National Climatic Data Center

DATA DOCUMENTATION

FOR

DATASET 9814a
Global Daily Climatology Network (subset).
Kazakhstan

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Version 1.0

National Climatic Data Center
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1. Abstract

These files are a compilation of in situ daily meteorological observations for Kazakhstan within the framework of joint efforts to create Global Daily Climatology Network among the Kazakhstani Scientific Research Institute of Ecology and Climate of the Ministry of Environment Protection of the Republic of Kazakhstan, 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 archives of the Russian Federation (prior to 1991) and The Republic of Kazakhstan, 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., daily data were calculated by arithmetic averaging of a complete set of synoptic observations within meteorological day (that starts at 9 PM of the local standard time, LST of the previous day). The maximum period of the data span is from January 1, 1881 to December 31, 2006. 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) or at Astana Standard times (UTC + 6). Only 5 stations have data in the 1880s but there are no digital precipitation information prior to 1891. In the 1890s, 1900s, 1910s, and 1920s, archive was enriched by daily data from 2, 12, 4, and 3 stations respectively. Ninety stations were added to the archive in the 1930s (after 1936) mostly in the 1936. The increase in 1936 and the following increase in the number of stations with available data in 1966 (by 40) were 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"). From the total number of 351 stations, the data set includes approximately 310 stations in the early 1990s (Figure 1). In year 2006, the archive contains daily data of 241 stations.

Variables in the data set include sea level and station pressure, surface air temperature, relative humidity, wind speed, and observed precipitation. 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** (351 files, 1 per station)
2. **STN_ID.flg** (351 files, 1 per station), and
3. **KAZ_dly_stn_inv.txt** (1 file with essential station metadata such as station identifier, latitude, longitude, elevation, date of the first and the last records, station name, update information, comment).

