Harvard Forest Schoolyard LTER

Looking at Data Workshop

Harvard Forest

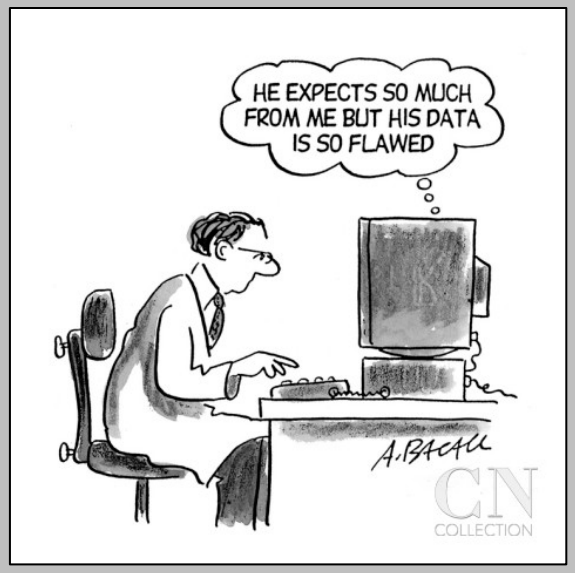
15 Dec 2016

Emery R. Boose

Photos contributed by program staff & teachers

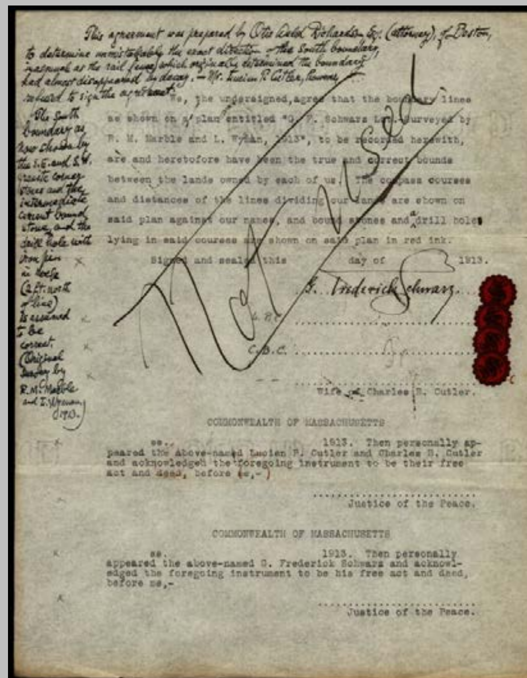
Level 1 Session

- Scientific data
- Data entry
- Online graphing tool
- Graphing exercises



The New Yorker

Paper Records



This agreement was prepared by Otis Dalal Richardson Esq. (attorney), of Boston, to determine unmistakably the exact direction of the South boundary, inasmuch as the rail fence which originally determined the boundary had almost disappeared by decay. — Mr. Lucien P. Cutler, however, refused to sign the agreement.

The South boundary as now shown by the S.E. and S.W. granite corner stones and the intermediate cement bound stones and the drill hole with iron pin in ledge (2 ft. north of line) is assumed to be correct. (Original survey by R. M. Marble and L. Wyman, 1913.)

We, the undersigned, agree that the boundary lines as shown on a plan entitled "G. F. Schwarz Lot. Surveyed by R. M. Marble and L. Wyman, 1913", to be recorded herewith, are and heretofore have been the true and correct bounds between the lands owned by each of us. The compass courses and distances of the lines dividing our lands are shown on said plan against our names, and bound stones and a drill hole lying in said courses are shown on said plan in red ink.

Signed and sealed this day of 1913.

G. Frederick Schwarz.

L. P. C. ....

C. B. C. ....

....
Wife of Charles B. Cutler.

COMMONWEALTH OF MASSACHUSETTS

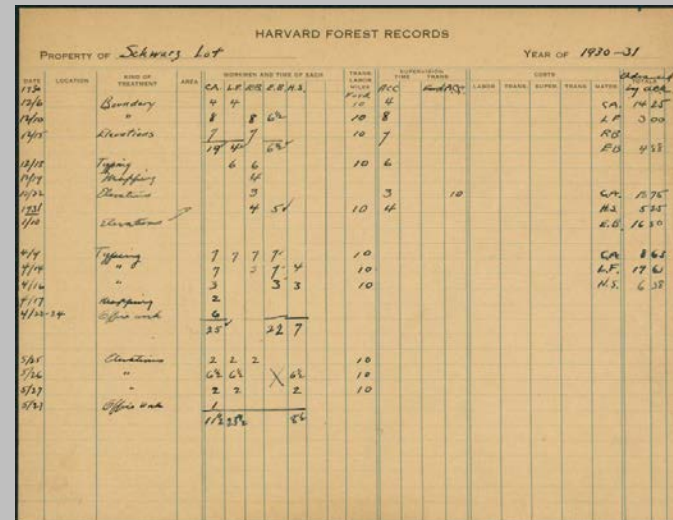
ss., 1913. Then personally appeared the above-named Lucien P. Cutler and Charles B. Cutler and acknowledged the foregoing instrument to be their free act and deed, before me,-

....
Justice of the Peace.

COMMONWEALTH OF MASSACHUSETTS

ss. 1913. Then personally appeared the above-named G. Frederick Schwarz and acknowledged the foregoing instrument to be his free act and deed, before me,-

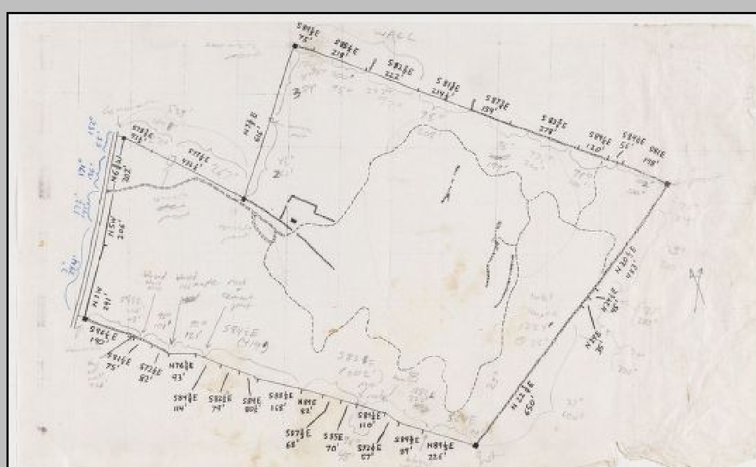
....
Justice of the Peace.

