Quality Control Technology for Hourly Routine Meteorological Element Data Files

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Abstract [**Objective**] In response to the issue of insufficient integrity in hourly routine meteorological element data files, this paper aims to improve the availability and reliability of data files, and provide high-quality data file support for meteorological forecasting and services. [**Method**] In this paper, an efficient and accurate method for data file quality control and fusion processing is developed. By locating the missing measurement time, data are extracted from the "AWZ. db" database and the minute routine meteorological element data file, and merged into the hourly routine meteorological element data file. [**Result**] Data processing efficiency and accuracy are significantly improved, and the problem of incomplete hourly routine meteorological element data files is solved. At the same time, it emphasizes the importance of ensuring the accuracy of the files used and carefully checking and verifying the fusion results, and proposes strategies to improve data quality. [**Conclusion**] This method provides convenience for observation personnel and effectively improves the integrity and accuracy of data files. In the future, it is expected to provide more reliable data support for meteorological forecasting and services.

Key words Integral point; Meteorological elements; Data file; Quality control

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Meteorological data is crucial in meteorological forecasting, climate research, and meteorological services, as its accuracy and completeness directly affect forecast accuracy and service effectiveness. However, external factors such as collector failures and communication problems often result in missing, incorrect, or suspicious data in actual observations, seriously affecting the availability of data and even causing incomplete file content, which poses great challenges to the archiving and subsequent analysis of meteorological data. Therefore, strict quality control[1-8] and fusion processing of meteorological data files are not only extremely important, but also provide a solid data foundation for meteorological forecasting and services.

Although its importance is self-evident, the research on quality control and fusion technology of hourly routine meteorological element data files at home and abroad is relatively weak, and there is a lack of relevant literature reports. This restricts the improvement of the quality of meteorological data file archiving to some extent and hinders the full utilization of meteorological forecasting and service efficiency. To address this challenge, it is necessary to strengthen research and exploration of relevant technologies, develop more advanced and effective quality control algorithms, and improve the accuracy and reliability of data. Simultaneously, it should study more efficient and intelligent data fusion technologies, and fully utilize multi-source meteorological data files to obtain more comprehensive and accurate meteorological information. In the process of data processing, it is also necessary to follow relevant regulations and standards to ensure standardization and scientificity, which is the key to improving the quality of meteorological data.

"Ground Comprehensive Observation Business Software" is a comprehensive business software that integrates automatic meteorological observation data collection, business processing, and data transmission. From data collection to transmission[9-11], the software also has a data saving function to ensure secure backup of data on the local computer, which follows the national unified format[12-13]. Although the software has powerful functions and can automatically save various data files such as hourly routine meteorological element data files, minute routine meteorological element data files, and database files (AWZ. db) on the local computer, during the collection and transmission of ground meteorological data, data may not be transmitted to the business computer in a timely manner due to faults in the collector, computer, or communication line. At this time, the staff need to use manual query and processing functions to supplement and upload data. If necessary, the suspected erroneous data are processed, input and saved in the "Provincial Self Determination and Emergency Observation" interface of the self observation project. Although the software already has the function of automatically uploading and saving data, there may still be a problem when performing manual data download operations: all data of hourly routine meteorological elements at individual times cannot be written to the local corresponding hourly routine meteorological element data file (stored in txt document format). In addition, when the emergency observation process is initiated, the staff will enter relevant data in the operation inter-

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face of "Provincial Self Determination and Emergency Observation". Although these data will be correctly saved to the database file (AWZ.db), they will not be automatically written to the local hourly routine meteorological element data file. These issues result in incomplete hourly routine meteorological element data files.

In response to the issue of data being unable to be written into hourly routine meteorological element data files during manual data downloading and "Provincial Self Determination and Emergency Observation" operations, the hourly routine meteorological element data files can be completed as much as possible by extracting data of corresponding time from minute routine meteorological element data files and database files (AWZ.db). According to the archiving status of the hourly routine meteorological element data file, the data is written into the file before the quality control, anomaly handling module, and emergency and provincial self determined module. The business process of data processing and transmission is shown in Fig.1. Based on this, this paper aims to supplement and improve the archiving and backup processing process of hourly routine meteorological element data files for Wuzhou National Benchmark (Basic) Climate Station. By developing more efficient and accurate data file quality control and fusion processing methods, it aims to improve the efficiency and accuracy of data processing, thereby providing more reliable data support for meteorological forecasting and services.

