Handbook of the Radiation Regime of the Arctic Basin

(Results from the Drift Stations)

by M.S. Marshunova and A.A. Mishin

edited by V.F. Radionov and R. Colony

Technical Report
APL-UW TR 9413
December 1994

Handbook of the Radiation Regime of the Arctic Basin
(Results from the Drift Stations)

by M.S. Marshunova and A.A. Mishin

edited by V.F. Radionov and R. Colony

Accesion For	
NTIS CRA&I	☑
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and / or Special
A-1	

Technical Report
APL-UW TR 9413
December 1994

Applied Physics Laboratory University of Washington
1013 NE 40th Street Seattle, Washington 98105-6698

М. С. МАРШУНОВА, А. А. МИШИН

СПРАВОЧНИК

по радиационному режиму Арктического бассейна

(дрейфующие станции)

Под редакцией В. Ф. Радионова

Санкт-Петербург Гидрометеоиздат 1994

Originally published in Russian in Saint Petersburg, 1994, by Gidrometeoizdat.
Translation by T.C. Grenfell. Translator's notes are in square brackets, [ ].

This Handbook summarizes the radiation data from the Soviet "North Pole" drifting research stations operated in the Arctic from 1950 to 1991. The Handbook contains reduced mean monthly values of the fluxes of solar radiation for solar elevations up to 35° at 5° intervals, monthly totals of the net radiation and its constituents, and mean monthly values of the albedo of the sea-ice surfaces.

The Handbook presents information of interest to specialists studying the physics of the atmosphere, climatology, geography, and related disciplines.

Arctic and Antarctic Research
Institute (AARI) 1994

M. S. Marshunova, A. A. Mishin

Handbook
on the Radiation Regime of the Arctic Basin
(from the Drifting Stations)

Printed [in Russian] 18 February 1994. Format 60 x 84/16. Offset paper and printing. 400 copies printed. Index MOL-40. Order 219. Hydrometeorological Publishing House, 199397, St. Petersburg, V. O., 38 Bering Street, FOP, 249020, Obninsk, 6 Korolev Street.

TABLE OF CONTENTS

LIST OF TABLES

FOREWORD

This Handbook, the first of its kind, summarizes the many years of radiation observations made from drifting Soviet research stations in the Arctic Basin. It is based on the observational data obtained at all the North Pole (NP) drifting stations, which are stored in the archives of the Arctic and Antarctic Research Institute (AARI). Observational data for all periods of station operations up to 1991 are included.

The tables of data in this Handbook are arranged in three parts. The first, Tables 1–10, contains auxiliary information and multiyear data on the solar radiation fluxes and the net radiation for every 5° of solar elevation up to 35°. The second, Tables 11–17, contains mean monthly totals of solar radiation and net radiation presented on a standard latitude-longitude grid. The third, Tables 18–23, presents monthly totals of solar radiation and the net radiation for the various years for each station.

The Handbook has been prepared at the Department of Meteorology of AARI under the general direction of Dr. M. S. Marshunova, Candidate of Geographic Sciences. Primary reduction of the radiation observations made at the NP stations was conducted by the Scientific Methods Department of AARI. Climatological reduction and analysis of the observations were carried out at the Department of Meteorology. Research assistant Yu. Ye. Pimanova and Engineer V. A. Shirokova took part in the analysis and preparation of the observational data for publication.

Financial support for the preparation and publication of the handbook was provided by the Russian Ministry of Science and Technology. This work was carried out under the auspices of the scientific program "Investigations of the natural environment of the polar regions."

INTRODUCTION

This Handbook contains long-term data on fluxes of direct solar radiation (S, S´), diffuse solar radiation (D), and total solar radiation (Q) and on the albedo (A_k,%) and net radiation (B) at the sea-ice surface. Long-term mean values have been obtained by averaging the observations made from the North Pole (NP) drifting stations NP-2 to NP-31 from 1950 to 1991. [See list of symbols, abbreviations, and definitions for more complete definitions of the radiation terms.]

The first radiation measurements over the Arctic sea ice were carried out in a region near the pole of inaccessibility in April 1941 [1]. In 1950, regular year-round observations began at the NP drifting stations using the same measurement methods used at the coastal polar stations.

The standard set of radiation observations includes measurements at fixed intervals of the fluxes of direct, diffuse, and total radiation, of net radiation, of reflected radiation (or albedo), and the net radiation of the surface. All measurements of the radiation fluxes were accompanied by the determination of solar elevation and detailed meteorological characteristics. Measurements of the radiation fluxes were taken from four to eight times daily; measurements were always taken at noon and midnight local solar time, with the remaining measurements distributed evenly between noon and midnight.

In addition, global radiation was measured continuously at all drift stations and, beginning in 1965, the diffuse and reflected radiation and net radiation were also measured. As a result, hourly totals were obtained. Daily, monthly, and yearly sums were based on the hourly totals. When radiation data were missing, 24-hour totals for the missing elements were evaluated from the existing data by linear interpolation to the beginning of each hour in the missing intervals.

The radiation observation sites were chosen so that the sea-ice surface was characteristic of most of the floe and so that the sites would not be flooded during the summer snow melt. Observations were carried out regularly one to two times each month to study the sea-ice albedo in the region around the station. In certain years, the net radiation was also sampled over a spatial grid in the vicinity of the station. During the summer melt season, the number of these spatial sampling observations was increased to five or six times per month.

The following standard thermoelectric instruments were used to obtain the radiation values: AT-50 Pyrheliometers, M-80 Pyranometers (or GP 3×3 pyranometer sensor heads), and M-10 radiation balance meters. GSA-1 galvanometers were used to record the signal voltages. In recent years PP-63-type portable recorders were also used. Until 1965 the data recording was carried out using disk galvanometers or recording millivoltmeters. In 1959, the EPP-09 multichannel electronic potentiometer was used for the first time to record total and scattered radiation. After 1965 the potentiometer was adapted for continuous recording of the total, scattered, and reflected radiation as well as the net radiation.

In 1970 significant modifications were made to allow continuous automatic recording of all elements of the net radiation, except for direct solar radiation. Because of the lack of a suitable guidance system, the direct radiation was recorded for a few minutes at defined intervals four times a day. The transfer from manual to automatic recording was accomplished following a series of parallel measurements and special systematic investigations that made it possible to choose the appropriate method of reducing the recording charts, to select the format of the presentation of the observational materials, and to provide homogeneity of the series of observations. To check the calibration of the recorded data, comparative observations were made using supplementary instruments.

All the thermoelectric sensors were calibrated at the Central Calibration Bureau before and after deployment at the drift stations. During the drift both the regular and comparative observations were calibrated periodically against a standard actinometer (during the day) or a radiation balance meter (at night). This procedure ensured the reliability of all the components of the shortwave radiation (S, S´, D, and Q). The measured longwave radiation and radiation balance data were less precise because of significant systematic errors (up to 30%) in the measurements made with the radiation balance meters.

All aspects of the recording, reduction, and calibration of the observations were carried out in accordance with the standard manual [2], operational methods, and instructions specified by AARI.

The tables in Part I of this Handbook include long-term mean values and the extremes of the radiation fluxes for different solar elevations at 5° intervals up to 35° obtained under various degrees of cloudiness from 1950 through 1991 (Tables 4–10). The tables were compiled independently of station location and of whether the observations were made before or after noon. This was based on a preliminary analysis of the data that showed no significant differences between the radiation fluxes measured in the morning and in the afternoon and no detectable dependence on the geographic location within the region of the Arctic Basin under consideration. The standard deviations (σ) for clear conditions and for complete cloudiness are listed along with the mean values of the radiation fluxes.

The tables in Part II (Tables 11–17) present the monthly totals of direct and global solar radiation plus the net radiation for points on a standard latitude-longitude grid. Values have been compiled for each component on the basis of long-term observations at the drifting stations and at land stations on the coast and islands.

The tables in Part III (Tables 18–23) contain monthly totals of direct, diffuse, total, and absorbed solar radiation plus the albedo and net radiation of the sea-ice surface for each year for each drift station.

All values of radiation fluxes in this Handbook are expressed in watts per square meter. Monthly and yearly radiation totals are expressed in megajoules per square meter.

SYMBOLS, ABBREVIATIONS, AND DEFINITIONS

S	Direct solar radiation flux at the surface on a plane perpendicular to the solar beam
S´	Direct solar radiation incident on a horizontal surface [direct solar radiation component of the incident flux]
D	Diffuse radiation flux [diffuse shortwave component of the incident radiation flux]
Q	Global radiation flux [Q = S´ + D, total incident shortwave radiation flux]
A	Albedo of the sea-ice surface [total upwelling shortwave radiation flux just above the surface divided by Q]
B	Net radiation [net radiative energy flux at the surface including both shortwave and longwave radiation]
B_k	Net shortwave radiation [flux] ([shortwave] radiation absorbed [by the ice and ocean])
$h_{\odot}$	Solar elevation
p. d.	Polar day (24-hour daylight)
p. n.	Polar night (24-hour darkness)
-	Data rejected or not obtained owing to technical difficulties.

The degree of obscuration of the solar disk by clouds is indicated by the following symbols:

$\odot^2$	The solar disk and a 5° zone around it free of clouds
$\odot$	Direct sunlight penetrates through the clouds, objects cast distinct shadows
$\odot^{\circ}$	Direct sunlight penetrates weakly through the clouds, shadows not distinguishable
P	Direct sunlight does not penetrate the clouds [solar disk not visible].

THE RADIATION REGIME

The parameters of the radiation regime over the Arctic Ocean have been obtained primarily from observational radiation data taken on the NP drifting stations and to a lesser extent from observations on scientific cruises operating principally in the northern Atlantic Ocean [3].

This accumulation of radiation observations makes it possible to evaluate the role of the various factors that contribute to the radiation regime of the surface, to specify more precisely mean characteristics obtained previously, and to study the spatial and temporal variability of the individual elements of the radiation.

The first summaries of the observational data obtained from the drifting stations [1, 4–10] showed that the radiation conditions in the Arctic Basin possess distinctive features compared to all other regions on Earth. These are a result of the homogeneity of the sea-ice surface and are characterized by the high values of albedo throughout the year, by the high transparency of the atmosphere, by the structure of the atmosphere, and by the cloudiness.

Since the region under consideration is located north of the Arctic Circle, there are periods of 24-hour daylight (polar day) and 24-hour darkness (polar night) (see Table 1). As a result, the incoming radiation varies greatly over a year.

The noontime elevation of the sun always decreases steadily with increasing latitude, but its elevation at midnight during the period of the polar day increases (see Table 2). As a result, the daily mean elevation of the sun during the polar day stays about the same. This governs the essential effect of solar elevation on the geographical distribution of daily and monthly radiation totals.

Direct Solar Radiation

The direct solar radiation flux (S) measured under clear skies (Table 5) characterizes the transparency of the atmosphere. For a particular solar elevation, the direct solar radiation flux and, consequently, the transparency of the atmosphere are almost constant throughout the season. Only during the spring is a small decrease observed. The day-to-day variability in S during the course of a year is not great but decreases somewhat from spring to summer. For a solar elevation of 10°, for example, σ is 20% of the mean value in March–April but decreases to 12% in July–August. At $h_{\odot}$ = 30°, the variability decreases to 4–5%.

Table 5 presents all the reduced radiation flux data except for the period 1964–1965 and for 1983, when the eruption of the Mt. Agung and El-Chichon volcanoes caused anomalous decreases in atmospheric transparency. The atmospheric transparency is determined by moisture and aerosol content. We define ΔS_{Re} as the decrease in the solar radiation for an ideal atmosphere [i.e., one with no aerosols or water vapor]. We assume ΔS_{Re} = 230 W/m^2 for h = 30° and calculate the decrease in solar radiation due to extinction by water vapor (ΔS_{H_2O}). Then, following Ref. 11, we obtain the aerosol component (ΔS_{aer}) of the extinction of the radiation. Results for the Arctic Basin are presented in Table A.

Table A. Components of the weakening of solar radiation in the Arctic Basin (in W/m²) for a solar elevation of 30° [$\Delta S = \Delta S_{Re} + \Delta S_{H_2 0} + \Delta S_{aer}$]

Component	Mar	Apr	May	Jun	Jul	Aug	Sep
ΔS	544	544	524	496	496	475	475
$\Delta S_{H_2 0}$	105	105	126	147	154	147	133
ΔS_{aer}	209	209	168	119	112	98	112

According to this table, the greatest absorption by water vapor occurs from June to August when the humidity content of the atmosphere is greatest. Between March and July, the extinction increases by a factor of 1.5. The aerosol component, on the other hand, is twice as large in the cold period as in the warm period. Production of aerosol in the polar regions is due primarily to condensation and sublimation of water vapor. As a result, the relative atmospheric aerosol content is greatest in the cold half of the year when the air is closest to saturation. Only in the warmest months does the decrease in radiation flux due to water vapor surpass that due to aerosols. This can explain the large variability in the direct solar radiation in the spring months, since the variability due to the aerosol component of the atmosphere is considerably greater than that due to water vapor.

In 1964, during the period of maximum decrease of the atmospheric transparency [April–May], ΔS_{aer} in the Arctic Basin reached 314 W/m^2 as a result of aerosol mixing into the atmosphere after the eruption of the Mt. Agung volcano. This was 1.5 times greater than the long-term average

The spatial distribution of the monthly values of direct solar radiation (Table 11) in spring and fall is defined by different durations of sunlight; i.e., with increasing latitude the radiation decreases. The influence of cloudiness in these seasons is purely zonal in character. During the polar day, when the influence of astronomical factors is small, the radiation field is specified by the cloud cover. The maximum in the mean monthly total of direct solar radiation is observed not in June, when the length of the day and the solar elevation are at their maximum, but in May, because the cloudiness is 1 to 2 tenths less than in June.

Diffuse Radiation

The magnitude of the diffuse radiation flux [D] depends on the solar elevation, the amount and type of clouds, the transparency of the atmosphere, and the reflectivity of the surface. The greatest values of diffuse radiation are observed for low- and mid-level clouds, which is also true for the global radiation. In the Arctic Basin, because of the particular properties of the cloudiness and of the surface, the greatest part of the total radiation consists of scattered radiation.

A characteristic property of the spatial distribution of the diffuse radiation is its regional homogeneity. Only in March and October do the monthly totals of diffuse radiation show a weak latitude dependence (Table 13).

It is characteristic of the Arctic Basin for the monthly totals of diffuse radiation to exceed the totals of direct radiation on a horizontal plane throughout the year. The maximum monthly total of diffuse radiation is always observed in June when the solar elevation is greatest.

Global Radiation

The global radiation is regulated by the transparency of the atmosphere, by the amount and type of clouds, and to some extent by the properties of the sea-ice surface. In the Arctic Basin, fluctuations in the atmospheric transparency, connected with changes in the aerosols, have little influence on the total incoming radiation, since in the presence of a snow cover the decrease in direct radiation is compensated for by an increase in scattered radiation as a result of multiple reflections [between the clouds and the surface]. Even in 1964 the global radiation did not decrease compared with the long-term mean values.

Analysis of the global radiation flux for different cloud conditions (Tables 6 and 7) shows that, for a complete overcast of any type, the global radiation flux decreases compared with that for cloud-free skies. This decrease is greatest for low-level cloudiness (Table 7). Low- and mid-level cloudiness in the Arctic Basin produces a strong seasonal dependence in the weakening of the radiation. This is related to the changes in the properties of the clouds: in the cold part of the year the clouds are more transparent because of their lower water content, reduced thickness, and different phase state. The standard deviations of the global radiation, presented in Tables 6 and 7, also characterize the decrease in the radiation flux caused by the variability of the cloud cover.

It is evident that in the winter the variability of the radiation is less for low-level clouds than for mid- or even high-level clouds. Clearly this characteristic feature of the Arctic Basin is connected with the conditions of formation of each type of cloud in that region. In the Arctic Basin in the winter, there is a strong tendency for single-level cloudiness below the atmospheric inversion. Under these conditions, the radiative properties are stable.

The spatial distribution of monthly values of global radiation (Table 12), just as for direct radiation, is determined in spring and fall by astronomical factors and during the polar day by the cloud conditions. Thus, from May to August the minimum radiation is observed in regions adjacent to the Barents and Norwegian Seas, i.e., in regions of greatest cloudiness. During this period, the total radiation is greater over the Arctic pack ice than over other regions because of multiple surface reflections [between the surface and the clouds].

The cloudiness significantly decreases the amount of incoming direct solar radiation compared with the maximum possible values (Table 17), especially in the summer and fall. The yearly total of direct incoming solar radiation amounts to 25–30% of the maximum possible value. At the same time, the cloudiness increases the scattered radiation 1.5 to 2.0 times (Table 13). As a result, the yearly global radiation is 70% of the maximum possible value for Arctic cloud conditions. The maximum monthly totals of global radiation are always observed in June.

Because of this dependence on cloudiness, the correlation between direct and diffuse radiation and the general amount of global radiation can be significantly different from the mean values presented in Tables 11–17.

Albedo

The reflectivity (albedo) of the sea-ice surface in the Arctic Basin has been determined from meteorological observations at each station. There are some seasons in which these data are not sufficiently representative of the surrounding region. The most difficult to characterize is the monthly average albedo of the surface during intensive melting of the snow and the upper layers of the ice when numerous melt ponds appear [7]. For different surface types, the albedo varies over comparatively narrow limits (Table B), whereas for the Arctic Basin as a whole the albedo varies from 10% in leads to 90% over snow surfaces. The highest albedo is found for freshly fallen snow. An albedo less than 70% is characteristic of melting snow.

Table B. Albedo of various surfaces in the Arctic Basin.

Surface	Albedo, %	Surface	Albedo, %
Fresh dry snow	80–90	Melt Ponds	30–40
Melting snow	60–70	Open Water	10–20
Dry (Drained) Ice	50–60		

The snow-free period in the Arctic Basin is very short, and only from June to August is the average albedo less than 80% (Table C).

Table C. Mean and extreme monthly values of albedo and their standard deviations, in %.

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Average	84	81	82	77	60	67	82	81
Maximum	90	86	87	86	80	82	88	90
Minimum	75	75	74	60	46	54	73	80
Std. Dev.	4	3	3	6	8	8	4	3

The variability of the monthly values of albedo in the period with a stable snow cover is very small—the standard deviation is 3 to 5%; but in July and August the standard deviation increases to 8% (Table C). Extreme values of albedo in the melt period can vary by 30%. Thus, in years when there is intensive melting, the albedo in July and August can decrease to 50% or less. This occurs primarily in years of greatest incident radiation. Thus in July 1978 when the monthly mean albedo was 46%, the direct solar radiation was the maximum for the whole observation period, 44 MJ/(m^2/month). This exceeds by almost a factor of two the maximum radiation values for other years. In years when melting did not occur, the albedo in July and August stayed at 80–82%. Under these circumstances, the incident direct solar radiation was usually reduced.

