

CALCULO DE LA EVAPOTRANSPIRACION POTENCIAL [ETP'

(Temperatura máxima v mínima, nubosidad v velocidad del viento												
Localidad:	Tarata			Altura (m/s/n/m)		3200 msnm						
Provincia:	Esteban Arce			COORDENADAS		(°)	(')	(")				
Depatamento	la PAZ			Latitud sur		16	31	10				
Serie climática	1991 - 2017			Longitud Oeste		68	4	17				
MES	ENERO	FEBRE	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOS	SEPTIEM	OCT	NOVIEM	DICIEM
Temperatura Minima (°C)	11.55	11.53	10.93	9.08	5.85	4.05	3.89	5.29	7.71	10.10	11.16	11.66
Temperatura Maxima (°C)	25.086	24.983	26.122	27.576	27.612	26.953	26.394	27.400	27.953	28.476	28.647	26.988
Punto de rocío (°C)	11.550	11.528	10.928	9.076	5.853	4.047	3.888	5.294	7.706	10.096	11.159	11.659
Temperatura Media (°C)	18.318	18.256	18.525	18.326	16.732	15.500	15.141	16.347	17.829	19.286	19.903	19.324
Temperatura absoluta	291.318	291.256	291.525	291.326	289.732	288.500	288.141	289.347	290.829	292.286	292.903	292.324
Constante de Boltzman	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
es (Tmin) presion de vapor se sat. (Kpa)	1.363	1.361	1.308	1.155	0.926	0.816	0.807	0.891	1.052	1.237	1.328	1.373
es (Tmax) presion de vapor se sat. (Kpa)	3.190	3.171	3.392	3.695	3.703	3.563	3.447	3.657	3.777	3.894	3.933	3.570
es mean	2.276	2.266	2.350	2.425	2.314	2.189	2.127	2.274	2.415	2.566	2.630	2.471
ea Presion Real de vapor (Kpa)	1.363	1.361	1.308	1.155	0.926	0.816	0.807	0.891	1.052	1.237	1.328	1.373
Radiación estraterrestre (de la Tabla 1)	41.300	39.950	37.100	32.450	28.000	25.650	26.500	30.200	34.950	38.700	40.750	41.450
n (numero de horas de sol)	5.048	5.195	4.518	3.970	3.748	4.662	5.451	6.105	5.396	5.197	5.317	4.896
N (de la Tabla 2) hrs sol maxima	12.95	12.55	12.1	11.6	11.25	11	11.05	11.45	11.9	12.4	12.85	13
Radiación solar en día despejado	30.975	29.963	27.825	24.338	21.000	19.238	19.875	22.650	26.213	29.025	30.563	31.088
Velocidad del viento (m/s)	0.820	0.820	0.668	0.770	0.620	0.720	0.820	1.130	1.180	0.926	1.028	0.772
Radiación solar	18.375	18.256	16.201	13.665	11.665	11.848	13.161	15.601	16.661	17.785	18.619	18.167
Boltz*T^4	35.427	35.395	35.558	35.530	34.843	34.287	34.107	34.668	35.331	35.997	36.281	35.950
0.34-0.14raiz(ea)	0.177	0.177	0.180	0.190	0.205	0.214	0.214	0.208	0.196	0.184	0.179	0.176
1.35*Rs/Rso-0.35	0.451	0.473	0.436	0.408	0.400	0.481	0.544	0.580	0.508	0.477	0.472	0.439
	2.820	2.955	2.789	2.748	2.860	3.524	3.974	4.179	3.526	3.166	3.062	2.777
0.77*Rs	14.149	14.057	12.474	10.522	8.982	9.123	10.134	12.013	12.829	13.695	14.336	13.989
Rn	11.329	11.102	9.685	7.774	6.122	5.598	6.160	7.834	9.303	10.529	11.274	11.212
G	-0.075	0.014	0.005	-0.125	-0.198	-0.111	0.059	0.188	0.206	0.145	0.003	-0.111
Rn-G	11.403	11.087	9.680	7.900	6.320	5.710	6.100	7.646	9.098	10.384	11.271	11.323
Delta	0.132	0.132	0.134	0.132	0.121	0.113	0.111	0.118	0.129	0.139	0.144	0.140
Gama (de la Tabla 3)γ (Kpa °C ⁻¹)	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
Delta termino radiativo	0.692	0.691	0.703	0.695	0.685	0.664	0.653	0.650	0.666	0.697	0.699	0.706
Gama , termino aerodinámico	0.241	0.242	0.242	0.242	0.260	0.270	0.271	0.253	0.238	0.230	0.223	0.233
900/Tabs.	3.089	3.090	3.087	3.089	3.106	3.120	3.123	3.110	3.095	3.079	3.073	3.079
es-ea	0.914	0.905	1.042	1.270	1.388	1.373	1.320	1.383	1.363	1.329	1.303	1.099
ETo (mm/día)	3.777	3.680	3.297	2.970	2.462	2.379	2.543	3.257	3.658	3.826	4.132	3.870
ETo (mm/mes)	117.073	103.042	102.197	89.106	76.315	71.383	78.825	100.964	109.745	118.609	123.953	119.967

