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SKUA METEOROLOGICAL ROCKETSONDE OBSERVATIONS, 1964-1980

by

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SKUA METEOROLOGICAL ROCKETSONDE OBSERVATIONS,

1964-1980

1. INTRODUCTION

Skua rocketsondes were first flown regularly by the Meteorological Office from West Geirinish (latitude 57° 21'N, longitude 07° 24'W) in the Outer Hebrides in 1964. The project was terminated in November 1980. Hamilton, Mason and Bridge (1973), in Meteorological Office Geophysical Memoirs No 119, presented a statistical analysis of the observations made at West Geirinish between 1964 and 1972. The main purpose of this paper is to bring up to date certain of these statistics. The paper also lists Skua firings made at other ranges and publications relating to Skua and its observations.

2. THE SKUA ROCKETSONDE SYSTEM

The Skua is a solid propellant, end-burning, rocket 2.5 m in length and 12.5 cm diameter, capable of carrying the sonde payload and parachute to a height of between 70-90 km, where a small charge separates the nose cone and ejects both sonde and parachute. The parachute has a flying diameter of 5 m. It is partially metalized to enable it to be tracked by a COSSOR 353 (10 cm) radar from which wind velocity, payload height and fall speed can be calculated.

The sonde was described by Almond (1969). This design was used, without modification, until 1978. A new sonde of simplified electronic construction, was brought into use from 1979. This new sonde showed no change in performance when compared with those flown previously; either in flight, or during exhaustive laboratory testing.

Throughout the project the temperature sensor remained unaltered from it's original design (Clark, 1965). Fundamentally it is a sensitive resistance thermometer, constructed from spiralized tungsten wire of 13 μm diameter and about 8 m in length. A more detailed description of its construction is given by Almond (1965).

Experimental and theoretical investigations of the corrections for the temperature sensor have been reported by Almond (1965) and Mason and Acres (1972). Because of the uncertainty in correcting for direct and reflected solar radiation it was the Office's practice to launch rockets only at night. In these circumstances the raw data received at the ground station need only be corrected for dynamical heating and cooling due to infra-red radiation. These corrections are a function of fall speed and typical values are given in Table I.

Since 1979, however, some flights have been made during daylight. In these circumstances additional corrections are necessary for solar radiation and earth's albedo (see table II and Almond 69)). The values in table II assume that the solar elevation is constant at 45° and the albedo 25%. The corrected temperatures were found to be in close agreement with those recorded by the MO MK III sondes at a nearby location (Stornoway) at a height of 30 km. Moreover, comparative daylight and night-time firings of Skua made within a few hours showed differences of 2-3° k up to 55 km.

The performance of the Skua rocketsonde system was compared with other (US, French, Japanese and USSR) rocketsondes during trials organised by CIMO at Kourou in 1972. The differences between the Skua and the US system were found to be insignificant (ie mean differences $< 2^{\circ}$ k, rms $< 2^{\circ}$ k below 50 km). These trials included both night and daytime flights. The rms of the daytime differences (UK-US) reached 5° k at 55 km, but the mean difference remained small to 60 km (Finger et al, 1975).

3. OBSERVATIONS AT WEST GEIRINISH

An index of the firings at West Geirinish up to 1972 was given in the Appendix to Geophysical Memoirs No 119. The firings from 1973 to 1980 are listed in Appendix 2 of this paper. Table III gives the number of firings made at West Geirinish in each month from 1964 to 1980. The table only lists those firings which resulted in winds and/or temperature up to at least 40 km. (Up to 1972 only night firings are included.)

Table III shows that almost two-thirds of all launchings from West Geirinish have taken place in the three months of December, January and February. In no other month does the number of firings reach 50% of that in any of these three months. This is because the research programme was directed towards studying stratospheric warmings which occur during the winter months. In the 1970's and until the project terminated a similar programme was maintained but with the added task of firing in conjunction with selected overpasses of both TIROS N and NOAA - 6 satellites, which carry the Meteorological Office's Stratospheric Sounding Units.

