Studying the role of Caspian Sea on Precipitation condition in the shores of the north of Iran

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Abstract:
Caspian Sea, the largest lake of the word, has a special role in environment circumstances of its regions. In this research, we have considered the role of Caspian Sea in precipitation in the shores of the north of Iran country.
Results show that three kinds of air mass and pressure system affect precipitation in the south shores of Caspian Sea: Siberia high pressure, low- pressure systems and emigrant anticyclones. Between those factors, most precipitation originates from Siberia high pressure, while most and strangest precipitation originates from emigrant anticyclones. Evaporation that produce by Caspian Sea, provide moisture for precipitation that originated from Siberia high pressure, while moisture for low pressure and part of moisture for emigrant anticyclones, provide from black sea, Mediterranean and Atlantic Ocean.
Necessary condition for tacking place of density precipitation in area while provide when in the south shores of Caspian sea in the surface of the earth settle a high pressure ridge that resulted from cold air expansion and exit a trough in the middle and upper level of atmosphere. It should be point out that cold airflow from high latitude to the south shores of Caspian Sea cause in increase of air pressure in area. With due attention to season and high temperature of seawater, when cold air pass over sea. The lower part of it become warm and humid and consequently become unstable. This humid and unstable air will be driven to the south coasts of sea by a anticyclone airflow. The exit of Trough in the upper level support ascent of airflow.
So, Higher of pressure in the surface of the earth and deeper of the trough in the upper level lead to more expectation of more intensity precipitation.
Key words: Caspian Sea, Precipitation of The north coasts of Iran, Synoptic maps, Iceland emigrant low pressure and Siberia high pressure

Introduction:
The Caspian Sea with a surface area of 392000 square kilometer is extended in latitude of 36 to 47 to the north and longitude of 47 to 54 to the east. Its length from north to south is 1200 kilometers and its average width is 300 kilometers. Iran, Russia, Turkmenistan, Azerbaijan and Ghazaghestan share the Caspian Sea. The southern wing of this sea constitutes the northern coastal line of Iran.
With a brief look at the rainfall in regions around the Caspian sea (table 1) and comparing it with rainfall at southern coastal line of the Caspian sea (table2), we can observe clear differences in annual and monthly rainfall of these regions (8). While the annual mean rainfall in northern, western and eastern coastal lines of the Caspian sea associates with arid and semi-arid climate at the same time it could be seen that in the southern coastal line of this sea the annual rate of rainfall has a range of 1815 mm in Bandar Anzali to 600 mm in Gorgan. The same condition applies to the temperature conditions of these regions (table 3 and 4) while the annual mean rainfall over the Caspian Sea is about 196 mm.

The southern coastal line of the Caspian Sea in addition to following the pattern general circulation atmosphere is under influence of local factors (10). The presence of the Caspian Sea as the main source of humidity and Alborz Mountains in south of the coasts and north and northwest winds in the region, together created an ideal ecological (climatic) conditions in the region, which is unique in the world. The presence of fertile soil, good temperature and sufficient rainfall has prepared the region for growth of different plants. so that the region possess dense forests with high commercial value and is considered as the main agricultural region in Iran. Despite this, the locals of this region frequently suffer from the drought and shortage of water at most of the time and they face with destructive floods, which imposes financial damages as well as heavy losses of lives (9).

Therefore it is logical that by identifying the mechanism, the creation, reinforcement and systematic move and expansion of climatically conditions dominating the region to benefit from its positive impact and to avoid its damaging consequences or to minimize them (11).

The main aim in this research is to study the role of the Caspian Sea in the rainfall of northern coasts of Iran.

Method and data:

In this research the climatic parameters of meteorology synoptic stations of Astara, Bandar Anzali, Rasht, Ramsar, Noshahr, Babolsar and Gorgan from 1959-93 together with meteorology maps of daily and monthly rainfall during 1971-72 to 1988-89 have been collected and being studied. The reason for choosing this period (1971-89) was the accessibility and availability of suitable maps during this period at Meteorology Organization of Iran. The region under study was chosen at latitude of 10 to 90 to the north and longitude of west 90 to east 90. The reason for choosing this boundary is to study the source and the way the active pressure centers influence the climatic conditions of the region. Since the two main factors in the rainfall are humidity and the ascend of air (3), hence in this study the maps of earth surface as well as contours of 500 hectopascal have studied for determining the instability conditions (2). The reason for choosing the 500 Hecto Pascal is that most of water vapor present in the atmosphere (about 0.90) is located in the layer under the contour of 500 Hectopascal (6). On the other hand, the waves formation in this contour is the best representation for determining the stable or instable conditions of a region (4). In this way, the waves formation and position of atmospheric active systems in connection with atmospheric condition dominating the northern coasts of Iran and the patterns dominating the region at the time of rainfall have been identified.