According to the long-term observations, there is no significant correlation between albedo and direct solar radiation. The coefficient of correlation for July is only 0.42 and for August 0.49.

Net Radiation

The net radiation, measured on drifting stations using thermoelectric balance meters [net radiometers], contains systematic errors. Consequently, a correction in the longwave portion of the net radiation was introduced for all values [9]. Over the period of stable snow cover, the net radiation is higher for overcast skies than for clear skies at every solar elevation (Tables 5, 8, and 9). In July and August during the melt period, this is true for $h_\odot \leq 15°$, but for higher solar elevations the net radiation for clear skies becomes greater than that for overcast skies. The change of sign of the net radiation for clear skies occurs when the snow cover is stable and the solar elevation is from 15° to 20°. During the melt period, this occurs for $h_\odot = 10°$ to 15°. For overcast skies, the net radiation is positive for $h_\odot > 15°$.

The variability of the net radiation is quite large under all conditions. For clear skies, the standard deviations are 20–50% of the mean values; for complete overcast, the standard deviations can be of the same order as the mean value.

Monthly values of the net radiation, which is determined by the incoming and outgoing radiation fluxes and by the absorption and emission by the Earth's surface, are a function of a large set of physical, geophysical, and hydrometeorological factors. The relative influence of these factors on the net radiation varies from season to season.

From October to March, during the polar night when the incident radiation is small, the net radiation results only from the longwave radiation, which depends on the temperature of the air and the sea-ice surface, on the stratification of the atmosphere, and on the cloudiness. During these months, the mean values of the net radiation are negative and vary from about –50 to –90 MJ/m^2, depending on the atmospheric stratification and cloudiness (Table 16). The lowest values of net radiation in winter occur over open-water surfaces, i.e., leads and polynyas, where heat losses are 2 to 3 times larger than over areas completely covered by ice.

In April and September, the net radiation is very close to zero; only over the 4 months of May through August is it positive. The values of the yearly net radiation cover a large range: from close to zero at the ice edge to 140 MJ/m^2 near the pole. Long-term observations on the drifting stations show that the net radiation for the year may stay positive in years when there is intense melting in July and August and the albedo of different parts of the surface decreases to 50 or 60%.

The lowest yearly values of the net radiation are obtained when the cloudiness in winter is very weak and there is almost complete cloud cover in summer (for example, at station NP-6 in 1957 and NP-16 in 1970; see Table 23). A comparison of the data in Tables 16 and 17 shows that the net radiation is higher for mean cloud conditions of 3–4 tenths in winter and 9–9.5 tenths in summer and fall than for clear skies throughout almost the entire year. In winter (from December to March), when the net radiation is determined by the surface emissivity [i.e., consists primarily of longwave radiation], cloudiness decreases the heat loss by 10–40%. If the cloudiness increases to 9–9.5 tenths from September to November, the net radiation becomes 2–4 times higher than for clear skies. In contrast, an increase in cloudiness in summer produces only a small change in net radiation, since both the global radiation and the net radiation decrease. The yearly totals of the mean monthly values of the net radiation are 2–4 times higher than the monthly values for cloudless skies.

All of the data presented have been obtained over pack ice and are characteristic only of that surface type. For areas of open water within the ice, the net radiation would be different.

REFERENCES

1. Chernigovskiy, N. T., Actinometric observations, in *Expeditions of the USSR-N-169 Aircraft in the Vicinity of the Pole of Inaccessibility*, Moscow-Leningrad, 1946, pp. 155–161 (in Russian).

2. *Manual on Radiation Observations for Hydrometeorological Stations,* Leningrad: Gidrometeoizdat, 1971, 220 pages (in Russian).

3. *The Radiation Regime of the Greenland and Norwegian Seas*, Leningrad: Gidrometeoizdat, 1989, 62 pages (in Russian).

4. Andreeva, N. N., and B.A. Pyatnenkov, Some features of the radiation balance in the central Arctic, in *Problems of the Arctic and Antarctic*, Issue 7, Leningrad, 1959, pp. 79–90 (in Russian).

5. Gaevskiy, V. L., On some features of the radiation regime of the central Arctic, *Transactions of AARI, 226,* 142–150, 1959 (in Russian).

6. Marshunova, M. S., Basic principles of the radiation balance of the surface and of the atmosphere in the Arctic, *Transactions of AARI, 229*, 5–53, 1961 (in Russian).

7. Nazintsev, Yu. L., The surface heat balance of the old ice cover in the Central Arctic, *Transactions of AARI, 267*, 110–126, 1964 (in Russian).

8. Chernigovskiy, N. T., Some characteristics of the radiation regime of the Central Arctic, *Transactions of AARI, 229,* 54–83, 1961 (in Russian).

9. Chernigovskiy, N. T., and M. S. Marshunova, *The Climate of the Soviet Arctic (The Radiation Regime)*, Leningrad: Gidrometeoizdat, 1965,198 pages (in Russian).

10. Yakovlev, G. I., The radiation regime of the central Arctic, *Transactions of AARI, 207*, 1957, 115 pages (in Russian).

11. Zvereva, S. V., On the extinction of solar radiation in the polar regions, *Transactions of AARI, 287*, 171–187 1969 (in Russian).

EXPLANATION OF THE TABLES

PART I. Solar Radiation and Net Radiation

Table 1. Data on the beginning and end of the polar day and the polar night

This table contains the dates of the beginning and end of the polar day and the polar night calculated for the upper limb of the solar disk, taking into account its angular dimensions and refraction ($h_{\odot} = -50'$).

Table 2. Solar elevation at noon and midnight on the 15th day of each month, degrees

This table gives the elevation above the horizon for local noon and midnight on the 15th day of the month (on the 14th for February) for latitudes from 70°N to 90°N. The values are calculated from the following formulae:

$$h_{\odot\,\text{noon}} = 90 - \varphi - \delta$$

$$h_{\odot\,\text{midnight}} = \varphi + \delta - 90,$$

where φ is the latitude and δ is the declination of the sun on the 15th day of the month.

Table 3. Times of sunrise (R) and sunset (S) on the 15th day of each month (mean solar time, hr:min)

This table presents the times of sunrise and sunset on the 15th day of each month (on the 14th for February) in mean solar time for latitudes from 70°N to 88°N. Sunrise (or sunset) is taken to be the moment when the upper limb of the solar disk appears above (or disappears below) the horizon. The calculations are carried out using the angular radius of the sun (16´) and the refraction angle (34´) via the formula

$$\sin h_{\odot} = \sin\varphi \sin\delta + \cos\varphi \cos\delta \cos\tau$$

for $h_{\odot\,\text{noon}} = -50'$ [where τ is the time].

Table 4. Mean monthly values of the radiation fluxes, W/m^2

This table presents mean values of the solar radiation fluxes S, S´, D, Q, and B for solar elevations up to 35° at intervals of 5°. The values are an average over every period of drifting-station operation except 1964, 1965, and 1983. Because of an anomalous decrease in the transparency of the atmosphere in those years as a result of increased volcanic activity, the magnitudes of S and S´ showed significant decreases and the value of D was anomalously large.

The values of the radiation fluxes presented in this table are characteristic of mean cloud conditions. For individual years, mean monthly values of the radiation fluxes may be different from the values presented here because of their dependence on cloudiness.

Table 5. Mean monthly values of the radiation fluxes for clear skies and their standard deviations, W/m^2

This table gives mean values and standard deviations of the radiation fluxes and of the net radiation for total cloudiness of less than 2 tenths with the solar disk unobscured by clouds ($\odot^2$) for solar elevations up to 35° at intervals of 5°. Data for the fluxes S, S′, and D have been averaged over all radiation observations at the drifting stations with the exception of 1964, 1965, and 1983 (see the explanation for Table 4). The data presented in the table represent the highest values of direct radiation, total radiation, and net radiation and the lowest values of diffuse radiation for the mean atmospheric transparency. This does not exclude the possibility that on individual days for certain cloud conditions the flux values of Q and B can be greater than for clear skies.

Table 6. Mean monthly values of the global solar radiation flux (Q) and their standard deviations (σ) for general overcast, W/m^2

This table presents mean values and standard deviations of the total radiation flux for general conditions of overcast (0 to 10 tenths, solar visibility $\odot^2$ to P [see page 3]). for solar elevations up to 35° at intervals of 5°. Data from all periods of radiation observations on the drifting stations have been included in the average.

Table 7. Mean monthly values of the global solar radiation flux (Q) and their standard deviations (σ) for complete low-level overcast, W/m^2

This table presents mean values and standard deviations of the total radiation flux under conditions of complete lower-level overcast (10 tenths, P) for solar elevations up to 35° at intervals of 5°. Data from all periods of radiation observations on the drifting stations have been included in the average.

Table 8. Mean monthly values of the net radiation (B) and their standard deviations (σ) for general overcast conditions, W/m^2

This table gives the mean values and standard deviations of the net radiation for conditions of general overcast (0 to 10 tenths, solar visibility $\odot^2$ to P) for solar elevations up to 35° at intervals of 5°. Data from all periods of radiation observations at the drifting stations have been included in the average.

Table 9. Mean monthly values of the net radiation (B) and their standard deviations (σ) for complete low-level overcast, W/m^2

This table presents the mean values and standard deviations of the net radiation for conditions of complete lower-level overcast (10 tenths, solar visibility P) for solar elevations up to 35° at intervals of 5°. Data from all periods of radiation observations at the drifting stations have been included in the average.

Table 10. Extreme values of the radiation fluxes, W/m^2

This table gives the maximum values of the fluxes S, S′, D, Q, and B and the minimum values of the fluxes D, Q, and B, chosen from the unaveraged observations for all periods of drift-station operation for solar elevations up to 35° at intervals of 5°. The values of D for 1964–65 and 1983 have been included in defining the maximum (see the explanation for Table 4). Minimum values for S and S′ are not reported since they equal zero.

PART II. Mean Monthly and Yearly Totals of Radiation at Intersections of the Coordinate Grid

Table 11. Mean monthly and yearly totals of direct solar radiation received on a horizontal plane, MJ/m^2

This table presents the mean monthly totals of direct solar radiation on a horizontal plane, obtained by averaging long-term observations for the listed sites. Yearly totals are obtained from sums of the monthly totals for each site.

Table 12. Mean monthly and yearly totals of the global radiation, MJ/m^2

This table presents mean monthly totals of global radiation, obtained by averaging the long-term observations for the listed sites. Yearly totals are obtained from sums of the monthly totals for each site.

Table 13. Mean monthly and yearly totals of the diffuse radiation, MJ/m^2

This table presents mean monthly totals of diffuse radiation for the listed sites, calculated as the difference between global radiation (Table 12) and direct solar radiation received on a horizontal plane (Table 11). Yearly totals are obtained from sums of the monthly totals for each site.

Table 14. Mean monthly and yearly values of the albedo of the sea-ice surface, %

This table presents mean monthly and yearly values of albedo, obtained from averages of long-term observations for the listed sites.

Table 15. Mean monthly and yearly totals of the absorbed solar radiation, MJ/m^2

This table presents mean monthly totals of absorbed solar radiation (B_k) for the listed sites, obtained from the expression

$$B_k = Q\,(1 - A/100),$$

where the values for Q are taken from Table 12 and the values for A from Table 14. Yearly totals are obtained by combining the monthly totals.

Table 16. Mean monthly and yearly totals of the net radiation, MJ/m^2

This table presents mean monthly totals of the net radiation, obtained by averaging long-term observations for the listed sites. Yearly totals are obtained by summing the monthly totals.

Table 17. Mean monthly and yearly totals of various types of radiation for clear skies, MJ/m^2

This table presents mean monthly values and yearly totals of direct, diffuse, global, and net radiation, calculated from the results of the standard observations [the systematic observation program described in Ref. 2] for clear-sky conditions (see Table 5) at the listed latitudes. The values for direct and global radiation appearing in the table are close to the maximum possible, and those for diffuse radiation are close to the minimum at the corresponding latitudes for mean atmospheric transparency.

Part III. Monthly Totals of the Radiation by Year [and by Ice Station]

Table 18. Monthly totals of direct solar radiation received on a horizontal plane, MJ/m^2
Table 19. Monthly totals of diffuse solar radiation, MJ/m^2
Table 20. Monthly totals of global radiation, MJ/m^2

Tables 18–20 give monthly totals of the elements of the radiation for various years, obtained from automatically recorded data. If recorded data were not available, the monthly totals were calculated from the observations recorded manually at regularly scheduled times.

Table 21. Mean monthly values of the albedo of the sea-ice surface, %

This table presents mean monthly values of the albedo of the surface in the meteorological observing areas for the various years, obtained from the data recorded manually at regularly scheduled times.

Table 22. Monthly totals of absorbed solar radiation, MJ/m^2

This table presents monthly totals of the radiation absorbed by the surface (the shortwave net radiation) in the meteorological observing areas for the various years. The data are derived from the values in Tables 20 and 21.

Table 23. Monthly totals of the net radiation, MJ/m^2

This table presents monthly totals of the net radiation in the meteorological observing areas for the various years. The values have been obtained from automatically recorded data or, when the recorded data were not available, they have been calculated from the results of manual observations at regularly scheduled times.

PART I

Solar Radiation and Net Radiation

Table 1. Data on the beginning and end of the polar day and the polar night.

Coordinate °N Lat.	Polar Day*		Polar Night	
	Beginning	End	Beginning	End
70	17 V	27 VII	26 XI	17 I
72	09 V	05 VIII	16 XI	26 I
74	02 V	12 VIII	09 XI	02 II
76	25 IV	18 VIII	03 XI	09 II
78	19 IV	24 VIII	27 X	15 II
80	14 IV	30 VIII	22 X	21 II
82	08 IV	04 IX	16 X	26 II
84	03 IV	09 IX	11 X	03 III
86	29 III	15 IX	06 X	08 III
88	24 III	20 IX	30 IX	13 III
90	19 III	25 IX	25 IX	19 III

*Roman numerals indicate the month.

Table 2. Solar elevation at noon and midnight on the 15th day of each month, degrees.

Coordinate °N Lat.	Time of Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
70	noon	p.n.	7.2	17.8	29.7	38.8	43.3	41.6	34.2	23.1	11.6	1.6	P.N.
	midnight						3.3	1.6					
72	noon	p.n.	5.2	15.8	27.7	36.8	41.3	39.6	32.2	21.1	9.6	p.n.	p.n.
	midnight					0.8	5.3	3.6					
74	noon	p.n.	3.2	13.8	25.7	34.8	39.3	37.6	30.2	19.1	7.6	p.n.	p.n.
	midnight					2.8	7.3	5.6					
76	noon	p.n.	1.2	11.8	23.7	32.8	37.3	35.6	28.2	17.1	5.6	p.n.	p.n.
	midnight					4.8	9.3	7.6	0.2				
78	noon	p.n.	p.n.	9.8	21.7	30.8	35.3	33.6	26.2	15.1	3.6	p.n.	p.n.
	midnight					6.8	11.3	9.6	2.2				
80	noon	p.n.	p.n.	7.8	19.7	28.8	33.3	31.6	24.2	13.1	1.6	p.n.	p.n.
	midnight					8.8	13.3	11.6	4.2				
82	noon	p.n.	p.n.	5.8	17.7	26.8	31.3	29.6	22.2	11.1	p.n.	p.n.	p.n.
	midnight				1.7	10.8	15.3	13.6	6.2				
84	noon	p.n.	p.n.	3.8	15.7	24.8	29.3	27.6	20.2	9.1	p.n.	p.n.	p.n.
	midnight				3.7	12.8	17.3	15.6	8.2				
86	noon	p.n.	p.n.	1.8	13.7	22.8	27.3	25.6	18.2	7.1	p.n.	p.n.	p.n.
	midnight				5.7	14.8	19.3	17.6	10.2				
88	noon	p.n.	p.n.	p.n.	11.7	20.8	25.3	23.6	16.2	5.1	p.n.	p.n.	p.n.
	midnight				7.7	16.8	21.3	19.6	12.2	1.1			
90	noon	p.n.	p.n.	p.n.	9.7	18.8	23.3	21.6	14.2	3.1	p.n.	p.n.	p.n.
	midnight				9.7	18.8	23.3	21.6	14.2	3.1			

p.n. = polar night

Table 3. Times of sunrise (R) and sunset (S) on the 15th day of each month (mean solar time, hr:min).

Coordinate °N Lat.		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
70	R	p.n.	08:22	06:12	03:57	00:36	p.d.	p.d.	02:49	05:16	07:24	10:05	p.n.
	S	p.n.	15:38	17:48	20:03	23:24	p.d.	p.d.	21:11	18:44	16:36	13:55	p.n.
72	R	p.n.	08:44	06:16	03:39	p.d.	p.d.	p.d.	02:23	05:10	07:36	11:07	p.n.
	S	p.n.	15:16	17:44	20:21	p.d.	p.d.	p.d.	21:37	18:50	16:24	12:53	p.n.
74	R	p.n.	09:11	06:20	03:19	p.d.	p.d.	p.d.	01:25	05:04	07:50	p.n.	p.n.
	S	p.n.	14:49	17:40	20:41	p.d.	p.d.	p.d.	22:35	16:56	16:10	p.n.	p.n.
76	R	p.n.	09:55	06:24	02:47	p.d.	p.d.	p.d.	p.d.	04:56	08:08	p.n.	p.n.
	S	p.n.	14:05	17:36	21:13	p.d.	p.d.	p.d.	p.d.	19:04	15:52	p.n.	p.n.
78	R	p.n.	06:28	06:28	01:57	p.d.	p.d.	p.d.	p.d.	04:45	08:36	p.n.	p.n.
	S	p.n.	17:32	22:03	22:03	p.d.	p.d.	p.d.	p.d.	19:15	15:24	p.n.	p.n.
80	R	p.n.	p.n.	06:33	00:26	p.d.	p.d.	p.d.	p.d.	04:27	09:20	p.n.	p.n.
	S	p.n.	p.n.	17:27	23:34	p.d.	p.d.	p.d.	p.d.	19:33	14:40	p.n.	p.n.
82	R	p.n.	p.n.	06:43	p.d.	p.d.	p.d.	p.d.	p.d.	04:03	10:40	p.n.	p.n.
	S	p.n.	p.n.	17:17	p.d.	p.d.	p.d.	p.d.	p.d.	19:57	13:20	p.n.	p.n.
84	R	p.n.	p.n.	06:56	p.d.	p.d.	p.d.	p.d.	p.d.	03:17	p.n.	p.n.	p.n.
	S	p.n.	p.n.	17:04	p.d.	p.d.	p.d.	p.d.	p.d.	20:43	p.n.	p.n.	p.n.
86	R	p.n.	p.n.	07:36	p.d.	p.d.	p.d.	p.d.	p.d.	01:10	p.n.	p.n.	p.n.
	S	p.n.	p.n.	16:24	p.d.	p.d.	p.d.	p.d.	p.d.	22:50	p.n.	p.n.	p.n.
88	R	p.n.	p.n.	07:51	p.d.	p.d.	p.d.	p.d.	p.d.	p.d.	p.n.	p.n.	p.n.
	S	p.n.	p.n.	16:09	p.d.	p.d.	p.d.	p.d.	p.d.	p.d.	p.n.	p.n.	p.n.

p.n. = polar night; p.d. = polar day

Table 4. Mean monthly values of the radiation fluxes, W/m².

