Comparing Weekly Irrigation to Rain Sensor Performance

Charles Swanson, M.Agr.

Extension Program Specialist II –Landscape Irrigation
TCEQ Licensed Irrigator #16931

Irrigation Technology Program

Texas A&M AgriLife Extension Service

Biological and Agricultural Engineering Unit
College Station, TX 77843-2117

Rain Sensors in Texas

* Also referred to as Rain Shutoff Devices
* 2009 State of Texas started requiring rain or moisture shutoff devices on all new automatically controlled irrigation systems
  * Majority of irrigation professionals use rain shutoff devices
* Many irrigation professionals (and homeowners) do not really understand how a rain sensor works
  * Many Question their use in irrigation scheduling

Questions about Rain Sensors

* How do Rain Sensors Operate?
  * How long will they prevent operation of the controller?
* How does Rain Sensor Performance effect weekly irrigation scheduling?
  * Should irrigation professionals create irrigation schedules that assume (average) rainfall?

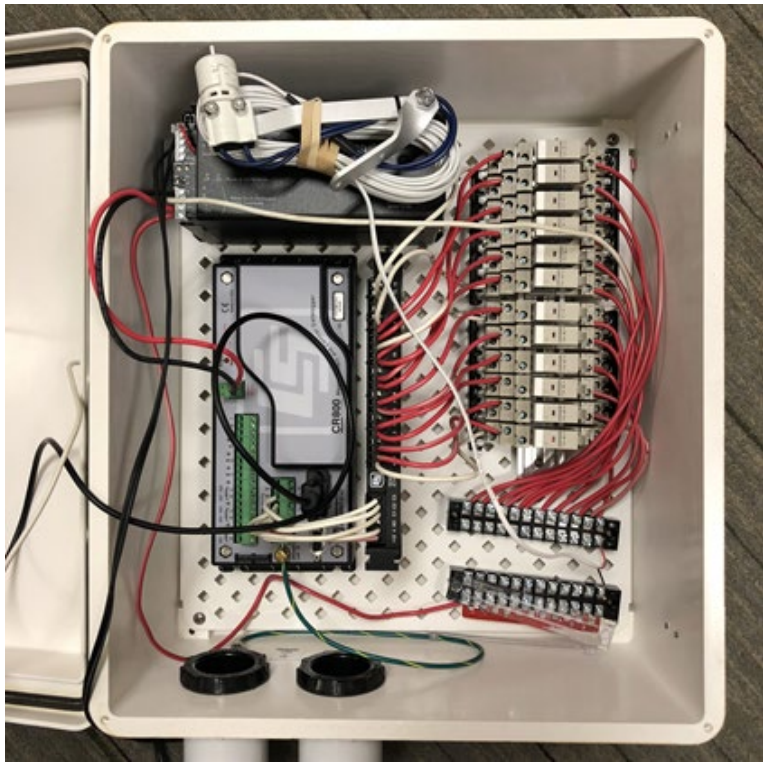
Rain Sensor Study

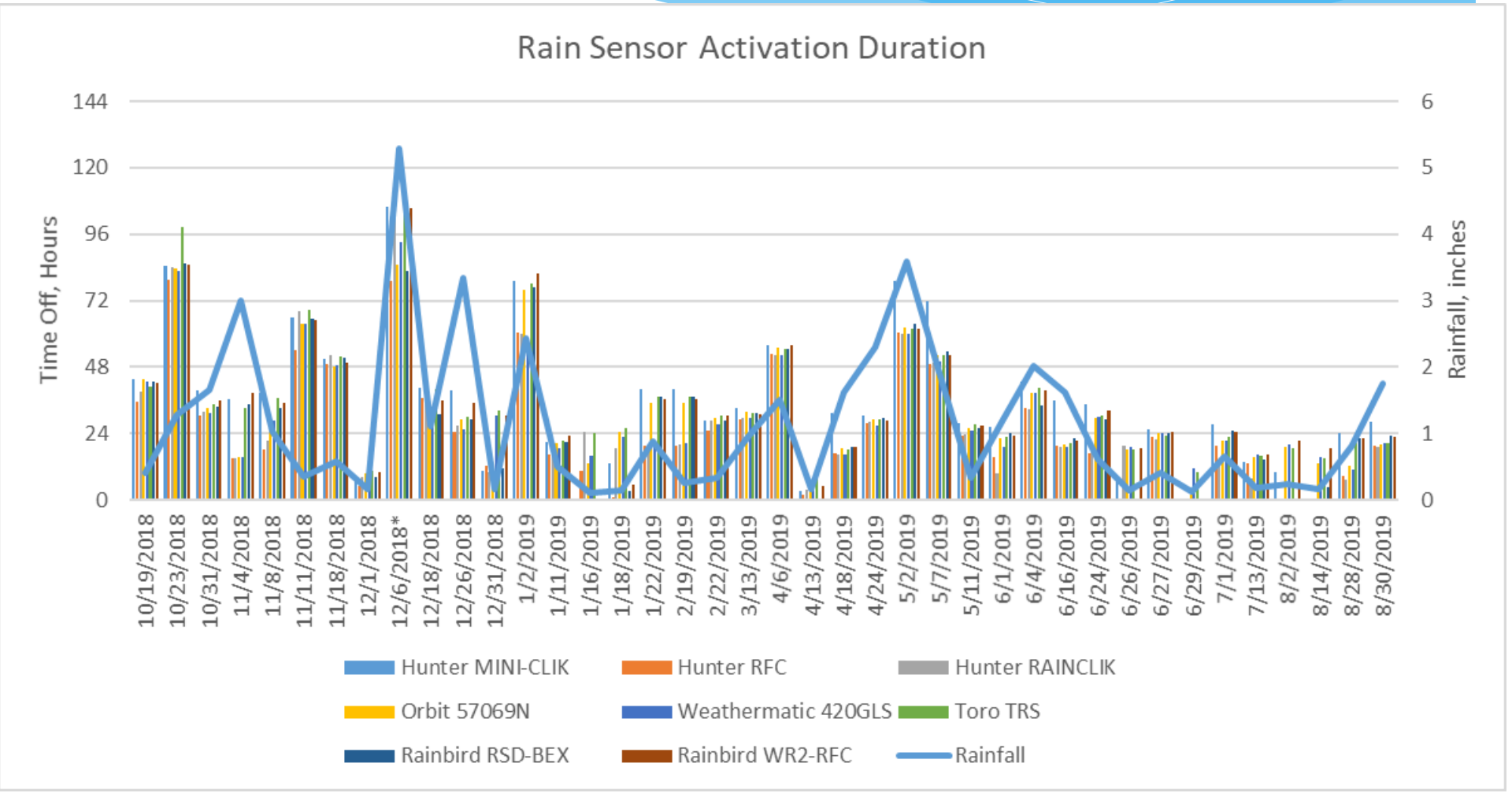
Rain Sensors

* Hunter
  * Mini-Click
  * RFC*
  * RainClick
* Orbit 57069N
* Weathermatic 420GLS
* Toro TRS
* Rainbird
  * RSD-BEX
  * WR2-RFC*

