Expansion of the USDM to the U.S.-Affiliated Pacific Islands

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NOAA / NESDIS / National Centers for Environmental Information

Asheville, North Carolina USA

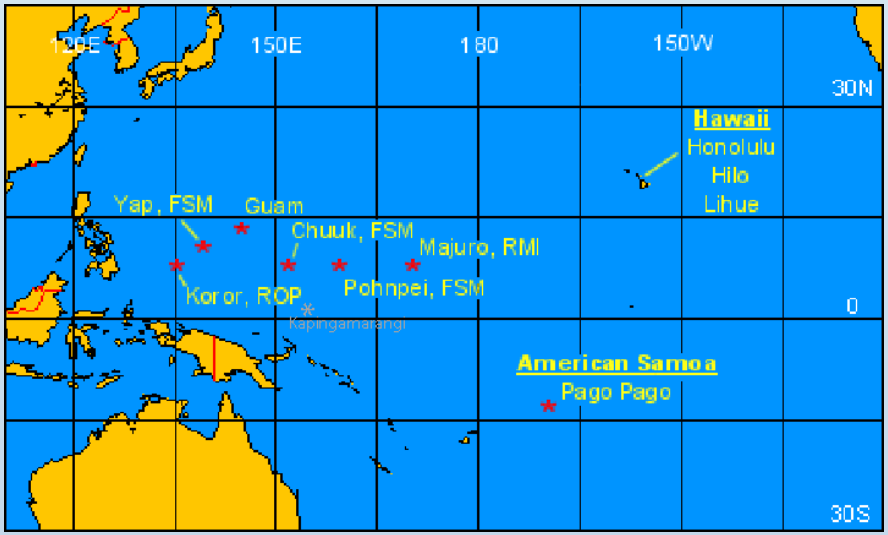
USDM Forum Workshop

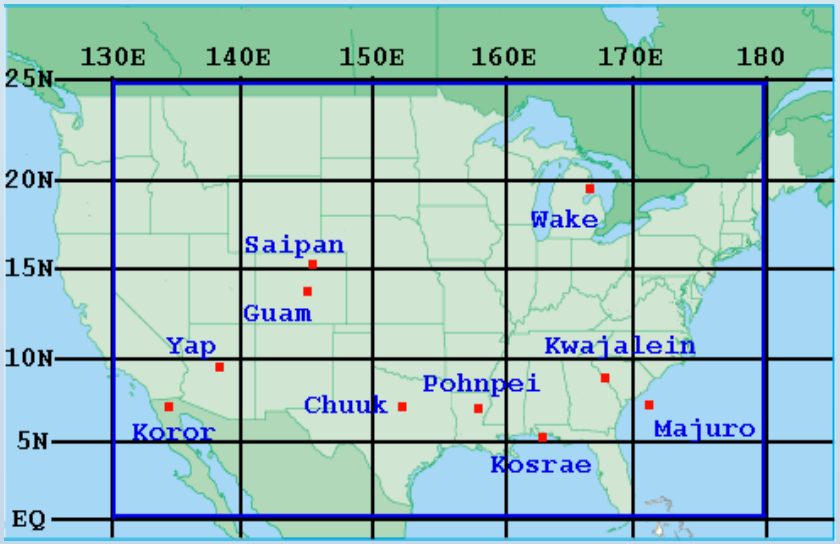
Keystone, SD - April 2017

Overview

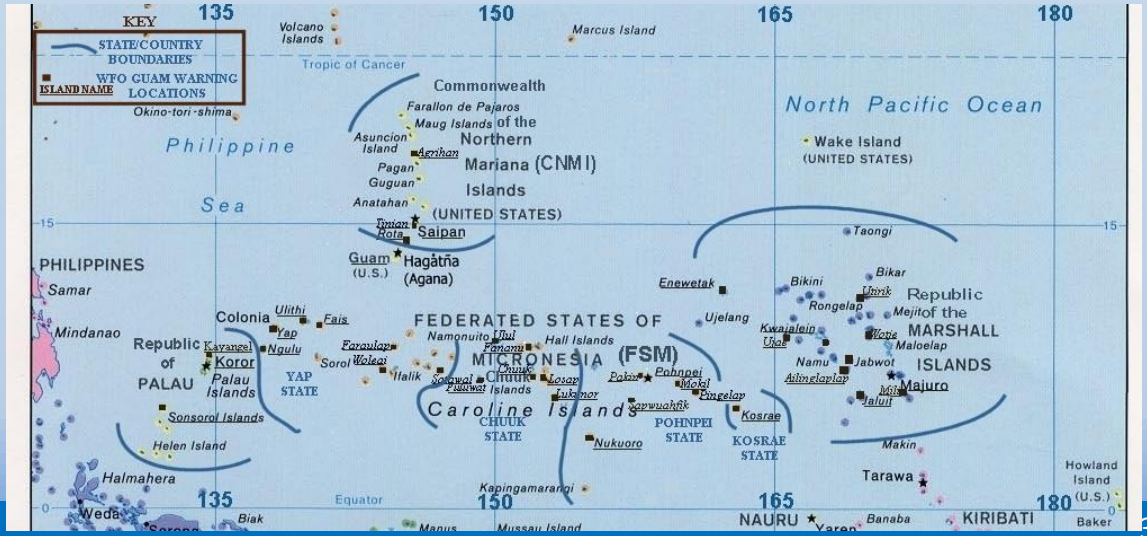
- Differences: Nature of drought and drought monitoring in the U.S. Affiliated Pacific Islands (USAPI)
- Data monitoring tools
- How we are doing it (monitor drought)
- Progress: What we have done so far
- Next steps

Nature of Drought and Drought Monitoring in the USAPI



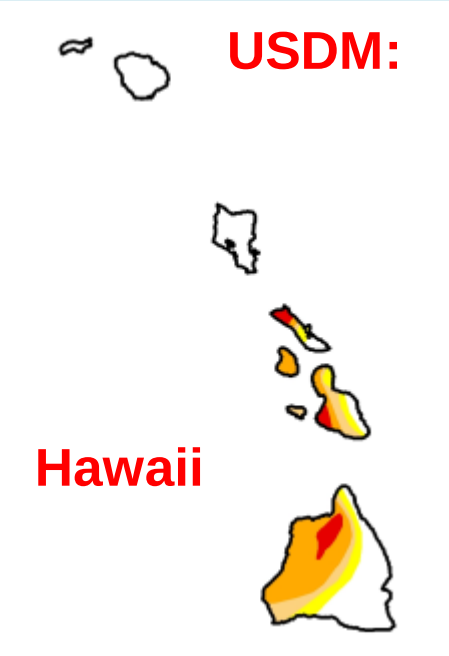


- Geography
  - Large spatial extent
  - Isolated small islands
- Varied Populations
  - From only a few people to 175,000 people



Nature of Drought and Drought Monitoring in the USAPI

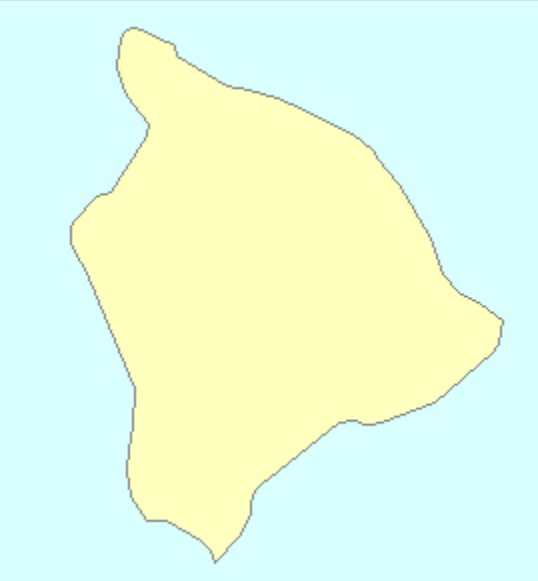
- Monthly mapping:
  - Drought condition plotted as points instead of polygons due to small size of islands



Hawaii, Big Island:
4,027 mi^2
93 mi across

Guam:
212 mi^2
3.7 mi x 29.8 mi

Kwajalein*:
1.2 mi^2
2.4 mi x 0.6 mi



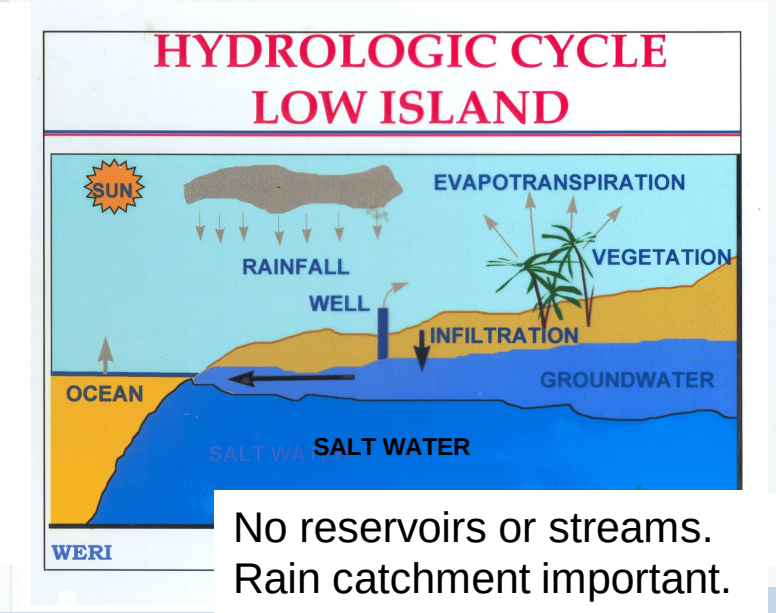
Big Island - Hawaii

Guam

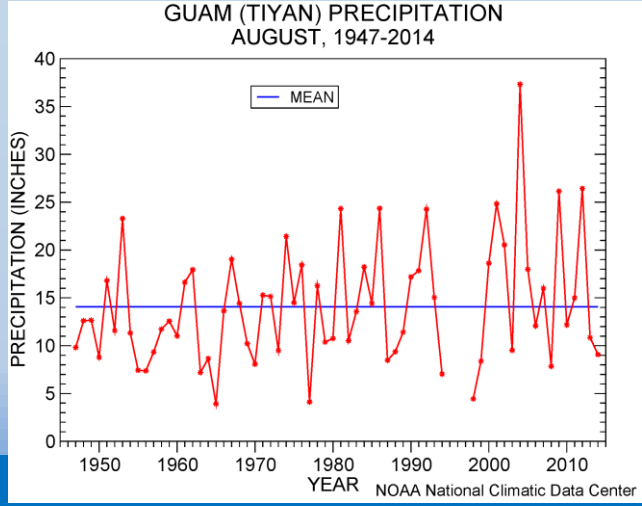
Kwajalein

Nature of Drought and Drought Monitoring in the USAPI

- Different Hydrology
  - Groundwater lenses, few reservoirs or streams, no snowpack storage, rainwater catchment important
- Different Meteorology & Agriculture
  - Tropical climate – precip more important than temperature; mean and standard deviation of precip can be large
    - Guam: 165” in 1997 (El Niño year), 55” in 1998 (El Niño + 1 year)
  - Tropical Cyclones
  - Minimum amount of rainfall needed each month to meet water needs



No reservoirs or streams. Rain catchment important.