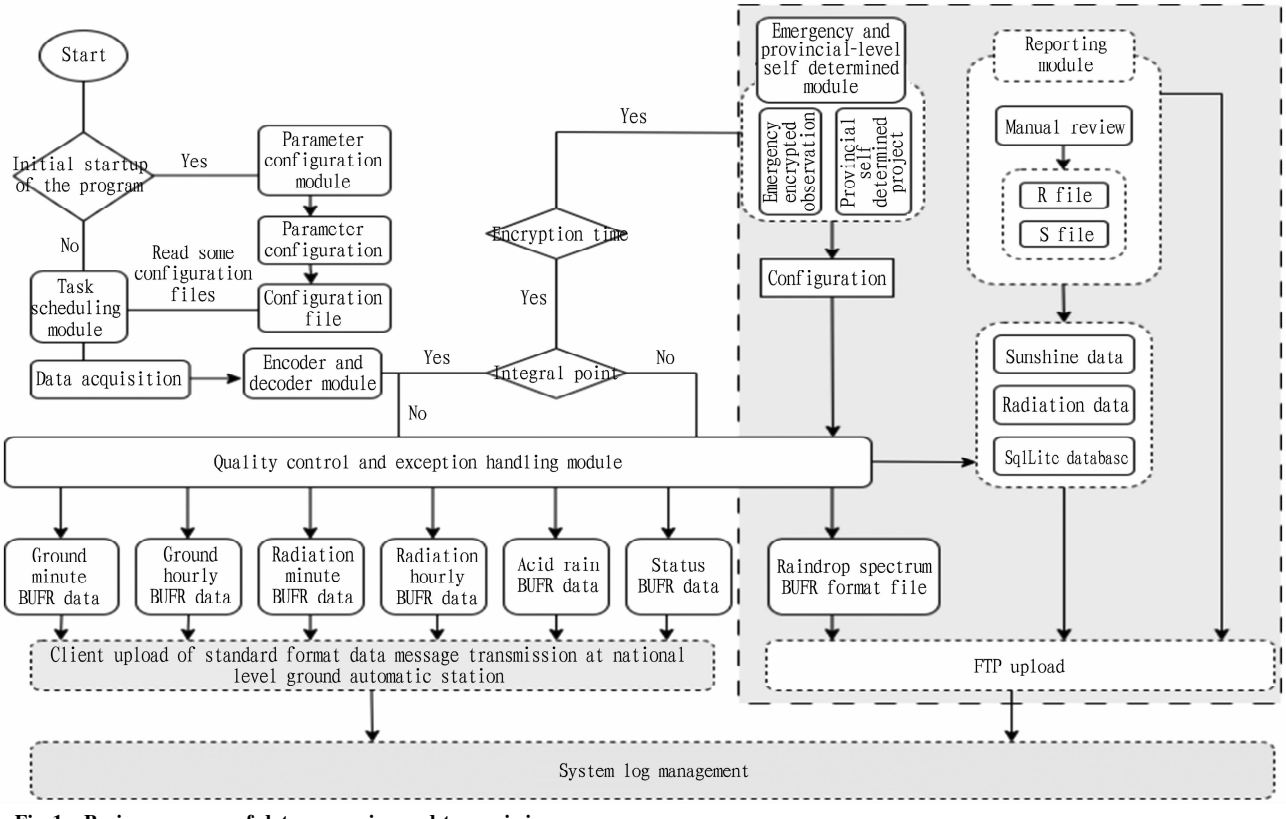

Fig.1 Business process of data processing and transmission

1 Key technologies for quality control and fusion of hourly routine meteorological element data files

The primary problem to be solved in the fusion of file quality control is how to obtain and locate the missing times in the hourly routine meteorological element data file. Identify the missing times: a dictionary mapping is set up, and a dictionary is created. The line number for each time in the hourly routine meteorological element data file (file name AWS_H_Z_IIiii_YYYYMM.txt) is set as the key of the dictionary, and the string composed of day and time is set as the value of the dictionary. Detect missing data: the '-----' line represents data missing, and a loop statement is used to detect the rows where all '-----' is located in the file. These line numbers are mapped to obtain dictionary values, which are the missing times. Additionally, it is to search for missing data from the database. Build a query statement: SQL query statements are used to search for data at missing times in the AWZ.db database. Query statement example: "select * from AWSHOUR where ObserveTime = = +"" + name + "", where name is the composite file name at the missing time. Read database data: the row where the missing data is located is queried, the query result is read, and an output.csv document is generated separately for the entire row information of the missing time.

