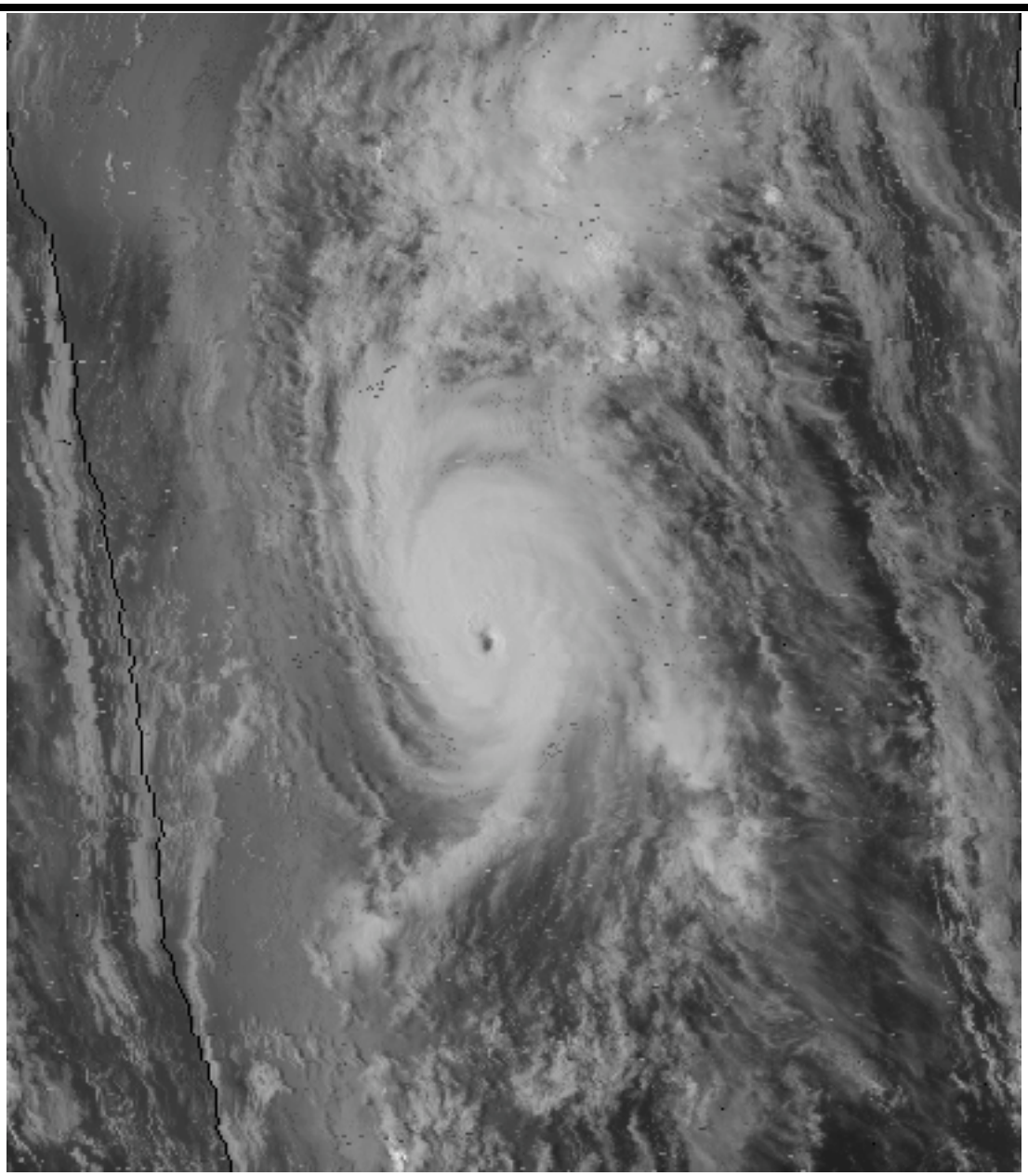

Comments on the Weather Conditions Observed in the Vicinity of the Coco Palms Resort, Wailua, Kauai, Hawaii in Association with Hurricane Iniki, September 11, 1992

Report Prepared by John P. Monteverdi, PhD, CCM
August 26, 1998

Mayacamas Weather Consultants

Executive Summary

- Hurricane Iniki rapidly crossed the island of Kauai between 1500 and 1620 Hawaii Standard Time (HST) on 11 September 1992
- The eye of the storm passed across the Hanapepe area around 1520 LST and exited near Hanalei at 1610 LST
- Sustained winds around the storm at peak intensity rate it just in Category 4 on the Saffir-Simpson Scale
- The track of the storm explains why the strongest effects of the hurricane were restricted to the south facing shore and a relatively narrow band from Hanapepe to Hanalei Bay
- Effects in the Coco Palms Resort area were maximum in the period from 1400 to 1600 HST
- Sustained winds of 80-90 mph with gusts to 115 mph were observed at Lihue AP during the period 1400 to 1600 HST
- Rainfall rates of over 0.80" per hour were observed at Lihue AP for the hour ending 1500 HST
- The Lihue wind gust of 115 mph was the strongest gust observed for the period of record on file at the National Climatic Data Center (period 1967-1998)
- The hourly rainfall rate at Lihue AP at the time of Iniki's passage exceeded the minimum value for the HEAVY category
- Damage in the Coco Palms Resort area was consistent with that observed for F2 tornadoes
- The opinion of the consultant is the combination of peak wind gusts, sustained winds, hourly rainfall intensity is consistent with the damage reported in the area
- The opinion of the consultant is that the combination of peak wind gusts, sustained winds and hourly rainfall intensity during the period 1400-1600 HST should have caused significant stress to windows and that significant bowing of windows within their frames would be expected. The consultant has been advised that such damage has been analyzed by structural engineers and architects in separate reports.
- The opinion of the consultant is that significant damage to unprotected/unroofed structures on the site would have occurred due to several extraordinary daily rains in December 1992, particularly the torrential daily total that occurred on December 26, 1992. Hourly rainfall intensity during this event could be expected to cause flash flooding and coastal flooding in periods of high tides.

