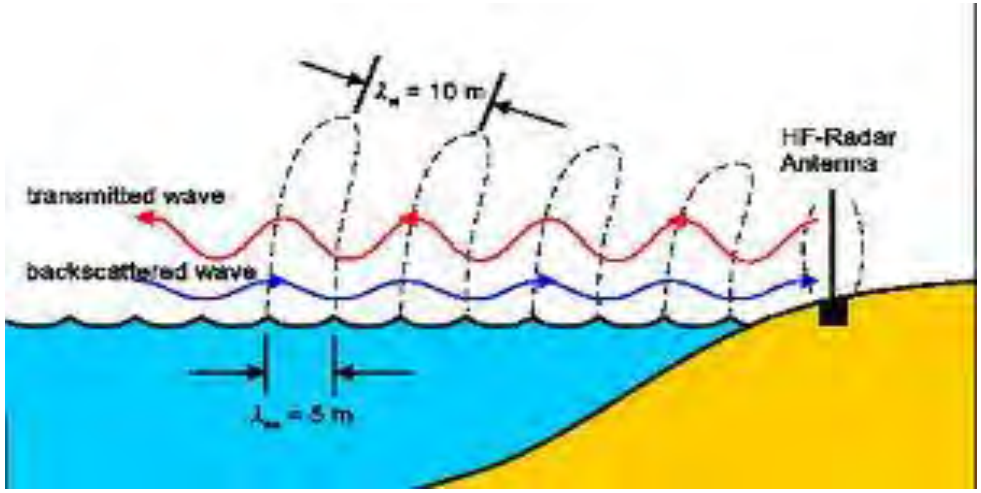
The Mexican Radar Network and ocean drifters program in the Gulf of Mexico

Xavier Flores Vidal

Autonomous University of Baja California - UABC

Background of our Radio Oceanography Laboratory



The University of Baja California started its own Radio oceanography laboratory in **2003**, operating more than 27 radar sites and 3 brands of ocean radars since then.

UABC

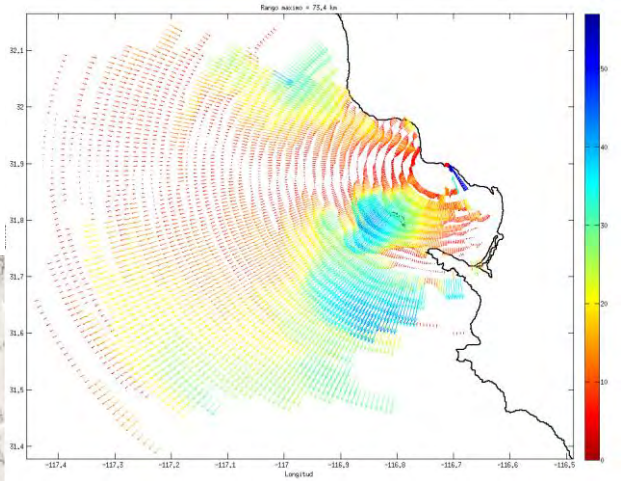
OORCo
Observatorio Oceanográfico Regional Costero

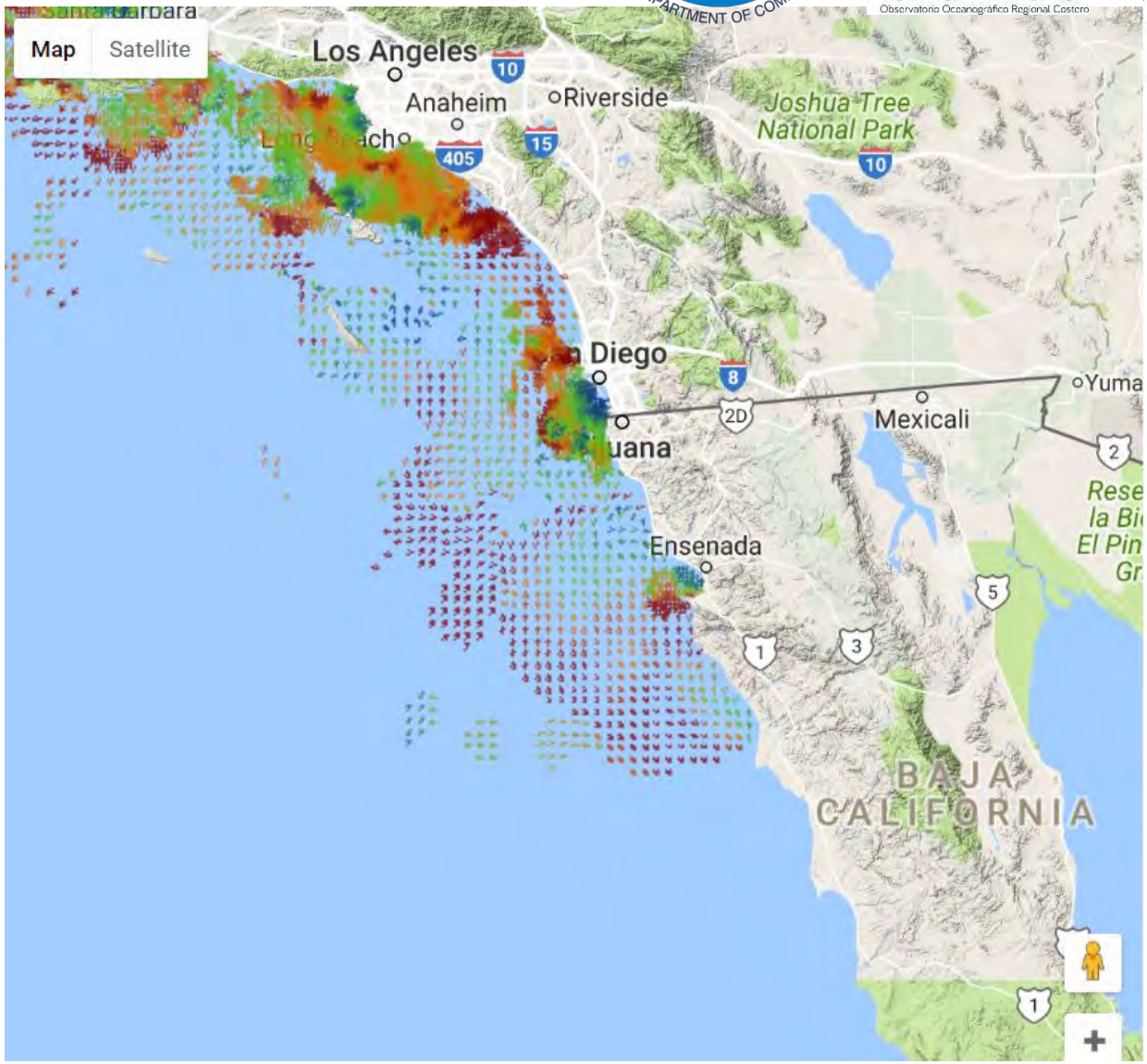
LABORATORIO DE
Radio Oceanografía

SOUTHERN CALIFORNIA COASTAL OCEAN OBSERVING SYSTEM

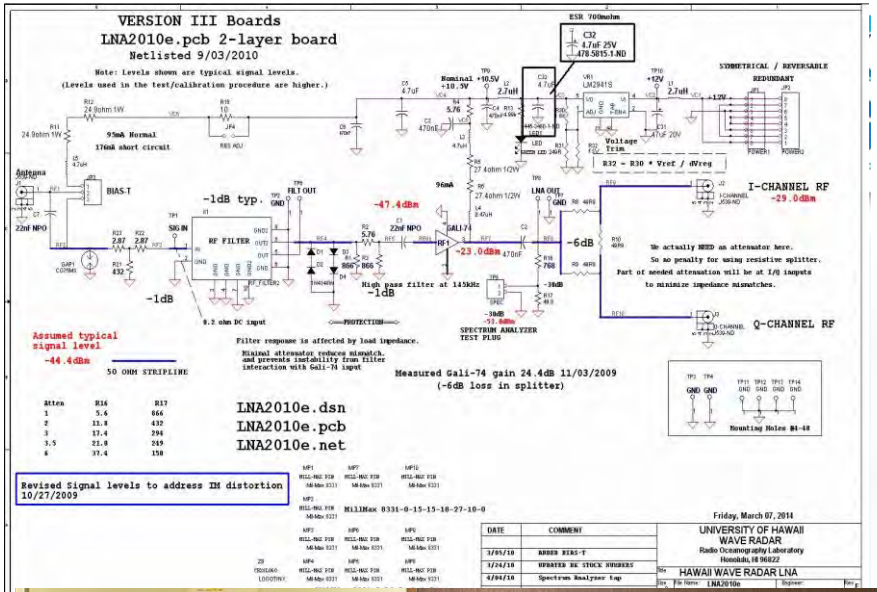
NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

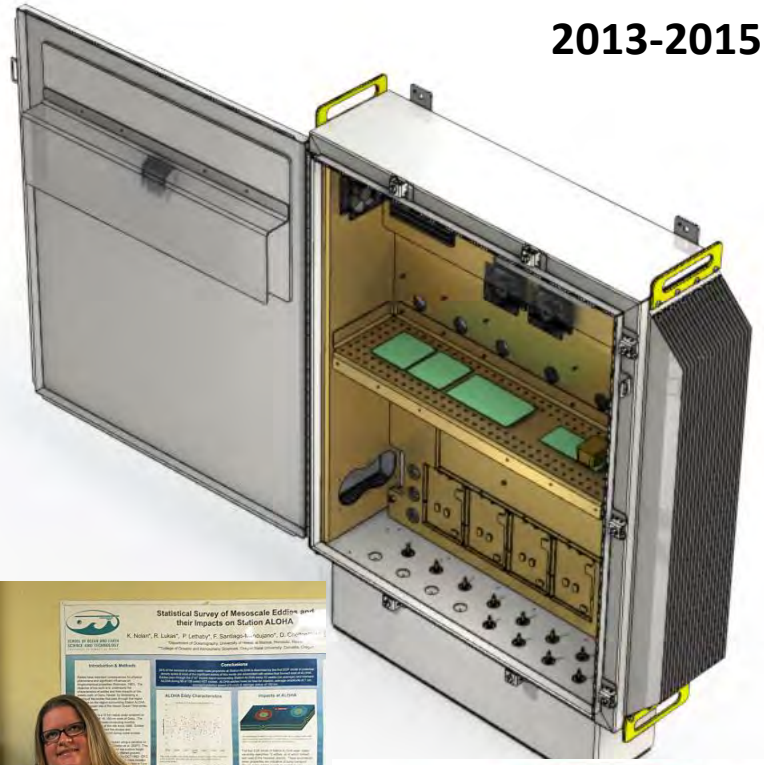
OORCo Observatorio Oceanográfico Regional Costero



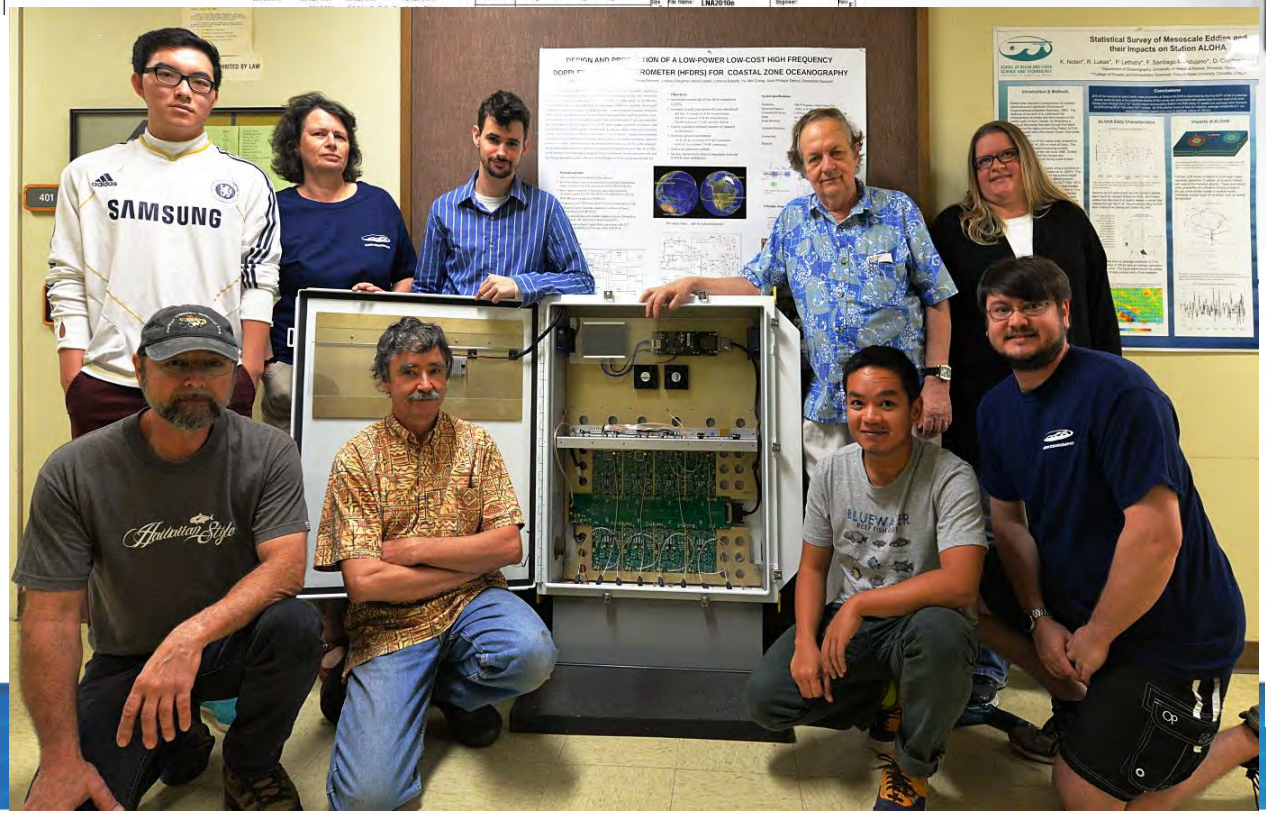


2009 – 2015 The Mexican Radar Network, shared Radial Currents (RUV files) with SCOOS





2013-2015



UNIVERSITY OF HAWAI'I
MĀLAMALAMA
1907
UA MAU KE EA O KA 'ĀINA I KA PONO
TM

LABORATORIO DE
Radio
Oceanografía

The Mexican Radio Oceanography Laboratory participated on the **construction of 22 HFR between 2016-2017**

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UNIVERSITY OF HAWAI'I
MĀLAMALAMA
UA MAU KE EA O KA 'ĀINA I KA PONO
1907
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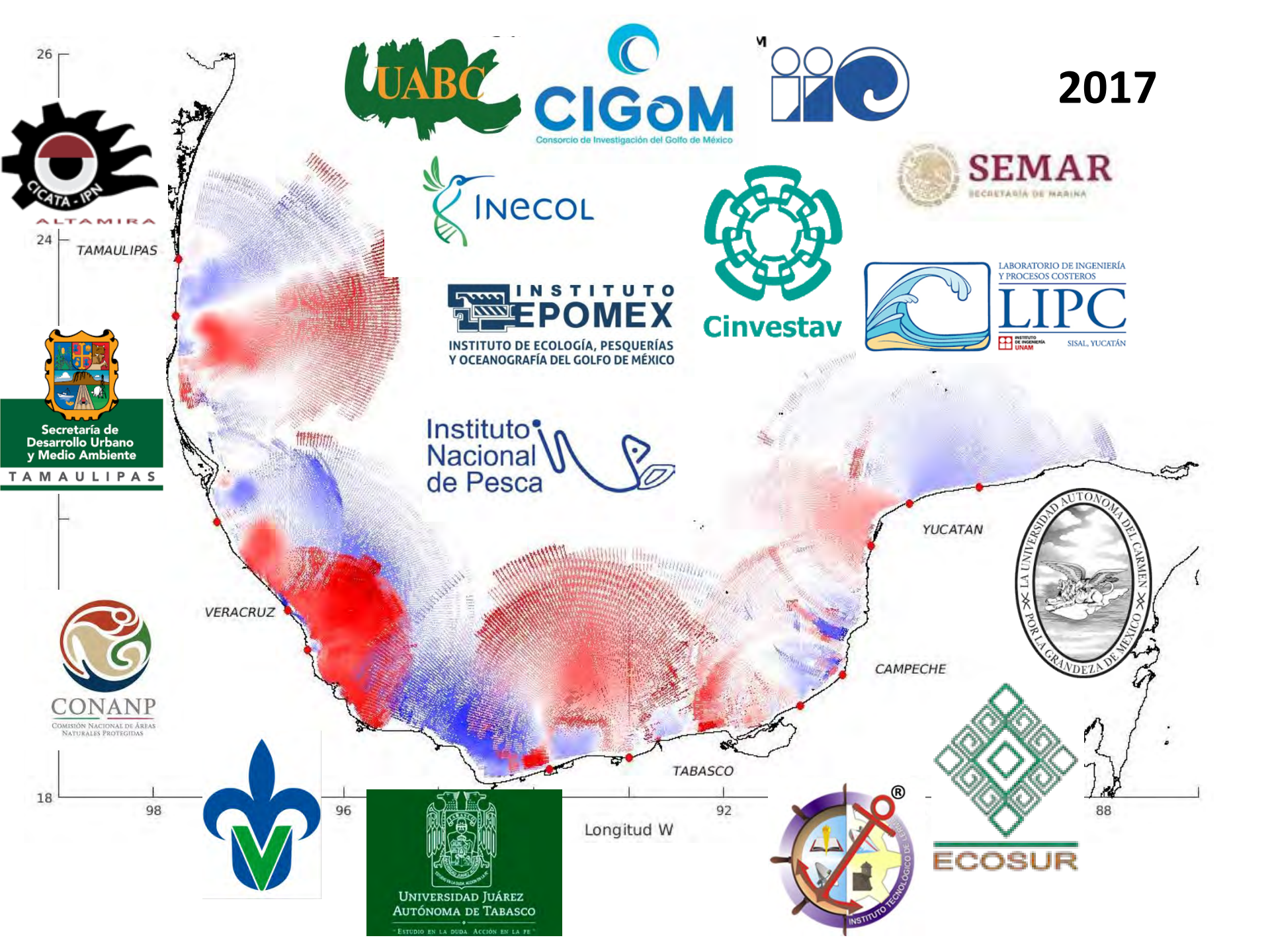
2017
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Longitud W
TAMAULIPAS
VERACRUZ
TABASCO
CAMPECHE
YUCATAN
ALTAMIRA
UABC
CIGoM
Consorcio de Investigación del Golfo de México
CICATA - IPN
INECOL
SEMAR
SECRETARÍA DE MARINA
Cinvestav
INSTITUTO EPOMEX
INSTITUTO DE ECOLOGÍA, PESQUERÍAS Y OCEANOGRAFÍA DEL GOLFO DE MÉXICO
LABORATORIO DE INGENIERÍA Y PROCESOS COSTEROS
LIPC
SISAL, YUCATÁN
Secretaría de Desarrollo Urbano y Medio Ambiente
TAMAULIPAS
Instituto Nacional de Pesca
LA UNIVERSIDAD AUTÓNOMA DEL CARMEN
POR LA GRANDEZA DE MÉXICO
CONANP
COMISIÓN NACIONAL DE ÁREAS NATURALES PROTEGIDAS
UNIVERSIDAD JUÁREZ AUTÓNOMA DE TABASCO
ESTUDIO EN LA DUDA. ACCIÓN EN LA FE
INSTITUTO TECNOLÓGICO DE
ECOSUR

