



Caspian Environment Programme

The review of scientific OPERATIONS ON CHANGE OF THE CASPIAN SEA LEVEL AND SOME UNITS OF ITS WATER BALANCE

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**Consultants Report
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Levels of the Caspian Sea and Volga River Runoff in XVI - XIX cc.

1. The Review of Scientific Operations on Change of the Caspian Sea Level and Some Units of its Water Balance

The review contains the enumeration of the monographies and papers published in scientific magazines and devoted to a research of a sea level and some units of its water balance. The operations executed per the last decade are included in this enumeration. For earlier years the monographies containing establishing methodical developments and observational data are included only in the review. Each reduced operation is accompanied by the brief summary.

1. Berg L.S. A level of the Caspian Sea for historical time. Problems of physical geography, 1934, V. 1. P. 11-64.

The historical items of information on a level of the Caspian Sea for separate years from a beginning X of century prior to the beginning XIX of century are reduced. It is shown, that from a middle XVI of century the sea level never mounted above 4 m above a level of 1925 (minus 26.56 m). Marks of a sea level concerning to 1804 and 1805. Under the judgement of the author are not absolutely authentic. It supposes, that from a middle XVI of century the sea level could mount above a level of 1925.

2. Zaykov B.D. Level of the Caspian Sea. Transactions of research establishments of a hydrometeorological service USSR, series 8, V. 1, M-L., 1941. P. 18-25.

The updated historical items of information and tool data about a level of the Caspian sea for separate years from a middle XVI of century up to a middle XIX of century are reduced. The marks are reduced as exceeding above a level of 1925 (minus 26.56 m) and in marks above zero of the Black Sea system of heights.

3. Feodorov P.V. About absolute age newcaspiian of a transgression. The reports of an Academy of sciences USSR, volume LXXVIII, № 5, 1951. P. 993-995.

The hollow Karagie, located on a peninsula Mangishlak during navigation G.S. Karelin (1836) was a gulf of the Caspian Sea. By the author in 1939-1940. And в1947 the is installed, that the low point водораздела between the sea and hollow did not exceed a minus 22.2минус 22.1 m. It confirms the items of information that in 1804-1805. The sea level was on marks a minus 22.3минус 22.5 m.

4. Leontiev O.K. Evolution of a coast line of the north-Dagestan coast of the Caspian Sea. Information of an All-Union geographical society volume 83, V. 4, July August 1951. P. 353-363.

Because of analysis of cartographical materials the items of information on splashing down of islands Seal and Chechen and depth Agrakhan's of a gulf in an extremity XVIII of century - beginning XIX of century are reduced. These items of information confirm a high position of a sea level in 1896 and 1809 - 1814.

5. Oscillation of a level of the Caspian Sea // Transactions of Institute of an oceanology, volume 15, 1956, 383 p.

In an outcome of the analysis of available materials of observations the values of a level of the Caspian Sea since 1830 are updated. The items of information on a sea level in historical time are considered. The dependencies of change of a sea level on temperature of an air and other factors are placed. It is shown, that for historical time the sea level did not mount above minus of 22 m. In operation a lot of useful information about level's a mode of the sea is reduced.

6. Kaznacheev E.N. New data about of the Caspian Sea level in an extremity XVIII and beginning XIX of centuries. Information of an All-Union geographical society. T 88, V. 6, 1956. P. 549-551.

The outcomes of the analysis of the historical description of splashing down of an island Seal in an extremity XVIII - beginning XIX of century are reduced. Because of records produced Feodor Redkin, in 1778, to 1800, 1804, 1810, 1814, 1819 and 1825 is shown, that in the beginning XIX of century the sea level stood highly enough. Since 1800 for 1809 it was increased, and lowering a level began from 1810 which till 1825 proceeded. These materials confirm the items of information of the academician Lenz that per 1805 the sea level on 10 ft (3.2 m) was higher, than in 1830 i.e. was on a mark about a minus of 22.6 m.

7. Nikolaeva R.V., Magomedov S.O. New data about of the Caspian Sea level for historical time. The collection « Problems of a physical oceanology ». AS USSR, V. 60, 1962. P. 178 - 189.

The historical items of information on splashing down by the sea of buildings of a defensive stability of are considered Derbent. The substantiation of marks of a sea level because of analysis of the available items of information about splashing down of walls and other buildings of a stability is given. The high position of a sea level in an extremity XVIII of century - beginning XIX of century is confirmed.

8. Nikolaeva R.V., Han-Magomedov S.O. New data about of the Caspian Sea level for historical time. Transactions of institute of an oceanology volume LX, 1962. P. 178-189.

The historical items of information on splashing down by the sea of defensive strengthening of are reduced Derbent. These items of information show, that the absolute mark of a sea level for 1800 makes a minus 21.2 m a minus of 21.5 m. The obtained data confirm the judgement of many contributors, that the high position of a level of the Caspian sea was marked in the beginning XIX of century and had a mark a minus 21.0 m a minus of 22.0 m. These marks are obtained on more exact materials and most completely reflect level's a mode of the sea for considered period of time.

