CATALOG OF MEASURED AND CALCULATED VALUES OF THE STRESS MODULUS OF THE GEOMAGNETIC FIELD ALONG THE ORBIT OF THE COSMOS-49 SATELLITE

Part I

From No. 1 to No. 6205

24 October-4 November, 1964

Sh. Sh. Dolginov, V. N. Nalivayko, et al

Editor: V. P. Orlov

Institute of Terrestrial Magnetism, the Ionosphere and Propagation of Radio Waves, Academy of Sciences USSR, Moscow 1967

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Catalog of Measured and Calculated Values
of the Stress Modulus of the Geomagnetic
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Annotation

The catalog of measured and calculated values of magnetic field intensity modulus (T) along the orbit of the satellite Cosmos-49 contains 17,489 measurements performed during November of 1964. The catalog consists of three parts. In the first part a brief text is presented, describing the measurements themselves, their processing, certain results and the content of the numerical tables. The first portion includes 6205 measurements. The second and third portions include only a description of the content of the tables and the tables themselves.

In the period from 24 October to 3 November 1964, measurements of the magnetic field of the earth were performed using absolute proton magnetometers in the Cosmos-49 satellite. These measurements were a part of the Soviet national program in the plan for world magnetic surveying.

1. Orbit and Magnetic Surveying

The satellite was placed in orbit at an angle of 49° to the plane of the equator. The distance from the surface of the earth at apogee was about 484 km, at perigee about 265 km. The rotation period around the earth was 91.83 min. The period of operation of the scientific apparatus on the flight was 11 days. Due to differences in the periods of rotation of the earth and the satellite and the asphericity of the earth, causing a shift of the orbit to the west at a rate of about 45° per day, during this eleven-day period the satellite performed even surveys over the surface bounded by latitudes ±49°, making up 75% of the surface of the earth.

An idea of the density of the survey net is given by Figure 1. This figure shows the flight trajectories at intervals of approximately 20 revolutions. The dots correspond to points where T was measured, the solid lines are flight sectors for which for various reasons no measurements were made. Figure 1 gives a good representation of the survey density along the orbits, but the number of orbits was actually approximately twenty times greater.

2. Nature of Primary Magnetometric Information

The Cosmos-49 satellite carried two proton magnetometers, which were operated alternately, with their transducer sections oriented at an angle of 90°. A skeletal diagram and description of the principle of operation of the proton magnetometers are presented in [1]. The accuracy of measurement using these proton magnetometers was 2 gammas. We present below a brief description of the cycle of operation of measurements of the magnetic field with the proton magnetometers, which is required in a discussion of the accuracy of the experimental material.

Upon receipt of an external command from the precision on-board time programming device, the polarization current was connected to magnetometer 1 for time t_1 = = 1.92 sec, after which the winding of the transducer was connected to the amplifier input. After a certain delay (t = 0.18) the search for the optimal-signal range was begun. Depending on the field intensity and the preceding reading, search time t_3 varied between 0 and 650 msec. After the logic circuits of the magnetometer established the presence of an optimal signal, the signal search was halted and the actual measurement process was begun, which continued, depending on the field intensity present, from 0.2 to 0.6 sec (t_4). The indications of the frequency meter were retained for 8 sec, the time necessary to record the measured values in the on-board memory device.

