
Weather Station Data Quality Assessment

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Version 1.3

August 17, 2017

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1 Introduction

US Forest Service's i-Tree Eco utilizes field-surveyed urban forest information, location specific data, weather data, and air pollutant measurements to quantify urban forest structure and numerous forest-related effects such as carbon sequestration, energy savings, and pollution removals. Key input is hourly global surface weather data (NCDC 2015) that provides worldwide hourly weather data. The i-Tree Eco server hosts those data from 2005 to 2016. The quality of the weather data is tested based on the method described in this document.

2 Methods

2.1 Hourly Data Derivation

Figure 1 presents an example of the surface weather data. Measurements are typically recorded once per hour but the timestamp is not always at the top-of-hour. During rain events, precipitation (PCP01) and other data tend to be recorded more often. By the weather preprocessor (Hirabayashi and Endreny 2015), the timestamp will be first adjusted to the nearest next top-of-hour (e.g. 10:08 am and 10:40 am are adjusted to 11:00 am). Then, if the records with the same timestamp exist the values found the last in the same timestamp will be used to create the hourly records for wind speed (SPD), cloud ceiling height (CLG), sky cover (SKC), temperature (TEMP), dew point temperature (DEWP), station altimeter setting

(ALT), and station pressure (STP) and the largest value will be used for 1-hour liquid precipitation (PCP01) and 6-hour liquid precipitation (PCP06).

745048-93210-2012.txt - Notepad																													
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USAF	WBAN	YR--MODAHRMN	DIR	SPD	GUS	CLG	SKC	L	M	H	VSB	WW	WW	WW	W	TEMP	DEWP	SLP	ALT	STP	MAX	MIN	PCP01	PCP06	PCP24	PCPXX	SD		
745048	93210	201201010053	***	0	***	722	CLR	***	10.0	***	***	***	***	***	54	39	1023.4	30.21	1015.9	***	***	0.00	***	***	***	***			
745048	93210	201201010153	***	0	***	722	CLR	***	10.0	***	***	***	***	***	49	38	1023.2	30.21	1015.9	***	***	0.00	***	***	***	***			
745048	93210	201201010253	***	0	***	722	CLR	***	10.0	***	***	***	***	***	45	38	1023.4	30.21	1015.9	***	***	0.00	***	***	***	***			
745048	93210	201201010353	***	0	***	722	CLR	***	7.0	***	***	***	***	***	45	38	1022.8	30.20	1015.6	***	***	0.00	***	***	***	***			
745048	93210	201201010453	***	0	***	722	CLR	***	8.0	***	***	***	***	***	43	38	1022.1	30.18	1014.9	***	***	0.00	***	***	***	***			
745048	93210	201201010553	***	0	***	722	CLR	***	7.0	***	***	***	***	***	40	37	1022.1	30.18	1014.9	57	40	0.00	***	***	***	***			
745048	93210	201201010653	***	0	***	722	CLR	***	10.0	***	***	***	***	***	40	37	1022.4	30.18	1014.9	***	***	0.00	***	***	***	***			
745048	93210	201201010753	130	6	***	722	CLR	***	6.0	***	***	***	***	***	38	36	1023.1	30.20	1015.6	***	***	0.00	***	***	***	***			
745048	93210	201201010759	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	58	***	***	***	0.00	***	***			
745048	93210	201201010759	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***			
745048	93210	201201010853	120	6	***	722	CLR	***	10.0	***	***	***	***	***	40	37	1023.7	30.22	1016.2	***	***	0.00	***	***	***	***			
745048	93210	201201010953	110	3	***	722	CLR	***	10.0	***	***	***	***	***	42	40	1023.9	30.23	1016.6	***	***	0.00	***	***	***	***			
745048	93210	201201011053	090	6	***	722	CLR	***	10.0	***	***	***	***	***	42	39	1024.0	30.24	1016.9	***	***	0.00	***	***	***	***			
745048	93210	201201011153	***	0	***	722	CLR	***	10.0	***	***	***	***	***	38	37	1024.2	30.24	1016.9	43	37	0.00	***	***	***	***			
745048	93210	201201011253	080	3	***	722	CLR	***	10.0	***	***	***	***	***	38	37	1024.0	30.23	1016.6	***	***	0.00	***	***	***	***			
745048	93210	201201011353	070	5	***	722	CLR	***	10.0	***	***	***	***	***	38	37	1024.4	30.24	1016.9	***	***	0.00	***	***	***	***			
745048	93210	201201011453	***	0	***	722	CLR	***	9.1	***	***	***	***	***	37	36	1024.5	30.25	1017.2	***	***	0.00	***	***	***	***			
745048	93210	201201011553	***	0	***	722	CLR	***	8.0	***	***	***	***	***	37	36	1024.9	30.26	1017.6	***	***	0.00	***	***	***	***			
745048	93210	201201011653	***	0	***	722	CLR	***	6.0	***	***	***	***	***	43	41	1025.4	30.27	1017.9	***	***	0.00	***	***	***	***			
745048	93210	201201011753	***	0	***	722	CLR	***	10.0	***	***	***	***	***	49	44	1025.5	30.28	1018.3	49	35	0.00	***	***	***	***			
745048	93210	201201011853	290	5	***	722	CLR	***	10.0	***	***	***	***	***	49	43	1024.8	30.26	1017.6	***	***	0.00	***	***	***	***			
745048	93210	201201011953	290	6	***	722	CLR	***	10.0	***	***	***	***	***	50	43	1023.9	30.23	1016.6	***	***	0.00	***	***	***	***			
745048	93210	201201012053	280	7	***	722	CLR	***	10.0	***	***	***	***	***	53	43	1023.4	30.21	1015.9	***	***	0.00	***	***	***	***			
745048	93210	201201012153	***	0	***	722	CLR	***	10.0	***	***	***	***	***	58	41	1022.5	30.19	1015.2	***	***	0.00	***	***	***	***			
745048	93210	201201012253	270	6	***	722	CLR	***	10.0	***	***	***	***	***	59	42	1022.1	30.18	1014.9	***	***	0.00	***	***	***	***			
745048	93210	201201012353	***	0	***	722	CLR	***	10.0	***	***	***	***	***	58	43	1022.1	30.18	1014.9	60	48	0.00	***	***	***	***			
745048	93210	201201020053	***	0	***	722	CLR	***	10.0	***	***	***	***	***	52	44	1022.6	30.19	1015.2	***	***	0.00	***	***	***	***			

