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WEATHER AND CLIMATE DATA FOR PHILIPPINE RICE RESEARCH[1]

ABSTRACT

The climate and weather of Los Baños are described with particular reference to the upland-lowland difference. A complete file of daily upland weather data for the period 1959-1978 has been prepared and its contents, quality control, and means of access outlined. Current surface observations at Los Baños are noted with comments on quality control.

Climatic data for 47 Philippine synoptic weather stations have been collected and an integrated file of weekly data for periods of up to 24 years has been prepared. Access to its contents is described.

[1]By J. F. Angus, IRRI visiting agronomist from the Commonwealth Scientific and Industrial Research Organization, Canberra, Australia, and E. B. Manalo, assistant scientist, Multiple Cropping Department, International Rice Research Institute, Los Baños, Philippines. Submitted to the IRRI Research Paper Series Committee June 1978.

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WEATHER AND CLIMATE DATA FOR PHILIPPINE RICE RESEARCH

A detailed set of surface weather observations at Los Baños has been collected at weather stations of the University of the Philippines at Los Baños (UPLB) and the International Rice Research Institute (IRRI). The sites are 1 km apart and observations are recorded at 0800 daily at both stations. IRRI data are published as monthly means in the IRRI Annual Report; UPLB data are published annually by the Institute of Agricultural Engineering and Technology. IRRI data are from an irrigated lowland environment and UPLB data are from an upland environment. The locations of the weather stations are in Figure 1, and elements measured and lengths of records are in Table 1.

CLIMATE AND WEATHER OF LOS BAÑOS

We describe the data on three levels: 1) as a series of comparisons of weather elements at the two sites to illustrate features of the upland and lowland environments, 2) as normals describing the climate of the location, and 3) as a file of a number of weather elements suitable for running simulation models of crop production.

Rainfall

Annual rainfall at the IRRI lowland site appears to be higher than at the nearby upland UPLB station (Fig. 2), and the difference applies to almost every month of the year. Presumably the difference is due to the orographic effects of Mt. Makiling. Observations at the IRRI upland station have not been made for a long enough period to determine weather rainfall differs from that at the other sites.

The long-term record at UPLB was examined for possible trends and the prewar mean appears higher than the postwar mean (Fig. 1). The difference may be partly due to a 1959 shift of the UPLB rain gauge from a site near the present UPLB Library Building (Fig. 1).

The apparent cycles in annual rainfall suggested by Figure 2 reflect a similar cyclical pattern in the record of Manila rainfall (Jose 1971), with wet years in the early 1920s, average years in the late 1920s, and wet years again in the mid to late 1930s. During World War II, when no records were made at Los Baños, the Manila data showed a steady fall from the high levels of the late 1930s to the lower levels of the 1950s. Both records show the low rainfall of the mid 1960s.

We do not speculate on the possible cause of these apparent cyclical patterns, but it may be relevant for researchers working on rainfed rice to consider the prevailing rainfall during experiments and compare it with the long-term rainfall pattern, if such experiments are to have long-term applicability.

Evaporation

Monthly means of evaporation measured by the Colorado open rim pan and the Class A pan for randomly selected months show that the monthly means are virtually identical (Fig. 3). From this we conclude that measurements from the Colorado open rim pan before December 1967 can be used without change as an estimate of Class A pan evaporation at the UPLB site.

A comparison of monthly averages of Class A pan evaporation for the upland station at UPLB and the lowland station at IRRI show that when rates of evaporation were generally low, the two sites had about equal rates of evaporation, but when evaporation rates were generally high the values from the upland site exceeded those from the lowland (irrigated) site by as much as 2 mm/day (Fig. 4). The presumed reason for this difference is that the air surrounding the upland evaporimeter, being drier, increased the evaporative demand during the summer.

This difference should be more closely examined by researchers interested in water balance, where they work with an evaporimeter with a different exposure from the experimental site.

Radiation

The radiation record at Los Baños for the period 1959-1969 was examined by Robertson (1971), who corrected for the drift in calibration of the UPLB instrument. His corrected values have been substituted in the records we describe.

Comparison of the IRRI and UPLB data for the 1970-78 period reveals major discrepancies. It is inconceivable that those are due to exposure or site differences and we conclude that one or both instruments may have been faulty at various times.

Both IRRI and UPLB record the daily duration of bright sunshine. These data show good agreement and therefore provide the basis for estimating global radiation. Using the appropriate constants in the Ångström equation

$$\frac{Qo}{Qt} = a + b\frac{n}{N}$$

where

- Qo is surface global short-wave radiation (*solar* radiation),
- Qt is extraterrestrial radiation,
- n is recorded hours of bright sunshine,
- N is day length, and
- a and b are constants (a = 0.235; b = 0.528 which have been determined for Los Baños by Robertson (1972),

estimates of monthly radiation from 1970 to 1978 were compared with measured values (Fig. 5). The comparison suggested that the true values had been underestimated by 10-15% and in 1972-73, by up to 30%.

Temperature

A comparison of temperature maxima and minima at UPLB and IRRI showed that the IRRI maxima were generally lower than the corresponding maxima at UPLB whereas IRRI minima were slightly higher on the average than the corresponding UPLB minima (Fig. 6). The comparison was made on mean weekly values recorded after 4 June 1978, when mercury-in-glass thermometers were first used to measure screen temperature at IRRI. Before that maxima and minima were recorded from a thermograph. When the thermograph data were plotted against UPLB data a relationship similar to that shown in Figure 6 was obtained, but with considerably more scatter in the data. That may reflect the difficulty of measuring temperature accurately with a thermograph.

The differences between UPLB and IRRI probably reflect the upland-lowland difference. The surface water on the IRRI lowlands presumably provides a heat buffer that dampens the day-night temperature difference.

Table 1. Instruments used and length of record at the University of the Philippines at Los Baños (UPLB) and International Rice Research Institute (IRRI) weather stations, Los Baños, 1917-19.

