National Climatic Data Center

DATA DOCUMENTATION

FOR

DATASET 9290c
Global Synoptic Climatology Network.
C. The former USSR

February 28, 2005

Version 1.0

National Climatic Data Center
151 Patton Ave.
Asheville, NC 28801-5001 USA

Table of Contents

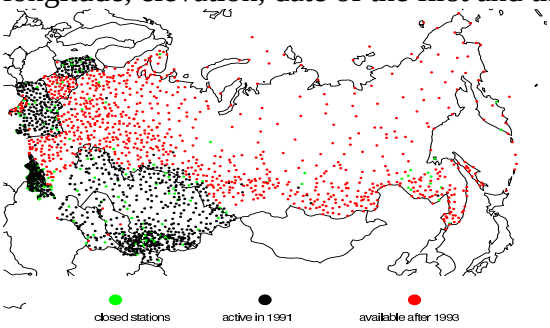
1. Abstract

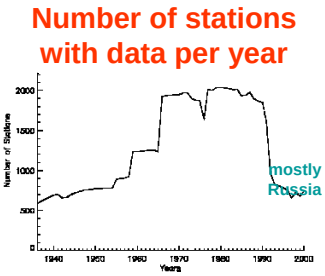
These files are a compilation of in situ hourly meteorological observations for the former USSR initially obtained within the framework of joint efforts to create Global Synoptic Climatology Network among the Meteorological Service of Canada (Downsview, Ontario and Vancouver, British Columbia), All-Russian Research Institute for Hydrometeorological Information-World Data Center of the Federal Service for Hydrometeorology and Environmental Monitoring, Obninsk, Russian Federation, and NOAA National Climatic Data Center, Asheville, North Carolina. The data in this archive have been compiled from several sources that include information delivered via the Global Telecommunication System, international exchange, and random data acquisitions. This information was verified versus the original data holdings at the national hydrometeorological archive of the Russian Federation and appended when it was necessary. These data were then pre-processed according to a standard quality control routine and generation of derived variables (e.g., some humidity characteristics were derived from others). Currently, there are mostly data for Russia but prior to 1991 the entire former USSR was covered by 2095 stations (Figure 1). The maximum period of the data span is from January 1, 1871 to January 1, 2001. Synoptic measurements were made three times a day prior to 1936 and four times a day at mean astronomic times during the 1936-1965 period. Since January 1, 1966, the measurements were made 3-hourly at Moscow Standard times (UTC+3) that can be easily converted into local standard times (LCT). There were only 75 stations with 8-hourly data prior to 1891. In the 1890s, 1900s, 1910s, and 1920s, archive was enriched with 8-hourly data from 28, 23, 32, and 30 stations respectively. Twenty six stations were added in the 1930s prior to 1936 and 463 stations were added in the 1936 alone. The increase in 1936 (and the following increase in the number of stations with available data in 1966) was not due to jump-wise increases in the network. Better archiving and digitizing of the available data were the causes. This means that some information can be (eventually) digitized and brought to light for research needs ("rescued"). The data set includes approximately 1,000 stations (mostly Russia) with 3-hourly data in the 1990s (Figure 1, right panel). Nine hundred ninety eight stations stopped reporting during the period from 1990 to 1993 with the peak years (415 and 364) in 1991 and 1992 respectively. In year 2000, the archive contains 3-hourly data of 757 stations.

Variables in the data set include sea level and station pressure, surface air temperature, water vapor pressure, relative humidity, wind speed and direction, several characteristics of cloudiness, and present weather. Each data file (extension .dat) is accompanied with a companion flags file (extension .flg). Thus, each data value is characterized by four flags: data measurement flag, quality control flag, confidence level/status flag, and data source flag.

Archive contains three types of data files:

1. **STN_ID.dat** (2095 files, 1 per station)
2. **STN_ID.flg** (2095 files, 1 per station), and
3. **ussr_hly_stn.list.txt** (1 file with essential station metadata such as station identifier, latitude, longitude, elevation, date of the first and the last records, and station name).





6-hourly and 3 hourly (since 1966) data

Figure 1. Left panel. Map of 2095 synoptic stations of the former USSR with the data available in this archive. Closed prior to 1990 stations are marked in green and the stations available in our archive in and after 1993 in red. Right panel: Data availability by year since 1936 and long-term stations (with more than 25 years of temperature observations).