Figure 1 Example of surface weather data

2.2 Surface Weather Data Quality Assessment

Quality of the weather data are categorized by Good, Fair, or Poor based on the number of missing values in the necessary weather parameters in the hourly records created in the Section 2.1.

- If the total missing data for each of the parameters are all less than 720 hours (30 days) the quality is “Good”. Note that either station pressure or altimeter is necessary and thus this criterion only applies to one or the other.
- If the total missing data for each of the parameters are less than the half of total yearly hours the quality is “Fair”.
- If the total missing data for each of the parameters are less than total yearly hours (i.e., there is at least one record for each parameter) the quality is “Poor”
- Weather stations that don’t meet the criteria above are not processible due to no records available for necessary parameters.
- Precipitation is not considered in the quality assessment as we have no idea if 0 precipitation records means everything is missing or there is no rain at all for a year.

At some stations, both PCP01 and PCP06 are recorded. Greater annual precipitation derived from either PCP01 or PCP06 records for each processible weather station will be presented

for users to pick a weather station in i-Tree Eco. PCP06 data are disaggregated into the previous 6 hours assuming the uniform distribution by the weather preprocessor in i-Tree Eco/Hydro.

Figures 2-4 present the location of worldwide “Good”, “Fair”, and “Poor” weather stations for 2010.