UABC

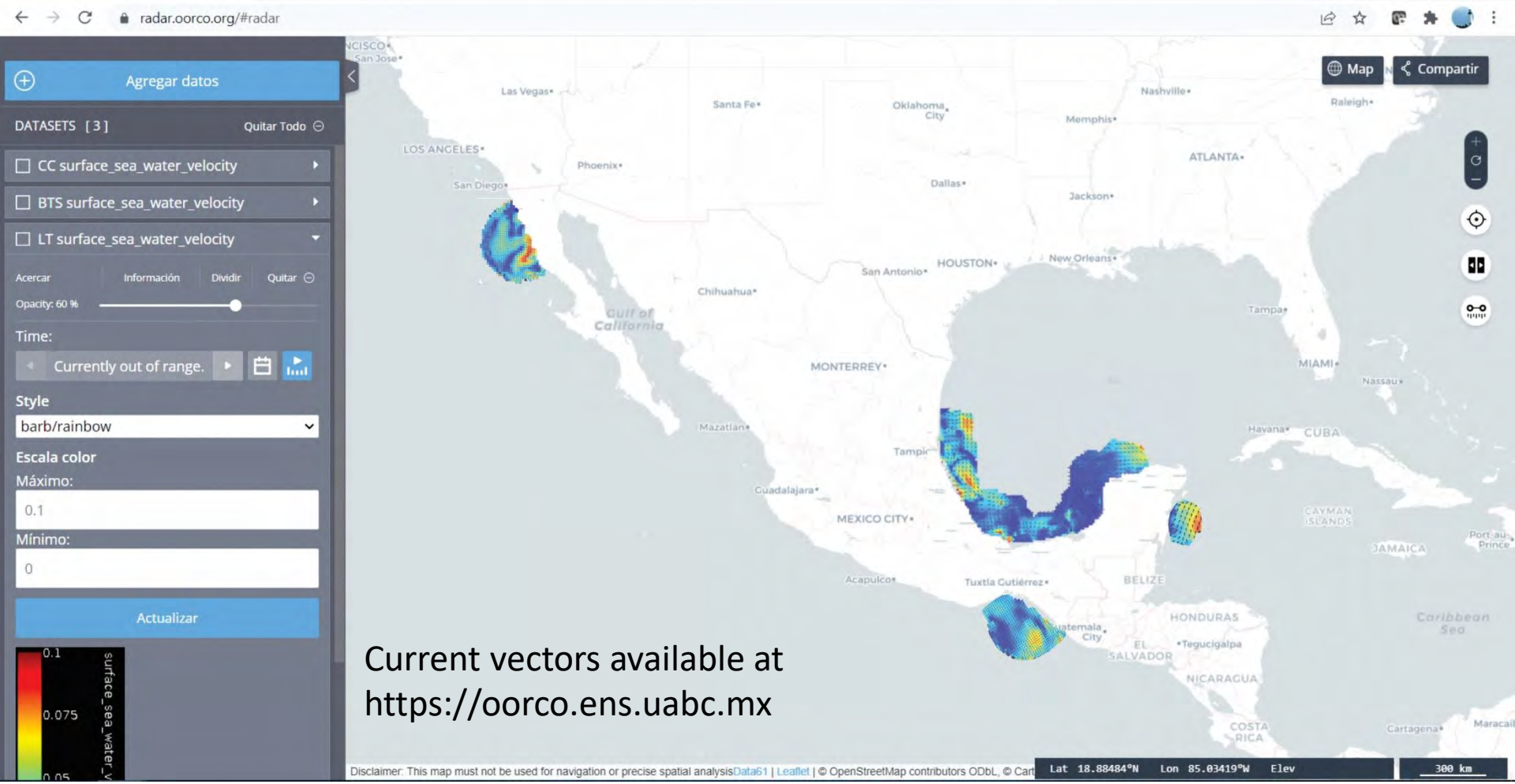
Telchac

Cinvestav

UNIVERSIDAD JUÁREZ AUTÓNOMA DE TABASCO

"ESTUDIO EN LA DUDA. ACCIÓN EN LA FE."

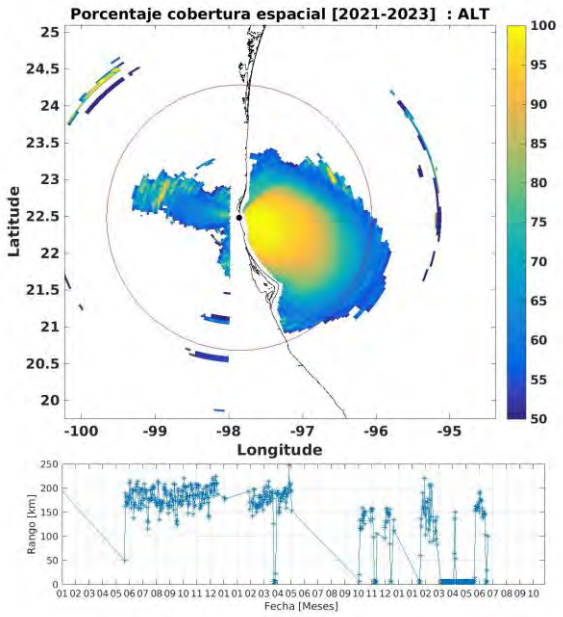
https://oorco.ens.uabc.mx/

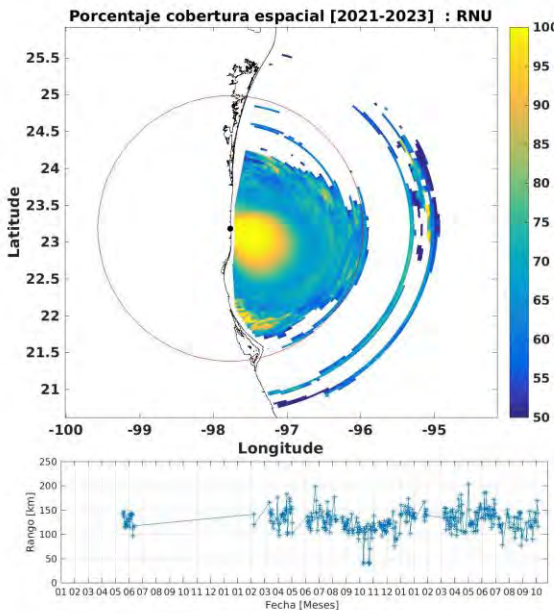


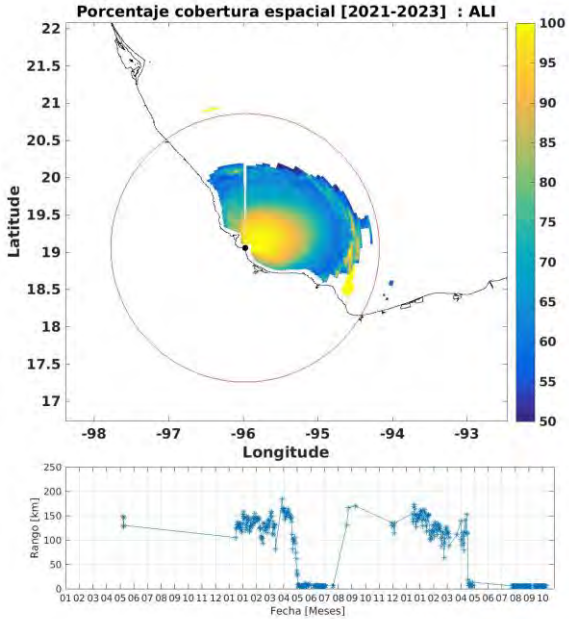
2 HFR sites at Gulf of Tehuantepec (2004-2008)
3 sites at the California Current (2003-2008, 2010-2015)
3 sites at the Todos Santos Bay (2009-2019)
2 sites at Laguna de Terminos (2017-2019)
15 sites at the Gulf of Mexico (2017-2022, 2024-) **
2 sites at the southern mexican Caribean (2021-2023)

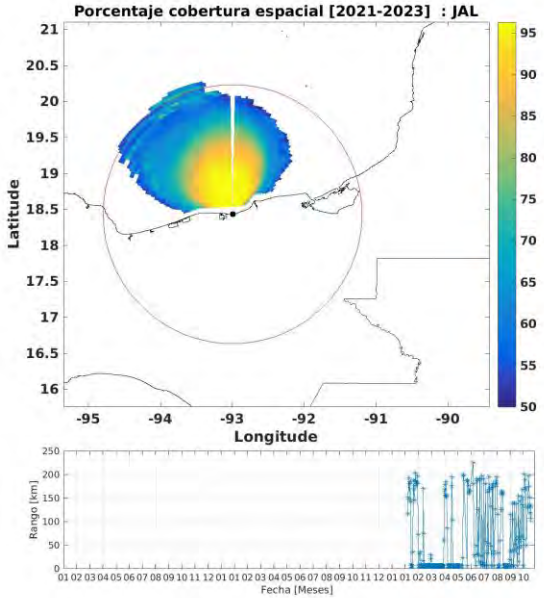
**5 radar sites operational today with a man power of 1 technicians and one PI

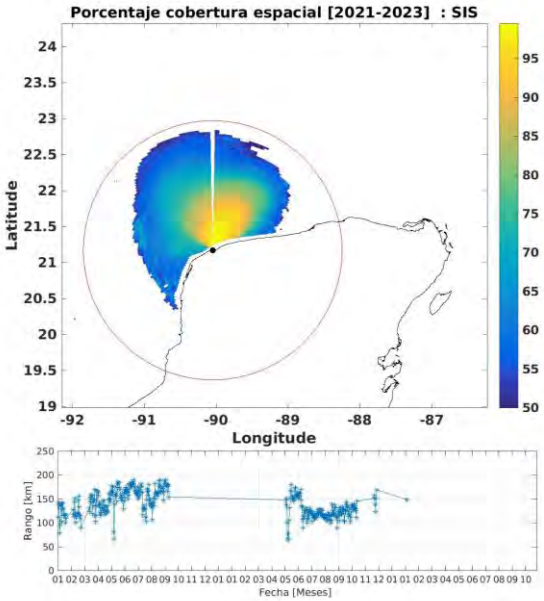
Red multi-institucional de Radares HF (2020-2023)

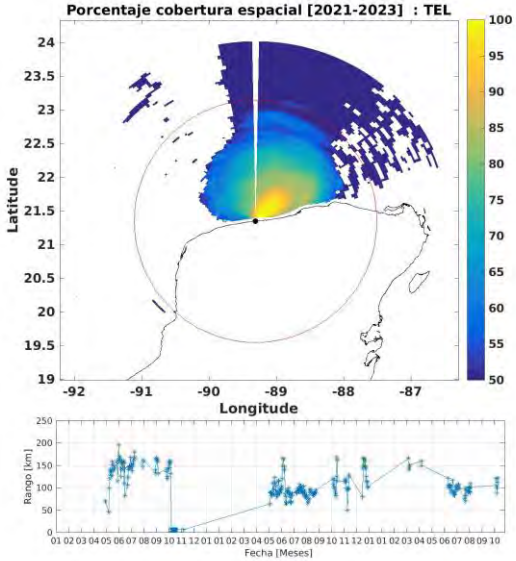


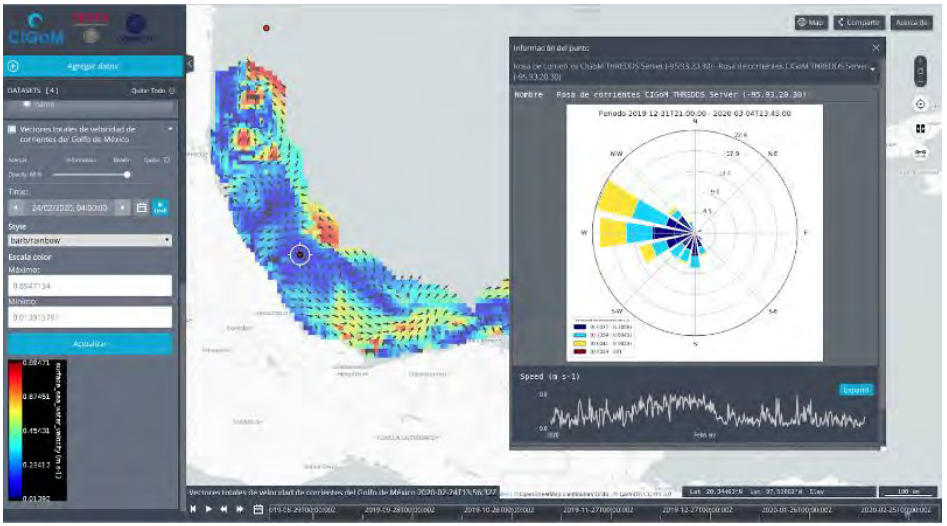








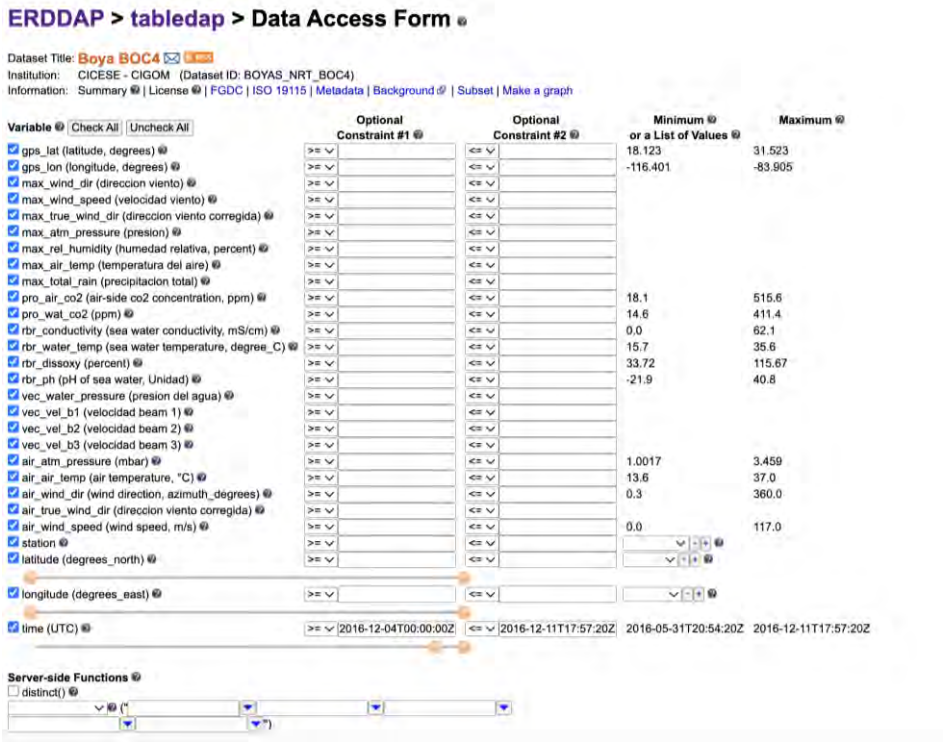




https://viz.dataserver.cigom.org

Aplicación web experta, con un mapa interactivo y un catalogo de todos los productos de datos hospedados en la plataforma.

Permite al usuario explorar visualmente los productos, tanto de manera espacial como temporal, y cargar datos locales o remotos de otras plataformas estándar.