9. Directory level's of observations of hydrometeorological servers and posts located by the Caspian Sea. - M., Hydrometeoizdat, 1964, 118 p.

The directory level's of observations by the Caspian Sea contains data stage gage of posts on 1960. The materials reduced in a Directory, enable to determine changes of a sea level in separate items of coast, to reveal secular changes of a level happening under influence tectonically of motions earth's crust of coast of the sea, to install dependencies of change of a sea level on the hydrometeorological factors and anthropogenous activity, to determine the characteristics of a sea level concerning zero main stage gage of a post and zero Krondshtadt tide-gauge.

10. Zubakov V.A. Oscillations of the Caspian Sea level in the geological past and its prognosis // a Meteorology and hydrology, №8, 1973. P.82 - 88.

Oscillations of the Caspian sea level in the geological past on 90 % was determined by changes of a climate. Oscillation frequency reached in historical time 15 m, in golocen 20 m and in pleistocen 100 m. The modern raising of a level (2m for 15 years) is usual for transgressive of a part secular (60 - 90 years) cycle, oscillation frequency, in which reaches 24 m. A problem of prediction of the Caspian level on XXI the century creates expected anthropogenous change of a climate which sizes, on a prediction climatologies, will exceed interglacial. How will react to this fast and sharp rise temperature of the Caspian level. The complex answer to this problem can give only full paleohydrology a research of a history Caspian. But it is not enough of available data already now to give the quantitative answer. If to a middle XXI of century global rise of temperature on 1.5 – 2.0°C is held, Caspian, most likely, will answer him by deep lowering of a level.

11. Gumilev L.N. History of oscillations the Caspian level after 2000 with IV of century about new era on XVI century of new era. The collection « Oscillations moisture of the Aral-Caspian region in golocen ». M., Science, 1980. P. 32-47.

Because of historical materials the oscillations of a level of the Caspian Sea for separate periods and years with IV of century about new era on XVI century of new era are considered. It is shown, that the significant oscillations of a sea level were observed of 2000.

12. Nikolaeva R.V., Kudriavcev A.A. Ancient Derbent monuments and oscillation of the Caspian Sea level . The collection « Oscillations moisture of the Aral-Caspian region in golocen ». M., Science, 1980. P. 142-146.

The historical items of information on splashing down by the sea of ancient monuments to are considered Derbent. It is marked, that for the last 15 centuries the sea level did not mount above minus 22.4 m, and in the beginning XIX of century of a mark of a sea level made a minus 22.3 - minus 22.7.

13. Komarova N.G. To a problem of change of the Caspian Sea level oscillations in golocen on historical data. The collection « Oscillations moisture of the Aral-Caspian region in golocen». M., Science, 1980. P. 155-163.

On historical materials the marks of the Caspian Sea level for separate years from an extremity XV of century prior to the beginning XIX of century are considered. Generalizing data about a position of the Caspian sea level in time XVIII century - first third XIX centuries the author selects period concerning a high position of a level (minus 25 m) in the beginning XVIII of century, then period minor (on 1.0 – 1.5 m) its lowering to 20 – 30 - years, then rise more than on 2.0 m to 40-m to years XVIII of century (minus 23.0 m, minus 23.5 m). In 60 - 70 years XVIII of century were marked some lowering of a level in comparison with 40-ми by years, but nevertheless it was higher, than in the beginning of century (up to a minus 24.0 m, minus 24.5). The maximum rise of a level for considered period was observed per 80 years XVIII of century. It was approximately on 5 m above modern (up to a minus 22.0 m, minus 23.0 m). Right at the beginning XIX of century the high level was saved, gradually being reduced to 20 - 30 years up to a mark a minus of 25.5 m.

14. Golicin G.S., Panin G.N. About a water balance and modern changes of the Caspian level // a Meteorology and hydrology, №1, 1989. P. 57 - 64.

The various methods of definition of the Caspian sea level and changes of units of a water balance are considered. The noticeable correlation between a river drain in the sea and visible evaporation (evaporation behind a residue of precipitation) from it of a surface, negative is

placed during sharp changes of a sea level and positive during weak changes. Is shown, that the predominant contribution to change of a level per the thirtieth years has given decrease of a drain, and per the last ten years decrease of visible evaporation and appropriate increase of a river drain. Is indicated on necessity of creation of reliable bank of monthly average values of a level and units of a water balance.

15. Rodionov S.N. Milestones in a course of the Caspian sea level and their link with changes of a climate for the latter thousand // Transactions GOIN, V. 183, 1991. P. 24 - 36.

The milestones in a course of the Caspian Sea level, since X of century AD are selected, and their comparison to change of a climate is carried out. The characteristic climatic situations reducing in transgressions and regressions of a sea level are circumscribed. Because of obtained legitimacies the evaluation of a possible direction of changes of a sea level in nearest some decades is given. The author considers, that is necessary to be oriented on saving begun with 1978 of the tendency to rise of the Caspian Sea level.

