Water demand for irrigation in Yingkou City, China

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1. Introduction

The study area we select is Yingkou City, where is the hometown of a group member, Zhechen Zhang. Yingkou City is bordered by the Liaodong Bay of the Bohai Sea to the west. It is between 121°56'~123°02' east longitude and 39°55'~40°56' north latitude, with a total area of 5402 square kilometers (Fig 1). The city has a warm temperate continental monsoon climate. Its climatic characteristics are four distinct seasons, the same season as rain and heat, mild climate, moderate precipitation, sufficient sunlight, and excellent climatic conditions. The annual average temperature is 9.5°C, the coldest in January, the average temperature is -8.5°C, the extreme minimum temperature can reach below minus 28°C; the hottest in July, the average temperature is 25°C. The annual precipitation in Yingkou City is about 650 millimeters, which is mainly concentrated in July-August. The rainfall in these two months accounts for about half of the annual precipitation.

Agricultural and sideline product is famous for rice, with an annual output of 420,000 tons of high-quality rice. Rice is a crop with high water demand, and it is generally dominated by flood irrigation. At the same time, the over-exploitation of groundwater in Yingkou City, the groundwater level dropped significantly, causing a series of ecological and environmental problems.

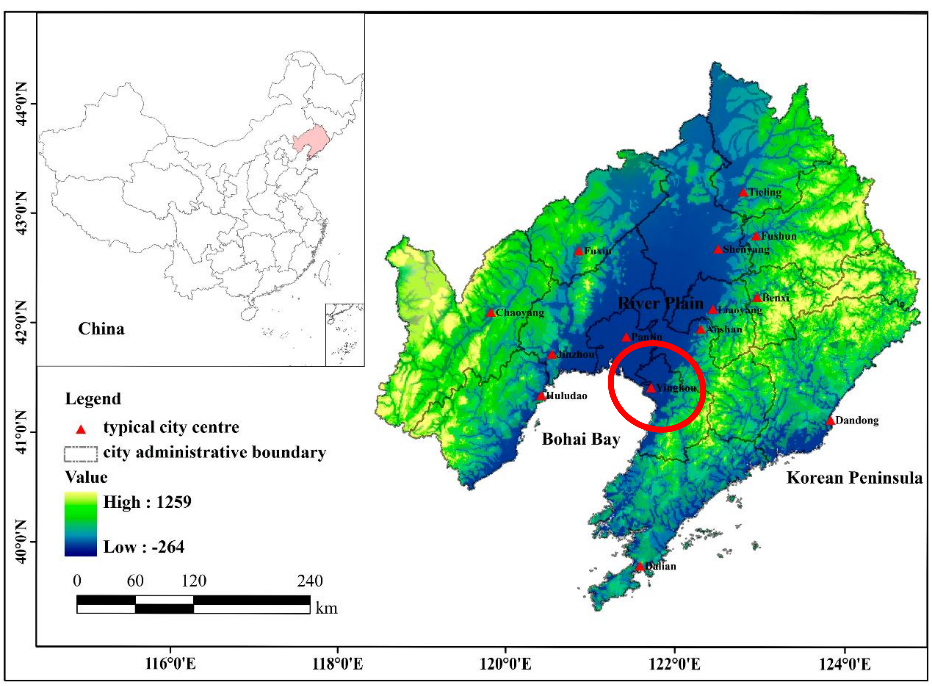


Figure 1 Yingkou City location and elevation map(Chen et al., 2017)

2. Input data

Data we retrieve is from the China Meteorological Data Service Center (http://data.cma.cn/en). Yingkou station is an international exchange meteorological data station, so the source of data is public. Data we retrieve from this website include minimum temperature, maximum temperature, daily precipitation, relativity humidity, average wind speed, CO_2 concentration five parameters from 2000 to 2017. Data can be downloaded as a text file with data type of floating-point number, so the process of changing the format according to AquaCrop evaporation calculator is propitious.

Because Yingkou is along the coastline of the Bohai Sea, this area has a four-season humid continental climate, with 500-600 mm/year annual precipitation. The annual cumulative precipitation in the crop cycle is generally more than 300 mm. However, in some dry years, the cumulative precipitation in the crop cycle is lower than 300 mm. By searching in our dataset, we found that 2007 is the driest year in crop period from 2000 to 2017 with 289.9 mm precipitation. Thus, in this report, we use 2007 meteorological data to simulate several scenarios of planting paddy rice to assess the water demand for irrigation in dry years in the Yingkou area.

Data of five parameters in 2017 are listed in the appendix. The input temperature and rainfall, and resulting evaporation data are visualized in Figure 2 and Figure 3. The temperature, rainfall and evaporation distributions are consistent with climate conditions in this area, which are higher in summer and lower in winter. Thus, the data of rainfall, evaporation, and temperature are reasonable.