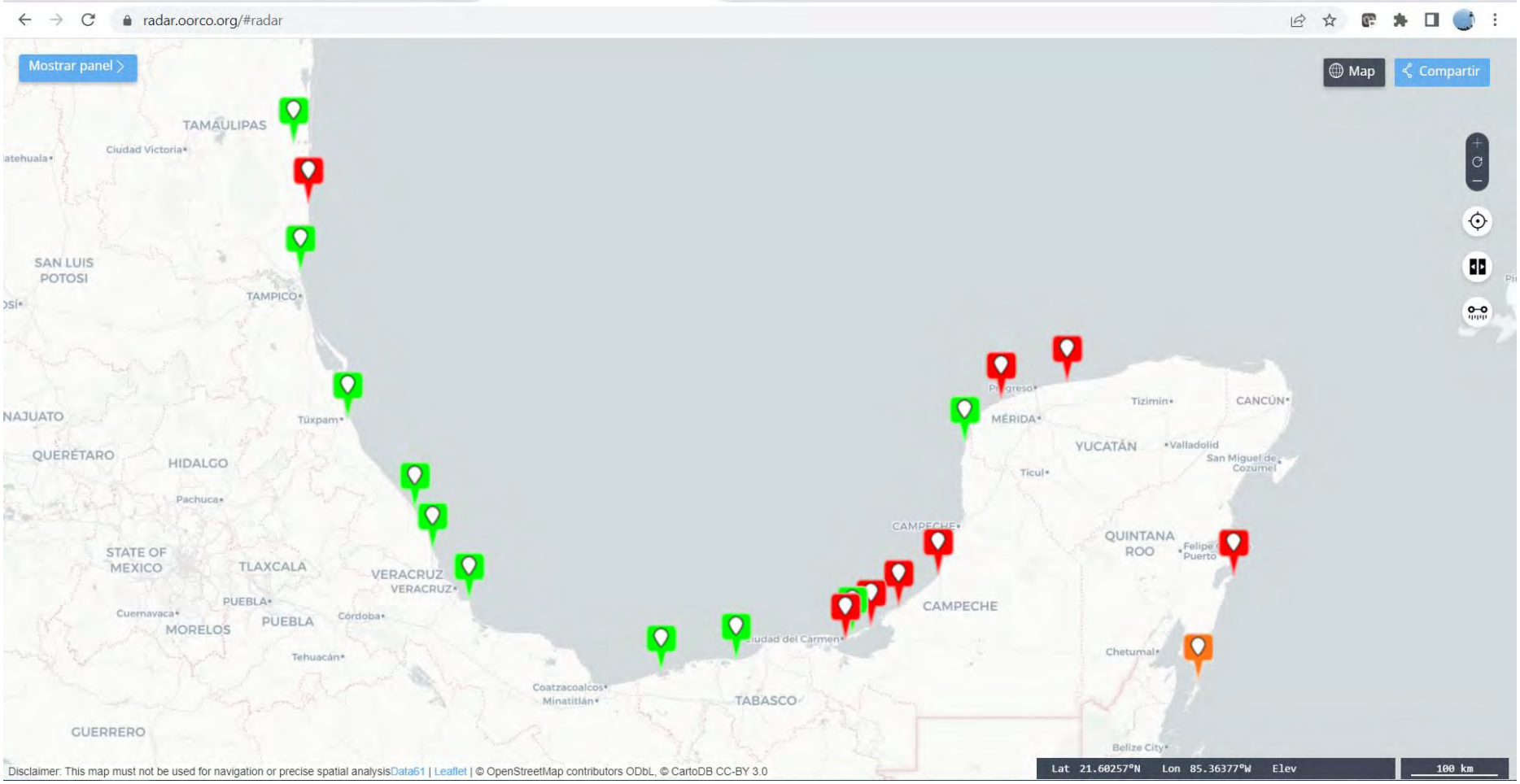
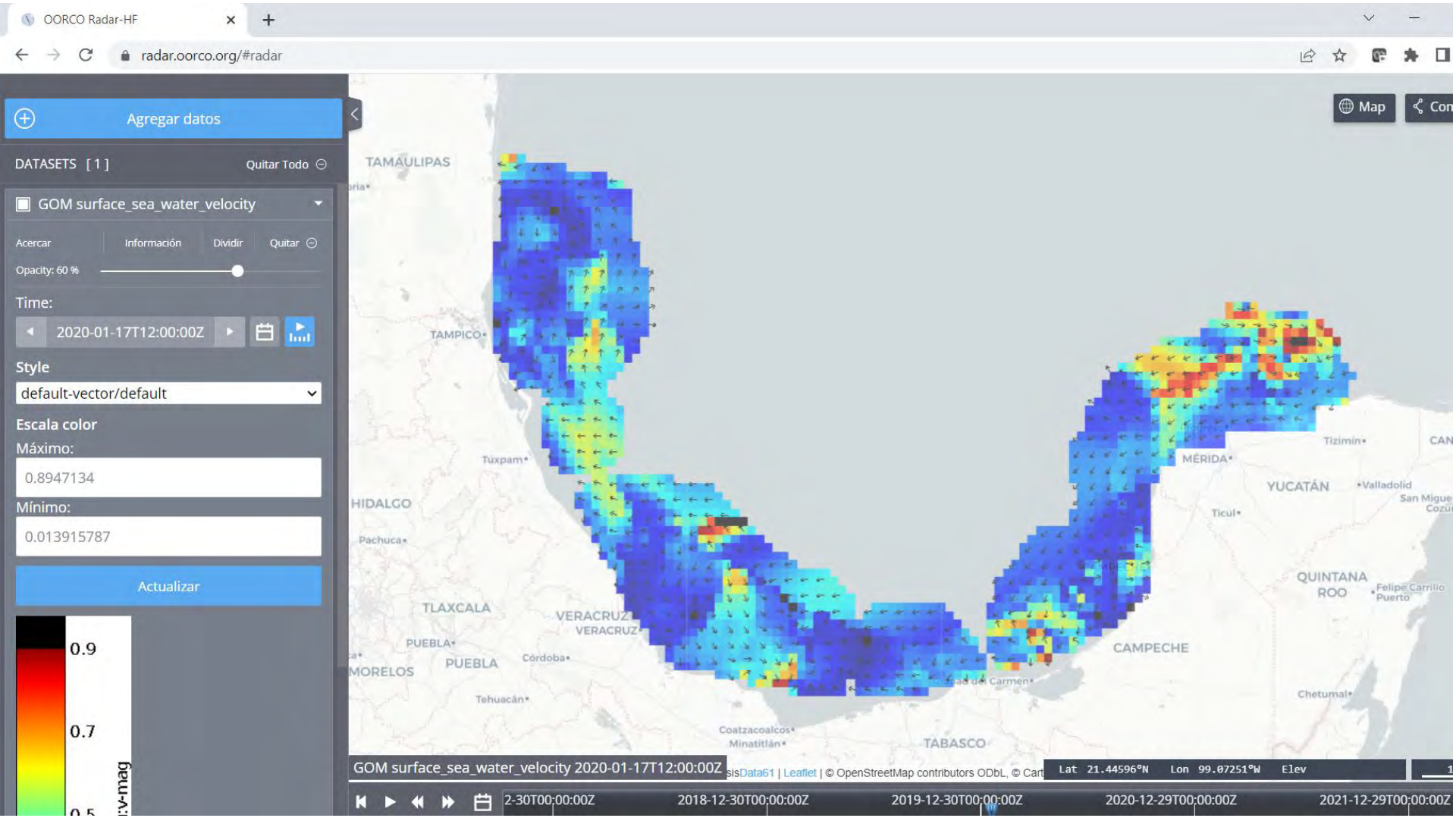
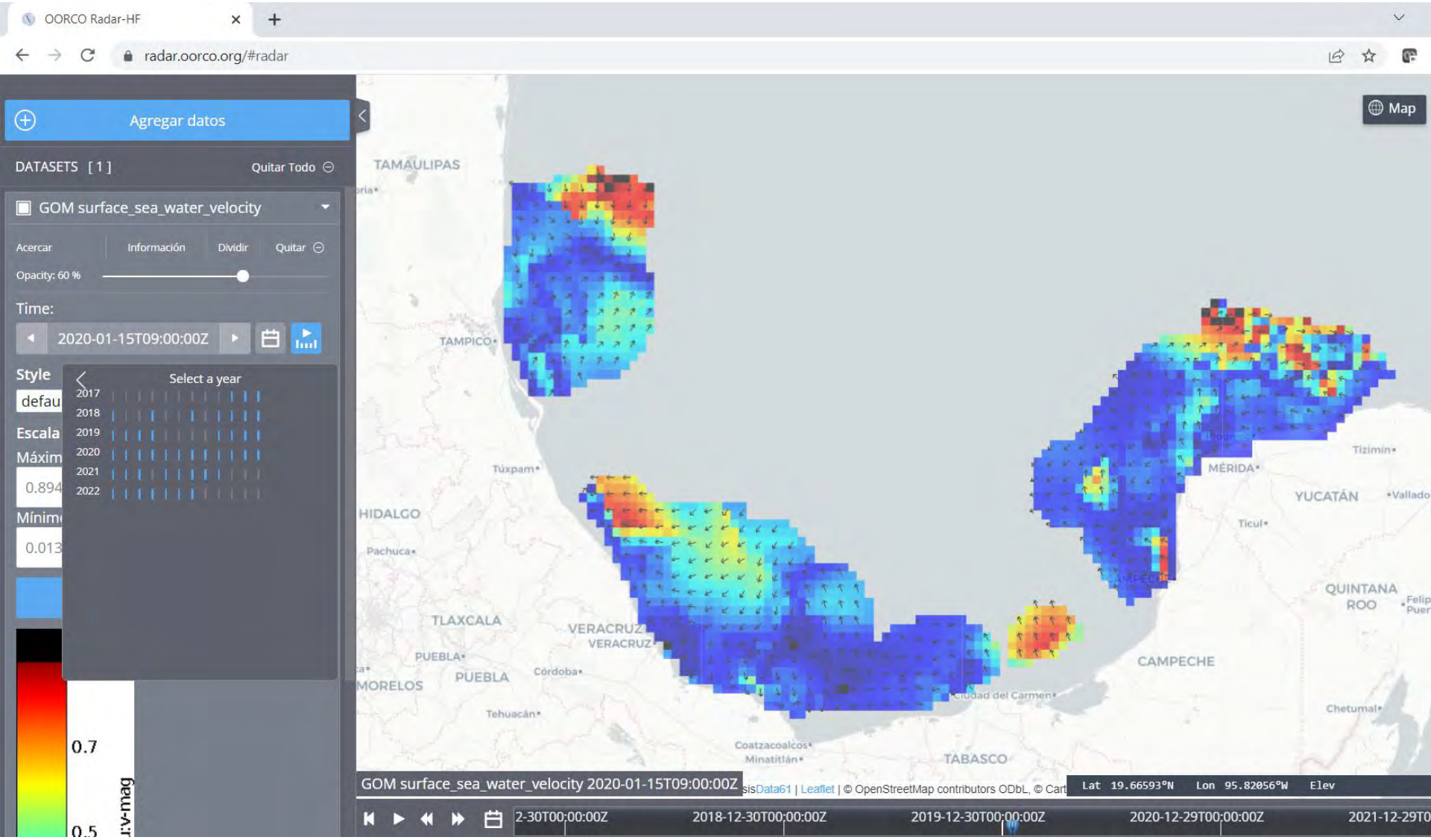

radar.oorco.org/#radar
Mostrar panel
Map
Compartir
TAMAULIPAS
Ciudad Victoria
SAN LUIS POTOSI
TAMPICO
Túxpam
QUERÉTARO
HIDALGO
Pachuca
STATE OF MEXICO
TLAXCALA
PUEBLA
Cuernavaca
MORELOS
Córdoba
Tehuacán
VERACRUZ
GUERRERO
Coatzacoalcos
Minatitlán
TABASCO
Ciudad del Carmen
CAMPECHE
MÉRIDA
Progreso
Tizimín
CANCÚN
YUCATÁN
Valladolid
Ticul
San Miguel de Cozumel
QUINTANA ROO
Chetumal
Belize City
Disclaimer: This map must not be used for navigation or precise spatial analysisData61 | Leaflet | © OpenStreetMap contributors ODbL, © CartoDB CC-BY 3.0
Lat 21.60257°N Lon 85.36377°W Elev
100 km

Figura 18. Pantalla que muestra la herramienta de visualización de corrientes marinas superficiales obtenidas de forma

