Australian VLab Centre of Excellence Regional Focus Group meeting

18th August 2022

Bodo Zeschke Australian VLab Centre of Excellence Point of Contact

Australian VLab Centre of Excellence Regional Focus Group meeting, 02UTC 18 August 2022

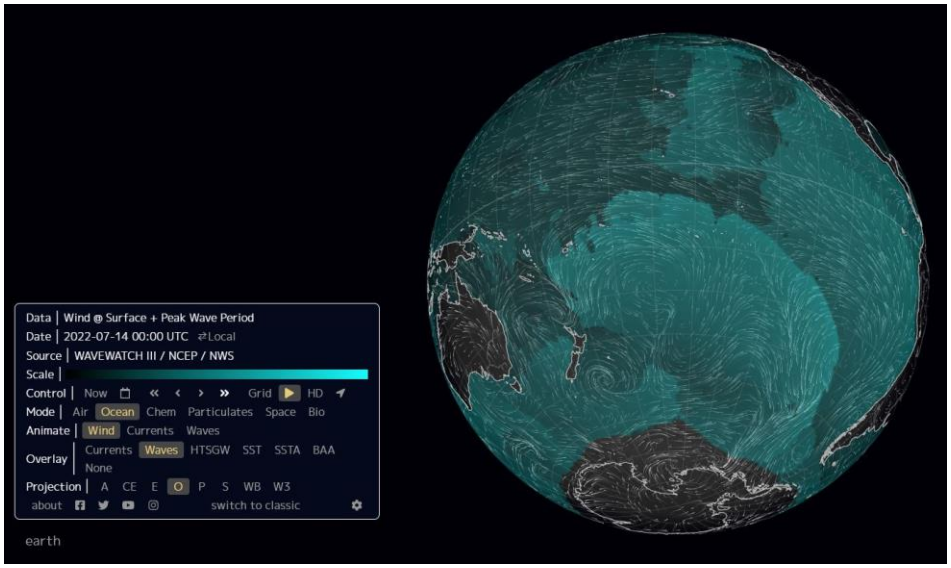
Contents

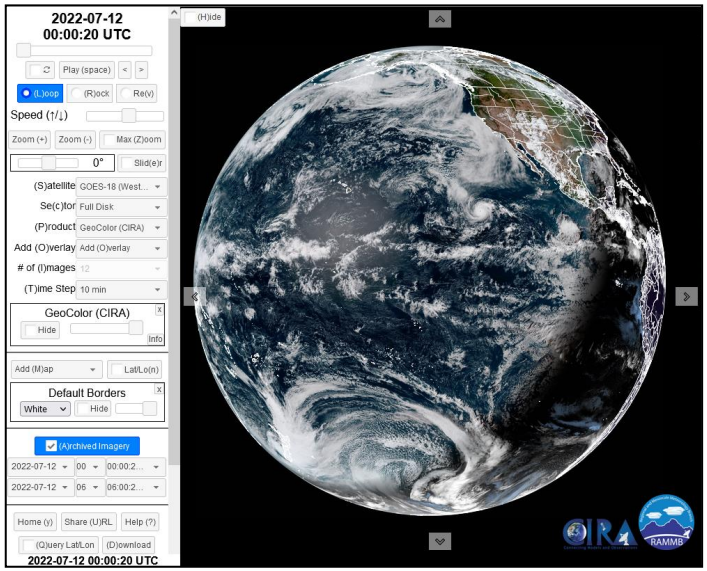
- **The significant Swell Event in the Pacific Ocean during 11-17th July, as monitored by satellite and surface observations and NWP data** (facilitator Mr Bodo Zeschke, Australian Bureau of Meteorology Training Centre).

- **Altimetric wave heights and how to view them efficiently** (facilitator Scott Lindstrom, SSEC University of Wisconsin-Madison)

image from the Earth NullSchool Viewer (Cameron Beccario) https://earth.nullschool.net/

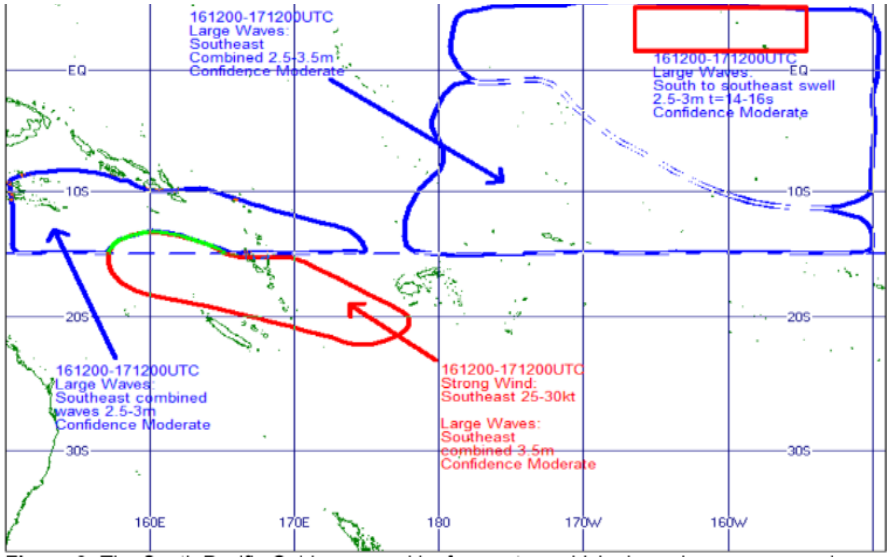
images courtesy CIRA/RAMMB





Significant Swell event, Pacific Ocean 11-17th July 2022, as monitored by satellite and surface observations and NWP model data

Screen grab from video posted on Facebook by Issa Sloan/Special to West Hawaii Today (Kona, Big Island)



Forecast kindly forwarded by Mauna Eria, Quality Assurance Officer Kiribati Meteorological Service (forecast source: MetService NZ)

Significant Swell Event Case Study, Pacific Ocean 11-17th July 2022

Part 1: Background and the early development of the Swell (11th to 14th July)

- The synoptic situation near New Zealand
- The influence of King / Spring Tides
- The possible impact of Tropical Storm Darby

Part 2: The developing swell situation (13th to 18th July)

- Effect on American Samoa
- Effect on Teraina, Kiribati
- Effect on Hawaiian locations

Useful online data resources that can be used for the reanalysis of these kinds of events.

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chart courtesy Chris Webster Met Service New Zealand

Early development of the Swell, east of New Zealand

MSLP Analysis Met Service New Zealand, 00UTC 11th July 2022

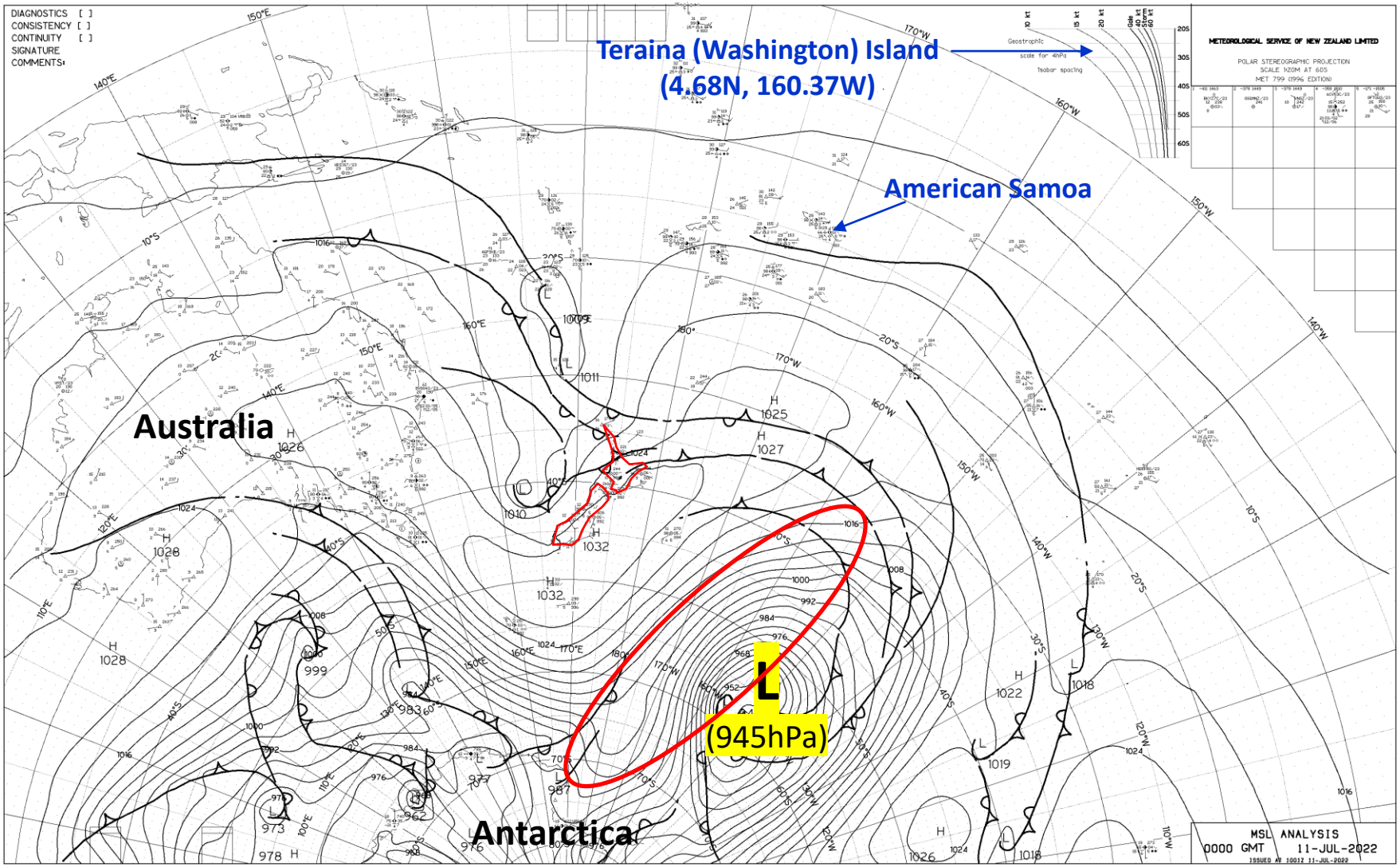
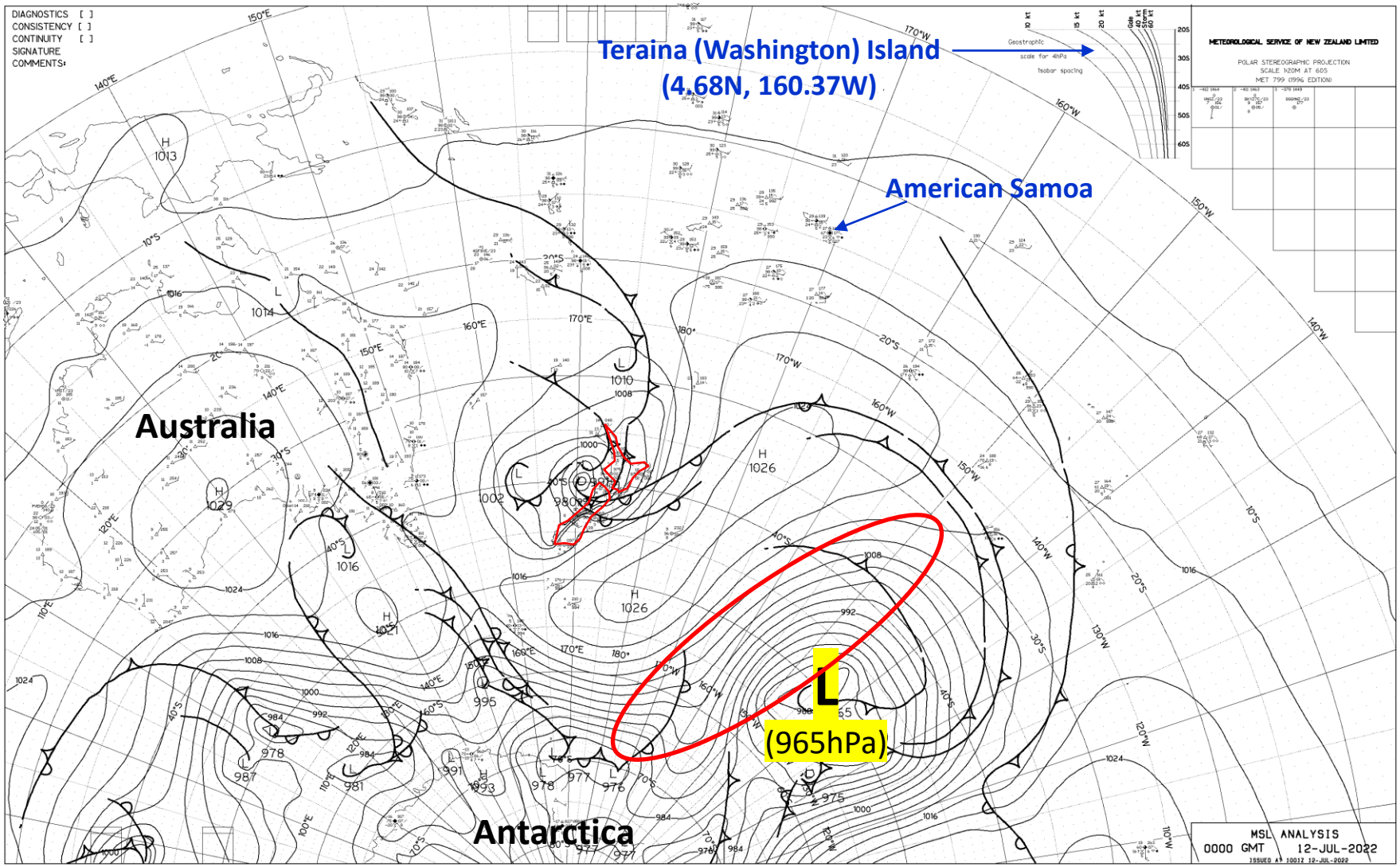


chart courtesy Chris Webster Met Service New Zealand

Early development of the Swell, east of New Zealand

MSLP Analysis Met Service New Zealand, **one day later** 00UTC 12th July 2022

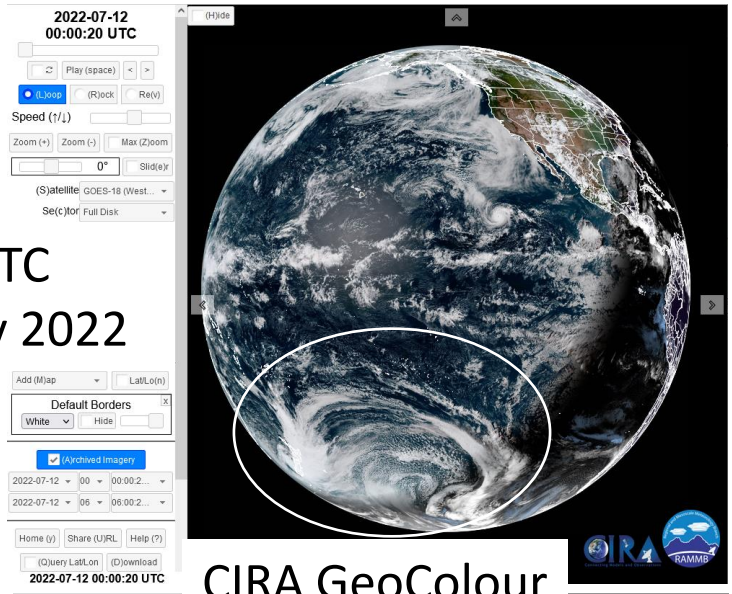


images courtesy CIRA/RAMMB

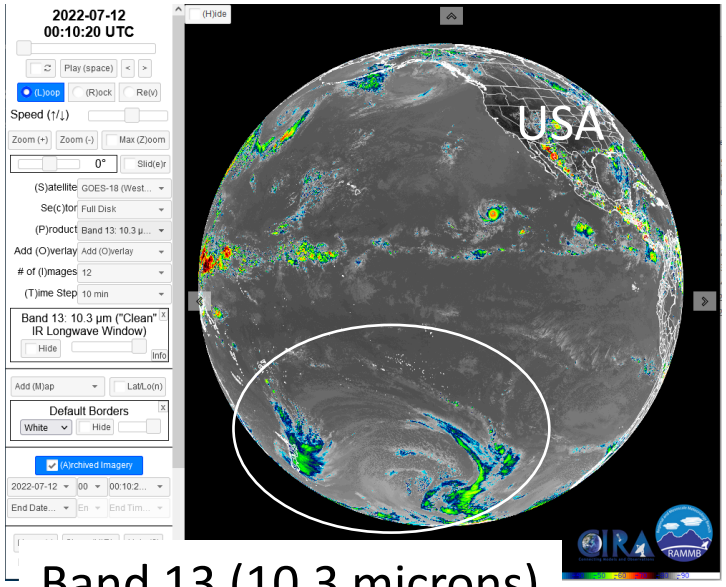
Showcasing imagery from the new GOES-18 satellite

(00UTC and 06UTC 12th July 2022, from the CIRA SLIDER webpage)

00UTC
12th July 2022

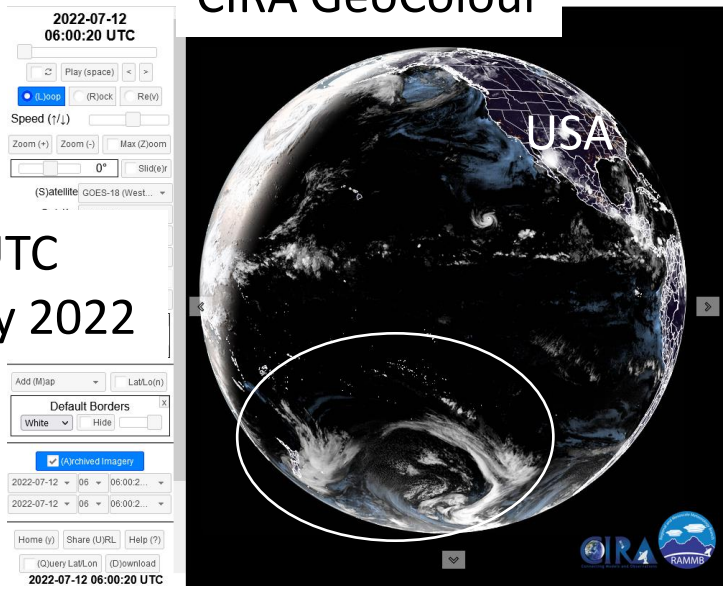


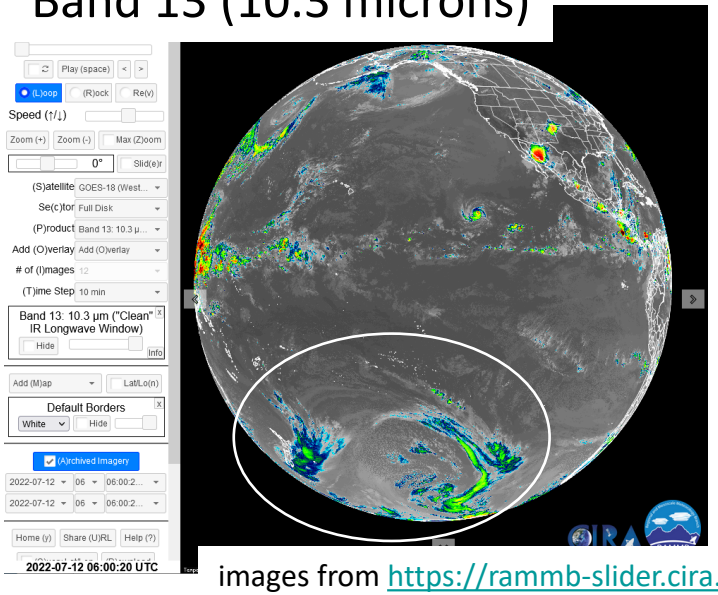
CIRA GeoColour



Band 13 (10.3 microns)