Study Period

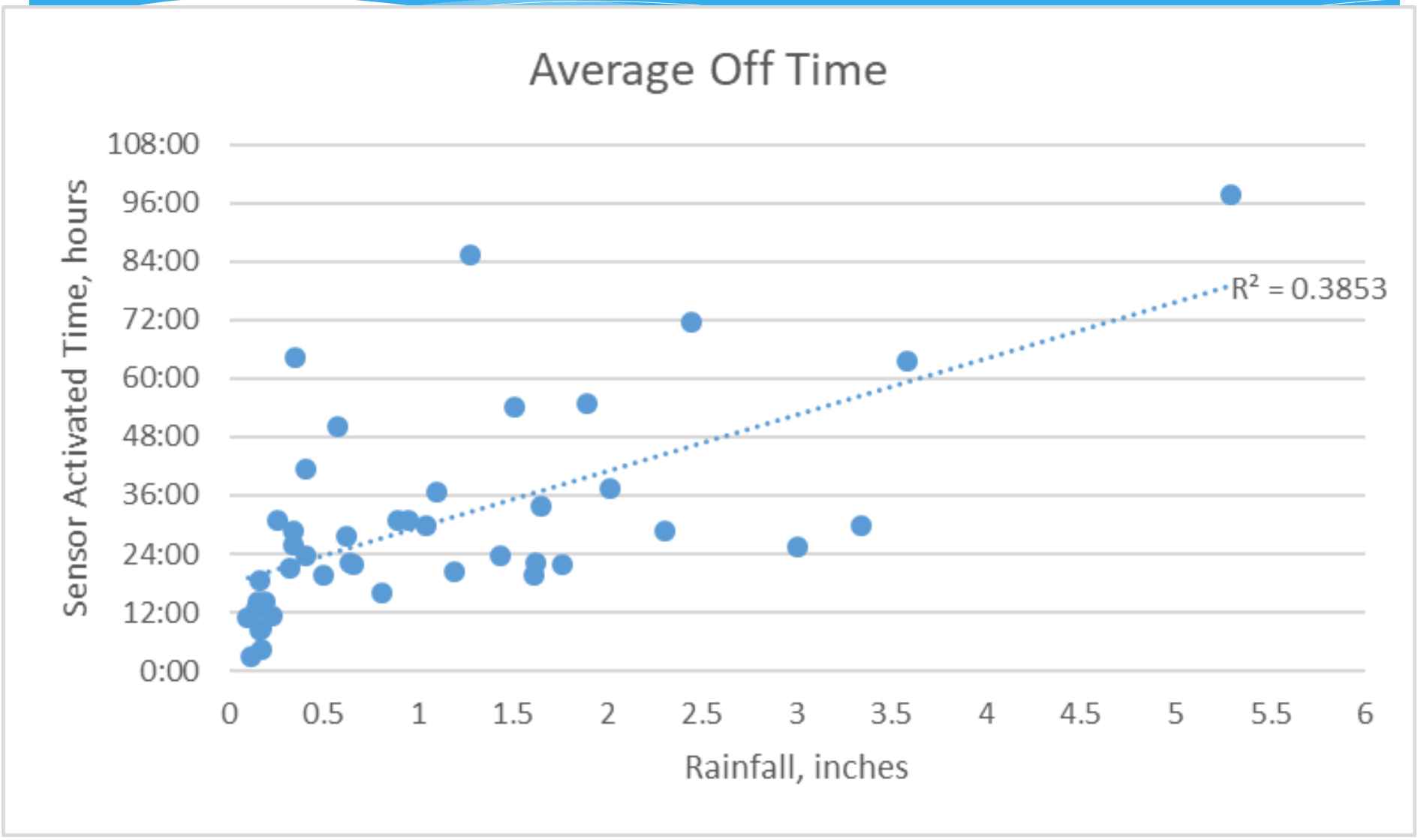
* Sensors installed October 2018
* Datalogger recorded timestamp when sensor triggered and “resumed irrigation”
* Sensors installed for minimum threshold, (1/8”)
* To Date (9/30/19)
  * 43 Rain Sensor Triggering Events
  * Total Rainfall: 47.79 inches