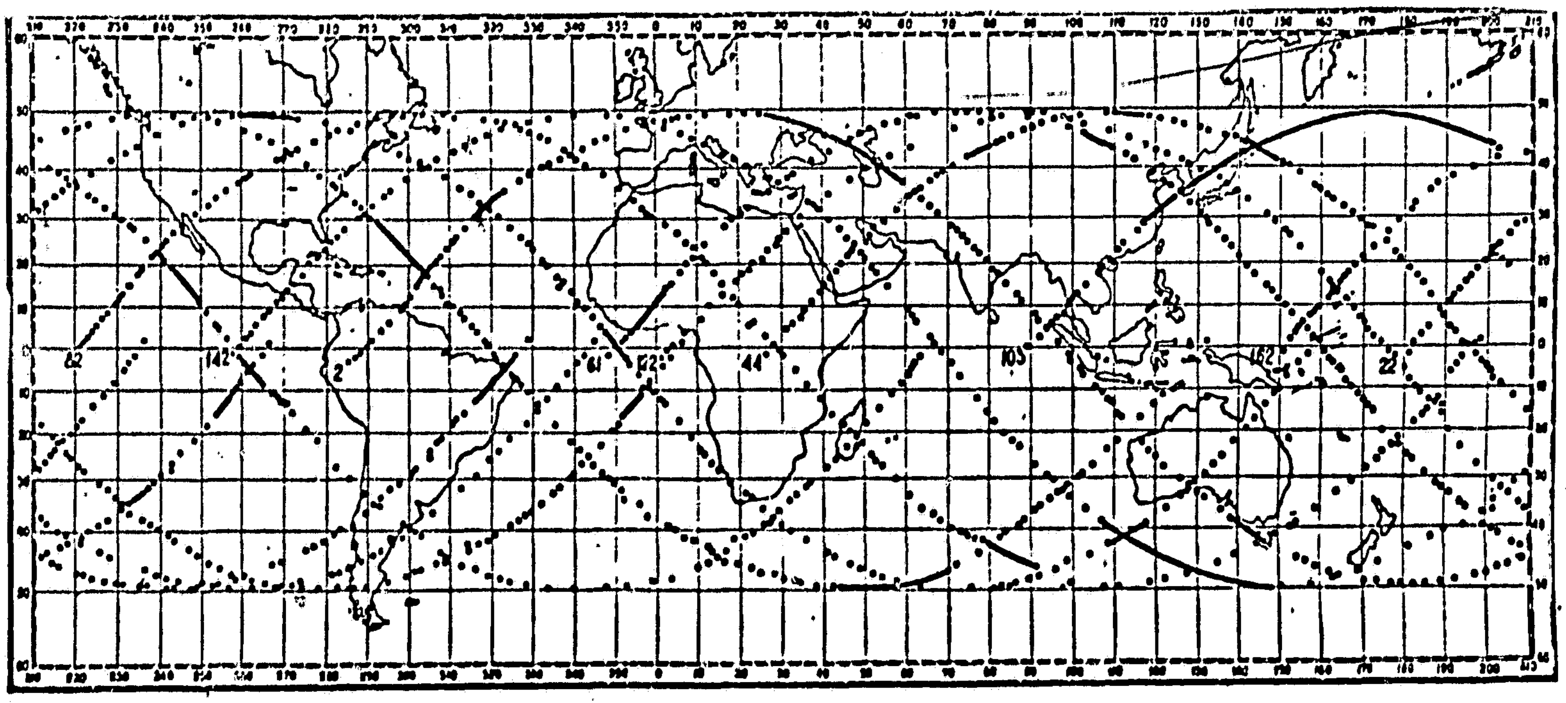

Figure 1

The scientific information was recorded as eight voltage levels varying between 0 and 6 volts. The information from one measurement (an octal number) consisted of six digits taken from the six photo units. The frequency meter measured the number of pulses N of the quartz magnetometer generator developed in time T, equal to 512 cycles of nuclear precession. In order to determine number N, the indications of the magnetometer were translated from octal code to decimal code.

The operation of calculation of T was performed using an M-20 computer:

$$T = \frac{12025.25\,(100000 + \Delta f)}{N}$$

where Δf is the temperature correction of the frequency of the crystal oscillator in the magnetometers;

N is the number of pulses, as mentioned above.

The memory device could store the information for up to 800 minutes. The information was recalled from storage on command from the earth as the satellite flew over the receiving stations.

The time programmer turned on the magnetometers in a 65.53-second cycle, alternately at intervals of 32.76 seconds. Also, the time programmer created on-board timing signals. Correlation of on-board time to absolute time was performed by comparing the on-board time signals in the reproduction mode with signals recorded during direct transmission. The above listed information processing steps produced a catalog of measured values of T of the geomagnetic field, correlated to Moscow time. The Moscow time of the moment of measurement was determined using the formula

$$t_{Mosc} = t + (n - 1)\Delta t + T_{inst}$$

where t_{Mosc} is the Moscow time of the first minute time signal;

Δt is the repetition period of the timer signals in seconds;

T_{inst} is the time correction required to consider the internal operating cycle of the magnetometer.

As was noted above, T_{inst} includes some uncertainty, since the value of search time t_3 is not precisely known. If in place of the precise value of T_{inst} we consider the mean value, the maximum error might be ±0.28 sec. Measurement time t_4 can be determined accurately, i.e. the field measured is known. However, the mean time was used in processing. These inaccuracies could lead to an error in time correlation of ±0.5 sec.

In the final analysis, it was necessary to know the coordinates ϕ, λ, and h of the satellite at the moment of measurement of the field. In order to produce these values, the catalog of orbits of the Cosmos-49 satellite can be used. The catalog contained values of h in meters, ϕ and λ in degrees and fractions of a degree for whole minutes (at intervals of one minute) of Moscow time. The geodesic coordinates and altitude of the satellite were calculated relative to a biaxial ellipsoid with the following characteristics: large half axis $\bar{a}$ = 6378.178 km, compression α = 0.00335238918. The maximum error in determination of the coordinates of the Cosmos-49 satellite was one kilometer of altitude h, three kilometers along the trajectory and one kilometer in the direction of a plane perpendicular to the orbit. Determination of the coordinates at the moment of measurement was performed by the method of interpolation using the quadratic formula. This operation was performed using the Ural-2 computer; the error of the process of interpolation was an order of magnitude less than the error involved in the process of output of the coordinates.

