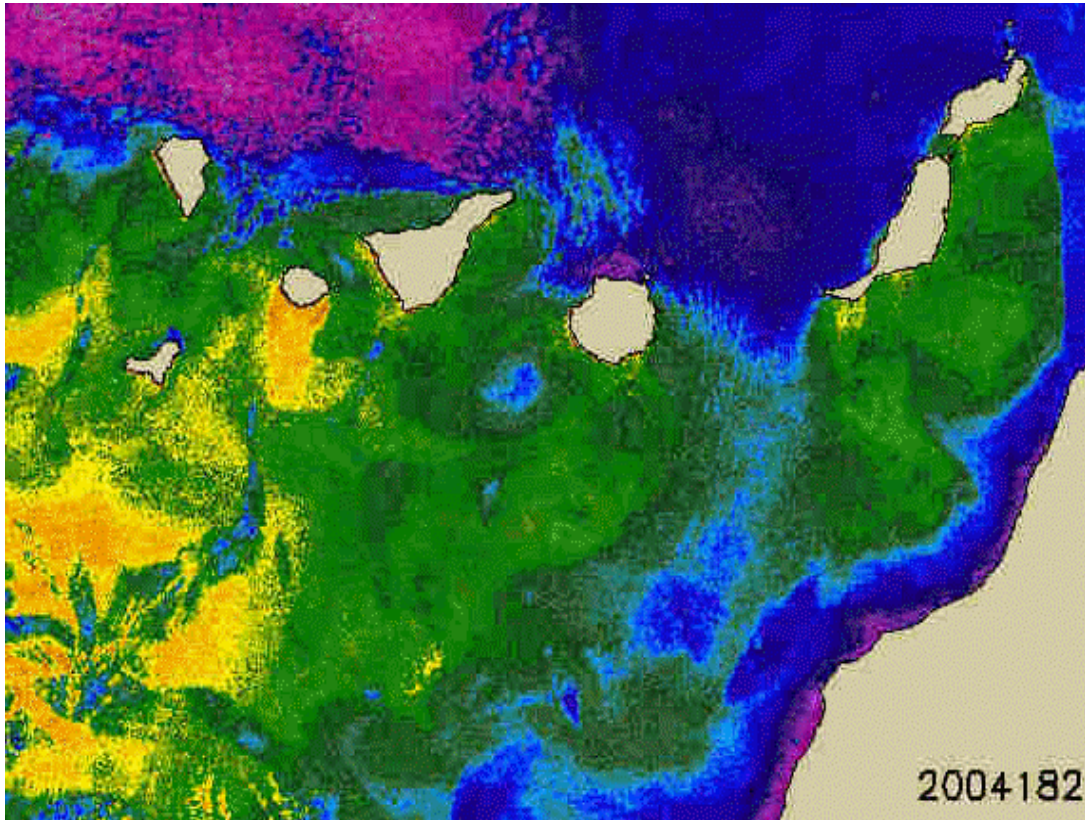
UNIVERSIDAD DE LAS PALMAS
DE GRAN CANARIA

SEASnet

www.seasnet.org



Dr. Antonio G RAMOS *Assistant Prof ULPGC + UB/RU*

antonio.ramos@ulpgc.es

Div. Robotic and Computational Oceanography

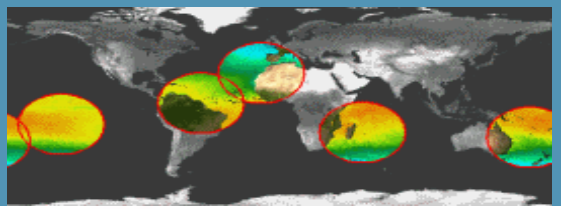
University Inst. Intelligence Systems & Numeric Aplications

RUTGERS THE STATE UNIVERSITY OF NEW JERSEY

IRD Institut de recherche pour le développement

unité espace

Parque Científico Tecnológico
Universidad de Las Palmas de Gran Canaria



SEASnet

Le réseau de stations de réception de l'IRD et ses partenaires

UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA

French Guyane, 05

RU COOL

French Polynesia, 04

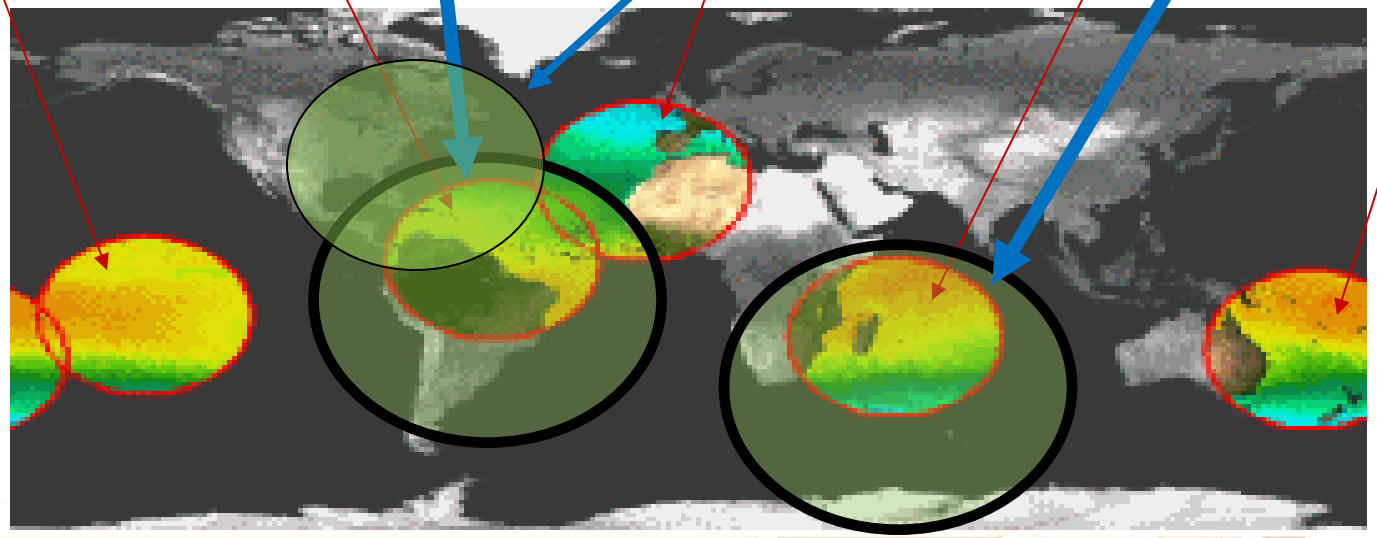
Réunion, 91

Réunion I, 11

New Caledonia, 97

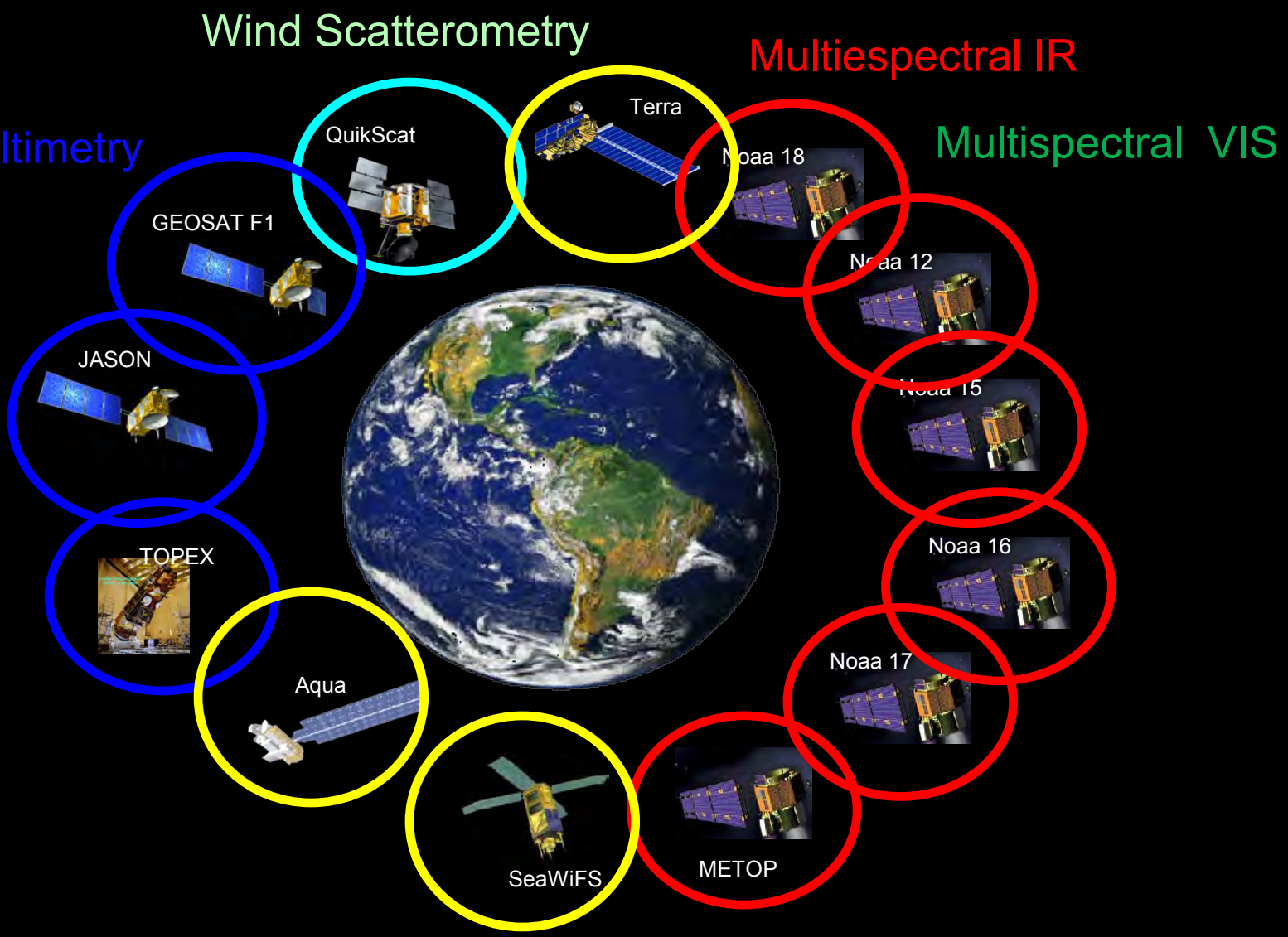
French Guyane, 98

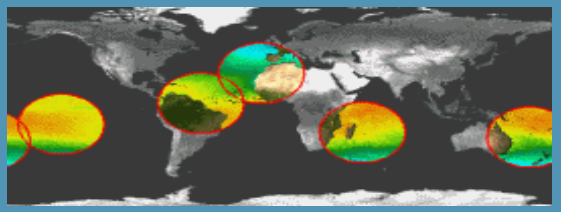
Canarias, 96



SEASnet
European RUP Network

Constellation SEASnet L, X

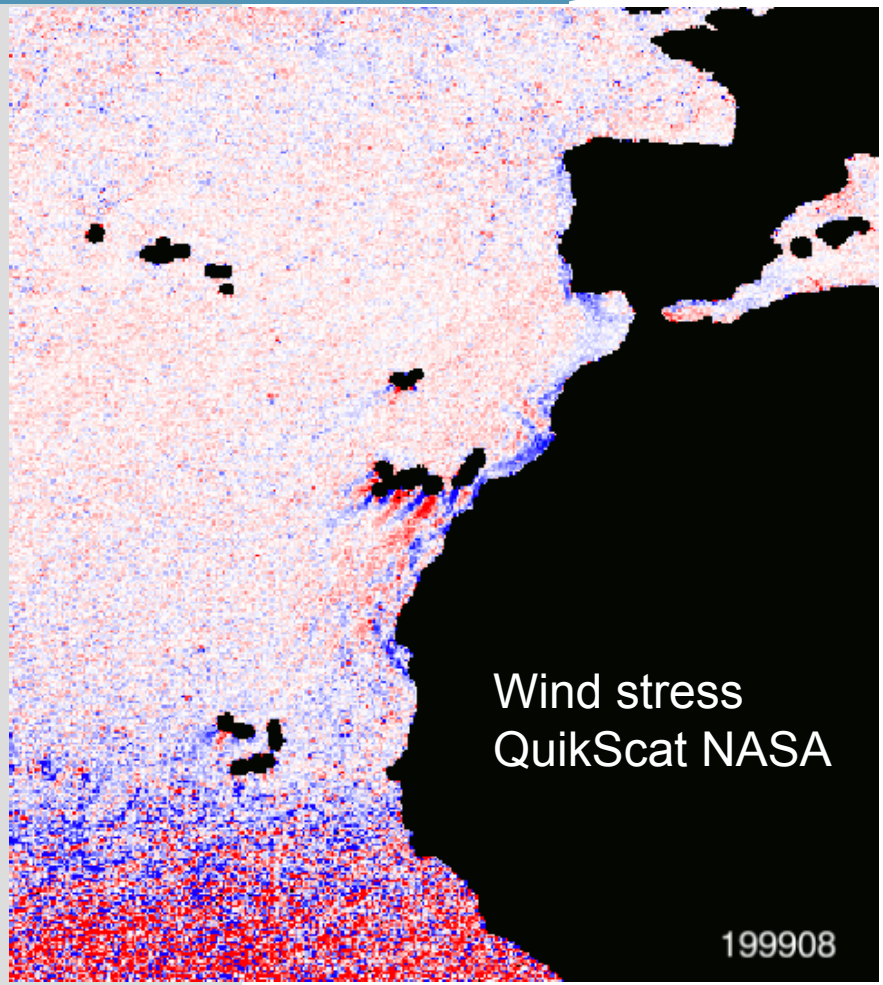


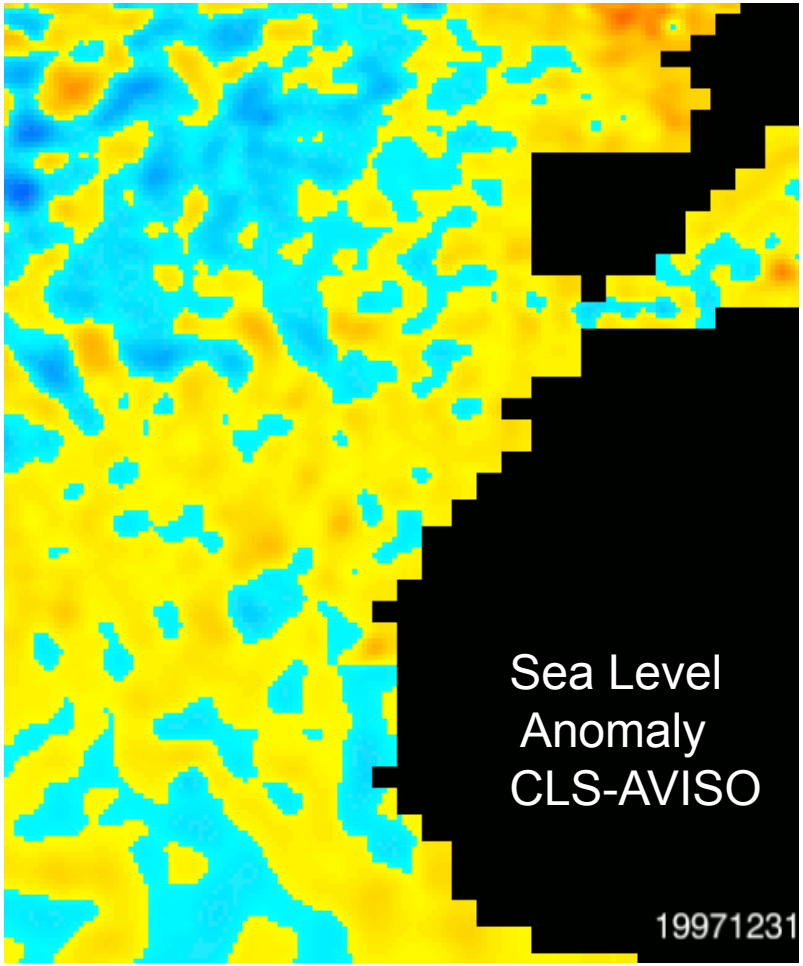


SEASnet

Réseau de stations de réception et d'exploitation de données des satellites d'observation de la Terre

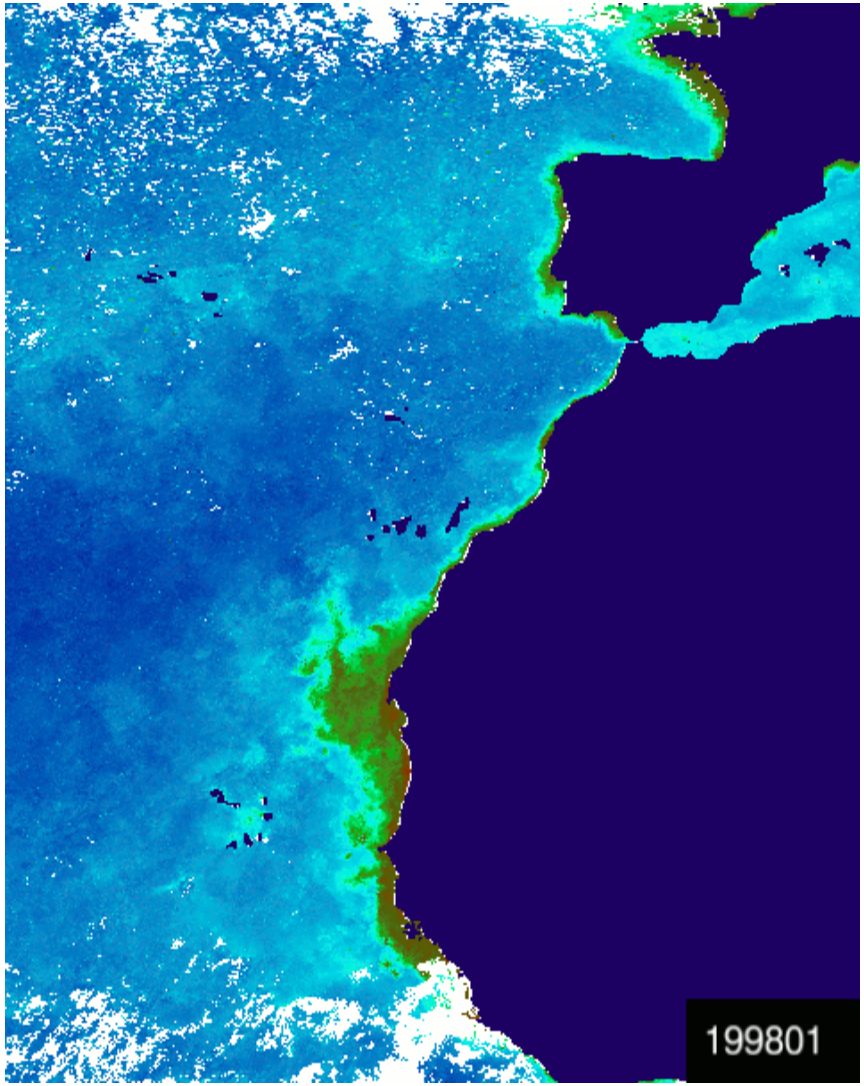
Diffusion de données





GOBIERNO DE ESPAÑA · MINISTERIO DE MEDIO AMBIENTE · AEMet Agencia Estatal de Meteorología

UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA · BSC



GOBIERNO DE ESPAÑA
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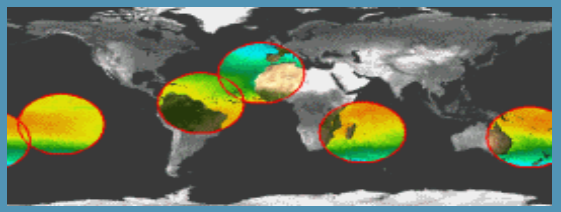
AEMet
Agencia Estatal de Meteorología
UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA
BSC