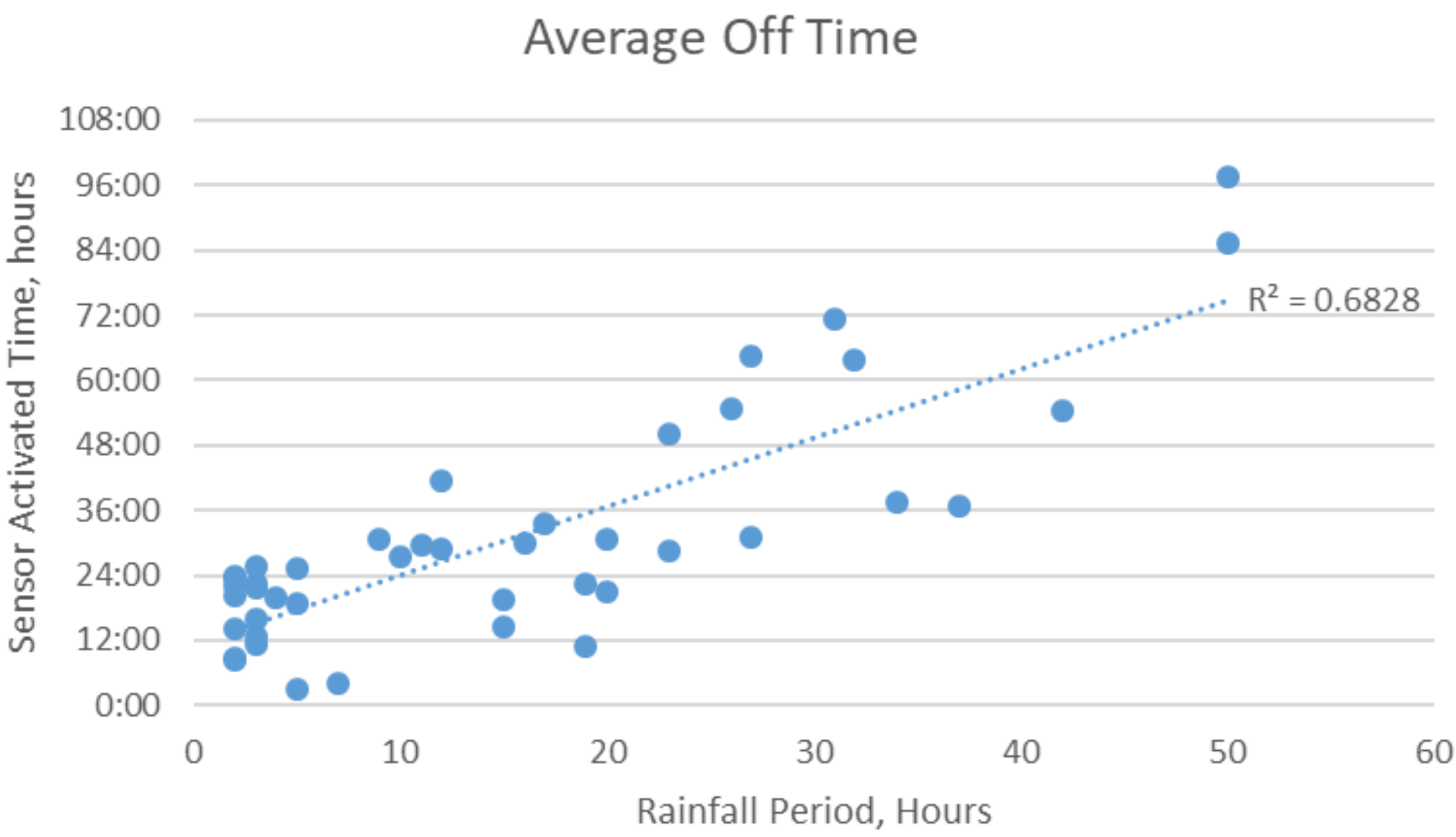


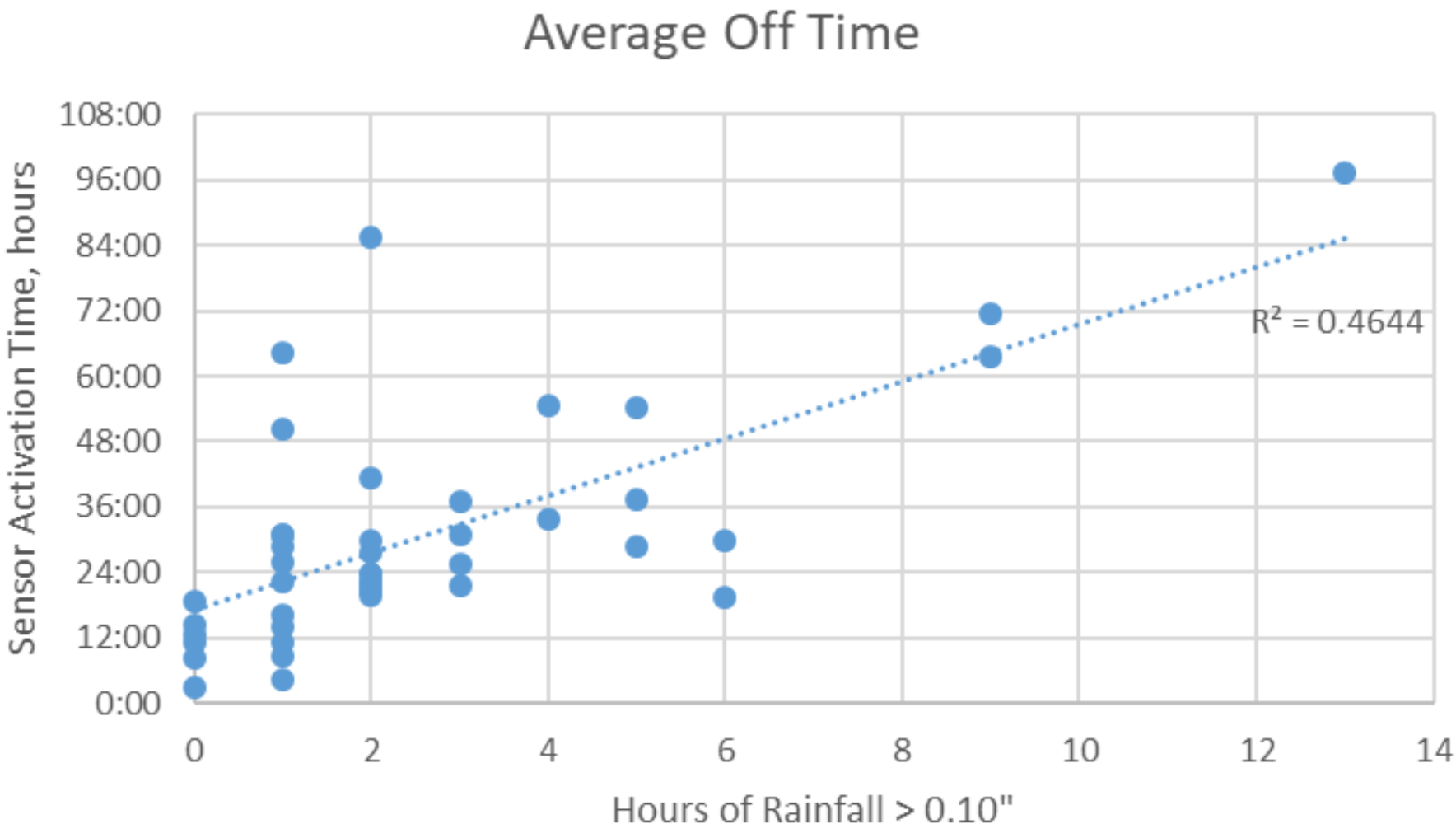

Rain Sensor Activation Duration
Time Off, Hours
Rainfall, inches
144
120
96
72
48
24
0
6
5
4
3
2
1
0
10/19/2018
10/23/2018
10/31/2018
11/4/2018
11/8/2018
11/11/2018
11/18/2018
12/1/2018
12/6/2018*
12/18/2018
12/26/2018
12/31/2018
1/2/2019
1/11/2019
1/16/2019
1/18/2019
1/22/2019
2/19/2019
2/22/2019
3/13/2019
4/6/2019
4/13/2019
4/18/2019
4/24/2019
5/2/2019
5/7/2019
5/11/2019
6/1/2019
6/4/2019
6/16/2019
6/24/2019
6/26/2019
6/27/2019
6/29/2019