Geophysical Memoirs No 119 presented a statistical analysis of the observations at West Geirinish up to 1972, in order to describe the climatology of the stratosphere in that area. Any such analysis is open to question because the series of observations are so fragmentary. With the availability of satellite data, monthly mean values (ie table III of GM No 119) are of limited value particularly when based on no more than ten values. There is still interest in the frequency with which various conditions arise. Tables IV-VI are up-dated versions of the corresponding tables in GM No 119, and give the percentage of observations of temperature, zonal and meridional wind components within specified intervals at height levels from 20 to 60 km in the months of December, January and February. Daytime observations are excluded. Note that in table V a positive zonal component corresponds to a westerly wind (ie a wind blowing from west to east), and in table VI a positive meridional component corresponds to a southerly wind.

(There was a mistake in table VI of GM No 119. The individual percentage frequencies for December at 40 km add up to 106%. It is probable that one or other of the entries for intervals 41-60 and 61-80 m/s (both of which are 6%) should be 0%. In constructing the new table it has been assumed that the previous entry for 61-80 m/s was incorrect.)

4. OTHER STUDIES USING THE SKUA ROCKETSONDE

The Meteorological Office has used to Skua system from various ranges other than West Geirinish. A number of campaigns were mounted at Gan, to study seasonal and diurnal (or rather, night-time) variations in winds and temperature close to the equator. In 1970 firings were organised at Thumba and Gan, to investigate the spatial extent of stratospheric features at low latitudes. Similar experiments, involving firings from Kiruna, Aberporth and West Geirinish were made to

investigate the spatial structure of sudden warmings. (The Kiruna flights were made in collaboration with Dr Groves, University College, London.) A number of Skuas were flown at Kourou, French Guiana, in 1973 during a comparison of rocketsonde systems. A few of the development flights of Skua from Aberporth have yielded meteorological data.

A list of the Skua meteorological soundings made from ranges other than South Uist between 1964 and 1980 is given in Appendix 3.

5. AVAILABILITY OF DATA

Temperatures and winds observed at West Geirinish have been made available promptly in ROCOB code via the meteorological telecommunications system. The observations were subsequently processed by computer, extra parameters (eg pressure, density) derived and made available, on magnetic tape, to World Data Centre A. Listings of these tabulated processed data are available in Met O 19 for nearly all the firings listed in the Appendix to GM 119 and in Appendix 2 of this paper.

For the firings at other sites (Appendix 3), and those West Geirinish firing not computer-processed, hand processed results are held in Met O 19. The Skua observations made at Kourou during the 1973 comparison of rocketsonde systems were published by Leviton (1975).

6. BIBLIOGRAPHY

Appendix 1 lists all publications relating to the Skua rocketsonde system by Office staff. Part A contains those papers in the open literature. Reference A13 gives a brief guide to these papers. Part B lists internal unpublished reports. Those in the MRCP series are not generally available but apart from B7 (which contains the analysis of the night-time variation experiments at Gan in 1972) most of the information is available in published papers.

No reference is made to papers which refer to Skua data as part of the generality of rocketsonde data (eg using Skua profiles, amongst others, in comparisons with satellite radiometers). References to analyses of firings made at ranges other than West Geirinish are given on the cover-sheet to Appendix 3.

ACKNOWLEDGEMENTS

The authors express their thanks to all members of the Skua team for their work over the years in reduction and presentation of the data used in this report.

We also wish to acknowledge the unstinted help given by Army personnel at the Hebrides (West Geirinish) Range and the assistance of SRC, AWRE, PERME and Bristol Aerojet Ltd.

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ALMOND R (1965) Techniques of temperature and wind sounding with the Skua meteorological rocket. Met Mag 94, 327-331.

ALMOND R (1969) The Skua meteorological rocket system. Progress Astronaut Aeronaut 22, 31-46.

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FINGER F G, GELMAN M E, SCHMIDLIN F J, LEVITON R and KENNEDY B W (1975) Compatability of meteorological rocketsonde data by international comparison tests. J Atmos Sci 32, pp 1705-1714.

HAMILTON R A, MASON B D and BRIDGE G C (1973) A climatology of the stratosphere over north-west Europe. Meteorological Office, Geophysical Memoirs No 119.

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MASON B D and ACRES J (1972) Temperature corrections for the Skua rocketsonde temperature sensor. Met Mag 101, 118-124.