1. Purpose of the Report

This report provides a brief overview of the conditions observed in the vicinity of the Coco Palms Resort while Hurricane Iniki was traversing the island of Kauai. The report is prepared for the firm of

2. Principle Investigator for the Study

3. Setting

The Coco Palms Resort is located on the east shore of the island of Kauai, approximately 6 miles north of Lihue (Fig. 1). The relatively close proximity of the Coco Palms to Lihue, the nearest site where a full time National Weather Service observing site is located, implies that the weather data recorded at Lihue is representative of the conditions at the site.

4. Iniki

A Tropical Depression that had tracked from just off the coast of Central America to about 1500 miles west of Acapulco, Mexico intensified to form Tropical Storm Iniki on 5 September 1992 (Fig. 2; Table 1). The storm intensified to Hurricane status on 9 September 1992 when it was about 500 miles southeast of Hilo. The disturbance tracked rapidly across the western portion of the Hawaiian Island group. Transit across the island of Kauai took less than 2 hours, the period between 1500 and 1630 HST on 11 September.

The information shown in Table 1 shows the status of the storm at the issuance of each advisory (numbered on left). Latitude and longitude coordinates are given at each date and time, with sustained wind speed (knots) in the eye wall and storm status. Note that Iniki became a minimal Category 4 hurricane (131 – 155 mph; see also Table 2) for the period 06 GMT 11 Sept through 00 GMT 12 September (1900 HST 10 Sept through 1300 HST 11 Sept). Thus, the storm was near or at peak strength just as it encountered the island of Kauai, and maintained Category 3 strength (111-130 mph) in its transit of the island. The eye of the storm passed across the Hanapepe area around 1520 LST and exited near Hanalei at 1610 LST.

ADV	LAT	LON	TIME	WIND	PR	STAT
1	11.90	-133.00	05/18Z	25	1010	TROPICAL DEPRESSION
2	11.90	-135.90	06/00Z	25	1010	TROPICAL DEPRESSION
3	12.00	-137.20	06/06Z	25	1010	TROPICAL DEPRESSION
4	12.10	-138.50	06/12Z	30	1009	TROPICAL DEPRESSION
5	12.20	-139.80	06/18Z	30	1008	TROPICAL DEPRESSION
6	12.30	-141.10	07/00Z	25	1008	TROPICAL DEPRESSION
7	12.30	-141.70	07/06Z	25	1007	TROPICAL DEPRESSION
8	12.20	-142.40	07/12Z	30	1006	TROPICAL DEPRESSION
9	12.10	-143.00	07/18Z	30	1004	TROPICAL DEPRESSION
10	12.00	-144.50	08/00Z	35	1002	TROPICAL STORM
11	12.00	-146.00	08/06Z	40	1000	TROPICAL STORM
12	12.10	-147.50	08/12Z	40	1000	TROPICAL STORM
13	12.30	-149.00	08/18Z	50	996	TROPICAL STORM
14	12.40	-150.20	09/00Z	60	996	TROPICAL STORM
15	12.70	-151.60	09/06Z	65	992	HURRICANE-1
16	13.00	-152.90	09/12Z	65	992	HURRICANE-1
17	13.40	-154.30	09/18Z	80	984	HURRICANE-1
18	13.80	-155.50	10/00Z	85	980	HURRICANE-2
19	14.30	-156.90	10/06Z	90	960	HURRICANE-2
20	14.70	-157.80	10/12Z	100	960	HURRICANE-3
21	15.20	-158.60	10/18Z	100	951	HURRICANE-3
22	15.90	-159.30	11/00Z	110	948	HURRICANE-3
23	16.80	-159.80	11/06Z	115	947	HURRICANE-4
24	18.20	-160.20	11/12Z	120	939	HURRICANE-4
25	19.50	-160.00	11/18Z	125	938	HURRICANE-4
26	21.50	-159.80	12/00Z	115	945	HURRICANE-4
27	23.70	-159.40	12/06Z	100	959	HURRICANE-3
28	25.70	-159.00	12/12Z	80	980	HURRICANE-1
29	28.10	-158.90	12/18Z	80	980	HURRICANE-1
30	30.40	-158.80	13/00Z	65	990	HURRICANE-1
31	33.00	-158.70	13/06Z	65	990	HURRICANE-1
32	35.00	-158.50	13/12Z	50	1000	TROPICAL STORM
33	36.70	-158.10	13/18Z	40	1002	TROPICAL STORM

Table 1. Location, Strength and Status Information for Iniki

Rating	*Sustained Winds*
Category 1	74-95 mph
Category 2	96-110 mph
Category 3	111-130 mph
Category 4	131-155 mph
Category 5	>155 mph

Table 2. Saffir-Simpson Hurricane Scale

5. Effects in Kauai

The rapid motion and track of the storm together with the relatively narrow width of the most active central portion of the storm meant that the

strongest impacts occurred in the western portion of the island. Accompanying effects, such as, storm surge damage, were restricted to the south facing beaches of Kauai.

The position of the Coco Palms Resort on the eastern shore protected it from the strongest effects of the storm. Neverthless, extremely strong winds in combination with brief, very heavy rainfall in the Lihue area did not spare the area from damage.

Fig. 3a and 3b shows the distribution of peak wind gusts and rainfall totals in the Hawaiian Islands for 11 September 1992. The length of the arrows are proportional to the wind speed and the orientation indicates direction. Rainfall totals are color coded with maximum values in red across Kauai.

Peak wind gusts were on the order of 125 knots west of offshore Kauai to in the 100 knot range across the whole island, including the Lihue area. Peak wind speeds occurred when the storm center was about to exit the northern portion of the island and, thus, wind directions were southwesterly at that time (Fig. 3a).