7/1/2019
7/13/2019
8/2/2019
8/14/2019
8/28/2019
8/30/2019
Hunter MINI-CLIK
Hunter RFC
Hunter RAINCLIK
Orbit 57069N
Weathermatic 420GLS
Toro TRS
Rainbird RSD-BEX
Rainbird WR2-RFC
Rainfall

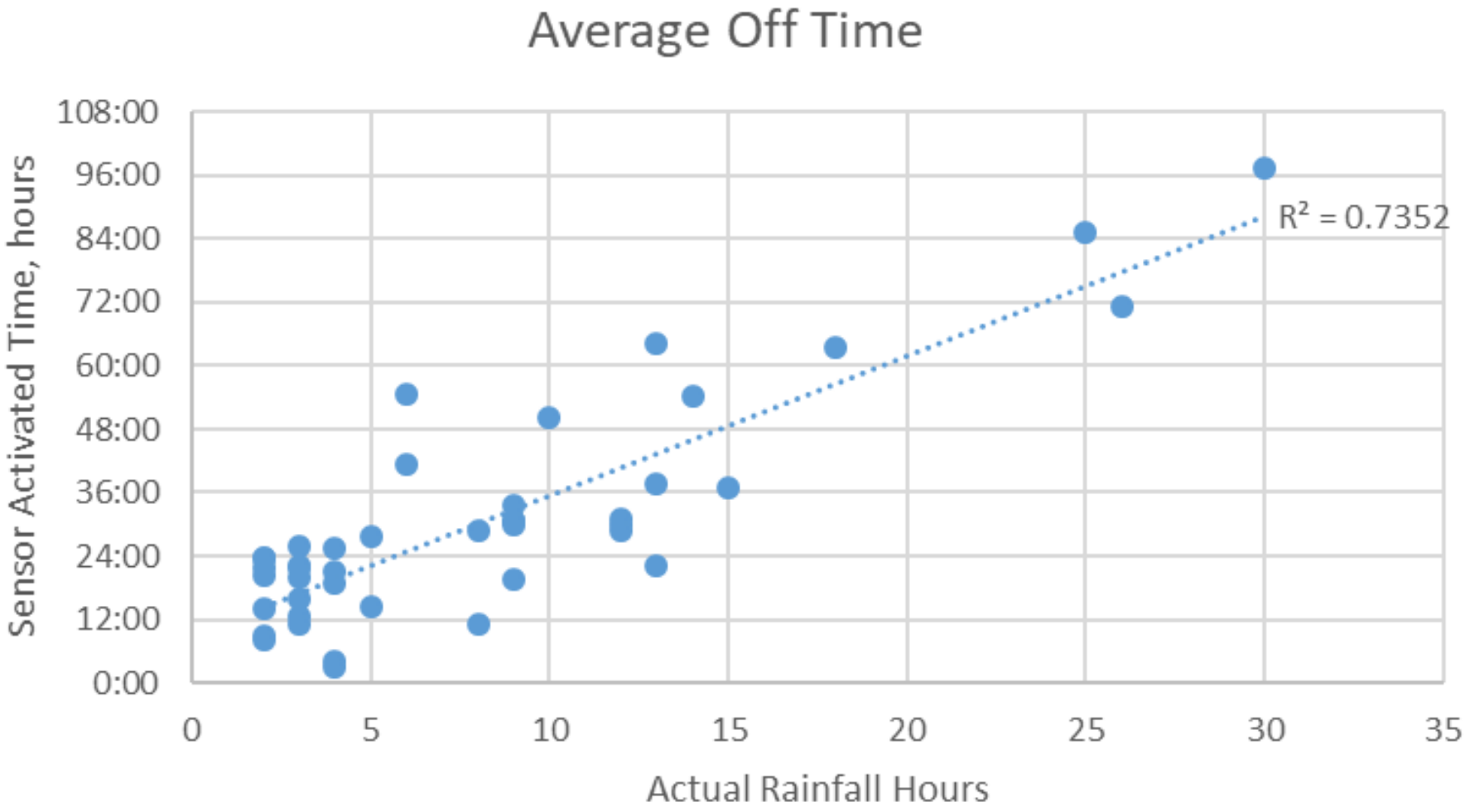
Analysis Breakdown

* What effects Sensors “off-time”??
  * Total Rainfall
  * Rainfall Period
    * Time from first rain to last rain recorded
  * Total Rain Time
    * Data logged hours that had rainfall (Actual Rain Time)
  * Rainfall Intensity
    * Average Total Rainfall / Total Rain Time