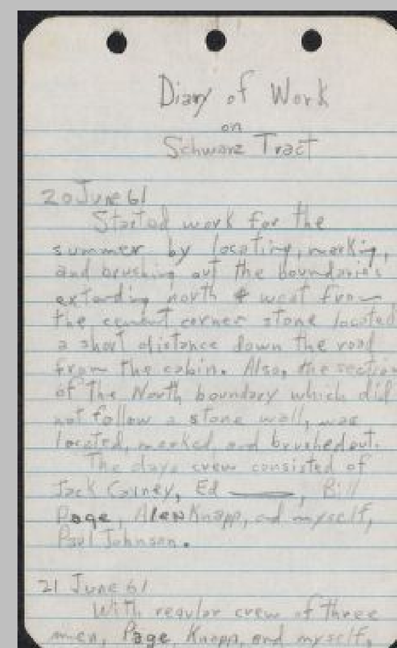


HARVARD FOREST RECORDS

Property of Schwarz Lot — Year of 1930–31

Date	Location	Kind of treatment	Area	CA.	LF.	RB.	E.B.	H.S.	Trans. labor miles Ford	Supervision time ACC	Supervision trans. Ford ACC	Labor	Trans.	Super.	Trans.	Mater.	Totals by area
1930																	
12/6		Boundary		4	4				10	4							CA. 14 25
12/10		"		8		8	6½		10	8							L.F. 3 00
12/15		Elevations		7		7			10	7							RB
				19	4		6½										EB 4 38
12/18		Typing			6	6			10	6							
12/19		Mapping				4											
12/22		Elevations				3				3	10						CA. 15 75
1931						4	5½		10	4							HS 5 25
1/10		Elevations															E.B. 16 50
4/4		Typing		7	7	7	7		10								CA. 8 65
4/14		" "		7		3	7	4	10								L.F. 17 60
4/16		"		3			3	3	10								H.S. 6 38
4/17		Mapping		2													
4/22-24		Office work		6													
				35			22	7									
5/25		Elevations		2	2	2			10								
5/26		"		6½	6½		X	6½	10								
5/27		"		2	2			2	10								
5/31		Office work		1													
				11½	25½			8½									





Diary of Work
on
Schwarz Tract

20 June 61
Started work for the summer by locating, marking, and brushing out the boundaries extending north & west from the cement corner stone located a short distance down the road from the cabin. Also, the section of the North boundary which did not follow a stone wall, was located, marked and brushed out.
The days crew consisted of Jack Gurney, Ed ______, Bill Page, Alex Knapp, and myself, Paul Johnson.

21 June 61
With regular crew of three men, Page, Knapp, and myself,

Data Entered at Keyboard

Harvard Forest Data Archive HF003

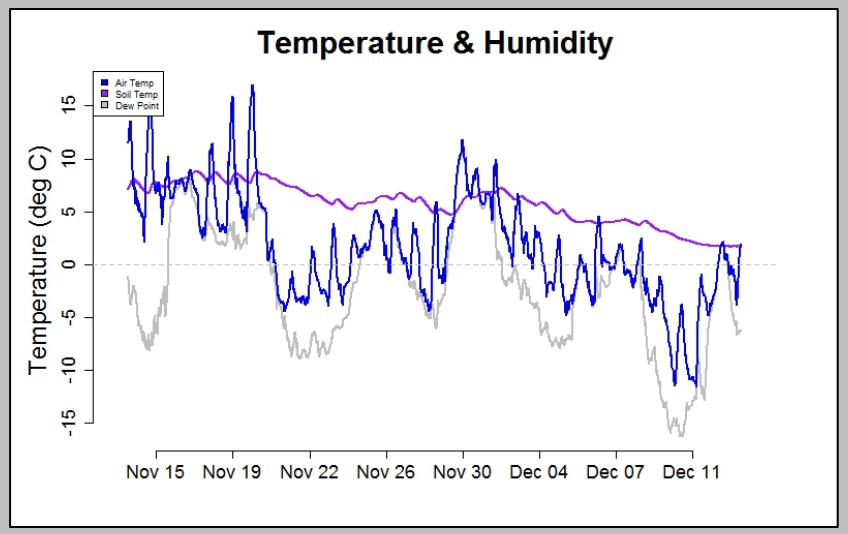
```
date,julian,tree.id,tag,circuit,fopn,fpst,lcolor,lfall,comments
2014-09-04,247,ACPE-01,PP022,12,NA,NA,2,0,NA
2014-09-04,247,ACPE-02,PP035,16,NA,NA,7,2,lots of fruit this year
2014-09-04,247,ACPE-03,PP040,19,NA,NA,3,0,NA
2014-09-04,247,ACPE-04,PP067,29,NA,NA,5,0,NA
2014-09-04,247,ACRU-01,PP008,4,NA,NA,3,0,NA
2014-09-04,247,ACRU-02,PP033,15,NA,NA,3,0,NA
2014-09-04,247,ACRU-03,PP063,28,NA,NA,0,0,NA
2014-09-04,247,ACRU-04,PP074,31,NA,NA,3,0,NA
2014-09-04,247,ACRU-05,PP106,49,NA,NA,12,1,NA
2014-09-04,247,ACSA-01,PP012,6,NA,NA,0,0,NA
```

