PRISM Update

Chris Daly

PRISM Climate Group

Northwest Alliance for Computational Science and Engineering

College of Engineering

Oregon State University

WERA-1012

10 June 2024

Ft. Collins, CO

USDA Risk Management Agency

Photo Credit: Andrew Shoemaker

Precipitation Mapping in Hawaii

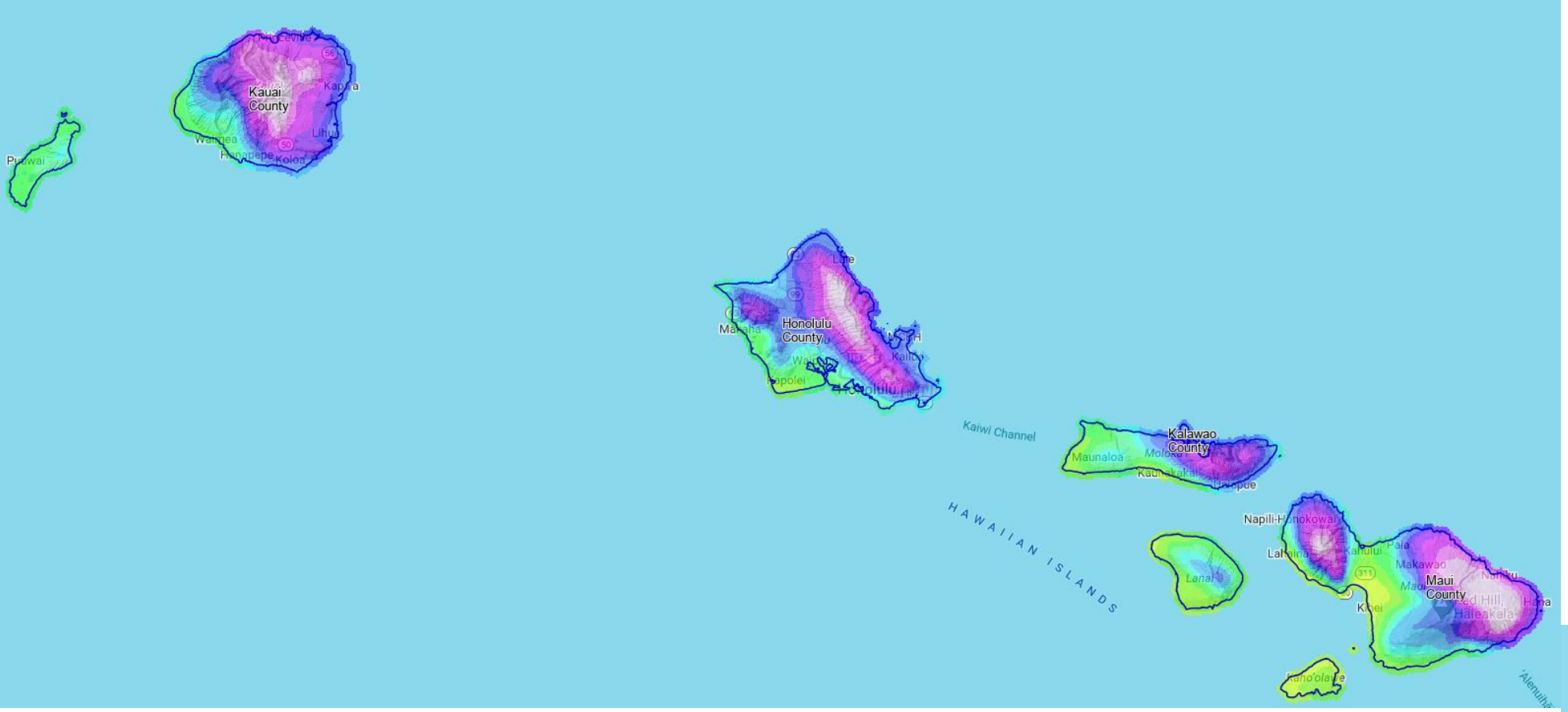
Adventures in working with COOP data

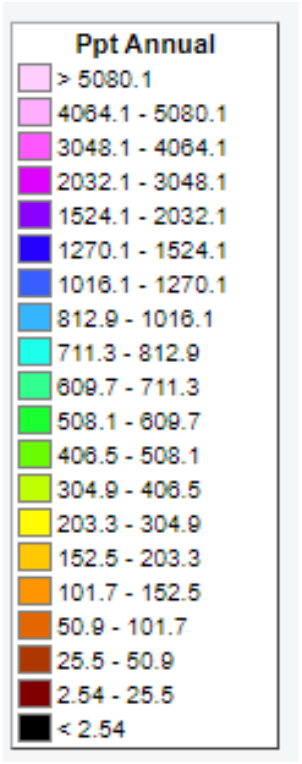
Expanding PRISM to Hawaii

- USDA Risk Management Agency is expanding crop insurance coverage in the state
- They would like to see PRISM used as the source of climate/weather data for loss adjustment, similar to the CONUS
  - Also asking us to expand to AK and PR

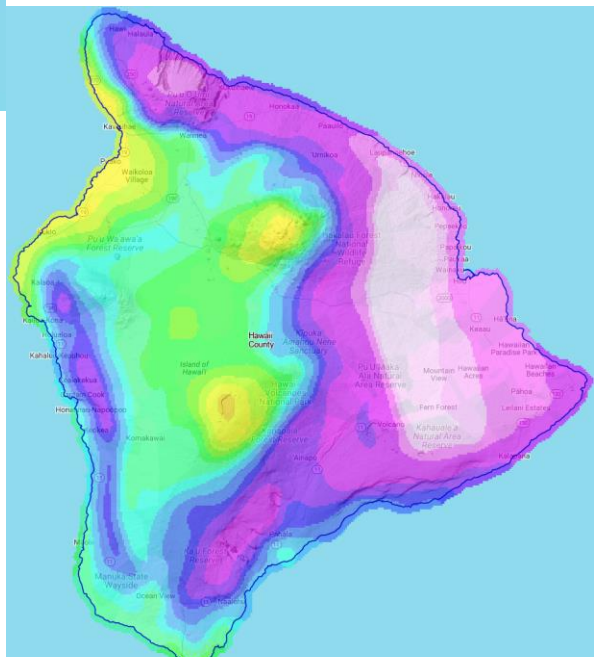
Lots of Data Infrastructure to Duplicate

- Elements to map: **Precip**, tmax, tmin
- Gather and QC station data from all available sources
- Create 1991-2020 30-year normals grids
  - We created 1971-2000 normals in early 2000s
  - UH-Manoa has 1978-2007 normals
    - Mostly based on PRISM normals
- Use normals as predictor grids for daily and monthly time series mapping with PRISM
  - Daily: 1981-present
  - Monthly: 1910? - present (little/no data before)
- Coordinate with UH-Manoa's activities

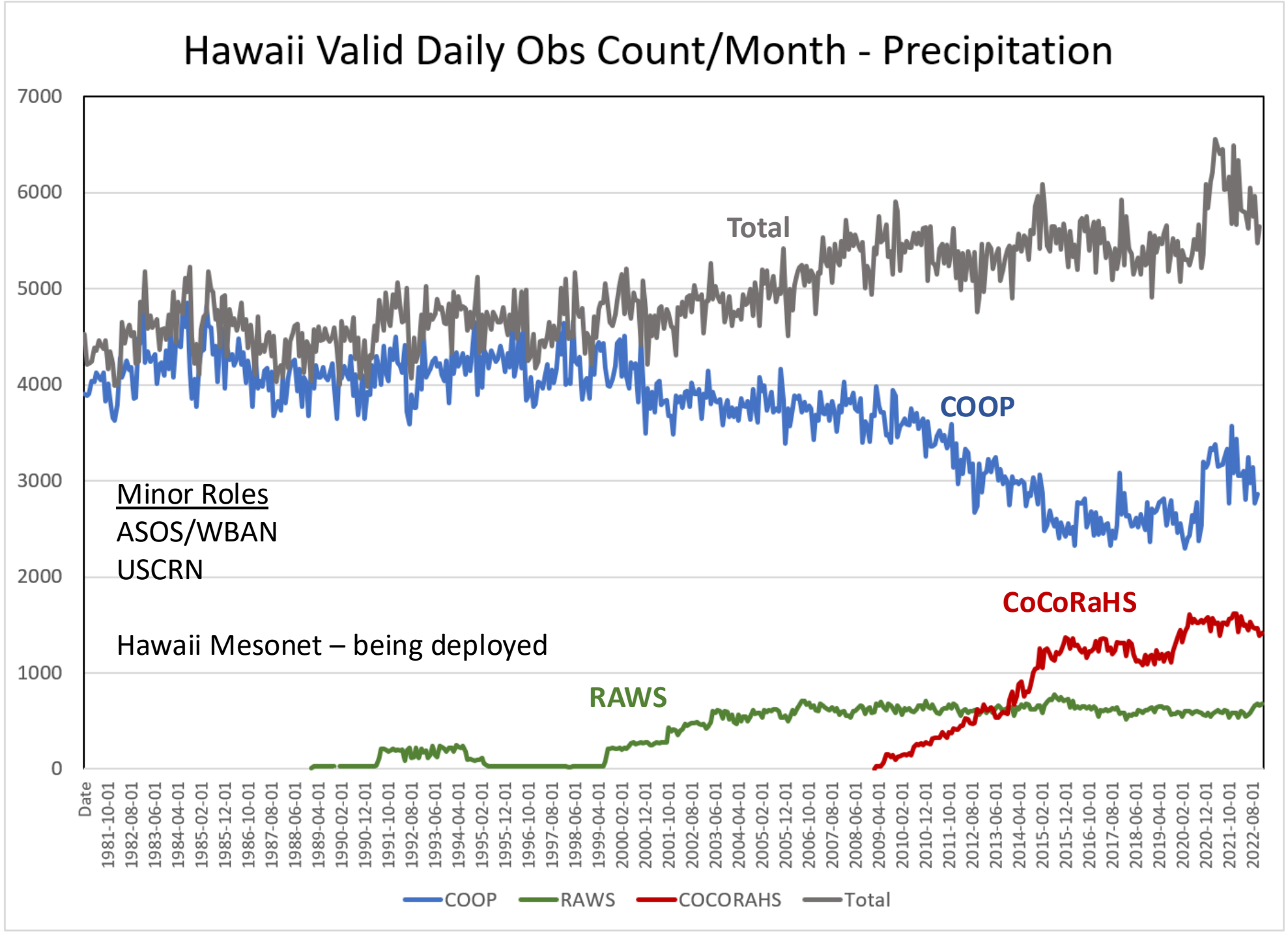




(mm)



