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RESEARCH AID

GENERAL CRITIQUE OF SOVIET GRAVIMETRIC DATA WITH AN ANNOTATED BIBLIOGRAPHY

Supplement to CIA/RR-ER-1, GRAVIMETRIC DATA IN THE USSR



CIA/RR-ER-3
15 April 1954

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CENTRAL INTELLIGENCE AGENCY

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Office of Research and Reports

FOREWORD

This report is one of a series prepared for an external research project entitled "The Problem of Soviet Capabilities in Geodesy and Cartography," which was sponsored by the CIA as an element of the research program of the Geography Division, Office of Research and Reports.

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Knowledge of the status of Soviet developments in geodesy, photogrammetry, and cartography has been a recognized intelligence deficiency, and intelligence reports in these fields are extremely few in number and limited in topical coverage. The Project was therefore initiated to assess Soviet capabilities on the basis of a systematic study of all available published information on Soviet developments in geodesy, geodetic gravimetry, geodetic astronomy, geodetic and photogrammetric instrumentation, and cartography. The resulting reports are derived almost entirely from an extensive search for and an analysis of published Soviet scientific source materials.

The reports of the Project are designed not only to provide provisional information on the current status of Soviet capabilities in surveying and mapping but also to serve as a datum for a continuing program of collection and research that will in the future provide increasingly accurate and timely intelligence on this subject. The opinions and conclusions in this report, therefore, do not represent

final CIA evaluation of Soviet capabilities in surveying and mapping. Comments by users of the reports are solicited by the Geography Division. Other types of information resulting from the Project that do not lend themselves to publication are available for reference in the CIA Library. Among these are an extensive bibliographic file, a register of miscellaneous Soviet institutes and laboratories, and a biographic file.

This report (ER-3) supplements the bibliography included in Geodetic Gravimetry in the USSR, 18 October 1951, [REDACTED]

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[REDACTED] Part I of the report describes the deficiencies in the quantity and quality of available Soviet gravimetric data and problems related to their use for geodetic control. Part II is an annotated bibliography of available Soviet source material in which gravimetric data are given.

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Other publications [REDACTED]

[REDACTED] issued to date are:

Geodetic Gravimetry in the USSR, CIA/RR ER-1, 18 October 1951 (Series A, No. 1). SECRET

Deformation of the Crust of the Earth and Terrestrial Magnetism, CIA/RR ER-2, 18 October 1951 (Series B, No. 1). SECRET

Selected Bibliography of Soviet Studies in the Field of Cosmic Rays, CIA/SI 78-54, 2 March 1954. SECRET

PART I

ANALYSIS OF PROBLEMS IN THE USE OF SOVIET GRAVIMETRIC SOURCE MATERIAL

In view of the close connection between geodesy and gravimetry in the U.S.S.R., it was necessary to examine all available Soviet technical and scientific sources for gravimetric information. The actual data contained in these sources have not been used in reports of the Project since its objective is limited to an appraisal of Soviet developments in geodesy and related fields. In view of the general lack of adequate gravimetric data on the U.S.S.R., however, every effort was made to collect and record each item found in order to make gravimetric data on the U.S.S.R. readily accessible to interested US and allied agencies. Each item located was studied and analyzed for information relating to Soviet development in gravimetry. In addition, this analysis revealed attributes and characteristics about the quantity and quality of the data that are significant to any future program of reduction and adjustment. The treatment of gravity data on the U.S.S.R. will involve much preliminary work and careful consideration of the problems outlined below. An investigator taking Soviet source material at its face value is likely to start his work with incorrect or inconsistent data; in which case the final result will be incorrect, no matter how good his mathematical technique may be. It is hoped, therefore, that these comments and bibliography will facilitate the proper use of Soviet gravimetric data.

(a) The subject of gravimetry, because of its close connection with geodesy, is considered by the Soviets to be of a defense nature, and all precautions are taken not to allow actual data on gravimetric

measures to leave the country. The actual number of pendulum observations reduced on one system* and utilized in a 1952 study (Z28) totals over 18,000 in number. The entire program, initiated in 1932, was set up to get at least one pendulum observation per 1,000 sq. km., a total of some 23,000 observations. The results of individual expeditions, which were published freely before 1935, have not been published since that date in open literature. In source Z27, for instance, the positions (often drifting vessels and floes) in the Arctic where gravimetric observations were made are given but not the measures themselves.

From time to time, the Soviets issue specific catalogues of gravimetric measures. One of these (G24), containing 532 determinations, is largely obsolete. Another catalogue (K46) contains a total of 2,716 observations made up to the year 1933. Neither of these catalogues was at first available in the United States but was found elsewhere and is now in hand. Still another catalogue, published in 1945, is reported to contain about 10,000 gravity determinations, but it is not available at present.

The best, or at least the most complete, source of information currently available is a catalogue by Zhuravlev (Z30). This is not an official catalogue, being, in fact, only an appendix to the author's essay on the shape of the earth. This source contains 10,712 measures of gravity determined on the surface of the earth up to 1937. About 7,000 of the measures fall within the U.S.S.R. territorial limits.

A comparison of Z30 with K46 at once gives rise to misgivings. The two catalogues often show differences amounting to 2 or 3 milligals

*As far as we know, it is still Potsdam.

in the value of observed g in addition to frequent misprints and poor typography. ** General agreement between the two catalogues, of course, is to be expected, since K46 was supposedly incorporated in Z30.