Average Off Time
Sensor Activated Time, hours
108:00
96:00
84:00
72:00
60:00
48:00
36:00
24:00
12:00
0:00
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Rainfall, inches
R² = 0.3853


Average Off Time
Sensor Activated Time, hours
108:00
96:00
84:00
72:00
60:00
48:00
36:00
24:00
12:00
0:00
0
10
20
30
40
50
60
Rainfall Period, Hours
R² = 0.6828


Average Off Time
Sensor Activation Time, hours
108:00
96:00
84:00
72:00
60:00
48:00
36:00
24:00
12:00
0:00
0
2
4
6
8
10
12
14
Hours of Rainfall > 0.10"
R² = 0.4644

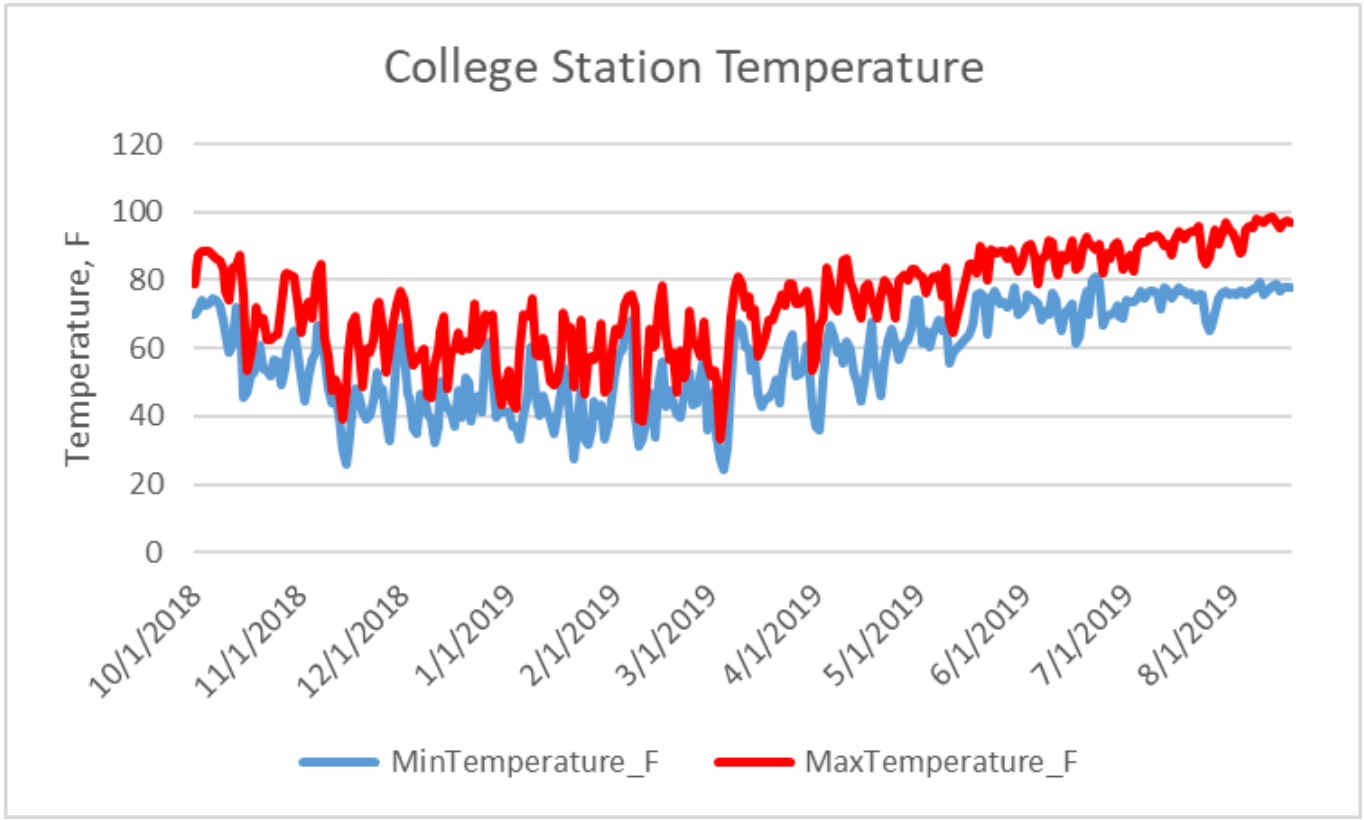

Average Off Time
Sensor Activated Time, hours
108:00
96:00
84:00
72:00
60:00
48:00
36:00
24:00
12:00
0:00
0
5
10
15
20
25
30
35
Actual Rainfall Hours
R² = 0.7352

Average Off Time Summary

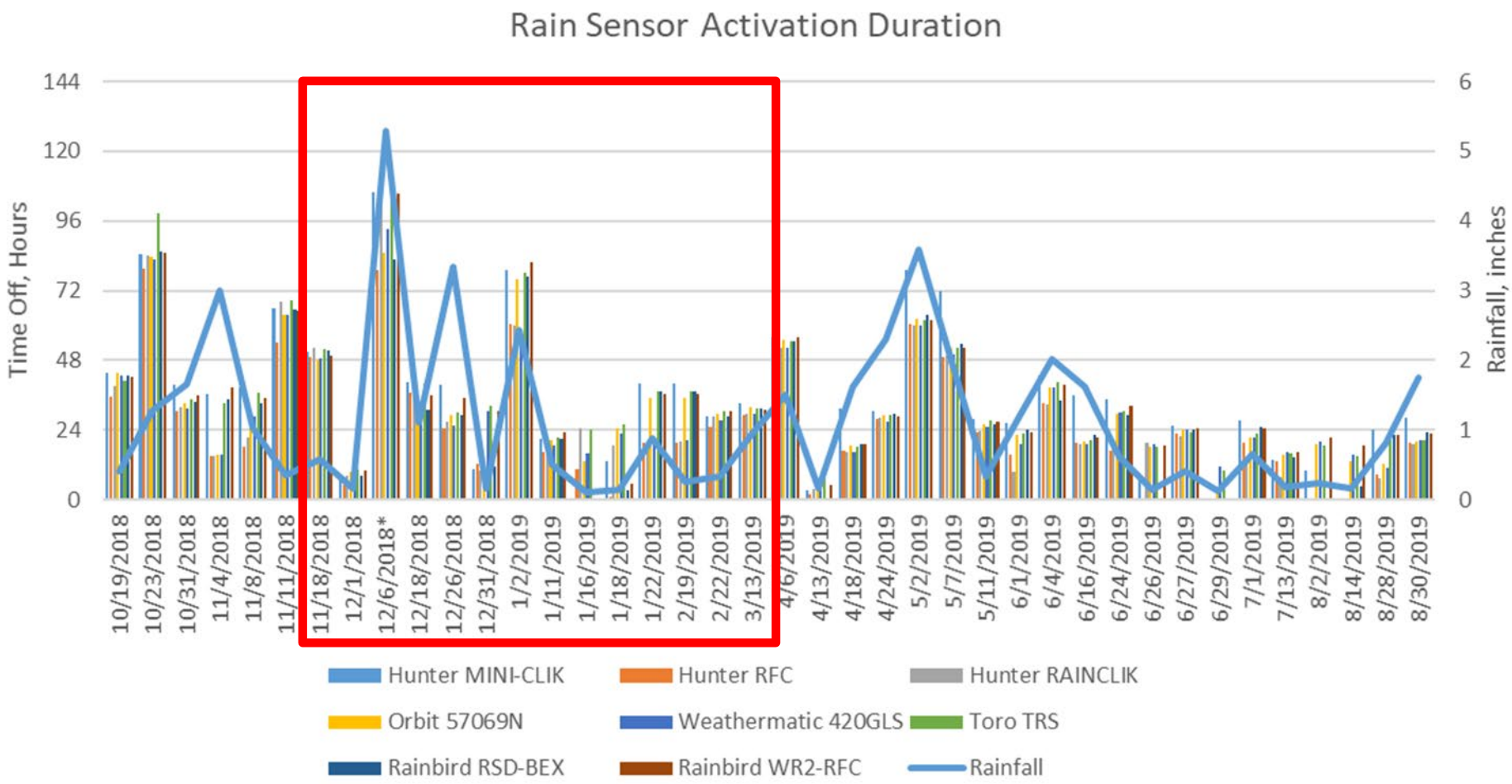
* On Average, “Actual Rainfall Time” had the strongest correlation to sensor triggered period
  * $R^2 = 0.7352$
* On Average, Total Rainfall had the weakest correlation to sensor triggered period
  * $R^2 = 0.3853$