Fig. 4 shows a timeline depicting hourly rainfall and average peak wind gust through September 11, 1992 for the Lihue AP National Weather Service observing site. Note that hourly rainfall totals approaching 0.90" per hour occurred about the time that the peak gusts for the day were occurring. The actual peak gust (not depicted) of 115 mph occurred just after the heaviest rainfall.

Fig. 5 shows the average daily wind speed (kts) and peak gust speed (kts) for September 1992 at Lihue. The passage of the hurricane is dramatically shown in the data. Fig. 6 shows the daily rainfall (in.) and peak wind gusts (kts) at Lihue for September 1992. The rainfall total on 11 September was 1.76."

6. Climatological Perspectives

a. Rainfall

The daily total at Lihue AP of 1.76" on 11 September 1992 was not a particularly remarkable 24 h rainfall amount, based upon examination of the historical record. Return period for such an amount is less than 2 y. However, the 24 h total was unusual in the sense that it represented a substantial fraction of the long term normal rainfall for September. Table 3

gives the normal[1] monthly and annual rainfall for Lihue AP. The normal monthly rainfall for Lihue AP is 2.37". Thus, Lihue received approximately 74% of the normal monthly rainfall in a few hours.

PRECIPITATION (in.)
Water Equivalent
-Normal

J	F	M	A	M	J	J	A	S	O	N	D	Ann
5.89	3.33	4.17	3.50	3.15	1.69	2.13	1.76	2.37	4.41	5.45	5.15	43.00

Table 3. Normal Monthly and Annual Rainfall, Lihue AP
(Source: USDC Climatological Data, Hawaii, 1961-1990 Averages

Fig. 7 gives other climatological information for Lihue AP. Of interest is the normal average daily rainfall for September, which ranges from .05" per day for the beginning fo the month, to about 0.10" per day by the end of the month. While the 1.76" that fell in association with Hurricane Iniki is not an atypically heavy total for Lihue at other times of the year, it was an unusually large 24 hour amount for a September day.

Fig. 8 shows the probability of daily rainfall totals of 0.10" or greater and 1.50" or greater at Lihue AP. The rather low historical frequency of heavy rainfall events in September is reflected in the 1-2% probability of totals greater than 1.50". From this standpoint, the rainfall associated with Iniki can be considered somewhat unusual.

The hourly rainfall total of nearly 0.90" between 1400 and 1500 HST is quite heavy. In its guidance to weather observers for reporting hourly present weather, the National Weather Service (Federal Meteorological Handbook 1, 1995) requires any total greater than 0.30 in to be recorded as heavy (that is, the top category of four to characterize rainfall intensity). Thus, the peak hourly rainfall at Lihue AP on 11 September was three times greater than the minimum value set for the "heavy" category.

b. Wind

Sustained winds in the 90 mph range with gusts to 115 mph were recorded during the peak of the storm in the Lihue area. While these winds were considerably less strong than those observed further west in Kauai, they clearly were remarkable. Fig. 9 shows the daily peak gusts at Lihue AP for the period of record (1967-1998; data not available at the Western Regional Climate Center previous to 1967). The reader will

[1] Normal is defined as the 30 y average of the given element for ther period ending the last even year of the previous decade. In this case, the normal is defined on the basis of the data for the period 1961-1990.

note that the peak gust for 11 September 1992 stands out as the strongest during the period of record. In fact, only two other events had gusts even greater than 65 knots.

Finally, despite the fact that wind speeds seemed less significant in Lihue on 11 September than in other areas of the island, one must keep in mind that the damage potential of wind gusts greater than 100 mph is very high. Tornado events are also categorized; however, this categorization is based upon the damage observed with such events. There are six categories of tornado ratings in the so-called Fujita-scale (Table 4). For each category, the National Weather Service issues Tornado Warnings; even in the lowest category potential for damage, injury and fatalities is high. In general, F2 and greater tornadoes are considered "strong" and are associated with the greatest loss of life and damge in the United States.

The winds associated with Iniki, if associated with a tornado, would have classified the event as an F3 (severe tornado) in the western portion of the island and F2 (significant tornado) in the eastern portion (and the Lihue area). Significant tornadoes are likely to uproot or snap large diameter trees, remove roofs, move small vehicles, cause substantial flying debris and destroy small structures. The damage in the Lihue area was consistent with that observed with an F2 tornado.

c. Winds in the Coco Palms Resort

It is difficult, if not impossible, to estimate actual winds in the Coco Palms Resort complex during the passage of Iniki. Certainly, wind gusts in the 115 mph range occurred in the area, with sustained winds in the 80-90 mph range. It is also true that the wind direction at time of peak speeds was southwesterly, so that the southern and southwesterly exposure of buildings in the facility would have taken the direct brunt of the winds.

However, a complex with many buildings, as is the case of the Coco Palms Resort, would create a very complicated microscale set of interactions. In some areas the wind speeds would have been augmented, and in others, wind speeds would have been dampened. In addition, eddies (areas of swirl) generated by the buildings could have produced unusual wind directions and speeds on "downwind" sides of the buildings. Such "eddying" of the wind would have been highly variable in space in time (comparable to the effects one experiences around tall buildings on a windy day).

This consultant does not feel that any statement about the EXACT nature of the wind speed and direction around each building can be made. General winds in the 100 mph range did occur in the area of the Coco Palms and the damage on the site is consistent with that.