LIST OF APPENDICES

TABLE I. CORRECTIONS FOR DYNAMIC HEATING AND INFRA-RED COOLING FOR A SONDE FALLING AT TYPICAL SPEED

Pressure (mbar)	Height* (km)	Fall Speed (m/s)	Corrections (°k) Dynamic	Infra-red
0.11	61.0	128	-11.3	+0.9
0.21	56.0	97	- 6.3	+0.5
0.43	50.5	68	- 2.5	+0.3
0.67	47.0	54	- 2.0	+0.2
1.33	42.0	37	- 1.4	+0.1
2.00	39.5	30	- 0.9	+0.1
2.67	37.5	25	- 0.6	+0.1
4.00	35.0	21	- 0.5	+0.1

TABLE II. CORRECTIONS FOR SOLAR RADIATION AND EARTH'S ALBEDO (WINTER)

Pressure (mbar)	Height* (km)	Correction for solar radiation and albedo (°k)
0.11	61.0	-15.5
0.21	56.0	-10.2
0.43	50.5	- 5.8
0.67	47.0	- 4.0
1.33	42.0	- 2.5
2.00	39.5	- 2.0
2.67	37.5	- 1.7
4.00	35.0	- 1.2

* Heights, in both tables, are based on US Standard Atmosphere 1966 for "60°N January, cold".

TABLE III. MONTHLY TOTAL OF SOUNDINGS AT WEST GEIRINISH.

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	month totals
Jan.	3	6	-	-	11	7	11	10	5	-	-	7	5	7	2	2	-	76
Feb.	2	5	9	4	15	-	-	8	-	3	-	4	8	4	1	1	4	68
Mar.	-	4	4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	13
Apr.	-	3	2	10	-	-	-	-	-	-	-	-	-	-	-	2	-	17
May	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	1	5
June	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	9
July	-	-	-	8	-	-	-	-	-	-	3	-	-	-	-	2	3	16
Aug.	-	-	-	-	-	-	-	-	-	-	2	-	3	-	-	-	-	5
Sept.	-	2	1	-	-	-	-	-	-	-	-	-	-	3	-	1	3	10
Oct.	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	2	-	12
Nov.	-	1	12	-	-	2	2	-	-	-	-	-	-	-	1	2	4	24
Dec.	-	-	2	9	5	11	4	7	-	-	7	-	4	-	2	-	-	51
Yearly totals	5	21	40	45	31	20	17	25	5	7	12	11	20	14	6	12	15	306

TABLE IV – FREQUENCY DISTRIBUTIONS OF TEMPERATURE AT WEST GEIRINISH DURING DECEMBER, JANUARY AND FEBRUARY

	Height km	Range (degrees Celsius)												
		–90– –81	–80– –71	–70– –61	–60– –51	–50– –41	–40– –31	–30– –21	–20– –11	–10– – 1	0– 9	10– 19	20– 29	
		per cent												N*
December	60	–	–	–	–	5	27	40	15	7	5	1	–	41
	55	–	–	–	–	2	9	28	28	23	9	–	–	45
	50	–	–	–	–	6	4	19	28	24	15	4	–	47
	45	–	–	–	–	8	16	16	24	21	5	5	5	47
	40	–	–	2	15	19	21	19	7	4	7	2	4	47
	35	–	4	17	40	12	12	9	4	–	2	–	–	47
	30	2	35	45	10	4	2	2	–	–	–	–	–	47
	25	11	48	30	9	2	–	–	–	–	–	–	–	46
	20	6	34	40	18	2	–	–	–	–	–	–	–	44
January	60	–	–	–	2	26	27	35	2	6	2	–	–	49
	55	–	–	–	–	5	33	36	24	2	–	–	–	58
	50	–	–	–	–	5	22	26	20	22	3	2	–	59
	45	–	–	–	2	16	20	18	16	16	10	–	2	61
	40	–	–	–	–	30	23	10	13	8	8	8	–	63
	35	–	2	5	19	27	21	15	4	2	–	3	2	63
	30	–	8	22	44	13	10	3	–	–	–	–	–	63
	25	3	23	33	31	10	–	–	–	–	–	–	–	61
	20	–	22	32	36	10	–	–	–	–	–	–	–	59
February	60	–	–	–	–	–	22	35	35	6	2	–	–	49
	55	–	–	–	–	–	4	27	42	23	2	2	–	56
	50	–	–	–	–	–	8	25	45	17	5	–	–	60
	45	–	–	–	2	6	20	37	25	10	–	–	–	60
	40	–	–	3	13	43	17	13	7	4	–	–	–	60
	35	–	–	26	40	18	7	7	–	2	–	–	–	60
	30	–	8	53	29	10	–	–	–	–	–	–	–	59
	25	2	15	59	20	4	–	–	–	–	–	–	–	59
	20	–	10	53	37	–	–	–	–	–	–	–	–	57