06UTC
12th July 2022



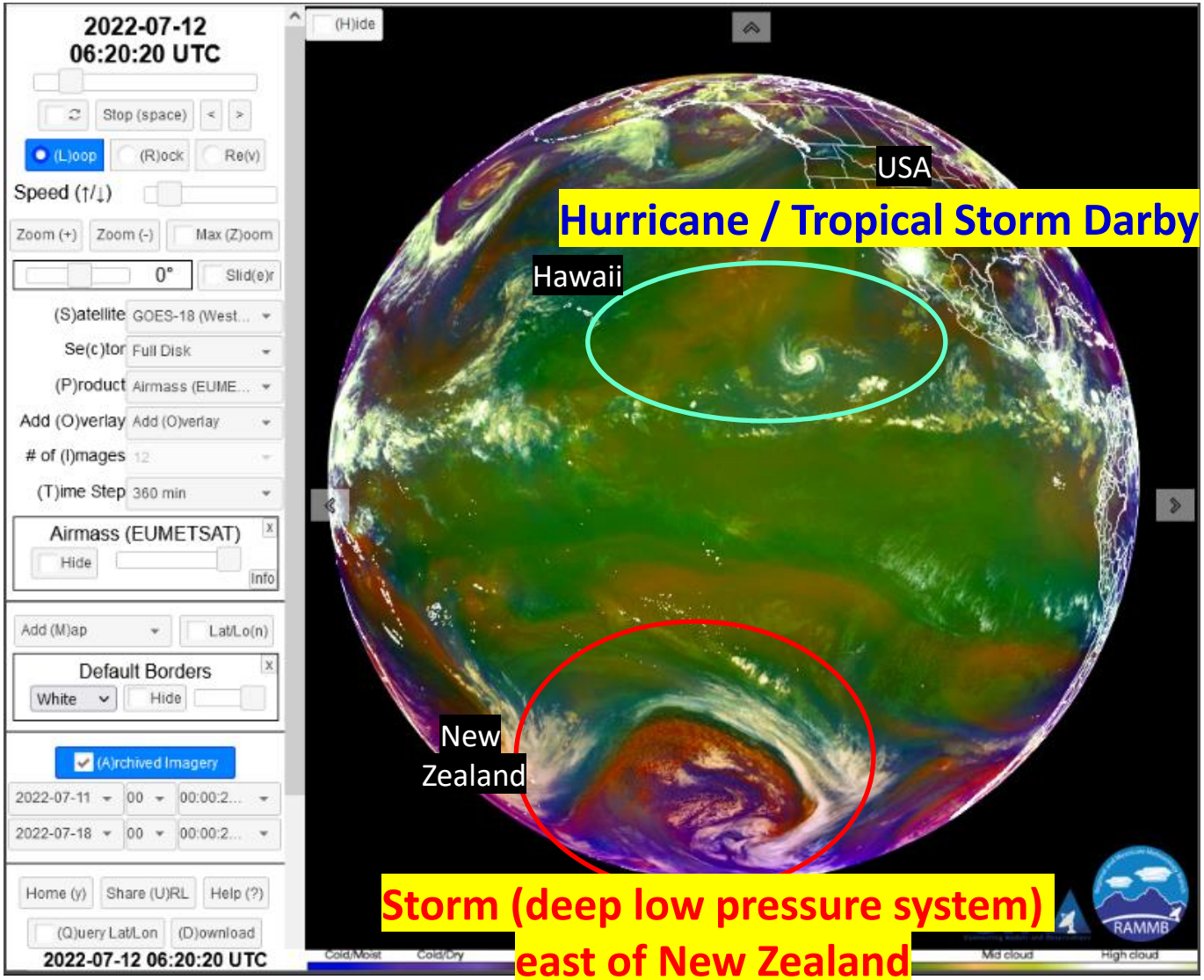


images from https://rammb-slider.cira.colostate.edu/

animation courtesy CIRA/RAMMB

Airmass RGB composite, GOES-18

(0620UTC 12th July 2022, from the CIRA SLIDER webpage)



Airmass RGB colour interpretation palette

Thick, high-level clouds	Thick, mid-level clouds
Jet (high PV)	Cold Airmass
Thick, low-level clouds (warm airmass)	Thick, low-level clouds (cold airmass)
Warm Airmass	Warm Airmass

images from https://rammb-slider.cira.colostate.edu/

Bureau of Meteorology Ice Bulletin: Antarctica, July 2022.

Analyst Jan L. Lieser, data courtesy ICDC, Uni. Hamburg

Figure 1 shows the pan-Antarctic sea-ice concentration anomaly based on passive microwave remote sensing data.

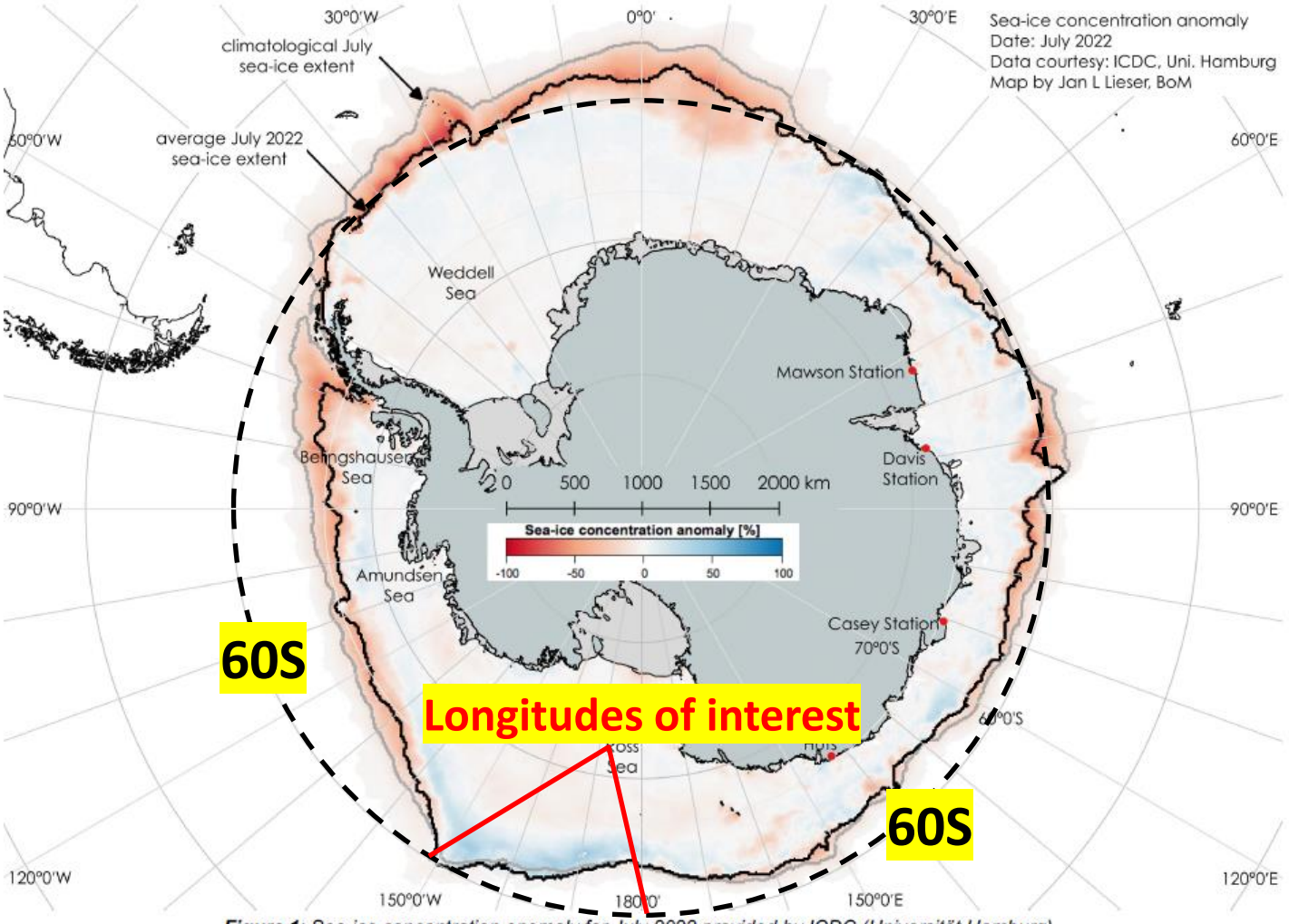
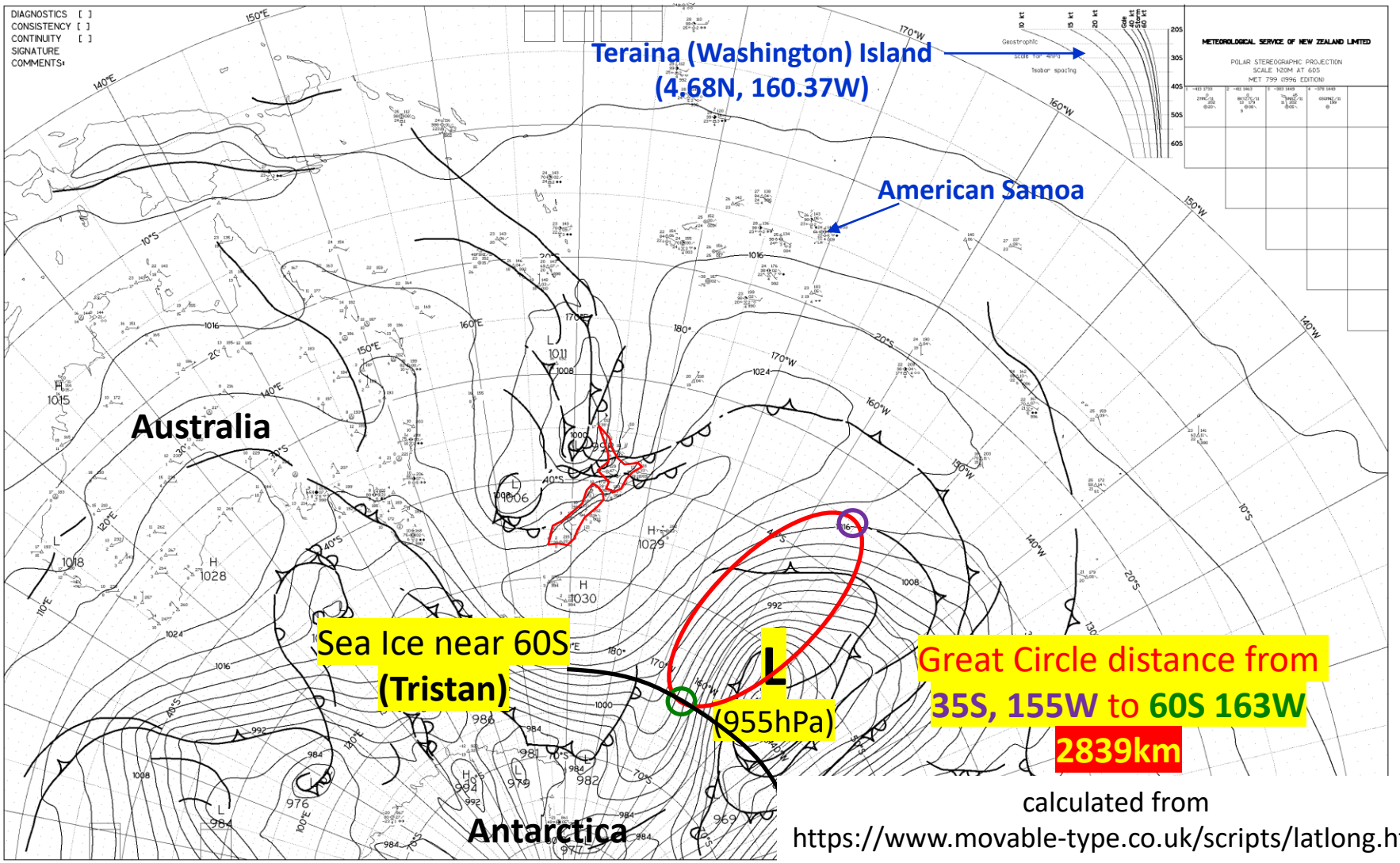


Figure 1: Sea-ice concentration anomaly for July 2022 provided by ICDC (Universität Hamburg).

chart courtesy Chris Webster Met Service New Zealand

Early development of the Swell, east of New Zealand

MSLP Analysis Met Service New Zealand, 12UTC 11th July 2022

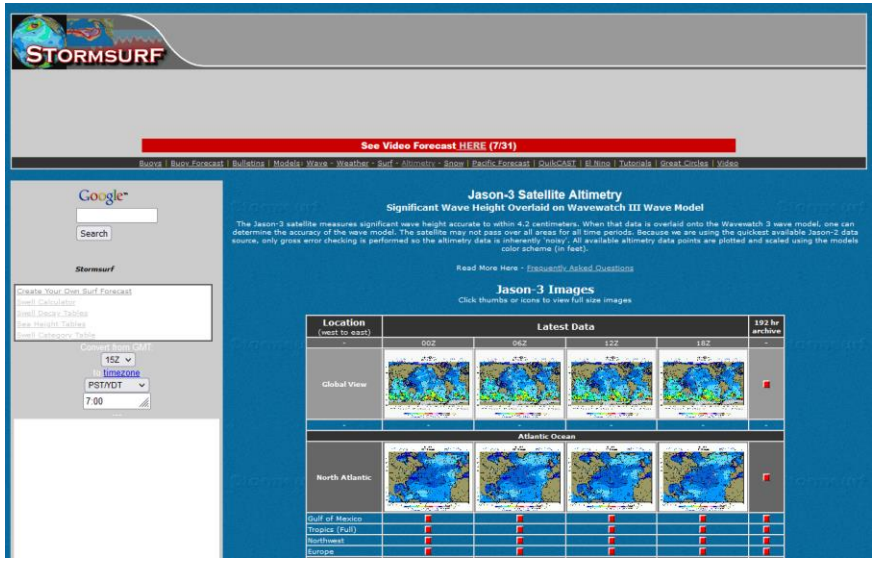


calculated from
https://www.movable-type.co.uk/scripts/latlong.html

Introducing additional data for information about seas and winds

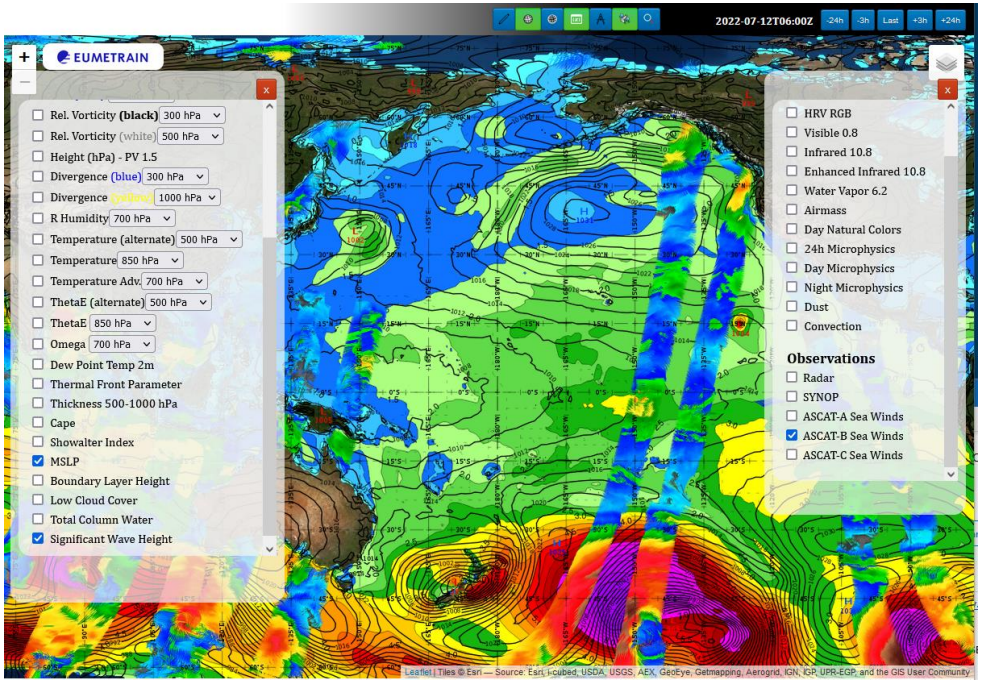
Stormsurf Web Page

http://www.stormsurf.com/mdls/menu_alt.html



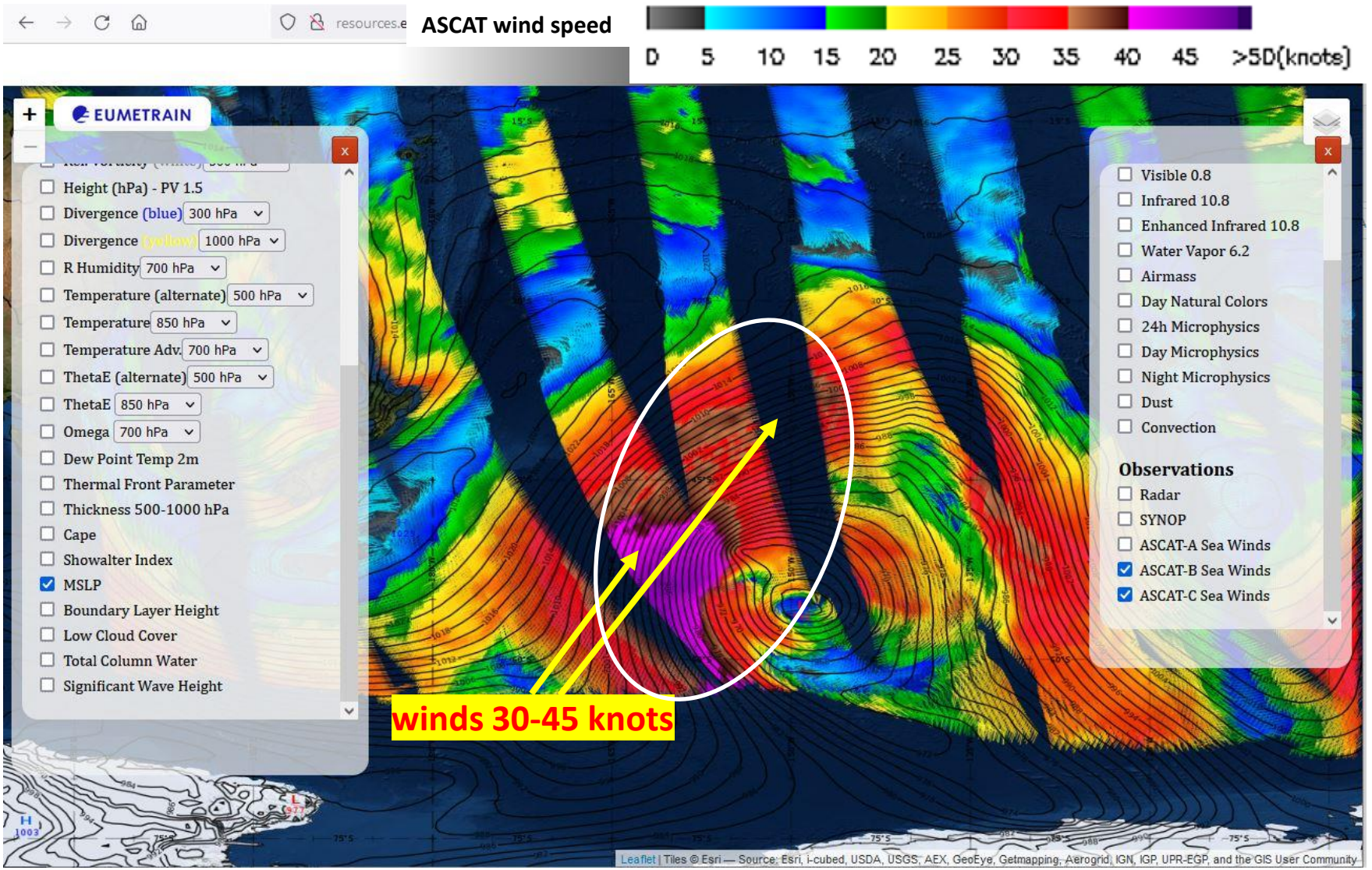
EUMETRAIN Map Viewer

http://resources.eumetrain.org/ePort_MapViewer/index.html



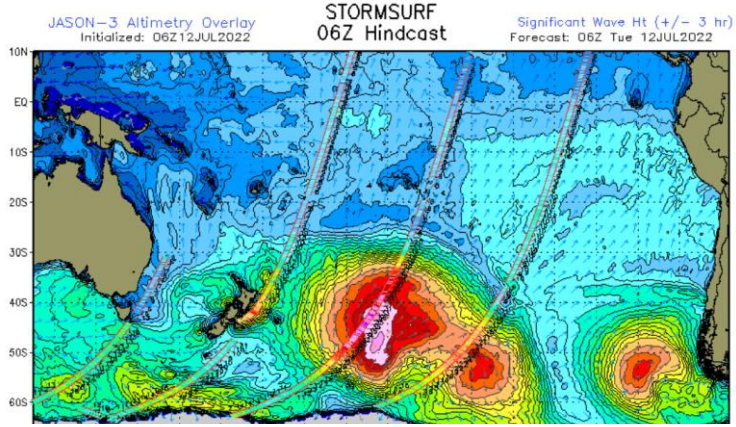
ASCAT winds and ECMWF MSLP, Original Situation