Evapotranspiración de referencia con información de la Temperatura máxima y mínima y nubosidad

MES	ENERO	FEBRE	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOS	SEPTIEM	OCT	NOVIEM	DICIEM
Temperatura Minima (°C)	11.550	11.528	10.928	9.076	5.853	4.047	3.888	5.294	7.706	10.096	11.159	11.659
Temperatura Maxima (°C)	25.086	24.983	26.122	27.576	27.612	26.953	26.394	27.400	27.953	28.476	28.647	26.988
Temperatura Media (°C)	18.318	18.256	18.525	18.326	16.732	15.500	15.141	16.347	17.829	19.286	19.903	19.324
Temperatura absoluta	291.318	291.256	291.525	291.326	289.732	288.500	288.141	289.347	290.829	292.286	292.903	292.324
Constante de Boltzman	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
es (Tmin) presion de vapor se sat. (Kpa)	1.363	1.361	1.308	1.155	0.926	0.816	0.807	0.891	1.052	1.237	1.328	1.373
es (Tmax) presion de vapor se sat. (Kpa)	3.190	3.171	3.392	3.695	3.703	3.563	3.447	3.657	3.777	3.894	3.933	3.570
es mean	2.276	2.266	2.350	2.425	2.314	2.189	2.127	2.274	2.415	2.566	2.630	2.471
ea Presion Real de vapor (Kpa)	1.363	1.361	1.308	1.155	0.926	0.816	0.807	0.891	1.052	1.237	1.328	1.373
Radiación estraterrestre	41.300	39.950	37.100	32.450	28.000	25.650	26.500	30.200	34.950	38.700	40.750	41.450
n	5.048	5.195	4.518	3.970	3.748	4.662	5.451	6.105	5.396	5.197	5.317	4.896
N	13.00	12.60	12.10	11.60	11.20	10.90	11.00	11.40	11.90	12.40	12.90	13.10
Radiación solar en día despejado	30.975	29.963	27.825	24.338	21.000	19.238	19.875	22.650	26.213	29.025	30.563	31.088
Velocidad del viento (m/s)	0.820	0.820	0.668	0.770	0.620	0.720	0.820	1.130	1.180	0.926	1.028	0.772
Radiación solar	18.344	18.223	16.201	13.665	11.685	11.898	13.191	15.636	16.661	17.785	18.586	18.108
Boltz*T^4	35.427	35.395	35.558	35.530	34.843	34.287	34.107	34.668	35.331	35.997	36.281	35.950
0.34-0.14raiz(ea)	0.177	0.177	0.180	0.190	0.205	0.214	0.214	0.208	0.196	0.184	0.179	0.176
1.35*Rs/Rso-0.35	0.449	0.471	0.436	0.408	0.401	0.485	0.546	0.582	0.508	0.477	0.471	0.436
0.77*Rs	14.125	14.031	12.474	10.522	8.998	9.161	10.157	12.040	12.829	13.695	14.311	13.943
Rn	11.313	11.086	9.685	7.774	6.128	5.611	6.168	7.846	9.303	10.529	11.258	11.182
G	-0.075	0.014	0.005	-0.125	-0.198	-0.111	0.059	0.188	0.206	0.145	0.003	-0.111
Rn-G	11.388	11.071	9.680	7.900	6.326	5.723	6.108	7.658	9.098	10.384	11.256	11.293
Delta	0.132	0.132	0.134	0.132	0.121	0.113	0.111	0.118	0.129	0.139	0.144	0.140
Gama (de la Tabla 3)γ (Kpa °C ⁻¹)	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
Delta termino radiativo	0.692	0.691	0.703	0.695	0.685	0.664	0.653	0.650	0.666	0.697	0.699	0.706
Gama , termino aerodinámico	0.241	0.242	0.242	0.242	0.260	0.270	0.271	0.253	0.238	0.230	0.223	0.233
900/Tabs.	3.089	3.090	3.087	3.089	3.106	3.120	3.123	3.110	3.095	3.079	3.073	3.079
es-ea	0.914	0.905	1.042	1.270	1.388	1.373	1.320	1.383	1.363	1.329	1.303	1.099