* N = number of observations

TABLE V – FREQUENCY DISTRIBUTION OF THE ZONAL WIND COMPONENT AT WEST GEIRINISH DURING DECEMBER, JANUARY AND FEBRUARY

	Height km	Range (m/s) –39–20	–19–0	1–20	21–40	41–60	61–80	81–100	101–120	121–140	141–160	161–180	181–200	N*
		per cent												
December	60	–	–	4	22	0	13	26	35	–	–	–	–	23
	55	–	–	7	13	0	7	25	15	15	10	3	5	40
	50	2	2	2	11	4	11	11	11	20	15	11	–	46
	45	2	2	0	4	15	11	13	15	17	15	6	–	47
	40	4	0	0	0	21	28	13	17	15	0	2	–	47
	35	4	0	0	15	28	23	28	2	–	–	–	–	47
	30	–	4	6	37	40	13	–	–	–	–	–	–	48
	25	–	–	27	69	4	–	–	–	–	–	–	–	48
	20	–	3	64	33	–	–	–	–	–	–	–	–	36
January	60	–	12	6	22	22	12	17	6	3	–	–	–	32
	55	–	5	9	11	30	11	11	12	11	–	–	–	56
	50	–	3	14	11	20	17	14	8	11	1	1	–	65
	45	–	9	10	20	13	22	10	9	6	1	–	–	69
	40	3	9	16	17	19	17	10	7	1	–	–	–	69
	35	1	11	24	15	16	24	8	1	–	–	–	–	73
	30	–	15	24	20	26	14	1	–	–	–	–	–	74
	25	–	11	33	37	18	1	–	–	–	–	–	–	76
	20	–	6	51	40	3	–	–	–	–	–	–	–	63
February	60	–	10	17	14	17	24	10	4	4	–	–	–	29
	55	–	4	14	6	16	14	29	15	2	–	–	–	51
	50	–	–	3	14	20	14	40	9	–	–	–	–	58
	45	–	2	2	16	22	44	12	0	2	–	–	–	58
	40	2	0	3	22	42	26	3	2	–	–	–	–	58
	35	–	2	17	38	25	14	2	2	–	–	–	–	58
	30	–	2	31	32	26	7	0	2	–	–	–	–	58
	25	–	2	46	31	19	2	–	–	–	–	–	–	58
	20	–	4	57	35	4	–	–	–	–	–	–	–	57

*N = number of observations

TABLE VI – FREQUENCY DISTRIBUTIONS OF THE MERIDIONAL WIND COMPONENT AT WEST GEIRINISH DURING DECEMBER, JANUARY AND FEBRUARY

	Height km	Range (m/s) –79– –60	–59– –40	–39– –20	–19– 0	1– 20	21– 40	41– 60	61– 80	81– 100	N*
		per cent									
December	60	–	–	13	30	26	22	0	9	–	23
	55	–	3	5	27	27	20	15	3	–	40
	50	–	–	4	24	35	22	13	2	–	46
	45	–	–	6	30	28	30	0	2	4	47
	40	–	–	9	36	36	15	4×	–×	–	47
	35	–	–	2	60	21	17	–	–	–	47
	30	–	–	4	67	29	–	–	–	–	48
	25	–	–	2	77	21	–	–	–	–	48
	20	–	–	6	69	25	–	–	–	–	36
January	60	3	3	6	22	28	22	10	6	–	32
	55	2	0	4	30	35	16	9	4	–	56
	50	–	3	8	23	40	9	14	3	–	65
	45	–	1	6	29	39	12	10	3	–	69
	40	–	4	4	42	25	13	9	1	1	69
	35	1	1	10	38	26	19	1	1	1	73
	30	1	1	10	45	34	7	1	1	–	74
	25	–	–	9	59	27	5	–	–	–	76
	20	–	–	5	67	28	–	–	–	–	63
February	60	3	0	28	14	35	17	0	3	–	29
	55	–	6	14	41	25	10	2	2	–	51
	50	2	3	14	40	34	5	2	–	–	58
	45	2	2	5	65	19	7	–	–	–	58
	40	–	2	7	62	27	2	–	–	–	58
	35	–	2	7	64	27	–	–	–	–	58
	30	–	–	9	60	29	2	–	–	–	58
	25	–	–	2	74	24	–	–	–	–	58
	20	–	–	5	68	25	2	–	–	–	57

* N = number of observations

× see text.