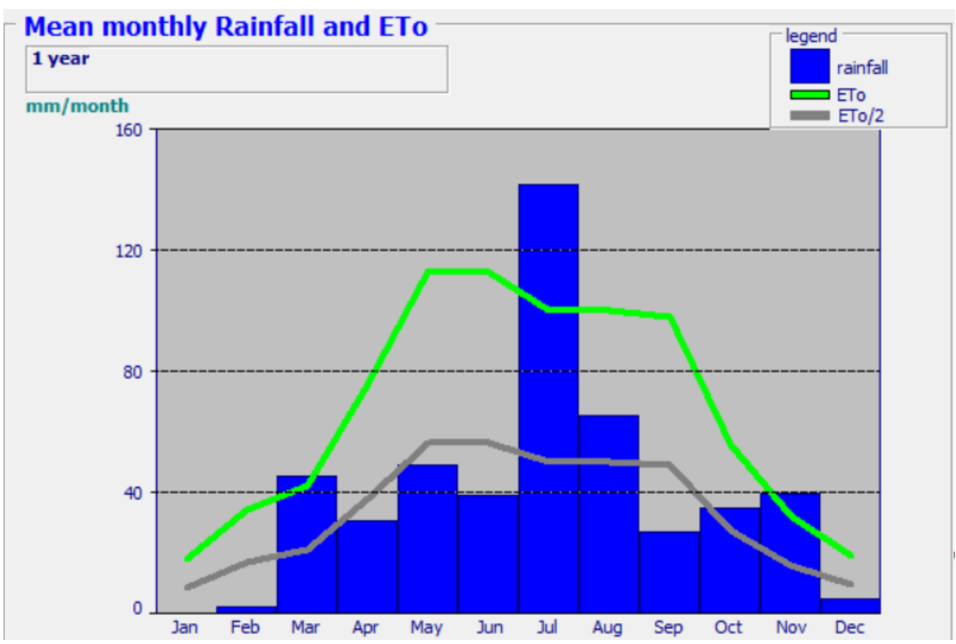


Figure 2 Rainfall and evaporation distribution in 2007

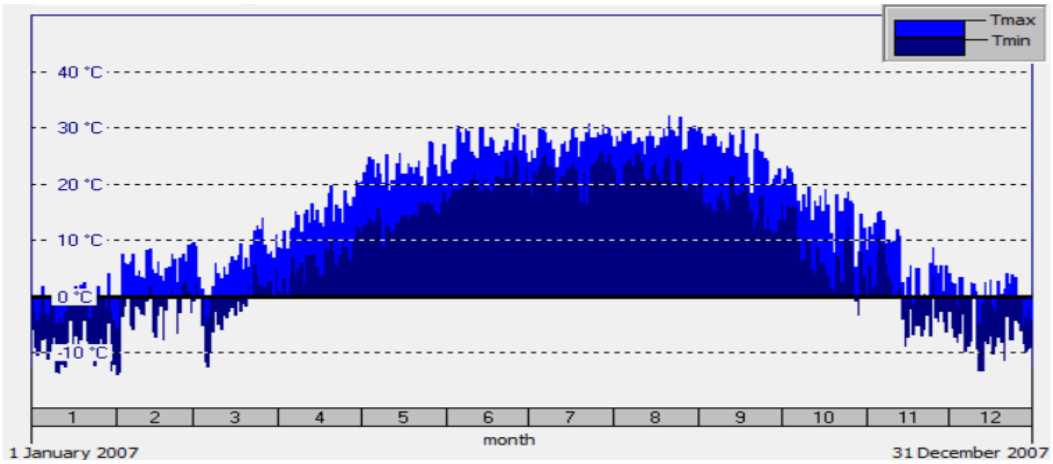
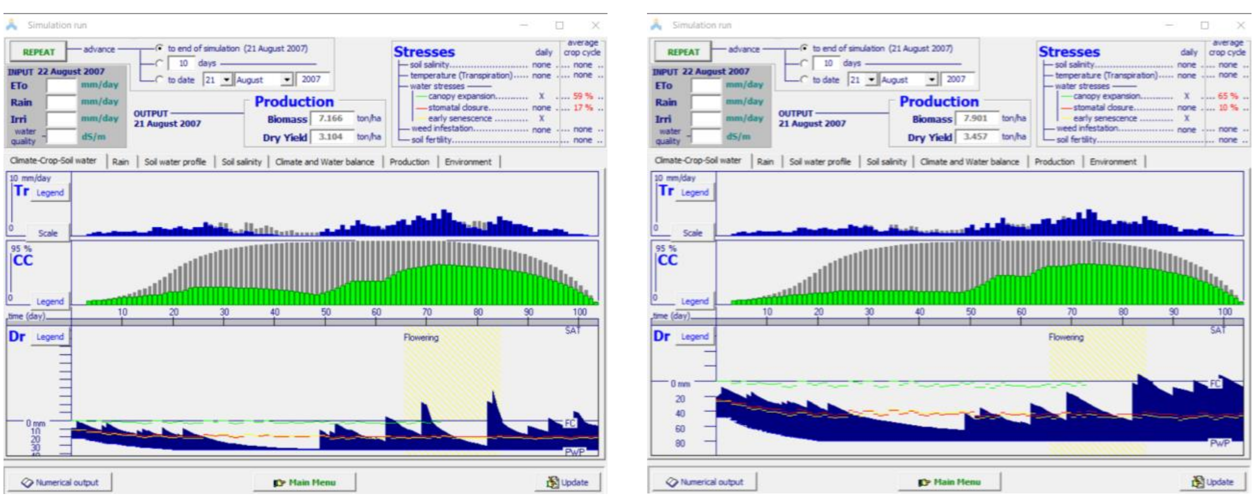