Next, it is necessary to extract data from the minute route meteorological element data file (file name AWS_M_Z_IIiii_YYYYMMDD.txt). The year and month from the hourly routine meteorological element data file name are extracted as the year and

month for the minute routine meteorological element data file name, and the day with missing time from the AWSHOUR table in the "AWZ. db" database is extracted as the day for the minute routine meteorological element data file name. A dictionary is created for the minute routine meteorological element data file, with a string consisting of day and hour as the key, and each row of data in the minute routine meteorological element data file as the value. The corresponding row value is searched for in the dictionary of the minute routine meteorological element data file for the missing time from the hourly routine meteorological element data file. For meteorological elements such as maximum temperature, minimum temperature, maximum wind speed, and extreme wind speed, it is selected from the 1st min before one hour of integral point to the 60th min of integral point in the minute routine meteorological element data file, namely reading 60 rows of data for calculation. For other elements, the value is read at the 60th minute of integral point, namely the line at the 60th minute.

Finally, the data is integrated, and files are generated. Fusing data: the hourly routine meteorological element data that missing needs retrieval is searched in the csv document. The hourly routine meteorological element data to be supplemented is retrieved from the minute routine meteorological element data file. The data retrieved from the csv document and the minute routine meteorological element data file is extracted and supplemented to the hourly routine meteorological element data file.

The fusion of quality control codes involves extracting corresponding meteorological element quality control codes from the AWSHOUR table in the AWZ. db database and the minute routine meteorological element data file.

For multiple missing times that need to be addressed, three steps are as follows. ① Split file: the hourly routine meteorological element data file is divided into several independent files based on the missing measurement times. ② Synthesize independent file: the meteorological element data in the AWSHOUR table of meteorological element AWZ. db database is combined with the meteorological element data in the minute routine meteorological element data file for each missing measurement time to generate an independent file. ③ Merge independent files: the independent file of hourly routine meteorological element data file is combined with the independent file of missing measurement time in chronological order to create the final hourly routine meteorological element data file.

The synthesizing process of hourly routine meteorological element data files is shown in Fig. 2.