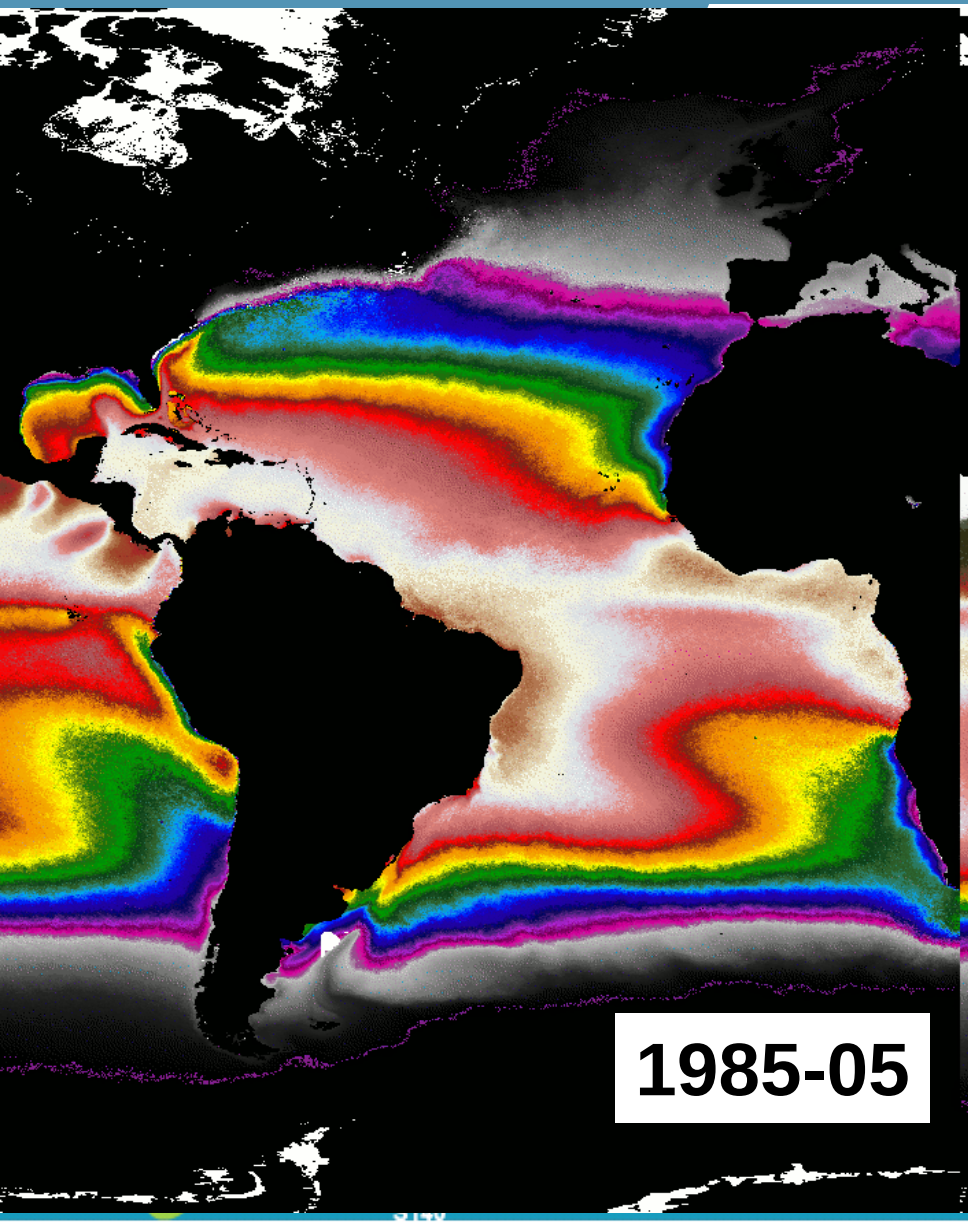
SST

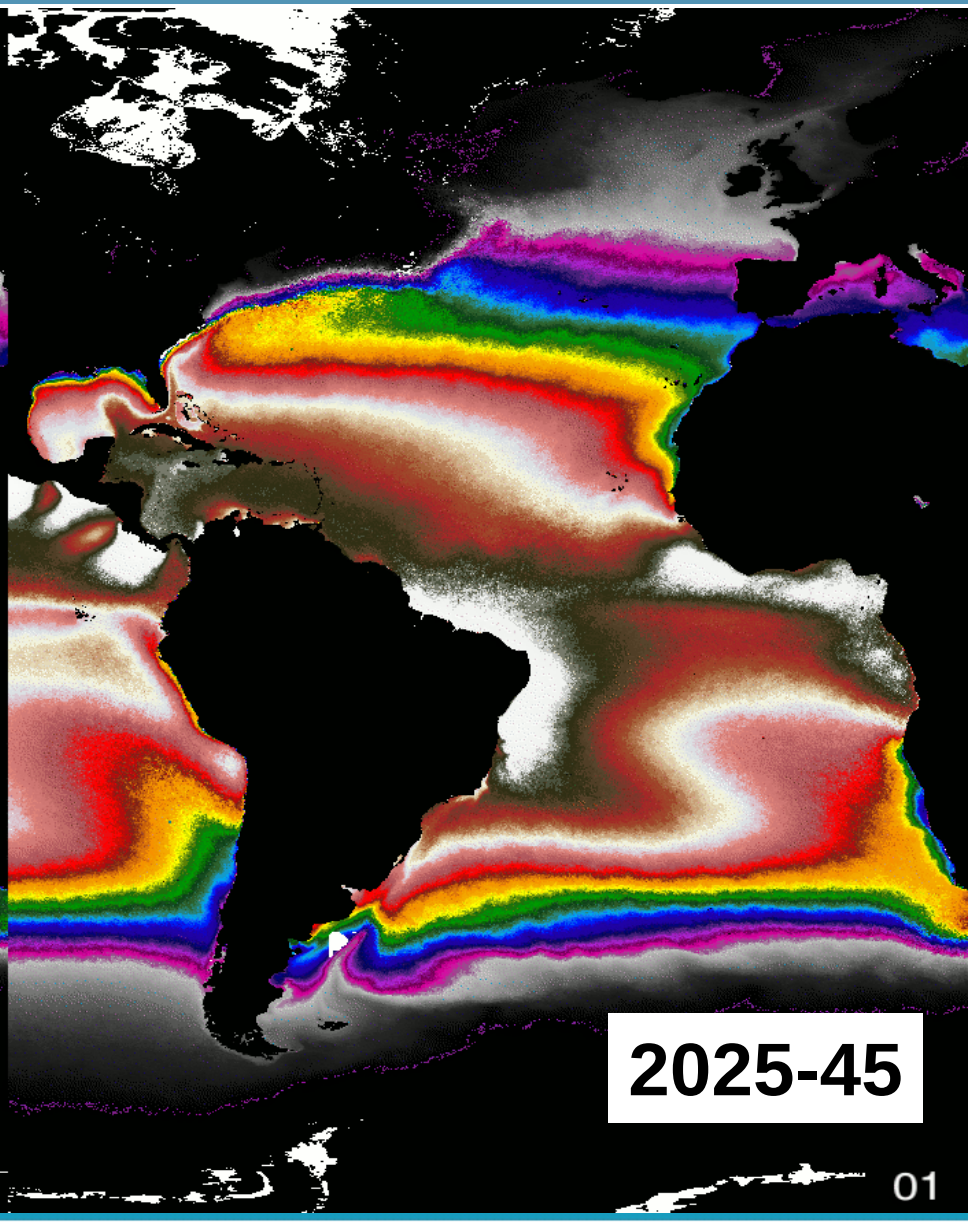
Primary Production

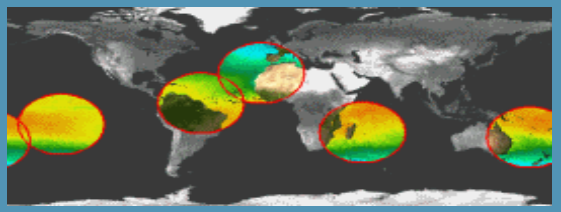


SEASnet

Réseau de stations de réception et d'exploitation de données des satellites d'observation de la Terre





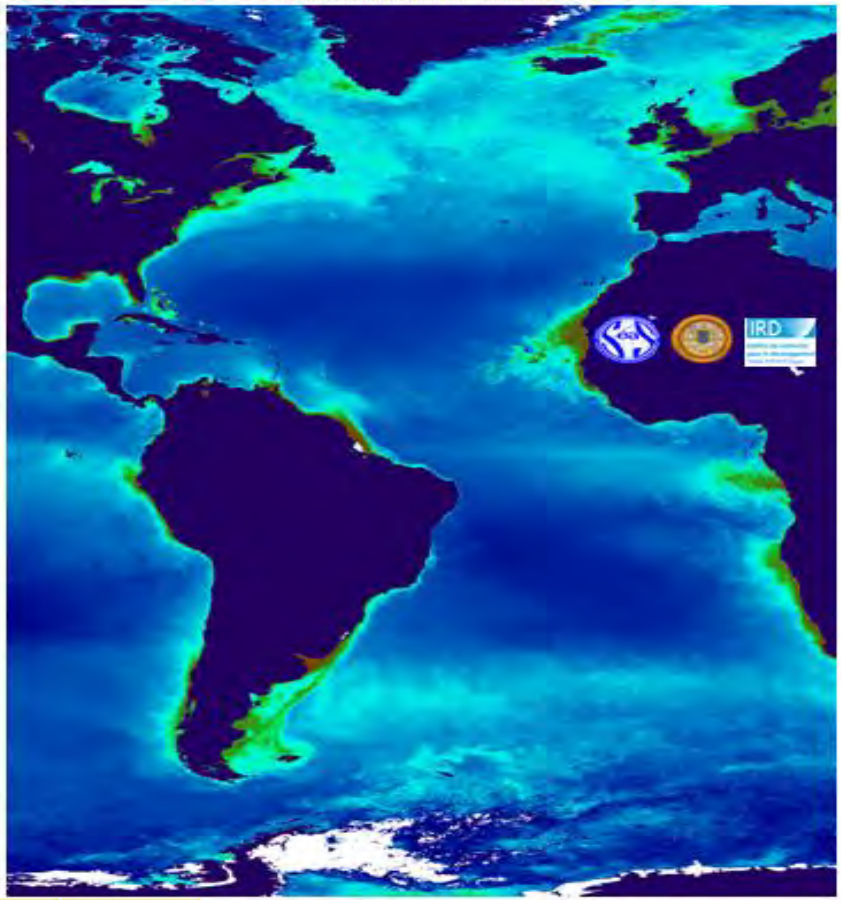


SEASnet

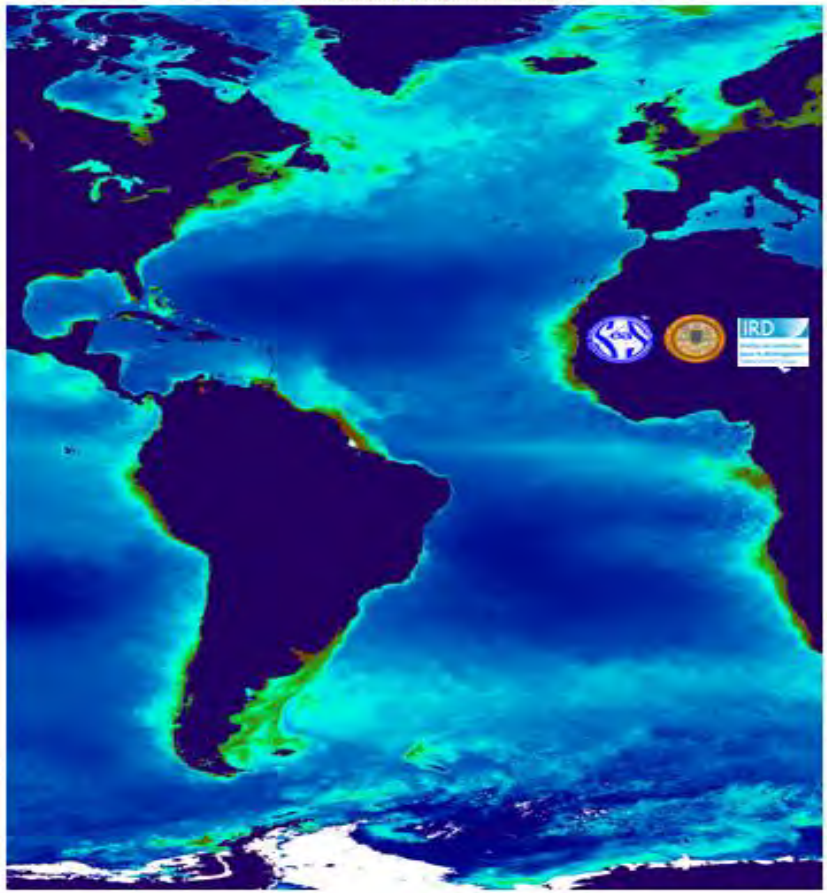
Réseau de stations de réception et d'exploitation de données des satellites d'observation de la Terre

Diffusion de données

1998. Satélite SeaWiFS/Orb-view2



2006. Satélite SeaWiFS/Orb-view2



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AEMet Agencia Estatal de Meteorología
UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA
BSC

SeaWiFS Ocean color Project
1998-2008

FLEET SITMA/ULPGC *Min. Economy & Competititveness*

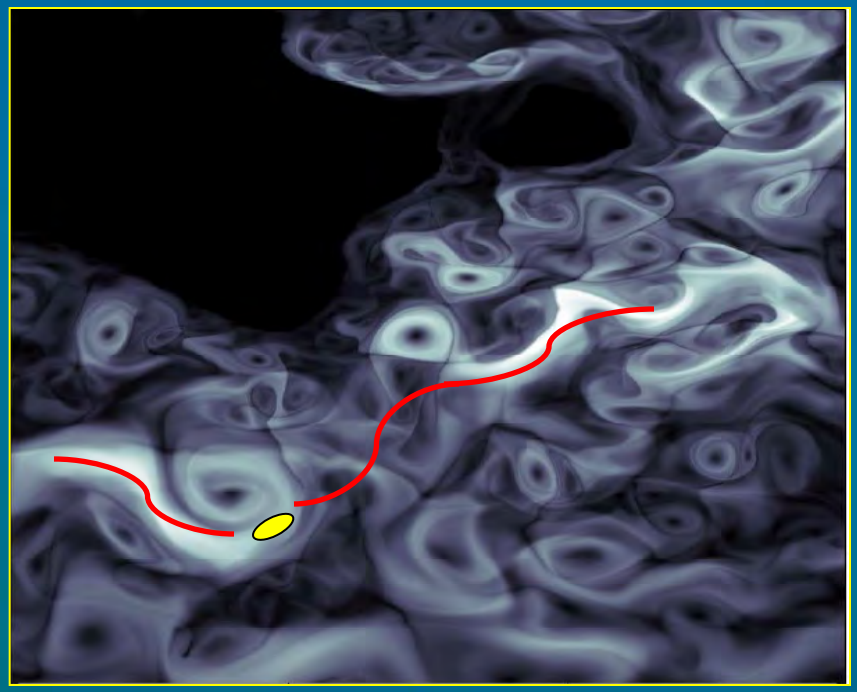
1 AUV *G-500* 500m
1ASV **SITMA**

2 Glider G2 TWR

CTD + Fluorometry + DVL + Turbidometer + O2 + MR turbulence

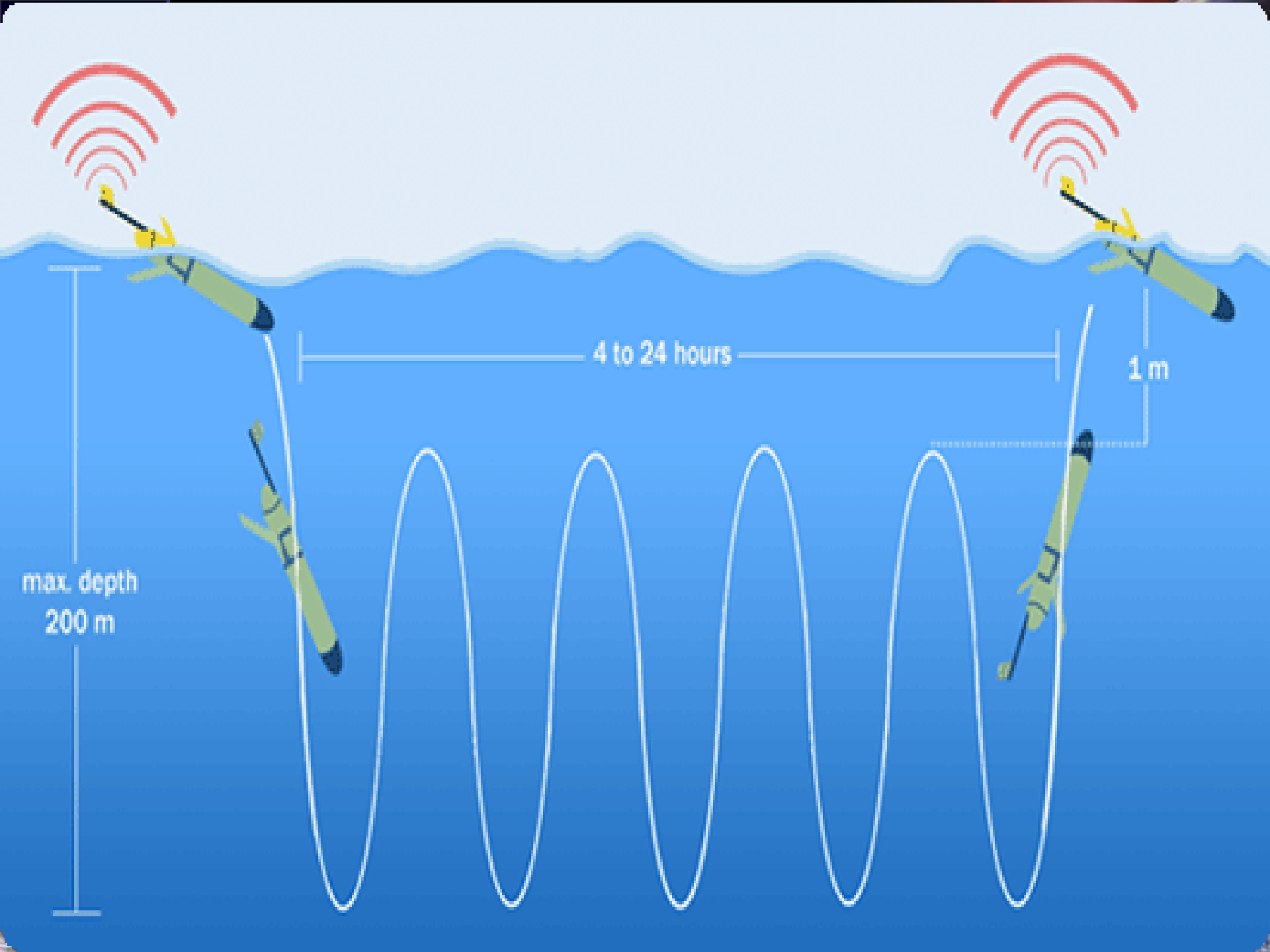
Lagrangian path planning for the first Autonomous Underwater Vehicles in transoceanic missions: The new boundaries of operational oceanography.

A.G. RAMOS[1], V.J GARCÍA-GARRIDO[2], S.GLENN[3], J.KOHUT[3], O.SCHOFIELD[3], D.K. ARAGON[3], N. STRANDSKOV[3], A.M. MANCHO[2], S. WIGGINS[2], J.COCA[1]. ***SITMA-ULPGC, ICMAT, RUTGERS.***



SILBO, NW Atlantic, June 2016

photo credit: *Ben Allsup*, Teledyne Webb Research


4 to 24 hours
1 m
max. depth
200 m

ULPGC
Robótica y Oceanografía Computacional
División ROC (IUSIANI)

RUTGERS
Coastal Ocean Observation Lab

CHALLENGER MISSION

http://www.i-cool.org/?cat=77

- > 2008
- 10 missions
- > 50 months/sea
- > 45,000 km

RU-17 Slocum. Across the Pond. (May – Oct 08)

RU-27 Slocum. Atlantic Crossing. (Apr – Dec 09)

Silbo Slocum. Challenger 1 (Apr11–Aug13)

RU-29 Slocum. Challenger 1 (Jan13 –March16)

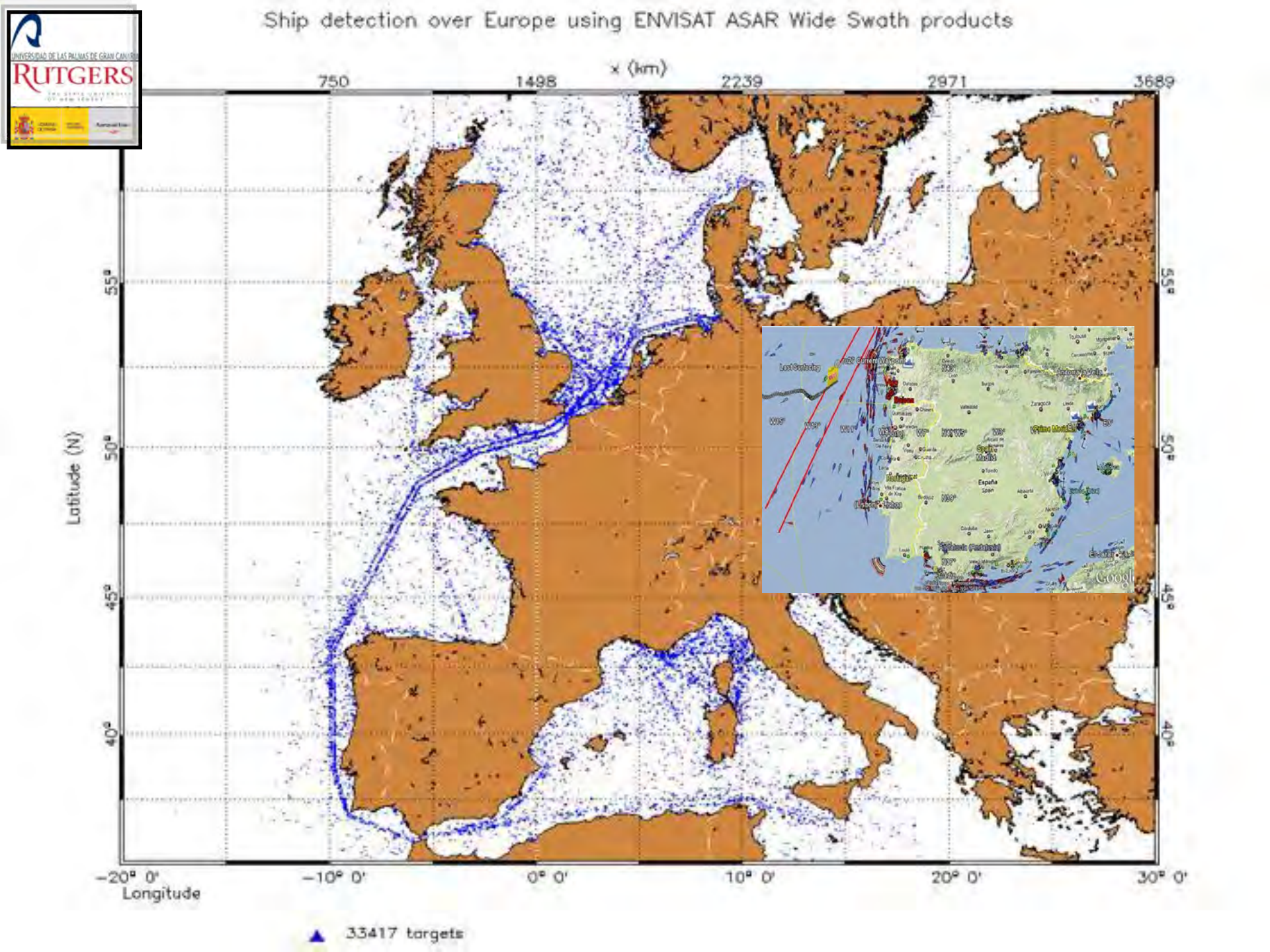
Scarlet Knight RU-27 challenge

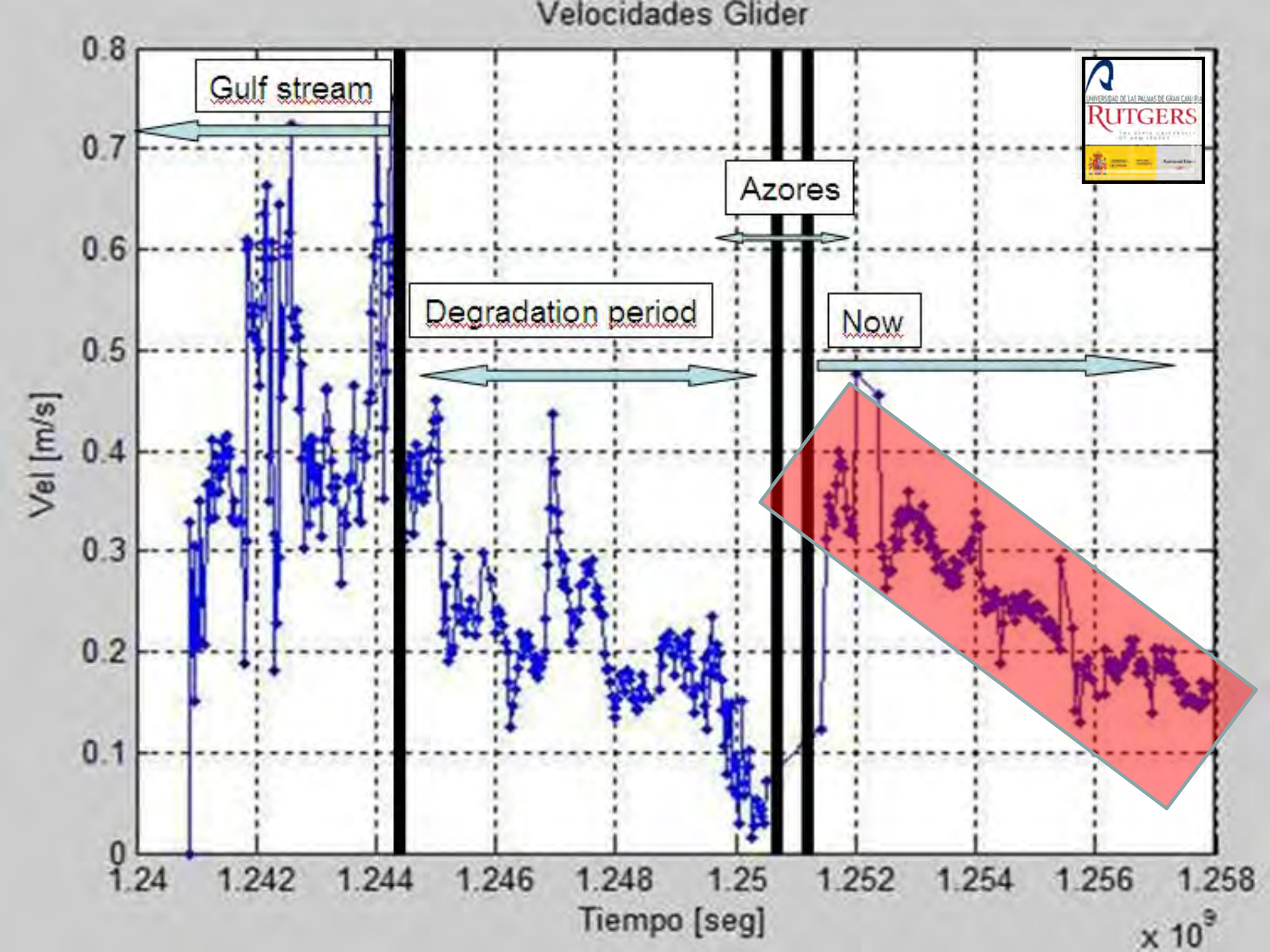
Science and History and Magic **. . .**

"…. She was at sea for 221 days. She was alone, often in dangerous places, and usually out of touch. Her predecessor had disappeared in October 2008 on a similar trip,, probably killed by a shark…"