Figure 3 Temperature distribution in 2007

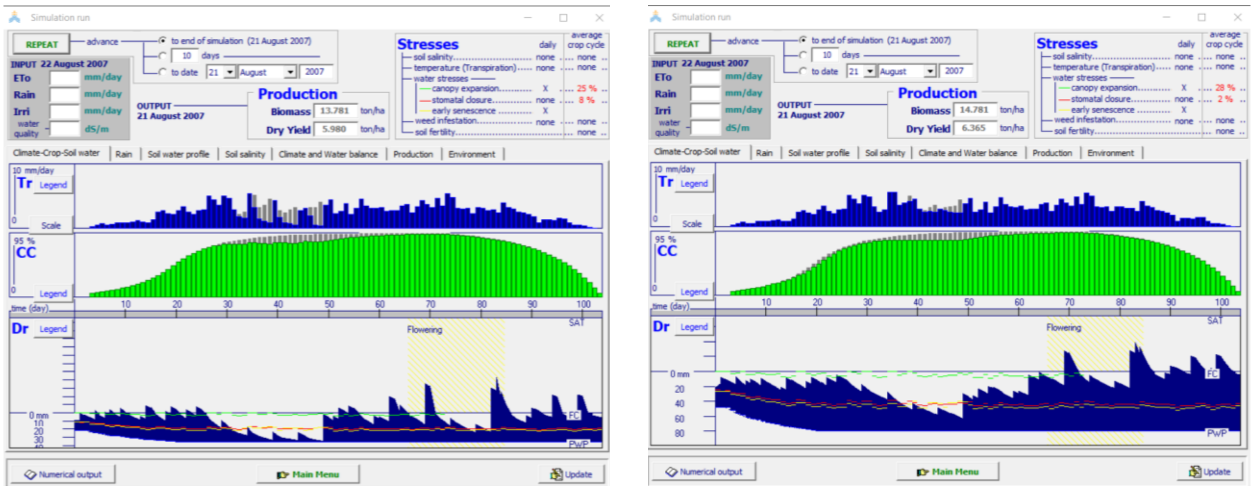
The typical sowing time of paddy rice is from the end of April to the beginning of May. But in 2007, the temperature at the end of April is too low to sow, so we set the sowing time is May 10th. Other settings of irrigation models include soil types, initial soil water content, and irrigation schedule. In this report, we use two different soil, sand, and loam and set up the soil depth as 3cm. Initial soil water content is set up as 75% of field capacity water content. Irrigation schedule is also set up in two different ways, one is fixed irrigation rate 10 mm irrigation water depth per 5 days, and another one is set up back to field capacity content by irrigation when the water content is depleted to 50% of field capacity. Up to now, the setting of the irrigation model is finished.

3. Results and discussions

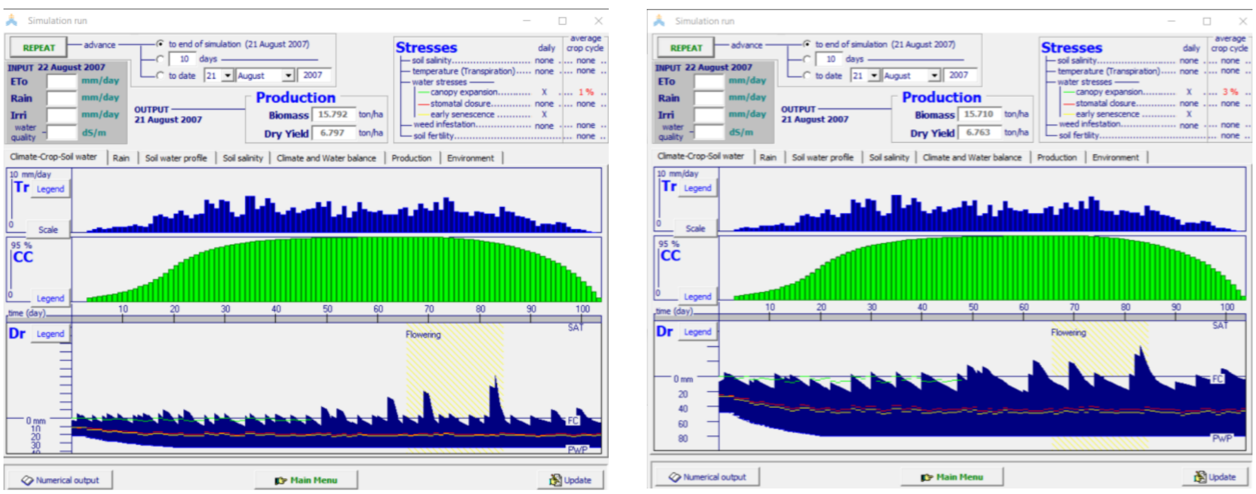
Results of the simulation are presented in Figure 4, Tables 1 and 2. Figure 4 shows the output of AquaCrop software in four different scenarios and the benchmark model without irrigation. Table 1 lists concepts about crop yield in different scenarios compared with the benchmark model. And Table 2 presents the water balance of different irrigation models.



(a) No irrigation



(b) Scenario 1



(c)Scenario 2

Figure 4 Output of different irrigation models

From Figure 3, we can see that the difference between no-limitation and actual green canopy cover is huge in the two no irrigation scenarios, and the difference between the maximum and actual transpiration also occurs. This indicates that water deficit exists without irrigation. While in the following irrigation scenarios, the difference almost totally disappears, which means the deficit of water is solved by irrigation. And the differences between four irrigation scenarios also occur, but these differences are too minor to analyze in Figure 4. The results of the comparison are shown in the following two tables. At the same time, we can see some similarities in Figure 4. Both from the results of the basic model and from the first scenario of irrigation, it can be seen that water shortage is not at all times during the crop cycle, but the main period of water shortage is 20 to 50 days after sowing. This period of water shortage is effectively solved in the first scenario irrigation mode, but there is still a certain amount of water shortage, while in the second irrigation mode, it is more completely solved.

