

## Supplementary information section

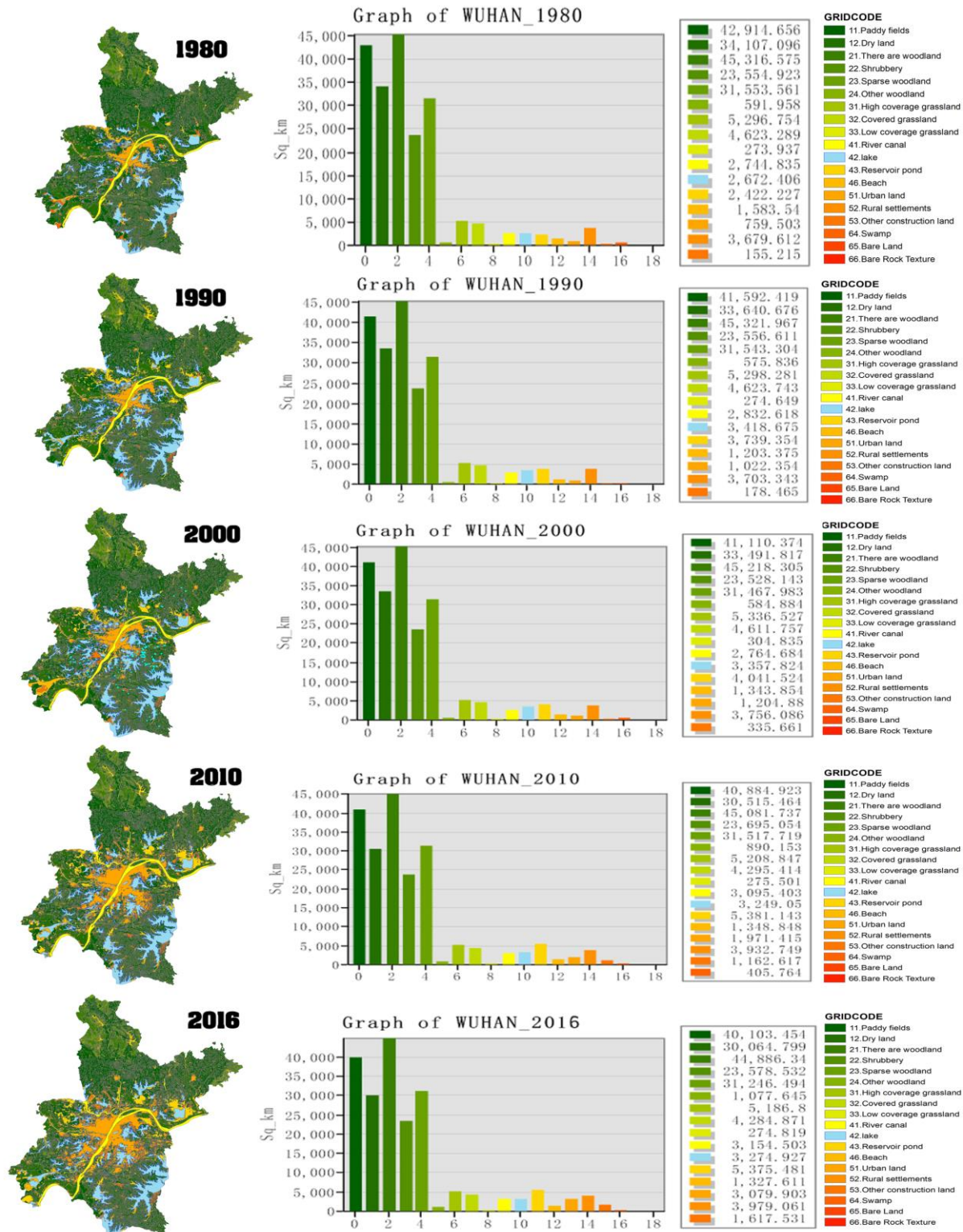
At the first stage of the long-term observational study, SRST technique is used by analyzing remote sense images to understand land-use/land-cover changes under Wuhan rapid urbanization process (1980-2016). Table1 shows all parameters of remote sense images classified by land-use.