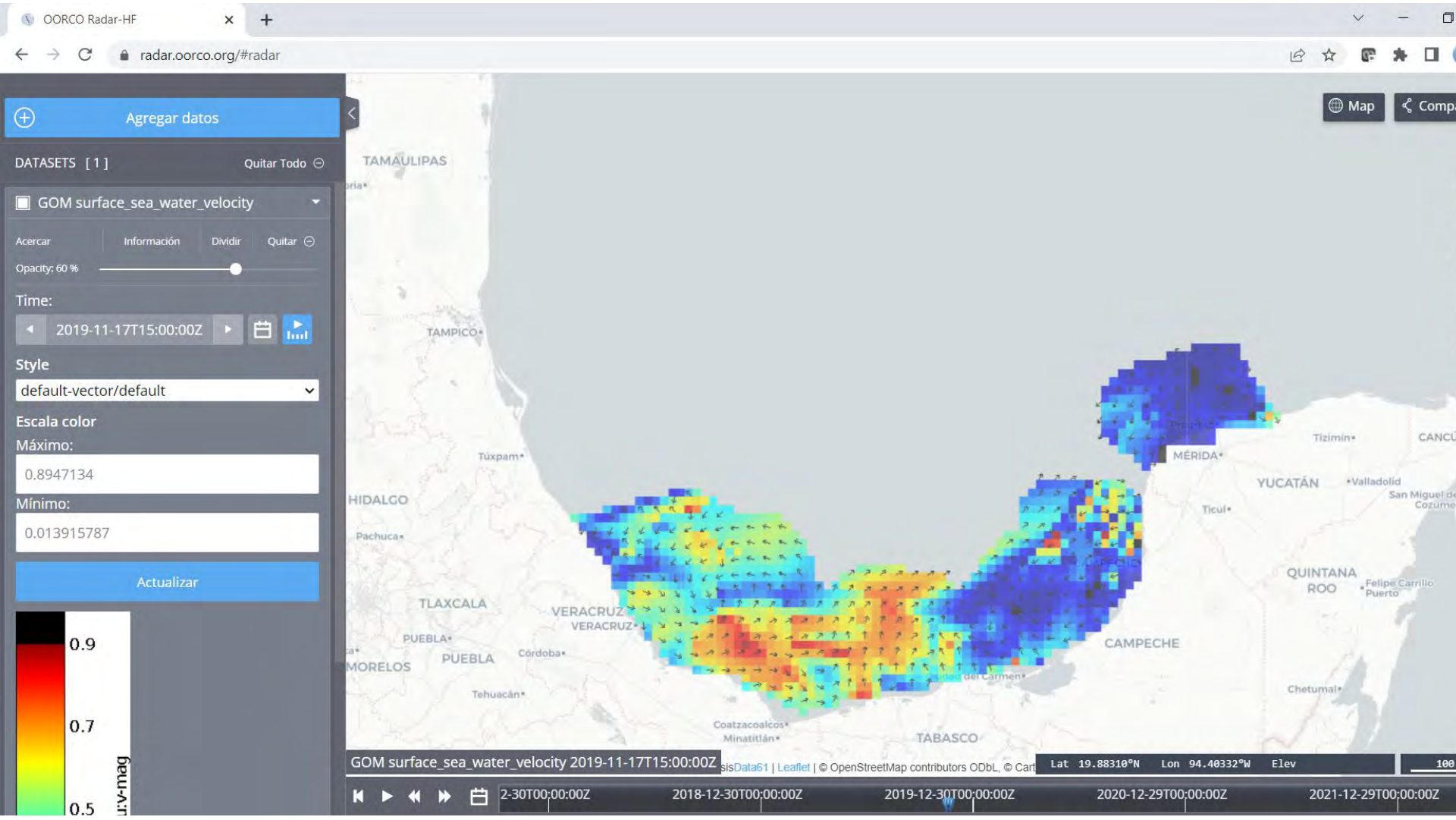
100% de los sitios operando



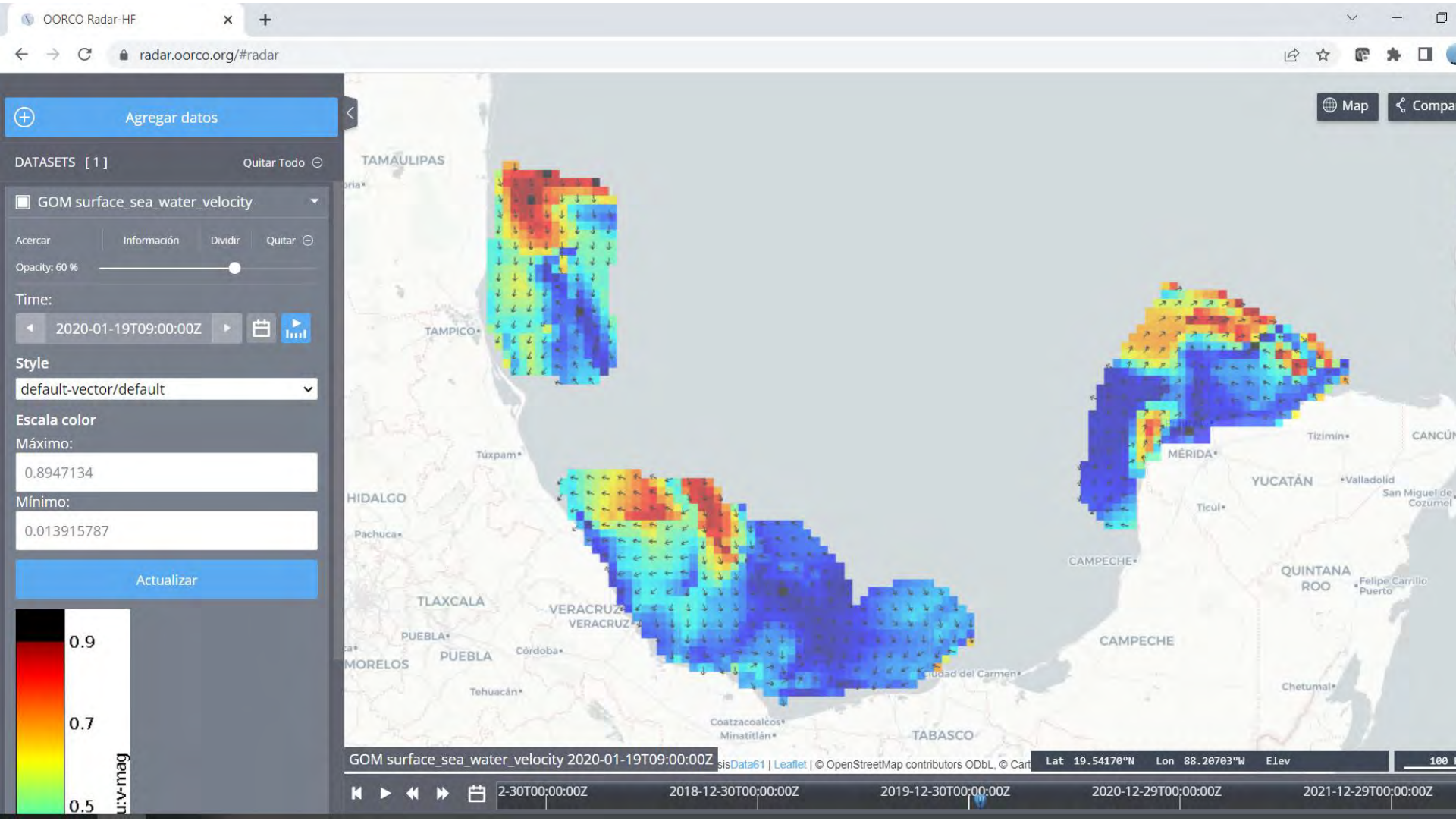
https://orco.ens.uabc.mx



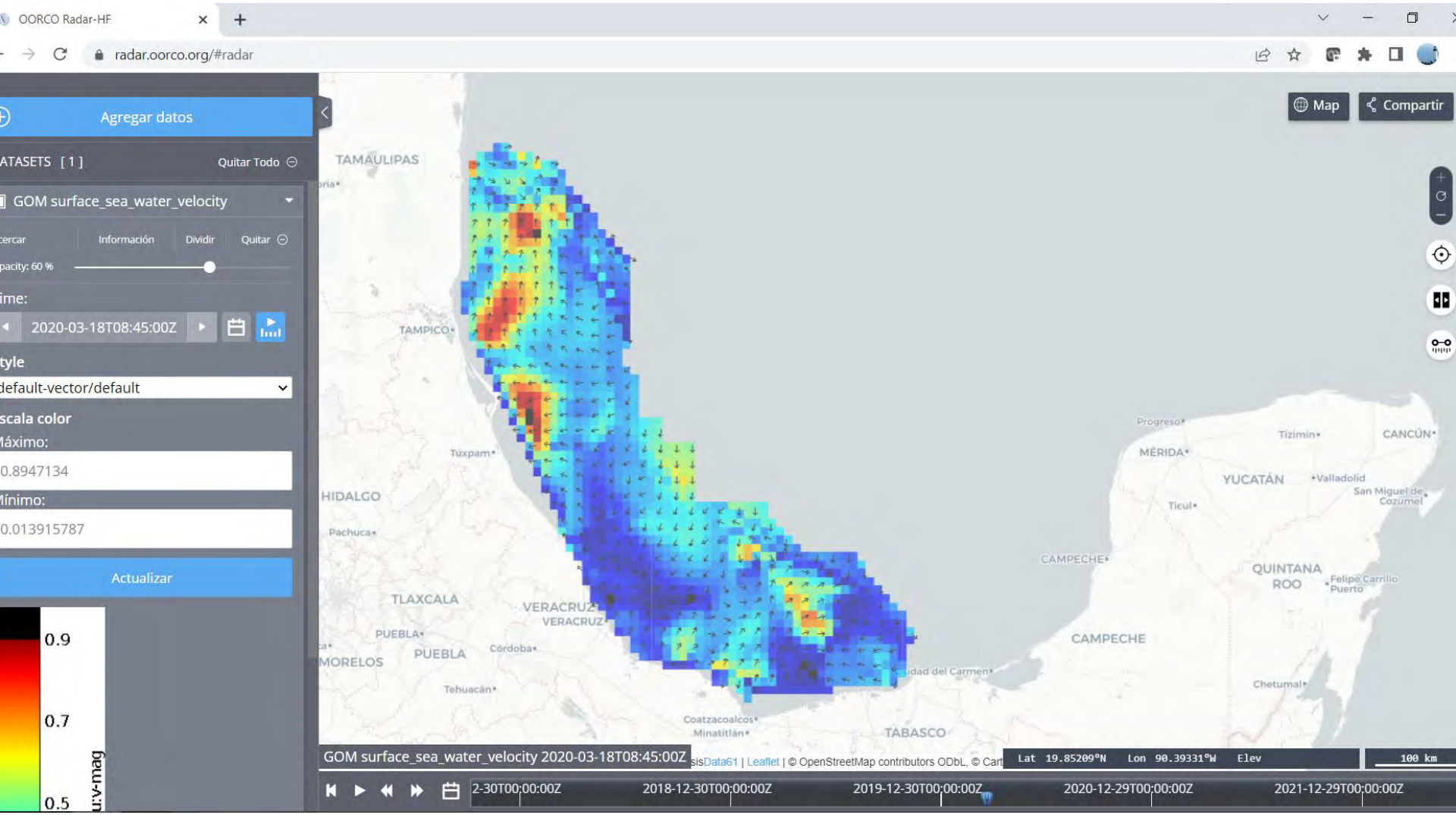
50-60% de los sitios operando



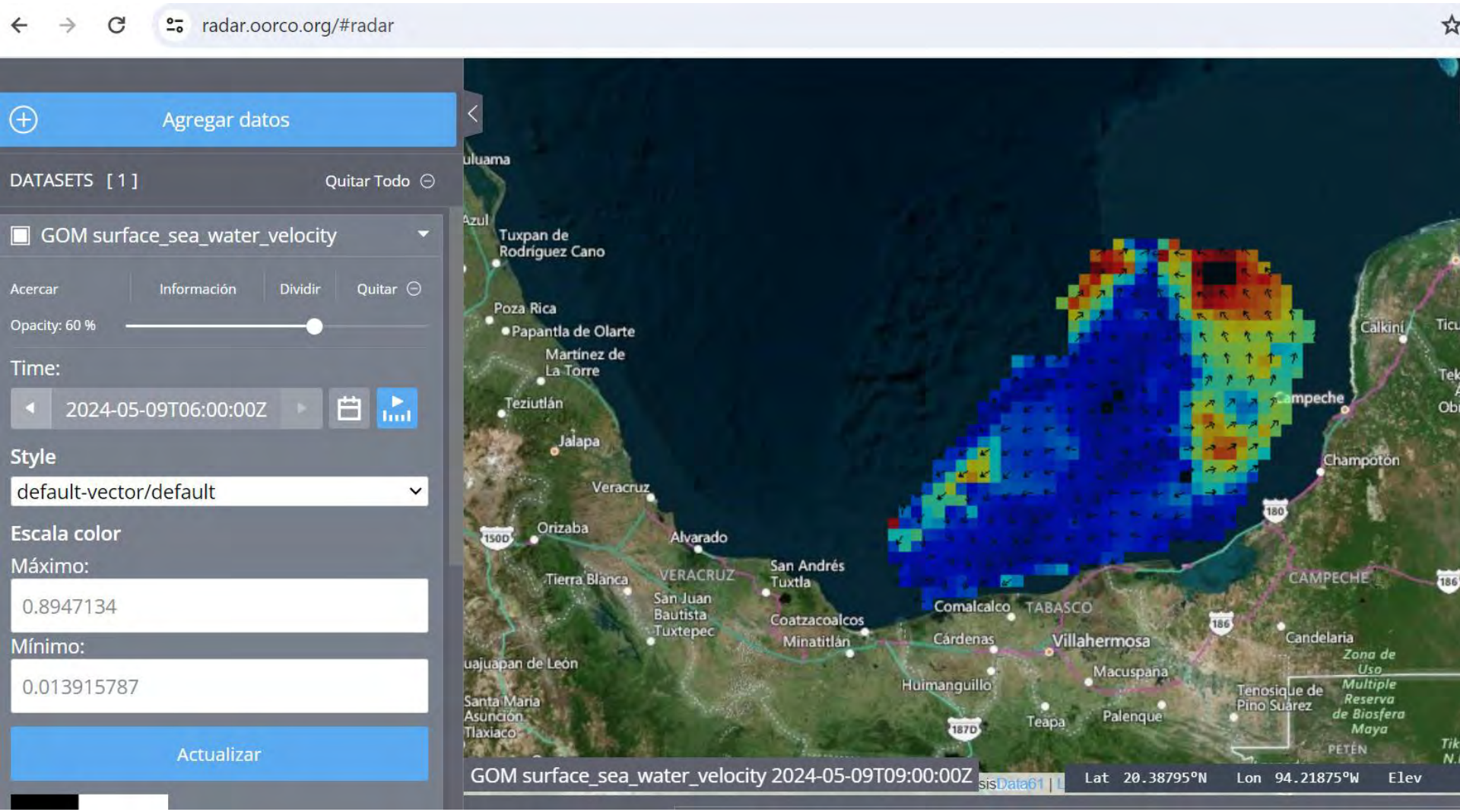
50-60% de los sitios operando

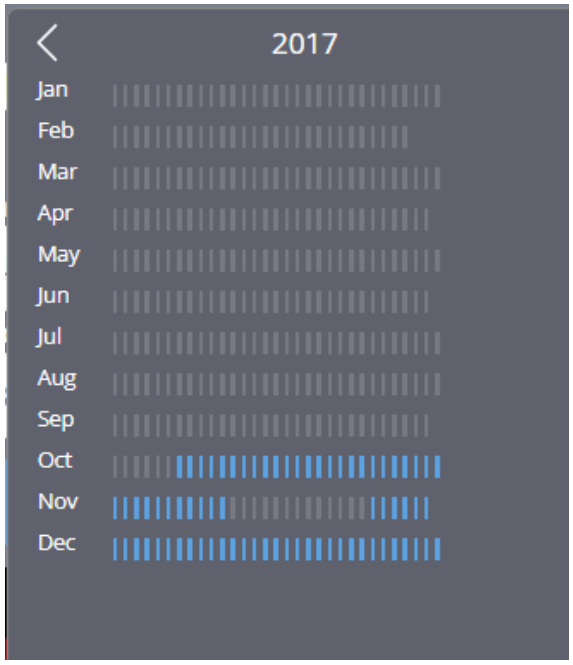


50% de los sitios operando



This morning

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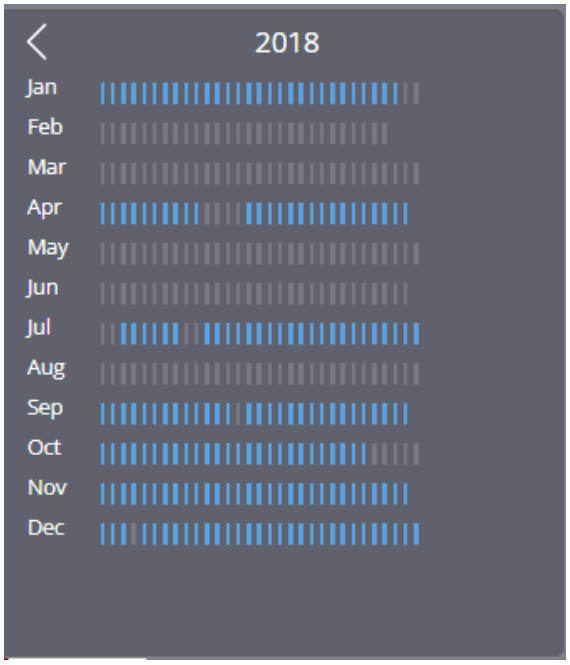
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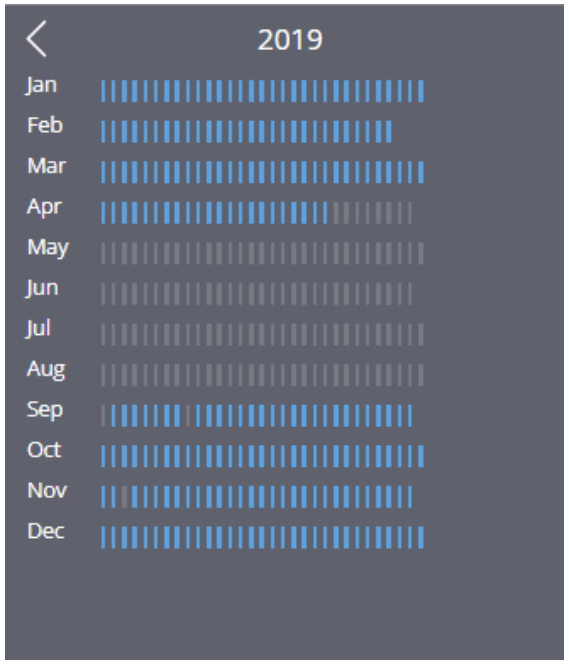
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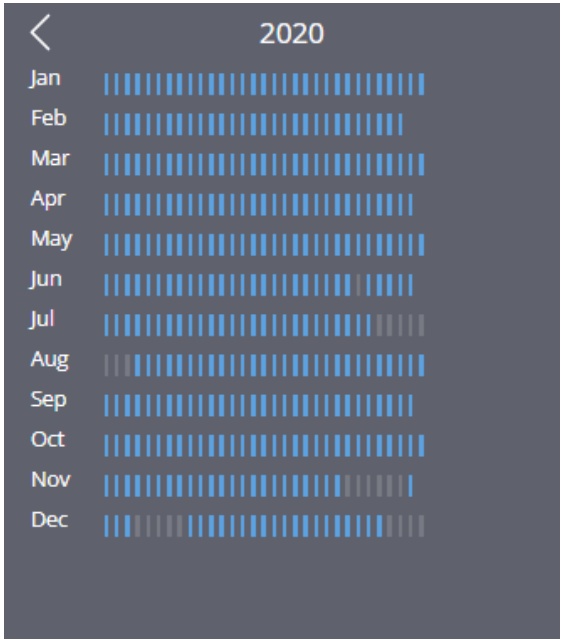
2020
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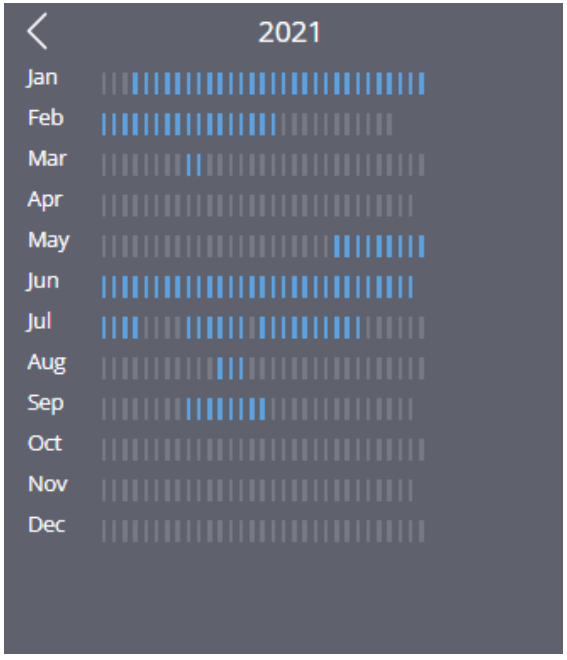
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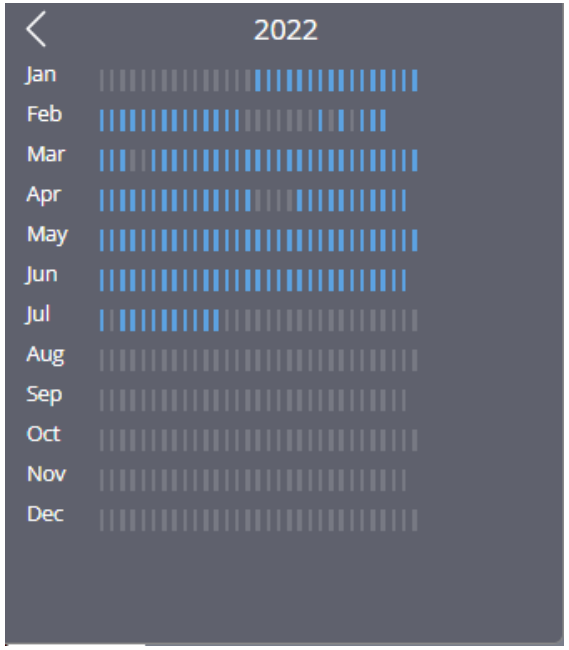
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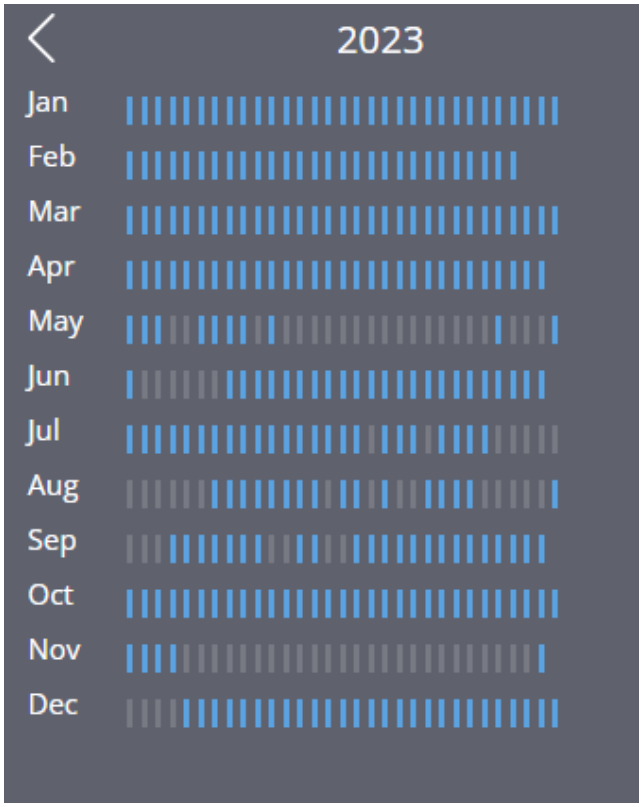
2023
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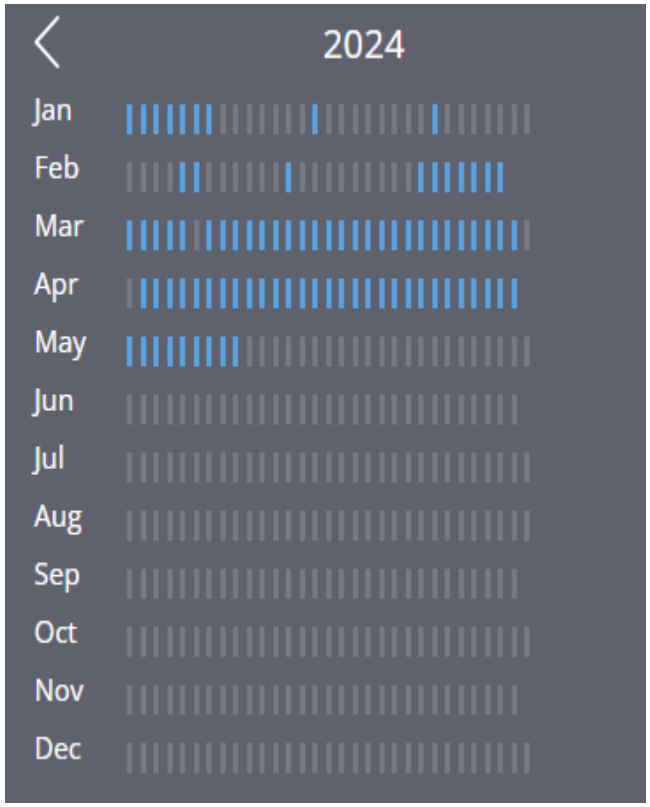
2024
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The Mexican Radar Network, has its own data management system (https://oorco.ens.uabc.mx) using world wide standards:

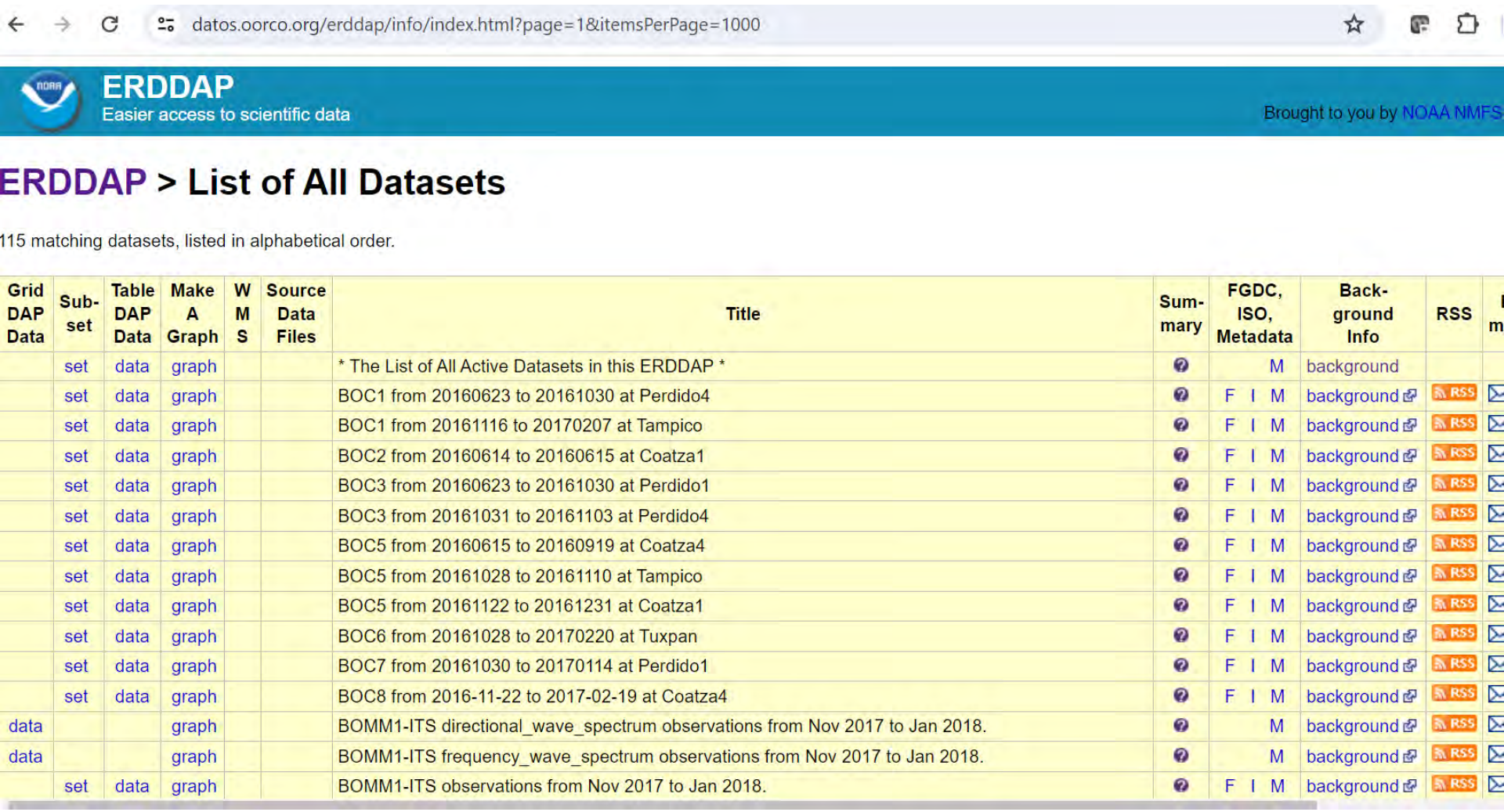
Data format for storage is **NetCDF4** format with metadata and structure adhered to the **Climate & Forecast conventions**.
Distribution now is thru, **ERDDAP** and **THREDDS** data servers, which provide web interfaces for users, as well as standard protocols, such as **OpenDAP**, **OGC-WMS**, among others.
With the intention of making the information more accessible to users, a web application for interactive visualization was deployed, where geospatial data layers are presented on a map. These graphical representations are dynamically generated on request from **THREDDS** or **ERRDAP** servers.