Publications relating to Skua rocketsonde by members of the Office

A. Open publications, in chronological order

(1) Almond,R., Farmer,S.G.F. and Frith,R.	1964	Rocket Soundings of the upper atmosphere. Nature, 202, 587
(2) Almond, R	1965	Techniques of temperature and wind sounding with the Skua meteorological rocket. Meteorol Mag, 94, 327-331
(3) Farmer, S F G	1965	Results from the Skua meteorological rocket programme. Meteorol Mag, 94, 332-337
(4) Clark, D D	1965	A meteorological rocket sonde. J. Sci. Inst. 42, 733-736
(5) Almond, R	1969	The Skua meteorological rocket system. Progress Astronaut. Aeronaut. 22, 31-46
(6) Shearman, R J	1969	Meteorological rocket soundings from Gan. Meteorol. Mag, 98, 318-324.
(7) Bridge, G C	1971	The stratospheric winter anomaly - a review of rocketsonde observations at South Uist (1967-71). Meteorol Mag, 100, 363-371
(8) Hamilton, R A and Shearman, R J	1972	Diurnal variation of temperature and wind in the equatorial stratosphere Q J R Meteorol Soc, 98, 668-672.
(9) Mason, B D and Acres, J	1972	Temperature corrections for the Skua rocketsonde temperature sensor. Meteorol Mag, 101, 118-124
(10) Bridge, G C	1973	A comparison of geostrophic and rocket winds at stratospheric levels, measured from a small network of rocket sounding stations. Meteorol Mag, 102, 205-215.

(11) Hamilton, R A, Mason, B D and Bridge, G C — 1973 — A climatology of the stratosphere over north-west Europe. Meteorological Offi Geophysical Memoirs No 119

(12) Bridge, G C — 1979 — Diurnal variations of temperature and wind in the 25-65 kilometre region of th equatorial stratosphere. Meteorol Mag, 108, 367-375

(13) D E Miller — 1981 — Skua meteorological rocket programme terminated. Meteorol Mag, 110,

B. Internal un-published reports

1. MRCP 99 — The five-inch meteorological rocket, R Frith — Oct 1961

2. MRCP 100 — Meteorological sonde rockets, R Frith and D D Clark — Oct 1961

3. MRCP 178 — A meteorological rocket sonde, D D Clark — Sept 1965

4. MRCP 179 — Temperature and wind measurements in the upper atmosphere using the Skua meteorological rocket, R Almond and S P G Farmer, — Sept 1965

5. MRCP 180 — Meteorological rocket soundings, R Frith — Sept 1965

6. MRCP 300 — Variations in the equatorial stratosphere, R A Hamilton and R J Shearman, — Dec 1971

7. MRCP 334 — Intensive series of night time rocket soundings at Gan, Marjory G Roy, B D Mason and G C Bridge — April 1973

8. Met O 19 Branch Memo No 60. — Skua meteorological rocketsonde observations, 1964-1980, G P Carruthers and S W Francis — Feb 1981

INDEX OF METEOROLOGICAL ROCKET SOUNDINGS AT WEST GEIRINISH
1973 - 1980

This index contains all soundings from which some meteorological data was obtained.

The index gives the maximum height from which useful data is available. The lower limit for data is generally 20km. Time refers to instant of launch.
For firings 1964 - 1972 see Appendix to Geophysical Memoirs No 119.

The West Geirinish launcher is at 57.3°N, 7.4°W.

Notes

* M383 - 389 carried chaff and a sonde. Radar data is available but winds have not been derived.

† M406 carried chaff and sonde. Winds available 82 - 60 km and below 39km.