Table 1 Yield results in different scenarios

Scenarios	Yield [t/ha]	WP_{ET} [kg/m^3]	Irrigation water [mm]	Crop growth duration [days]
Sand, no irrigation	7.166	1.39	0	101
Loam, no irrigation	7.901	1.32	0	101
Sand, schedule1	13.781	1.83	200	101
Loam, schedule1	14.781	1.78	200	101
Sand, schedule2	15.792	1.88	253.5	101
Loam, schedule2	15.710	1.89	215.6	101

Table 1 indicates that for two different soils, the yield of paddy rice and water productivity obviously increases under irrigation conditions compared with no irrigation model. And the schedule 2 has a better performance than schedule 1 in the yield and water productivity view. The irrigation water is also listed in Table 1, which is the highest in schedule 2. The crop growth duration does not change in a different model, which indicates that without irrigation, paddy rice also can grow in the total life cycle, but the yield is significantly reduced. We also can compare the yield performance between different soils from Table 1. When schedules are the same, the models with loam have better performance than the models with sand for all three different schedules. By comparing the results in Table 1, we can determine that loam is better than sand in the Yingkou area for paddy rice planting, and schedule 2 can bring more yield and water product efficiency. Thus, from the perspective of the yield of paddy rice, schedule 2 with loam soil is the most efficient scenario. Although schedule 2 uses more irrigation water causing more costs on water, we think the improving costs are not very much, which doesn't affect schedule 2 is better than schedule 1.

Following Table 2 tries to explain why loam is better than sand from the view of water balance. The drained water in the sand model is much higher than the drained water in the loam model with the same irrigation conditions, which is because sand has a much higher infiltration rate and lower storage ability than loam. This leads to that much water from precipitation and irrigation is wasted and not used for the growth of paddy rice.

Table 2 Water balance in different scenarios

Scenarios	Evaporation [mm]	Transpiration [mm]	Runoff [mm]	Infiltrated [mm]	Drained [mm]
Sand, no irrigation	97.2	126.5	1.9	288	48.9
Loam, no irrigation	122.4	139.3	7.7	282.2	0
Sand, schedule1	81.0	246.4	2.7	487.2	144.4
Loam, schedule1	91.8	265.2	17.4	472.5	71.4
Sand, schedule2	77.5	284	24.5	519	141.7
Loam, schedule2	75.8	282.4	44.0	461.5	59.7

4. Conclusions

We use open-source data to simulate four different scenarios with two soils and two schedules compared with no irrigation models to assess the water demand in dry years in the Yingkou area, China. The water demand for irrigation in 2007 in the Yingkou area is around 200 mm, which accurate value is determined by irrigation schedule. The deficit of water in the Yingkou area agriculture system is not along all the crop cycle but occurs in some specific period. From the models' results, the adding irrigation is effective, which can significantly improve the yield of paddy rice, especially in dry years. And by comparing between four scenarios results, we determine the schedule of returning field capacity by irrigation when depleting a specific percentage is better and loam soil is better than sand. Actually, peat is widely found in Yingkou area. This is one reason of this area is fit for planting paddy rice, which is a water-intensive crop.

References

Chen, T., Huang, Q., Liu, M., Li, M., Qu, L.a., Deng, S. and Chen, D. 2017. Decreasing Net Primary Productivity in Response to Urbanization in Liaoning Province, China. Sustainability 9(2).

Appendix

Table 1 Input of Meteorological Data in Yingkou in 2007

Station	Year	Month	Day	P	U	H	Tmin	Tmax
54471	2007	1	1	0	2	83	-6.1	-0.6
54471	2007	1	2	0	3.8	70	-9.2	-3.1
54471	2007	1	3	0	3.2	92	-10.6	-4.4
54471	2007	1	4	0	1.1	96	-10.1	-2.8
54471	2007	1	5	0	2.7	88	-7.8	1.7
54471	2007	1	6	0	4.8	56	-7.6	-3
54471	2007	1	7	0	1.8	55	-11.2	-3.2
54471	2007	1	8	0	1.8	64	-10	-0.7
54471	2007	1	9	0	3	64	-7.4	-1.3
54471	2007	1	10	0	3.3	54	-13.5	-4.9
54471	2007	1	11	0	1	66	-13.7	-3.6
54471	2007	1	12	0	1.8	56	-12.3	-4.6
54471	2007	1	13	0	1.8	64	-12.6	-2.7
54471	2007	1	14	0	2.5	62	-8.3	0.2
54471	2007	1	15	0	1.8	87	-4.4	-0.5
54471	2007	1	16	0	0.9	84	-8.9	-1
54471	2007	1	17	0	1.7	77	-7.1	1.9
54471	2007	1	18	0	2.3	65	-9.2	0.3
54471	2007	1	19	0	3.1	78	-7.8	2
54471	2007	1	20	0	1.6	76	-4.4	2.5
54471	2007	1	21	0.4	2.6	86	-8	0.5
54471	2007	1	22	0	0.8	67	-11.3	-3.9
54471	2007	1	23	0	0.8	67	-11.6	-0.2
54471	2007	1	24	0	0.6	66	-12.5	0
54471	2007	1	25	0	1.6	70	-9.1	1.7
54471	2007	1	26	0	2.9	60	-7.6	-0.4
54471	2007	1	27	0	2.3	60	-11.2	0.1
54471	2007	1	28	0	2.2	64	-11	-2
54471	2007	1	29	0.1	6.1	68	-4.9	4
54471	2007	1	30	0.1	2.6	49	-13.4	-2.7
54471	2007	1	31	0	3	52	-12.3	-4.2
54471	2007	2	1	0	3.3	44	-14.1	-5.7
54471	2007	2	2	0	3.4	54	-13.5	0.2
54471	2007	2	3	0	5.7	53	-3.6	7.6
54471	2007	2	4	0	6.1	57	-1.9	5.9
54471	2007	2	5	0	2.9	80	0	5.8
54471	2007	2	6	0	1.8	71	-5.3	6.2
54471	2007	2	7	0	2.5	57	-6.1	7.5
54471	2007	2	8	0	1.6	65	-1.8	3.7
54471	2007	2	9	0	1.5	82	-2.3	4.5
54471	2007	2	10	0	3.8	50	-3.3	3.5