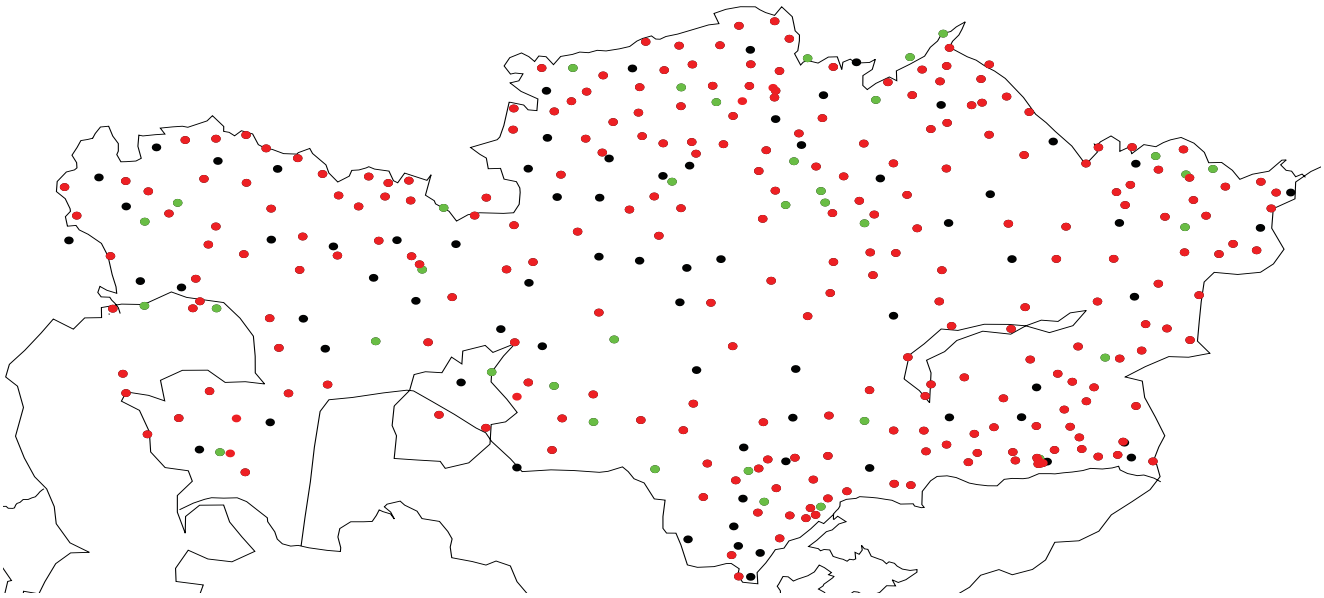

Figure 1. Map of 351 synoptic stations of the Republic of Kazakhstan with the daily data available in this archive. Closed prior to 1990 stations are marked in green and the stations available in our archive in and after 2006 in red. Stations that were discontinued (or their status degraded) in the 1990s are marked by black dots.

2. Element Names and Definitions

2.1. File "**KAZ_dly_stn.list.txt**" has 351 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, comment
           CHARACTER *45 stn_name
           CHARACTER *3 repub
           CHARACTER*1  update_inf
       READ(*,1) STN_id,lat,lon,elev,
     *  time_beg, time_end, stn_name, repub,
     *  update_inf,comment

 1      format(a11,6x,f5.2,1x,f7.2, 1x,f4.0, 2(1x,i8), 1x, a45, 1x,
   *     a3, 1x, a1, 1x,a11)
```

Where

STN_ID is the station ID composed from "625"– characters that identify Kazakhstan 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 and thereafter Kazakhstan Meteorological Service.
lat is the station latitude (degrees, N). It is provided with an accuracy to hundredths of a degree. Range from 40.8 to 54.90.
lon is the station longitude (degrees, E). It is provided with accuracy to hundredths of a degree. Range from 46.8 to 86.48.
elev is the station elevation in meters. Range from -28 to 3017.
time_beg and **time_end** provide year, month, and day 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 Republic of Kazakhstan. We stopped the update of the archive on December 31, 2006.
stn_name provides the names of the station used in the national Catalogue as of year 1990 or later and some earlier names under which the station was known.
repub is a three letter abbreviation used for stations of the republics of the former USSR (for Kazakhstan these three letters are always KAZ); and

`update_inf` is an indicator of the recent data presence. It is set to **'N'** to indicate the presence of the data in the national archive of the Republic of Kazakhstan (at least up to 2006); otherwise it is set to blank character.

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

These files were created using the following FORTRAN write statement:

```
CHARACTER*1 trace_flg
INTEGER year, month, day , slp, pres, temp, rh, wndspd, precip
 ……
    WRITE (*,80) year, month, day,  slp, pres, temp, rh, wndspd, precip
80  FORMAT (i4.4, 2i2.2, 1x, 2i5,i4,i3,i4,i4,a1)
```

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
slp	10 - 14	Sea Level Pressure [tenths of mB]
pres	15 - 19	Station Pressure [tenths of mB]
temp	20 - 23	Dry Bulb Temperature [tenths of C]
rh	24 - 27	Relative Humidity [percent]
wndspd	27 - 30	Wind Speed [tenths of m/sec]
precip	31 - 34	Measured precipitation [tenths of mm]

trace_flg	35 - 35	'T' or ' ' indicator of precipitation traces; prior to 1989 the data were homogenized using algorithm described by Groisman and Rankova (2001)[1]

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.

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, rh_flag, wndspd_flag, precip_flag
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, 2i2.2,1x,6a4)
        WRITE(*,20) year, month, day, slp_flag, pres_flag,
   +    temp_flag, rh_flag, wndspd_flag, precip_flag
```

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
T = trace (this flag-value accompanies zero precipitation value if trace precipitations were reported during the day)

Flag 2: Quality control flag
blank = unknown
N = normal QC by provider of data

[1] This flag may be dubbed in the Data measurement flag in file **STN_ID.flg** for precipitation value, if it is zero but trace precipitations were reported during the day.