Date	Time (GMT)	Serial No	Max Ht (Km) Temp	Wind
1973				
7/2	2013	M383	45	*
9/2	1845	M384	54	*
15/2	1931	M385	54	*
2/5	2241	M386	65	*
4/5	2154	M387	63	*
7/5	2237	M388	64	*
9/5	2237	M389	62	*
1974				
24/7	0132	M405	67	77
29/7	1200	M406	65	82 †
31/7	0109	M407	69	70
2/8	0134	M408	69	70
5/8	0100	M410	67	67
4/12	1859	M413	60	55
7/12	1807	M414	70	60
11/12	1930	M415	65	56
13/12	1748	M416	65	64
14/12	1825	M417	70	65
16/12	1741	M418	65	60
18/12	1754	M419	65	60
1975				
7/1	1809	M421	65	58
15/1	1757	M424	-	60
17/1	1859	M425	70	60
21/1	1805	M426	63	60
24/1	1821	M427	70	62
28/1	1834	M428	-	62
5/2	0058	M431	70	61
7/2	0150	M432	65	62
10/2	0039	M433	60	54
12/2	0055	M434	70	60
1976				
12/1	1931	M437	-	50
17/1	0300	M438	65	55
22/1	0203	M439	64	56
24/1	0130	M440	70	50
30/1	1833	M442	67	60

Date	Time (GMT)	Serial No	Max Ht (Km) Temp	Wind
1976 (cont)				
3/2	0128	M443	70	58
6/2	0054	M444	68	65
7/2	1910	M445	70	65
9/2	2019	M446	70	63
11/2	0128	M447	67	64
13/2	0118	M448	68	65
16/2	0102	M449	70	63
18/2	0114	M450	70	61
25/8	2308	M451	47	47
27/8	0105	M452	68	68
30/8	2226	M453	41	41
2/9	2227	M455	64	64
4/9	0126	M456	67	67
8/12	1739	M458	64	64
11/12	0105	M459	66	64
15/12	1700	M460	67	54
17/12	1702	M461	75	60
1977				
7/1	1759	M462	68	60
10/1	1738	M463	69	68
13/1	0034	M464	75	60
17/1	1733	M465	73	60
22/1	0131	M466	76	65
25/1	1756	M467	81	70
28/1	1758	M468	70	63
1/2	0125	M469	69	61
4/2	1810	M470	65	59
8/2	0045	M471	70	66
14/2	0212	M472	70	60
14/9	0106	M474	69	69
16/9	2300	M475	70	70
19/9	0135	M476	69	69
1978				
25/1	1757	M477	65	61
27/1	1804	M478	58	60
1/2	1810	M479	61	61
11/11	0422	M483	59	59
13/12	0354	M485	54	54

Date	Time (GMT)	Serial No	Max Ht (Km) Temp	Wind
1979				
11/1	0404	M486	65	56
18/1	0428	M487	65	55
23/2	0328	M488	60	60
24/4	0502	M490	70	70
25/4	1300	M491	70	60
9/7	0453	M492	66	65
11/7	0849	M493	71	71
12/7	0828	M494	68	68
29/9	0844	M495	59	45
2/10	0210	M496	64	60
2/10	0943	M497	55	35
14/11	1849	M499	56	60
15/11	0827	M500	53	60
1980				
14/2	1850	M501	60	42
15/2	0841	M502	58	56
19/2	1207	M503	56	56
19/2	1850	M504	60	60
21/7	1433	M509	65	60
23/7	0856	M510	63	60
23/7	1421	M511	65	57
16/9	0845	M513	38	60
16/9	1826	M514	70	64
19/9	0917	M515	67	58
19/9	1500	M516	59	59
6/11	0822	M517	58	55
6/11	1802	M518	65	55
13/11	1355	M521	57	60
14/11	0915	M522	55	60

INDEX OF METEOROLOGICAL ROCKET SOUNDINGS MADE WITH THE OFFICE'S SKUA SYSTEM AT RANGES OTHER THAN WEST GEIRINISH

1964 - 1980

Range	Location	Year	Objective	Ref
ABERPORTH	52.2N, 4.6W	1964	Vehicle trial	
		1966	Vehicle trial	
		1971	N.W.Europe network	A10,A11
		1973	Skua 4 trial	
		1974	Vehicle trial	
		1975/6/7	Vehicle trials	
GAN	0.7S, 73.1E	1968	Seasonal variations	A6,B6
		1969	Seasonal variations	B6
		1970	Dawn,dusk comparison	A8,B6
		1972	Night-time variation	B7
KIRUNA	67.8N,20.3E	1970	N.W.Europe network	A11
		1971	N.W.Europe network	A10,A11
KOUROU	5.2N,52.4W	1973	Rocketsonde comparison	A12
THUMBA	8.5N,76.9E	1970	Commonwealth venture	B6

Notes

- Only those soundings providing some meteorological data are listed.