	UPLB (Upland)	IRRI (Building)	IRRI-J10 (Lowland)	IRRI-MN (Near lowland)	IRRI-new farm (upland)
Rainfall					
Standard gauge	1917-58 old site 1959→ new site (no record 1939-46)		1966→	1971-79	Jun 1978→
Sunken gauge					Jun 1978→
Pluviograph					Jun 1978→
Evaporation					
Class A pan (screen 1978→)	1966→		1979→	1971-79	Jun 1978→
Colorado open rim pan	1959-Sep 1977				
Sunken pan (screen 1978→)	1959→				
Screen temperature					
Daily max-min	Hg in glass 1959→		Thermograph 1966-Jul 1978 Hg in glass Jul 1978→		Hg in glass Jul 1978→
0800 wet and dry	Sling inside screen Hg in glass 1959→		Sling outside screen Apr 1977-Jul 1978 Fan psychrometer Hg in glass Jul 1978		Fan psychrometer Hg in glass Jul 1978→
Humidity			Hair hygrograph 1966-Jul 1978		Hair hygrograph Jun 1978→
Sunshine duration	1959→	1965→			
Global radiation	Eppley pyranometer 1959-70 Actinograph 1970→	Eppley pyranometer 1966-75 Middleton pyranometer 1979→ Quantum silicon cell pyranometer Jun 1978→			
Net radiation			1966-74 Incomplete		

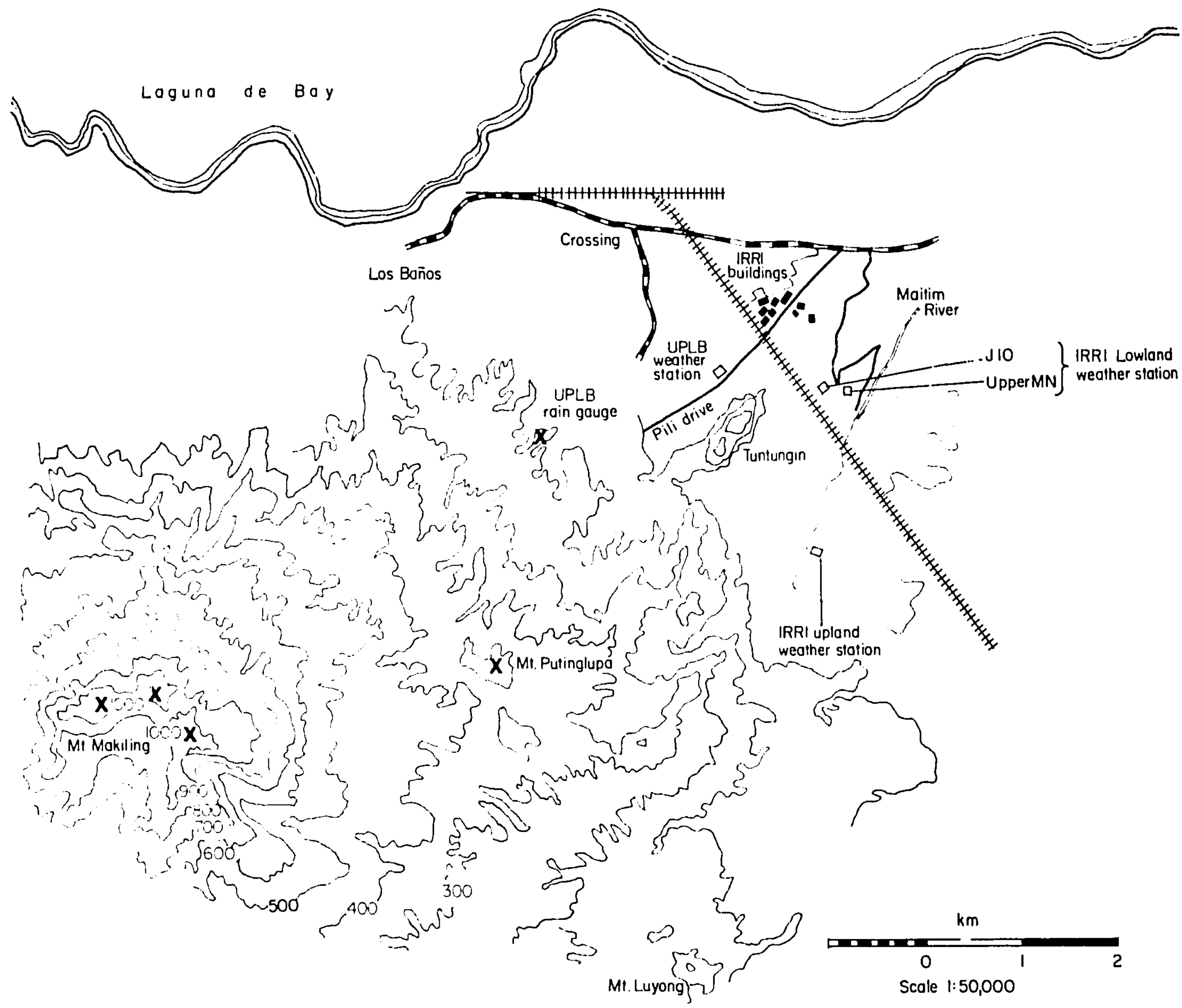

Fig. 1. Map of the Los Baños area showing location of weather stations.

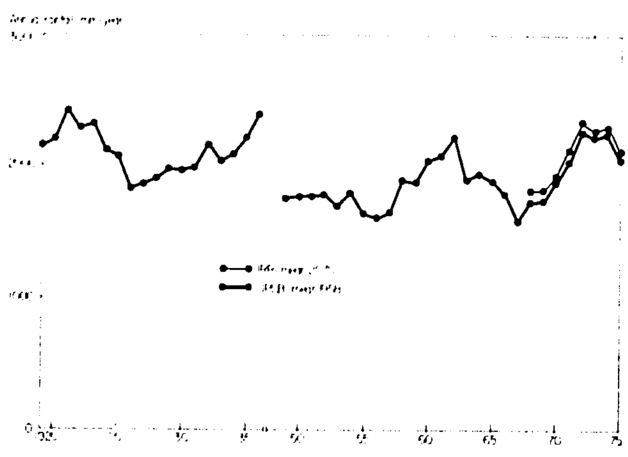

Fig. 2. Los Baños annual rainfall (5-year running mean).

Climatic normals for Los Baños

The monthly values for weather elements at Los Baños are in Table 2. The solar radiation data were derived from a composite of UPLB data from 1959-68, as corrected by Robertson (1971), and IRRI data for 1970-78 with corrections described in this report. Phytoday length was calculated by the method of Fleming (1972).

Integrated Los Baños weather data

To produce a consistent weather record for Los Baños we selected the upland condition as a standard and coded and checked a set of weather data from the UPLB weather station from 1959 until the end of 1978. The only exception is the radiation data, which are a composite of UPLB data from 1959-69 as corrected by Robertson (1971), and IRRI data from 1970 onward with corrections described in this report. The total daily weather record is on magnetic tape in EBCDIC code with a format shown in Table 3. The tape is held for public access at the Agricultural Resources Center (ARC), Los Baños. Because the total weather record refers to an upland site, it is not fully applicable to the lowland environment. Adjustment factors for evaporation and screen temperature to make the data more relevant to the lowland environment are:

- maximum temperatures should be decreased by 2°C and minimum temperatures increased by 0.5°C, and
- estimates of Class A pan evaporation for the lowland environment (Y) can be obtained from upland measurements (X) by

$$Y = 1.8637 + 0.5288X, \quad X>4 \quad (r = 0.93)$$

$$Y = X$$

Comparisons between upland and lowland estimates of other weather elements (such as humidity) have not been made for a sufficiently long period for relationships to be established.