The Washington Post ***Dec 2009***

14th November 2009, 7274 km
8.05 am. Saturday
Scarlet flies spaniards waters


Ship detection over Europe using ENVISAT ASAR Wide Swath products
x (km)
750
1498
2239
2971
3689
55°
50°
45°
40°
Latitude (N)
−20° 0'
−10° 0'
0° 0'
10° 0'
20° 0'
30° 0'
Longitude
33417 targets


Velocidades Glider
Gulf stream
Azores
Degradation period
Now
RUTGERS
Vel [m/s]
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1.24
1.242
1.244
1.246
1.248
1.25
1.252
1.254
1.256
1.258
Tiempo [seg]
x 10^9

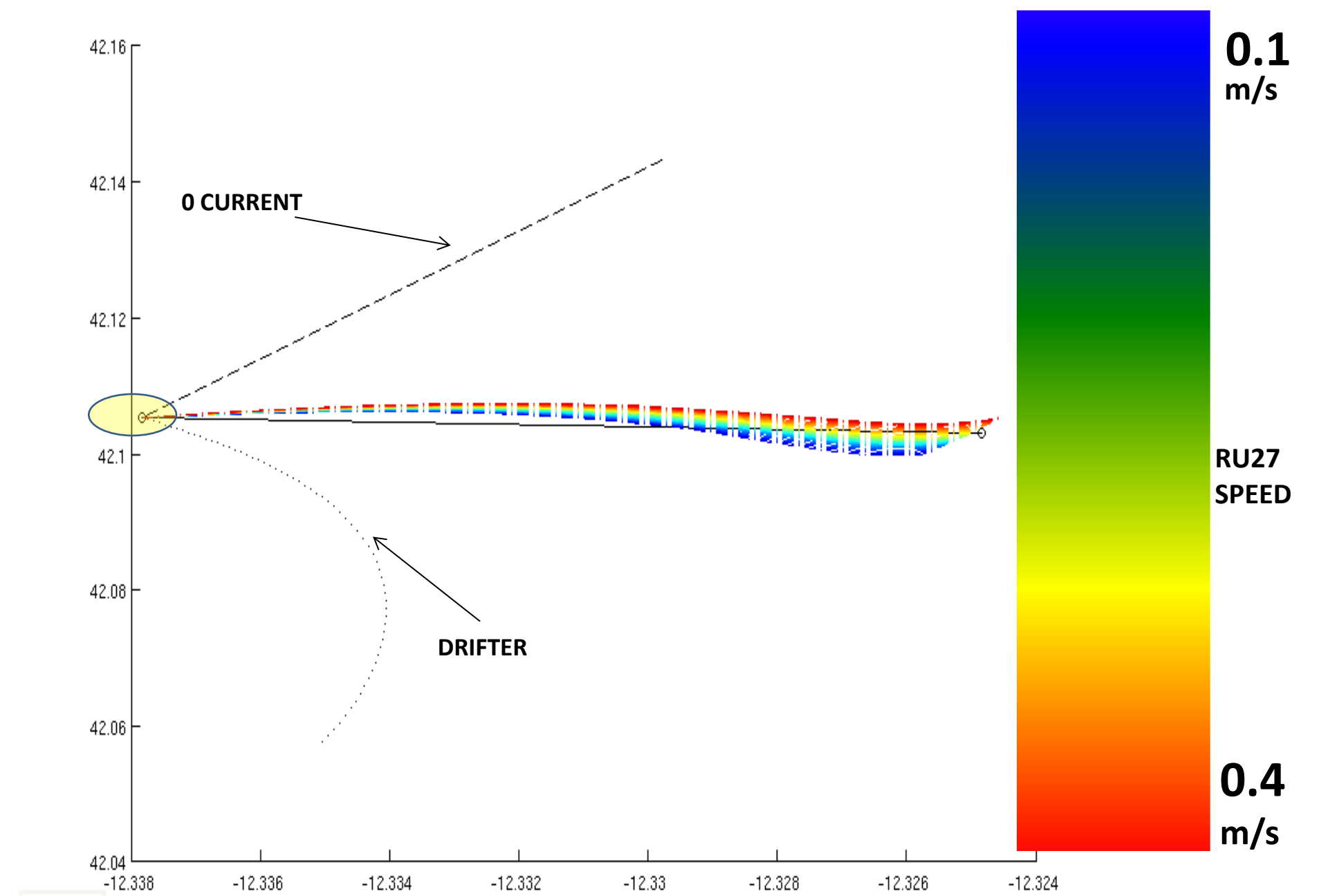
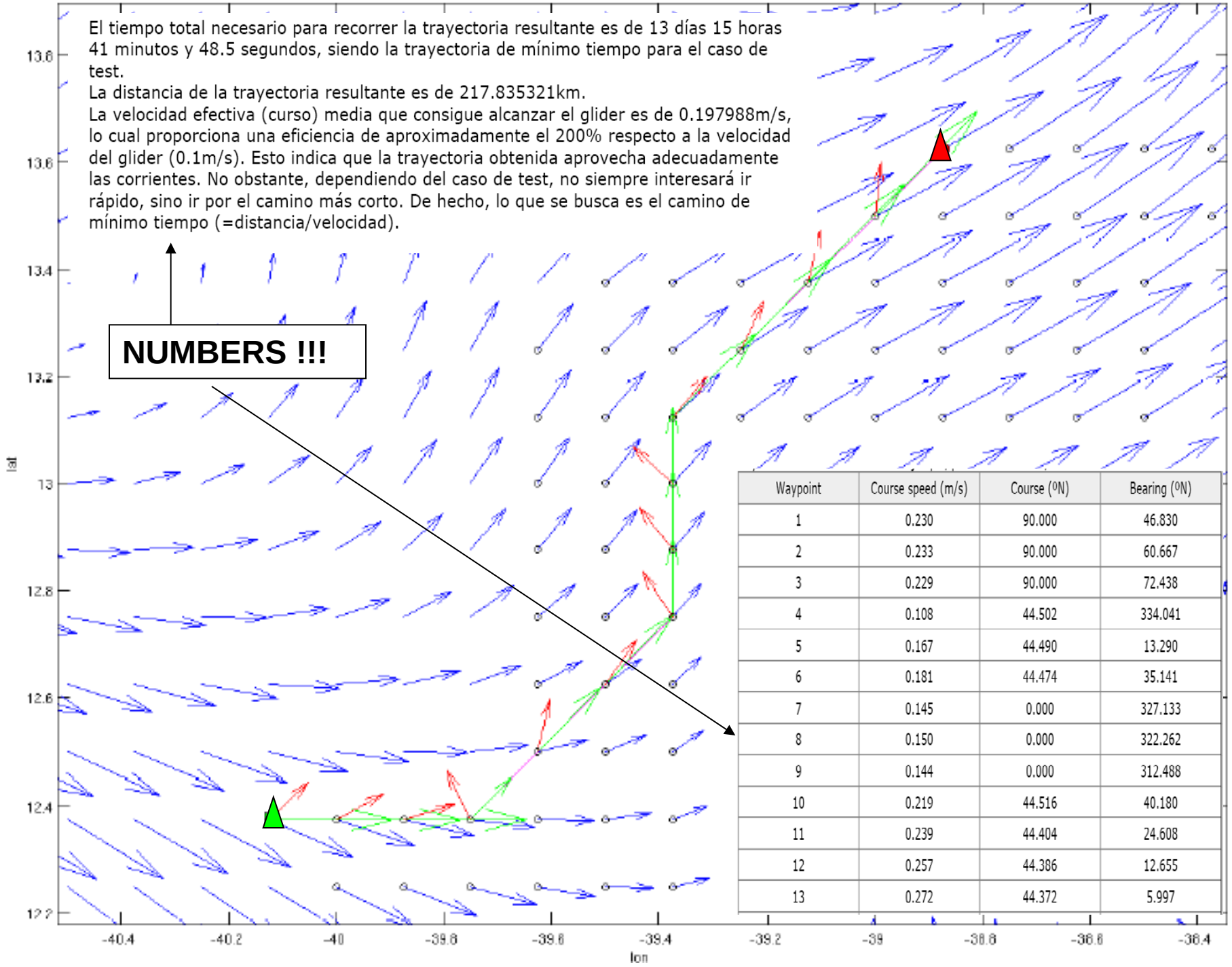


FIGURE 3. PINZON HEADING ERROR DIAGNOSTIC.


RUTGERS
N42.01°
N41.99°
N41.97°
N41.95°
N41.93°
N41.91°
N41.89°
N41.87°
N41.85°
N41.83°
W13.425°
W13.375°
W13.325°
W13.275°
W13.225°
W13.175°
W13.125°
W13.075°
RU27
Last S
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
©2009 Google

El tiempo total necesario para recorrer la trayectoria resultante es de 13 días 15 horas 41 minutos y 48.5 segundos, siendo la trayectoria de mínimo tiempo para el caso de test.
La distancia de la trayectoria resultante es de 217.835321km.
La velocidad efectiva (curso) media que consigue alcanzar el glider es de 0.197988m/s, lo cual proporciona una eficiencia de aproximadamente el 200% respecto a la velocidad del glider (0.1m/s). Esto indica que la trayectoria obtenida aprovecha adecuadamente las corrientes. No obstante, dependiendo del caso de test, no siempre interesará ir rápido, sino ir por el camino más corto. De hecho, lo que se busca es el camino de mínimo tiempo (=distancia/velocidad).

NUMBERS !!!

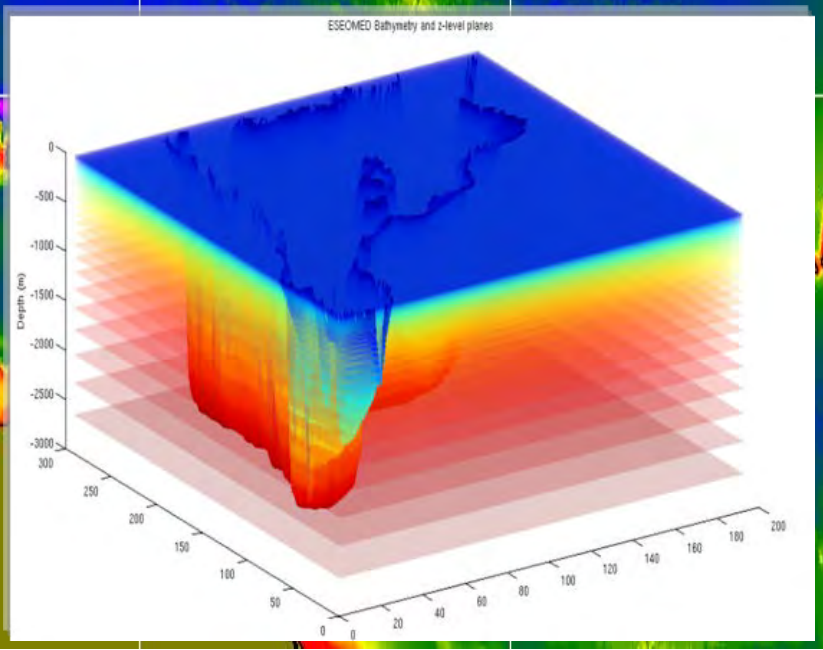


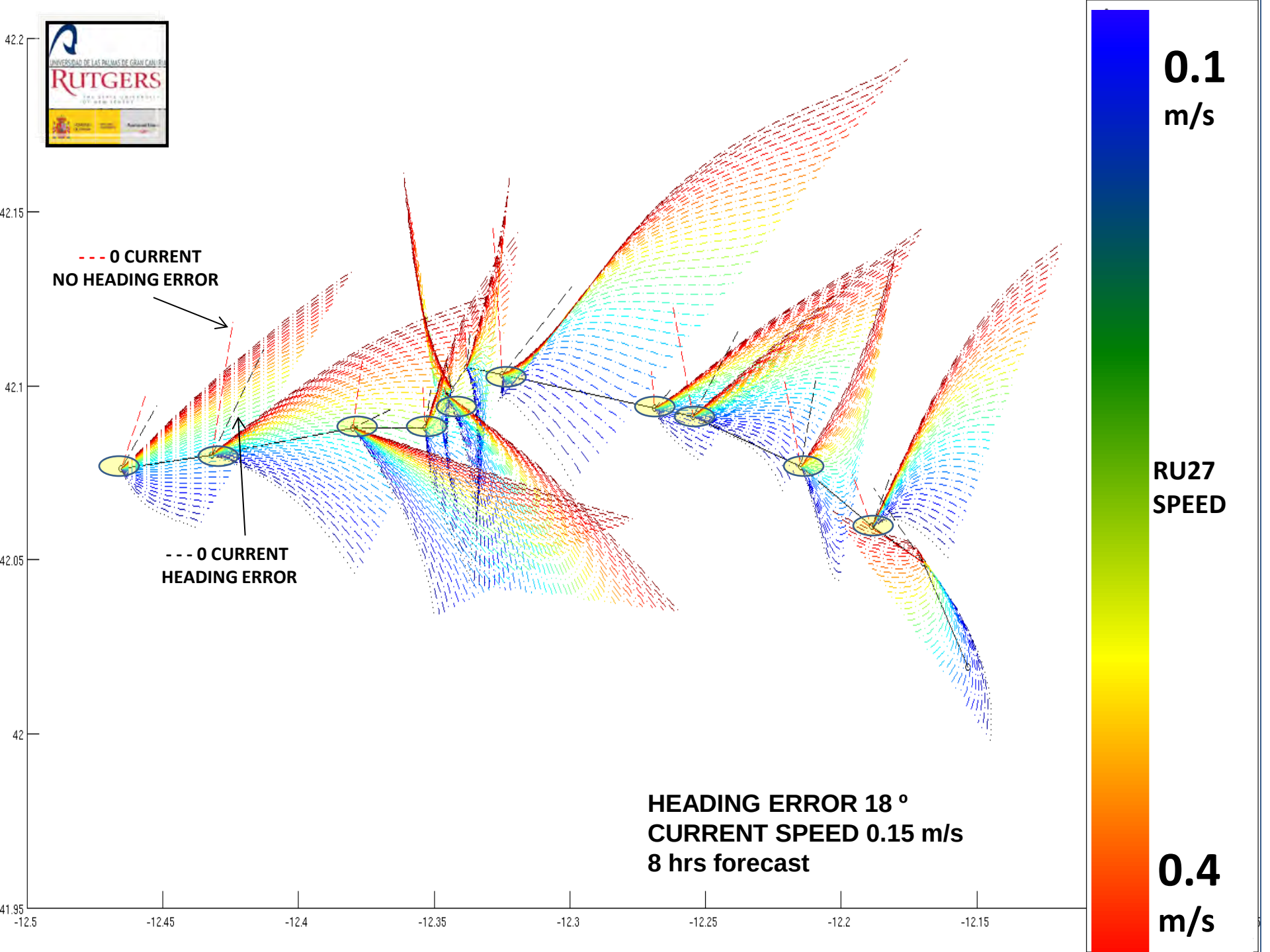
Waypoint	Course speed (m/s)	Course (ºN)	Bearing (ºN)
1	0.230	90.000	46.830
2	0.233	90.000	60.667
3	0.229	90.000	72.438
4	0.108	44.502	334.041
5	0.167	44.490	13.290
6	0.181	44.474	35.141
7	0.145	0.000	327.133
8	0.150	0.000	322.262
9	0.144	0.000	312.488
10	0.219	44.516	40.180
11	0.239	44.404	24.608
12	0.257	44.386	12.655
13	0.272	44.372	5.997

REGIONAL OCEAN MODEL. ESEOO domain. Data Sets.

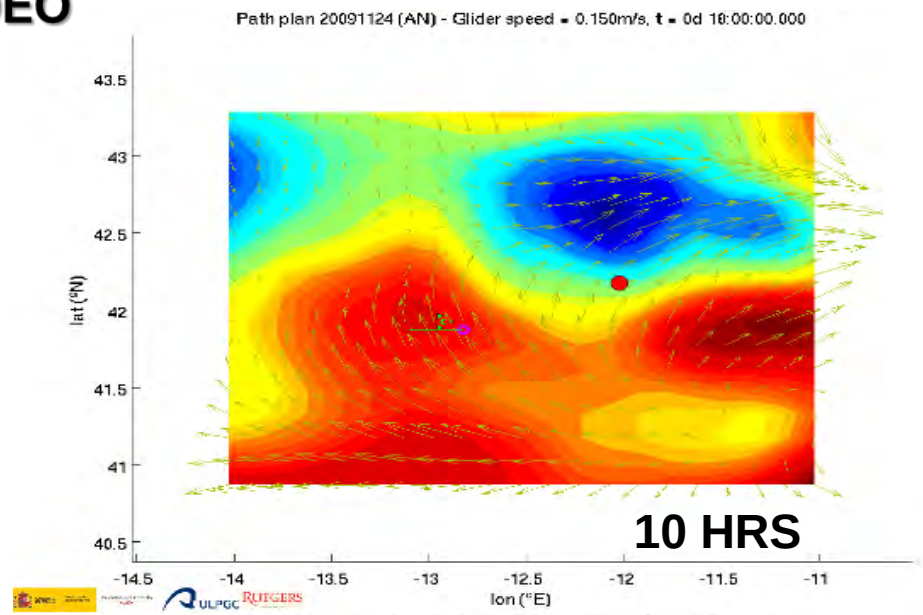
- 32 Sigma Levels
- (T,S,D, SSHa, Termoc, U,V,w, (1h, +72 h)
- 3D / 24 h (+72 h)

