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- 1. Scripts for image pre-processing using dense stacks of Landsat imagery, including date filtering, cloud masking and image mosaicking, random forest (RF) classification, accuracy assessment, and regional area calculations.**

Take the extraction of rainy and dry season surface water in 2008 as an example.

Links to the Google Earth Engine: l5_2008_rainy_season_classification.

YR_rainy_season_mean_water_2008_cloud90_0325_addDEM_2_show

<https://code.earthengine.google.com/938a2140afa989efc9373f69f9eb56a4>

Links to the Google Earth Engine: l5_2008_dry_season_classification.

YR_dry_Season_mean_water_2008_cloud90_2502_addDEM_1_show

<https://code.earthengine.google.com/438c5d8522c20109fcd6b9444f9c90a3>

- 2. Scripts for the comparative analysis of different classifiers.**

Links to the Google Earth Engine: compare with different classifiers.

YR_rainy_season_mean_water_1999_cloud90_0325_addDEM_1_Comparation_test_show

<https://code.earthengine.google.com/6bf5ca3545b154bc507c1e48f3e287bc>

3. Download link of Landsat composite image after NDVI and MNDWI Masks.

Links to the Google Drive of Landsat composite image.

2003_2005_rainy_Yangtze_mean_River_MNDWI_cloud90_0325_addDEM_1

<https://drive.google.com/drive/folders/1annuEsvY5qmBd0-6MI8FcfLtMHZPe3F?usp=sharing>

4. Download link of training sample dataset.

Links to the Google Drive of training sample points.

2003-2005_rainy_Yangtze_mean_River_cloud90_0325_TS_1

<https://drive.google.com/drive/folders/1ILDpCrMrFvPIXxs5SpXsZUzfFyIX4QjE?usp=sharing>

5. Download link of surface water dataset

Links to the Google Drive of surface water dataset

2003_rainy_Yangtze_mean_River_MNDWI_cloud90_0325_Water_addDEM_1

<https://drive.google.com/drive/folders/1zR2CTI9yGRCHNMSzqGhXhJpHeU14x8ci?usp=sharing>

2003_rainy_Yangtze_mean_River_MNDWI_cloud90_0325_Ice_addDEM_1

<https://drive.google.com/drive/folders/1yHb8EBRe4aDTs1JvPNEvCqmbFXfSDxzn?usp=sharing>

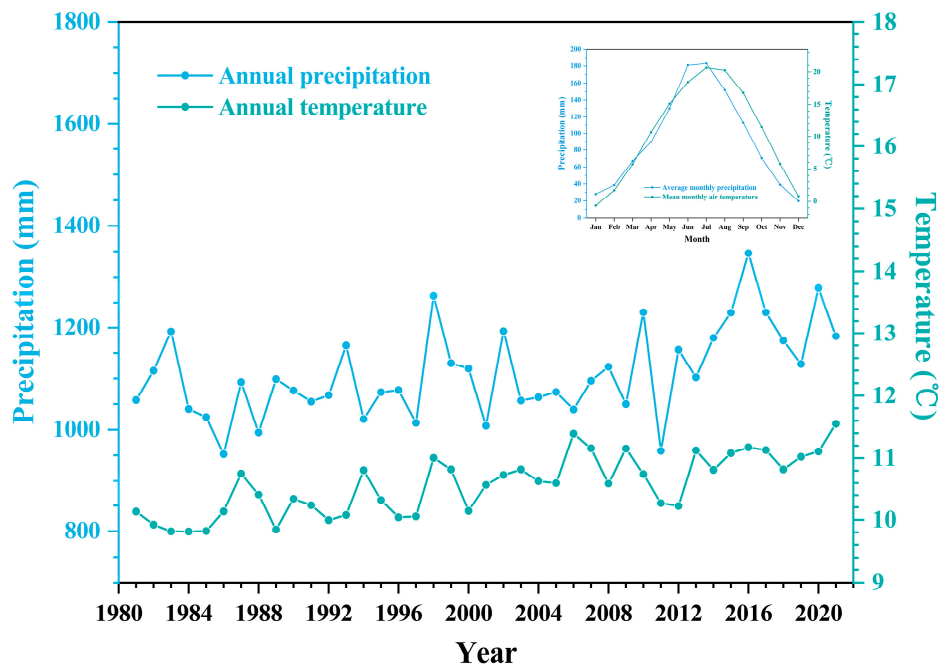


Figure S1. Annual precipitation and temperature in the YRB from 1981 to 2021. The illustration shows the average monthly precipitation and mean monthly air temperature in the YRB from 1981 to 2021.