ETo (mm/día)	3.772	3.676	3.297	2.970	2.464	2.383	2.545	3.260	3.658	3.826	4.127	3.861
ETo (mm/mes)	116.938	102.916	102.197	89.106	76.371	71.487	78.892	101.063	109.745	118.609	123.818	119.704

Evapotranspiración de referencia con información de la Temperatura máxima y mínima y velocidad del viento

MES	ENERO	FEBRE	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOS	SEPTIEM	OCT	NOVIEM	DICIEM
Temperatura Minima (°C)	11.550	11.528	10.928	9.076	5.853	4.047	3.888	5.294	7.706	10.096	11.159	11.659
Temperatura Maxima (°C)	25.086	24.983	26.122	27.576	27.612	26.953	26.394	27.400	27.953	28.476	28.647	26.988
Temperatura Media (grados centigrados)	18.318	18.256	18.525	18.326	16.732	15.500	15.141	16.347	17.829	19.286	19.903	19.324
Temperatura absoluta	291.318	291.256	291.525	291.326	289.732	288.500	288.141	289.347	290.829	292.286	292.903	292.324
Constante de Boltzmann	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
es (Tmin) presion de vapor se sat. (Kpa)	1.363	1.361	1.308	1.155	0.926	0.816	0.807	0.891	1.052	1.237	1.328	1.373
es (Tmax) presion de vapor se sat. (Kpa)	3.190	3.171	3.392	3.695	3.703	3.563	3.447	3.657	3.777	3.894	3.933	3.570
es mean	2.276	2.266	2.350	2.425	2.314	2.189	2.127	2.274	2.415	2.566	2.630	2.471
ea Presion Real de vapor (Kpa)	1.114	1.113	1.068	0.941	0.926	0.816	0.807	0.891	1.052	1.237	1.085	1.123
Radiación extraterrestre	42.080	40.060	36.350	30.860	25.980	23.410	24.380	28.400	33.890	38.480	41.330	42.410
Radiación solar en día despejado	31.560	30.045	27.263	23.145	19.485	17.558	18.285	21.300	25.418	28.860	30.998	31.808
Velocidad del viento (m/s)	0.820	0.820	0.668	0.770	0.620	0.720	0.820	1.130	1.180	0.926	1.028	0.772
Factor de corrección	0.76	0.76	0.82	0.91	0.96	0.97	0.84	0.80	0.73	0.75	0.75	0.77
Radiación solar estimada	18.921	17.802	18.499	19.409	18.669	17.338	15.574	17.065	17.690	19.733	20.671	20.354
Boltz*T^4	35.427	35.395	35.558	35.530	34.843	34.287	34.107	34.668	35.331	35.997	36.281	35.950
0.34-0.14raiz(ea)	0.192	0.192	0.195	0.204	0.205	0.214	0.214	0.208	0.196	0.184	0.194	0.192
1.35*Rs/Rso-0.35	0.459	0.450	0.566	0.782	0.943	0.983	0.800	0.732	0.590	0.573	0.550	0.514
0.77*Rs	14.570	13.707	14.244	14.945	14.375	13.350	11.992	13.140	13.621	15.195	15.917	15.673
Rn	11.441	10.645	10.313	9.270	7.627	6.153	6.148	7.868	9.530	11.393	12.041	12.132
G	-0.075	0.014	0.005	-0.125	-0.198	-0.111	0.059	0.188	0.206	0.145	0.003	-0.111
Rn-G	11.516	10.630	10.308	9.395	7.825	6.264	6.089	7.680	9.325	11.248	12.038	12.243
Delta	0.132	0.132	0.134	0.132	0.121	0.113	0.111	0.118	0.129	0.139	0.144	0.140
Gama (de la Tabla 3)γ (Kpa °C ⁻¹)	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
Delta Rad. Term	0.692	0.691	0.703	0.695	0.685	0.664	0.653	0.650	0.666	0.697	0.699	0.706
Gamma Aerod.term	0.241	0.242	0.242	0.242	0.260	0.270	0.271	0.253	0.238	0.230	0.223	0.233
900/Tabs.	3.089	3.090	3.087	3.089	3.106	3.120	3.123	3.110	3.095	3.079	3.073	3.079
es-ea	1.162	1.153	1.282	1.484	1.388	1.373	1.320	1.383	1.363	1.329	1.545	1.349