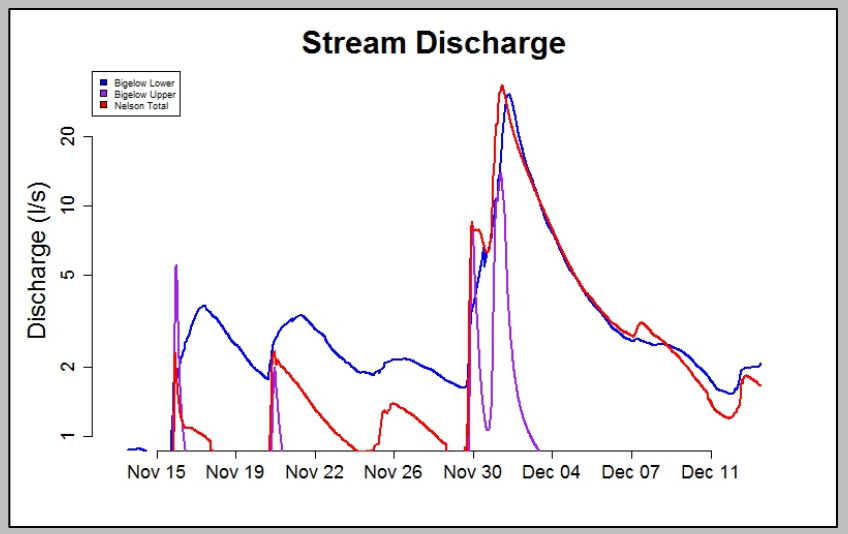
Born-Digital Data

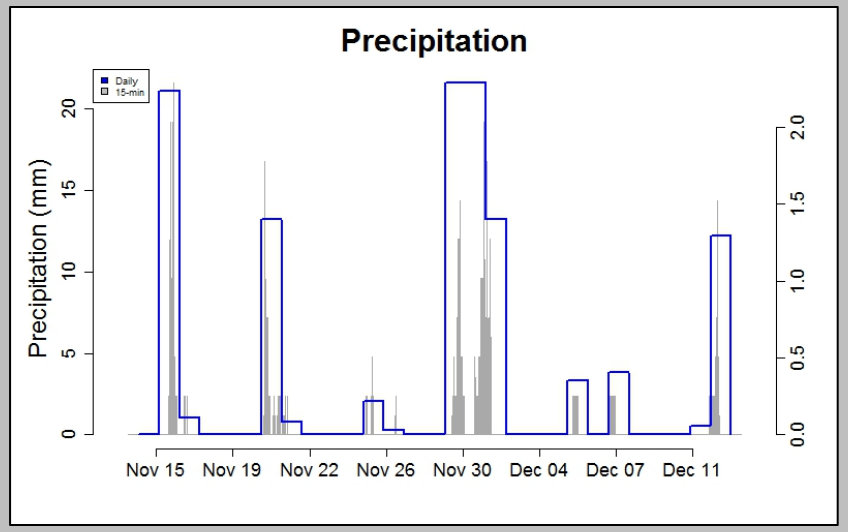
Harvard Forest Data Archive HF001

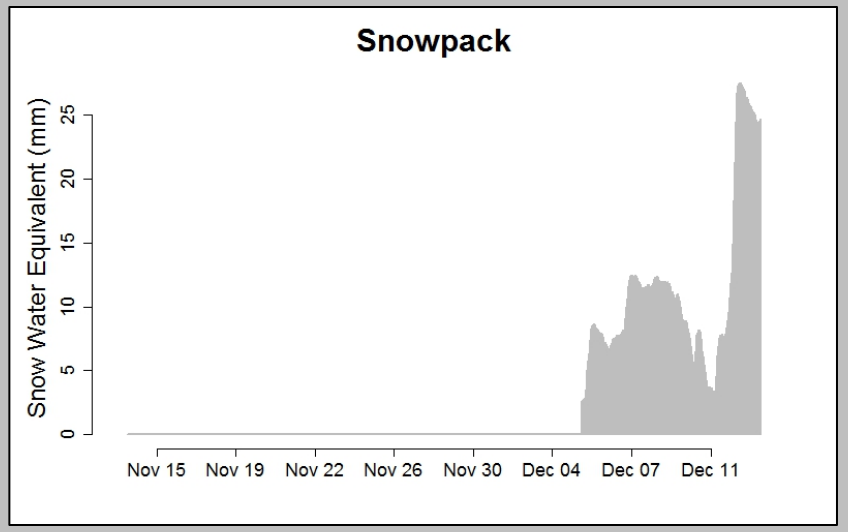
```
datetime,jd,airt,rh,dewp,prec,slrr,parr,netr,bar,wspd,wres,wdir,wdev,gspd,s10t
2015-11-01T00:15,305,6.2,77,2.5,0.0,0,0,-19,1016,1.4,1.3,214,24,4.1,10.4
2015-11-01T00:30,305,6.1,78,2.6,0.0,0,0,-14,1016,1.4,1.4,219,21,3.4,10.4
2015-11-01T00:45,305,6.2,79,2.7,0.0,0,0,-12,1016,1.4,1.3,225,28,4.8,10.4
2015-11-01T01:00,305,6.3,78,2.7,0.0,0,0,-12,1016,1.3,1.2,231,26,4.3,10.3
2015-11-01T01:15,305,6.4,78,2.9,0.0,0,0,-24,1016,1.1,1.1,238,22,3.8,10.3
2015-11-01T01:30,305,6.1,82,3.4,0.0,0,0,-24,1016,0.7,0.6,221,23,2.3,10.3
2015-11-01T01:45,305,5.9,86,3.7,0.0,0,0,-23,1016,0.9,0.9,195,24,2.7,10.3
2015-11-01T02:00,305,5.8,87,3.9,0.0,0,0,-23,1015,1.4,1.3,208,23,3.7,10.3
2015-11-01T02:15,305,5.8,89,4.1,0.0,0,0,-19,1015,1.2,1.0,207,26,3.5,10.3
```

Real-Time Data









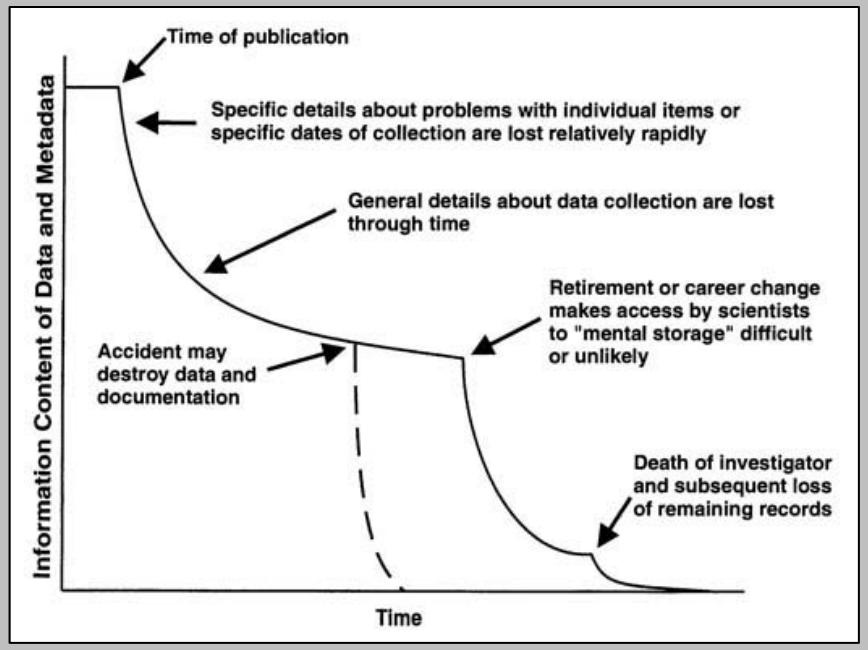
Harvard Forest Website: Real Time Data Graphs

Why Manage Data?

