THE CLIMATE OF THE CHANNEL ISLANDS, CALIFORNIA

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ABSTRACT

Climatological data for most of the Channel Islands has been, until very recently, extremely limited. Complete understanding of the environmental interactions of the islands' physical and biological processes requires detailed information about a variety of climatic factors, including temperature, rainfall, windspeed and direction, humidity, soil temperature and moisture, and the amount of fog drip which may be present. Fortunately, this situation is now being rectified as new data become available from a variety of sources. For more than a decade the Department of Geography at California State University, Northridge (CSUN) has been developing a network of weather stations on Santa Cruz and later on San Clemente Islands. These stations, together with those of the National Park Service and other agencies, now make it possible to develop a fairly full picture of variation within and among the Channel Islands. While the record is as yet far too short to draw definitive conclusions, we are at least in a position to develop a number of hypotheses relating to these variations.

Keywords: Channel Islands, climate, weather, instrumentation.

INTRODUCTION

Beginning with a single station on Santa Cruz Island in the mid-1980s, students and faculty of the Department of Geography at California State University, Northridge (CSUN) have gradually expanded a network of weather stations which, together with those of other agencies such as the National Park Service, Ventura and Santa Barbara County Flood Control, and the U.S. Navy, now provide data from throughout the Channel Islands. The department currently maintains an array of eight stations, three on Santa Cruz Island and five on San Clemente Island. The purpose of these stations is to monitor climatological variations found in a maritime environment on and in the vicinity of the Channel Islands, providing a better understanding of the islands' unique physical and biological processes.

This paper represents a preliminary analysis of data that have been collected since 1994 to explore climatological variations and the environment. Meteorological parameters discussed include temperature, relative humidity, wind speed/direction, and precipitation. Analysis of these parameters should provide a better understanding of the islands' influence on certain controls on micro- and mesoscale climatic regimes. Although the records from the automated stations are limited, some annual trends and variations are already identifiable. However, further studies with many additional years of data collection are necessary to develop an in-depth understanding of the climate of the Channel Islands.

PROJECT HISTORY

Work with a portable weather station on Santa Cruz Island led to a contract between CSUN and the Natural Resources Office (NRO) at North Island Naval Air Station in Coronado, California, in 1992. The purpose of the project was to assemble a network of automated weather stations and deploy them in three microhabitats on San Clemente Island. The data was to be used to monitor local meteorological variations in and around the microhabitats and would be used by numerous agencies and universities for environmental studies. Some of the projects include restoration of native flora and studies of endangered species, including the loggerhead strike (*Lanius ludovicianus*) (Hargleroad et al. 1996).

Three Automated Local Evaluation in Real Time (ALERT) weather stations were deployed in three microhabitats: coastal terraces (Eel Point), central plateau (Hoeppel) and eastern escarpment (Nanny). Hoeppel and Eel Point stations were deployed in January 1994, and Nanny was installed December 1994. Eel Point weather station is located on the western coastal terraces at an elevation of approximately 20 m. Hoeppel weather station is located on the central plateau at an elevation of approximately 350 m. Nanny is located near the bottom of the eastern escarpment at an elevation of approximately 68 m.

In addition to the ALERT stations, two portable Campbell Scientific micro-weather stations have been installed. The first was deployed in May 1996 at the Nursery site, in a small valley in the northern part of the island. The second station was deployed at Hoeppel in October 1996 while the ALERT station was under repair, and was then moved to a site near the southern end of the island at Observation Point 1 (OP1). An additional station is planned for installation in November 1998 at Observation Point 3 (OP3) also near the southern end of the island (Figure 1).

In 1995 two additional Campbell Scientific microweather stations were deployed on Santa Cruz Island. The first station was deployed at Prisoners Harbor on the northern side of the island at an elevation of approximately 130 m. The additional stations were installed at Christy Airfield located on the western side of the island at an elevation of approximately 75 m, and at Christy Pines in the mountains in the west-central area of the island at an elevation of approximately 450 m (Figure 2). This network of stations provides data for a detailed examination of inter- and intra-island climatic variations.

