

Where the Swell Begins

Walter Munk with Cher Pendarvis



Swells to the horizon



Surfing is a gift, a total involvement that takes us away from other thoughts
and the cares of the world . . .



The interaction with the wave is a creative dance with the moving water . . .
its the joy of riding a wave . . .



During our early surfing, some of us tried rough prediction from weather maps. . . we'd listen to the weather and then try to predict when to take off from school or work to catch the swell.

For instance, when we had high pressure on the west coast and isobar lines up by Alaska, we knew we may get a winter swell. In college, we'd plan our school schedules around the tides, and also study ahead so that we had time to surf when the waves were good.

Blacks Surf Camera, Surf Report and Forecast – Southern California, South San Diego | Surfline

http://www.surfline.com/reports/report.cfm?id=4245

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Surfline
KNOW BEFORE YOU GO

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Latitude: Longitude: Home > North America > Southern California > South San Diego
32.87723 -117.253

Blacks South San Diego Surf Spots

CAMS AND REPORTS **LOLA SURF MODEL** **LOCAL NEWS, PHOTOS AND VIDEO** **TRAVEL INFO** **SATELLITE VIEW** **FREE Forecast for this Region**

1263 Surf Spots
view all surf spots
Recently Visited:
Rincon
Blacks
Swami's
Sunset Cliffs
Publics

Full Surf Spot List:

- North America
 - British Columbia
 - Pacific Northwest
 - Northern California
 - Central California
 - Southern California
 - Santa Barbara
 - Ventura
 - North Los Angeles
 - South Los Angeles
 - North Orange County
 - South Orange County
 - North San Diego
 - South San Diego
- Blacks
 - Scorpio
 - La Jolla Shores
 - Horseshoe
 - Windansea

WEATHER, TIDES AND WIND

WATER SAFETY:
CAUTION
Water Safety Guide

HAZE

CURRENT WEATHER:
1:40 PM PST
WIND: NW @ 0 mph
AIR/WATER: 67°F /55°-57°
SUNRISE/SET 6:34 AM/5:32 PM
KCASH0270 (2 miles)

Need help? Find it here

Wetsand.com > Surf Reports > Home Page

http://www.wetsand.com/swellwatch/

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world wide waves

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Regions Features Tropical Center

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Wed 02/12/08

Click the map to select a region

1 2 3 4 5 6 7 8 9 10 12 15 20 25 30 feet

Height Period Wind

FEB 2008	WED 13	THU 14	FRI 15	SAT 16	SUN 17	MON 18	TUE 19

Surf Regions
Select from the regions below to get the latest surf report, swell models and forecasting

Today's Tropical Storm Report

Today's Headlines

Cyclone Nicholas grows, takes aim at Australian coast
2/13/2008, ABC News

Database launched to locate beach sand offshore
2/13/2008, NBC

Now we have forecasts and other services available from Surfline, Wetsand and others. You can also sign up to have surf reports sent to your email address.

Surfline | Blacks Surf Camera, Satellite View

http://www.surfline.com/reports/report_satellite.cfm?id=4245

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 - Blacks
 - Scripps
 - La Jolla Shores

CAMS AND REPORTS **LOLA SURF MODEL** **LOCAL NEWS, PHOTOS AND VIDEO** **TRAVEL INFO** **SATELLITE**

SATELLITE IMAGE

Map Satellite Hybrid

YOU ARE HERE

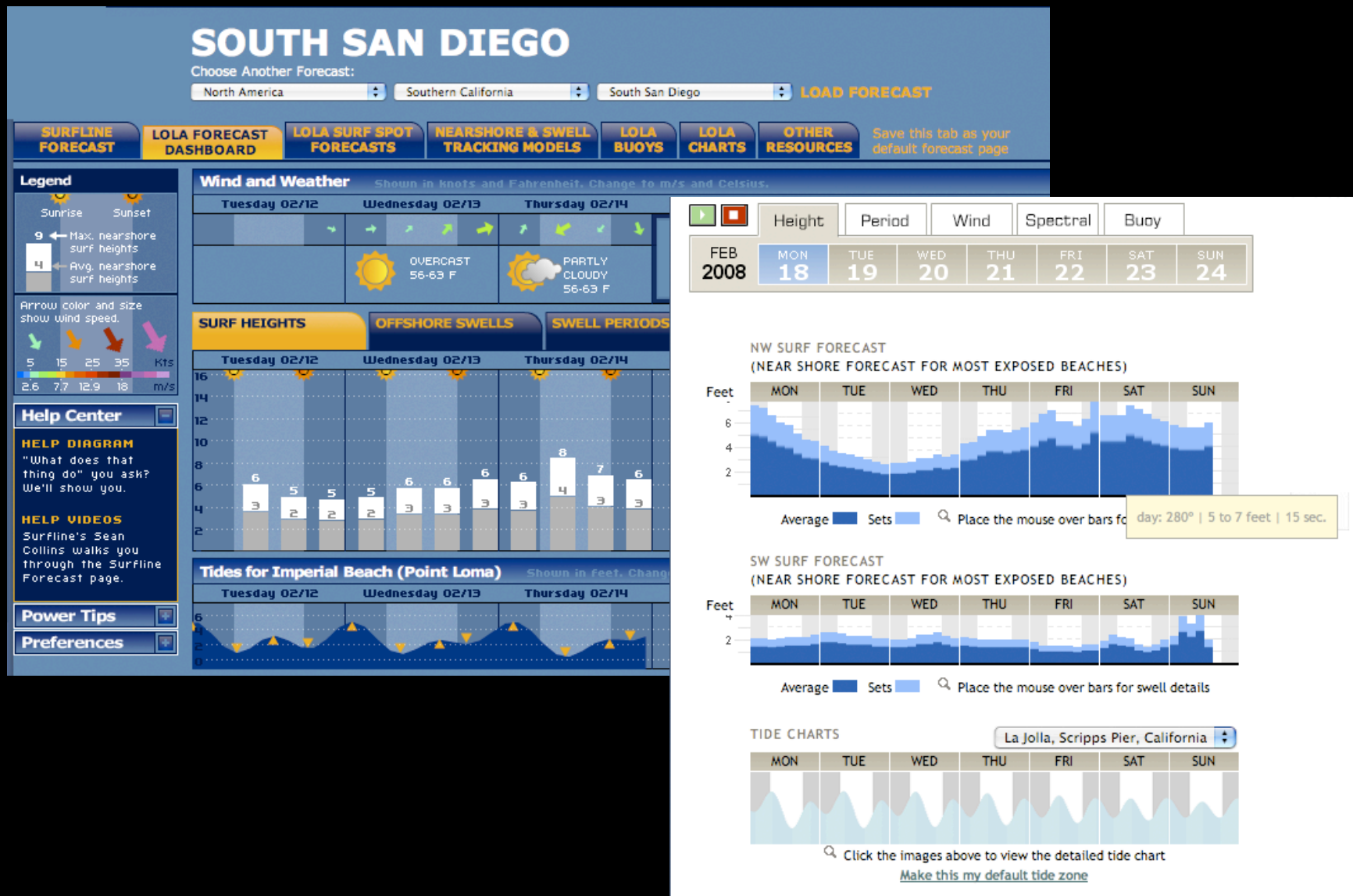
POWERED BY Google

MAP LEGEND

Imagery ©2008 DigitalGlobe Terms of Use

Scroll map or click below to see other spots:

We can view satellite photos for specific spots and zoom in for detail.