2. Element Names and Definitions

2.1. File "**ussr_hly_stn.list.txt**" has 2095 lines**.** Each line contains information about one station and can be read with the help of the following FORTRAN statement:

```
      REAL lat, lon, elev
      INTEGER time_beg, time_end
      CHARACTER*11 STN_ID
      CHARACTER *30 stn_name
      CHARACTER *3 prov
       READ(*,1) STN_id,lat,lon,elev,
     *  time_beg,time_end,stn_name,repub
1     format(a11,6x,f5.2,1x,f7.2, 1x,f4.0,2(1x,i10),1x,a30,a2,a3)
```

Where

STN_ID is the station ID composed from "222" and "638" – characters that identify former USSR in the coding system initially accepted in the Global Daily Climatology Network (DSI-9101), three reserved characters "000" and 5-character expanded WMO code for station accepted by the USSR Meteorological Service. In this WMO coding system the first two-digits are associated with specific boxes of the country (Figure 2).

lat is the station latitude (degrees, N). It is provided with an accuracy to hundredths of a degree. Range from 35.28 to 80.60.

lon is the station longitude (degrees, E). It is provided with an accuracy to hundredths of a degree. Range from 54.10 to 190.17.

elev is the station elevation in meters. Range from -28 to 4169.

time_beg and **time_end** provide year, month, day, and hour with the first and the last data record respectively available for the station in the archive. Note that these dates may not indicate the starting/ending points of hourly observations at the station. Many digital records start in January 1936 and/or 1966 which were the beginning of the new observational practices at the network that participated in the data records but not the actual start of the observations at a given location. The archive contains the data for the former USSR and then mostly for the Russian Federation. We stopped the update of the archive on January 1, 2001.

stn_name provides the name of the station used in the national Catalogue (as of year 1990) and **repub** is a three letter abbreviation used for stations of the republics of the former USSR (all these republics currently are independent states; Appendix 1).

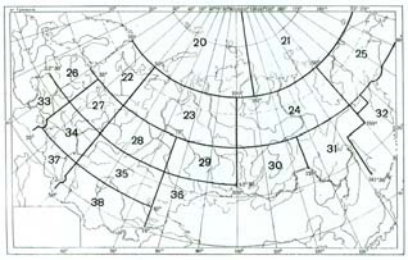


Figure 2. First two-digits allocation for the WMO station IDs.

2. 2. Each file `STN_ID`.dat contains the entire data available for STN_ID station.

The file structure is typical for the entire Global Synoptic Climatology Network (cf., DSI 9290a and 9290b).

These files were created using the following FORTRAN write statement:

```
CHARACTER*1 c37
INTEGER cldtyp(4), cloud_layer_elev(4),wea(24)
INTEGER year, month, day ,hour, minute, slp, pres, temp, vp, rh, wndspd, wndir,
op_cc, t_cc, locc, num_cld_typ, num_wx, opaque_cc, total_cc, locc
……
    WRITE (*,80) year, month, day, hour, minute, slp, pres, temp, vp, rh, wndspd,
wndir, op_cc, t_cc, c37, locc, num_cld_typ, num_wx,
      * (cldtyp(i), i=1,num_cld_typ),(wea(j),j=1,num_wx)
80  FORMAT (i4.4, 4i2.2, 1x, 2i5, 2i4, i3, 2i4, 2i3, 1x, a1 ,i3, i2, i3, 45i3.2)
```

The same record is described below in detail:

Variable	Position in the record	Meaning
Year	1 - 4	Year of the observation
month	5 - 6	Month of the observation
day	7 - 8	Day of the observation
hour	9 - 10	Hour of the observation, LST
minute	11- 12	Minute of the observation [in the USSR prior to 1965, mean astronomical times were used for meteorological observations that do not coincide with local standard times used thereafter]
slp	14 - 18	Sea Level Pressure [tenths of mB]
pres	19 - 23	Station Pressure [tenths of mB]
temp	24- 27	Dry Bulb Temperature [tenths of C]
vp	28- 31	Vapor Pressure [tenths of mB]
rh	32- 34	Relative Humidity [percent]
wndspd	35- 38	Wind Speed [tenths of m/sec]
wndir	40- 42	Wind Direction [degrees from N clockwise]
op_cc	43- 45	Opaque cloud cover [this variable is not observed in the former USSR]

t_cc	46- 48	Total cloud cover [percent]
c37	50- 50	Cloud type code (always =' ‘]
locc	51- 53	Low cloud cover [percent]
num_cld_typ	55- 55	Number of cloud types to follow (cloud types, **cld_typ**, are coded according to the WMO coding rules, cf., **DSI-3505**)
num_wx	57- 58	Number of weather codes to follow (present weather types, **wea**, are coded according to WMO coding rules)

Variable part of the record:

cld_typ	two digit numbers	Cloud types [**cld_typ(i), i=1,num_cld_typ]**
wea	two digit numbers	Weather codes [**wea(j), j=1, num_wx**]

Note about missing values. For positive values "–1" is the missing value code, for temperature, 999 in the field is used for the missing value code. See item **9.3** and **9.7** for missing information in **num_wx** and **num_cld_typ .** In practice, there were rare situations when the variable part of record was long. However, the restrictions used in array sizes for **cld_typ** and **wea** as well as in the FORMAT statements for the variable length portion of the records was never exceeded.