Results and discussions:

The rainfall and temperature positions of the stations studied have been provided in tables 2 and 4. The table No.1 shows the annual and monthly mean rainfall country around Caspian sea and the table No.2 shows the annual and monthly mean rainfall in the northern coasts of Iran. The tables 3 and 4 show the monthly, annual mean temperature in these regions, respectively. As one could see in the table No.2, there is no arid month in the southern coasts of the Caspian Sea. In all stations except Gorgan station, the highest rainfall was in autumn and the least rainfall was in spring. In Gorgan, the rainfall in winter and autumn were identical and are considered as the highest rainfall seasons and the summer season is considered as the most arid season. The highest humidity month in all stations except the Gorgan's station is October. May, June and July are considered as the most dried months. At Gorgan's station, the highest rainfall happens in March.

It could be said that the rainfalls in southeast of the Caspian Sea in some extent follow the regime of internal rainfall of Iran plain.

For comparing the rainfall position at southern coasts of the Caspian Sea with other coastal regions of this sea, the monthly and annual mean rainfall of some of these stations have been provided in table No.1. As it can be seen the rate of rainfall at the Caspian Sea region and its neighboring surroundings is very little and most of the time the average rainfall is less than 200mm. By averaging the 119-year statistics that presented by A.D.Doberolski, A.N. Kosario and O.K Leontif it was observed that the average rate of rainfall on the Caspian Sea is equal to 192 mm (9).

In analyzing synoptic meteorology maps the following results were obtained:

The northern coasts of Iran are under the influence of Mediterranean low pressures that reaches the Caspian sea via Turkey and black sea or it is directly influenced by migratory Island low pressure system that causes the invasion of the Caspian sea by cold weather via polar front or Arctic and would create plenty of rainfall, particularly in autumn, over Northern coasts of Iran by removal of humidity and warming during its passage over the warm water of the Caspian sea. When the migratory Island low-pressure system goes toward the southern regions and stabilizes over Eastern Europe. By expansion of cold front this low-pressure center goes toward the southern region, and the high-pressure ridge of northern Europe would settle over the Caspian Sea and gradually the north-northwest currents would settle over the Caspian Sea (5). With emergence of these currents, the cold weather of arctic would pass through the Caspian Sea and by absorbing sufficient heat and humidity from the sea become instable and particularly in western region of southern coasts of the Caspian Sea causes considerable rainfall. This rainfall would be more severe when the difference in temperature and water level is high and sometimes in some regions the rainfall would reach more than 300 mm in 24 hours (8). These rainfalls would continue until such time that the high pressure have not yet settle along the Caspian sea or on the other hand the currents are located in North-Northeast (figures No 1 and 2).

In other words, the severe rainfalls in southern coasts of the Caspian sea occurs when the earth surface is under the influence of high pressure ridge from cold type and the center of this high pressure is normally would settle in northwest of black sea (in eastern Europe). In front of this high pressure is a low pressure system, which is of Mediterranean origin, and it reaches south of Caspian Sea via Turkey and black sea and it causes the invasion of cold weather to the Caspian region via polar front (figure No 2). In contour of 500 Hectopascal, the occurrence of rainfall in the region together with settlement of ridge over the black sea, east to center of Europe and east of Mediterranean sea would cause a deep trough to be settled in the east of black sea in around eastern longitude of 40 to 50(figure No 3). When the center of this trough would be positioned around north pole and along the eastern Europe then by expansion of its cold front to the south, the high pressure ridge in the eastern Europe would settle over the Caspian sea and gradually with emergence of North-Northwest currents over the Caspian sea, the cold weather of arctic would pass over the Caspian sea and by absorbing heat and sufficient humidity becomes instable and particularly in western region of northern coasts of Iran would cause considerable rainfall. Therefore for the rainfall over the southern coasts of the Caspian sea is that to have trough in middle and upper atmosphere and on earth surface we would have front (specially cold front). More pressure on the earth surface the more would be the rate of rainfall, if other conditions would hold (such as humidity at different contours, presence of weather front on earth surface, presence of trough in upper contours and etc).