We can access maps and charts that help predict the wave direction, height and period, as well as the wind and weather conditions of locations. These examples are from Surfline and Wetsand.



In this Surfline screen we can check out the direction and size of the current swells and the wind and weather conditions.

WetSand.com > Surf Reports > Southern California

http://www.wetsand.com/swellwatch/swellwatch.asp?locationid=2&tabid=1441&subtabid=0&CatId

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Regions Features Tropical Center

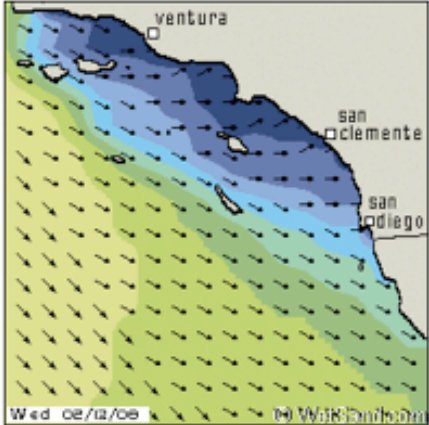
Surf Reports

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Surf Reports > Regions > North America WEST > Southern California

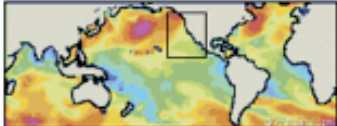
Southern California

SwellWatch Report Tools Water Quality



ventura san clemente san diego

Wed 02/12/08



Features

Today's Headlines

[Cyclone Nicholas grows, takes aim at Australian coast](#)
2/13/2008, ABC News

[Database launched to locate beach sand offshore](#)
2/13/2008, NBC

***WetSand Retail Store* Now open!**
446 East Main Street Ventura CA 93001

This screen shows the direction and size of the current swells.

Height

Period

Wind

Spectral

Buoy

FEB 2008

MON 18

TUE 19

WED 20

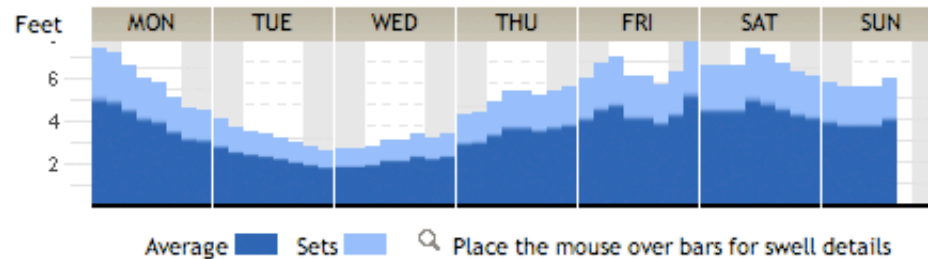
THU 21

FRI 22

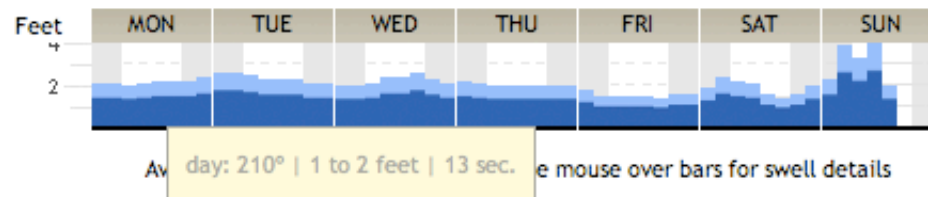
SAT 23

SUN 24

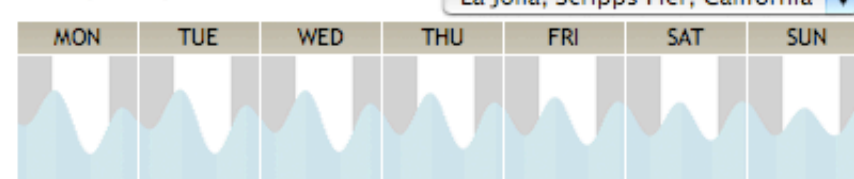
NW SURF FORECAST (NEAR SHORE FORECAST FOR MOST EXPOSED BEACHES)



SW SURF FORECAST (NEAR SHORE FORECAST FOR MOST EXPOSED BEACHES)



TIDE CHARTS



Click the images above to view the detailed tide chart
[Make this my default tide zone](#)

You can check the swell direction, height, period, wind and even check the buoys. Roll your mouse over a swell to view more details in this Wetsand screen.



A fun day at Windansea



A fun day at Ralphps, San Diego harbor



South Swell Shorebreak painting



We did not always have such great tools for forecasting the waves. Dr. Walter Munk was the first to discover how to forecast swells. Walter first came to Scripps Institution of Oceanography in 1939, and after completing his Bachelor's and Master's degrees at CalTech, he took a job at Scripps and worked alongside Dr. Harald Sverdrup, the Director of Scripps Institution of Oceanography.