Data Monitoring Tools

- Drought monitoring data very limited
  - Daily precipitation data
  - Monthly SPI for some (primary) stations with long records
- Other tools lacking
  - No Palmer Index
  - No VHI (islands too small)
  - No usable streamflow or groundwater observations
  - No soil moisture observations or modeled data
  - Timeliness & availability of data an issue for secondary stations
- Impacts
  - Crop damage, wildfires, low streamflow (where streams exist), water supplies run out
  - Water table fluctuates with ENSO status: Low Islands coralline & porous, High Islands coralline & basaltic & not so porous

Drought Monitoring Criteria -- Summary

Precipitation Amount

Drought Severity Classification

Category	Description	Possible Impacts	Ranges				
			Palmer Drought Index	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Short and Long-term Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9	21-30	21-30	-0.5 to -0.7	21-30
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9	11-20	11-20	-0.8 to -1.2	11-20
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10	-1.3 to -1.5	6-10
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	-1.6 to -1.9	3-5
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0-2	0-2	-2.0 or less	0-2

Short-term drought indicator blends focus on 1-3 month precipitation. Long-term blends focus on 6-60 months. Additional indices used, mainly during the growing season, include the USDA/NASS Topsoil Moisture, Keetch-Byram Drought Index (KBDI), and NOAA/NESDIS satellite Vegetation Health Indices. Indices used primarily during the snow season and in the West include snow water content, river basin precipitation, and the Surface Water Supply Index (SWSI). Other indicators include groundwater levels, reservoir storage, and pasture/range conditions.

Data Monitoring Tools

SPORT Short-term Prediction Research and Transition Center

NESDIS Experimental AHI QPE:

Select an image:
Mar. 27, 2017 - 12:00 UTC

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USAPI

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by product

Products

10-Minute
1-Hour
3-Hour
6-Hour

12-
1-
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Legend
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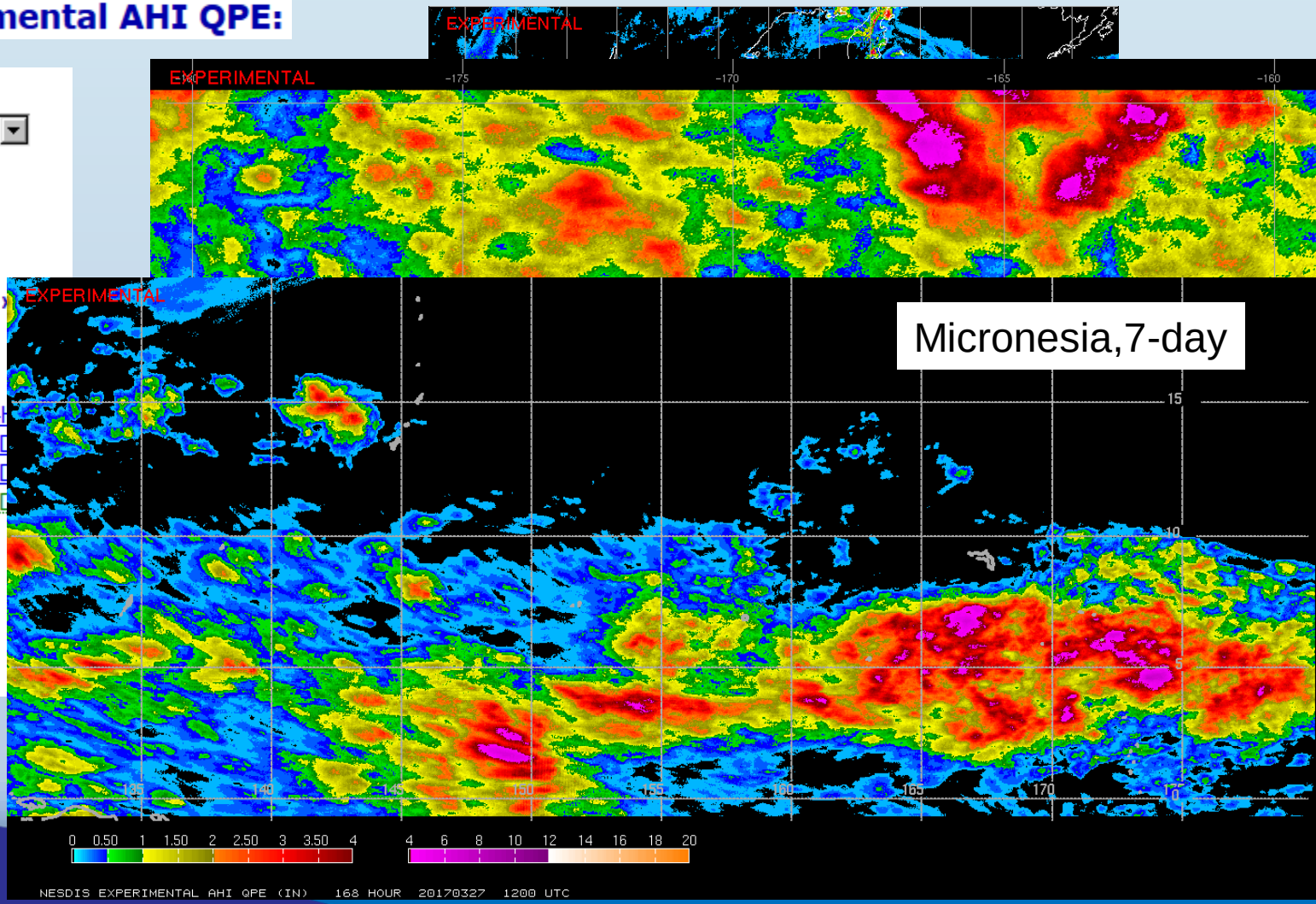
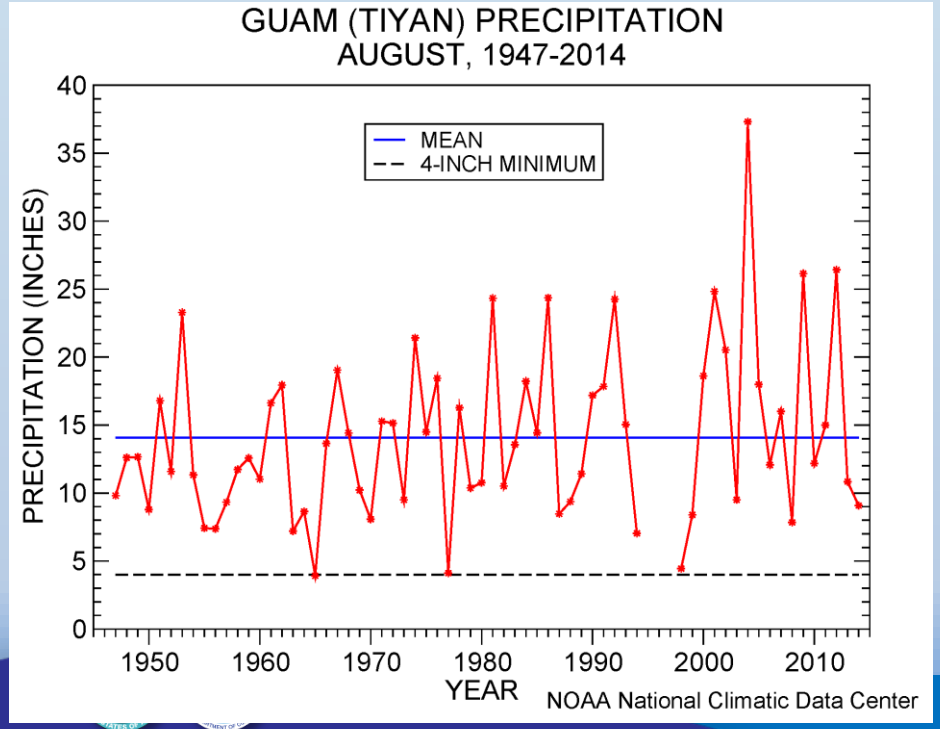
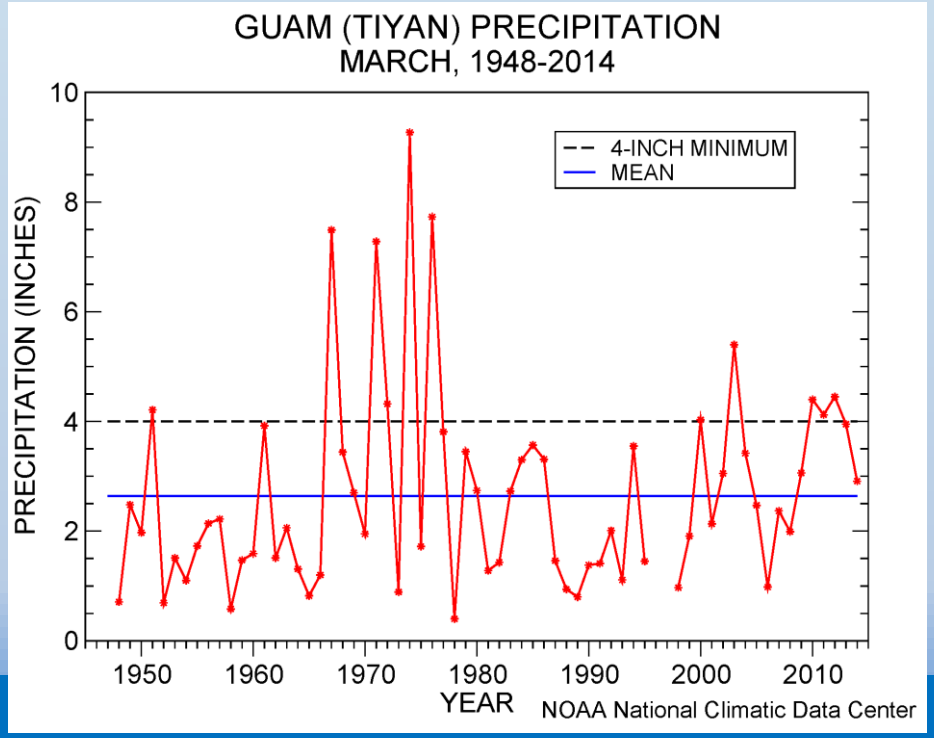


Drought Monitoring Criteria

- Monthly precipitation trigger: Minimum amount of rainfall needed each month to meet water needs
  - Monthly precipitation > minimum (8” or 4”) → No drought
  - Monthly precipitation < minimum for 2 or 3 months → Drought
- Strong seasonality of precip can result in some months always > min and other months mostly < min