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

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: 18810101

4. Stop Date: 20061231

5. Coverage:

a. Southernmost Latitude: 40.80 N
b. Northernmost Latitude: 54.90 N
c. Westernmost Longitude: 46.80 E
d. Easternmost Longitude: 86.48 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

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9. Known Uncorrected Problems

9.1. Observed precipitation by no means can be used for climate *change* analyses due to numerous changes in observational practice and rain gauge design (Groisman et al. 1990; Golubev et al .1996; Groisman and Rankova 2001; Bogdanova et al. 2002a,b; DSI 9813). The last such change occurred in 1984. For climatic change and bias-corrected precipitation data sets the user is advised to use homogeneity-adjusted precipitation data (e.g., DSI 9813 or this archive, DSI 9814a where daily precipitation data prior to 1989 were adjusted using algorithm described by Groisman and Rankova 2001). The raw precipitation data are in a companion archive DSI 9814. This is the only difference between in data between 9814 and this 9814a data set.
9.2. Prior to 1990, the data represent an averaging of original synoptic observational data[2] at synoptic stations into a format accepted for GSCN.

9.3 Several changes in observational practice have occurred throughout the network that could

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

affect homogeneity of temperature and humidity information. The most dramatic changes should be associated with modification of the times of observation for variables with strong diurnal changes. In 1936, an additional nighttime observation was introduced. This change (from 3 per day to 4 per day observing routine affected the mean daily temperatures across the former USSR (Brown 2000). 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, the Republic Kazakhstan made specific changes in time zones to better fit its needs in 2004. Prior to 2004, there were 3 time zones in Kazakhstan (UTC +4, UTC +5 и UTC +6) and summer daylight-saving time was implemented.. After October 1, 2004, the country has only two time zones, UTC +5 и UTC +6. Three westernmost administrative regions (Атырауская, Западно-Казахстанская и Мангистауская области), that previously were in UTC +4 time zone, were transferred to UTC +5 time zone. В Костанайской, Кзыл-Ординской и Актюбинской областях (previously in the UTC+5 time zone) were transferred to UTC+6 to match the time zone of the residual part of the nation (Astana time). At the same date, the use of the daylight saving time was discontinued. Currently all meteorological observations in Kazakhstan are made according to LST with additional indication of the corresponding Greenwich time.

9.4. Wind speed information in Kazakhstan was reported first by wind vane with light board, then with wind vane with heavy board[3] 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 station 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, many of these sites are not located at airports. The stations' surrounding has often gradually (and uncontrollably) changed due to urbanization and/or reforestation (cf., Mescherskaya et al. 2004). In this paper, the authors found that about 70% of the wind speed change across the European part of the former USSR was due to changes in the instrument exposure. The user is warned about this specifically in order to avoid misjudgment.

9.5. Sea level pressure variable was frequently unavailable in the original data sets. It is always absent in the data files prior to 1936 and frequently is not available there after 1991.

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10. Quality Statement

[3] 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 shows 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.

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 the Republic of Kazakhstan 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 in Kazakhstan was on January 13, 1971 (at 9.00 AM 1079.8 hPa) at the "Krasnokutsky Zernosovhoz" station (this station was closed in 1988). 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 1 day 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" 1 day 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 and the target, the suspect value passes the QC test and is not flagged. The threshold parameters are adjusted for each meteorological element individually.

Control that uses the data from different archives is based on **c**omparison of the data from different archive. For example, we calculated mean differences and their standard deviations

between mean daily meteorological variables in the 1990-1991 period (period of overlap) when we had two data sets based on synoptic national archive of the former USSR (DSI-9290C and DSI 9813) and the new National archive created by the Kazakhstani Scientific Research Institute of Ecology and Climate. Table 1 shows that both archives contain a coherent information without substantial biases. This comparison revealed also that relative humidity values (initially derived in DSI-9290C using dew point depression) should be replaced with direct measurements reported at the stations (nationwide mean standard deviation of differences, 3%, is quite high. Therefore, the replacement (upgrade) of DSI-9290C has been performed by RIHMI and will be included in the next release of that data set. After upgrade, both archives show very close relative humidity values with standard deviations of the differences reduced by 8 times (Table 2). Based on this finding, the present archive contains observed relative humidity values whenever it is possible.