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well constructed houses; trains overturned; most trees in fores uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	disintegrate; automobile sized missiles fly through the air in excess of 100 meters

Table 4. Fujita Scale of Tornado Intensity

7. Rainfall in December 1992 in the Lihue Area

Very heavy rainfall occurred in the Lihue area in December 1992. Fig. 10 shows the daily rainfall and average daily wind speeds observed at Lihue AP for each day in that month. Daily rainfalls of 4.10" on 4 December and 8.55" on 26 December and an monthly total of 22.20", an astounding 16.74" larger than the normal monthly total mark the rainfall occurring at Lihue in December 1992 as truly remarkable. In fact, the monthly total was greater than 50% of the normal annual total expected at Lihue. Hourly rainfall rates on 26 December could be expected to cause significant flash flooding and coastal flooding at times of high tide. Any unprotected structures could be expected to experience significant water damage when subjected to such torrential rainfall.

8. Consultant Opinions

It is the opinion of the consultant that a damaging combination of wind and rain occurred at the Coco Palms on the day of 11 September 1992. Wind speeds gusting in excess of 100 mph in combination with heavy hourly rainfall subjected all structures to great amount of stress. It is important to note that though even more damaging effects from Iniki occurred further west, that conditions in the Lihue area were sufficient to cause serous problems.

It is also the opinion of the consultant that the combination of strong winds on some or many of the window structures of the Coco Palms Resort would have caused bowing and/or stretching, in some cases substantial. This together with the heavy rain that was occurring at the time leads the consultant to suspect that serious passage of water into some or many of the rooms would have occurred.

The consultant recommends that structural engineers and architects should analyze the case to determine the exact effects of the combination of strong wind and rain on the windows of the Coco Palms. I understand that such analyses have taken place.

Finally, remarkable rainfall occurred in the Lihue area in December 1992. It is the opinion of the consultant that significant water damage would have occurred to unprotected structures, particularly during the spectacularly heavy rainfall event on December 25-26.

Report Submitted 26 August 1998 by John P. Monteverdi, CCM, PhD

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Appendix A.

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CURRENT POSITION:	Chair, Department of Geosciences San Francisco State University
	Professor of Meteorology, Department of Geosciences San Francisco State University
HONORARY TITLE:	Fellow, California Academy of Sciences (Awarded 1995)
OTHER POSITIONS:	Co-editor, *Weather and Forecasting*, (1992-1998) American Meteorological Society (AMS)
	Member, AMS Committee on Severe Local Storms
BUSINESS ADDRESS:	Department of Geosciences, San Francisco State University 1600 Holloway Ave., San Francisco CA 94132
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ACADEMIC BACKGROUND

1. Degrees

A.B., Geology, June 1968, University of California, Berkeley. Emphasis: Physical Science.

M.A., Geography, June 1970, University of California, Berkeley. Emphasis: Synoptic Climatology.

Ph.D., Geography. December 1977, University of California, Berkeley. Emphases: Synoptic Meteorology and Synoptic Climatology. (54 Quarter Units of Residence completed at Department of Meteorology, San Jose State University).

2. Dissertation Topic

A meteorological analysis of the variability of precipitation in the Great Plains, USA

CERTIFICATIONS

1. Refereed Certifications (Year of Certification and Certifying Body Indicated)

1988. CERTIFIED CONSULTING METEOROLOGIST, AMS.

1972. CANDIDATE OF PHILOSOPHY DEGREE CERTIFICATE, UC Berkeley.

1972. PROFESSIONAL MEMBER, AMS.

1971. PROFESSIONAL METEOROLOGIST, U.S. Civil Service.

2. Other Certifications (Year of Certification and Certifying Body Indicated)

1970. COMMUNITY COLLEGE CREDENTIAL, State of California.

AWARDS

(Year of Award and Awarding Body Indicated)

January 1997. PERFORMANCE SALARY STEP INCREASE AWARD. San Francisco State University.

Spring 1989. MERITORIOUS PERFORMANCE AND PROFESSIONAL PROMISE AWARD. San Francisco State University.

Spring 1986. MERITORIOUS PERFORMANCE AND PROFESSIONAL PROMISE AWARD. San Francisco State University.

1985. COOPERATIVE OBSERVER COMMENDATION. National Weather Service.

PUBLICATIONS

1. Refereed Publications

Monteverdi, J.P. and J. Null, 1998: The Impact of the 1997-98 El Niño on Precipitation in the West. Natural Hazards Observer. Volume XXII, Number 3--January 1998.

Monteverdi, J.P. and S. Johnson, 1996: A supercell thunderstorm with hook echo in the San Joaquin Valley, California. WEA. FORECASTING, **10**.

Berg, N., M. Heggli, and J. Monteverdi, 1995: The influence of meteorology on rime and snow chemistry at a mountaintop site in northern California. *Water Air Soil Poll.,* **81**, 25-36.

Monteverdi, J.P. and J. Quadros, 1994: Convective and rotational parameters associated with three tornado episodes in northern and central California.*WEA. FORECASTING.,* **9,** 165-178.

Braun, S.A. and J.P. Monteverdi, 1991: An investigation of a mesocyclone-induced tornado occurrence in northern California. *WEA. FORECASTING,* **6,** 13-31.

Monteverdi, J.P., Braun, S.A., and T.C. Trimble, 1988: Funnel clouds in the San Joaquin Valley, California. *MON. WEA. REV.* **116,** 782-789.

Byrne, R., Granger, O., and J.P. Monteverdi, 1983: Recent rainfall trends on the margins of the subtropical deserts: a comparison of selected Northern Hemisphere regions. *QUART.RES,* **3,** 1-12.

Monteverdi, J.P., 1976: The single air mass disturbance and precipitation characteristics at San Francisco, *MON. WEA. REV.* **104,** 1289-1296.

Monteverdi, J.P., and B.L. Wood, 1973: The December 1972 freeze and its effects on the eucalyptus forest of the Oakland-Berkeley Hills.*WEATHERWISE.* **26,** 160-167.

Monteverdi, J.P., 1973: The Santa Ana weather type and extreme fire hazard in the Oakland-Berkeley Hills.*WEATHERWISE.* **26,** 118-121.

2. Refereed Technical Memoranda and Invited Conference Publications

Monteverdi, J.P., and J. Null, 1997: El Niño and California Precipitation. National Weather Service Technical Attachment 97-31.