Big swell at Scripps in 1939



Scripps and Blacks in 1940

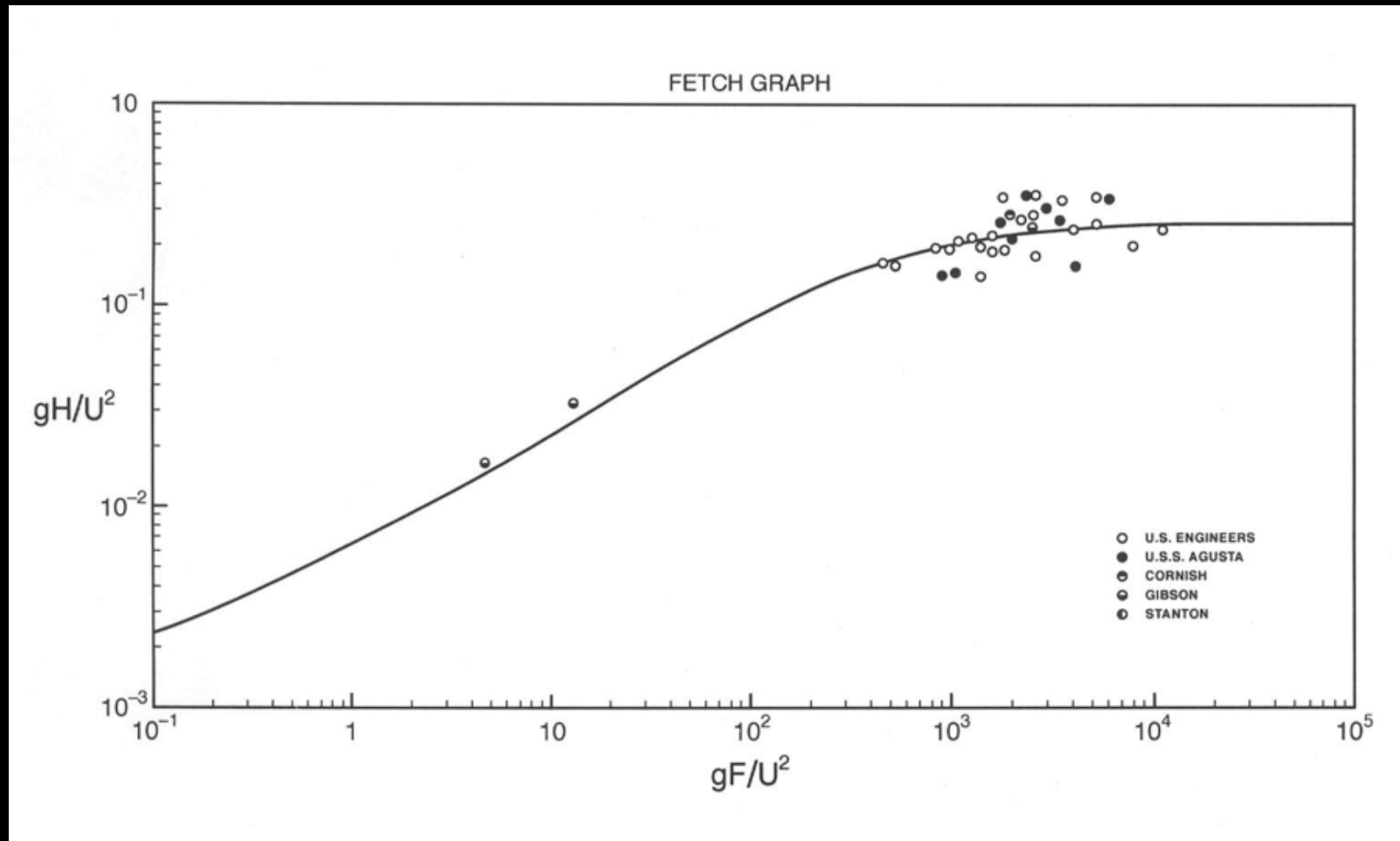


The wave prediction problem could be split into three quite distinct subjects: SEA, SWELL, SURF.

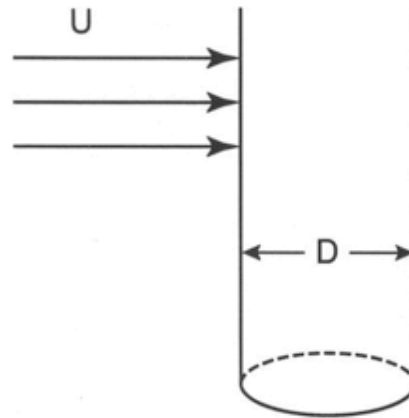
SEA dealt with wave height H and period T as functions of the wind velocity U , fetch F and duration D . These parameters could be combined into dimensionless quantities, such as gH/U^2 and gF/U^2 and plotted against one another.

SWELL involved an attempt to quantify the wave decay between the distant storm and the landing beaches, allowing for dispersion and geometric spreading.

SURF, the transformation in shallow water was computed from conservation in wave energy flux (this audience will appreciate the inadequacy of such a procedure). It was all pretty empirical with scarce data sets. The method remained classified SECRET until some years after the war (Hydrographic Office Publication 601).

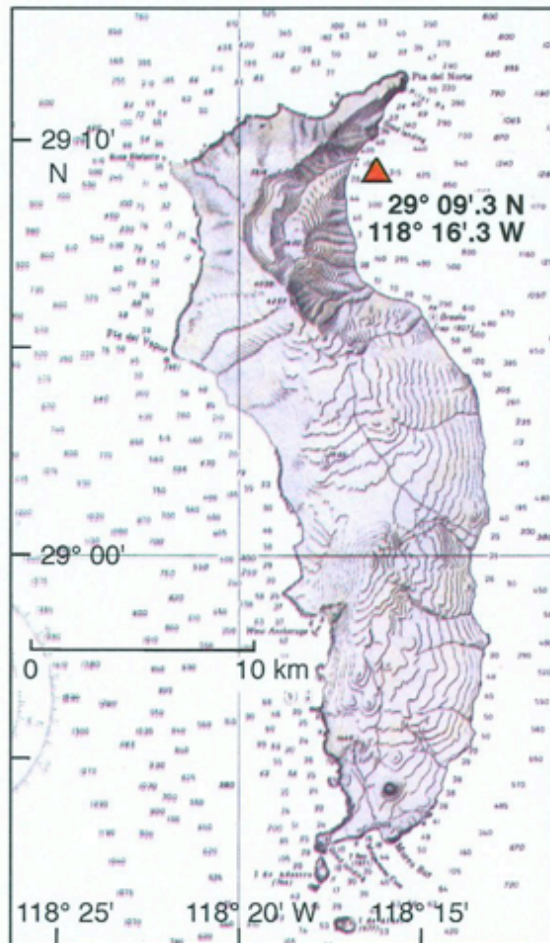


Dimensionless plot for predicting the wave height H as a function of windspeed U and storm fetch F . Only very few observations were available for predicting the dimensions of the sea.