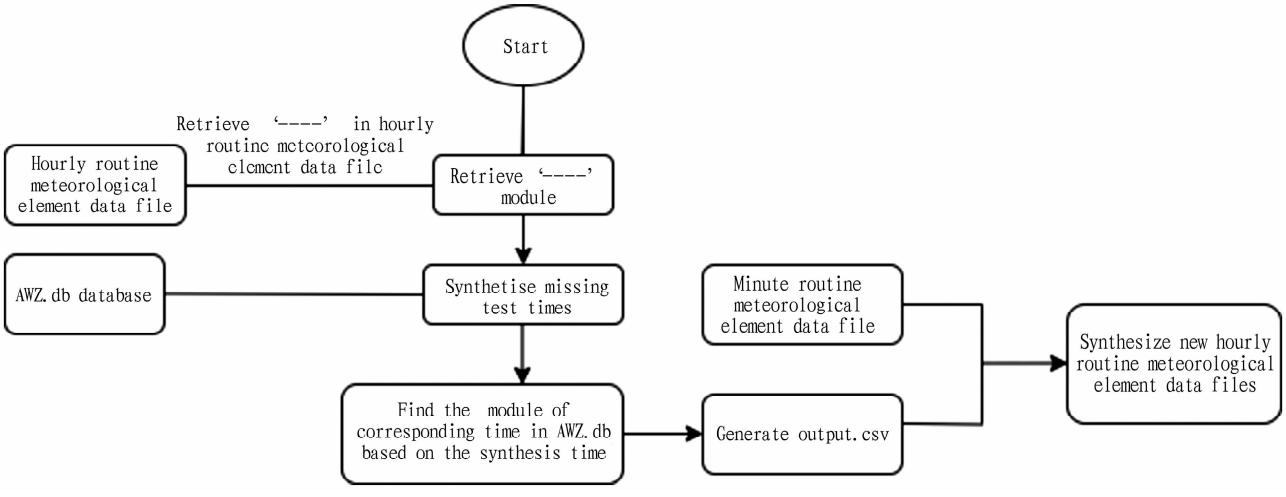

Fig. 2 Synthesis flow of hourly routine meteorological element data file

Meteorological element data are retrieved from AWSHOUR table of AWZ. db database and minute routine meteorological element data file with different colors and marks. The meteorological element values retrieved from AWSHOUR table of AWZ. db database are identified in English and blue, and the meteorological element values retrieved from the minute routine meteorological element data file are identified in Yes and yellow.

Table 1 is meteorological element retrieval of hourly routine meteorological element data file, and it is used to indicate which meteorological element data is retrieved from which data sources during the fusion process.

Based on the above technical ideas, a fusing tool of hourly routine meteorological element data files based on Python programming has been developed. The operating system is home Chinese version of Windows 11, and the development tool Spyder (Python 3.9) is used. The key modules are mainly sqlite3, csv, PyQt5, tkinter, os, and datetime. The main interface design of the software operation is concise, clear, and easy to use. The following are the main components and functions on main interface of software operation: open file, select catalog, and save (Fig. 3).

Operation process of fusion tool for hourly routine meteorological element data file of national ground automatic station: start the tool, click the "fuse data file" button, browse and select the hourly data file that needs to be fused after popping up the file selection dialog box. Click the "open" button and confirm the selected hourly data file. Find and select the catalog of minute data files for fusion operation, and click "select folder". Find and select the database file used for fusion operation, click the drop-down box, select "all files (*. *)" to display all types of files. The "AWZ. db" database file is found and selected from the file

Table 1 Meteorological element retrieval of hourly routine meteorological element data file

Hourly routine meteorological element data file (element name)	Database/table (AWZ/AWSHOUR)	Minute routine meteorological element data file	Hourly routine meteorological element data file (element name)	Database/table (AWZ/AWSHOUR)	Minute routine meteorological element data file
Daily time (Beijing time)	ObserveTime		Temperature (standard for louver box)		Yes
2-min average wind direction	WindDirect		Maximum temperature (standard for louver box)		Yes
2-min average wind speed	WindVelocity		Occurrence time of the maximum temperature (standard for louver box)		Yes
10-min average wind direction	WindD10Ms		Minimum temperature (standard for louver box)		Yes
10-min average wind speed	WindV10Ms		Occurrence time of the minimum temperature (standard for louver box)		Yes
Wind direction of the maximum wind speed	MaxWindD10Ms		Temperature (ventilation and radiation protection cover)		Yes
Maximum temperature 3 (louver box)		Yes	Data quality control mark	QC	
…			…		
Occurrence time of the maximum temperature 3 (louver box)		Yes	Data quality control mark-provincial		
Minimum temperature 3 (louver box)		Yes	Data quality control mark-national		
Occurrence time of the minimum temperature 3 (louver box)		Yes	CRLF		

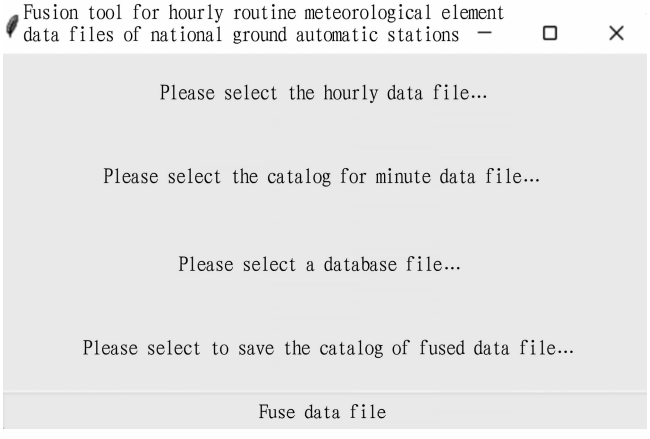

Fig. 3 Main interface of the fusion tool for hourly routine meteorological element data files of national ground automatic stations

list, which contains emergency input or other supplementary meteorological observation data. Click the "open" button, and confirm the selected database file. Find and select the catalog for saving the fused data files, click the "select folder" button, browse and select the target folder. The software starts processing and fusing the selected hourly data files. After the fusion operation is completed, users can find and click the "close" button in the upper left corner of the software main interface to exit the program.

