



CHANNEL ISLANDS CLIMATE: ADDENDA TO A MODIFIED
"KÖPPEN CLASSIFICATION OF CALIFORNIA'S CLIMATE"

John W. James*

Introduction

In 1966 this author wrote a paper for The California Geographer titled "A Modified Köppen Classification of California's Climate According to Recent Data"¹, complete with a multi-color map delimiting the various climatological regions of the state. Mainly due to a scarcity of data at that time no attempt was made to classify the climate of Southern California's offshore islands. Through Faculty Research Grants and Geography Department funding, while a member of the University of California, Santa Barbara faculty (1966-68), and later through unfunded research, the author was involved with meteorological studies of the Santa Barbara coast and Channel Islands. Initially this involved the establishment of two weather stations (recording temperature and precipitation, and in one case, evaporation) on the immediate Santa Barbara shoreline plus three others on Santa Cruz Island. Collection of data from these stations continued sporadically until the mid-1970's. Analysis of this data coupled with studies of meteorological information from San Nicolas, Santa Catalina, Anacapa, and San Miguel Islands has led to a better understanding of Southern California's Island Climates. It was also found that in the case of the largest offshore island, Santa Cruz, due to local topography, the interior isn't very "Maritime" at all!

This paper will briefly discuss the temperature regime of the Channel Islands and include them, and the remainder of Southern California's offshore islands, in a revised "Modified Köppen Classification of California's Climates" map patterned after the original publication in 1966. The map, a portion of which is included herein, was printed by the California Department of Water Resources in a special publication in 1975.² This entire topic was the subject

* John W. James is Adjunct Professor in the Department of Geography, University of Nevada, Reno, Nevada 89557, and President of Mtn. West Weather Service, Meteorological Consultants, Reno, Nevada.

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Some Notes on the Temperature Regime of Southern California's Channel Islands

Prior to the mid-1960's the only climate information available for the Channel Islands (from west to east: San Miguel, Santa Rosa, Santa Cruz, and Anacapa) (Figure 1) was sporadic records of precipitation and temperature from San Miguel (1894-1917, 1940-42, and 1945-46), and Anacapa (1946-55).⁴ Official records indicate no measurements on Santa Rosa or Santa Cruz, although cattle ranches on both islands have maintained off-and-on precipitation records from unofficial gauges for many years.

In 1966 three climate stations were installed on Santa Cruz Island - at Chinese (Prisoners) Harbor (temperature), in the Central Valley (temperature and precipitation), and on South Ridge (precipitation). (Figure 2) These stations were maintained by persons taking care of University of California research at the Central Valley Field Station. Charts were changed weekly (or bi-weekly) until the mid-1970's when data collection ended. However, during this roughly ten year period of existence, many blanks occur in the records due to equipment problems, neglect, and general lack of interest. There are enough data, though, to give some insight into a very unusual "interior" climate unknown except to the local ranch owner and workers and to island experts. This "interior" climate is generally devoid of the maritime influences that characterize the California coast and the other offshore islands, especially during the summer half-year.

Santa Cruz Island, largest California offshore island, is oriented west-east, approximately 23 miles long and 7 miles wide at its widest point (Figure 2). The highest elevation on the islands is also here in Picacho Diablo, at a height of 2,450' (Figure 3). Santa Catalina reaches only 2,125', San Clemente reaches 1,965', and Santa Rosa reaches 1,574'. All others have summits less than 1,000'. Santa Cruz Island also has a topographic anomaly not found in the other islands - an interior valley surrounded by summits generally over 1,000' and over 1,500' in the western half of the lowland. This graben, or Central Valley, as it is called (Figures 4 and 5) was caused by the same kind of tectonic forces that at one time isolated the Channel Islands from the onshore Santa Monica Mountains of which they were a part. Thus, with some geomorphic assistance, a climatic oddity was created.