16. Reshetnikov V.I. Drain of Volga with 1792 r // Water resources, volume 21, #4.- M., Science, 1994. P. 453 - 456.

Is restored because of analysis of link of maximum marks of levels of vernal high waters in Nizhni Novgorod and Astrakhan (1877 - 1939) continuous number of maximum levels of a high water in Astrakhan for 1792 - 1952. On these data in view of a drain at Volgograd with 1881 on 1940 the values of an annual drain of Volga for 1792 - 1880 are appreciated.

2. Levels of the Caspian Sea for 1500 – 1900

Monthly values of a level of the Caspian sea at one Baku town for 1830 - 1900. Were restored B.A. Apollov /5/ on materials of the academician Lenz. In it to operation they are reduced in cm above zero tide-gauge 1928. These data are reduced by the authors in absolute marks (tab. 1).

Table 1: Level of the Caspian Sea, m on Baku Stage Gage for 1830 - 1900.

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
1830			-25,88										-25,77
1832								-25,64					-25,86
1837	-25,76	-25,72	-25,74	-25,70	-25,65	-25,55	-25,39	-25,37	-25,48	-25,56	-25,64	-25,64	-25,60
1938	-25,66	-25,71	-25,71	-25,67	-25,61	-25,47	-25,41	-25,43	-25,56	-25,65	-25,69	-25,71	-25,61
1939	-25,76	-25,76	-25,72	-25,68	-25,60	-25,48	-25,40	-25,44	-25,54	-25,65	-25,72	-25,78	-25,63
1840	-25,82	-25,83	-25,84	-25,82	-25,76	-25,70	-25,63	-25,75	-25,78	-25,81	-25,96	-26,04	-25,81
1841	-26,09	-26,09	-26,08	-26,05	-25,98	-25,89	-25,81	-25,93	-25,97	-26,05	-26,10	-26,06	-26,01
1842	-26,11	-26,13	-26,13	-26,12	-26,07	-26,02	-25,97	-26,03	-26,14	-26,20	-26,52	-26,55	-26,17
1843	-26,42	-26,43	-26,42	-26,42	-26,34	-26,19	-26,07	-26,11	-26,22	-26,31	-26,34	-26,36	-26,30
1844	-26,36	-26,36	-26,32	-26,33	-26,19	-26,10	-26,02	-26,07	-26,17	-26,24	-26,28	-26,24	-26,22
1845	-26,29	-26,34	-26,33	-26,27	-26,19	-25,99	-25,94	-26,00	-26,09	-26,20	-26,16	-26,12	-26,16

Continue of the Table 1: Level of the Caspian Sea, m on Baku Stage Gage for 1830 - 1900.

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
1846	-26,08	-26,04	-25,99	-26,03	-25,95	-25,73	-25,53	-25,59	-25,68	-25,73	-25,77	-25,80	-25,83
1847	-25,83	-25,83	-25,82	-25,81	-25,75	-25,50	-25,39	-25,46	-25,61	-25,73	-25,74	-25,78	-25,69
1848	-25,79	-25,82	-25,78	-25,77	-25,70	-25,60	-25,59	-25,68	-25,81	-25,93	-25,98	-25,99	-25,79
1849	-26,00	-26,02	-26,00	-26,01	-25,95	-25,85	-25,80	-25,83	-25,94	-26,00	-26,02	-26,05	-25,96
1850	-26,08	-26,08	-26,06	-26,04	-25,99	-25,88	-25,83	-25,88	-25,93	-26,02	-26,06	-26,11	-26,00
1851	-26,05	-26,11	-26,02	-26,01	-25,98	-25,88	-25,89	-25,92	-26,06	-26,23	-26,25	-26,24	-26,05
1852	-26,27	-26,22	-26,18	-26,24	-26,24	-26,18	-26,17	-26,16	-26,21	-26,42	-26,43	-26,50	-26,27
1853	-26,54	-26,57	-26,62	-26,53	-26,49	-26,28	-26,18	-26,21	-26,34	-26,44	-26,47	-26,47	-26,43