$$\text{FORCE} = \left[aU^2 + b \frac{du}{dt} \right] D$$

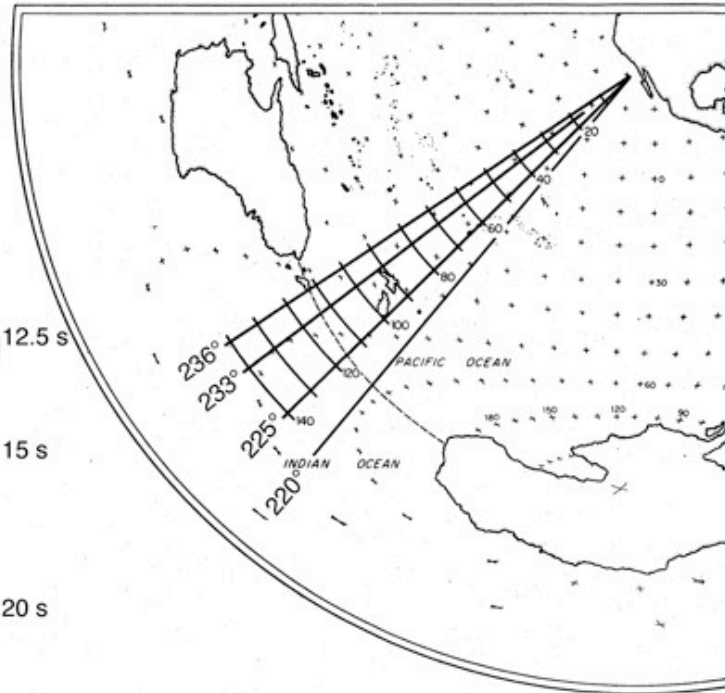
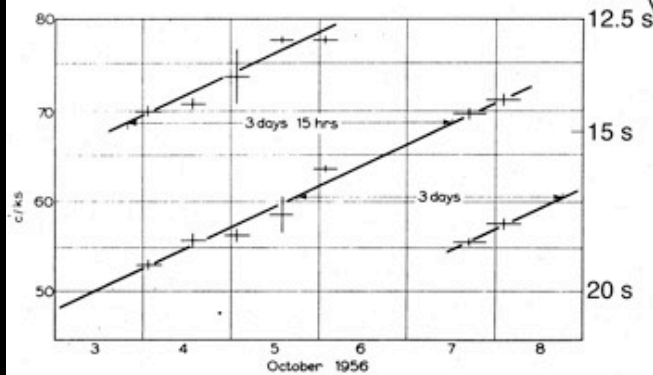
Wave force on a cylinder of diameter D. A prediction based on these formula led to early demise of a Humble Oil drilling platform.



Guadalupe Island. A sea floor pressure recorder at the north eastern end of the island (red triangle) recorded the arrival of distant ocean swell.