Monteverdi, J.P., 1996: Flood-producing storm types in California. Invited Paper in Preprints. Symposium on the California Floods of the Winter of 1994-1995. Sierra College, Rocklin, CA.

Monteverdi, J.P. and J. Quadros, 1993: Convective and rotational parameters associated with three tornado outbreaks in northern and central California. National Weather Service Western Region Tech. Mem., NWS-222.

Monteverdi, J.P., 1993: A case study of the operational usefulness of the SHARP Workstation in forecasting a "cold-sector" mesocyclone-induced tornado event in northern California. National Weather Service Western Region Tech. Mem., NWS-219.

Monteverdi, J.P. and S.A.Braun, 1988: An investigation of the 24 September 1986 "cold sector" tornado outbreak in northern California. National Weather Service Western Region Tech. Mem., NWS-203, 52 pp.

Monteverdi, J.P., 1986: Translation of German weather service documents for D-Day. Proceedings of the Conference on the Role of Meteorology in the D-Day Invasion. American Meteorological Society, Boston.

Monteverdi, J.P., 1984: Comparisons among three record-rain producing storms in north-central California. Excerpted in "Summary of the LANDSLIDES AND FLOODING CONFERENCE, Stanford University, August 1982". National Academy of Sciences, Washington, D.C.

Monteverdi, J.P., 1980: The effects of the physical environment on climate. *JOUR. WATER AIR SOIL POLL.*, **12**, 23-27.

3. Papers Presented at Conferences and Symposia

Monteverdi, J.P., 1995: Meteorology of hydrologically-critical storms in California. 1995 California Weather Symposium. Sierra College, June 1995.

Monteverdi, J.P., 1993: Convective and rotational parameters associated with two mesocylone-induced tornado outbreaks in north-central California. Presented at the 1993 Severe Local Storms Conference, St. Louis, October 4.

Monteverdi, J.P. and J. Quadros, 1993: Convective and rotational parameters associated with three tornado episodes in northern and central California. Presented at 1993 PACLIM Conference, Asilomar, April.

Monteverdi, J.P. and E. Seibel, 1984: A documentation of oceanographic and meteorological anomalies on the West Coast during the El Nino event of 1982-83. SYMPOSIUM ON THE EL NINO EVENT OF 1982-1983. American Association for the Advancement of Science, Annual Meeting, San Francisco State University, June 1984.

Monteverdi, J.P., 1983: Synoptic controls of recent warm season precipitation increases in a rainfall-sensitive agricultural region of California. SYMPOSIUM ON HUMAN-ATMOSPHERE INTERACTIONS IN THE SEMIARID REGIONS OF THE UNITED STATES. American Association for the Advancement of Science, Annual Meeting, Logan, Utah, June 1983.

Monteverdi, J.P., 1982: Comparisons among three record-rain producing storms in north-central California. CONFERENCE ON LANDSLIDING AND FLOODING, Stanford University, August 1982.

Monteverdi, J.P., 1980: An overview of the significance, patterns and meteorological controls of the precipitation variability of the Central Valley of California. American Association for the Advancement of Science, Annual Meeting, Davis, CA, June 1980.

Monteverdi, J.P., 1978: A drought and an end to the drought. Association of American Geographers, Annual Meeting, New Orleans, April 1978.

4. Laboratory Manuals

Monteverdi, J.P. and J. Michaelsen, 1979: A satellite photo atlas of selected weather patterns. California Book Co., Ltd., Berkeley, CA, 95 pp.

Monteverdi, J.P., 1974: Synoptic meteorology of California weather anomalies. California Book Co., Ltd., Berkeley, CA, 415 pp.

Monteverdi, J.P., Vannucci, S. and L. Gummerson, 1970: Descriptive meteorology of California weather anomalies. California Book Co., Ltd., Berkeley, CA. Two volumes: Vol. 1, 75 pp; Vol. 2, 225 pp.

- Website Authoring

1. El Niño and California Precipitation
http://tornado.sfsu.edu/geosciences/elniño.html

1995. Department of Geosciences
http://tornado.sfsu.edu/geosciences/geosciences.html

1995. Personal Storm Pages
http://tornado.sfsu.edu/geosciences/stormchase.html

University Public Relations

Professional Activities

1. Field Activities

1985 to Present Time. Annual trips (between 5 and 17 days) to the Great Plains to study and document tornadic severe thunderstorms.

1987 to Present Time. Impromptu trips into the Central Valley to document strong or severe thunderstorm features.

2. Visiting Appointments

Spring 1990. Visiting Scientist. National Weather Service Forecast Office, Redwood City, CA.

Spring 1990. Visiting Scientist. National Severe Storms Laboratory, Norman, Oklahoma.

3. Grants Received

1997. CET Grant.California Weather Events: WWW-Based Case Studies and Prototype Exercises, with D. Dempsey. ($7000)

1996. CET Grant. World Wide Web Authoring in the University, with D. Dempsey and O. Garcia. ($3000)

7. National Science Foundation, Instrumentation and Lab Improvement Grant, with O. Garcia and D. Dempsey. SUN Sparc Station (5 workstations + networking) ($56000)

1994. Justified Equipment Proposal. Tecktronic Dye-sublimColor Printer. ($15000)

1993. Justified Equipment Proposal. Weather Graphics Lab SUN-Sparc IPX. ($13000)

1992. Justified Equipment Proposal. Weather Graphics Lab SUN-Sparc IPX. ($13000)

1991. COMET. COOP. With WSFO, Redwood City. ($4000)
1991. COMET. Partners. With John Plankinton, WSFO, Redwood City. ($3800)

1990. COMET. COOP. With WSFO, Redwood City.
1990. COMET. Partners. With E. Jan Null, WSFO, Redwood City.

1989. State Lottery Grant. Weather Graphics Lab Laser Printer. ($3800)

1988. State Lottery Grant. Weather Graphics Lab Satellite Looping Facility. ($8500)
1988. State Lottery Grant. Distinguished Visiting Lecturer Funds. ($650 for C. Doswell)

1987. Student Computer Work Station Funds. Weather Graphics Lab. ($9500)

1983. School of Science Development Grant. Modems and Graphics Equipment. ($650)

d. School of Science Development Grant. Weather Station. ($1100)

4. Conferences Attended

January 1998. Annual Conference, American Meteorological Society, Phoenix, AZ.

