

# Data, Analytics, Visualization

## *The Three -Legged Maritime Domain Awareness Stool*

**Author/Presenter:** Matt Cadwallader

**40Geo**

[Matt.Cadwallader@40Geo.com](mailto:Matt.Cadwallader@40Geo.com)

**Co-Presenter:** Ridley Smith

**Eni**

[Ridley.Smith@eni.com](mailto:Ridley.Smith@eni.com)

**Co-Author:** Rafael Schiller

**Fugro**

[RSchiller@Fugro.com](mailto:RSchiller@Fugro.com)



# Data, Analytics, Visualization

---

*The Three -Legged Maritime Domain Awareness Stool*

**GIS provides us the universal visual language...**

**...to help make million dollar 'go/no go' decisions safely and efficiently.**

**Common Operating Picture**

*delivers*

**Maritime Domain Awareness**

*creates*

**Actionable Intelligence**

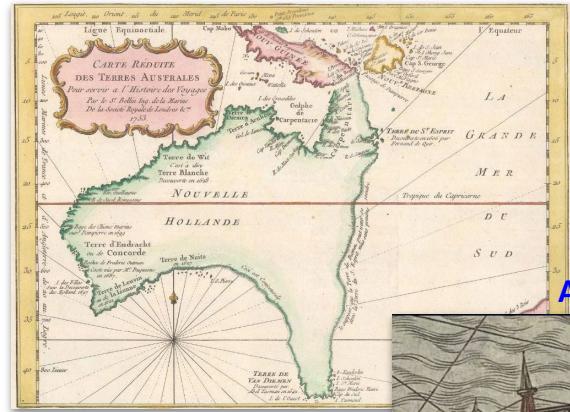
# Presentation Overview

---

- Maritime Domain Awareness
- MetOcean Challenges in the Gulf of Mexico
- Eni Requirements
- Fugro: Loop Current Monitoring & Forecasting
- 40Geo: Raptor MetOcean Dashboard

# Maritime Domain Awareness

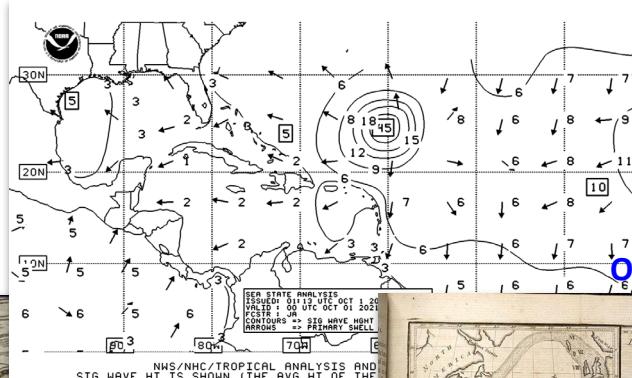
## Discovery<sup>1</sup>



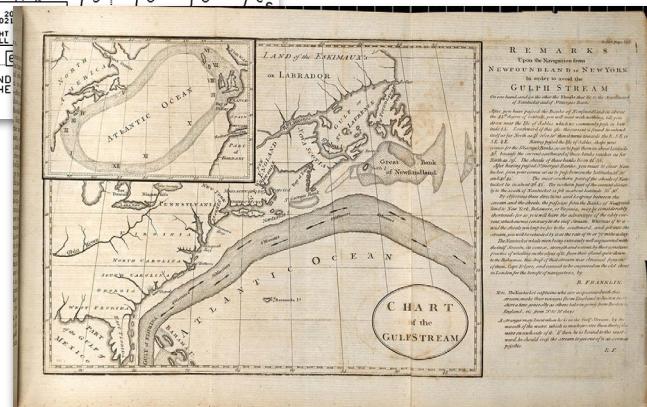
## Aids to Navigation<sup>2</sup>



## Meteorology<sup>3</sup>



## Oceanography<sup>4</sup>



***<sup>1</sup>Jacques-Nicolas Bellin (1703-1772)***

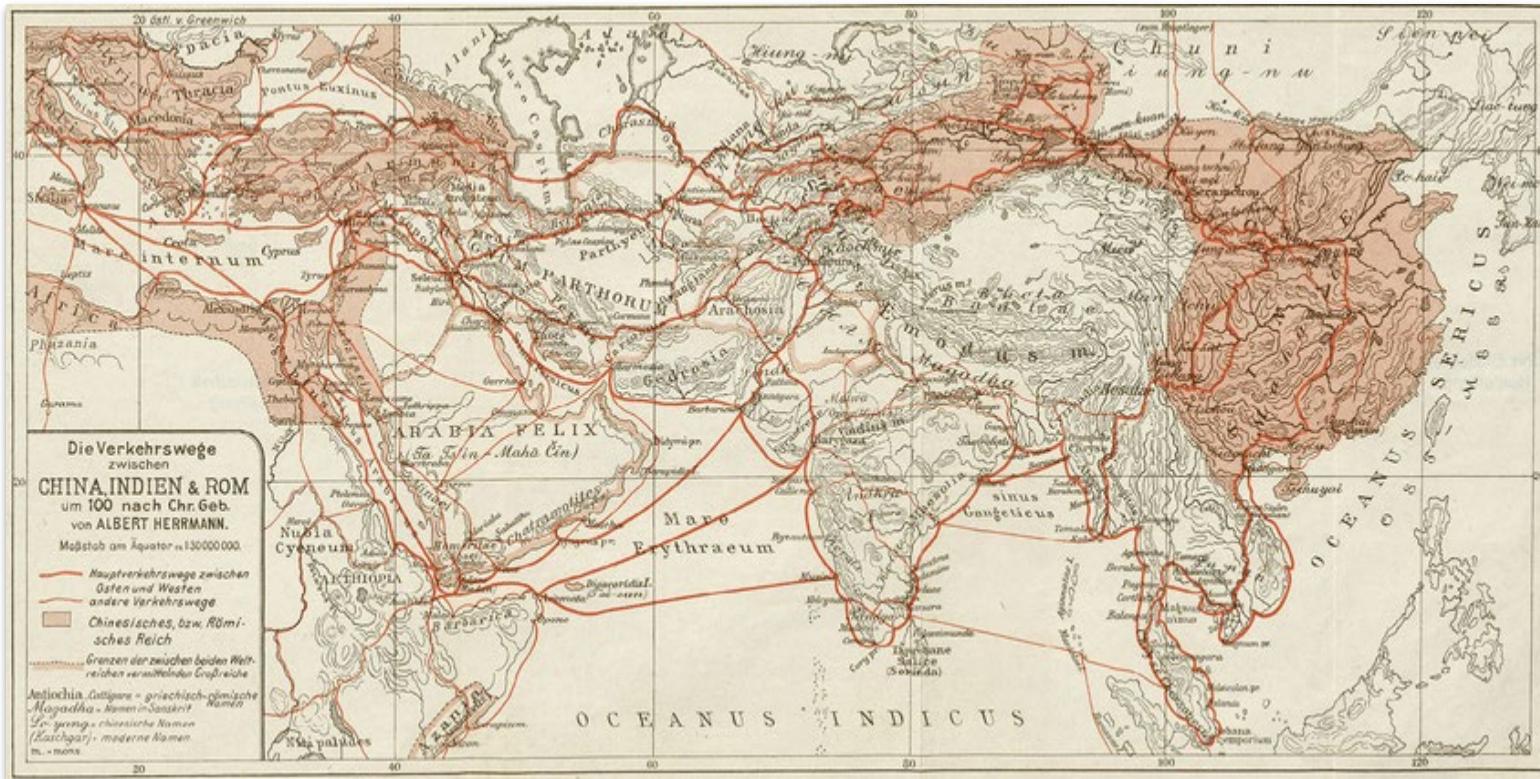
*<sup>2</sup>Chet Van Duzer - Sea Monsters on Medieval and Renaissance Maps*

<sup>3</sup>*NOAA National Weather Service Radiofax Chart*

#### *<sup>4</sup>Franklin-Folger chart of the Gulf Stream*

# Maritime Domain Awareness

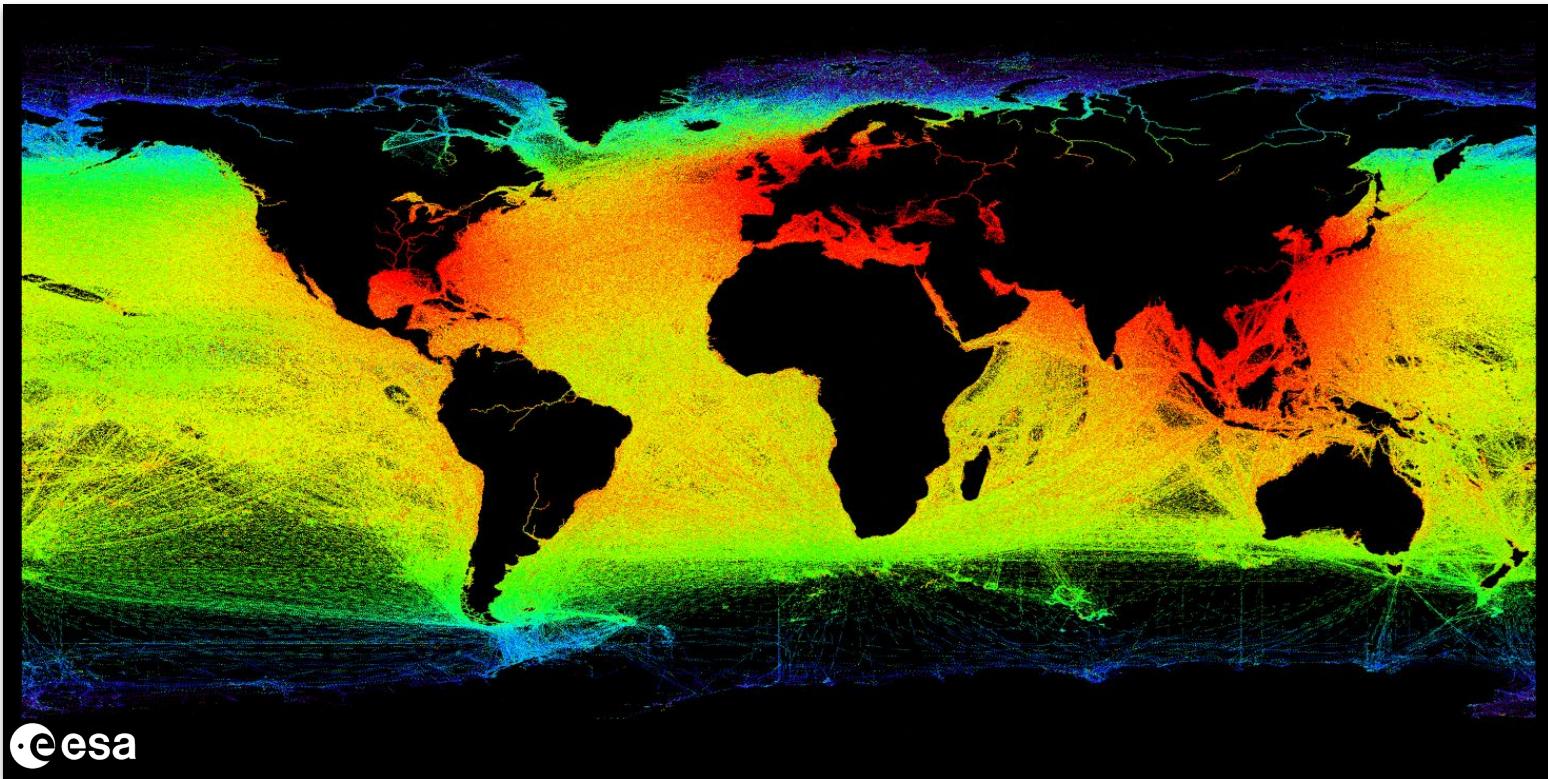
## *Trade*



## Map of the Silk Roads (Herrmann, 1922)

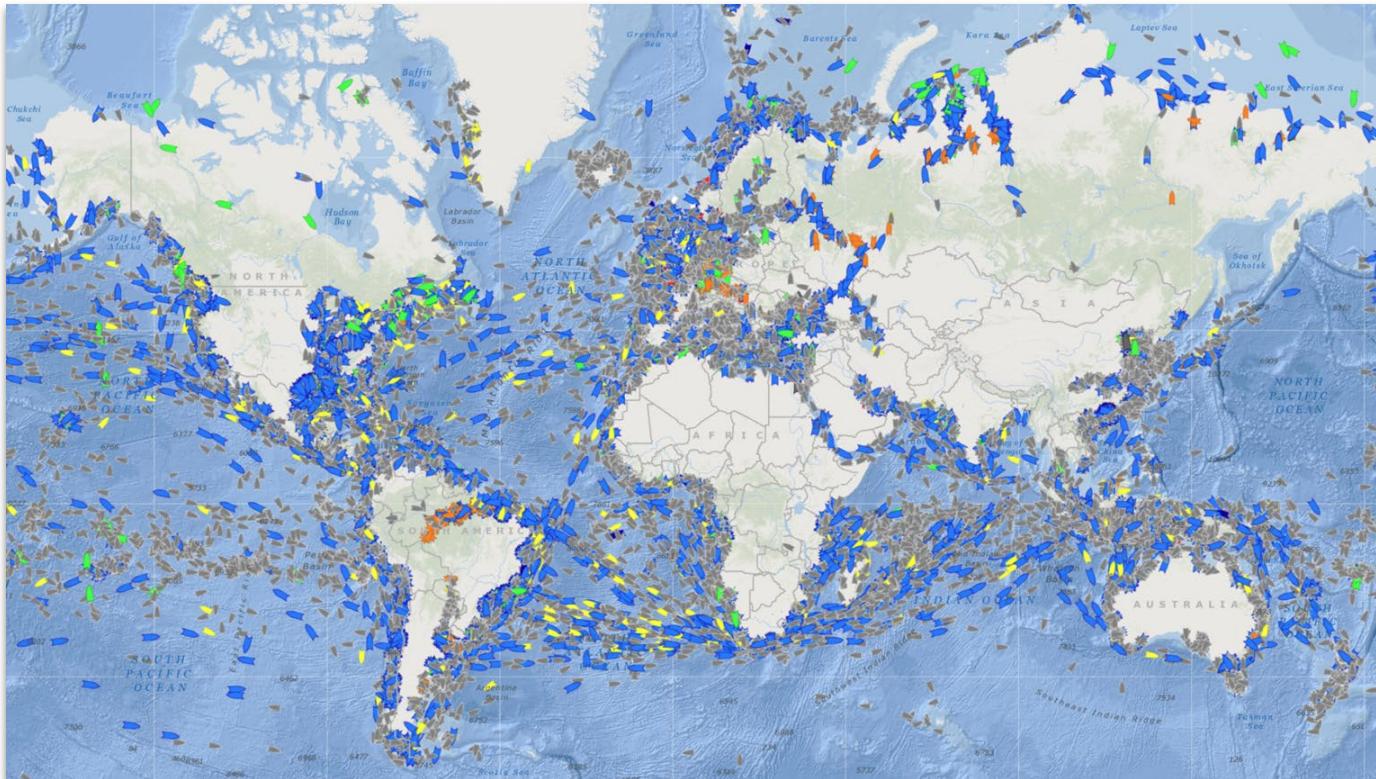
# Maritime Domain Awareness

*~90% of goods are transported via water*



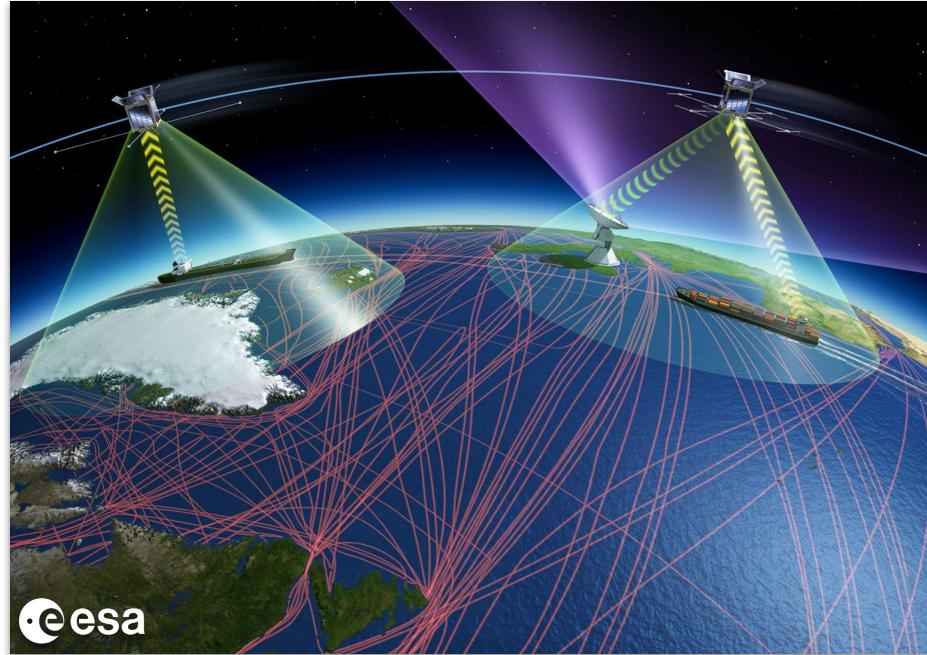
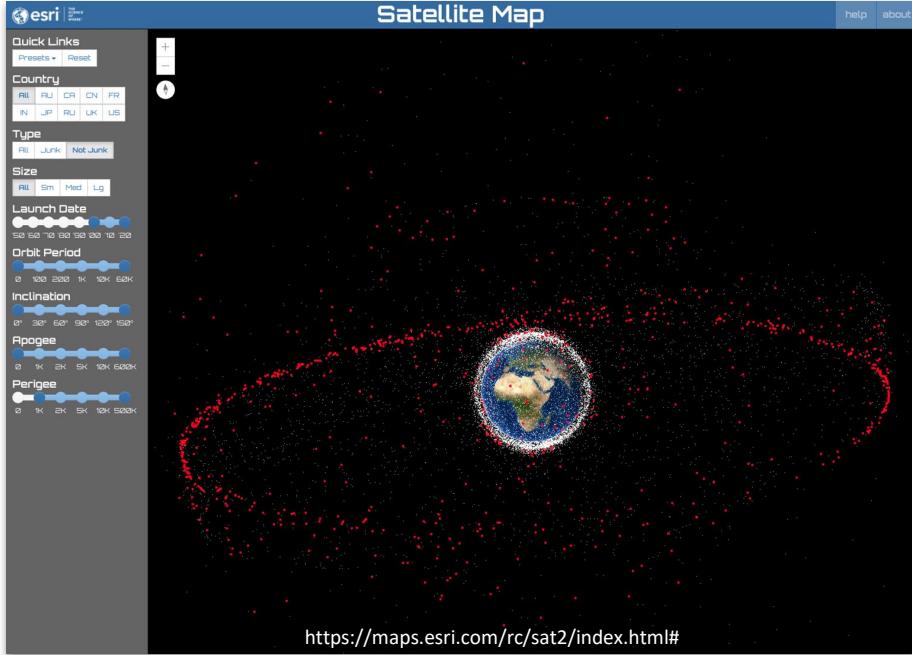
# Maritime Domain Awareness

*Location. Location. Location.*



# Maritime Domain Awareness

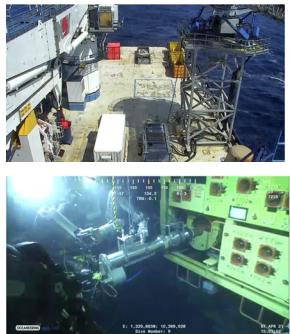
*Global Positioning System + Automatic Identification System*



# Maritime Domain Awareness

*Data.*

Live Video Feed(s)



Video Encoder



*In-situ* Sensors

- AIS
- Radar
- ADS-B
- Met
- Oceanographic

Serial Intercepter



3rd Party Data Sources



Client Data Lake



remo<sup>te</sup>.it

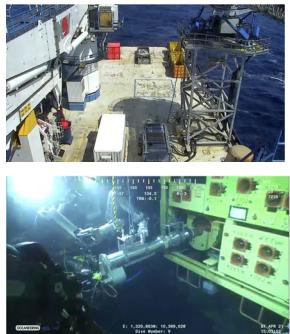


LAN

# Maritime Domain Awareness

*Data. Analytics.*

Live Video Feed(s)