	Solar Elevation (deg)								
Parameter	Below 0	0	5	10	15	20	25	30	35
January									
B	–28								
February									
S		0	161						
S′		0	14						
D		14	35						
Q		14	49						
B	–28	–21	–14						
March									
S		0	161	237	377				
S′		0	14	42	98				
D		14	35	77	105				
Q		14	49	119	202				
B	–21	–21	–14	–7	14				
April									
S		0	161	279	377	426	461		
S′		0	14	49	98	147	195		
D		14	42	84	112	154	195		
Q		14	56	133	210	301	390		
B	–28	–21	–14	–7	7	21	28		
May									
S		0	77	161	216	244	265	265	279
S′		0	7	28	56	84	112	133	161
D		21	56	91	147	195	251	314	363
Q		21	63	119	203	279	363	447	524
B		–21	–14	–7	7	21	28	42	56
June									
S			77	119	161	202	230	251	279
S′			7	21	35	70	98	126	161
D			56	91	140	202	258	321	363
Q			63	112	175	272	356	447	524
B			–14	0	21	35	56	63	84

Table 4. (continued).

	Solar Elevation (deg)								
Parameter	Below 0	0	5	10	15	20	25	30	35
				July					
S			77	84	105	126	147	168	195
S′			7	14	28	42	63	84	112
D			49	70	112	174	223	272	307
Q			56	84	140	216	286	356	419
B			–7	7	28	42	63	91	119
				August					
S		0	0	42	56	84	98	112	
S′		0	0	7	14	28	42	56	
D		14	42	77	126	168	210	258	
Q		14	42	84	140	196	252	314	
B	–21	–14	–7	7	21	42	63	91	
				September					
S		0	0	77	105	181			
S′		0	0	14	28	63			
D		14	42	84	133	161			
Q		14	42	98	161	224			
B	–21	–14	–7	–7	14	35			
				October					
S		0	84	84					
S′		0	7	14					
D		14	35	70					
Q		14	42	84					
B	–21	–14	–7	–7					
				November					
S		0							
S′		0							
D		14							
Q		14							
B	–21	–21							
				December					
B	–21								

Table 5. Mean monthly values of the radiation fluxes for clear skies and their standard deviations, W/m².

	Solar Elevation (deg)								
Parameter	Below 0	0	5	10	15	20	25	30	35
				January					
B	–42								
σ_B	7								
				February					
S		0	300						
σ_S			119						
S'		0	21						
σ_S			14						
D		14	21						
σ_D		7	—						
Q		14	42						
σ_Q		7	14						
B	–42	–42	–35						
σ_B	7	7	7						
				March					
S		0	335	516	621				
σ_S			112	105	77				
S'		0	28	84	161				
σ_S			14	28	21				
D		14	35	56	84				
σ_D		7	7	14	14				
Q		14	63	140	245				
σ_Q		7	21	28	35				
B	–42	–35	–28	14	0				
σ_B	7	7	14	14	—				
				April					
S		0	293	468	593	698	775		
σ_S			98	91	84	63	42		
S'		0	28	84	154	230	321		
σ_S			14	28	28	35	28		
D		14	42	63	84	105	119		
σ_D		7	14	14	14	14	14		
Q		14	70	147	237	335	440		
σ_Q		14	35	49	49	63	49		
B	–42	–35	–28	–14	0	14	28		
σ_B	7	7	14	21	21	28	21		

Table 5. (continued).

	Solar Elevation (deg)								
Parameter	Below 0	0	5	10	15	20	25	30	35
				May					
S			279	461	600	684	761	817	
σ_S			56	77	63	63	56	63	
S'			35	84	154	230	321	412	
σ_S			7	21	28	35	28	35	
D			42	70	91	105	119	133	
σ_D			7	14	14	14	14	14	
Q			77	154	245	335	440	545	
σ_Q			21	28	35	35	35	28	
B		–35	–28	–14	0	14	28	42	
σ_B		7	14	14	21	28	28	28	
				June					
S				558	663	733	789	831	859
σ_S				98	70	63	56	49	49
S'				98	174	251	328	412	496
σ_S				28	28	21	28	28	35
D				56	77	91	105	119	126
σ_D				7	14	14	14	21	21
Q				154	251	342	433	531	622
σ_Q				35	35	35	28	21	14
B				–14	0	21	42	84	112
σ_B				14	21	42	42	56	49
				July					
S			398	558	656	740	796	845	879
σ_S			70	63	63	49	35	35	35
S'			42	98	174	258	335	426	510
σ_S			7	14	21	28	35	28	28
D			35	56	63	70	84	91	98
σ_D			7	14	14	14	14	14	14
Q			77	154	237	328	419	517	607
σ_Q			14	21	28	28	28	28	28
B			–28	–14	28	42	77	119	147
σ_B			14	14	28	28	42	42	35

Table 5. (continued).

	Solar Elevation (deg)								
Parameter	Below 0	0	5	10	15	20	25	30	35
				August					
S			377	551	670	747	796	824	
σ_S			91	70	63	56	49	49	
S'			35	98	174	258	335	412	
σ_S			21	21	28	28	28	28	
D			35	49	63	77	91	105	
σ_D			7	14	14	14	14	14	
Q			70	147	237	335	426	517	
σ_Q			35	42	49	49	42	42	
B	–42	–42	–35	–14	14	49	105	134	
σ_B	7	7	14	21	28	35	35	28	
				September					
S			384	572	698				
σ_S			126	77	35				
S'			35	98	174				
σ_S			21	28	21				
D		21	35	49	63				
σ_D		14	7	7	7				
Q		21	70	147	237				
σ_Q		14	28	35	35				
B	–42	–42	–35	–21	7				
σ_B	14	14	21	14	21				
				October					
S		0	370	551					
σ_S			119	77					
S'		0	35	91					
σ_S			21	21					
D		14	28	49					
σ_D		7	7	7					
Q		14	63	140					
σ_Q		7	21	35					
B	–42	–35	–28	–21					
σ_B	14	14	14	14					
				November					
B	–42	–42							
σ_B	14	14							
				December					
B	–42								
σ_B	14								

Table 6. Mean monthly values of the global solar radiation flux (Q) and their standard deviations (σ) for general overcast, W/m².

	Solar Elevation (deg)							
Parameter	0	5	10	15	20	25	30	35
				February				
Q	14	42						
σ	7	21						
				March				
Q	14	42	98	181				
σ	7	21	35	49				
				April				
Q	14	49	105	174	251	328		
σ	7	21	35	42	56	63		
				May				
Q	14	42	91	161	230	314	398	489
σ	7	21	35	42	42	63	70	77
				June				
Q		42	91	154	216	279	349	419
σ		14	28	42	56	63	77	91
				July				
Q		35	77	119	168	223	286	363
σ		14	35	49	56	70	84	91
				August				
Q	14	35	77	119	168	223	272	
σ	7	21	28	49	56	70	84	
				September				
Q	14	42	84	140	195			
σ	14	21	35	42	56			
				October				
Q	14	42	84					
σ	7	21	28					

Table 7. Mean monthly values of the global solar radiation flux (Q) and their standard deviations (σ) for complete low–level overcast, W/m^2.

	Solar Elevation (deg)							
Parameter	0	5	10	15	20	25	30	35
				March				
Q	7	35	70	—				
σ	14	14	14	—				
				April				
Q	7	42	91	154	223	293		
σ	7	14	28	35	28	28		
				May				
Q	14	42	91	154	223	293	370	454
σ	7	21	21	35	35	49	49	56
				June				
Q		49	84	140	202	265	335	398
σ		14	28	35	49	63	70	77
				July				
Q		28	70	112	161	209	258	307
σ		14	28	35	49	56	70	77
				August				
Q	14	35	70	112	161	209	258	
σ	7	14	28	35	49	63	63	
				September				
Q	14	35	77	126	174			
σ	7	21	21	35	49			
				October				
Q	14	35	84					
σ	7	14	21					

Table 8. Mean monthly values of the net radiation (B) and their standard deviations (σ) for general overcast conditions, W/m^2.

	Solar Elevation (deg)								
Parameter	Below 0	0	5	10	15	20	25	30	35
January									
B	−7								
σ	14								
February									
B	−7	−7	0						
σ	14	7	7						
March									
B	−7	−7	−7	0	14				
σ	14	14	14	14	14				
April									
B	−14	−14	−7	0	7	14	21		
σ	14	14	14	14	21	21	28		
May									
B			−7	0	14	21	35	42	49
σ			14	14	14	21	21	28	28
June									
B			0	7	21	28	42	56	63
σ			7	14	21	21	21	35	35
July									
B			7	14	28	42	56	77	91
σ			7	14	21	28	35	42	49
August									
B	−7	−7	7	14	21	35	56	77	
σ	7	7	7	14	21	21	28	35	
September									
B	−7	−7	0	0	14	28			
σ	7	7	7	14	14	21			
October									
B	−7	−7	0	7					
σ	7	7	7	7					
November									
B	−7								
σ	14								
December									
B	−7								
σ	14								

Table 9. Mean monthly values of the net radiation (B) and their standard deviations (σ) for complete low–level overcast, W/m².

	Solar Elevation (deg)								
Parameter	Below 0	0	5	10	15	20	25	30	35
January									
B	–7								
σ	14								
February									
B	–7	–7	0						
σ	14	14	7						
March									
B	–7	–7	0	7	—				
σ	14	14	7	7	—				
April									
B	–7	–7	0	7	14	28	—		
σ	7	7	7	14	14	14	—		
May									
B		—	0	7	14	28	35	42	49
σ		—	7	7	14	14	21	21	21
June									
B			0	7	14	28	35	49	60
σ			7	14	14	21	21	28	35
July									
B			7	14	21	35	49	70	84
σ			7	14	14	21	28	35	42
August									
B	–7	–7	0	14	21	35	49	63	
σ	7	7	7	14	14	21	28	35	
September									
B	–7	–7	0	7	14	28			
σ	7	7	7	14	14	21			
October									
B	–7	–7	0	7					
σ	7	7	7	7					
November									
B	–7								
σ	7								
December									
B	–7								
σ	7								

Table 10. Extreme values of the radiation fluxes, W/m².

	Solar Elevation (deg)								
Parameter	Below 0	0	5	10	15	20	25	30	35
				Maxima					
S			572	719	768	824	866	914	928
S'			70	147	230	307	398	489	544
D		42	98	230	335	447	496	586	586
Q		70	161	265	398	586	614	740	893
B	14	21	35	112	147	181	230	258	307
				Minima					
D		7	7	21	42	56	70	77	84
Q		7	7	21	42	56	70	98	126
B	–77	–63	–63	–56	–56	–49	–35	–28	–14

PART II

Mean Monthly and Yearly Totals of Radiation at Intersections of the Coordinate Grid

Table 11. Mean monthly and yearly totals of direct solar radiation received on a horizontal plane, MJ/m^2.

° North Latitude	° East Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Total
Pole		p.n.	p.n.	0	147	230	147	101	67	4	p.n	p.n.	p.n.	696
85	0	p.n.	p.n.	8	147	230	189	147	117	13	0	p.n.	p.n.	851
85	60	p.n.	p.n.	17	126	210	151	113	71	13	0	p.n.	p.n.	701
85	120	p.n.	p.n.	17	147	210	147	113	54	13	0	p.n.	p.n.	701
85	180	p.n.	p.n.	17	155	230	147	113	54	13	0	p.n.	p.n.	729
85	240	p.n.	p.n.	17	155	247	176	126	105	17	0	p.n.	p.n.	843
85	300	p.n.	p.n.	17	168	272	251	117	176	25	0	p.n.	p.n.	1026
80	150	p.n.	0	34	172	201	159	117	54	21	0	p.n.	p.n.	758
80	180	p.n.	0	34	172	230	172	122	54	17	0	p.n.	p.n.	801
80	210	p.n.	0	34	172	230	189	126	71	17	0	p.n.	p.n.	839
80	240	p.n.	0	34	180	272	201	184	147	21	0	p.n.	p.n.	1039
75	170	p.n.	0	63	197	226	210	168	75	25	0	0	p.n.	964
75	190	p.n.	0	59	189	193	222	176	75	25	0	0	p.n.	939
75	210	p.n.	0	63	193	214	230	168	80	25	0	0	p.n.	973
75	230	p.n.	0	67	193	243	251	210	130	29	0	0	p.n.	1123

Table 12. Mean monthly and yearly totals of the global radiation, MJ/m^2.

° North Latitude	° East Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Total
Pole		p.n.	p.n.	8	356	700	771	566	360	75	p.n.	p.n.	p.n.	2836
85	0	p.n.	p.n.	38	344	696	754	578	364	80	0	p.n.	p.n.	2854
85	60	p.n.	p.n.	38	348	670	700	553	335	75	0	p.n.	p.n.	2719
85	120	p.n.	p.n.	38	365	687	733	561	352	80	0	p.n.	p.n.	2816
85	180	p.n.	p.n.	38	365	700	767	578	352	92	0	p.n.	p.n.	2892
85	240	p.n.	p.n.	38	365	721	788	582	360	88	0	p.n.	p.n.	2942
85	300	p.n.	p.n.	38	369	742	809	582	373	84	0	p.n.	p.n.	2997
80	150	p.n.	0	84	381	678	712	561	344	109	13	p.n.	p.n.	2882
80	180	p.n.	0	84	381	691	742	587	352	122	13	p.n.	p.n.	2972
80	210	p.n.	0	84	381	700	758	587	356	126	13	p.n.	p.n.	3005
80	240	p.n.	0	84	373	729	775	587	365	122	13	p.n.	p.n.	3048
75	170	p.n.	17	147	419	674	696	587	339	142	34	0	p.n.	3055
75	190	p.n.	17	147	419	678	716	587	344	142	29	0	p.n.	3079
75	210	p.n.	17	163	419	691	721	587	348	147	34	0	p.n.	3127
75	230	p.n.	17	163	436	704	742	587	352	147	29	0	p.n.	3177

Table 13. Mean monthly and yearly totals of the diffuse radiation, MJ/m^2.

° North Latitude	° East Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Total
Pole		p.n.	p.n.	8	209	470	624	465	293	71	p.n.	p.n.	p.n.	2140
85	0	p.n.	p.n.	30	197	466	565	431	247	67	0	p.n.	p.n.	2003
85	60	p.n.	p.n.	21	222	460	549	440	264	62	0	p.n.	p.n.	2018
85	120	p.n.	p.n.	21	218	477	586	448	298	67	0	p.n.	p.n.	2115
85	180	p.n.	p.n.	21	210	470	620	465	298	79	0	p.n.	p.n.	2163
85	240	p.n.	p.n.	21	210	474	612	456	255	71	0	p.n.	p.n.	2099
85	300	p.n.	p.n.	21	201	470	558	465	197	59	0	p.n.	p.n.	1971
80	150	p.n.	0	50	209	477	553	444	290	88	13	p.n.	p.n.	2124
80	180	p.n.	0	50	209	461	570	465	298	105	13	p.n.	p.n.	2171
80	210	p.n.	0	50	209	470	569	461	285	109	13	p.n.	p.n.	2166
80	240	p.n.	0	50	193	457	574	403	218	101	13	p.n.	p.n.	2009
75	170	p.n.	17	84	222	448	486	419	264	117	34	0	p.n.	2091
75	190	p.n.	17	88	230	485	494	411	269	117	29	0	p.n.	2140
75	210	p.n.	17	100	226	477	491	419	268	122	34	0	p.n.	2154
75	230	p.n.	17	96	243	461	491	377	222	118	29	0	p.n.	2054

Table 14. Mean monthly and yearly values of the albedo of the sea-ice surface, %.

° North Latitude	° East Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Total
Pole		p.n.	p.n.	83	81	82	77	69	71	81	p.n.	p.n.	p.n.	78
85	0	p.n.	p.n.	83	81	82	78	66	68	81	84	p.n.	p.n.	78
85	60	p.n.	p.n.	83	81	82	78	66	68	81	84	p.n.	p.n.	78
85	120	p.n.	p.n.	83	81	82	78	66	68	81	84	p.n.	p.n.	78
85	180	p.n.	p.n.	83	81	82	78	66	68	81	84	p.n.	p.n.	78
85	240	p.n.	p.n.	83	81	82	78	66	68	81	84	p.n.	p.n.	78
85	300	p.n.	p.n.	83	81	82	78	66	68	81	84	p.n.	p.n.	78
80	150	p.n.	—	83	81	82	78	64	70	81	84	p.n.	p.n.	78
80	180	p.n.	—	83	81	82	78	64	70	81	84	p.n.	p.n.	78
80	210	p.n.	—	83	81	82	78	64	70	81	84	p.n.	p.n.	78
80	240	p.n.	—	83	81	82	78	64	70	81	84	p.n.	p.n.	78
75	170	p.n.	—	83	81	82	78	61	60	81	84	—	p.n.	76
75	190	p.n.	—	83	81	82	78	61	60	81	84	—	p.n.	76
75	210	p.n.	—	83	81	82	78	61	60	81	84	—	p.n.	76
75	230	p.n.	—	83	81	82	78	61	60	81	84	—	p.n.	76

Table 15. Mean monthly and yearly totals of the absorbed solar radiation, MJ/m².

° North Latitude	° East Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Total
Pole		p.n.	p.n.	6	86	126	177	175	104	14	0	p.n.	p.n.	670
85	0	p.n.	p.n.	6	65	125	166	197	116	15	0	p.n.	p.n.	690
85	60	p.n.	p.n.	6	66	121	154	188	107	14	0	p.n.	p.n.	656
85	120	p.n.	p.n.	6	69	124	161	191	113	15	0	p.n.	p.n.	679
85	180	p.n.	p.n.	6	69	126	169	197	113	17	0	p.n.	p.n.	697
85	240	p.n.	p.n.	6	69	130	173	198	115	17	0	p.n.	p.n.	708
85	300	p.n.	p.n.	6	70	134	178	198	119	16	0	p.n.	p.n.	721
80	150	p.n.	0	14	72	122	157	202	103	21	2	p.n.	p.n.	693
80	180	p.n.	0	14	72	124	163	211	106	23	2	p.n.	p.n.	715
80	210	p.n.	0	14	72	126	167	211	107	24	2	p.n.	p.n.	723
80	240	p.n.	0	14	71	131	170	211	110	23	2	p.n.	p.n.	732
75	170	p.n.	0	25	80	121	153	229	136	27	5	0	p.n.	776
75	190	p.n.	0	25	80	122	158	229	138	27	5	0	p.n.	784
75	210	p.n.	0	32	80	124	159	229	139	28	5	0	p.n.	796
75	230	p.n.	0	32	80	127	163	229	141	28	5	0	p.n.	808

Table 16. Mean monthly and yearly totals of the net radiation, MJ/m².