(12UTC 11th July 2022, EUMETRAIN MapViewer)

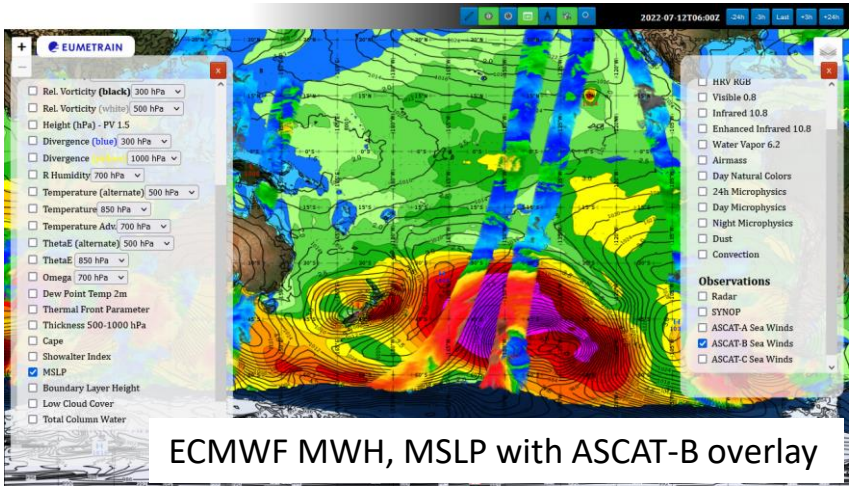


Surf and Swell event, Pacific Ocean, Original Situation

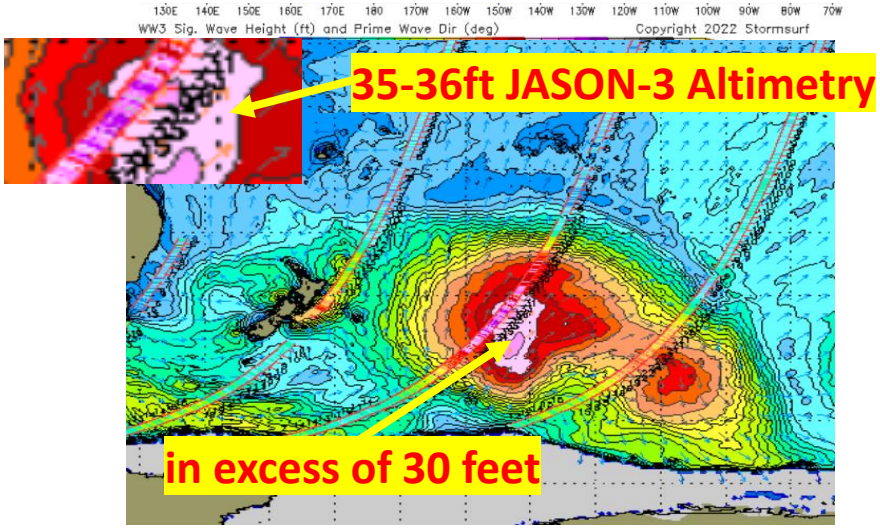
(Various other data, 06UTC 12th July 2022, Stormsurf and EUMETRAIN MapViewer)

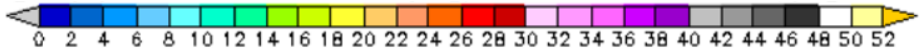


NOAA Wavewatch III with JASON-3 Altimetry overlay

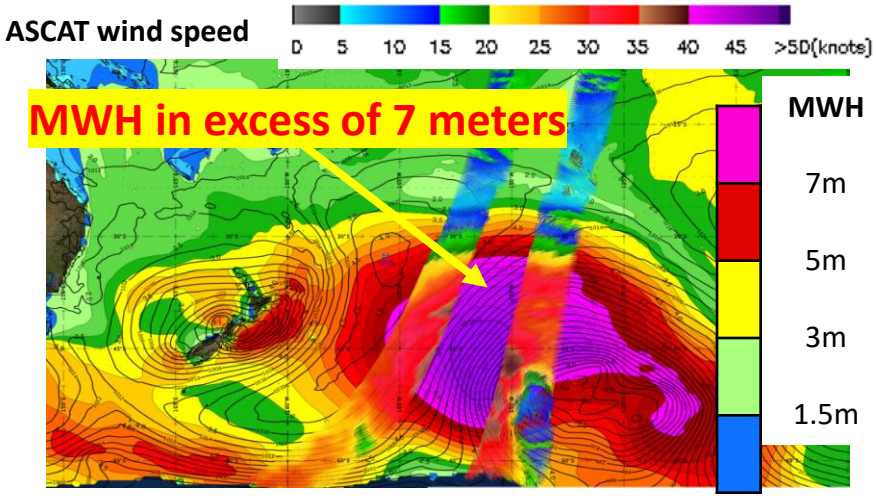


ECMWF MWH, MSLP with ASCAT-B overlay





Significant Wave Height (ft)

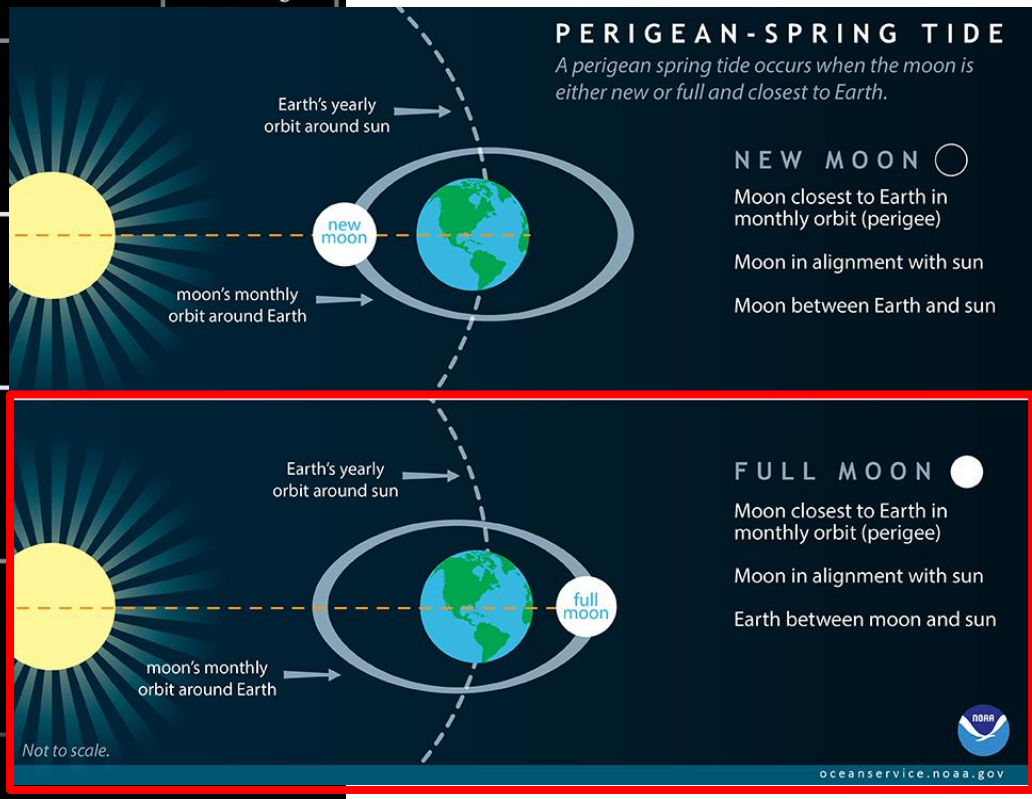


MSLP, Maximum Wave Height (MWH) and ASCAT wind speed

Moon phases July 2022

"The large swell exacerbated by the King tides…"
from a preliminary report by Patrick Cioffi NWS Pacific Region ROC.

Mon	Tues	Wed	Thurs	Fri	Sat	Sun
		1	2	3	4	5 Waxing
6	7 1st Quarter	8	9 Waxing Gibbous	10		
13	14 Full Moon June Edition Launch	15	16	17		
20 3rd Quarter	21	22	23	24 Waning Crescent		
27	28 New Moon	29	30			



https://seagrant.soest.hawaii.edu/coastal-and-climate-science-and-resilience/ccs-projects/what-is-a-king-tide/

https://wyldemoon.co.uk/monthly-wylde-moon-calendar/

Tides, July 2022

https://tidesandcurrents.noaa.gov/noaatidepredictions.html?id=1612340&legacy=1

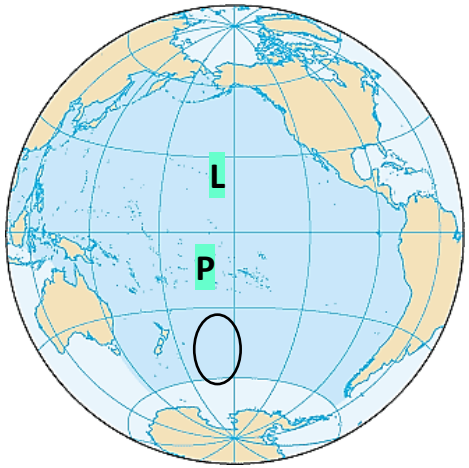
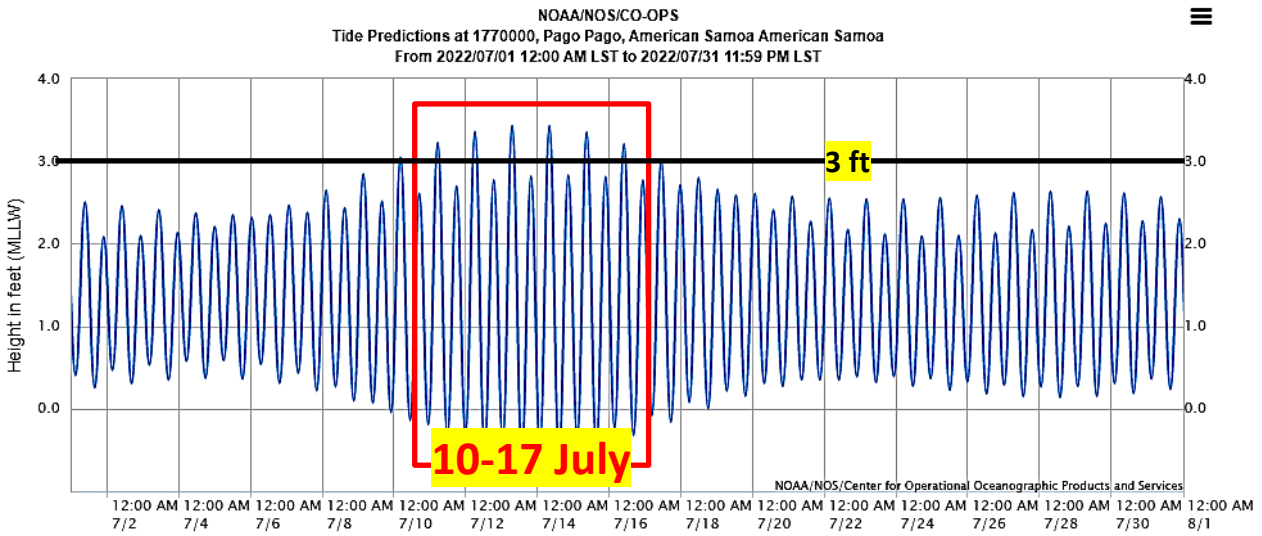
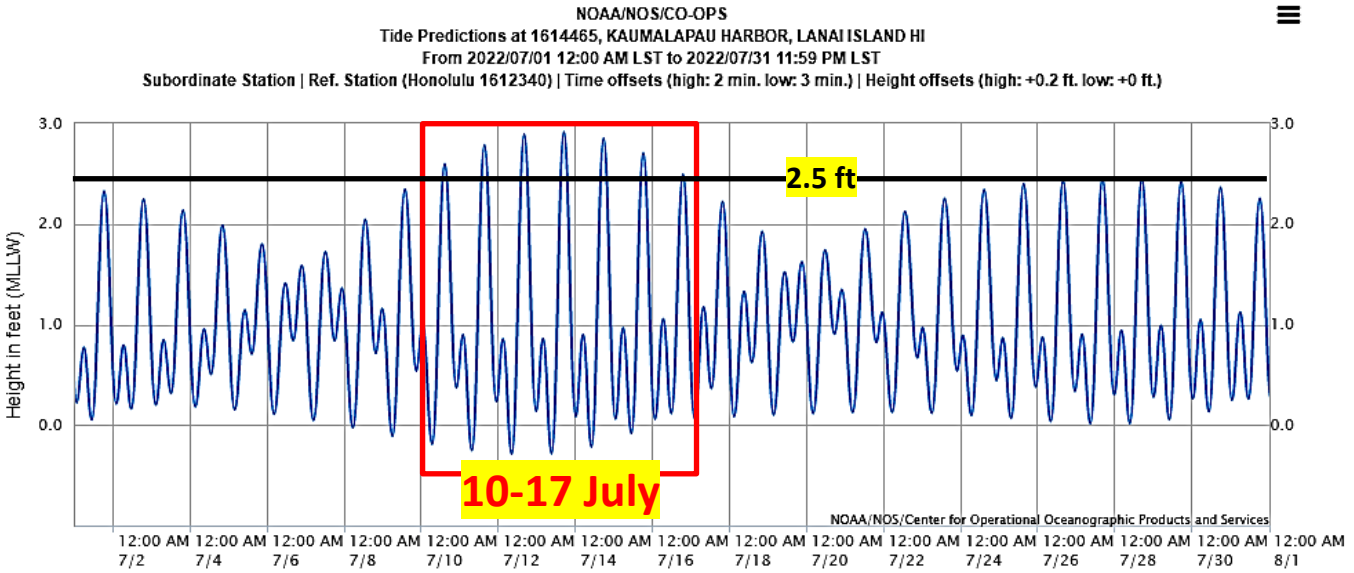


image from CIA World Factbook reproduced on Wikimedia Commons



Pago Pago (**P**) American Samoa

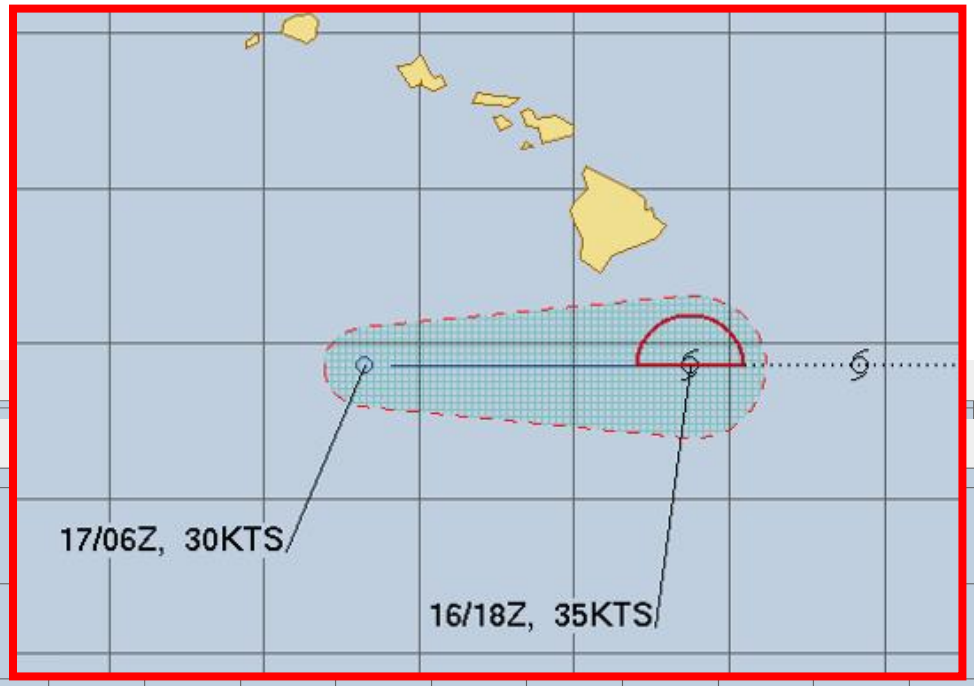


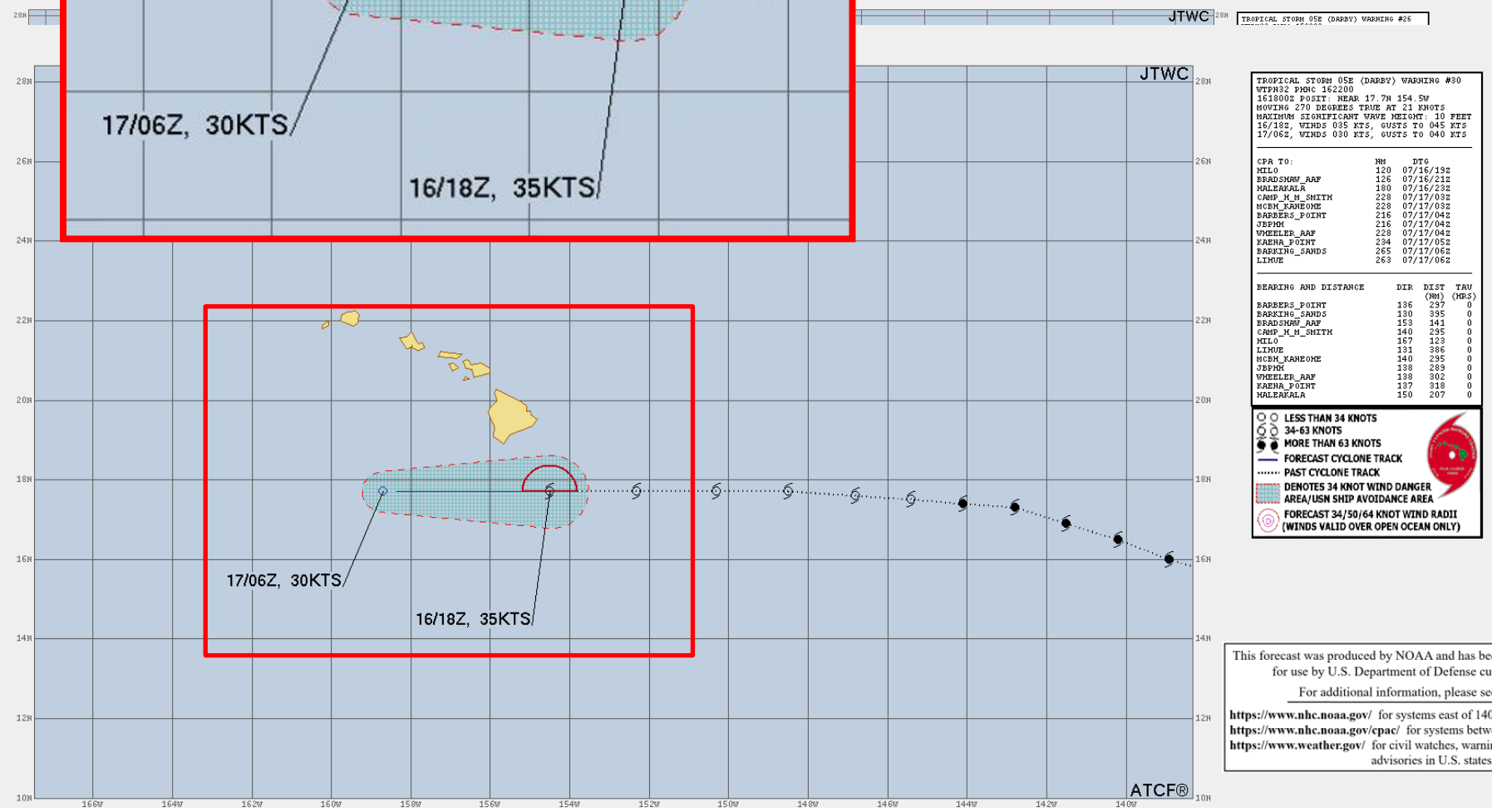
Lanai Island (**L**) Hawaii

tide plots courtesy NOAA

Tropical Storm Darby

12 hour forecast. Analysis time
18UTC 16th July





TROPICAL STORM 05E (DARBY) WARNING #30
WTPN32 PGNC 162200
1618002 POSIT: NEAR 17.7N 154.5W
MOVING 270 DEGREES TRUE AT 21 KNOTS
MAXIMUM SIGNIFICANT WAVE HEIGHT: 10 FEET
16/18Z, WINDS 035 KTS, GUSTS TO 045 KTS
17/06Z, WINDS 030 KTS, GUSTS TO 040 KTS