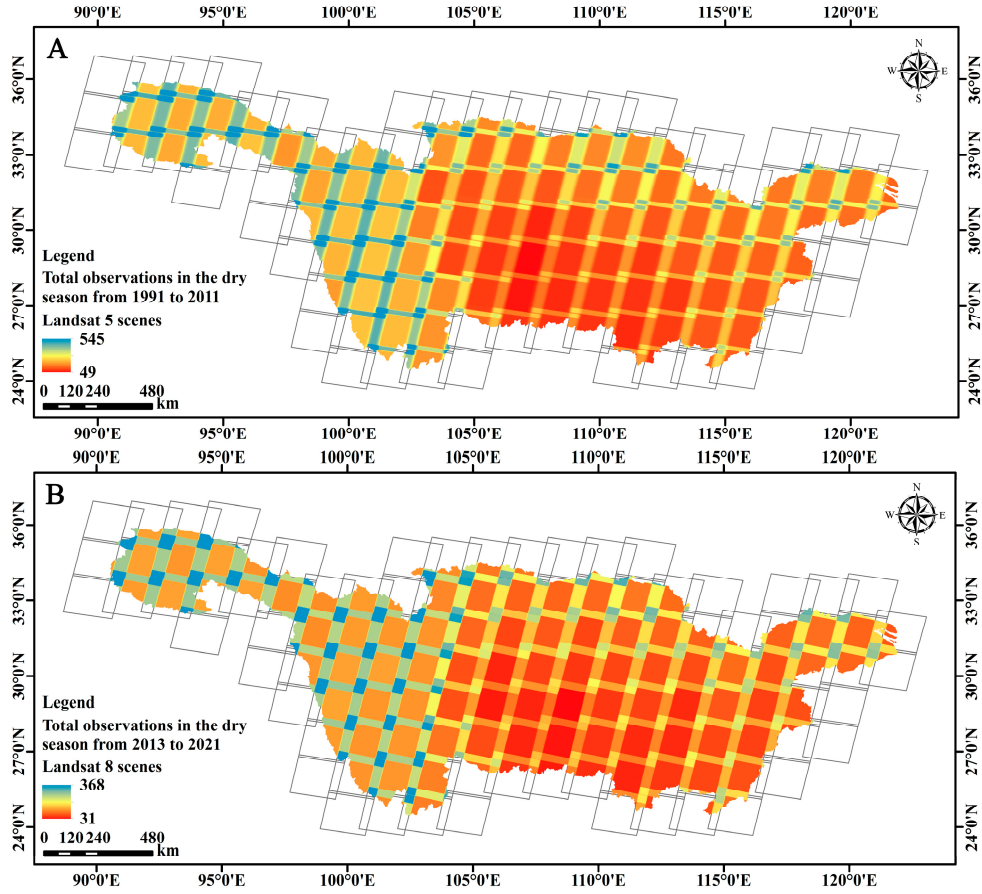


Figure S2. Spatial distribution of total observations in the dry season for the entire YRB during the study period: (a) Landsat 5 scenes from 1991 to 2011; (b) Landsat 8 scenes from 2013 to 2021.

Table S1. Accuracy assessment of the classification results for the rainy and dry season composite images in the Yangtze River Basin from 1991 to 2021.

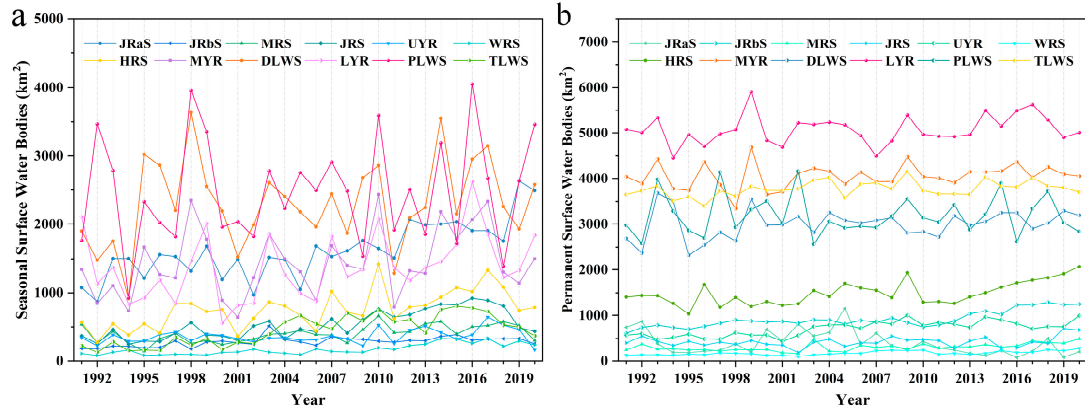
Year	Composite Images in the Rainy Season		Composite Images in the Dry Season	
	Overall Accuracy	Kappa	Overall Accuracy	Kappa
1990	0.96	0.93	0.97	0.94
1991	0.97	0.94	0.96	0.93
1992	0.98	0.97	0.97	0.95
1993	0.96	0.92	0.97	0.95
1994	0.98	0.96	0.96	0.94
1995	0.98	0.97	0.96	0.93
1996	0.97	0.94	0.97	0.95
1997	0.98	0.96	0.96	0.93
1998	0.98	0.97	0.97	0.95
1999	0.97	0.94	0.97	0.95
2000	0.98	0.97	0.97	0.94
2001	0.99	0.98	0.99	0.97
2002	0.97	0.95	0.96	0.92
2003	0.99	0.98	0.99	0.98
2004	0.99	0.98	0.97	0.95