Table. The land-use classification used to highlight the changes by ArcMap under Wuhan urbanization (1980-2016)

No	Label/ Type	Description
1	Arable land (1)	Refers to the cultivation of crops in the land, including cultivated land, new land reclamation, leisure, intermittent, grassland crop; to grow crops mainly farmer, agricultural mulberry, agricultural and forestry land; farming more than three years of beach and tideland.
2	Paddy Fields (11)	Refers to water conservation and irrigation facilities, in the general year to normal irrigation, for the cultivation of rice, lotus root and other aquatic crops such as arable land, including the implementation of rice and dryland crop rotation of cultivated land.
3	Dry-land (12)	Refers to irrigated water and facilities, by natural water crops to grow crops; water and watering facilities, in the general year under the normal irrigation of dry crop arable land; to cultivate the main cultivated land; the normal rotation of the leisure and Intermittently.
4	Woodland (2)	Refers to the growth of trees, shrubs, bamboo, and coastal mangrove land and another forestry land as well as Refers to cannabis> 30% of natural and planted forests. Including timber forest, economic forest, shelter forest, and another forest land.
5	Shrubbery (22)	Refers to the canopy height> 40%, the height of 2 meters below the dwarf forest and shrubland.
6	Sparse woodland (23) and another woodland (24)	23)Refers to the forest canopy closure of 10-30% of the woodland.24) Refers to not forest afforestation, trails, nursery and all kinds of the garden (orchard, mulberry, tea, hot forest garden, etc
7	Grassland (3)	Refers to the growth of herbaceous plants, covering more than 5% of the various types of grassland, including the main grassland and canopy density 10% of the sparse grassland.
8	High coverage grassland (31)	Refers to> 50% of the natural grass, improved grass, and lawn. Such grassland water conditions are generally good, the grass is growing dense.
9	Covered grassland (32)	Refers to the coverage in the 20-50% of the natural grass and improved grass, such grass is generally insufficient water, the grass is more sparse.
10	Low coverage grassland (33)	Refers to the coverage of 5-20% natural grassland. Such grassland lack of water, the grass is sparse, poor use of animal husbandry conditions.
11	Waters (4)	Refers to natural land and water conservancy facilities.
12	River canal (41)	Refers to the natural formation or artificial excavation of the river and the backbone of the annual water level below the land. Artificial drains include embankments.
13	Lake (42)	Refers to the natural formation of the water area below the perennial water level.
14	Reservoir pond (43)	Refers to the construction of the water storage area below the annual water level of the land.
15	Permanent glacier snow (44)	Refers to the perennial glaciers and snow covered by the land.
16	Beach (45-46)	45)Refers to the coastal tide of high tide and low tide between the tidal zone.46) Refers to the river and lake waters and the flood level between the water level between the land.
17	Urban and rural areas, industrial and mining, residential land (5)	Refers to urban and rural residential areas and other industrial and mining, transportation and other land.
18	Urban land (51)	Refers to large, medium and small cities and counties above the built area land.
19	Rural settlements (52)	Refers to rural areas other than towns.
20	Another construction land (53)	Refers to factories and mines, large industrial areas, oil, salt, quarry and other land and traffic roads, airports, and special land.
21	Unused land (6)	Land that has not yet been used, including difficult land.
22	Sandy land (61)	Refers to the surface for the sand cover, vegetation coverage below 5% of the land, including the desert, not including the desert in the water system.
23	Gobi (62)	The ground surface is dominated by crushed gravel, with vegetation covering under 5%.
24	Saline (63)	The land with saline and alkali-tolerant plants can only be grown when the surface is concentrated and the vegetation is scarce.
25	Swamp (64)	Refers to flat low-lying, poor drainage, long-term wet, seasonal stagnant water or perennial water, surface growth of wet plants of the land.
26	Bare Land (65)	Refers to land covered by soil and vegetation coverage under 5%.
27	Bare Rock Texture (66)	Refers to the surface of rock or gravel, covering the area of >5% land.