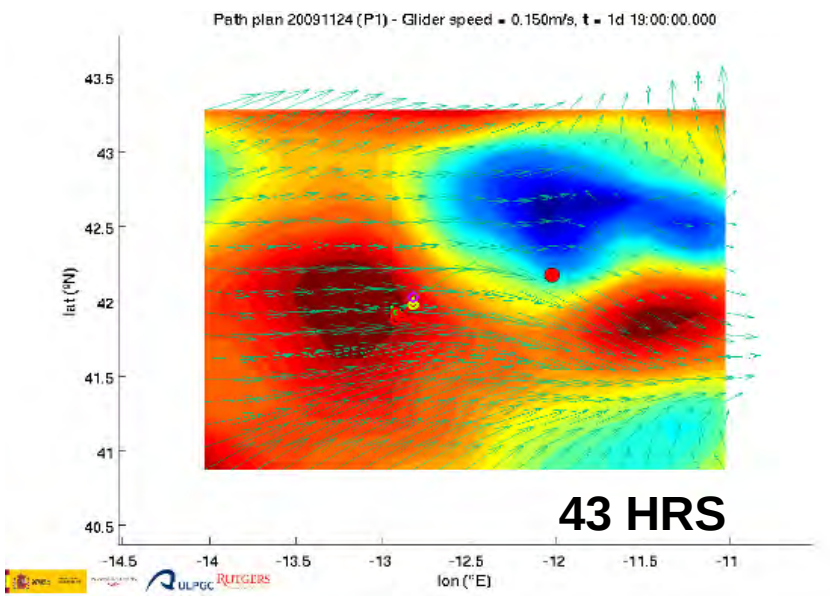
ESEOAT

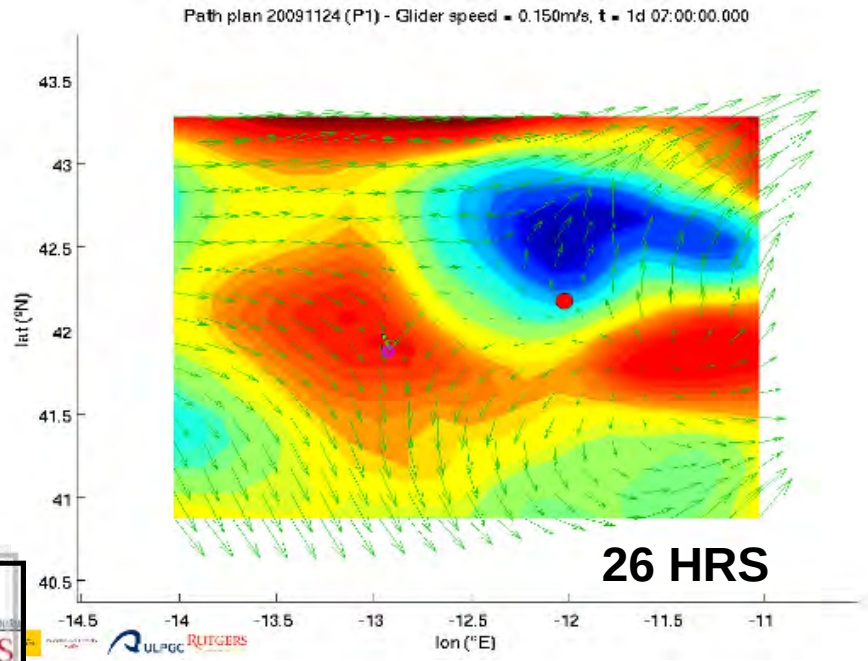


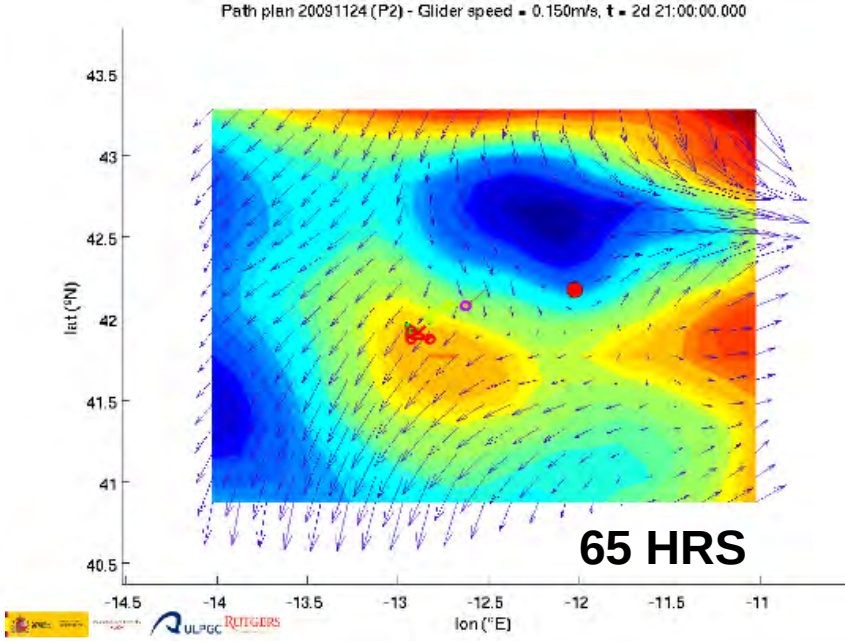

42.2
42.15
42.1
42.05
42
41.95
-12.5
-12.45
-12.4
-12.35
-12.3
-12.25
-12.2
-12.15
- - - 0 CURRENT
NO HEADING ERROR
- - - 0 CURRENT
HEADING ERROR
HEADING ERROR 18 º
CURRENT SPEED 0.15 m/s
8 hrs forecast
0.1
m/s
RU27
SPEED
0.4
m/s

VIDEO

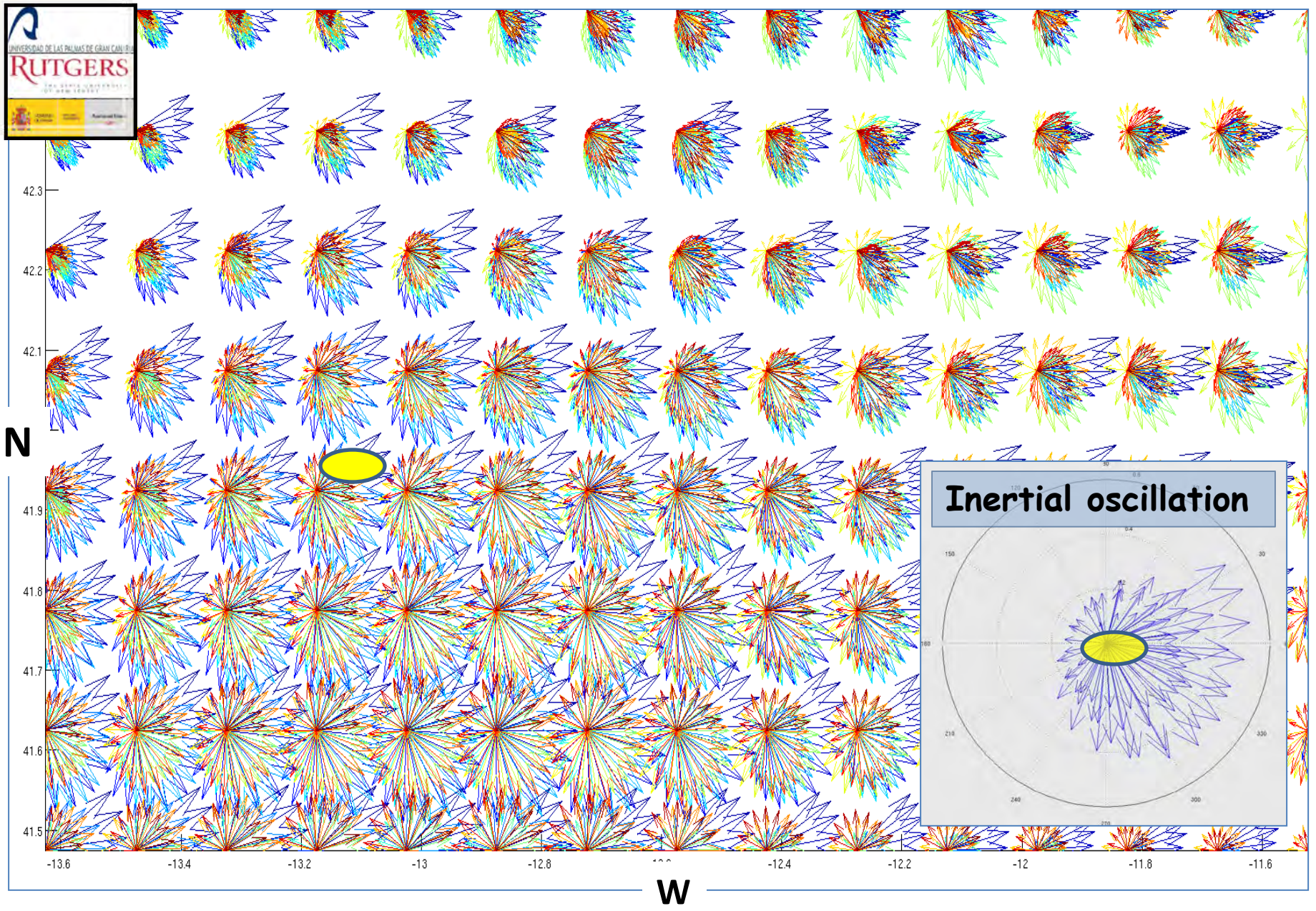






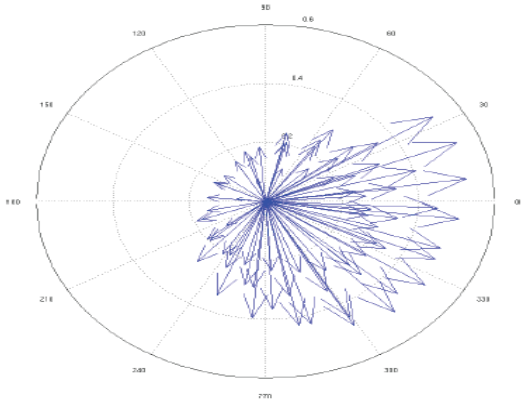


ESEOO SSHa. 24-27 NOV 2009

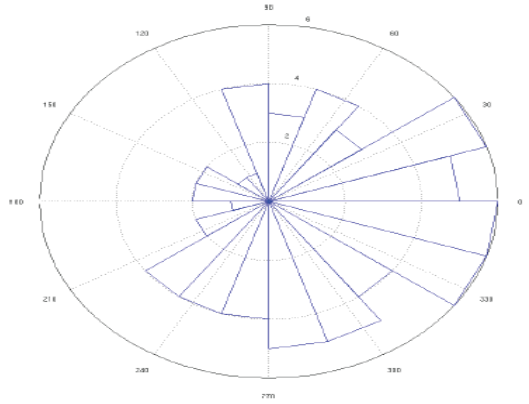


21 -23 Nov 2009. CURRENT FIELD USING HOURLY DATA FROM *ESEOO* ON THE RGIHT THE COMPASS PLOT AT THE NE OF RU27 POSITION. (the 3 days in different colors)= (42N, 13W).

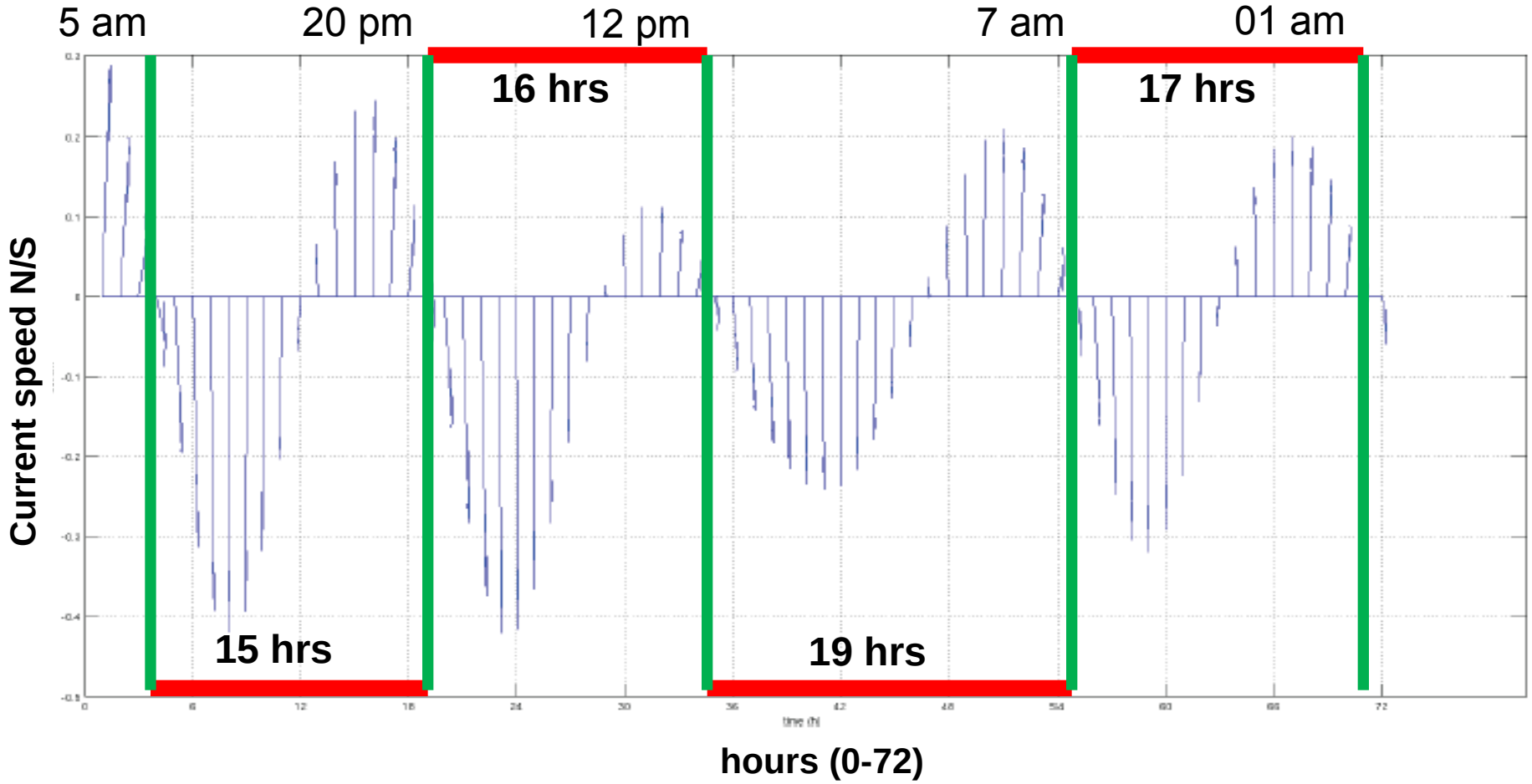
RU27
24-26 NOV 09
ESEOAT



(c) Compass plot



(d) Rose plot



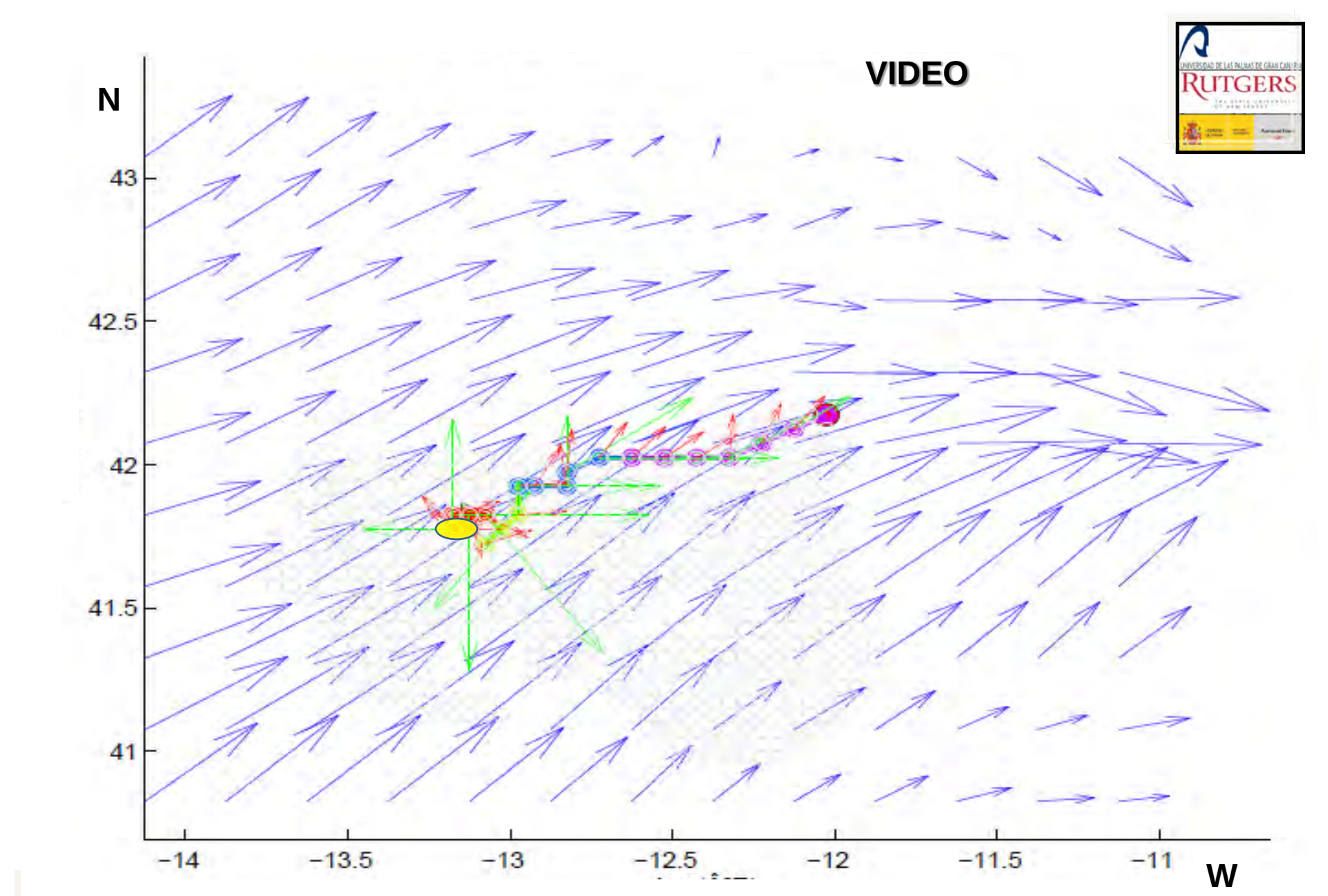
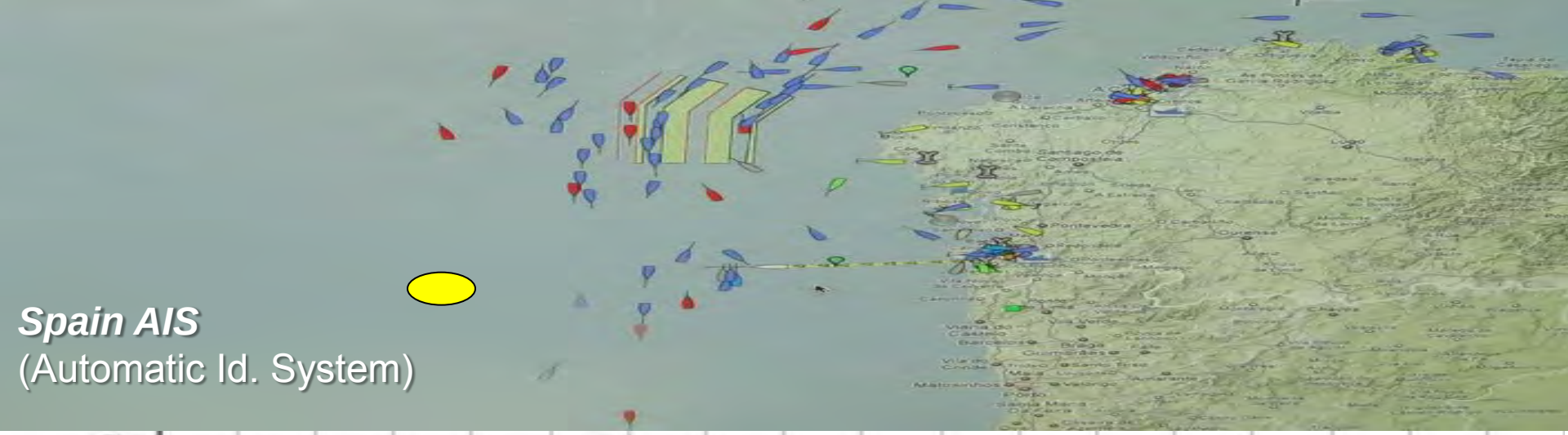


FIGURE 7. PINZON PATH PLAN ON 24 NOV 09 TO LEAVETHE INERTIAL OSCILLATION.

FIGURE 1. LA PINTA OF PINZON ( ) **AND LA NIÑA OF** COLUMBUS ( ) **FROM MID FEBRUARY TO MID MARCH OF 1493. PICTURE EXPOSED ON THE BAIONA TOWN.**


RU COOL


R/V El Investigador (47 m)


Spain AIS
(Automatic Id. System)


Cabo Sileiro buoy
Hmo(m)
0
1
2
3
4
5
6
7
8
-15 -14 -13 -12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2
Dias
Modelo días pasados:
Predicción de hoy:
Boya:


4th December 2009. 9.05 am, Costa da Morte, NW Spain
221 days, 7409 km
11000 yos 8000 CTD casts, 1000 sat coms
Energía = ½ litter of gas
R

Barco: "*The bear is in the igloo…*"
Centro de Control: *BZ*

4th December 2009 9.45 am
Costa da Morte, SPAIN

Print Materials:

- **Hopewell Valley News:** Yellow submarine surfaces at nearby school - 01/21/10
- **Rutgers Magazine:** Fantastic Voyage - 01/18/10
- **The Princeton Packet:** Yellow submarine surfaces in Montgomery classroom - 01/19/10
- **Star-Ledger:** Students get their hands on Rutgers' yellow submarine - 01/15/10
- **Star-Ledger:** Students get up close with Rutgers' yellow submarine - 01/15/10
- **The Times:** "Scarlet" glides her way to history - 01/15/10
- **El Pais:** Obama quiere que EE UU lleque al 3% del PIB en ciencia y tecnologia - 12/23/09
- **The Philadelphia Inquirer:** Rutgers glider robot a sleek ocean explorer - 12/21/09
- **The Washington Post:** Deep-sea glider - 12/15/09
- **Faro De Vigo:** Baiona devuelve Obama el submarino norteamericanó que exploro el Atlantico- 12/10/09
- **Atlantico:** Baiona reenvia el robot "Piolin" a Obama - 12/10/09
- **El Pais:** La ciencia hace historia en Baiona - 12/10/09
- **La Region:** "Piolin" cumplio su mision - 12/10/09
- **La Voz de Galicia:** Baiona recibe el robot prodigioso - 12/10/09
- **Puertos Informa:** Un pequeño planeador submarino atraviesa el Océano Atlántico - 12/09/09
- **Star-Ledger:** Spaniards fete Rutgers research sub - 12/09/09
- **La Region:** Fin de trayecto del primer robot submarino transoceanico - 12/09/09
- **La Voz de Galicia:** Más de 7.000 kilómetros bajo el mar - 12/05/09
- **Faro De Vigo:** El submarino Piolin culminasu travesia de 7.400 kilometros desde EE UU a Galicia - 12/05/09
- **Faro De Vigo:**Piolín cumple su destino - 12/03/09
- **Daily Targum:** Transatlantic glider slides into Spanish waters - 11/30/09
- **Star-Ledger:** Excitements runs deep for Rutgers' glider- 11/28/09

Office of Science & Technology Policy
Executive Office of the President

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Thursday, December 31, 2009

OSTP Blog
Science ◦ Technology ◦ Innovation

« Women In Science: A Discussion On The Diane Rehm Show
Voting Now Open for the President's SAVE Award »

An (Underwater) Flight Across the Atlantic

At 3 a.m. this morning, students and scientists from Rutgers University led a successful mission to recapture a small underwater robotic glider off the coast of Spain. The glider, dubbed The Scarlet Knight, is the first underwater robot to cross the Atlantic Ocean. With leadership from the National Oceanic and Atmospheric Administration (NOAA) and help from a number of international partners, students from the university's Coastal Ocean Observation Lab piloted The Scarlet Knight glider during its eight-month voyage.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

NOAA WORLD

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Great Lakes
North Atlantic

Science & Technology

First-Ever Trans-Atlantic Crossing by Unmanned Glider Advances Ocean Observation

Jennie Lyons and Deanna Eastman, National Ocean Service

January 4, 2009 — It took 221 days and international coordination, but a 7-foot-long, 135-pound Slocum deep-sea glider opened up a new world of ocean technology in December when it successfully crossed the Atlantic Ocean — a 7,300-mile-journey from the New Jersey coast to a famed Spanish harbor.

a single patent into different languages. The plan awaits debate in the European parliament.