PRISM 1971-2000 Mean Annual Precipitation
Hawaiian Islands


Hawaii Valid Daily Obs Count/Month - Precipitation
7000
6000
5000
4000
3000
2000
1000
0
Total
COOP
Minor Roles
ASOS/WBAN
USCRN
Hawaii Mesonet – being deployed
CoCoRaHS
RAWS
Date
1981-10-01
1982-08-01
1983-06-01
1984-04-01
1985-02-01
1985-12-01
1986-10-01
1987-08-01
1988-06-01
1989-04-01
1990-02-01
1990-12-01
1991-10-01
1992-08-01
1993-06-01
1994-04-01
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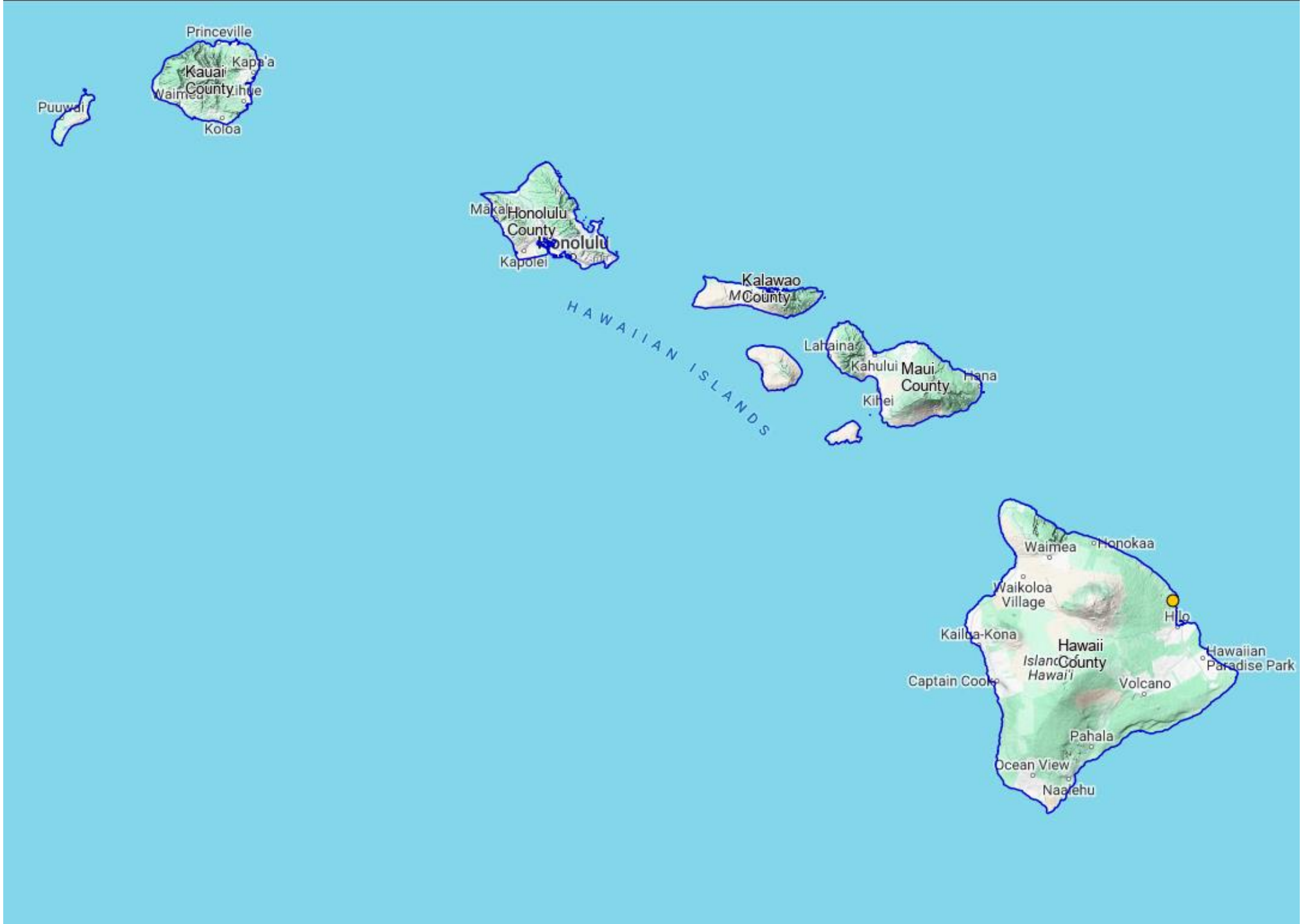
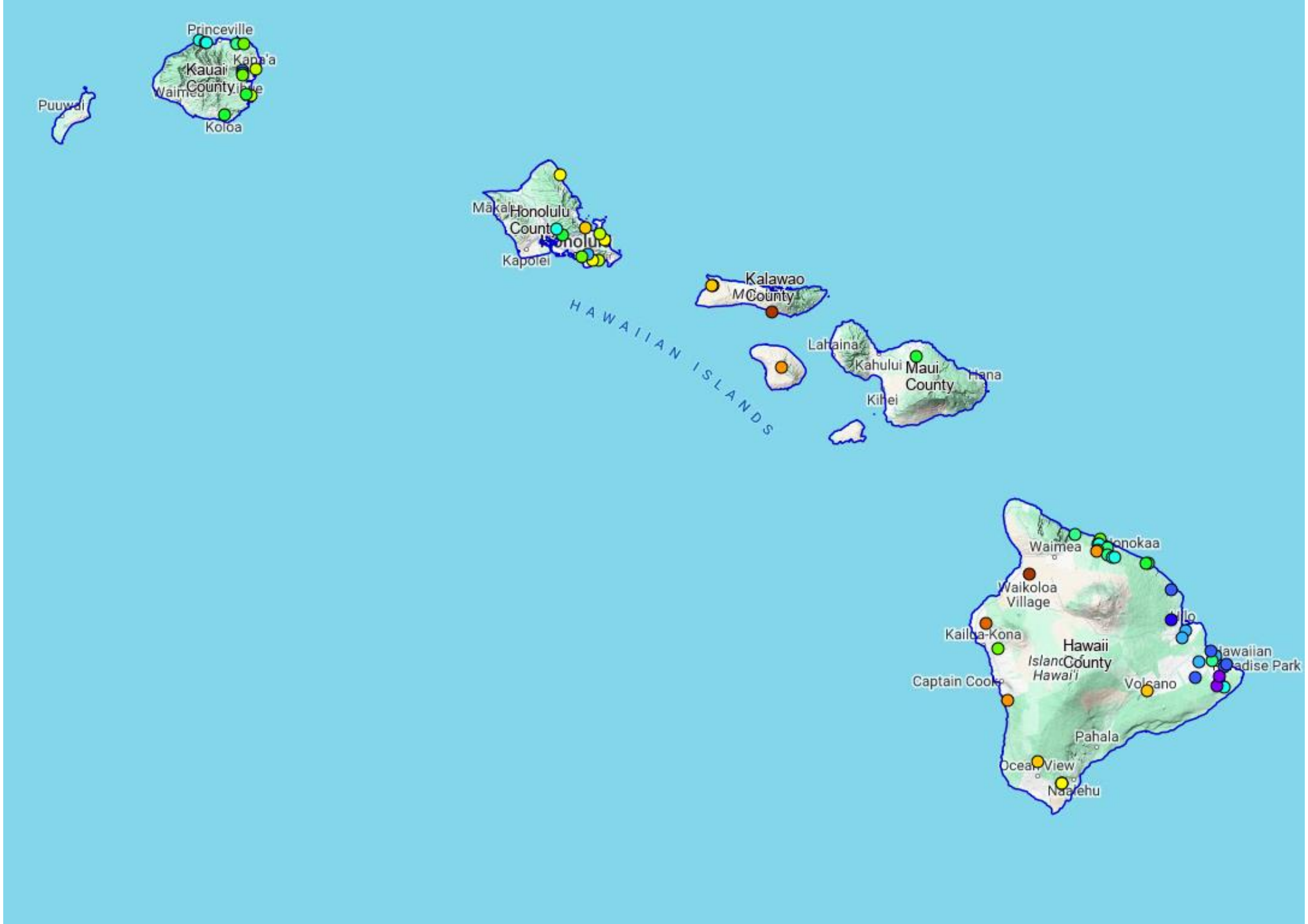
2011-10-01
2012-08-01
2013-06-01
2014-04-01
2015-02-01
2015-12-01
2016-10-01
2017-08-01
2018-06-01
2019-04-01
2020-02-01
2020-12-01
2021-10-01
2022-08-01
COOP
RAWS
COCORAHS
Total