° North Latitude	° East Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Total
Pole		–84	–80	–80	–29	34	126	151	63	–34	–54	–71	–80	–138
85	0	–84	–80	–71	–29	34	122	163	75	–29	–59	–75	–84	–117
85	60	–84	–80	–71	–29	34	101	159	75	–29	–59	–84	–75	–142
85	120	–84	–80	–75	–29	38	101	155	71	–29	–54	–75	–80	–141
85	180	–84	–80	–80	–29	42	105	151	71	–29	–42	–75	–92	–142
85	240	–84	–80	–71	–29	38	117	155	71	–29	–42	–75	–92	–121
85	300	–84	–80	–71	–29	34	122	163	80	–29	–54	–75	–92	–115
80	150	–84	–84	–67	–25	50	101	159	80	–21	–50	–67	–75	–83
80	180	–84	–80	–71	–25	50	101	159	80	–21	–42	–71	–80	–84
80	210	–84	–80	–80	–25	50	113	159	80	–21	–38	–71	–80	–77
80	240	–84	–80	–71	–25	50	117	168	84	–21	–38	–71	–75	–46
75	170	–84	–92	–67	–21	50	168	180	92	–17	–50	–71	–80	+8
75	190	–84	–92	–67	–21	50	151	163	117	–17	–50	–71	–80	–1
75	210	–84	–92	–67	–21	50	155	168	92	–17	–50	–71	–80	–17
75	230	–84	–80	–67	–21	50	155	184	80	–8	–50	–71	–80	+8

Table 17. Mean monthly and yearly totals of various types of radiation for clear skies, MJ/m^2.

° North Latitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Total
S, flux of direct-beam solar radiation incident at the suface, normal to the Sun beam													
90	p.n.	p.n.	168	1366	1953	2053	1994	1710	528	p.n.	p.n.	p.n.	9772
85	p.n.	p.n.	251	1341	1927	2032	1990	1718	587	0	p.n.	p.n.	9846
80	p.n.	0	398	1257	1886	1990	1927	1634	683	105	p.n.	p.n.	9880
75	p.n.	71	545	1190	1781	1906	1844	1466	796	275	0	p.n.	9874
S', flux of direct solar radiation received at the horizontal suface													
90	p.n.	p.n.	4	226	628	804	742	411	21	p.n.	p.n.	p.n.	2836
85	p.n.	p.n.	17	243	628	804	746	419	63	0	p.n.	p.n.	2920
80	p.n.	0	42	281	637	804	746	440	117	8	p.n.	p.n.	3075
75	p.n.	4	84	327	645	800	742	469	180	25	0	p.n.	3276
Q, flux of global radiation													
90	p.n.	p.n.	8	390	897	1056	1010	599	126	p.n.	p.n.	p.n.	4086
85	p.n.	p.n.	38	398	897	1048	1006	608	168	0	p.n.	p.n.	4163
80	p.n.	0	84	427	880	1039	989	616	222	12	p.n.	p.n.	4269
75	p.n.	12	151	478	859	993	964	641	293	59	0	p.n.	4450
D, flux of diffuse radiation													
90	p.n.	p.n.	4	163	268	251	268	189	105	p.n.	p.n.	p.n.	1248
85	p.n.	p.n.	17	155	268	243	260	189	105	0	p.n.	p.n.	1237
80	p.n.	0	42	147	243	235	243	176	105	4	p.n.	p.n.	1195
75	p.n.	8	67	151	214	193	222	172	113	34	0	p.n.	1174
B, radiation balance													
90	−96	−84	−75	−25	29	117	151	75	−80	−122	−105	−101	−316
85	−105	−92	−88	−25	25	117	155	50	−75	−117	−109	−101	−365
80	−105	−92	−88	−21	25	122	159	67	−67	−126	−109	−101	−336
75	−113	−96	−92	−21	25	138	168	92	−46	−126	−117	−113	−301

This page intentionally left blank.

PART III

Monthly Totals of the Radiation by Year [and by Ice Station]

Table 18. Monthly totals of direct solar radiation received on a horizontal plane, MJ/m².

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–6	1956						—	—	—	—	—	—	p.n.
	1957	p.n.	—	—	—	168	84	80	42	42	0	p.n.	p.n.
	1958	p.n.	p.n.	33	201	176	176	105	38	25	0	p.n.	p.n.
	1959	p.n.	p.n.	8	126	222	80	67	17				
NP–7	1957					314	189	105	38	8	0	p.n.	p.n.
	1958	p.n.	p.n.	4	172	272	163	147	80	21	0	p.n.	p.n.
	1959	p.n.	p.n.	8									
NP–8	1959					134	176	113	134	29	4	p.n.	p.n.
	1960	p.n.	0	38	192	163	289	126	163	0	0	p.n.	p.n.
	1961	p.n.	p.n.	59	197	101	63	121	29	46	0	p.n.	p.n.
NP–9	1960					155	264	184	109	21	4	p.n.	p.n.
	1961	p.n.	p.n.	0									
NP–10	1962	p.n.	0	63	142	209	134	46	34	17	4	p.n.	p.n.
	1963	p.n.	0	41	147	180	155	75	67	12	0	p.n.	p.n.
	1964	p.n.	p.n.	0									
NP–11	1962						126	29	88	8	0	p.n.	p.n.
	1963	p.n.	0	25									
NP–12	1963					—	109	230	42	46	0	p.n.	p.n.
	1964	p.n.	0	25	—	163	101	33	59	21	0	p.n.	p.n.
	1965	p.n.	0	8									
NP–13	1964					—	209	139	134	34	4	0	p.n.
	1965	p.n.	0	21	142	239	304	197	67	42	4	p.n.	p.n.
	1966	p.n.	0	25	117	170	168	80	67	8	p.n.	p.n.	p.n.
	1967	p.n.	p.n.	4									
NP–14	1965					168	268	109	38	59	4	p.n.	p.n.
	1957	p.n.	—	—	—	168	84	80	42	42	0	p.n.	p.n.
	1958	p.n.	p.n.	33	201	176	176	105	38	25	0	p.n.	p.n.
	1959	p.n.	p.n.	8	126	222	80	67	17				
NP–15	1966					159	125	163	167	26	5	p.n.	p.n.
	1967	p.n.	p.n.	17	113	213	176	67	42	4	p.n.	p.n.	p.n.
	1968	p.n.	p.n.										
NP–16	1968					—	172	218	55	4	0	p.n.	p.n.
	1969	p.n.	0	25	142	214	113	29	29	0	0	p.n.	p.n.
	1970	p.n.	p.n.	17	—	230	84	84	25	13	0	p.n.	p.n.
	1971	p.n.	p.n.	8	83	—	—	180	54	0	p.n.	p.n.	p.n.
NP–17	1968						180	71	75	4	0	p.n.	p.n.
	1969	p.n.	p.n.	4	—	—	50	46	25	—			
NP–19	1970	p.n.	0	—	155	147	21	117	25	25	4	p.n.	p.n.
	1971	p.n.	0	33	142	134	159	109	63	113	0	p.n.	p.n.
	1972	p.n.	p.n.	12	151	180	29	93	50	4	p.n.	p.n.	p.n.
	1973	p.n.	p.n.	13									

Table 18. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–20	1970					—	—	210	38	13	0	p.n.	p.n.
	1971	p.n.	0	38	—	226	239	172	13	17	4	p.n.	p.n.
	1972	p.n.	0	63	204								
NP–21	1972					—	163	193	46	38	4	p.n.	p.n.
	1973	p.n.	0	46	226	239	138	38	21	13	0	p.n.	p.n.
	1974	p.n.	p.n.	13									
NP–22	1974	p.n.	p.n.	—	—	109	93	142	50	25	0	p.n.	p.n.
	1975	p.n.	p.n.	8	159	235	478	134	13	13	0	p.n.	p.n.
	1976	p.n.	p.n.	13	193	172	268	105	17	8	0	p.n.	p.n.
	1977	p.n.	p.n.	17	138	281	339	243	50	17	4	p.n.	p.n.
	1978	p.n.	5	80	256	302	155	440	54	38	17	0	p.n.
	1979	p.n.	5	63	205	188	360	75	25	25	4	0	p.n.
	1980	p.n.	0	39	245	300	108	199	47	33	2	p.n.	p.n.
	1981	p.n.	p.n.	8	130	132	233	109	26	9	p.n.	p.n.	p.n.
	1982	p.n.	p.n.	7									
NP–23	1976	p.n.	—	—	—	—	147	113	36	25	8	0	p.n.
	1977	p.n.	0	63	189	168	147	251	42	13	0	p.n.	p.n.
	1978	p.n.	p.n.	4	142	218	214	109	59	4	p.n.		
NP–24	1978						285	151	130	13	0	p.n.	p.n.
	1979	p.n.	0	34	168	214	147	109	34	4	0	p.n.	p.n.
	1980	p.n.	p.n.	4	139	321	257	125	25	3	—		
NP–25	1981							186	82	48	4	p.n.	p.n.
	1982	p.n.	p.n.	28	191	204	113	112	27	1	0	p.n.	p.n.
	1983	p.n.	p.n.	5	102	108	95	156	52	3	0	p.n.	p.n.
	1984	p.n.	p.n.	7									
NP–26	1983							137	49	16	1	p.n.	p.n.
	1984	p.n.	0	26	112	197	—	86	57	6	0	p.n.	p.n.
	1985	p.n.	0	—	—	296	240	296	55	17	1	p.n.	p.n.
NP–27	1984							184	71	19	1	p.n.	p.n.
	1985	p.n.	0	20	130	246	224	201	64	17	1	p.n.	p.n.
	1986	p.n.	p.n.	7	126	136	158	112	38	—	p.n.	p.n.	p.n.
	1987	p.n.	p.n.	7	88								
NP–28	1986							95	25	16	0	p.n.	p.n.
	1987	p.n.	0	26	169	170	180	162	62	18	0	p.n.	p.n.
	1988	p.n.	p.n.	0	104	205	130	209	94	11	p.n.	p.n.	p.n.
NP–29	1987									30	1	p.n.	p.n.
	1988	p.n.	p.n.	8	115	196							
NP–30	1988	p.n.	3	61	184	257	196	127	56	45	5	0	p.n.
	1989	p.n.	1	35	182	—	77	96	85	11	0	p.n.	p.n.
	1990	p.n.	p.n.	20	130	169	223	109	148	24	0	p.n.	p.n.
NP–31	1989		1	34	167	153	150	44	74	24	1	p.n.	p.n.
	1990	p.n.	1	43	187	160	413	169	134	33	16	0	p.n.
	1991	p.n.	9	107									

Table 19. Monthly totals of diffuse solar radiation, MJ/m².

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–6	1956					—	—	—	—	—	—	0	p.n.
	1957	p.n.	0	—	—	473	545	444	306	117	25	p.n.	p.n.
	1958	p.n.	p.n.	46	209	524	658	440	323	93	0	p.n.	p.n.
	1959	p.n.	p.n.	25	193	457	616	411	260				
NP–7	1957					385	582	461	293	63	25	p.n.	p.n.
	1958	p.n.	p.n.	25	172	444	561	411	268	59	p.n.	p.n.	p.n.
	1959	p.n.	p.n.	21									
NP–8	1959					520	545	511	297	130	21	p.n.	p.n.
	1960	p.n.	29	67	193	482	511	465	293	117	8	p.n.	p.n.
	1961	p.n.	p.n.	21	184	524	599	461	272	84	4	p.n.	p.n.
NP–9	1960					524	490	444	268	93	4	p.n.	p.n.
	1961	p.n.	p.n.	17									
NP–10	1962	p.n.	4	63	230	444	561	511	285	122	12	p.n.	p.n.
	1963	p.n.	0	50	201	473	595	511	327	92	8	p.n.	p.n.
	1964	p.n.	p.n.	20									
NP–11	1962					—	578	490	276	117	8	p.n.	p.n.
	1963	p.n.	0	42									
NP–12	1963					—	659	448	360	109	13	p.n.	p.n.
	1964	p.n.	0	42	—	528	670	561	327	88	0	p.n.	p.n.
	1965	p.n.	0	55									
NP–13	1964					—	570	448	285	142	25	0	p.n.
	1965	p.n.	4	75	226	465	503	436	289	109	8	p.n.	p.n.
	1966	p.n.	0	50	239	520	620	520	310	93	p.n.	p.n.	p.n.
	1967	p.n.	p.n.	17									
NP–14	1965					553	591	545	360	134	21	p.n.	p.n.
NP–15	1966					536	675	553	310	121	8	p.n.	p.n.
	1967	p.n.	p.n.	29	247	520	679	494	310	71	p.n.	p.n.	p.n.
NP–16	1968					—	582	377	272	93	0	p.n.	p.n.
	1969	p.n.	0	33	218	494	574	515	318	75	0	p.n.	p.n.
	1970	p.n.	p.n.	33	—	507	695	507	323	93	0	p.n.	p.n.
	1971	p.n.	p.n.	33	235	—	—	406	272	63	p.n.	p.n.	p.n.
NP–17	1968						612	465	243	50	0	p.n.	p.n.
	1969	p.n.	p.n.	21	—	—	612	486	289	—			

Table 19. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–19	1970	p.n.	0	—	205	507	595	457	348	117	17	p.n.	p.n.
	1971	p.n.	0	38	230	574	645	457	314	88	4	p.n.	p.n.
	1972	p.n.	p.n.	21	209	507	637	503	285	93	p.n.	p.n.	p.n.
	1973	p.n.	p.n.	33									
NP–20	1970					—	—	444	272	96	13	p.n.	p.n.
	1971	p.n.	0	54	—	461	566	436	285	93	8	p.n.	p.n.
	1972	p.n.	0	54	197								
NP–21	1972					—	633	490	302	104	13	p.n.	p.n.
	1973	p.n.	0	59	180	444	524	473	285	93	4	p.n.	p.n.
	1974	p.n.	p.n.	33									
NP–22	1974	p.n.	p.n.	—	—	540	679	440	313	113	8	p.n.	p.n.
	1975	p.n.	p.n.	42	214	566	624	666	402	130	13	p.n.	p.n.
	1976	p.n.	p.n.	33	172	549	545	515	318	88	0	p.n.	p.n.
	1977	p.n.	p.n.	42	218	444	524	452	289	126	17	p.n.	p.n.
	1978	p.n.	8	84	205	452	616	239	335	130	42	0	p.n.
	1979	p.n.	8	88	218	478	515	478	281	138	25	0	p.n.
	1980	p.n.	4	74	182	427	576	424	314	103	11	p.n.	p.n.
	1981	p.n.	p.n.	39	225	525	594	495	271	73	p.n.	p.n.	p.n.
	1982	p.n.	p.n.	28									
NP–23	1976	p.n.	—	—	—	—	570	465	281	138	33	0	p.n.
	1977	p.n.	0	67	250	490	557	323	235	88	0	p.n.	p.n.
	1978	p.n.	p.n.	17	189	486	553	524	323	96	p.n.		
NP–24	1978						528	473	302	142	21	p.n.	p.n.
	1979	p.n.	0	59	205	486	608	482	276	96	4	p.n.	p.n.
	1980	p.n.	p.n.	22	203	414	558	453	316	72	—		
NP–25	1981							456	292	124	23	p.n.	p.n.
	1982	p.n.	p.n.	50	202	488	629	486	324	85	1	p.n.	p.n.
	1983	p.n.	p.n.	37	237	506	680	524	314	91	1	p.n.	p.n.
	1984	p.n.	p.n.	27									
NP–26	1983							463	310	125	19	p.n.	p.n.
	1984	p.n.	2	62	237	534	—	516	286	98	7	p.n.	p.n.
	1985	p.n.	0	—	—	450	550	455	319	95	6	p.n.	p.n.
NP–27	1984							466	290	124	15	p.n.	p.n.
	1985	p.n.	1	59	217	398	508	428	330	121	12	p.n.	p.n.
	1986	p.n.	p.n.	41	238	547	638	508	315	—	p.n.	p.n.	p.n.
	1987	p.n.	p.n.	21	225								
NP–28	1986							508	358	119	10	p.n.	p.n.
	1987	p.n.	1	60	210	518	631	486	290	90	0	p.n.	p.n.
	1988	p.n.	p.n.	17	241	476	630	474	281	62	p.n.	p.n.	p.n.

Table 19. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–29	1987									101	9	p.n.	p.n.
	1988	p.n.	p.n.	35	221	466							
NP–30	1988	p.n.	10	66	214	412	535	448	316	123	31	0	p.n.
	1989	p.n.	4	74	215	—	656	562	310	120	5	p.n.	p.n.
	1990	p.n.	p.n.	45	220	514	632	533	325	101	3	p.n.	p.n.
NP–31	1989		4	75	227	542	623	497	267	112	15	p.n.	p.n.
	1990	p.n.	9	86	230	515	457	480	319	171	43	2	p.n.
	1991	p.n.	23	97									

Table 20. Monthly totals of global radiation, MJ/m^2.

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–2	1950				419	771	825	855	452	197	21	p.n.	p.n.
	1951	p.n.	0	25									
NP–3	1954					649	888	561	318	84	p.n.	p.n.	p.n.
NP–4	1954					679	771	591	348	130	8	p.n.	p.n.
	1955	p.n.	0	96	511	775	817	754	335	121	4	p.n.	p.n.
	1956	p.n.	p.n.	29	348	675	771	550	302	63	p.n.	p.n.	p.n.
NP–5	1955					687	788	628	310	93	4	p.n.	p.n.
	1956	p.n.	p.n.	33	356	754	851	603	344	75			
NP–6	1956					679	750	599	406	168	33	0	p.n.
	1957	p.n.	8	147	344	641	628	524	348	159	25	p.n.	p.n.
	1958	p.n.	p.n.	80	411	700	834	545	360	117	0	p.n.	p.n.
	1959	p.n.	p.n.	33	318	679	695	478	276				
NP–7	1957					700	771	566	331	71	25	p.n.	p.n.
	1958	p.n.	p.n.	29	344	716	725	557	348	80	p.n.	p.n.	p.n.
	1959	p.n.	p.n.	29									
NP–8	1959					654	721	624	432	159	25	p.n.	p.n.
	1960	p.n.	29	105	385	645	800	591	457	117	8	p.n.	p.n.
	1961	p.n.	p.n.	36	381	624	662	582	302	130	4	p.n.	p.n.
NP–9	1960					679	753	628	377	113	8	p.n.	p.n.
	1961	p.n.	p.n.	17									
NP–10	1962	p.n.	4	126	373	653	695	557	316	138	16	p.n.	p.n.
	1963	p.n.	0	75	348	653	746	586	394	105	8	p.n.	p.n.
	1964	p.n.	p.n.	20									
NP–11	1962					687	704	499	364	125	8	p.n.	p.n.
	1963	p.n.	0	67									
NP–12	1963					624	767	679	402	155	13	p.n.	p.n.
	1964	p.n.	0	67	—	691	771	595	385	109	0	p.n.	p.n.
	1965	p.n.	0	63									
NP–13	1964					679	779	587	419	176	29	0	p.n.
	1965	p.n.	4	96	369	704	808	633	356	151	13	p.n.	p.n.
	1966	p.n.	0	75	356	691	788	599	377	101	p.n.	p.n.	p.n.
	1967	p.n.	p.n.	21									
NP–14	1965					721	859	654	398	193	25	p.n.	p.n.
NP–15	1966					695	800	725	473	147	13	p.n.	p.n.
	1967	p.n.	p.n.	46	360	733	855	561	352	75	p.n.	p.n.	p.n.