GENERAL CHARACTERISTICS OF THE CHANNEL ISLANDS CLIMATE

The only study to address the climate of the Channel Islands as a group is that of Kimura (1974), who examined the climate of the Southern California Coastal and Offshore Zone, and the following discussion is drawn from his paper. Kimura characterized this area as belonging to the Mediterranean Dry Summer Subtropical climatic type, with a cool summer regime. The zone includes the immediate coastal areas of southern California and extends westward to the 121st meridian. Temperatures are controlled by the sea and because of the moist ocean air, the relative humidity at night is generally high (90%), decreasing slightly during the day due to solar radiation. Precipitation is mostly concentrated in winter, with average values between 150 and 360 mm depending on the island.

The dominant climatic control during both summer and winter is the Pacific Subtropical Anticyclone. In summer this cell strengthens and migrates north with its eastern edge over the West Coast. Due to subsidence, air is heated by compression creating a temperature inversion at approximately 600 m. A second inversion is created near the surface from the relatively cold water flowing southward along the coast. These two inversions result in an extremely

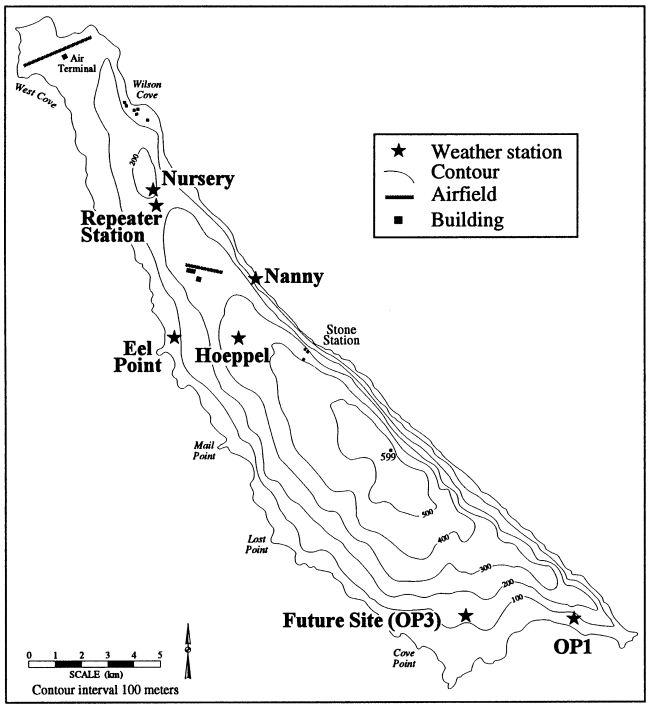

Figure 1. Location map of weather stations on San Clemente Island.

stable environment, effectively preventing the occurrence of precipitation during the summer, although early summer is the cloudiest time of year, with low-lying stratus often accompanied by light drizzle. In mid-summer, an increase in solar radiation causes a decrease in the stratus, and only night and morning coastal cloudiness remains. Thermally-induced lows over the deserts of the Southwest result in an increase in the sea-breeze along the coastal areas. Summer precipitation occurs on rare occasions as a result of moist, maritime subtropical air invading from the Gulf of California, or tropical storms which have moved well north of their usual path.

Although the Pacific Subtropical Anticyclone weakens and migrates to the south in winter, it still dominates the