CoCoRaHS
Feb 2009

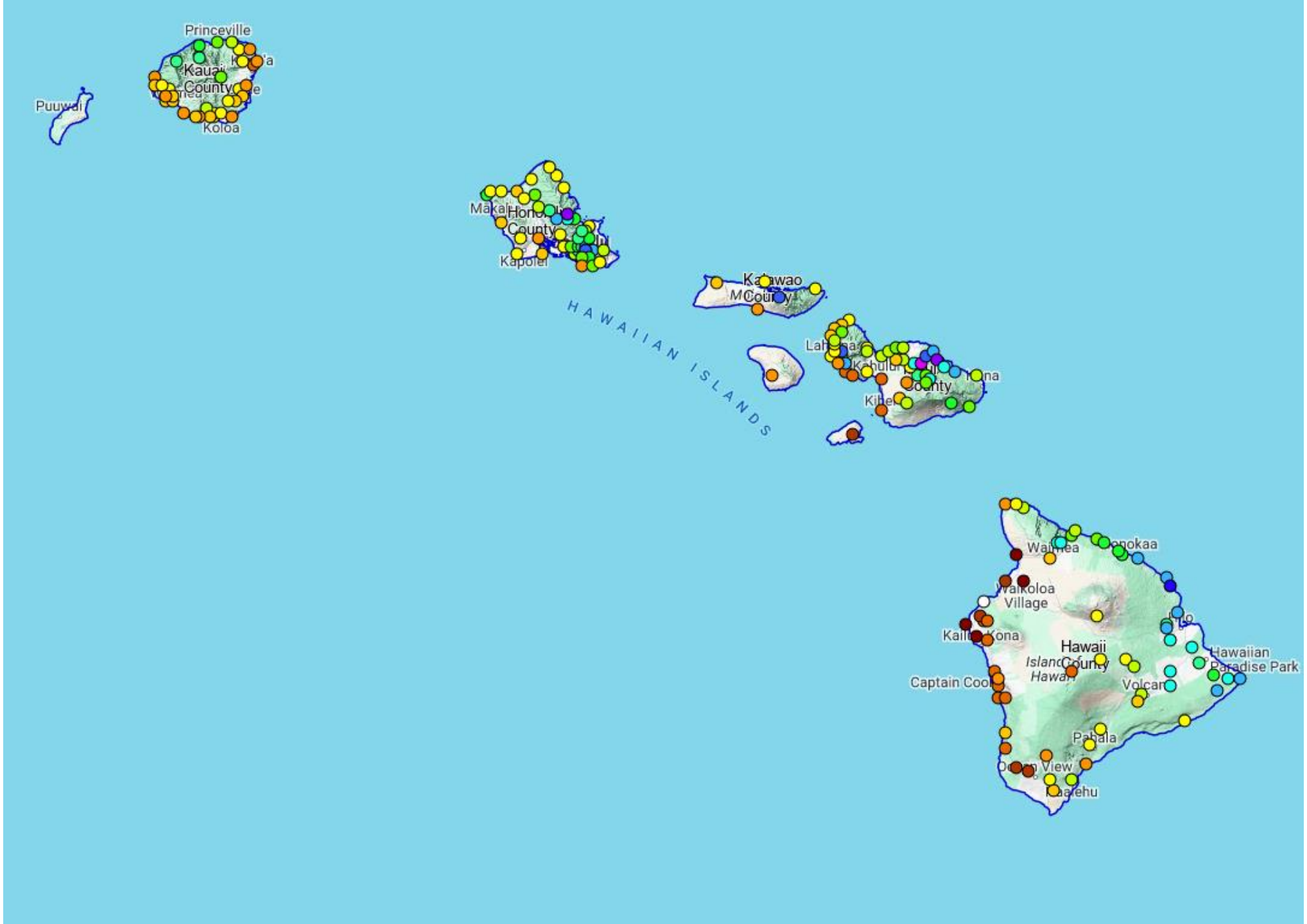


CoCoRaHS
Dec 2023



COOP
Feb 1981

COOP
Feb 1991



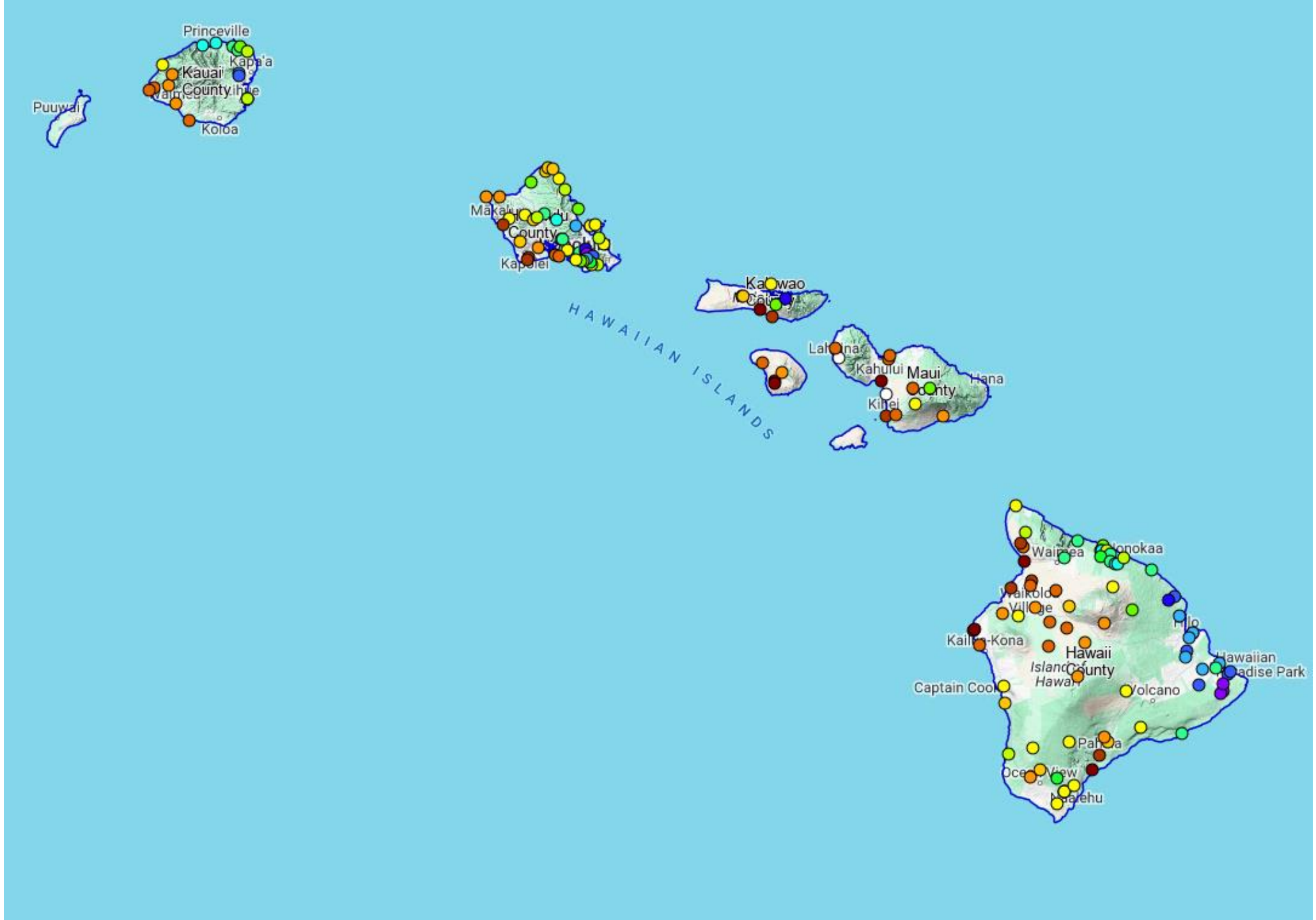
COOP
Feb 2001

COOP
Feb 2011

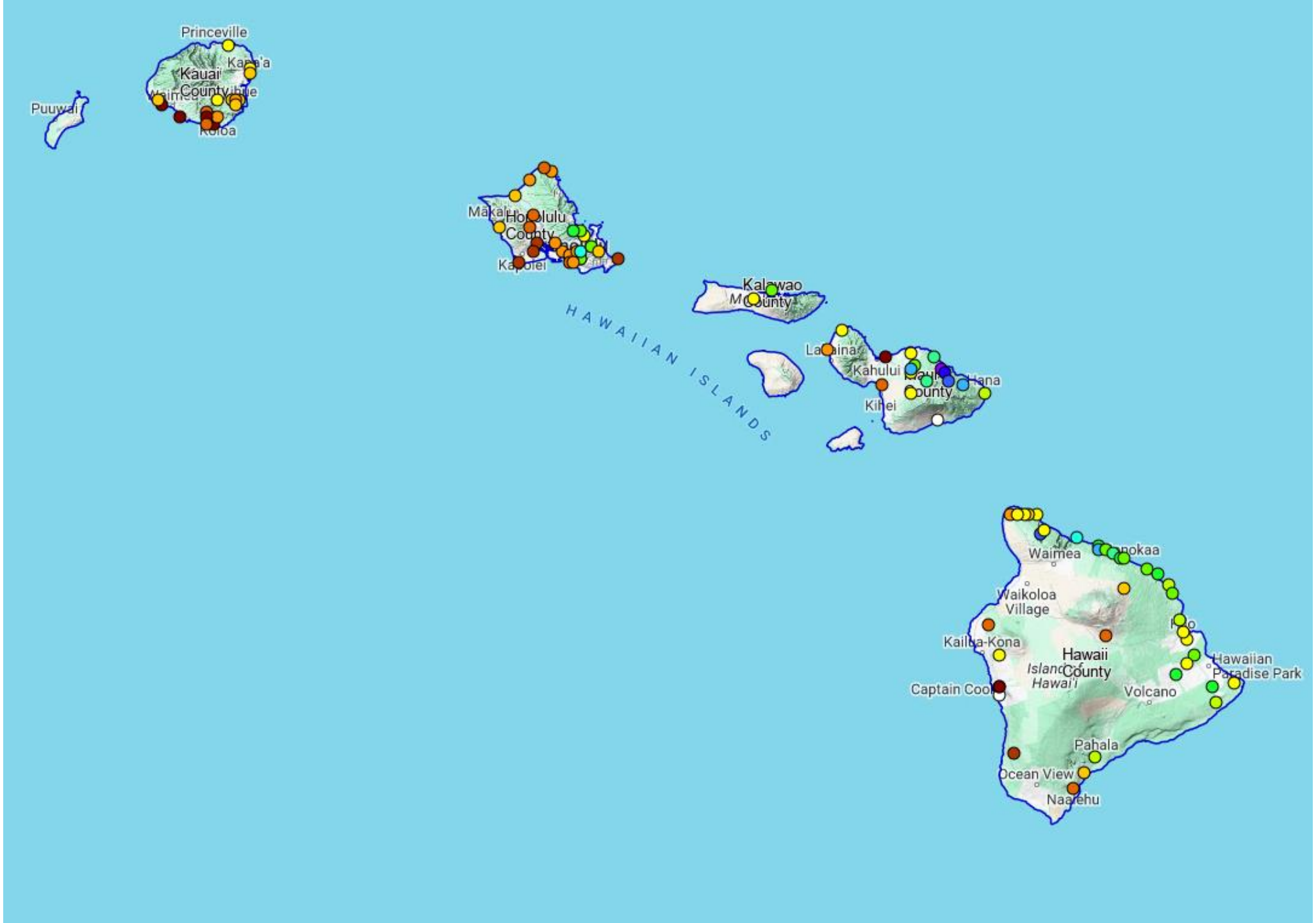
COOP
Dec 2023

All Networks Feb 1981

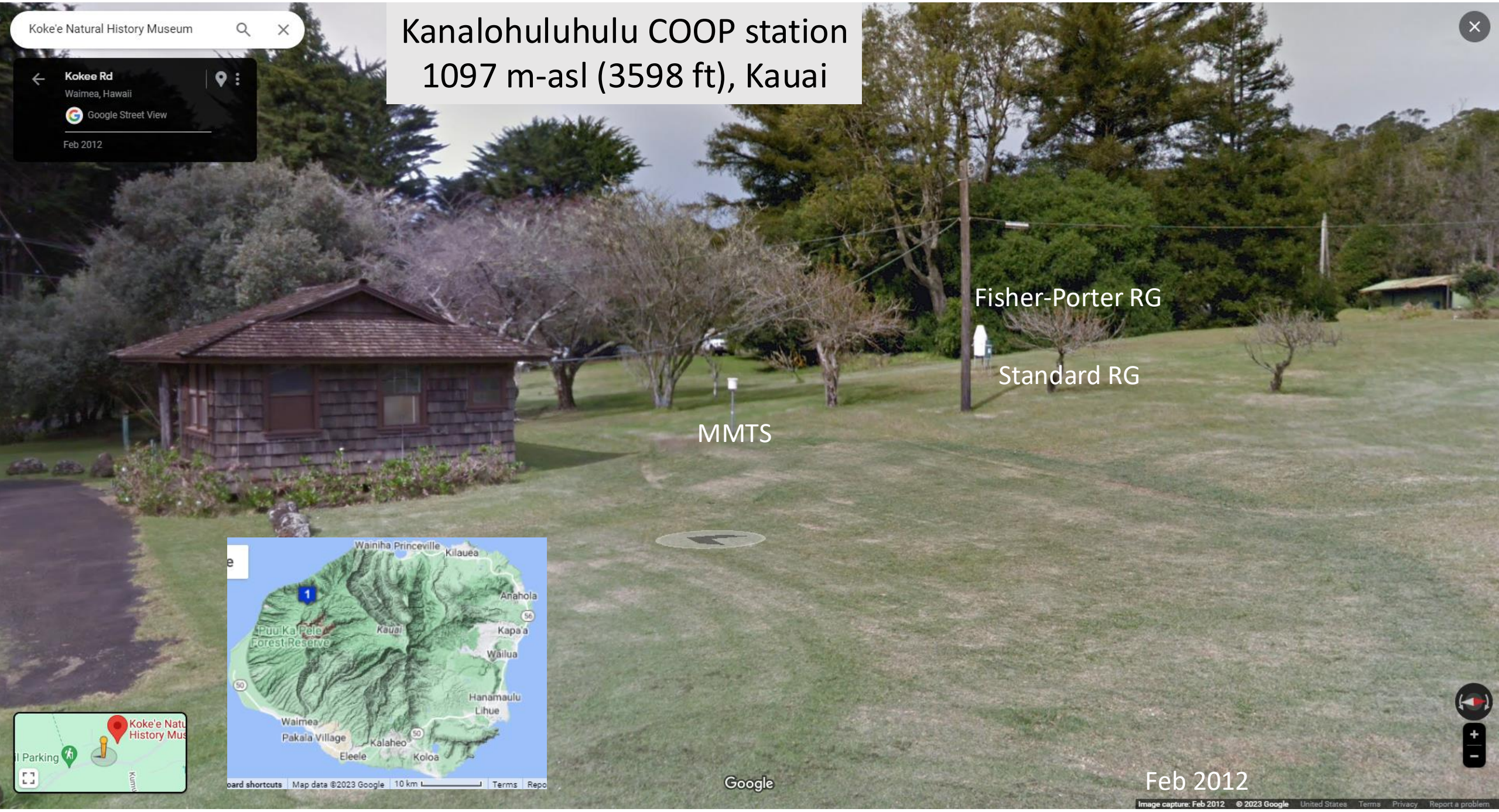
All Networks Dec 2023



COOP
Feb 1910



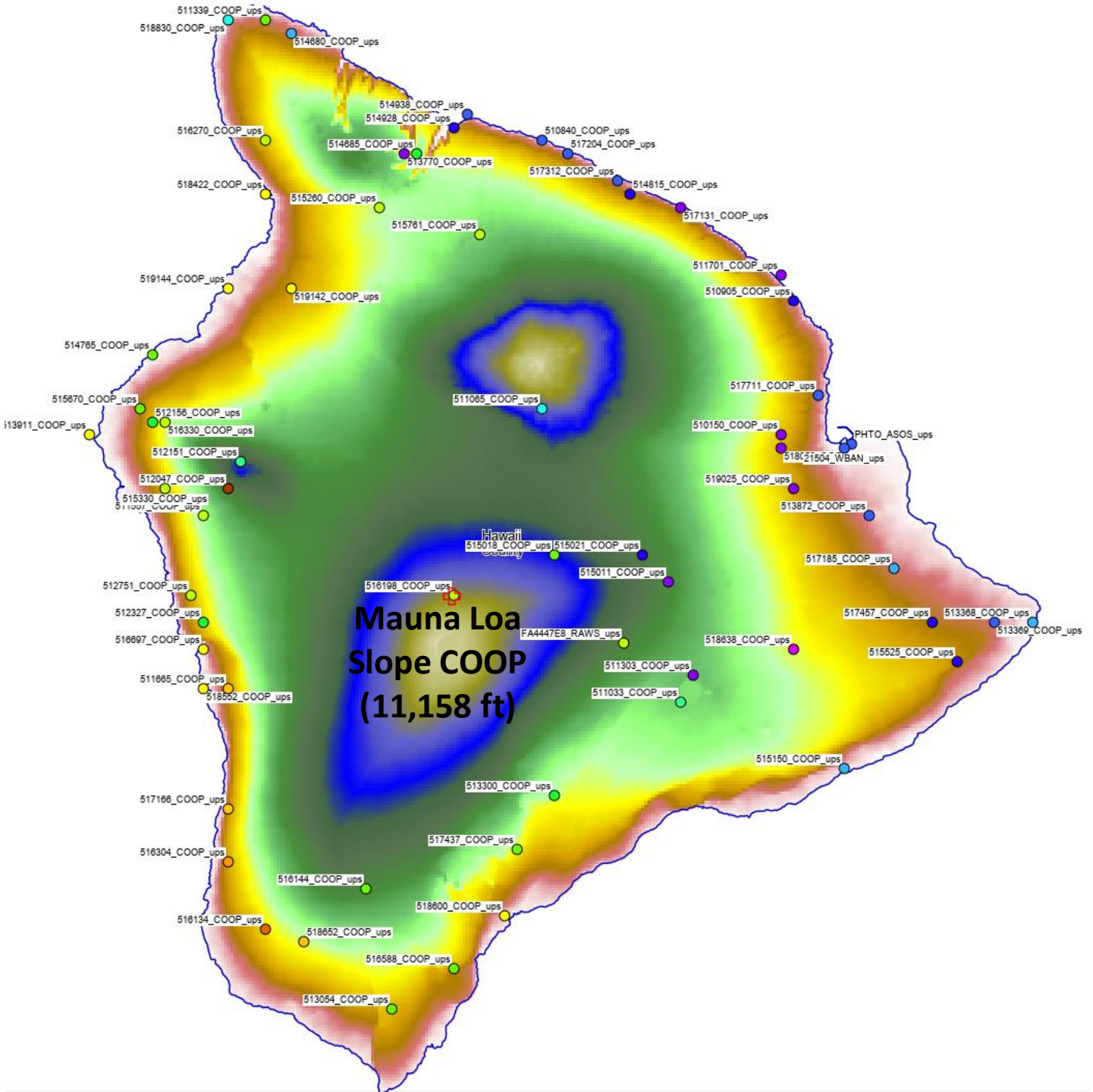