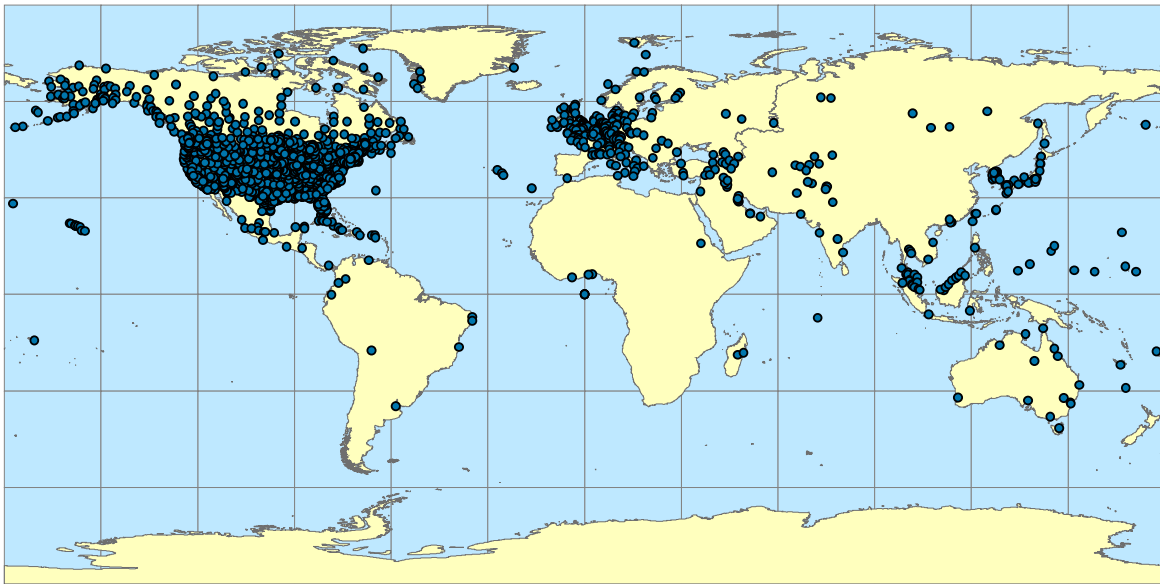


Figure 2 Worldwide “Good” weather stations for 2010

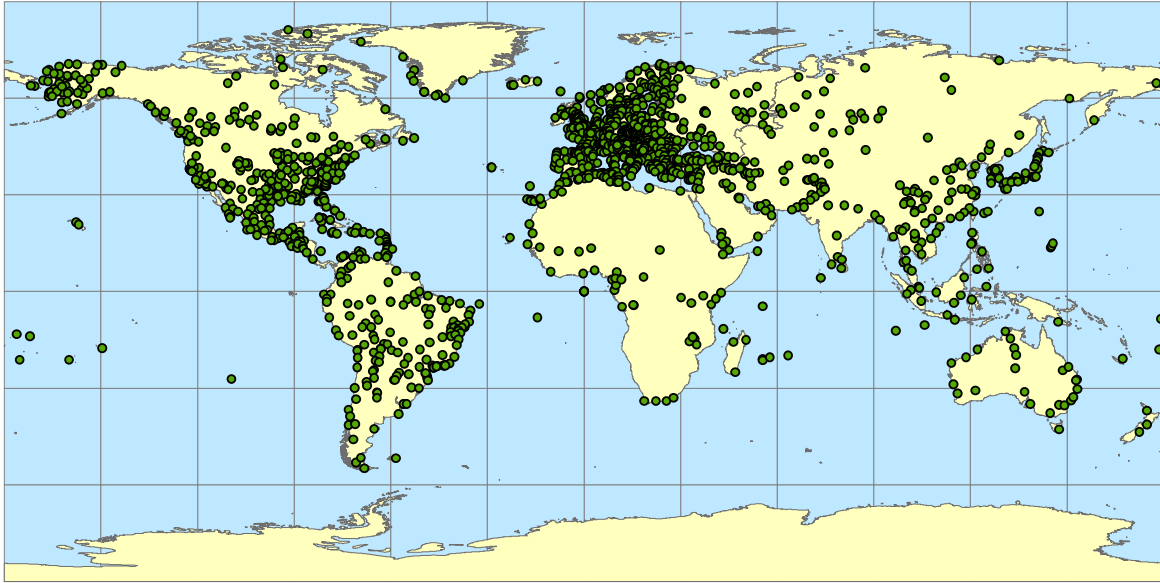


Figure 3 Worldwide “Fair” weather stations for 2010

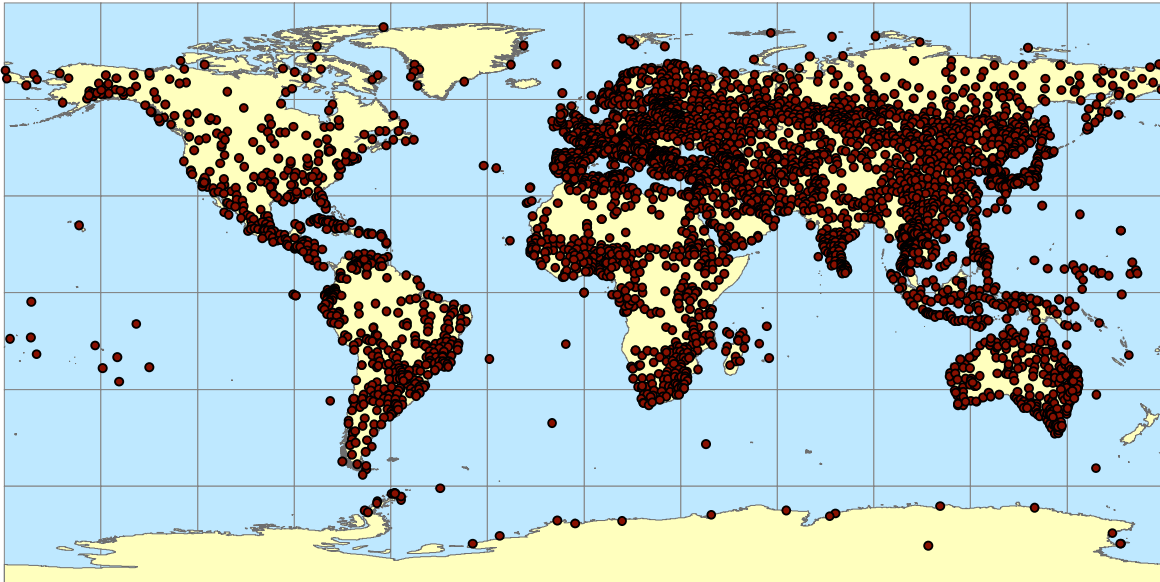


Figure 4 Worldwide “Poor” weather stations for 2010

Tables 1-3 present the number of “Good”, “Fair”, and “Poor” weather stations in countries where i-Tree Eco officially supports as well as other countries. Table 4 presents the number of weather stations excluded due to no value is available for required weather parameters.

Table 1 Number of “Good” stations for i-Tree supported countries (Australia, Canada, Puerto Rico, the United Kingdom and the United States) and other countries

Year	Australia	Canada	Puerto Rico	UK	US	Others
2005	0	136	1	19	1292	180
2006	7	149	1	36	1361	238
2007	9	147	1	41	1404	343
2008	10	144	1	41	1478	379
2009	11	150	1	42	1535	368
2010	14	143	1	36	1568	383
2011	14	113	1	41	1590	419
2012	14	100	2	41	1630	438
2013	2	1	0	0	46	84
2014	0	0	0	0	15	55
2015	2	1	0	0	11	19
2016	0	0	0	0	12	57

Table 2 Number of “Fair” stations for i-Tree supported countries (Australia, Canada, Puerto Rico, the United Kingdom and the United States) and other countries

Year	Australia	Canada	Puerto Rico	UK	US	Others
2005	20	85	1	58	234	1186
2006	22	51	1	43	281	1145
2007	23	47	1	49	273	1229
2008	0	0	0	0	0	0
2009	27	44	1	35	210	1260
2010	24	50	1	36	255	1229
2011	23	44	0	32	306	1234
2012	0	0	0	0	0	0
2013	31	145	0	38	1791	612
2014	35	32	0	21	1536	380