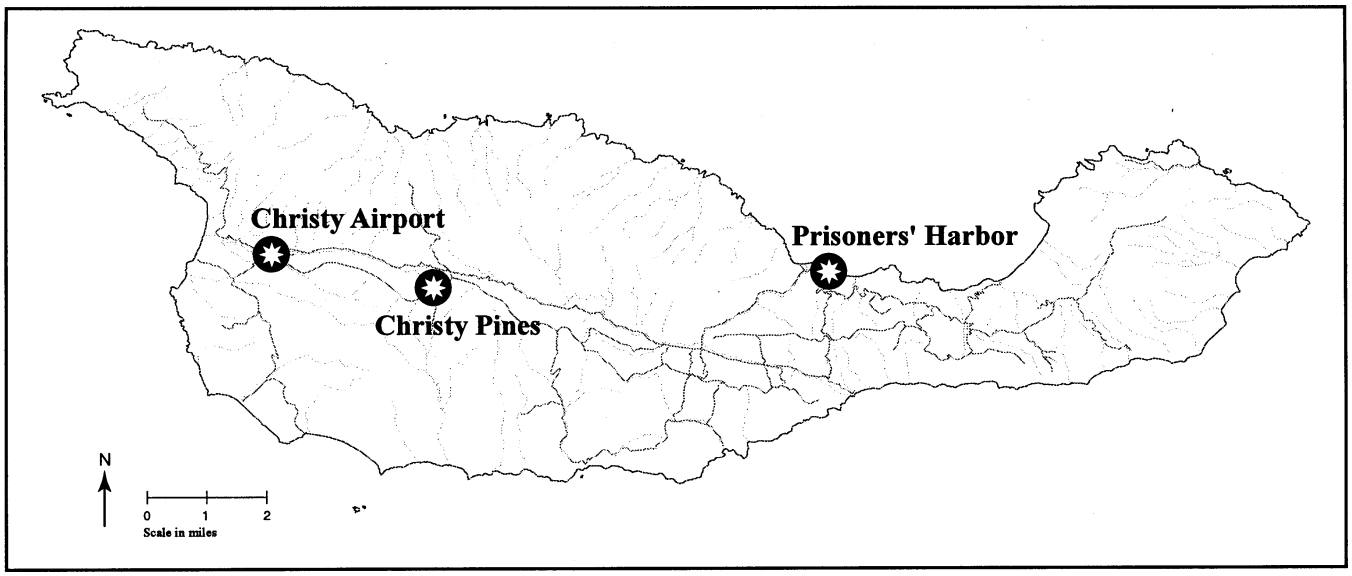

Figure 2. Location map of weather stations on Santa Cruz Island.

weather pattern. Ninety-five percent of the precipitation in this zone falls between the months of November and April. As the anticyclone migrates south, large storms that form in the Gulf of Alaska invade southern California. These storms are short in duration, usually lasting about one to two days, but on occasion some storms last up to a week, bringing great amounts of precipitation. Winds are usually southeasterly in advance of frontal storms but veer to a northwesterly direction as the fronts pass. The northwesterly winds are usually quite strong creating large swells of three meters or more. As high pressure reestablishes over the Great Basin, the flow changes to an offshore component resulting in "cold" Santa Ana conditions with gale and sometimes hurricane force winds with the relative humidity as low as 5%.

The distribution of average annual precipitation varies considerably from north to south. Catalina Island reports an average annual value of 350 mm. A little farther south and farther offshore, San Nicolas Island reports an average annual value of 180 mm while the southernmost island, San Clemente Island, reports an average annual value of 130 mm. Topography is important to the variability of precipitation. The summit of San Clemente Island (nearly 640 m) reports an average annual value of 170 mm of precipitation, virtually all as rain. Drizzle occurs frequently but rarely accumulates to more than a trace. Most of the rain in southern California is the result of frontal storms, which usually advance from the northwest and occur mostly in the winter months.

Air temperature over the Southern California Coastal and Offshore Region is controlled mainly by marine influences. Temperatures are moderated throughout the seasons throughout the year. Diurnal differences also tend to be small, with cool days and relatively warm nights. In the outer coastal waters (including San Clemente Island) lowest monthly mean temperatures are experienced in February while the warmest month is September. For the inner coastal waters the coolest month is January and the warmest is August. The difference is due to the lag time caused by the slower cooling and warming of ocean water compared to land areas. The temperature difference between warmest and coldest months is only about 4°C over the ocean.

Relative humidity readings in and around the Channel Islands vary diurnally. At night and in the early morning hours relative humidity often reaches 100% when the temperatures are the lowest. In the afternoon readings, on the average, drop to about 60% (Kimura 1974). Far lower readings occur during Santa Ana wind episodes in Fall and Winter.

The basic air flow along the Southern California Coastal and Offshore Area is northwesterly, resulting from the semi-permanent Pacific Anticyclone. This anticyclone is most dominant in the warm months, when northwest winds are strongest and most constant (Kimura 1974).

A local factor that affects the climate of the Southern California Offshore Zone is the Catalina Eddy. This vorticity is formed by north and northwesterly winds flowing around the coastal projections and mountains near Point Conception, most common in late spring and early summer. Because the north-south mountains abruptly change to an east-west orientation, the winds recurve, causing a deepening in the cyclonic flow. As the eddy moves down the coast, the winds veer to the south and southeast. The Catalina Eddy is generally centered around Catalina Island, hence the name. As the eddy becomes intense, marine air deepens, forcing the inversion upward allowing for greater vertical mixing. This layer is often 600 to 1000 m deep, sometimes as deep as 2000 m, and influences the development of stratus clouds and fog, delays daytime temperature increases along the immediate coast and coastal valleys, and raises daily minimum temperatures.