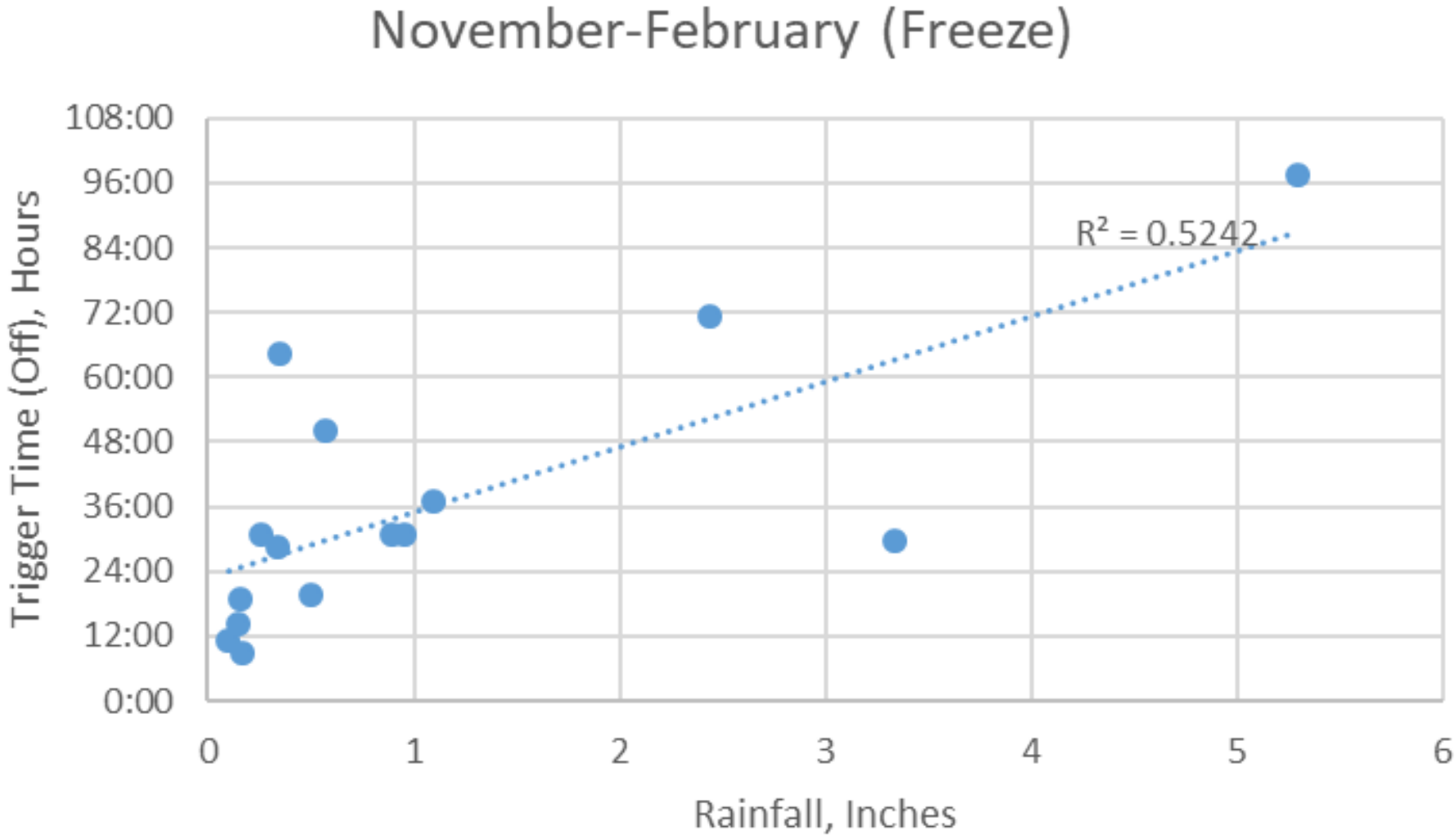
Freezing Effects

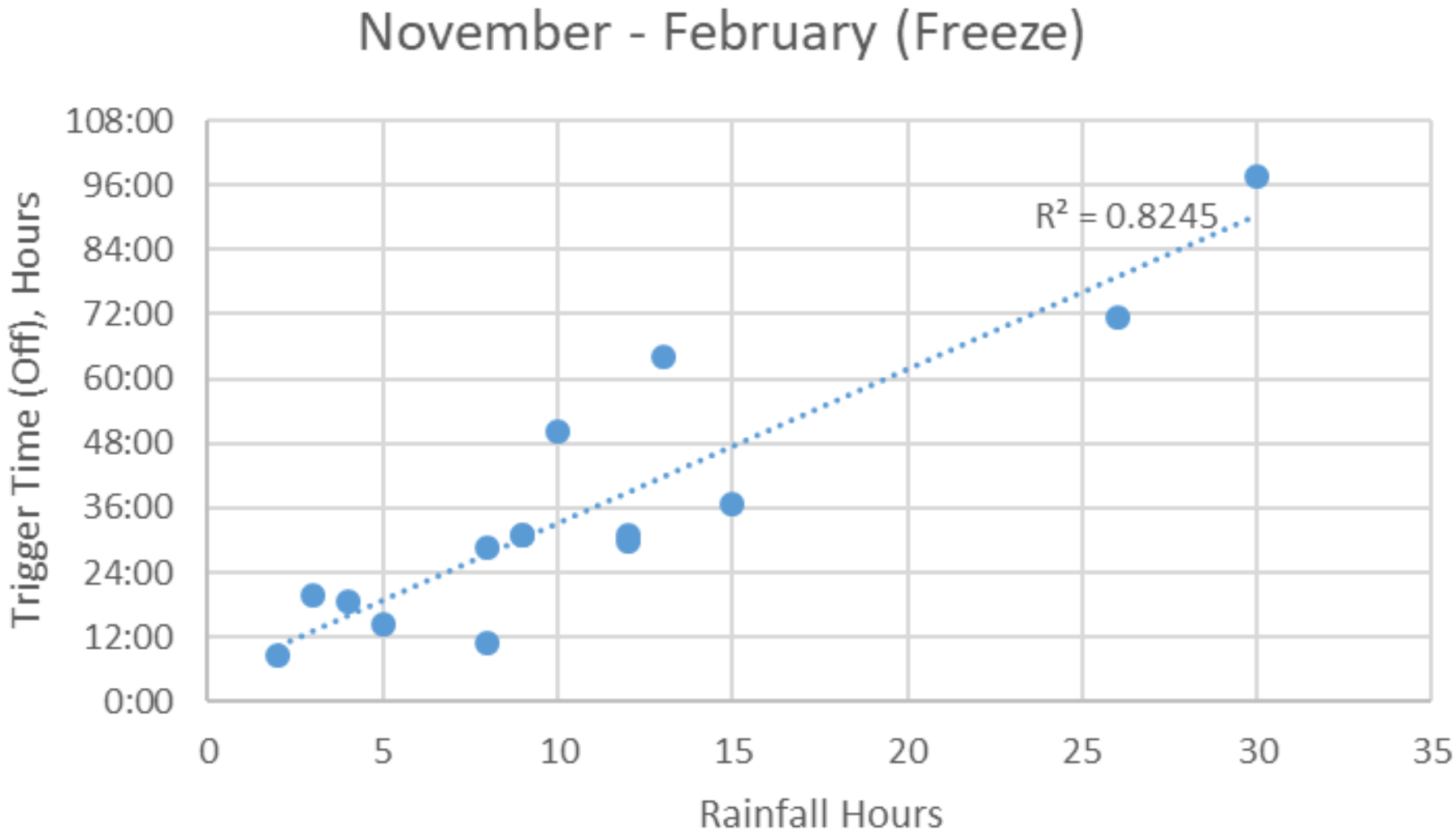
* Multiple Devices included Freeze Sensing
* Freeze Period: 11/12/19 - 3/6/19