Video Encoder



*In-situ* Sensors

- AIS
- Radar
- ADS-B
- Met
- Oceanographic

Serial Intercepter

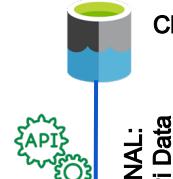


3rd Party Data Sources



Client Data Lake

OPTIONAL:  
OEM Pi Data



Raptor  
Geo-IoT  
aws

remote.it

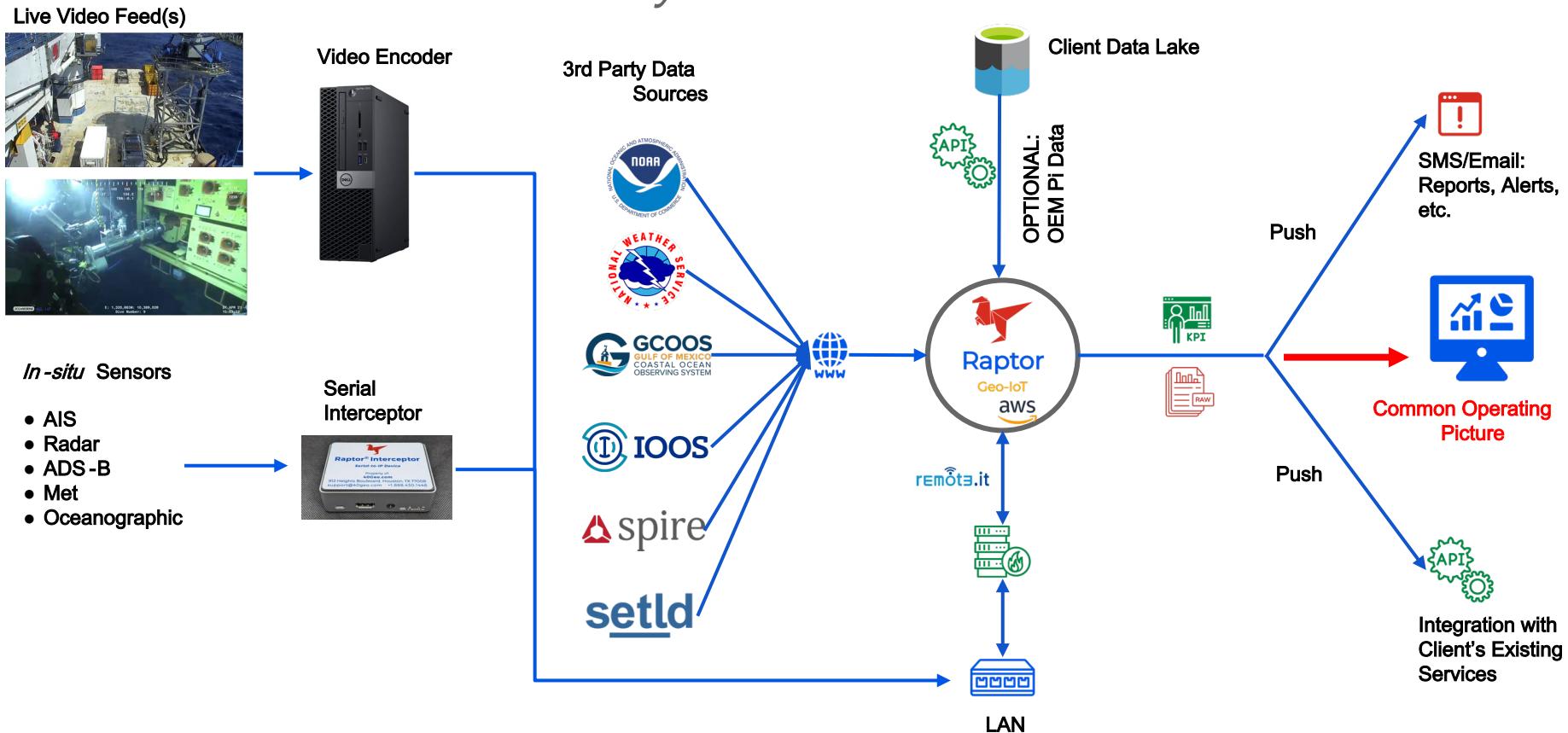


LAN



# Maritime Domain Awareness

*Data. Analytics. Visualization.*



# Maritime Domain Awareness

---

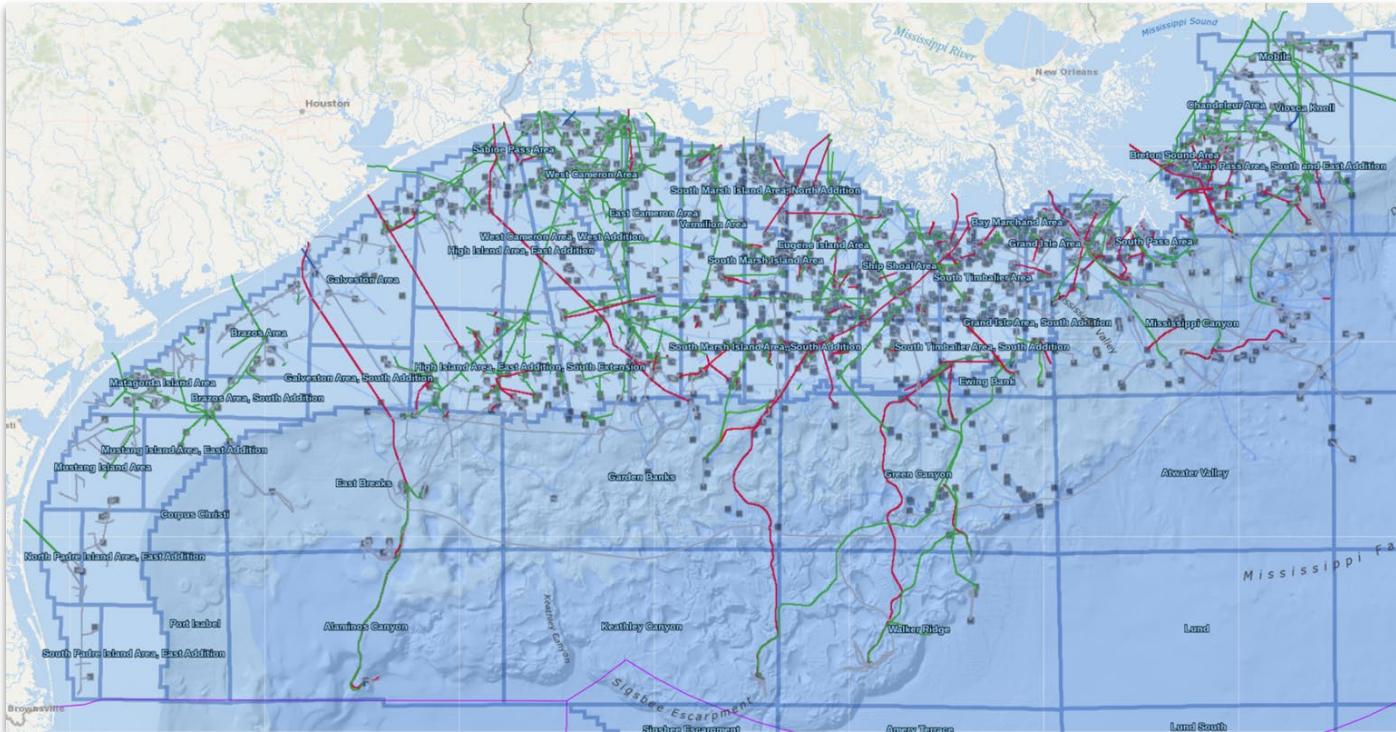
*Million dollar 'go/no go' decisions safely and efficiently*



*Captain Jan Berghuis*

# Gulf of Mexico

- 1,800+ production facilities
- 15% of U.S. oil production
- 5% of U.S. natural gas production
- 47% of U.S. petroleum refining
- 51% of total U.S. natural gas processing

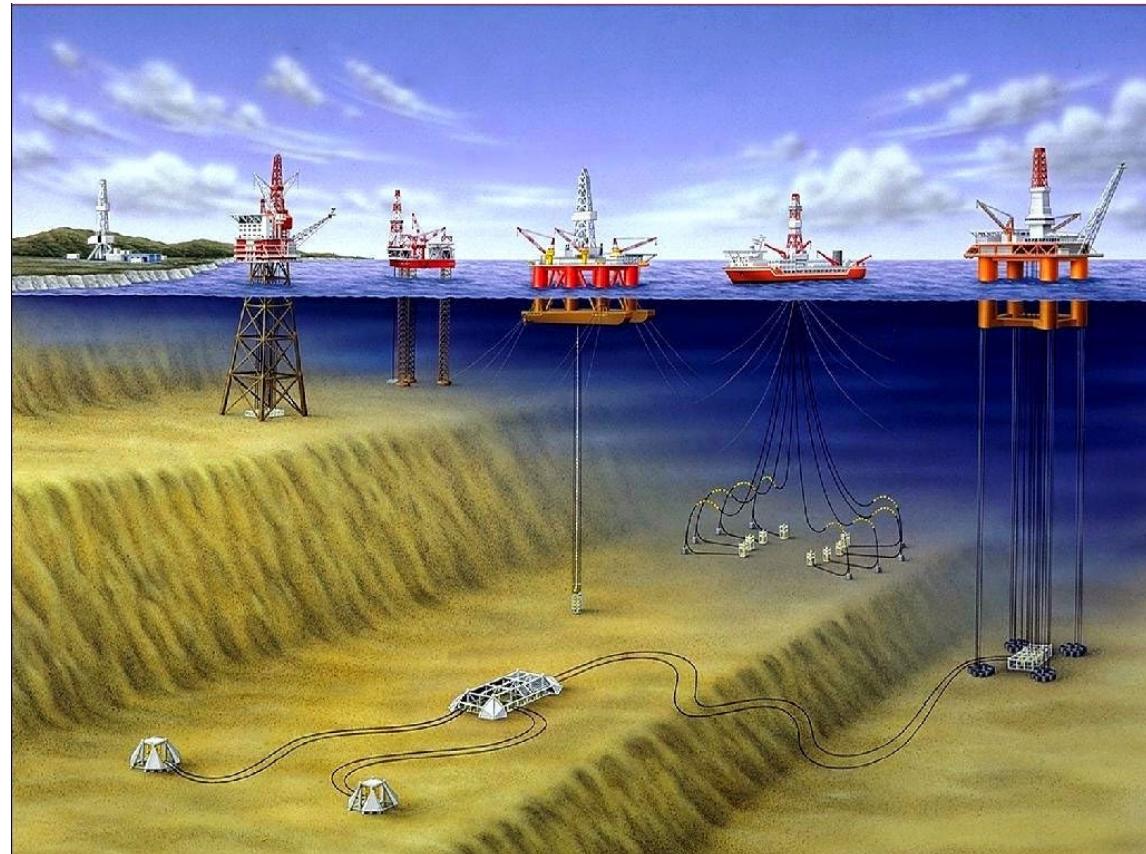


# Gulf of Mexico - Harsh Environmental

---

## Water Depth

- max: 14,000' (4,300m)
- Steep escarpment



# Gulf of Mexico - Harsh Environmental

## Intense Storms

- *Seacor Power* Tragedy

### Straight Winds Storm

- Winds: 70-80 kts (130-145 km/h)
- Max. Gust: 102 kts (188 km/h)
- Waves: rose 7-9' (2.1-2.7 m)

#### How a thunderstorm with the power of a hurricane capsized a ship

By Allison Chinchar, CNN Meteorologist

🕒 Updated 5:45 AM ET, Sat April 17, 2021



A Coast Guard boat heads toward a capsized commercial liftboat south of Port Fourchon, Louisiana, on Tuesday, April 13.

**(CNN)** — Nineteen people were on board a commercial ship when it capsized Tuesday during a thunderstorm off the Louisiana coast. But this was no ordinary storm.

# Gulf of Mexico - Harsh Environmental

---

## Catastrophic Storms

- 14 named storms
- 7 hurricanes / yr.
- 3x Cat. 3+ hurricanes / yr.

Cat. 1:

74-95 mph | 64-82 kt | 119-153 km/h

Cat. 2:

76-110 mph | 83-95 kt | 154-177 km/h

Cat. 3:

111-129 mph | 96-112 kt | 178-208 km/h

Cat. 4:

130-156 mph | 113-136 kt | 209-251 km/h

Cat. 5:

157+ mph | 137+ kt | 252+ km/h



# Gulf of Mexico - Harsh Environmental

≡ MENU

Q

HART ENERGY

## Loop Current & Loop Current Eddies

- 3+ knot Ocean Currents
- “Predictably Unpredictable”
- No True Seasonality
- Weeks/Months of Impact
- 1,000s hours of NPT /year

DEEPWATER

## Loop Currents Blamed For Big Foot Failure

Subsea Engineering News Fri, 06/26/2015 - 03:13 AM

...Chevron executives identifies **strong loop currents as the likely cause of the failure of nine of 16 tendons** that were to comprise the Big Foot tlp's four tension legs...

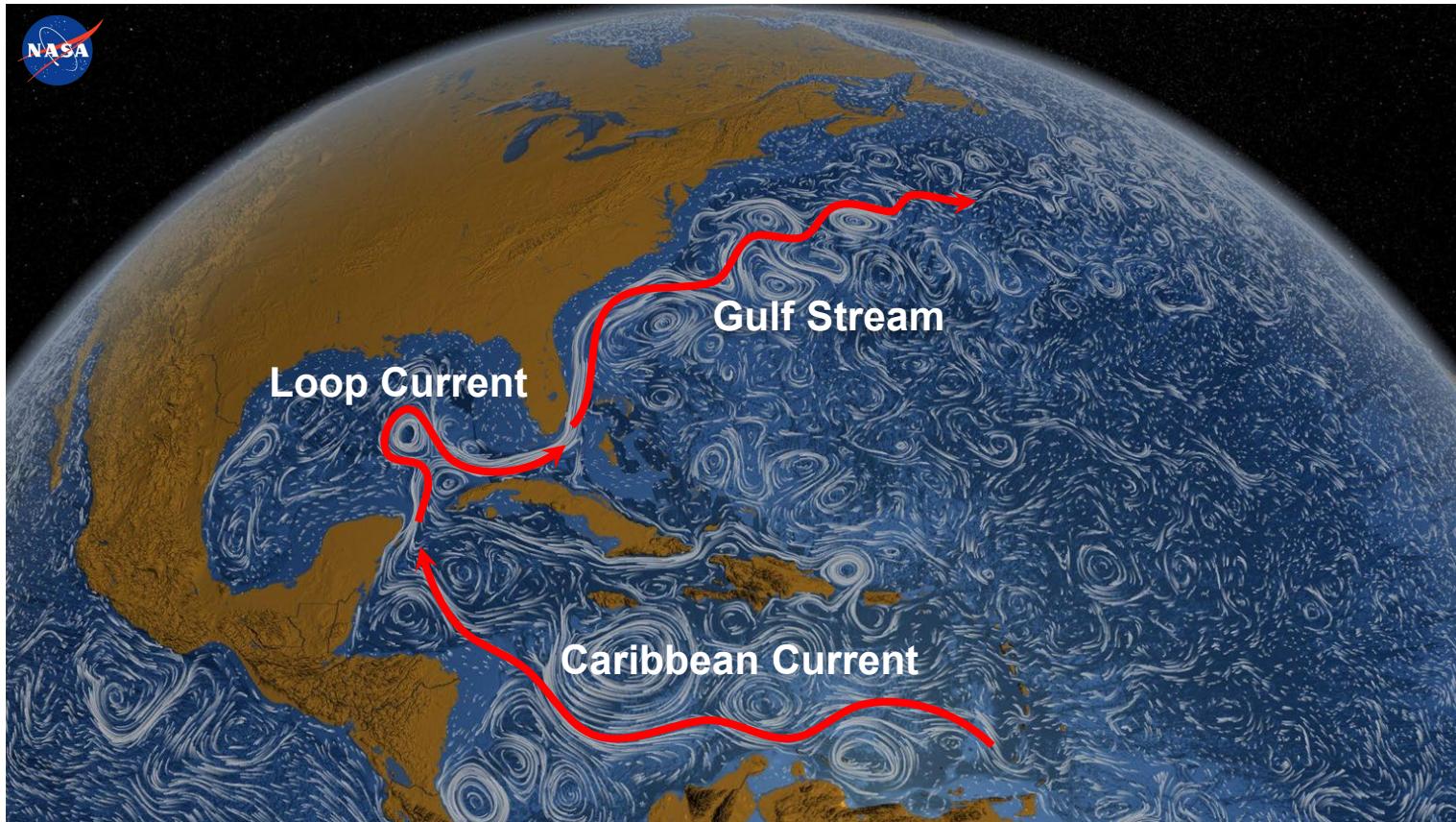


Image: <https://www.chevron.com/projects/big-foot>

Source: <https://www.hartenergy.com/news/loop-currents-blamed-big-foot-failure-104573>