2005	0.98	0.97	0.96	0.93
2006	0.99	0.99	0.98	0.97
2007	0.99	0.99	0.93	0.89
2008	0.99	0.99	0.97	0.96
2009	0.99	0.98	0.97	0.95
2010	0.98	0.96	0.97	0.94
2011	0.99	0.97	0.96	0.91
2012	0.97	0.94	0.97	0.93
2013	0.98	0.97	0.97	0.95
2014	0.98	0.97	0.97	0.95
2015	0.99	0.98	0.97	0.94
2016	0.99	0.98	0.99	0.98
2017	0.98	0.97	0.99	0.98
2018	0.97	0.95	0.96	0.93
2019	0.98	0.96	0.97	0.94
2020	0.98	0.96	0.98	0.96
2021	0.98	0.96		

Table S2. Comparative analysis and evaluation of different classification algorithms for the rainy season composite image in 1999.

Classifier	Land cover types	UA	PA	overall accuracy	kappa accuracy
CART	water	0.9580	0.9730	0.9455	0.9083
	Ice/snow	0.8631	0.9063		
	non-water	0.9585	0.9361		
Random Forest	water	0.9843	0.9888	0.9735	0.9551
	Ice/snow	0.9484	0.9188		
	non-water	0.9721	0.9766		
Minimum Distance	water	0.5972	0.9461	0.5172	0.3262
	Ice/snow	0.3493	1.0000		
	non-water	0.7619	0.0997		
LIBSVM	water	0.9478	0.9798	0.9479	0.9117
	Ice/snow	0.9211	0.8750		
	non-water	0.9543	0.9439		

Figure S3. Dynamics of seasonal and permanent surface water resources in the secondary water systems



of the YRB from 1991 to 2020. (a) Dynamics of seasonal surface water bodies in the 12 water systems in the YRB. (b) Dynamic changes of permanent surface water bodies in the 12 water systems in the YRB.

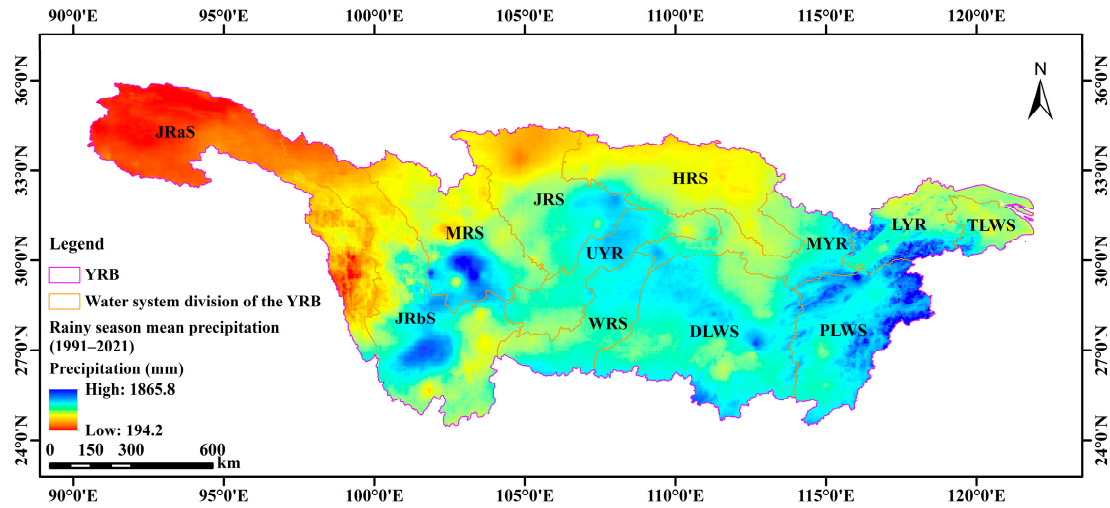


Figure S4. Spatial distribution of the rainy season mean precipitation in the YRB from 1991 to 2021.

Table S3. Rainy season precipitation in the YRB and its 12 secondary river systems from 1991 to 2021.