Current surface observations

Surface observations are made at two IRRI sites (Fig. 1). The lowland site was established in its present form in 1966 and the upland site was established in 1978 to conform with the World Meteorological Organisation recommendation that surface observations be made at upland sites. The lowland site was retained to clarify the lowland-upland weather differences noted in the previous section.

The weather elements observed and the instruments used in collecting data are listed in Table 4. Not all recorded data are reported in the weekly and monthly weather bulletins, but IRRI researchers may have access to all records of the Agroclimatic Service Unit.

The data are stored on magnetic tape cassettes with a minicomputer which is also used to print the weekly and monthly bulletins. The quality of the data is checked with a computer program that makes comparisons between weather elements (e.g. radiation vs sunshine duration, radiation vs evaporation, reset of maximum temperature thermometer vs dry bulb, reset of minimum temperature thermometer vs dry bulb). The calculation of the humidity parameters (dew point, relative humidity, and vapor pressure deficit) are by the Tetens formula (Lowe 1977); the vapor pressure deficit is based on the mean daily temperature /(max + min)/. Phytoday length, the duration of the period when the sky brightness is sufficient to activate plant phytochrome receptors, is estimated by the method of Fleming (1972).

At the time of establishment of the new upland station, two changes were made in the observations. 1) The pyranometer and sunshine recorder were moved to the roof of the LTCC building and a calibration system established, based on a standard

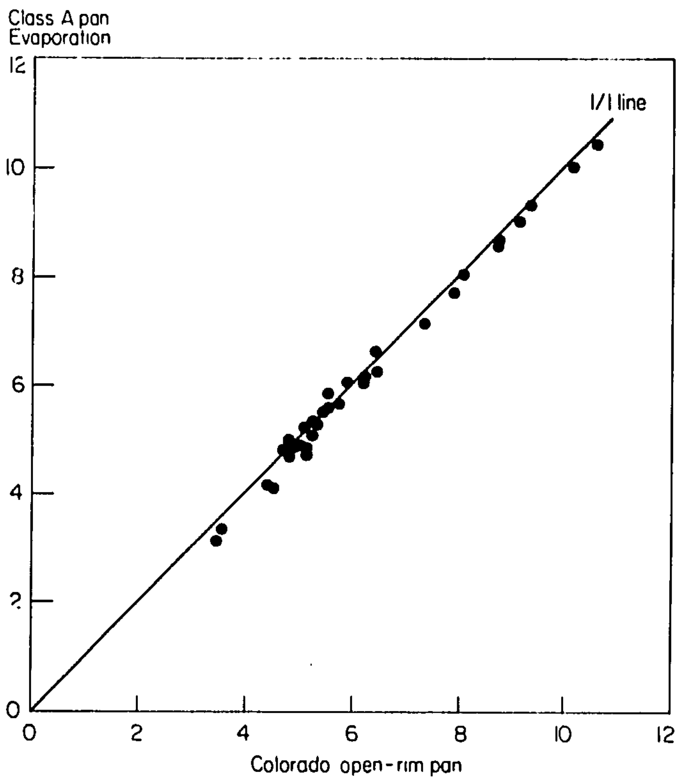

Fig. 3. Relationship between evaporation from a Colorado open rim pan and a Class A pan at the UPLB weather station.

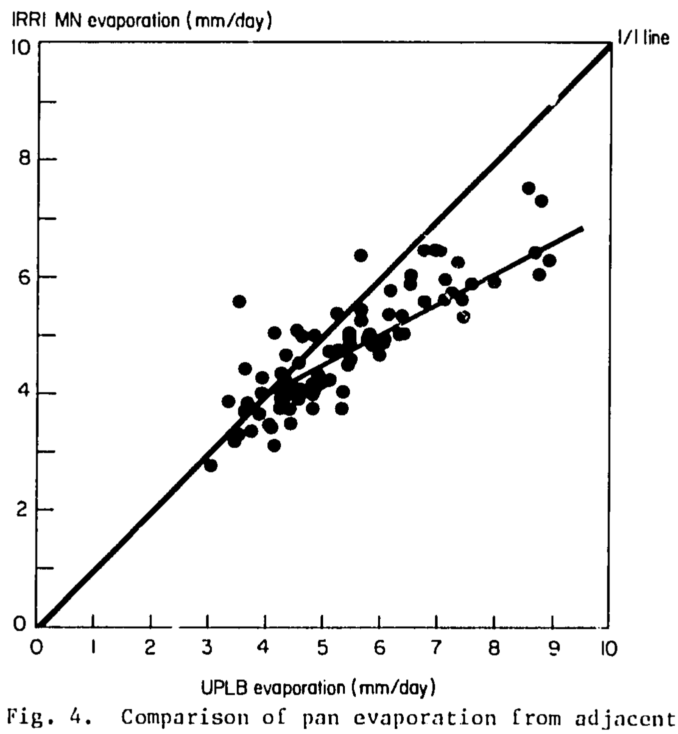

Fig. 4. Comparison of pan evaporation from adjacent upland and lowland sites.

