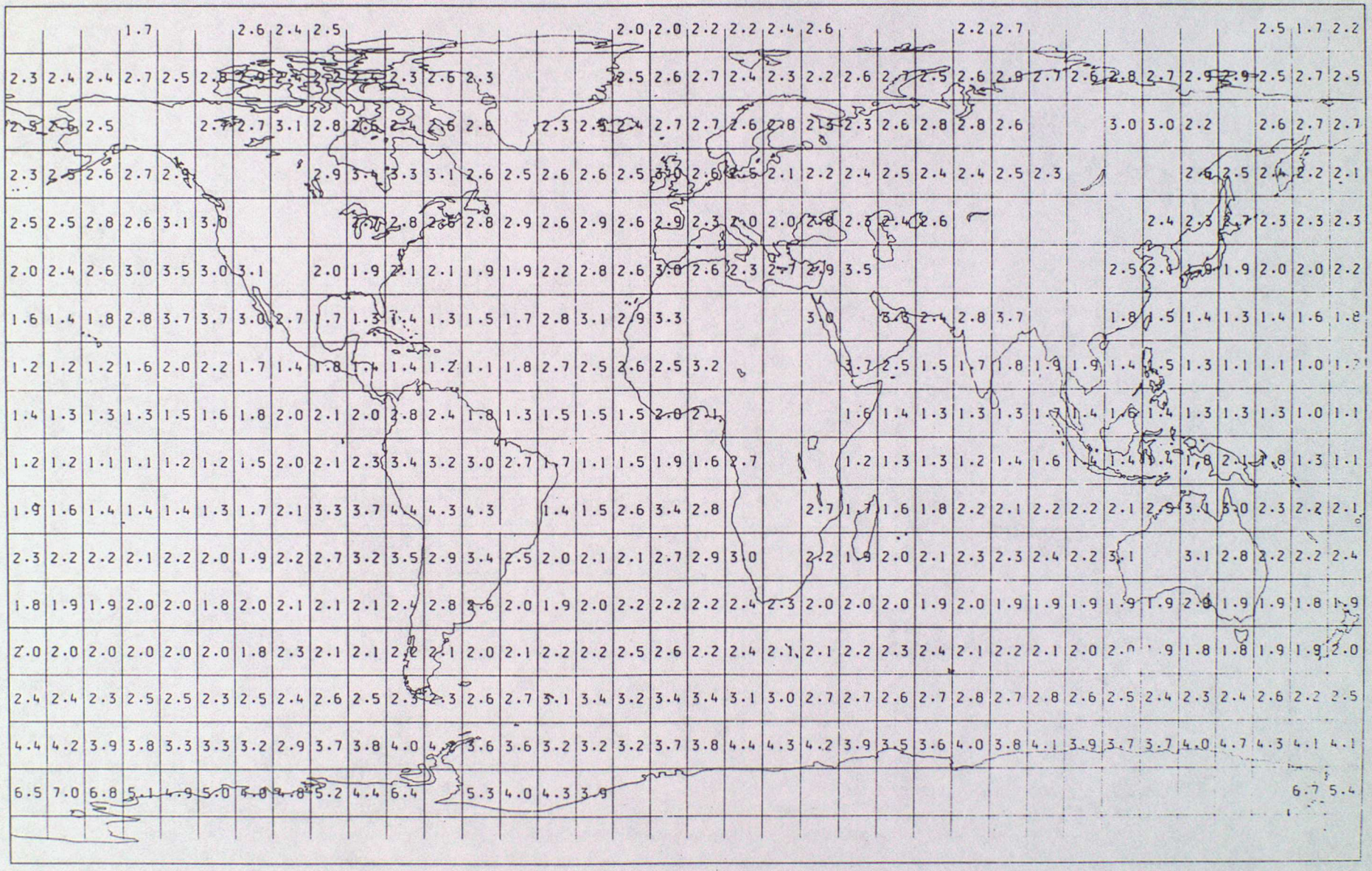
500 KM SATEMS : MEAN O-B TEMPERATURE DIFFERENCES (DEG C) : 850 TO 1000 HPA
JUNE-AUGUST 1992
NOAA-11 AND NOAA-12 STATISTICS COMBINED
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 1



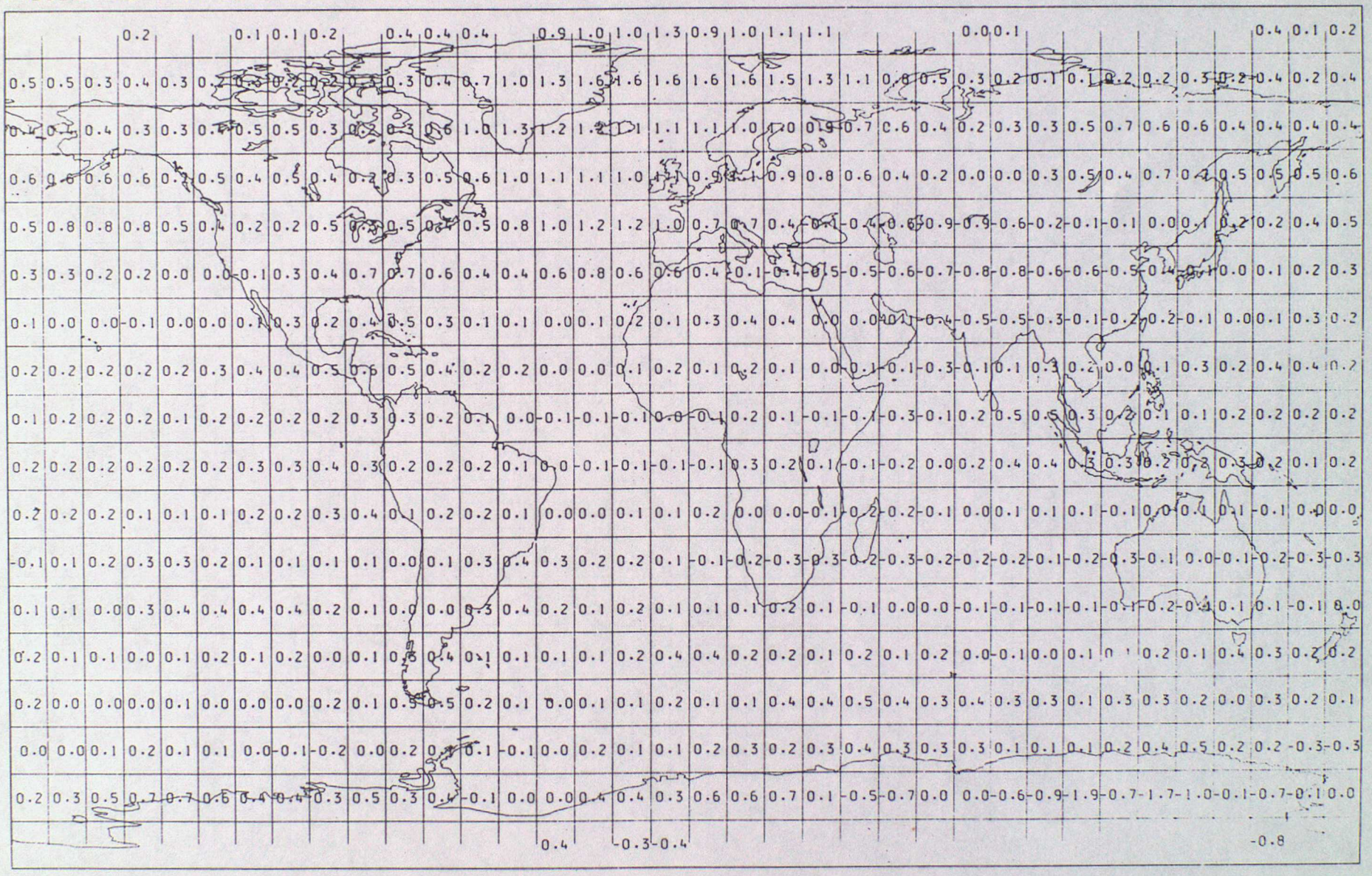
500 KM SATEMS : RMS O-B TEMPERATURE DIFFERENCES (DEG C) : 850 TO 1000 HPA
JUNE-AUGUST 1992
NOAA-11 AND NOAA-12 STATISTICS COMBINED
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 2



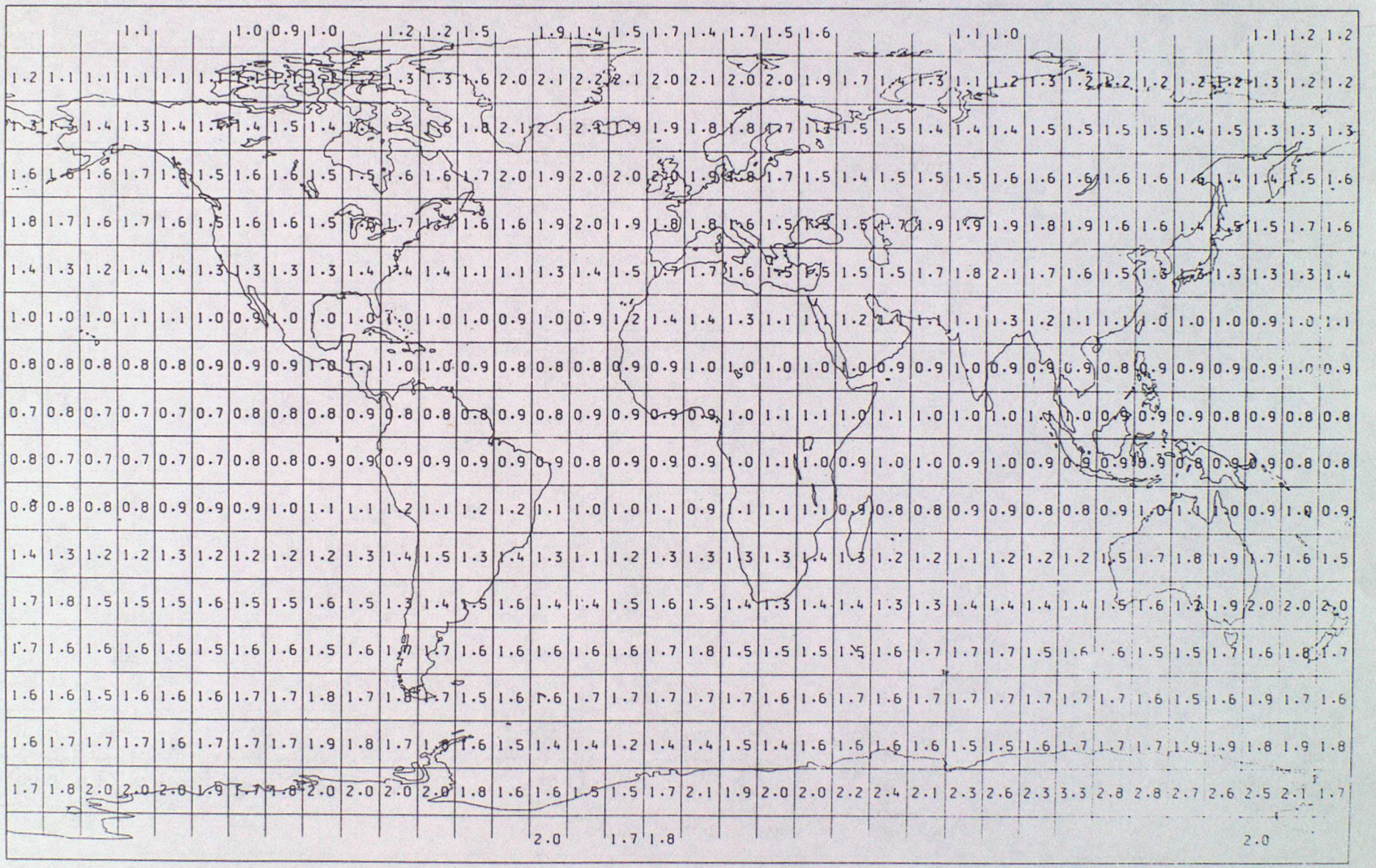
500 KM SATEMS : MEAN O-B TEMPERATURE DIFFERENCES (DEG C) : 100 TO 300 HPA
JUNE-AUGUST 1992
NOAA-11 AND NOAA-12 STATISTICS COMBINED
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 3



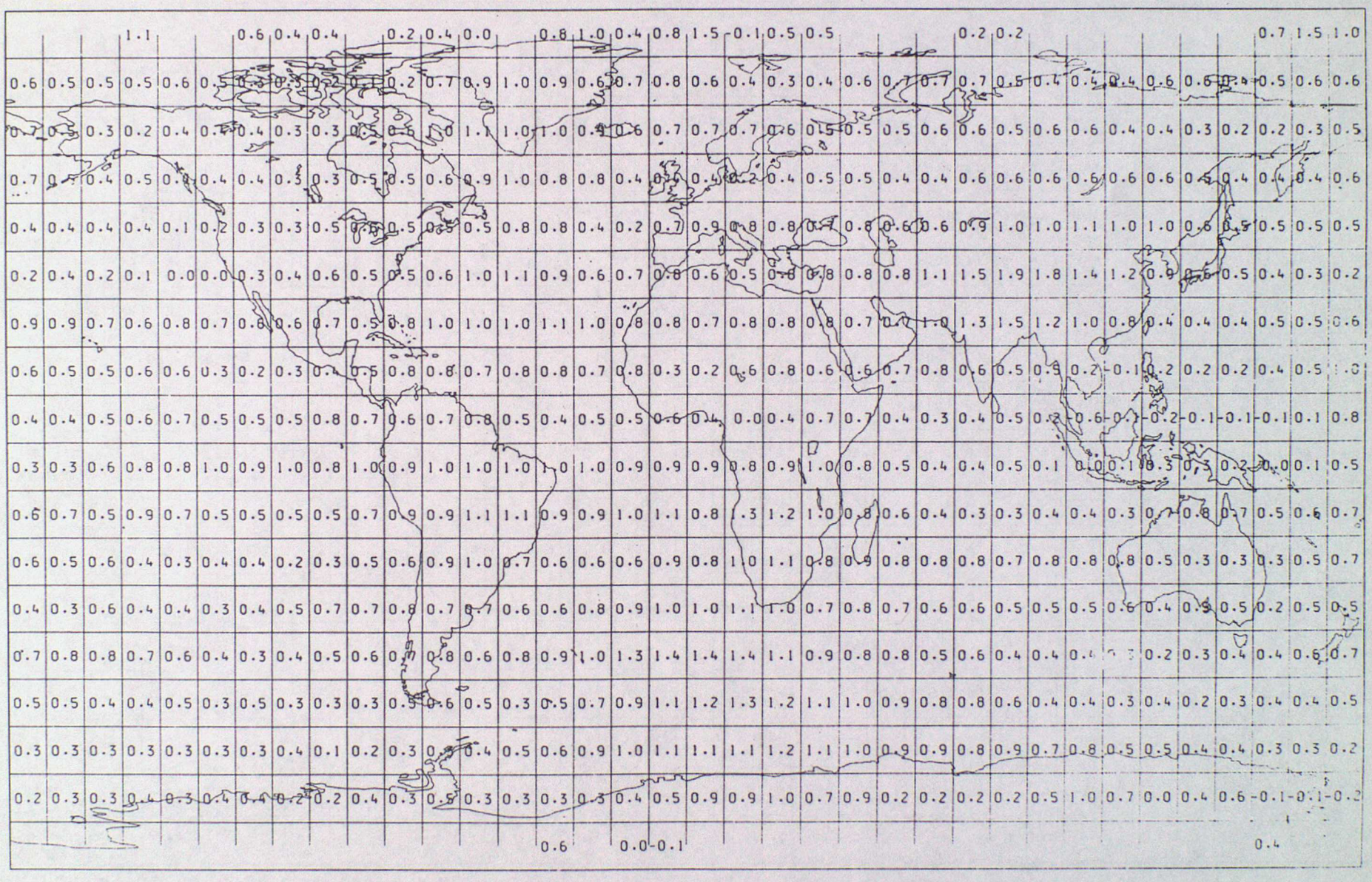
500 KM SATEMS : RMS O-B TEMPERATURE DIFFERENCES (DEG C) : 100 TO 300 HPA
JUNE-AUGUST 1992
NOAA-11 AND NOAA-12 STATISTICS COMBINED
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 4



500 KM SATEMS : MEAN O-B TEMPERATURE DIFFERENCES (DEG C) : 30 TO 50 HPA
JUNE-AUGUST 1992
NOAA-11 AND NOAA-12 STATISTICS COMBINED
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 5



500 KM SATEMS : RMS O-B TEMPERATURE DIFFERENCES (DEG C) : 30 TO 50 HPA
JUNE-AUGUST 1992
NOAA-11 AND NOAA-12 STATISTICS COMBINED
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 6

