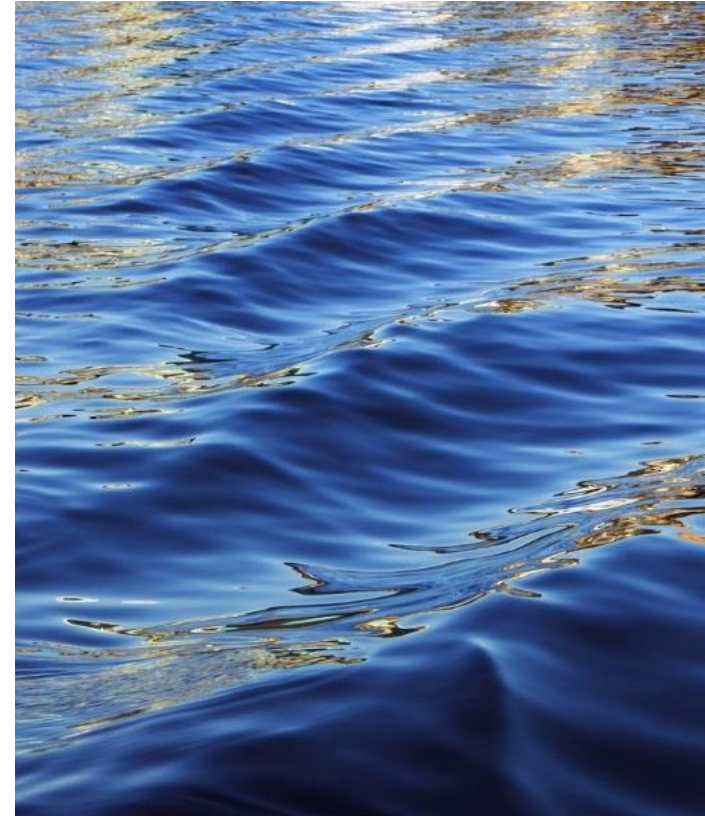


# REQUERIMIENTO DE AGUA EN CULTIVO TOMATE ROJO

Adan Baltazar (se710985)  
Maestría Diseño Electrónico  
Mayo, 2021

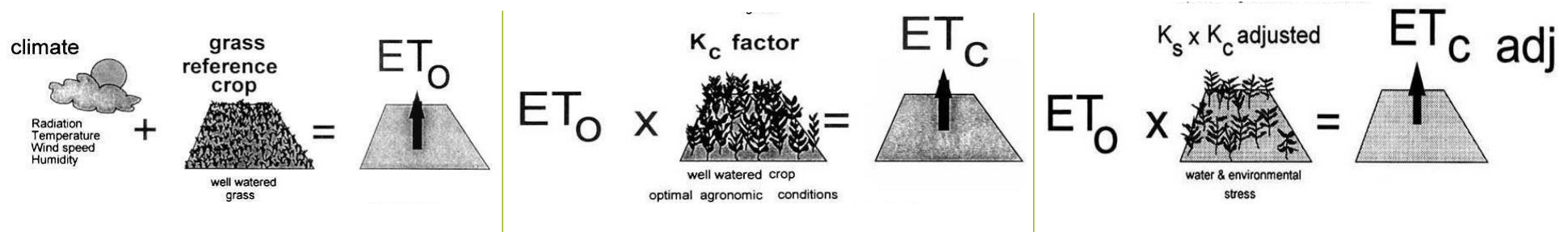


# Objetivo del Proyecto

- Crear base de datos climatológica proveniente de estación(es) Conagua referente a la región sur de Jalisco.
- Diseñar una herramienta SW para análisis y procesamiento de datos climatológicos en el cálculo de requerimiento de agua de un cultivo basado en el modelo FAO Penman-Monteith:

$$ET_o = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T + 273} u_2 (e_s - e_a)}{\Delta + (1 + 0.34u_2)}$$