The follow-up analyses at six Kazakhstan stations (Appendix 1) discovered a sizable fraction of errors in daily relative humidity data (mostly after 1990). These errors were replaced by missing codes.

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.

Table 1. Results of comparison of meteorological variables from three archives for the period of their overlap (1990-1991). Daily data generated (taken) from DSI-9290C & DSI 9813 are compared with daily data from the new National archive created by the Kazakhstani Scientific Research Institute of Ecology and Climate.

	Meteorological variables				
	Station pressure	Surface air temperature	Relative humidity	Wind speed	Precipitation
Mean difference	0.0009	-0.47	0.14	-0.79	0.0007
Standard deviation	0.6	0.5	3.0	0.5	0.4

Table 2. Results of comparison of relative humidity from two archives for the period of their overlap (1990-1991). Daily data generated from DSI-9290C are compared with daily data from the new National archive created by the Kazakhstani Scientific Research Institute of Ecology and Climate (after calculations of relative humidity based upon dew point depression were replaced with observations).

	Surface air relative humidity
Mean difference	-0.25
Standard deviation	0.4

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
- TD-9290c "Global Synoptic Climatology Network. C. The former USSR. Data Set 9290c, available at http://www1.ncdc.noaa.gov/pub/data/documentlibrary/tddoc/td9290c.pdf
- TD-9814 "Global Daily Climatology Network (subset). Kazakhstan". Variant of TD-9814a with original precipitation data prior to 1990.

12. References

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Appendix 1.

List of dates at 6 stations Kazakhstan stations where daily values of relative humidity were replaced with missing codes.
Six groups of data and in each group:
Station ID (last 5 digits e.g., 35169) is followed (a) with a number of intervals, N, where the data were replaced with missing code (e.g., 26) and (b) with N lines of three numbers:

1. Station ID (last 5 digits)
2. Start date when the bad values of relative humidity were spotted, and
3. End date when the bad values of relative humidity were spotted (if this was only one value then end and start dates may coincide.

Within these intervals, the relative humidity values were replaced with missing code (-1). The original data of these 6 stations (without removed humidity data) have been preserved to (with data file extension (.orig).

```
35169  26
35169  19710929 19710929
35169  19750706 19750706
35169  19900601 19900630
35169  19900901 19900930
35169  19910501 19910531
35169  19910901 19910930
35169  19911001 19911031
35169  19920701 19920731
35169  19921001 19921030
35169  19930531 19930531
35169  19931001 19931031
35169  19940601 19940630
35169  19940901 19940930
35169  19941001 19941031
35169  19950801 19950831
35169  19950901 19950930
35169  19951001 19951031
35169  19960901 19960930
35169  19961001 19961031
35169  19970901 19970930
35169  19971001 19971031
35169  19980801 19980831
35169  19980901 19980930
35169  19981001 19981031
35169  19990801 19990831
35169  19991001 19991031
36152  53
36152  19900101 19900131
36152  19900501 19900531
36152  19900601 19900630
36152  19900901 19900930
36152  19901001 19901031
36152  19910101 19911031
36152  19910601 19910630
36152  19910801 19910831
36152  19910901 19910930
```

36152	19911001	19911031
36152	19920401	19920430
36152	19920701	19920731
36152	19920801	19920831
36152	19920901	19920930
36152	19930901	19930930
36152	19931001	19931031
36152	19940901	19940930
36152	19941001	19941031
36152	19941101	19941130
36152	19951001	19951031
36152	19951101	19951130
36152	19960601	19960630
36152	19960901	19960930
36152	19961001	19961031
36152	19970601	19970630
36152	19970901	19970930
36152	19971001	19971031
36152	19980901	19980930
36152	19981001	19981031
36152	19981101	19981130
36152	19990901	19990930
36152	19991001	19991031
36152	20000901	20000930
36152	20000901	20000930
36152	20001001	20001031
36152	20001001	20001031
36152	20001101	20001130
36152	20020401	20020430
36152	20020601	20020630
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