METHODOLOGY

The data analyzed in this study was collected from the three ALERT stations on San Clemente Island and the Campbell Scientific micro-weather stations on San Clemente Island and Santa Cruz Island. Each ALERT station is 4 m tall with a diameter of 30 cm. Sensors are powered by a solar panel that feeds into a 12 volt 9.5 amp hour gel cell battery. Each station records data on wind, relative humidity, temperature, and rainfall. Additionally, Eel Point weather station is equipped with a solar radiation sensor that measures total sun and sky (global) radiation. Data at each station is recorded on a 32K-memory board and is automatically transmitted by VHF radio to a base station at field headquarters on the island at Stone Station.

Software at the base station provides fully integrated data analysis, modem support, graphics capabilities, data compression, statistical analysis, custom reports, automated reports and real-time equations. ALERT data is stored in the base station automatically at frequent intervals and is easily accessible for downloading. The Campbell Scientific micro-weather stations are also powered by solar panels. Each station is equipped with numerous sensors including wind, temperature/relative humidity, tipping-bucket rain gauge, soil temperature/moisture and leaf-wetness sensors. Data is stored in modules that are connected to data-loggers which can be easily accessed. The station at Prisoners Harbor transmits data directly to CSUN via satellite. Data discussed in this paper are based on the records from the Department of Geography stations for 1996 through the first half of 1998. Even with this limited data set, some general patterns are evident.

AIR TEMPERATURE

Diurnal differences tend to be small, contributing to cool days and relatively warm nights. The temperature patterns revealed by the analysis of data collected from ALERT and micro-logger weather stations over a period of three years confirms Kimura's analysis of the climate of the Channel Islands region. Although prevailing conditions are mild, extreme temperatures can occur throughout the year.

San Clemente Island

During 1996-1998, the annual mean temperature recorded at Eel Point was 17°C, the mean maximum was 25°C, and the mean minimum was 13°C. The warmest time of the year is August with a mean temperature of 21°C. Mean maximum temperatures for November were also high (particularly at Hoeppel and Nanny) which are attributed to Santa Ana wind conditions. Minimum temperatures are relatively warm throughout most of the year with the exception of the winter months when mean minimum temperatures of 10°C occur (Figure 3).

Hoeppel recorded an annual mean temperature of 17°C, a mean maximum of 29°C and a mean minimum of 10°C. At Hoeppel's elevation of about 350 m, temperatures appear to be less moderated by marine influences and show more temperature variability throughout the year. August has the highest mean temperature of 22°C. Mean maximum temperatures of 36°C occur in August with a secondary peak of 34°C in November, also attributed to the Santa Ana wind condition. Hoeppel also records the lowest mean minimum temperatures from the network. The mean temperature for the month of February is 12°C with a mean minimum temperature of 6°C (Figure 4).

Nanny recorded an annual mean temperature of 18°C, a mean maximum of 27°C and a mean minimum of 13° C. Although Nanny is located on the eastern side of the island near the ocean, marine influences are clearly less important than at Eel Point. August is the warmest month at Nanny with a mean temperature of 22°C. November's mean maximum temperature mirrors Eel Point and Hoeppel with 32°C, once again influenced by Santa Ana wind conditions. The lowest mean minimum temperatures are recorded in the winter months with readings of 10°C (Figure 5).

OP1 and the Nursery micro-logger stations record very similar averages. Again, the highest temperatures are recorded in August with secondary peaks in November and the lowest temperatures occur in January and February.

Santa Cruz Island

The 1996-1998 temperature data records from Santa Cruz Island weather stations are very similar to the temperature records from San Clemente Island. However, some minor differences are noted. Santa Cruz Island annual mean temperatures are 1 to 2°C lower than San Clemente Island, probably due to lower sea surface temperatures around the latter.

Prisoners Harbor recorded an annual mean temperature of 16°C, a mean maximum temperature of 22°C and a mean minimum temperature of 13°C. The warmest mean monthly temperature was recorded in September with a temperature of 19°C. The highest mean maximum temperatures are recorded in August and November with 24°C. The coldest temperatures are recorded in the months of January and February with a mean temperature of 14°C and a mean minimum temperature of 10°C (Figure 6).