Station	Year	Month	Day	P	U	H	Tmin	Tmax
54471	2007	2	11	0	2.4	75	-3.5	3.2
54471	2007	2	12	0	4.1	57	-1	8.3
54471	2007	2	13	0	4.4	69	1.8	8.5
54471	2007	2	14	0	6.8	34	-6.5	4.7
54471	2007	2	15	0	1.8	40	-7.4	4.1
54471	2007	2	16	0	3.5	68	-3.5	6.1
54471	2007	2	17	0	3.8	60	-1.9	3.7
54471	2007	2	18	0	2.9	49	-7.8	2.7
54471	2007	2	19	0	3	71	-2.6	5
54471	2007	2	20	0	2.3	79	0.3	5.3
54471	2007	2	21	0	4	86	1.1	7.5
54471	2007	2	22	0	5.3	53	-0.4	6.7
54471	2007	2	23	0	2.7	37	-6.7	2.5
54471	2007	2	24	0	3.6	59	-3	6.8
54471	2007	2	25	0	4.5	76	2.2	7.5
54471	2007	2	26	2.2	2.7	79	3	6.2
54471	2007	2	27	0.3	2.3	80	1	9.1
54471	2007	2	28	0	1.9	71	-3	9.3
54471	2007	3	1	1.9	1	80	-1	9.5
54471	2007	3	2	0	4.1	88	2.4	8.9
54471	2007	3	3	0	6.8	75	-0.3	3.5
54471	2007	3	4	34	11.8	90	-5.3	1.4
54471	2007	3	5	0.2	10.6	58	-11.8	-4.8
54471	2007	3	6	0	3.1	51	-12.7	-3.6
54471	2007	3	7	0	3.4	67	-9.8	-0.4
54471	2007	3	8	0	2.5	60	-6.5	1.8
54471	2007	3	9	0	5.1	68	-2.8	5.9
54471	2007	3	10	1	6.9	62	-5	4
54471	2007	3	11	0	3.1	58	-5.9	3.2
54471	2007	3	12	0	2.7	65	-3.4	5.2
54471	2007	3	13	0	3	70	-4	3.8
54471	2007	3	14	0	3	71	-2.7	6
54471	2007	3	15	0	3.2	64	-2	7
54471	2007	3	16	0	2.4	51	-3.4	6.4
54471	2007	3	17	0	2.7	57	-0.9	7.2
54471	2007	3	18	0	1.4	59	-2.9	9.4
54471	2007	3	19	0	4.1	63	-1.4	4.7
54471	2007	3	20	0	1.4	64	-1.8	6.8
54471	2007	3	21	0	1.8	81	2.3	5.2
54471	2007	3	22	0	3.2	87	-0.3	9.2
54471	2007	3	23	0	4.7	77	5.8	11.6
54471	2007	3	24	0	2.6	85	3.7	12.6
54471	2007	3	25	0	2.1	39	2.1	11.8
54471	2007	3	26	0	1	56	2	13.9

Station	Year	Month	Day	P	U	H	Tmin	Tmax
54471	2007	3	27	0	4	56	1.6	9.1
54471	2007	3	28	0	2.7	77	2.6	7.6
54471	2007	3	29	2	1.4	91	2.9	7.9
54471	2007	3	30	6	1.5	95	0.3	6.8
54471	2007	3	31	0.7	5.6	71	5	10.9
54471	2007	4	1	0	3.7	63	1	8.8
54471	2007	4	2	0	2.8	67	0	8.5
54471	2007	4	3	0	5.3	47	3.2	11.7
54471	2007	4	4	0	2.9	46	-0.4	8.4
54471	2007	4	5	0	5	57	4.2	11.6
54471	2007	4	6	0	4.2	79	6.9	12.1
54471	2007	4	7	0	2.3	76	3.6	15.2
54471	2007	4	8	0	3.5	57	5	14.5
54471	2007	4	9	0.1	3.3	62	6	11.4
54471	2007	4	10	0	3.1	63	2.1	14.7
54471	2007	4	11	0	2	54	7.3	15.4
54471	2007	4	12	24.2	3.7	88	7.3	13
54471	2007	4	13	2.4	6.4	63	7.4	16.4
54471	2007	4	14	0	3.9	61	7.5	13.6
54471	2007	4	15	0.1	2.7	77	5.2	15.4
54471	2007	4	16	0	4.3	59	3.7	13
54471	2007	4	17	0	2.5	68	4.2	12.4
54471	2007	4	18	0	6.2	64	8.7	15.7
54471	2007	4	19	0	4.6	76	8	18.3
54471	2007	4	20	0.3	4.5	50	10.5	19.6
54471	2007	4	21	4	3.4	80	8	13.3
54471	2007	4	22	0	4.7	56	5.5	16.3
54471	2007	4	23	0	2.9	58	7.4	15.5
54471	2007	4	24	0	6.2	72	10	13
54471	2007	4	25	0	4.7	55	8.7	18.8
54471	2007	4	26	0	4.4	39	8.5	16.4
54471	2007	4	27	0	3.4	43	6.3	16
54471	2007	4	28	0	5.5	56	9.7	17.7
54471	2007	4	29	0	7.2	63	12.6	20.6
54471	2007	4	30	0	7.8	65	12.1	20.2
54471	2007	5	1	0	3.7	71	11.3	20.4
54471	2007	5	2	0	4	70	12.7	22
54471	2007	5	3	0	5.5	66	12.9	23.3
54471	2007	5	4	0	4	42	13.7	24.7
54471	2007	5	5	0	0.2	48	13	24.3
54471	2007	5	6	0	4	58	13.4	21.1
54471	2007	5	7	0	6	52	15.5	23.6
54471	2007	5	8	0	6.9	16	13.8	21.8
54471	2007	5	9	3.4	3.5	68	8.9	20.2