2 Application of quality control fusion of hourly routine meteorological element data files

Taking the hourly routine meteorological element data file (H file) of Wuzhou National Reference Climate Station (station number: 59265) as an example, quality control processing is performed on the data file.

AWS_H_Z_59265_202307.txt

292	1223	141	30	132	25	165	302217	146	34	141	492258	308	3142201
293	1300	129	26	130	26	144	312306	135	34	152	492355	301	3082302
294	1301	129	19	133	24	133	290011	138	34	127	480021	297	3010001
295	1302	139	29	136	23	134	290146	132	44	110	470146	291	2960101
296	1303	143	27	136	22	138	270206	124	34	118	460219	287	2910201
297	1304	108	25	129	25	132	270313	135	38	129	460304	280	2870301
298	1305	126	34	128	31	128	310500	135	44	124	440459	274	2800401
299	1306	145	19	148	17	127	300501	135	21	93	370502	270	2740501
300	1307	131	13	137	14	148	160601	124	17	132	250658	278	2780658
301	1308	65	11	93	14	139	180751	323	13	152	310726	293	2940758
302	1309	138	32	137	26	138	270852	124	42	124	420900	302	3060844
303	1310	150	14	135	17	130	300919	124	15	143	420919	311	3140951
304													
305	1312	292	20	190	14	125	231119	273	25	143	401116	331	3311158
306	1313	164	10	196	14	253	201215	169	11	239	341210	333	3381247
307	1314	196	24	205	23	209	271351	188	33	214	421347	342	3421331
308	1315	238	12	240	15	202	221401	188	22	253	351414	350	3521455
309	1316	63	9	168	14	139	271522	93	16	135	351518	349	3491501
310	1317	137	27	128	36	125	391629	146	37	129	691623	338	3501605
311	1318	140	14	116	12	127	351701	141	22	129	501701	342	3421751
312	1319	111	38	117	32	124	341852	98	42	121	541859	335	3421804
313	1320	113	26	111	35	120	451950	124	39	129	821942	322	3341901
314	1321	109	23	121	31	108	352010	118	30	124	642008	316	3222001
315	1322	118	18	119	14	119	302101	132	23	135	482108	309	3162101

Fig. 4 Missing measurement of ground meteorological element data at 11:00 on July 13, 2023

At 11:00 on July 13, 2023, the site experienced a missing measurement of ground meteorological element data, as shown in Fig. 4.

The data at 11:00 on July 11, 2023 is extracted from the database "AWZ. db", as shown in Fig. 5.

Due to the missing measurement at the station occurring at 11:00, the program retrieves the minute data (minute routine meteorological element data file AWS_M_Z_59265_20230713. txt) from 10:01 to 11:00 (Beijing time) at the station and performs statistical analysis. The partial image of the minute routine meteorological element data file is shown in Fig. 6.

The program merges the retrieved missing test data into the original data of integral point, as shown in Fig. 7.

As shown in the above case, the program is used for other meteorological stations such as Wuzhou, Longwei, and Mengshan, to conduct fusion experiment of missing data at integral point. The results are shown in Table 2.