- Calcular ETo/ETc en cultivo de tomate rojo en la zona sur de Jalisco



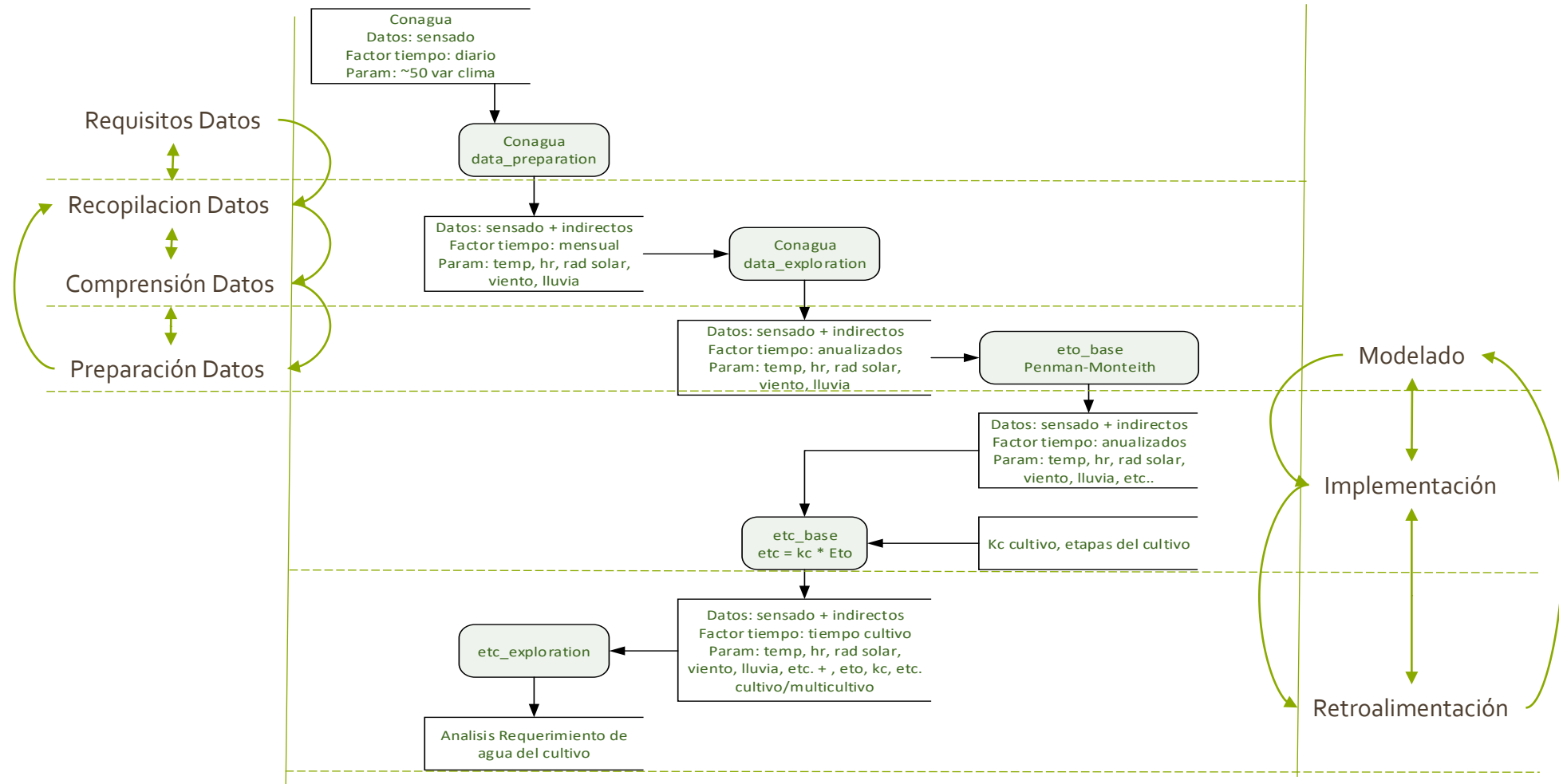
- Análisis de consumos en el uso de agua agrícola.

# Proceso para Obtención de Datos

- Fuente: Conagua Cd Guzman (Físico: <2019, Digital 2019-2020)
- Estación: Cd Guzman (lat = 19.59, lon = -103.59, msnm = 1408.99)
- Características: ~ 50 Variables Clima
- Frecuencia Registro: Diario (~ 1500 registros mensual)
- Medición Directa: Temp Aire, Hum Rel, Vel Viento, Lluvia, Horas Sol
- Medición Indirecta: Radiación Sup Cultivo, Def Saturación Vapor, Dens Flujo Suelo