Station	Year	Month	Day	P	U	H	Tmin	Tmax
54471	2007	5	10	0	2.2	58	12.7	25.3
54471	2007	5	11	8.2	3.8	67	12.1	18.8
54471	2007	5	12	1.3	4	77	11.5	20.6
54471	2007	5	13	0	3.4	73	11.7	20.7
54471	2007	5	14	0	3.5	54	13	23.6
54471	2007	5	15	0	4.9	51	13.6	25.5
54471	2007	5	16	7	4.8	78	14.4	21.7
54471	2007	5	17	6.4	4	73	14.2	21.7
54471	2007	5	18	0.1	5.7	58	13.8	23.5
54471	2007	5	19	0	3.5	70	14.5	23
54471	2007	5	20	0	5.4	64	14.9	21.8
54471	2007	5	21	0	1.9	74	14.5	22.9
54471	2007	5	22	0.3	4.4	73	16.4	24.1
54471	2007	5	23	4.2	3.8	73	16.7	21.4
54471	2007	5	24	5.1	2.7	91	16.2	19.9
54471	2007	5	25	0.8	2.9	69	16.9	22.9
54471	2007	5	26	0	3.8	53	16.3	27.4
54471	2007	5	27	0	3.8	47	16.4	27.3
54471	2007	5	28	10.8	4.4	71	15.2	23.4
54471	2007	5	29	0	4.2	80	14.7	21.4
54471	2007	5	30	0	3.4	60	16.8	24.9
54471	2007	5	31	1.8	4.6	69	18.6	27
54471	2007	6	1	10.6	5.1	83	16.5	22.5
54471	2007	6	2	0	5.6	77	17.4	21.7
54471	2007	6	3	0	6.1	66	18.7	23.9
54471	2007	6	4	0	4	75	19.1	24.4
54471	2007	6	5	0	3.4	51	18.8	30.2
54471	2007	6	6	0	2.5	54	19.1	29.1
54471	2007	6	7	0	2	79	19.4	27.2
54471	2007	6	8	0	3.8	60	19.6	29.7
54471	2007	6	9	0	3	55	19.4	29.3
54471	2007	6	10	0	5.1	61	20.9	25.7
54471	2007	6	11	0	6.7	57	22.1	25
54471	2007	6	12	0	4	69	20.4	24.5
54471	2007	6	13	0	3.5	55	18.7	30.1
54471	2007	6	14	0	3.6	48	18.7	30
54471	2007	6	15	0	3.7	71	20.9	26.6
54471	2007	6	16	0	2.7	67	19.3	26.5
54471	2007	6	17	0	5	52	18.6	28.2
54471	2007	6	18	0	3.1	59	19.2	27.7
54471	2007	6	19	0	3.6	80	21.2	25.5
54471	2007	6	20	0	3.5	80	21.2	24.9
54471	2007	6	21	0	4.5	82	20.9	25.7
54471	2007	6	22	0	6.3	73	21	26.6

Station	Year	Month	Day	P	U	H	Tmin	Tmax
54471	2007	6	23	0	5.4	67	24.1	27.7
54471	2007	6	24	0	3.8	74	21.1	25.9
54471	2007	6	25	0	3.5	71	22	27.2
54471	2007	6	26	0	4	67	25	29.7
54471	2007	6	27	0	4.2	64	23.9	30.7
54471	2007	6	28	23.1	4	90	19.2	25.8
54471	2007	6	29	0	4	82	20.5	28.6
54471	2007	6	30	5.8	2.3	83	22.9	25.5
54471	2007	7	1	12.4	3.4	84	20.3	23.9
54471	2007	7	2	0	1.9	81	18.1	25.8
54471	2007	7	3	0.6	3.3	84	21.9	24.5
54471	2007	7	4	1.1	2.6	83	21.5	26.3
54471	2007	7	5	0	4.7	76	23.1	30.1
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54471	2007	7	10	0	3.6	68	22.8	26.1
54471	2007	7	11	29.8	2	89	18.5	23
54471	2007	7	12	0	3.9	83	20.8	24.7
54471	2007	7	13	0	2.2	77	21.3	27
54471	2007	7	14	0	2.4	75	21.4	27.6
54471	2007	7	15	0	2.4	79	22.6	25.7
54471	2007	7	16	0	2.6	80	22.5	27.7
54471	2007	7	17	0	5.2	74	23.5	30
54471	2007	7	18	39.9	3.6	86	22.5	28.2
54471	2007	7	19	1.2	4.6	68	19.4	24.8
54471	2007	7	20	0	2.1	65	16.8	27.6
54471	2007	7	21	0	2.7	75	22.1	27.6
54471	2007	7	22	0	2.8	65	16.6	29.1
54471	2007	7	23	0	1.8	73	19.9	30.7
54471	2007	7	24	0	2.4	77	23.2	28.3
54471	2007	7	25	0	3.2	73	23.8	28.3
54471	2007	7	26	0	3.2	76	24.6	29.1
54471	2007	7	27	0	5.5	83	25.4	28.6
54471	2007	7	28	0	2.7	86	25.5	30.6
54471	2007	7	29	0.2	3.9	85	23.6	28.9
54471	2007	7	30	0	3.1	82	25.2	29.8
54471	2007	7	31	53	3	84	23.4	28.5
54471	2007	8	1	17	4.4	88	22.8	26.7
54471	2007	8	2	0	4.4	69	19	28.4
54471	2007	8	3	0	3.9	78	19.7	27.4
54471	2007	8	4	0	0.9	77	19.8	29.3
54471	2007	8	5	0	1.8	77	23.3	28.9