2.3. Each file STN_ID.flg contains the entire flag data available for STN_ID station.
This file was generated concurrently with the **STN_ID.dat** file and contains the set of four alpha-numeric flags for each variable in the data set:

slp_flag, pres_flag, temp_flag, vp_flag, rh_flag, wndspd_flag, wndir_flag,
op_cc_flag, t_cc_flag, c37_flag, locc_flag, (cldtyp_flag(i), i=1,num_cld_typ),
(wea_flag(j), j=1,num_wx).

Each variable in the file type **STN_ID.dat** containing the meteorological information is accompanied with four-character flag information.

These files were created using the following write statement:

```
20     FORMAT(i4.4, 4I2.2, 1X, 11A4, I2, I3,45A4)
       WRITE(*,20) year, month, day, hour, minute, slp_flag, pres_flag,
     +  temp_flag, vp_flag, rh_flag, wndspd_flag, wndir_flag,
     +  op_cc_flag, t_cc_flag, c37_flag, locc_flag,
     +  num_cld_typ, num_wx, (cldtyp_flag(i), i=1,num_cld_typ),
     +  (wea_flag(j), j=1,num_wx)
```

Each variable has a CHARACTER*4 description representing a string of one-character flags: [flag 1, flag 2, flag 3, flag 4] are associated with:

- Data measurement (flag 1),
- Quality control (flag 2),
- Confidence level/status (flag 3), and
- Data source (flag 4).

The individual flags can have the following values:

Flag 1: Data measurement flag
blank = measured value
E = estimated value
D = derived value
U = suspect
R = Dew point (used to estimate water vapor pressure) and/or relative humidity, originally calculated with respect to ice have been recomputed with respect to water
G = overcast skies with gaps

Flag 2: Quality control flag
blank = unknown
N = normal QC by provider of data
1 = data were subjected to GSHN version 1.0 QC procedures (replaces "N" but does not replace the "H" flag)
H = instrumental homogeneity adjusted.

Flag 3:Confidence level/status flag
0 = observed data has passed all original system checks
blank = unknown
B = value failed QC checks
C = scale corrected
D = derived value
E = edited value passed all original checks
H = homologous value, rigorously tested
I = interpolated value, not verified
M = missing value
N = not tested but within observed climatological boundaries
Q = questionable (actually wrong)
R = record-breaking value
S = Suspect value (outside climatological boundaries, not verified)
T = tested value, manually checked but not perfectly homologous
U = value suspect
These flags are a result of GSCN version 1.0 (and next steps) quality control routines and replace "blank" and "N" flags when needed.
X - exceeds known world extreme or impossible value
O - Outlier **.GE**. 6 bi-weight standard deviations from the bi-weighted mean values[1]
5 - Outlier **.GE.** 5 bi-weight standard deviations from the bi-weighted mean values
4 - Outlier **.GE**. 4 bi-weight standard deviations from the bi-weighted mean values
3 - Outlier **.GE**. 3 bi-weight standard deviations from the bi-weighted mean values
K - Value occurs 10 or more days in a row (0.0 cloudiness characteristics excluded)

[1] See [Lanzante 1996] and DSI-9101 for definitions and implementation of QC technique that use bi-weighted statistics.

Flag 4: Data source flag
blank = unknown
G = GTS
N = national meteorological service
F = foreign source (archive that was acquired not from the national source of data)
P = preliminary national data (e.g., operational update)

3. Start Date: 18710101

4. Stop Date: 20010101

5. Coverage:

a. Southernmost Latitude: 35.28 N
b. Northernmost Latitude: 80.60 N
c. Westernmost Longitude: 14.30 E
d. Easternmost Longitude: 190.17 E

6. How to Order Data:

The data are distributed free of charge for use with a non-commercial purposes according to regulations outlined in WMO resolution 40. Contact NCDC's Climate Services about costs of copying of the off-line version of this dataset.

Phone 828-271-4800
Fax 828-271-4876
e-mail NCDC.Orders@noaa.gov

7. Archiving Data Center:

Name: National Climatic Data Center/NCDC
Address: Federal Building
151 Patton Ave.
Asheville, NC 28801-5001

Phone: 828-271-4800
Fax 828-271-4876
e-mail NCDC.Orders@noaa.gov

8. Technical Contact:

Name: Pavel Ya. Groisman

Address: National Climatic Data Center
Federal Building
151 Patton Ave.
Asheville, NC 28801-5001

Voice Telephone: 828-271-4347
Facsimile Telephone: 828-271-4328
Electronic Mail Address:Pasha.Groisman@noaa.gov

9. Known Uncorrected Problems

9.1. The data represent a transformation of original USSR observational data[2] at synoptic stations into a format accepted for GSCN. Some conversions (for example, the use of dew point temperatures reported in the archived data with a 1ºC precision) were inaccurate and generated random errors.