December 1997. VORTEX Results Workshop. Asilomar. Invitational Conferences Sponsored by the National Severe Storms Laboratory and the NSF.

June 1997. Weather Forecasting and Mesoscale Processes. Invitational Conference Sponsored by the University Corporation for Atmospheric Research and NSF.

February 1996. 18th Conferences on Severe Local Storms. San Francisco, CA.

June 1995. Symposium on the California Floods of the Winter of 1994-1995. Sierra College, Rocklin, CA.

January 1993. Annual Conference, American Meteorological Society, Anaheim, CA.

5. Chairmanships Held

Summer 1990-Present Time. Department of Geosciences.

February 1996. Local Coordinator, 18th Conference on Severe Local Storms

June 1993. Cochair. El Nino Symposium. AAAS Meetings, SFSU.

Spring 1993. University Academic Assessment for Dean James Kelley.

Fall 1989. Department of Geosciences Curriculum Committee.

Fall 1989-Spring 1989. Chair. Department of Geosciences Hiring, Retention, Promotion Committee.

Fall 1987-Spring 1988. Department of Geosciences Computer Committee.

Summer 1987. Acting Chair. Department of Geosciences. San Francisco State University.

Spring 1986. Acting Chair. Department of Geosciences. San Francisco State University.

Summer 1984. Acting Chair. Department of Geosciences. San Francisco State University.

1984. Cochair. El Nino Symposium. AAAS Meetings, SFSU.

1983-1987. School of Science Development Committee.

1981-1982. School of Science Development Committee.

1980. Air Pollution Section, AAAS Meetings, UC Davis.

1979-1980. Northern California Chapter. American Meteorological Society.

1979. Session 1. Sixth Environmental Symposium on the Impact of Man on Climate.

Professional Organizations

1. Professional Organizations--Membership

American Meteorological Society, Professional Member
California Academy of Science
Gamma Theta Upsilon, National Geography Honorary
National Weather Association

2. Professional Organizations--Participation

1989. Science Fair Committee. American Meteorological Society, Northern California Chapter.

1982-1983. Treasurer. American Meteorological Society, Northern California Chapter.

1979-1982. Head. Science Fair Committee. American Meteorological Society, Northern California Chapter.

1979-1980. Chair. American Meteorological Society, Northern California Chapter.

1978-1979. Program Chair. American Meteorological Society, Northern California Chapter.

3. Professional Meetings--Organization

1996. Local coordinator. NINTH CONFERENCE ON SEVERE LOCAL STORMS. American Meteorological Society. San Francisco, CA..

1994. Co-chair of SYMPOSIUM ON THE 1991-1993 EL NINO EVENT. ANNUAL MEETING OF THE PACIFIC DIVISION. American Association for the Advancement of Science. SFSU.

1984. Co-chair of SYMPOSIUM ON THE 1982-1983 EL NINO EVENT. ANNUAL MEETING OF THE PACIFIC DIVISION. American Association for the Advancement of Science. SFSU.

1980. Chair. AIR POLLUTION SECTION. SECTION W (AMERICAN METEOROLOGICAL SOCIETY)..ANNUAL MEETING OF THE PACIFIC DIVISION. American Association for he Advancement of Science. UC Davis.

1979. Chair. SESSION 1. SIXTH ENVIRONMENTAL SYMPOSIUM ON THE IMPACT OF MAN ON CLIMATE. Mountain View.

Consulting Activities

1. Forensic Meteorology

1997

MONTGOMERY-WASHINGTON TOWER ASSN v. CROW-SPEIKER, Law Offices of Jack Provine

1996

GROSSMAN v REGAL TENTS. Levinson& Kaplan, Encino, CA.
PEOPLE V. LINCOLN. Law Offices of Philip DeJong

1995
Cleavland, Murray, Payne and Zia
DOERFLER V. SANTA CRUZ SNOWBOARDS. Latham & Watkins, Attorneys At Law
ESLER/WRAUGHT V. 3351 EL CAMINO. Romines and Eichner
GRAHAM V. PG&E. Sedgwick.
Murray and Associates.

1994

PEREZ V. PACIFIC BELL. Law Offices of Joseph W. Carcione, Jr.
VARIOUS CASES. Law Offices of Jon-Marc Dobrin
SELF-SERVICE FURNITURE V. ACTION INDUSTRIES. Long and Levit.
VARIOUS CASES. Romines and Eichner
IMAZIO V. DANIA. Christie, Paker & Hale Lawyers
JONES, ET AL. V. TOSCO, ET AL. Law Offices of William Veen
POULOS V. STATE OF CALIFORNIA. Murray and Associates.
PACIFIC PARK PLAZA V. TOWER HOUSE. Law Offices of Jack Provine

1993

VARIOUS ASSIGNMENTS. Bowles & Verna
BAXTER ET AL. V. PAINE-WEBBER ET AL. Larson & Burnham.

1992

LUI V. MARRIOTT. Bowles & Verna
STABILE V. PRESLEY. Cartwright, Slobodin, Bokelman, Borowsky, Wartnick, Moore & Harris.