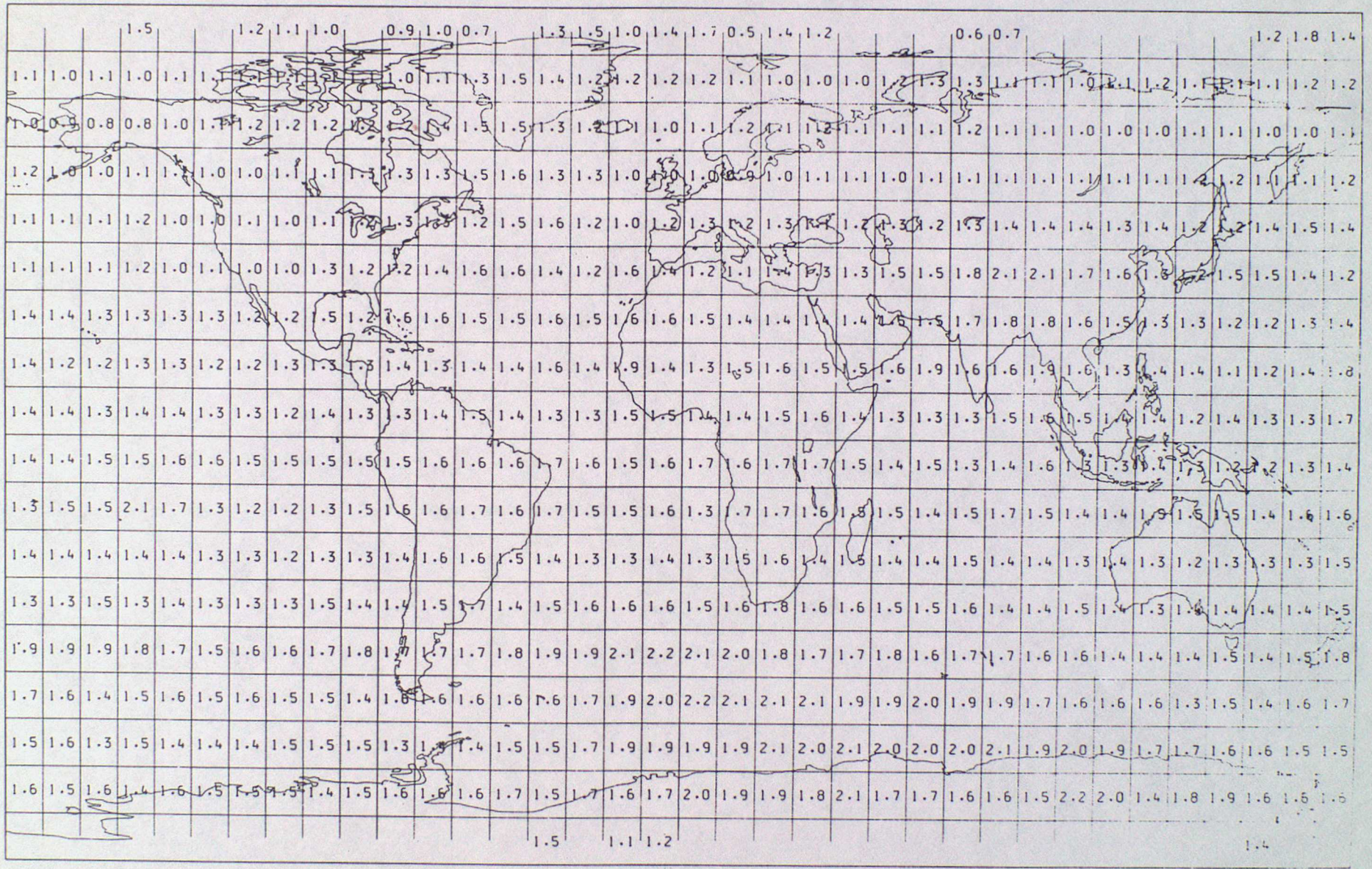
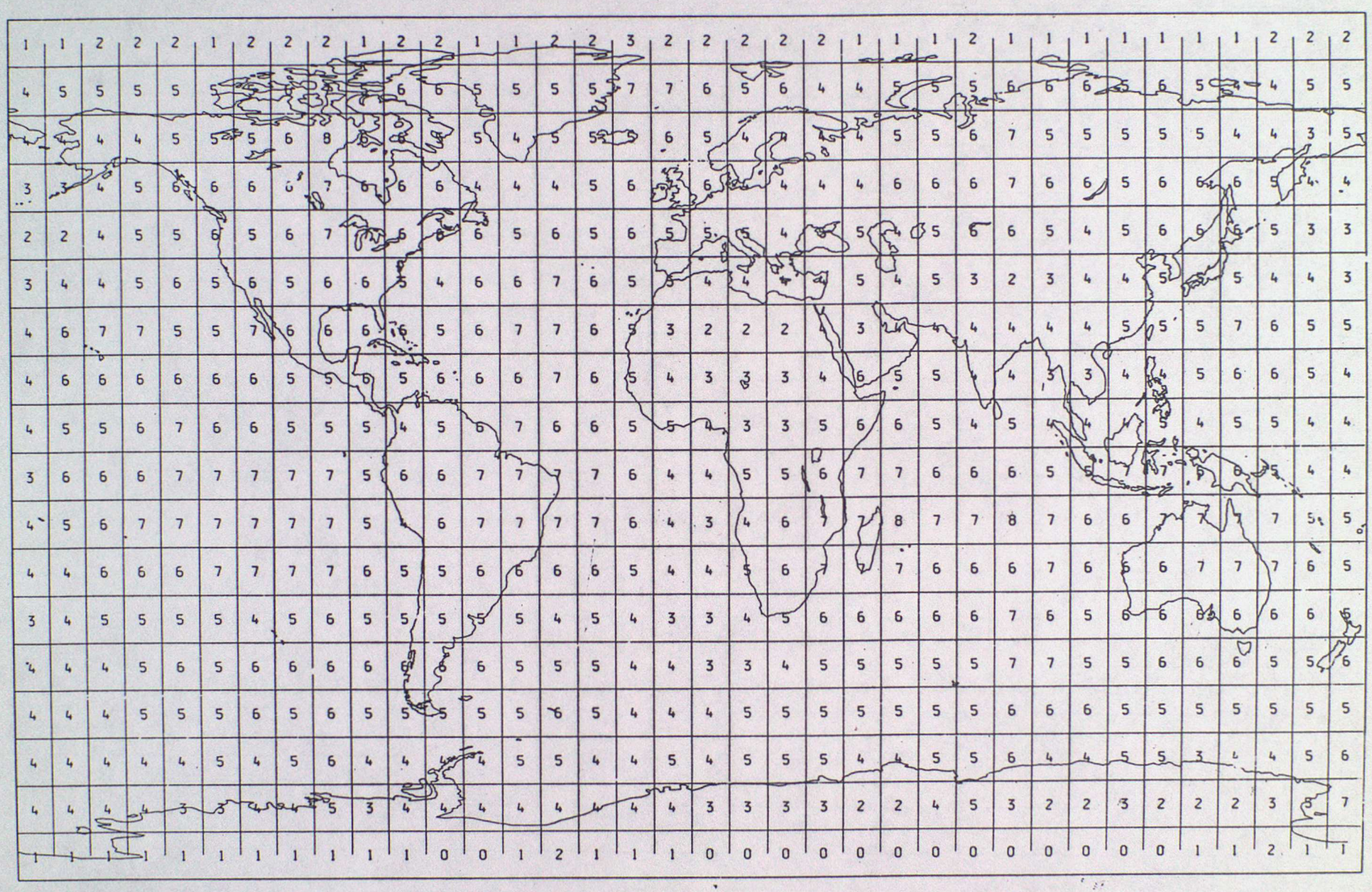


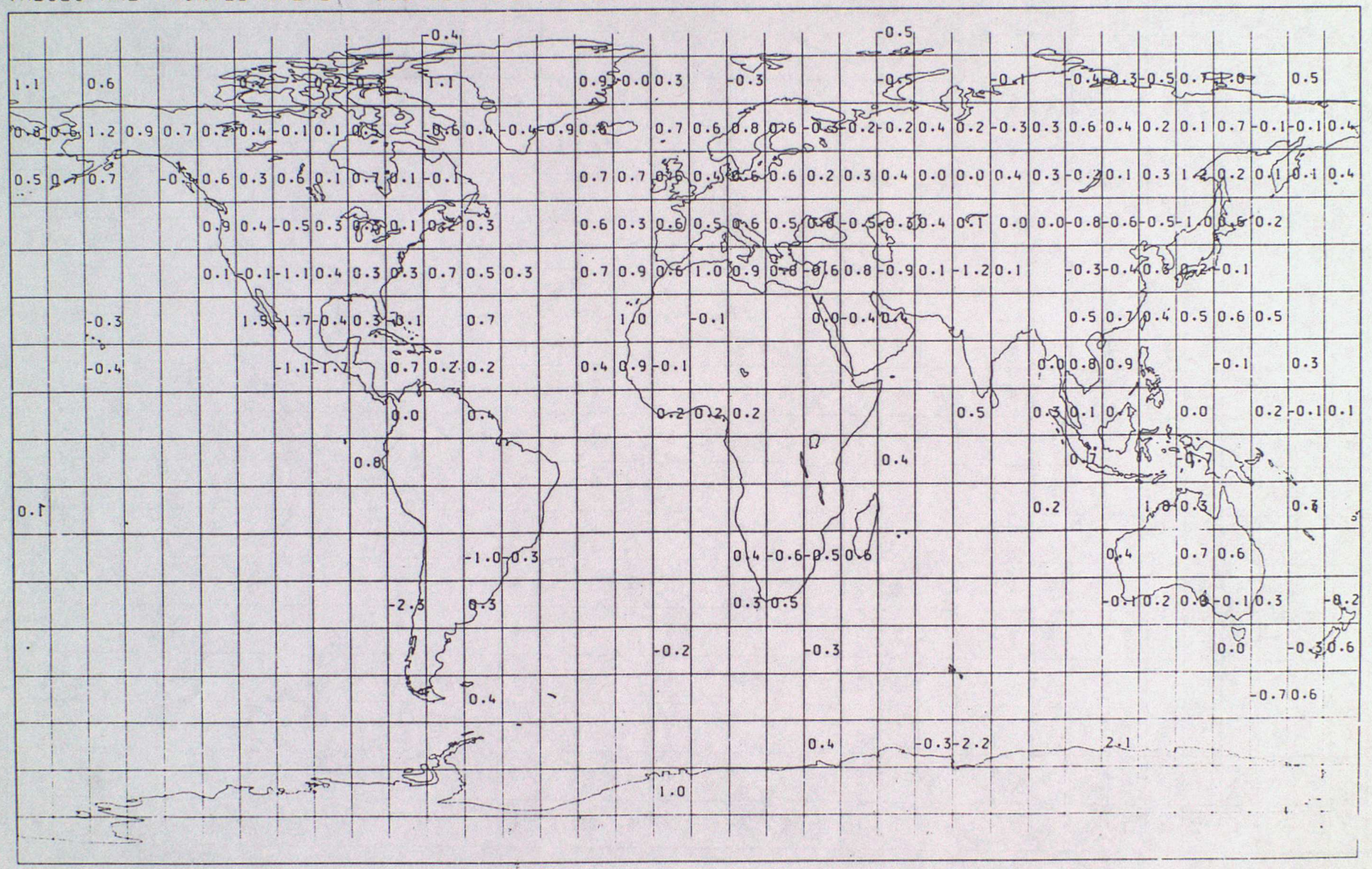
Figure 7

AVERAGE DAILY NUMBER OF 500 KM SATEMS
JUNE-AUGUST 1992
NOAA-11 AND NOAA-12 STATISTICS COMBINED



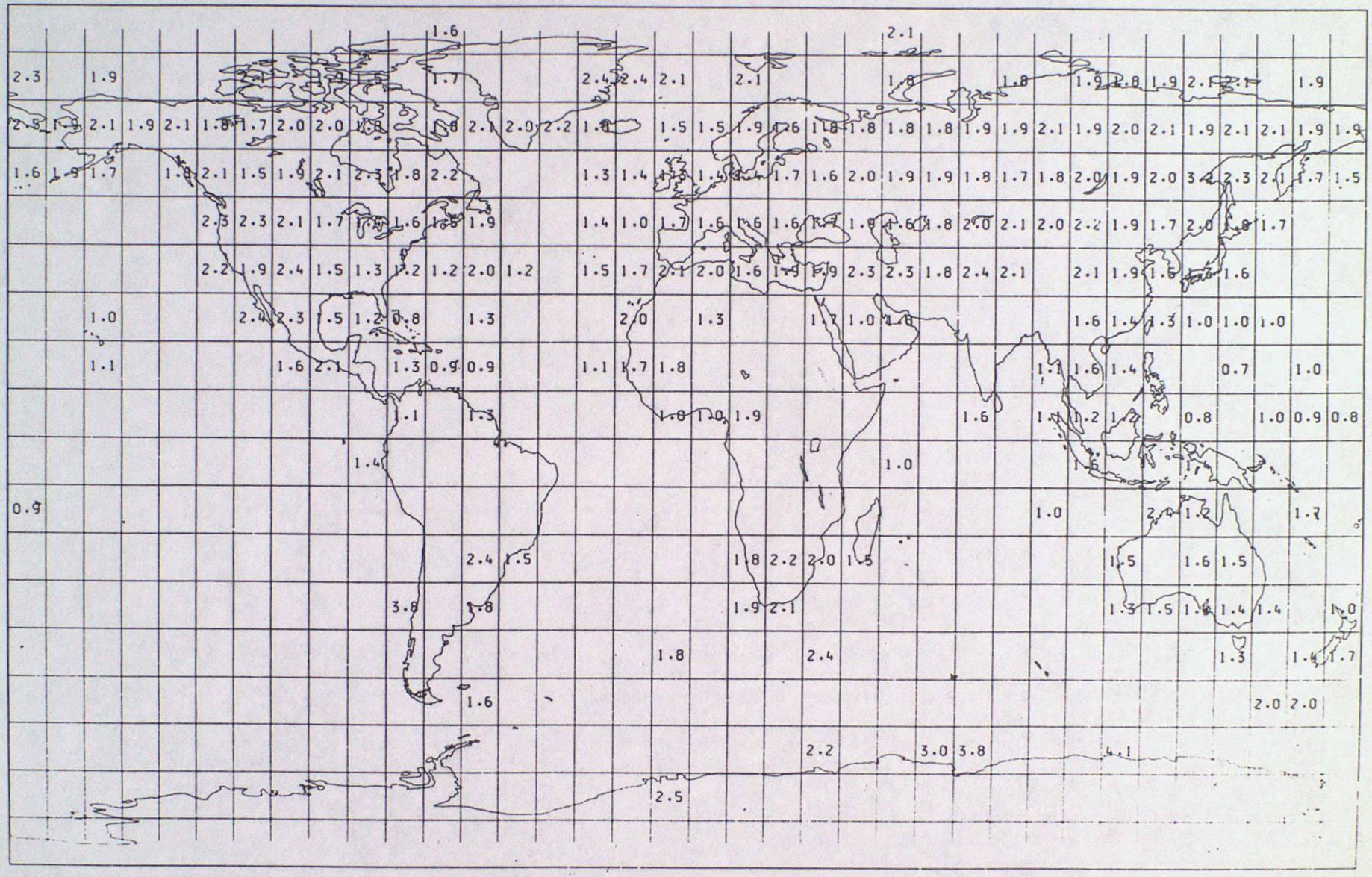
SONDES : O-B TEMPERATURE DIFFERENCES (DEG C) 801 TO 1000 HPA
JUNE-AUGUST 1992
QUALITY CONTROL APPLIED
VALUES ARE PRINTED WHERE > 100 OBS ARE PRESENT