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Table1: The annual and monthly mean rainfall rate in stations around the Caspian Sea

Year	D	N	O	S	A	J	J	M	A	M	F	J	Month / Station
203.8	25.2	30	22.2	14.3	3.2	7.9	2.4	13.2	17.4	29	12.4	15.6	Hassanghly
143.1	13.7	20.1	15.9	5.5	3.5	5.6	2.7	14.6	16.9	23.2	13.4	14	krasnodesk
157.9	13.4	15.2	17.7	11.2	11	15.4	26	12.3	12.3	12.6	89	10.1	ghoriov
209.6	16.2	12.8	20.2	22.5	16.3	14.2	25.5	20.7	19.8	15.3	11.6	13.1	astarakhan
321.8	26.4	27.3	32.8	37.1	25.9	25.7	26.8	23.6	19.9	22.5	29.7	24.1	mkachkla

Table2: The annual and monthly mean rainfall rate in stations Southern Coast of Caspian Sea in duration 1959-1993

Year	D	N	O	S	A	J	J	M	A	M	F	J	Month / Station
1219.5	96	140.9	281.5	212	65.4	28.8	43.4	50.6	48.1	96.9	72.4	83.5	astara
1815.	219.	292.	367.	207	107.	41.	44.	50.	49.	112.	136.	187.	anzaly

7	9	6	4		3	2	1	6	9	2	2	2	
1416.9	173.3	202.2	236.1	138.3	73.6	39.6	39.6	58.6	56.7	116.5	130.1	150.2	rasht
1248.9	119.3	161.7	309.8	161.8	69.4	49.7	49.7	50.4	40.5	89.2	78.6	84.4	ramsar
1326.6	140.1	206.9	242.1	153.8	79.5	52.6	52.6	48.2	47.8	92.4	109.1	114.4	noshar
913.4	131.8	131.8	166.3	73.3	67.1	16.4	16.4	23.7	31.3	70.5	79	99.2	babolsar
599.8	64.2	60.3	69.2	37.9	31.5	30.6	30.6	46.8	45.2	76.9	63.7	55.2	gorgan

Table3: The annual and monthly mean temperature rate in stations around the Caspian Sea

Year	D	N	O	S	A	J	J	M	A	M	F	J	Month / Station
15.9	6.7	11	17.3	23.7	27.1	26.8	23.9	20.2	14.9	8.9	5.6	4.5	Hassangholy
14.5	5.2	9.2	14.6	21.7	27.1	27.5	23.9	19.7	13.5	6.8	2.8	2.2	krasnodesk
9.4	-3.9	1.8	7.8	17.5	25.2	26.1	23.3	11.9	11.2	-0.3	-8.3	-7.3	ghoriov
9.7	-1.5	6.3	8.7	17.5	24.3	25.5	22.3	18.4	11.2	0.9	-5.2	-5.5	astarakhan
12.1	3.5	7.9	13.1	19.8	23.8	24.6	21.5	14.4	10.2	3.7	0.5	0.3	Mkachkla
-0.4	-13.4	-7.8	-0.8	7	12.4	15.7	13.1	7.8	0.9	-7.5	-15.7	-16.6	Bayser

Table4: The annual and monthly mean temperature in stations Southern Coast of Caspian Sea in duration 1959-1993

Year	D	N	O	S	A	J	J	M	A	M	F	J	Month / Station
15.1	7.7	12	16.6	21.5	24.7	25.6	22.5	18.1	12.8	8.5	5.5	5.7	astara
16.1	9.9	13.5	17.8	22.5	25.4	25.2	23.4	18.8	13.1	8.6	6.7	7.1	anzaly
15.7	8.7	12.6	17.1	22	24.8	25.2	23	19	14.1	8.8	6.6	6.7	rasht
15.8	9.3	13.2	17.5	22.4	24.8	25.6	22.8	18.6	13.6	8.8	7	7.1	ramsar
15.9	9.6	13.4	18	22.6	24.9	25	22.4	18.3	13.4	8.9	7.1	7.3	noshar
16.9	9.8	14.1	18.6	23.7	26	26.5	23.9	19.7	14.7	10	7.9	7.8	babolsar