Year	YRB	JRaS	JRbS	MRS	JRS	UYR	WRS	HRS	DLWS	MYR	PLWS	LYR	TLWS
1991	764.3	395.3	877.8	758.9	640.8	901.0	912.4	647.1	797.3	935.8	746.6	1204.6	1034.5
1992	735.5	326.3	649.6	850.4	844.1	899.0	894.7	684.9	807.1	780.4	982.8	722.1	729.5
1993	870.2	436.9	856.1	890.5	822.9	883.4	934.8	630.4	1116.1	903.2	1273.0	984.8	945.0
1994	746.4	302.6	726.8	771.6	620.2	832.6	802.5	594.9	1072.1	759.3	1134.5	693.8	634.6
1995	813.8	378.6	843.3	842.5	672.1	917.4	976.5	668.3	967.1	990.7	1139.9	875.1	774.0
1996	816.1	397.6	737.8	778.0	649.6	996.3	1065.8	704.8	1029.0	1007.5	1038.3	1051.6	832.2
1997	716.2	355.5	776.5	728.0	539.8	779.0	860.6	489.4	871.2	804.2	1124.0	725.9	726.1
1998	927.4	455.6	992.6	946.1	895.0	1091.7	1060.0	759.8	1072.3	976.9	1297.8	924.7	808.0
1999	902.2	409.8	1001.4	889.9	809.0	980.3	1042.3	656.0	1076.9	871.1	1376.1	1004.7	958.3
2000	869.2	445.8	843.8	780.2	826.1	1056.6	1061.8	918.3	1020.0	1046.0	1055.2	888.8	779.7
2001	731.8	439.6	916.5	846.6	681.9	770.2	795.5	553.0	780.0	616.3	938.7	672.7	786.6

2002	870.1	450.1	807.4	700.9	684.0	963.0	1009.9	683.3	1257.6	1007.8	1308.2	902.7	777.2
2003	787.8	441.9	806.7	871.9	892.3	955.0	816.5	836.8	782.3	877.2	802.5	942.6	673.7
2004	796.3	439.5	836.6	835.6	701.2	911.6	968.8	712.7	959.4	951.0	919.4	794.8	606.0
2005	804.8	454.0	799.3	844.4	803.4	972.1	805.7	900.5	803.4	910.3	1009.5	885.4	699.8
2006	756.9	387.1	756.0	749.0	674.9	767.4	763.9	641.5	976.1	769.0	1118.0	833.4	709.7
2007	836.2	414.4	835.9	842.1	844.1	1172.8	1099.0	803.3	903.8	993.4	891.6	888.2	820.5
2008	853.2	439.7	841.7	791.4	835.3	992.0	1024.6	784.6	983.1	1088.5	1047.3	952.3	847.9
2009	762.2	481.3	791.3	824.7	816.6	913.5	803.3	664.1	761.2	812.6	858.0	916.1	873.1
2010	927.2	472.0	808.0	917.1	883.0	961.4	932.9	869.5	1133.2	1121.5	1393.3	1059.5	803.9
2011	768.1	415.1	630.6	797.6	939.5	783.2	719.3	821.0	800.9	861.5	960.4	1058.0	976.2
2012	850.7	454.9	831.7	877.5	851.4	1043.8	1003.5	702.5	982.3	884.8	1146.7	884.3	801.1
2013	814.8	415.1	799.9	918.7	944.5	1001.7	874.5	760.7	869.7	978.3	856.4	928.2	782.9
2014	897.8	473.4	867.3	901.2	812.1	1089.7	1124.2	723.9	1072.2	884.4	1271.9	968.9	942.5
2015	896.9	366.0	850.4	854.7	742.9	945.4	1106.1	686.0	1125.3	952.1	1410.9	1217.7	1079.4
2016	965.1	431.8	890.1	859.5	737.6	1067.8	1075.8	773.7	1169.9	1239.9	1502.2	1391.5	1200.9
2017	942.6	436.2	856.4	864.0	829.6	1100.1	1078.8	908.4	1147.9	1173.8	1240.5	1205.4	1083.5
2018	858.5	486.4	912.6	1044.0	818.4	925.4	944.9	631.7	1047.8	752.6	1033.8	895.9	966.8
2019	839.0	423.9	828.5	996.9	920.9	974.6	970.7	718.8	1032.0	700.2	1081.1	660.3	785.5
2020	982.5	412.1	865.2	1037.4	900.6	1059.0	1188.5	788.8	1165.7	1280.8	1356.5	1392.8	1090.0
2021	948.6	408.6	830.6	939.1	1077.3	1098.1	1067.5	1006.3	1062.9	990.5	1213.2	1168.8	1203.7