Figure 8



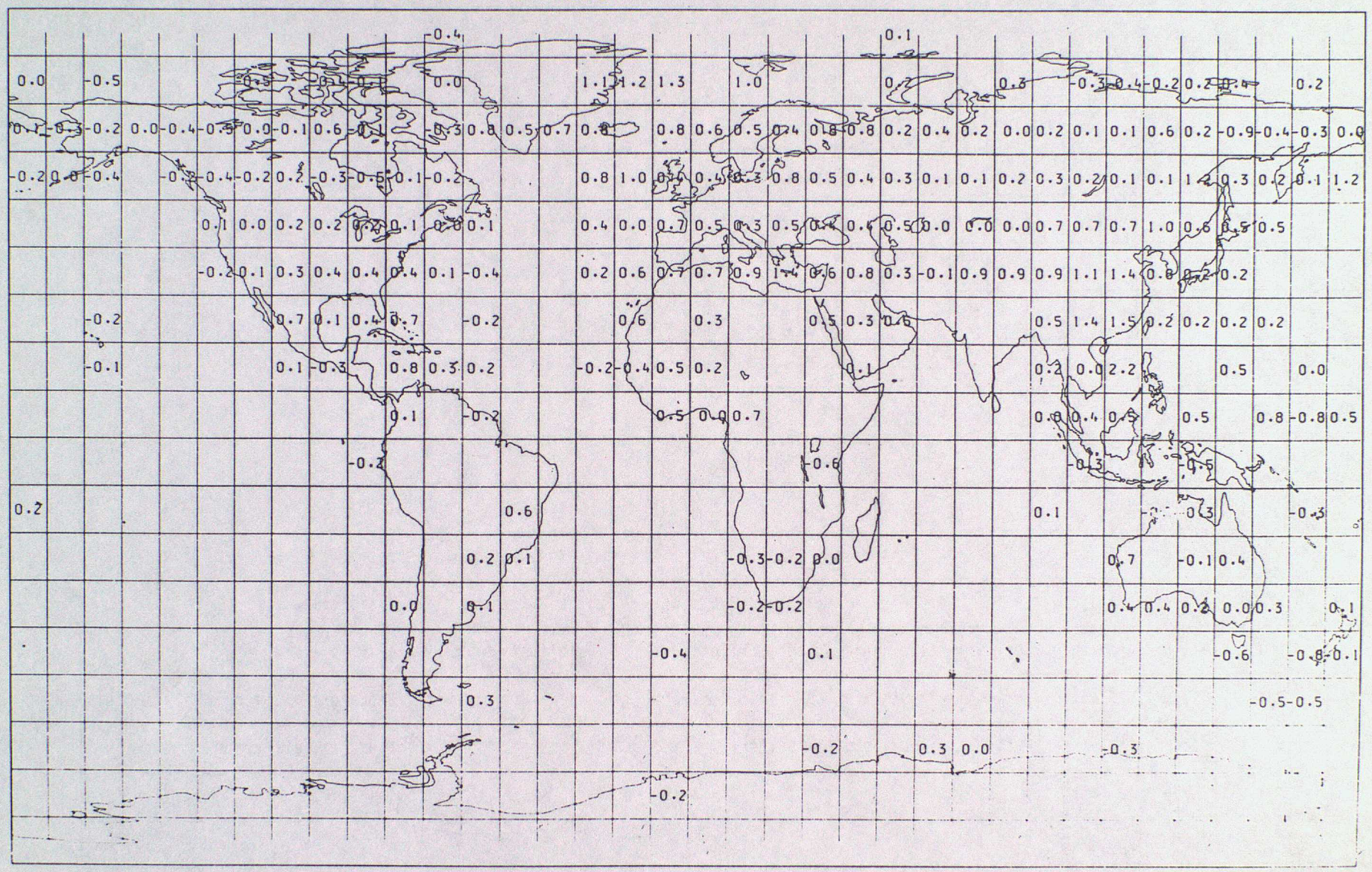
SONDES : RMS O-B TEMPERATURE DIFFERENCES (DEG C) 801 TO 1000 HPA
JUNE-AUGUST 1992
QUALITY CONTROL APPLIED
VALUES ARE PRINTED WHERE > 100 OBS ARE PRESENT

Figure 9



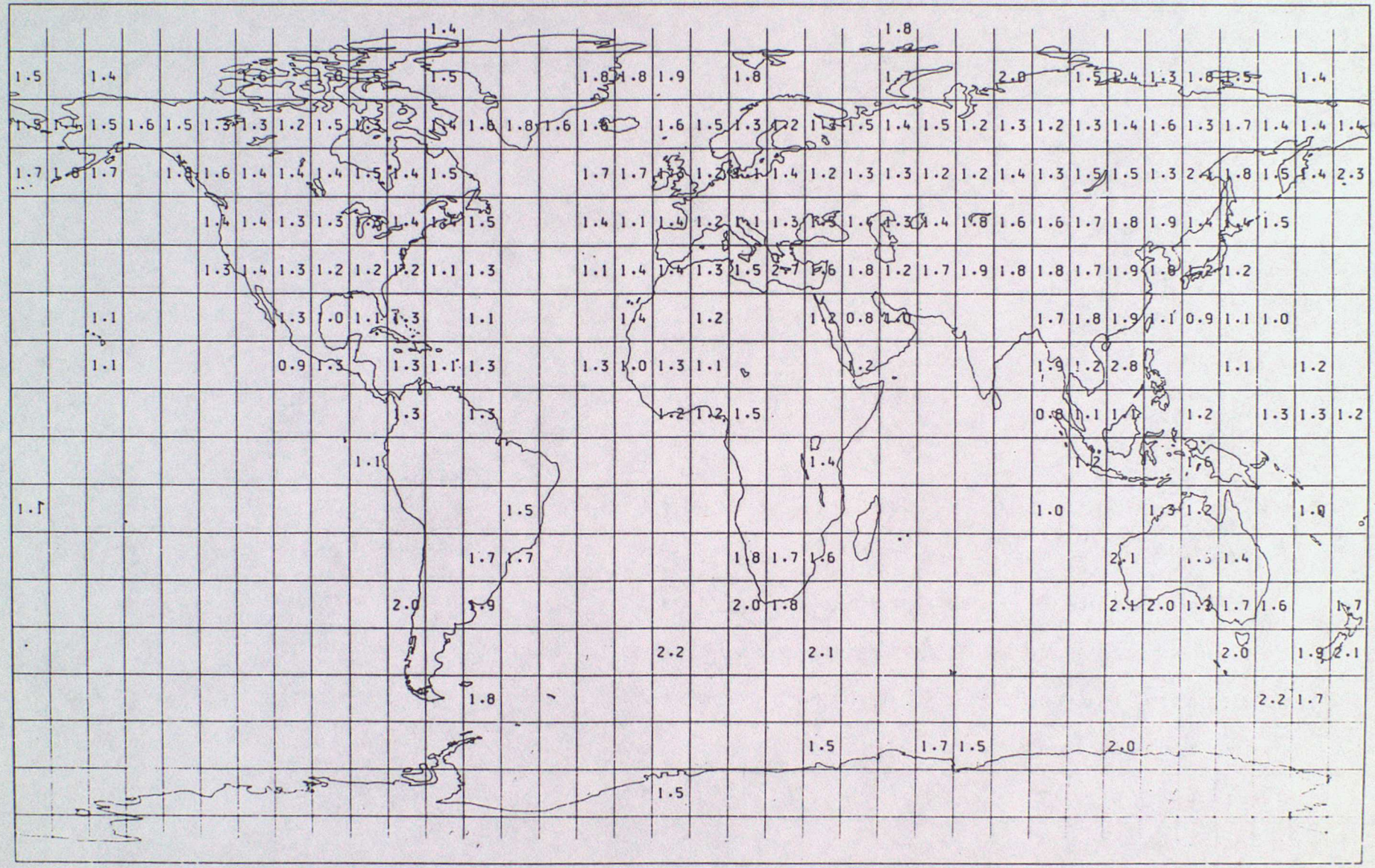
SONDES : O-B TEMPERATURE DIFFERENCES (DEG C) 101 TO 300 HPA
JUNE-AUGUST 1992
QUALITY CONTROL APPLIED
VALUES ARE PRINTED WHERE > 100 OBS ARE PRESENT

Figure 10



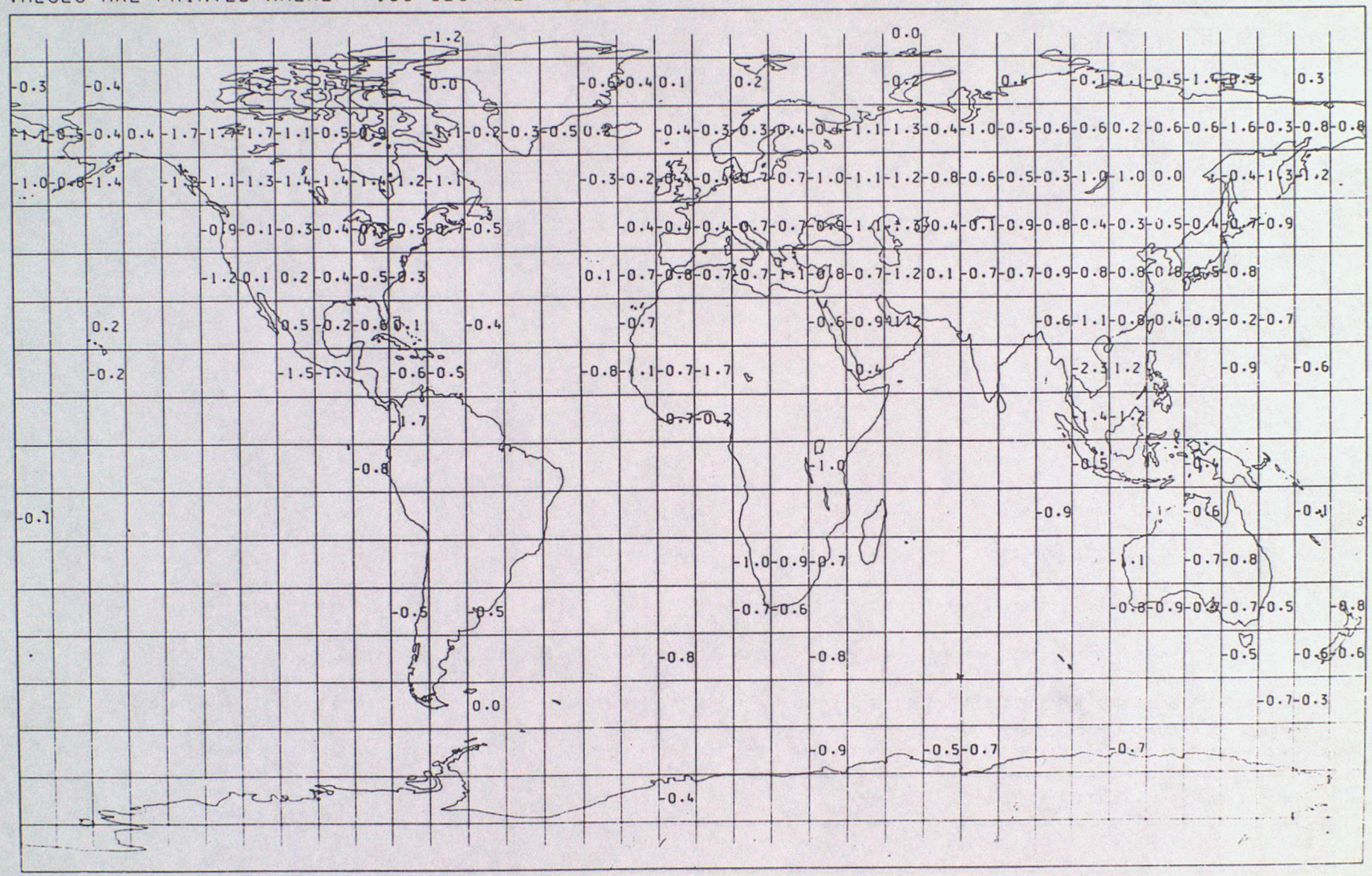
SONDES : RMS O-B TEMPERATURE DIFFERENCES (DEG C) 101 TO 300 HPA
JUNE-AUGUST 1992
QUALITY CONTROL APPLIED
VALUES ARE PRINTED WHERE > 100 OBS ARE PRESENT

Figure 11



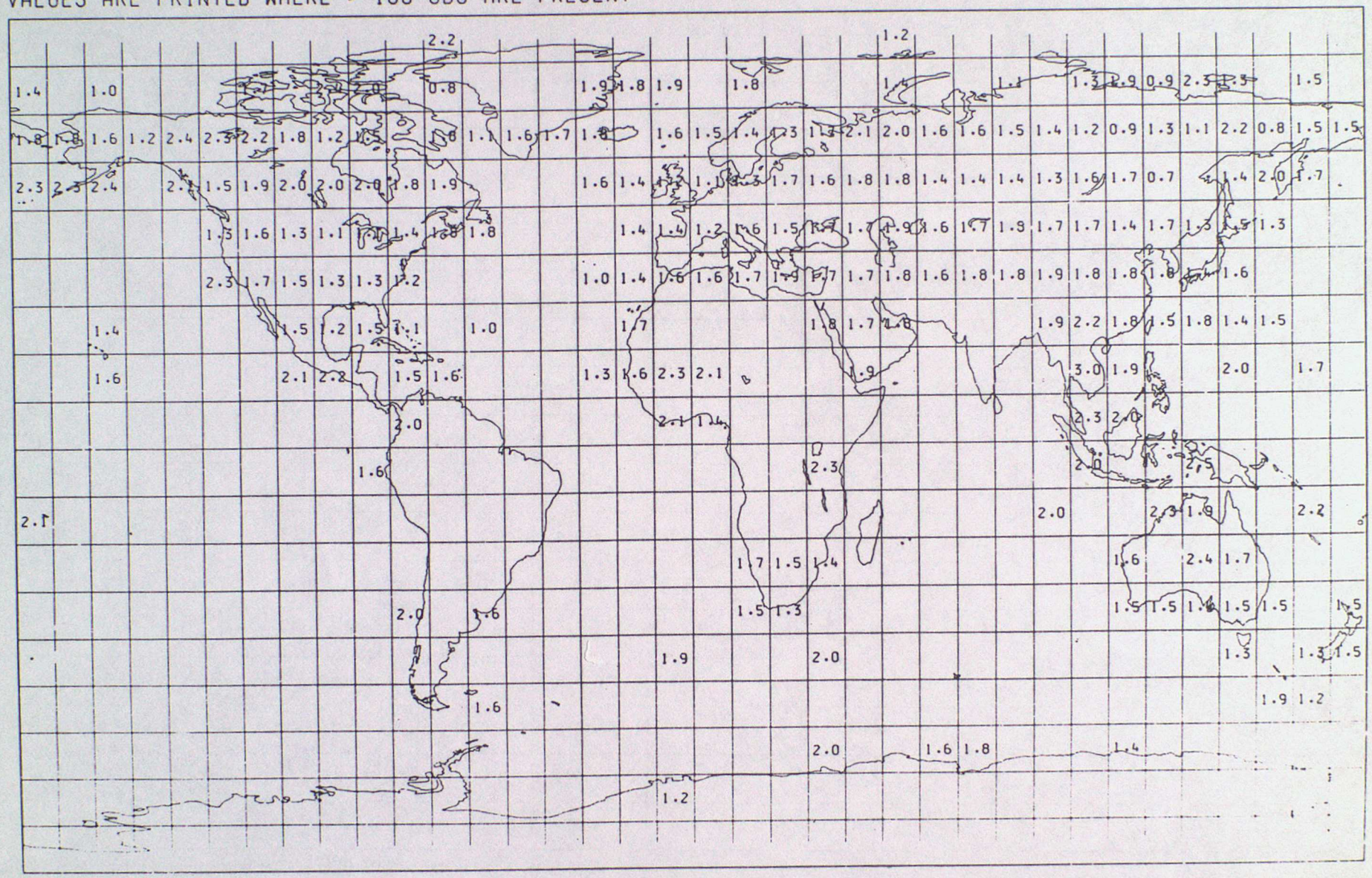
SONDES : O-B TEMPERATURE DIFFERENCES (DEG C) 11 TO 100 HPA
JUNE-AUGUST 1992
QUALITY CONTROL APPLIED
VALUES ARE PRINTED WHERE > 100 OBS ARE PRESENT