Biotech boost: The European life-sciences sector was perked up by its first large initial public offering for almost two years, after Belgian biotech firm Movetis raised €85 million (US$128 million) on its 3 December debut. Backed by venture-capital investment, Movetis has European approval to market a constipation drug, prucalopride (Resolor).

NUMBER CRUNCH

221

The number of days unmanned underwater glider Scarlet Knight took to cross the Atlantic Ocean, gathering water data. It is the first craft of its kind to make the crossing.

Source: Rutgers, the State University of New Jersey

quit the agency on 2 December. Clive Spash (pictured below), an ecological economist at the Commonwealth Scientific and Industrial Research Organization in Canberra, said he had "had enough" after his paper was accepted by the journal *New Political Economy* earlier this year, withdrawn by the acting chief of his division, and then approved again on condition that parts were reworded. See go.nature.com/OoYXwX for more.

THE WEEK AHEAD

9–11 DECEMBER
New Zealand hosts the Antarctic Treaty Meeting of Experts, which will recommend ways to manage ship-borne tourism to Antarctica.
go.nature.com/dJJGwl

10 DECEMBER
This year's Nobel science laureates receive their awards in Stockholm, Sweden.
go.nature.com/PUfasn


27

Museo Casa de la Navegación de Baiona, Vigo-SPAIN

ULPGC
Robótica y Oceanografía Computacional
División ROC (IUSIANI)

RUTGERS
Coastal Ocean Observation Lab

CHALLENGER MISSION

http://www.i-cool.org/?cat=77

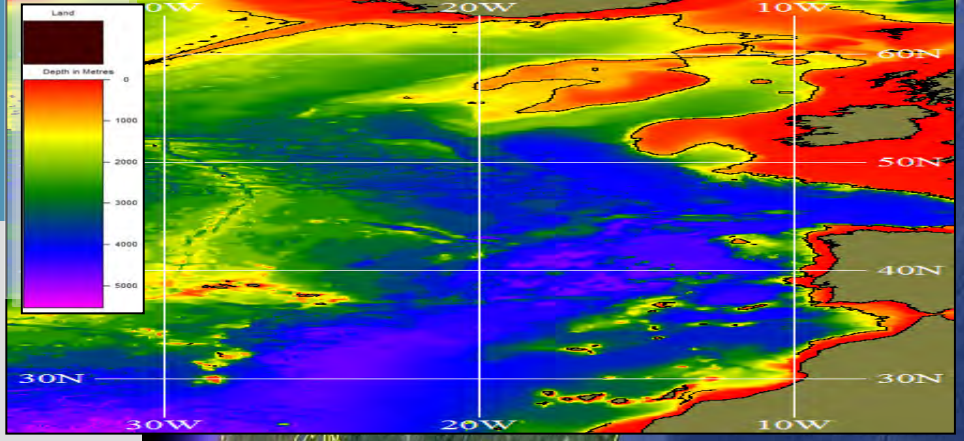
- > 2008
- 10 missions
- > 50 months/sea
- > 45,000 km

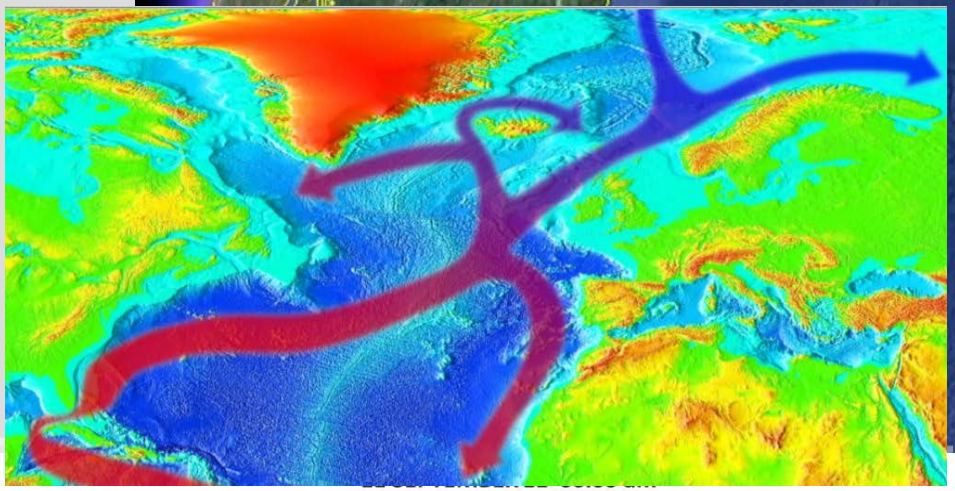
RU-17 Slocum. Across the Pond. (May – Oct 08)

RU-27 Slocum. Atlantic Crossing. (Apr – Dec 09)

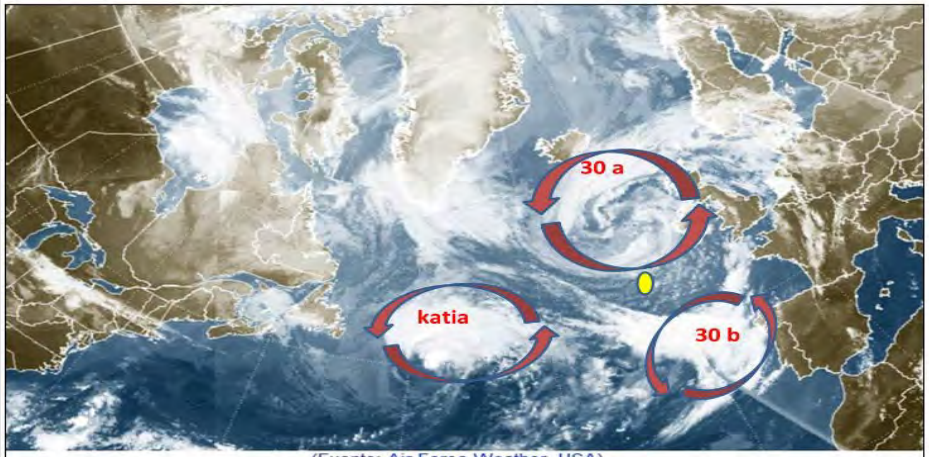
Silbo Slocum. Challenger 1 (Apr11–Aug13)

RU-29 Slocum. Challenger 1 (Jan13 –March16)



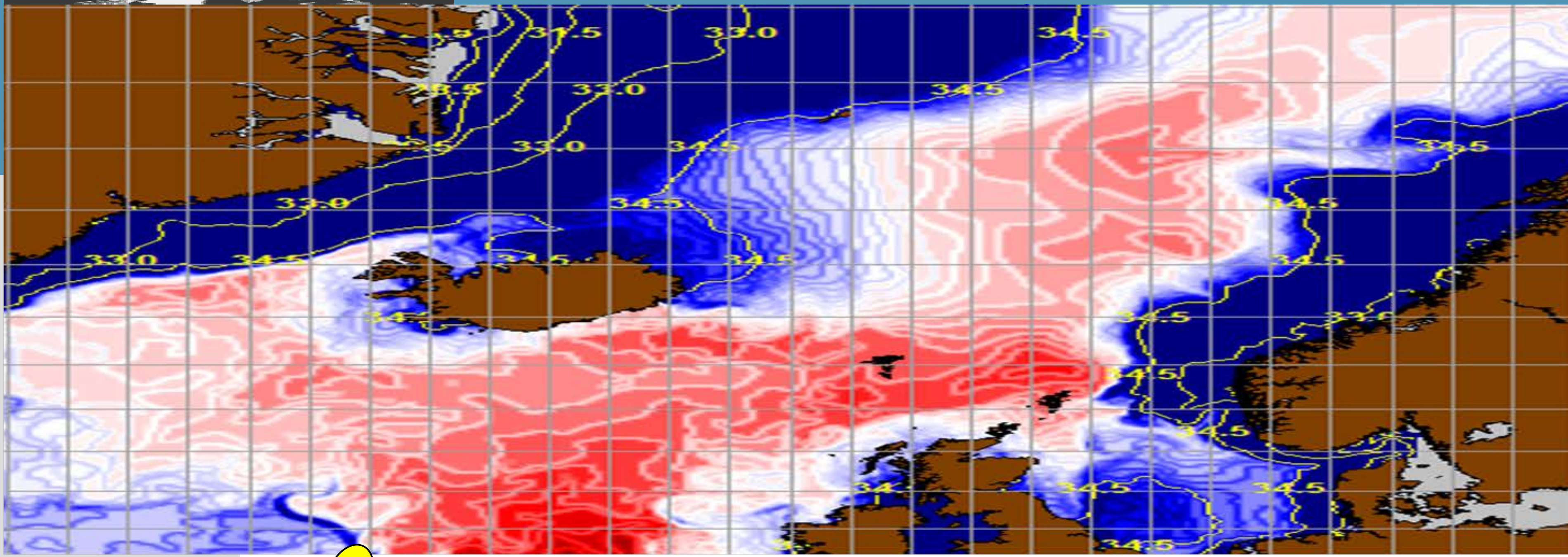


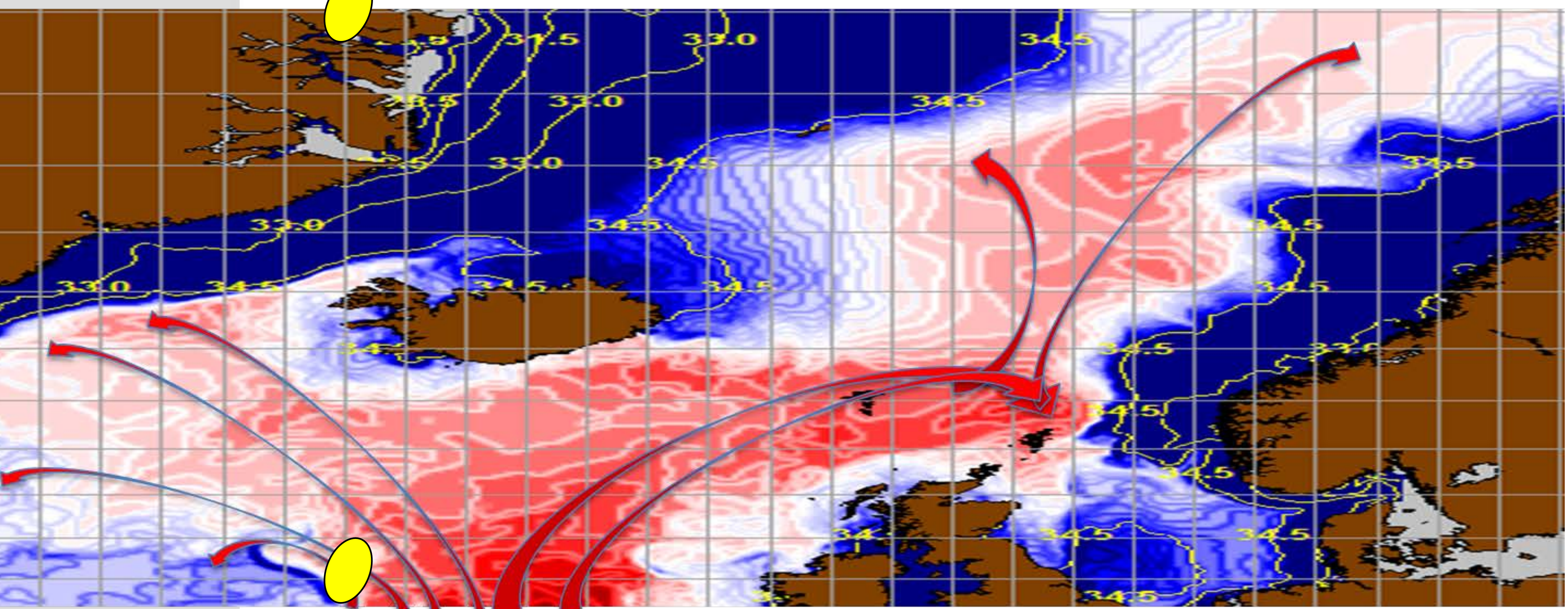
The Perfect Storm

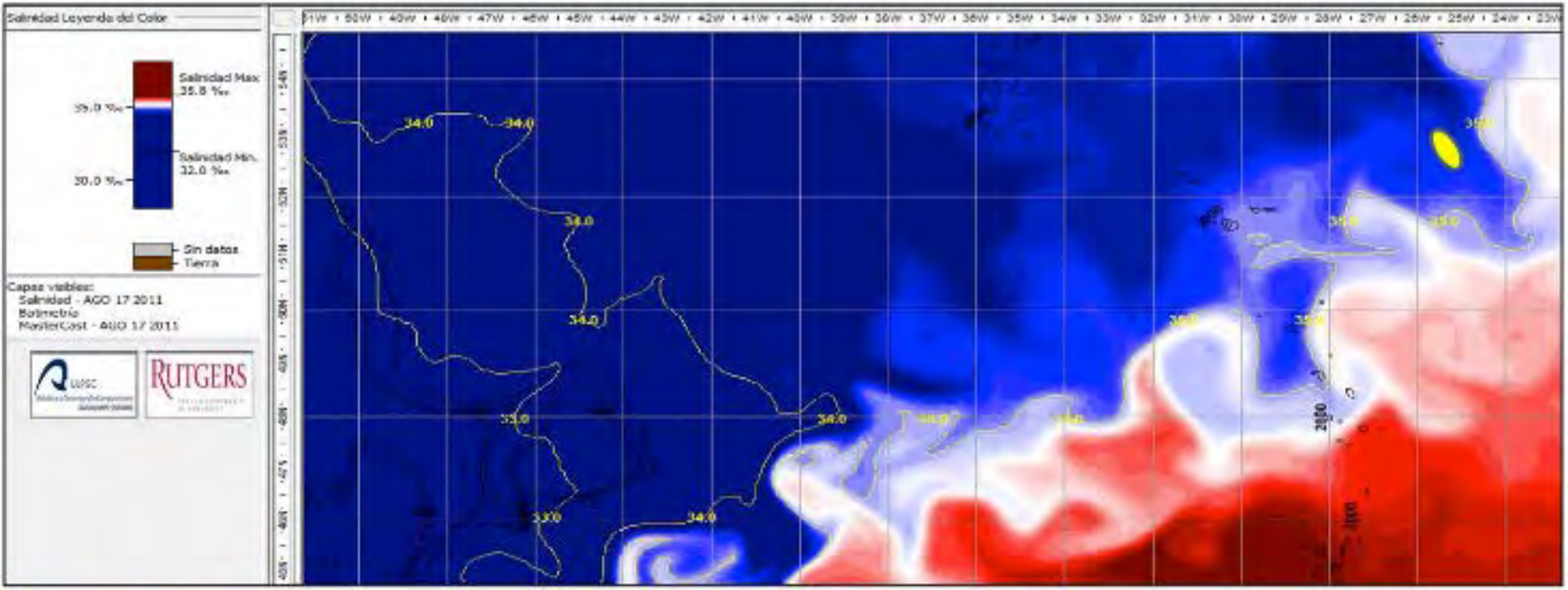


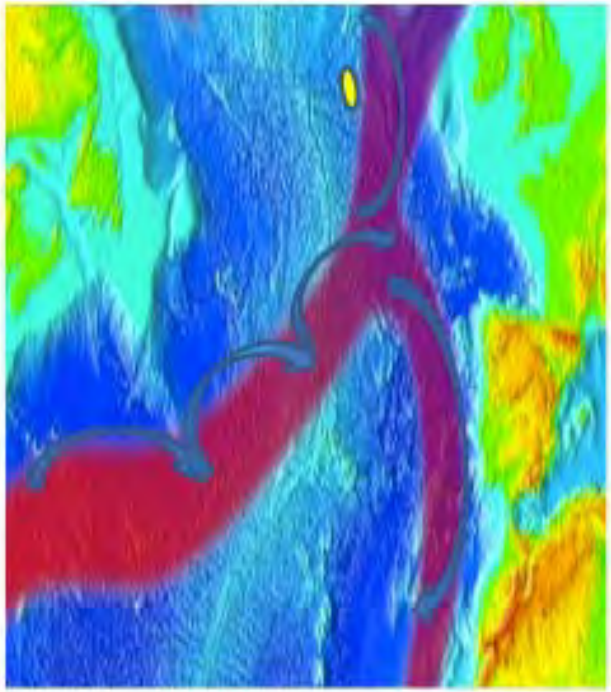
(Fuente: Air Force Weather, USA)

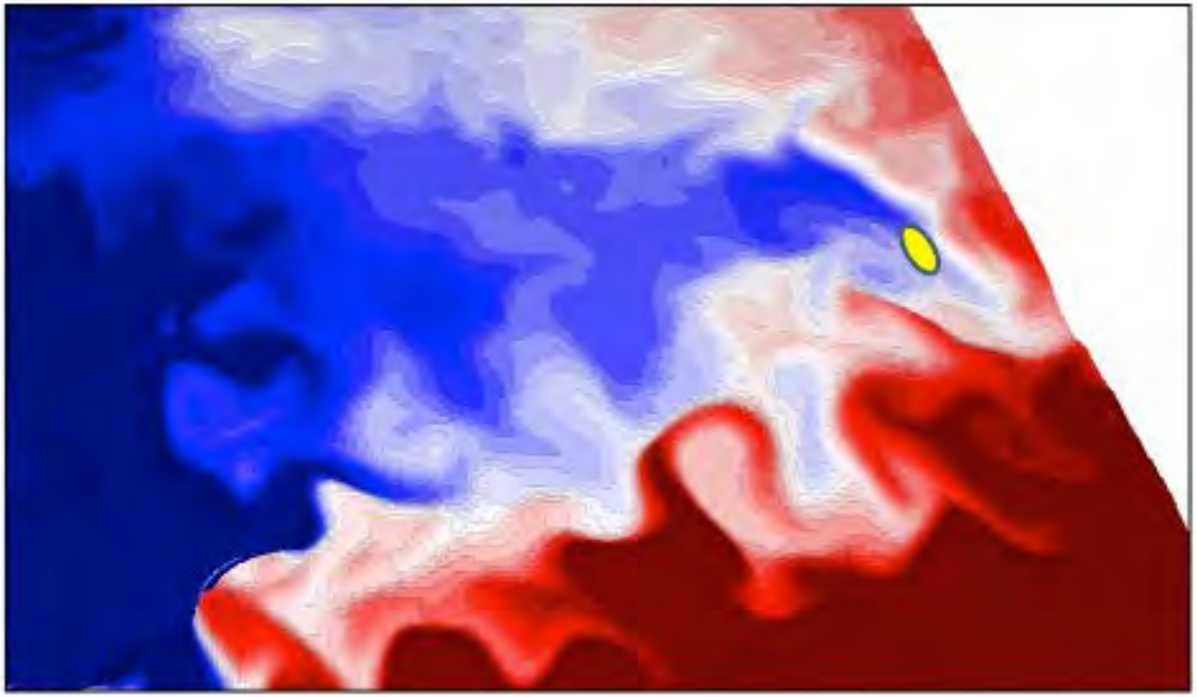
2.- Silbo,s job


33.0
34.5

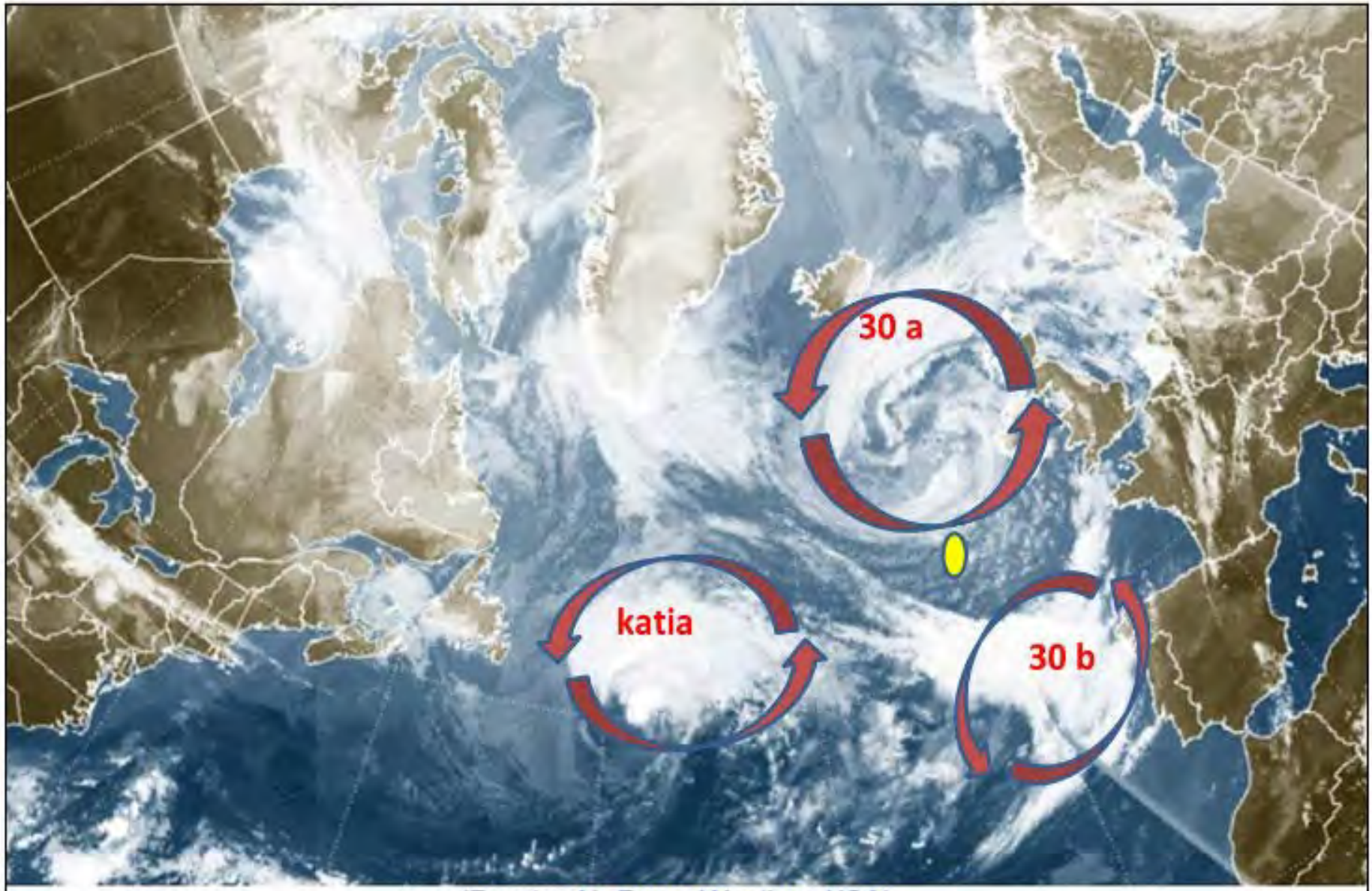

33.0
34.5


Salinidad Leyenda del Color
Salinidad Max.
35.8 ‰
35.0 ‰
Salinidad Min.
32.0 ‰
30.0 ‰
Sin datos
Tierra
Capas visibles:
Salinidad - AGO 17 2011
Batimetria
MasterCast - AGO 17 2011
USF
RUTGERS
34.0
35.0