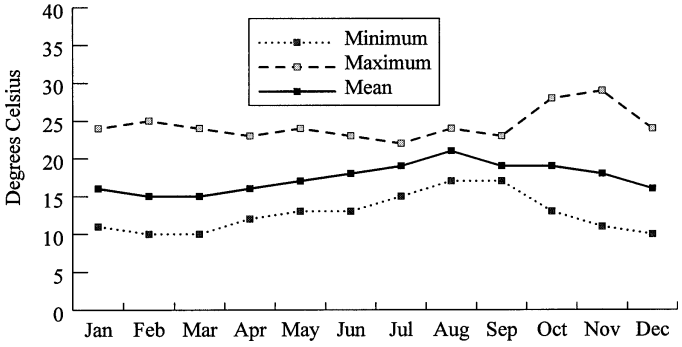

Figure 3. Eel Point monthly temperatures 1996-1998.

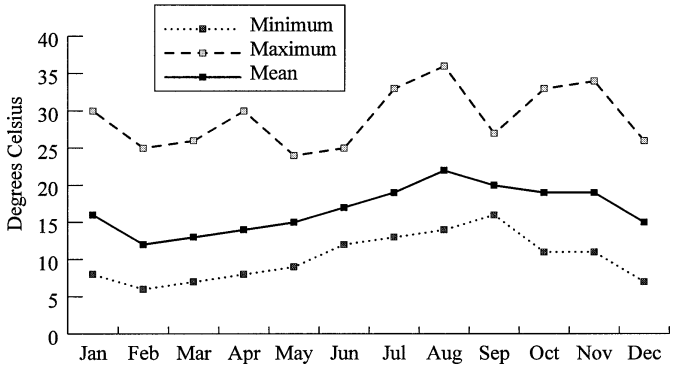

Figure 4. Hoeppel monthly temperatures 1996-1998.

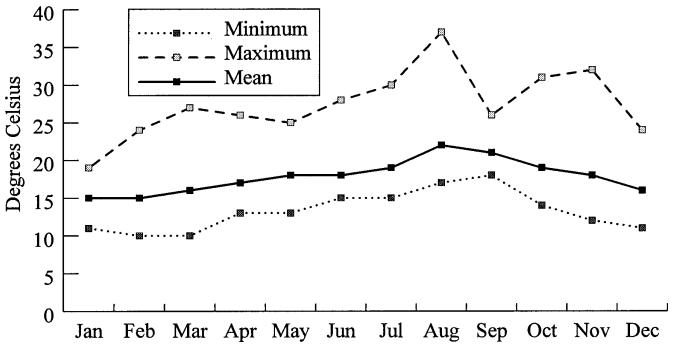

Figure 5. Nanny monthly temperatures 1996-1998.

Christy Airfield recorded an annual mean temperature of 15°C, a mean maximum of 19°C, and a mean minimum of 12°C. The warmest mean monthly temperatures are experienced in September with 19°C. Mean maximum temperatures increase to 26°C in October and November. The coldest temperatures are recorded in January and February with a mean of 12°C and a mean minimum of 9°C in December, January, and March (Figure 7).

At Christy Pines the annual mean temperature is 15°C, with a mean maximum of 23°C, and a mean minimum of 11°C. Similar to Hoeppel, Christy Pines weather station is the highest on the island at an elevation of 450 m and recorded more temperature variability. The highest mean temperature is recorded in September with 21°C. The highest

mean monthly maximum is recorded in August with 32°C. The coldest mean monthly temperature occurs in February with 11°C and a mean minimum of 7°C in March (Figure 8). It should be noted that a fairly dramatic decrease in mean maximum temperatures occurred in June at Hoeppel on San Clemente Island and at Christy Pines on Santa Cruz Islands.

RELATIVE HUMIDITY

San Clemente Island

Eel Point recorded an annual mean relative humidity of 86%, a mean maximum of 100% and a mean minimum of 39%. September has the highest mean monthly relative humidity with 94%. October, November, and December experience the lowest mean readings ranging between 11 to 18%, indicative of Santa Ana wind episodes.

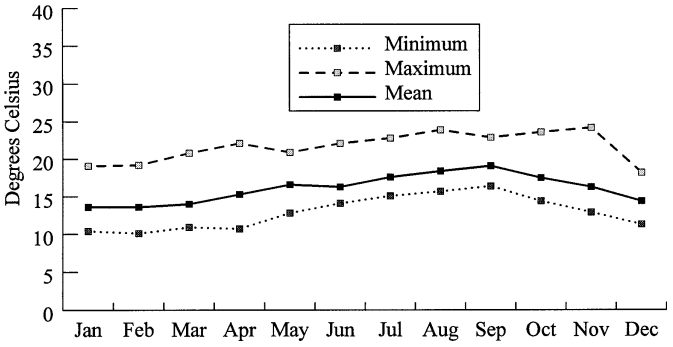

Figure 6. Prisoners Harbor monthly temperatures 1995-1998.