1854	-26.50	-26.46	-26.53	-26.43	-26.38	-26.20	-26.08	-26.08	-26.16	-26.25	-26.32	-26.34	-26.31
1855	-26.36	-26.39	-26.37	-26.38	-26.22	-26.14	-26.05	-26.05	-26.18	-26.27	-26.39	-26.37	-26.26
1856	-26.39	-26.40	-26.43	-26.40	-26.34	-26.21	-25.99	-26.05	-26.15	-26.18	-26.42	-26.45	-26.28
1857	-26.42	-26.43	-26.44	-26.43	-26.37	-26.24	-26.18	-26.27	-26.33	-26.46	-26.54	-26.52	-26.39
1858	-26.56	-26.56	-26.55	-26.48	-26.42	-26.24	-26.13	-26.21	-26.32	-26.42	-26.44	-26.51	-26.40
1859	-26.59	-26.59	-26.59	-26.48	-26.24	-26.09	-25.96	-25.99	-26.18	-26.26	-26.33	-26.45	-26.31
1860	-26.44	-26.45	-26.47	-26.41	-26.33	-26.18	-26.11	-26.16	-26.26	-26.37	-26.41	-26.44	-26.34
1861	-26.48	-26.47	-26.46	-26.42	-26.34	-26.19	-26.08	-26.22	-26.33	-26.36	-26.39	-26.47	-26.35
1862	-26.50	-26.46	-26.45	-26.39	-26.34	-26.18	-26.04	-26.08	-26.17	-26.19	-26.18	-26.25	-26.27
1863	-26.28	-26.28	-26.29	-26.29	-26.19	-26.12	-26.09	-26.12	-26.17	-26.24	-26.28	-26.28	-26.22
1864	-26.29	-26.34	-26.34	-26.32	-26.26	-26.18	-26.08	-26.12	-26.13	-26.17	-26.23	-26.28	-26.23
1865	-26.27	-26.32	-26.37	-26.38	-26.33	-26.28	-26.06	-26.00	-26.20	-26.30	-26.34	-26.37	-26.27
1866	-26.33	-26.34	-26.37	-26.32	-26.27	-26.10	-26.00	-26.05	-26.10	-26.21	-26.23	-26.32	-26.22
1867	-26.38	-26.37	-26.36	-26.29	-26.18	-25.98	-25.82	-25.63	-25.72	-25.74	-25.74	-25.75	-26.00
1868	-25.76	-25.77	-25.80	-25.77	-25.67	-25.62	-25.44	-25.32	-25.48	-25.59	-25.61	-25.63	-25.62
1869	-25.67	-25.65	-25.64	-25.60	-25.61	-25.38	-25.29	-25.25	-25.46	-25.69	-25.80	-25.82	-25.57
1870	-25.90	-25.94	-25.95	-25.89	-25.84	-25.73	-25.67	-25.72	-25.82	-25.92	-25.97	-26.02	-25.86
1871	-26.07	-26.10	-26.09	-26.06	-26.03	-25.89	-25.74	-25.79	-25.90	-25.98	-26.06	-26.17	-25.99
1872	-26.12	-26.18	-26.19	-26.08	-26.05	-25.98	-25.93	-26.00	-26.09	-26.09	-26.22	-26.25	-26.10
1873	-26.29	-26.26	-26.25	-26.18	-26.11	-25.96	-25.82	-25.86	-25.95	-26.01	-26.08	-26.17	-26.08
1874	-26.16	-26.17	-26.18	-26.11	-25.93	-25.77	-25.66	-25.64	-25.66	-25.12	-25.72	-25.81	-25.88
1875	-25.83	-25.80	-25.76	-25.73	-25.61	-25.49	-25.48	-25.52	-25.51	-25.64	-25.66	-25.74	-25.65
1876	-25.74	-25.72	-25.74	-25.74	-25.78	-25.66	-25.53	-25.42	-25.58	-25.63	-25.62	-25.70	-25.66
1877	-25.67	-25.68	-25.70	-25.63	-25.57	-25.39	-25.31	-25.36	-25.49	-25.59	-25.60	-25.60	-25.55
1878	-25.66	-25.69	-25.67	-25.64	-25.56	-25.44	-25.34	-25.36	-25.46	-25.56	-25.61	-25.62	-25.55
1879	-25.60	-25.61	-25.60	-25.56	-25.49	-25.47	-25.38	-25.47	-25.57	-25.62	-25.73	-25.69	-25.57
1880	-25.71	-25.80	-25.79	-25.78	-25.75	-25.52	-25.42	-25.46	-25.57	-25.66	-25.71	-25.76	-25.66
1881	-25.76	-25.69	-25.58	-25.56	-25.43	-25.28	-25.26	-25.34	-25.48	-25.60	-25.58	-25.55	-25.51
1882	-25.59	-25.51	-25.51	-25.50	-25.33	-25.19	-25.19	-25.22	-25.31	-25.44	-25.44	-25.56	-25.40
1883	-25.52	-25.62	-25.63	-25.47	-25.44	-25.32	-25.28	-25.40	-25.48	-25.55	-25.68	-25.72	-25.51
1884	-25.80	-25.79	-25.78	-25.76	-25.70	-25.60	-25.51	-25.55	-25.66	-25.74	-25.78	-25.85	-25.71
1885	-25.89	-25.89	-25.91	-25.84	-25.76	-25.64	-25.61	-25.71	-25.82	-25.94	-25.94	-26.00	-25.83
1886	-26.02	-26.01	-25.97	-25.93	-25.87	-25.68	-25.47	-25.57	-25.67	-25.71	-25.75	-25.77	-25.78
1887	-25.82	-25.86	-25.86	-25.83	-25.82	-25.72	-25.72	-25.64	-25.74	-25.83	-25.85	-25.86	-25.79
1888	-25.89	-25.90	-25.91	-25.87	-25.80	-25.65	-25.53	-25.58	-25.68	-25.77	-25.86	-25.86	-25.77
1889	-25.89	-25.94	-25.89	-25.89	-25.85	-25.75	-25.51	-25.58	-25.72	-25.84	-25.88	-25.81	-25.80
1890	-25.86	-25.84	-25.82	-25.69	-25.62	-25.41	-25.37	-25.42	-25.60	-25.72	-25.80	-25.80	-25.66
1891	-25.85	-25.87	-25.89	-25.82	-25.77	-25.63	-25.62	-25.70	-25.82	-25.93	-25.91	-25.93	-25.81
1892	-25.95	-25.94	-25.93	-25.93	-25.88	-25.76	-25.62	-25.67	-25.82	-25.89	-25.92	-25.98	-25.86
1893	-25.99	-25.98	-25.97	-25.95	-25.84	-25.75	-25.72	-25.71	-25.78	-25.90	-25.96	-25.97	-25.88
1894	-25.99	-25.99	-25.97	-25.92	-25.87	-25.79	-25.75	-25.77	-25.88	-25.94	-25.99	-26.02	-25.91
1895	-26.07	-26.05	-25.99	-25.96	-25.91	-25.65	-25.56	-25.63	-25.67	-25.74	-25.75	-25.72	-25.81
1896	-25.74	-25.78	-25.69	-25.67	-25.59	-25.46	-25.37	-25.39	-25.47	-25.61	-25.69	-25.66	-25.59
1897	-25.67	-25.67	-25.66	-25.68	-25.62	-25.49	-25.42	-25.50	-25.64	-25.70	-25.76	-25.76	-25.63
1898	-25.81	-25.78	-25.80	-25.78	-25.69	-25.54	-25.50	-25.47	-25.70	-25.79	-25.88	-25.93	-25.72
1899	-25.96	-25.90	-25.90	-25.85	-25.80	-25.60	-25.46	-25.48	-25.65	-25.73	-25.77	-25.79	-25.74
1900	-25.81	-25.77	-25.83	-25.89	-25.82	-25.74	-25.66	-25.62	-25.71	-25.74	-25.76	-25.78	-25.76