Figure 12



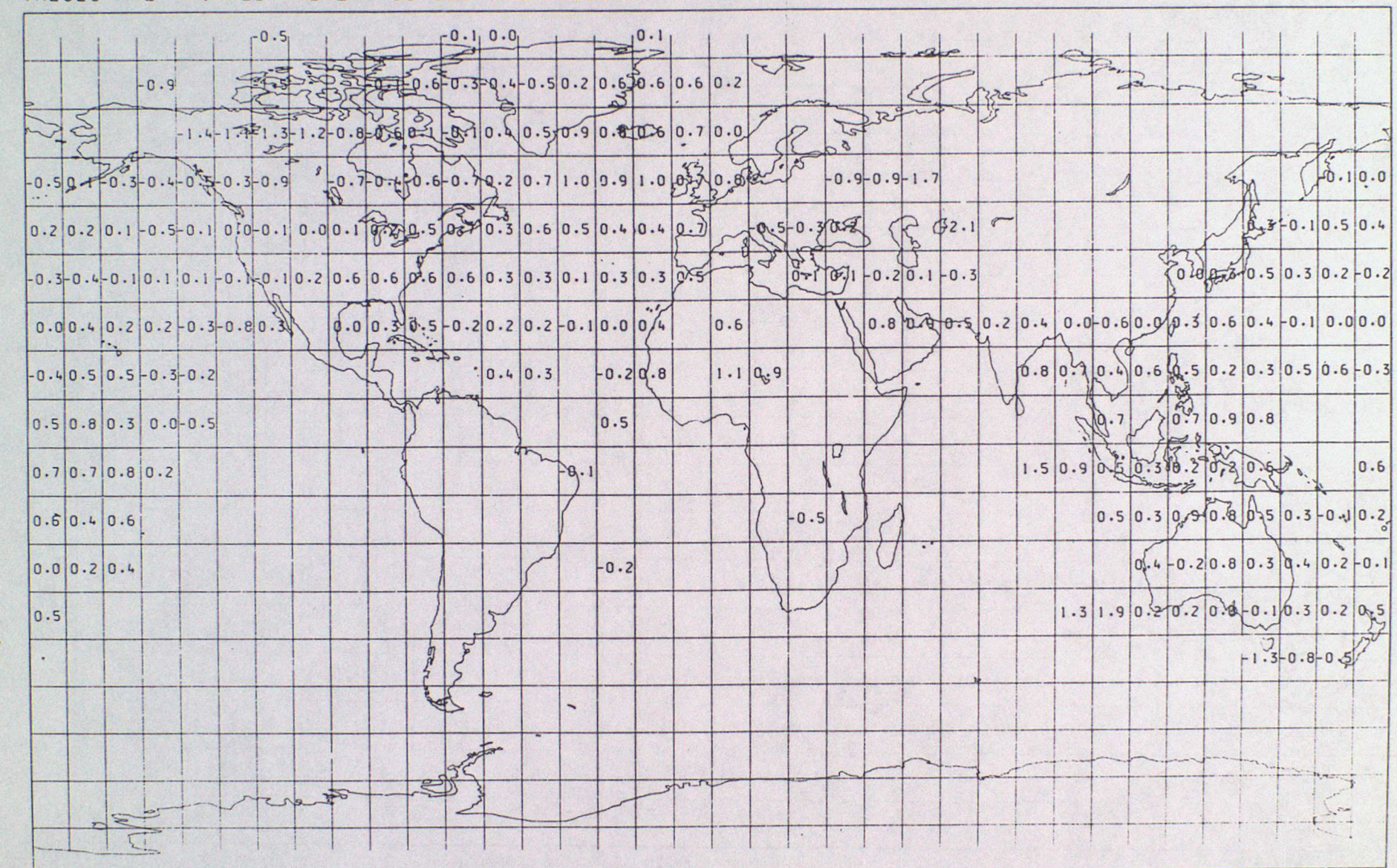
SONDES : RMS O-B TEMPERATURE DIFFERENCES (DEG C) 11 TO 100 HPA
JUNE-AUGUST 1992
QUALITY CONTROL APPLIED
VALUES ARE PRINTED WHERE > 100 OBS ARE PRESENT

Figure 13



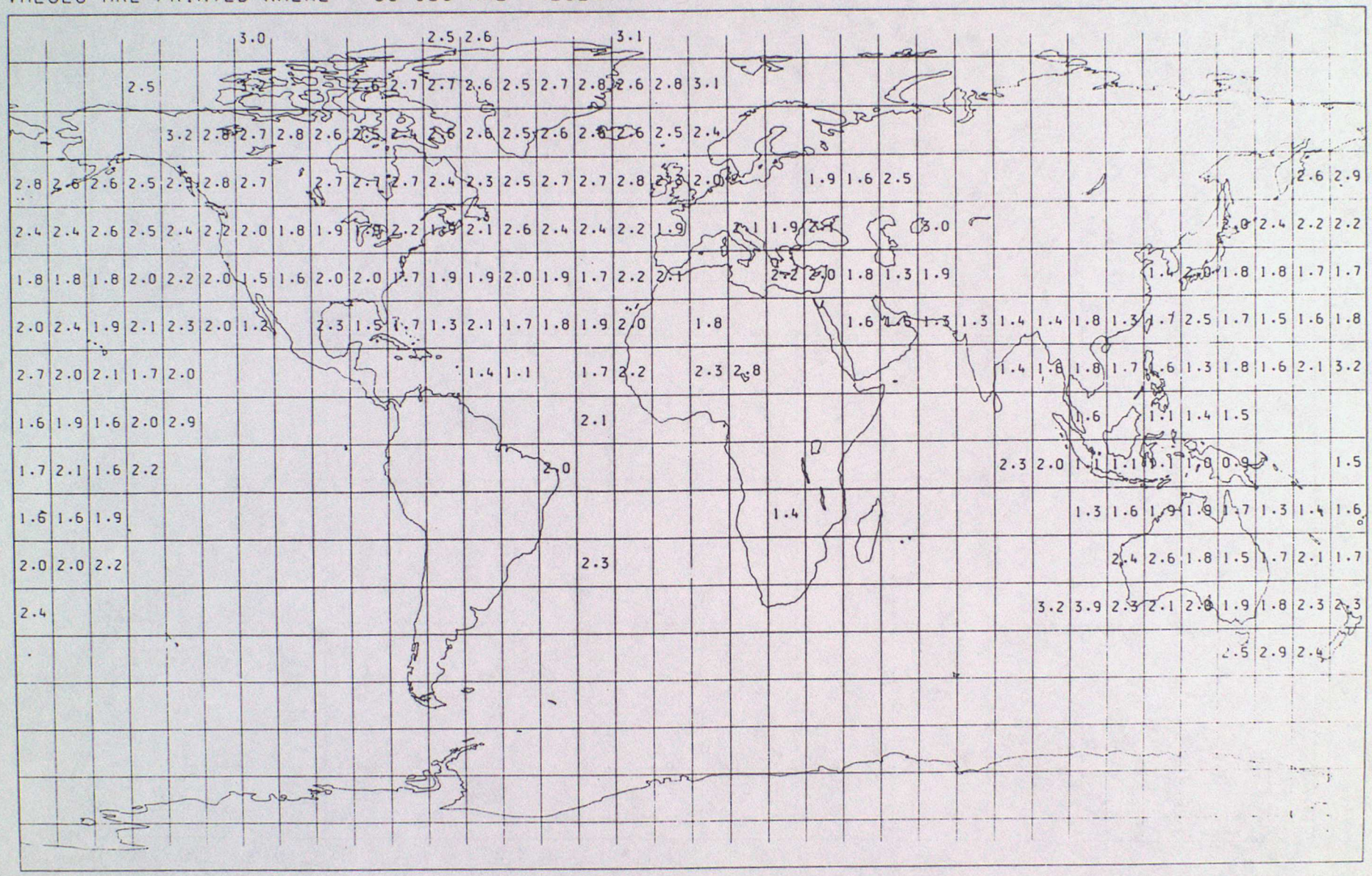
AIREPS & ASDARS : MEAN O-B TEMPERATURES BETWEEN 101 AND 300 HPA
JUNE-AUGUST 1992. UNITS DEG C
OBSERVATIONS WITH O-B > 10 DEG C EXCLUDED
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 14



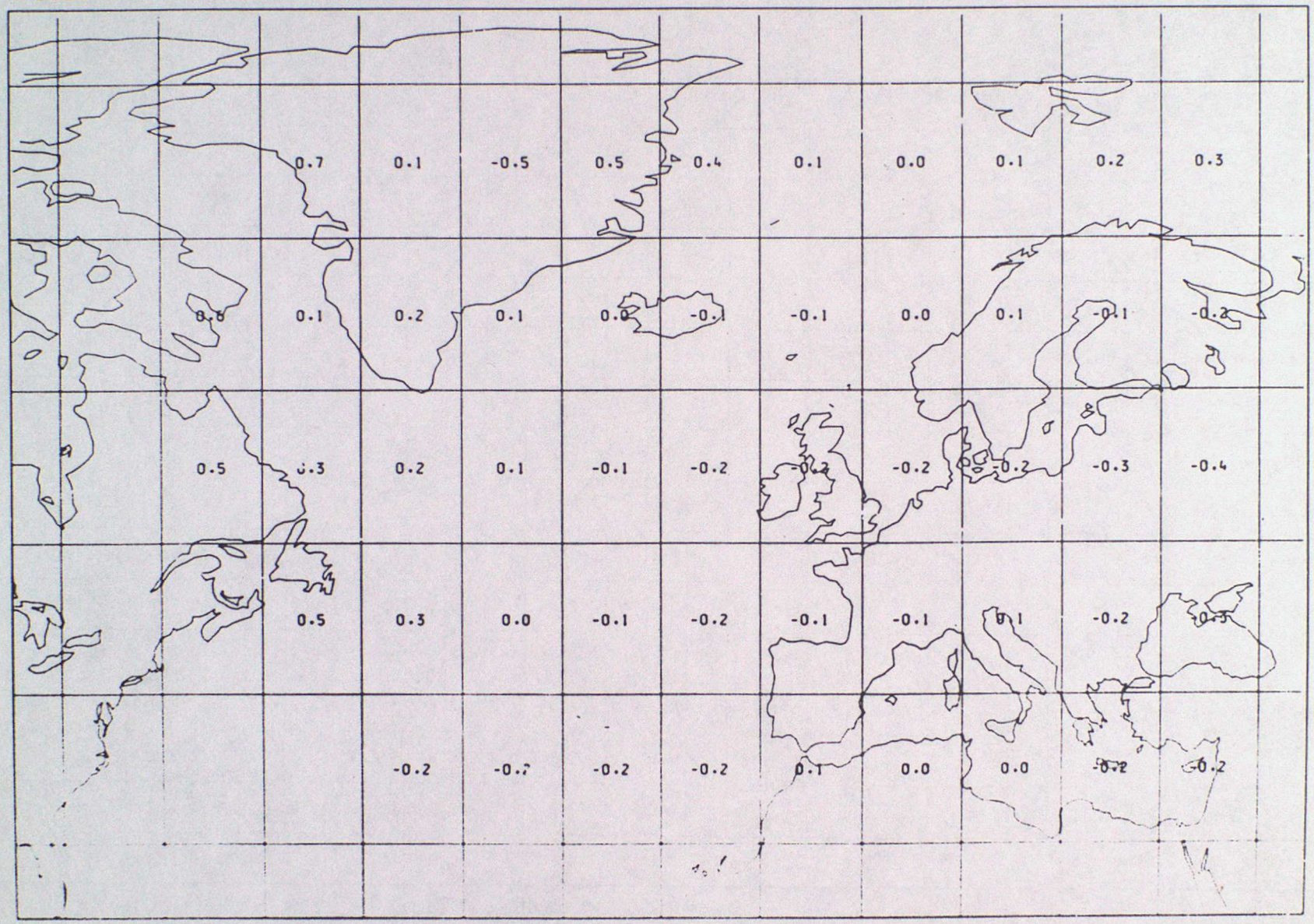
AIREPS & ASDARS : RMS O-B TEMPERATURES BETWEEN 101 AND 300 HPA
JUNE-AUGUST 1992. UNITS DEG C
OBSERVATIONS WITH O-B > 10 DEG C EXCLUDED
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 15



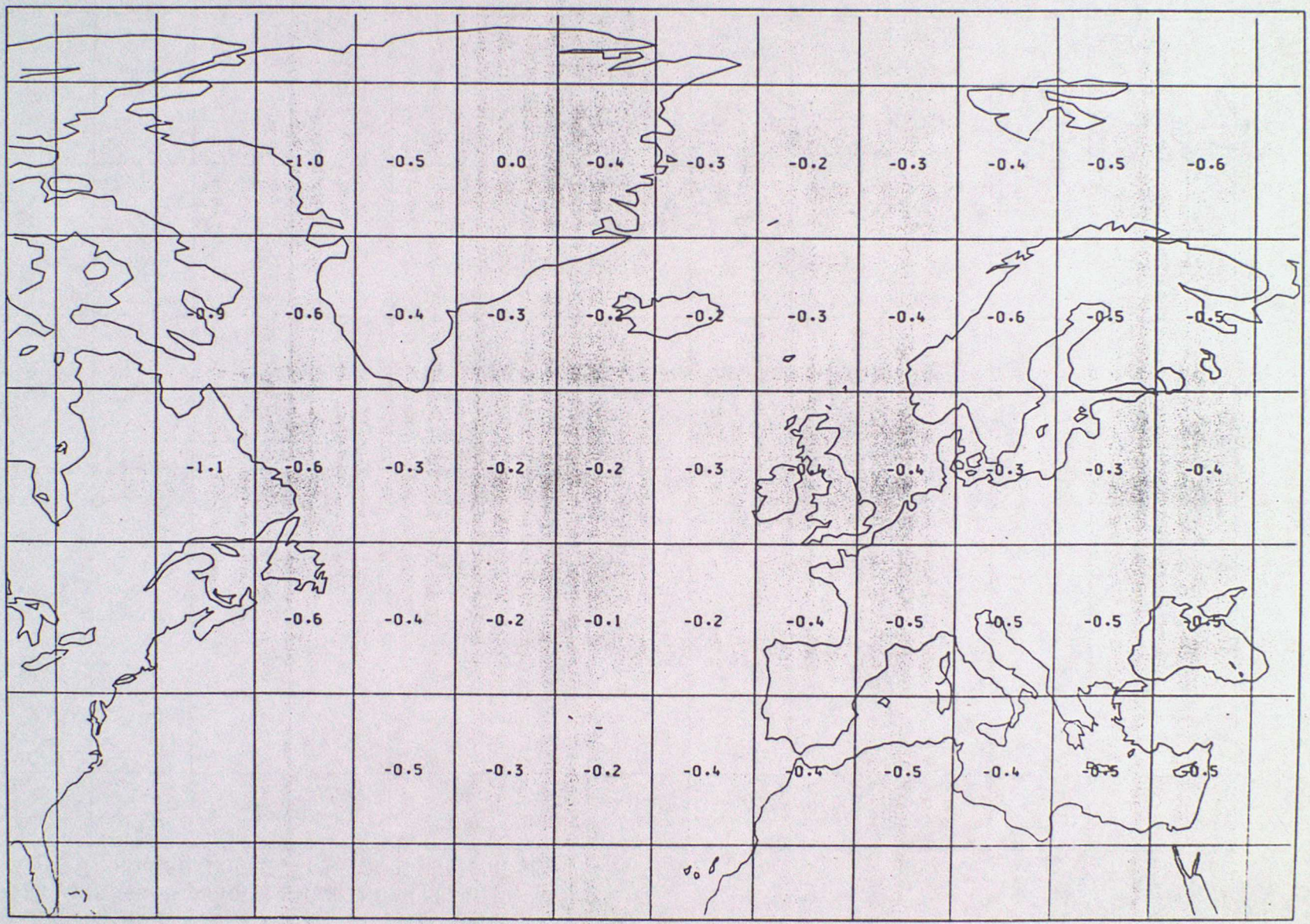
LASS : MEAN O-B TEMPERATURE DIFFERENCES (DEG C) AT 850 HPA
JUNE-AUGUST 1992
OBSERVATIONS FROM NOAA-11 AND NOAA-12
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 16



LASS : MEAN O-B TEMPERATURE DIFFERENCES (DEG C) 250 TO 150 HPA
JUNE-AUGUST 1992
OBSERVATIONS FROM NOAA-11 AND NOAA-12
VALUES ARE PRINTED WHERE 30 OBS ARE PRESENT

Figure 17



LASS : MEAN O-B TEMPERATURE DIFFERENCES (DEG C) 50 TO 30 HPA
JUNE-AUGUST 1992
OBSERVATIONS FROM NOAA-11 AND NOAA-12
VALUES ARE PRINTED WHERE > 5 OBS ARE PRESENT