- Scientists build on the work of others
- Scientific results must be reproducible

The New Yorker

Data may disappear



Michener et al. 1997

Information content may disappear

Data & Metadata

Metadata provide the information needed to locate, access, and correctly interpret a dataset

METADATA

datetime = Date and time at end of sampling period (YYYY-MM-DDThh:mm)
jd = Julian day (DDD)
airt = Air temperature. Average of 1-second measurements. (celsius)
rh = Relative humidity. Average of 1-second measurements. (percent)
dewp = Dew point. Average of 1-second values calculated from air temperature and relative humidity. (celsius)
prec = Precipitation. Includes water equivalent of snow. Total value for 15-minute period. Measured in increments of 0.01 inch. (millimeter)

DATA

datetime,jd,airt,rh,dewp,prec
2005-01-01T00:15,1,5.1,84,2.5,0.0
2005-01-01T00:30,1,5.0,84,2.5,0.0
2005-01-01T00:45,1,4.9,85,2.6,0.0
2005-01-01T01:00,1,4.7,86,2.6,0.0

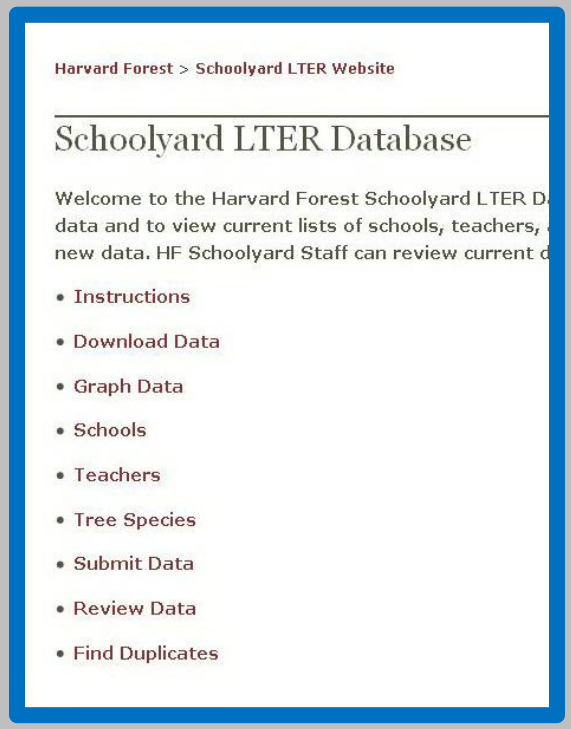
Schoolyard LTER Database

id	school_code	teacher_lastname	date	tree_id	species_code	leaves_total
1	AHE	Rosenthal	2010-09-14	1	SH	18
2	AHE	Rosenthal	2010-09-14	2	SA	12
3	AHE	Rosenthal	2010-09-14	3	RM	12
4	AHE	Rosenthal	2010-09-14	4	BC	12
5	AHE	Rosenthal	2010-09-14	5	GB	12
6	AHE	Rosenthal	2010-09-14	6	WB	18
7	AHE	Rosenthal	2010-09-14	7	WO	12
8	AHE	Rosenthal	2010-09-14	8	RO	12
9	AHE	Rosenthal	2010-09-14	9	BB	12
10	AHE	Rosenthal	2010-09-14	10	SA	18
11	AHE	Rosenthal	2010-09-14	11	WB	12
12	AHE	Rosenthal	2010-09-14	12	RM	12
13	AHE	Rosenthal	2010-09-21	1	SH	18
14	AHE	Rosenthal	2010-09-21	2	SA	12
15	AHE	Rosenthal	2010-09-21	3	RM	12
16	AHE	Rosenthal	2010-09-21	4	BC	12
17	AHE	Rosenthal	2010-09-21	5	GB	12
18	AHE	Rosenthal	2010-09-21	6	WB	18
19	AHE	Rosenthal	2010-09-21	7	WO	12
20	AHE	Rosenthal	2010-09-21	8	RO	12
21	AHE	Rosenthal	2010-09-21	9	BB	12
22	AHE	Rosenthal	2010-09-21	10	SA	18
23	AHE	Rosenthal	2010-09-21	11	WB	12
24	AHE	Rosenthal	2010-09-21	12	RM	12
25	AHE	Rosenthal	2010-09-29	1	SH	18
26	AHE	Rosenthal	2010-09-29	2	SA	12
27	AHE	Rosenthal	2010-09-29	3	RM	12
28	AHE	Rosenthal	2010-09-29	4	BC	12
29	AHE	Rosenthal	2010-09-29	5	GB	12
30	AHE	Rosenthal	2010-09-29	6	WB	18
31	AHE	Rosenthal	2010-09-29	7	WO	12
32	AHE	Rosenthal	2010-09-29	8	RO	12
33	AHE	Rosenthal	2010-09-29	9	BB	12
34	AHE	Rosenthal	2010-09-29	10	SA	18
35	AHE	Rosenthal	2010-09-29	11	WB	12
36	AHE	Rosenthal	2010-09-29	12	RM	12
37	AHE	Rosenthal	2010-10-05	1	SH	18

Programs

Data (PHP)

Graphs (R)



Back End
Database on HF Server
(MySQL)

Front End
Web page in your browser
(Firefox, etc)

Data Entry

RECOMMENDATIONS

- If you have more than one email address, pick one address to use as your login
- Check your data in the online form and again in Review Submissions
- Read the Instructions section

Harvard Forest > Schoolyard LTER Database

Schoolyard LTER Database

Edit Submission # 7770

Return to list of submissions

>>>>

Site Code	AHE-buds-001
Teacher Last Name	Rosenthal
Date (m/d/yyyy)	9/28/2016
Tree ID (number)	2
Species Code	SA (Sassafras)
Total Leaves	18
Fallen Leaves	0
Tree Color	1 (color 0-25%)
Delete This Record	no yes