For definition of annual values of the Caspian sea level for 1500 - 1836. The historical items of information reduced in operations of the academician h.p were used Berg /1/ and B.D. Zaikov /2 /, and also other authors. In an outcome the marks of a sea level for one years are obtained, for which there were historical items of information. At restoring of skips the rectilinear interpolation (tab. 2) was used.

Table 2: Average Levels of the Caspian Sea, m for 1500 - 1936.

Year	0	1	2	3	4	5	6	7	8	9
1500	-26	-26.02	-26.04	-26.06	-26.09	-26.11	-26.13	-26.15	-26.17	-26.19
1510	-26.21	-26.24	-26.26	-26.28	-26.3	-26.32	-26.34	-26.36	-26.39	-26.41
1520	-26.43	-26.45	-26.47	-26.49	-26.51	-26.54	-26.56	-26.58	-26.6	-26.62
1530	-26.64	-26.66	-26.69	-26.71	-26.73	-26.75	-26.77	-26.79	-26.81	-26.84
1540	-26.86	-26.88	-26.9	-26.92	-26.94	-26.96	-26.99	-27.01	-27.03	-27.05
1550	-27.07	-27.09	-27.11	-27.14	-27.16	-27.18	-27.2	-27.18	-27.16	-27.14
1560	-27.12	-27.1	-27.08	-27.05	-27.03	-27.01	-26.99	-26.97	-26.95	-26.93
1570	-26.91	-26.89	-26.87	-26.85	-26.82	-26.8	-26.78	-26.76	-26.74	-26.72
1580	-26.7	-26.7	-26.7	-26.71	-26.72	-26.72	-26.72	-26.73	-26.73	-26.74