1991

MILES V. LAWS. Belli, Belli, Brown and Monzione
NOBLE V. PARKSIDE. Boccardo Law Firm
Hoge, Fenton, Jones and Appel

1990

WATTERS V. SCOTSMAN. Ropers, Majeski, Kohn, Bentley, Wagner & Kane.
KISTLER & CURNOW V. COUNTY OF NEVADA. Newhouse & Associates.
KINDLER V. BARTLETT. Tamchin & Bruck.
HAIRO V. HARDENSTEIN. Bledsoe, Cathcart, Leahy, Starr & Diestel.
YUAN V. STANFORD. Cartwright, Slobodin, Bokelman, Borowsky, Wartnik, Moore & Harris.
DONOGHUE V. FIRST INTERSTATE. Gordon & Rees.

1989

The Jennings Law Group
HASSELTINE V. CITY OF ORINDA. Mr. George Jones.
GOODE MITSUBISHI V. STEEL COATING, INC. Adams, Duque & Hazeltine.
BAUERLE V. WELLS FARGO BANK. Sedgwick, Detert, Moran & Arnold.
DUQUE V. COUNTY OF STANISLAUS. Wilson, Elser, Moscovitz, Edelman & Dicker.
APPEL V. OAKLAND ATHLETIC CLUB. Boornazian, Jensen & Garthe.

1988

GARBEZ V. FIBREBOARD. Hyde & Forsblad.
PILOTTI V. NAPA SANITATION DISTRICT. Bishop, Barry, Howe, Haney & Ryder.
AETNA V. WESTERN FOAM. Maloney & Associates.
FIREMAN'S FUND V. QUALITY TREE SERVICE. Wilson, Elser, Moscovitz, Edelman & Dicker.

1987

GOODRICH V. PANCALLO. Severson, Werson, Berke & Melchior.
TUAN V. CITY OF EL CERRITO. William Bullard Attorney.
FREEMAN V. COPELAND. Gassett, Perry & Frank.
BRIDGES V. UNITED STATES. Mendes & Mount.
LSI WEST V. CHALLENGE DEVELOPMENT. Ropers, Majeski, Kohn, Bentley, Wagner, Kane.

1986

KESSLER V. SCOTT. Michael Weisberg, Attorney-at-law.
BYRNE V. CITY OF NOVATO. Law Offices of Reid and Axelrod.
FASNARO V. MOONEY. Sterns, Smith, Walker and Grell.

PROPERTY OWNERS V. CITY OF PETALUMA. Luchardt et al. Attorneys.
PANTANO V. CITY OF BELMONT. Ropers, Majeski, Kohn, Bentley, Wagner & Kane.

1985

LINTON V. CITY OF BERKELEY. City Attorney of Berkeley.
SAYERS V. SAN FRANCISCO WATER DEPARTMENT. City Attorney of San Francisco.

1984

REEF V. RING BROS. Ropers, Majeski, Kohn, Bentley, Wagner & Kane.
CNA V. VARIOUS MUNICIPALITIES. Ropers, Majeski, Kohn, Bentley, Wagner & Kane.
CARLMONT SHOPPING CENTER V. CITY OF BELMONT. Turner & Mulcare.

1983

PROPERTY OWNWERS V. CHALLENGE DEVELOMENT. Ropers, Majeski, Kohn, Bentley, Wagner & Kane.

2. Climatological, Forecasting, Hydrometeorological and Synoptic Studies

1994-1997

WEATHER FORECASTS. Mayacamas Vintners, Napa.

1993

CLIMATOLOGICAL ASSESSMENT. McCutchen, Doyle, Brown and Enersen.
WEATHER FORECASTS. Mayacamas Vintners, St. Helena.

1992

WEATHER DATA, SAN FRANCISCO, JUNE 1991. BART
WIND ASSESSMENT, SAN JOSE, FEBRUARY 1986. Horeis Engineering Co.

1991

CLIMATE OF THE TIBURON PENINSULA. Farrand, Cooper and Brunner.
WIND ASSESSMENT, OCTOBER 20, 1991. Horeis Engineering Co.
CLIMATE OF THE ANTIOCH AREA. McKeen Consulting Services.
WEATHER CONDITIONS ASSOCIATED WITH PEROXIDE SPILL. Southern Pacific Transportation Company.

1990

THE CLIMATE OF THE SIERRA POINT AREA., SAN MATEO COUNTY. The Koll Co.

WIND CLIMATOLOGY OF KELLAR BEACH, SANTA BARBARA. Southwest Diversified, Inc.THE WIND EVENT OF DECEMBER 18, 1988. Alan R. Horeis, Structural Engineers.
RAINFALL, WIND FORECASTS. LaSha Inc., Building Contractors.

1989

FOG CLIMATOLOGY OF THE BRISBANE AREA. Southwest Diversified, Inc.

1987

RAINFALL ANALYSES. Lindorf and Associates, Consulting Engineers.

1986

WIND FORECASTS. SportsTravel, Inc.
RAINFALL ANALYSES. Lindorf and Associates, Consulting Engineers.

1984

WIND CLIMATOLOGY. Interactive Research Institute.
WEATHER FORECASTS. Matanzas Creek Winery.

1983

WEATHER FORECASTS. Matanzas Creek Winery.

1982

REVIEW. Weather and Its Elements. Louis Battan.

1980

REVIEW. Air Pollution, David Greenland.

1979

REVIEW. The Science and the Wonders of the Atmosphere. Stanley David Gedzelman.
SYNOPTIC CLASSIFICATION OF METEOROLOGICAL PATTERNS DURING THE ARIZONA EXPERIMENT, 1957-1964. Statistics Lab, UC Berkeley.