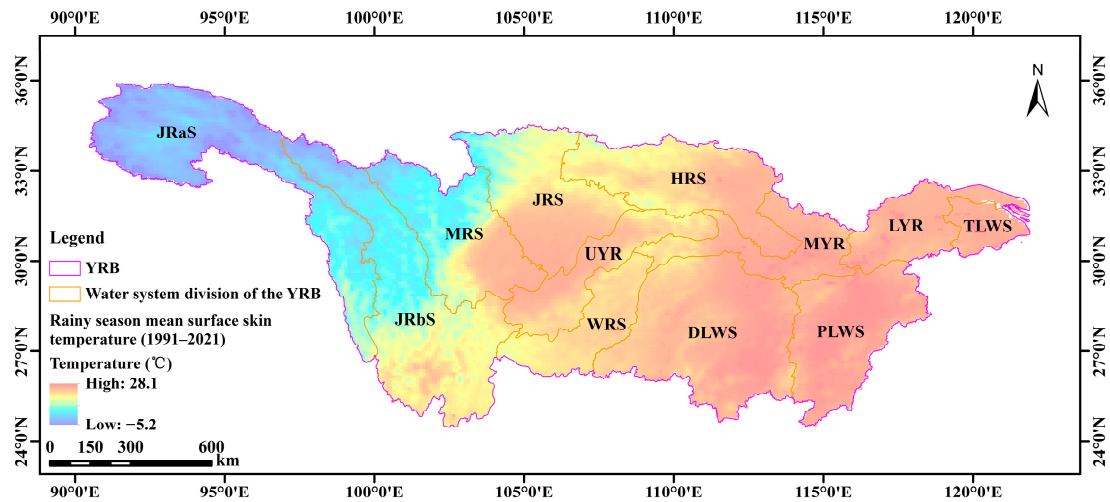


Figure S5. Spatial distribution of mean surface skin temperature in the YRB during the rainy season from 1991 to 2021.

Table S4. Surface skin temperature in the YRB and its 12 secondary river systems during the rainy season from 1991 to 2021.

Year	YRB	JRaS	JRbS	MRS	JRS	UYR	WRS	HRS	DLWS	MYR	PLWS	LYR	TLWS
1991	17.4	4.9	12.7	13.6	18.4	21.0	19.4	20.0	22.8	22.6	24.5	23.0	23.5
1992	17.1	3.9	12.4	13.1	17.7	21.0	19.4	19.6	22.9	22.5	23.9	22.8	23.1
1993	16.9	4.0	12.7	13.3	17.7	20.6	19.1	19.4	22.3	22.2	23.5	22.5	22.9
1994	17.8	5.4	13.3	14.1	18.5	21.4	19.7	20.5	22.7	23.2	24.1	24.3	24.9

1995	17.9	5.0	13.1	14.2	18.7	21.7	20.0	21.0	23.4	23.5	24.3	23.8	24.0
1996	17.5	4.5	13.0	13.8	18.3	21.2	19.7	20.1	22.9	22.8	24.4	23.5	24.0
1997	17.2	3.4	12.3	13.2	18.5	21.2	19.4	20.7	22.5	23.1	23.4	23.5	23.8
1998	18.2	5.4	13.6	14.4	18.9	21.7	20.2	20.8	23.7	23.4	25.0	23.8	24.3
1999	17.5	4.6	13.1	13.7	18.4	21.2	19.7	20.4	22.7	22.7	24.2	23.0	23.3
2000	17.5	4.1	12.7	13.8	18.6	21.3	19.8	20.4	22.9	23.2	24.4	23.9	24.1
2001	17.7	4.2	12.8	13.6	18.5	21.5	19.9	20.6	23.4	23.8	24.4	23.8	24.0
2002	17.3	4.2	12.6	13.7	18.7	21.3	19.5	20.3	22.4	22.7	23.7	23.2	23.6
2003	17.9	5.0	13.3	13.8	18.3	21.3	19.9	20.1	23.6	23.3	25.5	23.8	24.4
2004	17.3	4.3	12.5	13.1	17.9	20.7	19.4	20.0	23.0	22.9	24.3	23.6	24.1
2005	18.1	4.5	13.5	14.1	18.8	21.9	20.5	20.7	24.0	23.7	25.2	24.3	24.6
2006	18.5	4.8	13.4	14.7	19.9	23.0	20.9	21.7	24.0	24.4	24.9	24.4	24.7
2007	18.1	5.1	13.0	14.2	18.8	21.7	20.0	21.0	23.9	23.9	25.4	24.3	24.8
2008	17.9	4.1	12.9	14.1	18.9	21.8	20.2	20.8	23.8	23.6	25.0	24.0	24.5
2009	18.2	4.5	13.5	14.2	18.8	21.8	20.3	20.8	24.2	24.0	25.4	24.2	24.6
2010	17.8	5.2	13.5	14.0	18.6	21.4	19.6	20.5	23.2	23.1	24.7	23.6	24.1
2011	17.6	3.7	13.0	14.1	18.5	21.9	20.3	20.4	23.3	23.0	24.4	23.5	24.2
2012	17.8	4.6	13.3	13.8	18.6	21.4	19.8	21.0	23.2	23.4	24.4	23.7	24.0
2013	18.2	4.6	13.0	14.2	19.2	22.2	20.4	21.7	24.0	24.0	25.2	24.3	25.0
2014	17.9	5.0	13.6	14.0	18.6	21.3	20.1	20.7	23.4	22.9	24.9	23.2	23.5
2015	17.7	5.1	13.4	14.2	18.7	21.4	19.9	20.5	23.0	23.0	23.9	22.9	23.2
2016	18.3	5.1	13.7	14.7	19.3	22.1	20.4	21.4	23.6	23.6	25.0	23.9	24.5
2017	18.1	4.9	13.5	14.4	19.1	21.9	20.4	20.9	23.5	23.3	25.2	23.8	24.5
2018	18.1	4.8	13.2	13.9	19.0	21.8	20.2	21.1	23.7	24.0	25.1	24.3	24.5
2019	18.2	4.8	13.9	14.0	18.5	21.5	20.1	21.1	24.1	24.3	25.6	24.3	24.0
2020	18.0	5.6	13.7	14.1	18.5	21.5	20.0	20.5	23.2	23.0	25.0	23.6	24.0
2021	18.5	6.1	14.1	14.5	18.9	21.9	20.6	20.6	24.2	23.6	25.5	24.3	24.7