Source: meteorological bureau of Wuhan

ArcMap discovered significant changes in Wuhan land-use transformation and its city growth



Next, long-term meteorological data analysis represents a significant relationship with land-use changes after analysis.

站名	年份	月份	月平均气温(°C)	月平均相对湿度(%)	月平均风速(m/s)	月最多风向	站名	年份	月份	月平均气温(°C)	月平均相对湿度(%)	月平均风速(m/s)	月最多风向	站名	年份	月份	月平均气温(°C)	月平均相对湿度(%)	月平均风速(m/s)	月最多风向
蔡甸	1980	1	3.9	78	2.7	NNW	蔡甸	1990	1	3.4	84	2.0	N	蔡甸	2000	1	2.4	81	1.6	NNW
蔡甸	1980	2	5.1	73	1.9	C ENE	蔡甸	1990	2	4.4	89	2.0	N	蔡甸	2000	2	6.0	79	1.1	C NE
蔡甸	1980	3	7.5	89	2.6	N	蔡甸	1990	3	11.3	83	1.7	C N	蔡甸	2000	3	13.2	70	1.7	C ESE
蔡甸	1980	4	15.8	77	2.5	NNE	蔡甸	1990	4	16.2	80	2.1	ESE	蔡甸	2000	4	18.3	71	1.8	C ESE
蔡甸	1980	5	22.3	73	2.8	NNE	蔡甸	1990	5	21.6	77	2.2	N	蔡甸	2000	5	23.6	73	1.7	SSE
蔡甸	1980	6	25.0	85	2.7	SE	蔡甸	1990	6	26.3	83	1.7	C NW	蔡甸	2000	6	26.6	77	1.9	C SE
蔡甸	1980	7	26.8	86	2.4	C N	蔡甸	1990	7	29.6	79	2.6	S	蔡甸	2000	7	30.2	76	2.0	C SSE
蔡甸	1980	8	25.6	87	2.0	NE	蔡甸	1990	8	28.9	80	1.8	N	蔡甸	2000	8	28.0	82	1.7	N NNW
蔡甸	1980	9	22.3	80	2.3	N	蔡甸	1990	9	24.5	75	2.0	NNE	蔡甸	2000	9	23.7	78	1.8	NNW
蔡甸	1980	10	18.4	82	2.0	C NNW	蔡甸	1990	10	18.5	77	1.4	C NNE	蔡甸	2000	10	17.3	87	1.4	C NNW
蔡甸	1980	11	13.8	76	1.8	NNE	蔡甸	1990	11	13.4	82	1.7	C E	蔡甸	2000	11	9.6	82	1.5	C NNW
蔡甸	1980	12	6.5	62	2.0	C NNE NE	蔡甸	1990	12	6.3	75	1.4	N	蔡甸	2000	12	7.1	87	1.2	C N
黄陂	1980	1	3.4	75	3.1	N	黄陂	1990	1	3.1	84	2.6	NNE	黄陂	2000	1	2.2	78	2.2	NNE
黄陂	1980	2	4.9	70	2.2	NNE	黄陂	1990	2	4.3	87	2.1	NNE	黄陂	2000	2	5.6	77	1.5	NNW
黄陂	1980	3	7.6	86	3.2	NNE	黄陂	1990	3	11.1	82	1.9	C NNE	黄陂	2000	3	12.5	71	1.6	C NNE
黄陂	1980	4	15.5	76	3.5	NNE	黄陂	1990	4	16.0	79	2.1	C NNE	黄陂	2000	4	17.7	68	2.0	ENE SE
黄陂	1980	5	22.1	72	3.1	ESE	黄陂	1990	5	21.3	78	2.3	C NNE	黄陂	2000	5	23.1	71	2.0	SE
黄陂	1980	6	24.9	84	2.9	SE	黄陂	1990	6	26.2	83	2.1	C NNW	黄陂	2000	6	26.1	80	1.8	ENE
黄陂	1980	7	26.6	86	2.6	ESE	黄陂	1990	7	29.3	80	2.7	SSE	黄陂	2000	7	29.5	78	1.8	NNE
黄陂	1980	8	25.6	86	2.2	NNE	黄陂	1990	8	28.9	79	2.1	NNE	黄陂	2000	8	27.8	81	1.6	ENE
黄陂	1980	9	22.0	80	2.5	NNE	黄陂	1990	9	24.5	74	2.2	C NNE	黄陂	2000	9	23.4	77	1.9	NNE NNW
黄陂	1980	10	18.2	81	2.3	N	黄陂	1990	10	18.0	77	1.2	C NNE	黄陂	2000	10	16.9	86	1.7	NNE