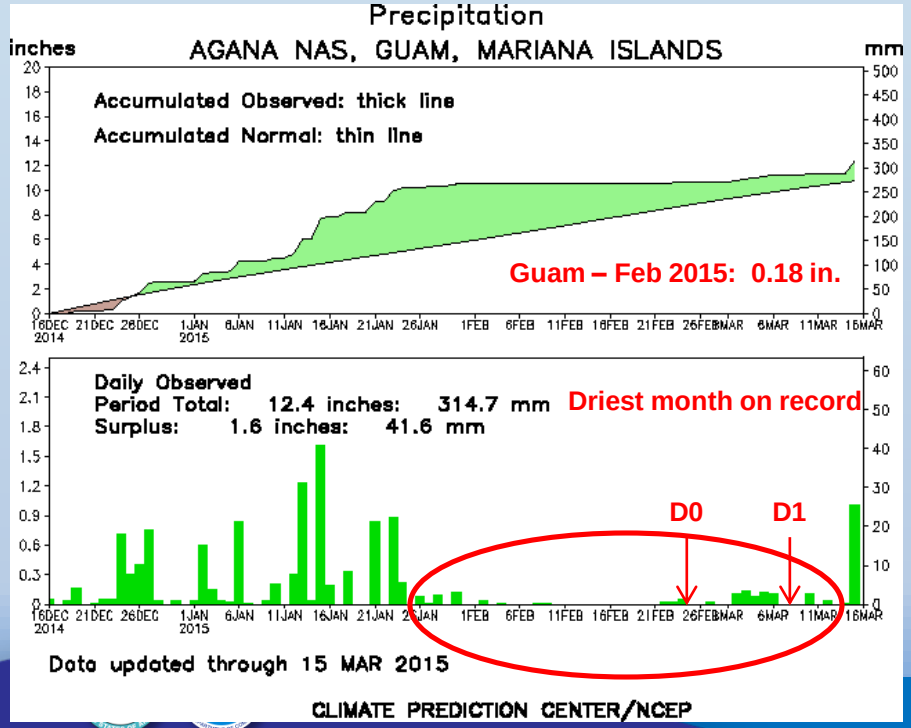




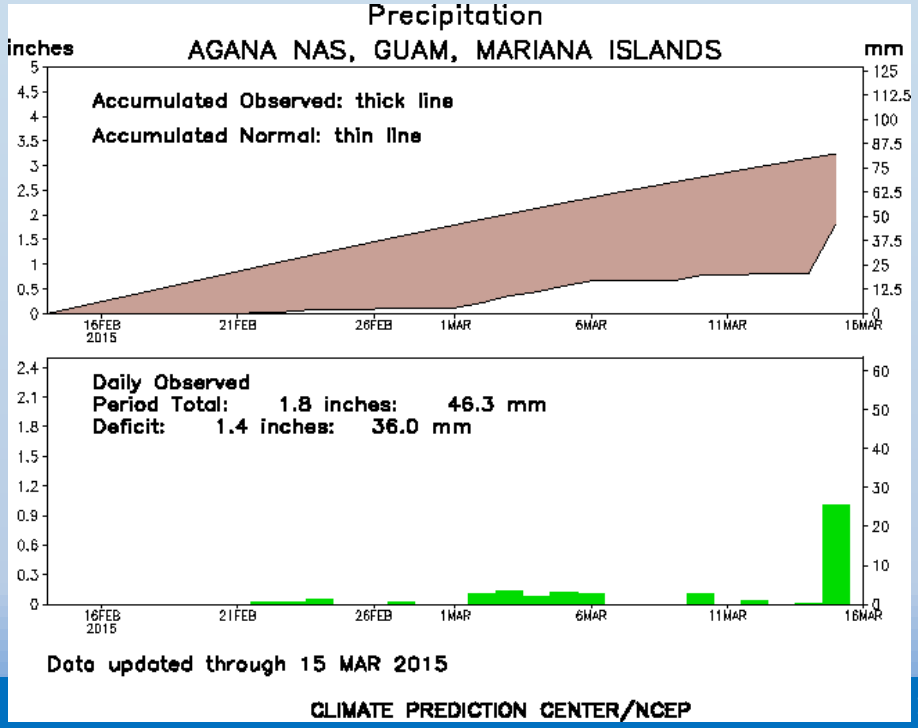
Drought Monitoring Criteria

- Daily precipitation trigger
  - Weekly minimum rainfall needed to meet water needs = (monthly min) / 4
  - 2 or 3 consecutive weeks of no rainfall or low (below weekly min) rainfall → Drought onset

Last 90 days – Dec 15-Mar 15:



Last 30 days – Feb 13-Mar 15:



Status: What Have We Done So Far

- Monthly data:
  - Verified in conjunction with PEAC conference calls (2nd Thurs.)
  - Monthly precipitation, monthly SPI (primary stns), impacts
- Monthly Analysis
  - Done manually in spreadsheets

Percent of Normal Precip | Precipitation | Normals

Pacific Island Precipitation (Inches)

STATION NAME	MAR 2016	APR 2016	MAY 2016	JUN 2016	JUL 2016	AUG 2016	SEP 2016	OCT 2016	NOV 2016	DEC 2016	JAN 2017	FEB 2017	MAR 2016-FEB 2017
Chuuk	7.08	10.73	12.11	10.61	11.27	9.50	10.04	6.73	10.39	19.83	11.37	8.27	127.93
Guam NAS	1.63	1.31	1.80	7.73	6.77	20.85	15.65	13.14	10.13	8.68	6.22	5.06	98.97
Kapingamarangi	10.02	12.78	4.07	3.30	9.33	7.38	7.61	2.14	6.58	11.22	14.54	19.18	108.15
Koror	2.68	9.90	13.55	16.25	8.28	8.20	13.51	18.06	16.38	7.13	13.30	14.99	142.23
Kosrae	5.15	3.99	12.70	18.99	13.07	12.48	12.71	9.87	7.76	26.99	17.21	27.51	168.43
Kwajalein	1.05	1.13	3.80	9.81	9.96	8.12	6.90	18.73	14.16	10.36	9.00	5.60	98.62
Lukonor	4.75	12.83	11.92	8.49	6.84	10.31	12.23	8.41	18.02	14.42	11.58	5.90	125.7
Majuro	1.33	2.05	11.12	7.27	10.09	8.78	13.73	15.28	17.36	11.77	17.65	9.50	125.93
Pago Pago	10.76	30.87	9.89	3.88	4.48	4.49	5.45	5.12	12.86	14.24	9.57	18.32	129.93
Pohnpei	5.76	11.01	16.06	21.18	12.12	15.91	18.13	18.39	17.00	22.83	24.00	6.76	189.15
Saipan	2.00	1.78	2.07	2.05	3.76	24.40	19.31	5.07	4.42	3.67	4.61	5.15	78.29
Yap	0.70	3.47	8.90	6.46	10.03	10.13	8.89	20.00	13.78	8.59	12.67	19.19	125.78

18	Honolulu			0.73	0.87	0.21	7.12
19	Kahului			0.56	6.59	0.55	1.93
20	Hilo			10.04	20.40	12.34	6.15
21							
22	Guam NAS	HIGH	4.00	10.13	8.68	6.22	5.06
23	Saipan	HIGH	4.00	4.42	3.67	4.61	5.15
24	Luchonoch (Lukonor)			18.02	14.42	11.58	5.90
25	Kapingamarangi	low	4.00	6.58	11.22	14.54	19.18

Fananu	D0-S
Nukuoro	D-Nothing
Pingelap	D-Nothing
Ulithi	missing
Woleai	D-Nothing
Ailinglapalap	D-Nothing
Jaluit	D-Nothing
Mili	missing
Utirik	missing
Wotje	D2-S

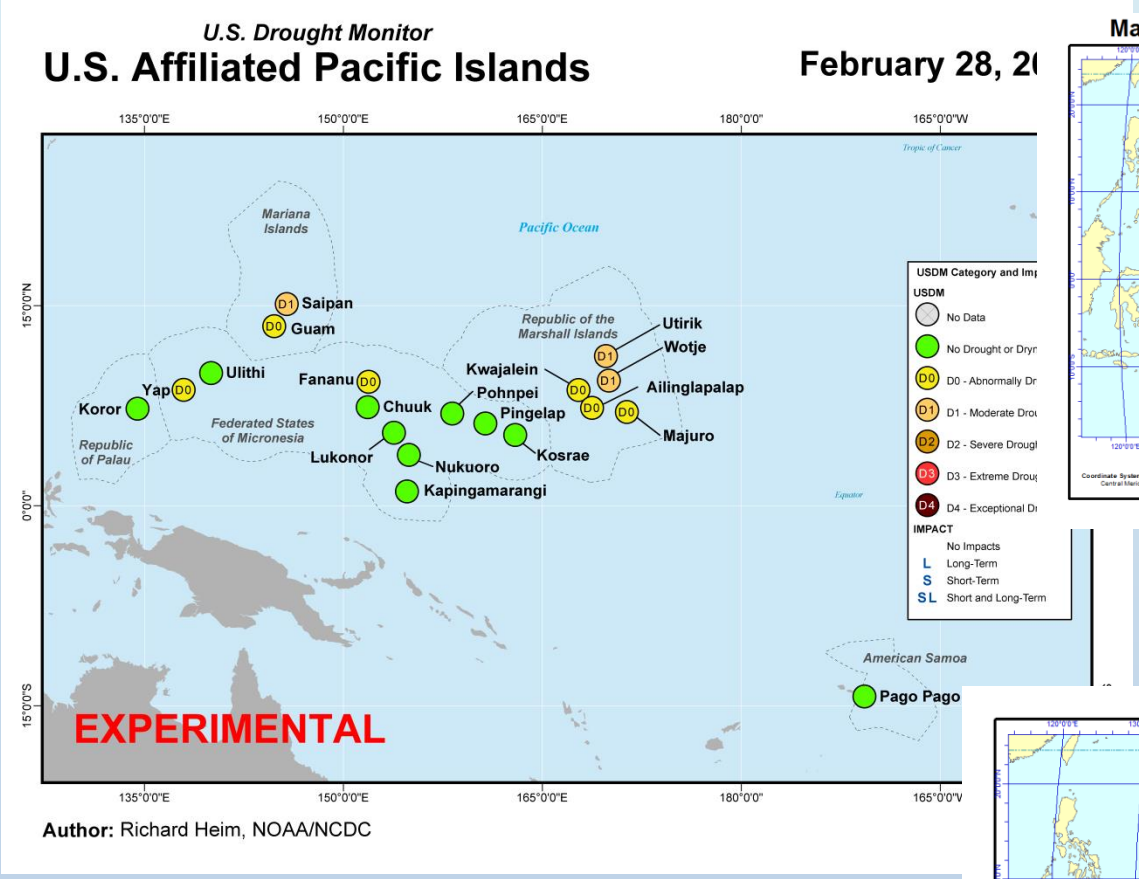
us		Reasoning:		
		Jan pcp	% norm	
	was D-no	> 8" (14.99")	> 100%	SPI > -0.5 @ 1- to 12-MO, < -0.5 @ 18- to 24-MO
	was D-no	> 8" (19.19")	> 100%	SPI > 0 @ 1- to 12-MO, < -0.5 @ 18- to 24-MO
	was D-no	> 4" (5.06")	> 100%	SPI > 0 @ all time scales
	was D-no	> 4" (5.15")	> 100%	SPI > 0 @ all time scales
	was D-no	> 8" (8.27")	> 100%	SPI < -0.5 @ 12- & 18-MO, > -0.5 @ all other time scales
	was D-no	< 8" (5.90")	< 100%	SPI > -0.5 @ 1- to 6-MO, < -0.5 @ 12- to 24-MO; 6th driest Feb out of 33 yrs
	was D-no	> 8" (19.18")	> 100%	last 3 months wet, previous 4 dry (< 8")
	was D-no	< 8" (6.76")	< 100%	SPI = -0.5 @ 1- & 18-MO, > 0 all other time scales; 18th driest Feb out of 66 yrs
	was D-no	> 8" (27.51")	> 100%	SPI > -0.5 @ 1- to 6-MO, < -0.5 @ 12- to 24-MO