ETo con rad.solar estimada (mm/dia)	3.960	3.703	3.596	3.518	2.882	2.530	2.540	3.266	3.720	4.072	4.521	4.273
ETo (mm/mes)	122.761	103.687	111.487	105.526	89.353	75.887	78.729	101.243	111.594	126.227	135.645	132.470

Evapotranspiración de referencia con datos de Temperatura máxima y mínima

MES	ENERO	FEBRE	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOS	SEPTIEM	OCT	NOVIEM	DICIEM
Temperatura Minima (°C)	11.550	11.528	10.928	9.076	5.853	4.047	3.888	5.294	7.706	10.096	11.159	11.659
Temperatura Maxima (°C)	25.086	24.983	26.122	27.576	27.612	26.953	26.394	27.400	27.953	28.476	28.647	26.988
Temperatura Media (°C)	18.318	18.256	18.525	18.326	16.732	15.500	15.141	16.347	17.829	19.286	19.903	19.324
Temperatura absoluta	291.318	291.256	291.525	291.326	289.732	288.500	288.141	289.347	290.829	292.286	292.903	292.324
Constante de Boltzmann	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
es (Tmin) presion de vapor se sat. (Kpa)	1.363	1.361	1.308	1.155	0.926	0.816	0.807	0.891	1.052	1.237	1.328	1.373
es (Tmax) presion de vapor se sat. (Kpa)	3.190	3.171	3.392	3.695	3.703	3.563	3.447	3.657	3.777	3.894	3.933	3.570
es mean	2.276	2.266	2.350	2.425	2.314	2.189	2.127	2.274	2.415	2.566	2.630	2.471
ea Presion Real de vapor (Kpa)	1.114	1.113	1.068	0.941	0.926	0.816	0.807	0.891	1.052	1.237	1.085	1.123
Radiación extraterrestre	42.080	40.060	36.350	30.860	25.980	23.410	24.380	28.400	33.890	38.480	41.330	42.410
Radiación solar en día despejado	31.560	30.045	27.263	23.145	19.485	17.558	18.285	21.300	25.418	28.860	30.998	31.808
Velocidad del viento (m/s)	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Factor de corrección	0.76	0.76	0.82	0.91	0.96	0.97	0.84	0.80	0.73	0.75	0.75	0.77
Radiación solar estimada	18.921	17.802	18.499	19.409	18.669	17.338	15.574	17.065	17.690	19.733	20.671	20.354
Boltz*T^4	35.427	35.395	35.558	35.530	34.843	34.287	34.107	34.668	35.331	35.997	36.281	35.950
0.34-0.14raiz(ea)	0.192	0.192	0.195	0.204	0.205	0.214	0.214	0.208	0.196	0.184	0.194	0.192
1.35*Rs/Rso-0.35	0.459	0.450	0.566	0.782	0.943	0.983	0.800	0.732	0.590	0.573	0.550	0.514
0.77*Rs	14.570	13.707	14.244	14.945	14.375	13.350	11.992	13.140	13.621	15.195	15.917	15.673