CPA TO:	NM	DTG
MILO	120	07/16/19Z
BRADSHAW_AAF	126	07/16/21Z
MALEAKALA	180	07/16/23Z
CAMP_M_M_SMITH	228	07/17/03Z
MCBH_KANEOHE	228	07/17/03Z
BARBERS_POINT	216	07/17/04Z
JBPHH	216	07/17/04Z
WHEELER_AAF	228	07/17/04Z
KAENA_POINT	234	07/17/05Z
BARKING_SANDS	265	07/17/06Z
LIHUE	263	07/17/06Z

BEARING AND DISTANCE	DIR	DIST (NM)	TAU (HRS)
BARBERS_POINT	136	297	0
BARKING_SANDS	130	395	0
BRADSHAW_AAF	153	141	0
CAMP_M_M_SMITH	140	295	0
MILO	167	123	0
LIHUE	131	386	0
MCBH_KANEOHE	140	295	0
JBPHH	138	289	0
WHEELER_AAF	138	302	0
KAENA_POINT	137	318	0
MALEAKALA	150	207	0

- LESS THAN 34 KNOTS
- 34-63 KNOTS
- MORE THAN 63 KNOTS
- FORECAST CYCLONE TRACK
- PAST CYCLONE TRACK
- DENOTES 34 KNOT WIND DANGER AREA/USN SHIP AVOIDANCE AREA
- FORECAST 34/50/64 KNOT WIND RADII (WINDS VALID OVER OPEN OCEAN ONLY)

This forecast was produced by NOAA and has been re-formatted for use by U.S. Department of Defense customers

For additional information, please see:

https://www.nhc.noaa.gov/ for systems east of 140°W
https://www.nhc.noaa.gov/cpac/ for systems between 140°W-180°
https://www.weather.gov/ for civil watches, warnings, and advisories in U.S. states and territories

This forecast was produced by NOAA and is displayed on the Navy/NRL TC page at https://www.nrlmry.navy.mil/

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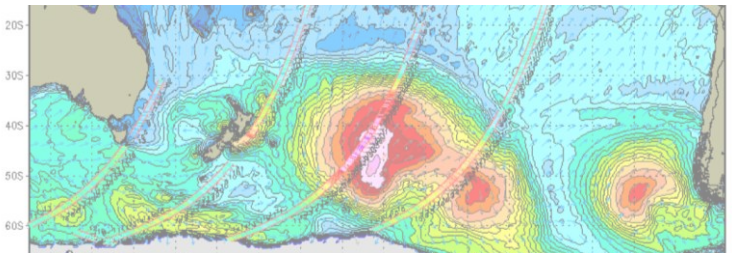
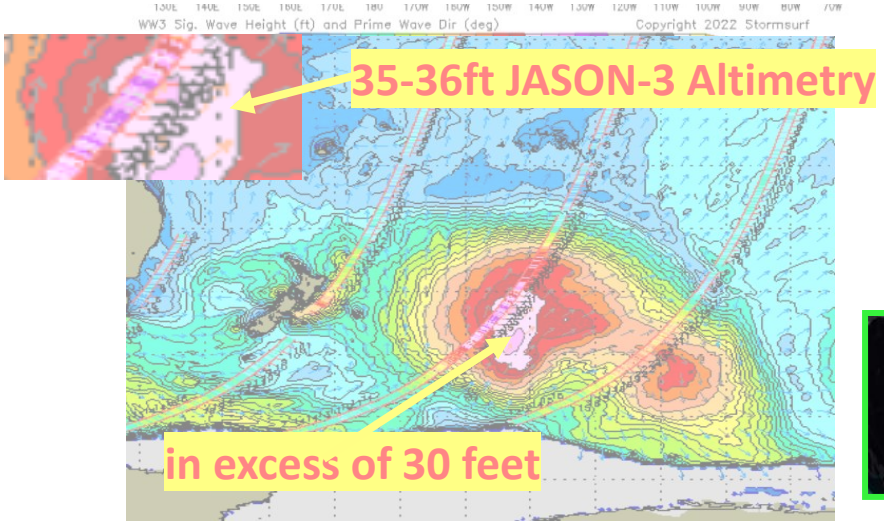
Introducing additional data: A little "revelation"

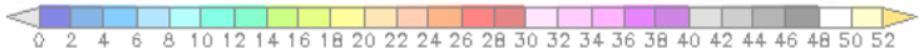
Stormsurf Web Page

http://www.stormsurf.com/mdls/menu_alt.html



NOAA Wavewatch III with JASON-3 Altimetry overlay

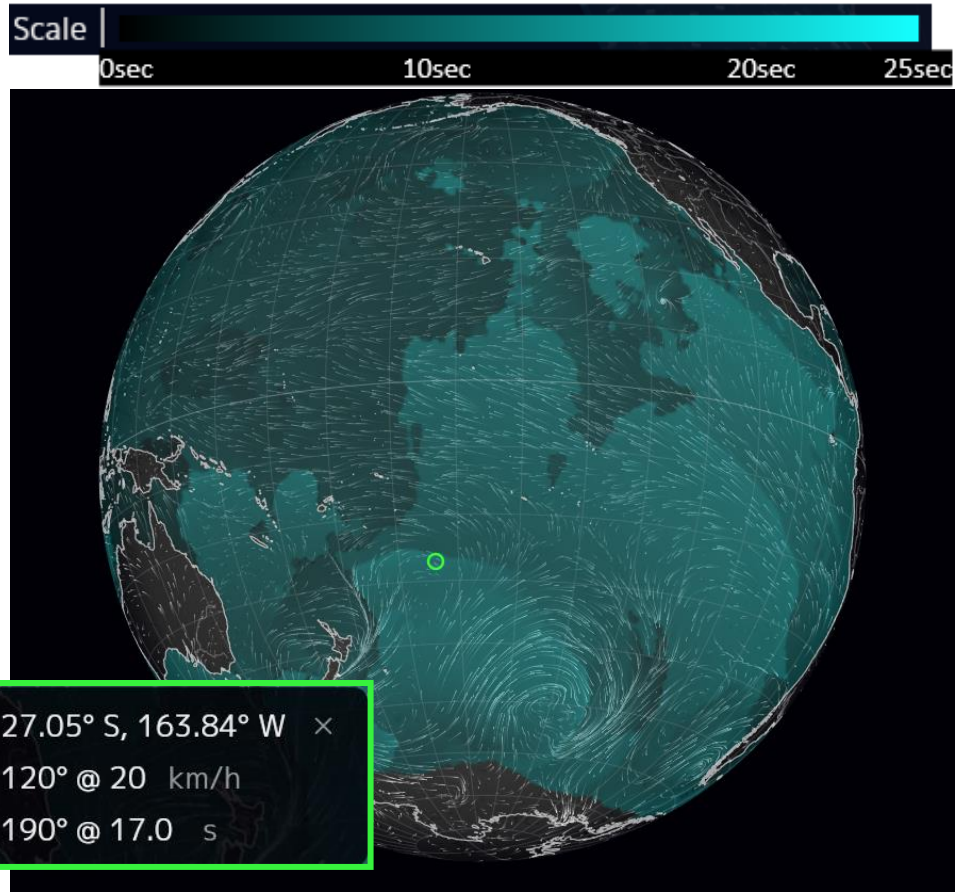




Significant Wave Height (ft)

Earth NullSchool Viewer (Cameron Beccario)

https://earth.nullschool.net/



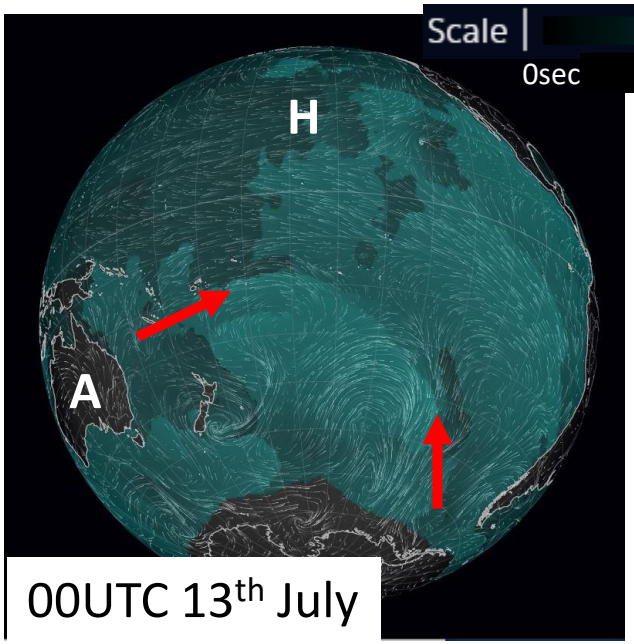
Surface Wind, **Peak Wave Period**

(A = Australia, H = Hawaii)

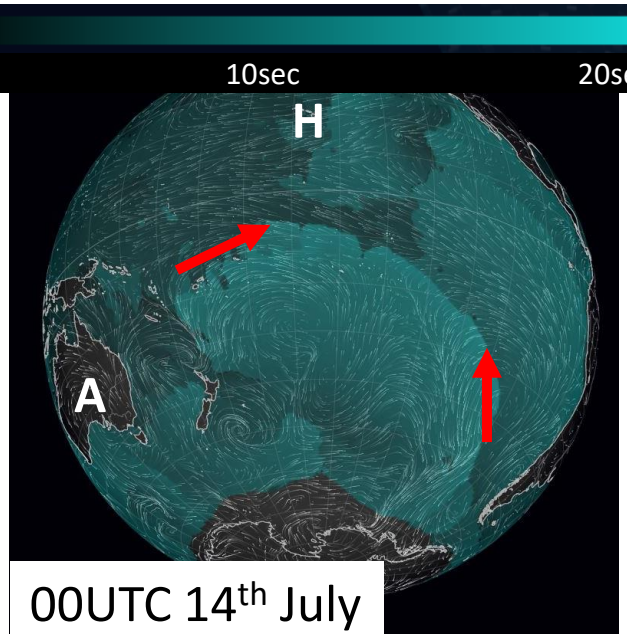
image from Stormsurf

Images from the Earth NullSchool Viewer (Cameron Beccario) https://earth.nullschool.net/

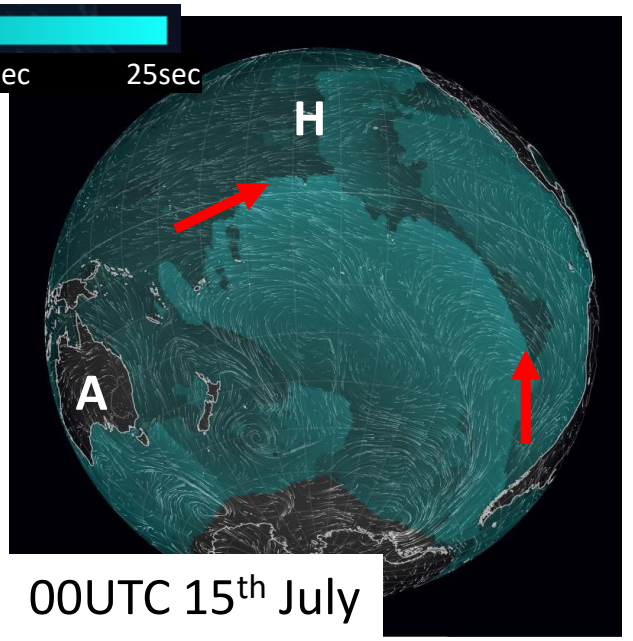
Capturing the "Swell Front" moving into the Pacific Ocean



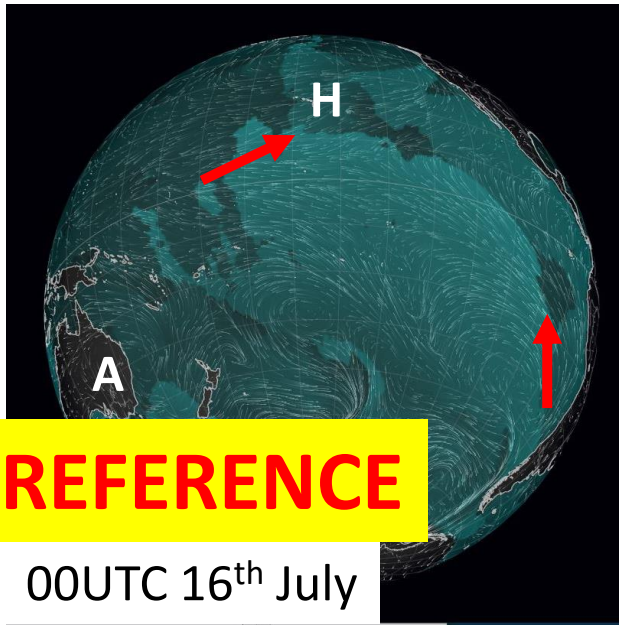
00UTC 13th July



00UTC 14th July



00UTC 15th July



REFERENCE

00UTC 16th July

Surface Wind, Peak Wave Period, rendered using the Earth NullSchool Viewer. A = Australia, H = Hawaii

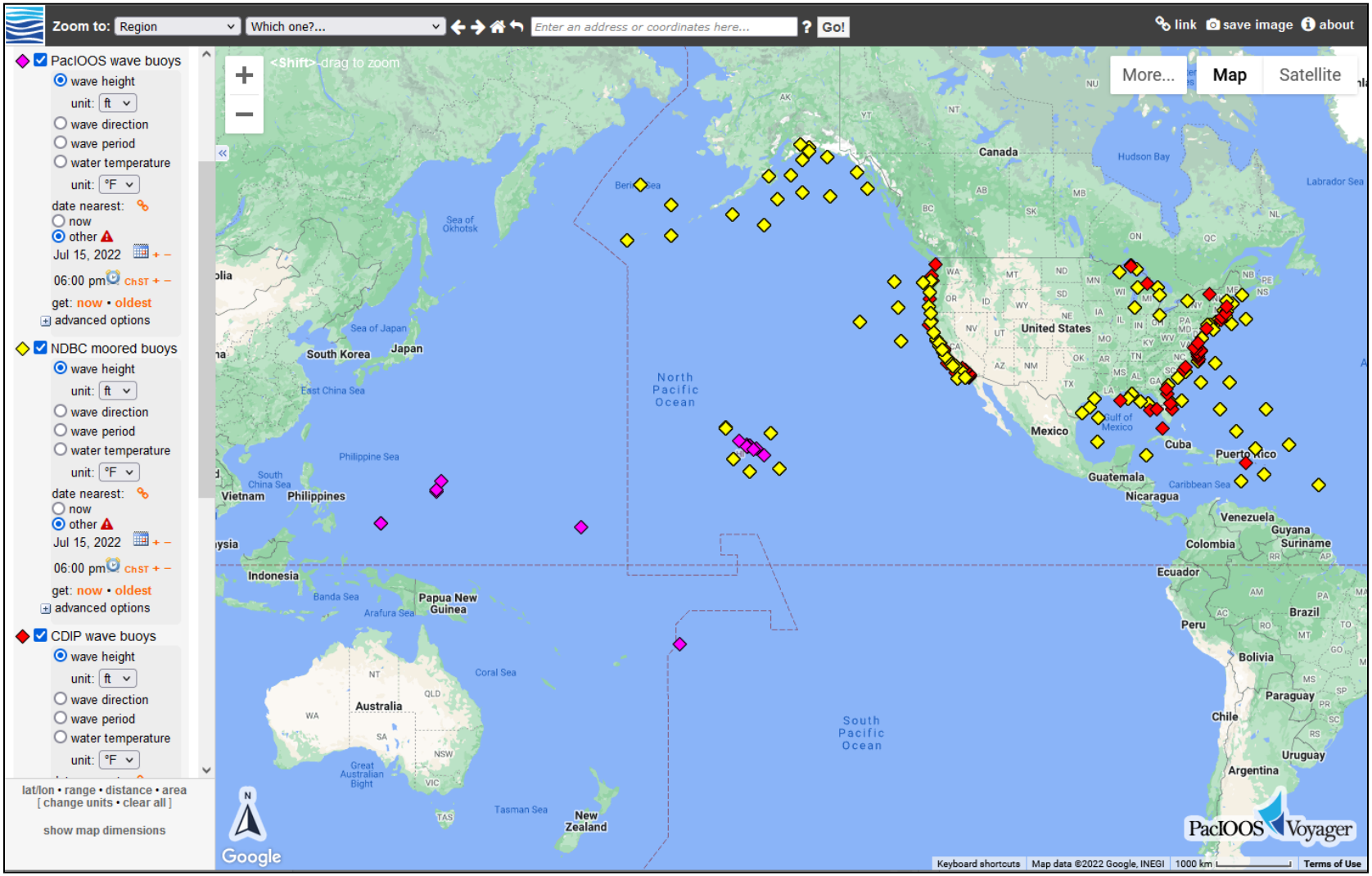
- Ocean waves updated every three hours using GFS Wavewatch III data.
- Peak Wave Period is the (inverse) frequency of the most energetic waves passing through a particular point, whether wind generated or swells. **These can often represent "swell fronts".**