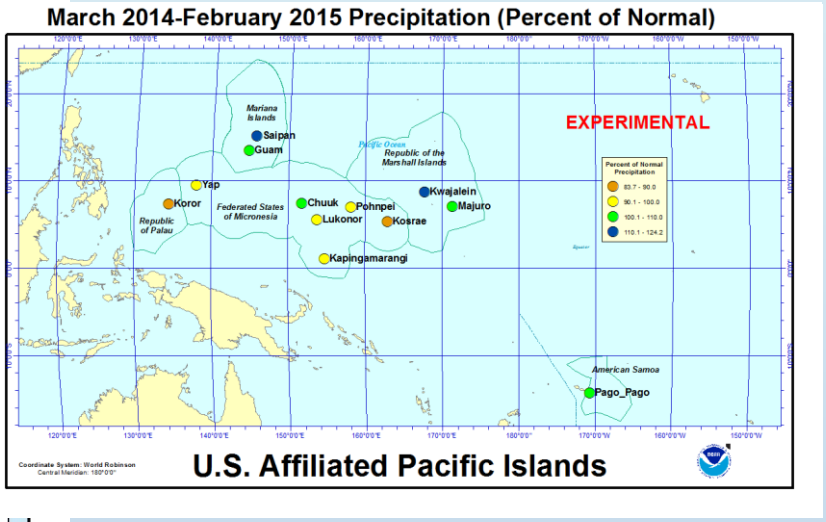
Percent of Normal Precip | Precipitation | Normals

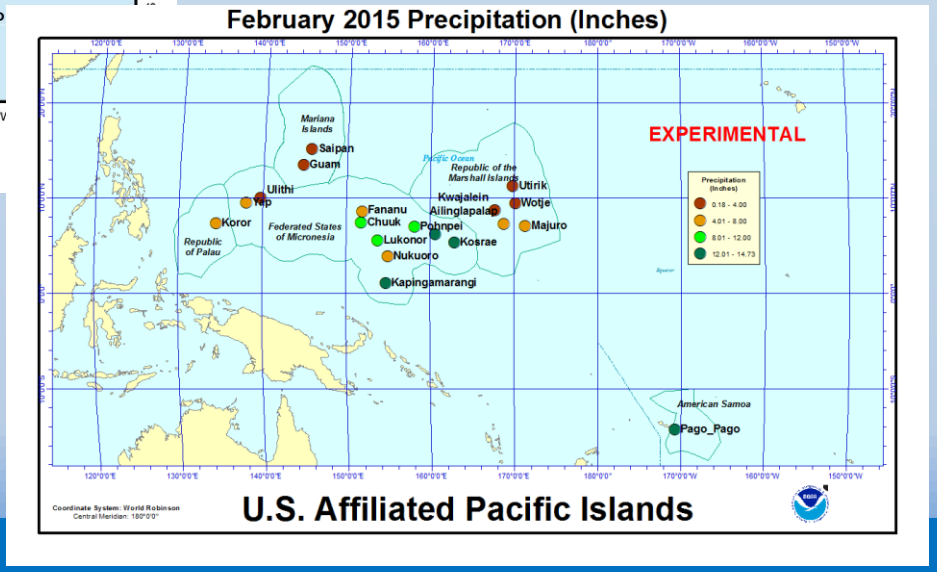
Pacific Island Percent of 1981-2010 Normal Median Precipitation

STATION NAME	MAR 2016	APR 2016	MAY 2016	JUN 2016	JUL 2016	AUG 2016	SEP 2016	OCT 2016	NOV 2016	DEC 2016	JAN 2017	FEB 2017	MAR 2016-FEB 2017
Chuuk	85%	86%	107%	91%	94%	74%	86%	58%	98%	176%	113%	114%	94%
Guam NAS	79%	52%	53%	125%	67%	141%	124%	115%	137%	170%	155%	167%	100%
Kapingamarangi	88%	94%	34%	24%	66%	91%	77%	26%	71%	114%	159%	207%	74%
Koror	36%	135%	115%	93%	45%	61%	115%	153%	144%	64%	131%	175%	93%
Kosrae	32%	23%	72%	130%	88%	88%	89%	90%	56%	168%	103%	213%	79%
Kwajalein	45%	21%	57%	142%	101%	83%	64%	168%	126%	156%	285%	212%	109%
Lukonor	51%	113%	102%	73%	43%	73%	120%	74%	198%	128%	138%	66%	83%
Majuro	20%	22%	110%	66%	90%	75%	123%	120%	129%	103%	228%	138%	101%
Pago Pago	101%	329%	102%	73%	81%	83%	83%	55%	127%	111%	72%	153%	103%
Pohnpei	44%	60%	80%	143%	79%	112%	144%	120%	115%	142%	182%	71%	104%
Saipan	106%	68%	87%	57%	42%	186%	191%	48%	79%	95%	182%	199%	111%
Yap	15%	62%	113%	54%	67%	88%	66%	164%	156%	101%	198%	370%	105%

Status: What Have We Done So Far







Status: What Have We Done So Far

- Daily precipitation data are used for the weekly USDM analyses – done manually in spreadsheet:

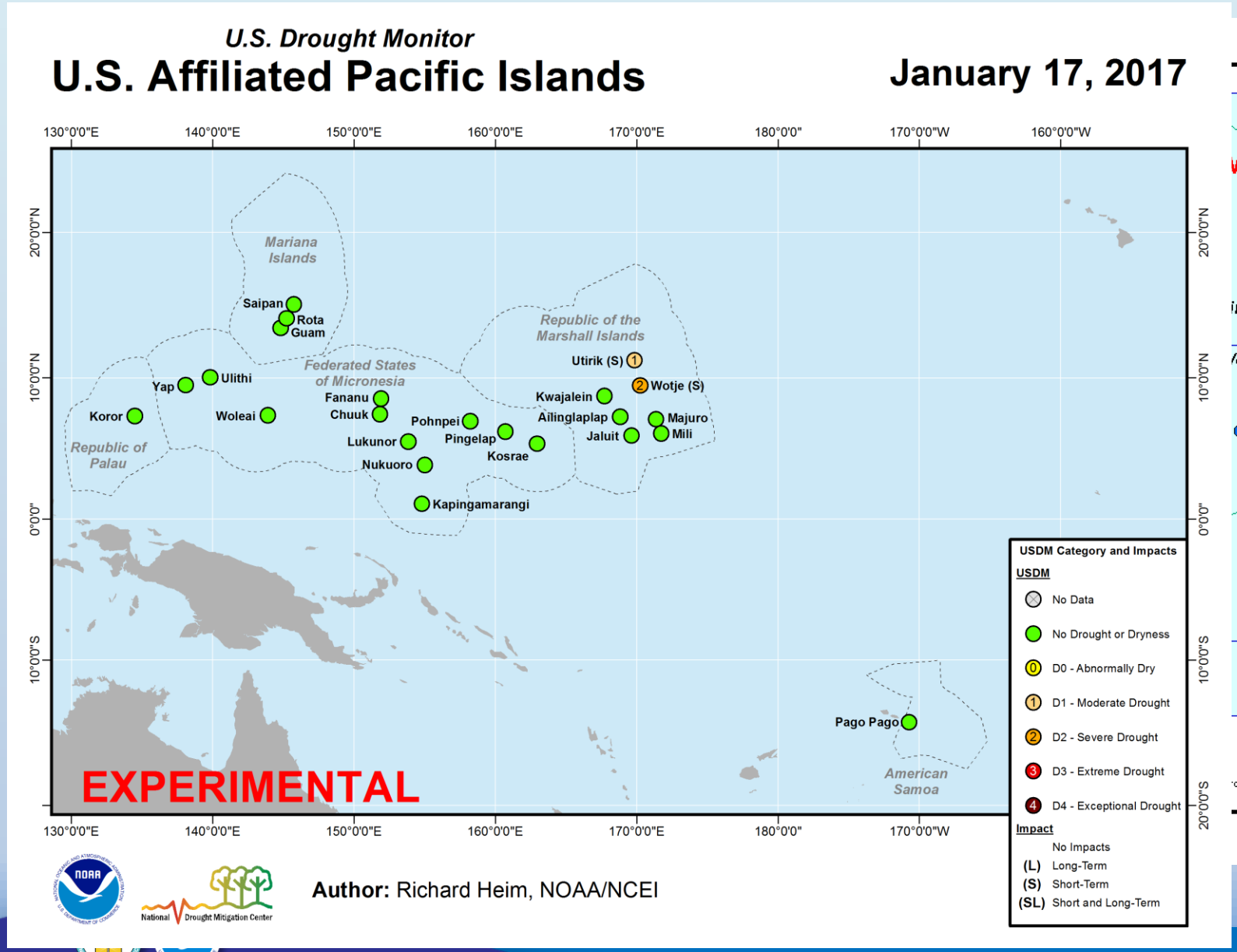
1	**Weekly Precipitation An**																								
2	(Weekly Precip as of Monday)																								
3	(4" Mariana < 8" / month					Weekly	2016-2017			2017					Weekly	2016-2017			2017						Weekly
4	(2" Mariana < 4" / month	Last 4 or 5 Weeks				USDM	Last 3 Months Precip			MTD	Last 4 or 5 Weeks				USDM	Last 3 Months Precip			MTD	Last 4 or 5 Weeks					USDM
5		Jan 4-10	Jan 11-17	Jan 18-24	Jan 25-31	Status	Nov	Dec	Jan	Feb	Feb 1-7	Feb 8-14	Feb 15-21	Feb 22-28	Status	Dec	Jan	Feb	Mar	Mar 1-7	Mar 8-14	Mar 15-21	Mar 22-28	Mar 29-31	Status
6	Palau	Koror	7.46	0.34	2.80	2.49	D-Nothing	16.38	7.13	13.30	14.99	2.46	6.17	4.05	2.31	D-Nothing	7.13	13.30	14.99	16.65	11.11	1.39	4.10	0.05		D-Nothing
7	Marianas	Guam	0.76	2.40	1.82	1.04	D-Nothing	10.13	8.68	6.22	5.06	2.51	1.44	0.97	0.14	D-Nothing	8.68	6.22	5.06	4.29	0.31	0.75	2.29	0.94		D-Nothing
8		Saipan	0.22	1.10	0.13	2.70	D-Nothing	4.42	3.67	4.61	5.15	0.90	4.02	0.11	0.12	D-Nothing	3.67	4.61	5.15	1.77	1.39	0.19	0.15	0.04	*watch*	D-Nothing
9		Rota Airport	0.12	5.48	0.65	2.38	D-Nothing	6.57	7.72	8.63	8.75	2.67	3.51	2.28	0.29	D-Nothing	7.72	8.63	8.75	7.01	0.06	0.19	6.19	0.57		D-Nothing
10		AMME NPS Saipan	0.14	1.55	0.28	1.06	Not Plotted	3.61	3.54	3.30	4.42	0.67	3.40	0.24	0.11	Not Plotted	3.54	3.30	4.42	1.37	0.71	0.21	0.30	0.15		Not Plotted
11		Dededo	0.98	4.43	2.39	0.81	Not Plotted	9.80	9.10	9.35	6.84	1.72	3.16	1.72	0.24	Not Plotted	9.10	9.35	6.84	6.04	1.73	0.19	3.11	1.01		Not Plotted
12		Mangilao	0.45	1.46	1.83	1.03	Not Plotted	10.87	9.89	4.87	6.11	3.01	1.92	0.73	0.45	Not Plotted	9.89	4.87	6.11	6.76	0.23	0.83	2.39	3.31		Not Plotted
13		Tinian	1.09	1.80	1.78	2.71	Not Plotted	4.81	4.70	7.44	9.39	1.58	5.21	1.03	1.57	Not Plotted	4.70	7.44	9.39	0.33	0.00	0.15	0.11	0.07	*missing*	Not Plotted
14	Federated States of Micronesia	**Yap**	0.15	4.89	0.76	6.66	D-Nothing	13.78	8.59	12.67	19.19	12.15	1.20	4.56	1.28	No Data	8.59	12.67	19.19	9.09	4.97	0.45	2.87	0.80		D-Nothing
15		Chuuk	3.47	1.29	1.02	4.05	D-Nothing	10.39	19.83	11.37	8.27	1.95	0.52	3.75	2.05	D-Nothing	19.83	11.37	8.27	10.63	6.04	0.92	3.43	0.24		D-Nothing
16		Pohnpei	7.46	3.68	2.34	3.02	D-Nothing	17.00	22.83	24.00	6.78	1.40	0.45	0.75	4.18	D-Nothing	22.83	24.00	6.76	11.59	4.16	2.60	2.55	2.28		D-Nothing
17		Kosrae	1.59	6.05	3.44	3.58	D-Nothing	7.76	26.99	17.21	27.51	4.30	2.73	5.69	14.79	D-Nothing	26.99	17.21	27.51	21.55	7.36	5.41	3.50	5.28		D-Nothing
18		Dugor	2.49	4.44	3.42	2.02	Not Plotted	14.73	7.69	12.94	24.20	13.95	1.65	4.74	3.86	Not Plotted	7.69	12.94	24.20	8.97	4.46	1.43	2.93	0.15		Not Plotted
19		Fananu	1.85	1.63	0.52	3.07	D-Nothing	8.94	11.57	7.27	2.58	0.84	1.28	0.22	0.24	D0-S	11.57	7.27	2.58	5.20	3.18	0.70	0.38	0.94		D0-S
20		Gilman	1.39	2.52	2.52	5.07	Not Plotted	17.88	7.30	11.65	26.08	16.96	0.85	4.44	3.83	Not Plotted	7.30	11.65	26.08	11.20	7.30	0.62	2.51	0.77		Not Plotted
21		Lukonor/Lukunoch	4.98	1.07	0.29	4.54	D-Nothing	18.02	14.42	11.58	5.90	1.14	1.69	0.96	2.11	D-Nothing	14.42	11.58	5.90	14.29	2.64	2.19	5.63	3.83		D-Nothing
22		Luweech	2.66	2.88	3.67	4.76	Not Plotted	16.86	9.40	14.28	22.85	15.32	0.81	3.66	3.06	Not Plotted	9.40	14.28	22.85	9.49	5.66	0.78	2.93	0.12		Not Plotted
23		Maap	0.12	2.82	2.80	2.73	Not Plotted	11.34	6.76	8.76	20.88	11.05	0.32	4.35	5.16	Not Plotted	6.76	8.76	20.88	5.20	4.04	0.20	0.96	0.00	*missing*	Not Plotted
24		Kapingamarangi	3.62	3.36	0.26	2.88	D-Nothing	6.58	11.22	14.54	19.18	5.57	2.25	1.06	10.30	D-Nothing	11.22	14.54	19.18	14.32	2.91	7.75	2.85	0.81		D-Nothing
25		**North Fanif**	2.14	3.86	2.32	6.37	ot this week	13.27	7.85	15.36	23.41	12.62	0.37	6.82	3.60	ot this week	7.85	15.36	23.41	9.26	3.89	2.38	2.75	0.24	do not plot this week	
26		Nukuoro	4.43	7.16	0.30	5.61	D-Nothing	5.80	19.08	18.64	26.92	8.46	5.81	1.76	10.89	D-Nothing	19.08	18.64	26.92	19.57	4.13	9.15	2.14	4.15		D-Nothing
27		Pingelap	1.20	4.46	0.30	4.74	D-Nothing	15.99	18.68	12.57	6.05	1.78	0.94	1.12	2.21	D-Nothing	18.68	12.57	6.05	11.69	6.30	0.80	3.44	1.15		D-Nothing
28		**Rumung**	1.21	1.24	2.29	4.48	ot this week	13.33	5.52	9.61	23.45	12.59	0.12	5.53	5.21	ot this week	5.52	9.61	23.45	6.75	3.83	0.81	2.01	0.10	do not plot this week	
29		Tamil	2.21	3.67	2.93	3.37	Not Plotted	14.93	9.41	12.82	25.02	12.07	3.32	5.28	4.35	Not Plotted	9.41	12.82	25.02	10.78	5.76	1.63	3.22	0.17		Not Plotted
30		Tofol	3.11	7.84	2.67	4.73	Not Plotted	12.97	22.62	21.50	23.35	3.07	4.36	7.29	8.63	Not Plotted	22.62	21.50	23.35	0.00	MSG	MSG	MSG	MSG		Not Plotted
31		Ulithi	12.67	3.24	0.18	MSG	No Data	7.17	10.67	16.66	0.27	MSG	MSG	0.27	MSG	No Data	10.67	16.66	MSG	2.11	0.01	0.47	1.39	0.24	*missing*	No Data
32		Woleai	1.05	1.35	1.89	7.94	D-Nothing	6.31	10.09	13.54	2.74	0.62	0.27	0.95	0.90	No Data	10.09	13.54	2.74	5.50	1.98	1.20	1.99	0.33	*D0*	D0-S
33	Marshalls	Ailinglapalap	1.45	4.33	0.73	4.55	D-Nothing	21.10	18.92	12.75	7.39	3.44	2.50	0.52	0.93	D-Nothing	18.92	12.75	7.39	6.46	0.36	0.86	1.53	3.71	*watch*	D-Nothing
34		Kwajalein	2.90	5.27	0.30	0.39	D-Nothing	14.16	10.36	9.00	5.60	1.76	3.47	0.18	0.19	D-Nothing	10.36	9.00	5.60	1.07	0.18	0.26	0.47	0.16		D0-S
35		Majuro	1.97	7.64	2.10	3.54	D-Nothing	17.36	11.77	17.65	9.50	1.71	3.56	1.99	2.24	D-Nothing	11.77	17.65	9.50	8.27	1.42	1.73	0.48	4.64		D-Nothing
36		Jaluit	0.70	1.94	2.65	3.20	D-Nothing	12.29	17.23	9.94	13.50	2.70	5.38	1.15	4.27	D-Nothing	17.23	9.94	13.50	8.34	2.72	1.21	1.15	3.26		D-Nothing
37		Mili	1.88	7.68	0.75	MSG	No Data	15.17	29.88	17.09	2.57	MSG	MSG	0.12	2.45	D-Nothing	29.88	17.09	2.57	4.63	1.55	1.78	0.59	0.71	*missing*	No Data
38		Utirik	0.31	0.05	0.17	0.10	D2-S	9.46	1.99	0.63	MSG	MSG	MSG	MSG	MSG	No Data	1.99	0.63	MSG	0.00	MSG	MSG	MSG	MSG		No Data
39		Wotje	0.00	0.08	0.00	0.00	D2-S	8.07	1.50	0.08	4.48	0.75	3.73	0.00	0.00	D2-S	1.50	0.08	4.48	0.99	0.00	0.82	0.17	0.00	*watch*	D2-S
40	Am. Samoa	Pago Pago	1.32	2.46	2.10	3.55	D-Nothing	12.86	14.24	9.57	18.18	1.01	7.03	8.01	2.13	D-Nothing	14.24	9.57	18.32	4.60	0.33	2.14	1.30	0.83		D-Nothing
41		Siufaga Ridge	MSG	MSG	MSG	MSG	Not Plotted	MSG	MSG	MSG	6.88	MSG	0.74	4.49	1.65	Not Plotted	MSG	MSG	6.88	5.92	0.64	2.06	1.98	1.24		Not Plotted
42		Toa Ridge	MSG	MSG	MSG	MSG	Not Plotted	MSG	MSG	MSG	MSG	MSG	MSG	MSG	MSG	Not Plotted	MSG	MSG	MSG	0.00	MSG	MSG	MSG	MSG		Not Plotted