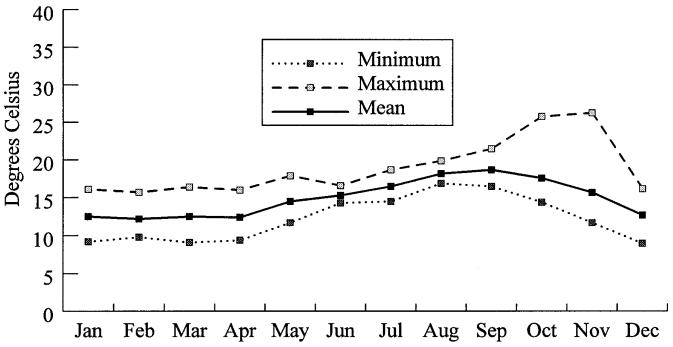

Figure 7. Christy Airport monthly temperatures 1996-1998.

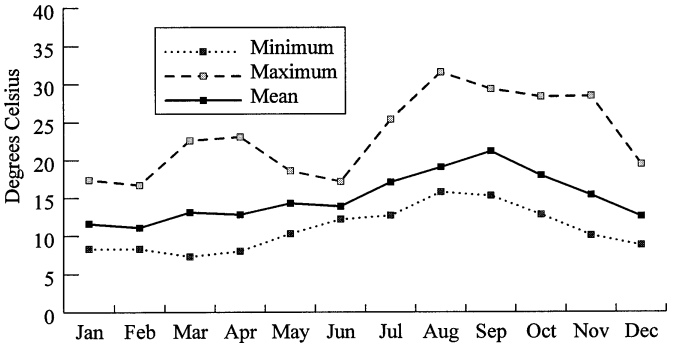

Figure 8. Christy Pines monthly temperatures 1996-1998.

Hoeppel recorded an annual mean relative humidity of 82%, a mean maximum of 98% and a mean minimum of 32%. June has the highest mean relative humidity with 94% and October through December averages the lowest readings ranging between 10 to 12% with Santa Ana winds. At Nanny the annual mean relative humidity is 82%, with a mean maximum of 100% and a mean minimum of 24%. July has the highest mean monthly relative humidity of 90% and the lowest mean monthly minimum ranging between 10 to 13% from October through December with Santa Ana winds. September experiences a significant relative humidity increase at all stations which is not evident in August or October.

OP1 and the Nursery micro-loggers record relative humidity patterns similar to the ALERT stations, with high readings recorded in June, July, and September and low readings recorded from October through December.

Santa Cruz Island

Prisoners Harbor recorded an annual mean relative humidity of 74%, a mean maximum of 100%, and a mean minimum of 12%. The highest mean monthly reading occurs in July and August with 83% while the lowest mean monthly reading occurs in April with 65%. Mean monthly minimums of less than 10% occur in April, May, October, and November.

Christy Airfield recorded an annual mean relative humidity of 79%, a mean monthly maximum of 98%, and a mean monthly minimum of 22%. The highest mean values occur in June, July, and August with 85%. The lowest means occur in October with 67% and mean minima ranging from 7 to 10% occur from October through December. Unlike Prisoners Harbor, Christy Airfield recorded a significant increase in mean monthly minimum readings from mid-April through July.

Christy Pines recorded an annual mean relative humidity of 75%, a mean monthly maximum of 100%, and a mean monthly minimum of 13%. The highest mean occurs in June with 92% with a secondary increase noted in November with 74%. The lowest mean monthly value occurs in October with 60%, with mean minimum readings of 7% in September and December. Similar to Christy Airfield, Christy Pines experiences a dramatic increase in mean minimum readings from mid-April through June.

Unlike San Clemente Island which experiences an increase in mean relative humidity in September, a decrease is evident on Santa Cruz Island. Also, mean readings are lower on Santa Cruz Island compared to those found on San Clemente Island.

PRECIPITATION

The Southern California Coastal and Offshore Zone receives 95% of its annual precipitation from November through April, and over 50% is recorded in the three winter months of December, January, and February (Kimura, 1974). Summer precipitation is very rare, although drizzle

associated with the marine layer and occasionally fog-drip is recorded from June through August. Remnants of tropical storms occasionally affect the Channel Islands in the form of late summer and early fall precipitation.