Figure 18

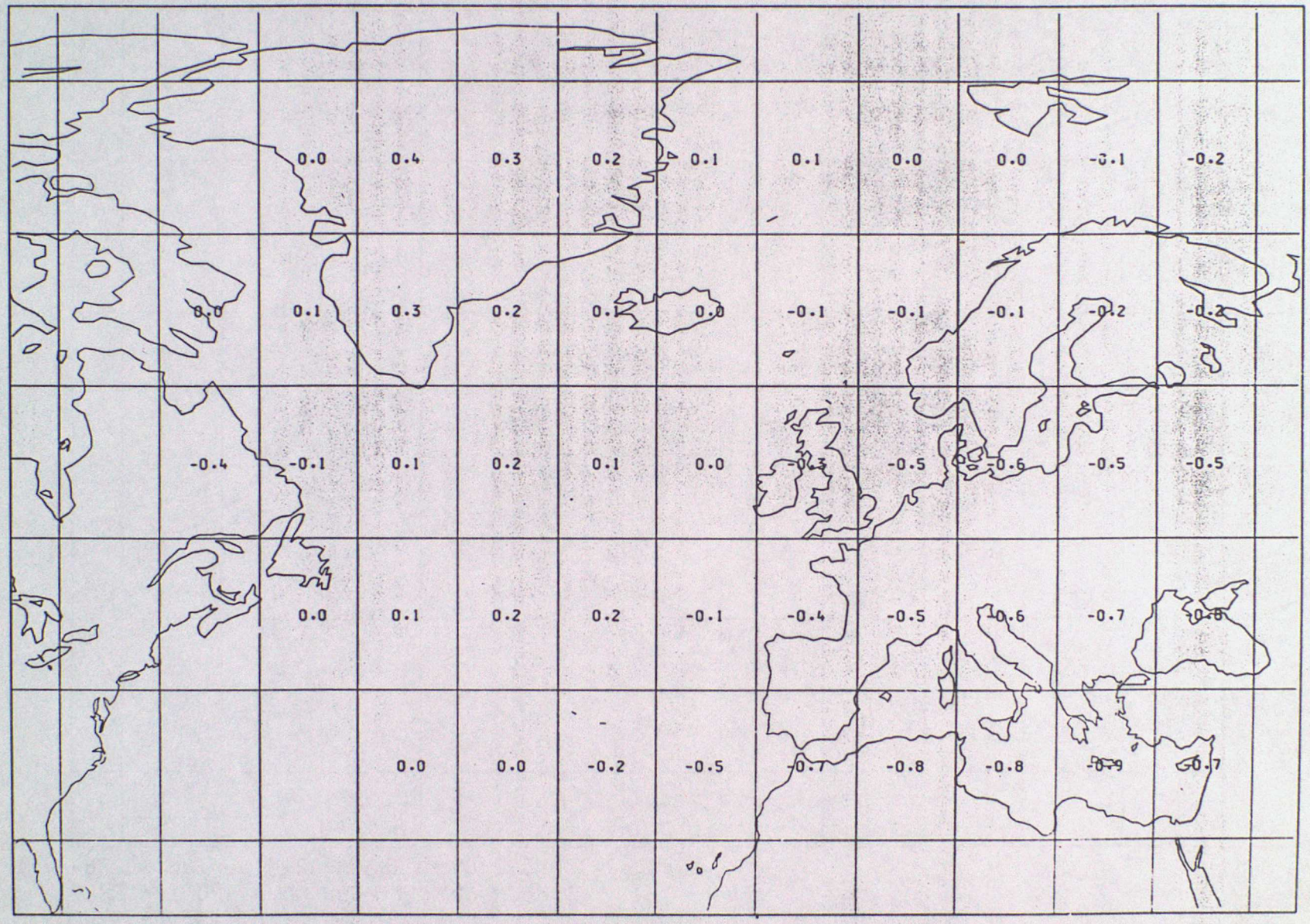
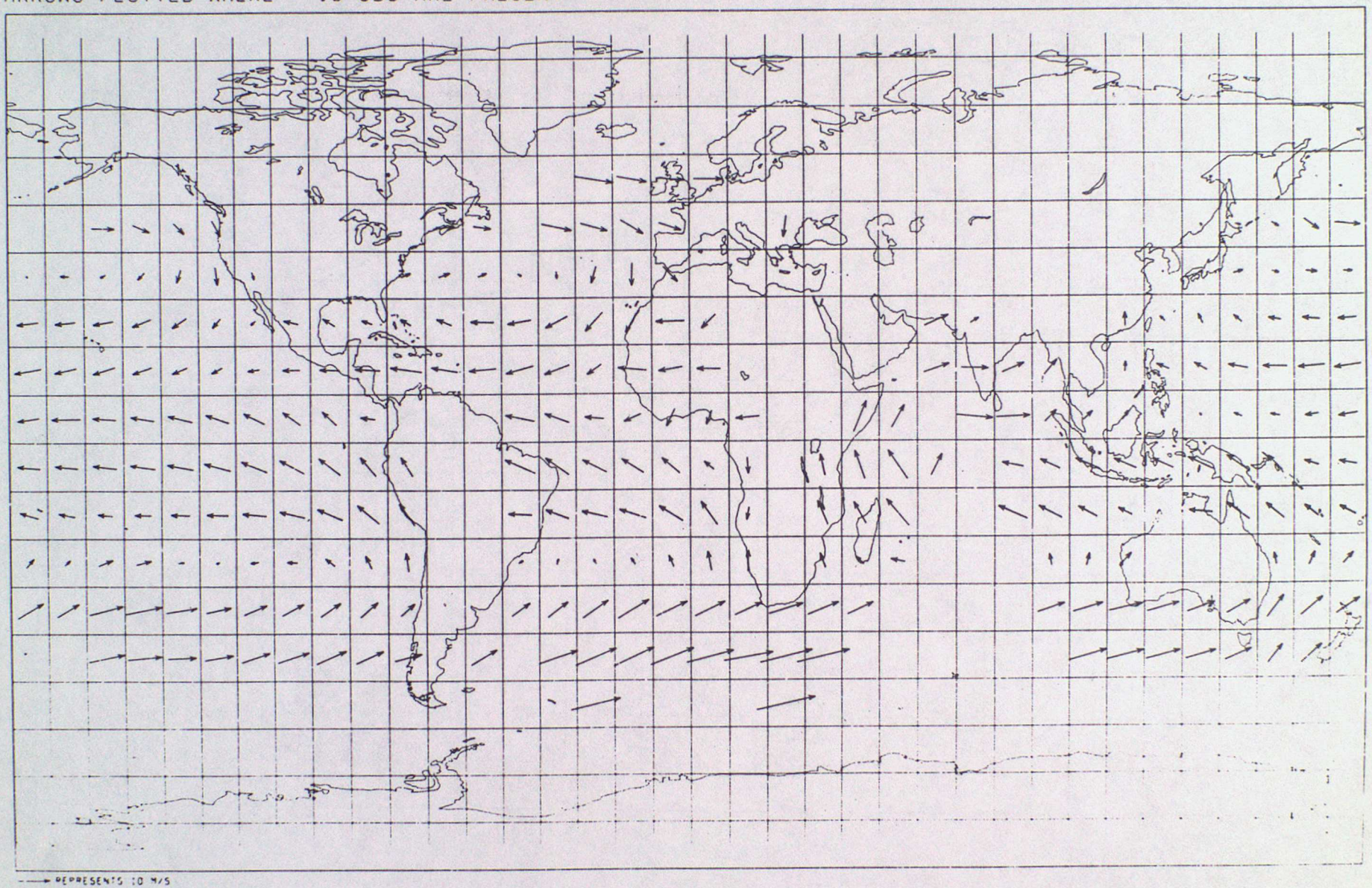


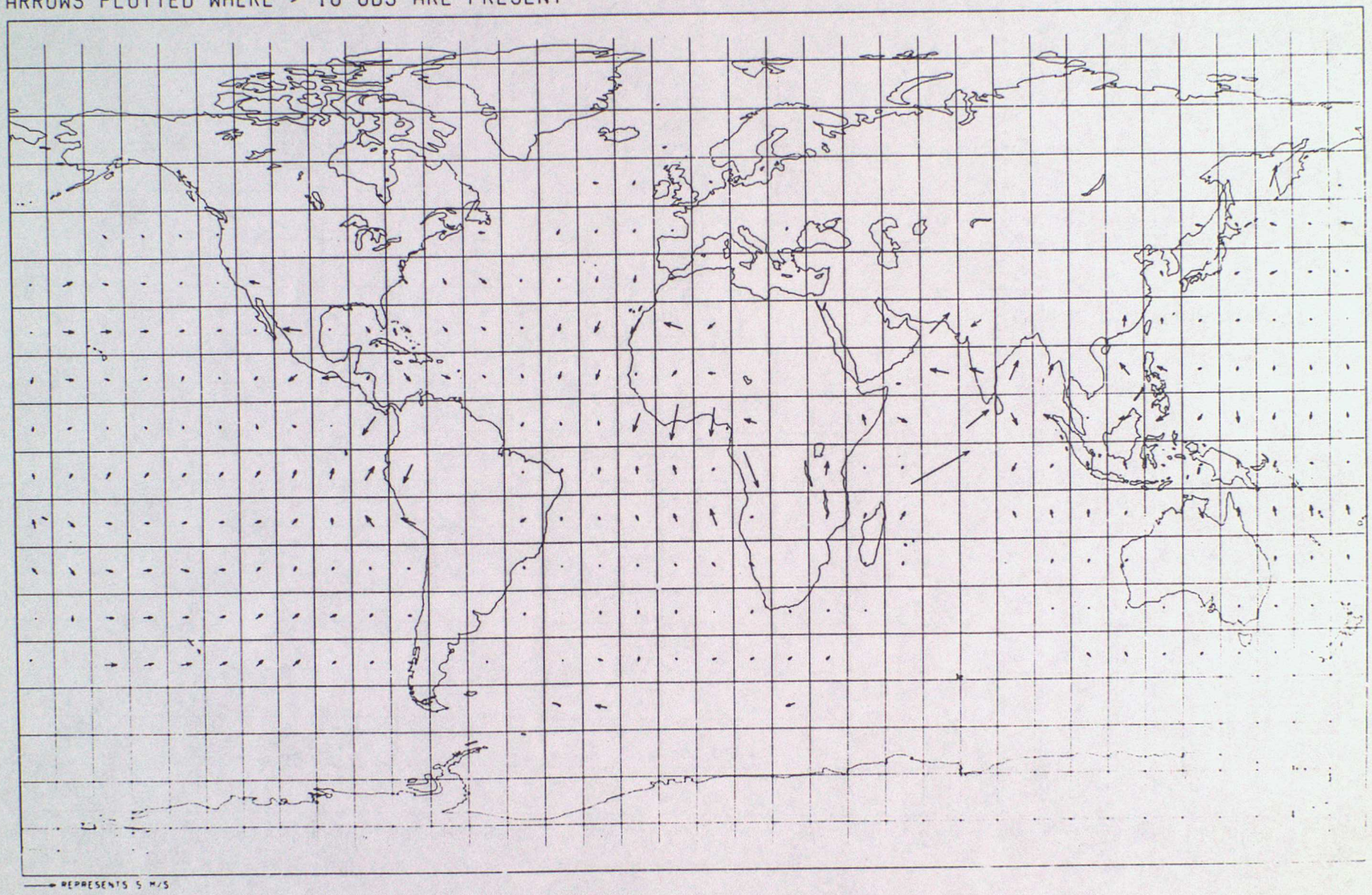
Figure 19

SATOB VECTOR MEAN WINDS BETWEEN 701-1000 HPA
JUNE-AUGUST 1992
ALL OBSERVATIONS
ARROWS PLOTTED WHERE > 10 OBS ARE PRESENT



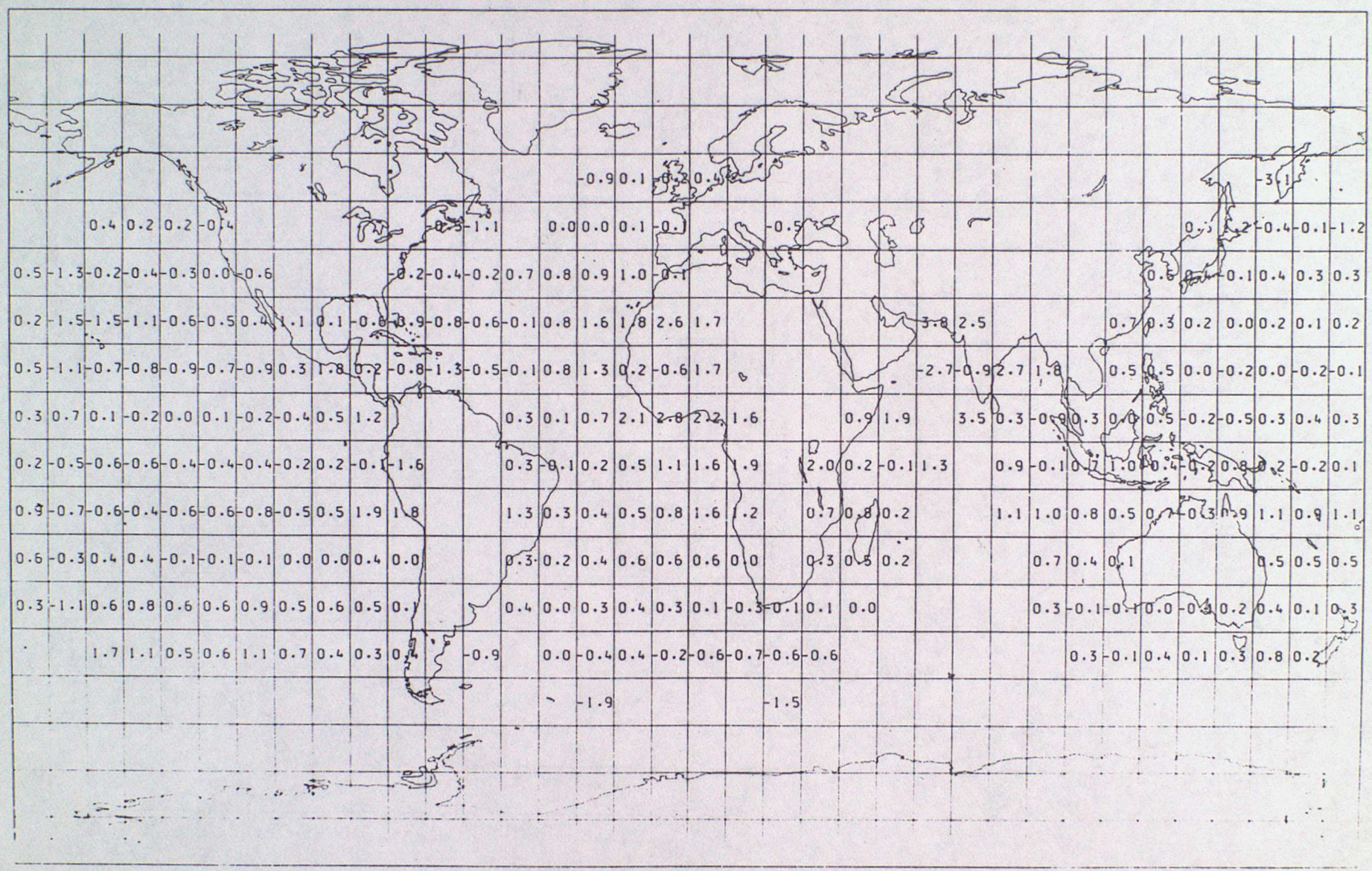
SATOB O-B VECTOR WIND DIFFERENCES BETWEEN 701-1000 HPA
JUNE-AUGUST 1992
ALL OBSERVATIONS
ARROWS PLOTTED WHERE > 10 OBS ARE PRESENT

Figure 20



SATOBS : MEAN O-B SPEED DIFFERENCES (M/S) BETWEEN 701 AND 1000 HPA
JUNE-AUGUST 1992
USING ALL OBSERVATIONS
VALUES ARE PRINTED WHERE > 10 OBS ARE PRESENT

Figure 21



SATOBS : RMS O-B VECTOR DIFFERENCES (M/S) BETWEEN 701 AND 1000 HPA
JUNE-AUGUST 1992
USING ALL OBSERVATIONS
VALUES ARE PRINTED WHERE > 10 OBS ARE PRESENT