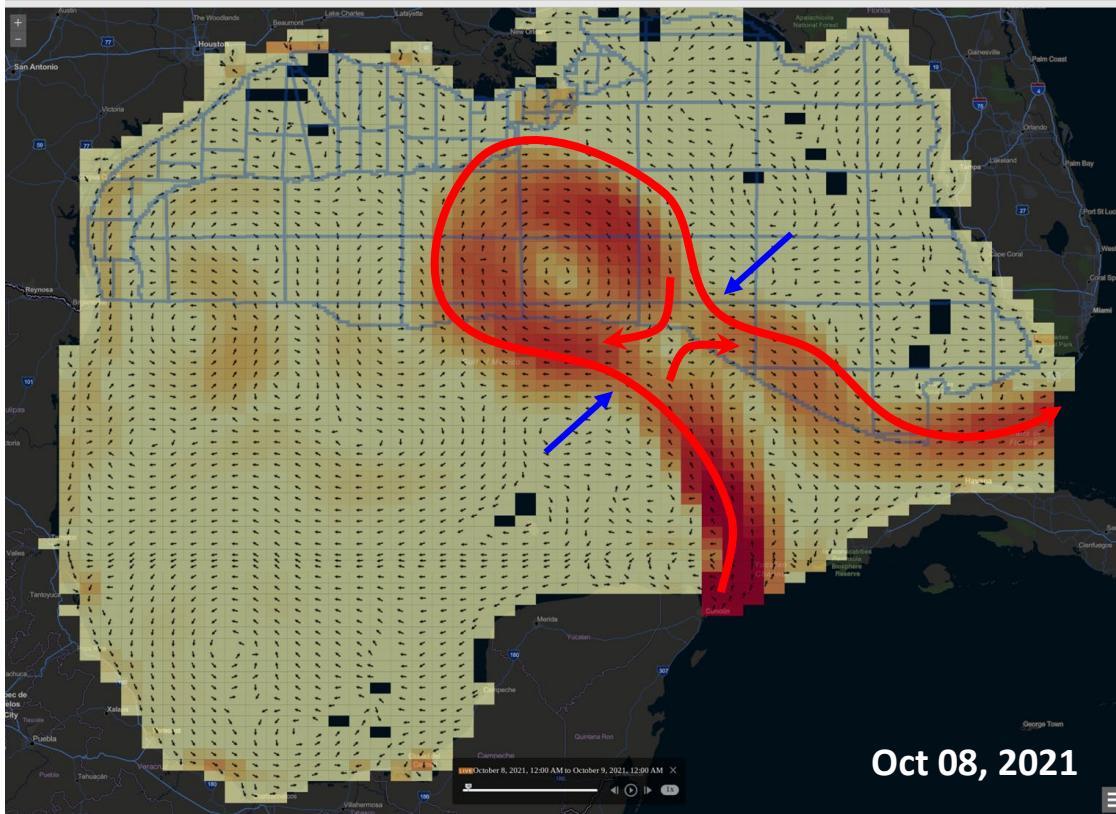
# Intra -America Seas

---



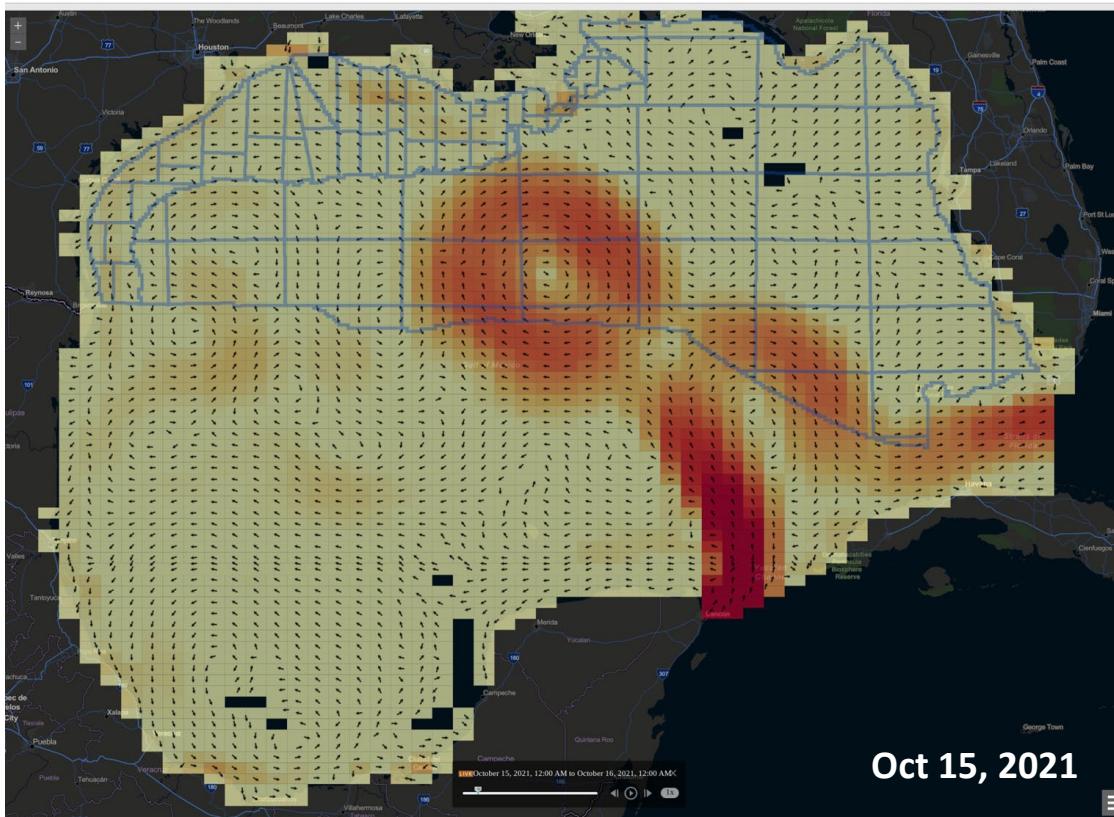
# Loop Current System

Raptor® MetOcean Dashboard & Mapping Interface



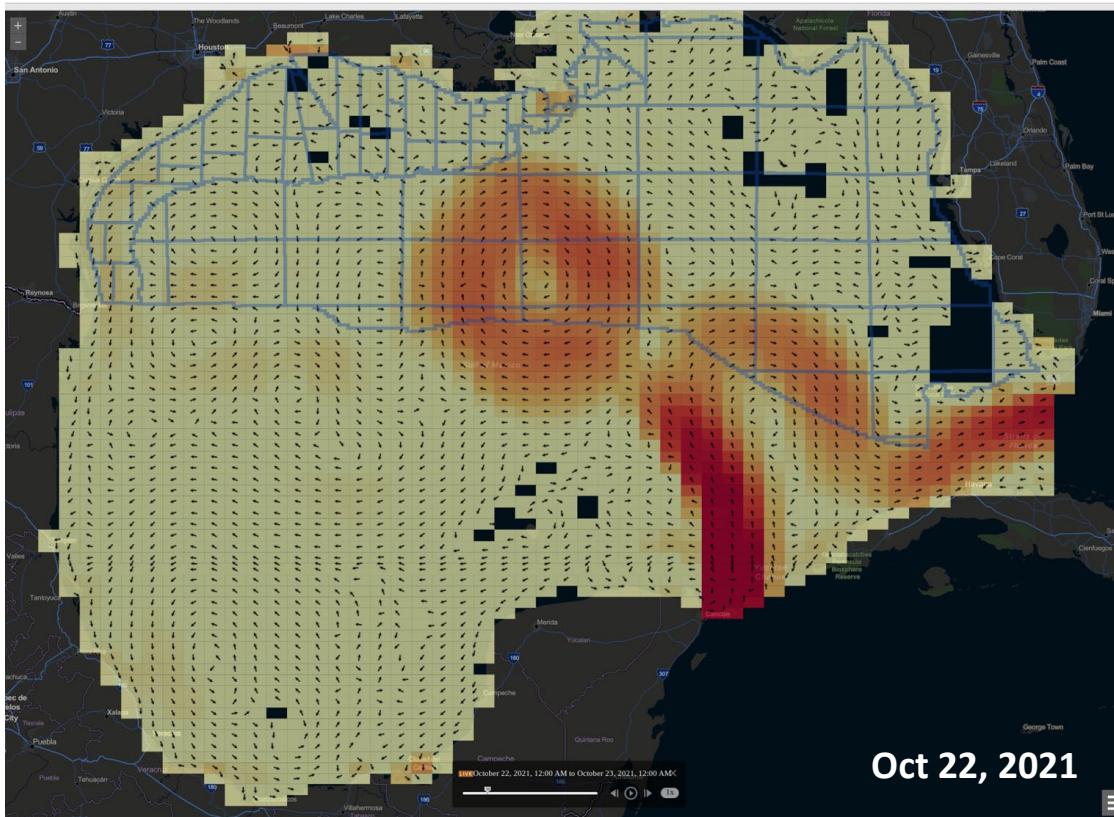
# Loop Current System

Raptor® MetOcean Dashboard & Mapping Interface



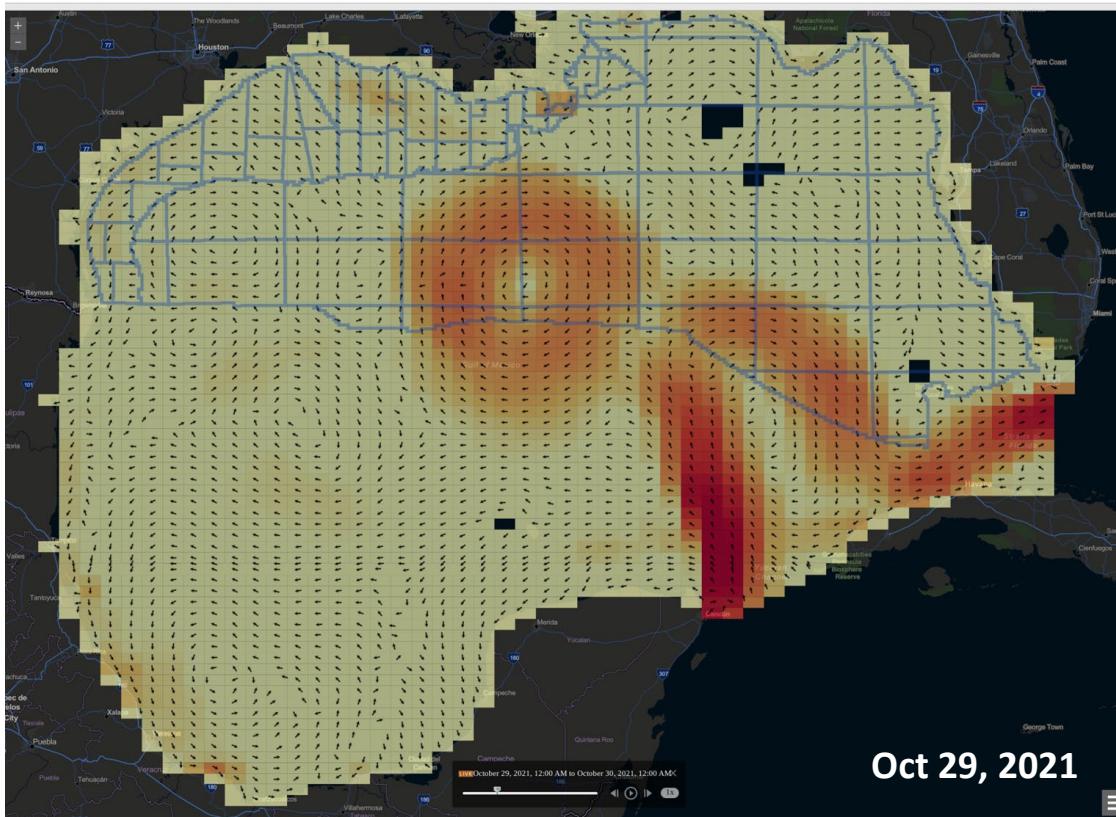
# Loop Current System

Raptor® MetOcean Dashboard & Mapping Interface



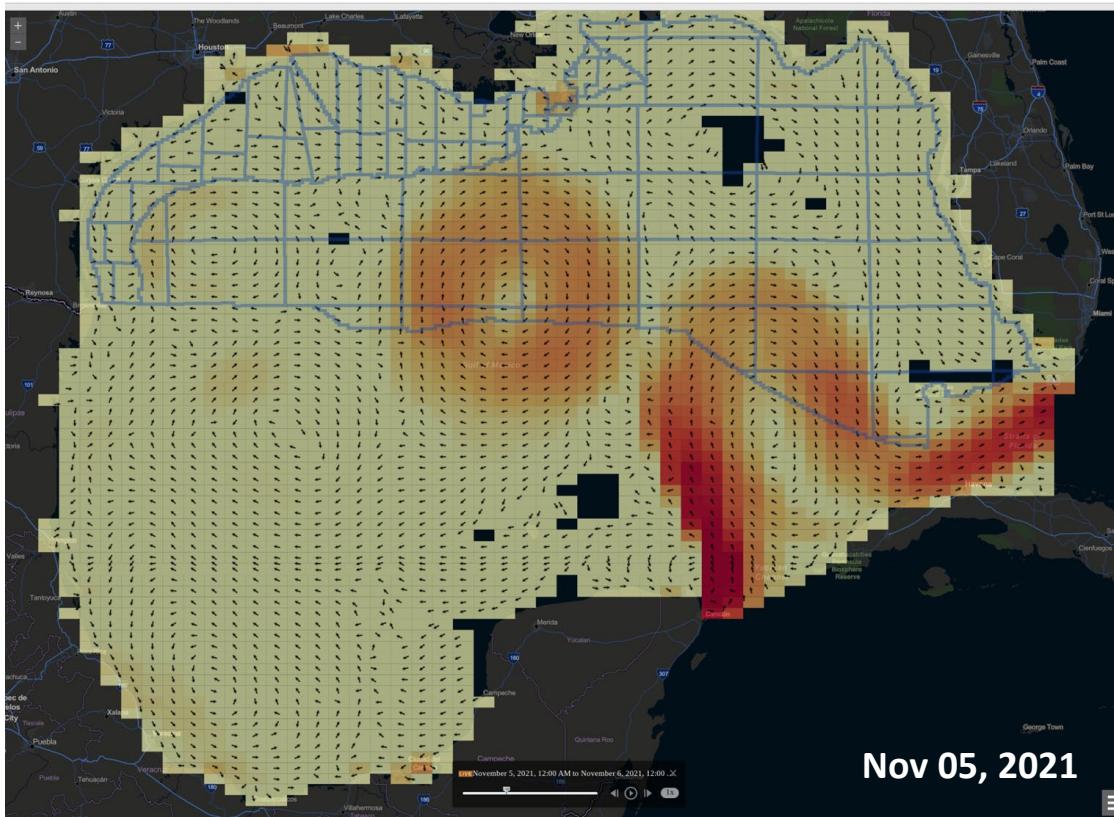
# Loop Current System

Raptor® MetOcean Dashboard & Mapping Interface



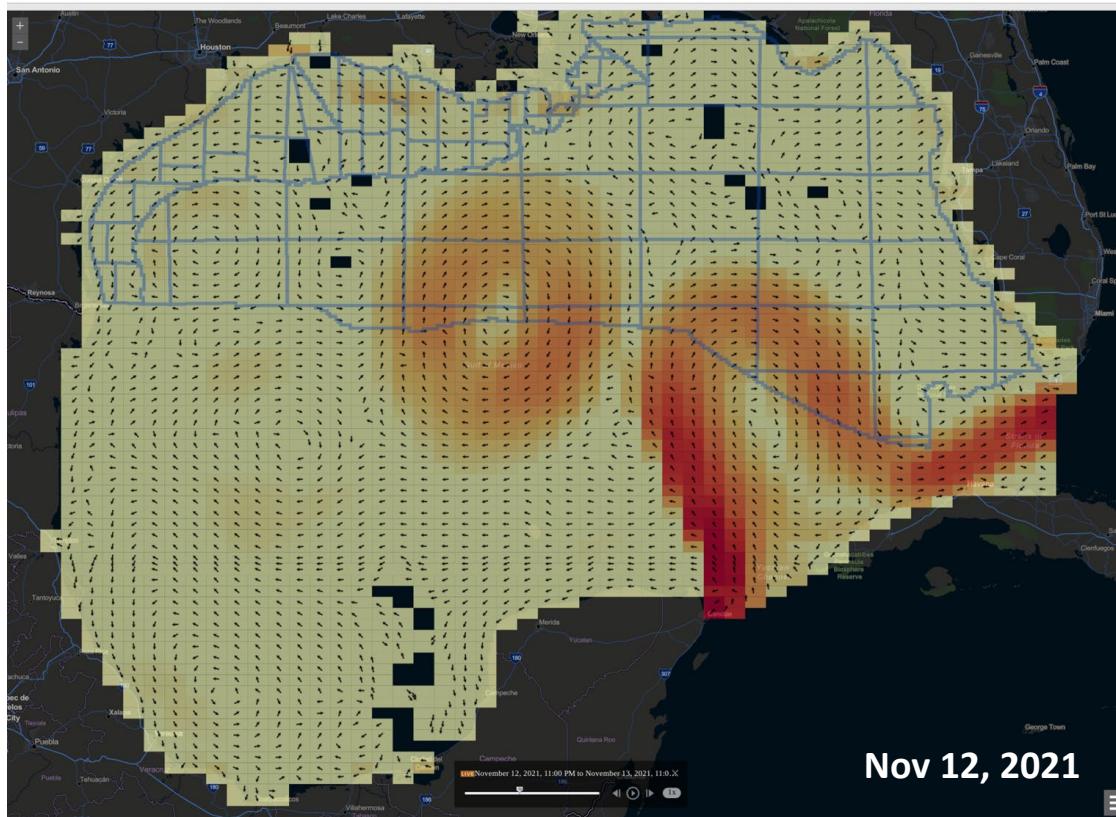
# Loop Current System

Raptor® MetOcean Dashboard & Mapping Interface



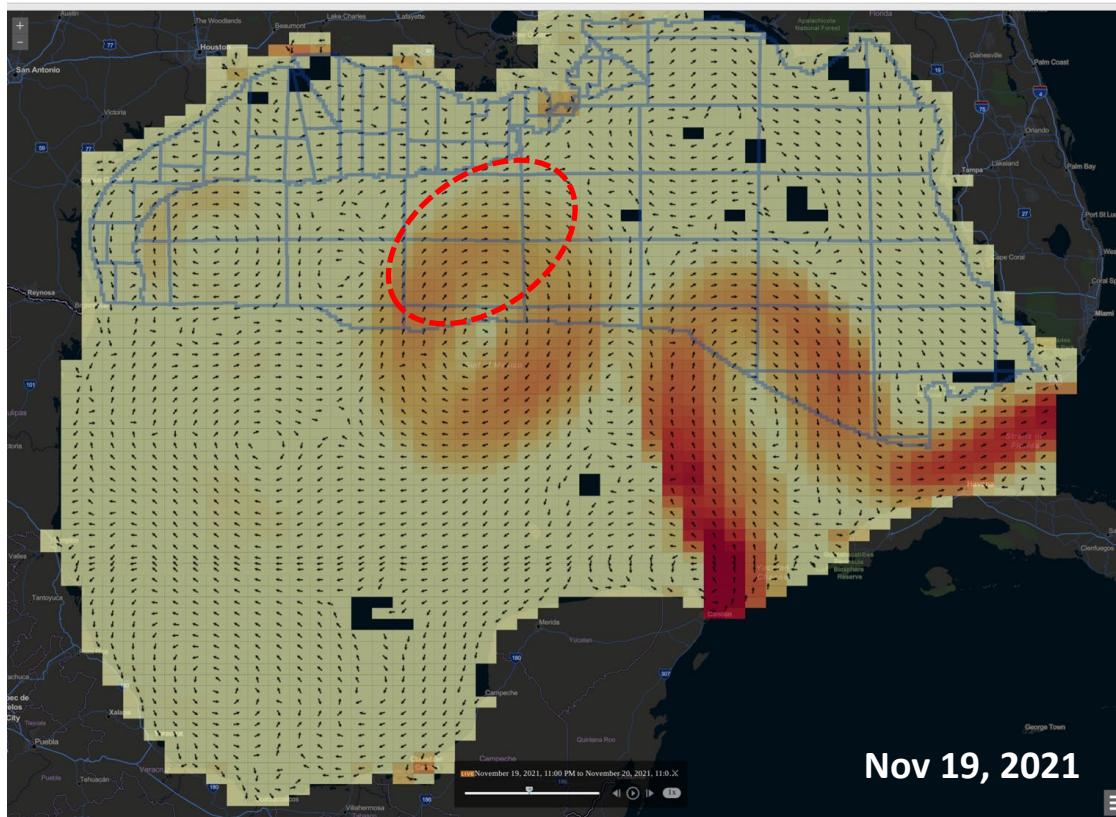
# Loop Current System

Raptor® MetOcean Dashboard & Mapping Interface



# Loop Current System

Raptor® MetOcean Dashboard & Mapping Interface



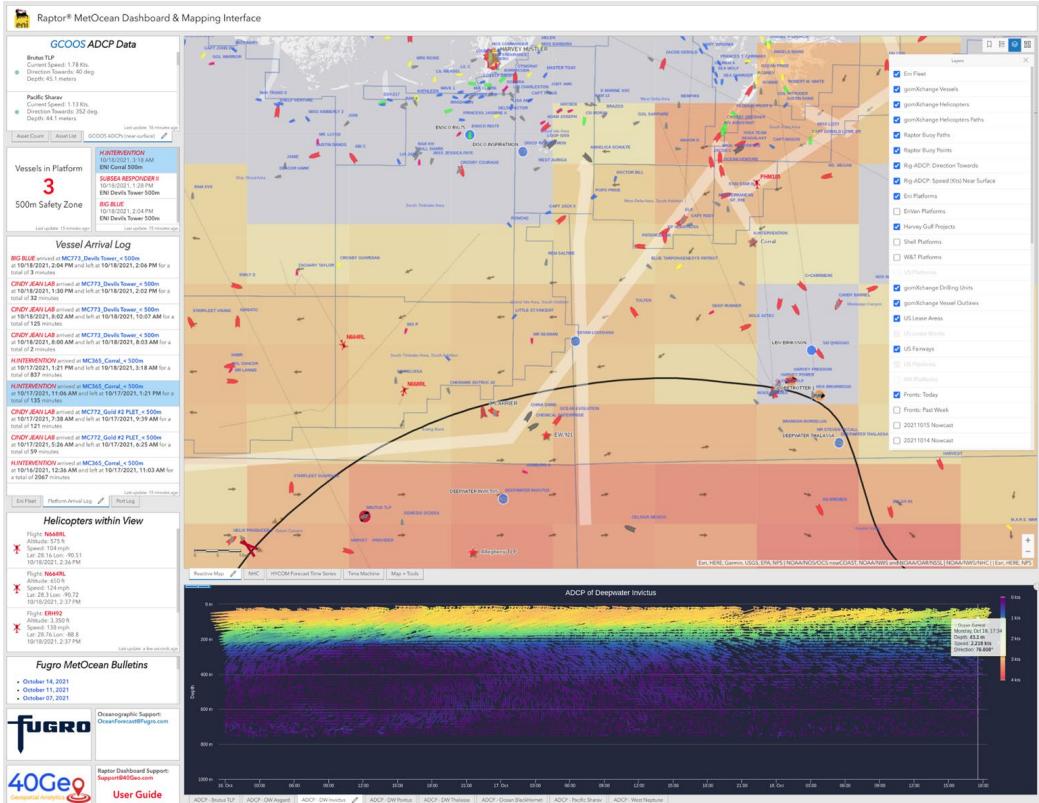
# Eni - Gulf of Mexico

## Operations:

- 3x Production Platforms
- Decommissioning
- Drilling
- Inspection

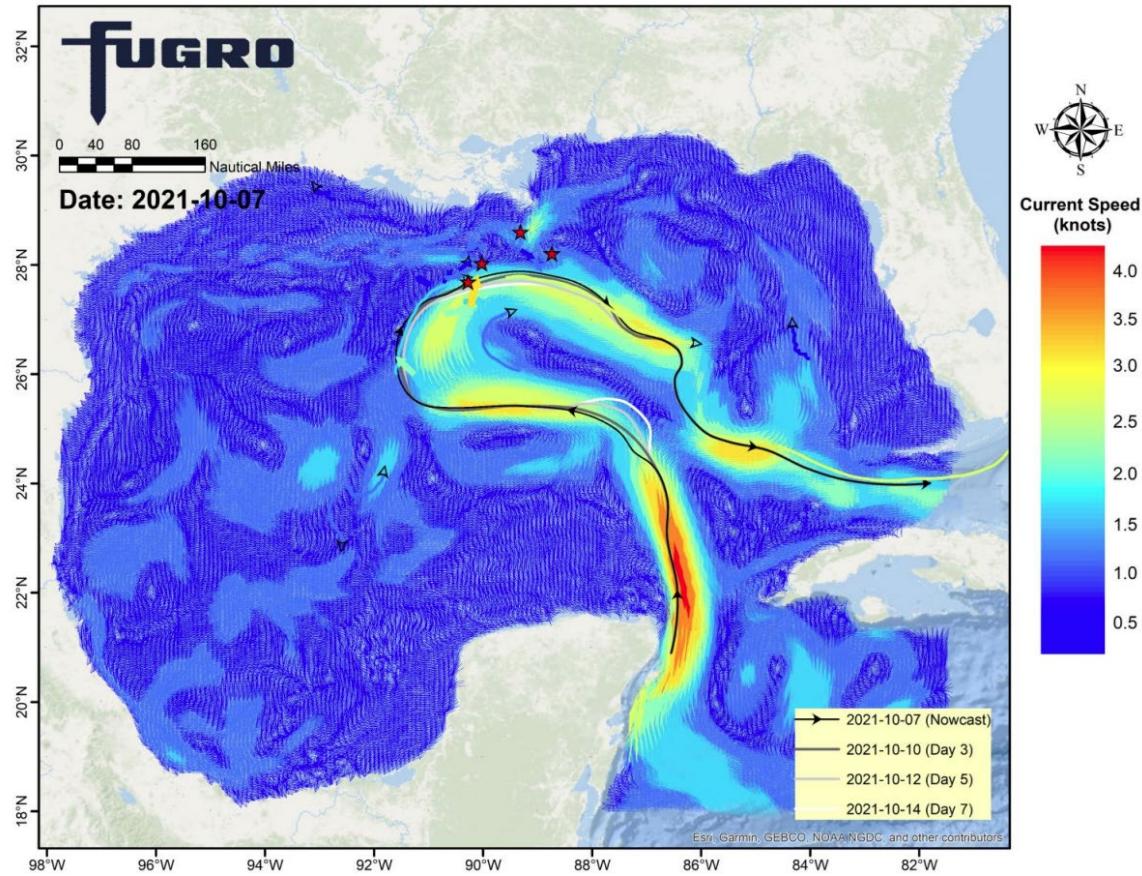
## Logistics:

- 6x Fleet vessels + adhoc fleet
- Crew change/Resupply
- Up to 4x helicopters

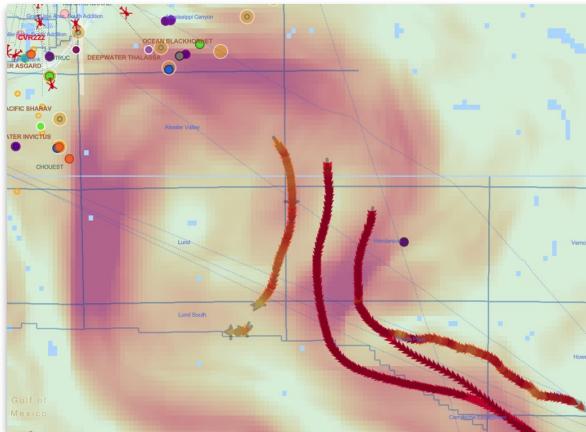
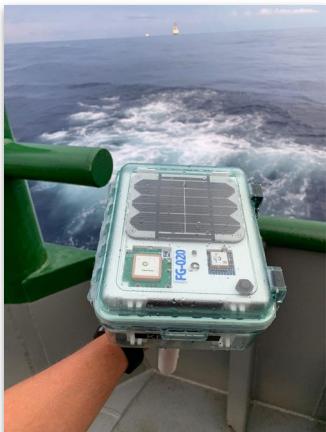
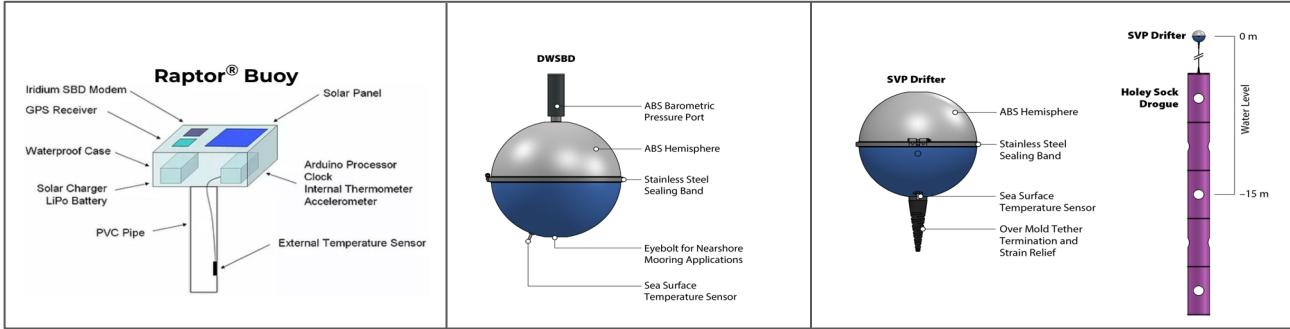


# Eni - Loop Current Monitoring Requirements

- Daily Frontal Analysis
  - In-situ Data
  - Remotely-sensed Data
- Twice Weekly Reports
  - Nowcast
  - 3-5 day Forecast
  - 7 day outlook
- Phone & Email Consultation
- Data & Analysis via COP
  - Frontal Analysis
  - Forecast
  - Vessel Tracking
  - Helicopter Tracking
  - Hurricane Tracking



# In-Situ Data

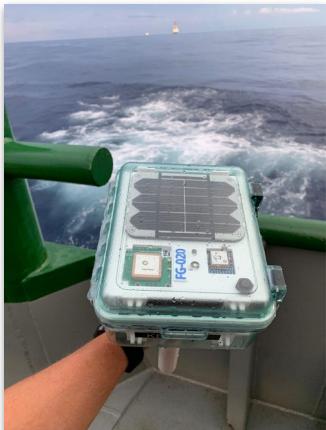


**...the instruments  
cannot be regarded as  
marine debris...**

**fugro**



# In-Situ Data



Find address or place

Allegheny T.

6.64 Nautical Miles

Measurement

Measurement Result

Clear

Drifting Buoys Points: FG-020

10/24/2021, 11:02 AM

25

1.39

84.24

2

6

13

38

27.65

-90.16

300,434,065,966,270

FG-020

FG-020

...

Zoom to

27.670 -90.196 Degrees

Reactive Map NHC HYCOM Forecast Time Series Time Machine Map + Tools

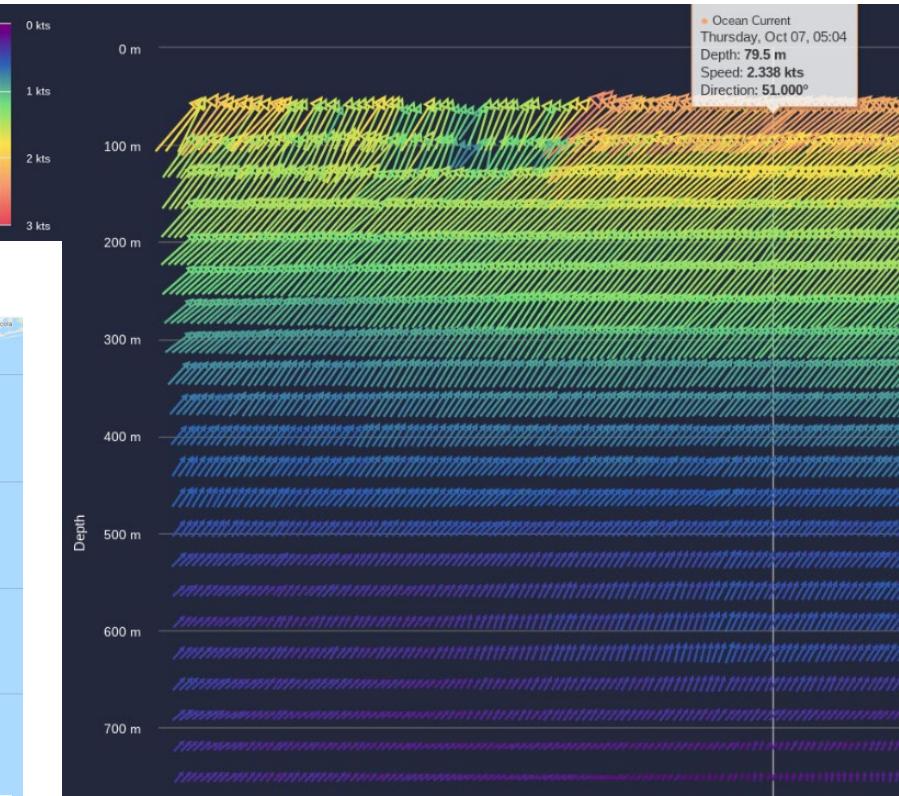
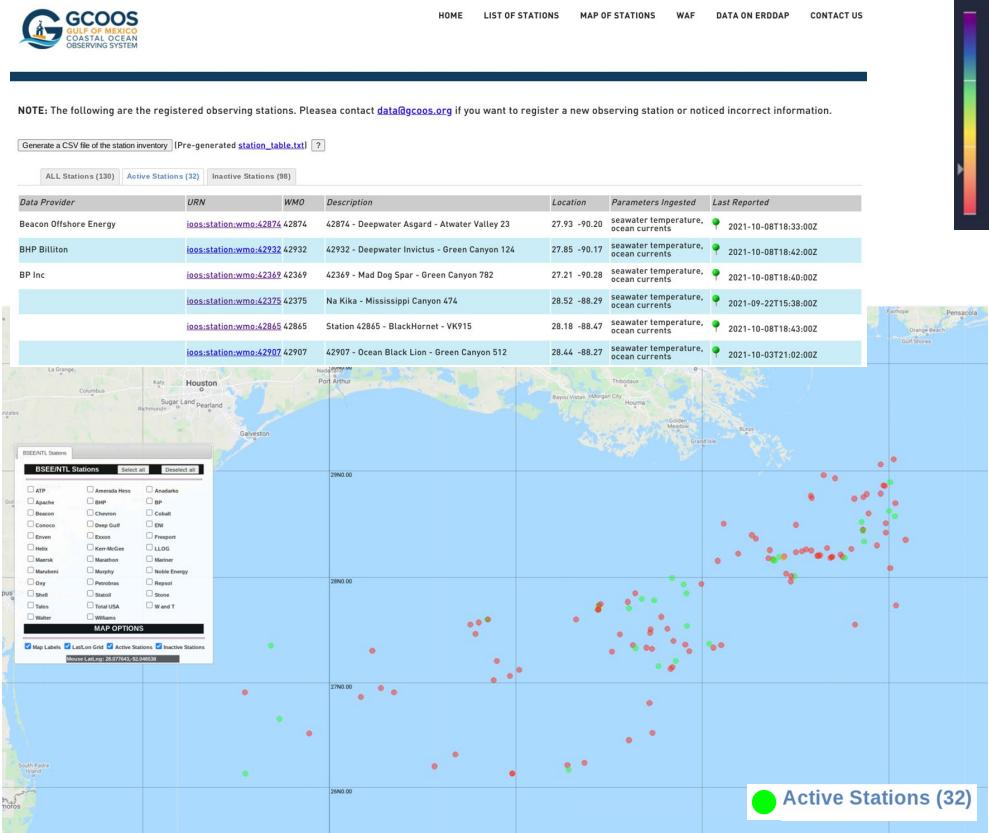
Esri, HERE, Garmin, INCREMENT P, USGS, EPA | NOAA/NOS/OCS newCOAST, NOAA/NWS and NOAA/...

POWERED BY esri

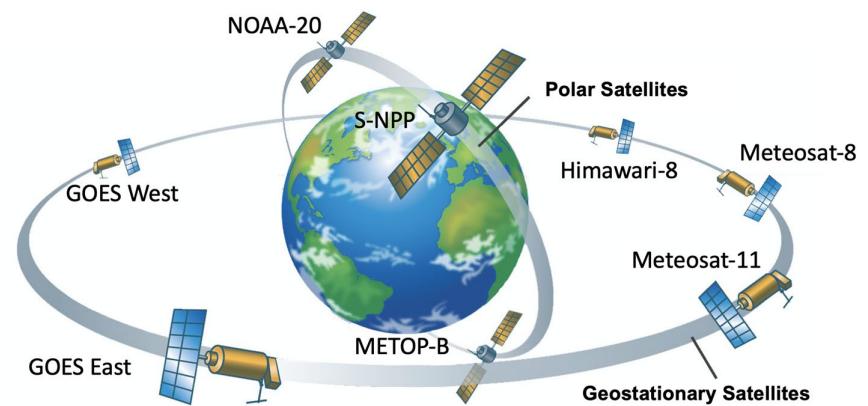
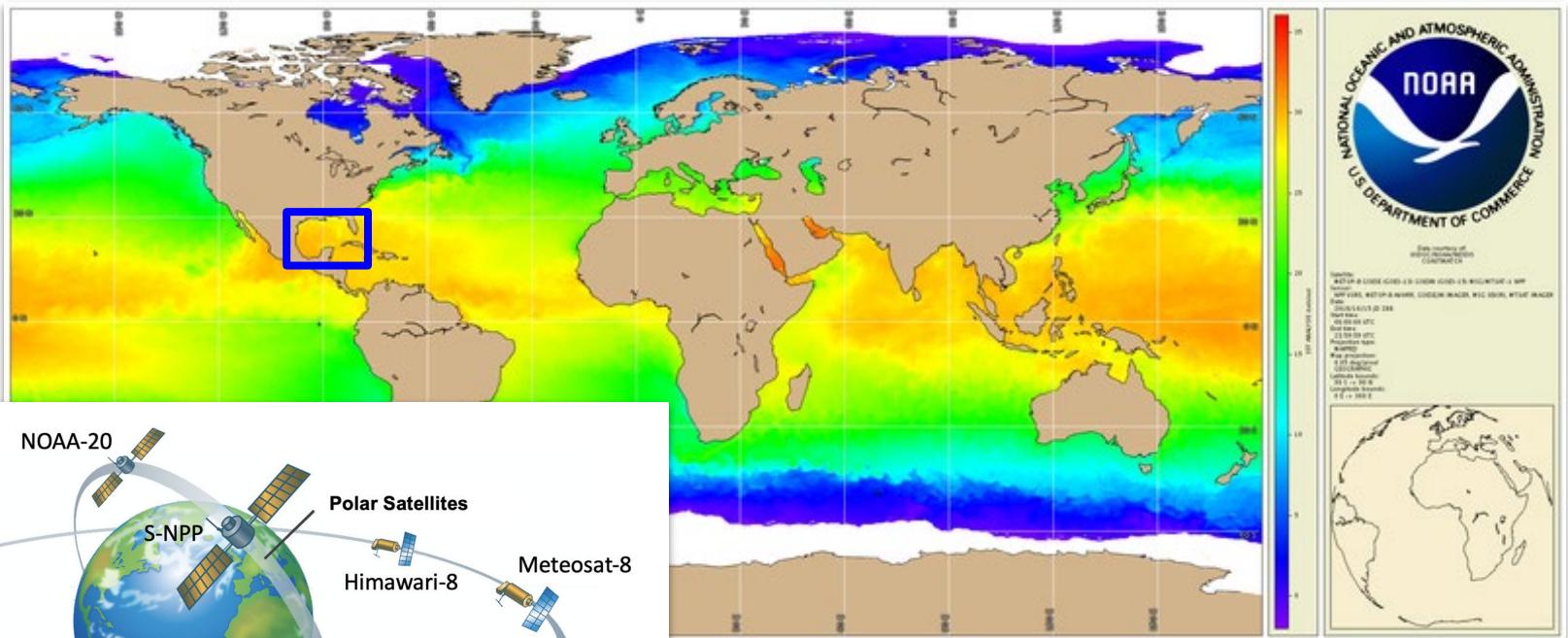
**gomXchange Drifting Buoys Points: FG-020**

time	10/24/2021, 11:02 AM
heading	25
speed	1.39
water_temp	84.24
wave_height	2
wave_period	6
ave_pitch	13
max_pitch	38
latitude	27.65
longitude	-90.16
imei	300,434,065,966,270
name	FG-020
id	FG-020