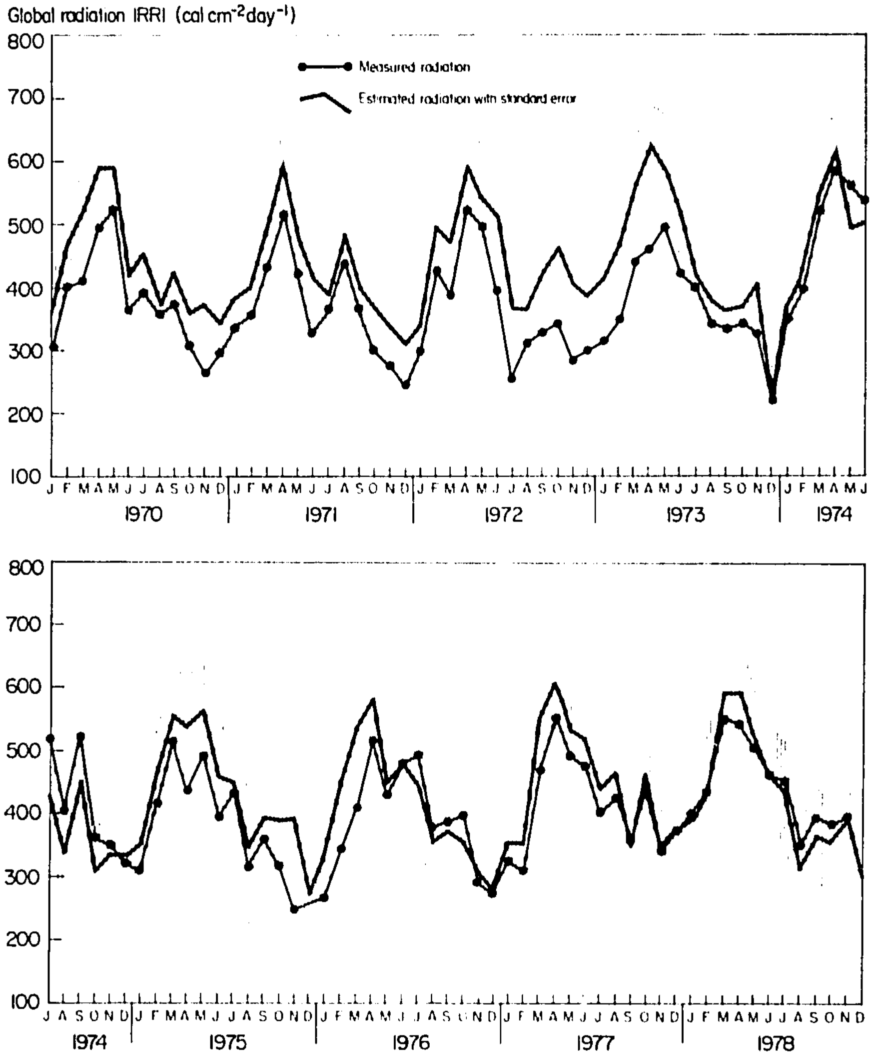

Fig. 5. Measured mean daily radiation for each month from 1970-78 compared to radiation estimated from a regression with sunshine hours.

instrument at the CSIRO Division of Atmospheric Physics, Australia. 2) The lowland evaporimeter was moved from Block MN to Block J10 near the other lowland instruments. Block MN was formerly rainfed but was commanded for irrigation in January 1979.

Use of weather data in interpreting crop performance. The data collected are intended to be relevant to various aspects of crop performance. Some elements have obvious usefulness such as solar radiation which is closely related to the productivity of well-managed irrigated rice, and rainfall and evaporation, important components of the water balance that can be used to estimate stress in rainfed rice.

Where there is a less well-defined environmental effect on crop performance, researchers may be interested in establishing relationships between crop and weather data. Caution is needed because many weather elements are correlated and the parameters selected should be those for which causal connection is known or suspected. For example, phasic development can be related to screen temperature and day length. Crop growth in cool weather may also be related to screen temperature, but the grass minimum may better reflect low-temperature damage. Root development and soil nitrogen transformation could be related to soil and water temperature which may differ from mean screen temperature in some conditions. The incidence and spread of some fungus diseases may be related to relative humidity whereas for other diseases the important elements may be the amount or duration of dew fall which are indicators of wet leaf surface.

INTEGRATED CLIMATIC DATA FILE

Philippine synoptic weather stations are operated by the Philippine Atmospheric, Geophysical and Astronomical Services Authority (PAGASA). A file of weekly climatic data from 47 of these stations (Table 5) was collected and edited. The data supplied were rainfall, maximum screen temperature, minimum screen temperature, wet bulb screen temperature at 0800, and dry bulb screen temperature at 0800.

The relative humidity is calculated from the wet- and dry-bulb data using the Tetens formula (Lowe 1977), and the mean weekly phytoday length by the method of Fleming (1972). Evaporation and solar radiation are not recorded at Philippine synoptic stations, but estimates of mean monthly potential evapotranspiration and solar radiation for most of the Philippine synoptic stations have been made by Tamisin (1977). In that study solar radiation was estimated using the duration of bright sunshine, or, where these data were not available, from records of observed cloudiness. The records of estimated radiation were used along with measurements of wind run and vapor pressure deficit, to calculate evaporation using the modified Penman method (Doorenbos and Pruitt 1977).

We found good relationships between Tamisin's estimates of evapotranspiration and class A pan evaporation for four sites in the Philippines, and also between his estimates and measured mean solar radiation for Los Baños (Fig. 7).

Using these relationships we were able to estimate mean monthly class A pan evaporation and solar radiation for 32 of the 47 synoptic stations. To make estimates for the remaining stations we plotted the available monthly estimates on base maps of the Philippines and interpolated from freehand isopleths. The monthly estimates for all stations were then plotted on a graph and mean weekly values were estimated by interpolation. Estimates of potential evapotranspiration have also been made by Obradovich (1973) using the Thornthwaite method, and the maps produced from his analysis are qualitatively similar to the maps we produced.

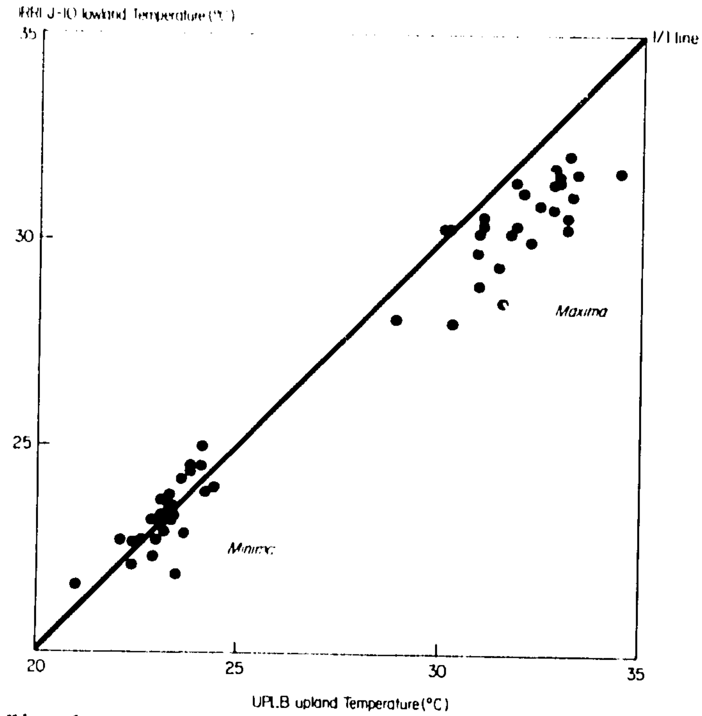

Fig. 6. Comparison of screen temperatures for adjacent upland and lowland sites.