(Earth NullSchool Viewer reference notes)

Introducing the PacIOOS Voyager web page

http://www.pacioos.hawaii.edu/voyager/

information forwarded by Professor Yi-Leng Chen, University of Hawaii

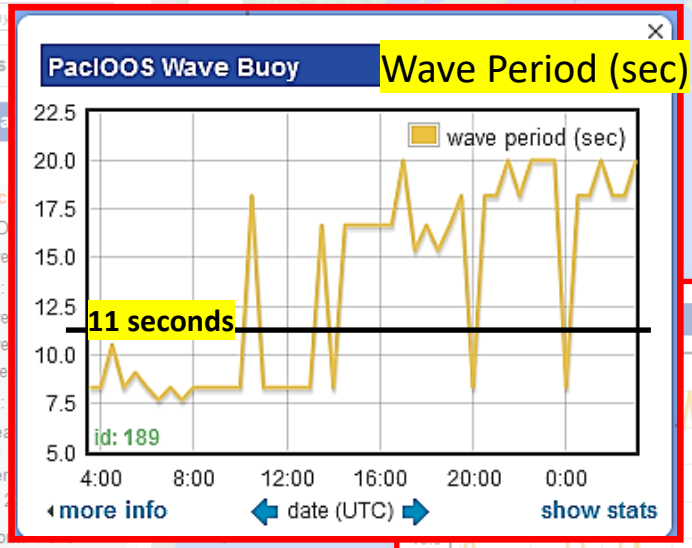


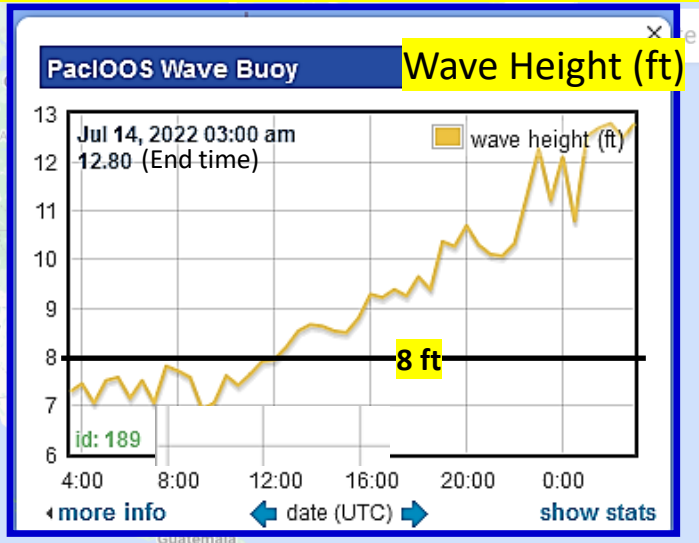
The PacIOOS Wave Buoy at Tutuila, American Samoa

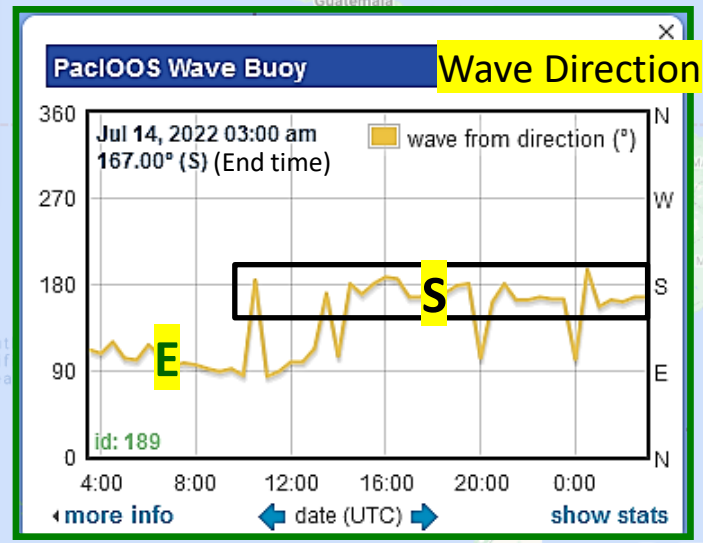
Observations from Wave Buoy 189, Aunuu; 04UTC 13th July to 03UTC 14th July

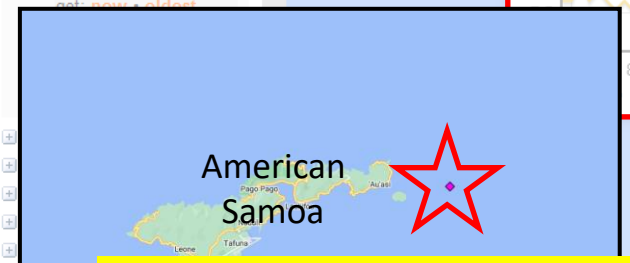
Note the increase in wave period to above 11 seconds

Note the increase in wave height to above 8 ft









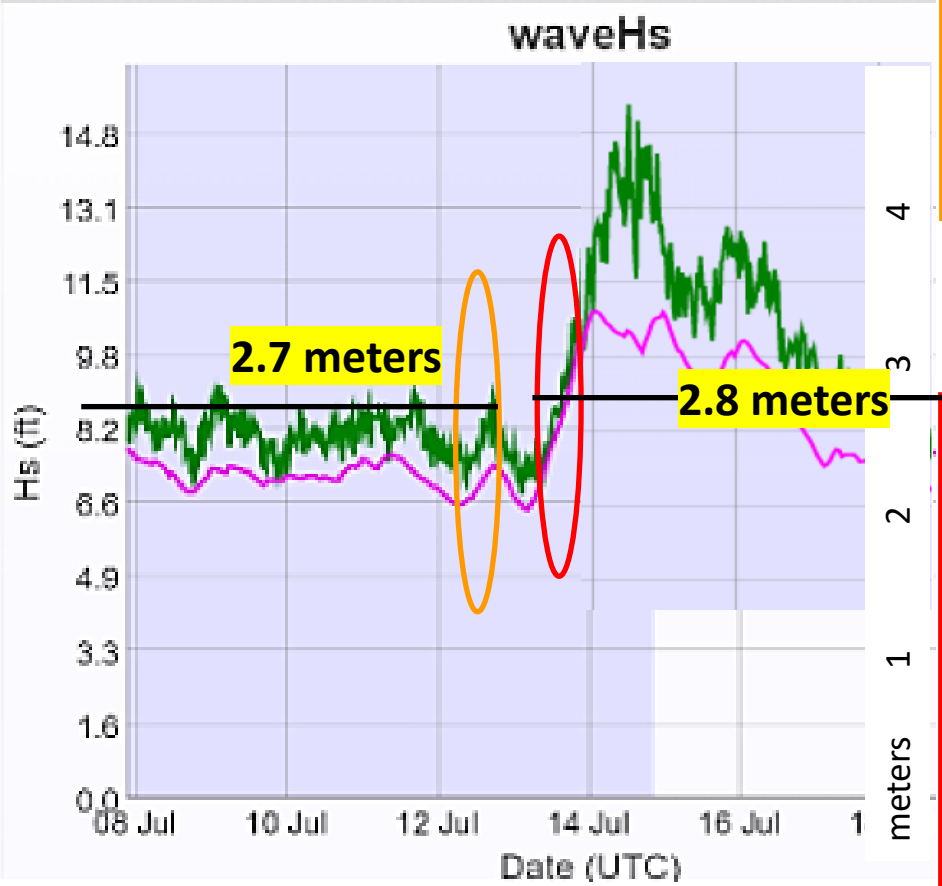
Note the wave direction change from easterly (90) to southerly (180)

The buoy is in open waters, away from land

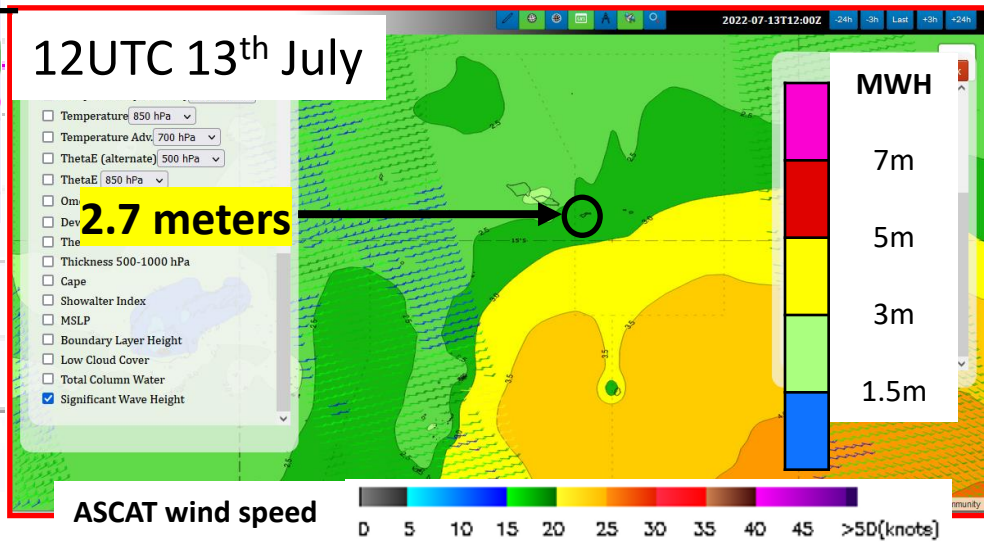
image courtesy PacIOOS, website http://www.pacioos.hawaii.edu/voyager/

WaveHs chart from a preliminary report by Patrick Cioffi NWS Pacific Region ROC. Also from Eric Lau NWS Pacific Region HQ Hawaii

Large waves affecting American Samoa



ECMWF wave model **Maximum Wave Height** with ASCAT-B wind speed overlay



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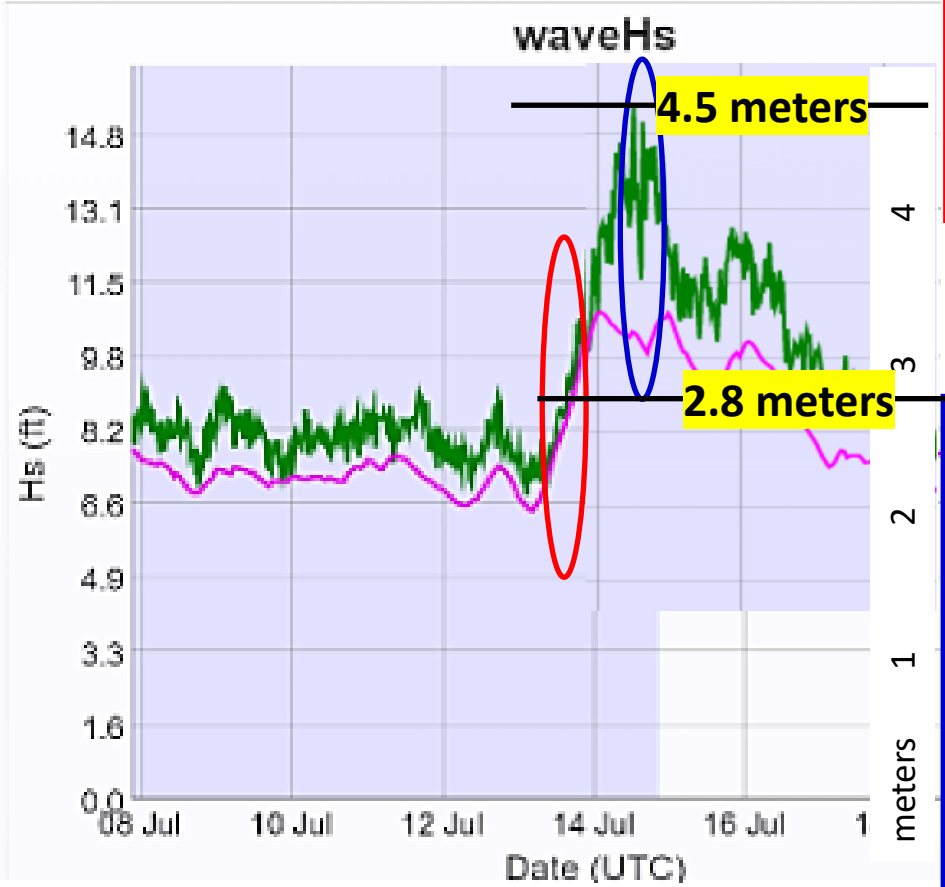

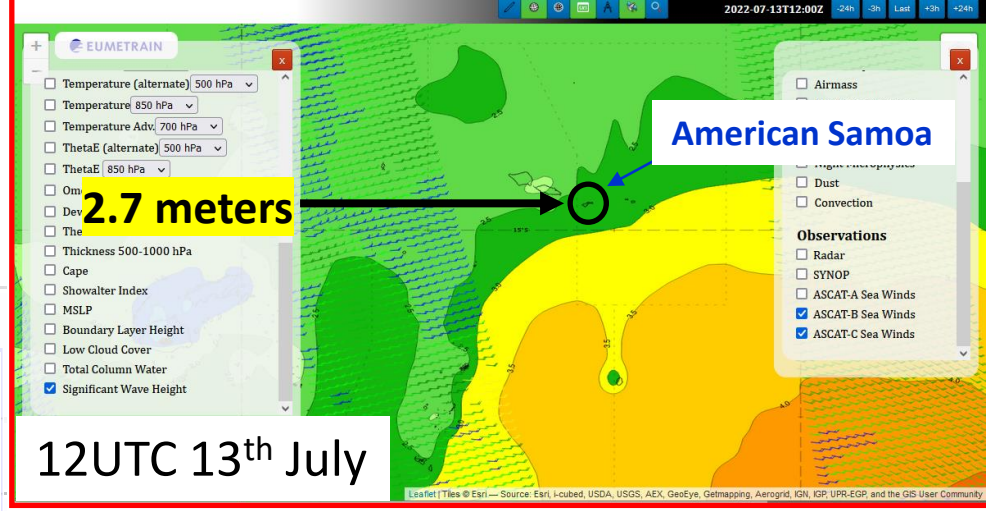

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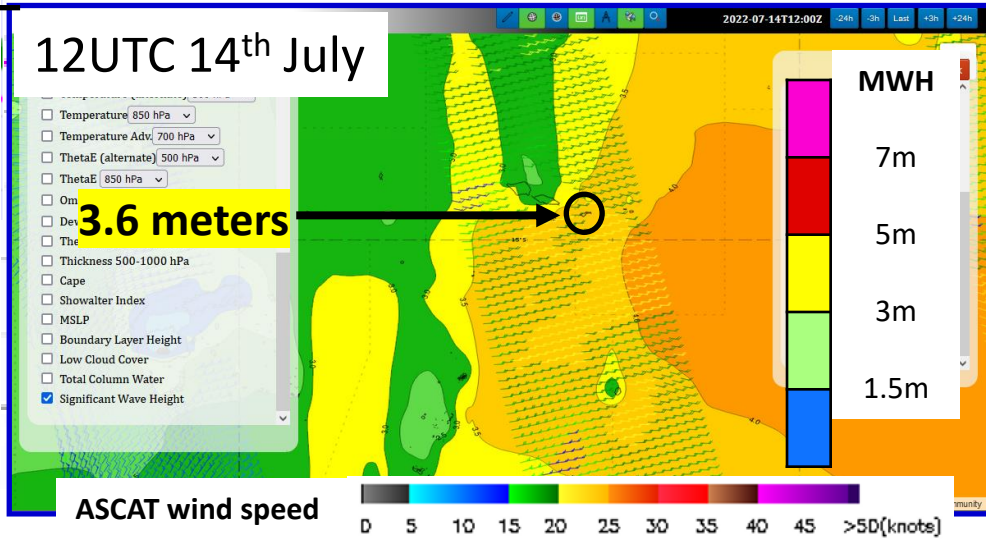

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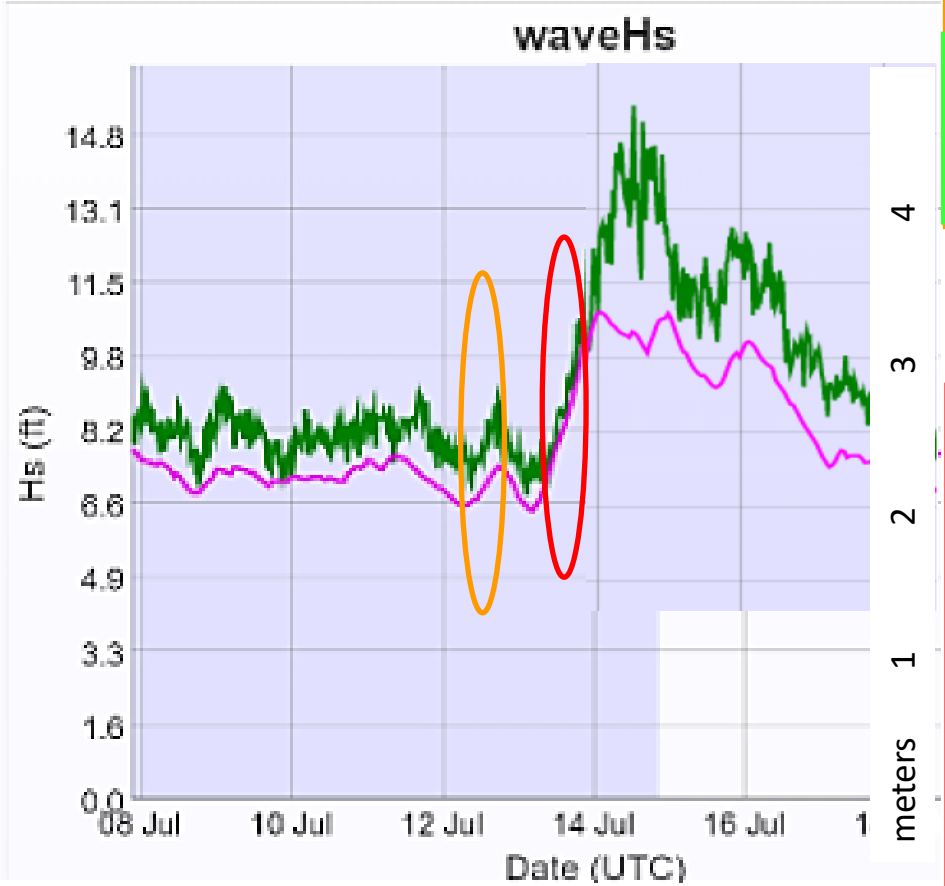
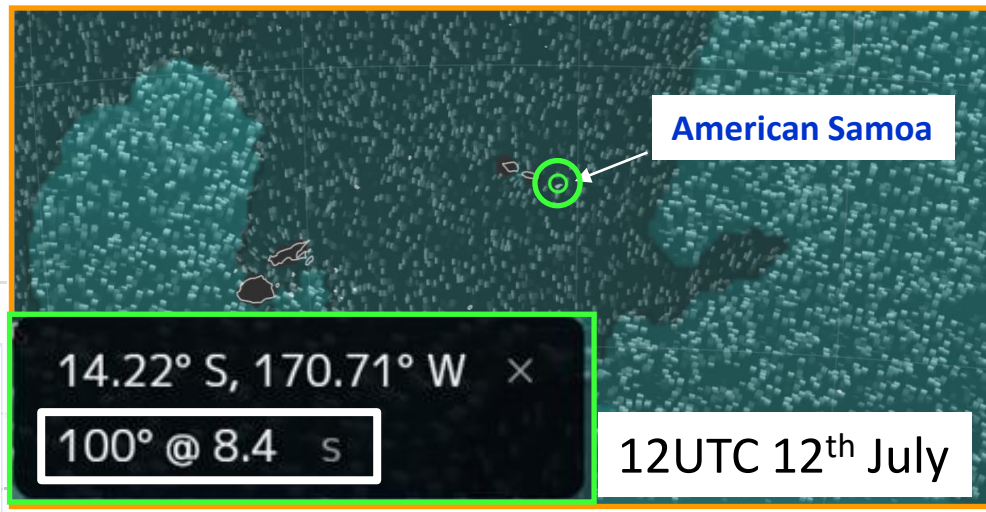
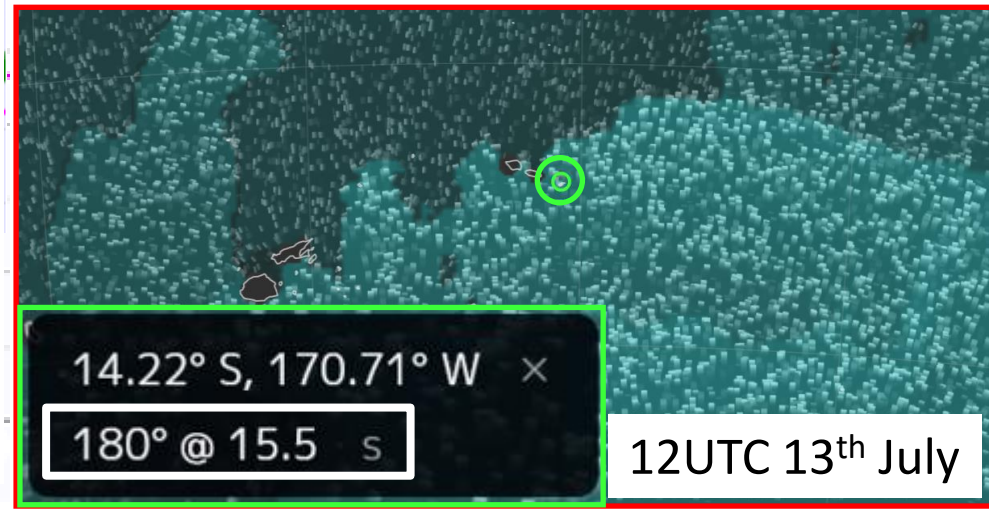