9.2. The archived source for most of humidity information was dew point temperature that does not coincide with variables used in this data set (water vapor pressure and relative humidity). The Magnus formula was used for conversion. This explains the numerous occurrences of the "D" flag signifying that those humidity data are derived from other humidity elements. We made estimates of accuracy of humidity calculations at selected stations. These estimates show that the biases due to this substitution are negligible. Standard deviations of errors associated with the use of dew point temperatures rounded to 1°C to calculate water vapor pressure and relative humidity[3] on average are 4 mb and 3 % respectively.

9.3. It is impossible to distinguish the situations when no weather was reported versus the occasions when no data were available; thus 0 reported for **num_wx** cannot be depended upon to indicate clear weather at some stations and/or periods of time (especially prior to 1936).

9.4. Several changes in observational practice have occurred throughout the network that could affect homogeneity and/or data availability of cloudiness and humidity information. The most dramatic changes should be associated with modification of the times of observation for variables with strong diurnal changes. Prior to 1966, all observations throughout the Russian Empire (and thereafter, the former USSR) were conducted according to the "mean astronomical time" (Nastavlenie …, 1958) which is defined by the station longitude and is not affected by reallocations of time zones, introduction of "decree" times, etc. In January 1, 1966 all observations were made by Standard Moscow times (UTC+3) that could be converted to UTC and/or to local standard times (LST). But, the LST was affected by political and administrative changes in the region. For example, practically all newly independent states made specific changes in time zones to better fit their needs. These include an introduction of the "nationwide" time zone (Uzbekistan), shift to the East-European time zone, UTC +2, from the Standard Moscow Time Zone (Baltic States, Belarus, Ukraine, and Moldova), and several modifications of the LST within the Russian Federation (the latest was a switch in February 2001 of the Tomsk

[2] or archived data with a special restrictions to the data accuracy.

3 When the actual relative humidity is 100% this error remains 3% but additionally an average negative bias of 3% has been introduced to the data, because we replaced the "unrealistic" calculated relative humidity (above 100%) with 100% value but cannot fix the negative error due to inaccuracy of dew point estimates in the original data.

Oblast'[4] in Siberia from UTC+7 to UTC+6). Therefore, throughout this archive LST, we used in 1991 prior to the disintegration of the former USSR.

9.5. Wind speed information in Russia was reported first by wind vane with light board, then with wind vane with heavy board[5] and then (in the early 1970s) by anemometer. The switch from vane to anemometer itself does not cause significant inhomogeneities in mean wind speeds (Berngardt and Zavarina 1974) but reporting of strong gust winds was somehow affected due to a different period of time-averaging of the wind gauge observation (10' by the anemometer versus 2' by the wind vane (Nastavlenie …, 1985). It appears that strong winds are reported "stronger" when the wind vane is used. This was not, however, the major problem with the homogeneity of the near-surface wind reporting but rather the character of the surrounding land and its changes. Wind measurements are a part of the observing routine at each of 2095 stations of this archive. Observations are always made at dedicated meteorological sites [26 m by 26 m; Nastavlenie…, 1958, 1985] at 10 m above the ground. However, most of these sites are not located at airports. The stations' surrounding has often gradually (and uncontrollably) changed due to urbanization and/or reforestation. The resulting large scale consequences are already reported as a 50 to 100% decrease in the wind speed over the European part of the former USSR (Mescherskaya et al. 2004). In fact, the changes in wind speed at open locations are much less and should be studied separately. In the last paper, the authors found that about 70% of the wind speed change was due to changes in the instrument exposure. The user is warned about this specifically in order to avoid misjudgment. At the same time, studies that use wind speed information at a given location to trace evaporation changes *at this point* or to correct precipitation gauge measurements are unhampered. It should be clearly understood, however, that some of the changes revealed in such studies carry with them a systematic land use component. We even take the liberty to suggest that the decreasing[6] wind trends at these sites could be used to bound this component to a certain extend when comparing the data at the airports and in the "common terrain".

9.6. Overcast total and low cloudiness were reported as 99% (instead of 100). See Hahn et al. (1995) for treatment of nighttime cloud cover observations.

9.7. Several variables (sea level pressure, humidity, cloud types and present weather information) were unavailable in the original data set prior to 1936 and, thus are absent.

9.8. Opaque cloud cover observations have never been included in Russian observational practice. The position for this element was preserved in the data set but it is always missing.