In the early 1960's the owner of most of Santa Cruz Island granted the

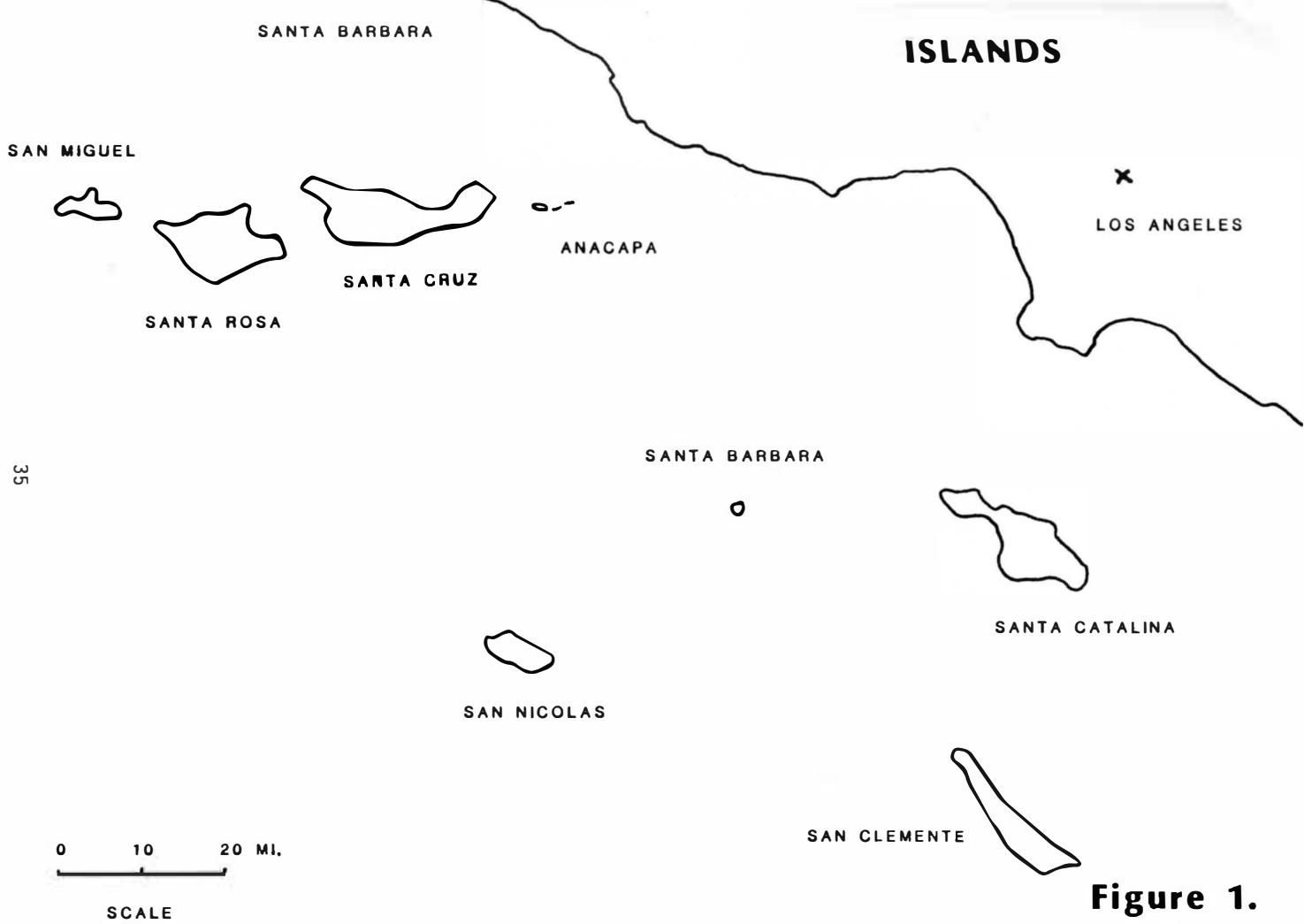


Figure 1.



Figure 2. Santa Cruz Island Weather Stations (circled)