黄陂	1980	11	13.5	74	2.1	N	黄陂	1990	11	12.7	81	2.0	C N NNE	黄陂	2000	11	9.0	82	1.7	N
黄陂	1980	12	5.9	59	2.2	NNE	黄陂	1990	12	5.5	74	1.7	C NNE	黄陂	2000	12	6.7	86	1.6	C NNE NNW
新洲	1980	1	3.4	80	2.5	N	新洲	1990	1	3.6	84	2.3	N	新洲	2000	1	2.4	81	1.3	NNE
新洲	1980	2	4.9	75	1.6	C N	新洲	1990	2	4.7	88	1.8	C N	新洲	2000	2	5.7	78	0.9	C NNE
新洲	1980	3	7.8	88	2.3	C NNE	新洲	1990	3	11.5	82	1.9	C N	新洲	2000	3	12.5	70	1.1	C N
新洲	1980	4	15.5	77	2.7	NNE SSE	新洲	1990	4	16.3	76	1.9	C N SSE	新洲	2000	4	17.9	68	1.5	C NNE
新洲	1980	5	22.1	74	2.3	SSE	新洲	1990	5	21.7	75	2.2	C N	新洲	2000	5	23.3	72	1.2	C NNE
新洲	1980	6	25.0	85	2.5	SSE	新洲	1990	6	26.8	78	1.9	C SSE	新洲	2000	6	26.4	78	1.0	C S
新洲	1980	7	26.9	86	2.3	SSE	新洲	1990	7	30.0	75	2.1	S	新洲	2000	7	29.8	76	1.2	C SSE
新洲	1980	8	25.6	87	1.6	C N	新洲	1990	8	28.9	77	2.0	N	新洲	2000	8	28.3	78	1.4	C NNE
新洲	1980	9	21.8	82	1.9	C N	新洲	1990	9	24.6	73	2.0	C NNE	新洲	2000	9	23.8	75	1.4	C N NNE
新洲	1980	10	18.2	83	1.4	C NNE	新洲	1990	10	18.3	76	1.3	C NNE	新洲	2000	10	17.4	84	1.2	C N
新洲	1980	11	13.1	76	1.6	C N	新洲	1990	11	13.1	81	1.7	C N	新洲	2000	11	9.3	80	1.1	C NNE
新洲	1980	12	5.6	64	1.8	C NNE	新洲	1990	12	5.9	75	1.5	C N NNE	新洲	2000	12	6.9	84	0.7	C N
江夏	1980	1	4.1	76	2.4	C NNE	江夏	1990	1	3.8	85	1.7	C N	江夏	2000	1	2.9	81	1.5	C NNE
江夏	1980	2	5.1	73	1.8	C N ESE	江夏	1990	2	4.6	90	1.7	C NNE	江夏	2000	2	6.1	78	0.8	C NNW
江夏	1980	3	7.7	88	2.5	C NNE	江夏	1990	3	11.3	83	1.4	C NNE	江夏	2000	3	13.2	71	1.1	C SE
江夏	1980	4	16.0	75	2.9	C ESE	江夏	1990	4	16.2	79	1.8	C ESE	江夏	2000	4	18.3	70	1.4	C WSW
江夏	1980	5	22.4	73	2.6	C ESE	江夏	1990	5	21.6	76	1.8	C NNE	江夏	2000	5	23.8	72	1.5	C NNE SE
江夏	1980	6	25.4	82	2.5	C SSW	江夏	1990	6	26.7	79	1.4	C ESE	江夏	2000	6	26.9	75	2.0	C SE
江夏	1980	7	27.1	84	2.0	C NNW	江夏	1990	7	30.7	71	2.4	SSW	江夏	2000	7	31.1	70	2.3	WSW
江夏	1980	8	25.5	87	1.8	C ENE	江夏	1990	8	29.4	75	1.9	C NNE	江夏	2000	8	28.6	77	2.3	NNE
江夏	1980	9	22.4	79	2.0	C NNE	江夏	1990	9	24.9	74	1.9	C NNE	江夏	2000	9	24.2	76	2.0	N
江夏	1980	10	18.5	80	1.7	C NNE	江夏	1990	10	18.5	76	1.1	C NNE	江夏	2000	10	17.7	86	1.8	C NNE
江夏	1980	11	14.0	73	1.6	C N NNE	江夏	1990	11	13.3	81	1.7	C NNE	江夏	2000	11	9.8	80	2.0	C NNE
江夏	1980	12	6.7	61	1.5	C NNE	江夏	1990	12	6.3	74	1.4	C NNE	江夏	2000	12	7.4	85	1.5	C N