9.9. The WMO-A list of stations and existing GIS boundary files were used to assign the **repub** parameter to each of stations in **ussr_hly_stn.list.txt** file. While all efforts were made to avoid erroneous assignment, we cannot guaranty absolute accuracy of these assignments near the borders. For example, manual inspection revealed several cases, when some oases and enclaves in Central Asia had the **repub** parameter assigned incorrectly by GIS due to restricted precision (to hundredths of degrees) of the stations' coordinates. The revealed errors were fixed but a few

4 Oblast' is an administrative region in Russia, Ukraine, and Byelorussia.

[5] Installations of wind vanes with heavy board has been conducted throughout the first half of the 20th century and completed in the 1950s. Comparison of two types of vanes show that the readings of vanes with light board became highly variable with strong winds. With moderate winds, both vanes deliver qualitatively similar wind speed measurements.

[6] and most of these trends are decreasing.

others may still exist.

10. Quality Statement

Control using the source data set. The data in this archive have been compiled from several sources (listed in **11**) that include information delivered via the Global Telecommunication System, international exchange, and random data acquisitions. This information was verified versus the original data holdings at the national hydrometeorological archive of the Russian Federation and appended when it was necessary. The discrepancies when they became apparent, were always treated to the benefit of the national archive data source. This was the first level of the quality control.

Statistical control. The general philosophy used in the quality control of these data is to create a data set which will cause "no harm" to the summary statistics. The other part of the philosophy is that the QC process never changes data, only flags. Therefore, if a user wishes to use every bit of data regardless of possible outliers, the flags can be ignored.

When possible, depending on the element to be checked, there are two classes of inspections; a set of within-station and another of among-station checks.

A) Within station

1) Range checks based on a single near-record value. For example, the highest sea-level pressure ever recorded was1083.8mb (12/31/68) in Siberia. Therefore this value could be used for the extreme-value flag parameter for this element.
2) Range checks based on the mean and standard deviation derived from monthly statistics from the station itself. A slight trim is used on each end of the sorted vector to eliminate possible outliers. The trim insures that there will always be a certain portion of all values that will undergo further scrutiny.
3) The data which are chosen to undergo further scrutiny are also subjected to a second-difference test which is an extremely simple but yet powerful means to detect "spikes" in a time series caused by an outlier. The suspect values are then passed to the next series of tests for further checking.

B) Among stations

1) A file containing each station ID accompanied by up to 30 nearby station IDs is created along with the distance between the target station and each neighbor.
2) Data that were flagged during the within station checks are placed in an array with 4 hrs of data before and after the suspect value. The other lines are the same but for nearby neighbors. The station number and the distance from the station to be checked follow. There can be 30 nearby neighbors, though the list is seldom large and is additionally restricted to some maximum distance (generally, 200 km).
3) A matrix of absolute differences from the "target" 4hrs before and after is produced. The consistency check consists of a series of comparisons between various rows and columns. If consistency is found within the ranges of the threshold parameters (C1-C3) and the target, the suspect value passes the QC test and is not flagged. The threshold parameters

are adjusted for each meteorological element individually. An example of the rules follows.

a) If any absolute difference on line 1 < C1, then pass.
b) If any absolute difference on neighbor's same hour (i.e. middle column) < C2 then pass.
c) If any value NOT on line 1 > than target, then pass.
d) If any absolute difference off target row and column < C3 then pass.

Disclaimer: While every effort has been made to ensure that these data are accurate and reliable within the limits of the current state of the art, NOAA and the Federal Service for Hydrometeorology and Environmental Monitoring cannot assume liability for any damages caused by any errors or omissions in the data, nor as a result of the failure of the data to function on a particular system. NOAA the Federal Service for Hydrometeorology and Environmental Monitoring make no warranty, expressed or implied, nor does the fact of distribution constitute such a warranty.

11. Essential Companion Datasets

Data description and additional information contained in these data sets can be helpful when working with this archive:

- TD-9813 Daily and Sub-daily Precipitation for the Former USSR. Data Set 9813, DSI-9813 available at http://www1.ncdc.noaa.gov/pub/data/documentlibrary/tddoc/td9813.pdf
- TD-3505 Integrated Surface Hourly Database (ISH); Data Set 3505, DSI-3505 available at http://www1.ncdc.noaa.gov/pub/data/documentlibrary/tddoc/td3505.pdf
- TD-9956 DATASAV3 Global Surface Hourly Data; Data Set 9956, DSI-9956 available at http://www1.ncdc.noaa.gov/pub/data/documentlibrary/tddoc/td9956.pdf
- TD-1300 Synoptic Surface Observations – USSR Teletype. Data Set 1300, DSI-1300 available at http://www1.ncdc.noaa.gov/pub/data/documentlibrary/tddoc/td1300.pdf
- Razuvaev, V.N., Apasova, E.G. and Martuganov, R.A. 1995. 'Six- and Three- Hourly Meteorological Observation from 223 USSR Stations', ORNL/CDIAC-66, NDP-048, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee. p. 68 + Appendices. Numerical Data Package, NDP-048 is available at http://cdiac.esd.ornl.gov/epubs/ndp/ndp048/ndp048.html