Table 20. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–16	1968					691	754	595	327	97	0	p.n.	p.n.
	1969	p.n.	0	58	360	708	687	545	348	75	0	p.n.	p.n.
	1970	p.n.	p.n.	50	—	737	779	591	348	105	0	p.n.	p.n.
	1971	p.n.	p.n.	42	318	—	—	587	327	63	p.n.	p.n.	p.n.
NP–17	1968						792	536	318	54	0	p.n.	p.n.
	1969	p.n.	p.n.	25	—	662	662	534	315	71			
NP–19	1970	p.n.	0	—	360	654	616	574	373	142	21	p.n.	p.n.
	1971	p.n.	0	71	373	708	804	566	377	101	4	p.n.	p.n.
	1972	p.n.	p.n.	33	360	687	666	595	335	96	p.n.	p.n.	p.n.
	1973	p.n.	p.n.	46									
NP–20	1970					—	—	654	310	109	13	p.n.	p.n.
	1971	p.n.	0	93	—	687	804	608	297	109	13	p.n.	p.n.
	1972	p.n.	0	80	402								
NP–21	1972					—	796	683	348	142	17	p.n.	p.n.
	1973	p.n.	0	105	406	683	662	511	306	105	4	p.n.	p.n.
	1974	p.n.	p.n.	46									
NP–22	1974	p.n.	p.n.	—	—	645	771	582	363	138	8	p.n.	p.n.
	1975	p.n.	p.n.	50	373	800	1102	800	415	142	13	p.n.	p.n.
	1976	p.n.	p.n.	46	364	721	813	620	335	96	0	p.n.	p.n.
	1977	p.n.	p.n.	59	356	725	863	695	339	142	21	p.n.	p.n.
	1978	p.n.	13	163	461	754	771	679	390	168	59	0	p.n.
	1979	p.n.	13	151	423	666	876	553	306	163	29	0	p.n.
	1980	p.n.	4	113	427	726	684	623	360	135	12	p.n.	p.n.
	1981	p.n.	p.n.	47	354	658	827	603	297	82	p.n.	p.n.	p.n.
	1982	p.n.	p.n.	35									
NP–23	1976	p.n.	—	—	—	—	716	578	318	163	42	0	p.n.
	1977	p.n.	0	130	439	658	704	574	276	101	0	p.n.	p.n.
	1978	p.n.	p.n.	21	331	705	767	633	381	101	p.n.		
NP–24	1978						813	624	432	155	21	p.n.	p.n.
	1979	p.n.	0	92	373	700	754	591	310	101	4	p.n.	p.n.
	1980	p.n.	p.n.	26	342	735	815	578	341	75	—		
NP–25	1981							642	374	172	27	p.n.	p.n.
	1982	p.n.	p.n.	78	393	692	742	598	351	86	1	p.n.	p.n.
	1983	p.n.	p.n.	42	339	614	775	680	366	94	1	p.n.	p.n.
	1984	p.n.	p.n.	34									
NP–26	1983							600	359	141	20	p.n.	p.n.
	1984	p.n.	2	88	349	731	—	602	343	104	7	p.n.	p.n.
	1985	p.n.	0	—	—	746	790	751	374	112	7	p.n.	p.n.

Table 20. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–27	1984							650	361	143	16	p.n.	p.n.
	1985	p.n.	1	79	347	644	732	629	394	138	13	p.n.	p.n.
	1986	p.n.	p.n.	48	364	683	796	620	353	—	p.n.	p.n.	p.n.
	1987	p.n.	p.n.	28	313								
NP–28	1986							603	383	135	10	p.n.	p.n.
	1987	p.n.	1	86	370	688	811	648	352	107	0	p.n.	p.n.
	1988	p.n.	p.n.	17	345	681	760	633	375	73	p.n.	p.n.	p.n.
NP–29	1987									131	10	p.n.	p.n.
	1988	p.n.	p.n.	43	336	662							
NP–30	1988	p.n.	12	128	398	669	731	575	372	168	36	0	p.n.
	1989	p.n.	5	109	397	—	733	658	395	131	5	p.n.	p.n.
	1990	p.n.	p.n.	64	350	683	855	642	473	125	3	p.n.	p.n.
NP–31	1989		5	109	394	694	772	541	341	136	16	p.n.	p.n.
	1990	p.n.	10	130	417	674	871	649	453	204	59	2	p.n.
	1991	p.n.	32	204									

Table 21. Mean monthly values of the albedo of the sea-ice surface, %.

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–2	1950				78	80	82	73	82	86	82	p.n.	p.n.
	1951	p.n.	p.n.	80									
NP–3	1954					78	60	—	65	79	p.n.	p.n.	p.n.
NP–4	1954					86	77	66	79	86	86	p.n.	p.n.
	1955	p.n.	—	—	—	81	79	52	54	85	—	p.n.	p.n.
	1956	p.n.	p.n.	—	—	82	83	77	73	77	p.n.	p.n.	p.n.
NP–5	1955					80	80	69	71	83	—	p.n.	p.n.
	1956	p.n.	p.n.	76	75	—	—	—	—	—			
NP–6	1956					82	79	56	56	82	86	p.n.	p.n.
	1957	p.n.	—	78	83	83	82	72	73	86	86	p.n.	p.n.
	1958	p.n.	p.n.	83	79	83	75	52	56	83	p.n.	p.n.	p.n.
	1959	p.n.	p.n.	75	83	81	81	53	58				
NP–7	1957					78	76	62	76	82	—	p.n.	p.n.
	1958	p.n.	p.n.	80	80	82	70	57	54	73	p.n.	p.n.	p.n.
	1959	p.n.	p.n.	—									
NP–8	1959					83	77	76	72	83	86	p.n.	p.n.
	1960	p.n.	—	88	81	85	82	66	67	82	88	p.n.	p.n.
	1961	p.n.	p.n.	77	82	85	77	70	71	85	87	p.n.	p.n.
NP–9	1960					83	76	56	62	79	84	p.n.	p.n.
	1961	p.n.	p.n.	78									
NP–10	1962	p.n.	84	81	82	80	77	69	78	83	84	p.n.	p.n.
	1963	p.n.	—	83	79	78	67	53	68	82	84	p.n.	p.n.
	1964	p.n.	p.n.	82									
NP–11	1962					—	73	67	76	85	87	p.n.	p.n.
	1963	p.n.	p.n.	86									
NP–12	1963					—	81	62	76	82	89	p.n.	p.n.
	1964	p.n.	—	88	—	83	86	76	69	86	p.n.	p.n.	p.n.
	1965	p.n.	—	88									
NP–13	1964					—	77	66	68	79	89	—	p.n.
	1965	p.n.	—	84	84	82	78	69	75	83	84	p.n.	p.n.
	1966	p.n.	—	84	85	85	84	63	60	74	p.n.	p.n.	p.n.
	1967	p.n.	p.n.	81									
NP–14	1965					87	79	63	70	85	82	p.n.	p.n.

Table 21. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–15	1966					86	86	76	68	84	87	p.n.	p.n.
	1967	p.n.	p.n.	90	85	87	83	—	81	87	p.n.	p.n.	p.n.
NP–16	1968					—	78	66	66	81	—	p.n.	p.n.
	1969	p.n.	p.n.	84	81	82	68	74	80	84	—	p.n.	p.n.
	1970	p.n.	p.n.	88	—	85	86	76	72	86	—	p.n.	p.n.
	1971	p.n.	p.n.	90	86	—	—	71	79	85	p.n.	p.n.	p.n.
NP–17	1968						82	68	71	85	—	p.n.	p.n.
	1969	p.n.	p.n.	86	—	—	82	64	70	—			
NP–19	1970	p.n.	p.n.	—	81	81	72	60	79	80	81	p.n.	p.n.
	1971	p.n.	p.n.	82	82	85	76	52	69	75	—	p.n.	p.n.
	1972	p.n.	p.n.	75	77	83	84	80	72	74	p.n.	p.n.	p.n.
	1973	p.n.	p.n.	80									
NP–20	1970					—	—	66	70	83	88	p.n.	p.n.
	1971	p.n.	p.n.	85	—	84	67	64	80	88	88	p.n.	p.n.
	1972	p.n.	p.n.	78	78								
NP–21	1972					—	81	64	58	76	—	p.n.	p.n.
	1973	p.n.	p.n.	88	77	77	79	70	74	80	—	p.n.	p.n.
	1974	p.n.	p.n.	80									
NP–22	1974	p.n.	p.n.	—	—	84	83	67	73	—	—	p.n.	p.n.
	1975	p.n.	p.n.	83	82	—	—	—	80	—	—	p.n.	p.n.
	1976	p.n.	p.n.	90	84	80	81	77	79	86	—	p.n.	p.n.
	1977	p.n.	p.n.	90	78	—	—	59	59	76	80	p.n.	p.n.
	1978	p.n.	—	75	75	84	80	45	59	60	79	p.n.	p.n.
	1979	p.n.	p.n.	83	84	89	77	61	47	83	80	p.n.	p.n.
	1980	p.n.	—	78	74	82	75	47	65	70	76	p.n.	p.n.
	1981	p.n.	p.n.	81	82	82	75	67	71	77	p.n.	p.n.	p.n.
	1982	p.n.	p.n.	80									
NP–23	1976	p.n.	—				74	59	58	82	—	p.n.	p.n.
	1977	p.n.	—	—	—	—	68	—	—	—	—	p.n.	p.n.
	1978	p.n.	p.n.	—	—	74	84	57	63	—	—		
NP–24	1978						75	62	66	82	84	p.n.	p.n.
	1979	p.n.	—	76	87	86	74	54	47	82	—	p.n.	p.n.
	1980	p.n.	p.n.	88	82	82	65	75	80	—			
NP–25	1981							74	77	81	—	p.n.	p.n.
	1982	p.n.	p.n.	—	81	83	80	72	80	88	—	p.n.	p.n.
	1983	p.n.	p.n.	—	89	88	88	74	66	84	—	p.n.	p.n.

Table 21. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–26	1983							56	70	83	—	p.n.	p.n.
	1984	p.n.	p.n.	85	83	82	—	60	72	80	—	p.n.	p.n.
	1985	p.n.	p.n.	—	—	85	70	61	75	85	—	p.n.	p.n.
NP–27	1984							67	75	78	—	p.n.	p.n.
	1985	p.n.	p.n.	86	77	84	77	66	72	80	—	p.n.	p.n.
	1986	p.n.	p.n.	—	86	87	87	67	73	78	—	p.n.	p.n.
	1987	p.n.	p.n.	—	80								
NP–28	1987	p.n.	p.n.	—	77	79	76	60	71	79	—	p.n.	p.n.
	1988	p.n.	p.n.	—	82	83	83	69	74	—	p.n.	p.n.	p.n.
NP–29	1987							—	—	77	—	p.n.	p.n.
	1988	p.n.	p.n.	—	86	88							
NP–30	1988	p.n.	—	85	80	86	74	63	76	75	74	—	p.n.
	1989	p.n.	—	85	78	—	86	76	74	82	—	p.n.	p.n.
	1990	p.n.	p.n.	86	85	84	83	66	64	83	—	p.n.	p.n.
NP–31	1989		—	83	88	84	67	49	66	79	—	p.n.	p.n.
	1990	p.n.	—	87	81	83	68	64	64	77	77	—	p.n.
	1991	p.n.	—	78									

Table 22. Monthly totals of absorbed solar radiation, MJ/m^2.

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–2	1950				92	154	148	231	81	28	4	p.n.	p.n.
	1951	p.n.	0	1									
NP–3	1954					143	355	—	111	18	p.n.	p.n.	p.n.
NP–4	1954					95	177	201	73	18	1	p.n.	p.n.
	1955	p.n.	0	15	107	147	172	362	154	18	0	p.n.	p.n.
	1956	p.n.	p.n.	4	52	121	131	126	82	14	p.n.	p.n.	p.n.
NP–5	1955					137	158	195	90	16	0	p.n.	p.n.
	1956	p.n.	p.n.	8	89	—	—	—	—	—			
NP–6	1956					122	158	264	179	30	5	0	p.n.
	1957	p.n.	0	32	58	109	113	147	94	22	4	p.n.	p.n.
	1958	p.n.	0	14	86	119	208	262	158	20	0	p.n.	p.n.
	1959	p.n.	p.n.	8	54	129	132	225	116				
NP–7	1957					154	185	215	79	13	—	p.n.	p.n.
	1958	p.n.	p.n.	6	69	129	218	240	160	22	p.n.	p.n.	p.n.
	1959	p.n.	p.n.	—									
NP–8	1959					111	164	150	121	43	4	p.n.	p.n.
	1960	p.n.	0	13	73	97	144	201	151	21	0	p.n.	p.n.
	1961	p.n.	p.n.	21	72	94	152	173	88	20	0	p.n.	p.n.
NP–9	1960					115	183	276	143	24	1	p.n.	p.n.
	1961	p.n.	p.n.	4									
NP–10	1962	p.n.	0	21	67	137	156	167	72	22	3	p.n.	p.n.
	1963	p.n.	0	13	79	145	246	280	121	19	0	p.n.	p.n.
	1964	p.n.	p.n.	4									
NP–11	1962					—	190	165	86	18	1	p.n.	p.n.
	1963	p.n.	0	9									
NP–12	1963					—	146	258	137	28	1	p.n.	p.n.
	1964	p.n.	0	8	—	117	108	143	119	15	0	p.n.	p.n.
	1965	p.n.	0	7									
NP–13	1964					—	179	200	134	37	3	0	p.n.
	1965	p.n.	0	15	59	127	178	196	89	26	2	p.n.	p.n.
	1966	p.n.	0	12	54	109	130	222	151	26	p.n.	p.n.	p.n.
	1967	p.n.	p.n.	4									

Table 22. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–14	1965					94	180	242	119	29	4	p.n.	p.n.
NP–15	1966					97	112	174	151	24	2	p.n.	p.n.
	1967	p.n.	p.n.	5	54	95	145	—	67	10	p.n.	p.n.	p.n.
NP–16	1968					—	166	212	111	23	0	p.n.	p.n.
	1969	p.n.	0	11	68	106	219	142	70	11	0	p.n.	p.n.
	1970	p.n.	p.n.	6	—	111	109	142	97	15	0	p.n.	p.n.
	1971	p.n.	p.n.	4	45	—	—	170	69	9	p.n.	p.n.	p.n.
NP–17	1968						143	172	92	8	0	p.n.	p.n.
	1969	p.n.	p.n.	4	—	—	119	196	100	—			
NP–19	1970	p.n.	0	—	75	122	181	224	68	50	4	p.n.	p.n.
	1971	p.n.	0	13	67	106	193	272	117	25	0	p.n.	p.n.
	1972	p.n.	p.n.	8	83	117	107	119	94	25	p.n.	p.n.	p.n.
	1973	p.n.	p.n.	8									
NP–20	1970					—	—	222	93	19	2	p.n.	p.n.
	1971	p.n.	0	14	—	110	265	219	50	13	2	p.n.	p.n.
	1972	p.n.	0	18	88								
NP–21	1972					—	151	246	146	34	—	p.n.	p.n.
	1973	p.n.	0	13	93	157	139	153	80	21	—	p.n.	p.n.
	1974	p.n.	p.n.	1									
NP–22	1974	p.n.	p.n.	—	—	103	131	192	100	—	—	p.n.	p.n.
	1975	p.n.	p.n.	8	67	—	—	—	83	—	—	p.n.	p.n.
	1976	p.n.	p.n.	5	58	144	154	143	71	13	—	p.n.	p.n.
	1977	p.n.	p.n.	6	78	—	—	285	139	34	4	p.n.	p.n.
	1978	p.n.	—	42	115	121	154	428	160	67	12	0	p.n.
	1979	p.n.	—	26	68	73	201	216	162	28	6	0	p.n.
	1980	p.n.	0	25	110	131	171	329	126	40	3	p.n.	p.n.
	1981	p.n.	p.n.	9	64	118	207	199	86	19	p.n.	p.n.	p.n.
	1982	p.n.	p.n.	1									
NP–23	1976	p.n.	—	—	—	—	186	237	134	29	—	0	p.n.
	1977	p.n.	0	—	55	101	225	348	155	13	0	p.n.	p.n.
	1978	p.n.	p.n.	4	63	184	123	272	141	26	p.n.		
NP–24	1978						214	239	156	29	4	p.n.	p.n.
	1979	p.n.	0	22	48	98	196	272	164	18	—	p.n.	p.n.
	1980	p.n.	p.n.	3	62	132	285	144	68	—	—		
NP–25	1981							160	90	33	6	p.n.	p.n.
	1982	p.n.	p.n.	18	55	111	148	179	67	10	—	p.n.	p.n.
	1983	p.n.	p.n.	—	37	80	93	177	124	14	—	p.n.	p.n.
	1984	p.n.	p.n.	1									

Table 22. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–26	1983							270	111	24	—	p.n.	p.n.
	1984	p.n.	p.n.	13	59	132	—	241	96	21	—	p.n.	p.n.
	1985	p.n.	p.n.	—	—	112	237	293	86	17	—	p.n.	p.n.
NP–27	1984							208	90	31	—	p.n.	p.n.
	1985	p.n.	p.n.	11	80	116	161	214	118	26	—	p.n.	p.n.
	1986	p.n.	p.n.	—	44	94	107	199	89	—	p.n.	p.n.	p.n.
	1987	p.n.	p.n.	4	66								
NP–28	1986							151	77	27	—	p.n.	p.n.
	1987	p.n.	p.n.	19	80	149	209	282	101	21	0	p.n.	p.n.
	1988	p.n.	p.n.	3	71	113	112	212	104	19	p.n.	p.n.	p.n.
NP–29	1987									28	4	p.n.	p.n.
	1988	p.n.	p.n.	10	50	79							
NP–30	1988	p.n.	3	18	80	98	176	222	90	41	9	0	p.n.
	1989	p.n.	2	16	86	—	112	158	106	25	—	p.n.	p.n.
	1990	p.n.	p.n.	9	60	122	147	224	183	20	—	p.n.	p.n.
NP–31	1989		1	18	49	110	254	277	116	27	2	p.n.	p.n.
	1990	p.n.	2	17	87	119	277	236	167	17	17	—	p.n.
	1991	p.n.	9	48									

Table 23. Monthly totals of the net radiation, MJ/m^2.