Station	Year	Month	Day	P	U	H	Tmin	Tmax
54471	2007	8	6	0	2.5	73	24	29.4
54471	2007	8	7	0	3.4	72	24.5	29.3
54471	2007	8	8	11	7.8	88	23.2	27.1
54471	2007	8	9	0	5.3	92	25.8	27.3
54471	2007	8	10	0	6.2	82	25.2	28.2
54471	2007	8	11	0	3.9	80	23.8	27.6
54471	2007	8	12	15.5	4.7	95	21.4	25.3
54471	2007	8	13	0	2.2	82	20.7	28.4
54471	2007	8	14	0	3.1	84	21.5	29.4
54471	2007	8	15	0	2.6	88	23.2	28.5
54471	2007	8	16	6.8	2.1	87	23.6	26.4
54471	2007	8	17	12.2	2.2	91	21.6	26.8
54471	2007	8	18	0	1.7	85	20.7	28.3
54471	2007	8	19	0	1.5	81	23	29.7
54471	2007	8	20	0	5.1	84	24.5	28.4
54471	2007	8	21	0	4	64	25.2	32
54471	2007	8	22	0	2.2	64	20.2	29.6
54471	2007	8	23	0	2.9	61	20.2	29.3
54471	2007	8	24	0	5.3	78	24.2	28.4
54471	2007	8	25	0	1.5	74	23.8	31.9
54471	2007	8	26	3	2.5	83	19.6	26
54471	2007	8	27	0	1.5	79	18.9	26.2
54471	2007	8	28	0	2.5	73	19.2	29.3
54471	2007	8	29	0	2.5	66	19.9	30
54471	2007	8	30	0	2.4	72	19.9	30.2
54471	2007	8	31	0	2.9	70	18.4	29.3
54471	2007	9	1	0	1.5	64	19.7	29.8
54471	2007	9	2	0	2.1	74	21.7	28.8
54471	2007	9	3	0	3.9	58	16.6	26.9
54471	2007	9	4	0	2.7	57	15.5	28.5
54471	2007	9	5	0	3.9	60	16.6	28.5
54471	2007	9	6	0	3.8	63	15.1	28.9
54471	2007	9	7	0	4.3	66	15	28.4
54471	2007	9	8	0.4	1.8	69	17.6	26.6
54471	2007	9	9	0	2.2	71	18.7	27.6
54471	2007	9	10	0	4.7	73	17	25.4
54471	2007	9	11	0	2.4	73	15.3	26.3
54471	2007	9	12	0	1.1	74	21.3	29.2
54471	2007	9	13	0	2.4	80	21.4	28.6
54471	2007	9	14	15.6	2.4	85	18.4	24.9
54471	2007	9	15	0	1.6	80	17.9	24.7
54471	2007	9	16	0	2.1	81	19	27
54471	2007	9	17	0	1.7	76	18.5	29.6
54471	2007	9	18	1	2.9	76	19.9	25.4

Station	Year	Month	Day	P	U	H	Tmin	Tmax
54471	2007	9	19	1	4.3	81	16.9	21
54471	2007	9	20	4.5	3.8	89	15.2	18.4
54471	2007	9	21	0	2.2	69	11.8	26.2
54471	2007	9	22	0	3.1	66	13.5	28.9
54471	2007	9	23	0	2.5	66	18.1	26
54471	2007	9	24	0	1.5	71	17.6	25.7
54471	2007	9	25	0	3.9	59	11.9	24.6
54471	2007	9	26	0	3.8	72	14.4	24
54471	2007	9	27	4.7	3.4	72	11.6	19.6
54471	2007	9	28	0	3.5	48	11.2	20.9
54471	2007	9	29	0	2.3	57	11.5	21.5
54471	2007	9	30	0	2.9	68	13.5	22.7
54471	2007	10	1	0	1.8	77	16.7	19.7
54471	2007	10	2	0	1.9	76	13.6	20.9
54471	2007	10	3	0	1.7	72	16.2	23.1
54471	2007	10	4	0	2.1	84	15.9	22.7
54471	2007	10	5	5.2	1.9	87	16.1	22
54471	2007	10	6	11.5	2.3	90	15.8	20
54471	2007	10	7	0.2	5.2	69	10.5	17
54471	2007	10	8	0	3.2	56	6.1	15.2
54471	2007	10	9	0	2	62	6.4	18
54471	2007	10	10	0	1.6	69	10.3	15.9
54471	2007	10	11	0	3.7	65	10.1	19.4
54471	2007	10	12	0	3.3	52	4.7	13.5
54471	2007	10	13	0	1.8	57	3.8	16.9
54471	2007	10	14	4	2.7	78	8.6	16.1
54471	2007	10	15	0	1.7	71	5.6	17.8
54471	2007	10	16	0	3.4	69	6.1	15.1
54471	2007	10	17	0	3.1	66	5	19.1
54471	2007	10	18	8.8	3.5	75	3.7	16.3
54471	2007	10	19	0	4.2	62	1.4	11.2
54471	2007	10	20	0	3.5	43	1	7.8
54471	2007	10	21	0	4.1	74	7.1	18.1
54471	2007	10	22	0	4.4	45	6.8	15.1
54471	2007	10	23	0	1.8	57	2.4	15
54471	2007	10	24	0	4	68	9.9	17.3
54471	2007	10	25	0	2.1	87	12.2	18.5
54471	2007	10	26	0	2.3	85	10.4	16.9
54471	2007	10	27	5.3	4.9	84	4.3	16.6
54471	2007	10	28	0.2	6.8	64	-1	5.3
54471	2007	10	29	0	2.7	62	-3.5	8
54471	2007	10	30	0	5.3	70	7.8	14.6
54471	2007	10	31	0	2.8	50	3.7	12.1
54471	2007	11	1	0	4	44	-0.5	8.2