Rn	11.441	10.645	10.313	9.270	7.627	6.153	6.148	7.868	9.530	11.393	12.041	12.132
G	-0.075	0.014	0.005	-0.125	-0.198	-0.111	0.059	0.188	0.206	0.145	0.003	-0.111
Rn-G	11.516	10.630	10.308	9.395	7.825	6.264	6.089	7.680	9.325	11.248	12.038	12.243
Delta	0.132	0.132	0.134	0.132	0.121	0.113	0.111	0.118	0.129	0.139	0.144	0.140
Gama (de la Tabla 3)γ (Kpa °C ⁻¹)	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
Delta Rad. Term	0.631	0.630	0.633	0.631	0.610	0.594	0.589	0.605	0.625	0.643	0.651	0.644
Gamma Aerod.term	0.220	0.220	0.218	0.220	0.232	0.242	0.245	0.235	0.223	0.212	0.208	0.212
900/Tabs.	3.089	3.090	3.087	3.089	3.106	3.120	3.123	3.110	3.095	3.079	3.073	3.079
es-ea	1.162	1.153	1.282	1.484	1.388	1.373	1.320	1.383	1.363	1.329	1.545	1.349

ETo con rad.solar estimada (mm/día)	4.542	4.302	4.391	4.434	3.949	3.589	3.481	3.919	4.261	4.689	5.170	4.977
ETo (mm/mes)	140.794	120.448	136.120	133.006	122.433	107.683	107.914	121.480	127.822	145.373	155.109	154.272

**EVAPOTRANSPIRACION DE REFERENCIA
DETERMINADA CON PENMAN-MONTEITH CON DATOS FALTANTES**

	JUN	JUL	AGO	SEP	OCT	NOV	DIC	ENE	FEB	MAR	ABR	MAY
Datos completos (mm/mes)	71.383	78.825	100.964	109.745	118.609	123.953	119.967	117.07	103.04	102.20	89.11	76.32
Temp,Hrs. Sol (mm/mes)	71.487	78.892	101.063	109.745	118.609	123.818	119.704	116.94	102.92	102.20	89.11	76.37
Temp, viento (mm/mes)	75.887	78.729	101.243	111.594	126.227	135.645	132.470	122.76	103.69	111.49	105.53	89.35
Temperatura (mm/mes)	107.683	107.914	121.480	127.822	145.373	155.109	154.272	140.79	120.45	136.12	133.01	122.43
% de variación												
Temp,Hrs. Sol	0.15	0.09	0.10	0.00	0.00	-0.11	-0.22	-0.12	-0.12	0.00	0.00	0.07
Temp, viento	5.93	-0.12	0.28	1.66	6.04	8.62	9.44	4.63	0.62	8.33	15.56	14.59
Temperatura	33.71	26.96	16.89	14.14	18.41	20.09	22.24	16.85	14.45	24.92	33.01	37.67

EVAPOTRANSPIRACION ELEGIDA

Temperatura (mm/mes)	107.68	107.91	121.48	127.82	145.37	155.11	154.27	140.79	120.45	136.12	133.01	122.43
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**COMPARACION DE LA ET_o OBTENIDA CON DIFERENTE
ACCESIBILIDAD DE INFORMACION (sin corrección de la
radiación solar)**