Submit

Edit	Person ID	Site	Teacher	Date	Tree ID	Species Code	Total Leaves	Fallen Leaves	Tree Color
7770	9654	AHE-buds-001	Rosenthal	9/28/2016	2	SA	18	0	1
7775	9654	AHE-buds-001	Rosenthal	9/28/2016	13	RM	12	0	1
7781	9654	AHE-buds-001	Rosenthal	9/28/2016	14	RO	12	0	1
7771	9654	AHE-buds-001	Rosenthal	10/7/2016	2	SA	18	0	1
7776	9654	AHE-buds-001	Rosenthal	10/7/2016	13	RM	12	0	1
7782	9654	AHE-buds-001	Rosenthal	10/7/2016	14	RO	12	0	1
7772	9654	AHE-buds-001	Rosenthal	10/14/2016	2	SA	18	0	2
7777	9654	AHE-buds-001	Rosenthal	10/14/2016	13	RM	12	0	1
7783	9654	AHE-buds-001	Rosenthal	10/14/2016	14	RO	12	0	1
7773	9654	AHE-buds-001	Rosenthal	10/19/2016	2	SA	18	0	4
7778	9654	AHE-buds-001	Rosenthal	10/19/2016	13	RM	12	0	3
7784	9654	AHE-buds-001	Rosenthal	10/19/2016	14	RO	12	0	1
7774	9654	AHE-buds-001	Rosenthal	11/2/2016	2	SA	18	18	4
7779	9654	AHE-buds-001	Rosenthal	11/2/2016	13	RM	12	11	4
7785	9654	AHE-buds-001	Rosenthal	11/2/2016	14	RO	12	1	2
7780	9654	AHE-buds-001	Rosenthal	11/10/2016	13	RM	12	12	4
7786	9654	AHE-buds-001	Rosenthal	11/10/2016	14	RO	12	12	4

Missing Values

source: sendaiben.org

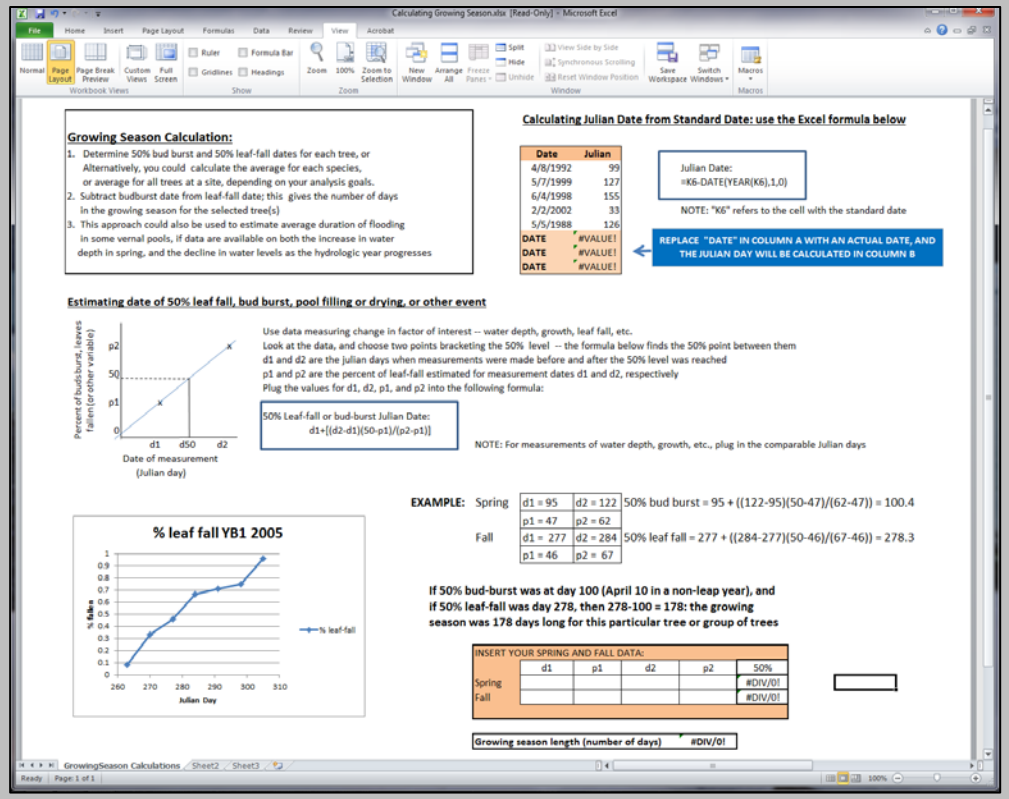
PROBLEMS

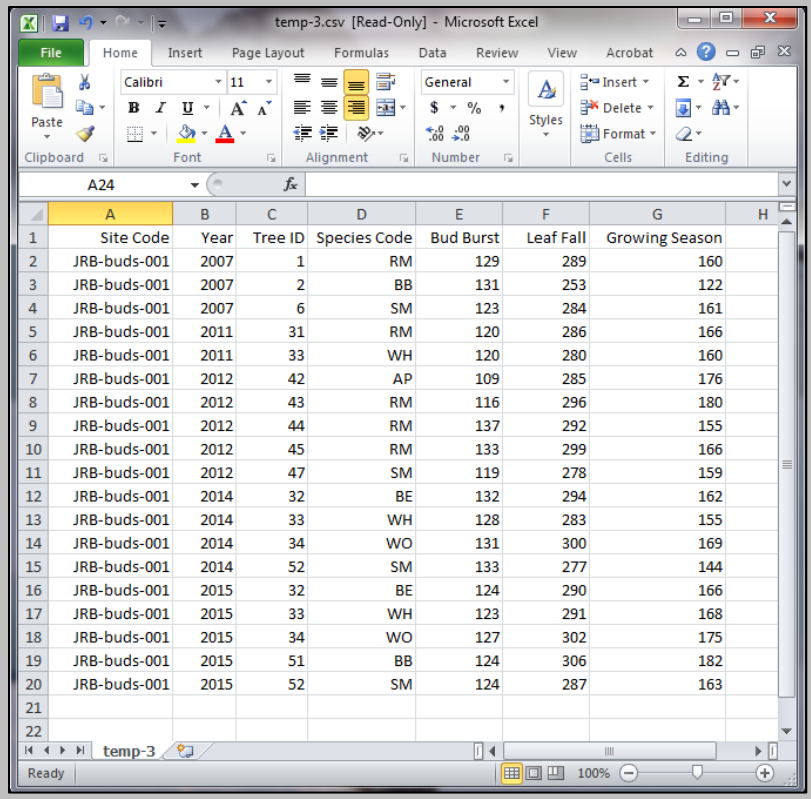
- Different software packages handle missing values differently
- Never use zero! Zero could be a measured value (0 degrees) or a code (0 = dead)

SCHOOLYARD DATABASE

- When entering data, leave text box empty or select “Missing Data” from pull-down list
- When data are downloaded, missing values are represented by NA
- Missing value code in Excel is #N/A

