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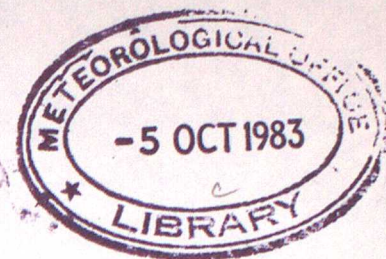
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COMPARISONS OF SATEMS WITH RADIOSONDES
MARCH 1979 TO MAY 1981

by

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January 1982

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Comparisons of SATEMs with radiosondes:

March 1979 to May 1981

1. Introduction

Atmospheric temperature retrievals, derived from radiances measured by instruments on polar orbiting satellites, are made available operationally in the form of SATEM messages on the Global Telecommunications System (GTS). In order to assess the quality of these data, Met O 19 has compiled monthly statistics of the differences between SATEM soundings and quasi-coincident radiosondes. This report covers the period March 1979 to May 1981 - SATEMs obtained from satellites in the TIROS-N series (TIROS-N: March 1979 to February 1981; NOAA-6: October 1979 to May 1981). However the archive of colocated satellite-sonde data from which these statistics were derived dates from 1975 and includes SATEMs (and earlier SIRS) from satellites NOAA-3, -4 and -5 in the previous series. The archive ends in May 1981.

2. Comparisons

The Meteorological Office synoptic data bank was searched for all SATEM - sonde collocations in the northern hemisphere. Satellite and radiosonde measurements were considered colocated if their reported positions differed by less than 167 km (equivalent to 1.5° of latitude) and their reported times were no more than 2 hours apart. No corrections were made to allow for biases between different national sonde types. For each collocation, the differences between the thicknesses (SATEM minus sonde) were calculated for the layers 1000-100 mb and 1000-500 mb.

From the differences for individual collocations, statistics were compiled each month giving the mean difference, (the bias) and the standard deviation of the differences for both layers. The results are shown in figure 1. No distinction is made in the statistics between SATEMs calculated by different retrieval methods; all are included. It should be noted that the statistics are geographically biased towards those areas which have a dense radiosonde network and for which SATEMs with times close to 0Z or 12Z are produced. Figure 2 shows typical distributions of SATEM - sonde comparisons for one month (January 1980).

Monthly statistics were also compiled for sub-sets of these data: the colocations were banded in terms of both latitude (10° bands) and also thickness value (bands of 100 geopotential metres, gpm). However, the results showed no consistent, significant dependence of the mean bias on either latitude or absolute thickness value.

The statistics described above refer to differences between SATEMs and sondes, and they should not be interpreted simply as errors in the SATEMs. The differences include SATEM errors but also errors in the radiosondes and "colocation errors" (contributions from real atmospheric differences caused by lack of coincidence in time and space). In order to estimate the relative importance of these effects, an exercise was performed in January 1980 in which similar statistics were compiled for many pairs of radiosonde stations separated by less than 300 km (i.e. "sonde-sonde" difference statistics). The mean differences calculated in these statistics are of little use since they are dominated by the bias of one station against the other caused by their latitude difference. However, the standard deviations for each station pair are of interest - they represent contributions from radiosonde error (excluding persistent biases) and from differences caused by spatial separation (excluding the monthly mean bias). About 50 pairs of stations each yielded 50 or more colocations during the month. The standard deviations varied widely from pair to pair but can be summarized as follows:

Standard deviation

1000-500 mb:	mainly 15-30 gpm	(c.f. SATEM-sonde value: 44 gpm)
1000-100 mb:	mainly 35-60 gpm	(c.f. SATEM-sonde value: 68 gpm)

3. Conclusions

3.1 Over the 2-year period the monthly bias of the 1000-500 mb SATEM-sonde thickness difference was consistently small - from August 1979 to the end of the period it was always less than 7 gpm, although for individual satellites it was occasionally higher.