3. Analytic Geomagnetic Field

Since for most investigations which include a program of scientific processing of the results of magnetic measurements performed by satellite it is necessary to use some variant of analytic representation of the geomagnetic field, this catalog includes calculated values of the scalar quantity T_{theor} along the orbit at the points of measurement of the field by the instruments of the satellite. The theoretical field was calculated using the coefficients of spherical harmonic analysis of world magnetic maps of the 1960 epoch, composed at the Leningrad department of IZMIRAN [Institute of Geomagnetism, the Ionosphere and Propagation of Radio Waves, Academy of Sciences USSR]. The analysis [2] was performed for a spherical earth using n = 6, m = 6, i.e. considering 48 coefficients. In order to produce T_{theor}, the values of the northern and eastern components were calculated for the coefficients g_n^m, h_n^m, values of the vertical coefficients using the coefficients j_n^m, k_n^m (Table 1). All coefficients up to n = 3 and m = 3 were corrected for the secular variation using the data of analyses of the secular variation for 1955-1960 [3].

Table 1. Coefficients of Spherical Harmonic Analysis Used in Calculation of T_{theor}

	0	I	2	3	4	5	6	I	2	3	4	5	6
				g_n^m							h_n^m		
I	- 3047	- 2I0						58I					
2	- I6I	292	I66					- I98	27				
3	II9	- I94	I29	84				- 43	20	- I6			
4	96	82	47	-36	3I			- I4	-3I	- I	-24		
5	- I9	35	25	- 3	- I7	-5		2	-I2	- 7	-II	7	
6	6	0	- I	-28	I	-I	-I0	- 3	I2	3	- I	-I	- I
				j_n^m							k_n^m		
I	6076	436						-II5I					
2	468	-906	- 490					+ 592	- 59				
3	- 443	+795	- 5I4	-335				I66	- 74	7I			
4	- 507	-398	- 260	I83	-I3I			- 6I	+I42	II	I04		
5	+ I43	-207	- I37	23	I0I	45		- 8	- 7I	50	69	-64	
6	- 70	- 50	- I8	I64	- I3	- 2	48	23	- 72	- 39	24	- 5	-I3

4. Testing of Initial and Calculated Values

Both the measured and the calculated values of T could contain errors. Improper measurement of T could occur in case of unfavorable positions of the axis of either transducer relative to the geomagnetic field. Although the magnetometer circuit forbids the performance of measurements with these positions, still, under boundary conditions, i.e. when the signal is not so slight as to be forbidden, false readings could be made. As a rule, false readings were easy to detect, since they differed sharply from neighboring values of field gradients. For testing purposes, graphs were constructed and the readings indicating sharp field gradients were easily recognized.

After the theoretical fields along the trajectory and the differences ΔT between measured and calculated field values were calculated, the graphs of ΔT allowed testing to be performed more easily, using the same criteria -- absence of sharp field gradients at the altitude of the satellite flight path. Subsequently, some of the readings which had been discarded can be subjected to additional filtration upon comparison with the effects in a variable field.

More detailed analysis of the value and geographic distribution of ΔT [4] allowed us to make the following conclusions:

1) over most of the area of the earth's surface which was investigated, the values of ΔT are less than 200 gamma; the areas of larger values (500-600 gamma) represent large scale anomalies. Our attention was drawn to the tendency of areas of ΔT to correspond with the world ocean, for which the world maps are less accurate.

2) there is no relationship between distribution of values of T and ΔT.

3) the dimensions and distribution of regions with large ΔT are such that the field of T should be described by low order harmonics.

Figure 2 shows a histogram of the distribution of ΔT from [4]. In correspondence with this histogram, made up on the basis of 4,000 values of ΔT, the algebraic mean value of ΔT (excess of negative ΔT over positive) is -60 gamma, the arithmetic mean is ±184 gamma. These values of ΔT are rather characteristic for the entire set of measurements on board Cosmos-49.