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–2	1950				16	101	117	184	63	–17	–50	–70	–105
	1951	–101	–109	–92									
NP–3	1954					46	272	180	84	–42	—	–75	–84
	1955	–101	–80	–96									
NP–4	1954					42	130	180	46	–34	–50	–59	–84
	1955	–101	–84	–84	–25	92	136	—	113	–29	–71	–92	–92
	1956	–63	–63	–92	–42	54	96	92	50	–42	–59	–50	–50
	1957	–63	–80	–63									
NP–5	1955					80	75	147	54	–29	–59	–80	—
	1956	–75	–80	–92	–21	84	109	147	67	–21			
NP–6	1956					50	117	214	212	–8	–46	–71	–71
	1957	–92	–80	–80	–42	42	63	117	34	–50	–50	–92	–105
	1958	–71	–92	–71	–28	63	105	176	113	–29	–54	–84	–54
	1959	–63	–54	–50	–29	38	59	169	75				
NP–7	1957					75	150	222	67	–38	–50	–101	–122
	1958	–75	–80	–75	–63	50	147	214	105	–25	–50	–59	–59
	1959	–71	–59	–46									
NP–8	1959					46	122	101	63	–21	–50	–59	–96
	1960	–84	–54	–59	–59	34	80	163	63	–29	–71	–71	–75
	1961	–71	–71	–92	–8	34	96	126	46	–42	–59	–80	–84
NP–9	1960					42	117	236	67	–21	–80	–84	–101
	1961	–84	–84	–134									
NP–10	1961											–80	–92
	1962	–75	–50	–42	–25	59	92	109	38	–21	–42	–46	–84
	1963	–71	–59	–54	–38	75	184	222	59	–42	–54	–80	–84
	1964	–75	–59	–54									
NP–11	1962					67	138	147	50	–34	–46	–54	–71
	1963	–80	–71	–71									
NP–12	1963					59	92	193	38	–25	–63	–75	–84
	1964	–109	–75	–75	—	25	67	92	67	–29	–67	–67	–80
	1965	–84	–59	–46									
NP–13	1964					—	—	150	88	–21	–42	–59	–92
	1965	–75	–75	–46	–42	29	88	138	50	–59	–71	–63	–101
	1966	–117	–105	–84	–50	21	71	184	84	–29	–63	–96	–71
	1967	–92	–96	–63									

Table 23. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–14	1965					—	105	168	63	–25	–54	–46	–71
	1966	–80											
NP–15	1966					34	50	109	67	–38	–59	–71	–63
	1967	–92	–80	–75	–67	–25	54	101	25	–25	–50	–71	–50
	1968	–59	–75										
NP–16	1968					63	88	113	42	–34	–50	–84	–75
	1969	–92	–75	–84	–25	42	172	88	29	–21	–46	–75	–84
	1970	–96	–84	–109	–25	46	67	88	50	–38	–84	–71	–84
	1971	–96	–71	–80	–38	46	105	117	17	–34	–54	–67	–50
	1972	–46	–67										
NP–17	1968					—	92	142	59	–25	–54	–80	–71
	1969	–75	–50	–75	–38	—	80	147	34	–29			
NP–19	1969	—	—	—	—	—	—	—	—	—	—	—	—
	1970	—	–67	—	—	13	84	105	–8	–17	–50	–29	–46
	1971	–67	–59	–71	0	—	—	130	46	–17	–46	–71	–46
	1972	–33	–46	–46	—	—	—	—	29	0	—	—	–42
	1973	–37	–52	–51									
NP–20	1970					—	—	138	38	–17	–50	–54	–71
	1971	–80	–71	–59	–25	0	126	101	–8	–46	–67	–84	–84
	1972	–84	–92	–71	–42								
NP–21	1972					—	96	150	—	—	–105	–142	—
	1973	—	–67	–71	–13	—	17	84	21	–29	–54	–80	–71
	1974	–54	–54	–54									
NP–22	1974	—	—	—	—	—	—	—	—	—	–29	–80	–54
	1975	–84	–54	–54	–17	67	138	34	4	–34	–21	–42	–59
	1976	–59	–50	–54	–8	—	—	—	—	–29	–67	–71	–67
	1977	–54	–59	–75	—	—	—	—	—	–8	–50	–67	–71
	1978	–92	–59	–50	—	—	—	—	—	—	–75	–59	–75
	1979	–54	–54	–92	–29	—	—	—	—	—	–42	–84	–67
	1980	–50	–52	–34	—	—	—	—	—	—	–68	–65	–68
	1981	–83	–75	–65	—	—	—	—	11	–40	–42	–64	–87
	1982	–77	–63	–39									
NP–23	1976	—	—	—	—	—	—	—	—	—	—	–75	—
	1977	–59	–67	–67	–21	–8	84	289	122	–34	–42	–59	–75
	1978	–80	–71	–71	–29	54	—	—	—	–38	–34		
NP–24	1978						—	—	—	–29	–50	–67	–92
	1979	–50	–54	–54	12	—	—	—	—	–25	–54	–67	–71
	1980	–65	–71	–56	–43	–20	—	—	—	–32	—		

Table 23. (continued).

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP–25	1981							—	—	—	–44	–62	—
	1982	–76	—	–65	10	—	—	—	—	—	–33	–53	–54
	1983	–61	–54	–67	–35	—	—	—	—	—	–47	–64	–72
	1984	–70	–52	–70									
NP–26	1983							—	—	—	–57	–92	–84
	1984	–66	–58	–62	—	—	—	—	—	—	–71	–77	–88
	1985	–95	–77	—	—	—	—	—	—	—	–58	–57	–90
	1986	–74	–58										
NP–27	1984							—	—	—	–34	–47	–55
	1985	–68	–63	—	–52	–33	90	137	33	–17	–34	–58	–53
	1986	–82	–55	–64	–24	62	158	—	—	—	–45	–60	–75
	1987	–67	–67	–87									
NP–28	1986							—	—	—	–56	–39	–41
	1987	–58	–69	–71	—	—	—	—	—	—	–86	–104	–105
	1988	–77	–69	–57	—	—	—	—	—	—	–59	–71	–76
NP–29	1987										–48	–64	–148
	1988	–62	–50	–65	—	—							
NP–30	1988	–43	–54	–60	—	—	—	—	—	—	–42	–80	–83
	1989	–95	–58	–52	—	—	—	—	—	—	–51	–57	–61
	1990	–43	–41	–52	—	—	—	—	—		–55	–86	–84
	1991	–62	–94										
NP–31	1989		–37	–53	—	—	—	—	—	—	–53	–94	–70
	1990	–73	–60	–46	—	—	—	—	—	—	–54	–88	–84
	1991	–63	–65	–32									

Appendix A
ACTINOMETRIC INSTRUMENTS AND MEASUREMENT METHODS

Ю. Д. ЯНИШЕВСКИЙ

АКТИНОМЕТРИЧЕСКИЕ ПРИБОРЫ И МЕТОДЫ НАБЛЮДЕНИЙ

ГИМИЗ

ГИДРОМЕТЕОРОЛОГИЧЕСКОЕ ИЗДАТЕЛЬСТВО
ЛЕНИНГРАД • 1957

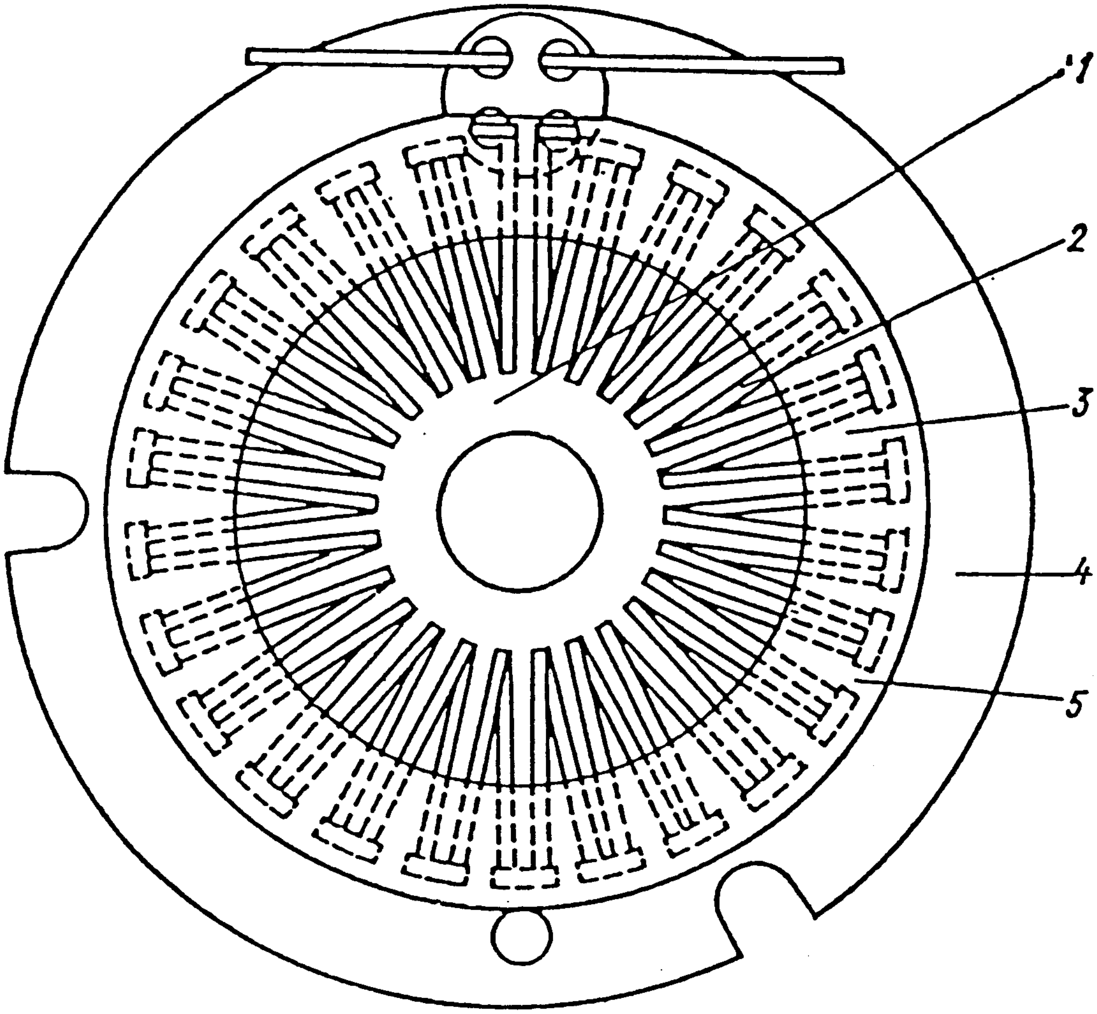

Рис. 3.2. Термобатарея актинометра М-3.

1 — приемник солнечной радиации, *2* — активные спаи, *3* — пассивные спаи, *4* — медное кольцо, *5* — изолятор (папиросная бумага).

Figure A1. M-3 actinometer's thermobattery. 1. Receptor of solar radiation. 2. Active junctions. 3. Passive junctions. 4. Cooper ring. 5. Insulator (tissue paper).

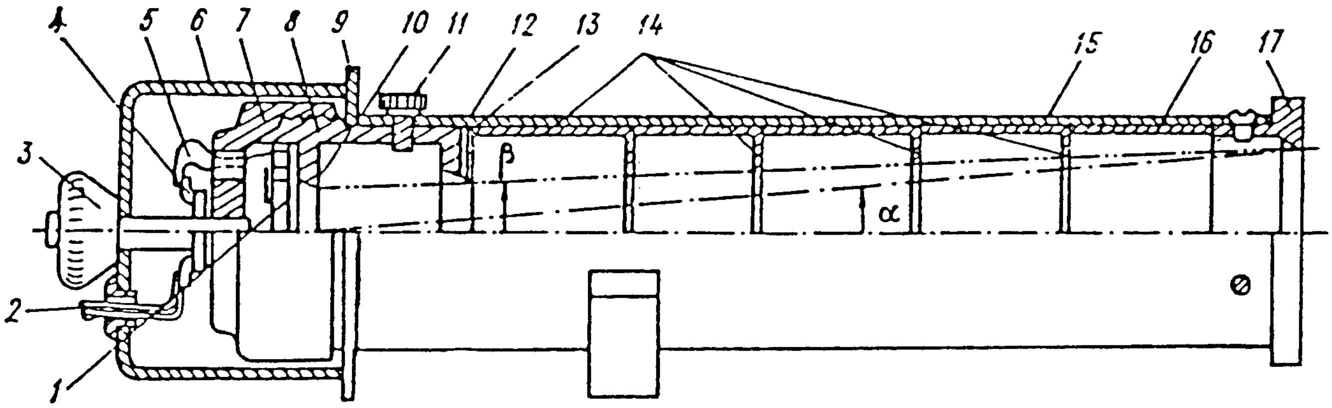

Рис. 3.3. Актинометр М-3.

1 — медное кольцо, 2 — гибкий кабель, 3 — гайка, 4 — скобы-клеммы, 5 — проводники, 6 — чехол, 7 — чашка, 8 — втулка, 9 — кольцо, 10 — наименьшая диафрагма, 11 — винт, 12 — плоская шайба, 13 — шайба пружинящая, 14 — диафрагмы, 15 — трубка, 16 — распорка, 17 — кольцо.

Figure A2. M-3 actinometer. 1. Cooper ring. 2. Flexible cable. 3. Nut. 4. Terminal clamps. 5. Conductors. 6. Case. 7. Cup. 8. Collar. 9. Ring. 10. Smallest diaphragm. 11. Screw. 12. Plane washer. 13. Spring washer. 14. Diaphragms. 15. Pipe. 16. Spacer. 17. Ring.

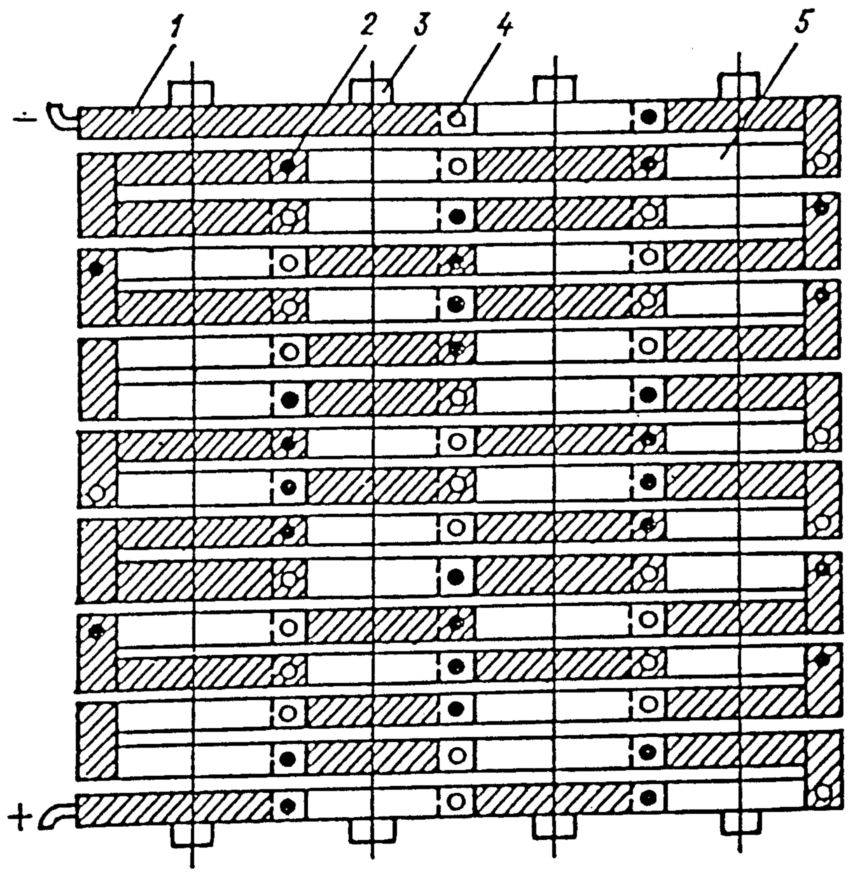

Рис. 3.4. Термобатарея пиранометра М-115М.

1 — ленточки манганина, 2 — четные спаи, 3 — охлаждающие ребра, 4 — нечетные спаи, 5 — ленточки константана.

Figure A3. M-115M pyranometer's thermobattery. 1. Manganine tapes. 2. Even junctions. 3. Cooling ribs. 4. Odd junctions. 5. Constantan tapes.

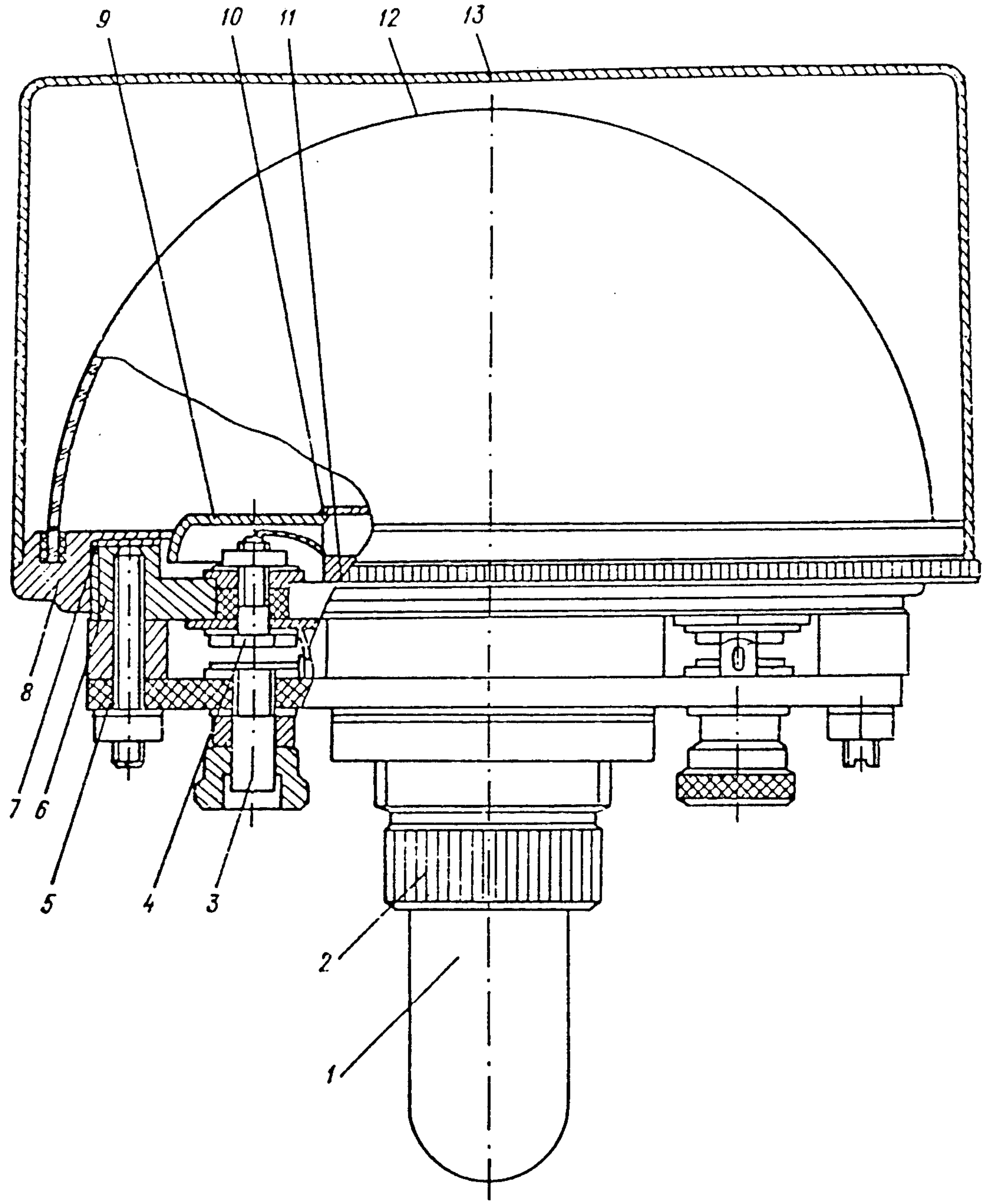

Рис. 3.5. Головка пиранометра М-115М.