Calculating Growing Season





Teacher Resources / Data Analysis

Colburn, E. 2014. Calculating Growing Season Active Worksheet

Schoolyard LTER Database / Download Data

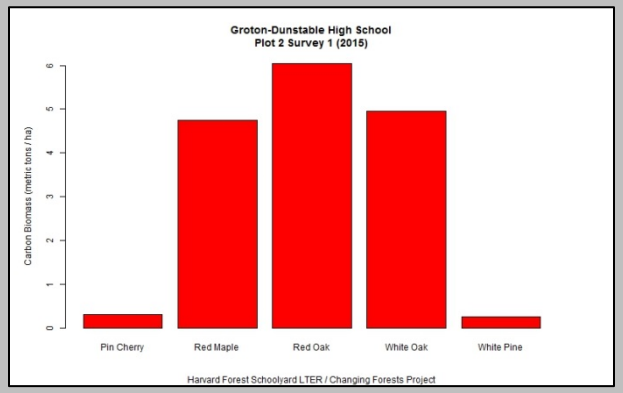
Length of growing season

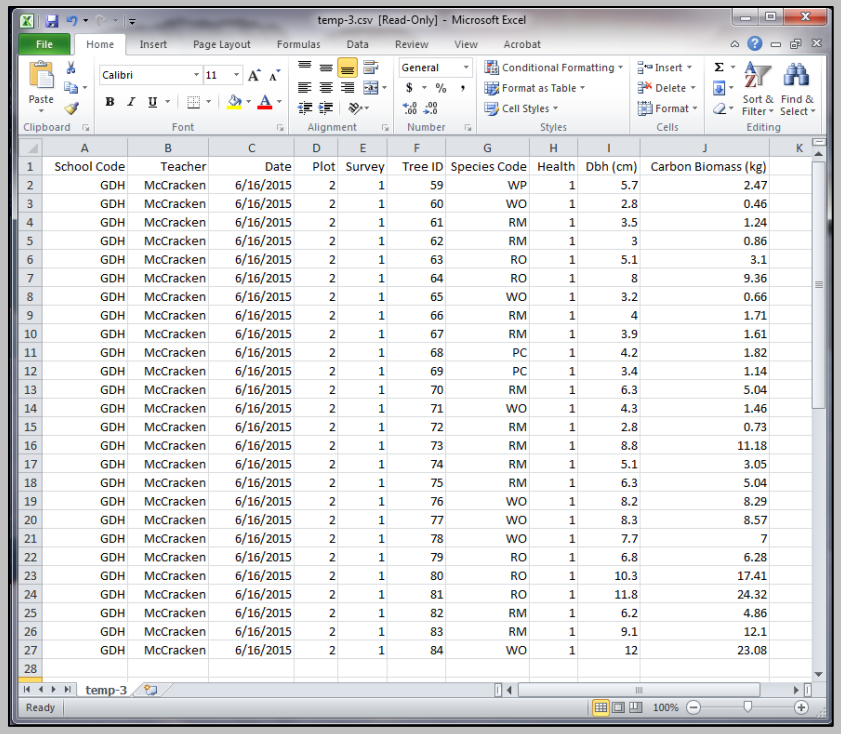
Calculating Carbon Biomass

Schoolyard LTER Database
Tree Biomass Equations
13-Nov-2013

Units: biomass = kilograms, dbh = centimeters
Biomass (metric tons) = biomass (kilograms)/1000
Carbon biomass = 0.5 * biomass
Default = red maple if biomass equation not available

Acer pensylvanicum (ST)	biomass = (exp(7.227+1.6478*log(dbh/2.54)))/1000
Acer rubrum (RM)	biomass = 0.1262*(dbh^2.3804)
Acer saccharum (SM)	biomass = 0.1008*(dbh^2.5735)
Betula alleghaniensis (YB)	biomass = 0.1684*(dbh^2.4150)
Betula lenta (BB)	biomass = 0.0629*(dbh^2.6606)
Betula papyrifera (WB)	biomass = 0.0612*(dbh^1.6287)
Betula populifolia (GB)	biomass = 0.1564*(dbh^2.3146)
Betula spp. (RB)	biomass = 0.0629*(dbh^2.6606)
Castanea dentate (CH)	biomass = 2.204*(exp(0.95595+2.4264*log(dbh/2.54)))
Fagus grandifolia (BE)	biomass = 0.1967*(dbh^2.3916)
Fraxinus Americana (WA)	biomass = (exp(7.1148+1.3707*log(dbh/2.54)))/1000
Nyssa sylvatica (BG)	biomass = (10^(1.1468+1.4806*log10(dbh^2)))/1000
Pinus resinosa (RP)	biomass = 0.1003*(dbh^2.3865)
Picea rubens (RS)	biomass = (10^(2.1735+2.1936*log10(dbh)))/1000
Picea spp. (BS, NS, WS)	biomass = (10^(2.1735+2.1936*log10(dbh)))/1000
Pinus strobus (WP)	biomass = 0.0696*(dbh^2.4490)
Populus grandidentata (LA)	biomass = 0.0785*(dbh^2.4981)
Populus tremuloides (TA)	biomass = 0.0637*(dbh^2.6087)
Populus spp. (CW)	biomass = 0.0785*(dbh^2.4981)
Prunus pensylvanica (PC)	biomass = 0.1556*(dbh^2.1948)
Prumus serotina (BC)	biomass = 0.0716*(dbh^2.6174)
Quercus alba (WO)	biomass = 0.0579*(dbh^2.6887)
Quercus rubrum (RO)	biomass = 0.1130*(dbh^2.4572)
Tsuga Canadensis (TS)	biomass = 0.0991*(dbh^2.3617)