ObserveTime	StaionID	Time	StationPress	SeaLevelPress	StationPressCh...	StationPressCh...	MaxStationPress	TimeHourMaxPSta	MinStationPress	TimeHourMinPSta	Temp
2023-07-13 11:00:00	59265	1100	9931	10061	-7	-14	9934	1001	9931	1059	320

MaxTemp	TimeHMaxTemp	MinTemp	TimeHMinTemp	TempChan24H	Tx24	Tn24	DewTemp	RelHumidity	MinRelHumidity	TimeHMinRelHu...	VapourPress
321	1051	311	1001	-1	350	270	238	62	60	1053	295

AutoPrecipAmo...	AutoPrecipAmo...	AutoPrecipAmo...	RRR3	RRR6	RRR12	RRR24	EnRound	EnRRR	AutoEvapgauge	WindDirect	WindVelocity	WindD10Ms
							--	-----	0	134	21	147

WindV10Ms	MaxWindD10Ms	MaxWindV10Ms	TimeHMaxWind...	InstantWindD	InstantWindV	HExMaxWindD	HExMaxWindV	TimeHExMaxWind	HExMaxWindV6H	HExMaxWindD6H	HExMaxWindV12H
17	117	21	1047	135	38	135	38	1100	42	143	49

HExMaxWindD1...	SurfaceTemp	SurfaceMaxTemp	TimeHSurfMaxT	SurfaceMinTemp	TimeHSurfMinT	Tg12	Temp5cm	Temp10cm	Temp15cm	Temp20cm	Temp40cm	Temp80cm
152	574	574	1100	517	1001	267	376	345	328	320	299	290

Temp160cm	Temp320cm	GrasslandTemp	GrasslandMaxT...	TimeHGrassMaxT	GrasslandMinTe...	TimeHGrassMinT	Visibility1M	Visibility10M	HMinVisibility	TimeHMinVisibility	Visibility	CloudAmount
270	247	426	426	1059	365	1001	19483	19607	17372	1001	196	

LowCloudAmount	CloudHeight	wwW1W2	GroundEstate	SnowDepth	SnowPress	FrozenSoilMax1TH	FrozenSoilMin1TH	FrozenSoilMax2TH	FrozenSoilMin2TH	GlazeRR	HailNn
///	////	0000	--	////	///					---	---

MinutePrecipAmount1	MinutePrecipAmount2	MinutePrecipAmount	HSunshine	WeatherPheno...	StationIdentity
00000000000000000...	00000000000000000...	00000000000000000...	--		099

ntity	QC	InsertTime	HailWeight
49994444444449994444666663374444444444499994444944444444444333396333333333366666333300000000000000000400000000000000000000000000000000000000			

InsertTime	HailWeight
2023-07-13 11:00:35	-----

Fig. 5 Ground meteorological element values at 11:00 on July 13, 2023 at station 59265