1. Prisoner's Harbor
2. Central Valley
3. South Ridge

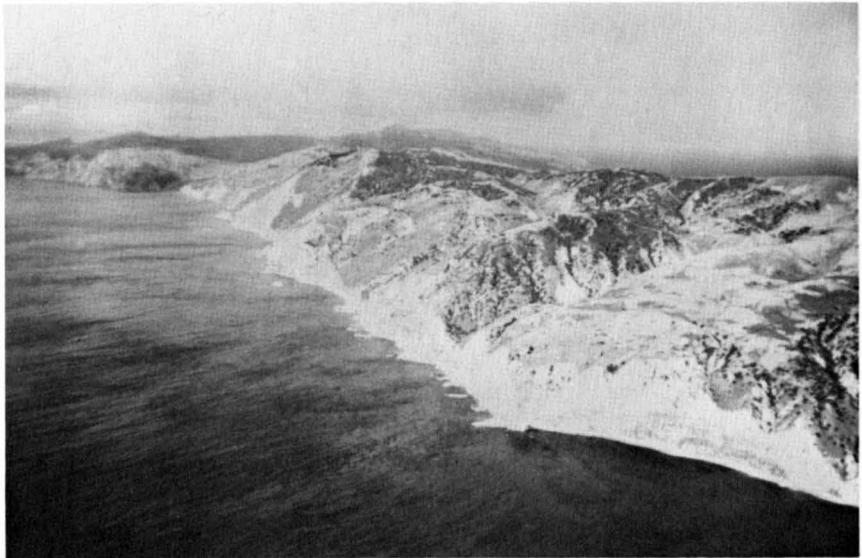


Figure 3. View west, of Santa Cruz Island. Picacho Diablo is high point in background.



Figure 4. View east down the Central Valley Graben on Santa Cruz Island. U.C. Field Research Station is located in trees in valley just over ridge in foreground.



Figure 5. View from South Ridge northwest across Central Valley of Santa Cruz Island toward 2,450' Picacho Diablo, highest point of Southern California's Islands. U.C. Field Research Station is located in trees in valley in lower right hand corner of photo.

University of California the right to conduct various types of scientific research on the island. This research right also included the use of one of the many ranch buildings on the island, in this case in the middle of the Central Valley. The author became involved in coastal research when, arriving in Santa Barbara in 1966, he was told about the hot summers at the Santa Cruz Island research field station as compared to the immediate coastal region. Thus, in the Fall of 1966 hygrothermographs were installed in thermometer shelters at the field station in the Central Valley (Figure 6) and at Chinese Harbor on the north side of the island (Figure 7) about 3 air miles northeast of the Valley station. In addition, recording precipitation gauges were installed at the Central Valley site and at the 1,500' level on South Ridge just southwest of the field station site (Figures 6 and 8).

Although data collection at the Valley site was sporadic it was sufficient to indicate very pronounced temperature differences between the Chinese Harbor and Central Valley sites, especially during the summer half-year. In fact, the climate of the Central Valley (at least the western half where topography isolates the area from marine influences) can be rated as Csa (Mediterranean with a warm summer) as the average temperature of the warmest month, July, is over 73°F. This is greater than the 71.6°F average used by Köppen to separate the "a" and "b" climates and about 11°F higher than that measured at the Chinese Harbor site (62°F). Even in September, normally the warmest month on California's beaches, the Harbor site averaged 64°F (average maximum, 70°F; average minimum, 52°F). Table I summarizes the summer temperature regions for the two sites for the period of record, 1967-74.

TABLE I
Summer Temperatures (°F) at Two Locations on Santa Cruz Island,
California, 1967-74 (all months do not have complete data)

	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>
<u>Chinese (Prisoners) Harbor</u>				
Average Maximum	65	67	68	70
Average Minimum	55	57	57	58
Average	60	62	62.5	64
Highest	81	84	86	92
<u>Central Valley</u>				
Average Maximum	84	92	91	88
Average Minimum	50	54	54	52
Average	67	73	72.5	70
Highest	102	108	109	105



Figure 6. View southwest toward U.C. Field Research Station (in grove of Eucalyptus Trees) in Central Valley of Santa Cruz Island. Weather Station is circled. South Ridge is in background.