Topography is clearly an important control on precipitation variability on San Clemente Island and Santa Cruz Island where precipitation patterns are quite variable from one site to the next. San Clemente Island usually receives more precipitation on the northern half and less on the southern half.

San Clemente Island

Eel Point recorded 113.79 mm of precipitation for the 1996-1997 water year (July 1 to June 30). A high percentage of the precipitation fell in November with a total for the month of 53.09 mm. February and March 1997 were unusually dry in southern California including the Channel Islands. No precipitation was recorded at Eel Point. The 1997-1998 water year totaled 285.75 mm of precipitation with the highest amounts recorded in February (112.78 mm). No precipitation was recorded from June through October in 1996 and 1997 (Table 1).

Hoeppel recorded 200.41 mm of precipitation for the 1996-1997 water year. Again, the highest amount fell in November (62.99 mm). The 1997-1998 water year recorded 491.74 mm with the highest amounts recorded in February (182.12 mm). In September 1997, 4.06 mm of precipitation was recorded, as a result of remnants from Tropical Storm Nora (Table 1).

Nanny recorded 125.22 mm during the 1996-1997 water year with 74.93 mm recorded in November. In 1997-1998 416.81 mm of precipitation was recorded with 175.77 mm falling in February. September's 3.05 mm of precipitation resulted from remnants of Tropical Storm Nora (Table 1).

Higher totals for the 1997-1998 water year are attributed to the higher storm frequency during the 1997-1998 El Niño year. The fact that Hoeppel consistently received more precipitation than the other stations is clearly linked to orographic lifting (Table 1).

Santa Cruz Island

Prisoners Harbor recorded 454.90 mm of precipitation for the 1996-1997 water year. The highest monthly total was recorded in January with 223.50 mm. All summer months in 1996 received precipitation either in the form of drizzle or fog-drip. A dramatic precipitation increase was recorded in the 1997-1998 water year with 948.65 mm recorded, with 413.74 mm falling in February (Table 1).

Christy Airfield recorded 148.86 mm of precipitation for the 1996-1997 water year with the highest monthly total recorded in January with 126.51 mm. In the 1997-1998 water year a total of 764.28 mm was recorded with the highest monthly total recorded in February with 333.23 mm (Table 1).

Christy Pines recorded 280.16 mm for water year 1996-1997 with the highest monthly total recorded in January (126.51 mm). Of the three stations on Santa Cruz Island, Christy Pines had the highest 1997-1998 water year total of 1081.51 mm of precipitation with the highest monthly total recorded in February with 469.08 mm (Table 1).

The 1997-1998 water year totals recorded on Santa Cruz Island are quite impressive and are linked with the 1997-1998 El Niño event. Totals recorded on that island in February 1998 exceeded many annual totals recorded on San Clemente Island (see Boyle and Laughrin, 1999). Christy Pines, like Hoeppel on San Clemente Island, experienced the highest precipitation totals, also the result of orographic lifting (Table 1).

WIND

Unfortunately, due to sensor malfunction and configuration problems, ALERT wind data is unavailable for San Clemente Island between 1996 and 1998. The two microloggers, OP1 and the Nursery, are the source of wind data in this section and provide a general view of air flow over the island.

San Clemente Island

The Nursery station recorded northwest winds over 50% of the time between 1996 and 1998. On average, the speed ranged between 4 to 6 meters per second (m/s). Higher gusts from the north-northeast of between 8 to 10 m/s occasionally occur in association with Santa Ana wind episodes.

OP1 experienced different average wind directions throughout the study period. In 1996, the dominant wind flow was between the north and the northeast 56% of the time. The average speed ranged between 4 to 6 m/s. Occasionally, gusts from the north exceeding 14 m/s occurred. Southwest winds were also very common and included gusts over 14 m/s. In 1997, the pattern remained very similar to that of 1996. However, some minor fluctuations are noted. Winds exceeding 16 m/s occurred from the northeast and the south. The southerly winds are in response to the prevailing flow ahead of frontal systems that invade the area in the winter months. In 1998, the flow changed from a prevailing north-northeasterly wind to north-northwesterly and southerly winds with gusts exceeding 16 m/s. This change may be indicative of increased storm activity during the 1997-1998 El Niño Event.