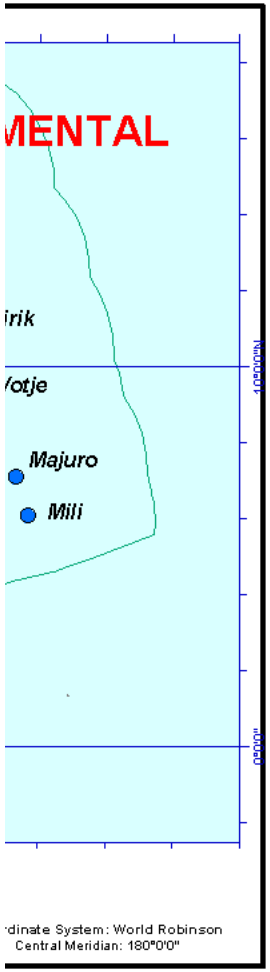
Status: What Have We Done So Far

- Timeliness of daily data can be an issue for the secondary stations

1	**Weekly Precipitation An**																												
2	(Weekly Precip as of Monday)																												
3	(4" Mariana	< 8" / month					Weekly		2016-2017			2017						Weekly		2016-2017			2017							Weekly
4	(2" Mariana	< 4" / month		Last 4 or 5 Weeks				USDM	Last 3 Months Precip			MTD		Last 4 or 5 Weeks				USDM	Last 3 Months Precip			MTD		Last 4 or 5 Weeks					USDM
5			Jan 4-10	Jan 11-17	Jan 18-24	Jan 25-31	Status	Nov	Dec	Jan	Feb	Feb 1-7	Feb 8-14	Feb 15-21	Feb 22-28	Status	Dec	Jan	Feb	Mar	Mar 1-7	Mar 8-14	Mar 15-21	Mar 22-28	Mar 29-31	Status
43								No. of Days Mi		Month	Week						No. of Days Mi		Month	Week							
44		missing days	Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31	WxCoder III	Koror		??	??	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28	verified in W	Koror		??	??	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		WxCoder III
45			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31	F6 & CLM ag	Guam		0	0	Feb 1-6	Feb 7-12	Feb 13-20	Feb 21-28		Guam		1	1	Mar 1-6	Mar 7-12	Mar 13-19	Mar 20-26		
46			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31	ASOS: 0.46"-	Saipan		0	0	Feb 1-6	Feb 7-12	Feb 13-20	Feb 21-28	ASOS (thru 2	Saipan		1	1	Mar 1-6	Mar 7-12	Mar 13-19	Mar 20-26		ASOS (thru 3
47			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Rota Airport		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Rota Airport		0	0	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		
48			Jan 4-9	Jan 10-17	Jan 18-24	Jan 25-31		Saipan AMME I		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Saipan AMME I		0	0	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		
49			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Dededo		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Dededo		0	0	Mar 1-7	Mar 8-13	Mar 14-20	Mar 21-27		
50			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Mangilao		1	1	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Mangilao		0	0	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		
51			Jan 4-9	Jan 10-17	Jan 18-24	Jan 25-31		Tinian		0	0	Feb 1-6	Feb 7-12	Feb 13-20	Feb 21-28		Tinian		16	4	Mar 5	Mar 9-12	Mar 15-19	Mar 23-25		
52			Jan 4-8	Jan 9-17	Jan 18-20	Jan 21-31	CLM & WxC	Yap		0	0	Feb 1-5	Feb 6-12	Feb 13-21	Feb 22-28	CLI thru 2/1	Yap		0	0	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		CLI: 3/22 8.2
53			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31	agrees with	Chuuk		??	??	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28	verified in W	Chuuk		1	1	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-26		WxCoder III
54			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31	WxCoder III	Pohnpei		??	??	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28	WxCoder III	Pohnpei		??	??	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		WxCoder III
55			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Kosrae		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Kosrae		0	0	Mar 1-7	Mar 8-13	Mar 14-19	Mar 20-27		
56			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Dugor		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Dugor		0	0	Mar 1-6	Mar 7-13	Mar 14-19	Mar 20-27		
57			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Fananu		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Fananu		1	1	Mar 1-6	Mar 7-13	Mar 14-19	Mar 20-26		
58			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Gilman		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Gilman		0	0	Mar 1-7	Mar 8-13	Mar 14-20	Mar 21-27		
59			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Lukonor/Lukun		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Lukonor/Lukun		1	1	Mar 1-6	Mar 7-13	Mar 14-19	Mar 20-26		
60			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Luweech		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Luweech		2	2	Mar 1-6	Mar 7-13	Mar 14-19	Mar 20-27		
61			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Maap		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Maap		5	5	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-22		
62			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Kapingamaran		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Kapingamaran		0	0	Mar 1-6	Mar 7-13	Mar 14-19	Mar 20-27		
63			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		North Fanif		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		North Fanif		0	0	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		
64			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Nukuoro		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Nukuoro		1	0	Mar 1-6	Mar 7-13	Mar-14-20	Mar 21-27		
65			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Pingelap		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Pingelap		0	0	Mar 1-6	Mar 7-13	Mar 14-19	Mar 20-27		
66			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Rumung		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Rumung		0	0	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		
67			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-28		Tamil		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Tamil		1	1	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-26		
68			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Tofol		0	0	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28		Tofol		All	All	MSG	MSG	MSG	MSG		
69			Jan 4-9	Jan 10-17	Jan 18-20	MSG		Ulithi		26	7	MSG	MSG	Feb 14-15	Feb 22-28		Ulithi		15	4	Mar 6	Mar 7-13	Mar 14-20	Mar 21-27		
70			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Woleai		6	2	Feb 1-6	Feb 7-12	Feb 14-20	Feb 21-28		Woleai		1	0	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		
71			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Ailinglapalap		0	0	Feb 1-6	Feb 7-14	Feb 15-20	Feb 21-28		Ailinglapalap		0	0	Mar 1-5	Mar 6-12	Mar 13-20	Mar 21-27		
72			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31	9.00 confirm	Kwajalein		??	??	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28	Feb total 5.6	Kwajalein		??	??	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		
73			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31	WxCoder III	Majuro		??	??	Feb 1-6	Feb 7-13	Feb 14-20	Feb 21-28	WxCoder III	Majuro		??	??	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		WxCoder III
74			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-30		Jaluit		0	0	Feb 1-6	Feb 7-14	Feb 15-20	Feb 21-28		Jaluit		0	0	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21-27		
75			Jan 4-9	Jan 10-17	Jan 18-21	MSG		Mili		15	1	MSG	MSG	Feb 15-20	Feb 21-27		Mili		6	6	Mar 1-6	Mar 7-13	Mar 14-20	Mar 21		
76			Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-30		Utirik		All	All	MSG	MSG	MSG	MSG		Utirik		All	All	MSG	MSG	MSG	MSG		
77		Jul=SinceJun1-Jun-	Jan 4-9	Jan 10-17	Jan 18-23	Jan 24-31		Wotje		0	0	Feb 1-6	Feb 7-14	Feb 15-20	Feb 21-28		Wotje		0	0	Mar 1-6	Mar 7-13	Mar 14-19	Mar 20-27		
78		3.99	Jan 3-8	Jan 9-16	Jan 17-22	Jan 23-31		Pago Pago		??	??	Feb 1-5	Feb 6-12	Feb 13-19	Feb 20-28	Feb total 18	Pago Pago		??	??	Mar 1-5	Mar 6-12	Mar 13-19	Mar 20-26		
79			MSG	MSG	MSG	MSG		Siufaga Ridge		8	0	MSG	Feb 9-12	Feb 13-19	Feb 20-28		Siufaga Ridge		0	0	Mar 1-5	Mar 6-13	Mar 14-20	Mar 21-26		
80			MSG	MSG	MSG	MSG		Toa Ridge		All	All	MSG	MSG	MSG	MSG		Toa Ridge		All	All	MSG	MSG	MSG	MSG		
81																										

Status: What Have We Done So Far - Maps





Status: What Have We Done So Far

- NDMC Tool for Making the ArcGIS USDM Map

USAPI Map Editor

Time Scale

Weekly Monthly

March 28, 2017

Author

Heim, Richard

Status

Submit Changes

Marshall Islands

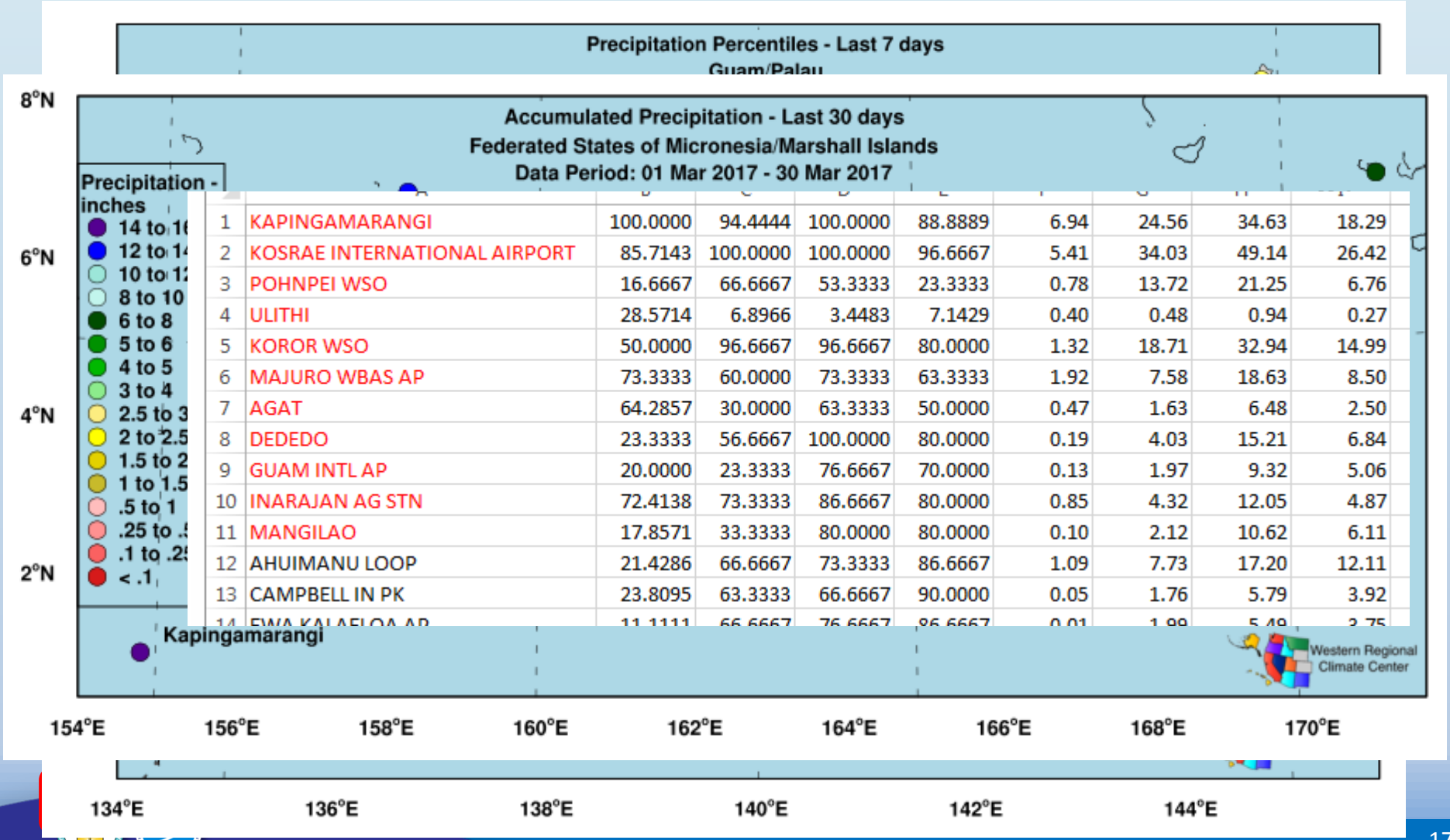
Location	Not Visible	No Data	None	D0	D1	D2	D3	D4	No Impacts	S	L	SL
Ailinglaplap	○	○	●	○	○	○	○	○	●	○	○	○
Jaluit	○	○	●	○	○	○	○	○	●	○	○	○
Kwajalein	○	○	○	●	○	○	○	○	○	●	○	○
Majuro	○	○	●	○	○	○	○	○	●	○	○	○
Mili	○	●	○	○	○	○	○	○	●	○	○	○
Utirik	○	●	○	○	○	○	○	○	●	○	○	○
Wotje	○	○	○	○	○	●	○	○	○	●	○	○