(b) In view of frequent mistakes and misprints in Soviet catalogues, it is desirable to verify catalogue entries from original sources wherever possible. These sources refer mostly to the period before 1935, but they have the advantage of giving locations much more precisely than in the catalogues and detailed descriptions of procedure. The verification introduces considerable difficulty, since practically all sources give values of observed g that differ from the catalogues. This difference is usually of a systematic character, but its amount often varies very widely. A few such examples are as follows:

<u>Source</u>	<u>Source Z30 Difference in g</u>	<u>Remarks</u>	<u>No. of Determinations</u>	<u>Year</u>
N33	+5 milligals	Constant	14	1928
A17	-20	From -5 to -29	22	1928
B13	-14	From -11 to -18	84	1932
V2	-12	From -10 to -18	50	1933
Y9	-14	From -10 to -22	84	1948

The last item (Y9) deserves special attention. It gives Δg (free-air) rather than g , with a statement that it was derived from the new catalogue of gravimetric data published in 1945.

It is therefore evident that the values of g or Δg given in source Z30 should be treated with considerable caution, that a comparison with other sources should be made (this can be done with about

**On page 86, for instance, the right half of the entries were moved up one line in reference to the left half. The printing was done during World War II.

3,000 determinations), and that the causes of discrepancy should be adequately explained.

In the more recent sources, gravity values (or Δg) are sometimes given to illustrate some point of theory. These data are often based on the most recent, and presumably more reliable, determinations (e.g., source G39 of 1952). From such sources, some 400 gravity data can be collected that are not included in source Z30.

(c) Another source of information concerning the gravity field of the U.S.S.R. comprises the gravimetric maps and profiles often printed in more recent publications. These are indicated in Part II if they are to be found in the original paper (ER-1). Some of the maps give not only iso-anomaly curves but also the values of anomalies for points of observation not to be found in the available catalogues. Such a map, for instance, is in source M45 of 1948. Over 200 maps and profiles have been found, most of which cover the area south and west of the line Leningrad-Moscow-Irkutsk. This material, if critically examined and reduced to one system and one kind of anomaly, should give a fairly accurate gravity map of the region indicated, but the amount of work involved will be very substantial.

Soviet gravimetrists themselves are aware of uncertainties introduced by the use of different gravity formulas for reduction. In source Z7 Zagrebin warns of the confusion caused by the use in recent Soviet sources of both the Helmert formula (1901-1909) and the International formula. This raises difficulties particularly in the use of Soviet gravity maps, which do not always indicate the formula used in the reduction.

Finally, in view of complete lack of gravity data for the north-east section of Siberia, the appearance of source Z28 of 1952 should be especially welcome. This source gives the average free-air anomalies for sectors of 100 square degrees each for the entire world, including Siberia. At least some idea of the gravity field in northeastern Siberia can thus be obtained.

Part II of this report lists 408 Soviet gravimetric sources located in this country up to September 1, 1953. Each item has been examined
25X1A5a1 [redacted] and, if the original was not readily available, it has been recorded on microfilm. In some cases photostats were made, either from the original material (series R) or from the microfilm (series P). Since the work was carried out at the
25X1A5a1 [redacted] references are to catalogue numbers there. If the materials were found
25X1A5a1 [redacted] no further attempt was made to locate them elsewhere. In some cases, no library source is indicated, which means that the material in question was received through the CIA. Libraries most
25X1A5a1 frequently mentioned are the Library of Congress; [redacted] and the Army Map Service.

The material has been arranged alphabetically according to the surnames of the authors transliterated according to the BGN system, which differs somewhat from the LC system. Under each letter of the alphabet the entries are numbered consecutively.

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*For key to abbreviations used throughout the bibliography see p. 95.

**If no Library of Congress Call No. is given, the source was not catalogued when received [REDACTED]

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p. 330 N.W. European Russia; contour interval 10 mlg. (same as A16)
p. 343 Profile Kamyshbosh-Gava (Fergana Valley)
p. 352 Region North of Caspian Sea 45°-54°N; 43°-60°E; contour interval 10 mlg.
p. 355 Emba Region 46°15'-48°N; 52°30'-53°45'E; contour interval 4 mlg.
p. 367 Profile Allaguvatovo-Ishimbayevo-Smokayevo
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Several maps of gravity anomalies (Bouger) are given, which vary from +30 to -90 mlg.
Area covered: 48° - 51°30'N; 22°-26°E.
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Three anomaly profiles.

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Examples in text:
p. 322: Tsioris-Tskhali 41°37'6N, 49°59'6 E, h 267 met.
g = 980.142. Isostatic reduction of this point. This is 27954
p. 329: 6 groups of 71 stations in Caucasus, various corrections.
p. 337: Gravity anomalies in Baku region 38° - 42° N, 47° - 50° E.
given on map 1:100,000. Description p. 351, Contour intervals 25 mlg.
p. 336: Gravity anomalies in Moscow region 54°50' - 57°10' N, 36° - 39° E.
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N.N. Pariyskiy determined for the gosudarstvennyy Astronomicheskii Institut im. Shternberga in 1935 $g = 981.559.1 \pm 0.74$
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No data in this article.

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- | | | | |
|---------|---------|-----------|---------|
| Yakutsk | 982.047 | Isit' | 981.927 |
| Ust'Kut | 981.513 | Olekminsk | 981.881 |

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I order m.e. less than 1 mlg. II order less than 2 mlg. Gravimeters of
Melodenaskiy and Norgaard used. For Kiyev Observatory $g = 981.072.3 \pm 0.78$.

△g Moscow Airport - Gos. Astr. Inst. Shteynb.	-28.1. ± 0.20 mlg.
Poltava " - Observatory	+ 1.1 ± 0.16
Kiyev " - Observatory	+ 3.9 ± 0.18

First order points at present: Pulkovo, Moscow, Kazan', Poltava, Tbilisi
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DLC: AS262.A62 Library Call Number at the Library of Congress; all other prefixes (corresponding to "DLC") are those used in the Union List of Serials.

AMS Army Map Service

CGS U. S. Coast and Geodetic Survey
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