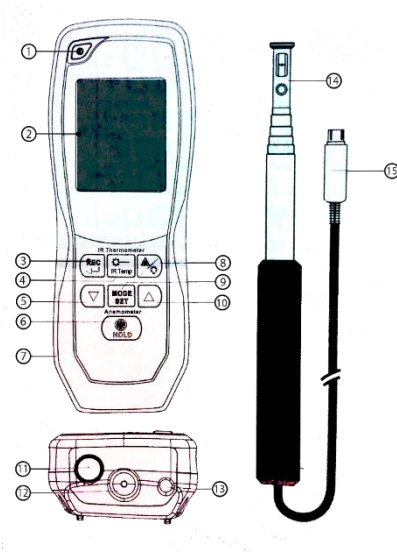
1980

1990

2000

站名	年份	月份	月平均气温(°C)	月平均相对湿度(%)	月平均风速(m/s)	月最多风向	站名	年份	月份	月平均气温(°C)	月平均相对湿度(%)	月平均风速(m/s)	月最多风向
蔡甸	2010	1	4.9	77	1.5	N	蔡甸	2016	1	1.1	81	2.3	N
蔡甸	2010	2	7.1	81	1.6	N	蔡甸	2016	2	8.2	69	2.4	N
蔡甸	2010	3	10.8	72	2.2	N	蔡甸	2016	3	13.2	72	2.4	NNE
蔡甸	2010	4	15.2	72	1.9	N	蔡甸	2016	4	19.3	83	2.3	NNW
蔡甸	2010	5	22.2	75	1.5	NNE	蔡甸	2016	5	21.3	82	2.6	NNE
蔡甸	2010	6	25.8	76	1.4	SSE	蔡甸	2016	6	25.2	87	2.3	SSW
蔡甸	2010	7	28.6	81	1.6	SSE	蔡甸	2016	7	29.2	85	2.5	SSW
蔡甸	2010	8	29.0	74	1.6	N	蔡甸	2016	8	29.4	81	2.3	NNE
蔡甸	2010	9	24.4	80	1.6	N	蔡甸	2016	9	25.6	71	2.4	NNE
蔡甸	2010	10	17.6	74	1.3	N	蔡甸	2016	10	18.2	88	2.4	NNE
蔡甸	2010	11	13.4	69	1.1	C NNE	蔡甸	2016	11	11.5	88	2.0	N
蔡甸	2010	12	7.6	66	1.7	NNE	蔡甸	2016	12	8.0	83	1.9	NNW
黄陂	2010	1	4.5	77	1.8	C NNE	黄陂	2016	1	3.3	77	2.0	N
黄陂	2010	2	7.0	83	2.2	N	黄陂	2016	2	7.1	64	1.9	N
黄陂	2010	3	10.2	77	2.5	N	黄陂	2016	3	12.6	68	2.1	N
黄陂	2010	4	14.8	77	2.3	NNE	黄陂	2016	4	18.8	78	2.1	N
黄陂	2010	5	21.9	81	1.9	NNE	黄陂	2016	5	20.9	78	2.3	N
黄陂	2010	6	25.5	83	1.8	SE	黄陂	2016	6	24.6	82	2.0	SE
黄陂	2010	7	28.3	90	1.7	C ESE	黄陂	2016	7	28.8	81	2.0	ESE
黄陂	2010	8	28.5	84	1.9	C NNE	黄陂	2016	8	29.3	75	1.9	N
黄陂	2010	9	24.0	88	1.7	C N	黄陂	2016	9	25.3	66	2.2	N
黄陂	2010	10	17.1	81	1.4	C NNE	黄陂	2016	10	17.9	84	1.9	N
黄陂	2010	11	12.4	76	0.9	C NNE	黄陂	2016	11	11.0	82	1.9	N
黄陂	2010	12	6.6	71	1.7	C N	黄陂	2016	12	7.1	79	1.7	NNW
新洲	2010	1	4.9	77	1.4	N	新洲	2016	1	3.5	79	2.4	N
新洲	2010	2	7.5	81	1.6	N	新洲	2016	2	7.5	62	2.4	N