$$\frac{x}{t} = V = \frac{g}{4\pi f}$$

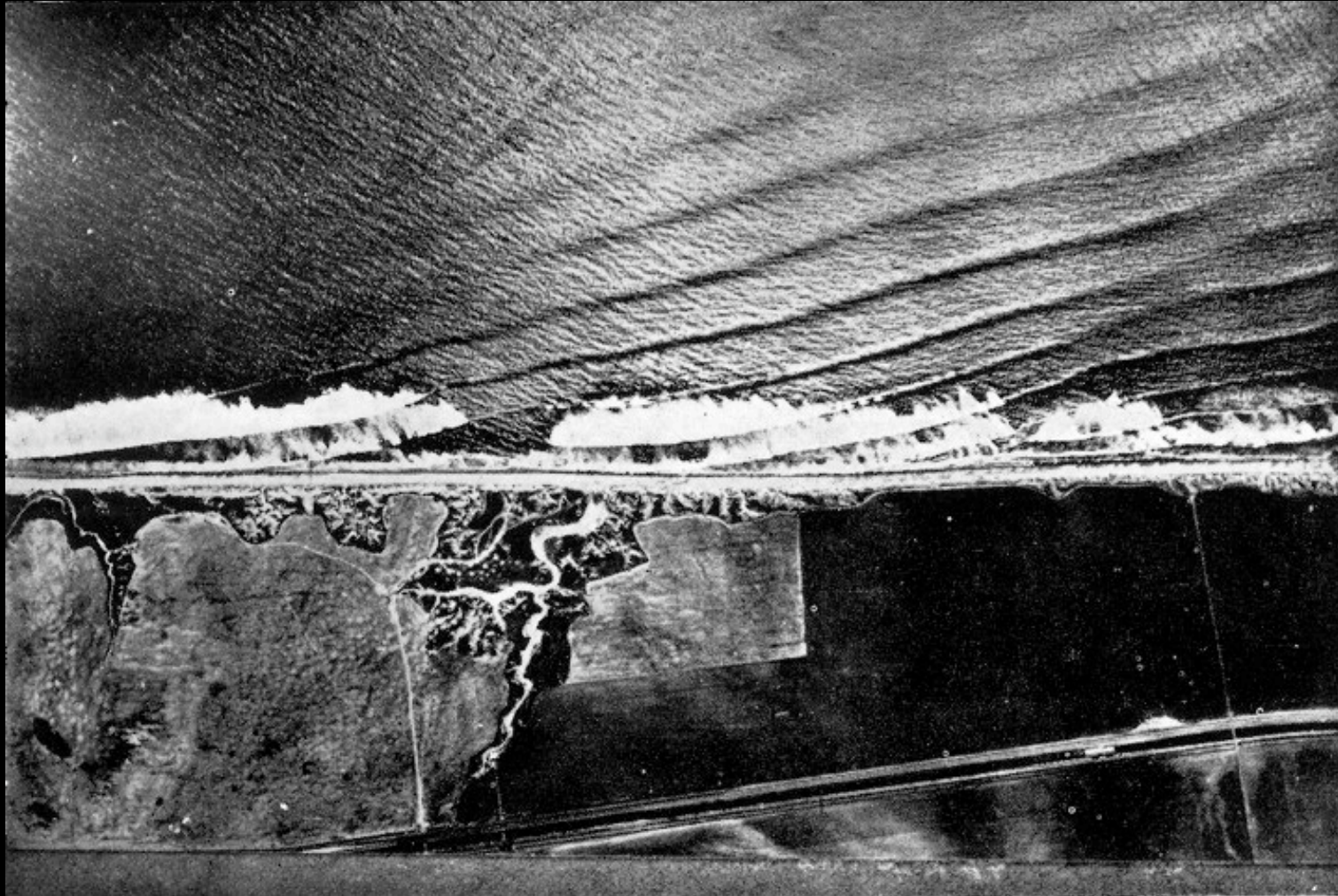
$$\frac{df}{dt} = \frac{g}{4\pi x}$$



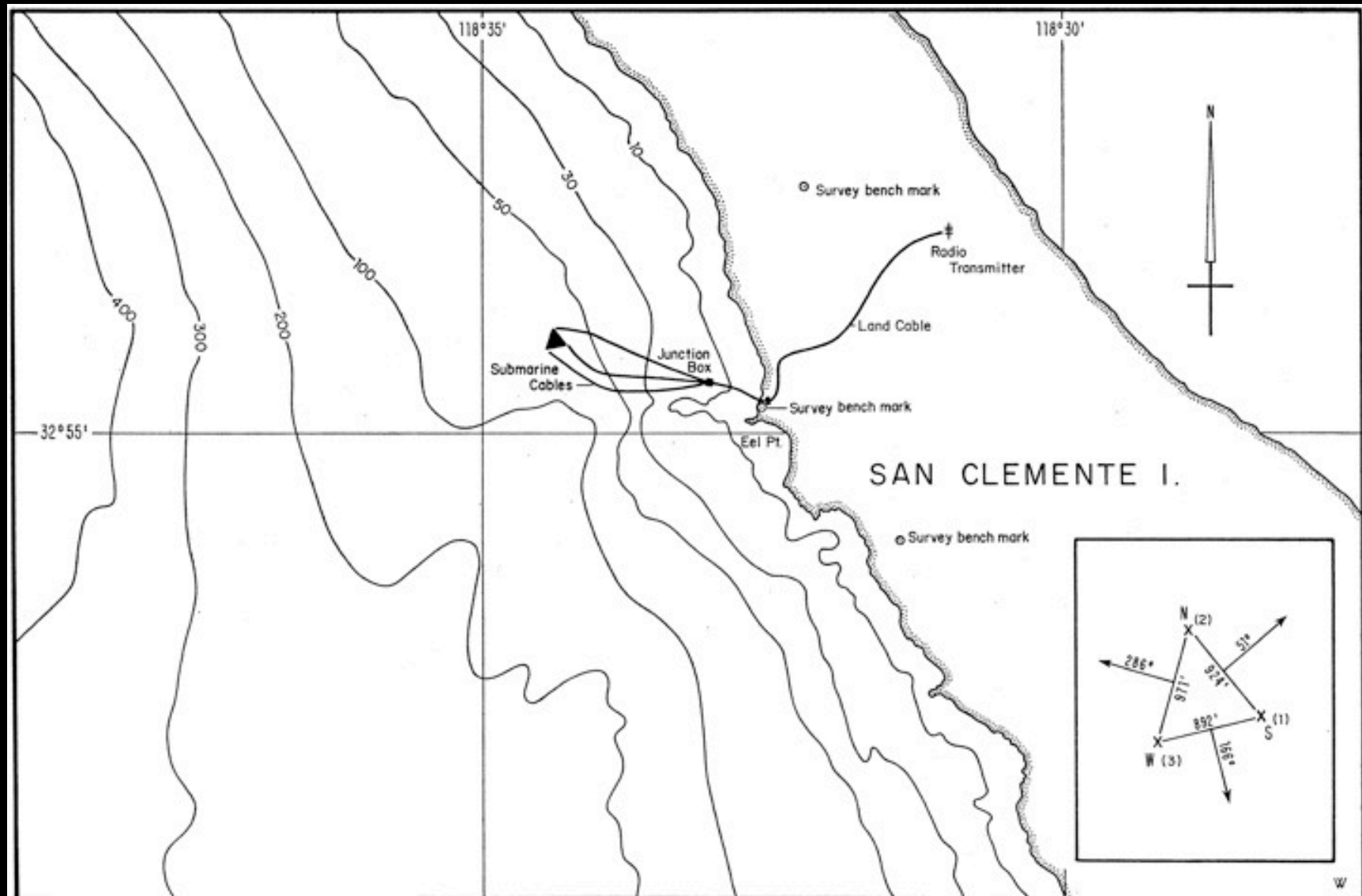
t =	Oct 04, 0 ^h	Oct 08, 0 ^h	Δt = 4 days
Wave Period	19 ^s	14 ^s	
f = waves per minute	$\frac{60}{19} = 3.1$	$\frac{60}{14} = 4.3$	Δf = 4.3 - 3.1 = 1.2

$$\text{RANGE} = \frac{\Delta t}{\Delta f} 4048 = \frac{4}{1.2} 4048 = 13,500 \text{ km}$$

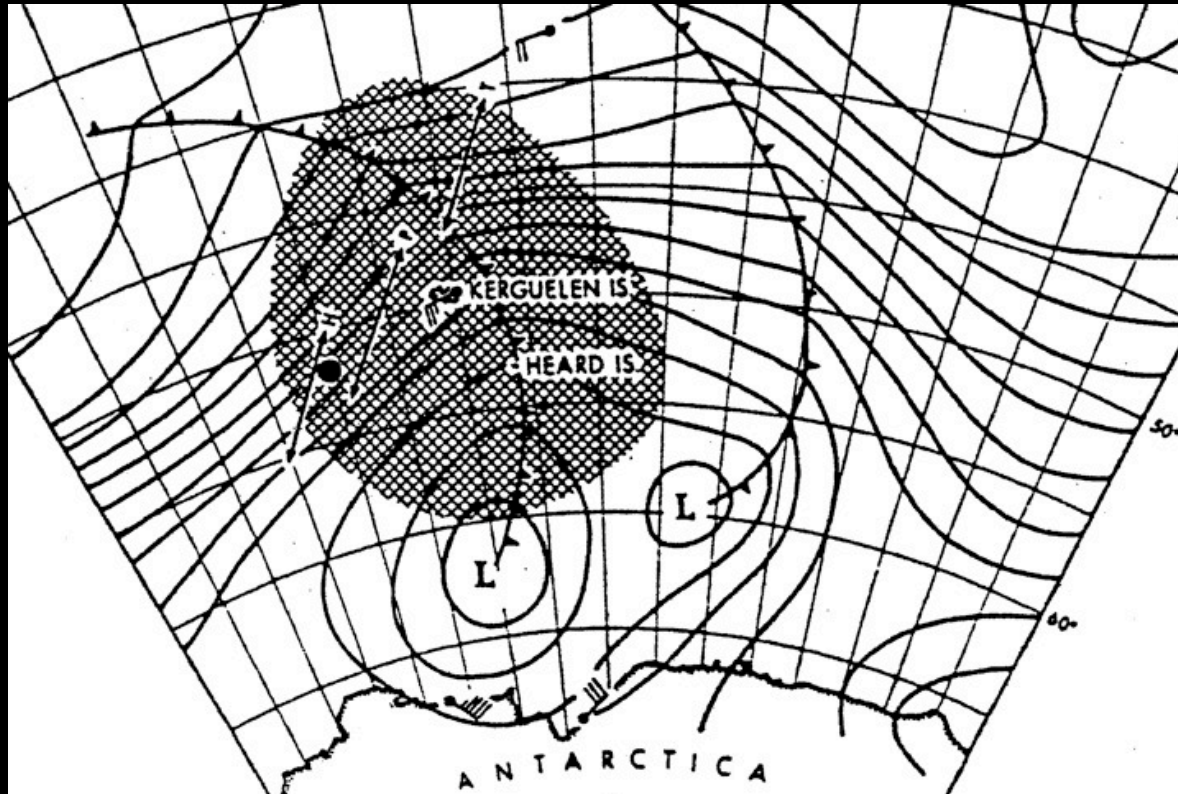
Early long waves 19s followed by 4 days of shorter 14s waves. In our case the decrease from 19s waves to 14s waves in 4 days is consistent with an incredible source distance of 13,500 km. The Pacific Ocean is big, but not that big!