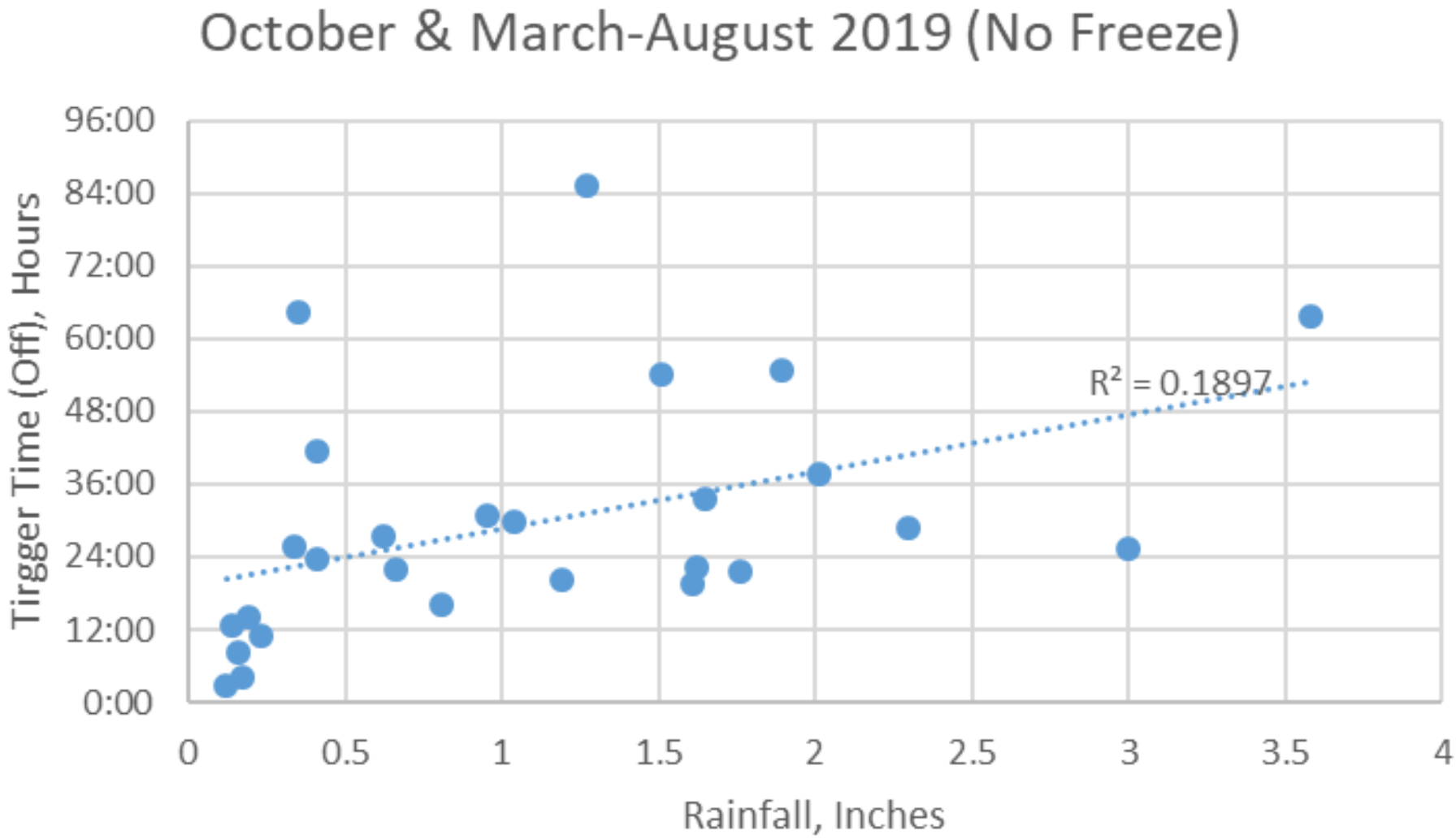


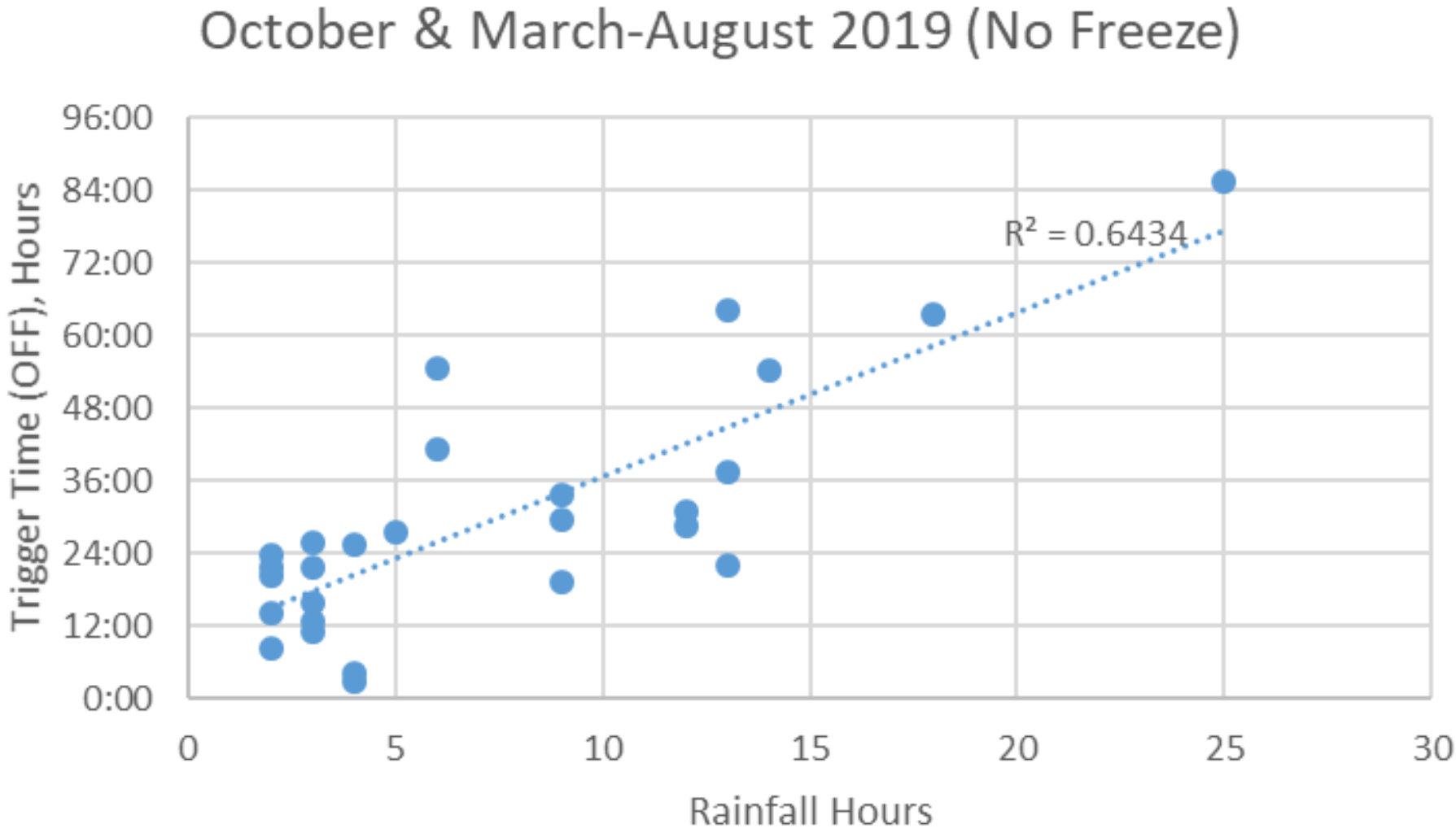
Freeze Range




November-February (Freeze)
Trigger Time (Off), Hours
108:00
96:00
84:00
72:00
60:00
48:00
36:00
24:00
12:00
0:00
0
1
2
3
4
5
6
Rainfall, Inches
R² = 0.5242


November - February (Freeze)
Trigger Time (Off), Hours
108:00
96:00
84:00
72:00
60:00
48:00
36:00
24:00
12:00
0:00
0
5
10
15
20
25
30
35
Rainfall Hours
R² = 0.8245


October & March-August 2019 (No Freeze)
Tirgger Time (Off), Hours
96:00
84:00
72:00
60:00
48:00
36:00
24:00
12:00
0:00
0
0.5
1
1.5
2
2.5
3
3.5
4
Rainfall, Inches
R² = 0.1897


October & March-August 2019 (No Freeze)
Trigger Time (OFF), Hours
96:00
84:00
72:00
60:00
48:00
36:00
24:00
12:00
0:00
0
5
10
15
20
25
30
Rainfall Hours
R² = 0.6434

Freeze Vs Non-Freezing Season Summary

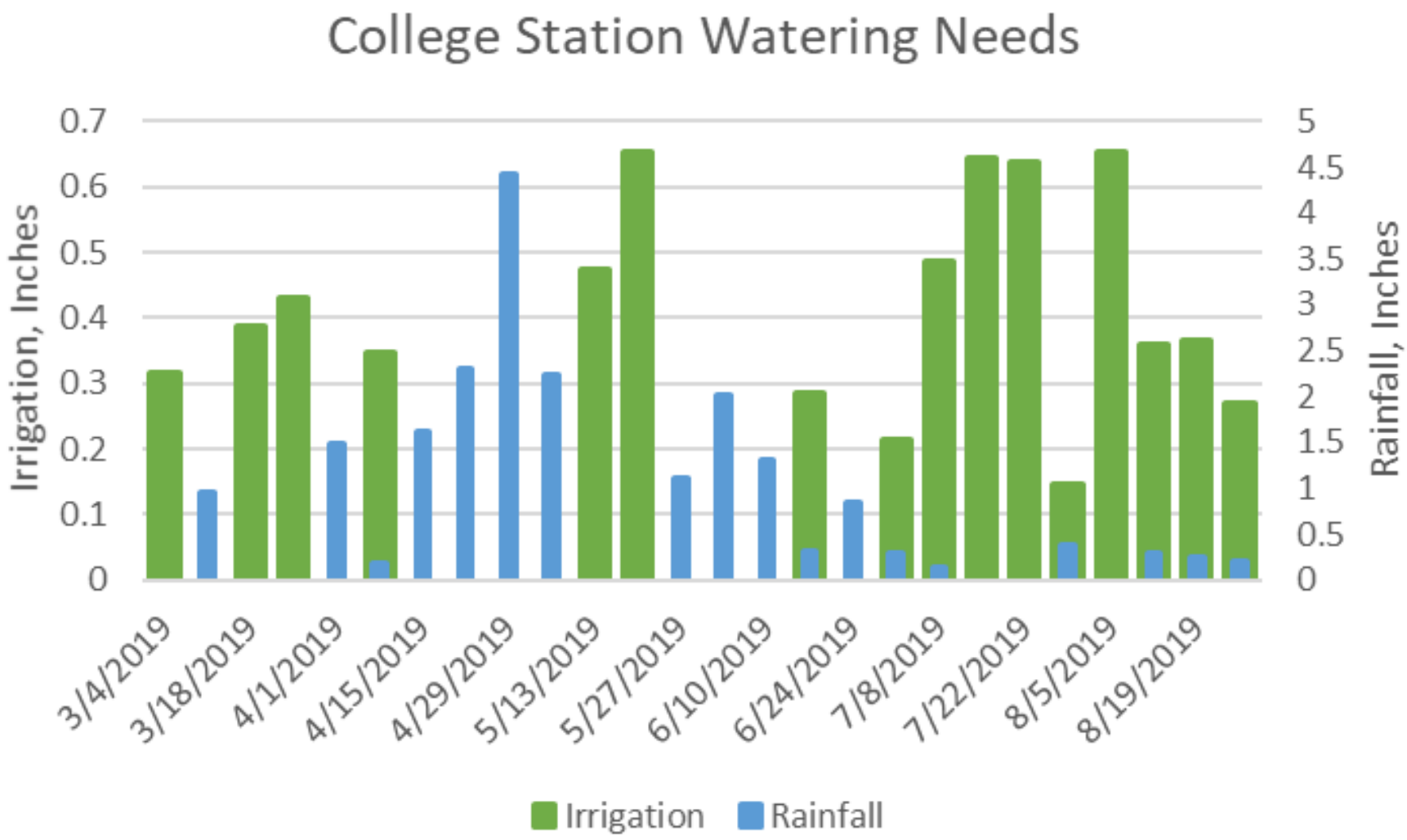
* When comparing the freezing to the non-freezing season, the rainfall time still showed the stronger correlation to off time, compared to total rainfall