All the software was developed is using open source libraries.

Netcdf https://www.unidata.ucar.edu/software/netcdf/
Climate & Forecast http://cfconventions.org/
OpenDAP https://www.opendap.org/
OGC-WMS https://www.ogc.org/standards/wms
Thredds https://www.unidata.ucar.edu/software/tds/current/
ERDDAP https://coastwatch.pfeg.noaa.gov/erddap/download/setup.html
TerriaJS https://terria.io/
Go Fair https://www.go-fair.org/

https://datos.oorco.org/thredds/catalog.html

https://datos.oorco.org/erddap



Grid DAP Data	Sub-set	Table DAP Data	Make A Graph	WMS	Source Data Files	Title	Sum-mary	FGDC, ISO, Metadata	Back-ground Info	RSS	m
	set	data	graph			* The List of All Active Datasets in this ERDDAP *		M	background		
	set	data	graph			BOC1 from 20160623 to 20161030 at Perdido4		F I M	background	RSS	
	set	data	graph			BOC1 from 20161116 to 20170207 at Tampico		F I M	background	RSS	
	set	data	graph			BOC2 from 20160614 to 20160615 at Coatza1		F I M	background	RSS	
	set	data	graph			BOC3 from 20160623 to 20161030 at Perdido1		F I M	background	RSS	
	set	data	graph			BOC3 from 20161031 to 20161103 at Perdido4		F I M	background	RSS	
	set	data	graph			BOC5 from 20160615 to 20160919 at Coatza4		F I M	background	RSS	
	set	data	graph			BOC5 from 20161028 to 20161110 at Tampico		F I M	background	RSS	
	set	data	graph			BOC5 from 20161122 to 20161231 at Coatza1		F I M	background	RSS	
	set	data	graph			BOC6 from 20161028 to 20170220 at Tuxpan		F I M	background	RSS	
	set	data	graph			BOC7 from 20161030 to 20170114 at Perdido1		F I M	background	RSS	
	set	data	graph			BOC8 from 2016-11-22 to 2017-02-19 at Coatza4		F I M	background	RSS	
data			graph			BOMM1-ITS directional_wave_spectrum observations from Nov 2017 to Jan 2018.		M	background	RSS	
data			graph			BOMM1-ITS frequency_wave_spectrum observations from Nov 2017 to Jan 2018.		M	background	RSS	
	set	data	graph			BOMM1-ITS observations from Nov 2017 to Jan 2018.		F I M	background	RSS	

ERDDAP
Easier access to scientific data

ERDDAP > griddap > Make A Graph

Dataset Title: **Red Mexicana de Radares Oceanograficos 3 horas** RSS
Institution: UABC.EDU (Dataset ID: RADMEX_GM_10km_3hr)
Information: Summary | License | FGDC | ISO 19115 | Metadata | Background | Data Access Form

Graph Type: surface
X Axis: longitude
Y Axis: latitude
Color: v

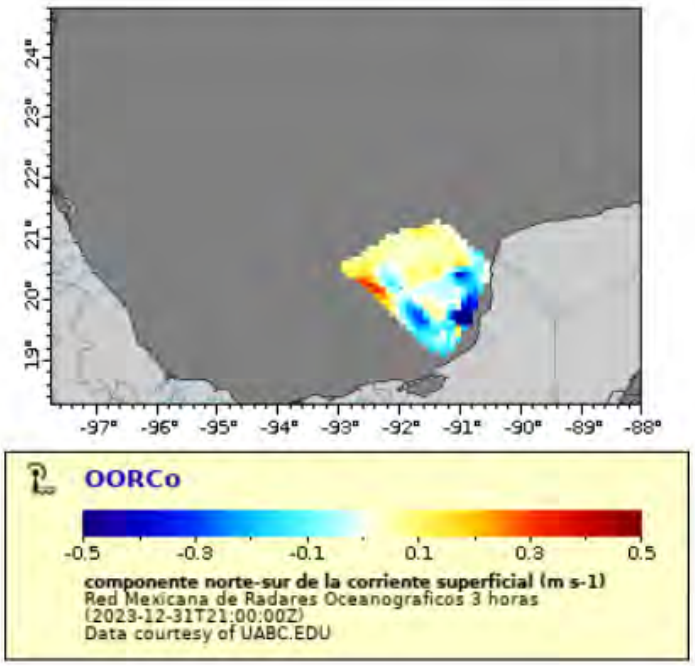
Dimensions | **Start** | **Stop**
time (UTC) | specify just 1 value → | 2023-12-31T21:00:00Z
latitude (degrees_north) | 18.27273 | 24.81818
longitude (degrees_east) | -97.72727 | -88.0

Graph Settings
Color Bar: | Continuity: | Scale:
Minimum: | Maximum: | N Sections:
Draw land mask:
Y Axis Minimum: | Maximum: | Ascending

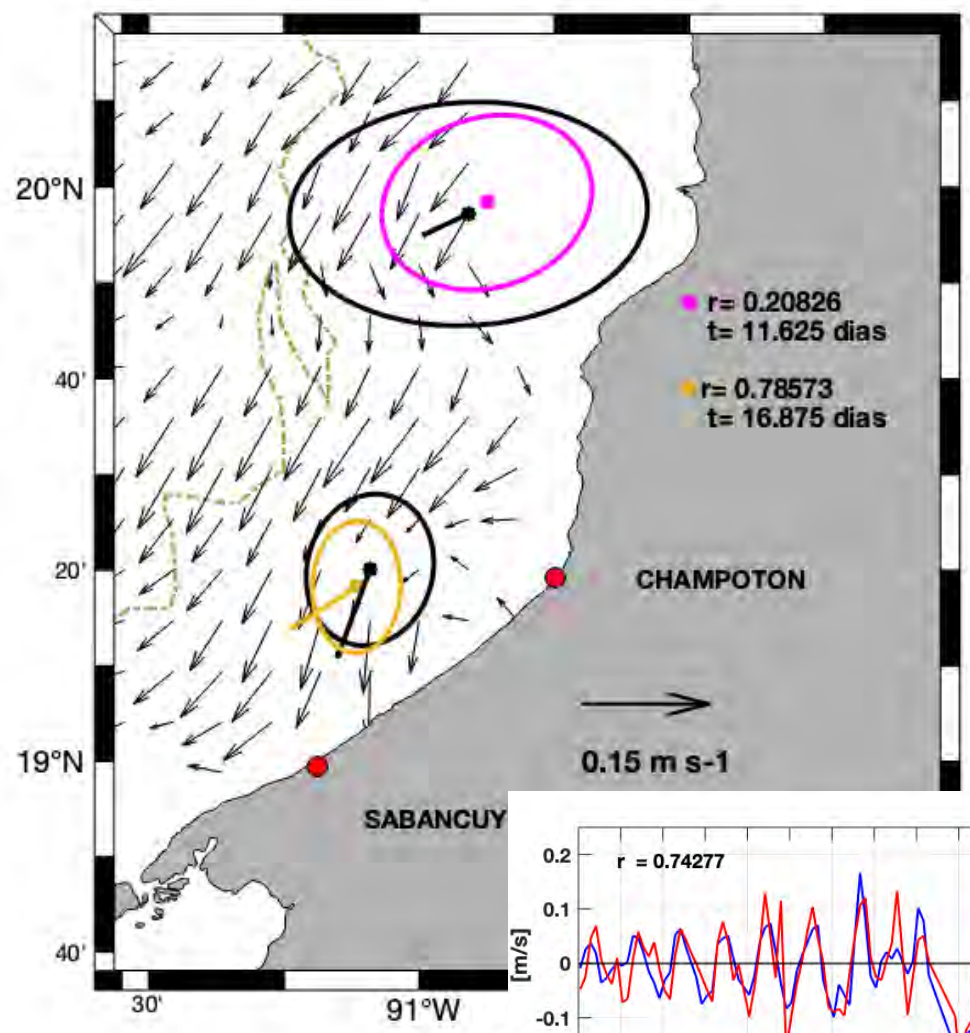
Redraw the Graph (Please be patient. It may take a while to get the data.)

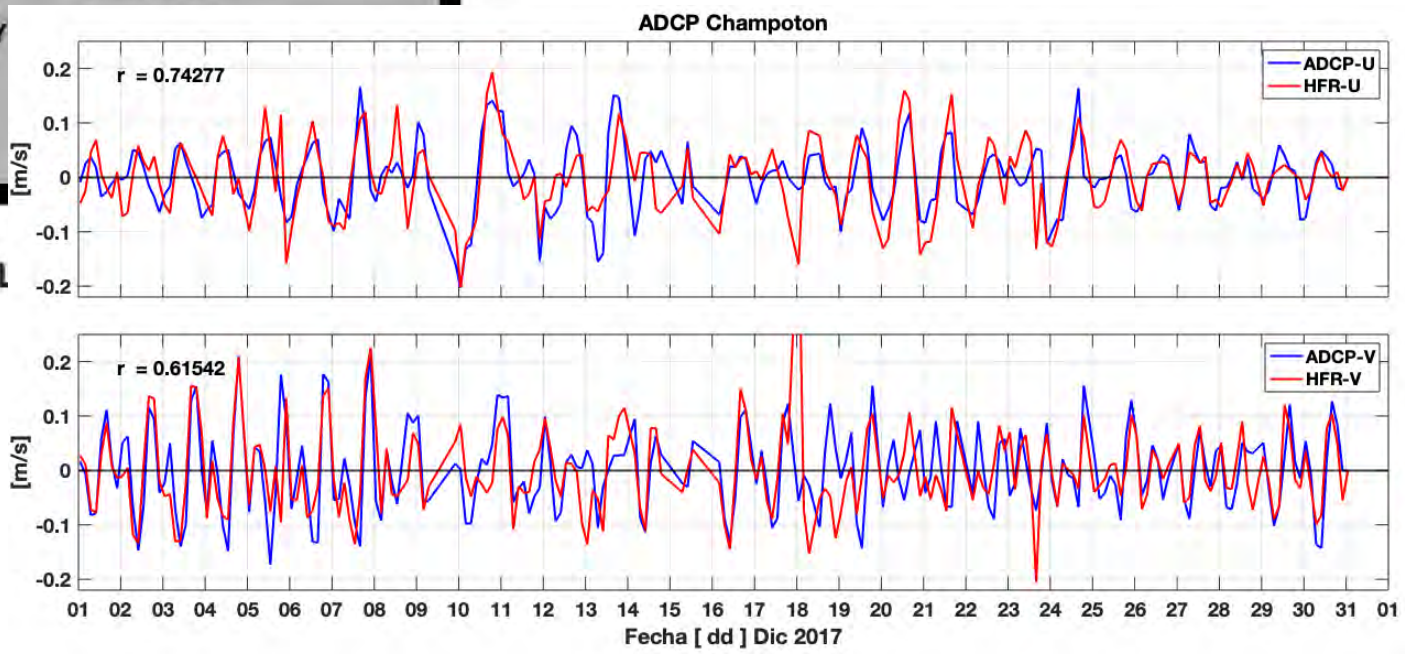
Optional:
Then set the File Type: .htmlTable (File Type information)
and Download the Data or an Image
or view the URL: https://datos.oorco.org/erddap/griddap/RADMEX_GM_10km_3hr.htmlTable?v
(Documentation / Bypass this form)

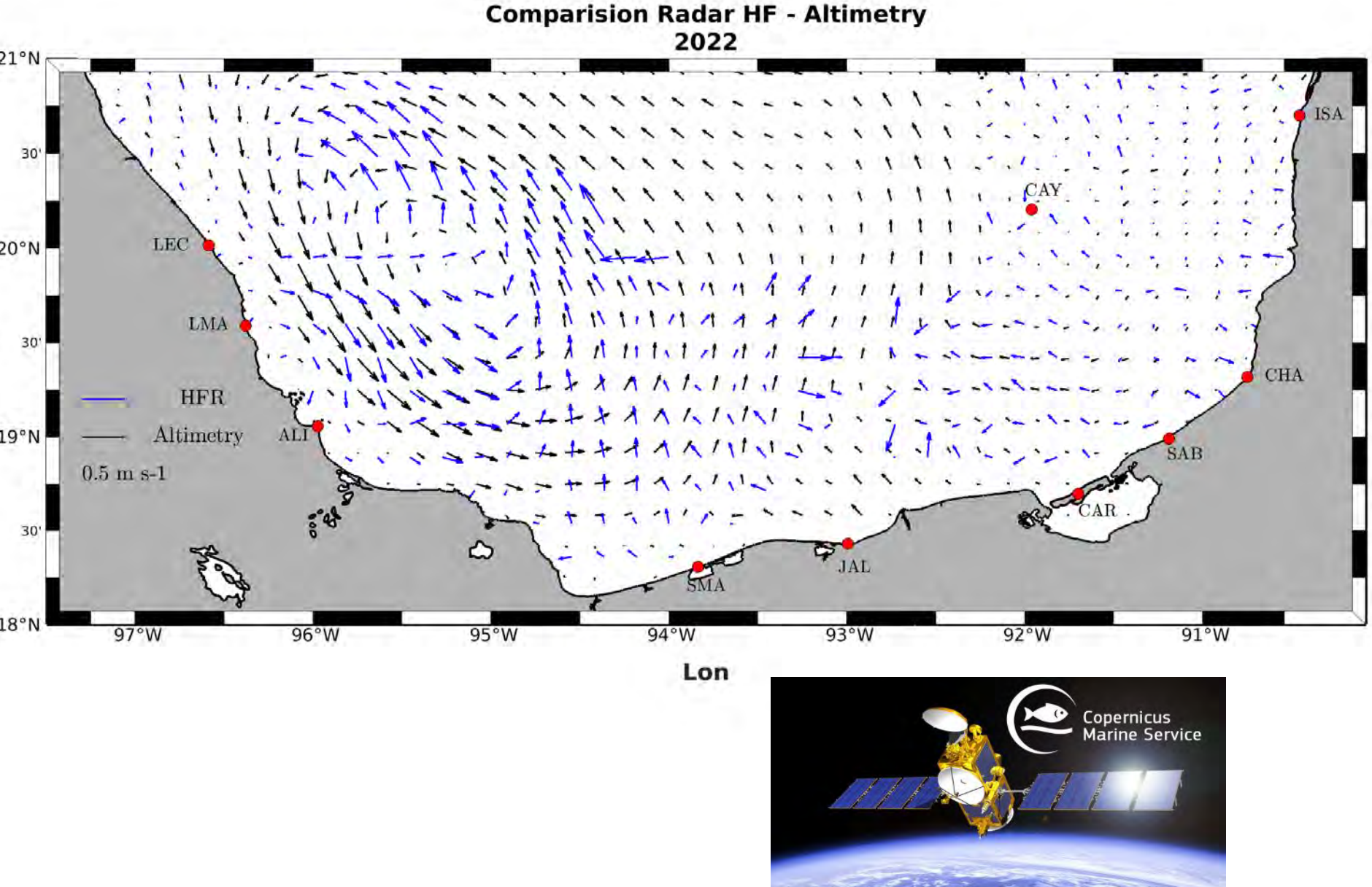
Click on the map to specify a new center point.
Zoom: Data | Out 8x | Out 2x | Out | In | In 2x | In 8x