1 — стеклянная сушилка, *2* — оправа сушилки, *3* — клемма, *4* — гермоввод, *5* — прокладка, *6* — корпус, *7* — герметизирующая прокладка, *8* — кольцо, *9* — диафрагма, *10* — батарея, *11* — оправа, *12* — стеклянный колпак, *13* — металлическая крышка.

Figure A4. M-115M pyranometer's head. 1. Glass dryer. 2. Dryer's holder. 3. Clamp. 4. Pressurized input. 5. Separator. 6. Frame. 7. Sealing gasket. 8. Ring. 9. Diaphragm. 10. Battery. 11. Holder. 12. Glass hood. 13. Metal cover

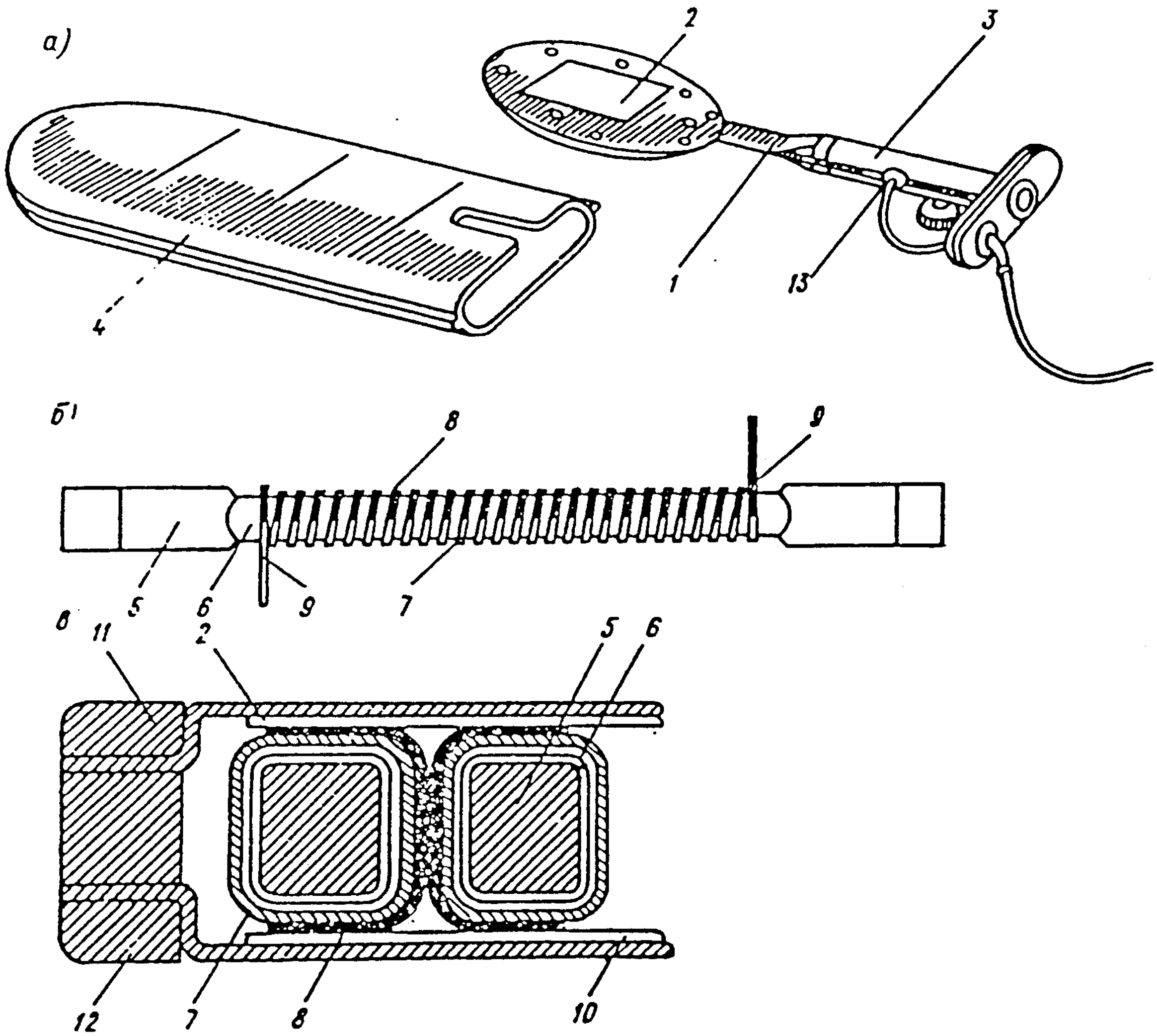

Рис. 3.6. Балансомер М-10М.

а — внешний вид, *б* — отдельная секция термобатареи, *в* — поперечное сечение термобатареи.
1 — корпус, *2* — приемные пластины, *3* — рукоятка, *4* — чехол, *5* — медный брусок, *6* — изолирующий слой, *7* — константановая лента, *8* — слой серебра, *9* — выводы, *10* — изоляция, *11*, *12* — латунные рамки, *13* — сальник.

Figure A5. M-10M balansometer: a. Appearance. b. Separate cell of the thermobattery. c. Thermobattery's cross section. 1. Housing. 2. Receiving plates. 3. Handle. 4. Case. 5. Cooper bar. 6. Dielectric layer. 7. Constantan tape. 8. Silver bed. 9. Terminals. 10. Insulation. 11,12. Small brass frames. 13. Stuffing box.

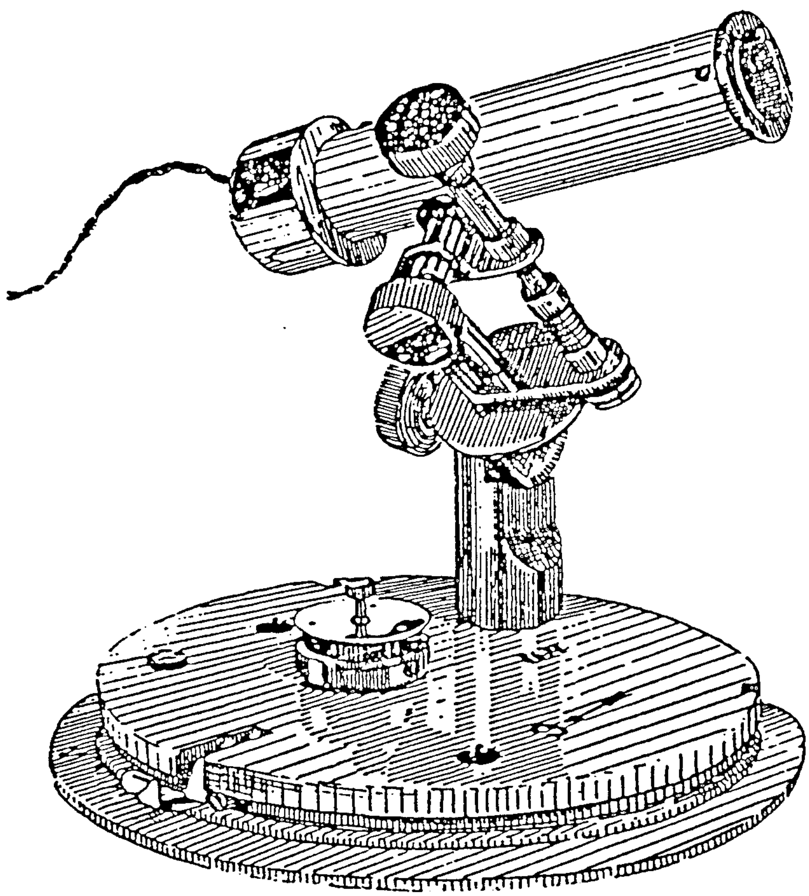

Рис. 5. Внешний вид термоэлектрического актинометра нового выпуска.

Figure A6. Appearance of the new thermoelectric actinometer.

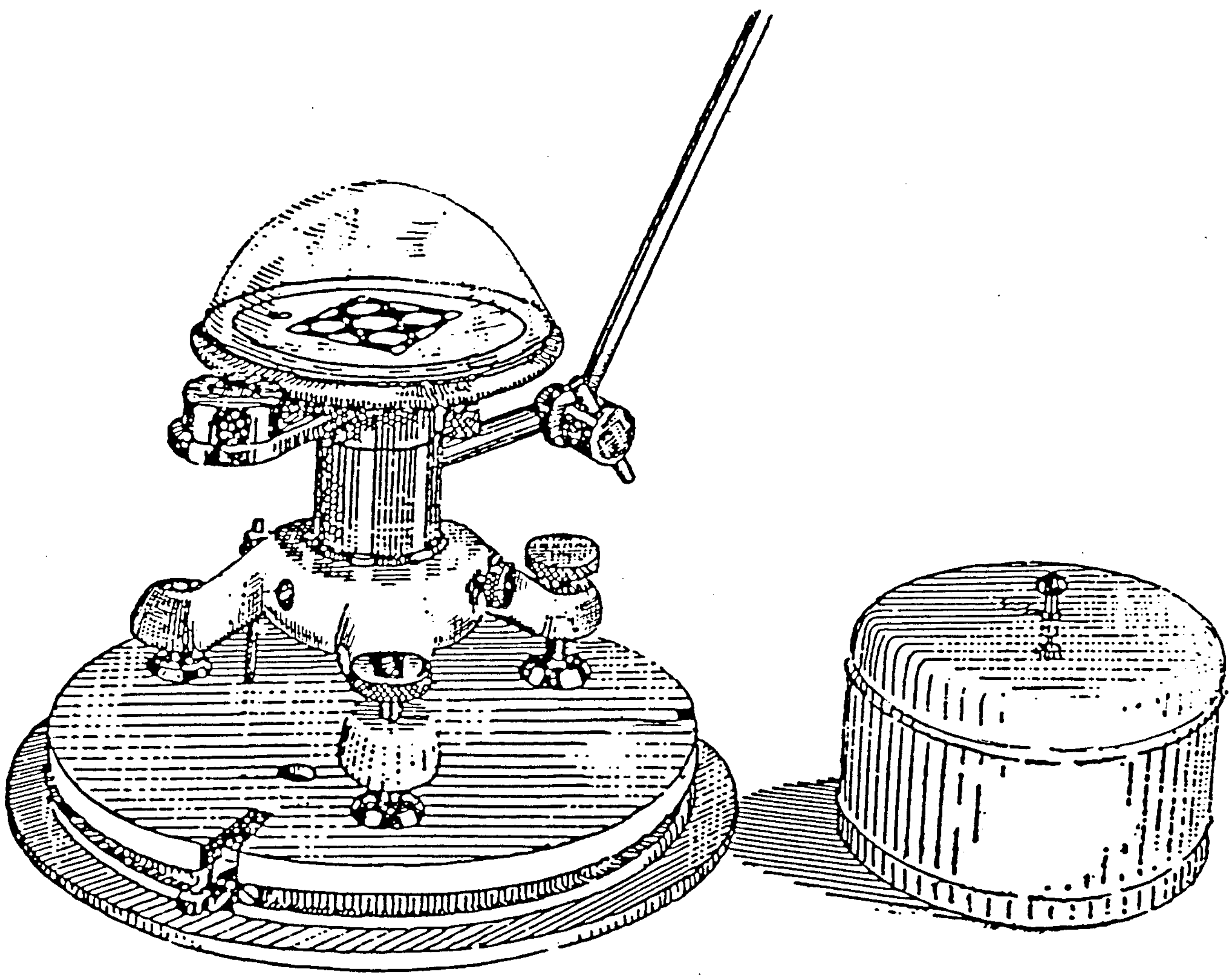

Figure A7. Appearance of the M-115M pyranometer.

BIBLIOGRAPHY

1. Yu.D. Yanishevsky, Actinometric Instruments and Methods of the Measurements. Leningrad: Gidrometeoizdat, 1957, 416 pp. (in Russian)

2. Manual on Actiometric Observations for Hydrometeorological Stations. Leningrad: Gidrometeoizdat, 1971, 220 pp. (in Russian)

Appendix B
MEAN MONTHLYPOSITIONS

Mean monthly positions

Station	Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP-2	1950	°N Lat				87.94	76.32	76.57	77.31	78.48	79.11	78.98	79.94	80.59
		°E Lon				-5.46	-167.4	-169.79	-168.58	-168.16	-167.25	-164.55	-159.5	-160.89
	1951	°N Lat	80.68	80.67	80.68	81.38								
		°E Lon	-162.24	-162.38	-160.29	-161.48								
NP-3	1954	°N Lat				81.44	86.76	87.06	87.13	88.06	89.16	89.41	88.76	88.37
		°E Lon				-162.48	-176.36	-176.2	-163.09	-153.04	-138.79	-66.53	-78.34	-68.04
	1955	°N Lat	88.22	87.24	86.42	86.17								
		°E Lon	-57.26	-34.57	-28.69	-33.94								
NP-4	1954	°N Lat											86.05	80.79
		°E Lon											-35.1	178.97
	1955	°N Lat	80.34	80.36	80.59	80.39	80.71	81.1	81.62	81.99	82.44	83.27	84.88	85.49
		°E Lon	-137.71	-175.58	-173.43	-173.6	-176.22	-177.61	-178.34	-176.08	-172.02	-174.7	84.79	-3.69
	1956	°N Lat	86.33	87	86.75	87.1	87.48	87.84	88.55	89.44	88.27	88.34	87.16	86.74
		°E Lon	-175.94	15.61	-159.76	-173.96	-161.83	165.28	-171.21	43.81	70.83	48.75	31.85	23.09
	1957	°N Lat	87.22	86.89	86.74	86.76								
		°E Lon	14.53	9.06	6.7	-3.25								
NP-5	1955	°N Lat				86.44	82.25	82.72	83.6	84.11	84.52	84.77	85.03	85.7
		°E Lon				-1.32	154.99	152.76	151.97	153.34	152.71	145.3	129.6	118.78
	1956	°N Lat	86.43	86.56	86.25	86.46	86.4	86.54	86.3	84.91	84.19	84.73		
		°E Lon	102.41	88.09	98.6	93.52	87.54	78.35	64.88	68.1	76.34	70.15		
NP-6	1956	°N Lat				84.32	74.67	74.88	75.3	74.8	74.83	75.1	75.92	75.85
		°E Lon				63.82	-178.11	55.31	176.9	-107.78	-72.8	176.52	174.61	174.13
	1957	°N Lat	75.26	74.91	75.24	75.62	76.18	76.86	77.51	78.16	77.58	77.32	77.21	77.69
		°E Lon	174.66	175.41	172.58	169.67	166.7	163.67	161.12	157.9	160.6	163.92	161.23	157.1
	1958	°N Lat	78.56	78.97	79.71	80.37	81.09	81.24	82.49	83.45	84.74	85.38	85.3	85.95
		°E Lon	152.35	153.02	153.24	151.47	148.66	147.57	141.38	136.14	124.6	113.84	117.02	115.71
NP-7	1957	°N Lat					86.84	82.5	83.26	84.4	86.07	87.17	86.75	86.14
		°E Lon					95.7	-164.1	-163.35	-169.94	-84.09	166.61	167.93	-44.19
	1958	°N Lat	85.75	85.7	85.97	86.11	86.41	86.37	86.81	87.11	87.23	87.58	87.52	86.9
		°E Lon	-168.8	-160.94	-155.08	-152.33	-149.62	-147.91	-138.56	-126.76	-109.92	-80.78	-67.6	-61.86
	1959	°N Lat	86.42	86.3	86.12									
		°E Lon	-63.52	-62.5	-59.07									
NP-8	1959	°N Lat						85.64	77.13	78.06	78.02	78.3	78.28	78.05
		°E Lon						-43.83	-165.6	-167.61	-170.77	-176.73	-177.29	-176.08
	1960	°N Lat	77.8	77.46	77.91	78.74	79.22	79.74	79.99	80.21	80.48	81.04	82.44	83.22
		°E Lon	-173.29	-172.31	-176.06	-108.67	179.52	96.03	20.59	142.98	-120.15	93.66	-178.42	-172.42
	1961	°N Lat	83.63	83.85	83.73	83.64	83	83.27	83.74	83.14	83.01	82.95	82.37	82.33
		°E Lon	-165.4	-158.52	-153.67	-151.21	-149.47	-148.14	-144.15	-146	-149.25	-147.59	-143.4	-142.62
	1962	°N Lat	82.88	82.96	82.79									
		°E Lon	-138.26	-134.79	-132.87									
NP-9	1960	°N Lat					83.17	77.67	77.77	77.73	78.94	80.09	81.75	83.41
		°E Lon					-132.17	162.75	163.21	161.31	159.44	154.18	153.99	157.39
	1961	°N Lat	84.66	85.51	86.04									
		°E Lon	162.88	166.76	175.27									

Mean monthly positions (continued)