Kanalohuluhulu COOP station
1097 m-asl (3598 ft), Kauai



Key Station

Mauna Loa Slope Observatory COOP

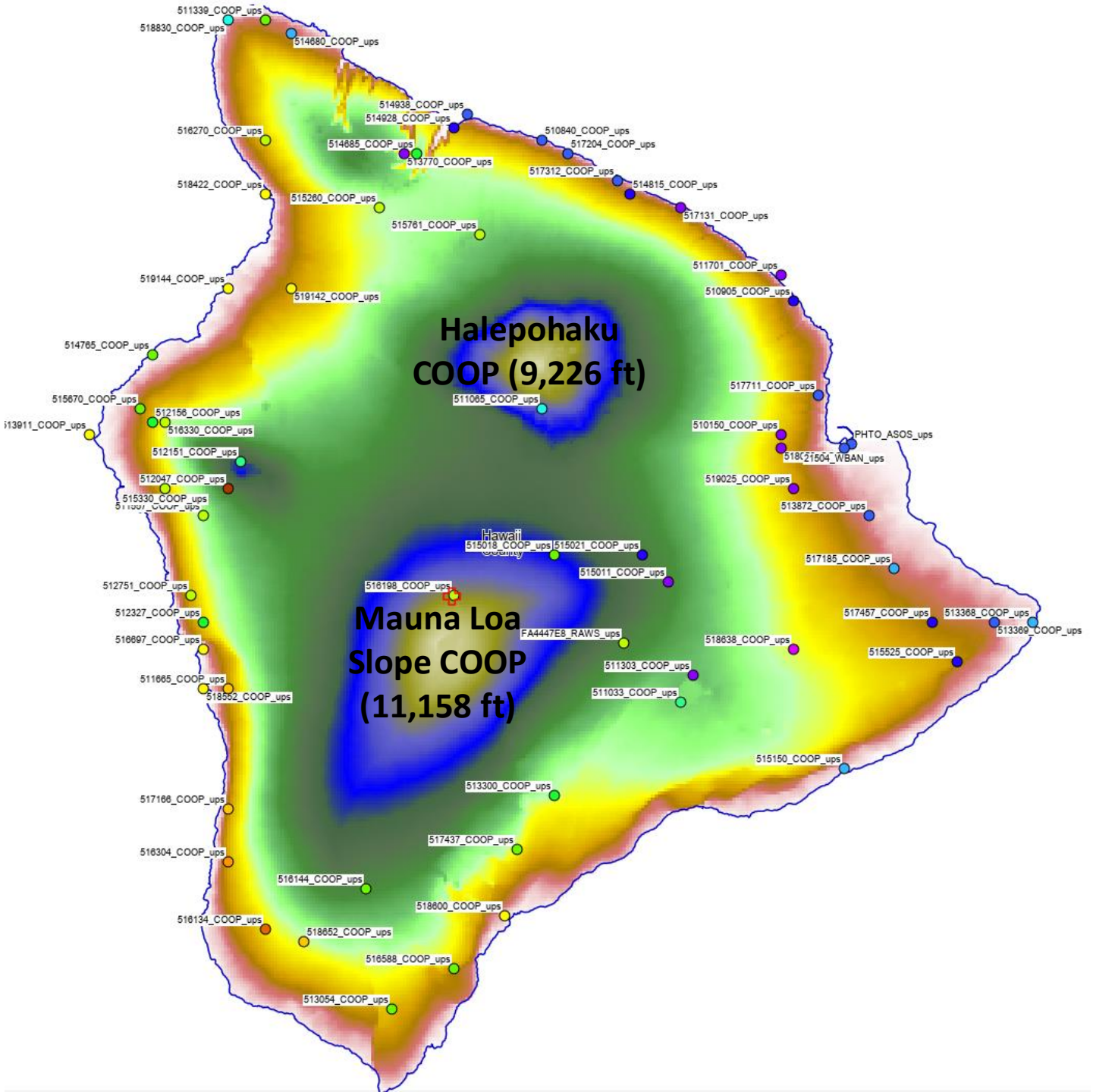
Feb 1990



Key Station

Mauna Loa Slope Observatory COOP

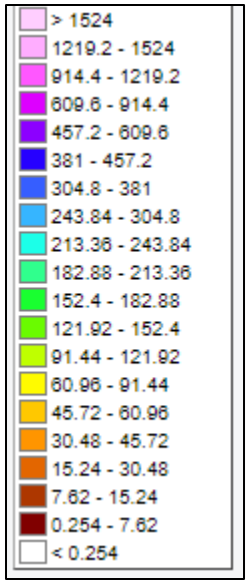
Feb 1990

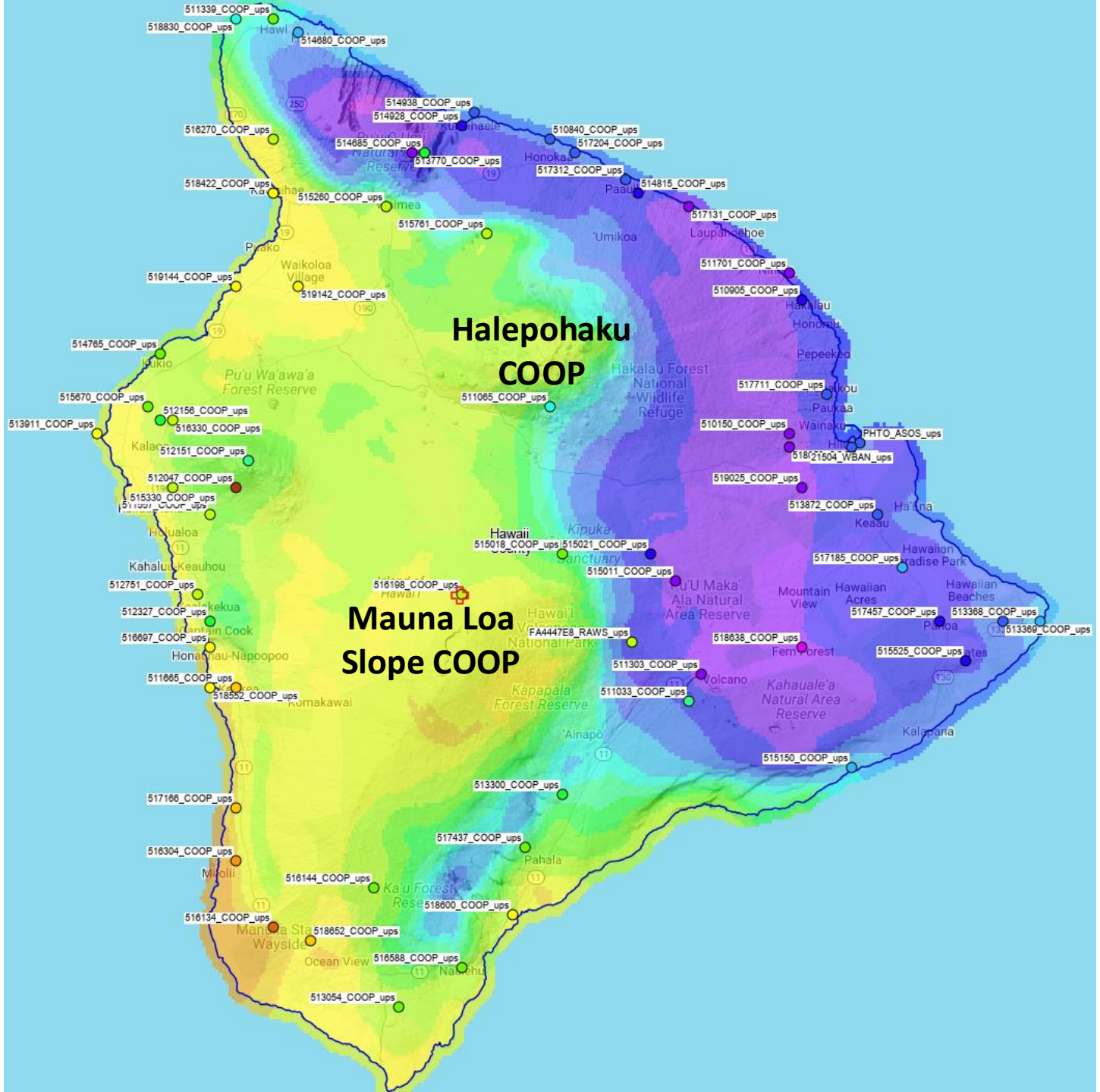


Key Station

Mauna Loa Slope Observatory COOP

February 1990
(mm)