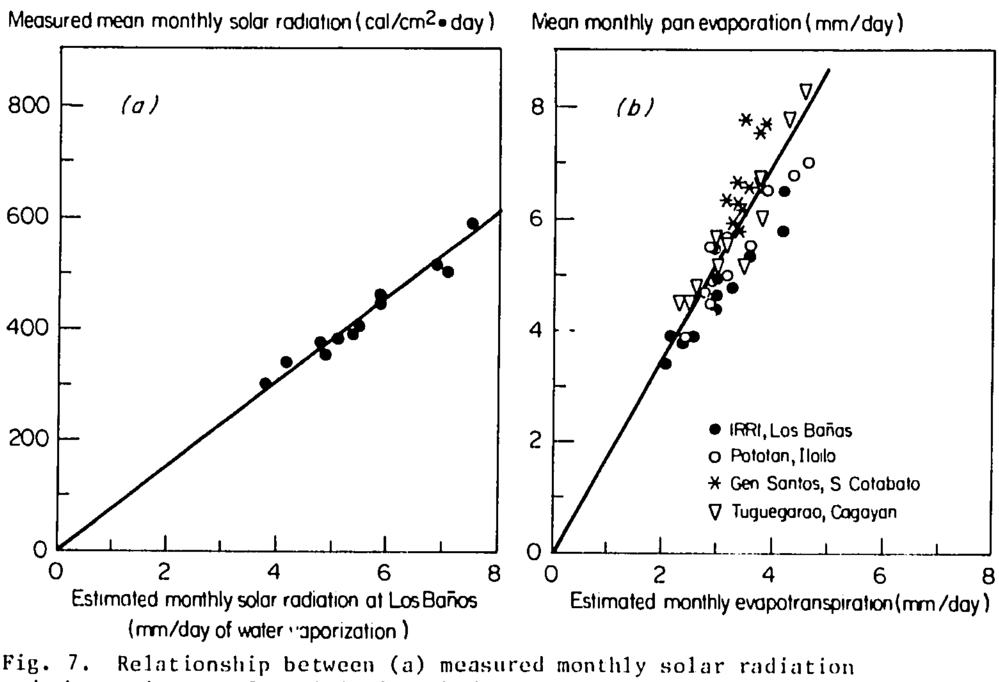

Fig. 7. Relationship between (a) measured monthly solar radiation and the estimates of Tamisin (1977) for radiation at Los Baños, and (b) measured mean monthly pan evaporation and the estimates of Tamisin (1977) for evapotranspiration at 4 well-distributed sites in the Philippines.

Completed data files

The estimates of weekly class A pan evaporation and solar radiation were combined with the data for measured weather elements supplied by PAGASA and the calculated elements of relative humidity and phytoday length.

Because two of the important weather elements, class A pan evaporation and solar radiation, are available only as mean data we computed the means of all weather elements, but retained actual weekly rainfall totals because of its variability. An example of a complete weather file for one station is shown in Table 6. The data are stored as:

- punched cards containing the actual weekly PAGASA data. These data would be useful only to those requiring actual weekly temperature data. (Weekly rainfall in each year of record is included on magnetic tape.)
- magnetic tape held at the ARC. Computer users have access to data for all stations, or for any station identified by its PAGASA number. Data may be printed directly, or used in other ways, such as simulation or classification of climatic regions.
- a master list held by the Agroclimatic Service Unit, IRRI, which also has copies of the monthly evaporation and radiation maps used in estimating weekly data for these elements.

Table 3. Contents of the integrated weather file for Los Baños. The data are stored in EBCDIC code with the integer format 1115.

Year		1- 5
Julian day		6-10
Rain	mm x 10	11-15
Evaporation	mm x 10	16-20
Maximum screen temperature	°C x 10	21-25
Minimum screen temperature	°C x 10	26-30
Dry bulb screen temp. (0800 h)	°C x 10	31-35
Wet bulb screen temp. (0800 h)	°C x 10	36-40
Global radiation flux	cal/cm^2 per day	41-45
Duration of bright sunshine	h x 10	46-50
Phytoday length	h x 10	51-55

Table 2. Climate normals for Los Baños for 1959-78[a] with standard deviations in brackets. All data except solar radiation are from the upland site at UPLB. Solar radiation is from a composite of data from UPLB 1959-69 as modified by Robertson (1971), and from IRRI 1970-78 as modified in this report.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)	44 (46)	20 (31)	27 (24)	30 (33)	189 (195)	237 (116)	266 (158)	256 (109)	273 (150)	235 (176)	280 (143)	178 (143)	2036[b] (454)
Class A pan evaporation (mm/month)	132 (15)	156 (20)	209 (14)	242 (25)	208 (42)	156 (23)	138 (25)	135 (23)	122 (23)	132 (23)	109 (17)	109 (17)	1843[b] (132)
Solar radiation (cal/cm^2 per day)	360 (35)	442 (43)	523 (39)	588 (26)	510 (62)	458 (39)	410 (38)	371 (65)	384 (30)	374 (56)	317 (95)	305 (53)	426[c] (20)
Sunshine duration (h / day)	5.4 (1.1)	6.4 (1.7)	7.4 (1.2)	8.6 (1.7)	7.6 (2.0)	5.8 (1.5)	5.3 (1.2)	5.1 (1.5)	5.3 (1.2)	5.3 (1.3)	4.7 (1.5)	4.5 (1.3)	5.92[c] (0.85)
Maximum temperature (°C)	28.9 (0.9)	29.9 (0.9)	31.6 (1.1)	33.7 (0.8)	34.0 (1.2)	32.8 (0.9)	31.8 (0.8)	31.4 (0.6)	31.4 (0.6)	31.0 (0.5)	30.1 (0.6)	29.1 (0.8)	31.3[c] (0.4)
Minimum temperature (°C)	20.8 (0.5)	20.7 (0.6)	21.4 (0.7)	22.7 (0.6)	23.6 (0.6)	23.4 (0.4)	23.3 (0.6)	23.2 (0.4)	23.0 (0.5)	22.8 (0.3)	22.4 (0.5)	21.9 (0.6)	22.4[c] (0.3)
Dry bulb at 0800 (°C)	24.0 [illegible]	24.3 (0.6)	25.8 (0.7)	27.8 (0.7)	28.8 (0.9)	28.0 (0.5)	27.3 (0.4)	27.0 (0.4)	26.8 (0.5)	26.5 (0.5)	15.9 (0.5)	14.9 (0.6)	26.4[c] (0.3)
Wet bulb at 0800 (°C)	[illegible] (0.8)	22.2 (0.7)	23.1 (0.6)	24.4 (0.5)	25.6 (0.4)	25.4 (0.5)	25.2 (0.3)	25.1 (0.6)	24.9 (0.3)	24.6 (0.4)	23.9 (0.7)	23.2 (0.5)	24.1[c] (0.6)
Relative humidity at 0800 (%)	86 (3.3)	84 (2.3)	80 (2.3)	76 (3.6)	77 (5.6)	82 (3.1)	84 (2.4)	85 (2.5)	86 (3.3)	86 (3.8)	85 (3.1)	87 (2.9)	88 (1.8)
Phyto-day length	11.59	11.87	12.23	12.63	12.98	13.15	13.07	12.78	12.40	12.01	11.68	11.51	