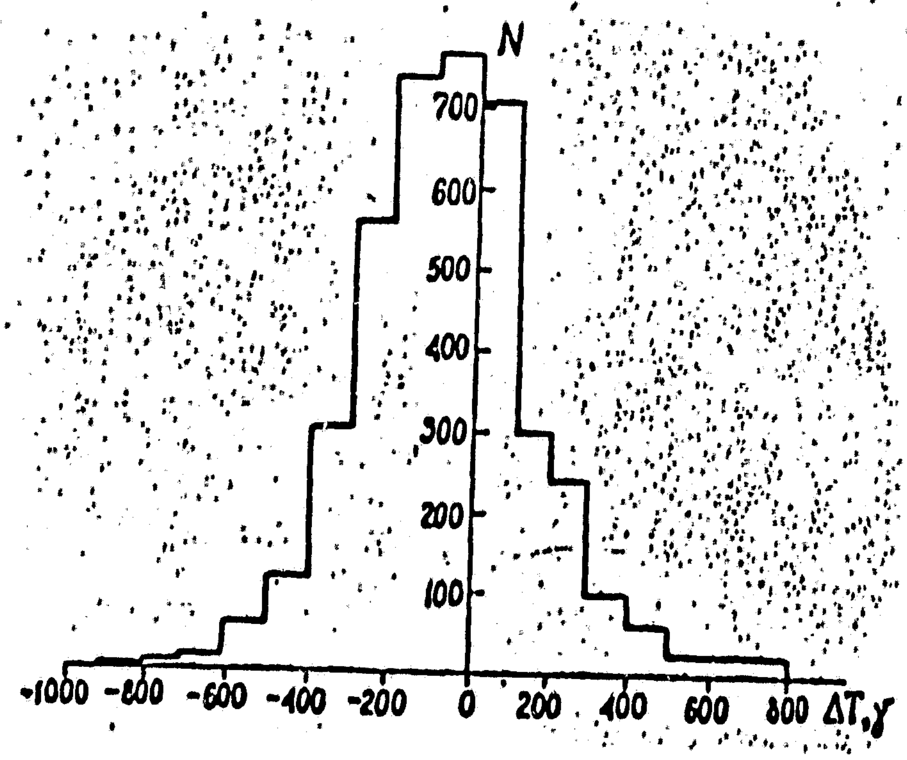

Figure 2

The results of the primary processing are presented in the form of a numerical catalog and set of graphics.

5. Description of Catalog

Due to the large volume of information produced from Cosmos-49 (17300 measurements), the catalog is divided into three parts. The first part contains this text plus the first 6,000 measurements.

The second part is a description of the catalog, plus measurements from 6,000 to 12,000; the third part consists of another description and measurements from 12,000 to 17,300.

The catalog consists of eight columns:

1. The ordinal number of the measurement.

2. Moscow time in hours and minutes. The moments of time are rounded off to the even minutes in correspondence with the time base of standard magnetograms (20 mm-60 min).

3. Height h, at which the measurement was performed, in kilometers.

4-5. The geographical coordinates down to 0.01°. Northern and southern latitudes are distinguished by their sign, longitudes are measured from Greenwich, always east.

6. The measured value of intensity modulus T in gammas.

7. The theoretical (calculated) value of intensity modulus in gammas.

8. The difference $\Delta T = t_{meas} - t_{theor}$ in gammas.

Columns 1 and 8 require additional explanation.

For technical reasons, the processing of experimental material was performed first for the measurements made by the first instrument, then by the second. The machine carried 360 measurements at one time. In order to simplify composition of the overall numeration of the catalog, the numbers were given out in the following order: ~360 measurements of the first instrument, then ~360 measurements over the same trajectory interval and the same time interval by the second instrument. The next numbers cover the following trajectory-time segment for the first instrument, etc. Changes of instruments and dates are indicated. The distribution of ordinal numbers by instruments is given preceding the numerical tables in each portion of the catalog.

Column 8 gives the difference between T_{meas} and T_{theor}. This difference was produced using values of T_{meas} and T_{theor} which had not been rounded off, and may differ by one gamma from the values produced directly from catalog data.

6. Set of Graphs of ΔT

Based on the catalog, a set of graphs of ΔT, ϕ and h as a function of λ has been produced for all revolutions from 1 to 163. The beginning of a revolution was considered to be the moment when the satellite intersected the plane of the equator moving from south to north. The relationship between the beginning of a revolution and the catalog number is given in Table II. In those cases when no measurements were made near the equator, a dash is placed in the column "according to catalog." The instrument used to make the measurement taken as the first for the revolution is shown after the hyphen. A reduced sample of one such graph is shown on Figure 3.

Photo copies of the set of illustrations in natural size can be ordered from IZMIRAN. The basis of the composition of the graphs was the fact that each 77 revolutions, the trajectories of the satellite had corresponding values of ϕ and λ; revolution 79 had similar ϕ and λ to revolution 2, revolution 80 to revolution 3, etc., although there was considerable change in the altitude due to orbital deformation. Since altitude changes have little influence on ΔT_i and ΔT_{i+77}, these "paired" revolutions could be considered repetitions. The "paired" orbits, their ϕ, λ and h are shown on one sheet of the graph set and are accompanied by curves for $dT = \Delta T_i - \Delta T_{i+77}$ and $\Delta H = H_i - H_{i+77}$.

The values of dT depend on:

1. The error in determination of coordinates.

2. The difference in the magnetic activity and local time, i.e. the varying influence of external field sources. Therefore, it can be considered that the value of dT characterizes the summary uncertainty of the measured values of T resulting from field sources within the earth.