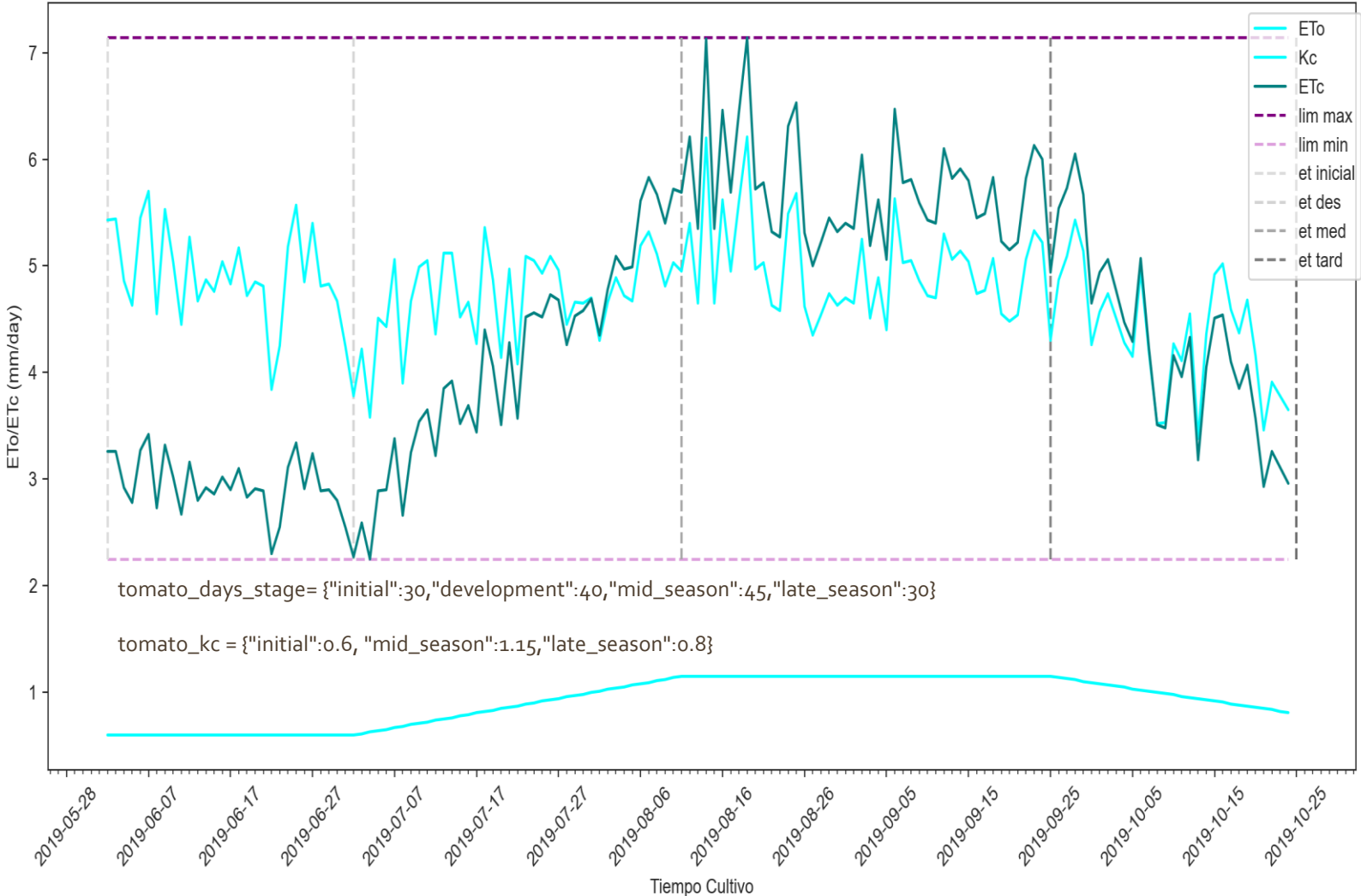
	DA	T.S	T.R	T.V	MAX	MIN	P.R	R.R	MAX	MIN	P.SEN	MAX	MIN	O.SC	P.FMM	MAX	MIN	O.SC	
1		15.5	10.1	11.2	12.3	10.6	8.6	80	90	40	850.2	850.9	848.8	2.1	1031.9	1031.2	1031.2	4.0	
	DA	T.S	T.R	T.V	MAX	MIN	P.R	R.R	MAX	MIN	P.SEN	MAX	MIN	O.SC	P.FMM	MAX	MIN	O.SC	DIREC.
1		15.4	11.5	10.5	11.6	9.3	7.6	59	90	30	851.1	853.8	850.3	3.5	1017.5	1021.1	1021.6	8.5	15W
2		21.0	15.7	14.4	17.2	11.3	12.2	62	90	30	851.5	852.7	849.8	2.9	1013.7	1015.9	1009.9	0	051.5 CV
3		15.8	11.6	10.7	11.8	9.4	7.7	59	90	30	851.7	854.4	851.9	3.6	1017.7	1021.3	1021.8	8.6	15E
4		15.9	11.7	10.8	11.9	9.5	7.8	60	90	30	851.9	854.6	852.1	3.7	1017.9	1021.5	1022.0	8.7	
5		16.0	11.8	10.9	12.0	9.6	7.9	61	90	30	852.1	854.8	852.3	3.8	1018.1	1021.7	1022.2	8.8	
6		16.1	11.9	11.0	12.1	9.7	8.0	62	90	30	852.3	855.0	852.5	3.9	1018.3	1021.9	1022.4	8.9	
7		16.2	12.0	11.1	12.2	9.8	8.1	63	90	30	852.5	855.2	852.7	4.0	1018.5	1022.1	1022.6	9.0	
8		16.3	12.1	11.2	12.3	9.9	8.2	64	90	30	852.7	855.4	852.9	4.1	1018.7	1022.3	1022.8	9.1	
9		16.4	12.2	11.3	12.4	10.0	8.3	65	90	30	852.9	855.6	853.1	4.2	1018.9	1022.5	1023.0	9.2	
10		16.5	12.3	11.4	12.5	10.1	8.4	66	90	30	853.1	855.8	853.3	4.3	1019.1	1022.7	1023.2	9.3	
11		16.6	12.4	11.5	12.6	10.2	8.5	67	90	30	853.3	856.0	853.5	4.4	1019.3	1022.9	1023.4	9.4	
12		16.7	12.5	11.6	12.7	10.3	8.6	68	90	30	853.5	856.2	853.7	4.5	1019.5	1023.1	1023.6	9.5	
13		16.8	12.6	11.7	12.8	10.4	8.7	69	90	30	853.7	856.4	853.9	4.6	1019.7	1023.3	1023.8	9.6	
14		16.9	12.7	11.8	12.9	10.5	8.8	70	90	30	853.9	856.6	854.1	4.7	1019.9	1023.5	1024.0	9.7	
15		17.0	12.8	11.9	13.0	10.6	8.9	71	90	30	854.1	856.8	854.3	4.8	1020.1	1023.7	1024.2	9.8	
16		17.1	12.9	12.0	13.1	10.7	9.0	72	90	30	854.3	857.0	854.5	4.9	1020.3	1023.9	1024.4	9.9	
17		17.2	13.0	12.1	13.2	10.8	9.1	73	90	30	854.5	857.2	854.7	5.0	1020.5	1024.1	1024.6	10.0	
18		17.3	13.1	12.2	13.3	10.9	9.2	74	90	30	854.7	857.4	854.9	5.1	1020.7	1024.3	1024.8	10.1	
19		17.4	13.2	12.3	13.4	11.0	9.3	75	90	30	854.9	857.6	855.1	5.2	1020.9	1024.5	1025.0	10.2	
20		17.5	13.3	12.4	13.5	11.1	9.4	76	90	30	855.1	857.8	855.3	5.3	1021.1	1024.7	1025.2	10.3	
21		17.6	13.4	12.5	13.6	11.2	9.5	77	90	30	855.3	858.0	855.5	5.4	1021.3	1024.9	1025.4	10.4	