[a]Class A pan evaporation is for 1966-78. [b]Annual totals. [c]Daily means.

Table 4. Weather data collected and reported by the IRRI Agroclimatic Service Unit. Records are taken and charts changed at 0800 except for radiation totals, which are observed after sundown. Observations marked with an * are not reported but the data are obtainable on request.

Weather element	Upland site	Lowland site	IRRI building
Rainfall	Phil. standard gauge Phil. standard gauge with surface-level orifice Casella pluviograph (24 h)*	Phil. standard gauge	
Evaporation	Class A pan with spike gauge (unscreened)	Class A pan with spike gauge (unscreened)	
Solar (global radiation)	Gunn-Bellani radiation integrator		Middleton pyranometer with Breck-Bowles integrator Lambda pyranometer and integrator
Sunshine duration			Campbell stokes sunshine recorder, Casella (London)
Temperature	Screer max - (Hg in glass) Screen min - (alcohol in glass) Continuous screen temperature Weather Measure thermohydrograph* Screen wet and dry - Hg in glass Soil temperature Thermograph 5 and 10 cm deep Weather Measure (Hg in steel)* Grass minimum-(alcohol in glass)	Screen max - Hg in glass Screen min - alcohol in glass Continuous screen temperature Weather Measure thermohydrograph* Screen wet and dry at 0800 - Hg in glass	
Dew fall	Dew recorder R. Fuess (110 cm^2 collector) Berlin-Steglitz		
Wind run	2 m Weather Measure cup anemometer (1 m/s starting speed) 0.75 m Casella cup anemometer* (0.5 m/s starting speed) 10 m propeller*	2 m Weather Measure cup anemometer (1 m/s starting speed)	
Barometric pressure			Microbarograph (7-day chart) (Weather Measure) Hg barometer with attached thermometer
Wind-direction	Indicating console		Observations

Table 5. Weather stations included in the file of Philippine Weather data.

PAGASA Index Number	Synoptic stations of the Philippines	Coordinates Latitude	Coordinates Longitude	Elevation (m)	Start of record (yr)	End of record (yr)	Type of environ- ment[a]
444	Legaspi, Albay	13.13	123.73	19	1951	1974	L
133	Calayan, Babuyan	19.26	121.46	13	1951	1974	L
135	Basco, Batanes	20.45	121.96	11	1951	1974	L
432	Ambulong, Batangas	14.08	121.05	11	1951	1974	L
751	Malaybalay, Bukidnon	08.15	125.08	627	1952	1974	U
232	Aparri, Cagayan	18.36	121.63	4	1951	1974	L
233	Tuguegarao, Cagayan	17.61	121.73	24	1951	1974	L
439	Daet, Camarines Norte	14.08	122.98	4	1951	1974	L
538	Roxas, Capiz	11.58	122.75	3	1951	1974	L
446	Virac, Catanduanes	13.58	124.23	6	1951	1974	U
645	Cebu, Cebu	10.33	123.90	35	1951	1974	L
754	Davao del Sur	07.06	125.60	20	1951	1974	L
553	Borongan, Eastern Samar	11.61	125.43	7	1951	1974	L
223	Laoag, Ilocos Norte	18.18	120.53	5	1951	1974	L
222	Vigan, Ilocos Sur	17.56	120.38	33	1952	1974	L
637	Iloilo, Iloilo	10.70	122.56	14	1951	1974	L
550	Tacloban, Leyte	11.25	124.00	21	1951	1974	U
543	Masbate, Masbate	12.36	123.61	11	1951	1974	L
748	Cagayan de Oro, Mis. Or.	08.48	124.63	6	1952	1974	L
328	Baguio, Mt. Province	16.41	120.60	1501	1951	1974	U
642	Dumaguete, Negro Or.	09.30	123.30	6	1951	1974	U
746	Cotabato, North Cotabato	07.25	124.25	14	1951	1974	L
546	Catarman, Northern Samar	12.48	124.63	6	1951	1974	L
329	Cabanatuan, Nueva Ecija	15.48	120.96	32	1951	1974	L
431	Calapan, Or. Mindoro	13.41	121.18	40	1951	1974	U
526	Coron, Palawan	12.00	120.20	14	1951	1974	L
630	Cuyo, Palawan	10.85	121.03	4	1951	1974	L
618	Puerto Princesa, Palawan	09.75	118.73	16	1951	1974	L
325	Dagupan, Pangasinan	16.05	120.33	2	1951	1974	L
435	Alabat, Quezon	14.08	122.01	1	1951	1974	L
437	Aurora, Quezon	13.33	122.50	4	1951	1974	L
333	Baler, Quezon	15.76	121.56	6	1951	1974	L
336	Casiguran, Quezon	16.28	122.11	4	1951	1974	L
434	Infanta, Quezon	14.75	121.65	7	1951	1973	L
427	Lucena, Quezon	13.93	121.61	157	1951	1970	U
429	Manila, Metro Manila	14.58	120.98	15	1951	1974	L
536	Romblon, Romblon	12.58	122.26	47	1951	1974	L
548	Catbalogan, Samar	11.78	124.88	5	1951	1974	L
851	General Santos, Cotabato	06.11	125.18	15	1951	1974	L
830	Jolo, Sulu	06.05	121.18	13	1951	1972	L
653	Surigao, Surigao del Norte	09.80	125.50	21	1951	1974	L
755	Hinatuan, Surigao del Sur	08.36	126.33	3	1951	1974	L
741	Dipolog, Zamboanga del Norte	08.60	123.35	5	1951	1974	L
836	Zamboanga, Zamboanga del Sur	06.90	122.06	6	1951	1974	L
324	Iba, Zambales	15.33	119.96	5	1951	1974	L
644	Tagbilaran, Bohol	09.63	123.85	5	1961	1974	L
646	Mactan, Cebu	10.30	123.96	8	1972	1974	L

[a] L = lowland, U = upland.