Table II. Ordinal Number of Revolutions of Flight of Cosmos-49 and Corresponding Catalog Numbers

Revolution	Catalog numbers	Revolution	Catalog numbers	Revolution	Catalog numbers
2-II	227	30-II	3322	58-II	5642
3-II	238	31-II	3385	59-I	5701
4	-	32	-	60-I	5766
5-II	316	33	-	61-I	5832
6-I	380	34-I	3573	62	-
7-I	450	35	-	63-I	6258
8-I	520	36	-	64	-
9-I	589	37-I	3832	65-I	6500
10-II	1175	38-I	3895	66-I	6564
11-I	986	39-I	3956	67-II	6881
12-I	1029	40-I	4013	68-II	6943
13-I	1085	41	-	69	-
14-II	1425	42	-	70	-
15-I	1477	43	-	71-I	7136
16-I	1536	44-I	4248	72-II	7462
17-I	1601	45-II	4507	73	-
18-I	1668	46	-	74	-
19-I	1968	47-I	4420	75-II	7889
20-I	2034	48	-	76-II	7950
21-I	2095	49	-	77-I	8012
22-II	2426	50-I	4670	78-I	8074
23-I	2485	51-I	4729	79-I	8134
24	-	52-I	4785	80-I	8202
25	-	53-II	5085	81-I	8240
26-I	2642	54-I	5174	82-I	8534
27-I	2692	55-I	5212	83-I	8602
28-II	3197	56-II	5534	84-I	8659
29-II	3265	57	-		

Note: I, II mean first and second instruments.

Table II continued. Ordinal Number of Revolutions of Flight of Cosmos-49

and Corresponding Catalog Numbers

Revolution	Catalog numbers	Revolution	Catalog numbers	Revolution	Catalog numbers
85-I	87I5	II2	-	I39	-
86	-	II3	-	I40-I	I4833
87-I	9068	II4-I	II693	I4I	-
88	-	II5-I	II86I	I42-I.	I5073
89-П	9627	II6-П	I2I70	I43-I	I5360
90-П	9684	II7	-	I44-I	I54I4
9I-П	9740	II8	-	I45-I	I546I
92-П	9783	II9	-	I46	-
93-П	9846	I20	-	I47	-
94-П	I0I66	I2I-П	I2746	I48-П	I5629
95-П	I0224	I22-П	I28I5	I49-П	I569I
96-П	I0268	I23	-	I50	-
97-П	I03II	I24-I	I2936	I5I	-
98-I	I0372	I25	-	I52-I	I6276
99-I	I0430	I26	-	I53-П	I6072
I00-I	I0496	I27-I	I3II7	I54-I	I6384
I0I-I	I0525	I28-I	I3436	I55-П	I6445
I02	-	I29-I	I3505	I56-П	I6503
I03-I	I0878	I30-П	I3938	I57-I	I6720
I04-П	III83	I3I-П	I4002	I58-П	I6576
I05-I	I0999	I32-П	I4070	I59-I	I6636
I06-I	II06I	I33-П	I4I33	I60-П	I6878
I07-П	II497	I34	-	I6I-I	I7I73
I08-I	II428	I35-П	I45I7	I62-П	I7238
I09	-	I36-П	I4579	I63-I	I7306
II0	-	I37-П	I4639		
III-I	II60I	I38-I	I4698		