22		17.7	13.5	12.6	13.7	11.3	9.6	78	90	30	855.5	858.2	855.7	5.5	1021.5	1025.1	1025.6	10.5	
23		17.8	13.6	12.7	13.8	11.4	9.7	79	90	30	855.7	858.4	855.9	5.6	1021.7	1025.3	1025.8	10.6	
24		17.9	13.7	12.8	13.9	11.5	9.8	80	90	30	855.9	858.6	856.1	5.7	1021.9	1025.5	1026.0	10.7	
25		18.0	13.8	12.9	14.0	11.6	9.9	81	90	30	856.1	858.8	856.3	5.8	1022.1	1025.7	1026.2	10.8	
26		18.1	13.9	13.0	14.1	11.7	10.0	82	90	30	856.3	859.0	856.5	5.9	1022.3	1025.9	1026.4	10.9	
27		18.2	14.0	13.1	14.2	11.8	10.1	83	90	30	856.5	859.2	856.7	6.0	1022.5	1026.1	1026.6	11.0	
28		18.3	14.1	13.2	14.3	11.9	10.2	84	90	30	856.7	859.4	856.9	6.1	1022.7	1026.3	1026.8	11.1	
29		18.4	14.2	13.3	14.4	12.0	10.3	85	90	30	856.9	859.6	857.1	6.2	1022.9	1026.5	1027.0	11.2	
30		18.5	14.3	13.4	14.5	12.1	10.4	86	90	30	857.1	859.8	857.3	6.3	1023.1	1026.7	1027.2	11.3	
31		18.6	14.4	13.5	14.6	12.2	10.5	87	90	30	857.3	860.0	857.5	6.4	1023.3	1026.9	1027.4	11.4	
32		18.7	14.5	13.6	14.7	12.3	10.6	88	90	30	857.5	860.2	857.7	6.5	1023.5	1027.1	1027.6	11.5	
33		18.8	14.6	13.7	14.8	12.4	10.7	89	90	30	857.7	860.4	857.9	6.6	1023.7	1027.3	1027.8	11.6	
34		18.9	14.7	13.8	14.9	12.5	10.8	90	90	30	857.9	860.6	858.1	6.7	1023.9	1027.5	1028.0	11.7	
35		19.0	14.8	13.9	15.0	12.6	10.9	91	90	30	858.1	860.8	858.3	6.8	1024.1	1027.7	1028.2	11.8	
36		19.1	14.9	14.0	15.1	12.7	11.0	92	90	30	858.3	861.0	858.5	6.9	1024.3	1027.9	1028.4	11.9	
37		19.2	15.0	14.1	15.2	12.8	11.1	93	90	30	858.5	861.2	858.7	7.0	1024.5	1028.1	1028.6	12.0	
38		19.3	15.1	14.2	15.3	12.9	11.2	94	90	30	858.7	861.4	858.9	7.1	1024.7	1028.3	1028.8	12.1	
39		19.4	15.2	14.3	15.4	13.0	11.3	95	90	30	858.9	861.6	859.1	7.2	1024.9	1028.5	1029.0	12.2	
40		19.5	15.3	14.4	15.5	13.1	11.4	96	90	30	859.1	861.8	859.3	7.3	1025.1	1028.7	1029.2	12.3	
41		19.6	15.4	14.5	15.6	13.2	11.5	97	90	30	859.3	862.0	859.5	7.4	1025.3	1028.9	1029.4	12.4	
42		19.7	15.5	14.6	15.7	13.3	11.6	98	90	30	859.5	862.2	859.7	7.5	1025.5	1029.1	1029.6	12.5	
43		19.8	15.6	14.7	15.8	13.4	11.7	99	90	30	859.7	862.4	859.9	7.6	1025.7	1029.3	1029.8	12.6	
44		19.9	15.7	14.8	15.9	13.5	11.8	100	90	30	859.9	862.6	860.1	7.7	1025.9	1029.5	1030.0	12.7	
45		20.0	15.8	14.9	16.0	13.6	11.9	101	90	30	860.1	862.8	860.3	7.8	1026.1	1029.7	1030.2	12.8	