Santa Cruz Island

The prevailing wind flow at Prisoners Harbor is from the northwest. Average speeds range between 4 to 6 m/s. South-southwesterly winds are also a common occurrence. Stronger gusts exceeding 10 m/s occur from the west-northwest and northerly directions. Christy Airfield recorded a majority of wind from the west-northwest direction with speeds averaging between 4 to 6 m/s. Stronger gusts to 10 m/s commonly occur from the east-northeast during Santa Ana wind episodes. Christy Pines recorded a westerly wind approximately 75% of the time with average speeds ranging between 4 to 6 m/s. Stronger gusts measure between

Table 1. Rainfall totals for San Clemente Island and Santa Cruz Island.

San Clemente Island

OP1	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Calendar Year	Water Year
1996							0.0	0.0	0.0	8.9	41.2	24.4	74.4	141.5
1997	66.8	0.0	0.0	0.3	0.0	0.0	0.0	0.0	5.3	0.5	15.2	109.7	197.9	
1998														

Nursery	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Calendar Year	Water Year
1996					3.3		0.3	0.3	0.3	12.7	76.5	31.5	124.7	202.4
1997	77.5	1.0	0.8	1.5	0.3	0.0	0.3	0.8	3.3	2.8	15.2	80.8	184.1	
1998														

Eel Point	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Calendar Year	Water Year
1996	0.0	17.3	8.1	3.0	0.0	0.0	0.0	0.0	0.0	6.1	53.1	18.3	105.9	113.8
1997	35.3	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	14.2	69.1	119.6	285.8
1998	1.5	112.8	53.1	26.9	8.1	0.0	0.0	0.0					202.4	

Hoeppel	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Calendar Year	Water Year
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.1	63.0	32.0	115.1	200.4
1997	84.3	0.0	0.0	1.0	0.0	0.0	0.0	0.0	4.1	21.1	22.4	94.2	227.1	491.7
1998	38.6	182.1	85.1	27.9	16.3	0.0	0.0	0.0					350.0	

Nanny	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Calendar Year	Water Year
1996	0.0	25.1	19.3	7.1	0.0	0.0	0.0	0.0	0.0	16.0	74.9	34.3	176.8	125.2
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	4.1	29.2	72.1	108.5	416.8
1998	22.4	175.8	72.1	26.9	11.2	0.0	0.0	0.0					308.4	

Santa Cruz Island

Prisoners Harbor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Calendar Year	Water Year
1995						4.8	0.0	0.3	0.0	0.0	2.5	27.9	35.6	53.6
1996	0.8	0.3	1.5	18.5	1.0	0.8	0.3	0.3	0.8	35.8	38.6	154.9	253.5	454.9
1997	223.5	0.0	0.0	0.3	0.0	0.5	0.0	1.0	0.5	0.0	56.9	297.7	580.4	948.7
1998	72.9	413.7	67.8	38.1	53.1	0.8							646.4	

Christy Pines	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Calendar Year	Water Year
1996												57.4	57.4	280.2
1997	221.2	0.0	0.0	0.3	0.3	1.0	0.5	3.3	1.5	0.0	68.8	302.0	599.0	1081.5
1998	113.3	469.1	77.5	45.5	75.7	1.0	2.5	0.0					784.6	

Christy Airfield	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Calendar Year	Water Year
1996												21.8	21.8	148.9
1997	126.5	0.0	0.0	0.0	0.0	0.5	0.0	0.5	2.0	0.0	63.8	208.6	401.9	764.3
1998	69.9	333.2	53.1	33.3	43.9	0.8	0.0	0.0					534.1	

10 to 12 m/s from the northeast during Santa Ana wind episodes. Wind patterns on Santa Cruz Island are discussed in greater detail by Boyle and Laughrin (1999, this volume).

CONCLUSION

This paper provides a brief summary of the preliminary analysis of meteorological data collected from automated weather stations located on San Clemente Island and Santa Cruz Island operated by the Department of Geography at CSUN. Integration of these data with data from stations currently maintained by other agencies can provide a much more detailed analysis of conditions on several islands individually, and of the Channel Islands as a group. In addition, many more years of data collection and analysis involving all the Channel Islands is necessary for a thorough understanding of the meso- and micro-climate behavior offshore. Additional weather stations throughout the Channel Islands, and the integration of all existing data, give promise of soon providing students of the region with a great deal of useful, specific climatic information.

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