3.2 The standard deviation for the SATEM-sonde difference of the 1000-500 mb layer was consistent around 30-40 gpm. There is also a suggestion of an annual cycle with a minimum in the summer. This would be reasonable on the following counts:

- a) more extensive cloud cover in the winter would lead to less accurate retrievals,

b) greater thermal gradients in the atmosphere would lead to more "colocation error" in winter,

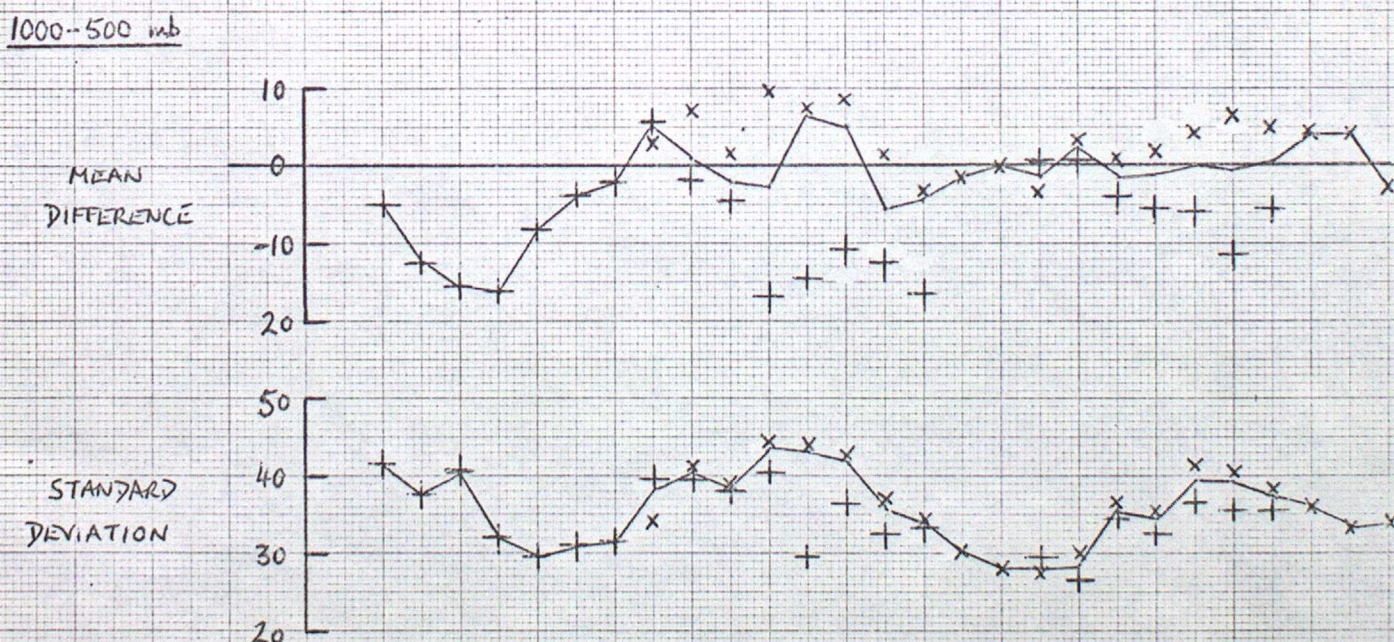
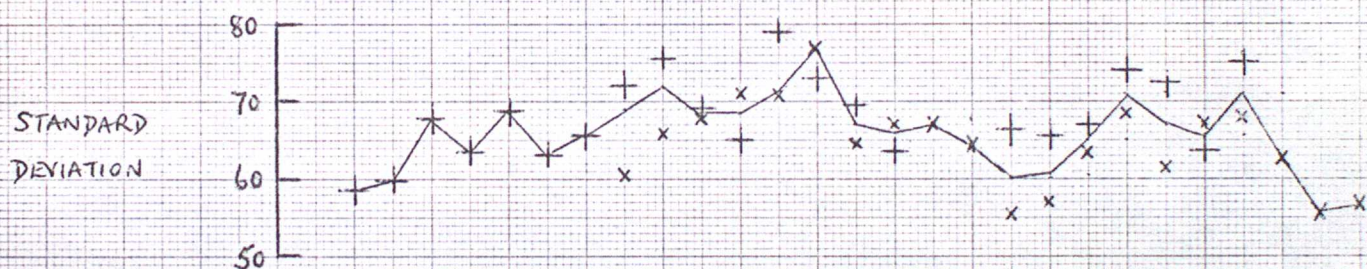
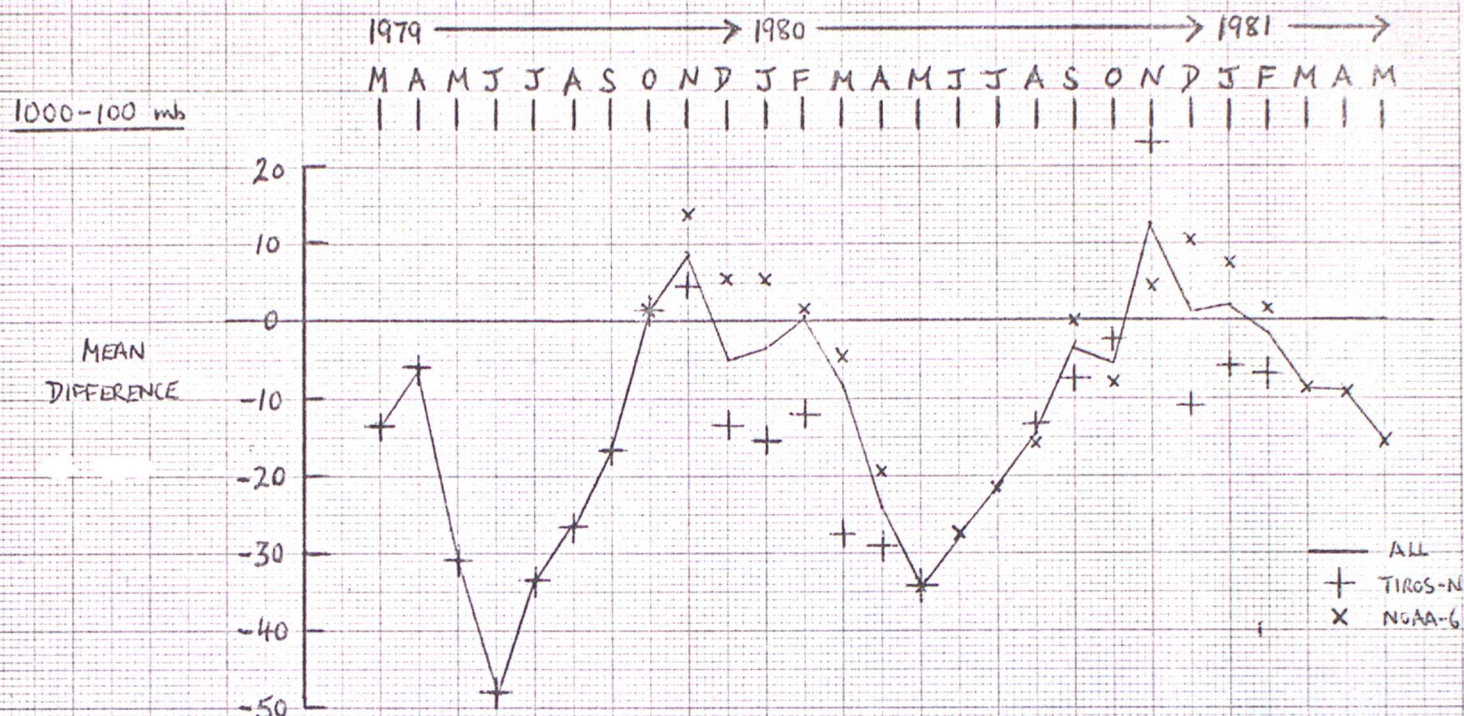
c) in winter, when the atmospheric variability is large, the variance which the regression coefficients used in the retrieval try to explain is also large, and so the error attributable to unexplained variance is expected to be correspondingly greater than in summer.