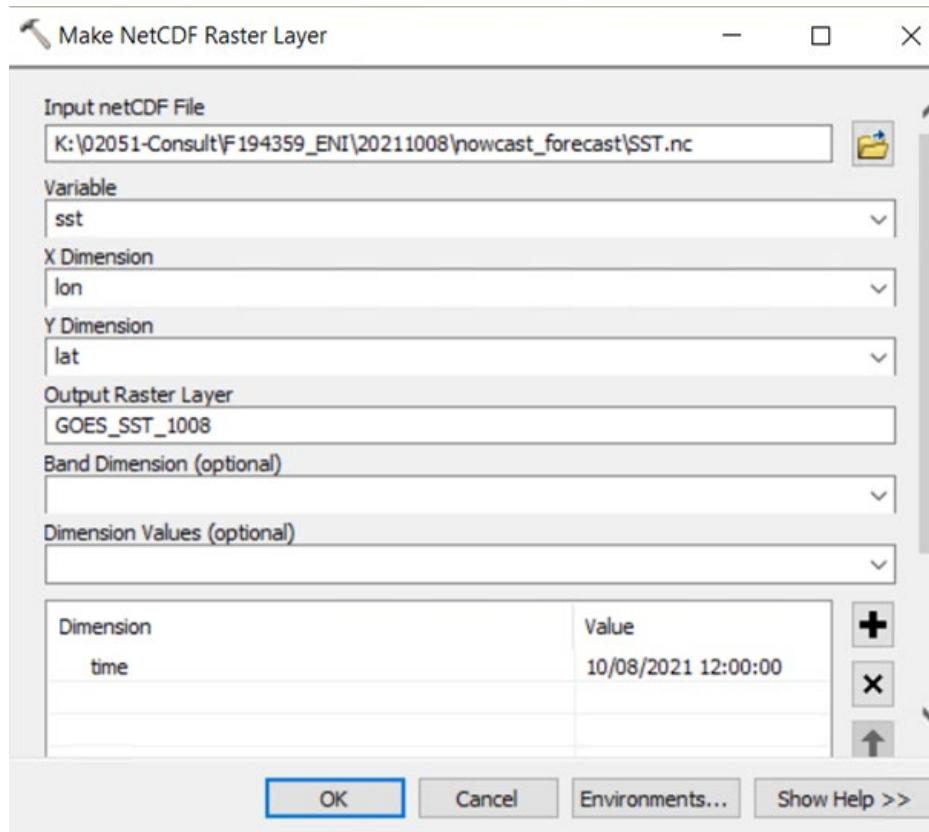
## In-Situ Data



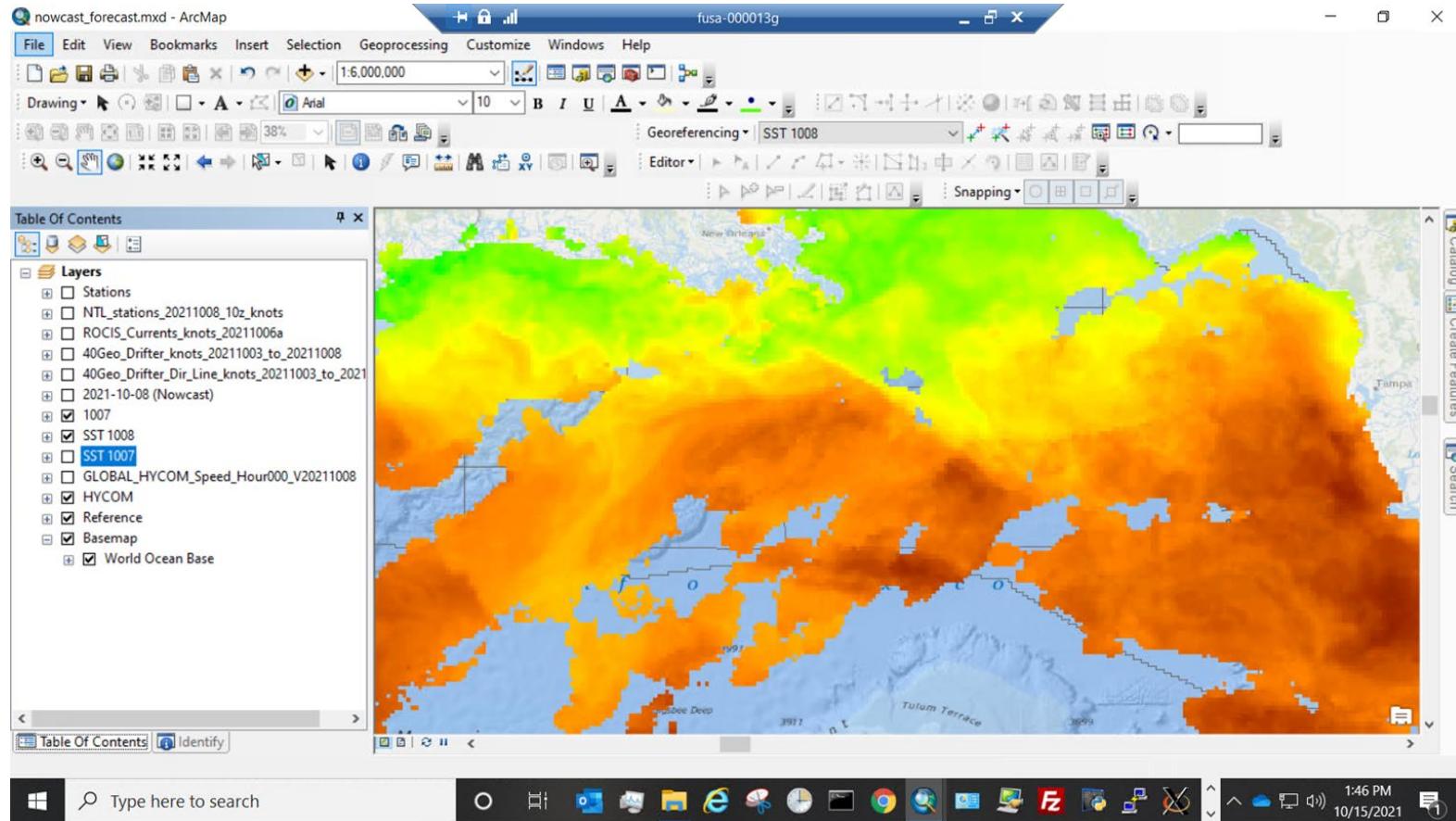
# Remotely -Sensed Data



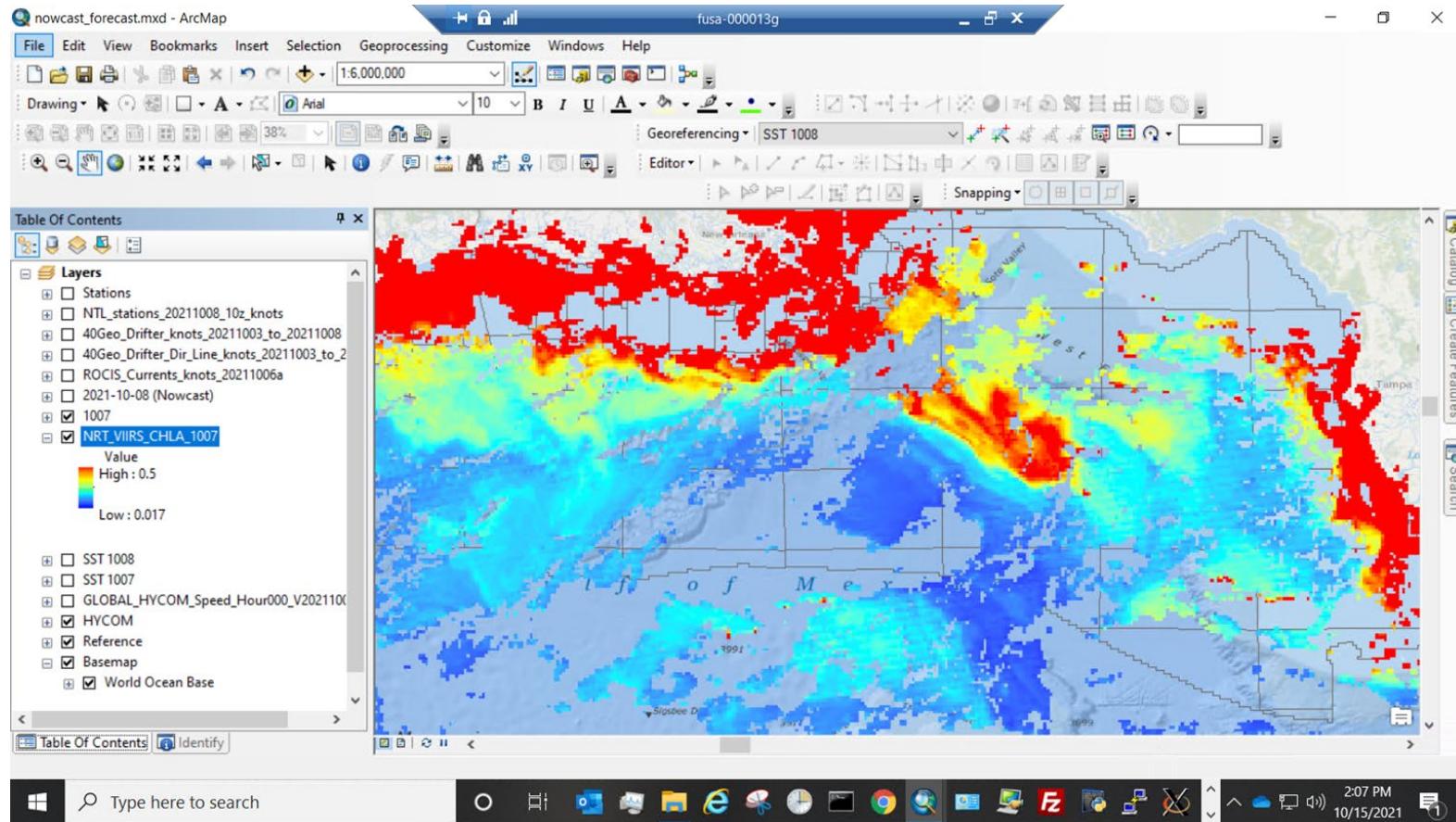
# SST



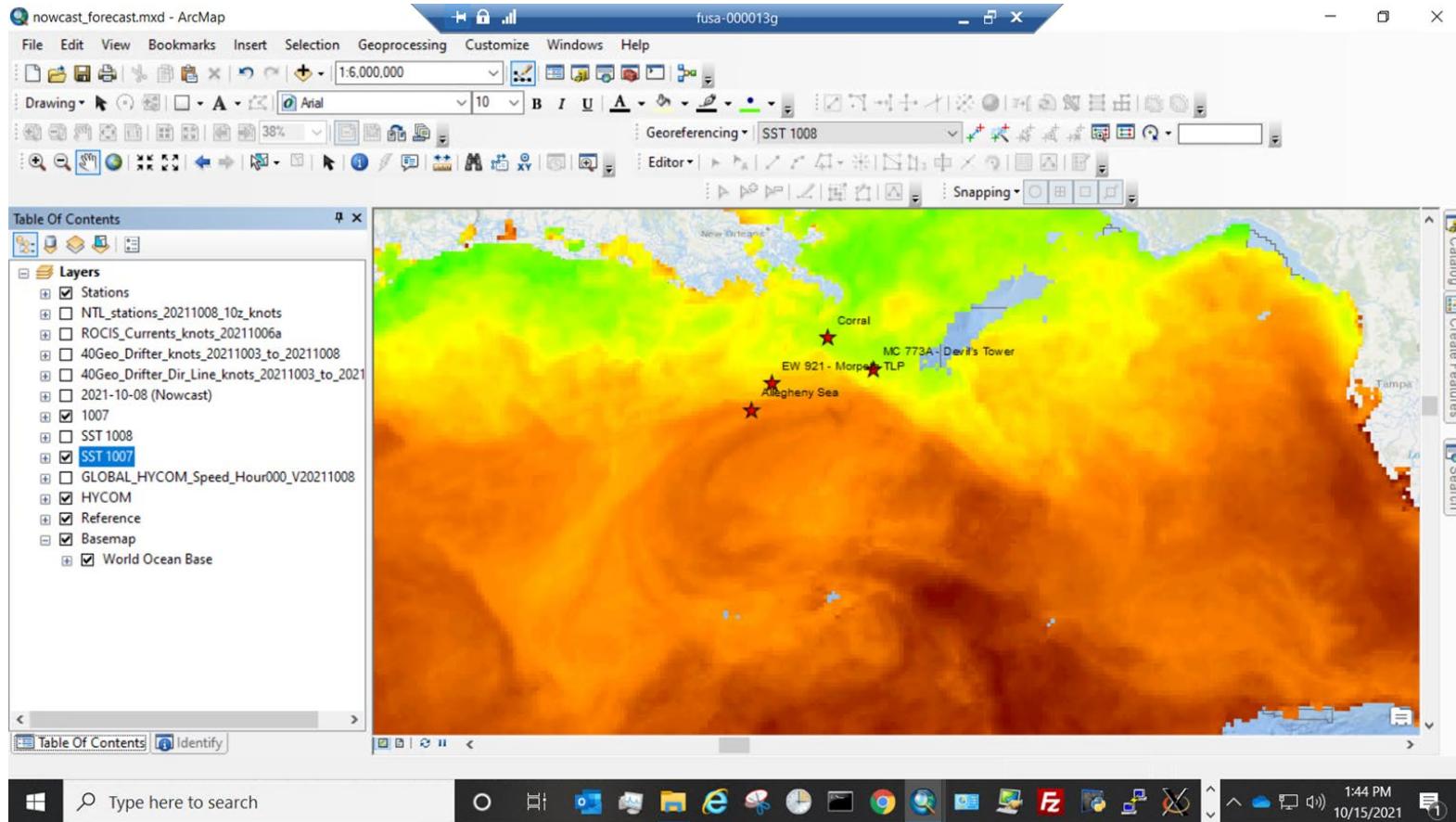
# SST



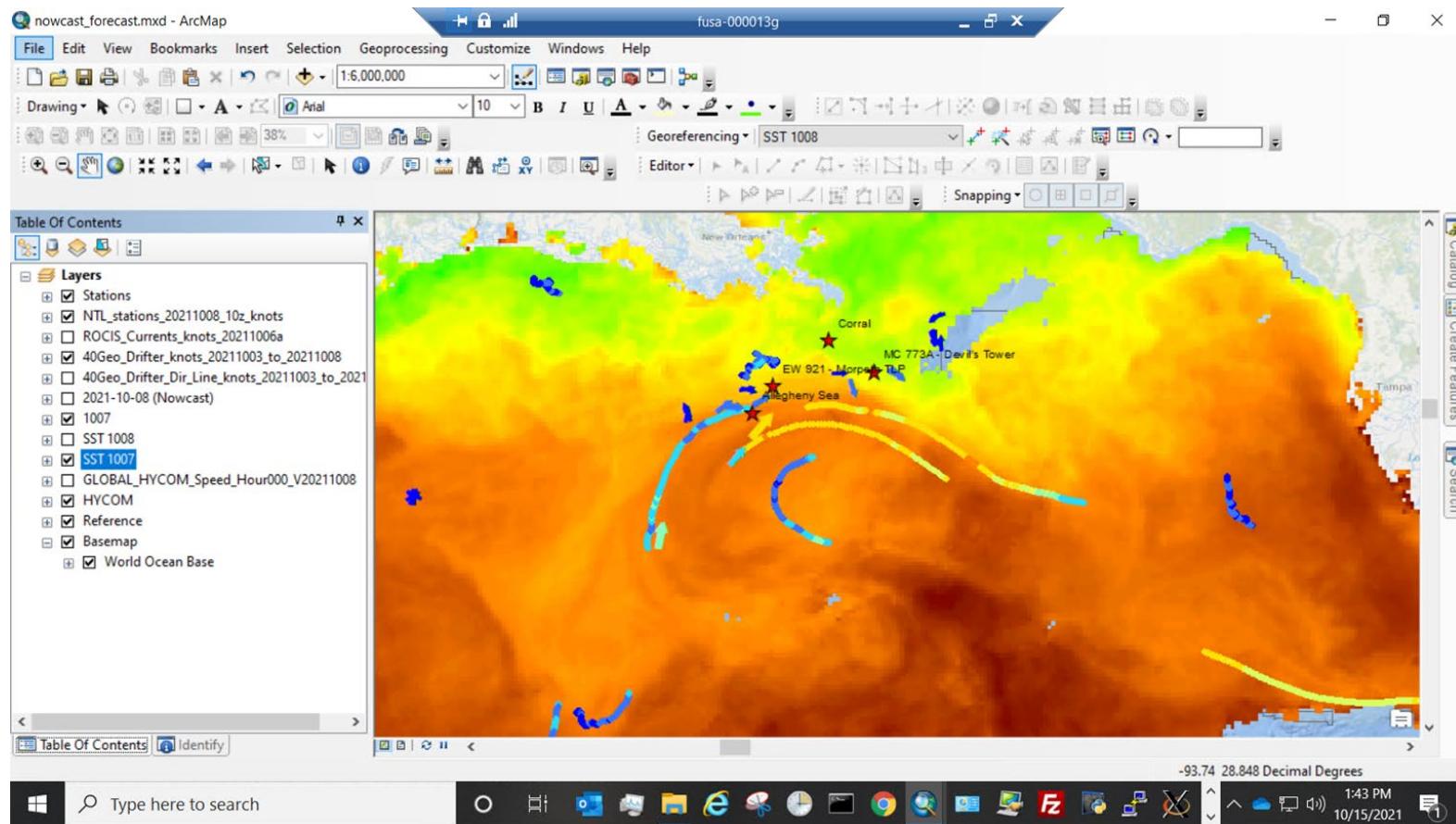
# Ocean Color



# 2-day SST



# 2-day SST + Buoys + ADCPs

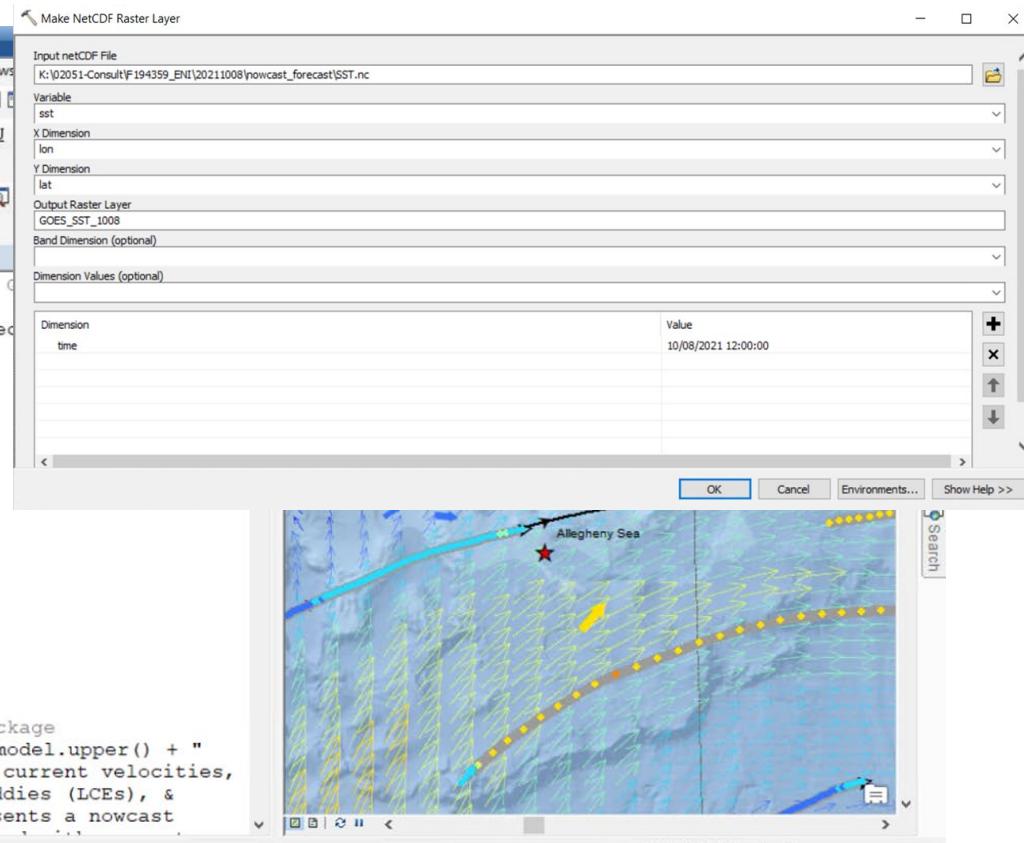


# HYCOM Nowcast

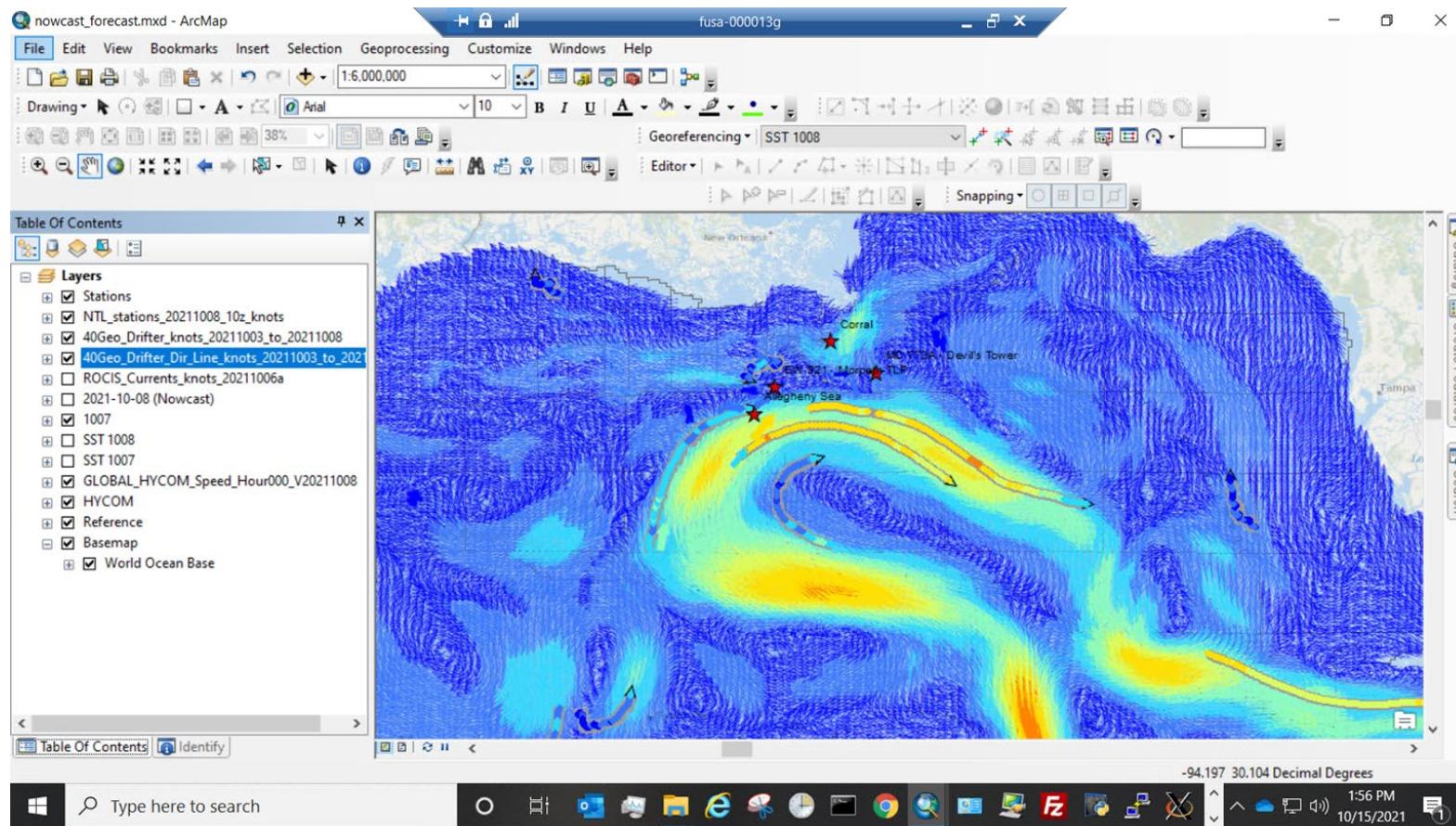
nowcast\_forecast\_zoom.mxd - ArcMap

```
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows
Drawing A Arial 10 B I U
38%
Python
...
... #Sets mask to limit raster processing to the
... GoM_mask = "GoM_mask"
... env.mask = env.workspace + "/Cdrive_eddy_forecast"
shape
...
... #NC variables for speed
... inVariables ="water_u;water_v;lat;lon"
... SSH_NC_variables = "surf_el;lat;lon"
... inXVariable = "lon"
... inYVariable = 'lat'
... rowDimensions = "lat;lon"
... ZVariable = ''
... MVariable = ''
... dimensionValues = ''
... valueSelectionMethod = 'BY_VALUE'
... config_keyword = "#"
... speed = 'Speed'
... dir = 'Direction'
... nc = '.nc'
...
... # Description/Summary/Tag Info needed for package
... Summary_pkg = "We have used the Global " + model.upper() + "
forecast product to generate figures of surface current velocities,
locations of Loop Current (LC) & Loop Current Eddies (LCEs), &
areas of strong current speed. This package presents a nowcast
"

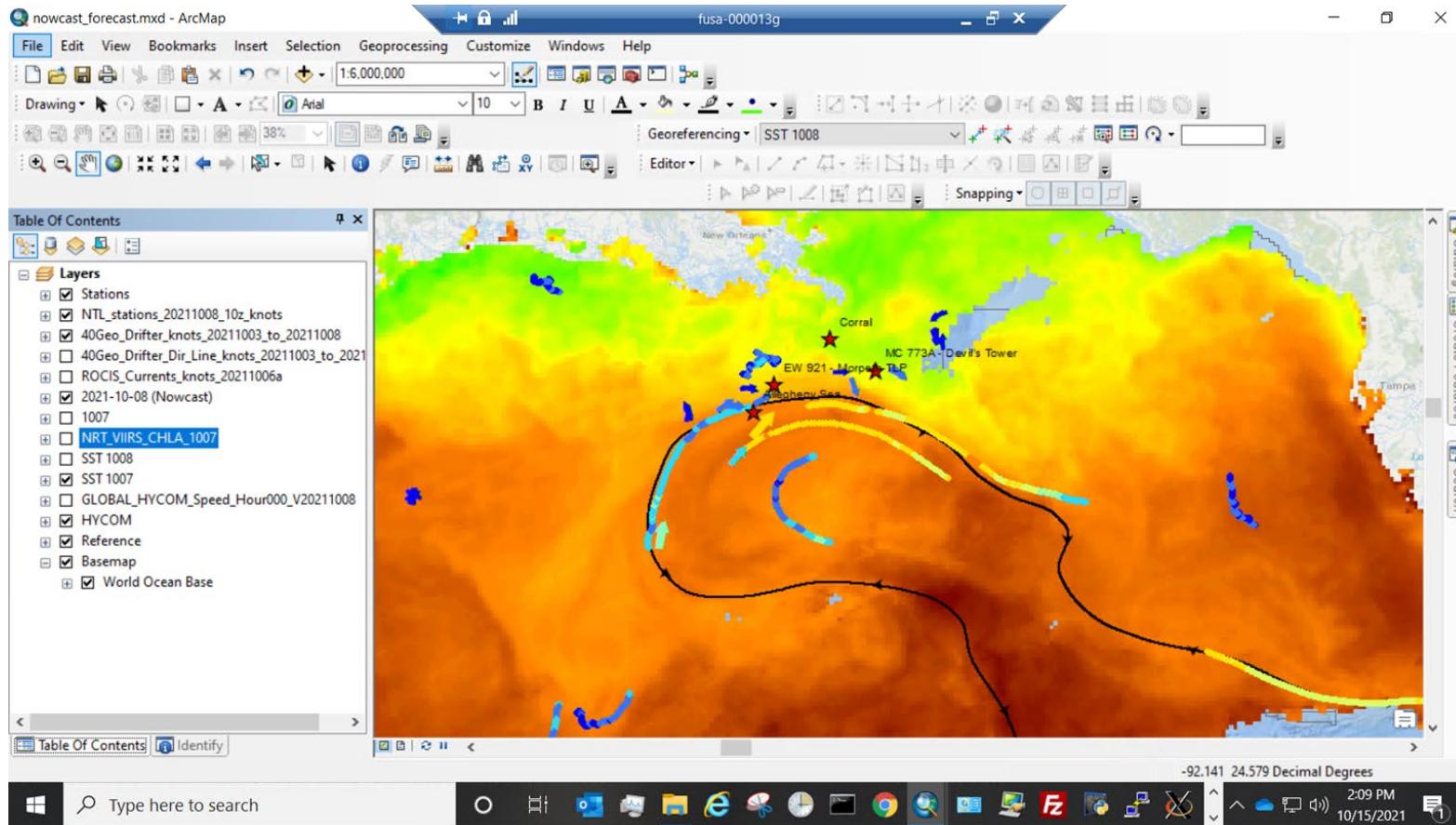
```