First we tried to infer the wave direction from a beautiful set of aerial photographs taken by John Isaacs during the war. The trouble is that all wave crests turn parallel to shore as they come into shallow water, and allowing for this refraction is difficult especially when offshore shoals and islands are in the way.

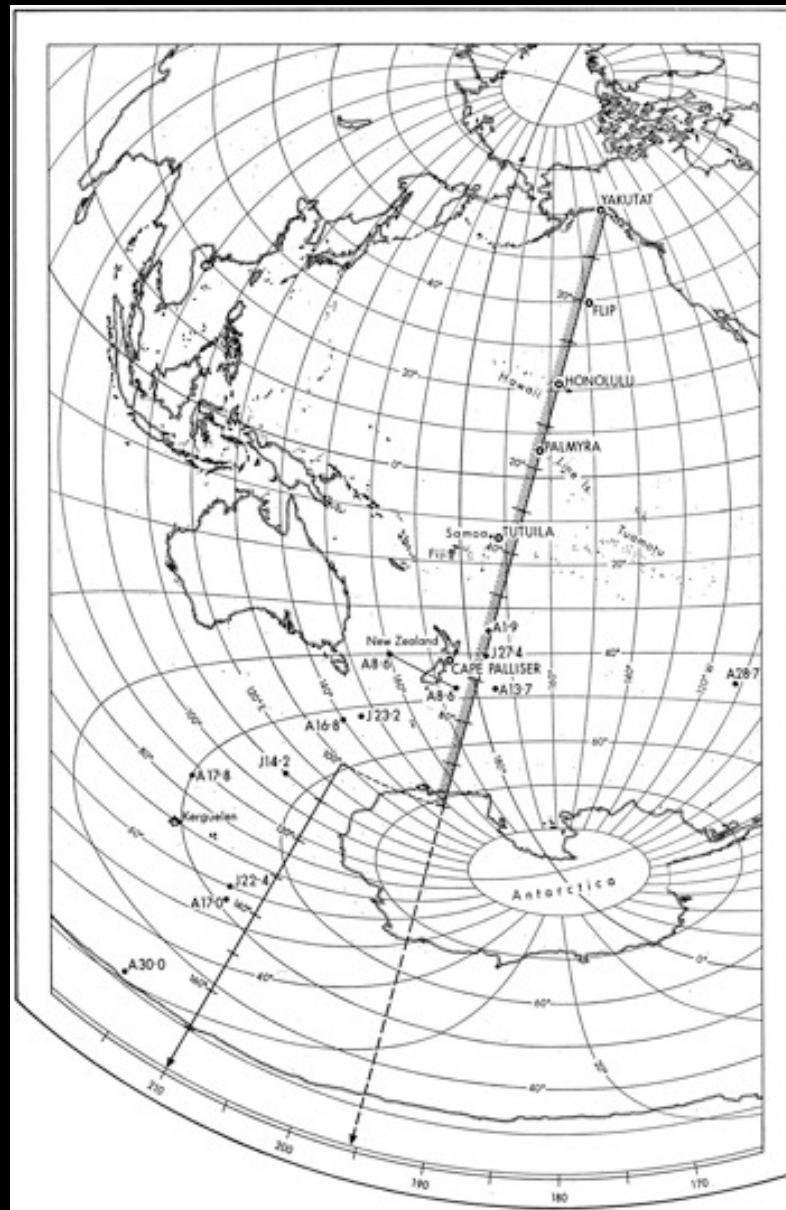


Frank Snodgrass established a triangular wave recording array on the western shores of San Clemente Island to measure the direction from which the swell is coming.



A crude attempt to draw the weather map for the 9 October, 1959 storm. The results were simple and decisive: distant sources were within a beam between 210° and 220° True, which is the angle subtended by the Antarctic to New Zealand window as seen from San Clemente.

As an example take the storm of 8 October 1959: direction 215° True, range 15,400 km from San Clemente Island. This put the center of the storm over Heard Island, an uninhabited island in the south Indian Ocean.



The stations were deployed along a 10,000 km great circle route from New Zealand to Alaska.



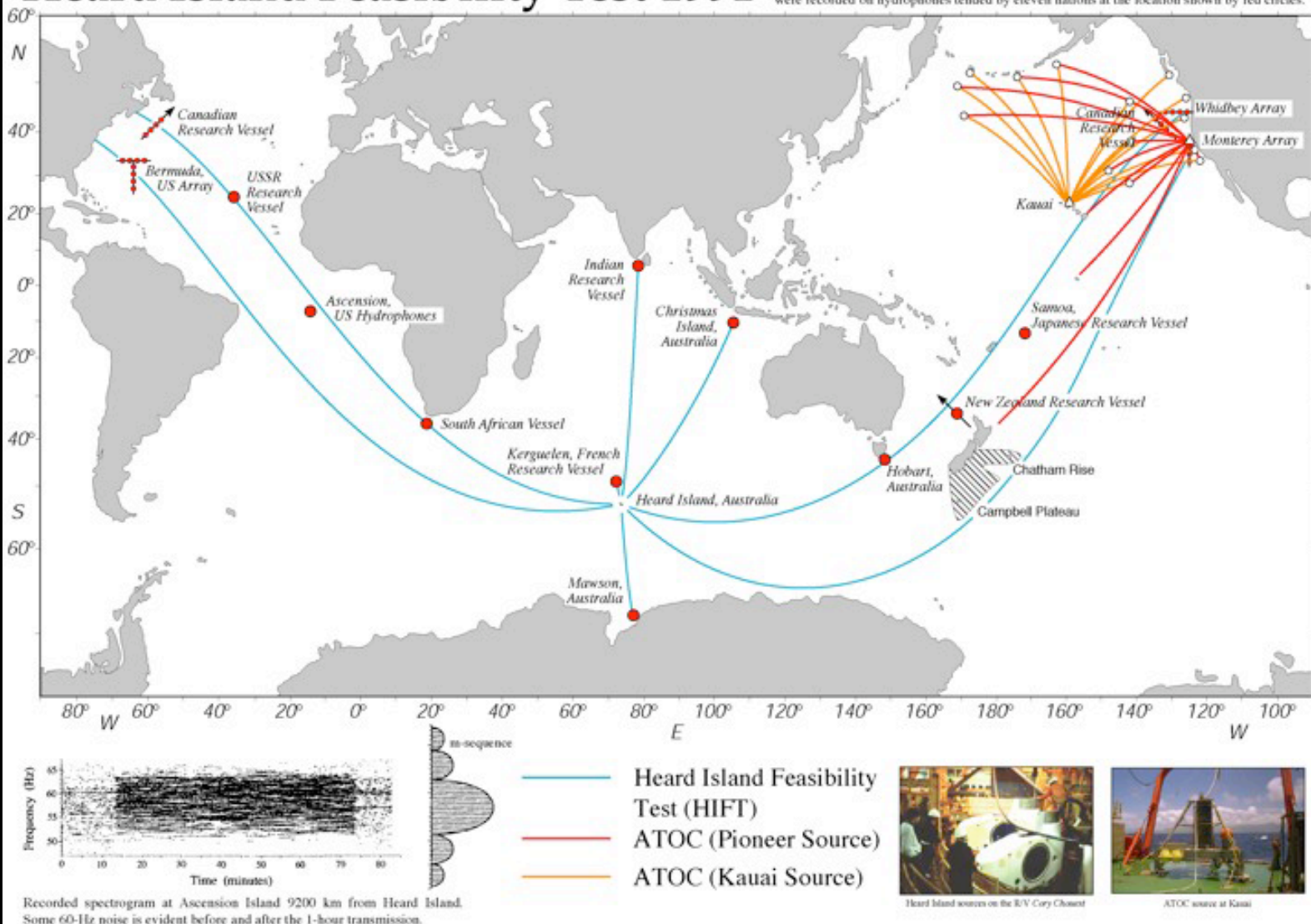
Walter and his family on Samoa in their fale on Tutuila Island, American Samoa.
By that time Judith Munk had volunteered for the 4 AM to 8 AM watch.