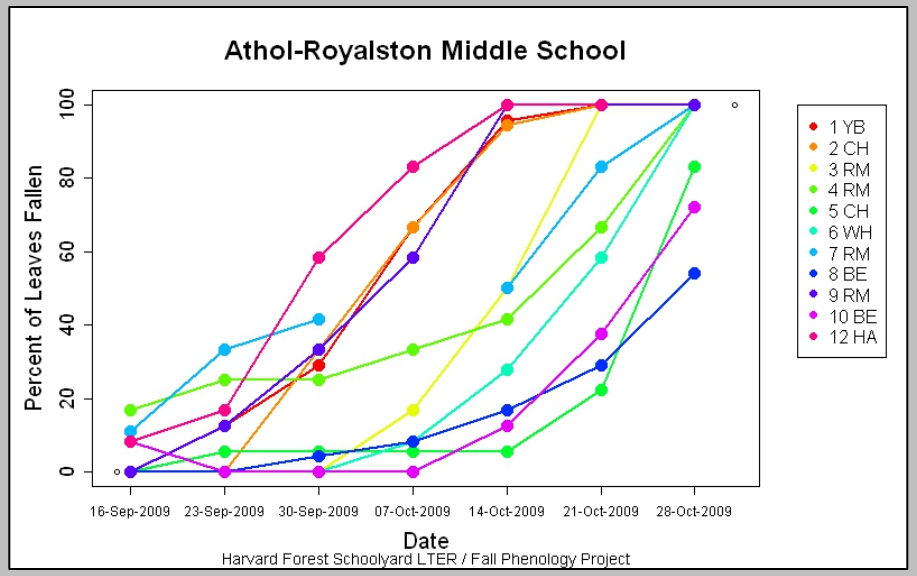


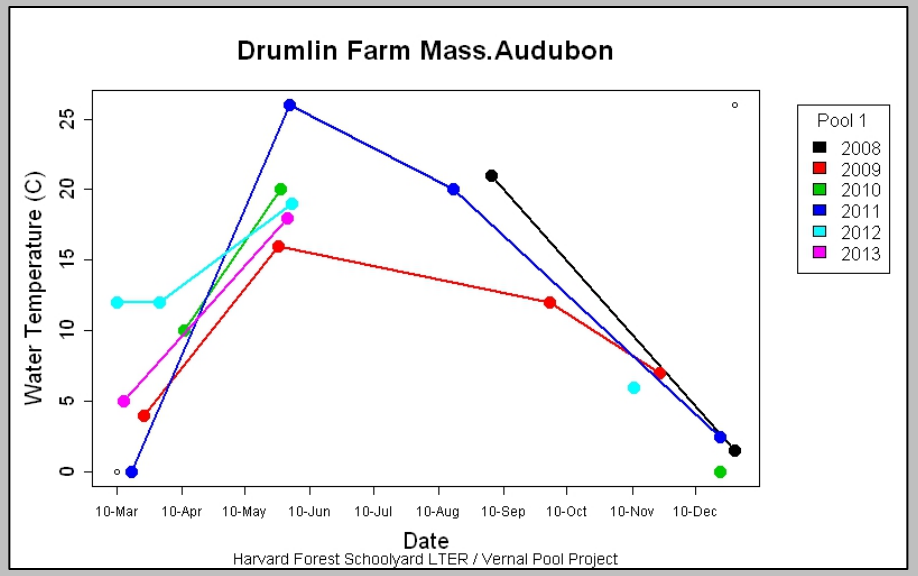
	A	B	C	D	E	F	G	H	I	J	K
1	School Code	Teacher	Date	Plot	Survey	Tree ID	Species Code	Health	Dbh (cm)	Carbon Biomass (kg)	
2	GDH	McCracken	6/16/2015	2	1	59	WP	1	5.7	2.47	
3	GDH	McCracken	6/16/2015	2	1	60	WO	1	2.8	0.46	
4	GDH	McCracken	6/16/2015	2	1	61	RM	1	3.5	1.24	
5	GDH	McCracken	6/16/2015	2	1	62	RM	1	3	0.86	
6	GDH	McCracken	6/16/2015	2	1	63	RO	1	5.1	3.1	
7	GDH	McCracken	6/16/2015	2	1	64	RO	1	8	9.36	
8	GDH	McCracken	6/16/2015	2	1	65	WO	1	3.2	0.66	
9	GDH	McCracken	6/16/2015	2	1	66	RM	1	4	1.71	
10	GDH	McCracken	6/16/2015	2	1	67	RM	1	3.9	1.61	
11	GDH	McCracken	6/16/2015	2	1	68	PC	1	4.2	1.82	
12	GDH	McCracken	6/16/2015	2	1	69	PC	1	3.4	1.14	
13	GDH	McCracken	6/16/2015	2	1	70	RM	1	6.3	5.04	
14	GDH	McCracken	6/16/2015	2	1	71	WO	1	4.3	1.46	
15	GDH	McCracken	6/16/2015	2	1	72	RM	1	2.8	0.73	
16	GDH	McCracken	6/16/2015	2	1	73	RM	1	8.8	11.18	
17	GDH	McCracken	6/16/2015	2	1	74	RM	1	5.1	3.05	
18	GDH	McCracken	6/16/2015	2	1	75	RM	1	6.3	5.04	
19	GDH	McCracken	6/16/2015	2	1	76	WO	1	8.2	8.29	
20	GDH	McCracken	6/16/2015	2	1	77	WO	1	8.3	8.57	
21	GDH	McCracken	6/16/2015	2	1	78	WO	1	7.7	7	
22	GDH	McCracken	6/16/2015	2	1	79	RO	1	6.8	6.28	
23	GDH	McCracken	6/16/2015	2	1	80	RO	1	10.3	17.41	
24	GDH	McCracken	6/16/2015	2	1	81	RO	1	11.8	24.32	
25	GDH	McCracken	6/16/2015	2	1	82	RM	1	6.2	4.86	
26	GDH	McCracken	6/16/2015	2	1	83	RM	1	9.1	12.1	
27	GDH	McCracken	6/16/2015	2	1	84	WO	1	12	23.08	
28											

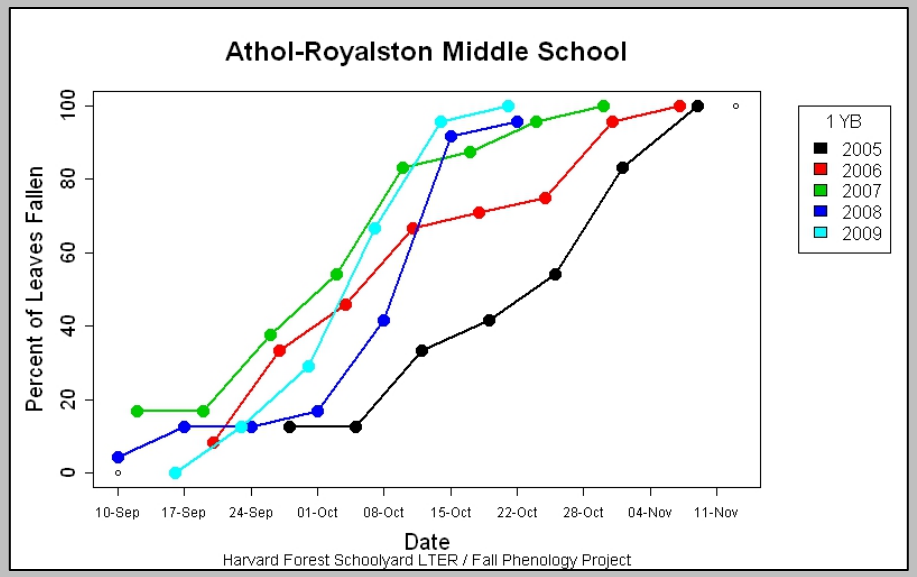
Changing Forests / Resources / Tree Biomass Equations