12. References

a. Berngardt, R.P. and M.V. Zavarina 1974: Climatological estimates of accuracy of measurements of strong winds. *Trans. Main Geophys. Observ*., **333**, 121-129 (in Russian).

b. Fedorova, E. G., 1966: Calculation of wind speed at the level of the precipitation gauge considering the degree of station protection. *Trans. Main Geophys. Observ*., **195**, 63-68 (in Russian).

c. Gandin, L.S. 1988: Complex Quality Control of Meteorological Observations. *Mon. Wea. Rev*., **116,** 1137-1156.

d. Golubev V.S., Bogdanova E.G., Simonenko A. Yu. The effect of blizzards on the correction method of precipitation data in Arctic region. In Proc. of the Workshop on the implementation of the Arctic precipitation data archive of the Global Precipitation Climatology Center. — Offenbach, Germany, July, 1996. WMO/TD No. 804, 1997, p.p.74-79.

e. Gruza, G.V., Rankova, E.Ya., Razuvaev, V.N. and Bulygina,O.A. 1999: Indicators of climatic change for the Russian Federation. *Climatic Change*, **42**, 219-242.

f. Hahn, C.J., Warren, S.G. and London, J. 1995. 'The effect of moonlight on observation of cloud cover at night, and application to cloud climatology', *J. Climate*, **8**, 1429-1446.

g. Hydrometeorological Service of the USSR, 1967-1970. '*Reference Book on the USSR Climate'*, Issues 1 through 34, part IV, Leningrad, Gidrometeoizdat (in Russian).

h. Lanzante, J.R., 1996: Resistant, robust and nonparametric techniques for the analysis of climate data: theory and examples, including applications to historical radiosonde station data. *Int. J. Climatol.*, **16**, 1197-1226.

i. Meshcherskaya A.V., I.F. Getman, M.M. Borisenko and E.I. Shevkunova, 2004: Wind speed monitoring on watersheds of the Volga and Ural rivers in the twentieth century. – *Russian Meteorol. Hydrol*., 2004, No. 3, 83-97

j. Nastavlenie meteorologicheskim stantsiyam i postam. Instructions to meteorological stations and posts. Issue. 3, Part I. Leningrad, Gidrometeoizdat, 1958, 223 pp. (in Russian).

k. Nastavlenie meteorologicheskim stantsiyam i postam. Instructions to meteorological stations and posts. Issue. 3, Part I. Leningrad, Gidrometeoizdat, 1985, 300 pp. (in Russian).

l. National Climatic Data Center, NCDC, 2002: Data Documentation For Data Set 9101, Global Daily Climatology Network, Version 1.0, 26 pp. [Available: at http://nndc.noaa.gov/?http://ols.nndc.noaa.gov].

m. Razuvaev, V.N., Apasova, E.G. and Martuganov, R.A. 1993. 'Daily Temperature and Precipitation Data for 223 USSR Stations', ORNL/CDIAC-56, NDP-040, ESD Publ. No. 4194, Carbon Dioxide Information Data Center, Oak Ridge National Lab., Oak Ridge, TN. 47 pp. + Appendices

n. Razuvaev, V.N., Apasova, E.G. and Martuganov, R.A. 1995. 'Six- and Three- Hourly Meteorological Observation from 223 USSR Stations', ORNL/CDIAC-66, NDP-048, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee. p. 68 + Appendices.

o. Sun B. and P. Ya. Groisman, 2000: Cloudiness variations over the former Soviet Union. *Internat. J. Climatol.*, **20**, 1097-1111.

p. Sun, B. and P.Ya. Groisman, 2004: Variations in low cloud cover over the United States during the second half of the 20th century. *J. Climate,* **17**, 1883-1888.

q. Sun, B., Groisman, P.Ya., and I. I. Mokhov, 2001: Recent Changes in Cloud Type Frequency and Inferred Increases in Convection over the United States and the Former USSR. *J. Climate,* **14**, 1864-1880.

r. Sun, B., P. Ya. Groisman, R. S. Bradley, and F. T. Keimig, 2000: Temporal Changes in the Observed Relationship between Cloud Cover and Surface Air Temperature, *J. Climate,* **13**, 4341-4357.

s. USAFETAC, 1986: DATSAV2 Surface USAFETAC Climatic Database. User Handbook No. 4, December 1986. USAF Environmental Technical Application Center, Operating Location A, Federal Building, Asheville, NC. 6 pp. + Appendices.

Appendix 1.