Upon arrival at Heard Island, we were greet by a two km high snow covered volcano, that had been climbed only once. The island is uninhabited; the huts in the foreground are used by Australian biologists during summer visits.

Heard Island Feasibility Test 1991

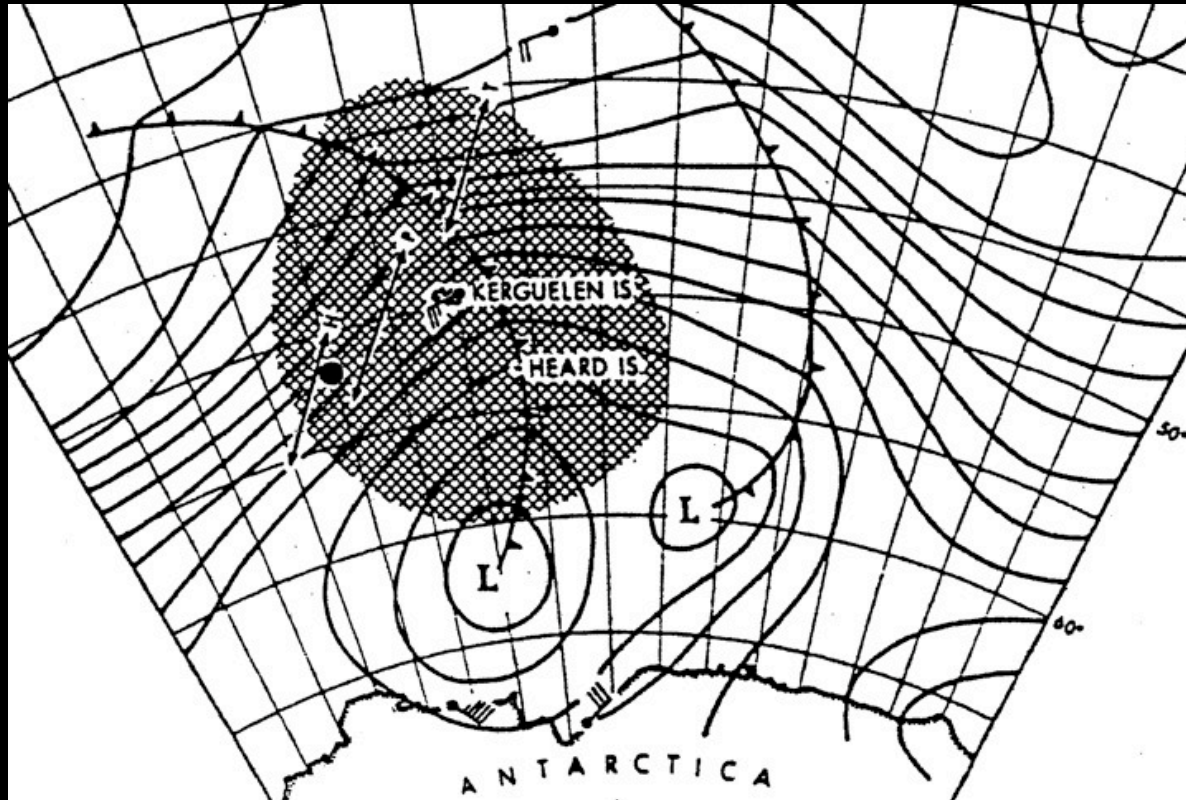
The Heard Island Feasibility Test conducted in January 1991. An acoustic source was located near Heard Island in the Southern Indian Ocean. The blue lines are refracted geodesics (great circles corrected for Earth flattening and horizontal refraction). Signals were recorded on hydrophones tended by eleven nations at the location shown by red circles.



Geodesics (great circle routes), from the Heard Island source to receivers in various ocean basins.