Station	Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP-10	1961	°N Lat										86.49	75.14	75.47
		°E Lon										178.85	175.17	171.91
	1962	°N Lat	75.24	75.46	75.9	76.59	77.35	77.89	78.31	77.86	77.73	77.88	78.57	79.4
		°E Lon	170.41	170.22	168.61	164.24	161.97	162.01	158.56	157.56	160.44	160.8	160.98	160.66
	1963	°N Lat	79.1	79.64	80.4	80.97	80.86	81.68	81.83	82.79	82.92	83.41	84.1	84.55
		°E Lon	161.33	159.99	159.73	158.39	155.89	153.76	149.92	144.89	142.76	142.53	142.1	143.65
	1964	°N Lat	85.69	86.84	87.86	88.42								
		°E Lon	142.17	135.58	124.6	104.6								
NP-11	1962	°N Lat					88.71	77.59	78.74	80.24	81.24	81.67	81.6	82.13
		°E Lon					85.35	-167.08	-165.76	-161.52	-153.74	-155.25	-150.93	-148.31
	1963	°N Lat	81.97	81.37	81.27	81.38								
		°E Lon	-145.42	-141.78	-138.27	-137.72								
NP-12	1963	°N Lat					80.96	77.08	77.14	78.03	77.91	78.3	78.68	78.7
		°E Lon					-138.4	-167.31	-169.95	-172.56	-174.56	-177.62	-173.96	-175.65
	1964	°N Lat	79.69	80.49	80.69	81.03	81.17	81.56	82.52	82.26	82.79	83.06	83.35	83.03
		°E Lon	-173.58	-171.66	-170.14	-168.23	-166.42	-164.85	-162.22	-160	-155.75	-157.82	-157.81	-152.03
	1965	°N Lat	82.32	82.02	81.17	80.85								
		°E Lon	-150.99	-149.4	-146.51	-146.06								
NP-13	1964	°N Lat					81.14	74.04	74.62	74.52	75.12	75.83	76.09	76.1
		°E Lon					-146	-167.84	-167.69	-166.85	-167.94	-175.05	-178.38	109.4
	1965	°N Lat	76.5	77.23	77.74	77.76	78.19	78.3	79.56	80.4	80.13	80.4	80.74	80.54
		°E Lon	172.59	169.87	167.98	168.16	165.84	163.48	160.28	155.86	157.12	154.04	156.19	146.72
	1966	°N Lat	80.45	80.95	81.6	82.11	82.21	82.91	83.83	83.69	84.65	86.7	87.86	88.86
		°E Lon	142.74	145.49	140.67	135.89	133.46	132.51	133.67	133.38	134.49	143.71	133.05	121.33
	1967	°N Lat	88.98	89.14	89.01	88.41								
		°E Lon	145.08	91.01	44.2	14.48								
NP-14	1965	°N Lat					88.24	74.64	75.41	75.79	75.5	76.01	76.28	76.45
		°E Lon					2	-176.57	38.7	173.37	171.3	167.95	165.99	161.52
	1966	°N Lat	76.51	76.65										
		°E Lon	159.1	159.16										
NP-15	1966	°N Lat				76.98	78.78	79.17	79.51	79.41	79.84	80.5	81.37	82.41
		°E Lon				155.8	168.92	169.53	172.73	175.46	173.93	174.6	168.32	163.11
	1967	°N Lat	82.5	82.89	83.65	84.26	84.61	85.68	86.39	86.41	86.11	86.35	87.9	88.9
		°E Lon	162.08	163.19	162.65	165.89	167.4	161.63	155.89	157.57	154.42	160.79	159.05	151.17
	1968	°N Lat	89.56	88.35	87.24									
		°E Lon	8.41	-11.8	-9.53									
NP-16	1968	°N Lat					86.6	75.64	76	76.4	78.13	78.96	78.95	80.04
		°E Lon					-9.77	-178.02	-177.53	31.99	177.33	-165.8	-166.42	177.28
	1969	°N Lat	80.52	80.96	80.81	80.97	81.57	82.13	82.88	83.45	82.43	83.25	84.1	84.31
		°E Lon	177.36	176.15	176.19	177.49	177.53	176.58	136.22	-61.68	173.57	174.05	-2.92	-175.21
	1970	°N Lat	84.26	84.21	83.47	83.32	83.23	83.49	84.01	84.27	84.62	85.54	85.13	85.52
		°E Lon	-170.77	-162.27	-156.34	-154.3	-153.13	-150.09	-146.74	-143.85	-140.37	-133.83	-139.25	-135.36
	1971	°N Lat	85.64	85.75	85.62	85.8	85.96	86.01	86.07	85.94	86.46	86.58	87.01	86.63
		°E Lon	-131.66	-127.6	-123.04	-121.05	-118.66	-117.21	-111.78	-104.2	-100.68	-103.4	-94.36	-90.65
	1972	°N Lat	86.58	86.28	86.04									
		°E Lon	-81.61	-87.34	-87.11									

Mean monthly positions (continued)

Station	Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP-17	1968	°N Lat					85.99	81.58	82.2	83.54	84.85	85.41	86.16	87.08
		°E Lon					-87.05	165.72	166.73	169.06	166.64	154.94	145.09	134.14
	1969	°N Lat	87.71	88.14	88.57	88.92	88.79	88.5	88.21	87.76	87.52			
		°E Lon	133.32	113.71	130.34	113.14	72.58	51.68	36.32	44.03	50.68			
	1970	°N Lat	85.61	76.11	76.76	77.09	77.3	78.04	78.33	78.29	78.61	77.74	77.96	78.69
		°E Lon	156.24	156.18	153.16	150.49	148.53	143.7	143.39	145.8	147.7	151.55	150.1	148.27
NP-19	1971	°N Lat	79.46	80.35	80.72	80.62	81.39	81.75	82.76	83.64	83.19	83.7	84.88	86.21
		°E Lon	146.9	143.95	148.63	151.27	149.05	149.66	140.99	139.58	139.38	143.27	140.22	131.24
	1972	°N Lat	87.03	87.42	88.28	88.49	89.06	89.43	89.79	89.32	88.41	88.2	87.44	87.18
		°E Lon	119.13	139.99	150.35	153.8	137.82	89.93	92.37	8.56	-7.18	-33.96	-35.17	-36.98
	1973	°N Lat	87	85.75	85.29	84.58								
		°E Lon	-59.08	-47.4	-40.75	-30.8								
NP-20	1970	°N Lat					83.73	76.69	77.39	77.59	78.17	78.58	77.34	77.96
		°E Lon					-20.53	173.2	171.12	175.81	175.3	-57.12	-176.13	-176.68
	1971	°N Lat	78.65	79.07	78.99	78.84	79.21	79.1	80.4	81.38	80.97	80.24	80.26	80.97
		°E Lon	-176.1	-179.41	-176.81	-175.86	-175.82	-175.09	-177.8	-174.99	-174.7	-172.95	-173.05	-175.55
	1972	°N Lat	81.81	81.05	81.02	81.04	81.25							
		°E Lon	-174.72	-172.43	-168.29	-167.58	-166.46							
NP-21	1972	°N Lat					81.69	74.94	75.52	76.02	77.07	77.69	77.91	77.7
		°E Lon					-166.19	174.9	170.82	171.08	169.6	164.26	167.2	166.25
	1973	°N Lat	77.84	78.39	78.87	79.3	79.85	80.44	81.27	81.64	81.77	82.22	83.05	83.66
		°E Lon	161.91	161.71	161.18	161.67	159.01	156.31	158.51	158.06	155.03	146.15	139.73	135.33
	1974	°N Lat	84.45	85.03	84.68	84.9	85.78							
		°E Lon	129.2	132.1	143.53	145.5	148.44							
NP-22	1973	°N Lat										86.03	76.72	77.78
		°E Lon										146.04	-116.99	177.57
	1974	°N Lat	78.55	78.6	77.81	78.03	78.11	78.47	79.25	80.12	81.01	81.53	82.25	82.18
		°E Lon	172.97	174.29	125.81	-178.5	-178.1	-178.74	124.24	-95.17	-171.39	-172.75	-175.89	-175.3
	1975	°N Lat	82.28	82.37	82.95	83.42	83.78	83.98	84.16	83.96	83	82.9	83.15	83.78
		°E Lon	-173.55	-171.13	-169.84	-170.16	-171.33	-168.45	-167.81	-163.71	-162.76	-160.65	-155.63	-154.18
	1976	°N Lat	84.09	84.63	84.16	83.88	83.56	83.4	83.31	83.35	83.76	84.29	84.25	84.3
		°E Lon	-149.44	-143.64	-142.52	-140.43	-141.19	-140.85	-139.07	-137.34	-133.89	-128.9	-126.17	-124.99
	1977	°N Lat	83.84	82.92	82.38	82.08	82.03	81.93	81.63	80.29	79.37	79.1	78.45	77.01
		°E Lon	-124.5	-126.94	-128.83	-129.15	-129.25	-127.32	-127.11	-128.47	-128.05	-127.06	-127.69	-132.08
	1978	°N Lat	76.19	76.03	75.47	75.22	75.09	74.67	74.27	74.55	73.7	73.63	73.35	73.15
		°E Lon	-132.2	-132.58	-133.96	-136.2	-137.01	-140.62	-142.21	-145.57	-146.02	-150.84	-156.01	-158.04
	1979	°N Lat	73.81	74.78	74.98	75.05	74.89	75.24	75.67	75.55	76.39	76.79	77.04	77.08
		°E Lon	-161.97	-166.96	-170.13	-171.31	-172.24	-174.35	-177.79	-178.32	140.27	168.24	161.44	159.34
	1980	°N Lat	77.27	77.65	77.92	78.25	78.58	79.16	79.77	81	80.58	79.63	80.79	81.7
		°E Lon	158.04	157.03	153.94	153.62	152	147.86	145.4	139.78	143.23	150.44	153.66	151.8
	1981	°N Lat	82.06	82.96	83.68	84.36	85.43	86.34	87.56	87.81	87.69	87.18	88.16	89.25
		°E Lon	150.03	152.32	157.71	159.66	156.49	150.26	138.52	123.23	120.4	123.33	139.36	125.78
	1982	°N Lat	88.94	88.26	87.11									
		°E Lon	48.15	19.6	8.41									

Mean monthly positions (continued)

Station	Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP-23	1975	°N Lat												86.47
		°E Lon												3.84
	1976	°N Lat	73.87	74.3	73.9	74.08	73.89	74.06	74.68	74.73	75.46	75.76	76.15	76.15
		°E Lon	-177.89	-177.15	-175.67	-177.71	-178.22	120.31	175.43	175.16	175.14	175.41	173.28	172.82
	1977	°N Lat	76.28	76.48	76.58	76.79	77.09	77.96	79.09	80.98	82.32	83.14	83.57	84.07
		°E Lon	171.91	168.54	166.94	164.55	163.73	164.32	161.13	158.26	155.48	153.03	150.74	152.72
	1978	°N Lat	84.94	86.25	87.1	88.15	88.53	88.92	89.47	89.67	89.2	88.68		
		°E Lon	158.2	154.14	148.88	146.04	144.85	151.76	147.42	16.29	41.48	11.99		
NP-24	1978	°N Lat					88.21	75.97	76.7	77.29	77.08	77.55	78.23	79.03
		°E Lon					-23.85	165.13	163.23	158.23	158.39	157.63	156.43	158.58
	1979	°N Lat	79.35	79.87	80.12	80.71	80.92	81.85	82.5	82.18	82.34	82.17	83.12	83.74
		°E Lon	155.84	152.13	150.06	148.79	147.87	144.15	141.54	143.13	143.45	135.86	134.07	132.91
	1980	°N Lat	84.42	85.79	86.42	86.99	87.47	88.1	88.51	88.54	87.83	87.27	86.6	
		°E Lon	127.51	131.09	129.51	128.57	130.03	128.56	106.81	49.98	47.57	62.24	49.36	
NP-25	1981	°N Lat					86.06	75.27	76.47	76.6	76.42	76.53	77.44	78.05
		°E Lon					34.52	169.29	167.38	165.83	166.74	166.74	162.89	163.72
	1982	°N Lat	78.9	79.97	81.08	81.28	81.62	82.32	83.74	84.49	84.7	85.3	85.47	84.95
		°E Lon	163.02	160.9	162.05	164.93	164.18	160.93	156.81	159.9	161.9	168.48	-37.49	-169.99
	1983	°N Lat	84.84	84.84	84.93	84.14	84.12	83.96	84.21	84.55	84.59	85.48	85.78	86.12
		°E Lon	-162.4	-155.37	-149.56	-144.15	-142.32	-140.7	-139.47	-134.38	-135.28	-137.02	-140.65	-135.26
	1984	°N Lat	85.76	85.71	85.64	85.63								
		°E Lon	-130.74	-127.18	-125.48	-122.47								
NP-26	1983	°N Lat							85.81	78.93	79.41	79.23	79.13	79.35
		°E Lon							-120.99	178.46	177.28	177.42	177.05	175.81
	1984	°N Lat	80.13	80.53	80.02	80.04	80.35	80.86	81.72	81.72	81.36	81.5	81.9	82.03
		°E Lon	177.62	175.62	173.24	172.47	174.46	177.35	178.92	179.32	178.62	177.22	172.84	168.78
	1985	°N Lat	81.88	81.96	81.81	82.11	82.28	82.38	82.58	82.9	82.86	82.22	81.67	81.83
		°E Lon	165.58	164.84	165.85	165.68	165.65	166.35	168	166.88	168.11	170.87	173.67	171.15
	1986	°N Lat	81.93	81.9	82.38									
		°E Lon	174.32	175.63	174.28									
NP-27	1984	°N Lat						82.65	78.75	78.3	77.98	78.39	78.52	79.06
		°E Lon						172.24	160.78	161.62	160.6	162.27	165.19	165.24
	1985	°N Lat	79.77	79.92	79.92	80.07	80.71	81.15	81.5	82.44	81.99	81.72	81.55	82.33
		°E Lon	163.81	163.58	160.75	161.79	160.32	158.65	155.78	152.66	150.47	152.28	151.52	154.52
	1986	°N Lat	82.72	83.54	84.45	85.32	86.07	87.08	87.35	87.34	87.23	87.49	87.89	88.3
		°E Lon	150.29	147.97	147.45	146.9	143.51	125.96	111.38	106.56	109.88	102.25	74.55	43.61
	1987	°N Lat	87.96	88.58	88.47	87.46	87.05							
		°E Lon	28.54	17.98	1.85	2.31	2.49							
NP-28	1986	°N Lat					86.6	80.79	81.43	81.84	81.49	81.05	81	81.72
		°E Lon					6.86	168.02	167.21	167.88	164.59	161.65	167.68	167.42
	1987	°N Lat	81.99	80.94	80.94	81.68	82.26	82.26	83.35	84.52	85.11	84.35	85.13	86.1
		°E Lon	167.48	169.43	168.53	168.4	168.39	167.14	163.02	162.14	163.61	152.79	162.9	167.05
	1988	°N Lat	86.57	87.04	87.71	88.27	89.27	88.8	88.04	88.07	88.16	87.84	86.7	85.59
		°E Lon	169.53	141.21	-125.44	-152.75	-58.61	-119.34	-108.42	-80.46	-69.14	-33.21	-5.36	-6.05
	1989	°N Lat	83.36											
		°E Lon	-4.18											

Mean monthly positions (continued)

Station	Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NP-29	1987	°N Lat						81.47	80.42	80.7	81.53	81.15	81.44	82.33
		°E Lon						-0.49	112.29	111.71	109.72	110.75	116.94	115
	1988	°N Lat	83.14	84.2	84.8	84.7	84.72	85.68	86.38	85.95				
		°E Lon	112.62	105.16	98.8	97.68	88.98	77.46	65.67	57.56				
NP-30	1987	°N Lat										85.36	74.54	74.79
		°E Lon										52.88	-171.76	-175.79
	1988	°N Lat	74.4	74.45	75.22	75.46	75.98	76.42	76.58	76.73	76.21	75.62	75.76	76.88
		°E Lon	-2.03	175.75	173.04	173.32	173.34	167.42	161.92	160.57	159.9	164.24	167.42	166.65
	1989	°N Lat	77.26	77.59	77.98	78.55	79.27	79.25	80.33	80.71	81.41	82.27	82.77	82.95
		°E Lon	168.87	170.85	171.07	172.88	172.18	172.08	174.47	-101.69	-174.84	-169.73	-166.08	-160.51
	1990	°N Lat	83.27	82.65	82.07	82.24	82.65	83.39	84.02	84.66	84.13	83.79	83.96	84.32
		°E Lon	-154.74	-151.08	-150.26	-149.61	-145.88	-138.13	-134.03	-128.9	-129.4	-128.78	-125.47	-121.74
	1991	°N Lat	83.85	83.7	83.01	82.51								
		°E Lon	-122.12	-124.11	-123.53	-127.49								
NP-31	1988	°N Lat												82.54
		°E Lon												-125.41
	1989	°N Lat	76.11	77.01	77.48	77.82	78.09	77.98	78.58	78.61	78.94	78.63	78.62	78.15
		°E Lon	-153.26	-154.99	-152.31	-150.28	-150.68	-150.44	-147.17	-141.78	-140.02	-139.73	-137.98	-135.8
	1990	°N Lat	77.52	76.54	76.31	76.33	76.25	76.35	76.07	75.57	74.07	73.01	73.01	73.07
		°E Lon	-135.3	-134.83	-134.64	-134.44	-133.8	-133.26	-132.89	-131.69	-131.69	-134.78	-137.41	-140.58
	1991	°N Lat	72.96	72.46	72.21	72.15								
		°E Lon	-144.37	-144.59	-145.08	-147.96								

REPORT DOCUMENTATION PAGE

Form Approved
OPM No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	December 1994	Technical

4. TITLE AND SUBTITLE
Handbook of the Radiation Regime of the Arctic Basin (Results from the Drift Stations)

5. FUNDING NUMBERS
Grant NAGW-4382

6. AUTHOR(S)
M.S. Marshunova and A.A. Mishin, edited by V.F. Radionov and R. Colony

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Applied Physics Laboratory
University of Washington
1013 NE 40th Street
Seattle, WA 98105-6698

8. PERFORMING ORGANIZATION REPORT NUMBER
APL–UW TR 9413

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
National Aeronautics and Space Administration
Dr. Robert Thomas, Polar Research, Code 45
300 E Street S.W.
Washington, DC 20546

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Unlimited distribution

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This Handbook summarizes the radiation data from the Soviet "North Pole" drifting research stations operated in the Arctic from 1950 to 1991. The Handbook contains reduced mean monthly values of the fluxes of solar radiation for solar elevations up to 35° at 5° intervals, monthly totals of the net radiation and its constituents, and mean monthly values of the albedo of the sea-ice surfaces.

The Handbook presents information of interest to specialists studying the physics of the atmosphere, climatology, geography, and related disciplines.

14. SUBJECT TERMS
Arctic, solar radiation, radiation flux, global radiation, soviet north pole drifting stations, diffuse radiation, direct radiation, albedo, arctic sea-ice, PSC/UW, AARI, meteorology, atmospheric science, climatology, geography, thermoelectric instruments

15. NUMBER OF PAGES
69

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18
299-01