GFS Wavewatch III **Peak Wave Period** from the Earth NullSchool viewer



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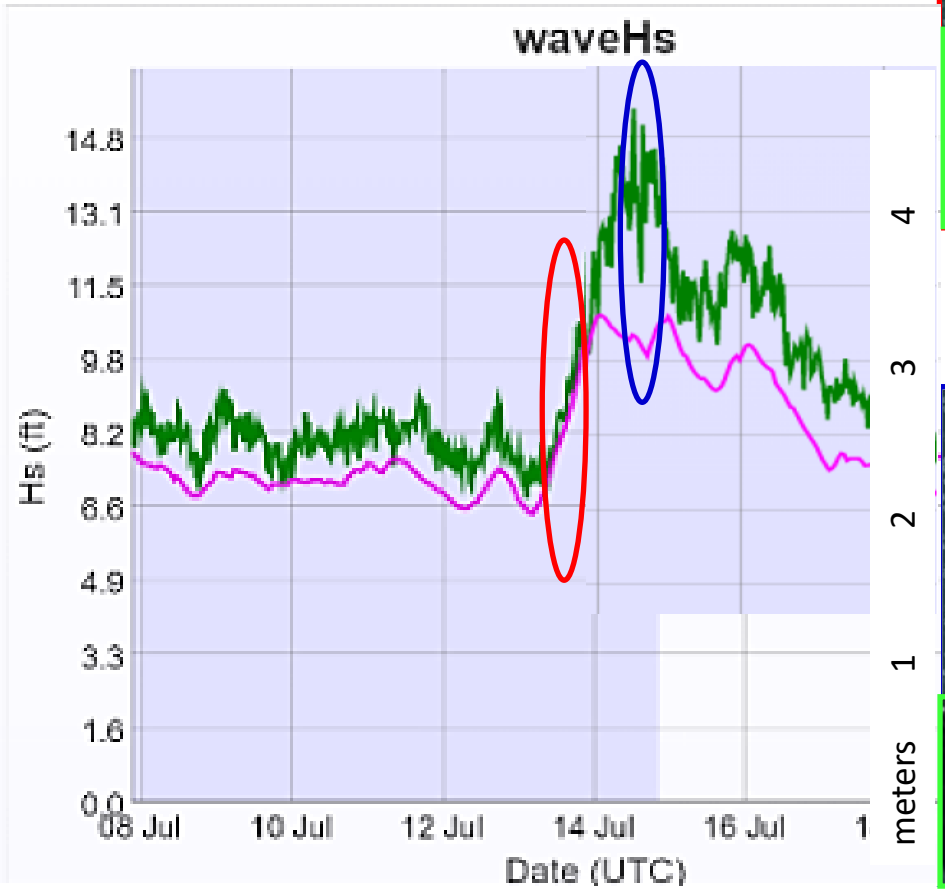

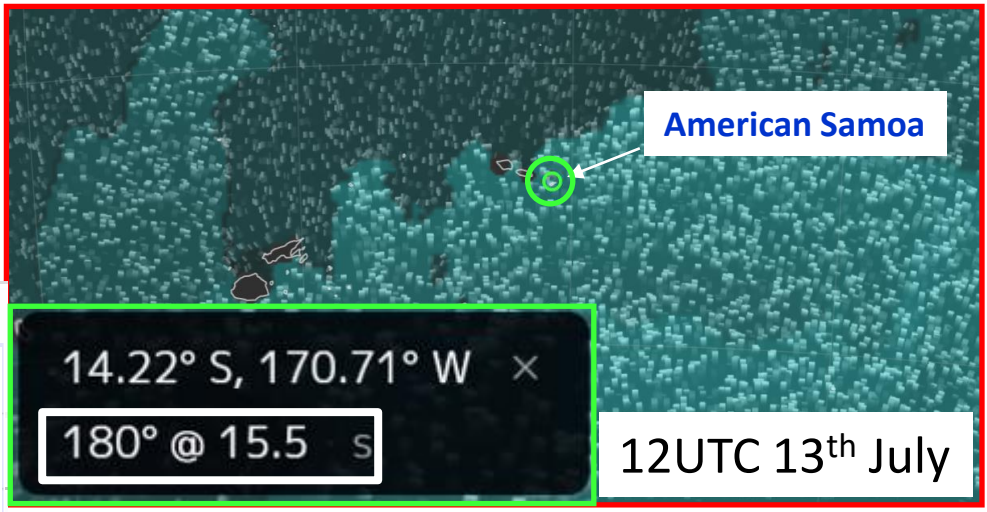

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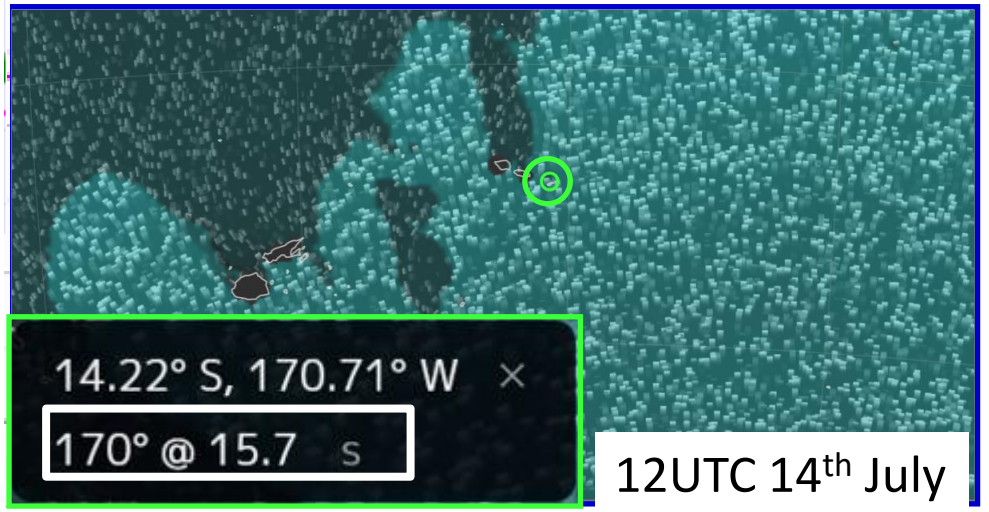

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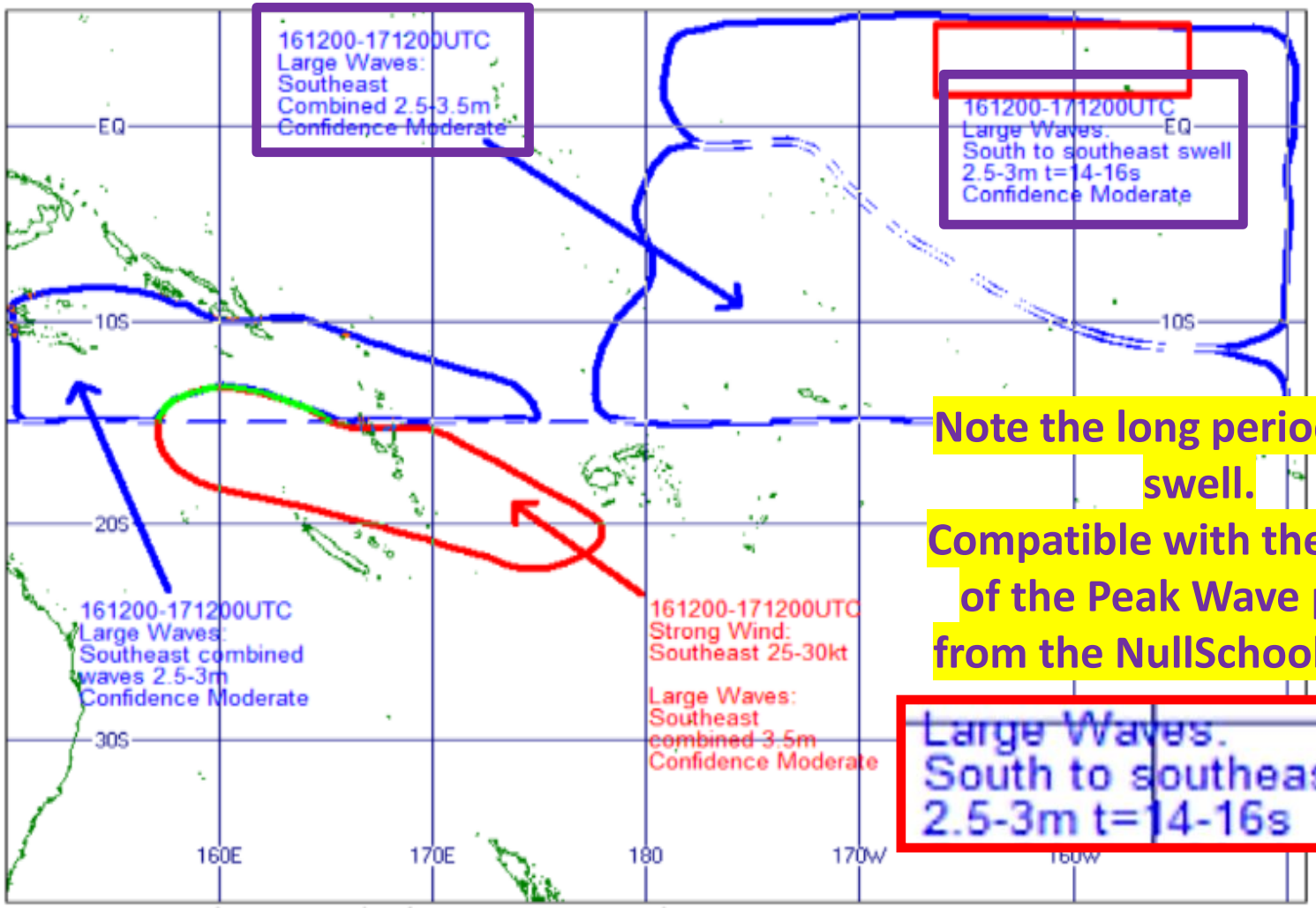
South Pacific Guidance used by forecasters

12UTC 16th July to 12UTC 17th July 2022



Forecast kindly forwarded by Mauna Eria, Quality Assurance Officer Kiribati Meteorological Service (forecast source: MetService NZ)

The PacIOOS Wave Buoy at Lanai, Hawaii

Observations from Wave Buoy 239, Lanai SW; 12UTC 16th July to 12UTC 19th July

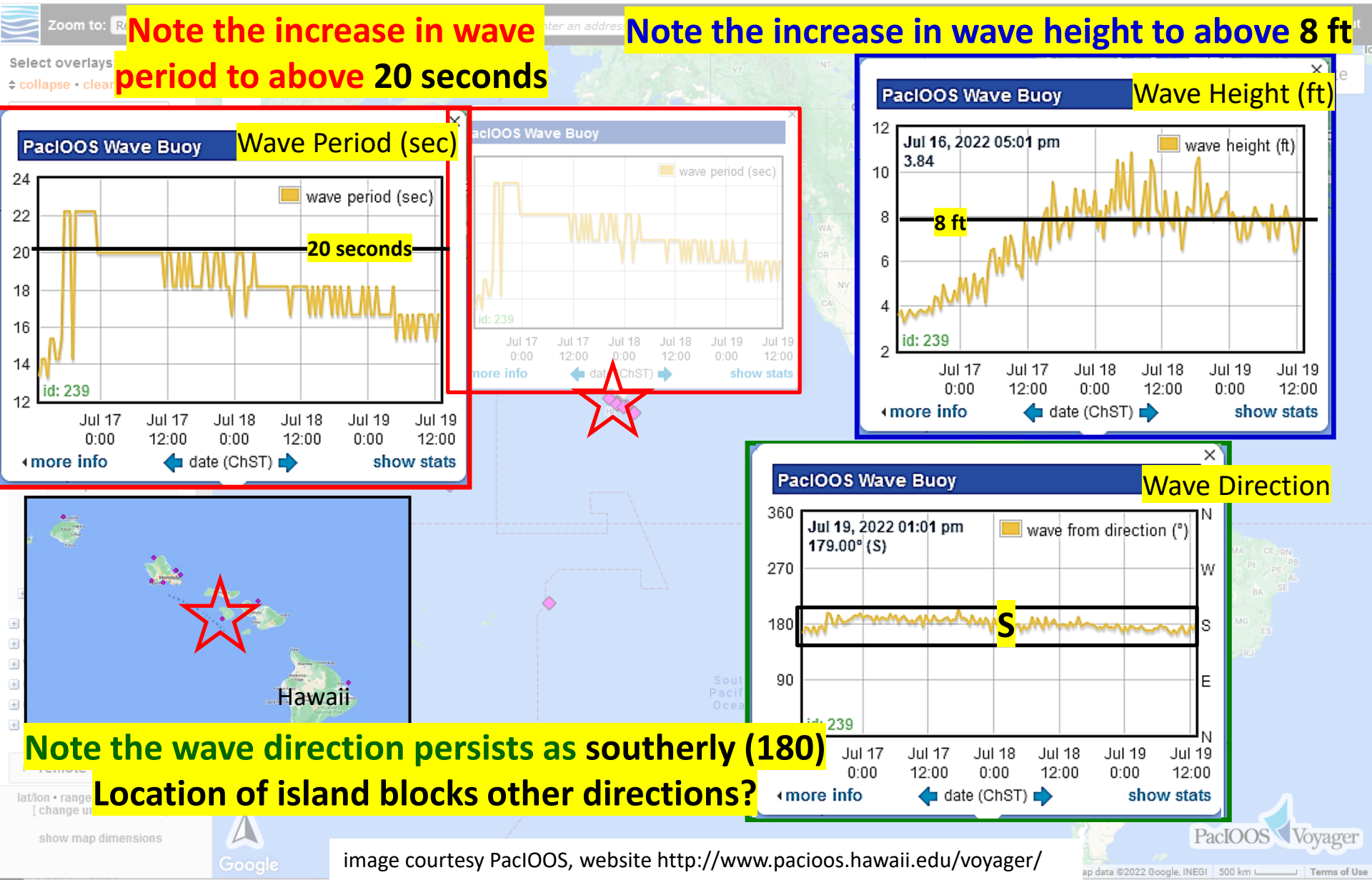
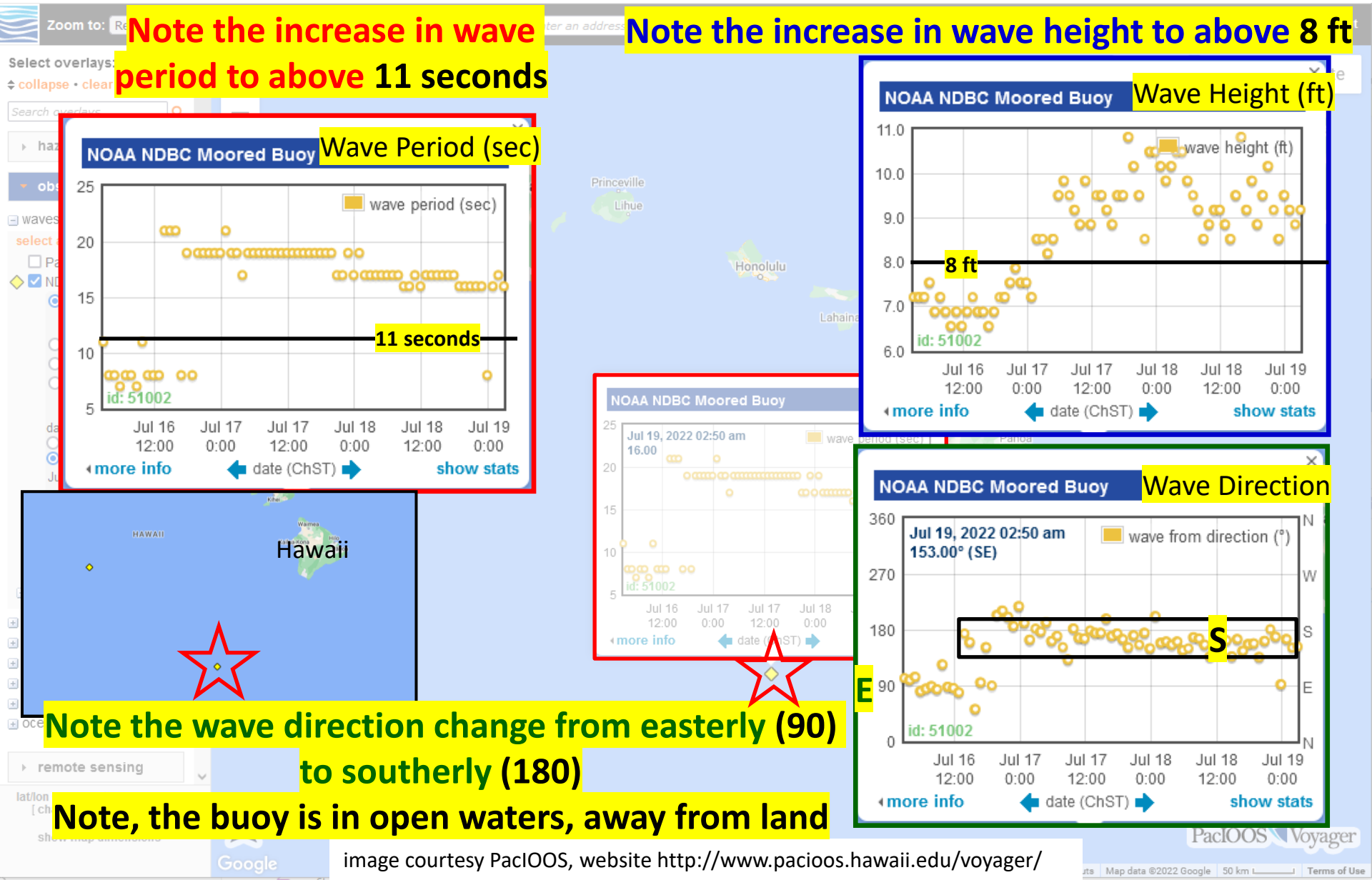


image courtesy PacIOOS, website http://www.pacioos.hawaii.edu/voyager/

The NOAA NDBC Wave Buoy near Hawaii

Moored Buoy 51002, 215NM SSW of Hawaii Island; 00UTC 16th July to 00UTC 19th July