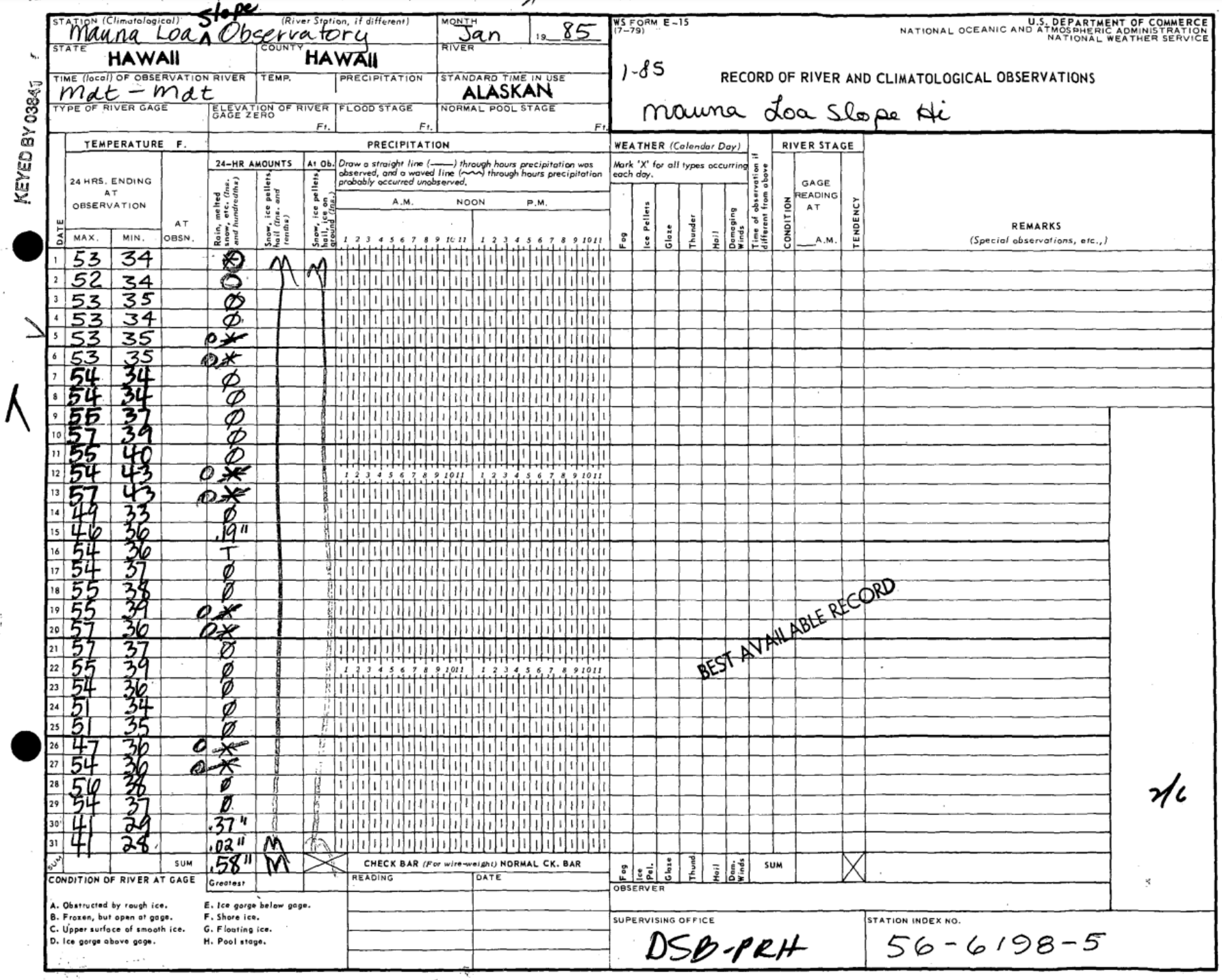
Mauna Loa Observatory

Mauna Kea

Ted Coran
Smithsonian Magazine

Mauna Loa Slope Observatory
January 1985

- Weekends and holidays missing
- Common to see this at other more remote sites in Hawaii
- If MDA was zero, missing days were keyed as zero



STATION (Climatological) Mauna Loa Slope Observatory (River Station, if different)
STATE HAWAII COUNTY HAWAII RIVER
MONTH Jan 19 85
TIME (local) OF OBSERVATION RIVER Mdt – Mdt TEMP. PRECIPITATION STANDARD TIME IN USE ALASKAN
TYPE OF RIVER GAGE ELEVATION OF RIVER GAGE ZERO Ft. FLOOD STAGE Ft. NORMAL POOL STAGE Ft.

WS FORM E-15 (7-79) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE
1-85 RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS
Mauna Loa Slope Hi

KEYED BY 03845

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M. 1 2 3 4 5 6 7 8 9 10 11 1 2 3 4 5 6 7 8 9 10 11	WEATHER (Calendar Day) Mark 'X' for all types occurring each day. Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	Time of observation if different from above	RIVER STAGE CONDITION	GAGE READING AT ___ A.M.	TENDENCY	REMARKS (Special observations, etc.,)
1	53	34		0	M	M											
2	52	34		0													
3	53	35		0													
4	53	34		0													
5	53	35		0	*												
6	53	35		0	*												
7	54	34		0													
8	54	34		0													
9	55	37		0													
10	57	39		0													
11	55	40		0													
12	54	43		0	*												
13	57	43		0	*												
14	49	33		0													
15	46	36		.19													
16	54	36		T													
17	54	37		0													
18	55	38		0													
19	55	39		0	*												
20	57	36		0	*												
21	57	37		0													
22	55	39		0													
23	54	36		0													
24	51	34		0													
25	51	35		0													
26	47	36		0	*												
27	54	36		0	*												
28	56	36		0													
29	54	37		0													
30	41	29		.37													
31	41	28		.02	M												
SUM			SUM	.58	M		CHECK BAR (For wire-weight) NORMAL CK. BAR	SUM									
				Greatest			READING DATE										

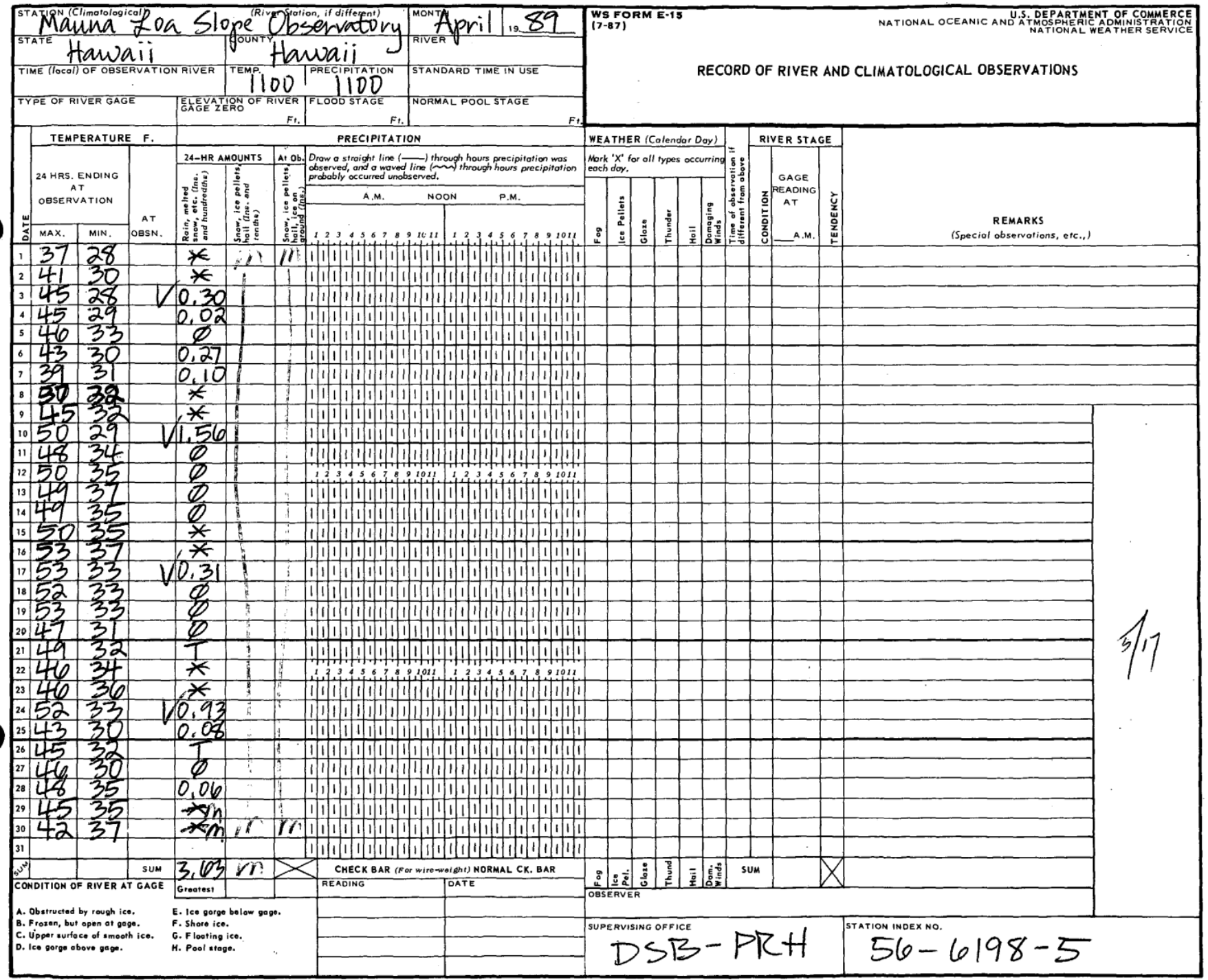
BEST AVAILABLE RECORD

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER
SUPERVISING OFFICE DSB-PRH
STATION INDEX NO. 56-6198-5

Mauna Loa Slope Observatory
April 1989

- Weekends and holidays missing
- If MDA is not zero, missing time period is keyed as multi-day accumulation
- Mauna Loa is also an “offtime” station so ppt must be reapportioned
- “PRISM Day” is 0000-0800 local



KEYED BY 00732

STATION (Climatological) Mauna Loa Slope Observatory (River Station, if different)
MONTH April 19 89
STATE Hawaii
COUNTY Hawaii
RIVER
TIME (local) OF OBSERVATION RIVER TEMP. 1100 PRECIPITATION 1100 STANDARD TIME IN USE
TYPE OF RIVER GAGE ELEVATION OF RIVER GAGE ZERO Ft. FLOOD STAGE Ft. NORMAL POOL STAGE Ft.