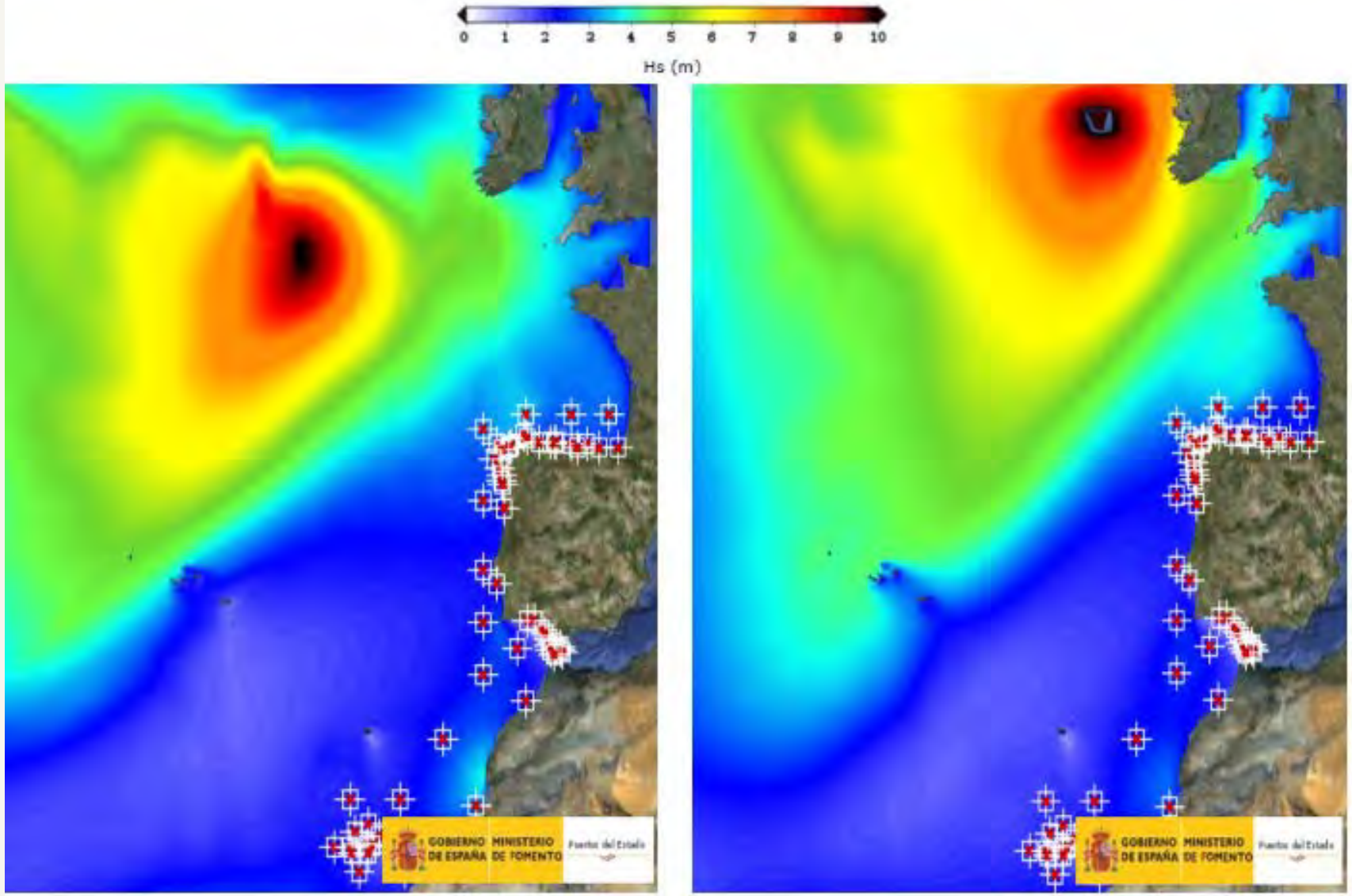




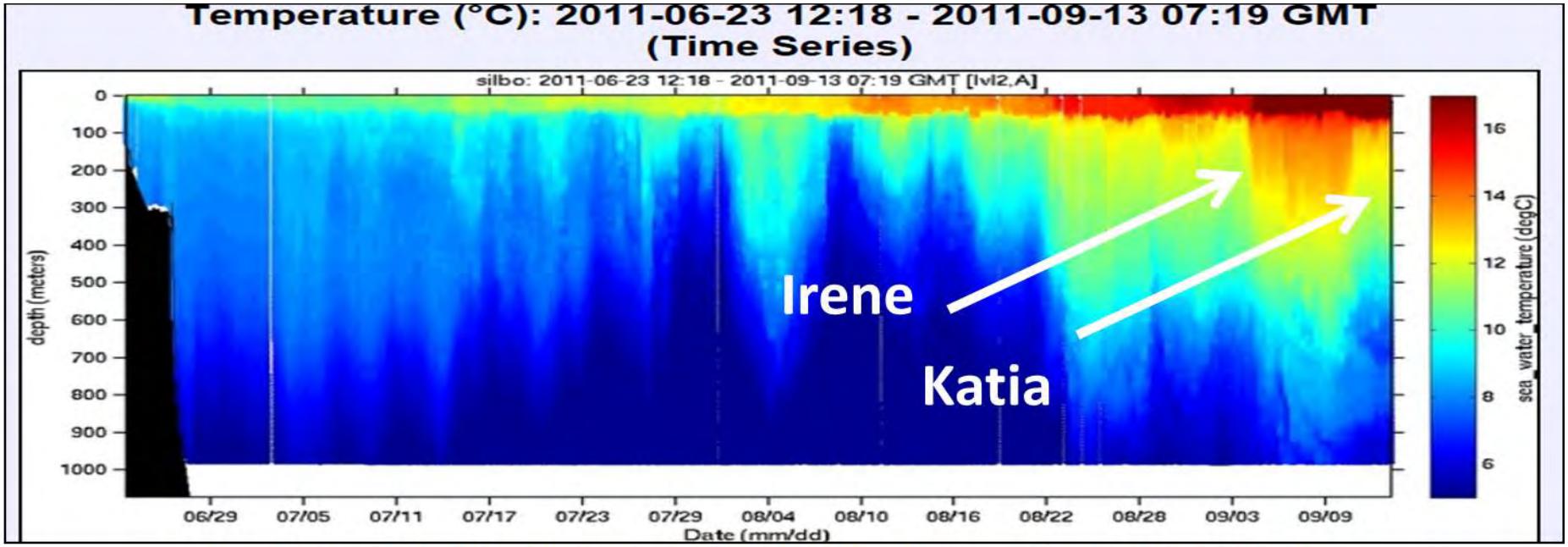
11 SEPTEMBER 11 00.00 am
The Perfect Storm

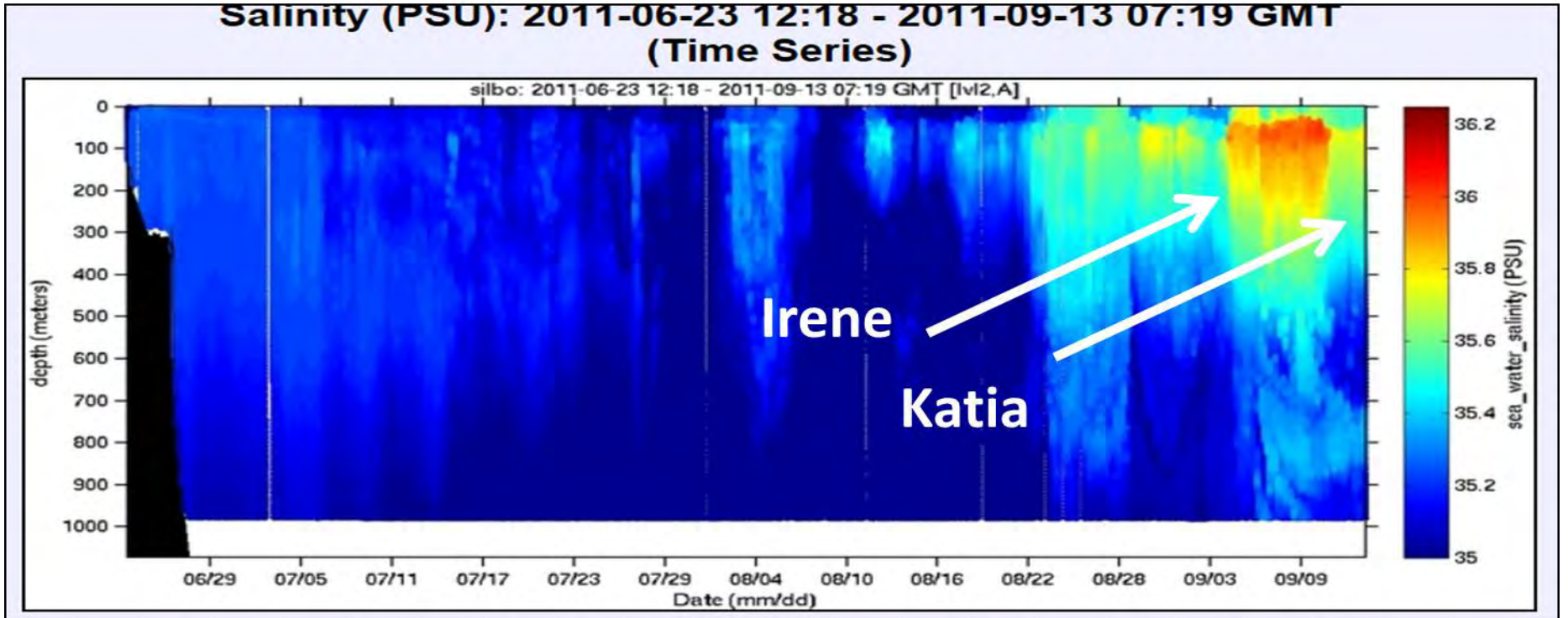


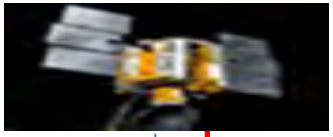
(Fuente: Air Force Weather, USA)

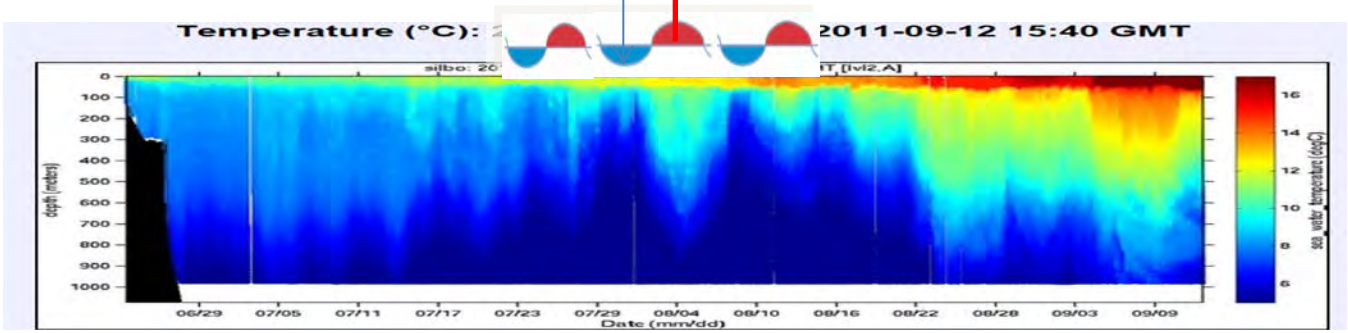


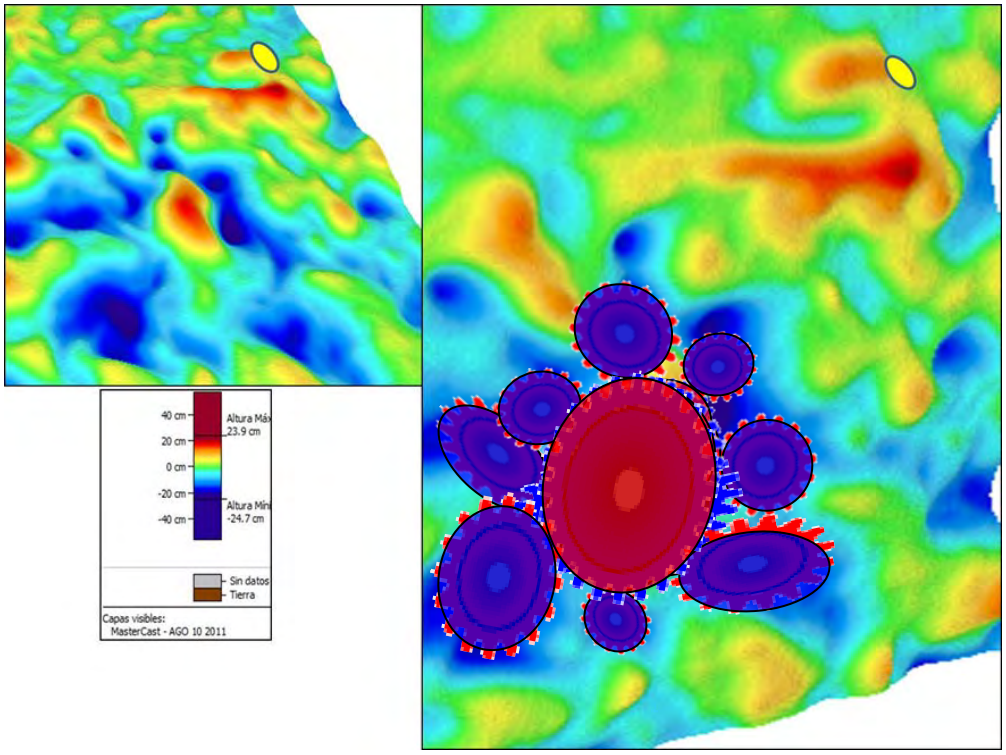
12 September 06.00 am

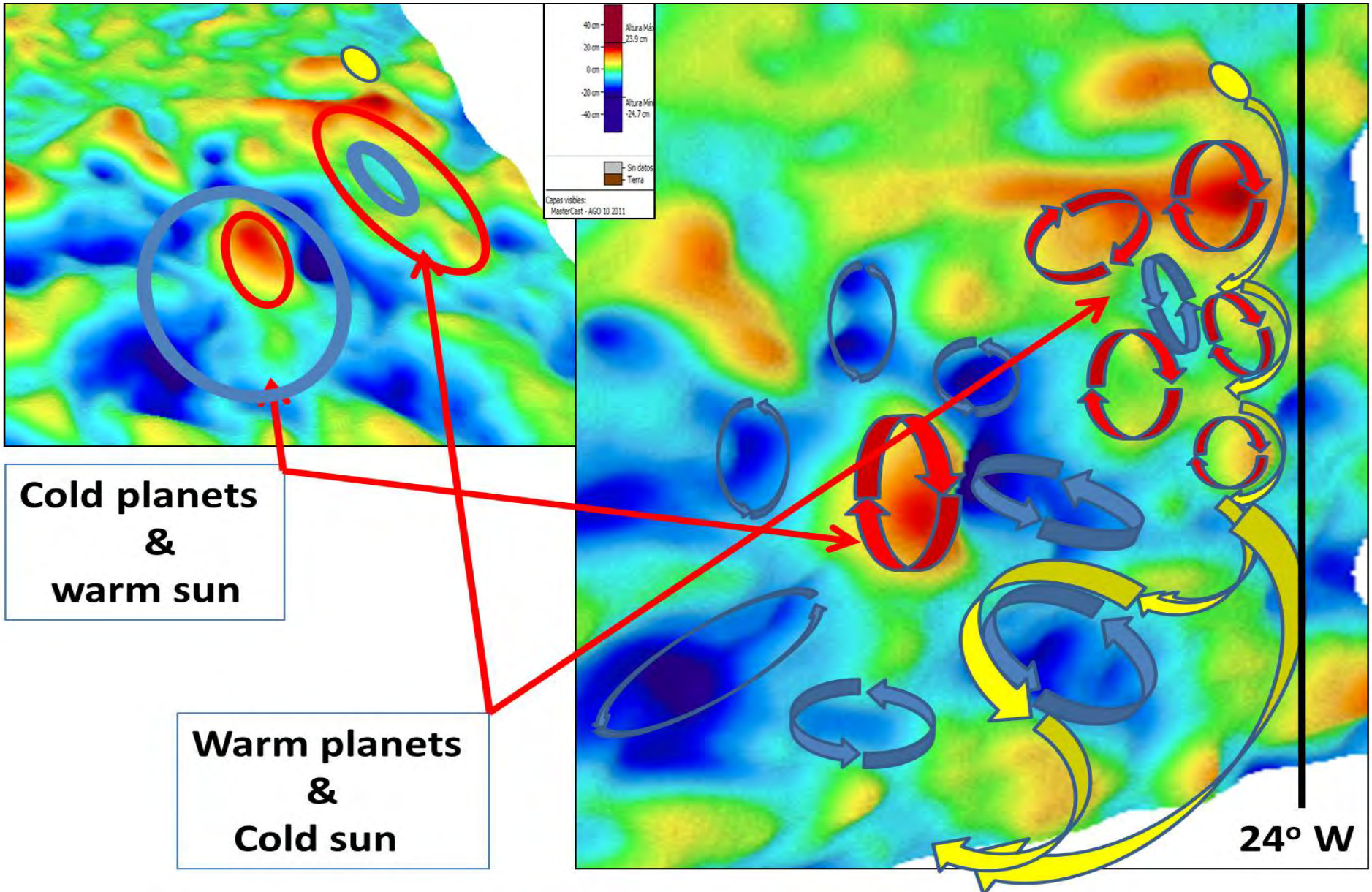

Temperature (°C): 2011-06-23 12:18 - 2011-09-13 07:19 GMT
(Time Series)
silbo: 2011-06-23 12:18 - 2011-09-13 07:19 GMT [lvl2,A]
depth (meters)
0
100
200
300
400
500
600
700
800
900
1000
06/29
07/05
07/11
07/17
07/23
07/29
08/04
08/10
08/16
08/22
08/28
09/03
09/09
Date (mm/dd)
Irene
Katia
sea_water_temperature (degC)
16
14
12
10
8
6

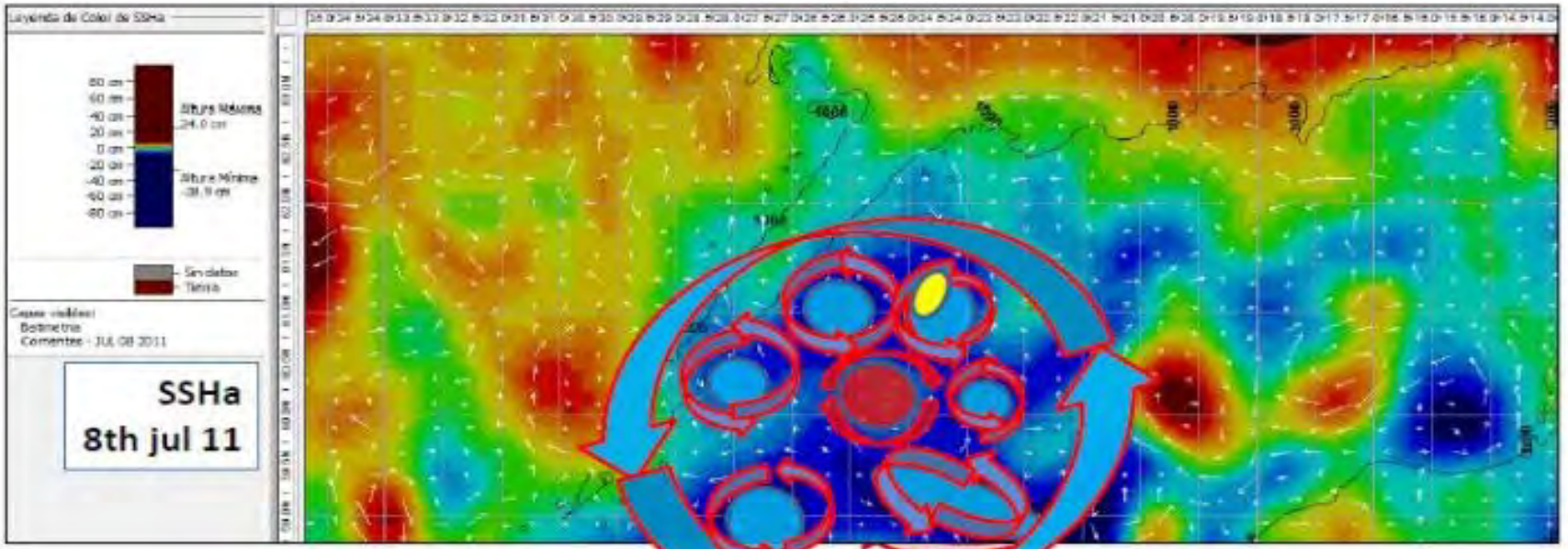

Salinity (PSU): 2011-06-23 12:18 - 2011-09-13 07:19 GMT
(Time Series)
silbo: 2011-06-23 12:18 - 2011-09-13 07:19 GMT [lvl2,A]
depth (meters)
0
100
200
300
400
500
600
700
800
900
1000
06/29
07/05
07/11
07/17
07/23
07/29
08/04
08/10
08/16
08/22
08/28
09/03
09/09
Date (mm/dd)
Irene
Katia
sea_water_salinity (PSU)
36.2
36
35.8
35.6
35.4
35.2
35