Micronesia

Location	Not Visible	No Data	None	D0	D1	D2	D3	D4	No Impacts	S	L	SL
Chuuk	○	○	●	○	○	○	○	○	●	○	○	○
Fananu	○	○	○	●	○	○	○	○	○	●	○	○
Kapingamarangi	○	○	●	○	○	○	○	○	●	○	○	○
Kosrae	○	○	●	○	○	○	○	○	●	○	○	○
Lukunor	○	○	●	○	○	○	○	○	●	○	○	○
North Fanif	●	○	○	○	○	○	○	○	●	○	○	○
Nukuoro	○	○	●	○	○	○	○	○	●	○	○	○
Pingelap	○	○	●	○	○	○	○	○	●	○	○	○

Status: What Have We Done So Far

- WRCC mapping of real-time data



1	KAPINGAMARANGI	100.0000	94.4444	100.0000	88.8889	6.94	24.56	34.63	18.29
2	KOSRAE INTERNATIONAL AIRPORT	85.7143	100.0000	100.0000	96.6667	5.41	34.03	49.14	26.42
3	POHNPEI WSO	16.6667	66.6667	53.3333	23.3333	0.78	13.72	21.25	6.76
4	ULITHI	28.5714	6.8966	3.4483	7.1429	0.40	0.48	0.94	0.27
5	KOROR WSO	50.0000	96.6667	96.6667	80.0000	1.32	18.71	32.94	14.99
6	MAJURO WBAS AP	73.3333	60.0000	73.3333	63.3333	1.92	7.58	18.63	8.50
7	AGAT	64.2857	30.0000	63.3333	50.0000	0.47	1.63	6.48	2.50
8	DEDEDO	23.3333	56.6667	100.0000	80.0000	0.19	4.03	15.21	6.84
9	GUAM INTL AP	20.0000	23.3333	76.6667	70.0000	0.13	1.97	9.32	5.06
10	INARAJAN AG STN	72.4138	73.3333	86.6667	80.0000	0.85	4.32	12.05	4.87
11	MANGILAO	17.8571	33.3333	80.0000	80.0000	0.10	2.12	10.62	6.11
12	AHUIMANU LOOP	21.4286	66.6667	73.3333	86.6667	1.09	7.73	17.20	12.11
13	CAMPBELL IN PK	23.8095	63.3333	66.6667	90.0000	0.05	1.76	5.79	3.92
14	EWA KALAELOA AP	11.1111	66.6667	76.6667	86.6667	0.01	1.99	5.49	2.75

Status: What Have We Done So Far

- Proof of Concept
  - Manual analysis – monthly since Oct 2012 & weekly since Dec 9, 2014
  - Proven that a weekly assessment of USAPI drought conditions <u>can be done</u>
  - Established methodology and data requirements so that they can later be automated

Next Steps

- Automate the downloading and analysis of the daily precipitation data – @ NCEI
  - Latest daily precip data from HPRCC feed appended to GHCN-Daily historical daily data
  - Daily cron to compute the weekly and month-to-date precipitation and missing days statistics currently being done by hand
  - Create output files that could feed into mapping software & web
  - Compute other statistics (e.g., moving X-day precip total; number of days since X inches [0.10, 0.25, 0.50, 1.00”])
  - Generate “first guess” Dx value
  - Manual – 3 to 4 hours each week
  - Automated – projected 15-30 minutes.
- Phase 1 → Get approval from USDM Administrators to make USAPI operational as part of the USDM

Phase 1

2

3

Next Steps

23 drought,
37 precip

Palau	Koror
Marianas	Guam
	Saipan
FSM	**Yap**
	Chuuk
	Pohnpei
	Kosrae
Marshalls	Kwajalein
	Majuro
Am. Samoa	Pago Pago

10

Palau	Koror
Marianas	Guam
	Saipan
	Rota Airport
	AMME NPS Saipan
	Dededo
	Mangilao
	Tinian
Federated States of Micronesia	**Yap**
	Chuuk
	Pohnpei
	Kosrae
	Dugor
	Fananu
	Gilman
	Lukonor/Lukunoch
	Luweech
	Maap
	Kapingamarangi
	North Fanif
	Nukuoro
	Pingelap
	Rumung
	Tamil
	Tofol
	Ulithi
	Woleai
Marshalls	Ailinglapalap
	Kwajalein
	Majuro
	Jaluit
	Mili
	Utirik
	Wotje
Am. Samoa	Pago Pago
	Siufaga Ridge
	Toa Ridge

Appendix: Additional stations from NWS Guam data base:

Aasufou(AMS)
PagoPago(AMSamoa)****
Hagatna Treatment Plnt-GWA
Agat(Guam)****CO
Agat Treatment Plnt-GWA
Andersen AFB (Guam)
Asan (Aydletts)
Dededo Ypaopao (Lander)
Dededo(Guam)****CO
Nrn Dist Treatment Plnt-GWA
WFO Guam/NWS****
Inarajan Ag Stn(Guam)****CO
Inarahan Treatment Plnt--GWA
Ipan Talofofo (****CO (Jeff's))
Mangilao WERI (UOG)
Mangilao(Guam)****CO
Mangilao (Guam) (NASA gage)
Sinajana (Guard)
Sinajana (Guard) Electronic
Baza Gardens Treat Plnt-GWA
Toto (NWS Middlebrooke))
UGUM Watershed (UOG)
Umatac-Merizo Treat Plnr-GWA
Windward Hills (McElroy)
Yigo(Guam)****CO
Piti [Guam]****FP
Fena Reservoir (Guam)****FP
Isley Field (manned) (CNMI) **
Red Cross Saipan (Hirsh)
Saipan[CNMI]****FP
Capitol Hill/EMO (CNMI) **
Tinian Air (Tinian) **
Rota Airport(CNMI)
Ailinglapalap(Marshalls)****CO
Arno(Marshalls)****CO
Chuuk WSO(Chuuk)****
Dugor (Yap)****CO
Ettal Island (Chuuk)****CO
Fananu (Chuuk)****CO
Jaluit(Marshalls)****CO
Gilman(Yap)****CO
Kapingamwarangi (Pohnpei)****
Koror WSO(Palau)****
Kwajalein(Marshalls)*
Laura[Marshalls]****CO
Losap (Chuuk) (91336)
Lukunoch(Chuuk)****CO
Luweech(Yap)****CO
Maap(Yap)****CO
Majuro WSO(Marshalls)****
Mili(Marshalls)****
Mwoakilloa (Pohnpei)****CO
Nautilus Hotel [Kosrae]****CO
Nama Island (Chuuk)****CO
Nekken Forestry(Palau)****CO
Namoluk (Chuuk)
North Fanif(Yap)****CO
Nukuoro(Pohnpei)****CO
Onoun Island [Chuuk]
Palau Int'l Airport [Palau]
Palikir(Pohnpei)****CO
Peleliu(Palau)****CO
Piis Panew (Lagoon)****CO
Pingelap(Pohnpei)****CO
Pohnpei Airport (SAWRS)
Pohnpei WSO(Pohnpei)****CO
Polowat (Chuuk)****CO
Rumung(Yap)****CO
Sawrs(Kosrae)****CO
Ta Island [Chuuk]****CO
Tamil(Yap)****CO
Tofol(Kosrae)****CO
Ulithi(Yap)****CO
Utirik(Marshalls)****
Utwa(Kosrae)****CO
Wotje(Marshalls)****CO
Woleai Atoll(Yap)****CO
Yap WSO (Yap)****

78 “potential” stations

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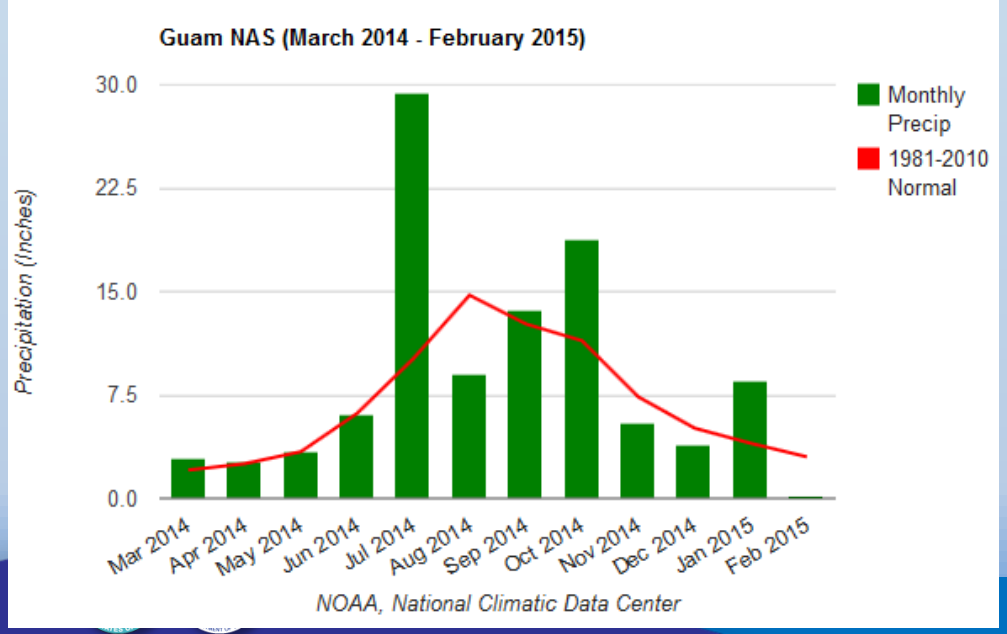
Thank You!