2015	32	71	1	21	1663	408
2016	0	0	0	0	0	0

Table 3 Number of “Poor” stations for i-Tree supported countries (Australia, Canada, Puerto Rico, the United Kingdom and the United States) and other countries

Year	Australia	Canada	Puerto Rico	UK	US	Others
2005	249	82	2	55	92	4032
2006	236	62	1	21	116	3701
2007	244	59	1	25	100	3620
2008	268	110	2	57	331	4749
2009	243	59	1	19	89	3830
2010	243	74	1	23	140	3668
2011	242	71	2	21	73	3650
2012	261	127	1	53	362	5495
2013	225	126	3	64	157	5063
2014	145	209	3	72	456	5128
2015	156	170	2	70	242	5250
2016	189	240	1	99	1942	5676

Table 4 Number of stations excluded for i-Tree supported countries (Australia, Canada, Puerto Rico, the United Kingdom and the United States) and other countries

Year	Australia	Canada	Puerto Rico	UK	US	Others
2005	564	635	2	159	799	2276
2006	551	659	2	182	803	2052
2007	548	687	3	170	837	2096
2008	544	726	4	165	929	2243
2009	536	748	14	157	1025	2474
2010	538	759	14	160	1126	2255
2011	535	545	15	164	1059	2226
2012	526	555	15	172	1101	2272
2013	514	735	17	159	1188	2410
2014	591	758	14	148	1151	2775
2015	571	752	15	147	1291	2834
2016	544	748	15	143	1127	2697

References

- Hirabayashi, S., Endreny, T.A., 2015. Surface and upper weather pre-processor for i-Tree Eco and Hydro. http://www.itreetools.org/eco/resources/Surface_weather_and_upper_air_preprocessor_description.pdf (accessed October 2015).
- National Climatic Data Center (NCDC), 2015. <ftp://ftp.ncdc.noaa.gov/pub/data/noaa/> (accessed October 2015).