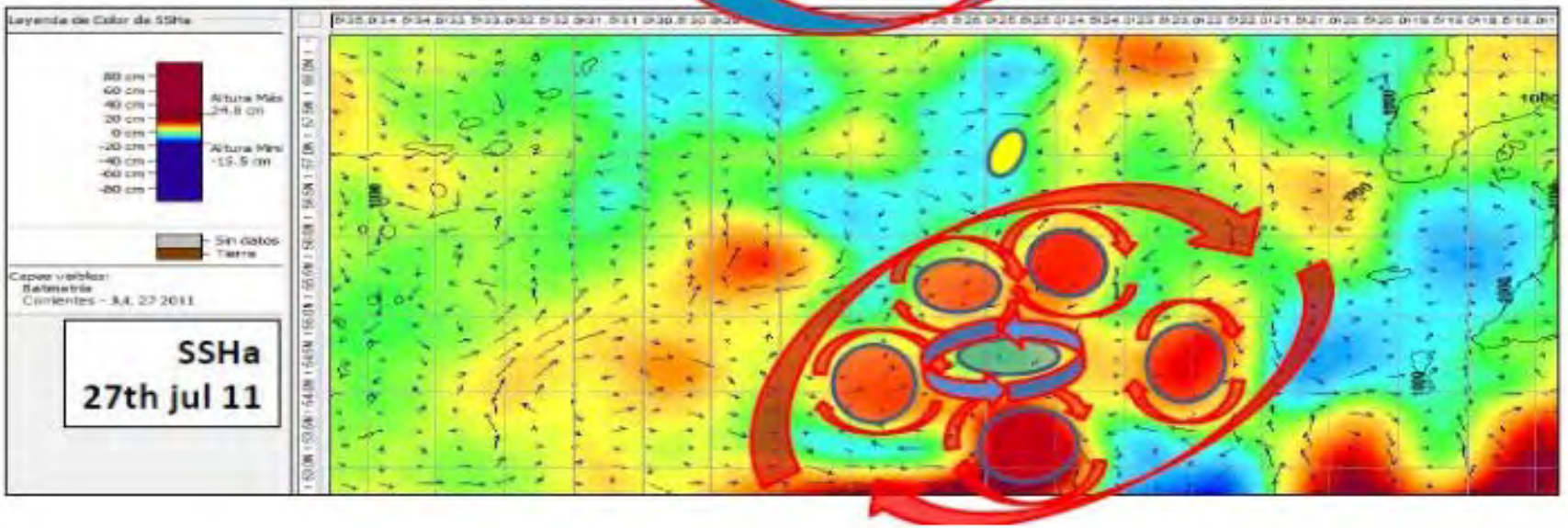


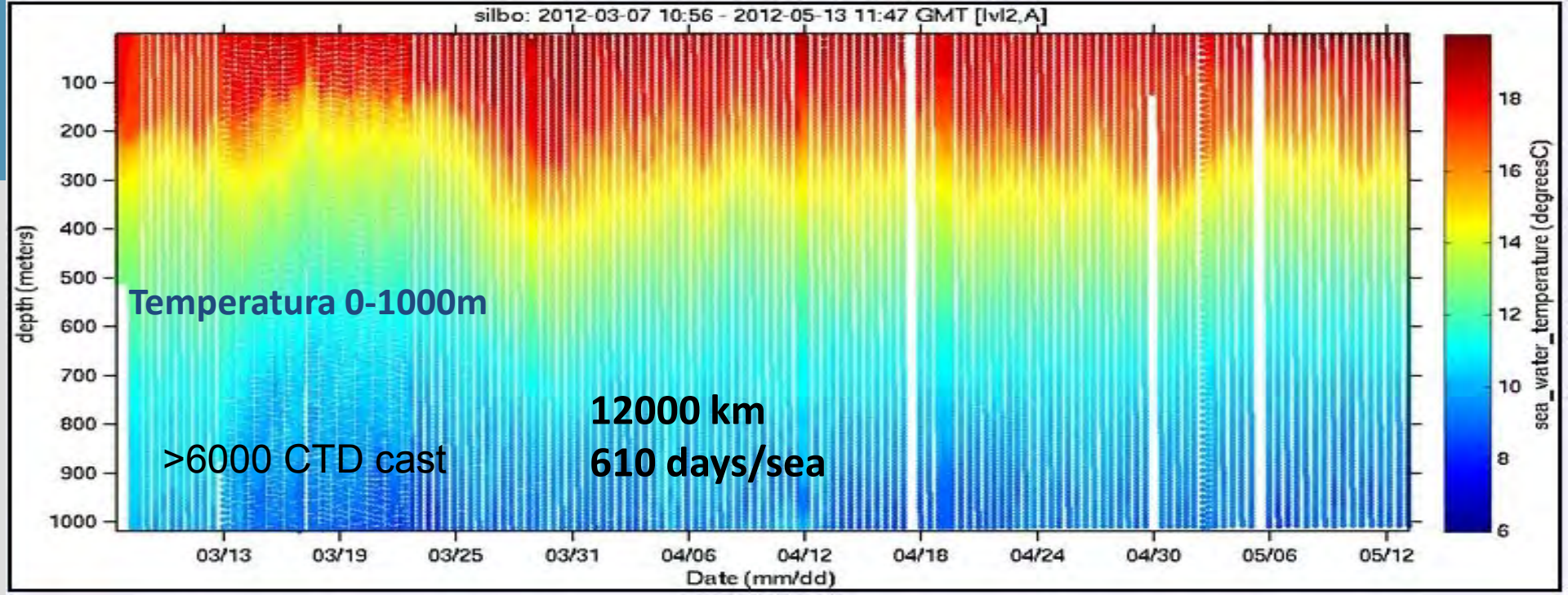

Temperature (°C):
2011-09-12 15:40 GMT
depth (meters)
0
100
200
300
400
500
600
700
800
900
1000
06/29
07/05
07/11
07/17
07/23
07/29
08/04
08/10
08/16
08/22
08/28
09/03
09/09
Date (mm/dd)
16
14
12
10
8
6

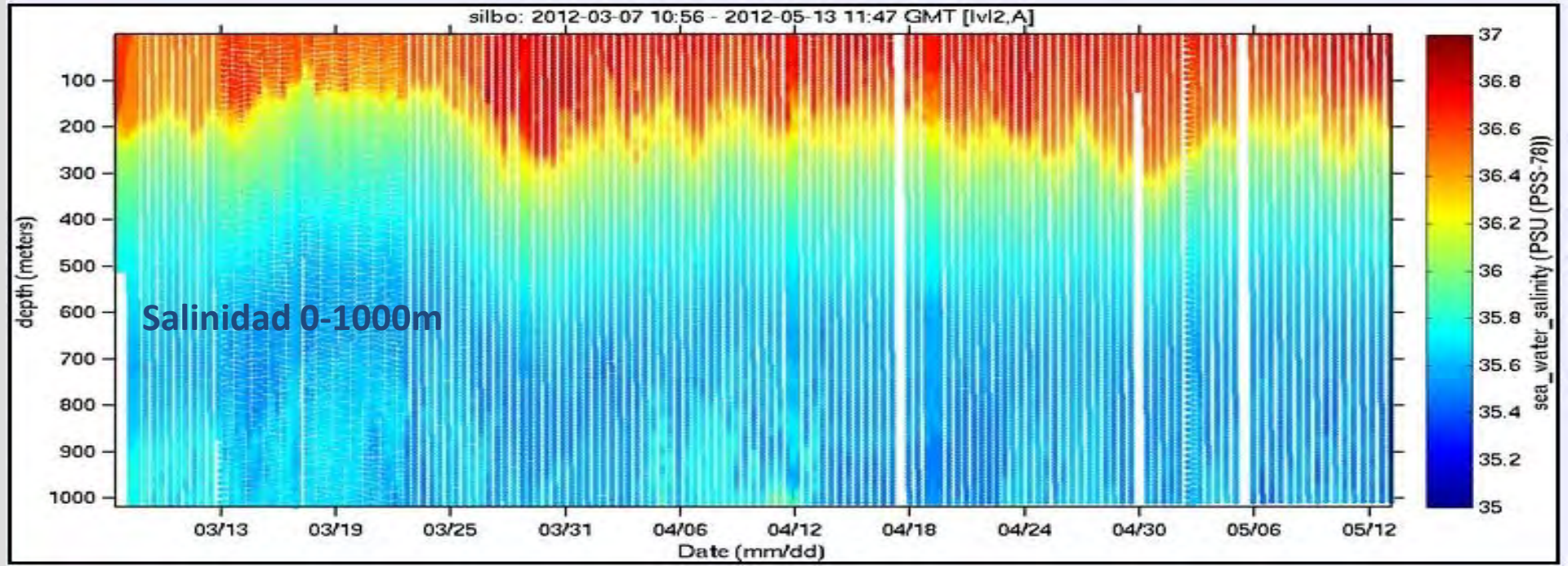

40 cm
20 cm
0 cm
-20 cm
-40 cm
Altura Máx
23.9 cm
Altura Mín
-24.7 cm
Sin datos
Tierra
Capas visibles:
MasterCast - AGO 10 2011


40 cm
20 cm
0 cm
-20 cm
-40 cm
Altura Máx
23.9 cm
Altura Mín
-24.7 cm
Sin datos
Tierra
Capas visibles:
MasterCast - AGO 10 2011
Cold planets
&
warm sun
Warm planets
&
Cold sun
24º W


Leyenda de Color de SSHa
Altura Máxima
24.0 cm
Altura Mínima
-38.9 cm
Sin datos
Tierra
Capas visibles:
Batimetría
Corrientes - JUL 08 2011
SSHa
8th jul 11


Leyenda de Color de SSHa
Altura Máx
24.8 cm
Altura Mín
-15.5 cm
Sin datos
Tierra
Capas visibles:
Batimetría
Corrientes - JUL 27 2011
SSHa
27th jul 11


silbo: 2012-03-07 10:56 - 2012-05-13 11:47 GMT [lvl2,A]
depth (meters)
100
200
300
400
500
600
700
800
900
1000
Temperatura 0-1000m
>6000 CTD cast
12000 km
610 days/sea
03/13
03/19
03/25
03/31
04/06
04/12
04/18
04/24
04/30
05/06
05/12
Date (mm/dd)
sea_water_temperature (degreesC)
18
16
14
12
10
8
6


silbo: 2012-03-07 10:56 - 2012-05-13 11:47 GMT [lvl2,A]
depth (meters)
100
200
300
400
500
600
700
800
900
1000
Salinidad 0-1000m
03/13
03/19
03/25
03/31
04/06
04/12
04/18
04/24
04/30
05/06
05/12
Date (mm/dd)
sea_water_salinity (PSU (PSS-78))
37
36.8
36.6
36.4
36.2
36
35.8
35.6
35.4
35.2
35

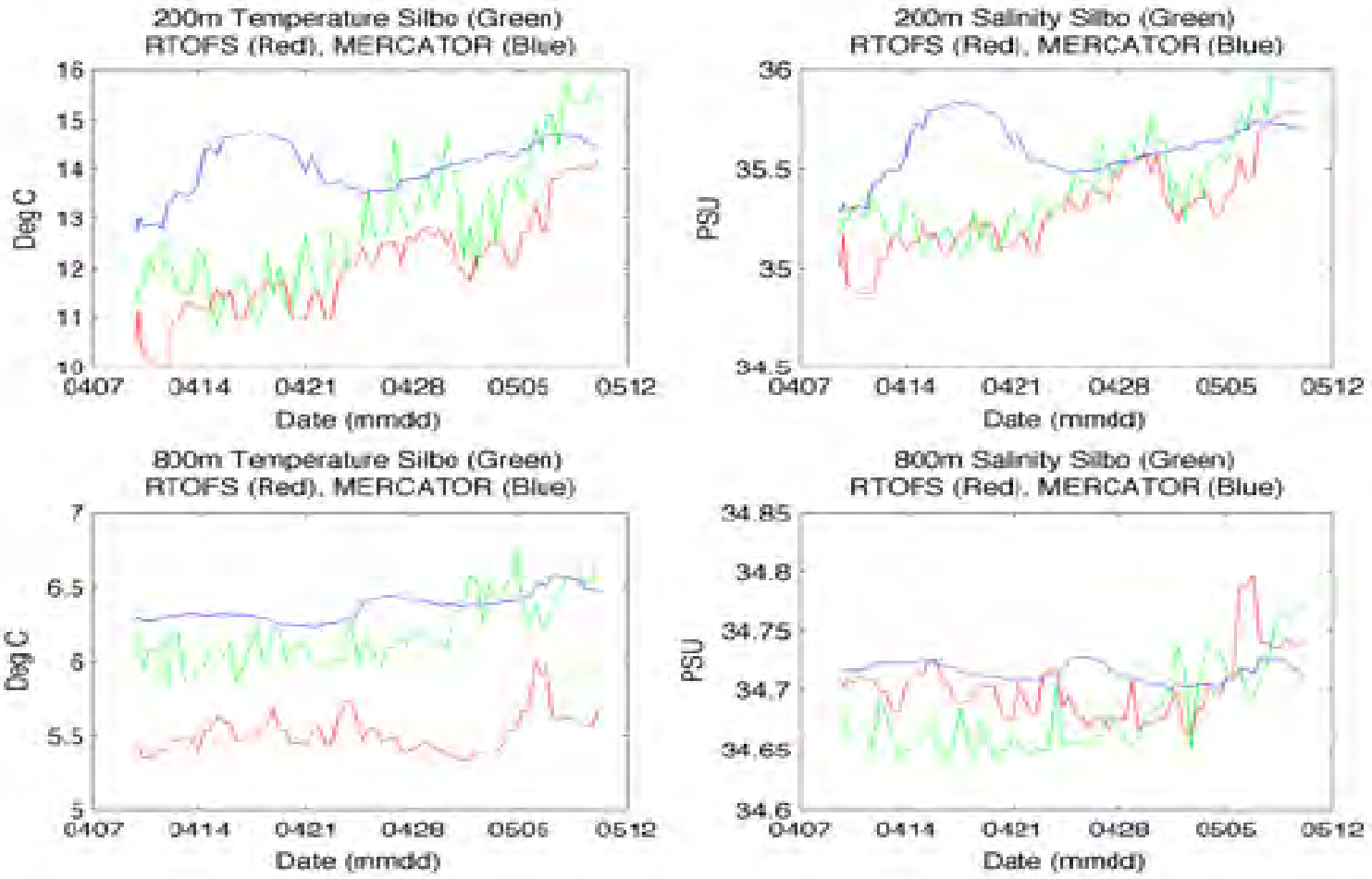


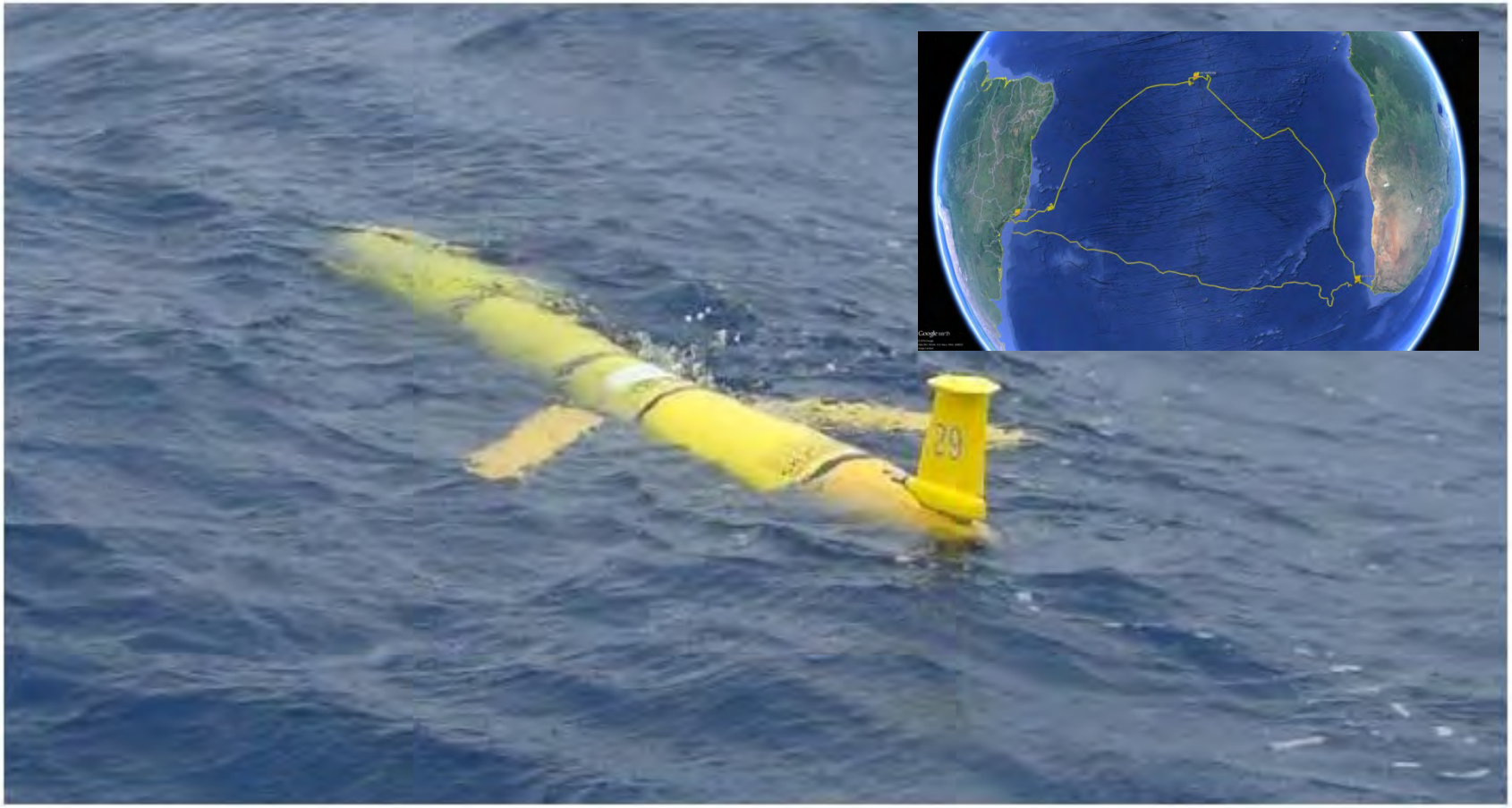
Figure 7: Comparisons of Silbo (green) with RTOFS (red) and MyOcean (blue) model data of temperature at 200m (top left), 800m (bottom left) and salinity at 200m (top right) and 800m (bottom right).

CHALLENGER 1 MISSION

RU-29 (“*Challenger*”): 17400km 760 days

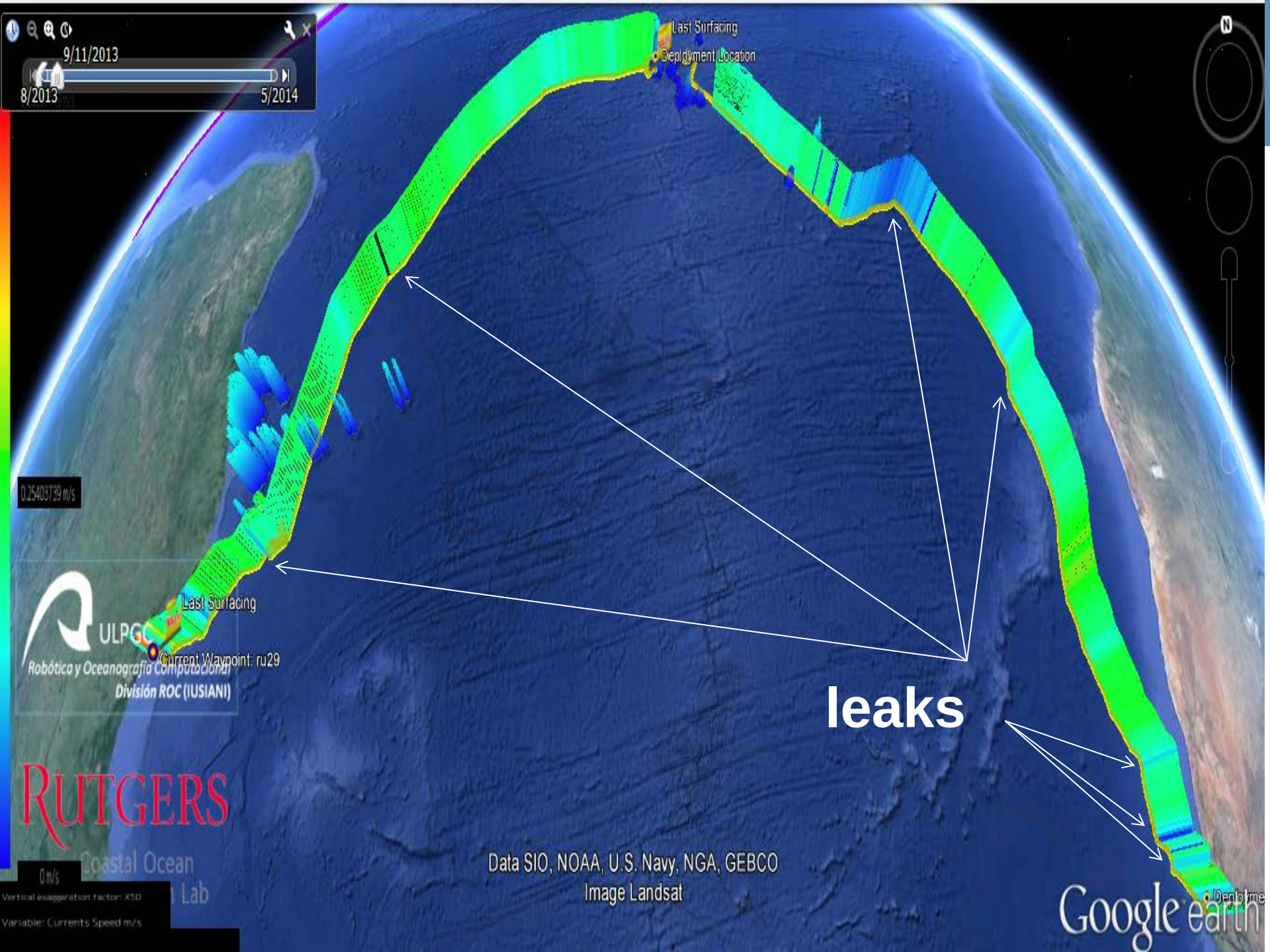
1st Circumnavigation Jan 2013 – Mar 2016