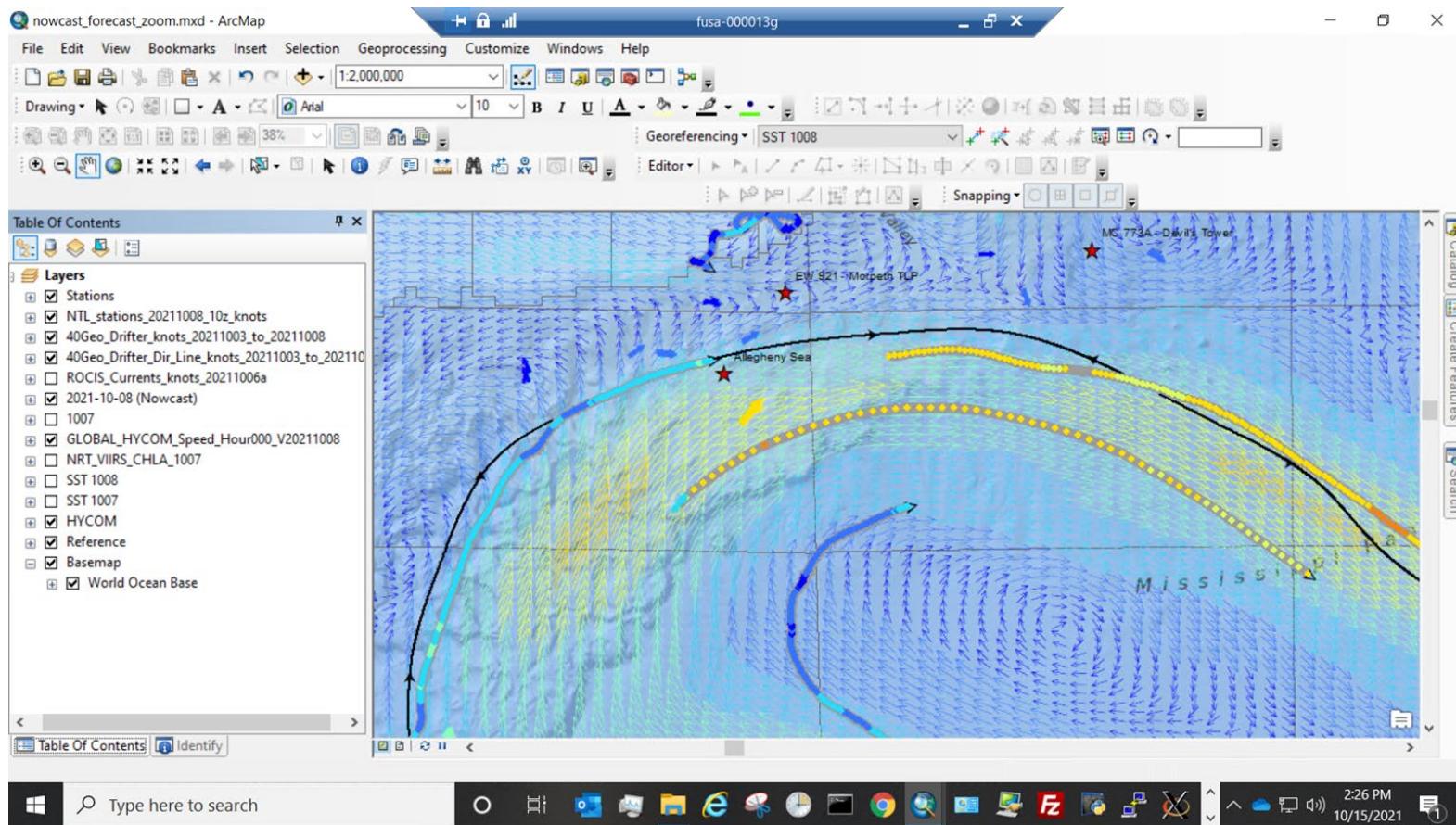
# HYCOM Nowcast



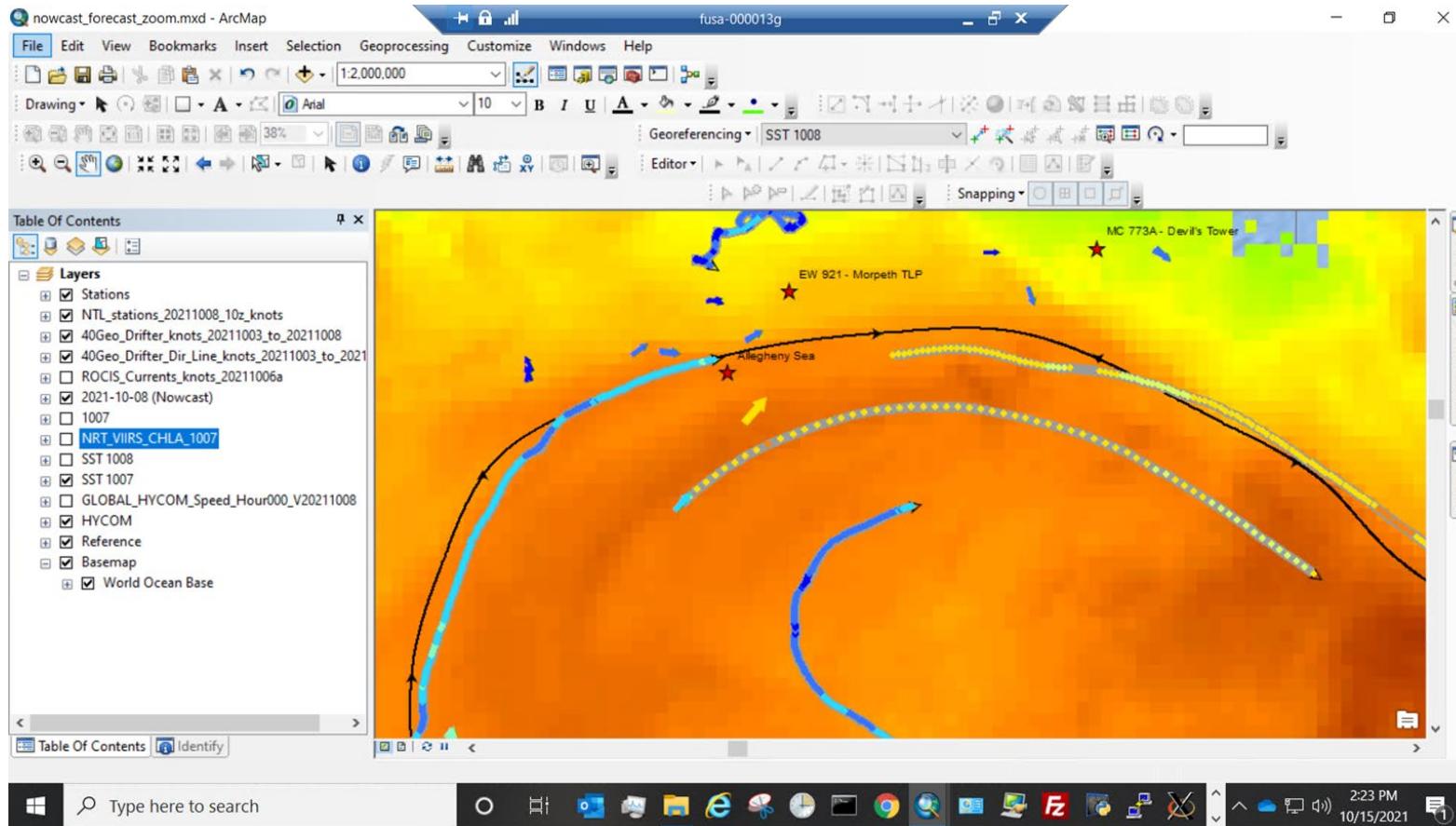
# Frontal Analysis



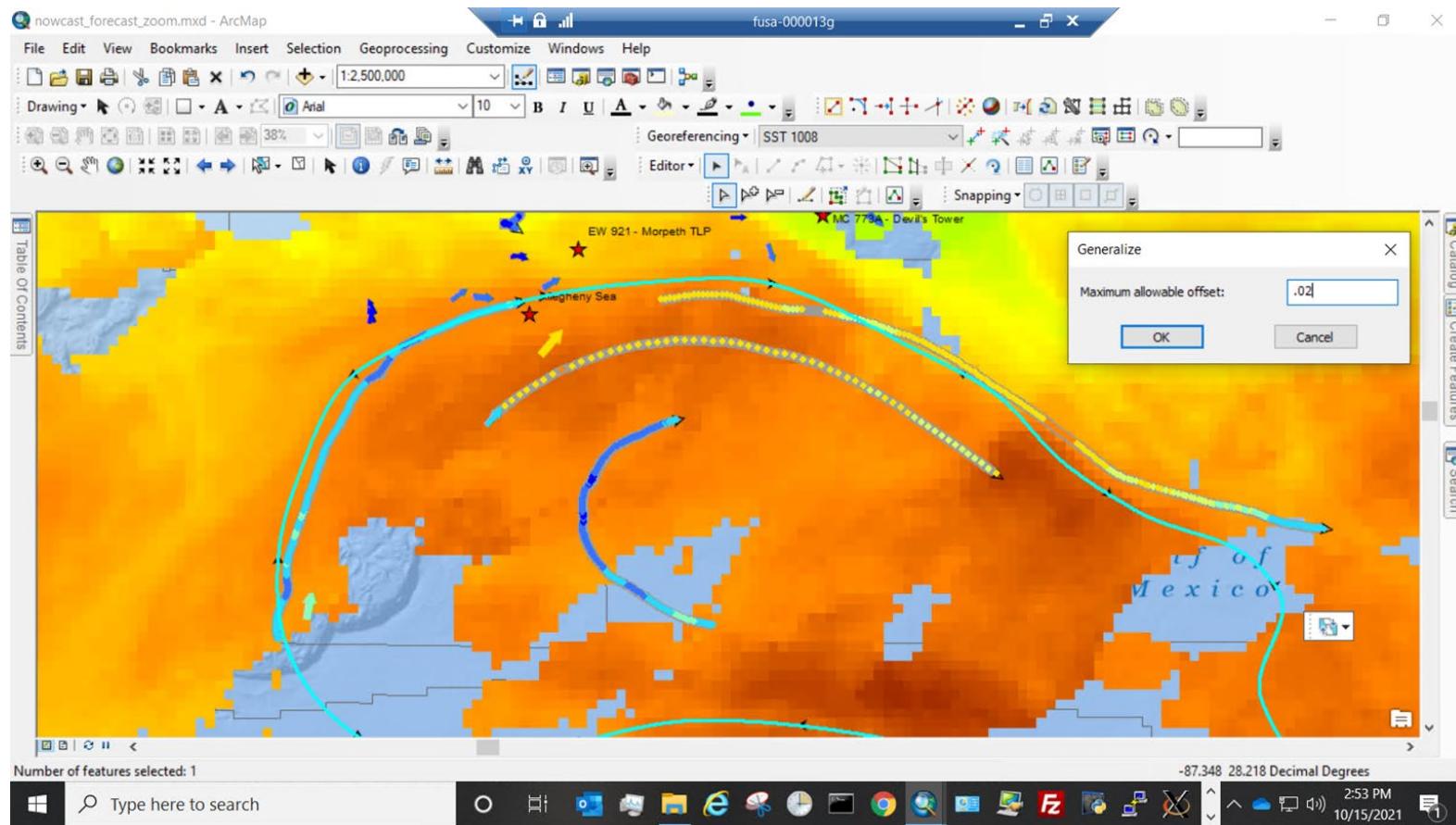
# Frontal Analysis



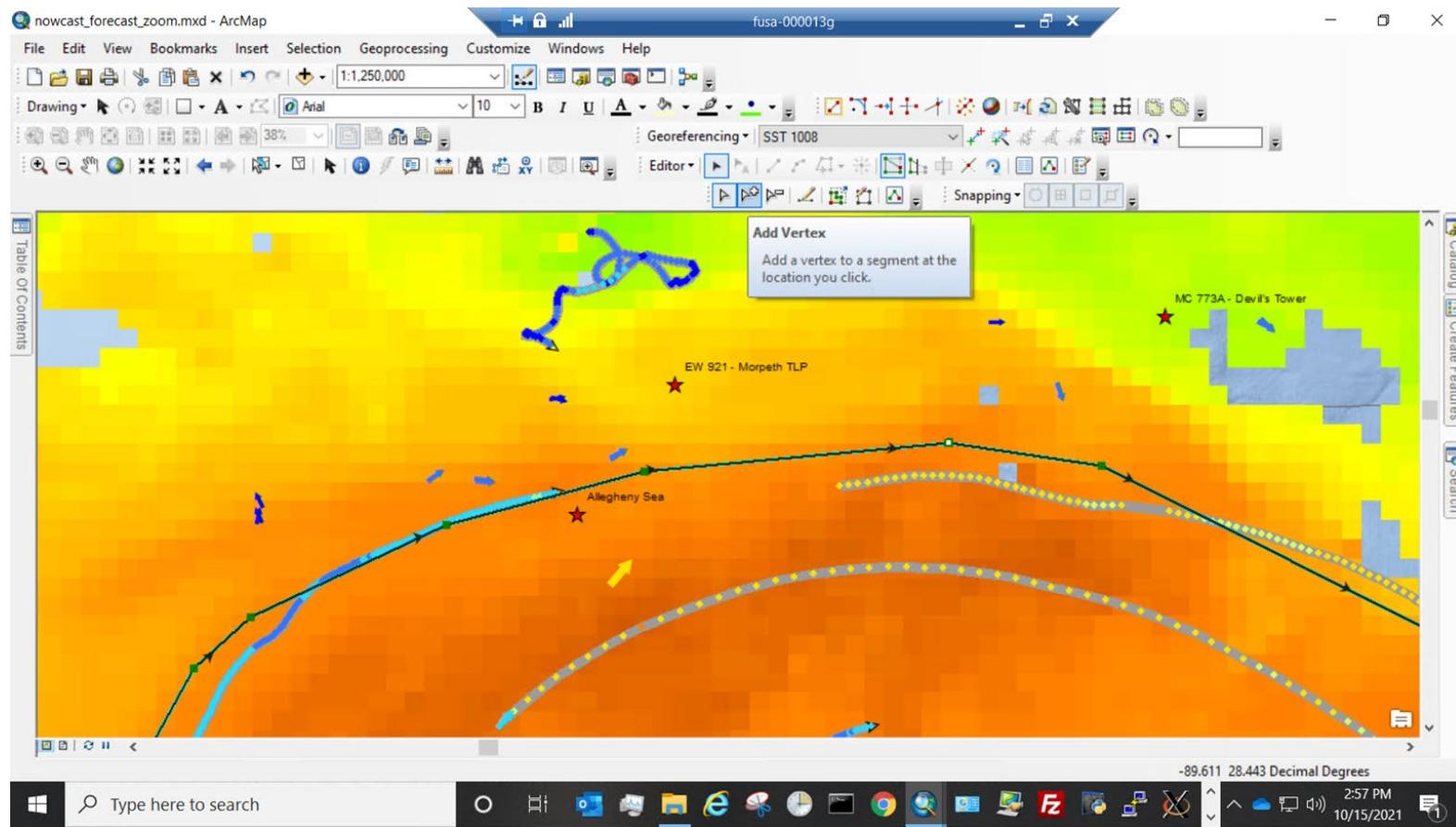
# Frontal Analysis



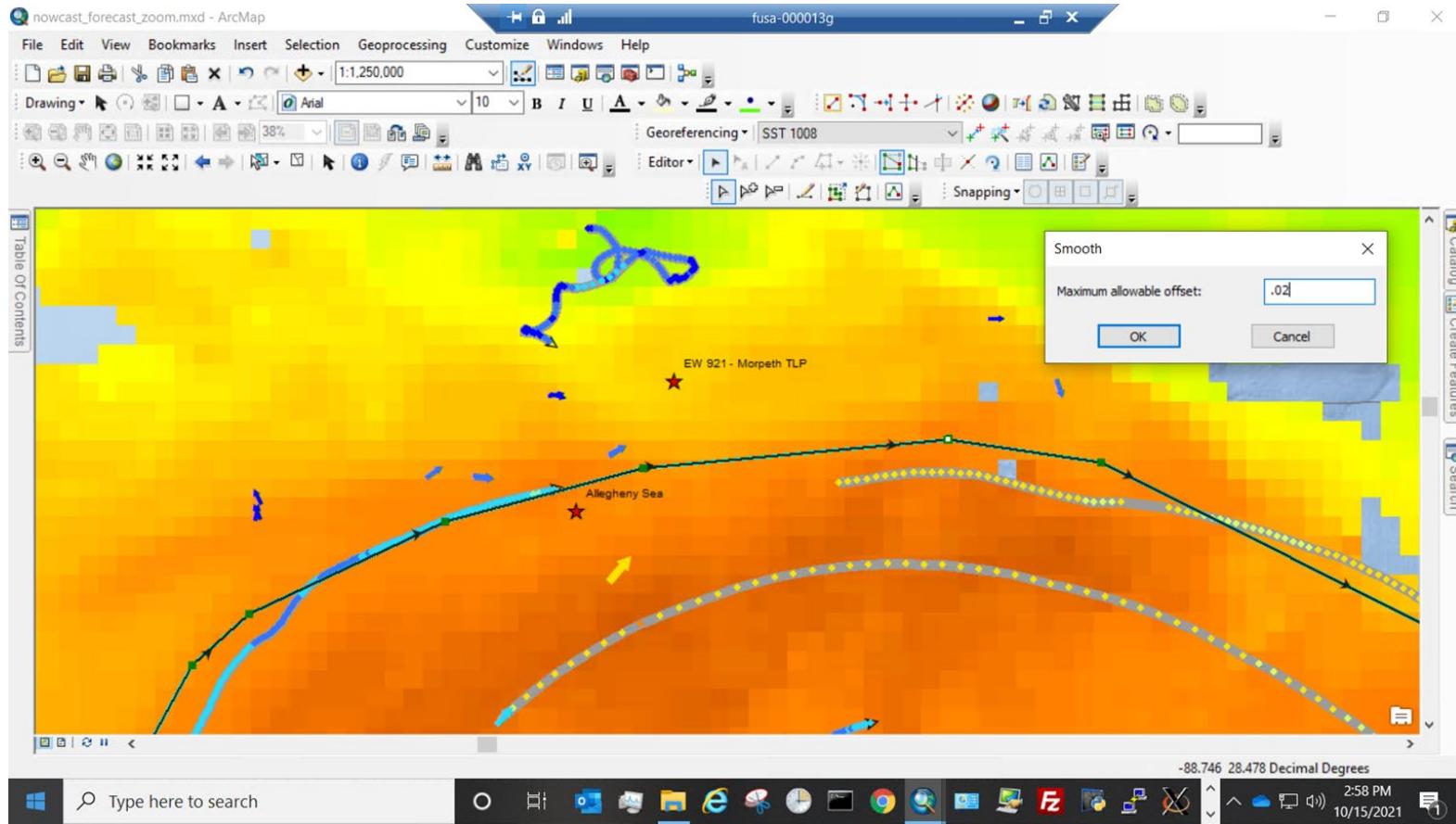
# Frontal Production



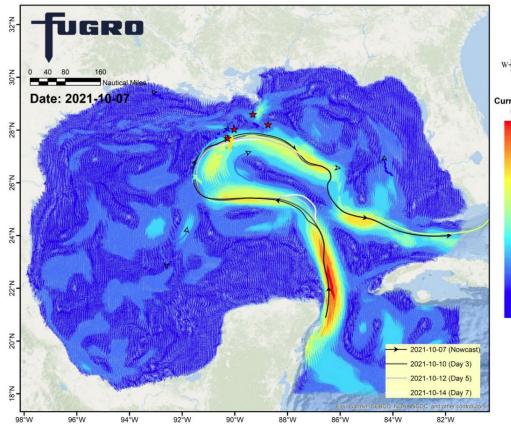
# Front Production



# Front Export



# Loop Current Bulletin



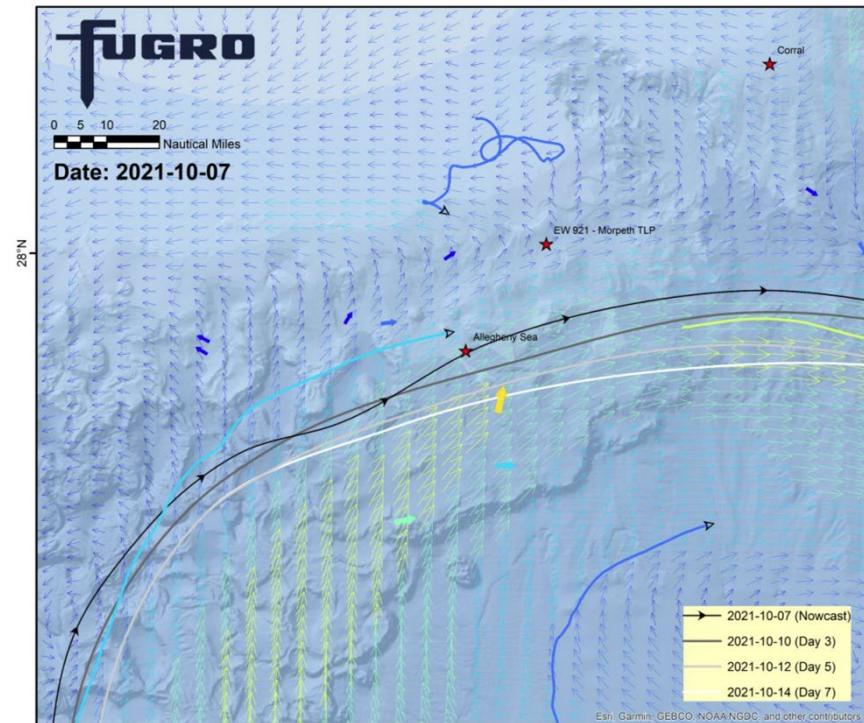
Oceanographer: J. Molina  
Technical Reviewer: R. Schiller