1590	-26.74	-26.75	-26.75	-26.75	-26.76	-26.76	-26.77	-26.77	-26.78	-26.78
1600	-26.78	-26.79	-26.79	-26.8	-26.8	-26.77	-26.75	-26.72	-26.69	-26.67
1610	-26.64	-26.62	-26.59	-26.56	-26.54	-26.51	-26.48	-26.46	-26.43	-26.41
1620	-26.38	-26.35	-26.33	-26.3	-26.24	-26.18	-26.12	-26.05	-25.99	-25.93
1630	-25.87	-25.81	-25.75	-25.68	-25.62	-25.56	-25.5	-25.48	-25.46	-25.45
1640	-25.43	-25.41	-25.39	-25.37	-25.35	-25.34	-25.32	-25.3	-25.28	-25.26
1650	-25.25	-25.23	-25.21	-25.19	-25.17	-25.15	-25.14	-25.12	-25.1	-25.08
1660	-25.06	-25.05	-25.03	-25.01	-24.99	-24.97	-24.95	-24.94	-24.92	-24.9
1670	-24.91	-24.93	-24.94	-24.96	-24.97	-24.99	-25	-25.01	-25.03	-25.04
1680	-25.06	-25.07	-25.09	-25.1	-25.14	-25.18	-25.22	-25.26	-25.29	-25.33
1690	-25.37	-25.41	-25.45	-25.49	-25.53	-25.57	-25.61	-25.64	-25.68	-25.72
1700	-25.76	-25.8	-25.83	-25.87	-25.9	-25.93	-25.97	-26	-26.03	-26.07
1710	-26.1	-26.13	-26.17	-26.2	-26.23	-26.27	-26.3	-26.3	-26.3	-26.3
1720	-26.5	-26.55	-26.6	-26.3	-26.1	-25.9	-25.7	-25.58	-25.46	-25.34
1730	-25.22	-25.11	-24.99	-24.87	-24.75	-24.63	-24.51	-24.39	-24.28	-24.16
1740	-24.04	-23.92	-23.8	-24.1	-24.4	-24.46	-24.52	-24.59	-24.65	-24.71
1750	-24.78	-24.84	-24.9	-24.96	-25.02	-25.09	-25.15	-25.21	-25.28	-25.34
1760	-25.4	-25.02	-24.65	-24.28	-23.9	-23.8	-23.6	-23.53	-23.47	-23.4
1770	-23.42	-23.44	-23.46	-23.48	-23.5	-23.52	-23.54	-23.56	-23.58	-23.6
1780	-23.53	-23.47	-23.4	-23.44	-23.48	-23.52	-23.56	-23.6	-23.64	-23.68
1790	-23.72	-23.76	-23.8	-23.84	-23.88	-23.92	-23.96	-24	-23.81	-23.63
1800	-23.44	-23.26	-23.07	-22.89	-22.7	-22.8	-23.2	-23.6	-23.6	-23.6
1810	-23.6	-23.7	-23.8	-23.9	-24.13	-24.37	-24.6	-24.65	-24.7	-24.75
1820	-24.8	-25.1	-25.3	-25.5	-25.8	-25.2	-25.31	-25.43	-25.54	-25.66
1830	-25.77	-25.81	-25.86	-25.81	-25.76	-25.7	-25.65			

The reduced items of information are considered by the authors as average of value of the sea level.

3. Runoff of Volga River for 1792 - 1880

At restoring of Volga river runoff /16/ the maximum levels of high waters of this river at of Nizhni Novgorod (Z_n) and were used. Astrakhan (Z_a) in cm. As main the number of these values was used at Astrakhan. However in data for this item about a height of a high water there were skips. They are restored on link with heights of a high water at of Nizhni Novgorod ($r = 0.86$):

$$Z_a = 0,342 Z_n - 15$$

To data at Astrakhan for separate periods the corrections are placed. In an outcome the continuous number of heights of a high water at Astrakhan is restored (h_A , m) for 1792-1952.

Annual runoff at Volgograd Q_B , km^3/year for 1792 - 1880. Is restored on the equation obtained on data for 1881 - 1940:

$$Q_B = 3,17 h_A^3 + 143$$

In tab. 3 the annual values Q_B for 1792 - 1987 are reduced.

Table 3: Volga River Runoff - Volgograd, km^3/year for 1792 - 1987

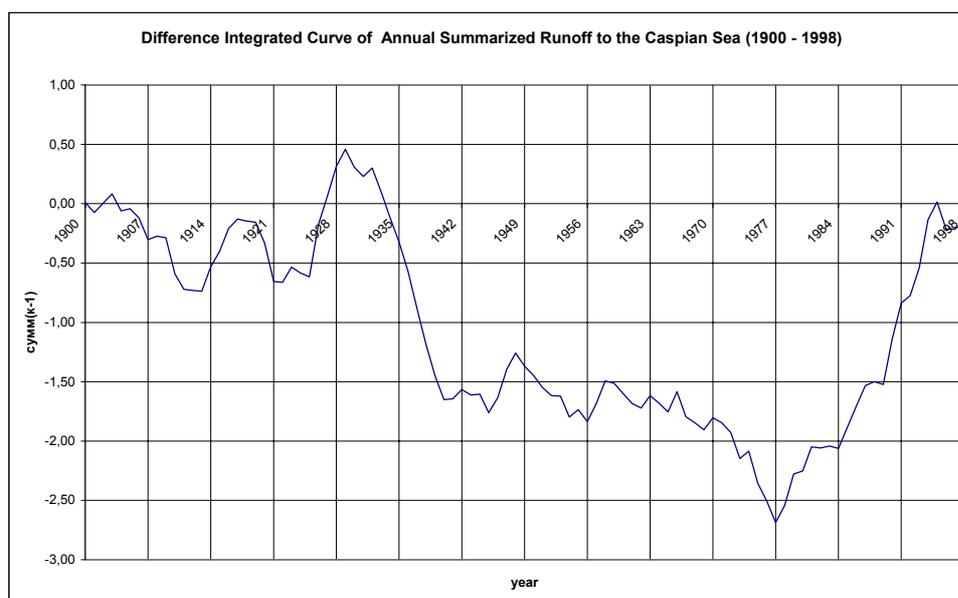
Year	0	1	2	3	4	5	6	7	8	9
1790			312	226	242	245	343	358	260	265
1800	261	281	243	277	265	350	316	317	316	266
1810	254	330	286	265	225	184	219	248	216	189
1820	327	322	240	181	177	214	173	242	296	363
1830	251	239	254	235	260	334	196	245	250	249
1840	170	208	183	253	314	255	287	294	178	285
1850	279	255	240	350	287	310	360	241	292	331