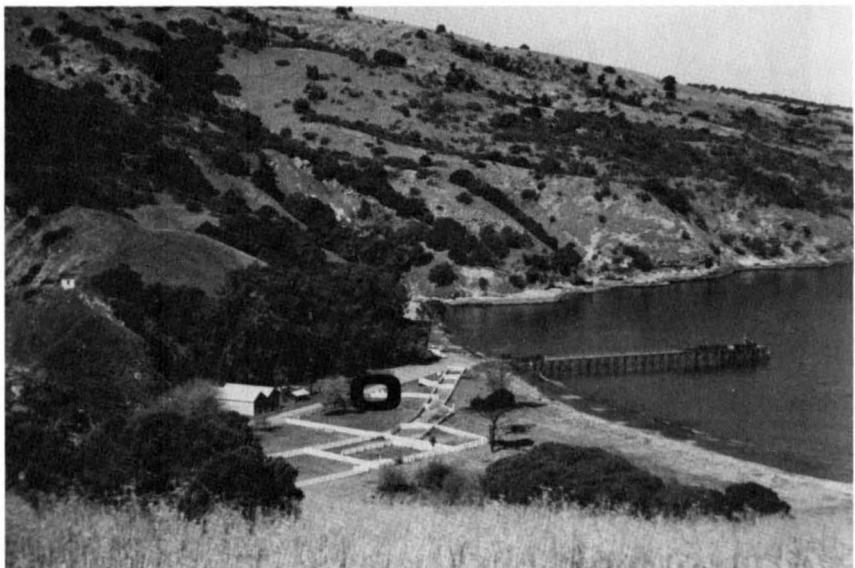


Figure 7. View west overlooking Prisoner's Harbor on north side of Santa Cruz Island. Weather Station is circled.



Figure 8. South Ridge recording rain gage. View south. Elevation 1,500'. Rough wooden barrier is to prevent cattle from damaging gage.

At the Central Valley site 100°F or greater was reached at least once during each July and August of record but during only about half the Septembers; while at the beach site, the mercury passed 90°F only twice during the period of available record and that was during September. In addition, diurnal ranges in the Central Valley occasionally exceeded 60°F (e.g., June, 1968--high of 99°F and low of 38°F; and July, 1971--high of 105°F and low of 44°F). Such diurnal ranges are more common in elevated valley bottoms in dry interior locations but are not common near marine influenced coastlines. However, similar large-scale diurnal temperature ranges were found only 14 miles inland from the central California coast where topography was also the main factor in creating "continental" temperature ranges near the shoreline.⁵

Available temperature data from now nonoperative weather stations on Anacapa and San Miguel Islands show them to be completely marine in temperature. In part, the latter station, even though not contemporary with Chinese Harbor on Santa Cruz, showed similar characteristics, especially during summer.

A Revised Modified K^bppen Classification of California's Climates Map

A portion of the original Climates of California map published in The California Geographer is repeated here as Figure 9 with the addition of the classification of Southern California's islands. For discussion purposes they can be divided into Southern and Northern Groups with the Channel Islands forming the Northern Group and, from west to east, San Nicolas, Santa Barbara, San Clemente, and Santa Catalina forming the Southern Group (Figure 1).

Uninhabited San Miguel Island, the westernmost of the Channel Islands, does not show on the climate map (nor did it on the 1966 map), but it is just 3 miles west of Santa Rosa Island across the San Miguel Passage. Data from a weather station located here many years ago, plus the fact that the island has the lowest elevation of all the islands (high point is 831'), except tiny Santa Barbara, puts it entirely into the Csbn category. Nearby Santa Cruz is somewhat more complex due to the higher interior elevations (high point is 1,574') that do not have the frequency of fog that would qualify for the "n" classification. Thus, the island is shown as Csbn (outer portions of the island) and Csb (interior area, generally above 1,000'). As discussed earlier, Santa Cruz Island is unique among the offshore islands in that a Csa, or warm summer, climate is found in at least the western half of the interior Central Valley. With that exception, Csb and Csbn climates make up the major portion of the island. Uninhabited Anacapa (Figure 10), too small to show on the Climate map and about

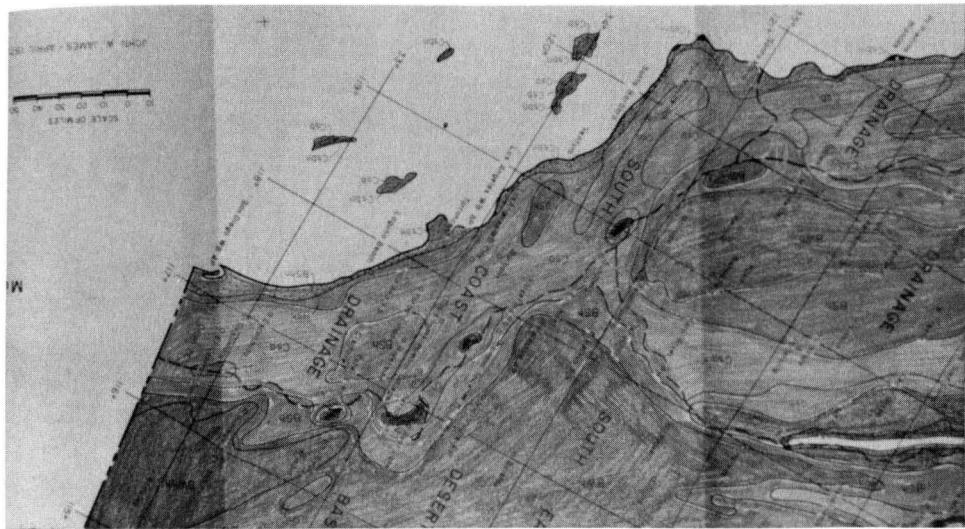


Figure 9. A Modified Körpen Classification of Southern California's Islands.