Ocean Model: Global HYCOM  
Region: Gulf of Mexico (GOM)  
Contract Number: F194359  
Client: ENI  
Positions: 28.2086°N, 88.7372°W (Devil's Tower)  
28.0300°N, 90.0200°W (Morpeth TLP); 27.6916°N, 90.2755°W (Allegheny TLP)

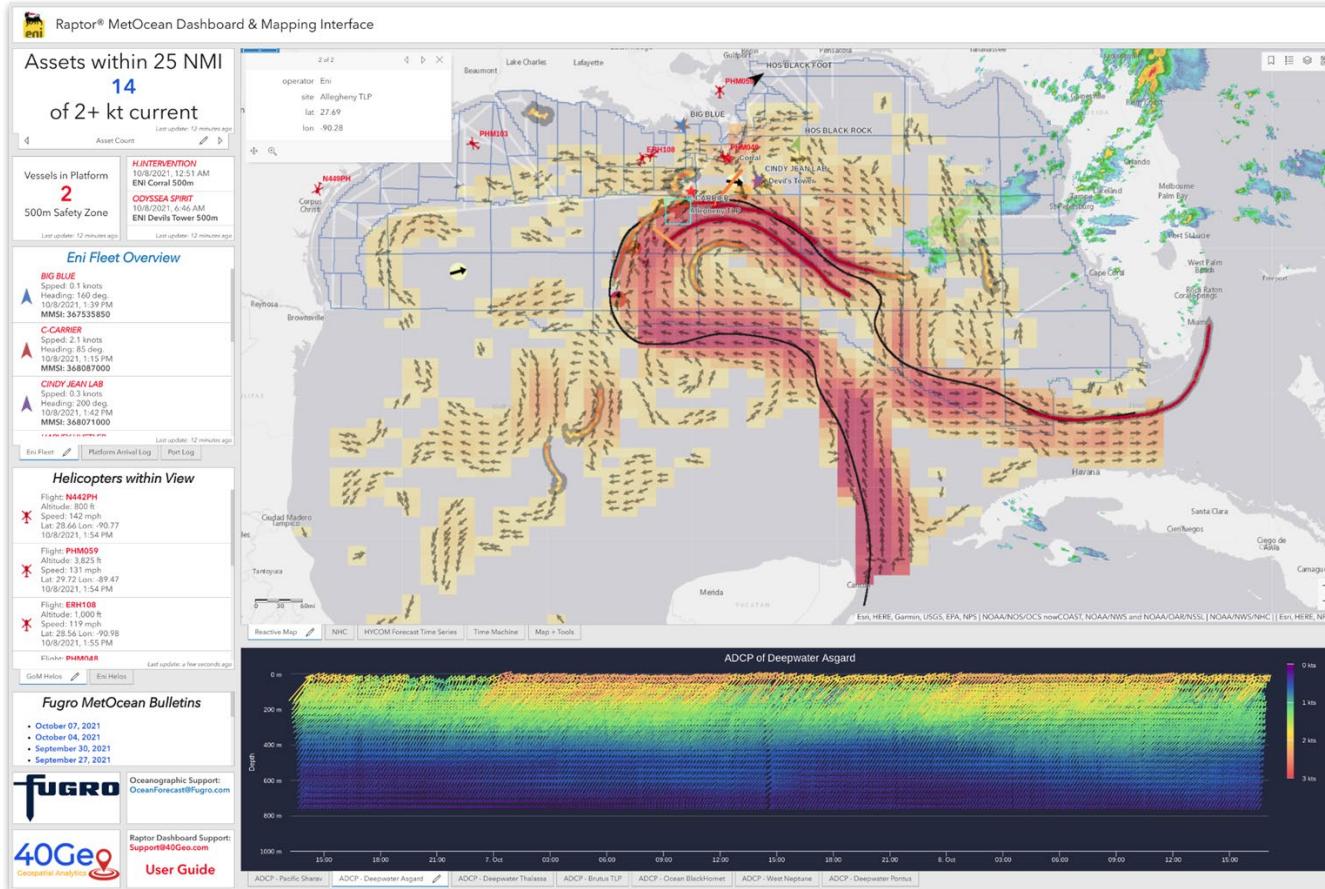
## Current Advisory Bulletin for Allegheny TLP – 7 October 2021

### Loop Current Advisory - Allegheny TLP - 7 October 2021

- The Allegheny TLP site is currently being affected by the Loop Current (LC).
- Based on the measurements in the area, the near-surface currents at the Allegheny TLP site are ~1.0 knot with a northeastward direction. Near-surface current speeds of ~1.0 knot to ~3.0 knots are being observed at nearby rigs.
- 3-day outlook
  - Depending on where the band of high currents are, current speeds near the Allegheny TLP site will remain above ~1.5 knot over the next 3 days.
- 5-day forecast
  - Depending on where the band of high currents are, current speeds near the Allegheny TLP site will remain above ~2.0 knots over the next 5-7 days.



# Common Operating Picture

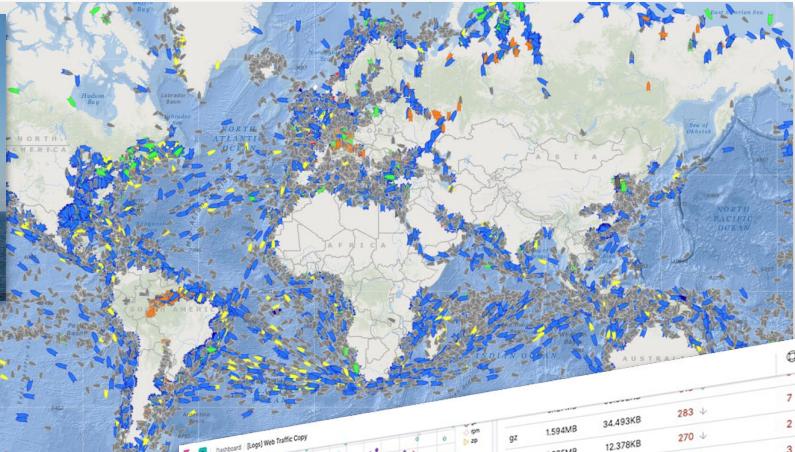


# Data Aggregation & Analytics



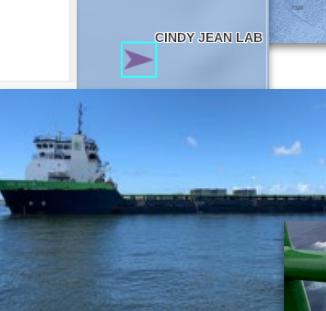
Vessels of Interest: CINDY JEAN LAB

SPEED 0.50  
HEADING 91  
LAT 28.20  
LON -88.74  
COURSE 209  
STATUS under way u  
engine  
TIMESTAMP 10/19/2021,  
PM  
SHIPNAME CINDY JEAN  
MMSI 368071000  
IMO 9421398  
CALLSIGN WDK4946  
SHIPTYPE 0  
TYPE\_NAME Passenger Ship  
GENERAL\_CLASSIFICATION

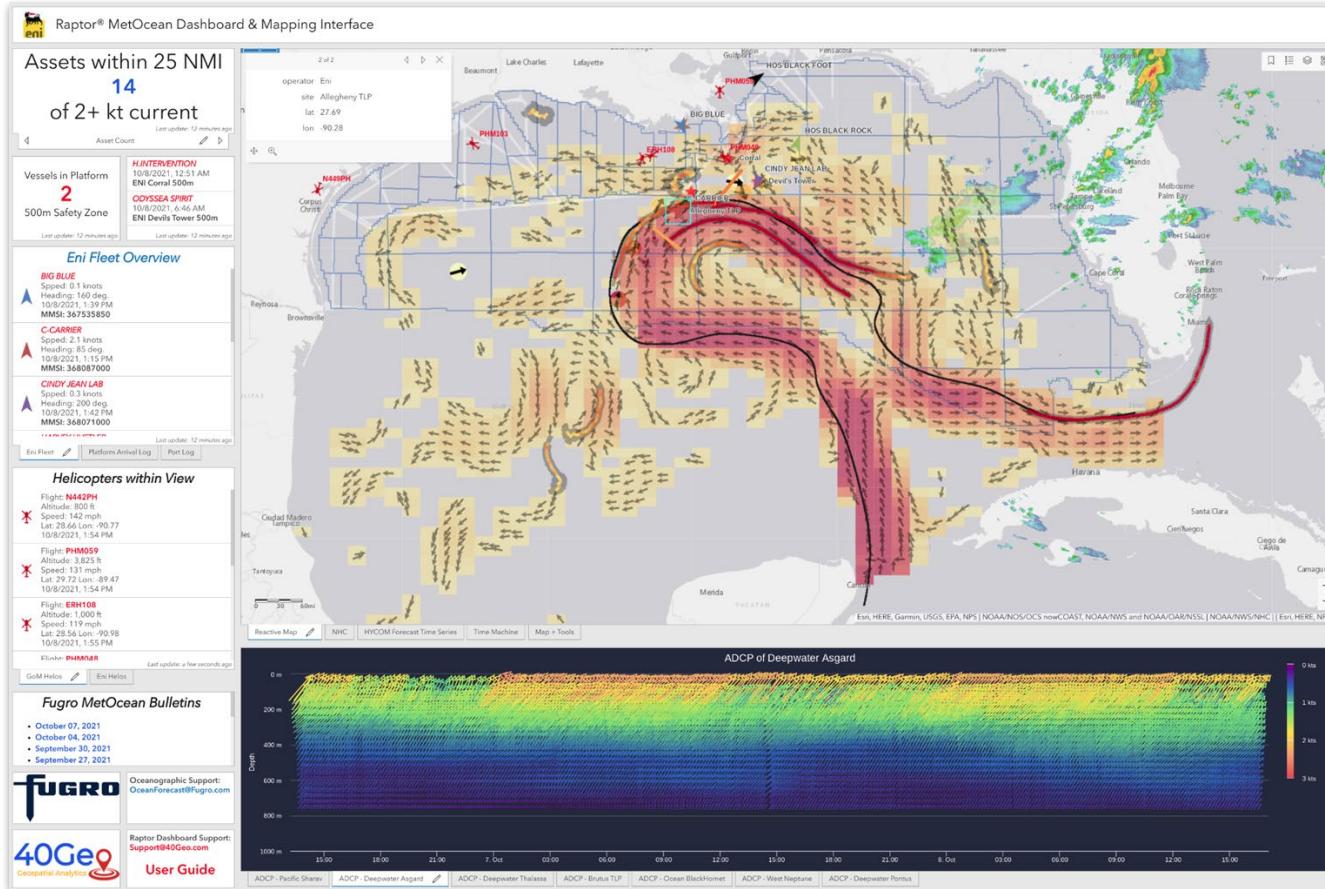


PHM046  
X

LOCATION  
LENGTH 0  
WIDTH 0

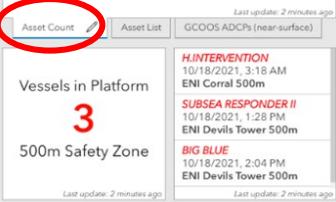


# Common Operating Picture



# Dashboard Analytics

Assets within 25 NMI  
28  
of 2+ kt current



Asset Distance to 2+Kt Current

**MC503 Manifold A** predicted 6 miles from the closest 2kt current for the time period of 10/18/2021, 8:00:00 PM

**GC254 Allegheny Sea** predicted 6 miles from the closest 2kt current for the time period of 10/18/2021, 8:00:00 PM

**GC254 SSMANIFO** predicted 6 miles from the closest 2kt current for the time period of 10/18/2021, 8:00:00 PM

**GC254 SSMANIFO** predicted 6 miles from the closest 2kt current for the time period of 10/19/2021, 8:00:00 PM

Last update: 3 minutes ago

GCOOS ADCP Data

**Brutus TLP**  
Current Speed: 1.78 Kts.  
Direction Towards: 40 deg.  
Depth: 45.1 meters

**Pacific Sharer**  
Current Speed: 1.13 Kts.  
Direction Towards: 352 deg.  
Depth: 44.1 meters

Last update: 3 minutes ago

Asset Count  Asset List  GCOOS ADCPs (near-surface)

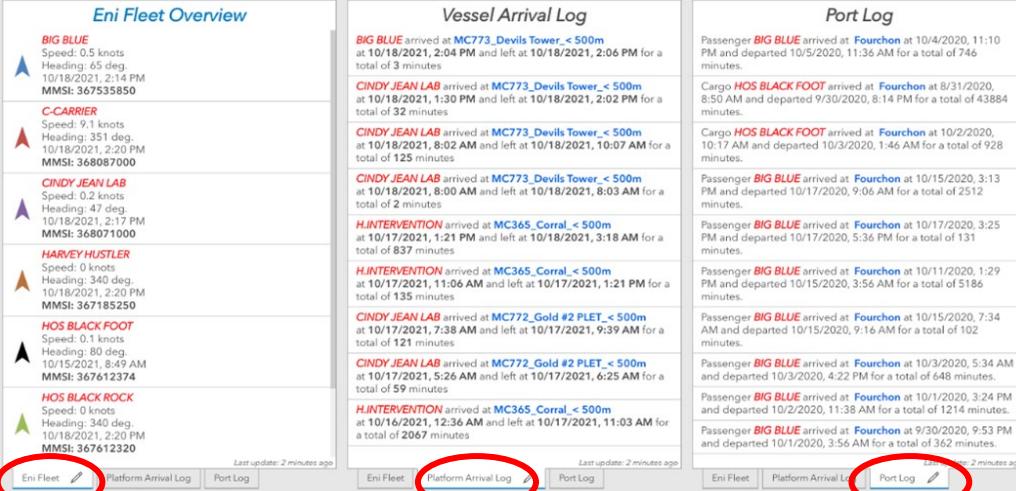
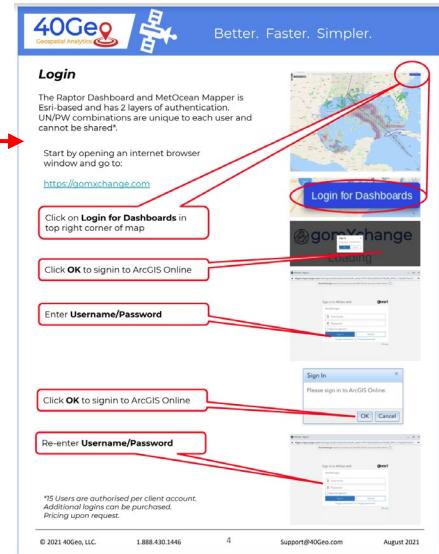
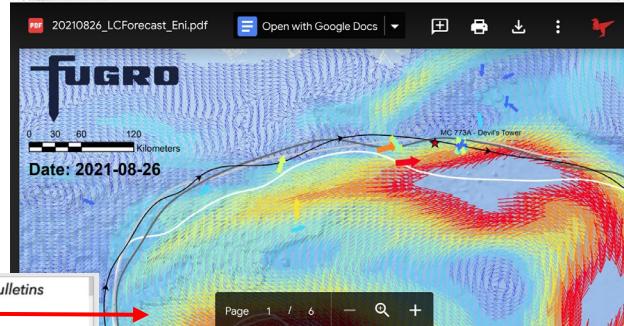
Vessels in Platform 3 500m Safety Zone

**H.INTERVENTION**  
10/18/2021, 3:18 AM  
ENI Corral 500m

**SUBSEA RESPONDER II**  
10/18/2021, 1:28 PM  
ENI Devils Tower 500m

**BIG BLUE**  
10/18/2021, 2:04 PM  
ENI Devils Tower 500m

Last update: 2 minutes ago



Helicopters within View

Flight: **N664RL**  
Altitude: 500 ft  
Speed: 101 mph  
Lat: 28.47 Lon: -90.89  
10/18/2021, 2:22 PM

Flight: **PHM112**  
Altitude: 4,800 ft  
Speed: 136 mph  
Lat: 27.94 Lon: -90.8  
10/18/2021, 2:23 PM

Flight: **N443PH**  
Altitude: 1,250 ft  
Speed: 130 mph  
Lat: 28.09 Lon: -90.95  
10/18/2021, 2:23 PM

Last update: a few seconds ago

# Map Features

The screenshot displays the Raptor® MetOcean Dashboard & Mapping Interface. The interface includes a main map view showing assets within 25 NMI of 2+ kt current, a legend, and several data layers. A red box highlights the top-level map controls (Bookmarks, Layers, and Basemaps) and the 'Bookmarks' panel. Another red box highlights the 'Layers' panel, which lists various data sources and their status. A third red box highlights the 'Basemaps' panel, showing different map types and services available.

**Bookmarks**

- Default Map Extent
- Devil's Tower
- Allegheny
- Corral
- Port Fourchon
- Shenzi
- GoM

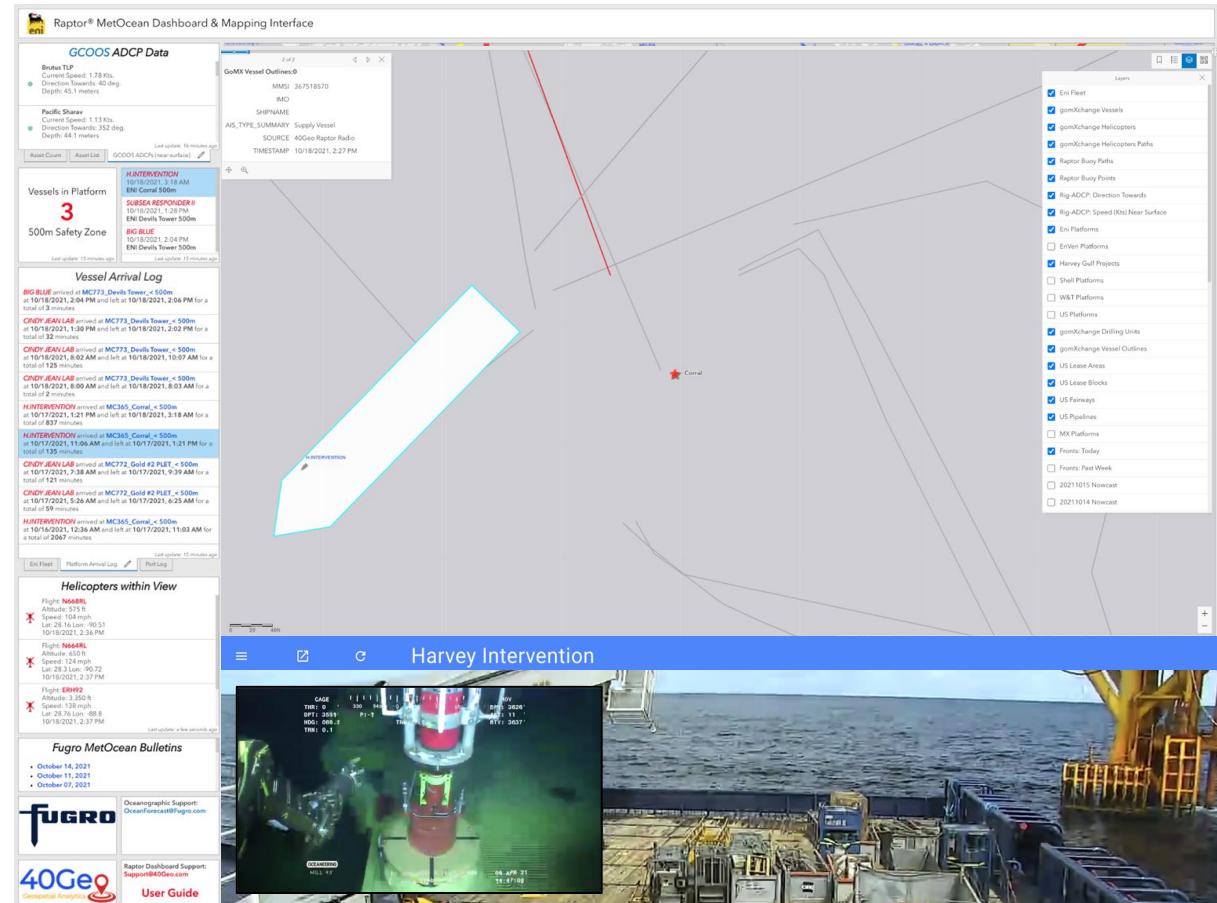
**Layers**

- Eni Fleet
  - BIG BLUE
  - C-CARRIER
  - CINDY JEAN LAB
  - HARVEY HUSTLER
  - HOS BLACK FOOT
  - HOS BLACK ROCK
  - OCEAN RIG SANTORINI
- gomXchange Helicopters
- gomXchange Helicopters Paths
- Raptor Buoy Paths
- Raptor Buoy Points
- Rig-ADCP: Direction Towards
- Rig-ADCP: Speed (Kts) Near Surface
- Eni Platforms
- EnVen Platforms
- Harvey Gulf Projects
- Shell Platforms
- W&T Platforms
- US Platforms
- gomXchange Drilling Units
- gomXchange Vessel Outlines
- US Lease Areas
- US Lease Blocks
- US Fairways
- US Pipelines
- MX Platforms
- 20211015 Nowcast
- 20211014 Nowcast
- 20211017 Forecast (20211014 +3)
- 20211019 Forecast (20211014 +5)