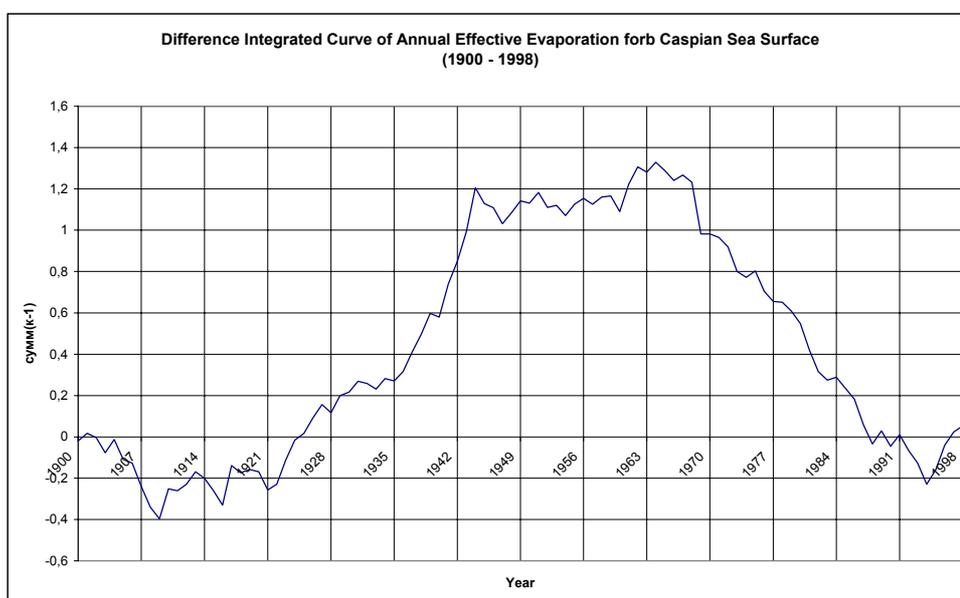
1860	250	224	337	265	255	237	296	392	292	277
1870	201	320	251	246	297	250	261	274	210	282
1880	269	272	272	220	271	229	264	279	324	289
1890	205	174	250	271	277	298	219	208	180	333
1900	264	230	275	265	216	269	231	208	274	263
1910	179	224	251	254	297	290	325	288	269	260
1920	208	162	248	293	251	249	383	332	329	292
1930	229	240	269	214	200	214	186	161	174	180
1940	193	246	269	239	242	218	283	332	282	222
1950	243	237	218	256	200	276	197	270	290	232
1960	199	228	243	262	216	223	294	180	221	221
1970	273	231	217	173	261	166	186	184	271	318
1980	247	293	224	237	224	290	291	277		

For 1881 - 1956 data on runoff at Volgograd are updated by institute the Hydroproject. For later years the drain is reduced on data Hydrometeocentre.

4. Dependence Between a Runoff in the Sea and Effective Evaporation from it of the Surface.

The coefficient of correlation between values of a drain in the sea and effective evaporation (evaporation a minus of a settling) for all period of observations is close to zero. However, as have shown researches /14 /, for separate short enough periods the coefficient of correlation r of this link essentially varies from negative before positive values.





So during sharp changes of a level with 1930 - 1939 and 1978 - 1994 they were negative ($r = -0.650 \div 0.67$), and during minor changes of a level (1940 - 1970) they were positive ($r \approx 0.65$). The dependence of effective evaporation on the value of a drain in the sea is well illustrated by comparison of difference integrated curve these units (Fig. 1, 2).

The reason of such oscillations of the sign of this link, apparently, is the change of atmospheric circulation (configuration of a planetary frontal high-altitude zone) above Volga river pool and water area of the Caspian sea.

5. Definition of Losses of Volga River Runoff on Formation of Ice

Change of Volga river runoff in the Caspian sea at Volgograd - mouth and v. Verkhne- Lebiagie – mouth in time freezing and the destruction of an ice cover can be defined at presence of the items of information about square of a water surface and width of an ice cover on sites. Square of a water surface p. Volga and sleeves Akchtuba on a site - Volgograd – v. Verkhne- Lebiagie makes about 900 sq. kms. Square of a water surface of sleeves and ilmenei of a delta p. Volga located on a site v. Verkhne- Lebiagie - the mouth makes about 5 800 sq. kms. Therefore, square of a water surface Volga river in law water on a site of. Volgograd - the mouth makes 6 700 sq. kms.

Freezing on Volga river is lower than. Volgograd usually begins in an extremity of November and 120 days proceed 90 -. The destruction of an ice cover and ice drift is observed in March - April. Mean of date ice drift at Astrakhan - March 18; at Volgograd - April 4. The average duration ice drift makes 10 - 13 days; per separate years up to 20 - 25 days. Mean of date of refinement of the rivers from ice: at Astrakhan - March 22, at Volgograd - April 17.