AWS_M_Z_59265_20230713. txt

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1001 148  10 135  15 124  12---------- 0 0 0 0 0 0 0 0 0 0---------- 311 311 311 308 311--------****---- 67 303 242 9934 365 517---- 349 328 319 318 300
1002 102  10 129  14  84  22---------- 0 0 0 0 0 0 0 0 0 0---------- 312 312 312 309 312--------****---- 69 314 248 9933 366 520---- 350 328 319 318 300
1003------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 313 313 313 311 313--------****---- 70 320 252 9933 367 522---- 350 328 320 318 300
1004------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 315 315 314 313 314--------****---- 70 324 254 9933 370 525---- 351 329 320 318 300
1005------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 316 316 315 314 315--------****---- 66 307 245 9933 373 527---- 351 329 320 318 300
1006------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 316 316 315 315 315--------****---- 65 302 242 9933 376 528---- 352 329 320 318 300
1007------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 317 317 316 316 316--------****---- 67 313 248 9934 379 531---- 352 329 320 318 300
1008------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 316 316 316 315 316--------****---- 66 307 245 9933 380 531---- 352 330 320 318 300
1009------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 316 316 316 315 316--------****---- 67 311 247 9934 381 532---- 353 330 320 318 300
1010------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 316 316 316 315 316--------****---- 67 311 247 9934 381 532---- 353 330 320 318 300
1011------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 316 316 316 315 316--------****----////////////////////////----////////////////////
1012------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 315 315 315 314 315--------****---- 66 305 244 9933 380 537---- 354 331 321 318 300
1013------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 315 315 315 313 315--------****---- 66 305 244----- 379 536---- 355 331 321 318 300
1014------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 315 315 315 314 315--------****---- 67 310 246----- 379 537---- 355 331 321 318 300
1015------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 316 316 316 314 316--------****---- 67 311 247----- 377 537---- 356 332 321 318 300
1016------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 317 317 316 315 316--------****---- 66 309 246----- 378 538---- 356 332 321 319 300
1017------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 316 316 316 315 316--------****---- 65 302 242----- 379 540---- 357 332 321 319 300
1018------------------------------------ 0 0 0 0 0 0 0 0 0 0---------- 317 317 317 315 317--------****---- 66 309 246----- 381 541---- 357 332 321 319 300
1019----  0----  0----  0---------- 1 1 1 1 1 1 0 0 1 1---------- 317 317 317 315 317--------****---- 65 304 243----- 382 542---- 358 333 321 319 300
1020 236  0 236  0 236  0---------- 0 1 0 1 0 1 1 1 0 1---------- 318 318 317 316 317--------****---- 66 310 247----- 383 542---- 358 333 322 319 300
1021 236  0 236  0 236  0---------- 0 1 0 1 0 1 0 1 0 1---------- 317 317 317 316 317--------****---- 64 299 240----- 382 541---- 359 333 322 319 300
1022 236  0 236  0 236  0---------- 0 1 0 1 0 1 0 1 0 1---------- 317 317 317 315 317--------****---- 63 295 238----- 381 541---- 359 334 322 319 300
1023 236  0 236  0 236  0---------- 0 1 0 1 0 1 0 1 0 1---------- 316 316 316 315 316--------****---- 63 293 237----- 381 538---- 360 334 322 319 300
1024 239  3 237  1 124 29---------- 0 1 0 1 0 1 0 1 0 1---------- 316 316 316 314 316--------****---- 64 297 240----- 382 538---- 360 334 322 319 300
1025 320 14 242  3   0 26---------- 0 1 0 1 0 1 0 1 0 1---------- 315 315 316 314 315--------****---- 63 291 236----- 382 537---- 360 335 322 319 300
1026  13 20 248  5  93 25---------- 0 1 0 1 0 1 0 1 0 1---------- 315 315 315 314 315--------****---- 63 291 236----- 383 540---- 361 335 322 319 300
1027  79 19 241  7  93 23---------- 0 1 0 1 0 1 0 1 0 1---------- 315 315 315 313 315--------****---- 64 296 239----- 384 542---- 361 335 322 319 300
1028 162 17 231  8 188 19---------- 0 1 0 1 0 1 0 1 0 1---------- 315 315 316 314 315--------****---- 65 300 241----- 385 547---- 362 335 323 319 300
1029 180 21 220 11 188 36---------- 0 1 0 1 0 1 0 1 0 1---------- 316 316 317 315 316--------****---- 65 302 242----- 387 550---- 362 336 323 319 300
1030 255 28 231 14 357 32---------- 0 1 0 1 0 1 0 1 0 1---------- 317 317 317 316 317--------****---- 64 299 240----- 388 550---- 363 336 323 319 300
1031 280 24 238 16 259 25---------- 0 1 0 1 0 1 0 1 0 1---------- 316 316 317 316 316--------****---- 62 288 234----- 387 547---- 363 336 323 319 300
1032 268 19 249 17 267 24---------- 0 1 0 1 0 1 0 1 0 1---------- 315 315 316 314 315--------****---- 62 287 233----- 388 547---- 364 337 323 319 300
1033  15 14 261 19 349 14---------- 0 1 0 1 0 1 0 1 0 1---------- 315 315 315 313 315--------****---- 64 296 239----- 392 550---- 364 337 323 319 300
1034  88 11 150 19  39 17---------- 0 1 0 1 0 1 0 1 0 1---------- 314 314 315 313 314--------****---- 64 294 238----- 396 550---- 365 337 324 319 300
1035  63 11 124 18  34 19---------- 0 1 0 1 0 1 0 1 0 1---------- 315 315 316 314 315--------****---- 64 296 239----- 399 552---- 365 338 324 319 300
1036  57 12 145 17 124 19---------- 0 1 0 1 0 1 0 1 0 1---------- 316 316 316 315 316--------****---- 65 302 242----- 402 554---- 366 338 324 319 300
1037  72 14  78 17 113 28---------- 0 1 0 1 0 1 0 1 0 1---------- 317 317 317 316 317--------****---- 67 313 248 9932 403 556---- 366 338 324 319 300
1038  47 16  44 17   6 27---------- 0 1 0 1 0 1 0 1 0 1---------- 318 318 318 317 318--------****---- 65 306 244 9932 404 555---- 366 338 324 319 300
1039  76 21  43 17   0 34---------- 0 1 0 1 0 1 0 1 0 1---------- 319 319 319 318 319--------****---- 64 303 242 9932 406 554---- 367 339 324 319 300
1040  58 23  51 16 354 27---------- 0 1 0 1 0 1 0 1 0 1---------- 319 319 319 319 319--------****---- 65 307 245 9932 407 556---- 367 339 324 319 300
1041 124 20  67 16 172 25---------- 0 1 0 1 0 1 0 1 0 1---------- 320 320 320 319 320--------****---- 65 309 246 9932 407 558---- 368 339 325 319 300
1042 153 19  79 16 146 23---------- 0 1 0 1 0 1 0 1 0 1---------- 319 319 319 319 319--------****---- 62 293 237 9932 408 561---- 368 340 325 319 300
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Fig. 6 Partial view of the minute routine meteorological element data file for station 59265