46		20.1	15.9	15.0	16.1	13.7	12.0	102	90	30	860.3	863.0	860.5	7.9	1026.3	1029.9	1030.4	12.9	
47		20.2	16.0	15.1	16.2	13.8	12.1	103	90	30	860.5	863.2	860.7	8.0	1026.5	1030.1	1030.6	13.0	
48		20.3	16.1	15.2	16.3	13.9	12.2	104	90	30	860.7	863.4	860.9	8.1	1026.7	1030.3	1030.8	13.1	
49		20.4	16.2	15.3	16.4	14.0	12.3	105	90	30	860.9	863.6	861.1	8.2	1026.9	1030.5	1031.0	13.2	
50		20.5	16.3	15.4	16.5	14.1	12.4	106	90	30	861.1	863.8	861.3	8.3	1027.1	1030.7	1031.2	13.3	
51		20.6	16.4	15.5	16.6	14.2	12.5	107	90	30	861.3	864.0	861.5	8.4	1027.3	1030.9	1031.4	13.4	
52		20.7	16.5	15.6	16.7	14.3	12.6	108	90	30	861.5	864.2	861.7	8.5	1027.5	1031.1	1031.6	13.5	
53		20.8	16.6	15.7	16.8	14.4	12.7	109	90	30	861.7	864.4	861.9	8.6	1027.7	1031.3	1031.8	13.6	
54		20.9	16.7	15.8	16.9	14.5	12.8	110	90	30	861.9	864.6	862.1	8.7	1027.9	1031.5	1032.0	13.7	
55		21.0	16.8	15.9	17.0	14.6	12.9	111	90	30	862.1	864.8	862.3	8.8	1028.1	1031.7	1032.2	13.8	
56		21.1	16.9	16.0	17.1	14.7	13.0	112	90	30	862.3	865.0	862.5	8.9	1028.3	1031.9	1032.4	13.9	
57		21.2	17.0	16.1	17.2	14.8	13.1	113	90	30	862.5	865.2	862.7	9.0	1028.5	1032.1	1032.6	14.0	
58		21.3	17.1	16.2	17.3	14.9	13.2	114	90	30	862.7	865.4	862.9	9.1	1028.7	1032.3	1032.8	14.1	
59		21.4	17.2	16.3	17.4	15.0	13.3	115	90	30	862.9	865.6	863.1	9.2	1028.9	1032.5	1033.0	14.2	
60		21.5	17.3	16.4	17.5	15.1	13.4	116	90	30	863.1	865.8	863.3	9.3	1029.1	1032.7	1033.2	14.3	
61		21.6	17.4	16.5	17.6	15.2	13.5	117	90	30	863.3	866.0	863.5	9.4	1029.3	1032.9	1033.4	14.4	
62		21.7	17.5	16.6	17.7	15.3	13.6	118	90	30	863.5	866.2	863.7	9.5	1029.5	1033.1	1033.6	14.5	
63		21.8	17.6	16.7	17.8	15.4	13.7	119	90	30	863.7	866.4	863.9	9.6	1029.7	1033.3	1033.8	14.6	
64		21.9	17.7	16.8	17.9	15.5	13.8	120	90	30	863.9	866.6	864.1	9.7	1029.9	1033.5	1034.0	14.7	
65		22.0	17.8	16.9	18.0	15.6	13.9	121	90	30	864.1	866.8	864.3	9.8	1030.1	1033.7	1034.2	14.8	
66		22.1	17.9	17.0	18.1	15.7	14.0	122	90	30	864.3	867.0	864.5	9.9	1030.3	1033.9	1034.4	14.9	
67		22.2	18.0	17.1	18.2	15.8	14.1	123	90	30	864.5	867.2	864.7	10.0	1030.5	1034.1	1034.6	15.0	
68		22.3	18.1	17.2	18.3	15.9	14.2	124	90	30	864.7	867.4	864.9	10.1	1030.7	1034.3	1034.8	15.1	
69		22.4	18.2	17.3	18.4	16.0	14.3	125	90	30	864.9	867.6	865.1	10.2	1030.9	1034.5</			