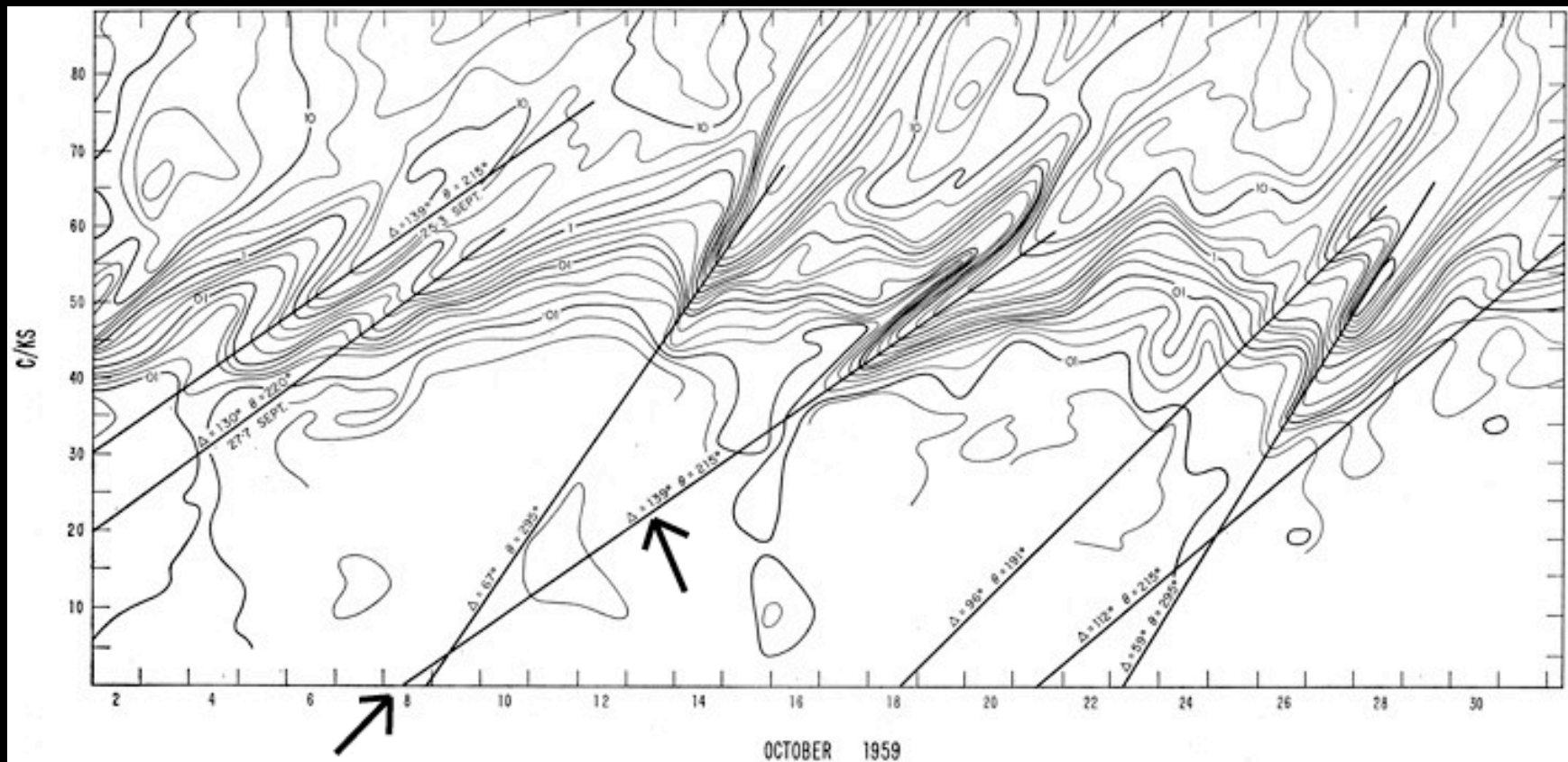


The remainder of the Corey-Chouest acoustic transmitter

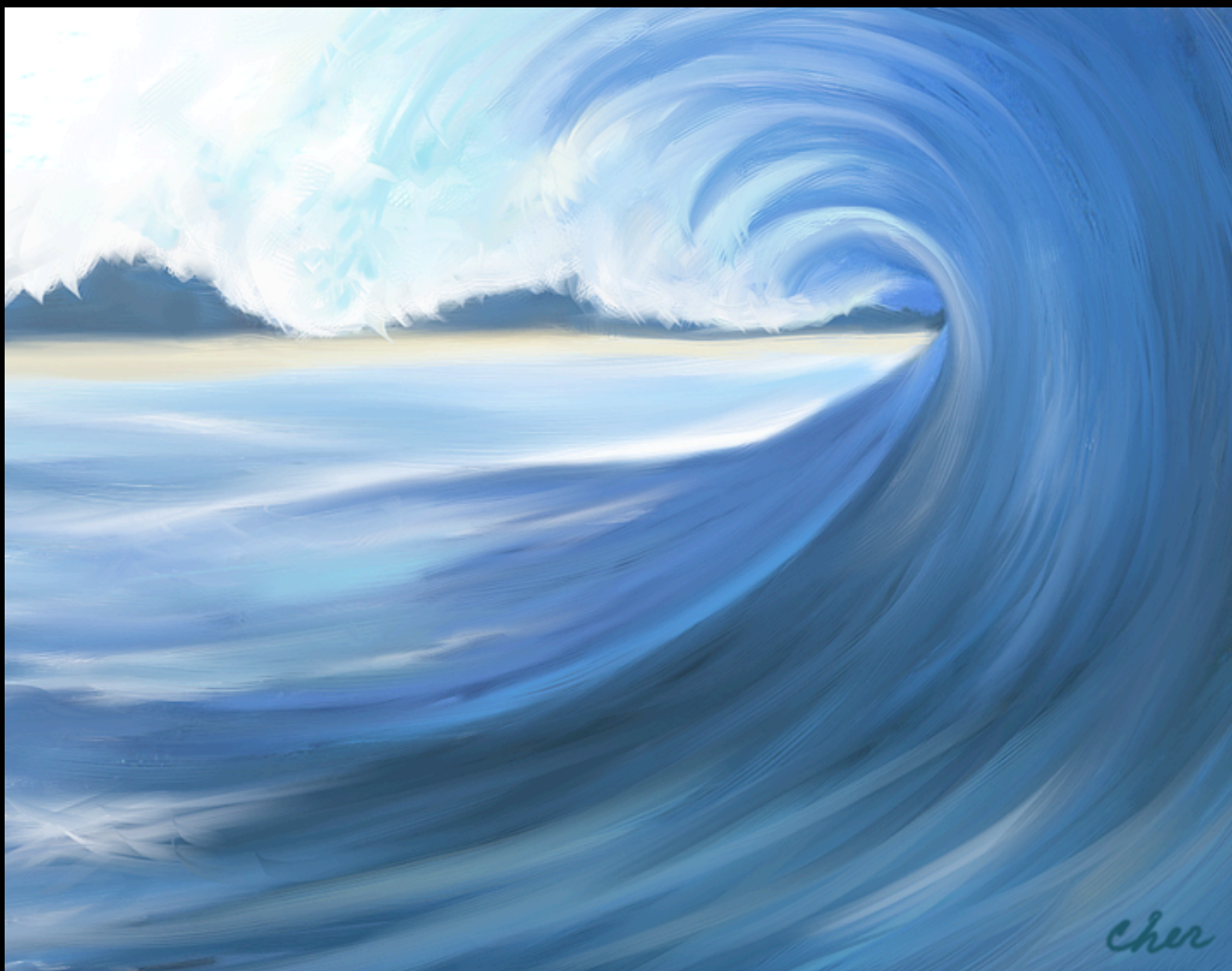


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Data from the San Clemente array showed the arrival of swells from distant storms. The storm of 8 October 1959 from direction 215° came from a distance of 15,100 km, placing the source at near Heard Island in the Indian Ocean.



In the Barrel