Abbreviations used for **repub** parameter (see also **9.9**).

ARM Armenia	**AZE** Azerbaijan	**BYE** Belarus
EST Estonia	**GEO** Georgia	**KAZ** Kazakhstan
KYR Kyrgyzstan	**LAT** Latvia	**LIT** Lithuania
MOL Moldova	**RUS** Russia	**TAJ** Tajikistan
UKR Ukraine	**UZB** Uzbekistan	**TUR** Turkmenistan

Appendix 2.

PRESENT-WEATHER-OBSERVATION manual atmospheric condition code (taken from DSI-3505). This code denotes a specific type of weather observed manually.

Note: Lack of this report normally indicates that the station did not report any present weather data.

00-49 No precipitation at the station at the time of observation

---

00-19 No precipitation, fog, ice fog (except for 11 and 12), duststorm, sandstorm, drifting or blowing snow at the station at the time of observation or, except for 09 and 17, during the preceding hour.

00: Cloud development not observed or not observable
01: Clouds generally dissolving or becoming less developed
02: State of sky on the whole unchanged
03: Clouds generally forming or developing
04: Visibility reduced by smoke, e.g. veldt or forest fires, industrial smoke or volcanic ashes
05: Haze
06: Widespread dust in suspension in the air, not raised by wind at or near the station at the time of observation
07: Dust or sand raised by wind at or near the station at the time of observation, but no well-developed dust whirl(s) or sand whirl(s), and no dust storm or sandstorm seen or, in the case of ships, blowing spray at the station
08: Well developed dust whirl(s) or sand whirl(s) seen at or near the station during the preceding hour or at the time of observation, but no dust storm or sandstorm
09: Dust storm or sandstorm within sight at the time of observation, or at the station during the preceding hour
10: Mist
11: Patches of shallow fog or ice fog at the station, whether on land or sea, not deeper than about 2 meters on land or 10 meters at sea
12: More or less continuous shallow fog or ice fog at the station, whether on land or sea, not deeper than about 2 meters on land or 10 meters at sea
13: Lightning visible, no thunder heard

14: Precipitation within sight, not reaching the ground or the surface of the sea
15: Precipitation within sight, reaching the ground or the surface of the sea, but distant, i.e., estimated to be more than 5 km from the station
16: Precipitation within sight, reaching the ground or the surface of the sea, near to, but not at the station
17: Thunderstorm, but no precipitation at the time of observation
18: Squalls at or within sight of the station during the preceding hour or at the time of observation
19: Funnel cloud(s) (Tornado cloud or waterspout) at or within sight of the station during the preceding hour or at the time of observation

---

20-29 Precipitation, fog, ice fog or thunderstorm at the station during the preceding hour, but not at the time of observation.

20: Drizzle (not freezing) or snow grains not falling as shower(s)
21: Rain (not freezing) not falling as shower(s)
22: Snow not falling as shower(s)
23: Rain and snow or ice pellets not falling as shower(s)
24: Freezing drizzle or freezing rain not falling as shower(s)
25: Shower(s) of rain
26: Shower(s) of snow or of rain and snow
27: Shower(s) of hail (Hail, small hail, snow pellets), or rain and hail
28: Fog or ice fog
29: Thunderstorm (with or without precipitation)
30: Slight or moderate dust storm or sandstorm has decreased during the preceding hour
31: Slight or moderate dust storm or sandstorm no appreciable change during the preceding hour
32: Slight or moderate dust storm or sandstorm has begun or has increased during the preceding hour
33: Severe dust storm or sandstorm has decreased during the preceding hour
34: Severe dust storm or sandstorm no appreciable change during the preceding hour
35: Severe dust storm or sandstorm has begun or has increased during the preceding hour
36: Slight or moderate drifting snow generally low (below eye level)
37: Heavy drifting snow generally low (below eye level)
38: Slight or moderate blowing snow generally high (above eye level)
39: Heavy blowing snow generally high (above eye level)

40-49 Fog or ice fog at the time of observation

40: Fog or ice fog at a distance at the time of observation, but not at the station during the preceding hour, the fog or ice fog extending to a level above that of the observer
41: Fog or ice fog in patches
42: Fog or ice fog, sky visible, has become thinner during the preceding hour
43: Fog or ice fog, sky invisible, has become thinner during the preceding hour
44: Fog or ice fog, sky visible, no appreciable change during the preceding hour
45: Fog or ice fog, sky invisible, no appreciable change during the preceding hour
46: Fog or ice fog, sky visible, has begun or has become thicker during the preceding hour
47: Fog or ice fog, sky invisible, has begun or has become thicker during the preceding hour
48: Fog, depositing rime, sky visible
49: Fog, depositing rime, sky invisible