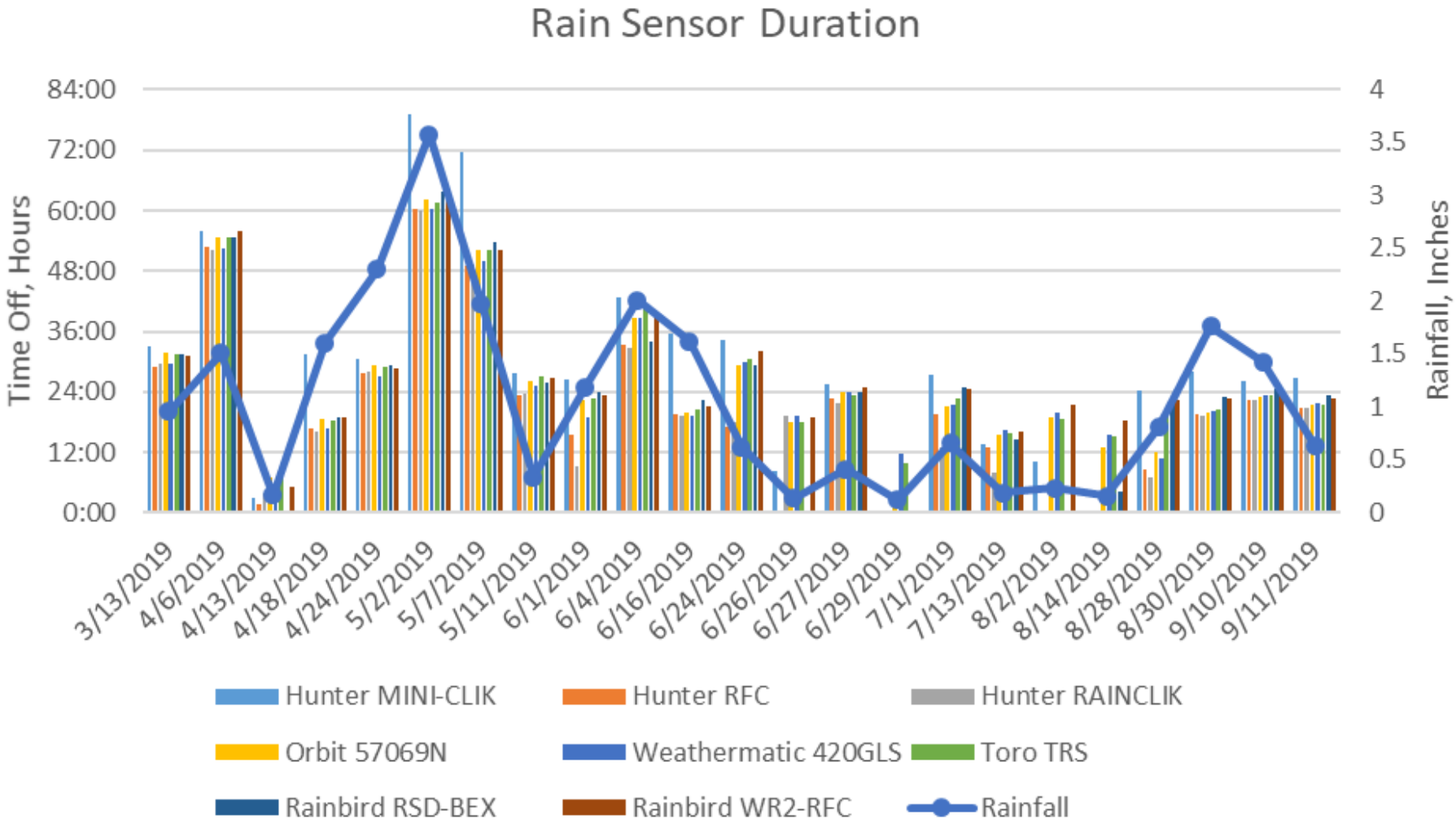
	Freeze	No Freeze
Total Rainfall, Inches	0.52	0.19
Rainfall Hours	0.82	0.64

* Normally would expect irrigation to be turned off during the freezing season…

Performance Effects on Scheduling

* Weekly irrigation needs were calculated for a neighborhood in College Station, Texas
  * March – August, 2019
  * 26 Weeks
* Calculations showed that no irrigation was needed for at least 10 weeks due to rainfall
  * Greater than 0.96” of rain per week
* The average sensor performance was compared to the irrigation schedules of 8 random irrigation systems in a single neighborhood
  * Focus on the 10 Rainfall Weeks


College Station Watering Needs
Irrigation, Inches
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Rainfall, Inches
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3/4/2019
3/18/2019
4/1/2019
4/15/2019
4/29/2019
5/13/2019
5/27/2019
6/10/2019
6/24/2019
7/8/2019
7/22/2019
8/5/2019
8/19/2019
Irrigation
Rainfall


Rain Sensor Duration
Time Off, Hours
84:00
72:00
60:00
48:00
36:00
24:00
12:00
0:00
Rainfall, Inches
4
3.5
3
2.5
2
1.5
1
0.5
0
3/13/2019
4/6/2019
4/13/2019
4/18/2019
4/24/2019
5/2/2019
5/7/2019
5/11/2019
6/1/2019
6/4/2019
6/16/2019
6/24/2019
6/26/2019
6/27/2019
6/29/2019
7/1/2019
7/13/2019
8/2/2019
8/14/2019
8/28/2019
8/30/2019
9/10/2019
9/11/2019
Hunter MINI-CLIK
Hunter RFC
Hunter RAINCLIK
Orbit 57069N
Weathermatic 420GLS
Toro TRS
Rainbird RSD-BEX
Rainbird WR2-RFC
Rainfall

Programmed Irrigation Days								
Site #	Start Time	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
31	5:00 AM							
34	6:00 AM							
37	5:30 AM							
38	4:00 AM							
39	5:00 AM							
40	3:00 AM							
41	6:30 AM							
42	5:00 AM							

* 8 Residential Sites in 1 Neighborhood were selected
* Controller Settings were documented for:
  * Start Time – All sites had only 1 start time
  * Runtime
  * Watering Days

Comparing Sensor Operation to Rain Events and Daily Irrigations

Ave Sensor Performance - Irrigate That Day?									
Rain Week	Total Rain	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	(Monday)
11-Mar	0.96	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes
1-Apr	1.53	Yes	Yes	Yes	Yes	Yes	Yes	**No**	Yes
15-Apr	1.61	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes
22-Apr	2.3	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes
29-Apr	4.42	Yes	Yes	Yes	**No**	**No**	Yes	Yes	Yes
6-May	2.26	Yes	Yes	**No**	**No**	Yes	Yes	**No**	Yes
27-May	1.19	Yes	Yes	Yes	Yes	Yes	Yes	**No**	Yes
3-Jun	2.01	Yes	Yes	**No**	Yes	Yes	Yes	Yes	Yes
10-Jun	1.3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**
24-Jun	1.03	**No**	**No**	Yes	**No**	**No**	Yes	Yes	Yes

Rain Day

Site Irrigations based on Average Sensor Performance

Site	Total Irrigations	Prevented Irrigations	% Prevented	% Allowed
31	30	5	16.7%	83.3%
34	30	10	33.3%	66.7%
37	30	3	10.0%	90.0%
38	20	9	45.0%	55.0%
39	30	10	33.3%	66.7%
40	10	2	20.0%	80.0%
41	20	7	35.0%	65.0%
42	30	7	23.3%	76.7%
Average			27.1%	72.9%

*10 Week Period

Summary

* The amount of rain has little effect on duration a rain sensor is active
* Analysis suggest irrigation professionals (and homeowners) should anticipate the effects of rainfall when programming controllers
  * Maximize the use of controllers with programmable sensor delay
* There is a need for better rain sensor technology that not only detects rain but also takes credit for rain

Controller Rain Gage-Sensors that have been discontinued by Manufacturers

Contact Information

Charles Swanson
Extension Program Specialist II-Landscape Irrigation
Biological & Agricultural Engineering Dept.
College Station, Tx
clswanson@tamu.edu
979-845-5614

http://itc.tamu.edu
Irrigation Technology Program