Figure 10. View east, of Anacapa Island(s). U.S. Navy site and weather station was located here.

5 miles east of Santa Cruz Island, has a Csbn climate.

The westernmost of the Southern Group of Southern California islands, San Nicolas, has a climate that is probably borderline between Bshn and Csbn. Precipitation data collected by the U. S. Navy on the island tends to put it in the former category. However, too much missing data make it difficult to assess the true average precipitation at this site. In addition, although it is a very windy location, no windshield was placed on either the non-recording or recording gauge further depleting the precipitation gauge catch. On the map, San Nicolas is shown as Csbn but could easily be Bshn in the Modified Köppen scheme.

Tiny, uninhabited Santa Barbara Island is probably in the same category as San Nicolas - either Bshn or Csbn climate and probably the former due to lack of elevation (less than 100' above sea level at the highest point compared to 905' on San Nicolas) sufficient to generate orographic precipitation during the winter wet season.

No official weather data have ever been collected on San Clemente Island, southernmost of the California Islands; so the climate there is only supposition. Precipitation is probably lower than on Santa Catalina due to location west and south of that island in a drier region and higher than on San Nicolas. due to greater elevation (1,965'). In fact, the entire island is a long NW-SE tilted fault block with the gentle slope facing west. As much as one third of the island is above 1,000'. This abrupt elevation increase from sea level encourages winter orographic rainfall and should make the island wet enough to qualify for the Csb category with enough foggy days on the island fringes to receive the Csbn classification.

Santa Catalina has the longest weather record of the islands, data having been collected at Avalon since 1909. Records do not indicate any other data collection points on the island, but considering the Avalon data and the island topography, it is thought to have a Csbn climate with Csb in the interior at higher elevations. Although no large interior valley exists, such as the Central Valley on Santa Cruz, the eastern portion of Middle Canyon, west of Avalon on the western slope of the island, may be topographically isolated enough (ridges between 1,000' and 2,000' surround it on 3 sides) to have also a Csa climate.

Conclusion

Climate classification of Southern California's islands is a challenge due to the lack of weather data. Only one island, Santa Catalina, has had a weather record long enough to have great validity. Of the other islands, only

3 (San Miguel, Anacapa, and San Nicolas) have ever had official weather stations, and in all those cases the period of record was short with much missing data making it difficult to assess the climate. Due to a "rumored" unusual "hot summer" interior valley, weather stations were installed on Santa Cruz Island to compare the shoreline and interior climates. These stations operated about 7 years, and although plagued with missing data, indicated that the contrast between the marine and interior locations was great (about 11°F for average monthly temperatures during summer months) due to topographic isolation from the summer marine influence.

The data also showed that a true Mediterranean with a warm summer climate (Csa) existed in a portion of Santa Cruz Island's Central Valley.

Although some question exists as to the exact climate classification of San Nicolas and San Clemente Islands and portions of the interior of Santa Catalina Island (due to lack of data) these areas were included in the revised California Climate map included in this study.

Further research into the climate of Southern California's islands would be an important addition to our understanding of both California's and the Eastern Pacific's physical geography. Such research could lead to further revisions of the California Climates map.

NOTES

1. James, John W., A Modified Koppen Classification of California's Climates According to Recent Data", The California Geographer, Vol. 7 (1966), 11, 1-10.
2. James, John W., Climates of California, California Department of Water Resources Special Publication, 1975.
3. James, John W., "Channel Islands Climate: Addenda to a Modified Köppen Classification of California's Climate", Annual Meeting, California Council for Geographic Education, Redding, 1980.
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5. James, John W., "Nocturnal Temperature Inversions in an Island Valley in California's Coast Ranges", Chapter 2, Arctic and Alpine Environments, W. E. Osborn and H. E. Wright, Jr., editors (Indiana University Press, 1968).