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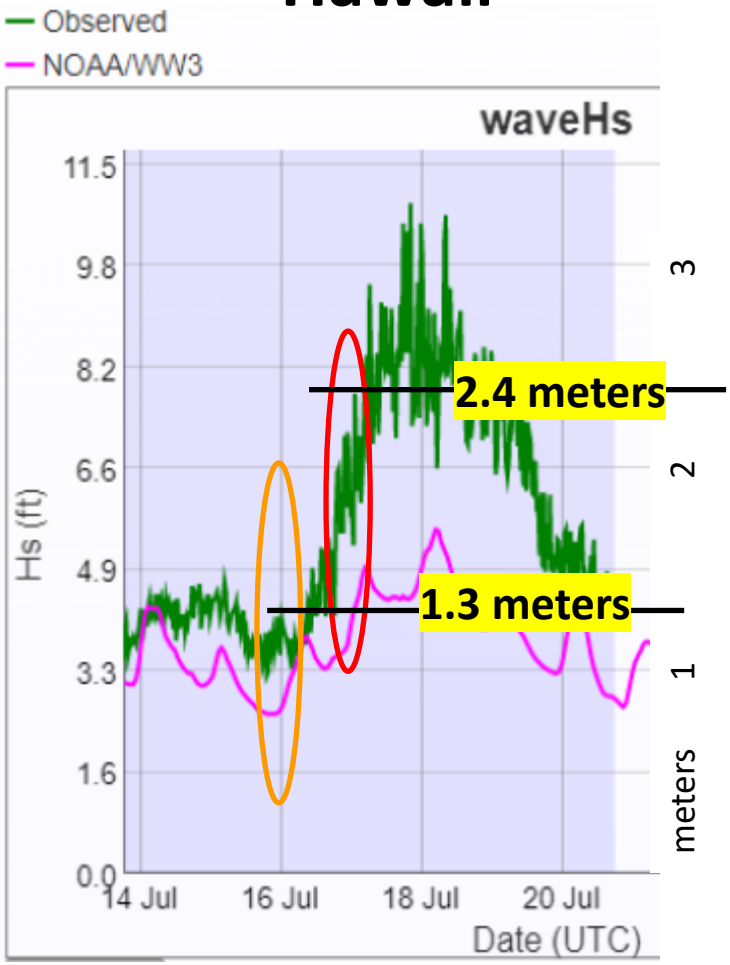

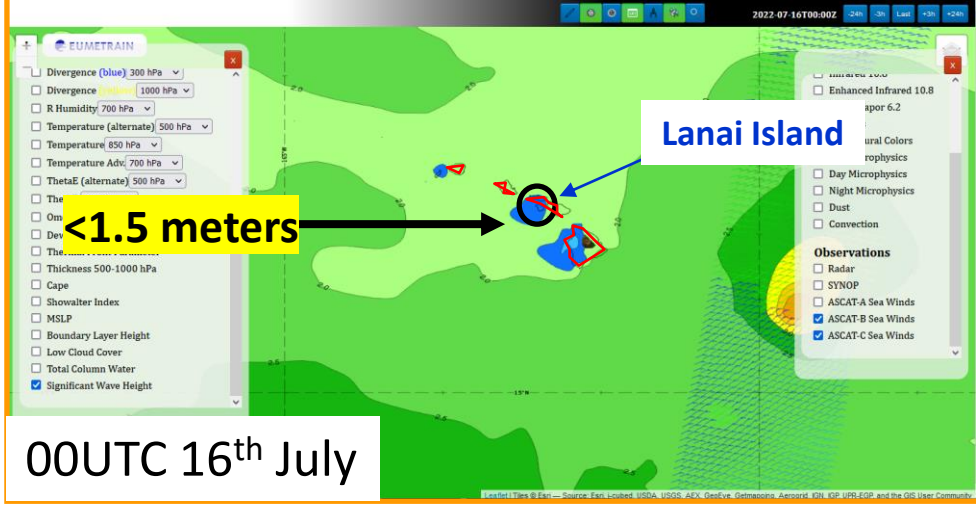

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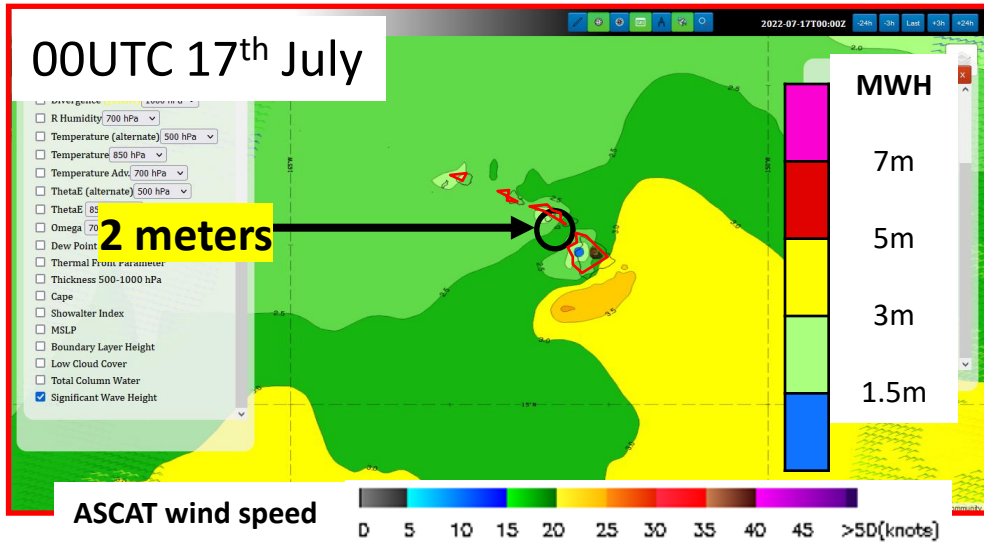

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images from EUMETSAT

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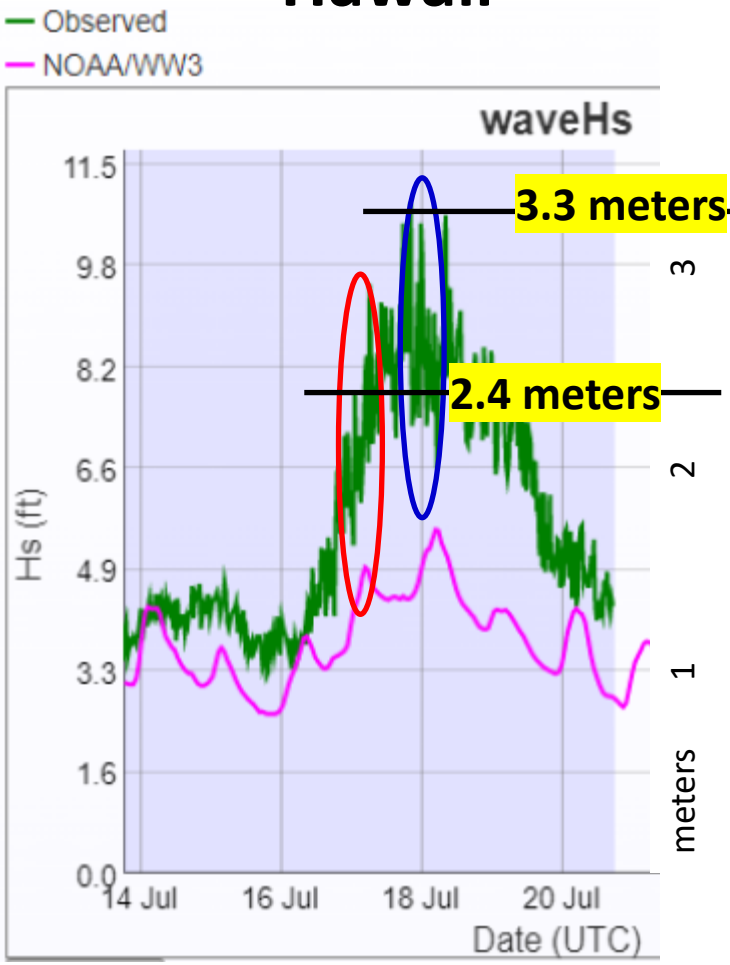

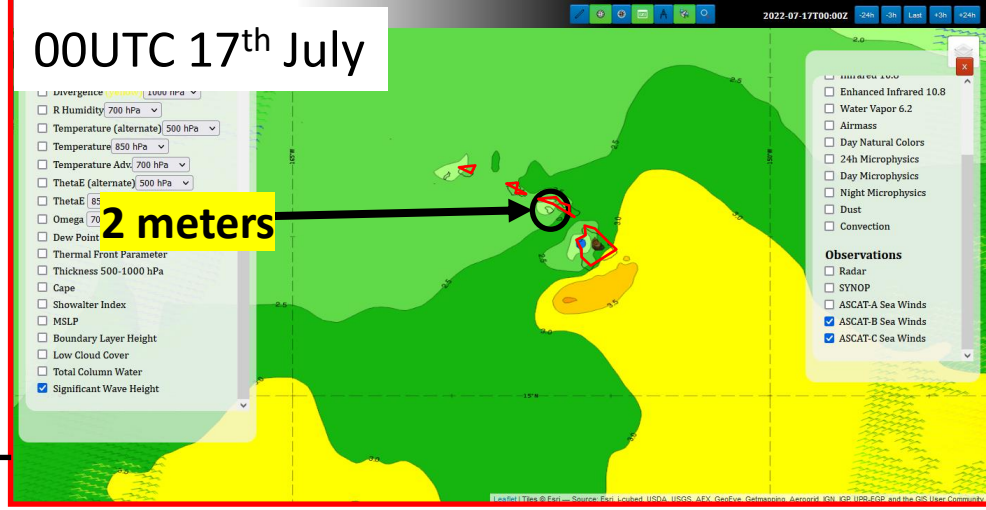

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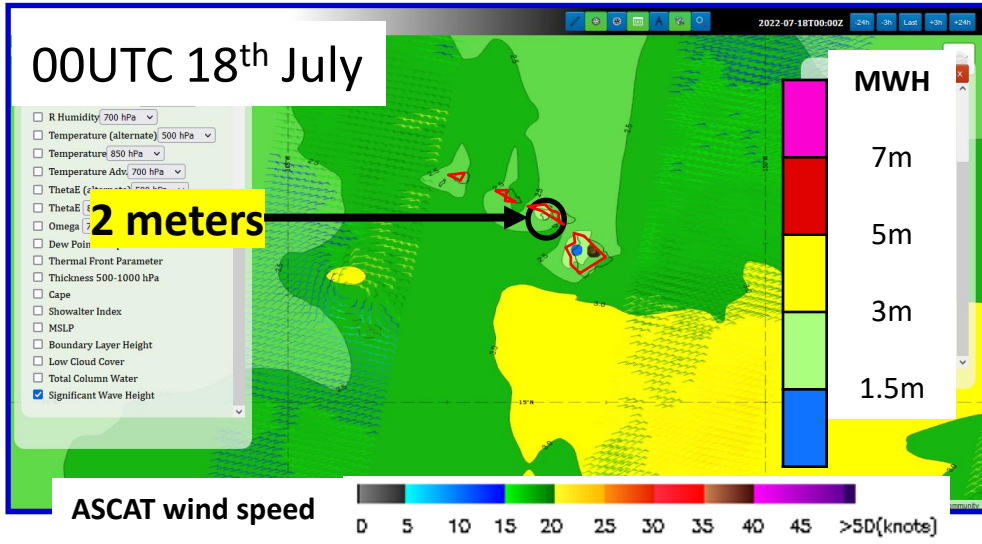

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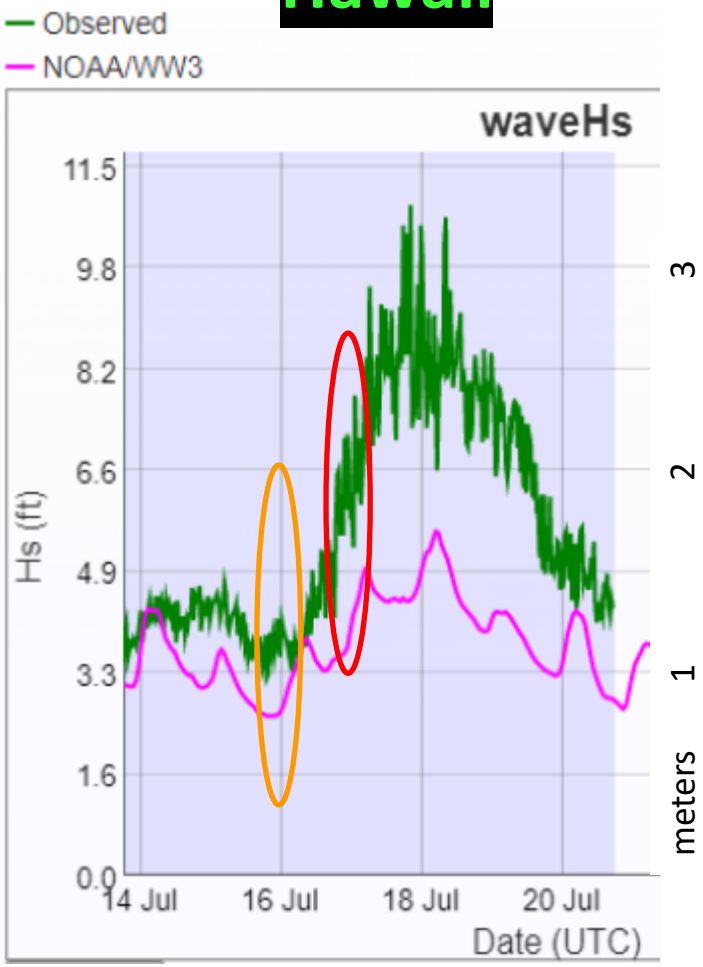

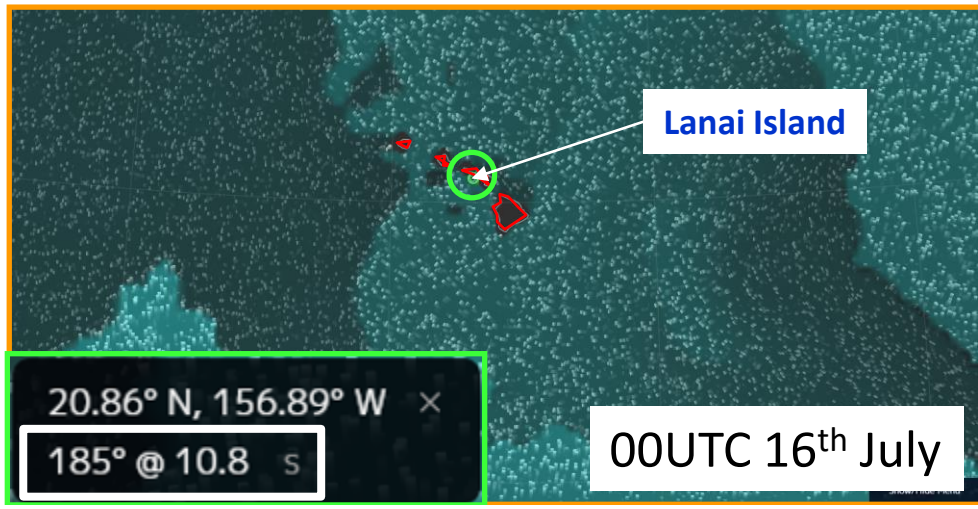

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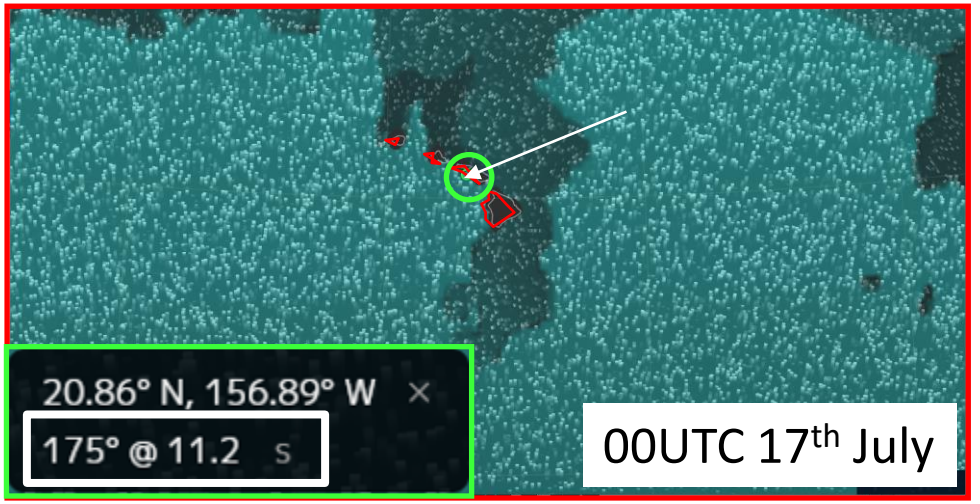

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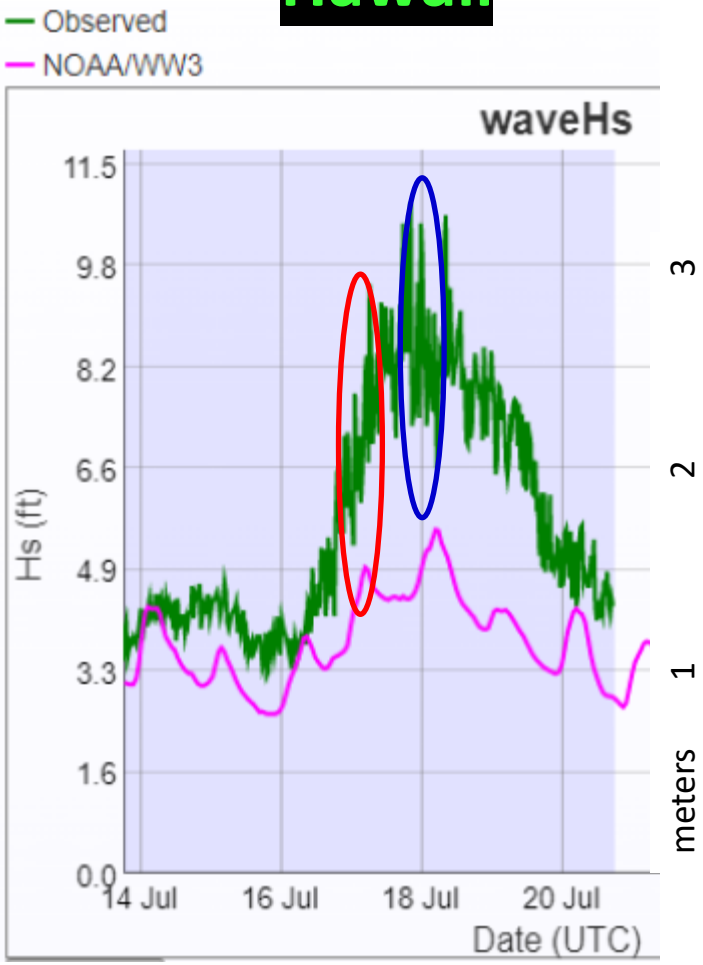