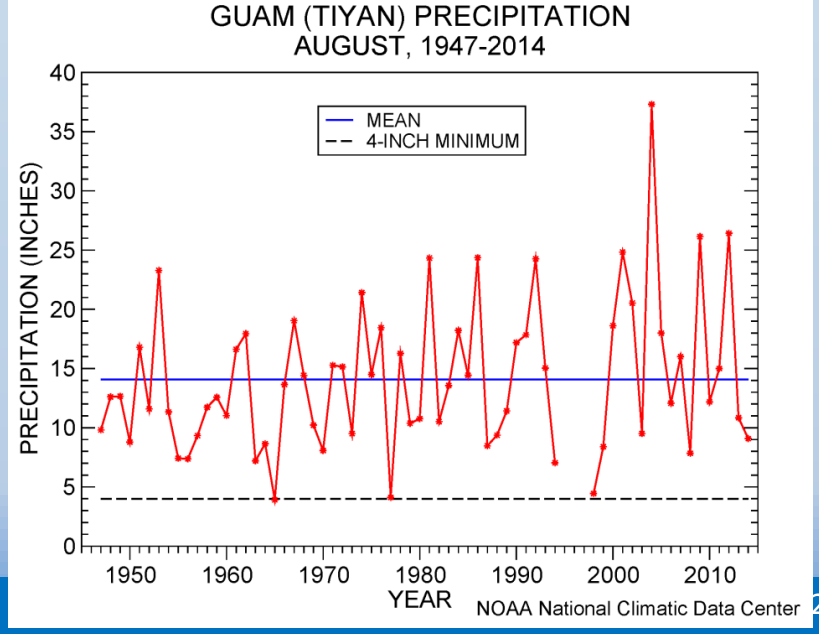
- Acknowledgements – This work would not be possible without:
  - NWS Offices and Partners in the USAPI
  - PEAC Center (Pacific ENSO Application Climate Center)
  - NDMC (National Drought Mitigation Center)
  - WRCC (Western Regional Climate Center)
  - And probably others whom I've forgotten

EXTRA SLIDES

Drought Monitoring Criteria

- Monthly SPI
  - Can be useful for determining Dx intensity once drought is established, but not for triggering drought
- Monthly Percent of Normal Precipitation
  - Not as useful if normal is too much different from the monthly minimum precip drought trigger





Drought Monitoring Criteria

- Impacts – Is the lack of rain causing any problems for the human sectors or the environment?
  - Crop damage, wildfires, low streamflow ("lowest I've seen in many years"), water supplies get low or run out, groundwater becomes brackish
  - Useful for determining changes in Dx intensity
  - Can also be used as a drought trigger

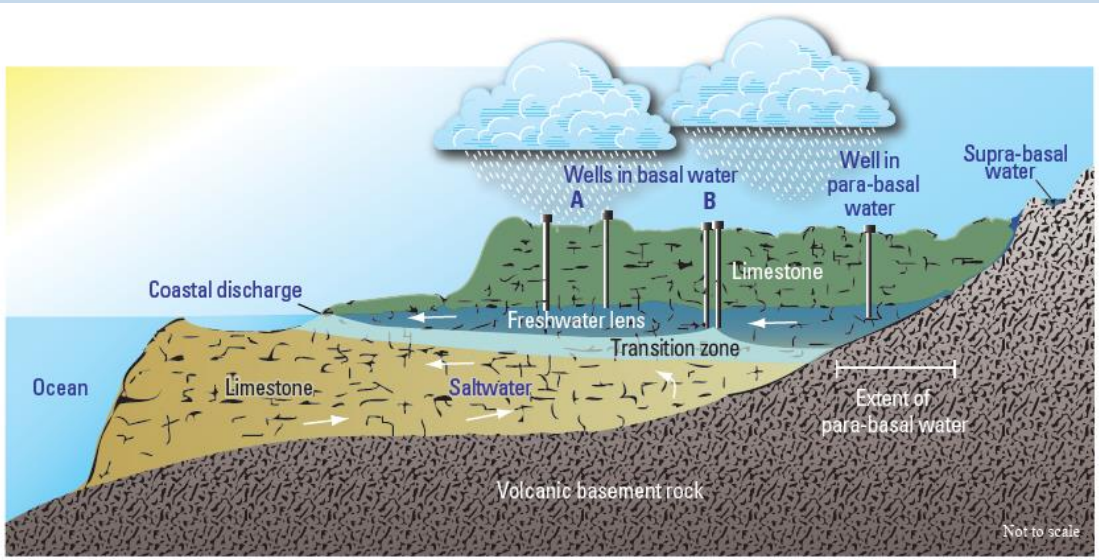


Figure 6. Schematic cross section of the study area showing groundwater occurrence and movement, Northern Guam Lens Aquifer, Guam.

Status: What Have We Done So Far

- Daily data for weekly analysis:
  - Timeliness of daily data can be an issue for the secondary stations through xmacis

On March 20 …

Climatological Data for

Click column heading to sort ascen

Date	Precipitation
2015-03-01	0.06
2015-03-02	0.81
2015-03-03	0.00
2015-03-04	0.27
2015-03-05	0.00
2015-03-06	0.06
2015-03-07	0.00
2015-03-08	0.00
2015-03-09	0.00
2015-03-10	0.18
2015-03-11	0.00
2015-03-12	0.00
2015-03-13	0.10
2015-03-14	0.12
2015-03-15	M
2015-03-16	M
2015-03-17	M
2015-03-18	M
2015-03-19	M
2015-03-20	M
2015-03-21	M

Climatological Data for R

Click column heading to sort ascen

Date	Precipitation
2015-03-01	0.00
2015-03-02	0.00
2015-03-03	0.00
2015-03-04	0.50
2015-03-05	0.00
2015-03-06	0.02
2015-03-07	0.59
2015-03-08	0.61
2015-03-09	0.00
2015-03-10	0.00
2015-03-11	0.00
2015-03-12	0.00
2015-03-13	0.12
2015-03-14	M
2015-03-15	M
2015-03-16	M
2015-03-17	M
2015-03-18	M
2015-03-19	M
2015-03-20	M
2015-03-21	M

Climatological Data for UTIRIK

Click column heading to sort ascen

Date	Precipitation
2015-03-01	0.04
2015-03-02	T
2015-03-03	T
2015-03-04	T
2015-03-05	M
2015-03-06	M
2015-03-07	M
2015-03-08	M
2015-03-09	M
2015-03-10	M
2015-03-11	M
2015-03-12	M
2015-03-13	M
2015-03-14	M
2015-03-15	M
2015-03-16	M
2015-03-17	M
2015-03-18	M
2015-03-19	M
2015-03-20	M
2015-03-21	M

Climatological Data for LUKUNOCH,

Click column heading to sort ascending, click a

Date	Precipit
2015-03-01	M
2015-03-02	1.23
2015-03-03	0.27
2015-03-04	0.22
2015-03-05	M
2015-03-06	0.00
2015-03-07	0.03
2015-03-08	M
2015-03-09	0.00
2015-03-10	0.04
2015-03-11	M
2015-03-12	M
2015-03-13	M
2015-03-14	M
2015-03-15	M
2015-03-16	0.05
2015-03-17	0.06
2015-03-18	M
2015-03-19	M
2015-03-20	M
2015-03-21	M

Not enough data for weekly analysis

Status: What Have We Done So Far

- Weekly analysis:
  - Done manually in a spreadsheet

	A	B	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK
1	**Weekly Precipitation Ar**												
2	(Weekly Precip as of Monday)												
3	(4" Mariana	< 8" / month	2014-2015			2015		2015					Weekly
4	(2" Mariana	< 4" / month	Last 3 Months Precip			MTD	Feb 24-	Week 1	Last 4 Weeks				USDM
5			Dec	Jan	Feb	Mar	Mar 2	Mar 1-2	Mar 3-9	Mar 10-16	Mar 17-23	Mar 24-30	Status
6	Palau	Koror	13.14	6.48	7.07	4.48	1.38	1.31	3.00	0.17			D-Nothing
7	Marianas	Guam	3.87	8.56	0.18	1.22	0.20	0.10	0.43	0.69			D1-S
8		Saipan	1.80	4.66	0.35	1.90	0.30	0.03	0.10	1.77			D0-S
9		AMME NPS Saipan	1.25	4.17	0.11	2.89	0.06	0.00	0.27	2.62			Not Plotted
10	Micronesia	**Yap**	16.77	5.86	4.60	0.00	MSG	MSG	MSG	MSG			Not Plotted
11		Chuuk	6.46	14.32	9.68	0.99	3.90	0.33	0.35	0.31			D-Nothing
12		Pohnpei	16.67	10.24	9.58	2.89	5.25	1.51	1.12	0.26			D-Nothing
13		Kosrae	13.80	19.28	14.73	1.33	1.50	1.05	0.28	MSG			Not Plotted
14		Fananu	6.86	7.13	7.39	2.41	3.24	0.05	0.47	1.89			D0-S
15		Lukonor/Lukunoch	9.65	19.16	8.70	1.90	2.15	1.23	0.56	0.11			No Data
16		Kapingamarangi	11.37	20.91	12.19	4.22	5.79	2.03	2.19	MSG			No Data
17		**North Fanif**	20.98	7.18	4.96	1.81	0.46	0.39	1.21	0.21			alternate
18		Nukuoro	13.25	25.91	6.84	3.40	0.00	0.00	3.04	0.36			No Data
19		Pingelap	6.75	6.81	14.13	2.72	1.06	1.06	1.58	0.08			No Data
20		**Rumung**	19.24	7.99	4.81	1.84	0.07	0.00	1.72	0.12			D0-S
21		Tofol	18.69	15.33	16.92	2.48	2.76	2.27	0.21	MSG			Not Plotted
22		Ulithi	6.55	13.64	3.72	1.60	0.96	0.87	0.33	0.40			D0-S
23	Marshalls	Ailinglapalap	11.88	5.51	4.17	0.05	0.85	0.05	0.00	MSG			No Data
24		Kwajalein	4.54	2.33	3.94	18.39	1.54	0.82	2.25	15.32			D-Nothing
25		Majuro	7.68	8.24	4.32	10.59	0.41	0.00	3.12	7.47			D-Nothing
26		Mili	6.73	3.80	0.00	0.00	MSG	MSG	MSG	MSG			Not Plotted
27		Utirik	2.63	0.42	0.59	0.04	0.40	0.04	0.00	MSG			No Data
28		Wotje	0.64	0.12	0.93	0.58	0.34	0.34	0.24	MSG			No Data
29	Am. Samoa	Pago Pago	18.13	26.87	12.22	2.62	2.51	0.13		2.49			D-Nothing
30		Siufaga Ridge	17.39	15.44	6.78	2.51	0.83	0.69	0.54	1.28			Not Plotted
31		Toa Ridge	13.41	13.15	3.36	0.47	MSG	MSG	MSG	0.47			Not Plotted
32													
33		missing days	Koror					Mar 1-2	Mar 3-9	Mar 10-16			
34			Guam					Mar 1-2	Mar 3-8	Mar 9-15			
35			Saipan					Mar 1-2	Mar 3-8	Mar 9-15			
36			Saipan AMME NPS					Mar 1	Mar 2-10	Mar 11-16			
37			Yap					MSG	MSG	MSG			
38			Chuuk					Mar 1-2	Mar 3-9	Mar 10-16			
39			Pohnpei					Mar 1-2	Mar 3-9	Mar 10-16			
40			Kosrae					Mar 1-2	Mar 3	MSG			
41			Fananu					Mar 1-2	Mar 3-8	Mar 9-15			
42			Lukonor/Lukunoch					Mar 1-2	Mar 3-10	Mar 16-17			
43			Kapingamarangi					Mar 1-2	Mar 3-9	MSG			
44			North Fanif					Mar 1-2	Mar 3-9	Mar 10-14			
45			Nukuoro					Mar 1-2	Mar 3-9	Mar 10-12			
46			Pingelap					Mar 1-2	Mar 3-9	Mar 10-12			
47			Rumung					Mar 1-2	Mar 3-9	Mar 10-13			