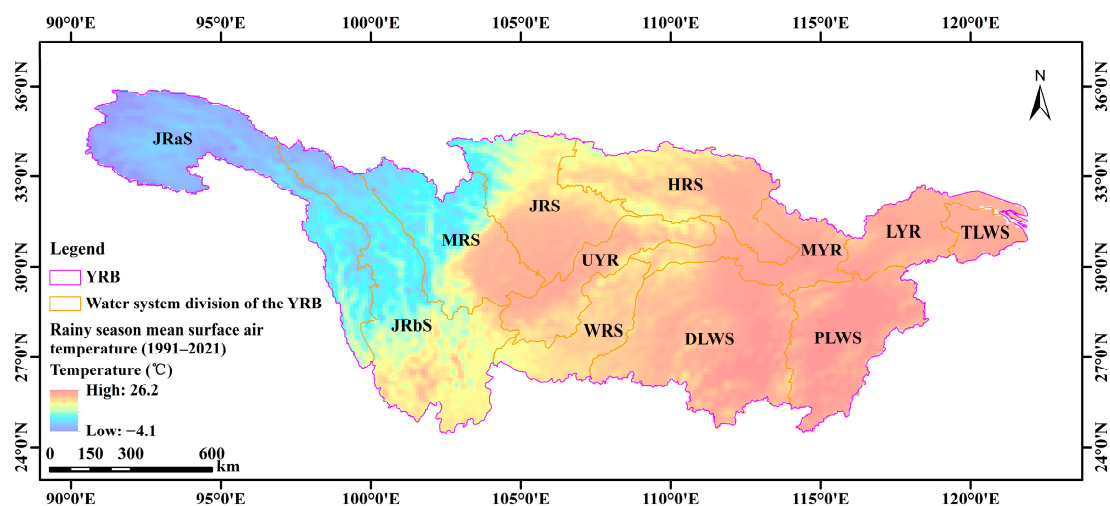


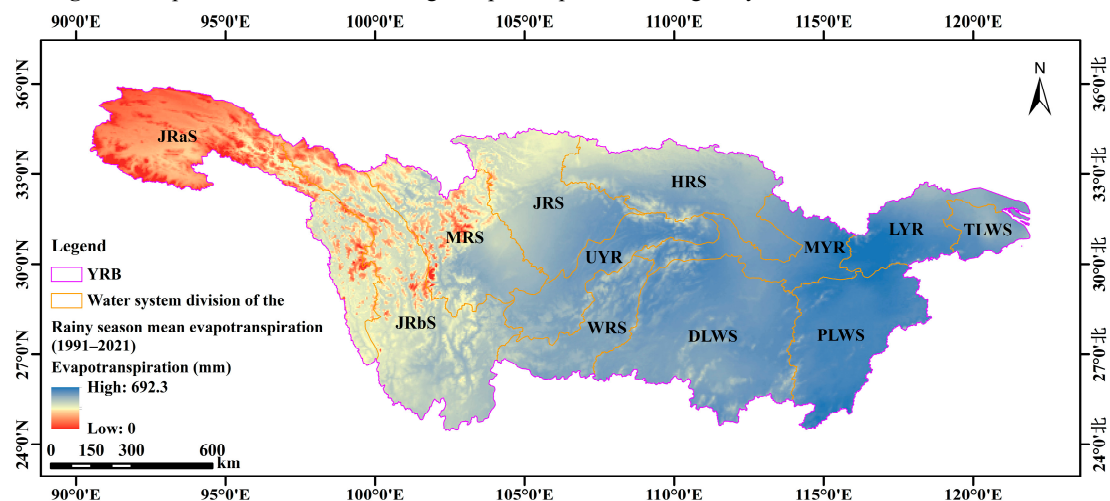
Figure S6. Spatial distribution of mean surface air temperature in the YRB during the rainy season from 1991 to 2021.