Station	Year	Month	Day	P	U	H	Tmin	Tmax
54471	2007	11	2	0	4.3	51	5.5	12.4
54471	2007	11	3	0	2	49	1.3	11
54471	2007	11	4	0	3.4	67	1.7	13
54471	2007	11	5	0	4.5	69	8.1	14.9
54471	2007	11	6	0	4.2	76	10.5	15.1
54471	2007	11	7	0	2.6	88	9.1	13.5
54471	2007	11	8	31.8	4.4	94	5.8	9.3
54471	2007	11	9	1.9	4.1	76	3.6	9.9
54471	2007	11	10	0	3.5	72	2.2	9.6
54471	2007	11	11	0	1.5	66	-0.5	9.9
54471	2007	11	12	0	3.5	79	0.8	11.8
54471	2007	11	13	0	4.1	54	1.6	10.7
54471	2007	11	14	0.4	6.6	54	-4.2	2.4
54471	2007	11	15	0	3.9	54	-8.9	-1
54471	2007	11	16	0	2.6	61	-7.4	3.5
54471	2007	11	17	0	4.9	50	-2.3	5.4
54471	2007	11	18	0	3.5	37	-7	-1.4
54471	2007	11	19	5.8	5.3	62	-5.4	5.1
54471	2007	11	20	0	3	66	-5.4	5.1
54471	2007	11	21	0	2.8	65	-7.1	0
54471	2007	11	22	0	3.4	73	-5.9	0.4
54471	2007	11	23	0	3.6	65	-3.4	0.1
54471	2007	11	24	0	3.9	68	-7.2	6
54471	2007	11	25	0	5.5	74	3.7	8.7
54471	2007	11	26	0	3.1	43	-3.9	5.5
54471	2007	11	27	0	1.7	67	-4.6	4.1
54471	2007	11	28	0	3.5	64	-2.8	5.5
54471	2007	11	29	0	3.9	55	-4.6	0.9
54471	2007	11	30	0	2.8	64	-6.4	5.4
54471	2007	12	1	0	2.6	61	-2.8	4
54471	2007	12	2	0	2.2	59	-5.7	2.6
54471	2007	12	3	0	5.4	51	-7.4	2.3
54471	2007	12	4	0	1.5	52	-8.4	-1.8
54471	2007	12	5	0	3.3	61	-6.7	3.3
54471	2007	12	6	1.5	3.9	77	-3.3	3.5
54471	2007	12	7	0	1.4	67	-9.9	0.1
54471	2007	12	8	0	0.9	70	-9	-0.3
54471	2007	12	9	0	2.1	61	-8.1	2.4
54471	2007	12	10	2	2	81	-0.4	2.3
54471	2007	12	11	0.2	3.3	85	-9.5	0.9
54471	2007	12	12	0	1.3	87	-13.3	-4.9
54471	2007	12	13	0	1.3	71	-13.4	-1.5
54471	2007	12	14	0	2.3	68	-8	2.6
54471	2007	12	15	0	2.5	68	-8.6	-0.1

Station	Year	Month	Day	P	U	H	Tmin	Tmax
54471	2007	12	16	0	4	70	-7.2	2.9
54471	2007	12	17	0	2.4	55	-10.4	-1.9
54471	2007	12	18	0	2	61	-9	-2.9
54471	2007	12	19	0	2.6	82	-7.4	2.8
54471	2007	12	20	0	3.1	79	-8.4	0.5
54471	2007	12	21	0	1.5	71	-11.5	1.3
54471	2007	12	22	0	3.1	75	-3.8	4.2
54471	2007	12	23	0	1.8	67	-7.9	2.3
54471	2007	12	24	0	3.5	71	-7.8	3.8
54471	2007	12	25	0	2.8	81	-4.3	3.4
54471	2007	12	26	0	1.6	96	-4.9	-0.1
54471	2007	12	27	0.2	4.2	92	-6.3	-0.1
54471	2007	12	28	1.3	2.9	91	-8.5	-5.3
54471	2007	12	29	0	5.6	59	-9.8	-3.6
54471	2007	12	30	0	3.2	50	-9.4	-2.2
54471	2007	12	31	0	3.6	57	-9.1	-4.4