新洲	2010	3	10.5	75	1.8	N	新洲	2016	3	12.8	66	2.2	N
新洲	2010	4	15.0	76	1.6	NNE	新洲	2016	4	18.8	81	1.9	N
新洲	2010	5	22.3	79	1.2	C N	新洲	2016	5	21.0	80	2.1	SSE
新洲	2010	6	26.0	79	1.3	SE	新洲	2016	6	24.7	86	1.9	SSE
新洲	2010	7	28.7	88	1.2	SE	新洲	2016	7	28.7	84	1.9	SSE
新洲	2010	8	29.1	83	1.4	SE	新洲	2016	8	29.0	79	1.9	N
新洲	2010	9	24.6	87	1.4	N	新洲	2016	9	24.7	71	2.2	N
新洲	2010	10	17.6	80	1.2	C NNE	新洲	2016	10	18.0	87	2.2	N
新洲	2010	11	12.9	75	0.9	C NNE	新洲	2016	11	11.1	85	2.2	N
新洲	2010	12	7.1	70	1.4	C N	新洲	2016	12	7.1	80	2.1	N
江夏	2010	1	5.0	78	2.4	E	江夏	2016	1	4.3	75	2.3	NNW
江夏	2010	2	7.3	81	2.5	NNW	江夏	2016	2	8.6	58	2.5	E
江夏	2010	3	10.7	72	3.0	ESE	江夏	2016	3	13.5	66	2.2	E
江夏	2010	4	14.8	74	2.9	ESE	江夏	2016	4	19.0	78	2.5	ESE
江夏	2010	5	21.8	77	2.4	E	江夏	2016	5	21.0	79	2.4	ESE
江夏	2010	6	25.1	80	2.1	ESE	江夏	2016	6	25.0	80	2.4	E
江夏	2010	7	28.1	87	2.4	SE	江夏	2016	7	29.0	80	2.3	ESE
江夏	2010	8	28.9	79	2.3	C SE	江夏	2016	8	29.7	72	2.4	ENE
江夏	2010	9	24.3	86	2.3	E	江夏	2016	9	25.8	64	2.4	N
江夏	2010	10	18.0	75	2.1	NNW	江夏	2016	10	18.4	83	2.2	NNW
江夏	2010	11	14.1	67	1.8	C E	江夏	2016	11	11.8	81	2.3	NNW
江夏	2010	12	8.2	65	2.5	E	江夏	2016	12	8.5	74	2.2	E

In field observational study section (mobile and fixed observation), equipment used as follow:



(A)



(B)



(C)



(D)



(E)

Where A is the anemometer (wind speed is recorded 1.5 m above the ground)[3], B is the temperature/humidity data-logger, and C is the small weather station (fixed-point), D is a Global Positioning System (GPS), and E.is JTsoft-METER.