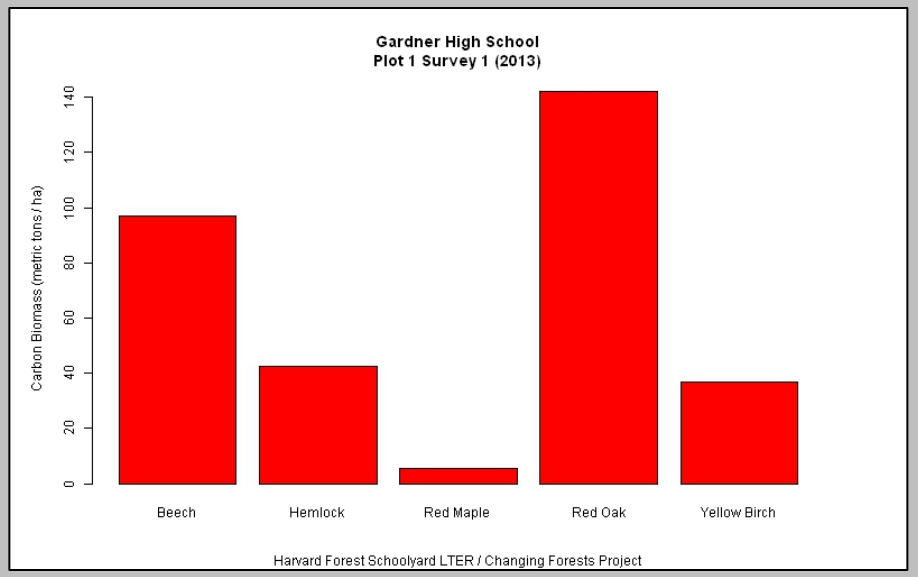
Schoolyard LTER Database / Download Data / Carbon Biomass

Online Graphing

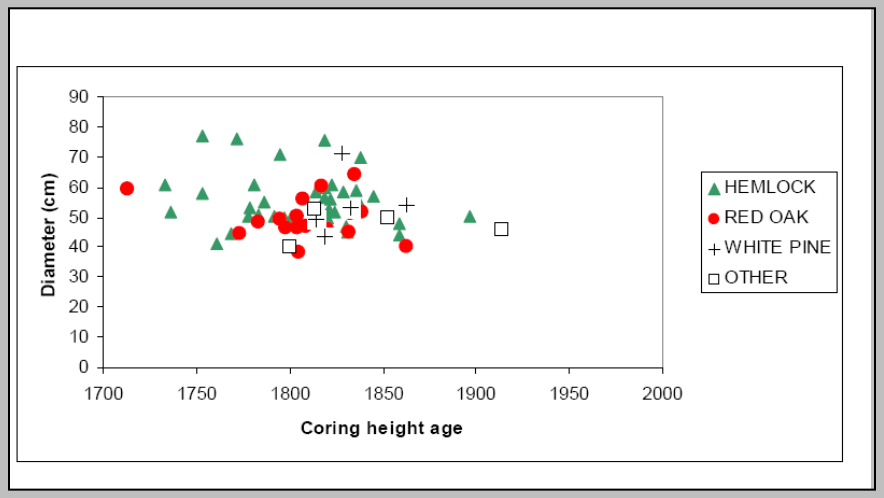


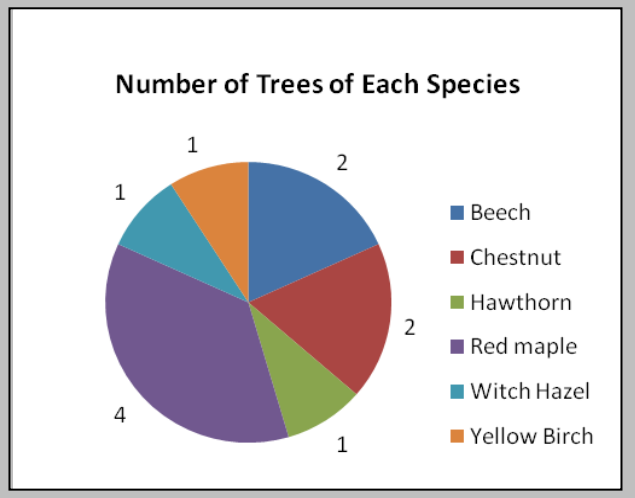


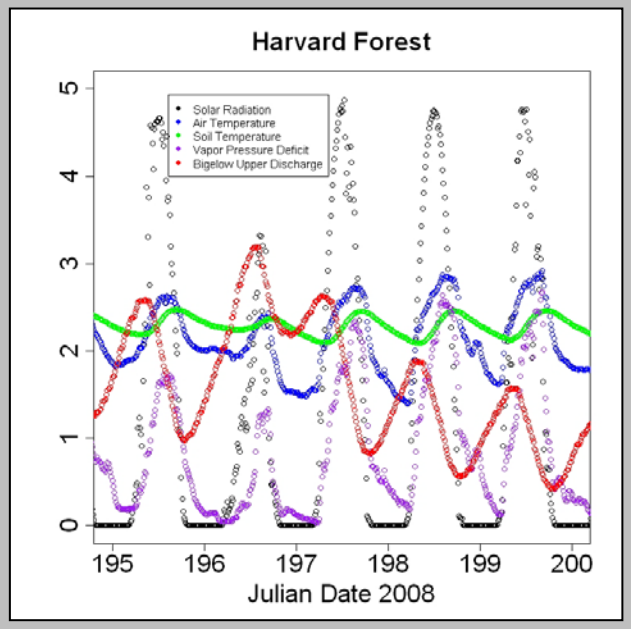


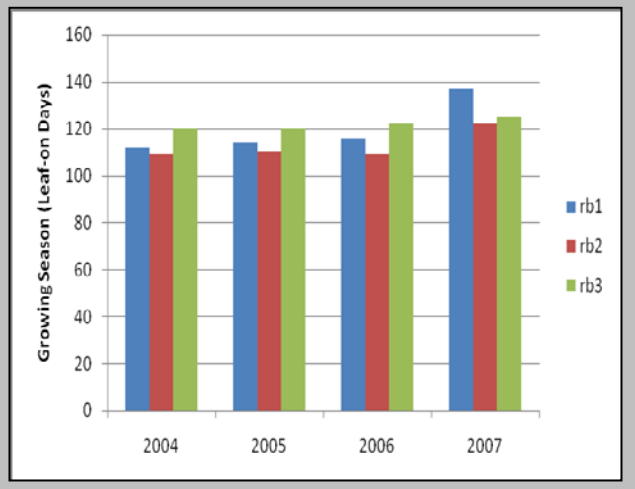


Data Visualization









Graphs from Colburn, Orwig & Boose