WS FORM E-15 (7-87)
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M. 1 2 3 4 5 6 7 8 9 10 11 1 2 3 4 5 6 7 8 9 10 11	WEATHER (Calendar Day) Mark 'X' for all types occurring each day. Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	Time of observation if different from above	RIVER STAGE CONDITION	GAGE READING AT ___A.M.	TENDENCY	REMARKS (Special observations, etc.,)
1	37	28		*		11											
2	41	30		*													
3	45	28		V 0.30													
4	45	29		0.02													
5	46	33		0													
6	43	30		0.27													
7	39	31		0.10													
8	~~30~~	~~28~~		*													
9	45	32		*													
10	50	29		V 1.56													
11	48	34		0													
12	50	35		0													
13	49	37		0													
14	49	35		0													
15	50	35		*													
16	53	37		*													
17	53	33		V 0.31													
18	52	33		0													
19	53	33		0													
20	47	31		0													
21	49	32		T													
22	46	34		*													
23	46	36		*													
24	52	33		V 0.93													
25	43	30		0.06													
26	45	32		T													
27	46	30		0													
28	48	35		0.06													
29	45	35		~~*~~ m													
30	42	37		~~*~~ m	11	11											
31																	
SUM			SUM	3.03	VT									SUM			
				Greatest				Fog	Ice Pel.	Glaze	Thund	Hail	Dam. Winds				

CHECK BAR (For wire-weight) NORMAL CK. BAR
READING DATE

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER

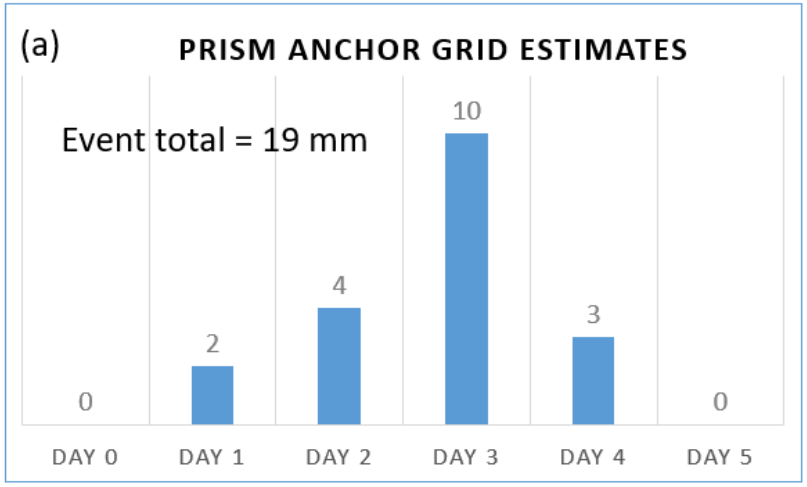
SUPERVISING OFFICE DSB-PRH

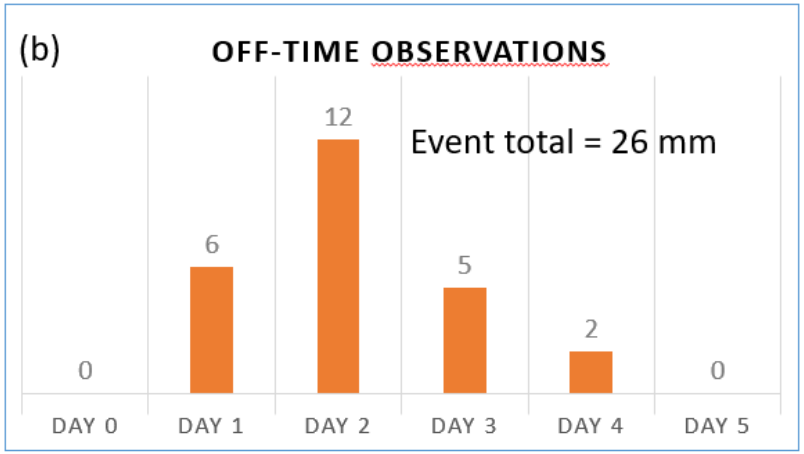
STATION INDEX NO. 56-6198-5

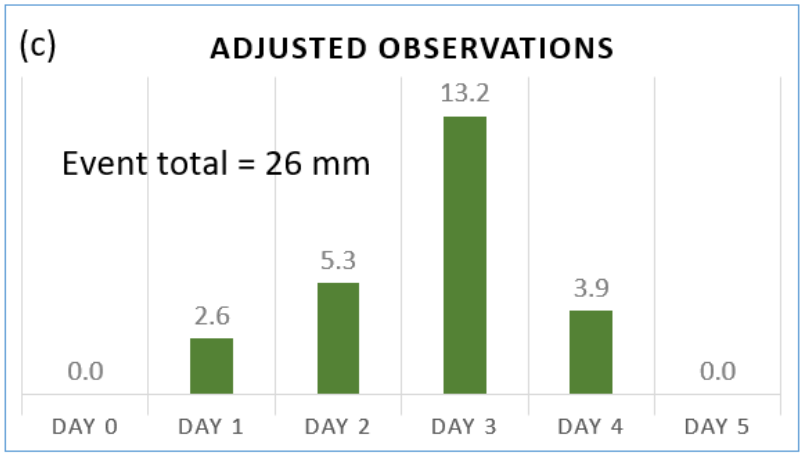
3/17

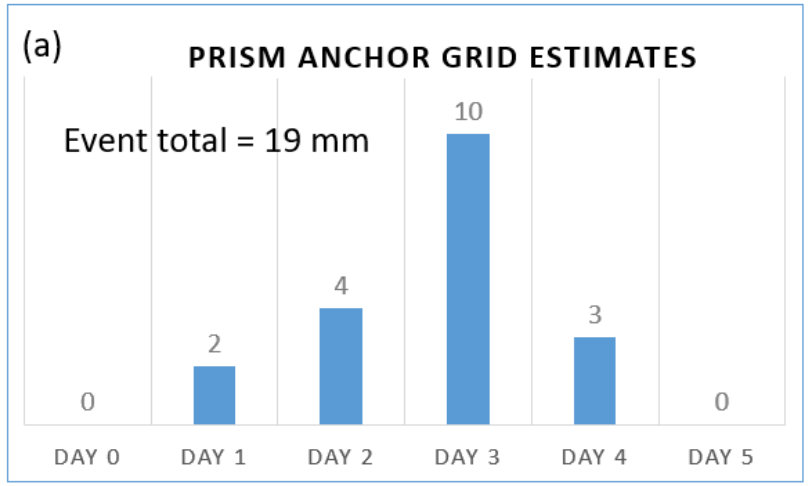
PRISM Precip Reapportioning Script

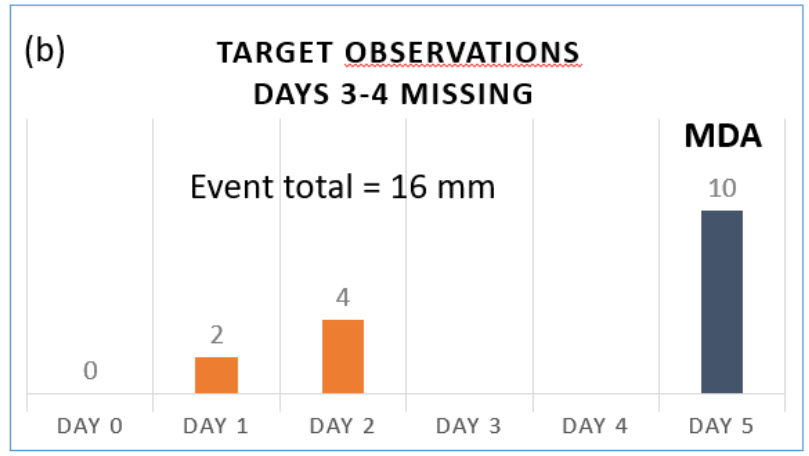
- Uses “anchor” grid made from on-time obs only
- Reapportions “off-time” (non-PRISM Day) daily observations on an event-by-event basis
- Distributes on-time (0000-0800 local) multi-day accumulations
- …Or both off-time and multi-day accumulations

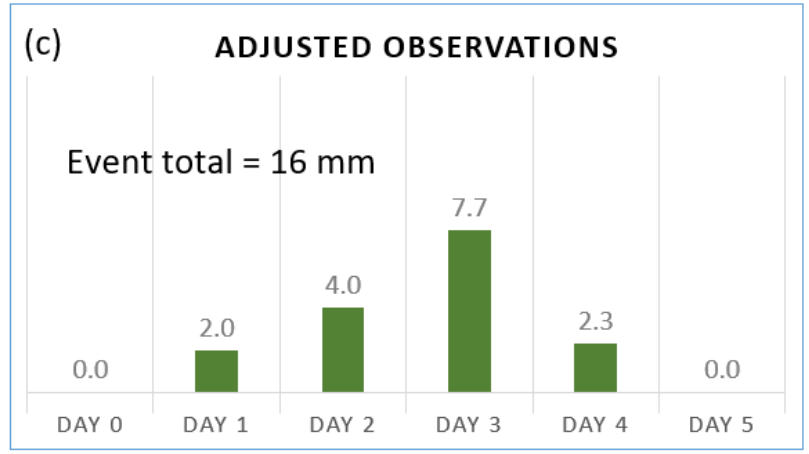






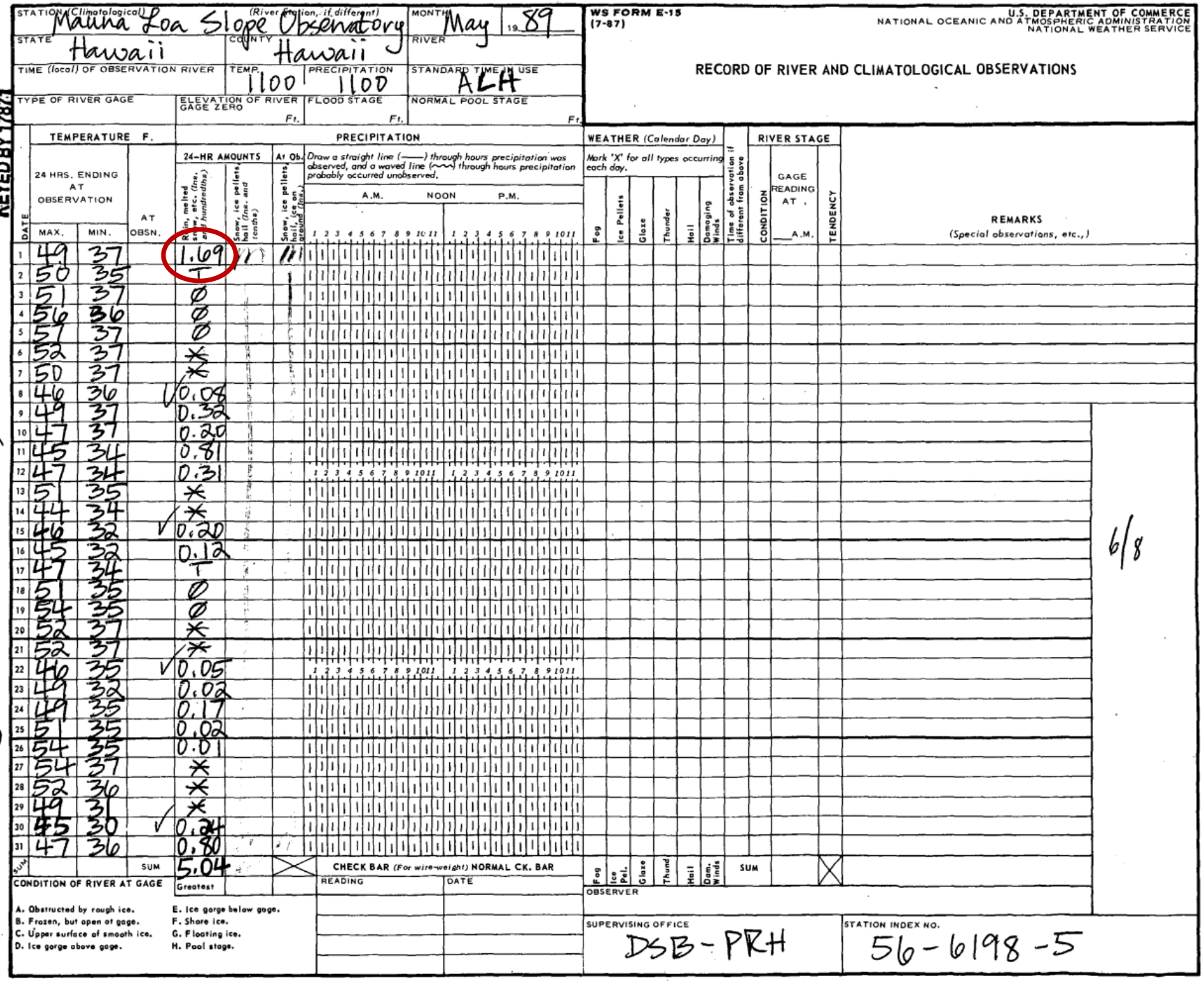






Mauna Loa Slope Observatory
May 1989

- **Unless it isn't – Large event on May 1st not keyed as an MDA**
- Precip apportioning script sees it as just another missing day at an off-time station
- PRISM anchor grid had this event a day earlier April 30, which is a missing day
- Script will not insert precip on a missing day
- 1.69" event was omitted