ADCP moorings *vs* HFR

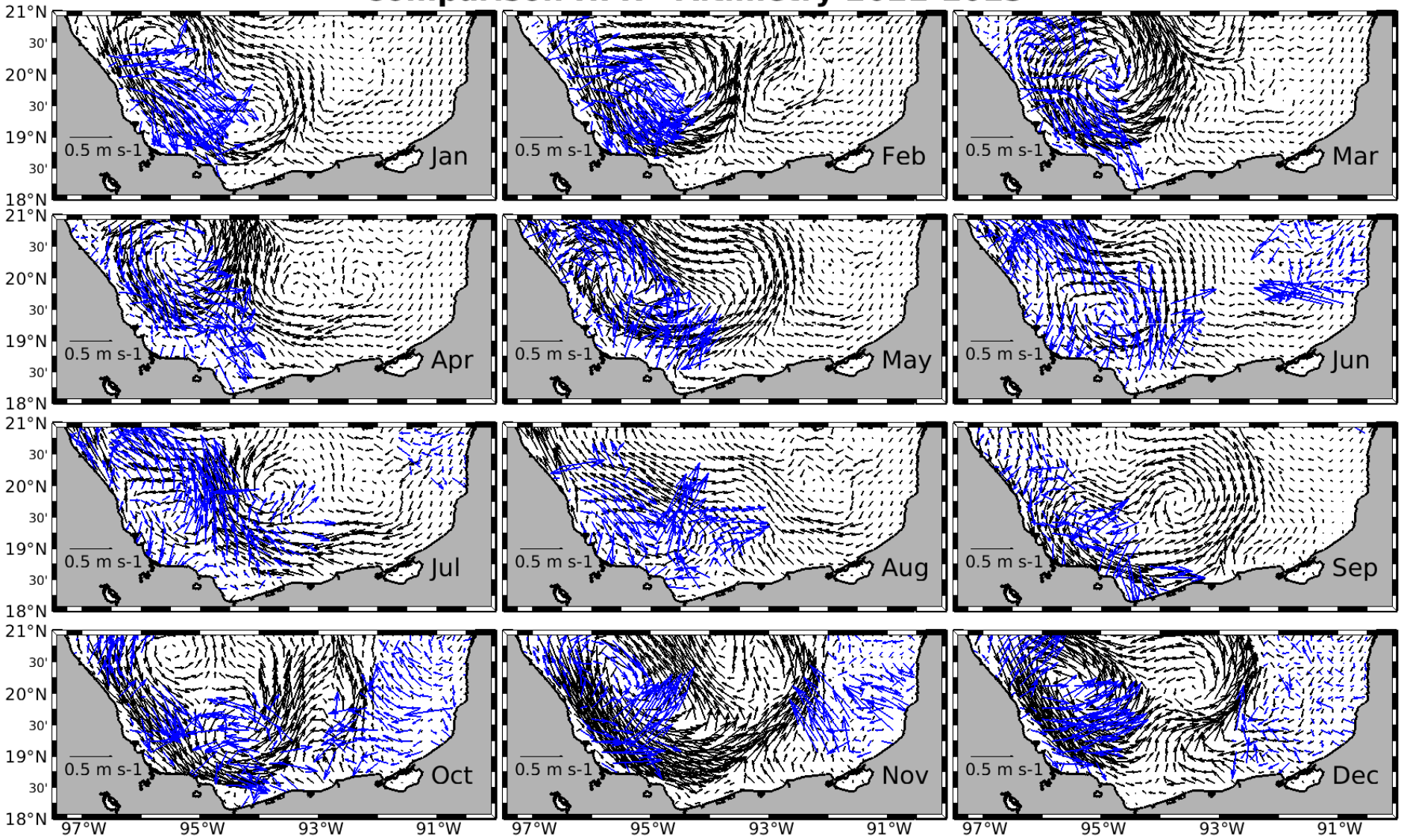


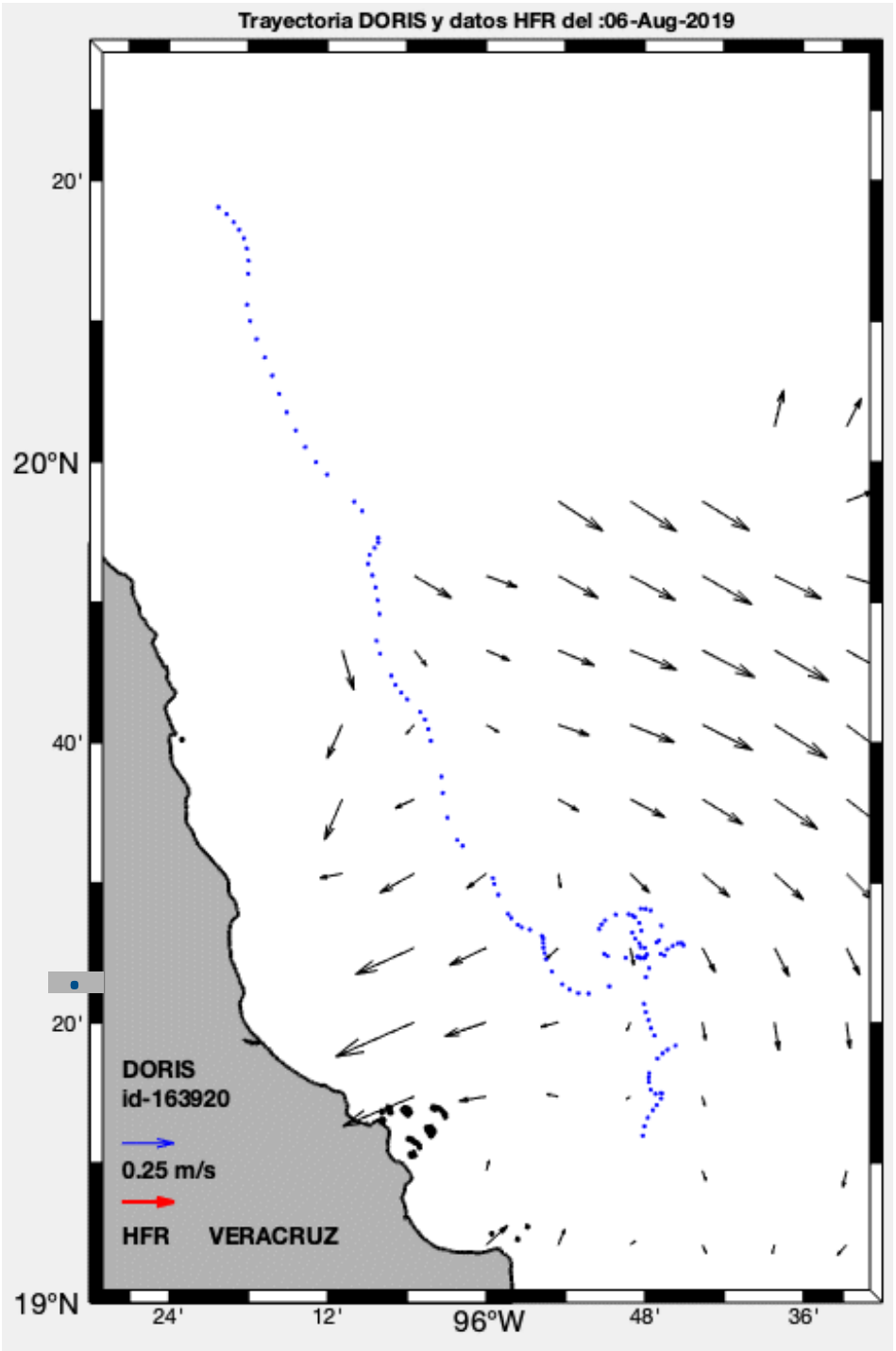



Comparision Radar HF - Altimetry
2022
21°N
30'
20°N
30'
19°N
30'
18°N
97°W
96°W
95°W
94°W
93°W
92°W
91°W
Lon
LEC
LMA
ALI
SMA
JAL
CAR
SAB
CHA
CAY
ISA
HFR
Altimetry
0.5 m s-1

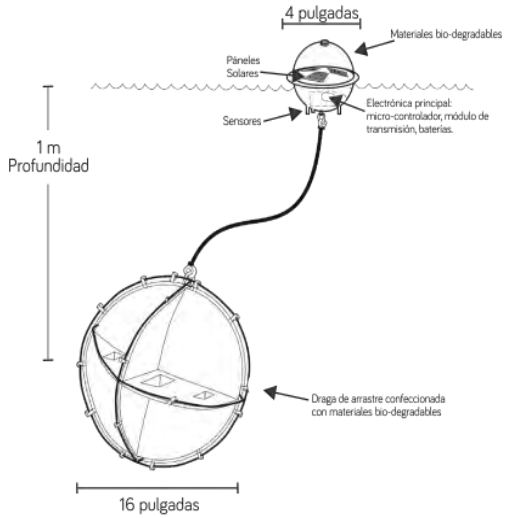
Copernicus
Marine Service

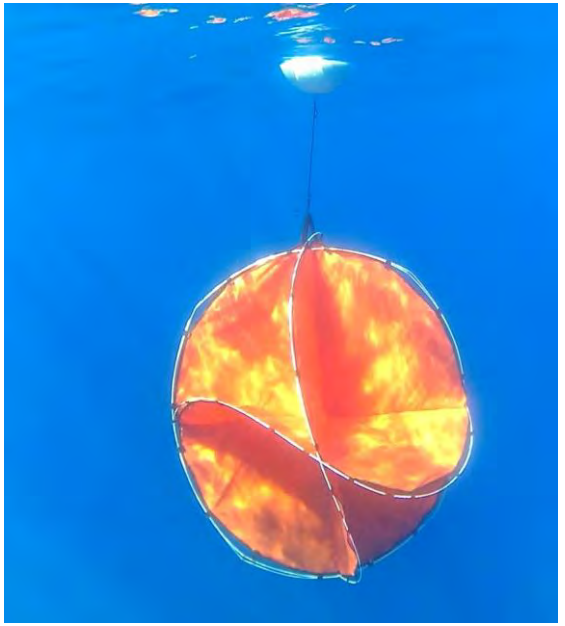
Comparison HFR - Altimetry 2022-2023

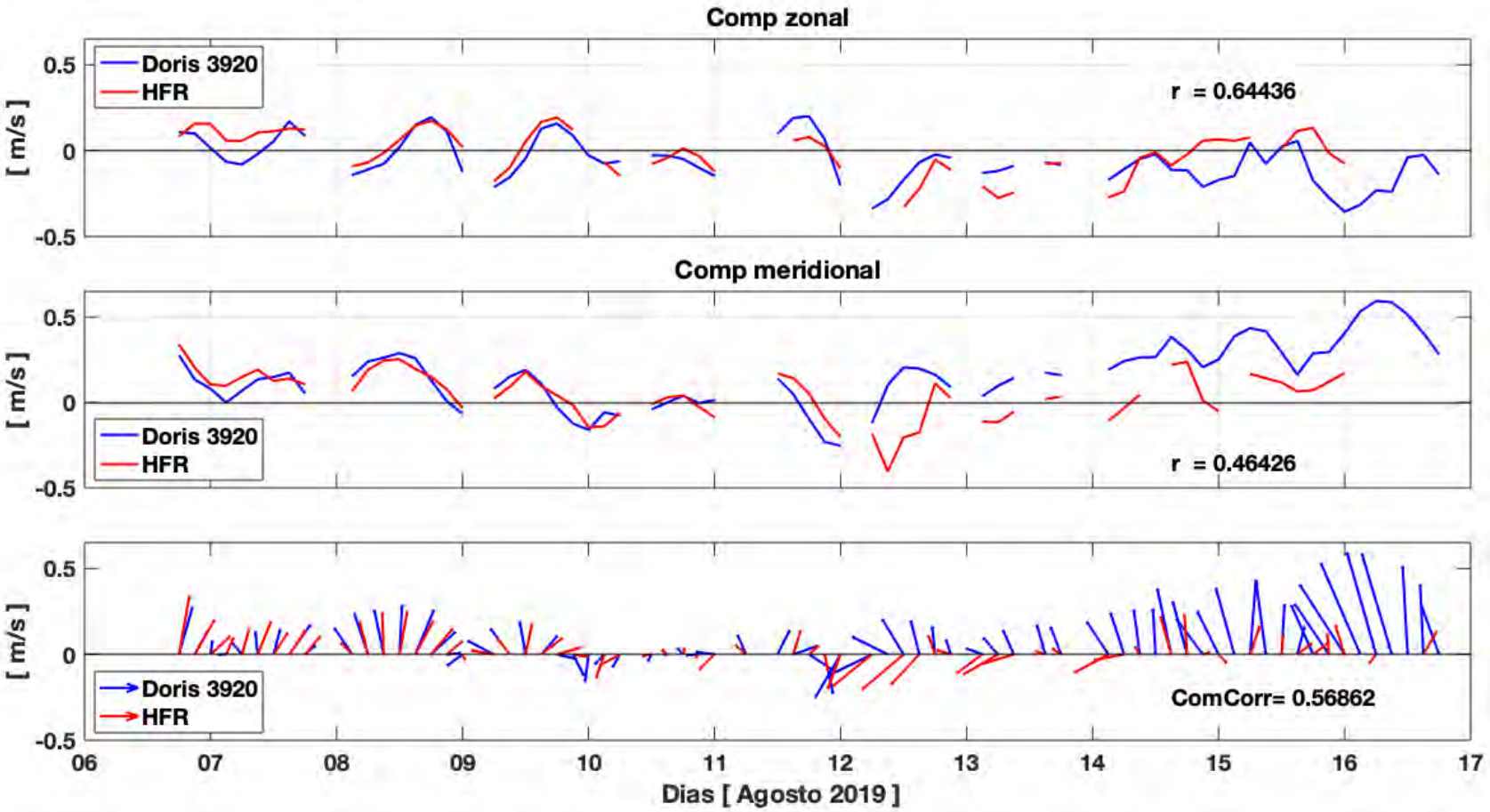



Trayectoria DORIS y datos HFR del :06-Aug-2019
20'
20°N
40'
20'
19°N
24'
12'
96°W
48'
36'
DORIS
id-163920
0.25 m/s
HFR
VERACRUZ

DORIS VS HFR


4 pulgadas
Materiales bio-degradables
Páneles
Solares
Electrónica principal:
micro-controlador, módulo de
transmisión, baterías.
Sensores
1 m
Profundidad
Draga de arrastre confeccionada
con materiales bio-degradables
16 pulgadas