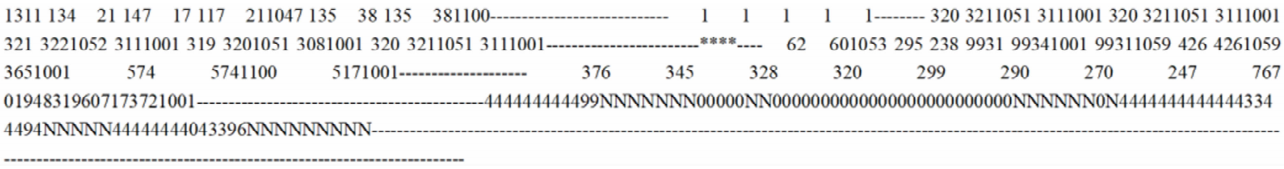

Fig. 7 Ground meteorological element fusion data at 11:00 on July 13, 2023 at station 59265

Table 2 Experimental results

Station		Missing testing time	Fusion result
Station name	Station No.		
Wuzhou National Benchmark Climate Station	59265	11:00 on July 13, 2023	Successful
		11:00 on September 26, 2023	Successful
		10:00 on April 17, 2024	Successful
		17:00 on April 18, 2024	Successful
		19:00 on April 18, 2024	Successful
Longwei National Basic Meteorological Station	59266	12:00 on February 14, 2023	Successful
		13:00 on February 14, 2023	Successful
Mengshan National Basic Meteorological Station	59508	01:00 on December 30, 2023	Successful

According to the above experimental results, the fusion tool of data file can effectively assist station personnel in completing the supplementary collection work after missing data measurements, greatly reducing the workload of station personnel and also reducing errors in supplementary collection work caused by manual problems.

3 Conclusions

In this paper, an efficient and accurate method for quality control and fusion processing of hourly routine meteorological element data files is developed to address the issue of insufficient integrity. By accurately locating the missing measurement time, this method effectively retrieves relevant data from the "AWZ.db" database and the minute routine meteorological element data file, and synthesizes and supplements them to the hourly routine meteorological element data file. The experimental results show that this method not only significantly improves data processing efficiency and accuracy, but also effectively solves the problem of incomplete hourly routine meteorological element data files. At the same time, this paper emphasizes the importance of ensuring the accuracy of the files used in practical operations and carefully checking and verifying the fusion results, and proposes targeted strategies for various situations to improve data quality.

On this basis, a program for quality control fusion of hourly routine meteorological element data files at meteorological stations is further developed using Python language. This program aims to solve the problem of a large amount of data and easy errors in manual verification during the supplementary collection work caused by the lack of data measurement at integral point in the actual work of the station. After multiple fusion experiments on actual missing measurements at multiple stations, the program has achieved good results, effectively improving the efficiency and accuracy of data processing.

In summary, the data file quality control and fusion processing method and its supporting program developed by the author have provided great convenience for observation personnel, effectively improving the completeness and accuracy of hourly routine meteorological element data files. Looking ahead, this method and its program are expected to provide more solid and reliable data support for meteorological forecasting and services, further promoting the development of the meteorological field.

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