17.6	9.8	13.6	19.1	23.9	27.3	27.9	25.5	12.2	16.3	10.8	8.2	8	gorgan

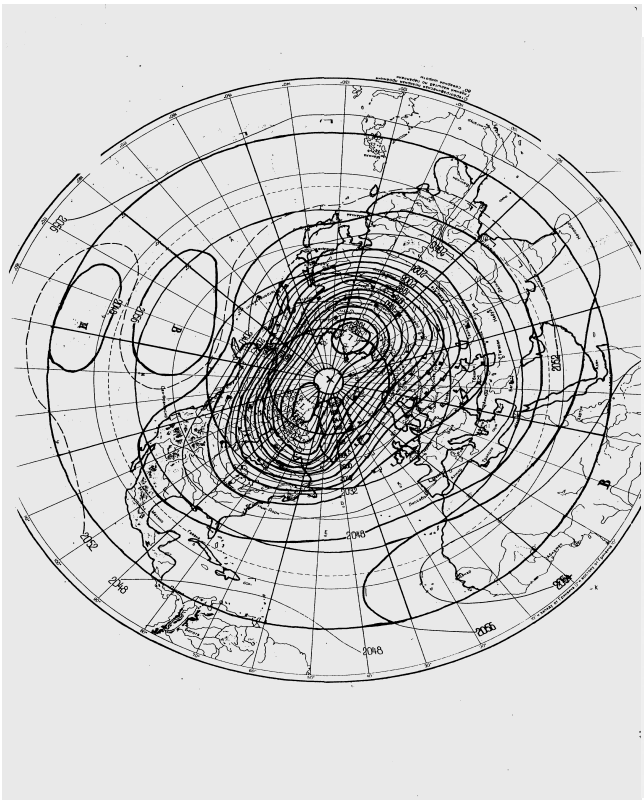

Figure 1: the synoptic map level 50 hp
Of the January 1972

Figure 4: the mean sea surface
Temperature Caspian Sea

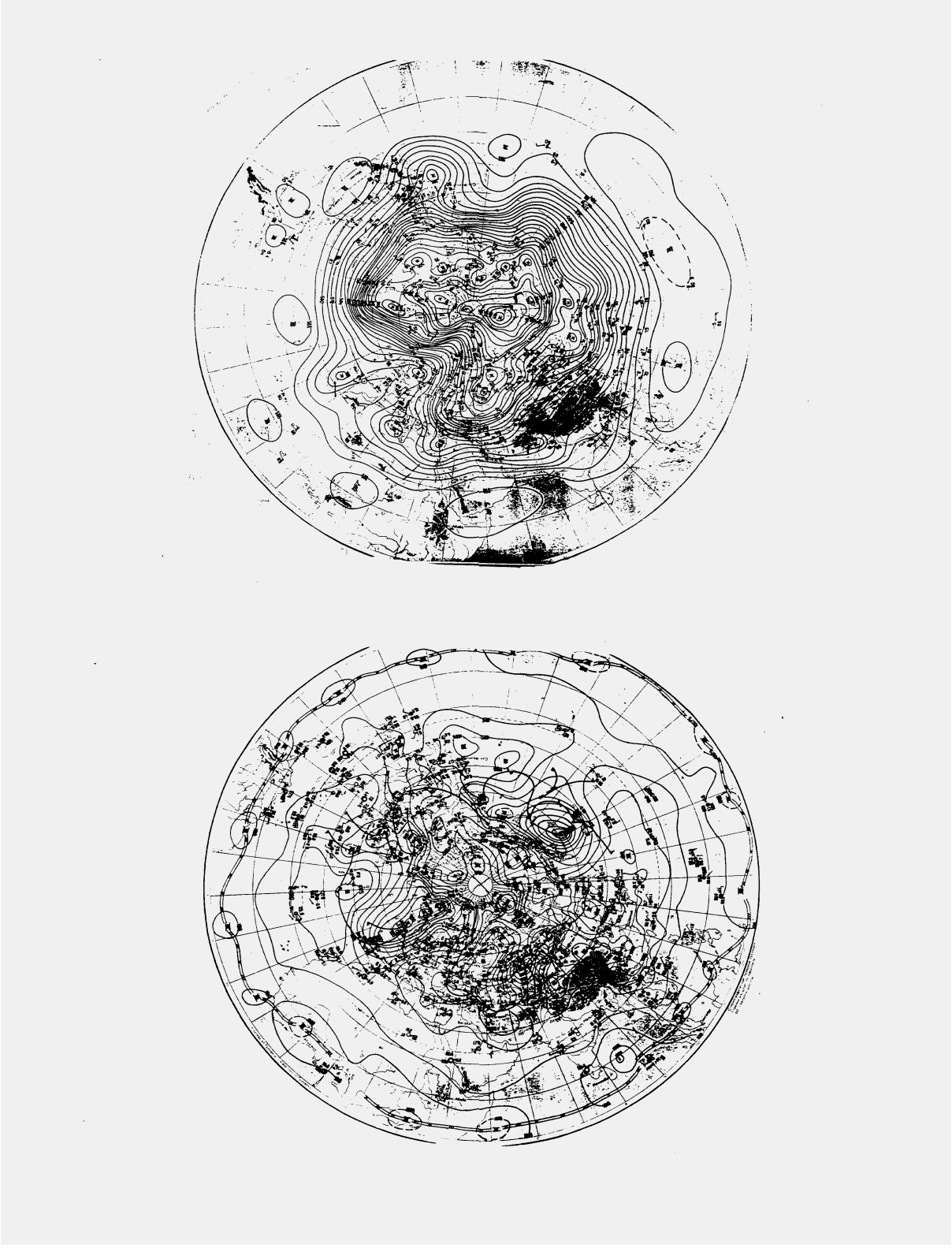

Figure 2(above): the synoptic map level 500 hp 2/1/1989
Figure 3(below): the synoptic map earth surface 30/11/1984