Figure 22

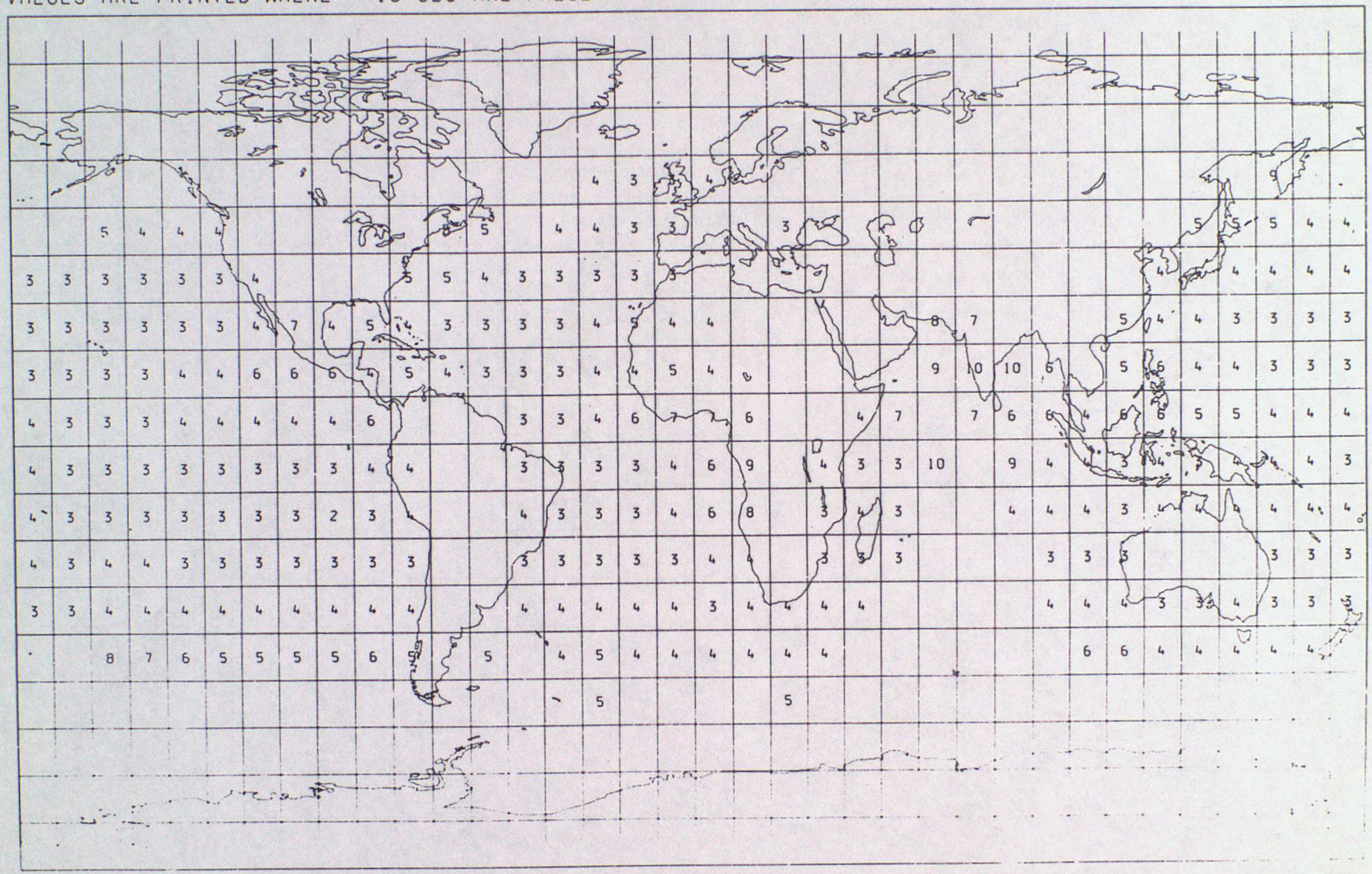
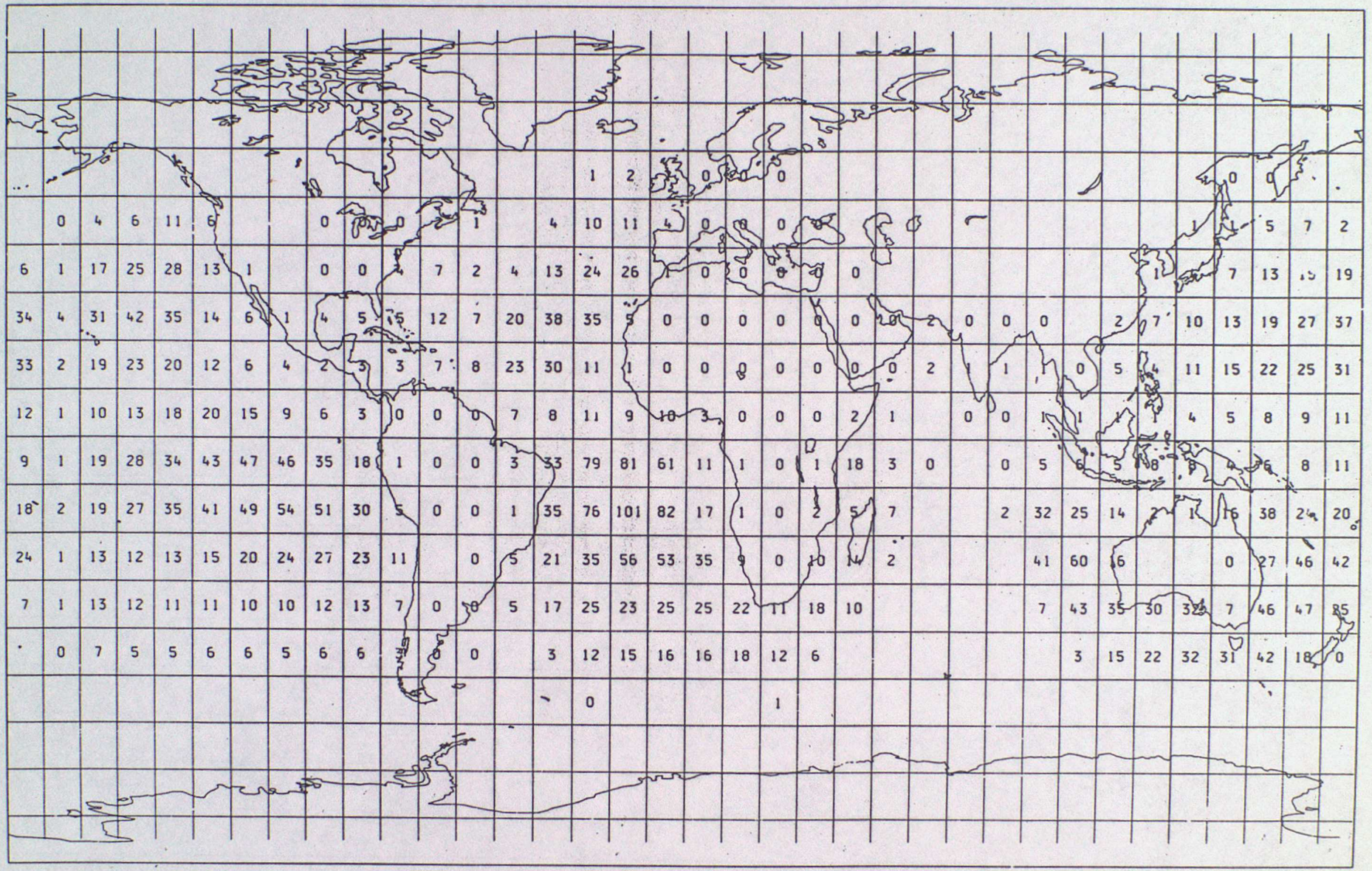


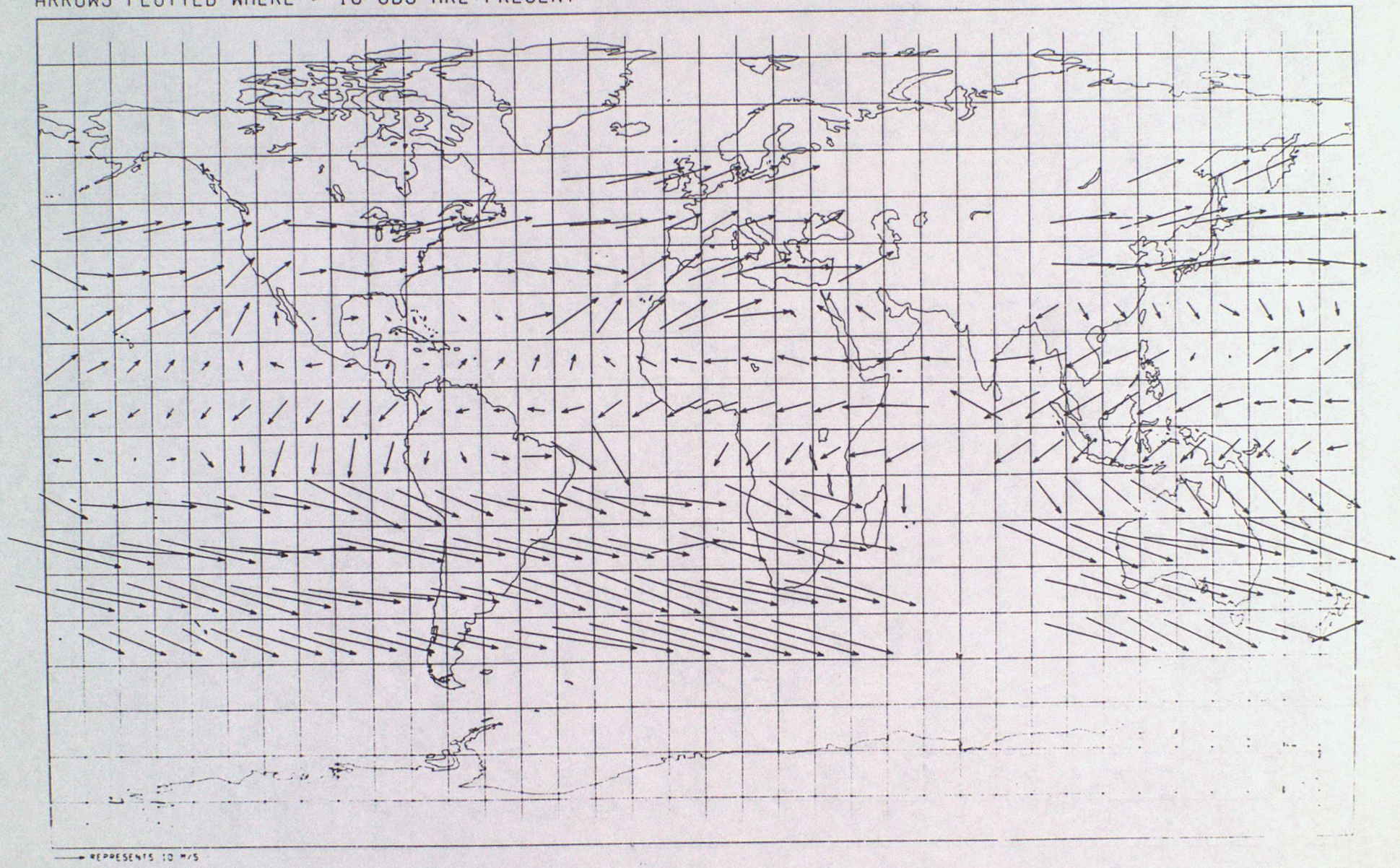
Figure 23

AVERAGE DAILY NUMBER OF SATOB OBSERVATIONS BETWEEN 701 AND 1000 HPA
JUNE-AUGUST 1992



SATOB VECTOR MEAN WINDS BETWEEN 101-400 HPA
JUNE-AUGUST 1992
ALL OBSERVATIONS
ARROWS PLOTTED WHERE > 10 OBS ARE PRESENT

Figure 24



SATOB O-B VECTOR WIND DIFFERENCES BETWEEN 101-400 HPA
JUNE-AUGUST 1992
ALL OBSERVATIONS
ARROWS PLOTTED WHERE > 10 OBS ARE PRESENT

Figure 25

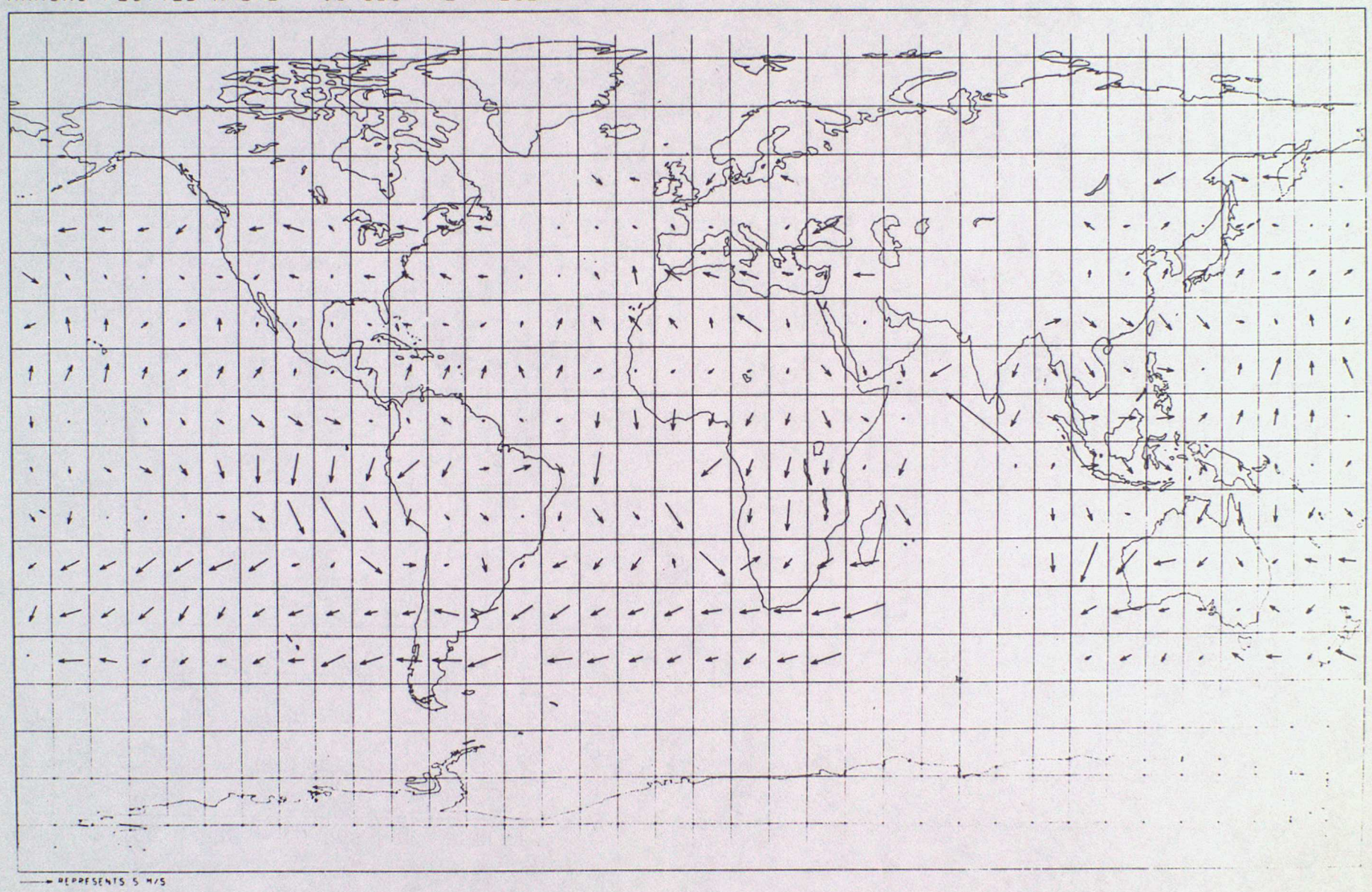


Figure 26

SATOBS : MEAN O-B SPEED DIFFERENCES (M/S) BETWEEN 101 AND 400 HPA
JUNE-AUGUST 1992
USING ALL OBSERVATIONS
VALUES ARE PRINTED WHERE > 10 OBS ARE PRESENT

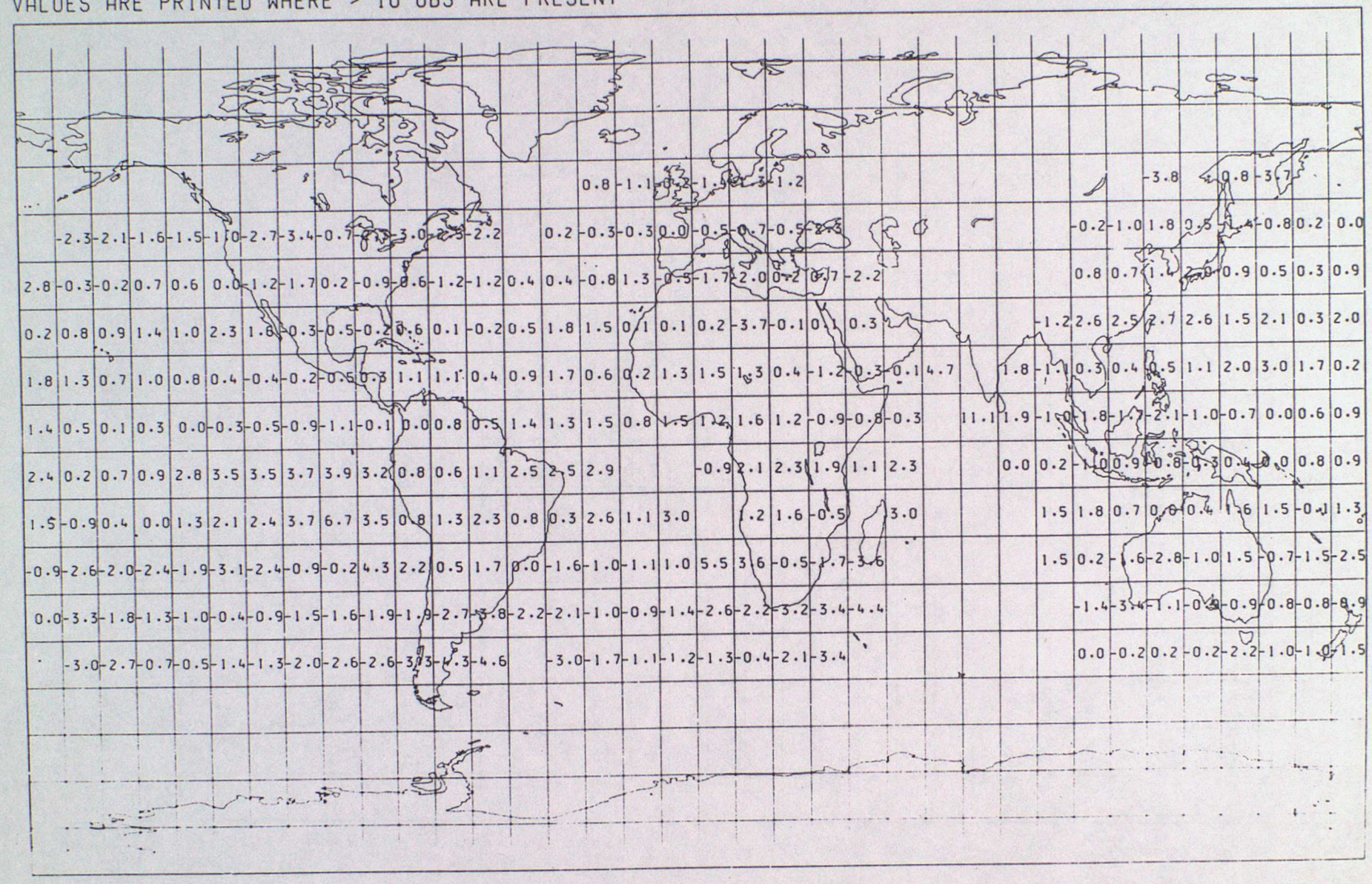


Figure 27

SATOBS : RMS O-B VECTOR DIFFERENCES (M/S) BETWEEN 101 AND 400 HPA
JUNE-AUGUST 1992
USING ALL OBSERVATIONS
VALUES ARE PRINTED WHERE > 10 OBS ARE PRESENT