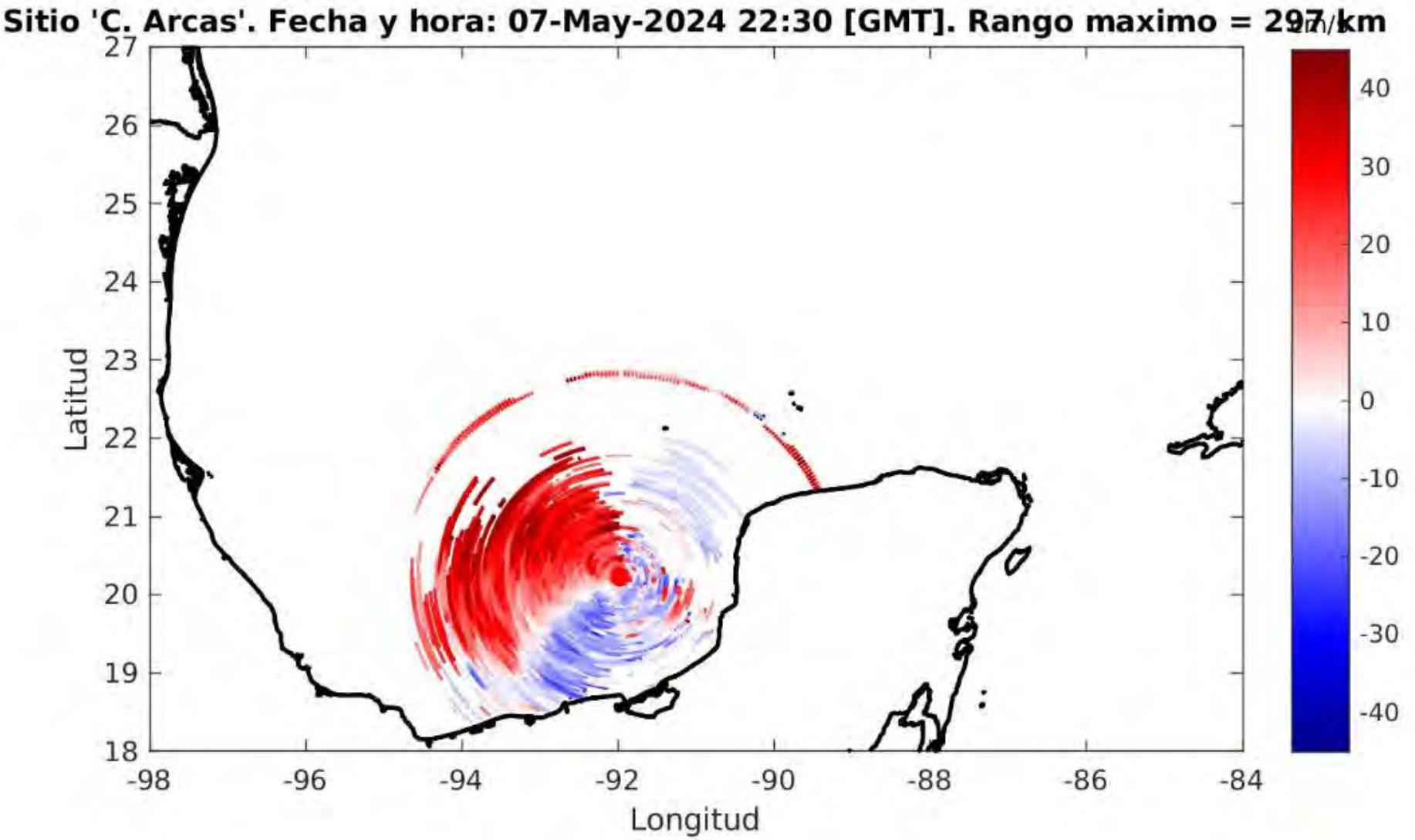




SEMAR
SECRETARÍA DE MARINA

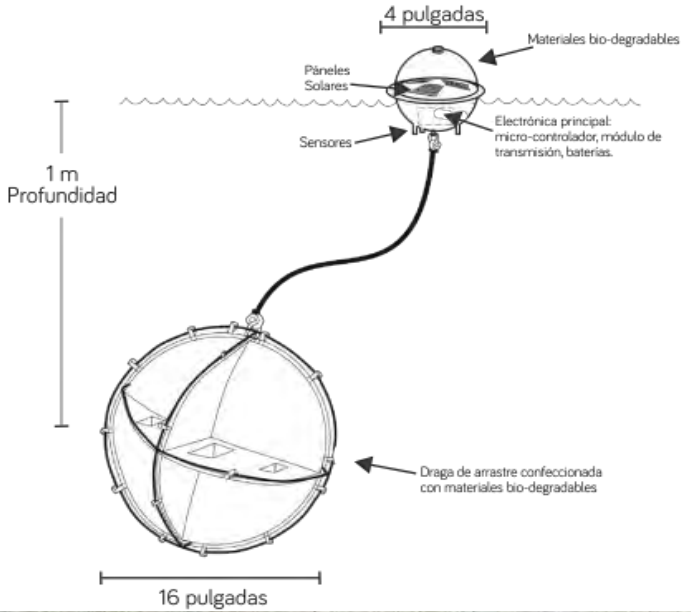
New HFR site in Cayo Arcas 2023

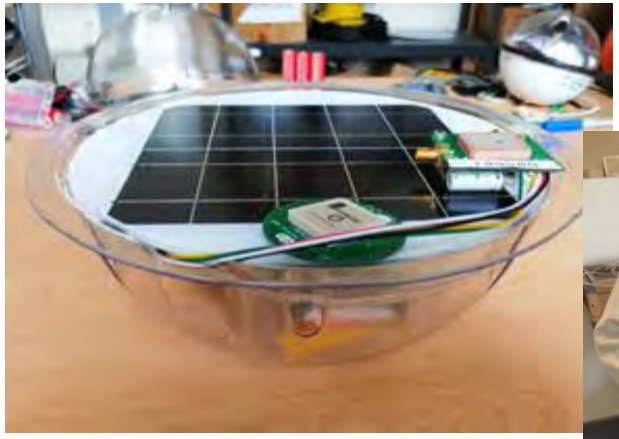
New HFR site in Cayo Arcas



http://ocomex.ens.uabc.mx/data-public/arc/

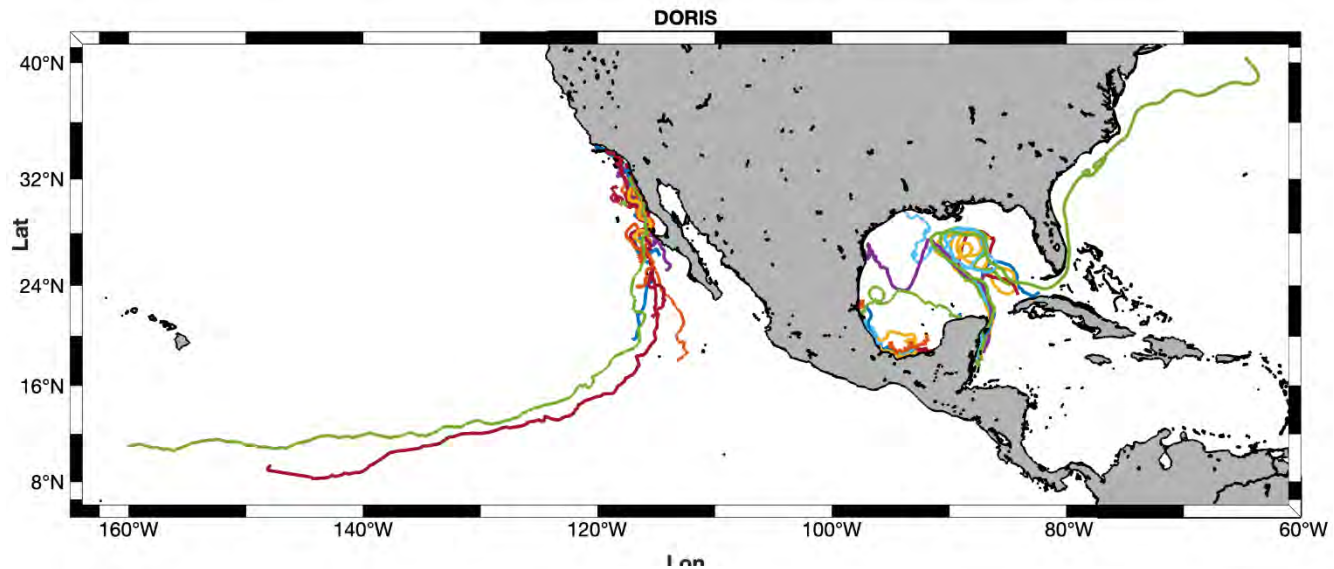
DORIS®

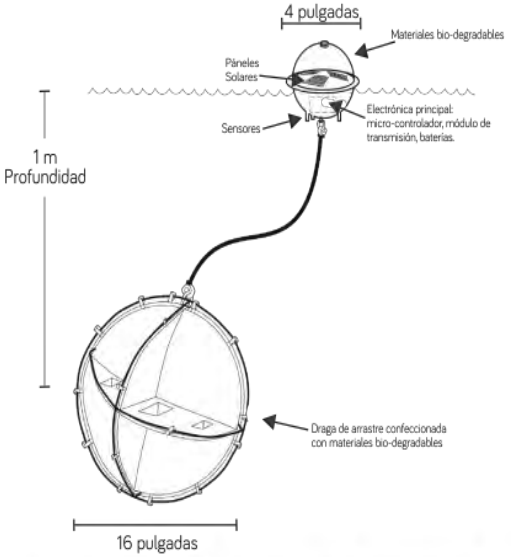

4 pulgadas
Materiales bio-degradables
Páneles Solares
Sensores
Electrónica principal: micro-controlador, módulo de transmisión, baterías.
1 m Profundidad
Draga de arrastre confeccionada con materiales bio-degradables
16 pulgadas

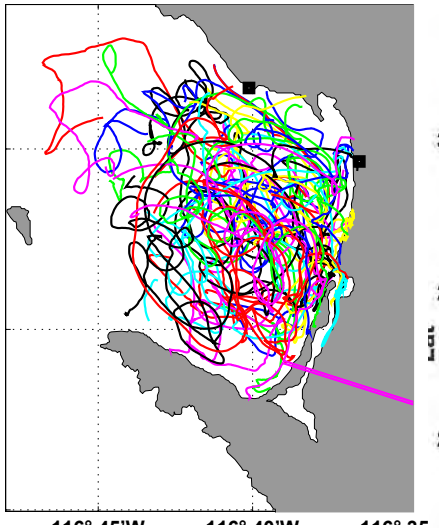



FW Revi
ISP
5V
SD Adapter
RS232

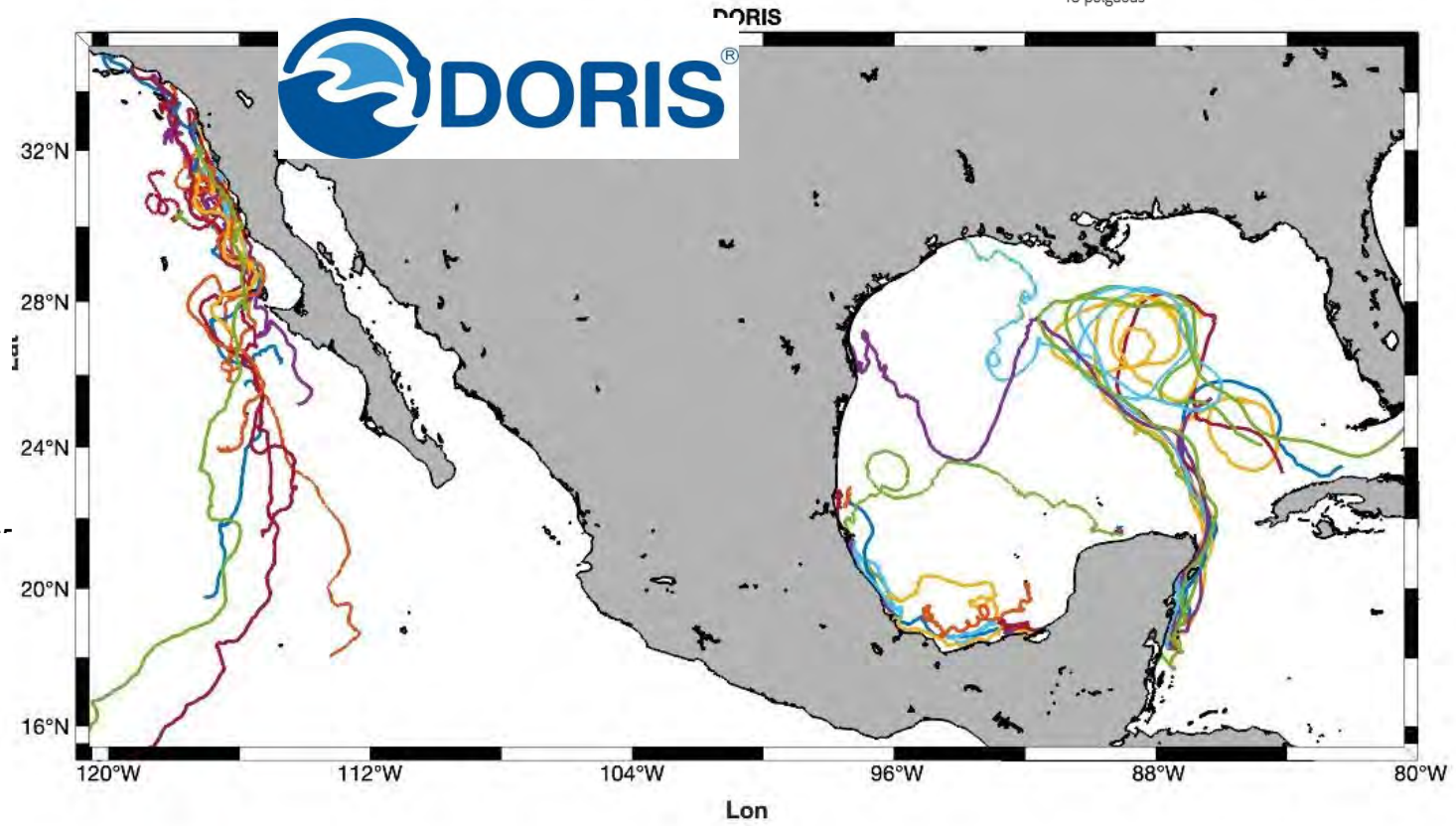

02/25/

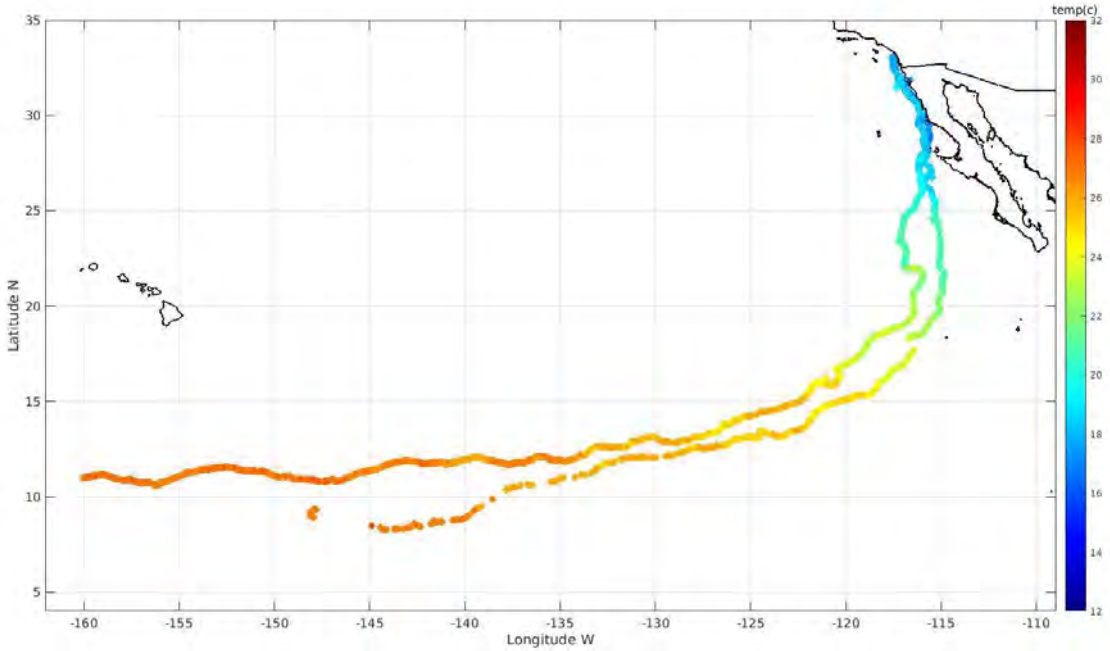

DORIS
40°N
32°N
24°N
16°N
8°N
Lat
160°W
140°W
120°W
100°W
80°W
60°W
Lon


4 pulgadas
Materiales bio-degradables
Páneles Solares
Sensores
Electrónica principal: micro-controlador, módulo de transmisión, baterías.
1 m Profundidad
Draga de arrastre confeccionada con materiales bio-degradables
16 pulgadas