- 'Ref' are references to publications in Appendix 1.

ABERPORTH

Round No	Date	Time UT	Temp Data Ranges In KMS	Wind Data Ranges In KMS
M27A	64.09.23	1102	20–65	20–62
M28A	64.09.29	1129	20–65	19–59
M79A	66.06.03	0848	19–65	20–65
M324A	71.01.22	1903	19–65	20–60
M326A	71.01.26	1815	19–61	19–61
M328A	71.01.28	1822	19–57	20–65
M330A	71.02.04	1902	19–65	19–62
M332A	71.02.08	1845	19–62	20–62
M334A	71.02.10	1905	19–62	19–62
M390A	73.08.24	1100	21–55	?
M403A	74.03.26	1527	20–65	20–65
M404A	74.03.29	1330	nil	20–65
M435A	75.10.16	2141	20–66	20–64
M436A	75.10.30	1610	20–60	20–60
M457A	76.11.19	1400	21–59	22–58
M473A	77.06.22	1438	21–52	22–51

GAN

1968

Round No	Date	Time UT	Temp Data Ranges In KMS	Wind Data Ranges In KMS	Remarks
M203G	68.09.27	1412	19-52	20-52	
M204G	68.09.28	1409	20-65	20-64	
M205G	68.09.30	1410	19-53	20-55	
M208G	68.10.04	1407	20-59	20-60	
M209G	68.10.07	1417	19-61	20-65	
M210G	68.10.09	1412	20-62	20-60	
M211G	68.10.10	0740	20-61	20-60	

GAN

1969

Round No	Date	Time UT	Temp Data Ranges In KMS	Wind Data Ranges In KMS	Remarks
M225G	69.04.16	1445	23-48	20-63	
M226G	69.04.18	1437	23-52	20-52	
M227G	69.04.21	1438	20-60	20-60	
M228G	69.04.23	1423	Nil	20-65	
M229G	69.04.24	1415	Nil	20-64	
M230G	69.04.27	1954	Nil	20-62	
M231G	69.04.29	1400	20-60	20-60	
M232G	69.05.01	2028	20-65	20-62	
M233G	69.05.03	1352	Nil	20-65	
M234G	69.05.03	1957	20-59	20-57	
M238G	69.09.23	1440	20-63	20-61	
M240G	69.09.26	1510	20-40	20-30	

GAN

1970

Round No	Date	Time UT	Temp Data Ranges In KMS	Wind Data Ranges In KMS	Remarks
M266G	70.03.10	1436	19-65	20-61	
M268G	70.03.12	1400	30-65	20-61	
M270G	70.03.13	1436	19-65	19-61	
M272G	70.03.14	1420	19-61	20-62	
M274G	70.03.16	1412	19-64	20-62	
M276G	70.03.18	1416	19-63	20-60	
M278G	70.03.20	1430	40-63	20-59	
M282G	70.03.22	1541	19-65	19-62	
M284G	70.03.23	1430	23-64	20-59	
M286G	70.09.02	1413	20-62	20-60	
M287G	70.09.02	2307	20-53	20-53	
M288G	70.09.03	1356	19-60	19-62	
M289G	70.09.03	2302	19-65	19-62	
M291G	70.09.05	1515	Nil	19-37	
M292G	70.09.05	2301	20-60	20-62	
M293G	70.09.06	1417	19-65	19-62	
M294G	70.09.06	2305	19-27	19-28	
M295G	70.09.08	1415	19-65	19-62	
M296G	70.09.08	2313	Nil	20-61	
M297G	70.09.09	1416	19-65	19-61	