Table 6. Example of complete weather file for one station.

PAGASA	LOCATION	LAT.	LONG.	ELEV.(m)	YEARS OF RECORDS	UPLAND OR LOWLAND
No. 644	Tagbilaran, Bohol	5.63	23.85	5	61-74	(1 - UPLAND)

Week No.	Mean rainfall/ week	Mean class A pan evap/day	Mean global rad/day cal per cm^2	Maximum temperature (°C)	Minimum temper- ature (°C)	Dry bulb at 0800 (°C)	Wet bulb at 0800 (°C)	Relative humidity at 0800 (°C)	Phytoday length (h)
1	32.5	4.0	287.0	30.5	21.8	25.6	23.7	83.8	11.8
2	19.4	4.2	294.0	30.1	21.3	25.4	23.1	80.7	11.8
3	[illegible]	4.4	300.0	30.2	21.2	25.4	23.2	81.7	11.8
4	15.7	4.5	306.0	30.6	21.2	25.5	23.2	81.7	11.9
5	16.8	4.7	309.0	30.5	21.0	23.6	21.3	80.5	11.9
6	28.6	4.8	310.0	30.5	21.3	25.7	21.5	81.3	12.0
7	26.8	4.9	312.0	30.7	21.5	23.8	21.7	81.9	12.0
8	17.8	4.9	322.0	30.9	21.3	25.7	23.2	79.8	12.1
9	25.8	4.9	331.0	30.9	21.4	25.8	23.3	79.6	12.1
10	22.1	4.9	340.0	31.1	21.3	25.9	23.3	79.0	12.2
11	32.6	5.0	349.0	31.2	21.7	26.1	23.6	79.6	12.2
12	12.6	5.2	356.0	31.7	21.3	26.9	23.7	75.7	12.3
13	9.1	5.3	366.0	32.2	21.6	26.7	23.8	77.3	12.4
14	18.7	5.5	375.0	32.5	21.5	26.8	23.8	76.7	12.4
15	14.0	5.7	383.0	32.7	22.1	27.3	24.2	75.7	12.5
16	9.8	5.6	385.0	33.0	22.5	27.7	24.5	75.8	12.6
17	22.1	5.5	385.0	32.8	22.7	27.7	24.7	76.7	12.6
18	16.1	5.3	384.0	33.3	22.9	28.0	24.9	77.0	12.7
19	18.8	5.2	378.0	33.2	23.2	28.0	25.1	77.8	12.7
20	22.6	5.0	365.0	33.0	23.2	28.0	25.1	77.4	12.8
21	20.7	4.9	354.0	33.2	23.7	28.2	25.3	78.4	12.8
22	21.0	4.8	339.0	33.1	23.7	28.1	25.3	78.6	12.8
23	36.2	4.7	326.0	30.7	22.4	26.2	23.4	78.1	12.9
24	37.5	4.7	[illegible]	30.5	21.8	25.7	23.3	80.2	12.9
25	36.2	4.8	312.0	30.1	21.8	25.5	23.3	81.6	12.9
26	30.7	5.0	310.0	31.9	23.4	27.3	24.9	81.6	12.9
27	41.3	5.1	309.0	32.0	23.4	27.3	24.9	81.2	12.9
28	35.1	5.2	310.0	32.1	23.2	27.4	24.9	80.4	12.8
29	20.0	5.2	310.0	32.6	23.6	27.9	25.0	78.2	12.8
30	31.3	5.1	308.0	32.5	23.7	27.8	24.9	77.8	12.8
31	12.0	5.1	303.0	33.2	23.8	28.2	25.0	75.8	12.7
32	26.8	5.0	298.0	30.3	22.1	25.8	23.1	78.5	12.7
33	16.3	5.0	293.0	30.4	22.0	26.0	23.2	77.4	12.6
34	[illegible]	4.8	294.0	30.3	21.9	25.7	23.3	80.3	12.6
35	[illegible]	4.7	295.0	32.3	23.4	27.8	24.9	78.0	12.5
36	15.5	4.5	295.0	32.9	23.7	28.0	25.1	77.9	12.4
37	26.5	4.5	296.0	33.1	23.7	28.1	25.1	76.8	12.4
38	34.5	4.6	295.0	32.7	23.4	27.5	25.0	80.5	12.3
39	41.6	4.7	294.0	32.3	23.4	27.4	24.9	81.0	12.3
40	53.8	4.8	290.0	32.2	23.0	27.2	24.9	82.1	12.2
41	35.1	4.9	284.0	32.1	23.2	27.3	25.0	82.0	12.1
42	51.7	4.7	280.0	32.3	23.0	27.0	24.8	82.7	12.1
43	21.4	4.5	279.0	32.3	22.8	27.1	24.8	82.4	12.0
44	44.5	4.2	279.0	32.3	22.7	27.0	24.7	82.4	12.0
45	52.0	3.9	279.0	32.0	22.6	26.7	24.6	83.2	11.9
46	55.3	3.8	278.0	31.8	22.4	26.5	24.4	83.3	11.9
47	55.1	3.7	273.0	31.5	22.6	26.6	24.5	83.3	11.8
48	25.9	3.7	269.0	31.5	22.3	26.4	24.3	82.9	11.8
49	33.7	3.8	262.0	31.4	21.9	26.3	24.1	82.9	11.8
50	22.5	3.8	259.0	31.6	22.3	26.4	24.2	82.9	11.8
51	23.6	3.7	261.0	31.2	22.2	26.1	24.1	84.0	11.8
52	30.2	3.6	265.0	30.8	22.0	25.9	23.9	83.8	11.8