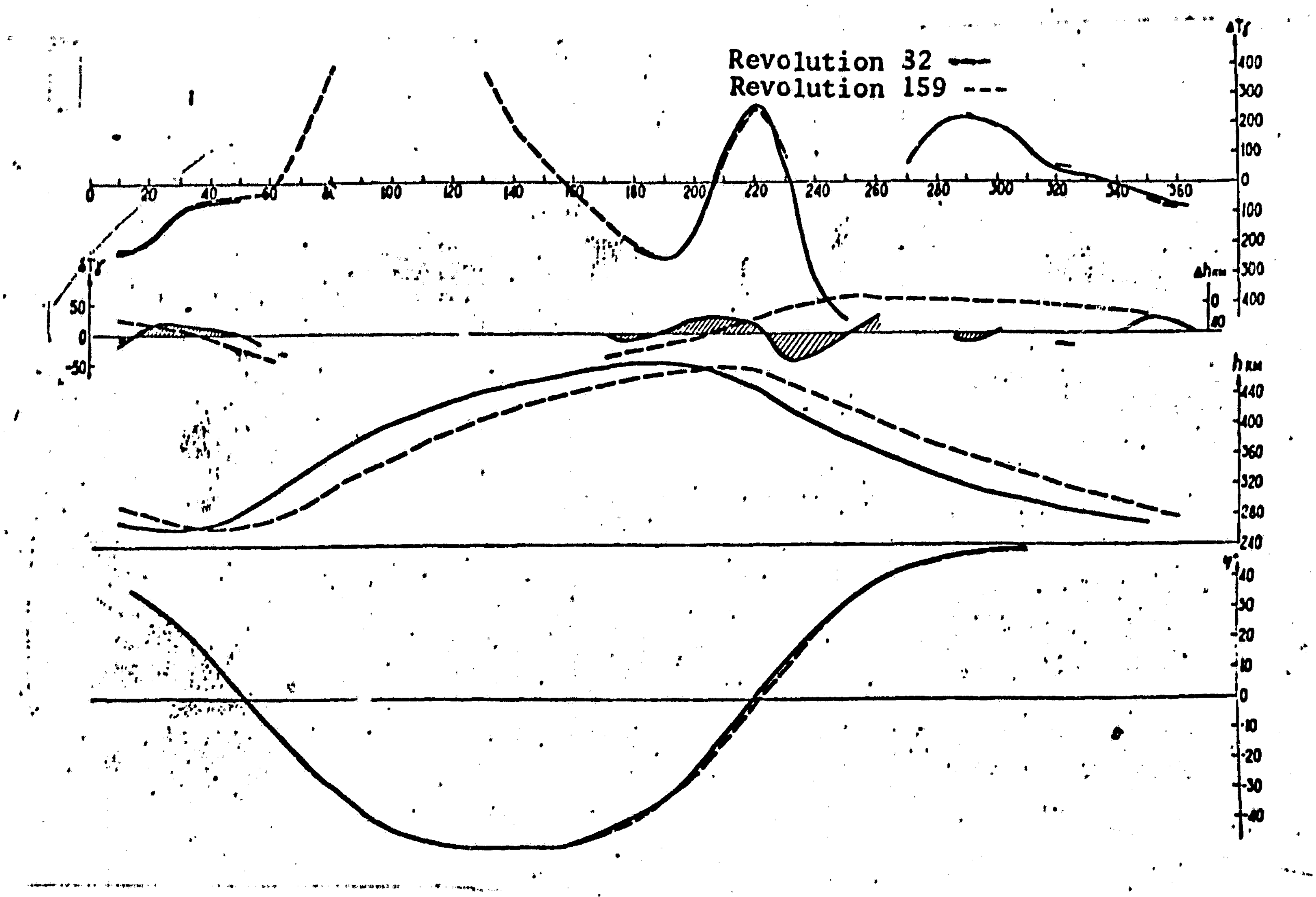

Figure 3

7. Map of Residual Field T at Altitude h = 400 km

The results of measurements made on the Cosmos-49 satellite were also summarized in the form of a map of the residual field of modulus T. This map was made on the basis of 4,000 measurements of T performed at various altitudes and corrected to an altitude of 400 km according to the gradients $\partial T/\partial h$, calculated from the spherical harmonic coefficients (see Table I). The values of the field of homogeneous magnetization for the same altitude were subtracted from the values of T_{400}, i.e. the field of the first harmonic term was subtracted. T_{res} is shown on Figure 4. The distribution of T_{res} (figure 4) at the altitude of the Cosmos-49 retains all the primary features of the residual field at the surface of the earth: the centers of the world anomalies, the areas of large gradients both retain the same geographic distribution.

A comparison of T_{res} at 400 km and on the surface of the earth is presented below:

	Northern hemisphere						Southern hemisphere	
Longitude of epicenter of anomaly	$\bar{\lambda}$ = 102°		λ = 190°		λ = 270°		λ = 135°	
h in km	0	400	0	400	0	400	0	400
T_{res}	15300	11300	-2300	-1400	6100	8900	11200	8800

The lack of change in the position of the world anomalies when the distance from the surface of the earth is increased indicates the correctness of approximating their fields by radial dipoles located at great depths (MacNish, Rancorn, Aldridge, Pudovkin, et al.). The decrease in intensity of T_{res} at 400 km altitude corresponds to a location of the dipoles approximating the world anomalies at the boundary of the core or near it (at depths of 2000-4000 km), which confirms the evaluations of Aldridge, made using surface data alone.