Missing Days Not Reapportioned

Mauna Loa Slope Observatory COOP

- 15,664 daily observations, 1981-2023
- 353 missing days **not** reapportioned (2%)
- Most in 1980s-90s
- Days of week:

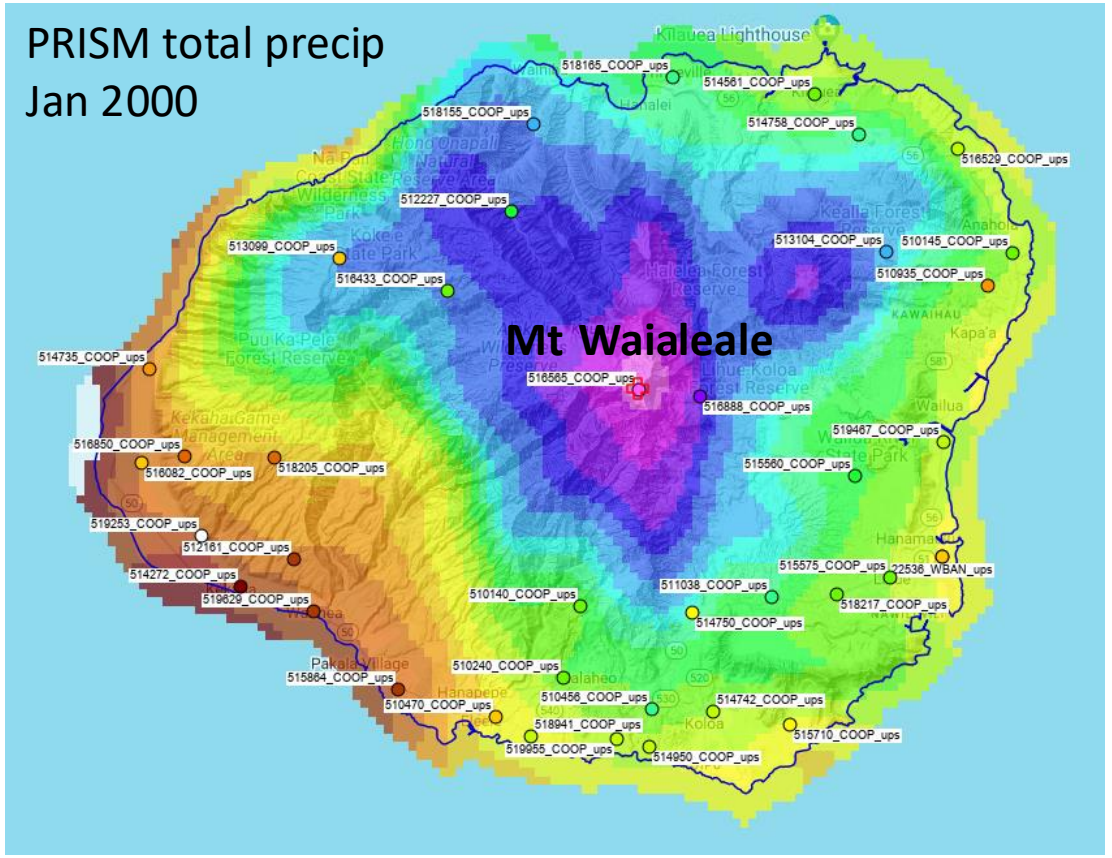
Mon	41
Tue	25
Wed	18
Thu	23
Fri	24
Sat	**119**
Sun	**103**

Key Station

Mount Waialeale
Kauai
(5,154 ft)

300-400 inches/year

USGS recording gauge accessed by helicopter every few months

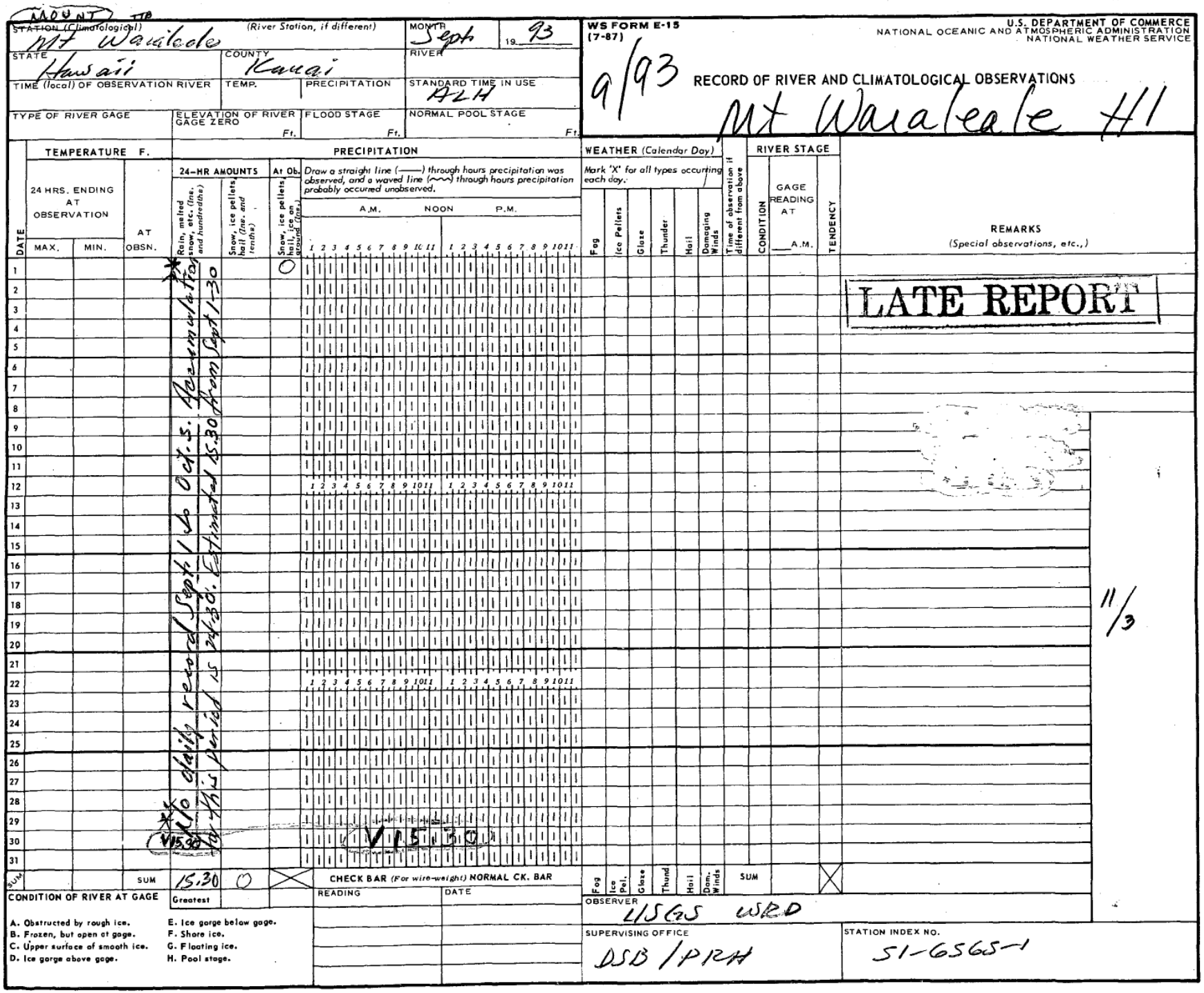


Mount Waialeale, Kauai

September 1993

"No daily record Sept 1 to Oct 3. Accumulation for this period is 24.30. Estimated 15.30 from Sept 1-30."

- Keypunched as a month-long MDA
- Precip re-apportionment script handled it well



WS FORM E-15 (7-87) — U.S. DEPARTMENT OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological) MOUNT Mt Waialeale (River Station, if different) — MONTH Sept 19 93 — STATE Hawaii — COUNTY Kauai — RIVER — TIME (local) OF OBSERVATION RIVER — TEMP. — PRECIPITATION — STANDARD TIME IN USE AZH — TYPE OF RIVER GAGE — ELEVATION OF RIVER GAGE ZERO Ft. — FLOOD STAGE Ft. — NORMAL POOL STAGE Ft.

9/93 Mt Waialeale #1

KEYED BY 01114

TEMPERATURE F. — 24 HRS. ENDING AT OBSERVATION: MAX., MIN. — AT OBSN.

PRECIPITATION — 24-HR AMOUNTS: Rain, melted snow, etc. (Ins. and hundredths); Snow, ice pellets, hail (Ins. and tenths); At Ob. Snow, ice pellets, hail, ice on ground (Ins.)

Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved.

A.M. NOON P.M. 1 2 3 4 5 6 7 8 9 10 11 1 2 3 4 5 6 7 8 9 10 11

WEATHER (Calendar Day) — Mark 'X' for all types occurring each day. Fog, Ice Pellets, Glaze, Thunder, Hail, Damaging Winds

Time of observation if different from above

RIVER STAGE — CONDITION, GAGE READING AT ___ A.M., TENDENCY

REMARKS (Special observations, etc.,)

LATE REPORT

DATE	MAX.	MIN.	AT OBSN.	Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)
1				Accumulated 24.30 Oct. 3. Estimated 15.30 from Sept 1-30		
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30				No daily record Sept 1 to Oct 3. Accumulation for this period is 24.30. Estimated 15.30 from Sept 1-30.		
31						
SUM			SUM	15.30	0	
			Greatest			