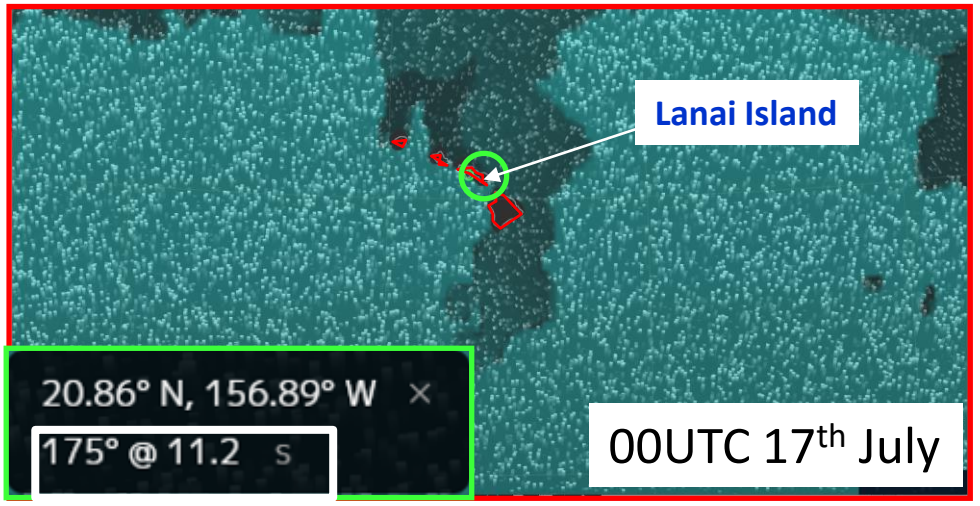

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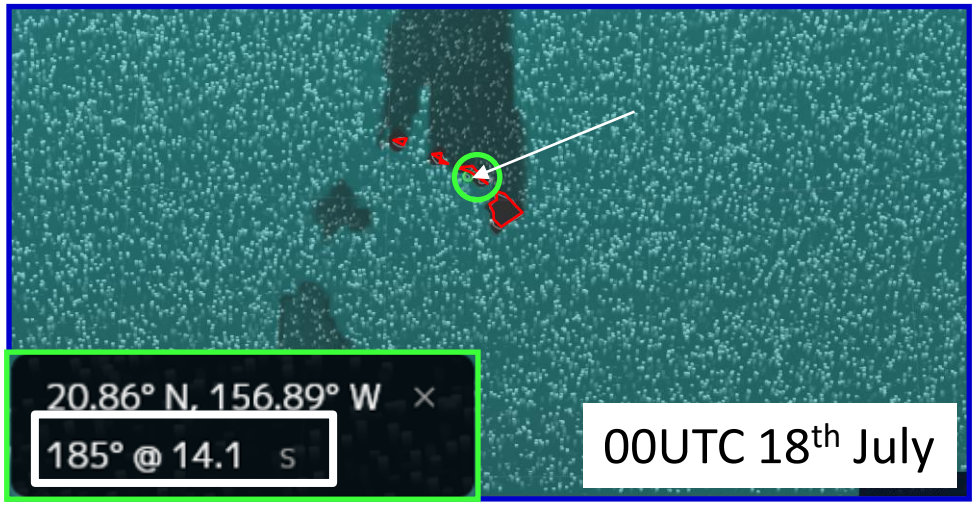

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Impact of the event, American Samoa and Hawaii

(from a preliminary report by Patrick Cioffi NWS Pacific Region ROC, Hawaii).

- **American Samoa:** The Governor declared a State of Emergency on Thursday, July 14, 2022 which ended Monday, July 18, 2022.
- **Hawaii:** Numerous beaches across the state were closed based on the forecast. Honolulu Ocean Safety made 1,554 rescues along Oahu's south shore on July 17.
- Viral Videos via Twitter:
- https://twitter.com/MalikaDudley/status/1548782003884961792
- https://twitter.com/MalikaDudley/status/1548759216004800512

American Samoa

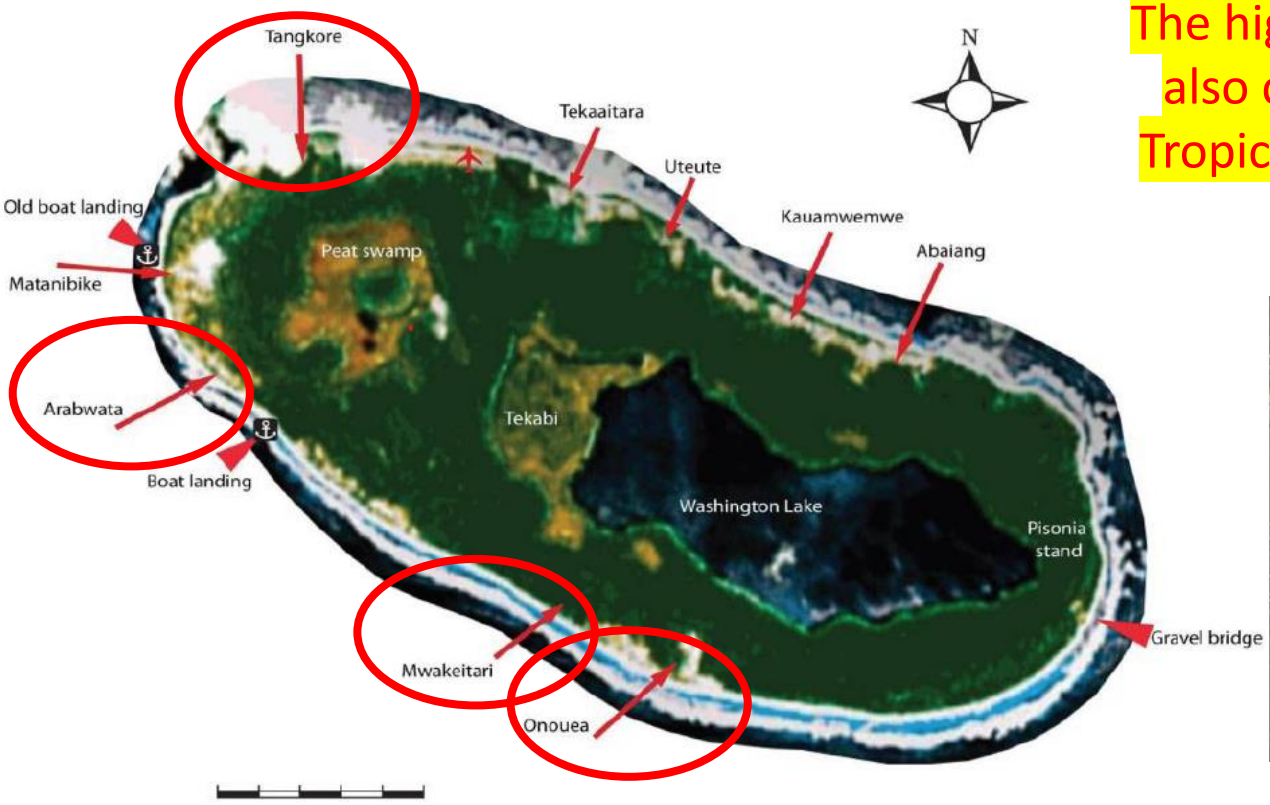
Picture courtesy of Dora Ah Sue

Hawaii

Screen grab from video posted on Facebook by Issa Sloan/Special to West Hawaii Today (Kona, Big Island)

Impact on Teraina Island (Washington Island) Kiribati

This "swell event" has been the highest impact swell event for Teraina Island over the past decade



The high spring tides at the time also contributed to this event Tropical Storm Darby could also have contributed

The four villages shown were most severely affected by the waves of the swell event

Map and information from a report by Miriam Kataunati, Ag Forecaster Kiribati Meteorological Service. Report forwarded by Mauna Eria, Quality Assurance Officer Kiribati Meteorological Service

Summary

- A southerly swell generated by a very strong storm east of New Zealand with winds 30-45 knots extending over a fetch of over 2800km.
- The large swells were exacerbated by the King/Spring tides causing higher run ups along southern shores of the islands in the path of the swell.
- Satellite based altimetry data also showed wave heights of 35-40 feet in the source region east of New Zealand.
- Swell incident affected American Samoa from the 14-15 July, Teraina Island in Kiribati on the 16th July and Hawaii from the 16-17 July
- Hawaii and American Samoa buoy observations were higher than the computer modelled wave heights - in this case, a comparison with the NOAA Wave Watch III
- The swell front could be followed in the GFS Wavewatch III Peak Wave Period (PWP) from the Earth NullSchool viewer.
- **The case study was a great example of International VLab collaboration!**

Australian VLab Centre of Excellence Regional Focus Group meeting, 02UTC 18 August 2022

Contents

- **The significant Swell Event in the Pacific Ocean during 11-17th July, as monitored by satellite and surface observations and NWP data** (facilitator Mr Bodo Zeschke, Australian Bureau of Meteorology Training Centre).

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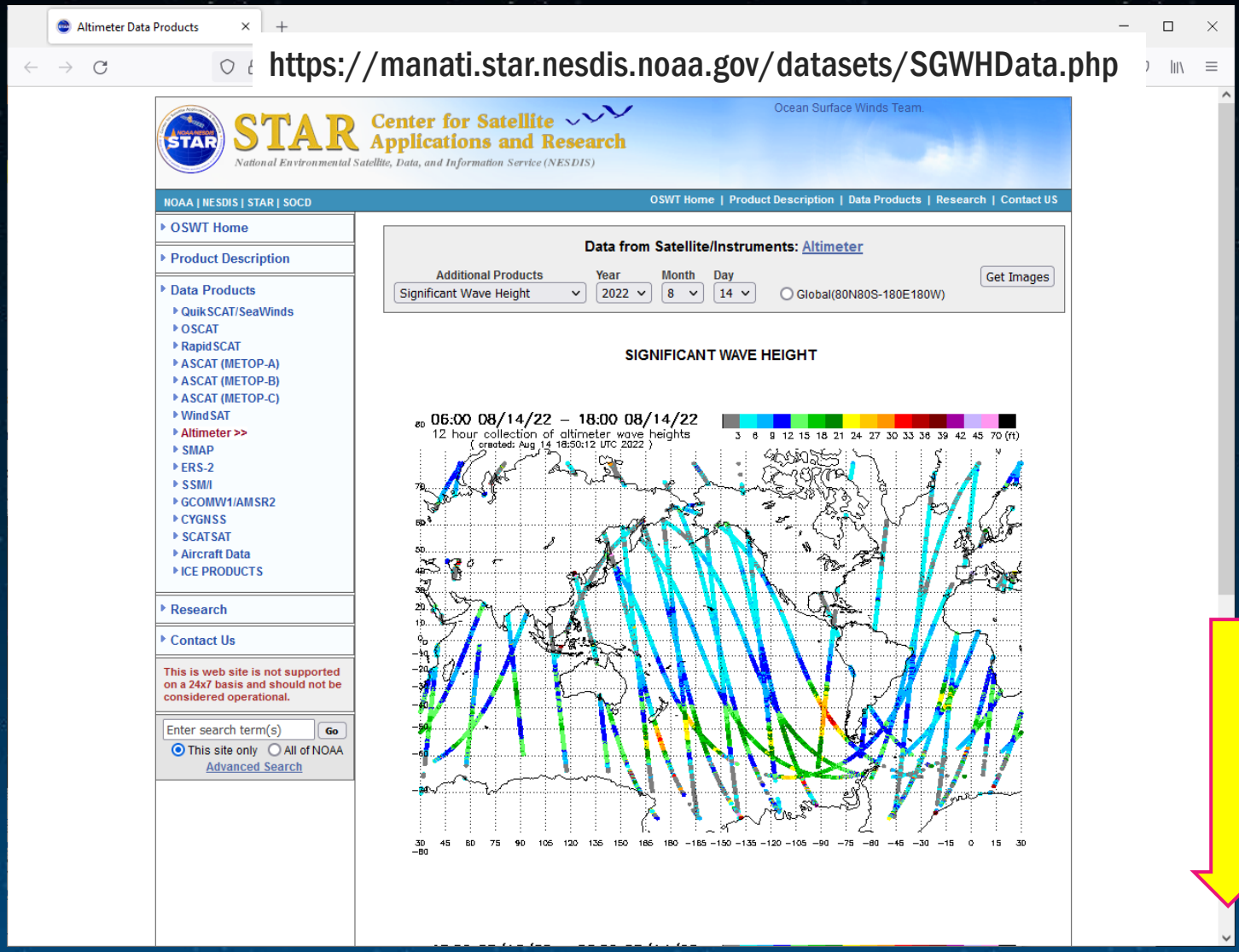
SIGNIFICANT WAVE HEIGHT OBSERVATIONS

HOW TO MAKE VIEWING THEM EFFICIENT

Scott Lindstrom
University of Wisconsin-Madison
CIMSS

OSPO Wave Site



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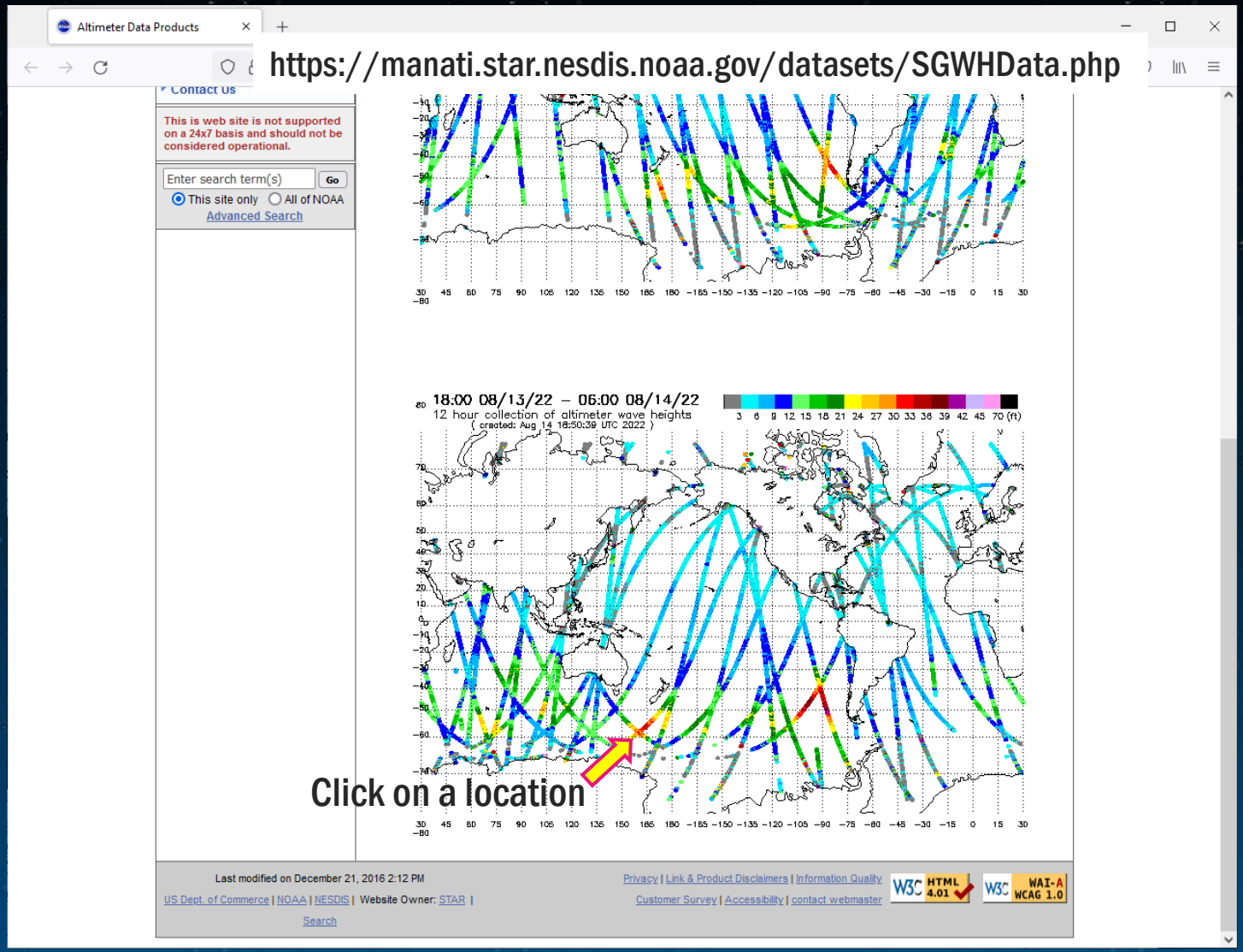
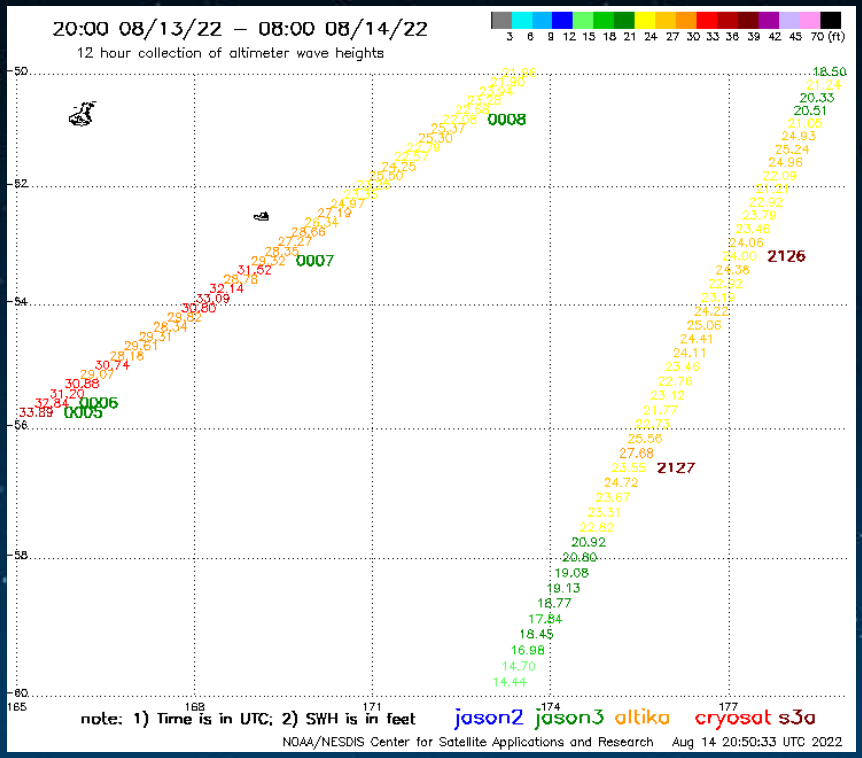


..and you see a small region



- Just one time, one location
- Significant Wave heights are color-coded (in feet)
- What does Significant Wave Height mean? Average of the highest 3rd of all waves
  - NOAA Quick Guide
  - Training Video
  - COMET Module

Can we do better?

- Pluses: The data for these images are stored on-line, and can be accessed easily.
  - https://manati.star.nesdis.noaa.gov/rscat_images/sgwh/sgwh_wh_arch/WH2022224/zooms
- The 'sector number' is constant
- It's pretty easy to scrape the data from the source machine, put it in order, and make an animation
- Waves move slowly across a basin. Create large domains so you can view the wave progression.

Website created

- Shell scripts called by cron – gets data from the last week and puts it on a website where animation is controlled by hAnis.

- https://www.ssec.wisc.edu/~scottl/Waveheight/PacificRegionWaves.html

Thanks!

- If you want a copy of the shell script that does this, please email me
  - scott.lindstrom@ssec.wisc.edu

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