Table 4: Width of Ice Z, m and it Change in Winter Period in Lower Current Volga River

Characteristic	Month									
	XII		I		II		III		IV	
	Z	ΔZ	Z	ΔZ	Z	ΔZ	Z	ΔZ	Z	ΔZ
Volga - Volgograd (586 kms from a mouth)										
Average	0.23	0.23	0.41	0.18	0.48	0.07	0.42	-0.06	0.0	-0.42
Greatest	0.42	0.42	0.63	0.21	0.86	0.23	0.66	-0.20	0.0	-0.66
Volga - v. Luchky (542 kms from a mouth)										
Average	0.19	0.19	0.31	0.12	0.40	0.09	0.19	-0.21	0.0	-0.19
Greatest	-	-	-	-	-	-	-	-	-	-
Volga - v. Black Iar (393 kms from a mouth)										
Average	0.36	0.36	0.47	0.11	0.61	0.14	0.50	-0.11	0.0	-0.50
Greatest	0.68	0.68	0.77	0.09	0.88	0.11	0.66	-0.22	0.0	-0.66
Volga - v. Enotaevka (249 kms from a mouth)										
Average	0.30	0.30	0.47	0.17	0.47	0.0	0.26	-0.21	0.0	-0.26
Greatest	0.48	0.48	0.64	0.16	0.70	0.06	0.52	-0.18	0.0	-0.52
Volga - v. Verkhne- Lebiagie (156 kms from a mouth)										
Average	0.17	0.17	0.3	0.13	0.32	0.02	0.17	-0.15	0.0	-0.17
Greatest	0.40	0.40	0.54	0.14	0.54	0.0	0.56	0.02	0.0	-0.56
Volga - Astrakhan (101 kms from a mouth)										
Average	0.18	0.18	0.36	0.18	0.25	-0.11	0.12	-0.13	0.0	-0.12
Greatest	0.46	0.46	0.54	0.08	0.57	0.03	0.34	-0.23	0.0	-0.34
The average characteristic Volga river on a site of Volgograd - v. Verkhne- Lebiagie										
Average	0.25	0.25	0.39	0.14	0.46	0.07	0.31	-0.15	0.0	-0.31
Greatest	0.50	0.50	0.64	0.14	0.74	0.10	0.60	-0.14	0.0	-0.60
The average characteristic Volga river on a site v. Verkhne- Lebiagie - mouth										
Average	0.18	0.18	0.33	0.15	0.28	-0.05	0.14	-0.14	0.0	-0.14
Greatest	0.43	0.43	0.54	0.11	0.56	0.02	0.45	-0.11	0.0	-0.45

In the table 4 the items of information on width of ice Z m and it change ΔZ m in lower current p are reduced Volga for winter period for separate gauge line and for sites of. Volgograd -v. Verkhne- Lebiagie and v. Verkhne- Lebiagie - mouth. Average width of ice on a site of. Volgograd - v. Verkhne- Lebiagie makes 0.46 m. reaching in separate severe winters of 0.74 m. On a site v. Verkhne- Lebiagie - a mouth the average width of an ice cover makes 0.33 m, reaching in separate severe winters of 0.56 m.

Table 5: Calculation of Sizes of Losses of Water on Formation of Ice and Increase of a Runoff at Destruction of an Ice Cover

Characteristic	Month									
	XII		I		II		III		IV	
	W	ΔW	W	ΔW	W	ΔW	W	ΔW	W	ΔW
Site of Volgograd - v. Verkhne- Lebiagie										
Average	0.20	0.20	0.32	0.11	0.37	0.06	0.25	-0.12	0.0	-0.25
Greatest	0.40	0.40	0.52	0.11	0.60	0.08	0.49	-0.11	0.0	-0.49
Site - v. Verkhne- Lebiagie - mouth										
Average	0.94	0.94	1.72	0.78	1.46	-0.26	0.73	-0.73	0.0	-0.73
Greatest	2.24	2.24	2.82	0.57	2.92	0.10	2.35	-0.57	0.0	-0.57

Continue of the Table 5: Calculation of Sizes of Losses of Water on Formation of Ice and Increase of a Runoff at Destruction of an Ice Cover

Site of Volgograd - mouth										
Average	1.14	1.14	2.04	0.90	1.83	-0.21	0.98	-0.85	0.0	-0.85

Greatest	2.64	2.64	3.34	0.70	3.52	0.18	2.84	-0.68	0.0	-0.68
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In the table 5 the outcomes of calculation of sizes of losses of water on formation of ice and increase of a drain are reduced at destruction of an ice cover. At execution of calculations density of river ice started equal 0.90.

The data which are listed in table 5 show, that sizes of losses of water on formation of ice for a site v. Verkhne- Lebiagie - the mouth on the average makes 1.72 cub. km per year, reaching in separate severe winters 2.92 cub. km per year; on a site of Volgograd - a mouth they on the average make 2. 04 cub. km per year, reaching 3.52 cub. km per year.