3. Environmental Impact Reports: Enviros Inc.

1978

Creekside Development, Santa Rosa
Riverfront Development, Fresno

Parker Ranch Development, Saratoga
Holly Sugar Development, Union City

1977

Brassfield Development, Fremont
Citation Development, Fremont
Fuller Development, Fremont

1976

Ferrarri Brothers Waste Disposal Site, Mountain View
Chevron Oil Dry Creek Exploratory Geothermal Development, Middletown

1975

Republic Geothermal Development, Middletown
Newhall Proposal, Mountain View
Coyote Valley Development, San Jose
Langmuir Shopping Center, Milpitas

1974

Burmah Oil and Gas Geothermal Development, Middletown
Norwood Creek Development, San Jose
San Carlos Homes Development, Redwood City
Hagen Condo Proposal, Santa Clara

1973

John Gull Subdivision, San Jose
Williams Condo Proposal, Santa Clara
Avco Community Development, San Jose
Santa Monica Lands/Fig Garden Proposal, Fresno

Lectures

FEBRUARY 1998. How "Twister" Got It Wrong: Perspectives of a storm chaser and researcher. Thursday Colloquium. UC Davis. American Meteorological Society.

JUNE 1996. Diagnosing Patterns Favorable for Supercell Thunderstorms in California in an Operational Environment. Seminars given at National Weather Service Forecast Offices in Monterey and Hanford, CA.

MAY 1994. Great Plains West: Sacramento Valley Tornadoes. Weekly Seminar. Department of Meteorology, San Jose State University.

JULY 1993. Weather and Climate of the San Francisco Bay Region. Senior and 60's Club. SFSU.

DECEMBER 1992. Use of the SHARP Workstation in forecasting a northern California tornado event. Presented to the National Weather Service Lead Forecasters, Redwood City, CA.

JUNE 1992. An operational use of the SHARP Workstation. Presented to the National Weather Service Lead Forecasters, Redwood City, CA.

FEBRUARY 1992. The October 20, 1991 East Bay Hills Fire: Meteorological Overview. Seminar. Department of Engineering, University of California, Berkeley.

NOVEMBER 1990. A Mesocyclone-Induced Tornado in Northern California. Seminar. Department of Meteorology, San Jose State University.

JULY 1990. San Francisco Bay Area Climate: Is it Changing? Naturalists of the East Bay Park District.

FEBRUARY 1990. Operational Aspects of the Development of a Tornadic Supercellular Thunderstorm in California. Seminar. National Weather Service Forecast Office, Redwood City.

NOVEMBER 1988. The September 24, 1986 Tornadoes in Northern California. American Meteorological Society, Northern California Chapter.

JULY 1988. Climate of the San Francisco Bay Area. Naturalists of the East Bay Park District.

MAY 1987. Chasing Severe Thunderstorms: An Oklahoma Odyssey. Commemorative Lecture Series. Department of Geography. California State University, Hayward.

MAY 1986. Severe Thunderstorms in Oklahoma. Keynote Address: Annual Dinner Meeting. American Meteorological Society, Northern California Chapter.

APRIL 1986. Chasing Severe Thunderstorms: An Oklahoma Odyssey. Commemorative Lecture Series. Department of Geosciences Seminar Series. San Francisco State University.

FEBRUARY 1986. Chasing Severe Thunderstorms: An Oklahoma Odyssey. Commemorative Lecture Series. Department of Geography. University of California, Berkeley.

NOVEMBER 1985. Normal and Abnormal West Coast Weather Patterns. American Meteorological Society, Northern California Chapter.

NOVEMBER 1984. Departmental Tea, Department of Geosciences, San Francisco State University. West Coast Climate: Is it Changing?

OCTOBER 1984. Departmental Seminar, Department of Meteorology, San Jose State University. The Impact of Anomalously Warm Sea-Surface Temperatures on West Coast Synoptic Patterns.

OCTOBER 1984. El NIno and West Coast Weather Patterns. American Meteorological Society, Northern California Chapter.

AUGUST 1984. KCBS Afternoon Magazine.

APRIL 1984. The Bay Area Climate Explained. National Audobon Society.

JANUARY 1984. Synoptic Controls on Recent Increases in Late Summer Precipitation in Nevada and California. American Meteorological Society, Northern Nevada Chapter.

DECEMBER 1983. Whither Weather? Army Corps of Engineers.

MAY 1983. The Storm of January 1982. KABL Radio Panel Discussion.

OCTOBER 1982. The Storm of January 1982: A comparison with other major storms of the last 25 years. Department of Geography Seminar, UC Berkeley.

MARCH 1981. Pacific Ocean: Bane and Boon to Weather Forecasters. Cal Academy of Sciences.

OCTOBER 1980. Normal and Abnormal California Weather Patterns. Department of Geography Seminar, UC Berkeley.

MAY 1980. Mt. Saint Helens. KTVU-TV Panel Discussion.

MAY 1980. Satellite Views of Normal and Abnormal West Coast Meteorological Patterns. Department of Meteorology, San Jose State University.

MAY and MARCH 1980. The California Environment. ESL, UC Extension.

MAY 1978. A Panel Discussion on the Drought of 1975-77. Department of Meteorology, San Jose State University.

MAY 1978. A Drought and an End to a Drought. University of California Alumni Society.

OCTOBER 1977. California Weather Extremes. Lawrence Hall of Science, Berkeley.
AUGUST 1977. The Weather and Climate of the San Francisco Bay Region. University of California Alumni Society.
APRIL 1977. Weather Patterns of the San Francisco Bay Region. Docents of the Oakland Museum.

Pertinent Work Experience

1987-Present. PROFESSOR OF METEOROLOGY, SFSU.
1978-1986. ASSOCIATE and ASSISTANT PROFESSOR OF METEOROLOGY, SFSU.
1973-Present. Consulting Meteorologist.

1973-1978. Earth Science Consultant. ENVIROS INC., Los Altos, CA.
1978. LECTURER, Department of Geography, UC Davis.
1973-1978. LECTURER and ACTING INSTRUCTOR. Department of Geography, UC Berkeley.
1974-1978. INSTRUCTOR. University of California Extension, Berkeley.
1969-1978. WEATHER OBSERVER and STAFF RESEARCH ASSOCIATE. Department of Geography, UC Berkeley.