# Metodologías Empleadas Preparación Datos



# Conclusiones

Evapotranspiracion - Etapas Cultivo



Cultivo: Tomate Rojo	
Fecha de Trasplante: 2019-06-01 00:00:00	
Agua requerida durante el cultivo:	639.70 mm (~6.4x10^6L)
Agua de lluvia durante el cultivo:	820.8 mm
Deficit agua durante el cultivo:	-181.09 mm
Temp Max durante el cultivo:	25.6 °C
Temp Min durante el cultivo:	12.2 °C
Humedad Max durante el cultivo:	98.0 %
Humedad Min durante el cultivo:	27.0 %
Vel Viento Max durante el cultivo:	4.1 m/s
Vel Viento Min durante el cultivo:	0.6 m/s
Rad Solar Max durante el cultivo:	36.8 MJ[day-1][m-2]
Rad Solar Min durante el cultivo:	23.06 MJ[day-1][m-2]

	transp_day_season	etc_crop_season	rain_crop_season	irrig_water_crop_season
0	2019-05-27	643.730042	812.6	-168.869958
1	2019-05-28	643.625212	823.2	-179.574788
2	2019-05-29	642.322771	823.2	-180.877229
3	2019-05-30	641.909063	829.5	-187.590937
4	2019-05-31	640.849346	830.0	-189.150654
5	2019-06-01	639.770587	820.8	-181.029413
6	2019-06-02	638.398858	782.4	-144.001142
7	2019-06-03	636.829037	782.3	-145.470963
8	2019-06-04	635.054604	782.3	-147.245396
9	2019-06-05	633.519283	782.3	-148.780717
10	2019-06-06	631.927321	782.3	-150.372679





+ Info:

[https://github.com/polkg6/crop\\_water\\_requirement](https://github.com/polkg6/crop_water_requirement)