50-99 Precipitation at the station at the time of observation

---

50-59 Drizzle

50: Drizzle, not freezing, intermittent, slight at time of observation
51: Drizzle, not freezing, continuous, slight at time of observation

52: Drizzle, not freezing, intermittent, moderate at time of observation
53: Drizzle, not freezing, continuous, moderate at time of observation
54: Drizzle, not freezing, intermittent, heavy (dense) at time of observation
55: Drizzle, not freezing, continuous, heavy (dense) at time of observation
56: Drizzle, freezing, slight
57: Drizzle, freezing, moderate or heavy (dense)
58: Drizzle and rain, slight
59: Drizzle and rain, moderate or heavy

60-69: Rain

60: Rain, not freezing, intermittent, slight at time of observation
61: Rain, not freezing, continuous, slight at time of observation
62: Rain, not freezing, intermittent, moderate at time of observation
63: Rain, not freezing, continuous, moderate at time of observation
64: Rain, not freezing, intermittent, heavy at time of observation
65: Rain, not freezing, continuous, heavy at time of observation
66: Rain, freezing, slight
67: Rain, freezing, moderate or heavy
68: Rain or drizzle and snow, slight
69: Rain or drizzle and snow, moderate or heavy

70-79 Solid precipitation not in showers

70: Intermittent fall of snowflakes, slight at time of observation
71: Continuous fall of snowflakes, slight at time of observation
72: Intermittent fall of snowflakes, moderate at time of observation
73: Continuous fall of snowflakes, moderate at time of observation
74: Intermittent fall of snowflakes, heavy at time of observation
75: Continuous fall of snowflakes, heavy at time of observation
76: Diamond dust (with or without fog)
77: Snow grains (with or without fog)
78: Isolated star-like snow crystals (with or without fog)
79: Ice pellets

80-99 Showery precipitation, or precipitation with current or recent thunderstorm

---

80: Rain shower(s), slight
81: Rain shower(s), moderate or heavy
82: Rain shower(s), violent
83: Shower(s) of rain and snow mixed, slight
84: Shower(s) of rain and snow mixed, moderate or heavy
85: Show shower(s), slight
86: Snow shower(s), moderate or heavy
87: Shower(s) of snow pellets or small hail, with or without rain or rain and snow mixed, slight
88: Shower(s) of snow pellets or small hail, with or without rain or rain and snow mixed, moderate or heavy
89: Shower(s) of hail (hail, small hail, snow pellets) , with or without rain or rain and snow mixed, not associated with thunder, slight
90: Shower(s) of hail (hail, small hail, snow pellets), with or without rain or rain and snow mixed, not associated with thunder, moderate or heavy
91: Slight rain at time of observation, thunderstorm during the preceding hour but not at time of observation
92: Moderate or heavy rain at time of observation, thunderstorm during the preceding hour but

not at time of observation
93: Slight snow, or rain and snow mixed or hail (Hail, small hail, snow pellets), at time of observation, thunderstorm during the preceding hour but not at time of observation
94: Moderate or heavy snow, or rain and snow mixed or hail(Hail, small hail, snow pellets) at time of observation, thunderstorm during the preceding hour but not at time of observation
95: Thunderstorm, slight or moderate, without hail (Hail, small hail, snow pellets), but with rain and/or snow at time of observation, thunderstorm at time of observation
96: Thunderstorm, slight or moderate, with hail (hail, small hail, snow pellets) at time of observation, thunderstorm at time of observation
97: Thunderstorm, heavy, without hail (Hail, small hail, snow pellets), but with rain and/or snow at time of observation, thunderstorm at time of observation
98: Thunderstorm combined with duststorm or sandstorm at time of observation, thunderstorm at time of observation
99: Thunderstorm, heavy, with hail (Hail, small hail, snow pellets) at time of observation, thunderstorm at time of observation

Appendix 3. SKY-COVER-LAYER cloud type code (taken from DSI-3505).

00: Cirrus (Ci)
01: Cirrocumulus (Cc)
02: Cirrostratus (Cs)
03: Altocumulus (Ac)
04: Altostratus (As)
05: Nimbostratus (Ns)
06: Stratocumulus (Sc)
07: Stratus (St)
08: Cumulus (Cu)
09: Cumulonimbus (Cb)
10: Cloud not visible owing to darkness, fog, duststorm, sandstorm, or other analogous phenomena
11: Not used
12: Towering Cumulus (Tcu)
13: Stratus fractus (Stfra)
14: Stratocumulus Lenticular (Scsl)
15: Cumulus Fractus (Cufra)
16: Cumulonimbus Mammatus (Cbmam)
17: Altocumulus Lenticular (Acsl)
18: Altocumulus Castellanus (Accas)
19: Altocumulus Mammatus (Acmam)
20: Cirrocumulus Lenticular (Ccsl)
99: Missing