11/3

CHECK BAR (For wire-weight) NORMAL CK. BAR — READING — DATE

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

Fog | Ice Pel. | Glaze | Thund | Hail | Dam. Winds | SUM

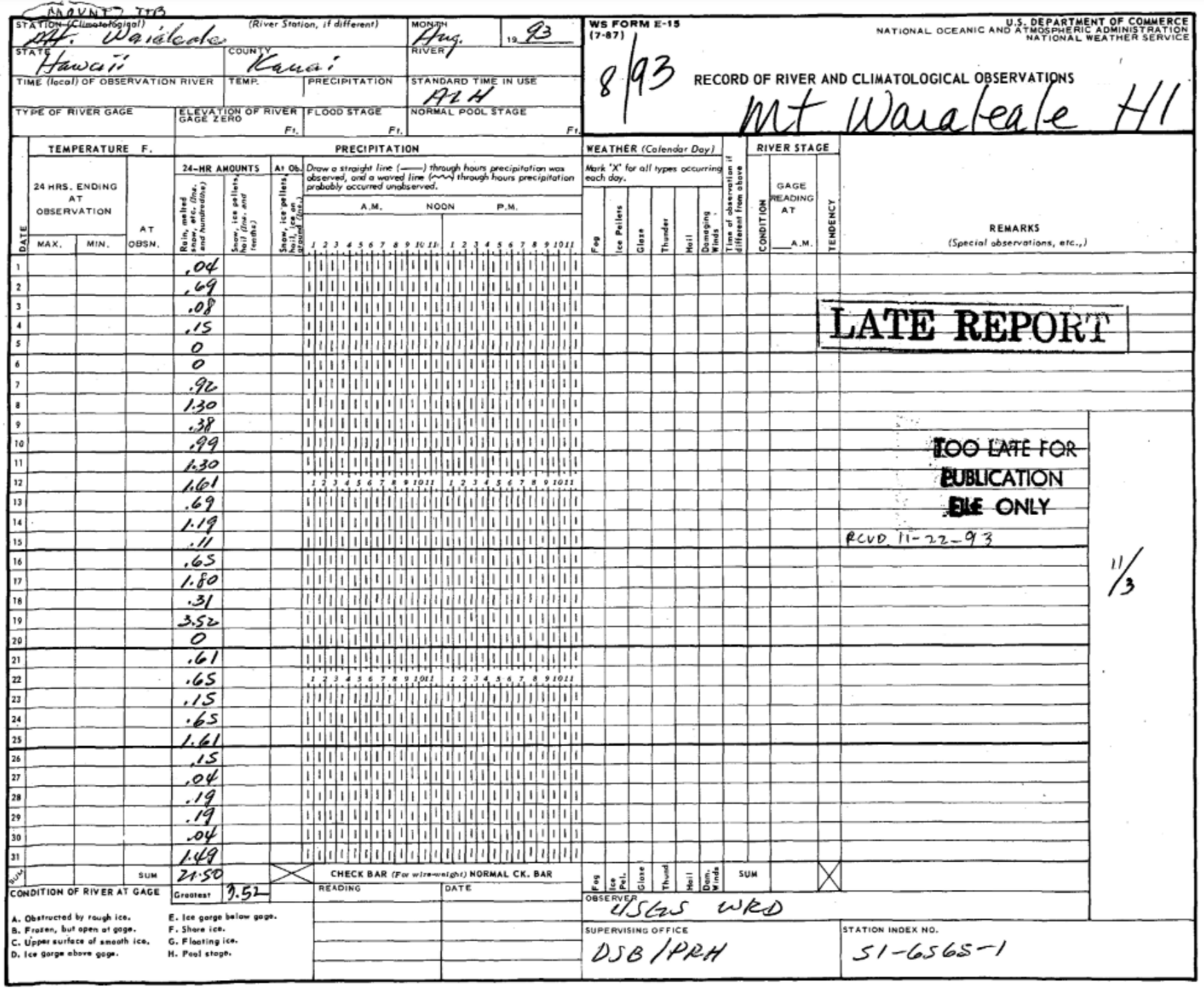
OBSERVER LIGS WRD

SUPERVISING OFFICE DSB/PRH

STATION INDEX NO. 51-6565-1

Mt Waialeale
August 1993

- Received 22 Nov 1993
- Too late to be keypunched(!)
- Not recorded in GHCN-D
- Must be digitized manually
- Several months like this



MAUNT TTB

STATION (Climatological) Mt. Waialeale (River Station, if different) MONTH Aug. 19 93
STATE Hawaii COUNTY Kauai RIVER
TIME (local) OF OBSERVATION RIVER TEMP. PRECIPITATION STANDARD TIME IN USE AH
TYPE OF RIVER GAGE ELEVATION OF RIVER GAGE ZERO Ft. FLOOD STAGE Ft. NORMAL POOL STAGE Ft.

WS FORM E-15 (7-87)
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

8/93 RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

Mt Waialeale HI

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Inc. and hundredths)	Snow, ice pellets, hail (Inc. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Inc.)	Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved. A.M. 1 2 3 4 5 6 7 8 9 10 11 NOON P.M. 1 2 3 4 5 6 7 8 9 10 11	WEATHER (Calendar Day) Mark 'X' for all types occurring each day. Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	Time of observation if different from above	RIVER STAGE CONDITION	GAGE READING AT ___A.M.	TENDENCY	REMARKS (Special observations, etc.,)
1				.04													
2				.69													
3				.08													
4				.15													
5				0													
6				0													
7				.92													
8				1.30													
9				.38													
10				.99													
11				1.30													
12				1.61													
13				.69													
14				1.19													
15				.11													
16				.65													
17				1.80													
18				.31													
19				3.52													
20				0													
21				.61													
22				.65													
23				.15													
24				.65													
25				1.61													
26				.15													
27				.04													
28				.19													
29				.19													
30				.04													
31				1.49													
SUM			SUM	21.50		X	CHECK BAR (For wire-weight) NORMAL CK. BAR	SUM							X		
				Greatest	3.52		READING DATE										

LATE REPORT

TOO LATE FOR PUBLICATION FILE ONLY
RCVD 11-22-93

11/3

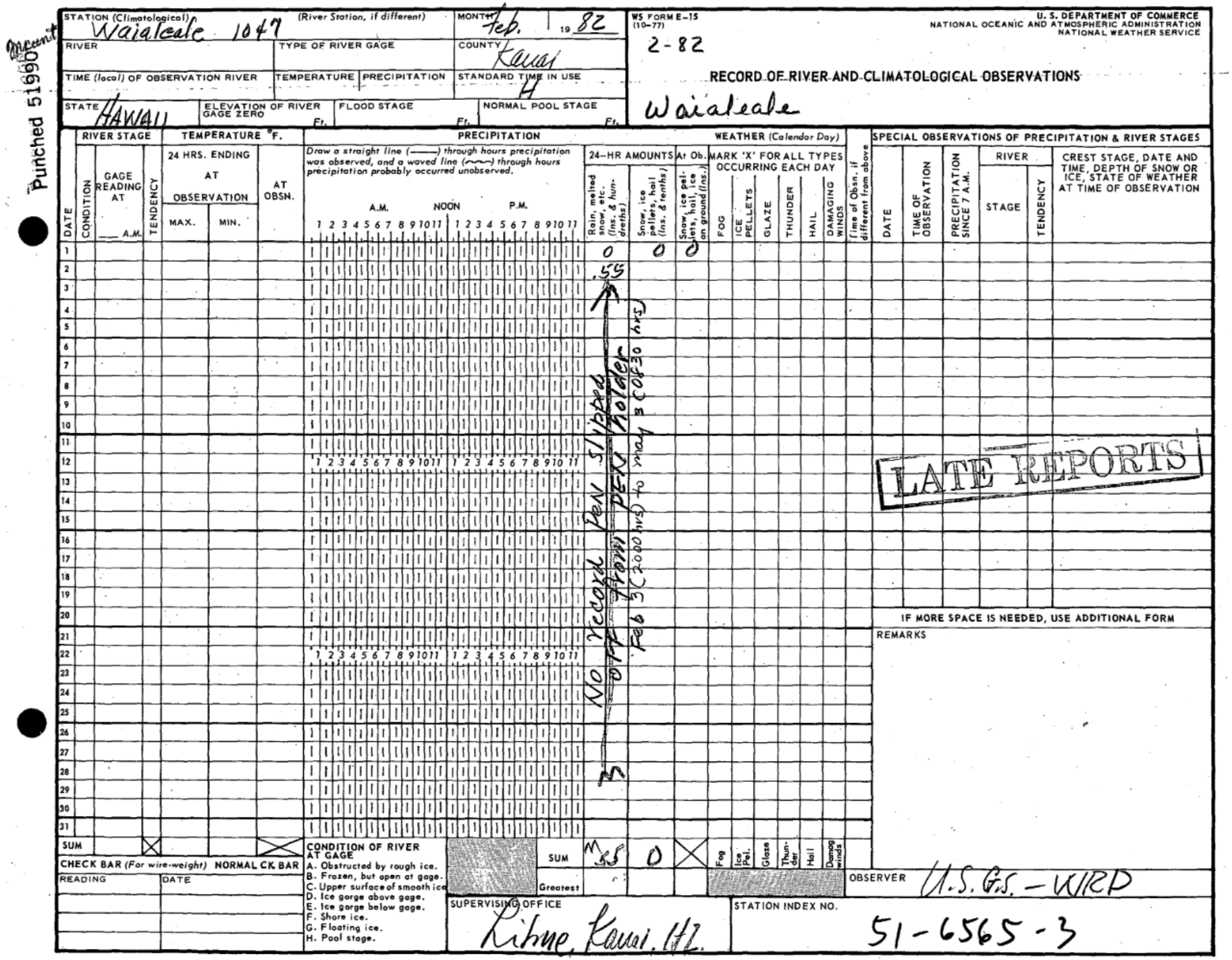
CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER USGS WRD
SUPERVISING OFFICE DSB/PRH
STATION INDEX NO. 51-6565-1

Mt Waialeale
February 1982

"No record, pen slipped off from pen holder. No data Feb 3 (2000 hrs) to May 3 (0830 hrs)."

- Uh-oh, not much we can do, here…



Mount

Punched 51660

STATION (Climatological) Waialeale 1047 (River Station, if different) | MONTH Feb. 19 82 | WS FORM E-15 (10-77) 2-82 | U. S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE

RIVER | TYPE OF RIVER GAGE | COUNTY Kauai

TIME (local) OF OBSERVATION RIVER | TEMPERATURE | PRECIPITATION | STANDARD TIME IN USE H

STATE HAWAII | ELEVATION OF RIVER GAGE ZERO Ft. | FLOOD STAGE Ft. | NORMAL POOL STAGE Ft.

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

Waialeale

RIVER STAGE: DATE | CONDITION | GAGE READING AT ___ A.M. | TENDENCY

TEMPERATURE °F.: 24 HRS. ENDING AT OBSERVATION: MAX. | MIN. | AT OBSN.

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M. 1 2 3 4 5 6 7 8 9 10 11 1 2 3 4 5 6 7 8 9 10 11

24-HR AMOUNTS: Rain, melted snow, etc. (Ins. & hundredths) | Snow, ice pellets, hail (Ins. & tenths) | At Ob. Snow, ice pellets, hail, ice on ground (Ins.)

WEATHER (Calendar Day) MARK 'X' FOR ALL TYPES OCCURRING EACH DAY: FOG | ICE PELLETS | GLAZE | THUNDER | HAIL | DAMAGING WINDS | Time of Obsn. if different from above

SPECIAL OBSERVATIONS OF PRECIPITATION & RIVER STAGES: DATE | TIME OF OBSERVATION | PRECIPITATION SINCE 7 A.M. | RIVER STAGE | RIVER TENDENCY | CREST STAGE, DATE AND TIME, DEPTH OF SNOW OR ICE, STATE OF WEATHER AT TIME OF OBSERVATION

DATE	Rain, melted snow, etc. (Ins. & hundredths)	Snow, ice pellets, hail (Ins. & tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)
1	0	0	0
2	.55		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
SUM	M.55	0	

No record from pen slipped off pen holder Feb 3 (2000 hrs) to May 3 (0830 hrs)

LATE REPORTS

IF MORE SPACE IS NEEDED, USE ADDITIONAL FORM

REMARKS

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
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C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

Greatest

CHECK BAR (For wire-weight) NORMAL CK BAR

READING | DATE

OBSERVER U.S.G.S. - WRD

SUPERVISING OFFICE Lihue, Kauai, HI.

STATION INDEX NO. 51-6565-3

Next Steps: Data Rescue and Clean Up of Earlier COOP Records

Rescue

- Determining which periods should be MDAs and which should not
- Manually modifying flat files from GHCN-D to indicate multiday accumulations, and re-ingesting into database
- Digitizing unkeyed daily data and ingesting into database

Cleanup

- Looking for stations that say they are on-time (midnight-0800) but are not – HOMR sometimes has incorrect obs times compared to forms, or both are wrong
- Day-shifted precip - Contaminates the PRISM anchor grids
- Modifying station metadata so they can be re-apportioned

Send Henry to Hawaii to Sign up More CoCoRaHS Observers

Photo Credit: Andrew Shoemaker