**Basemaps**

- Imagery
- Imagery with Labels
- Streets
- Topographic
- Dark Gray Canvas
- Light Gray Canvas
- National Geographic
- Terrain with Labels
- Oceans
- OpenStreetMap
- USGS National Map
- USA Topo Maps

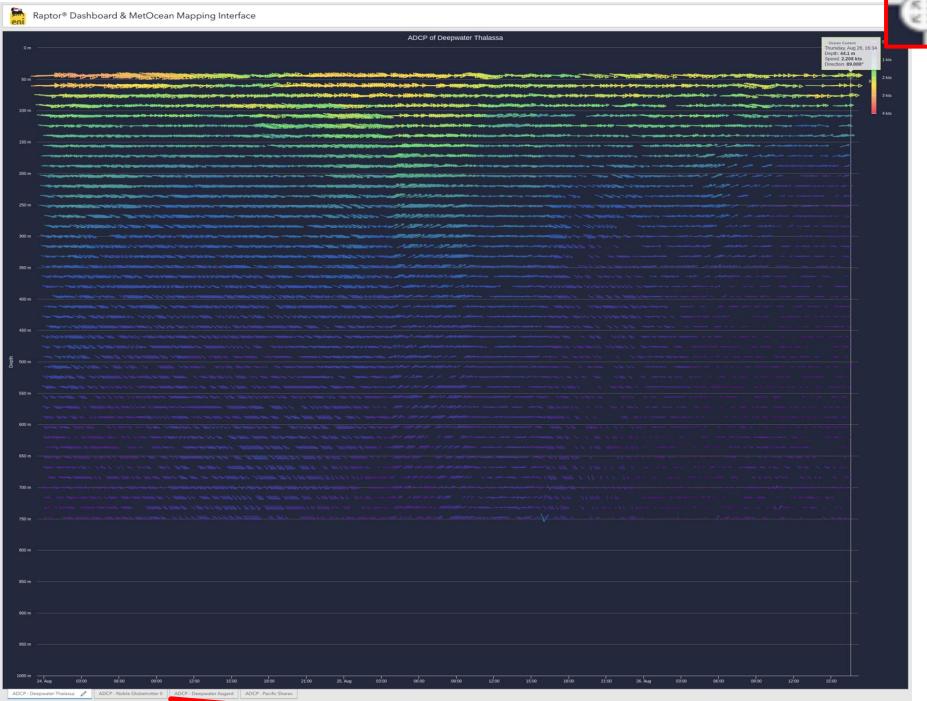
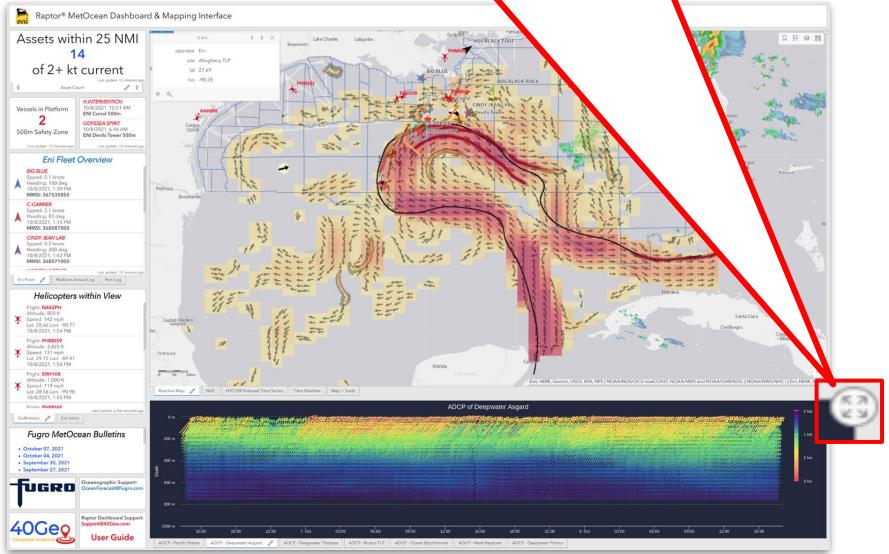
# Dynamic Mapping + Live Video + Vessel Analytics



# Data Rich Environment

Nearby Rig -ADCP data (in profile)  
are provided as a timeseries.

- Clicking top right button expands window.
- Clicking on the top right button will return the interface to standard configuration.

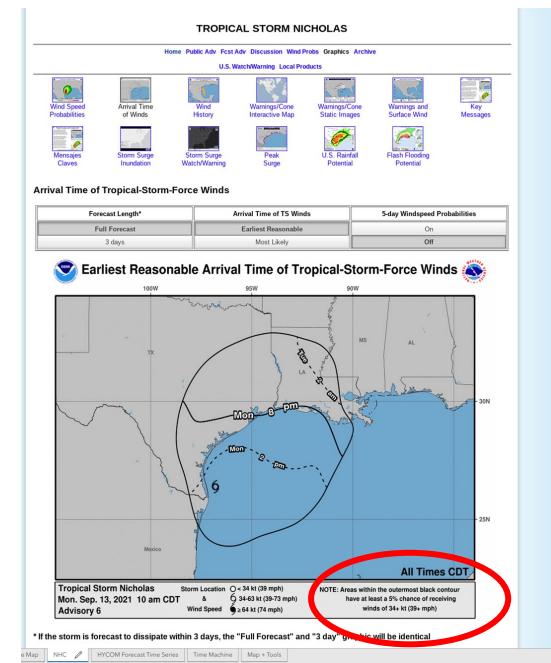
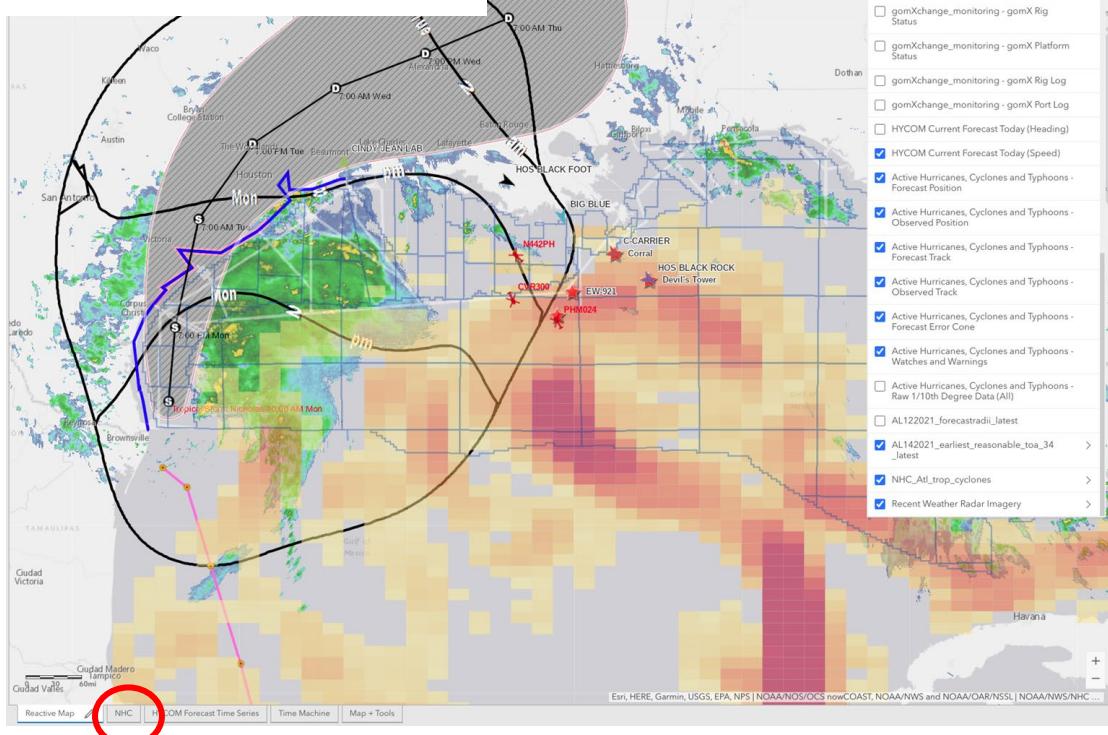


Tabs across the bottom of the window display ADCP data from other rigs.

# Source Data

## Hurricane Nicholas (Cat. 1)

- Major Flooding Event



**All Times CDT**

**NOTE: Areas within the outermost black contour have at least a 5% chance of receiving winds of 34 kt (39+ mph)**

# AIS Data

**Dataset Selection**

**Incident Analysis**

Capture a look into where things were and what led up to a specific point in time. This tool will allow you to select an area on the map and see where things were in the hour leading up to and at a specific time.

**Tracks**

See where they have been. This tool will allow you to select several items and see where they have been over a specified time period.

**Fleet**

Build and monitor your fleets.

**Create Now**

**Create Now**

**Open Now**

CONANP, Esri, Garmin, FAO, NOAA, EPA | Copyright information varies by provider. For more information, please contact the source of this data.

Powered by Esri

Reactive Map NHC HYCOM Forecast Time Series Time Machine Map + Tools

# AIS Data – Incident Analysis

MC367	MC368	MC369	MC370	MC371	MC372	MC373	MC374	MC375	MC376	MC377	MC378	MC379	MC380	MC381	MC382	MC383	MC384	MC385	MC386	MC387	MC388
MC411	MC412	MC413	MC414	MC415	MC416	MC417	MC418	MC419	MC420	MC421	MC422	MC423	MC424								
MC455	MC456	MC457	MC458	MC459	MC460	MC461	MC462	MC463	MC464	MC465	MC466	MC467	MC468								
MC499	MC500	MC501	MC502	MC503	MC504	MC505	MC506	MC507	MC508	MC509	MC510	MC511	MC512								
MC543	MC544	MC545	MC546	MC547	Who Dat	Mississippi Canyon		MC550	MC551	MC552	MC553	MC554	MC555	MC556							
MC587	MC588	MC589	MC590	MC591	MC592	MC593	MC594	MC595	MC596	MC597	MC598	MC599	MC600								
MC631	MC632	MC633	MC634	MC635	MC636	MC637	MC638	MC639	MC640	MC641	MC642	MC643	MC644								
MC675	MC676	MC677	MC678	MC679	MC690	MC691	MC692	MC693	MC694	MC695	MC696	MC697	MC698	MC699	MC700						
MC719	MC720	MC721	MC722	MC723	MC724	MC725	MC726	MC727	MC728	MC729	MC730	MC731	MC732								
MC763	DEEPWATER PONTUS		MC766	MC767	MC768	MC769	MC770	MC771	MC772	MC773	MC774	MC775	MC776								
Mars	MC807	MC808	MC809	Ursa	MC811	MC812	MC813	MC814	MC815	MC816	MC817	MC818	MC819	MC820	MC821	MC822	MC823	MC824	MC825	MC826	MC827
MC851	MC852	MC853	MC854	MC855	MC856	MC857	MC858	MC859	MC860	MC861	MC862	MC863	MC864	MC865	MC866	MC867	MC868	MC869	MC870	MC871	MC872



## Noble details Globetrotter II damage, declares force majeure

The vessel, which had been under contract with Shell, was impacted by Hurricane Ida

2 September 2021 22:59 GMT *UPDATED 8 September 2021 13:19 GMT*

By [Mark Passwaters](#)  in [Houston](#)

Noble Corporation has declared force majeure on a drilling contract with Shell in the US Gulf of Mexico after its ultra-deepwater drillship Globetrotter II was hit by Hurricane Ida, said the rig owner on late Thursday afternoon US time.

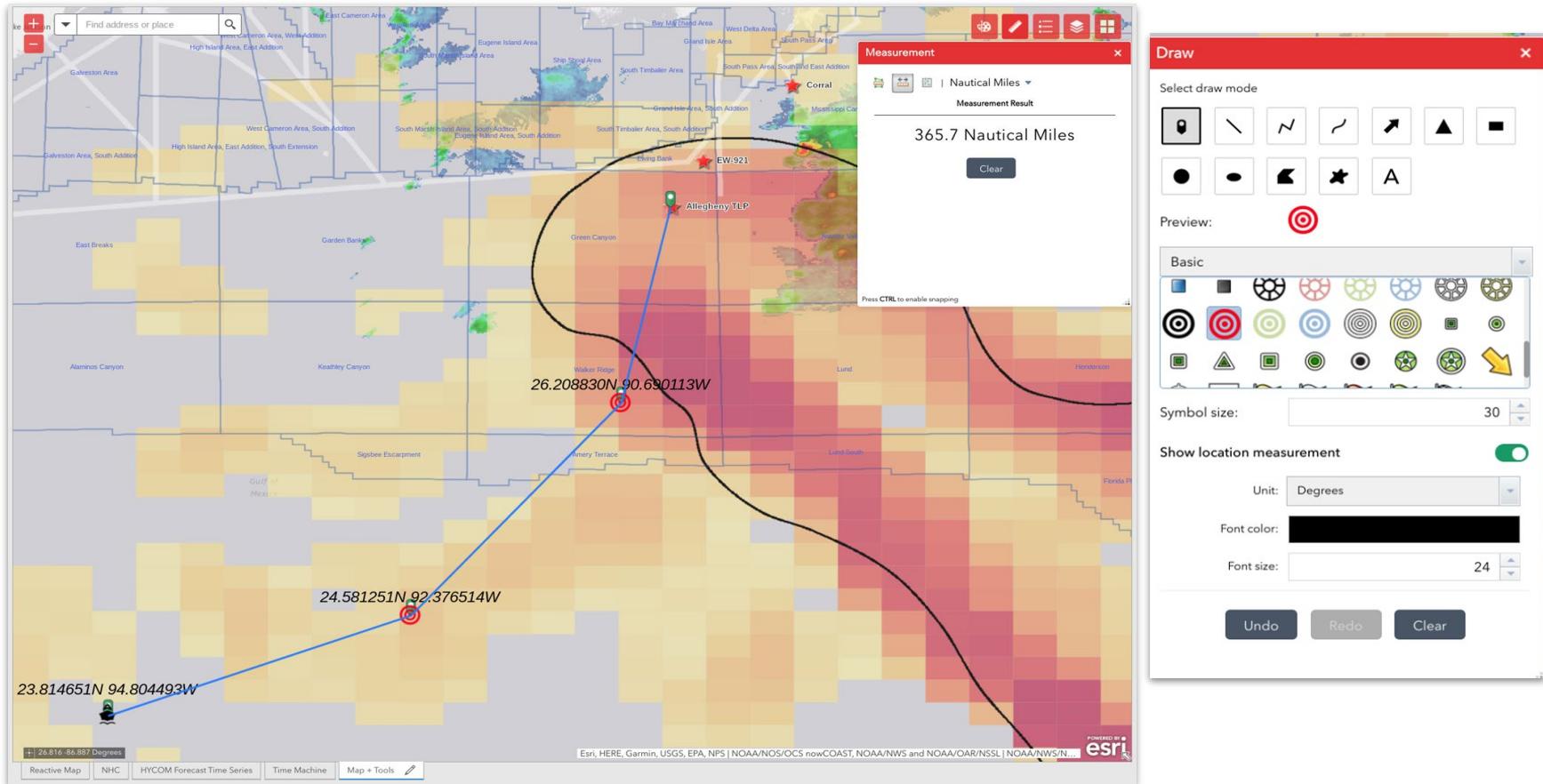
# Map Tools

The image shows a screenshot of the Raptor MetOcean Dashboard & Mapping Interface. The interface includes a top navigation bar with 'Raptor MetOcean Dashboard & Mapping Interface' and 'eni'. Below the navigation is a search bar 'Find address or place' and a 'Measurement' section showing '3.92 Nautical Miles'.

The main area displays a map with several data layers and tools:

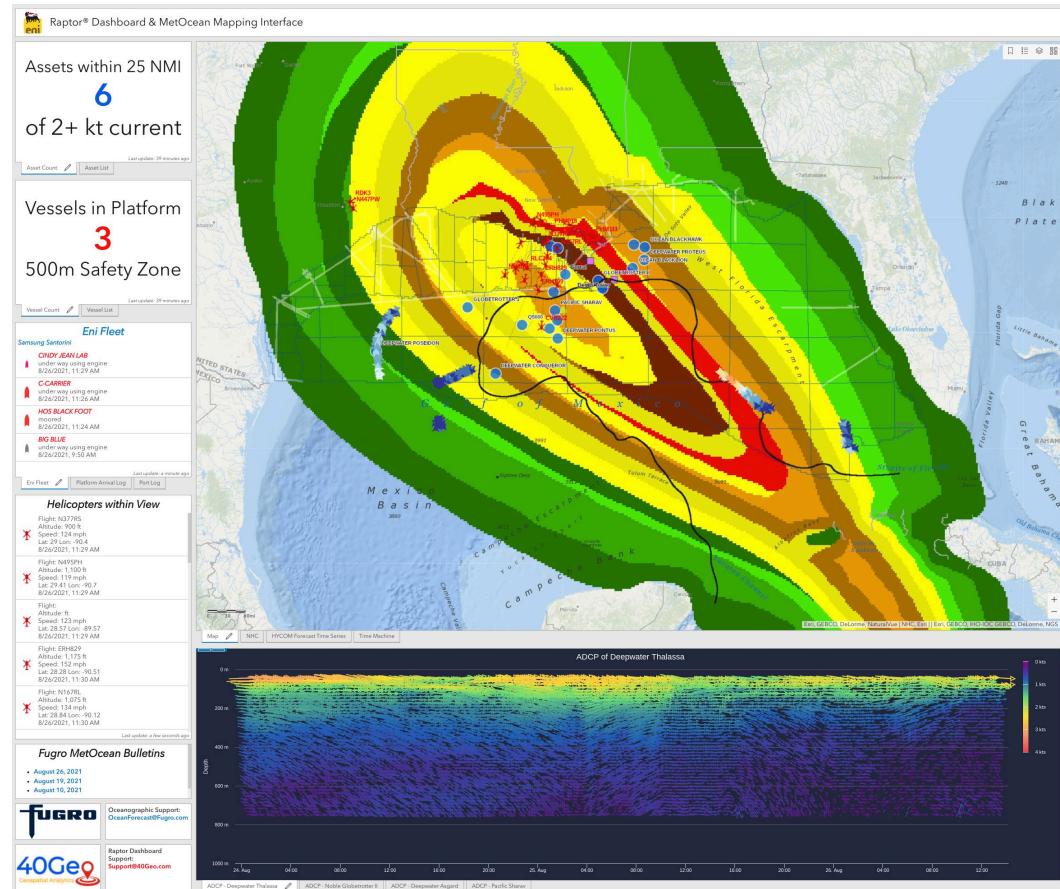
- Assets within 25 NMI:** 14 of 2+ kt current.
- Vessels in Platform:** 2 (HUNTRIVEN and OLYSEA SPRT).
- 500m Safety Zone:** Indicated by a green polygon.
- Eni Fleet Overview:** Shows vessel details for BIG BLUE, CARRIER, CINDY JEAN LAB, and PHM059.
- Helicopters within View:** Shows flight details for PHM059, N449PH, and EHT108.
- Annotation:** A red line and text box indicating 'Measure area & Distance'.
- Layer Selection:** A red box indicating 'Layer Selection'.
- Map Background:** A red box indicating 'Map Background'.
- Layers Legend:** A red box indicating 'Layers Legend'.
- Longitude & Latitude of cursor:** A red box indicating 'Longitude & Latitude of cursor'.
- Map + Tools\*:** A red box indicating 'Map + Tools\*'. Below it, text states '\*is not Dashboard reactive'.
- Bottom Panel:** Includes a 'Map + Tools' button, 'RYCOM Forecast Time Series', 'Time Machine', and 'User Guide'.
- Bottom Graph:** An ADCP (Acoustic Doppler Current Profiler) depth profile titled 'ADCP of Deepwater Asgard' showing current speed over depth (0 to 800 m) and time (15:00 to 00:00).

# Map Tools – Plan & Communicate



# Summary

Common Operating Picture  
*delivers*  
Maritime Domain Awareness  
*creates*  
Actionable Intelligence



# Data, Analytics, Visualization

## *The Three -Legged Maritime Domain Awareness Stool*

Ridley Smith | **Eni** | Ridley.Smith@eni.com

Rafael Schiller | **Fugro** | RSchiller@Fugro.com

Matt Cadwallader | **40Geo** | Matt.Cadwallader@40Geo.com