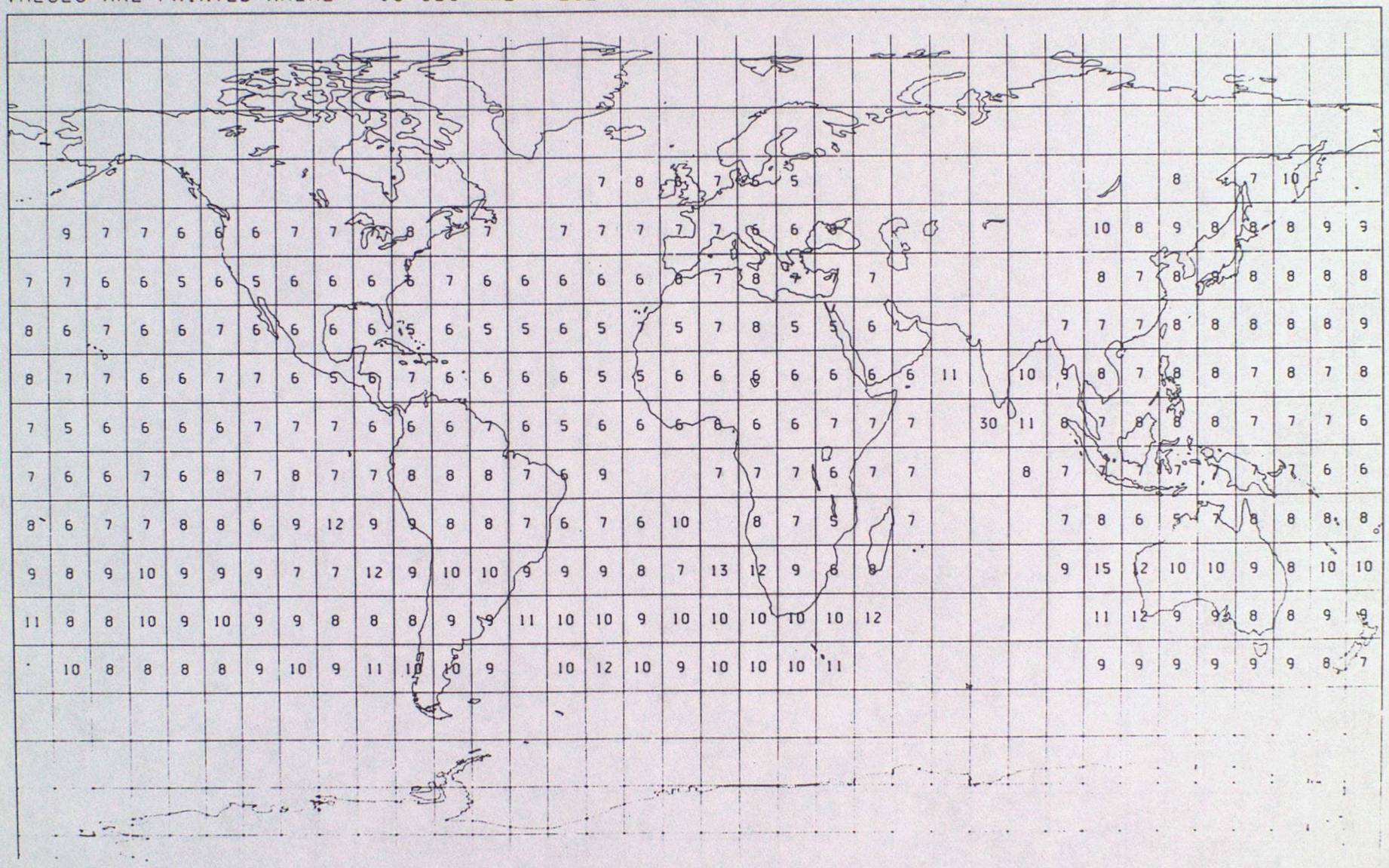
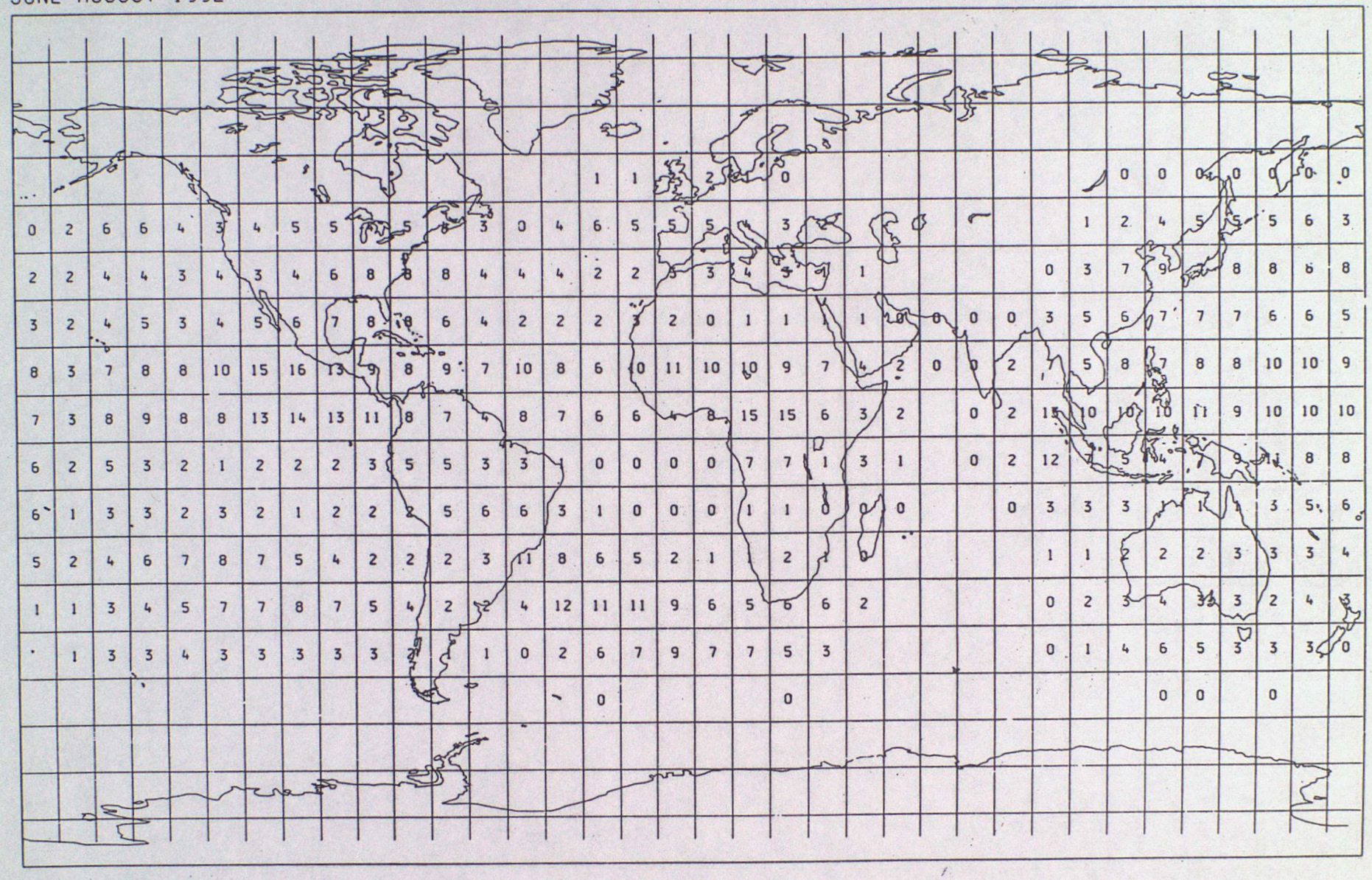


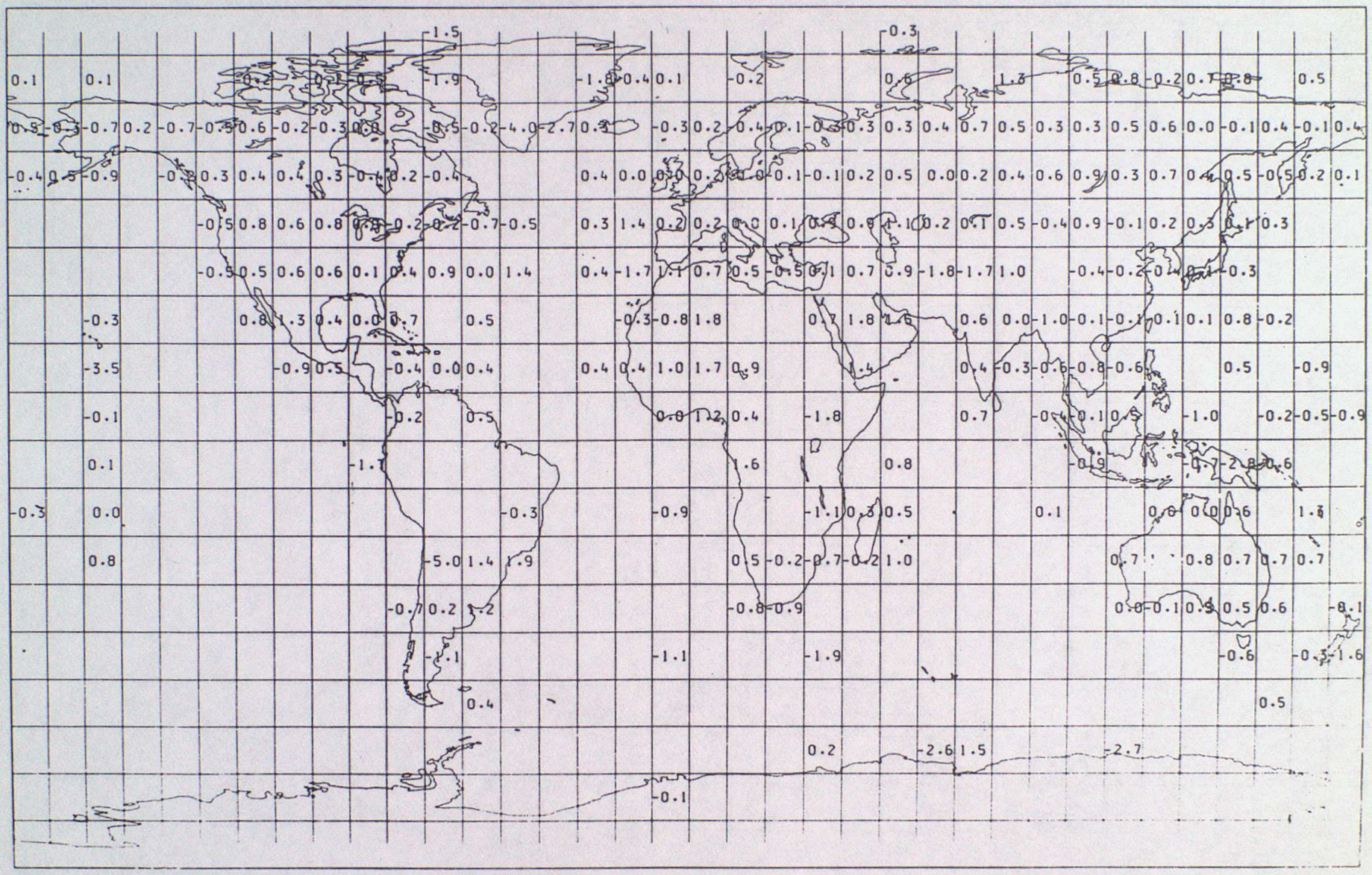
Figure 28

AVERAGE DAILY NUMBER OF SATOB OBSERVATIONS BETWEEN 101 AND 400 HPA
JUNE-AUGUST 1992



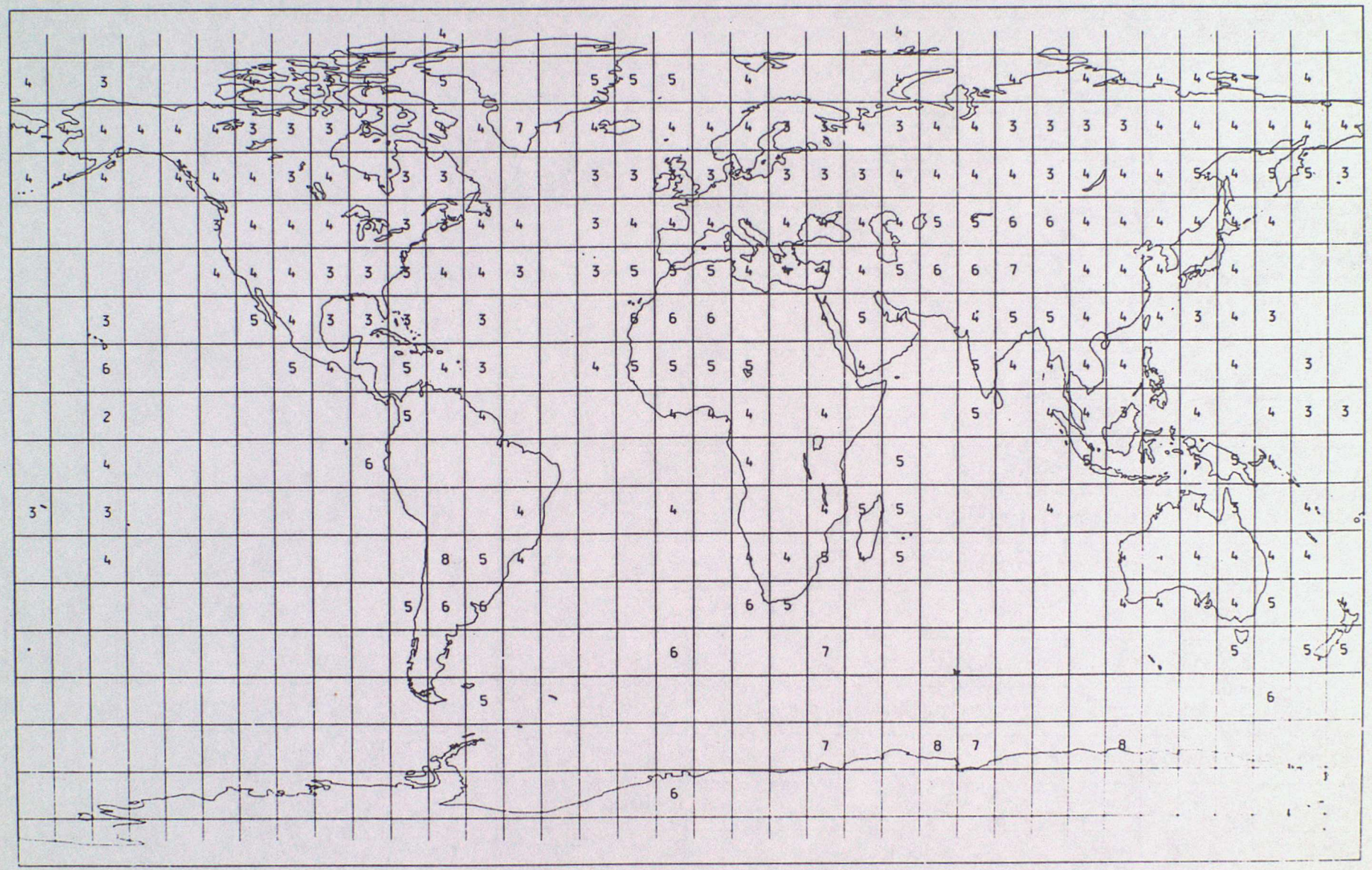
SONDES : O-B SPEED DIFFERENCES (M/S) BETWEEN 701 AND 1000 HPA
JUNE-AUGUST 1992
QUALITY CONTROL APPLIED
VALUES ARE PRINTED WHERE > 100 OBS ARE PRESENT