Table S5. Surface air temperature in the YRB and its 12 secondary river systems during the rainy season

from 1991 to 2021.

Year	YRB	JRaS	JRbS	MRS	JRS	UYR	WRS	HRS	DLWS	MYR	PLWS	LYR	TLWS
1991	16.8	3.1	11.6	12.5	18.1	20.8	19.1	19.9	22.7	22.5	24.4	22.9	23.2
1992	16.5	2.4	11.4	12.1	17.5	20.8	19.2	19.5	22.7	22.4	23.8	22.6	22.8
1993	16.4	2.6	11.6	12.1	17.5	20.4	18.8	19.4	22.2	22.0	23.5	22.4	22.7
1994	17.2	3.6	12.0	12.9	18.3	21.3	19.3	20.5	22.6	23.1	24.0	24.2	24.5
1995	17.3	3.4	12.0	13.0	18.4	21.5	19.7	20.8	23.3	23.2	24.3	23.6	23.6
1996	17.0	3.0	11.9	12.6	18.1	21.0	19.4	20.0	22.8	22.7	24.3	23.4	23.7
1997	16.6	1.9	11.3	12.2	18.3	21.1	19.1	20.7	22.4	22.9	23.4	23.4	23.6
1998	17.6	3.8	12.5	13.2	18.6	21.6	19.9	20.7	23.6	23.4	24.9	23.8	24.0
1999	16.9	3.1	11.8	12.6	18.1	21.0	19.3	20.3	22.5	22.5	24.1	22.9	23.1
2000	17.0	2.9	11.6	12.8	18.3	21.1	19.5	20.2	22.9	23.1	24.3	23.8	23.9
2001	17.1	2.7	11.6	12.6	18.3	21.4	19.6	20.5	23.3	23.5	24.3	23.6	23.7
2002	16.7	2.7	11.4	12.5	18.4	21.1	19.1	20.2	22.3	22.6	23.7	23.1	23.3
2003	17.3	3.2	12.1	12.6	18.1	21.2	19.7	20.0	23.4	23.1	25.2	23.7	24.1
2004	16.7	2.6	11.3	12.0	17.7	20.6	19.1	20.0	22.8	22.7	24.2	23.4	23.8
2005	17.5	3.0	12.2	12.9	18.5	21.7	20.2	20.5	23.7	23.4	25.1	24.2	24.4
2006	17.9	3.3	12.3	13.7	19.7	22.8	20.6	21.6	23.8	24.1	24.8	24.2	24.5
2007	17.6	3.5	11.9	13.0	18.6	21.6	19.7	20.9	23.8	23.7	25.2	24.2	24.7
2008	17.4	2.7	11.8	13.0	18.7	21.7	19.9	20.7	23.7	23.4	24.9	23.9	24.2
2009	17.7	3.3	12.5	13.1	18.6	21.8	20.1	20.8	24.0	23.8	25.3	24.1	24.4
2010	17.2	3.3	12.3	12.9	18.3	21.3	19.4	20.4	23.1	23.0	24.6	23.5	23.9
2011	17.1	2.2	11.9	12.9	18.4	21.8	19.9	20.2	23.1	22.8	24.4	23.4	23.9
2012	17.2	2.7	12.1	12.6	18.4	21.2	19.4	20.9	23.2	23.3	24.4	23.7	23.8
2013	17.7	2.9	12.0	13.1	19.0	22.3	20.3	21.6	23.9	23.9	25.1	24.3	24.8
2014	17.2	3.0	12.4	12.8	18.4	21.2	19.7	20.5	23.3	22.7	24.8	23.1	23.3
2015	17.2	3.1	12.2	13.0	18.5	21.4	19.7	20.5	23.0	22.9	24.0	22.9	23.1
2016	17.7	3.4	12.5	13.5	19.1	21.9	20.2	21.1	23.4	23.3	25.0	23.8	24.3
2017	17.5	3.2	12.4	13.2	18.8	21.7	20.0	20.8	23.3	23.1	25.0	23.8	24.3
2018	17.5	2.9	12.0	12.8	18.7	21.7	19.9	21.1	23.6	23.8	25.1	24.2	24.4
2019	17.6	3.0	12.7	12.9	18.3	21.4	19.9	21.0	23.8	23.8	25.2	23.9	23.7
2020	17.5	4.2	12.7	13.2	18.4	21.4	19.7	20.4	23.0	22.9	24.9	23.5	23.9
2021	17.9	4.3	12.9	13.3	18.6	21.7	20.3	20.5	24.0	23.5	25.4	24.2	24.5

Figure S7. Spatial distribution of average evapotranspiration during rainy season over the YRB from



1991 to 2021.