GAN
1972

Round No	Date	Time UT	Temp Data Ranges in KMS	Wind Data Ranges in KMS
M359G	27 Sept	1350	25-65	23-63
M360G	27 Sept	1425	24-61	24-66
M361G	27 Sept	1529	nil	23-71
M362G	27 Sept	1801	18-58	19-61
M363G	27 Sept	2007	23-52	24-35
M364G	27 Sept	2046	20-67	21-69
M365G	27 Sept	2247	21-62	22-66
M366G	27 Sept	2346	20-69	21-71
M367G	2 Oct	1347	24-65	25-65
M368G	2 Oct	1424	23-56	24-44
M369G	2 Oct	1526	19-66	19-66
M370G	2 Oct	1805	19-68	19-70
M371G	2 Oct	2008	23-68	23-71
M372G	2 Oct	2050	20-55	20-75
M373G	2 Oct	2256	20-70	20-72
M374G	2 Oct	2353	20-65	21-66
M375G	6 Oct	1348	24-70	24-71
M376G	6 Oct	1426	24-65	19-65
M377G	6 Oct	1600	25-65	25-65
M378G	6 Oct	1813	20-69	20-72
M379G	6 Oct	2016	23-69	24-72
M380G	6 Oct	2055	20-66	21-67
M381G	6 Oct	2340	32-66	33-71
M382G	7 Oct	0001	20-67	20-71

KIRUNA

1970

Round No	Date	Time UT	Temp Data Ranges In KMS	Wind Data Ranges In KMS	Remarks
01	70.01.05	1423	Nil	19-57	
02	70.01.07	1426	19-54	19-54	
03	70.01.09	1444	19-62	19-62	
04	70.01.12	1439	21-65	21-65	
05	70.01.14	1440	20-43	19-43	
06	70.01.17	1446	Nil	19-61	
07	70.01.19	1501	20-63	19-63	
08	70.01.21	1500	20-62	19-62	
09	70.01.23	1506	19-59	19-61	
10	70.01.26	1518	20-63	19-63	
11	70.01.28	1518	20-60	19-60	
12	70.01.30	1527	19-65	19-65	

KIRUNA

1971

Round No	Date	Time UT	Temp Data Ranges In KMS	Wind Data Ranges In KMS	Remarks
02	71.01.15	1525	20-55	20-55	
04	71.01.19	1520	20-60	20-60	
05	71.01.21	1507	20-60	20-58	
06	71.01.23	1553	Nil	20-55	
07	71.01.25	1610	20-58	20-58	
08	71.01.27	1626	20-37	20-35	
09	71.01.29	1721	20-60	20-60	
10	71.01.31	1645	20-37	20-60	
11	71.02.03	1912	20-60	20-55	
12	71.02.08	2148	20-44	20-44	
13	71.02.09	1900	20-50	20-60	
14	71.02.11	1850	20-55	20-55	
15	71.02.12	1830	Nil	20-55	

KOUROU

1973

Round No	Date	Time UT	Temp Data Ranges in KM	Wind Data Ranges in KM
M392K	21 Sept	0344	25-35	25-27
M393K	21 Sept	1539	nil	25-65
M394K	22 Sept	0431	25-69	25-69
M395K	25 Sept	0051	25-70	25-70
M396K	25 Sept	1835	25-70	25-70
M397K	26 Sept	0101	25-64	25-64
M398K	26 Sept	1435	25-65	25-65
M399K	27 Sept	1420	25-55	25-66
M400K	28 Sept	0306	25-70	25-70
M401K	29 Sept	0324	25-68	25-68
M402K	1 Oct	0402	25-53	25-53

THUMBA

1970

Round No	Date	Time UT	Temp Data Ranges In KMS	Wind Data Ranges In KMS	Remarks
M267T	70.03.06	1345	20-60	20-59	
M269T	70.03.08	1345	20-57	20-57	
M271T	70.03.10	1415	20-58	20-58	
M273T	70.03.12	1345	20-64	20-63	
M275T	70.03.14	1405	Nil	20-62	
M277T	70.03.16	1345	20-60	20-60	
M279T	70.03.16	2350	32-61	20-61	
M281T	70.03.18	1345	20-62	20-60	
M283T	70.03.20	1345	20-63	20-65	
M285T	70.03.22	1345	19-62	19-62	