Figure 29



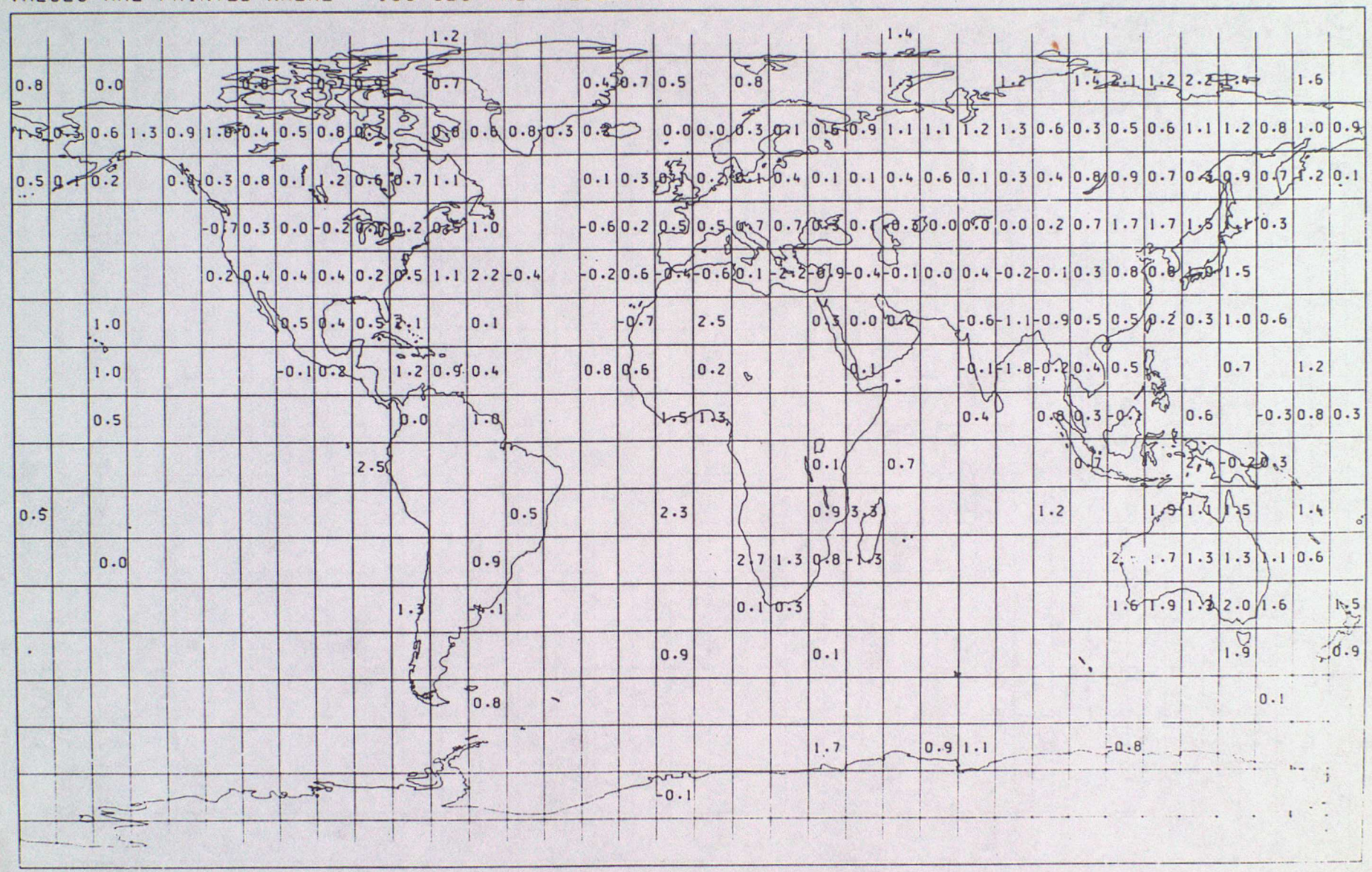
SONDES : RMS O-B VECTOR WIND DIFFERENCES (M/S) BETWEEN 701 AND 1000 HPA
JUNE-AUGUST 1992
QUALITY CONTROL APPLIED
VALUES ARE PRINTED WHERE > 100 OBS ARE PRESENT

Figure 30



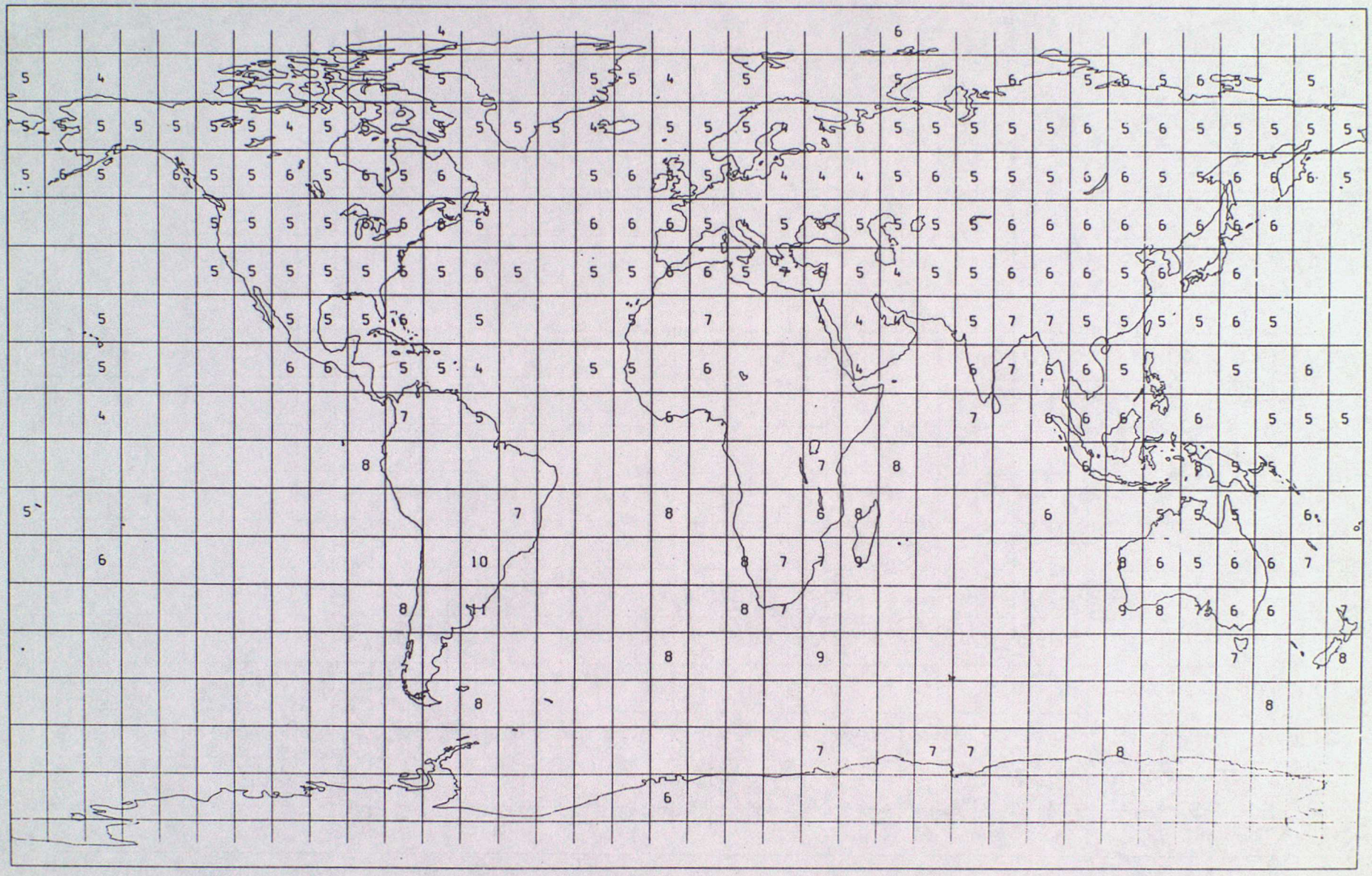
SONDES : O-B SPEED DIFFERENCES (M/S) BETWEEN 101 AND 400 HPA
JUNE-AUGUST 1992
QUALITY CONTROL APPLIED
VALUES ARE PRINTED WHERE > 100 OBS ARE PRESENT

Figure 31



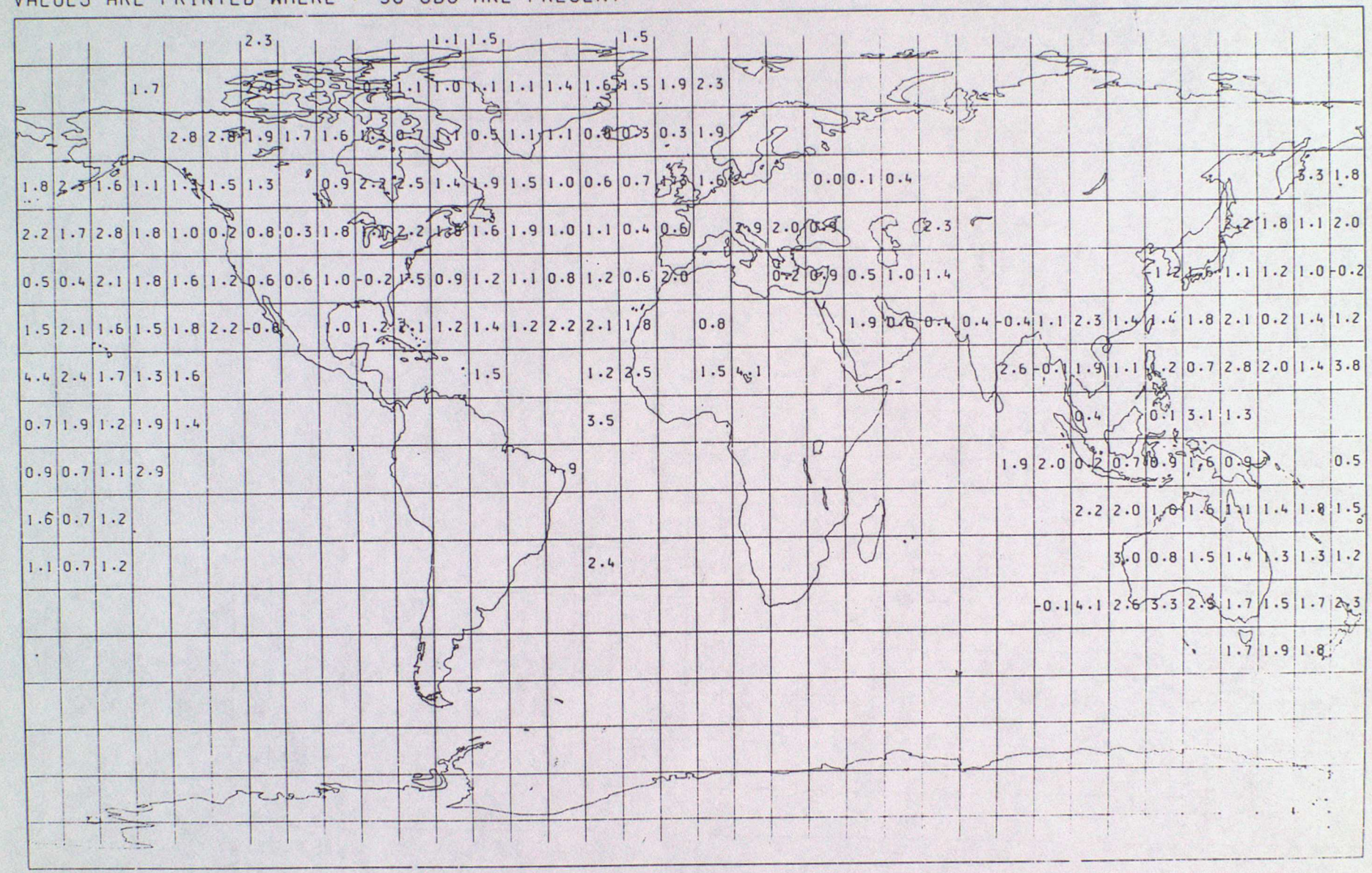
SONDES : RMS O-B VECTOR WIND DIFFERENCES (M/S) BETWEEN 101 AND 400 HPA
JUNE-AUGUST 1992
QUALITY CONTROL APPLIED
VALUES ARE PRINTED WHERE > 100 OBS ARE PRESENT

Figure 32



AIREPS & ASDARS : MEAN O-B SPEEDS (M/S) BETWEEN 101 AND 400 HPA
JUNE-AUGUST 1992
OBSERVATIONS WITH RMSVW DIFFERENCE > 60 MPS EXCLUDED
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 33



AIREPS & ASDARS : RMS O-B VECTOR (M/S) BETWEEN 101 AND 400 HPA
JUNE-AUGUST 1992
OBSERVATIONS WITH RMSVW DIFFERENCE > 60 MPS EXCLUDED
VALUES ARE PRINTED WHERE > 30 OBS ARE PRESENT

Figure 34

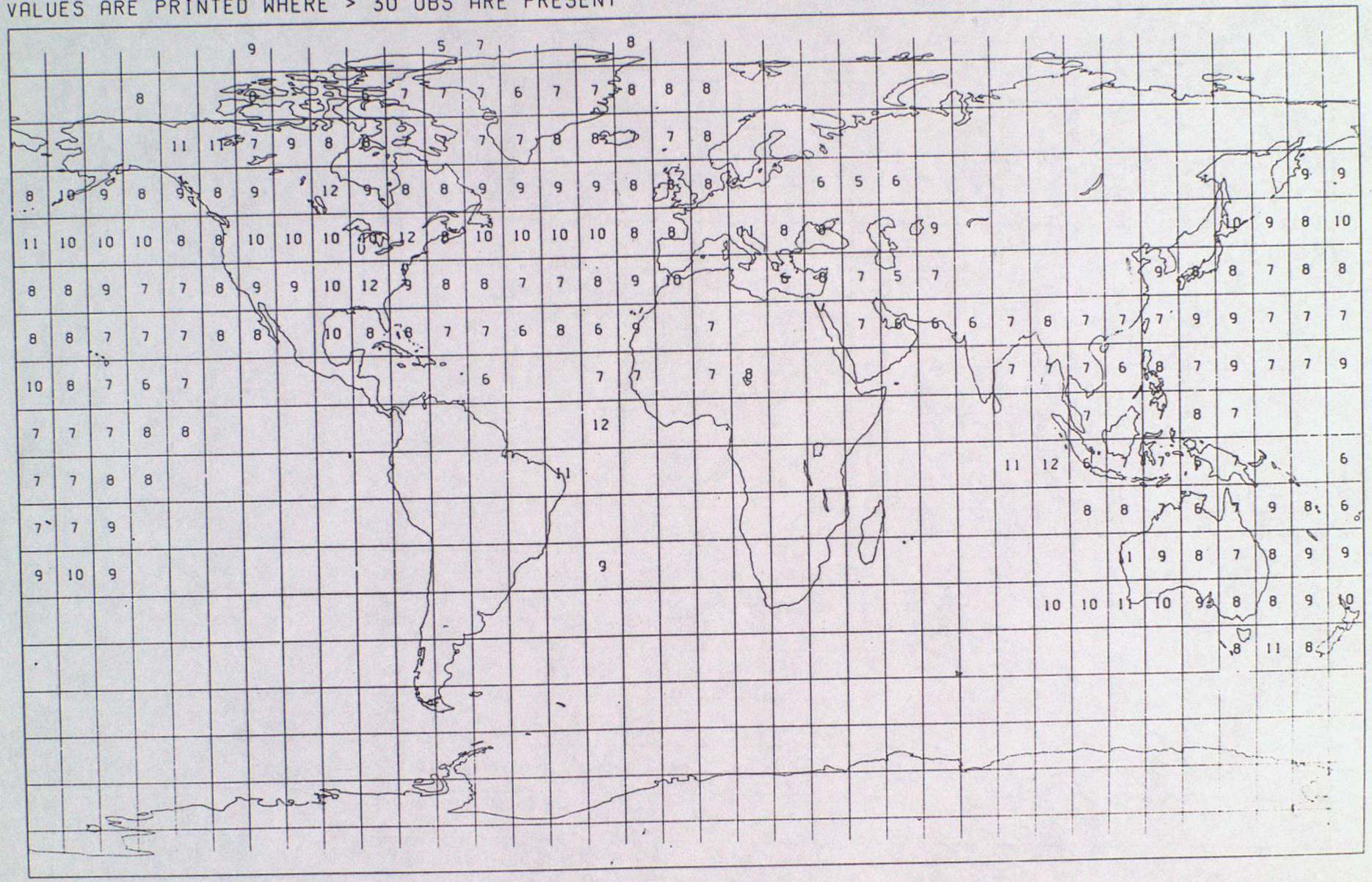


Figure 35

MEAN DAILY COUNT OF AIREPS AND ASDARS 101 - 400 HPA
JUNE-AUGUST 1992
OBSERVATIONS WITH RMSVW DIFFERENCE > 60 MPS EXCLUDED