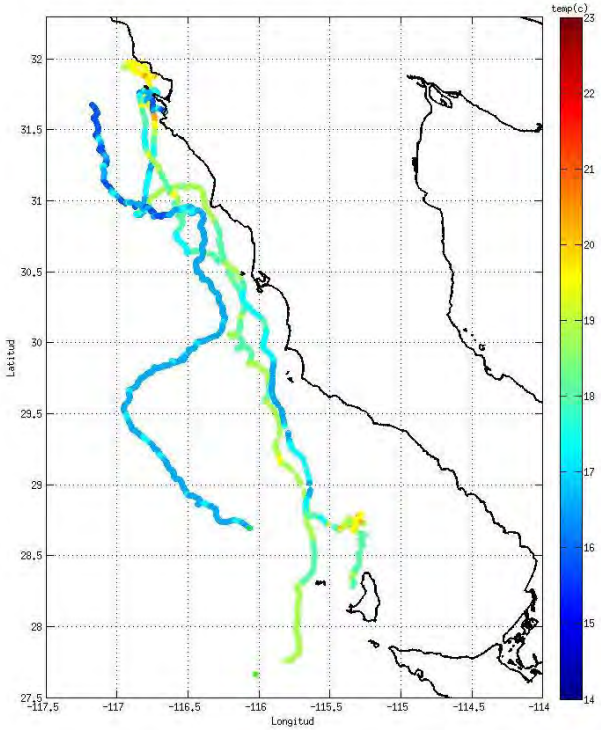


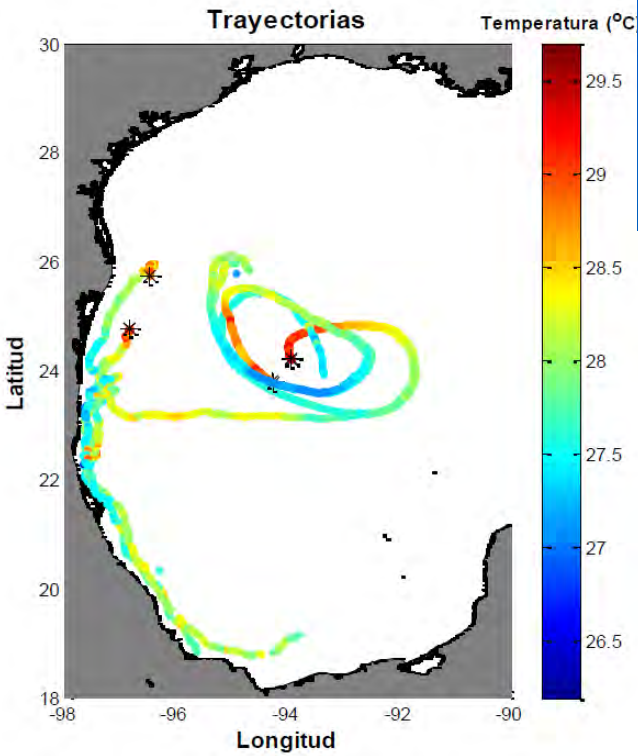
DORIS®

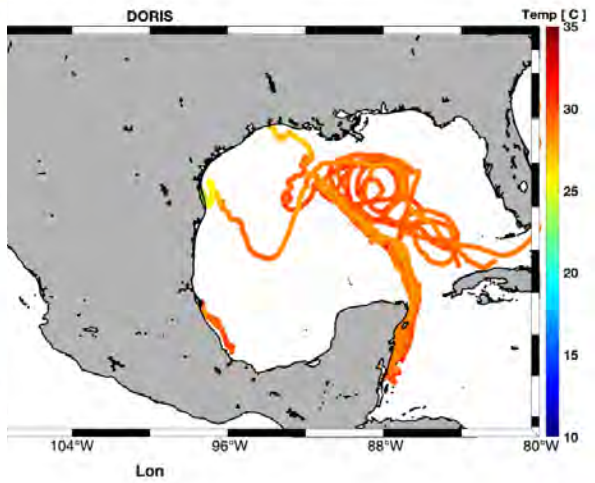

32°N
28°N
24°N
20°N
16°N
120°W
112°W
104°W
96°W
88°W
80°W
Lon

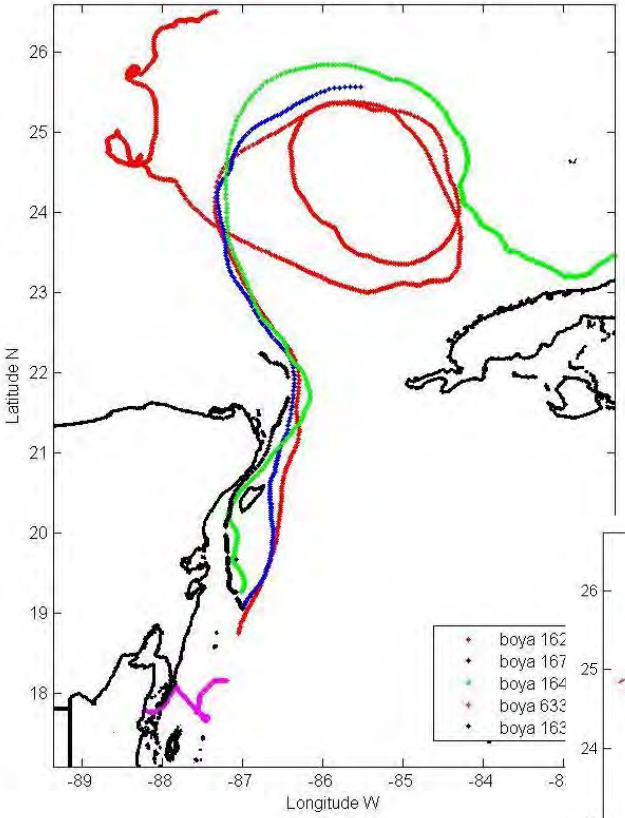

temp(c)
Latitude N
Longitude W


02/25/2016

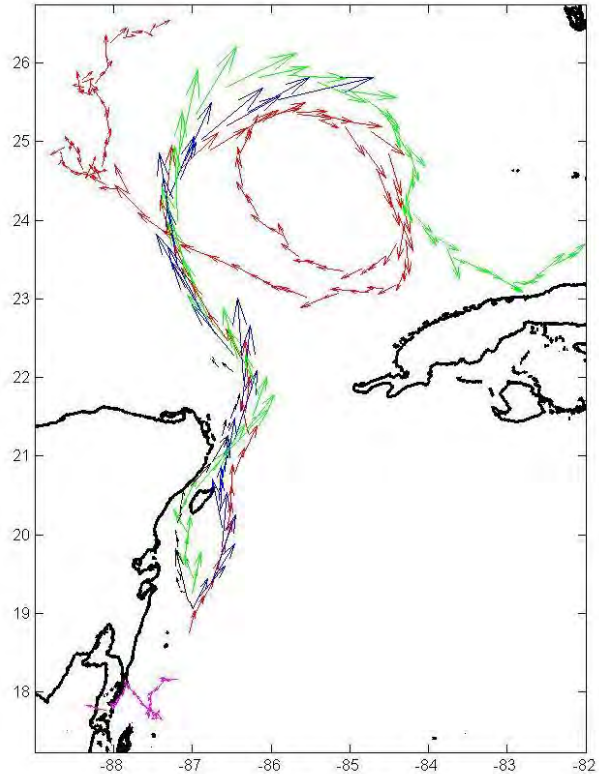

temp(c)
Latitud
Longitud

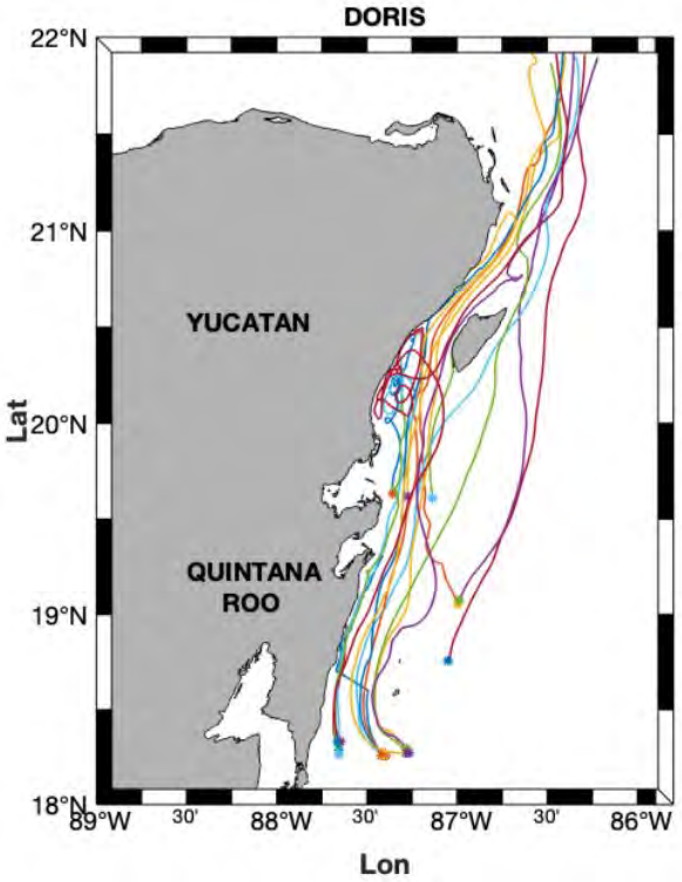

Trayectorias
Temperatura (°C)
Latitud
Longitud


DORIS
Temp [C]
104°W
96°W
88°W
80°W
Lon


Latitude N
Longitude W
boya 162
boya 167
boya 164
boya 633
boya 163


SEMAR
SECRETARÍA DE MARINA




DORIS
YUCATAN
QUINTANA ROO
Lat
Lon
22°N
21°N
20°N
19°N
18°N
89°W
30'
88°W
30'
87°W
30'
86°W

https://oorco.ens.uabc.mx/

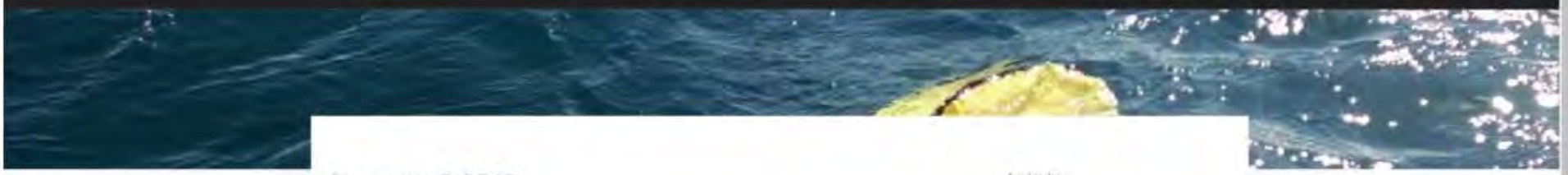
SONDAS OCEANOGRÁFICAS | C

oorco.ens.uabc.mx/sondas-oceanograficas

En pausa

OORCo

RED DE RADARES | SONDAS OCEANOGRAFICAS | ESTACIONES METEOROLÓGICAS

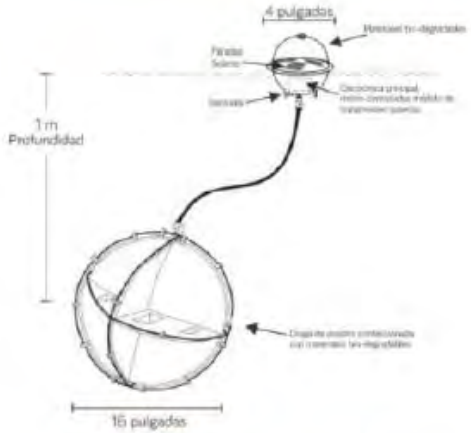


Proyecto DORIS

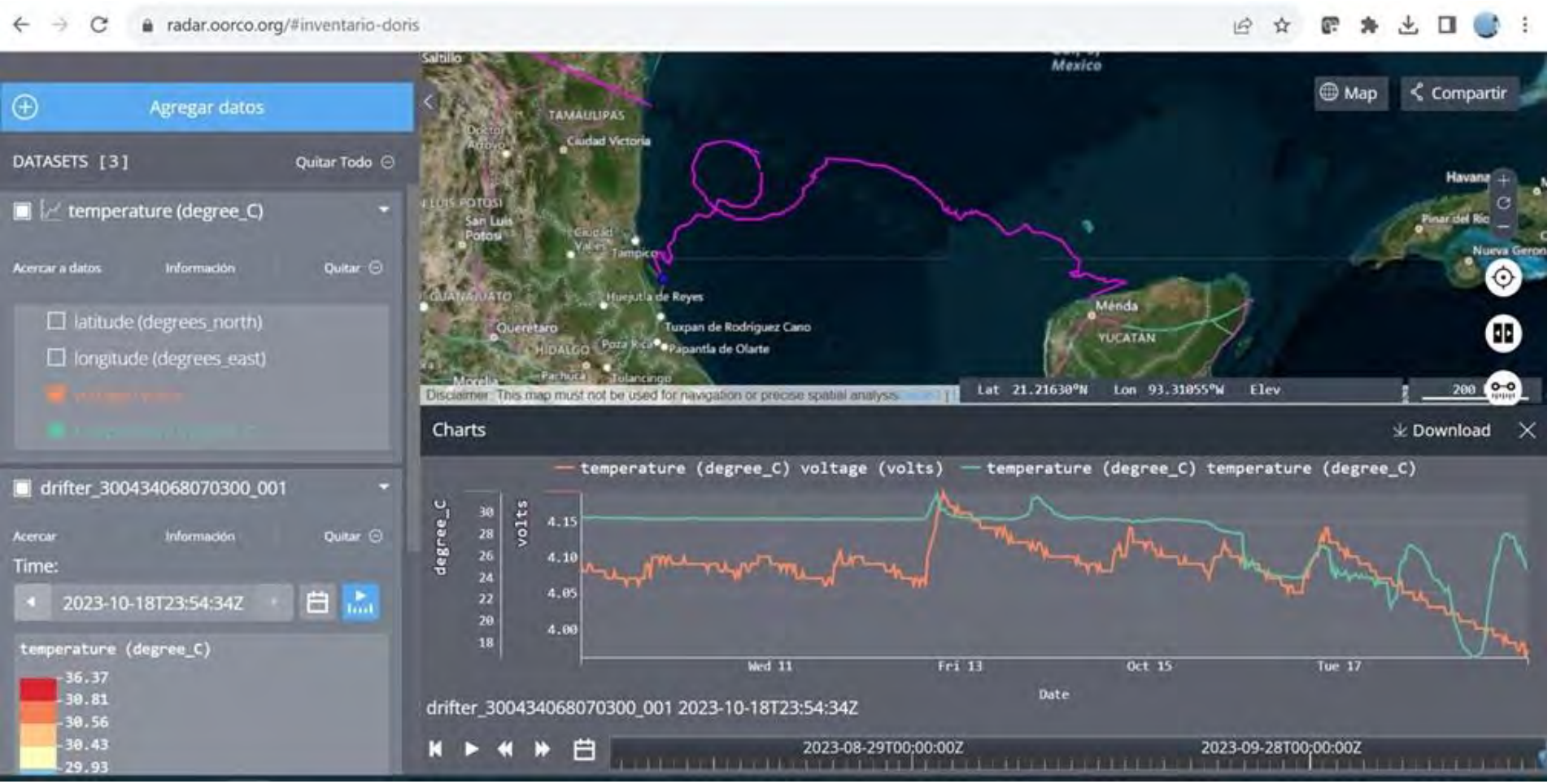
El derivador Oceanográfico Remoto In Situ (DORIS), es una sonda oceanográfica diseñada para realizar mediciones autonomas y trasmitirlas al usuario en tiempo real.

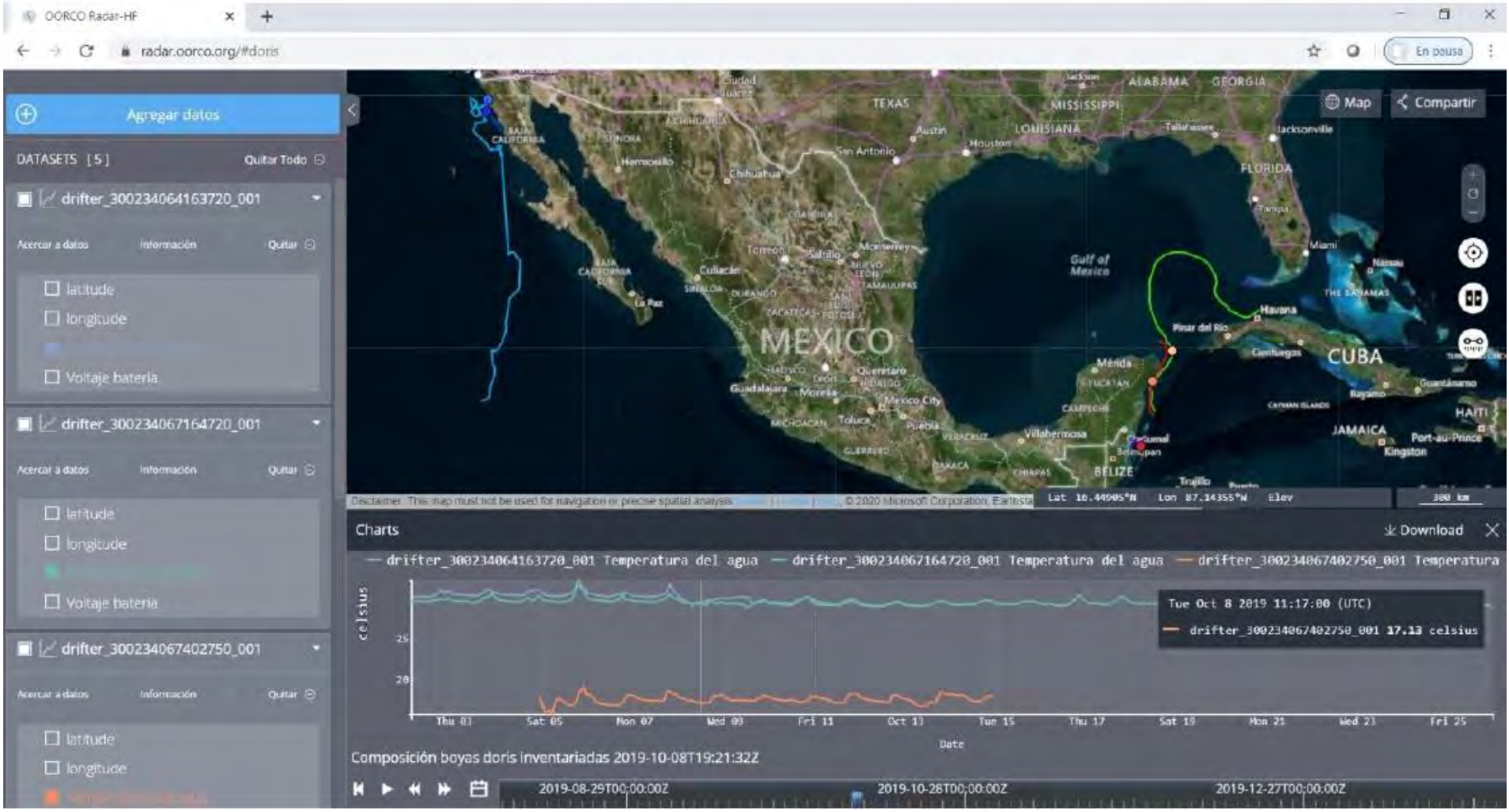
Su diseño es compacto, ligero y económico por lo que se puede instalar anclado de forma simple para obtener series de tiempo (Mediciones Eulerianas) o dejarse a la deriva para obtener mediciones Lagrangeanas.

DORIS ha sido diseñado y construido en los laboratorios del IIO-UABC, éste utiliza un micro-controlador con capacidad para obtener, procesar y enviar en tiempo real, variables de hasta seis sensores (i.e. posición geográfica, temperatura, conductividad, PH, oxigeno y fluorescencia).



DORIS


radar.oorco.org/#inventario-doris
Agregar datos
DATASETS [3]
Quitar Todo
temperature (degree_C)
Acercar a datos
Información
Quitar
latitude (degrees_north)
longitude (degrees_east)
drifter_300434068070300_001
Acercar
Información
Quitar
Time:
2023-10-18T23:54:34Z
temperature (degree_C)
36.37
30.81
30.56
30.43
29.93
Map
Compartir
Saltillo
TAMAULIPAS
Ciudad Victoria
San Luis Potosí
Tampico
Huejutla de Reyes
Querétaro
Tuxpan de Rodríguez Cano
Papantla de Olarte
Mérida
YUCATAN
Havana
Disclaimer: This map must not be used for navigation or precise spatial analysis.
Lat 21.21630°N Lon 93.31055°W Elev
200
Charts
Download
temperature (degree_C) voltage (volts)
temperature (degree_C) temperature (degree_C)
degree_C
volts
Wed 11
Fri 13
Oct 15
Tue 17
Date
drifter_300434068070300_001 2023-10-18T23:54:34Z
2023-08-29T00:00:00Z
2023-09-28T00:00:00Z


OORCO Radar-HF
radar.oorco.org/#doris
En pausa
Agregar datos
DATASETS [5]
Quitar Todo
drifter_300234064163720_001
Acercar a datos
Información
Quitar
latitude
longitude
Voltaje bateria
drifter_300234067164720_001
Acercar a datos
Información
Quitar
latitude
longitude
Voltaje bateria
drifter_300234067402750_001
Acercar a datos
Información
Quitar
latitude
longitude
Map
Compartir
MEXICO
CUBA
Gulf of Mexico
Havana
Miami
Jacksonville
Tallahassee
Tampa
Houston
San Antonio
Austin
Monterrey
Culiacán
Mérida
Villahermosa
Kingston
Port-au-Prince
Lat 16.44905°N
Lon 87.14355°W
Elev
300 km
Charts
Download
drifter_300234064163720_001 Temperatura del agua
drifter_300234067164720_001 Temperatura del agua
drifter_300234067402750_001 Temperatura
celsius
25
20
Tue Oct 8 2019 11:17:00 (UTC)
drifter_300234067402750_001 17.13 celsius
Thu 03
Sat 05
Mon 07
Wed 09
Fri 11
Oct 13
Tue 15
Thu 17
Sat 19
Mon 21
Wed 23
Fri 25
Date
Composición boyas doris inventariadas 2019-10-08T19:21:32Z
2019-08-29T00:00:00Z
2019-10-28T00:00:00Z
2019-12-27T00:00:00Z

ERDDAP
Easier access to scientific data

ERDDAP > tabledap > Make A Graph

Dataset Title: **drifter_300434064535220_001**
Institution: Observatorio Oceanográfico Regional Costero (Dataset ID: drifter_300434064535220_001)
Range: longitude = -116.666695 to -86.002975°E, latitude = 18.273346 to 31.862621°N, time = 2021-05-05T01:41:00Z to 2021-11-13T09:34:00Z
Information: Summary | License | FGDC | ISO 19115 | Metadata | Background | Subset | Data Access Form | Files

Graph Type: markers
X Axis: longitude
Y Axis: latitude
Color: time

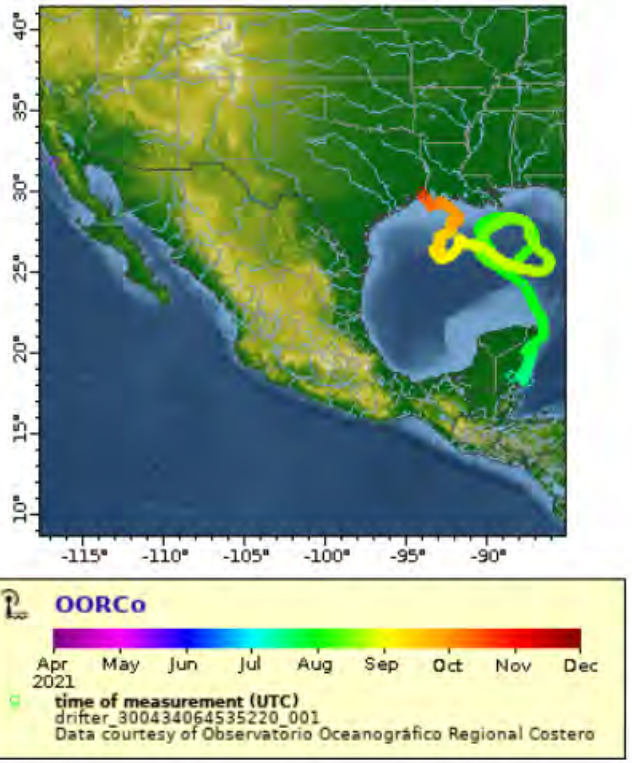
Constraints		Optional Constraint #1		Optional Constraint #2
	>=		<=	
	>=		<=	
	>=		<=	
	>=		<=	
	>=		<=	

Server-side Functions
distinct()

Graph Settings
Marker Type: Circle Size: 5
Color:
Color Bar: Continuity: Scale:
Minimum: Maximum: N Sections:
Draw land mask:
Y Axis Minimum: Maximum: Ascending

Redraw the Graph (Please be patient. It may take a while to get the data.)

Click on the map to specify a new center point.
Zoom: Out 8x | Out 2x | Out | Data | In | In 2x | In 8x



Final Remarks

Mexican HFR is now financed by the Project “Implementation of the Strategic Action Program of the Gulf of Mexico Large Marine Ecosystem GoM-LME”

https://gulfmexico.org/

With two objectives

1) Habilitated the gulf of Mexico radar stations and include as much as possible weather stations (2024-2026).

2) Start a drifter program to build and release 150 Doris between 2024 and 2026

It is of UABC and OORCo interest to share all this data with GCOOS

GRACIAS

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Laboratorio de Radio Oceanografía
xavier@uabc.edu.mx