3.3 The monthly biases of the 1000-100 mb layer ranged from -50 to +15 gpm with standard deviations around 60-70 gpm. No annual cycle is apparent in the standard deviation. An apparent annual cycle in the biases may be real but is possibly misleading; geographical biases in the statistics may cause this type of effect and small changes in processing methods from time to time may also contribute to the pattern.

3.4 Comparison of SATEM-sonde statistics with sonde-sonde statistics suggests that a significant fraction of the SATEM-sonde difference is attributable to sonde and colocation errors rather than to SATEM errors, particularly for the 1000-100 mb layer.

Figure 1. Statistics of SATEM-sonde differences

(Units: geopotential metres)



NUMBER OF	ALL	174	165	208	205	652	908	861	1018	1170	1610	1347	813	956	1367	967	823	896	1639	1441	1355	1308	1260	1306	1341	901	891
COMPARISONS:	TIROS-N	174	165	208	205	652	908	861	760	748	901	603	46	173	644	104			628	583	542	531	501	553	533		
	NOAA-6								258	422	709	744	767	733	722	863	823	896	1011	878	813	777	749	833	808	901	891

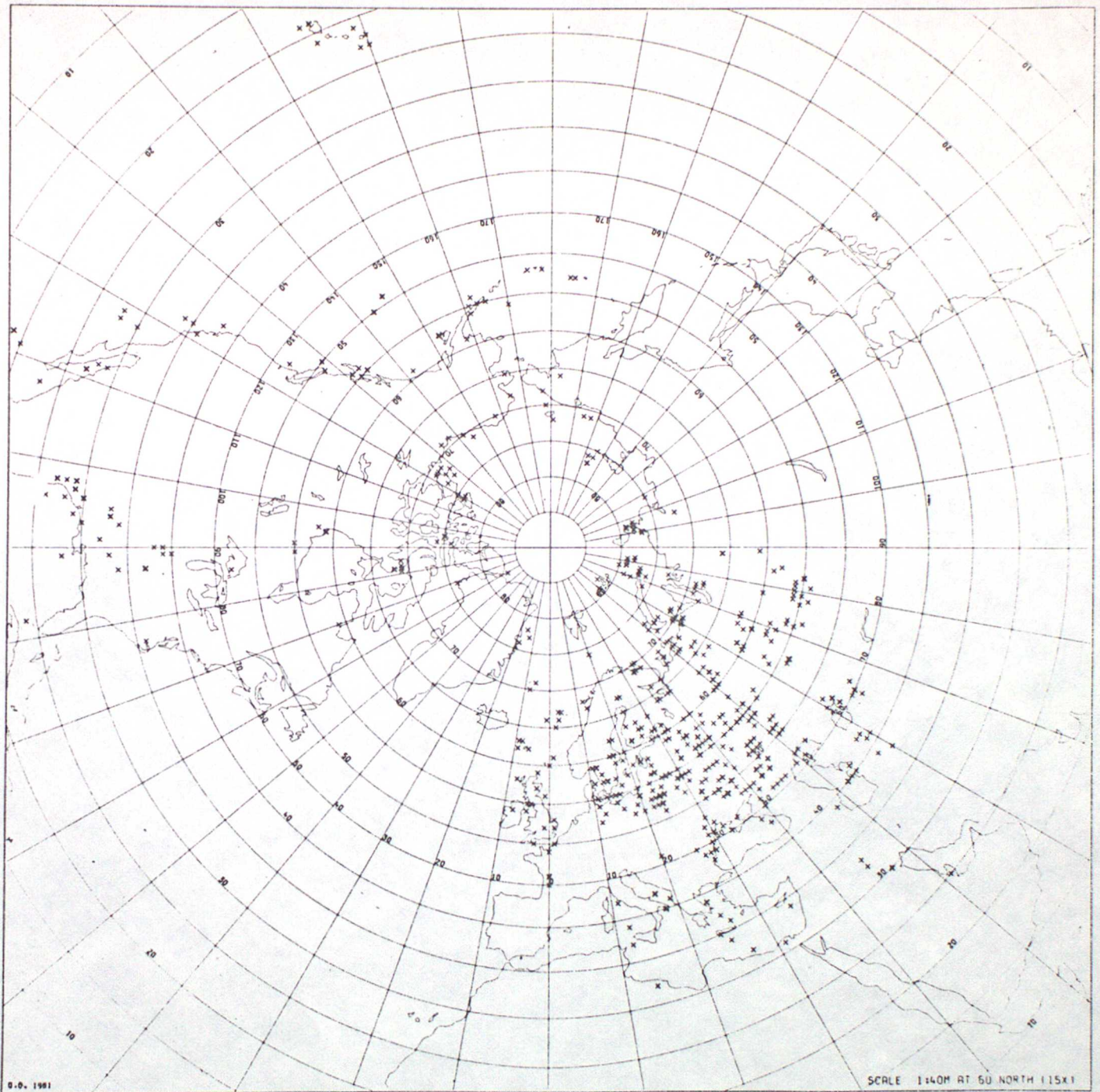


Figure 2(a)