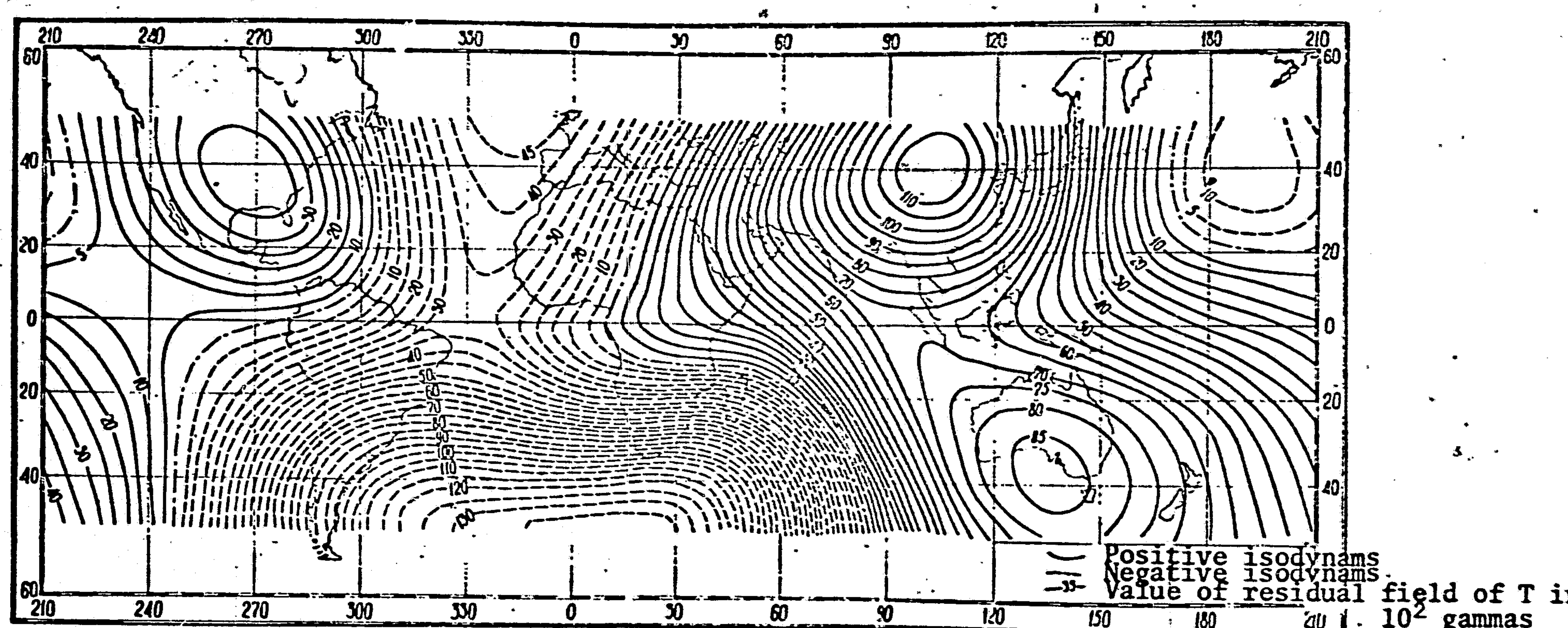
Positive isodynams
Negative isodynams
Value of residual field of T in 10^2 gammas

Figure 4

8. Spherical Analysis of Modulus T

The observations of modulus T made on the Cosmos-49 satellite were used to calculate the coefficients of spherical harmonic analysis by the method described in [5] and [6]. The analysis was performed for two samples of 4,000 measurement points each with a spherical harmonic series length n = 9 and m = 9 [7]. The mean square error in the reproduction of measured values of T was ±15 gamma, although in the polar areas the error would be greater.

The coefficients produced (see Table III) can be used for calculation of the field in near earth space or can be used as an analytical representation of the world magnetic maps and maps of the "normal" field, but cannot be used to give information on regional anomalies.

9. Personnel

The program, technical assignment for the experiment and technical assignment for development of the measuring apparatus were made up by Candidate of Physical and Mathematical Sciences Sh. Sh. Dolginov and Senior Engineer of the Magnetic Laboratory of IZMIRAN V. I. Nalivayko.

The magnetometric apparatus of Cosmos-49 was developed and prepared by the team of P.O. Box 244, Kiev, Sovnarkhoz, consisting of M. M. Chinchevoy, Zh. Dazhuk, E. A. Bulychev, G. V. Drov, B. G. Tavrovskiy, O. G. Nagasnik and T. Ya. Bezmen, under the leadership of M. M. Chinchevoy. Independent tests of the magnetometric apparatus, adjustment of the apparatus and geophysical correlation, as well as tests of all on-board equipment as assembled were performed by: M. M. Chinchevoy, V. I. Nalivayko, Sh. Sh. Dolginov and A. V. Tyurmin.

Decoding of satellite data and composition of the initial catalog of measured values of T correlated to absolute time were performed by a team at the Computations

Bureau of Box No. 2286 and by IZMIRAN, consisting of scientific workers R. Z. Brodskaya, G. N. Zlotyn, I. N. Kiknadze, A. R. Freydin and laboratory assistants: R. D. Kuznetsova, I. P. Ivchenko, N. Yu. Protenko, V. N. Fursenko, T. D. Grishina and A. K. Pozorova. Primary processing of the experimental data, the composition of this catalog and graph set were performed by teams from the Constant Field Laboratory, the Computations Department and Magnetic Laboratory of IZMIRAN consisting of scientific colleagues: N. V. Adam, L. O. Tyurmina, T. N. Cherevko, N. A. Zhuravleva, L. V. Konovalova, and laboratory assistants: Z. F. Agafonnikova, T. N. Baranova, V. V. Blinova, T. D. Grishina, L. V. Kurakova, I. P. Ivchenko, Ye. Ye. Kanonidi, A. I. Tereshchenko, L. I. Ulanova and O. A. Krutikhovskaya, under the leadership of Doctor of Physical and Mathematical Sciences N. P. Ben'kova.