Table S6. Evapotranspiration in the YRB and its 12 secondary river systems during the rainy season from 1991 to 2021.

Year	YRB	JRaS	JRbS	MRS	JRS	UYR	WRS	HRS	DLWS	MYR	PLWS	LYR	TLWS
1991	512.4	302.9	416.3	440.8	510.9	577.2	559.6	562.8	601.2	586.1	640.3	651.6	647.0
1992	490.1	283.0	437.8	450.6	519.1	569.2	541.4	532.7	529.4	548.3	596.0	594.6	571.1
1993	506.8	273.5	433.3	449.4	527.9	563.8	547.5	547.2	589.3	604.3	619.7	635.2	625.8
1994	520.1	287.8	464.4	463.7	489.5	596.3	579.6	536.4	624.1	659.2	673.6	562.6	507.1
1995	513.0	302.7	445.9	457.7	501.4	604.1	592.2	514.4	610.3	634.0	628.6	563.7	566.7
1996	511.2	289.1	450.3	439.6	503.5	571.7	562.8	575.2	600.3	624.5	636.6	586.6	497.8
1997	504.7	288.9	452.5	483.7	491.0	557.0	553.4	461.8	609.2	582.5	666.6	584.0	524.8
1998	507.4	322.1	415.8	442.8	511.8	577.3	574.8	543.7	574.9	614.5	610.4	628.1	603.4
1999	500.6	306.2	441.6	425.9	496.0	557.3	545.6	483.9	598.1	601.5	625.7	607.2	585.0
2000	532.6	305.8	456.0	448.1	493.6	571.1	569.4	583.6	635.6	664.8	677.4	655.0	668.0
2001	484.5	308.7	466.1	452.4	464.0	543.0	531.2	439.0	566.8	490.2	647.4	523.0	521.6
2002	540.1	312.3	489.7	477.1	528.8	590.7	557.7	587.0	607.2	651.7	676.4	664.2	652.0
2003	503.8	304.9	455.3	465.0	526.3	585.3	554.6	560.5	526.1	627.4	537.8	691.4	519.7
2004	540.5	323.0	488.2	471.2	542.3	614.0	603.1	580.8	629.1	647.7	675.1	573.7	511.5
2005	536.7	330.8	467.8	485.0	536.6	620.4	591.9	574.8	559.0	672.1	671.6	690.1	575.2
2006	546.3	319.8	510.5	495.5	494.3	580.1	595.7	539.4	669.1	660.0	671.3	657.2	562.0
2007	547.7	316.8	484.1	479.5	519.5	609.8	620.6	581.3	641.8	662.1	659.4	692.9	620.2
2008	562.1	334.0	498.1	491.7	553.7	641.1	623.2	568.5	662.9	673.2	702.1	666.9	580.7
2009	541.2	354.8	482.9	480.5	538.8	615.1	589.5	572.1	583.0	614.1	673.8	660.4	632.1
2010	544.0	350.7	464.5	466.8	519.5	601.7	590.0	568.2	618.4	671.7	681.8	684.8	627.6
2011	521.9	323.0	458.5	508.0	574.9	580.0	521.8	540.6	573.0	578.5	658.8	606.2	538.8
2012	538.1	327.3	431.3	457.9	527.9	576.8	554.3	556.5	638.3	678.5	721.0	678.7	619.6
2013	552.6	302.5	507.1	517.0	595.4	675.0	604.1	611.1	603.0	696.8	579.2	671.1	595.8
2014	513.6	312.2	416.9	430.5	502.7	576.7	552.4	518.8	609.0	642.4	648.0	674.1	647.2
2015	535.6	295.0	453.6	465.1	512.6	602.4	574.3	572.7	624.9	658.7	681.2	699.6	665.2
2016	554.7	360.7	483.1	508.6	543.6	626.2	622.4	549.5	643.3	621.6	690.5	643.3	629.1

2017	542.2	357.9	480.3	482.8	535.5	619.2	593.6	577.1	596.1	650.6	643.8	644.9	619.0
2018	546.2	334.7	470.6	472.9	522.4	602.3	600.4	534.6	648.7	618.0	716.3	692.6	648.4
2019	475.4	353.6	469.3	472.3	503.9	543.9	552.1	461.8	510.2	445.5	513.3	464.0	579.8
2020	519.6	365.2	469.1	463.6	518.4	534.0	538.0	524.3	596.9	588.1	646.4	588.3	584.3
2021	536.3	353.2	482.9	492.8	539.4	603.0	595.3	574.0	581.8	613.8	610.0	644.8	674.3