Distribution of SATEM-sonde collocations in January 1980:

TIROS-N

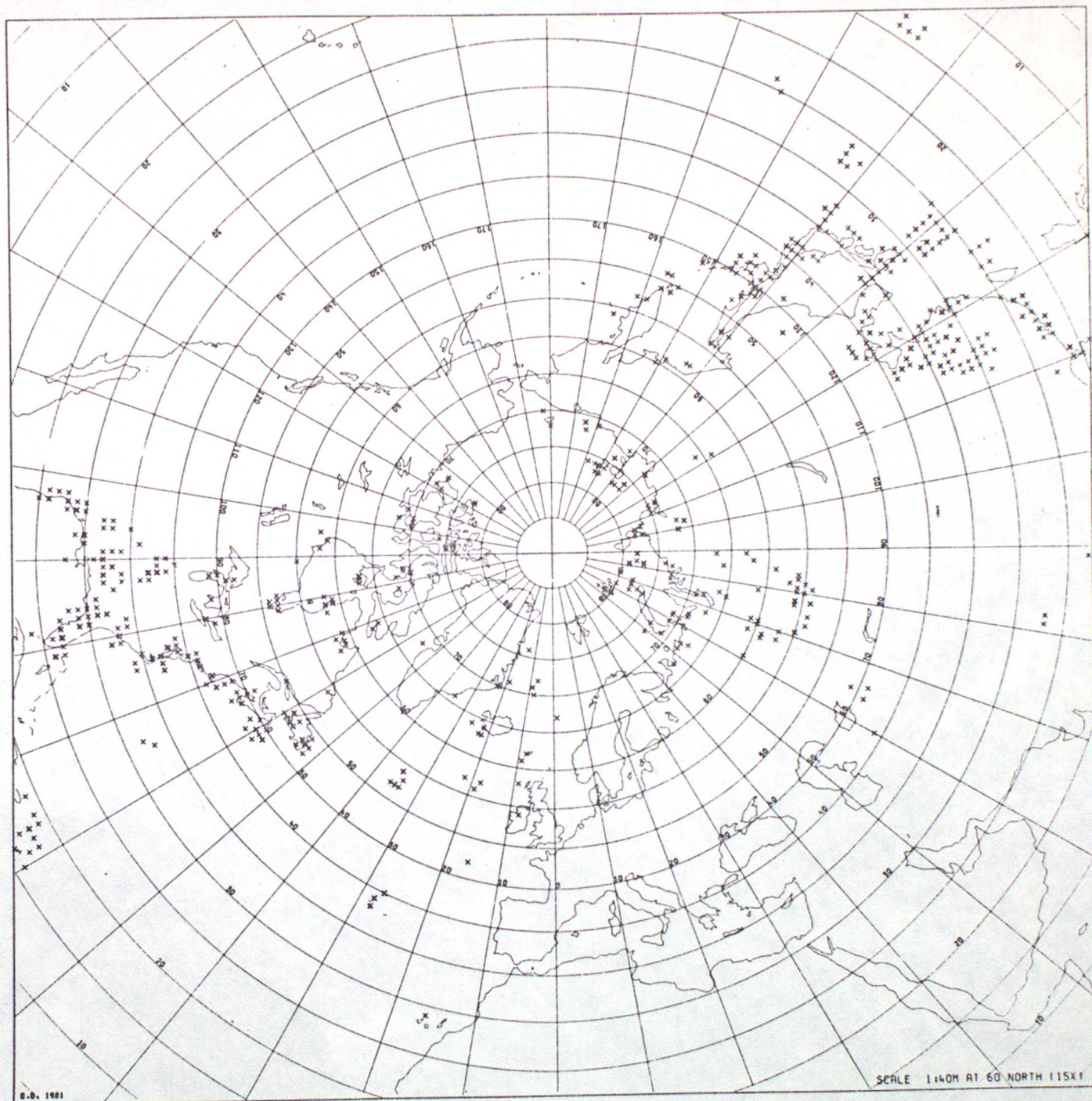


Figure 2(b)

Distribution of SATEM-sonde collocations in January 1980:

NOAA-6