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Table III. Coefficients Calculated from Measurements on Cosmos-49

n-m	g_n^m	h_n^m	n-m	g_n^m	h_n^m
I-0	-30362	-	7-0	+64	-
I-I	-2I49	+5707	7-I	-55	-73
2-0	-I625	-	7-2	+ 4	-27
2-I	+3000	-20I3	7-3	+ 3	-I4
2-2	+I552	+ 204	7-4	-I9	+I2
3-0	+I297	-	7-5	- 8	+3I
3-I	-2033	- 392	7-6	+I3	-I6
3-2	+I289	+ 264	7-7	-I0	-I3
3-3	+ 758	- 228	8-0	+I6	-
4-0	+ 976	-	8-I	+I0	+ 4
4-I	+ 8I4	+ I38	8-2	- 9	-22
4-2	+ 486	- 308	8-3	-I0	+ 2
4-3	- 388	- 2	8-4	- 6	-II
4-4	+ 266	- I74	8-5	+I8	- 2
5-0	- 242	-	8-6	+ 8	+26
5-I	+ 344	- 6	8-7	+I6	-I0
5-2	+ 262	+ I02	8-8	+ 8	- 8
5-3	- 5	- 99	9-0	0	-
5-4	- I74	- I06	9-I	+ 5	-3I
5-5	- 42	+ 52	9-2	+I2	+ 4
6-0	+ 62	-	9-3	-I4	+I3
6-I	+ 68	+ I8	9-4	+I0	- 2
6-2	+ 6	+ II2	9-5	+ 2	- 6
6-3	- 226	+ 76	9-6	0	+ 6
6-4	+ 2	- 58	9-7	+ 4	+ 9
6-5	- 20	+ 5	9-8	+ 4	- 2
6-6	- I60	- 30	9-9	+ 2	+ I

Note: Coefficients calculated for spheroidal earth.

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Part I

From No. 1 to No. 6205

Table

Distribution of Catalog Numbers by Dates and Instruments

Instrument I:	Date	Numbers of points	Time	Instrument II	Date	Point numbers	Time
	24/X	I-I90	07 I6-I3 42		24/X	I9I-352	07 I8- I3 44
	-	353-653	I3 44-20 I8		-	654-9I2	I5 44-20 I6
	24-25/X	9I3-II67	20 I8-02 52		24-25/X	II68-I437	20 I8- 02 50
	25/X	I438-I690	03 02-09 38		25/X	I69I-I945	02 54-09 38
		I946-22I6	09 38-I6 I2			22I7-2480	09 38-I6 I0
	-	248I-2703	I6 I6-22 46		-	2704-2898	I6 I2-22 42
	25-26/X	2900-3I48	23 02-05 I8		25-26/X	3I49-34I7	22 46-05 I8
	26/X	34I8-3599	05 20-09 52		26/X	3600-376I	05 20-09 52
	-	3762-40I3	II 56-I8 20		-	40I4-4247	II 56-I8 20
	26-27/X	4248-4443	00 30-05 40		27/X	4444-4637	00 30-05 38
	27/X	4638-4884	03 52-I5 20			4885-5I34	08 54-I5 26
		5I35-5396	I5 26-2I 50		-	5397-5645	I5 26-22 00
	27-28/X	5646-5927	2I 54-04 24		27-28/X	5928-6205	22 00-04 26

Instrument I 24 October

Point numbers	Time hr	min	Height in km			T^{γ}_{meas}	T^{γ}_{theor}	
c № I								
I	07	06	282,5	+21,24	I02,95	38402	38392	+ I0
2	07	06	287,I	+I8,07	I05,93	36962	36930	+ 32
3	07	20	292,2	+I4,86	I08,78	35794	35692	+I02
4	07	22	297,9	+II,6I	III,53	34922	3476I	+I60
5	07	22	304,I	+ 8,33	II4,2I	34476	34200	+276
6	07	24	3I0,8	+ 5,04	II6,84	34322	34037	+284
7	07	24	3I7,9	+ I,74	II9,43	34582	34275	+307
8	07	26	325,4	- I,55	I22,00	35I92	34880	+3II
9	07	26	333,3	- 4,83	I24,58	36II3	35802	+3II
I0	07	28	34I,5	- 8,I0	I27,I8	37255	36968	+286
II	07	30	358,5	-I4,53	I32,5I	39985	39730	+254
I2	07	30	367,3	-I7,68	I35,28	4I399	4II74	+225
I3	07	32	376,I	-20,77	I38,I5	4277I	4257I	+200
I4	07	34	385,0	-23,80	I4I,I5	44024	43868	+I55
I5	07	36	402,6	-29,59	I47,59	46I3I	4602I	+II0
I6	07	38	4I9,5	-34,94	I54,80	475II	47466	+ 44
I7	07	38	427,6	-37,4I	I58,76	47922	479I5	+ 7
I8	07	40	435,4	-39,7I	I62,98	48I48	48I89	- 4I
I9	07	40	442,7	-4I,82	I67,50	482I2	48296	- 85
20	07	42	449,7	-43,7I	I72,30	48I08	48246	-I39