Actual weekly rainfall for the length of record

21.5	48.5	1.5	2.2	49.5	21.8	36.3	1.5	24.1	0.0	118.3	0.0	7.6
64.5	0.2	0.0	12.4	11.4	41.9	13.7	2.0	36.3	12.6	52.3	49.7	16.7
73.1	19.5	31.2	1.5	0.7	17.0	33.5	11.4	9.6	6.0	0.0	39.3	28.1
57.1	5.8	45.4	10.9	0.2	24.1	47.4	25.9	40.1	57.1	25.1	46.7	27.9
24.6	23.8	0.5	0.5	1.5	102.6	2.2	39.6	35.0	28.9	43.4	4.8	22.6
3.5	11.9	2.0	0.7	0.7	1.0	19.5	34.7	3.3	7.1	91.1	50.5	38.3
36.5	18.5	0.0	88.3	4.3	61.7	30.9	48.0	16.2	27.4	84.5	42.1	4.8
8.3	25.3	76.9	3.8	105.9	9.6	1.2	66.0	68.0	14.9	5.8	16.7	40.8
111.7	1.7	16.2	22.0	1.5	16.5	48.7	29.9	20.8	75.4	9.1	35.5	0.0
0.0	6.3	1.0	27.9	0.0	0.0	13.2	0.7	4.8	0.0	0.5	5.3	3.3
3.8	39.3	19.3	13.2	51.3	24.3	24.3	52.3	8.8	5.5	1.0	59.6	27.4
49.7	12.4	16.7	24.3	46.7	136.9	50.0	49.7	14.4	12.4	27.4	16.7	8.3
25.9	22.4	14.6	26.3	15.6	4.5	43.6	12.8	55.0	0.0	0.6	0.0	6.3
24.8	66.3	48.5	71.0	28.0	92.1	41.0	4.0	22.3	6.3	37.3	43.1	34.5
88.1	65.0	6.5	33.0	2.0	10.0	0.0	47.0	30.0	13.0	105.5	16.0	80.0
62.5	14.0	51.0	27.0	84.8	42.0	58.6	151.1	15.6	15.6	0.5	37.0	59.3
20.6	40.6	62.0	11.5	12.1	7.8	8.2	37.7	0.8	38.4	28.2	46.0	1.0
34.1	67.6	12.3	2.0	0.0	19.0	13.5	4.1	14.3	32.0	47.5	2.8	21.6
14.4	52.8	2.5	24.0	7.1	38.4	15.7	34.5	9.2	75.6	3.3	0.5	31.1
66.9	20.9	82.6	13.7	56.9	14.0	28.0	55.5	22.7	3.5	27.2	17.2	8.3
1.0	7.6	6.3	5.0	0.0	0.5	12.8	22.9	78.0	2.8	10.9	2.8	0.0
0.0	0.0	3.5	6.6	0.0	19.1	36.5	13.2	4.7	11.6	56.0	34.4	5.6
35.0	35.1	55.7	96.3	19.1	30.7	0.0	29.5	68.1	0.0	10.5	16.2	15.4
76.6	13.1	42.9	20.5	2.9	83.6	103.2	10.6	26.2	105.5	35.2	38.6	12.5
50.8	40.6	131.9	23.5	3.1	63.2	71.5	21.9	17.6	69.6	61.5	0.0	11.6
0.0	2.5	39.3	7.2	41.0	5.1	18.8	33.5	0.0	0.0	33.0	75.5	22.2
42.8	79.6	37.9	5.6	0.0	19.2	5.8	35.9	4.9	7.3	0.0	26.5	12.5
95.6	71.9	11.2	3.2	110.4	67.6	35.9	3.8	14.3	0.5	69.8	25.0	19.2
2.3	6.4	3.3	31.5	11.9	28.9	0.0	1.0	0.0	25.8	13.7	5.3	0.0
35.9	0.3	0.3	2.3	39.7	4.8	5.6	30.8	0.5	8.7	17.7	10.7	113.3
6.3	2.7	34.9	8.5	48.2	35.4	4.8	5.4	0.0	1.3	41.3	14.6	30.6
56.5	20.6	26.5	7.5	17.1	24.1	46.2	143.7	8.2	24.2	0.4	6.2	72.8
13.3	7.1	3.1	1.0	0.0	3.0	0.0	0.0	0.0	14.5	0.0	15.8	0.0
0.0	0.5	3.0	10.7	0.0	18.1	11.6	2.5	9.3	164.5	18.3	40.5	6.3
54.9	29.6	59.9	20.0	1.8	24.0	41.7	26.7	63.4	15.2	11.5	29.2	11.0
71.4	16.0	35.5	69.8	3.3	14.0	91.2	29.2	0.0	37.0	12.0	34.8	24.4
14.5	44.2	18.6	42.2	43.6	34.0	17.2	6.4	29.3	0.0	13.1	4.3	8.6
6.1	6.1	0.3	1.3	32.8	7.1	0.0	15.5	17.6	131.8	25.2	70.1	86.8
10.2	49.4	3.1	0.8	5.1	0.0	20.1	33.3	0.0	3.3	31.5	14.8	49.4
2.9	74.7	6.4	21.0	53.3	103.9	6.3	66.0	53.2	6.9	38.3	25.4	11.7
57.5	0.8	0.0	11.7	68.3	79.6	53.1	28.7	0.0	29.0	55.4	0.0	20.4
5.0	9.4	0.3	16.1	53.9	17.1	37.3	77.2	30.7	-2.0	-2.0	-2.0	0.0
75.8	26.8	0.8	2.7	0.0	-2.0	-2.0	-2.0	0.0	16.0	0.0	13.7	77.6
44.8	46.9	218.1	61.6	54.8	80.9	15.0	15.0	68.0	23.5	5.8	22.2	27.5
85.0	18.5	56.0	0.8	6.6	10.7	6.3	27.2	39.4	2.3	93.5	24.7	8.7
17.7	3.3	2.8	1.3	18.3	4.6	0.0	13.5	120.3	0.0	0.5	65.5	20.8
9.8	0.0	0.0	0.0	1.8	8.8	32.5	31.0	109.8	8.3	28.0	5.8	137.7
10.0	7.3	22.5	1.5	5.9	25.0	80.1	36.0	25.0	109.2	3.7	3.3	3.3
9.0	8.8	0.0	0.0	8.2	1.8	0.3	0.0	0.5	1.0	0.3	1.6	32.8
32.8	11.7	8.8	16.7	0.0	3.4	3.4	25.0	21.5	0.0	8.6	19.2	1.5
80.3	62.7	5.3	78.8	17.8	77.1	2.3	48.3	52.0	35.6	36.1	170.8	74.6
76.8	2.8	22.9	20.2	67.9	77.6	135.0	100.3	6.3	39.6	38.8	28.9	68.3
16.7	0.8	5.0	41.0	13.0	26.2	74.5	19.1	61.0	21.7	8.2	36.2	7.9
37.4	10.4	14.7	133.3	0.0	30.2	102.7	33.5	8.2	96.6	99.8	3.8	59.3
47.6	9.1	22.5	65.6	8.3	1.6	0.5	0.5	4.9	2.9	18.4	34.2	2.1
74.3	160.4	64.8	14.5	13.2	25.2	75.5	19.8	0.5	21.8	25.2	11.5	39.1

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