Cape Town (Sudáfrica) – Isla Ascensión (UK) - Brasil

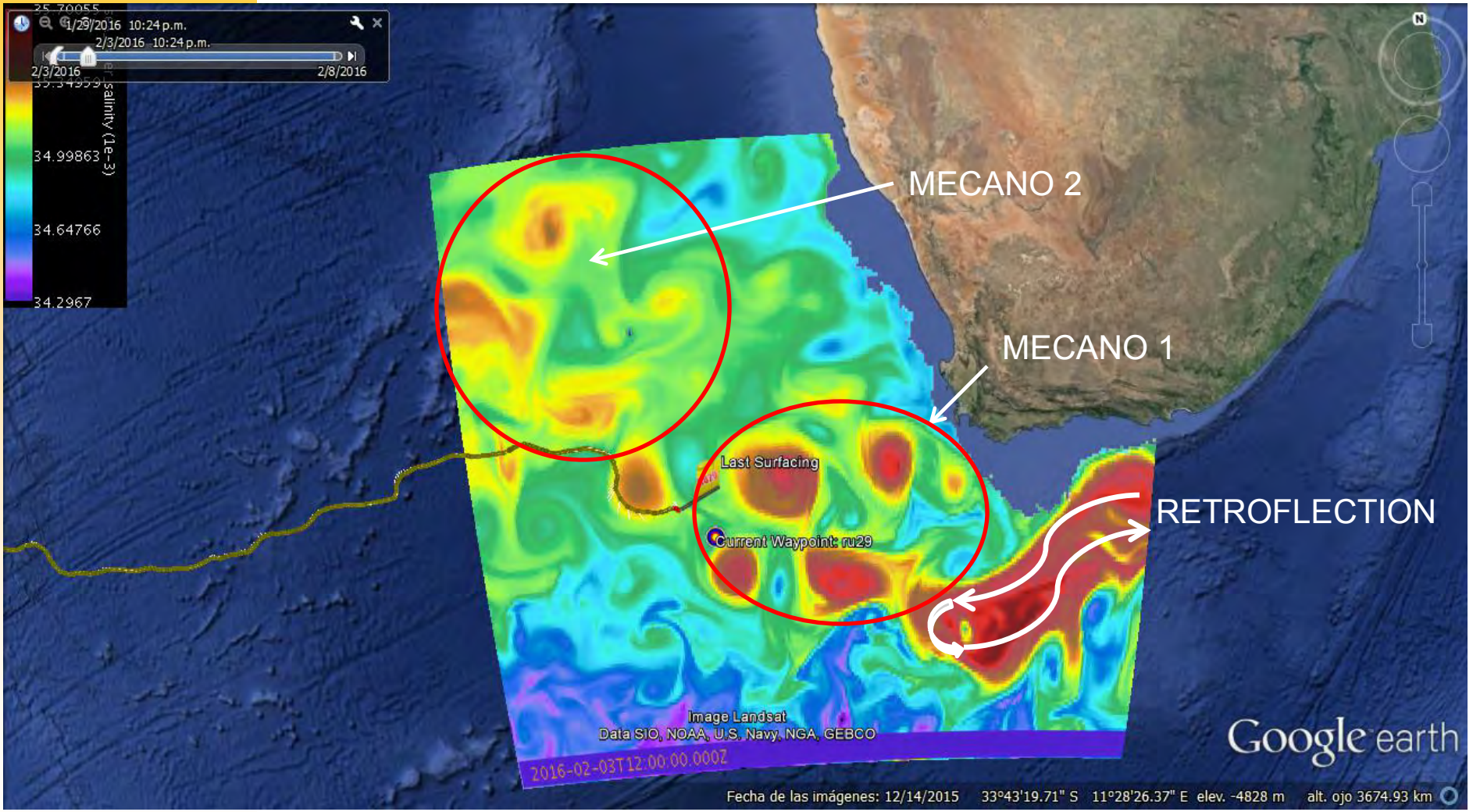


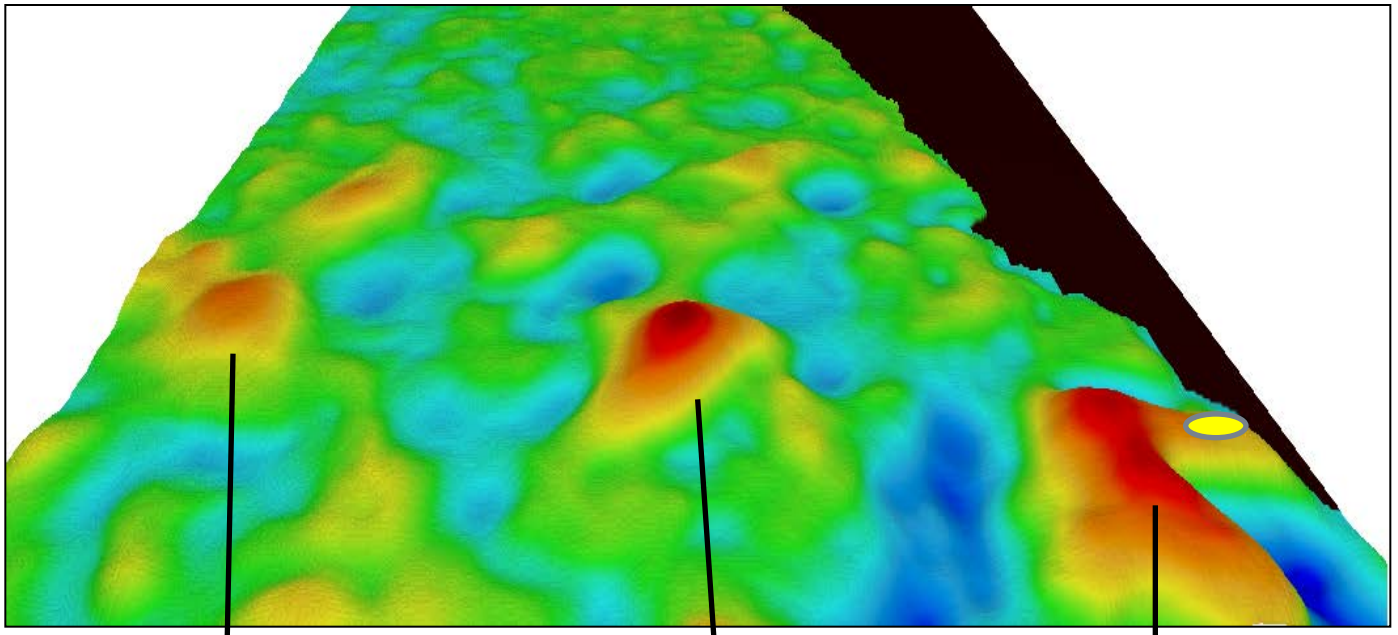
The bear is in the igloo

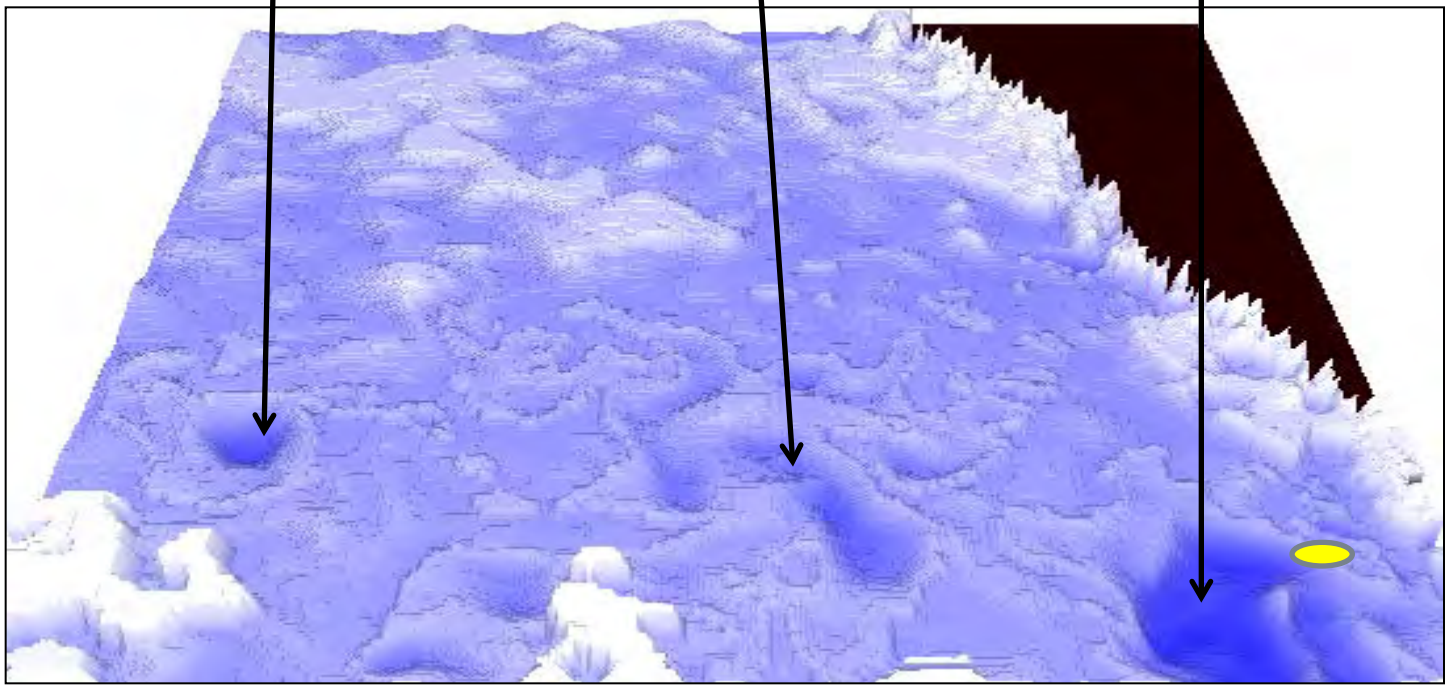
Cape of Good hope . R/V Algoa 31 March 2016


9/11/2013
8/2013
5/2014
Last Surfacing
Deployment Location
0.25403739 m/s
Last Surfacing
ULPGC
Robótica y Oceanografía Computacional
División ROC (IUSIANI)
Current Waypoint: ru29
leaks
RUTGERS
Coastal Ocean
Lab
0 m/s
Vertical exaggeration factor: X50
Variable: Currents Speed m/s
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Google earth

SALINITY FIELD 260m depth. 8th February 2016







Leyenda de Profundidad de Termoclina

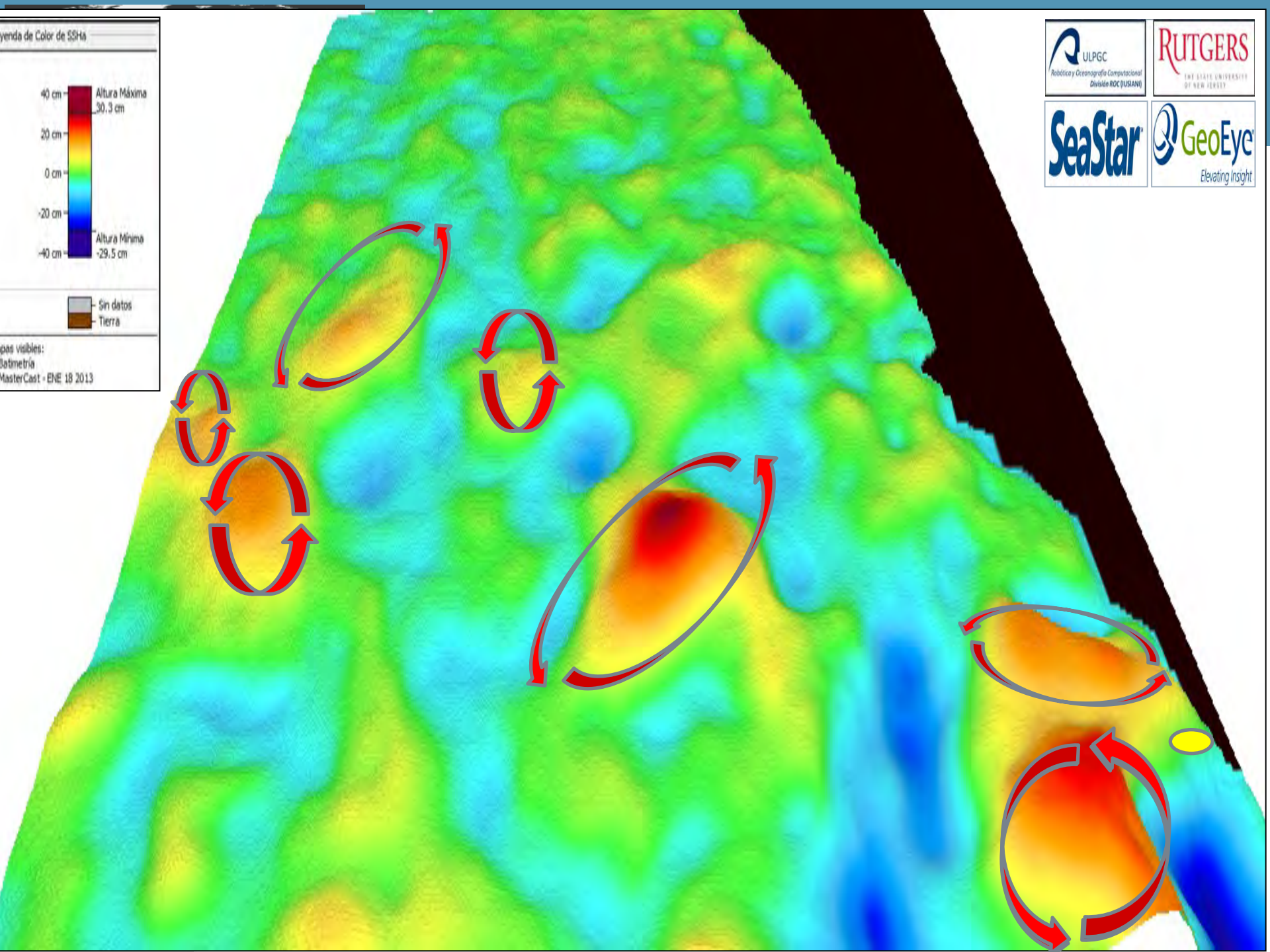
250 m
200 m
150 m
100 m
50 m

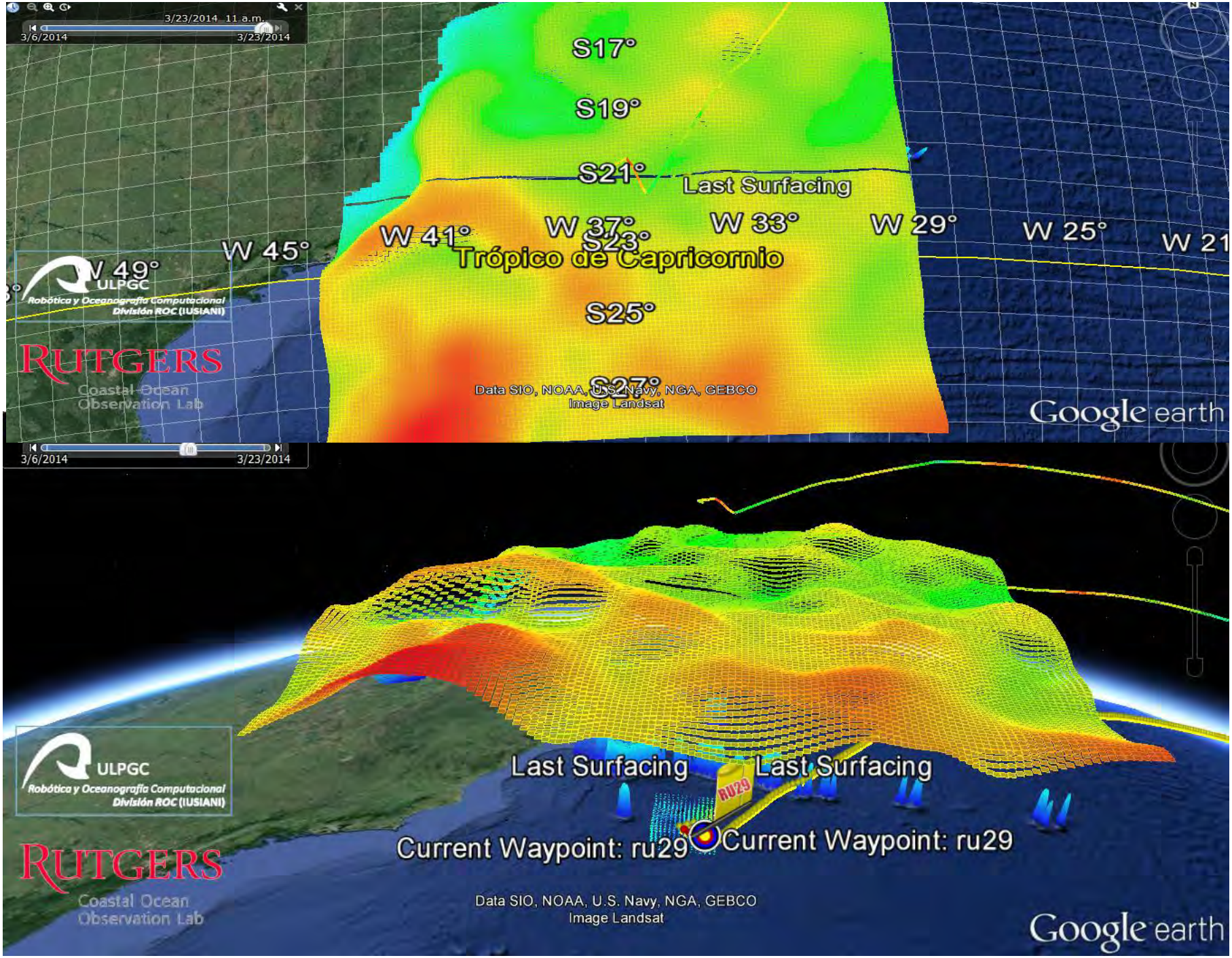
Profundidad Max.
60 m

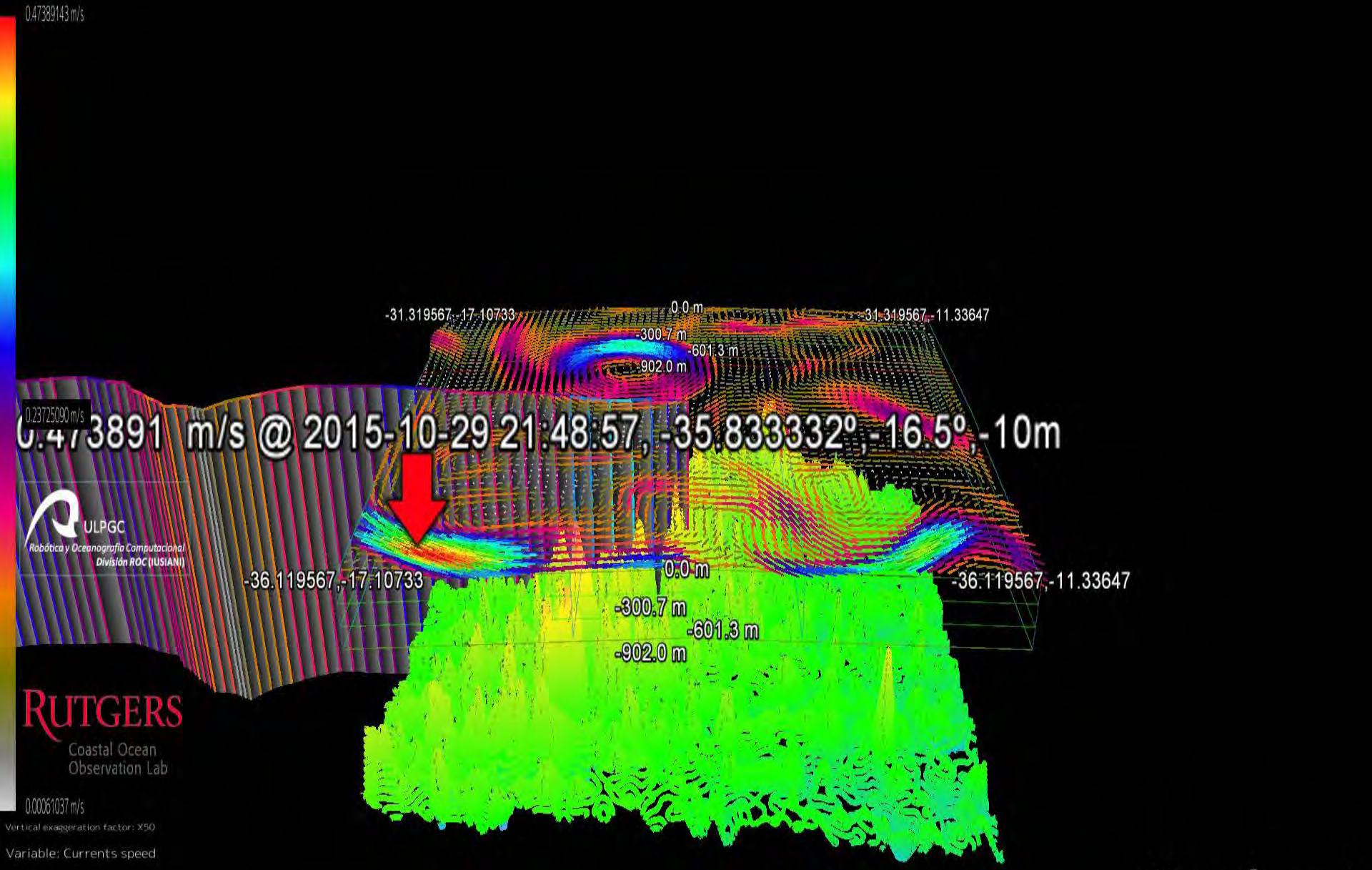
Profundidad Min.
1 m

Sin datos
Tierra

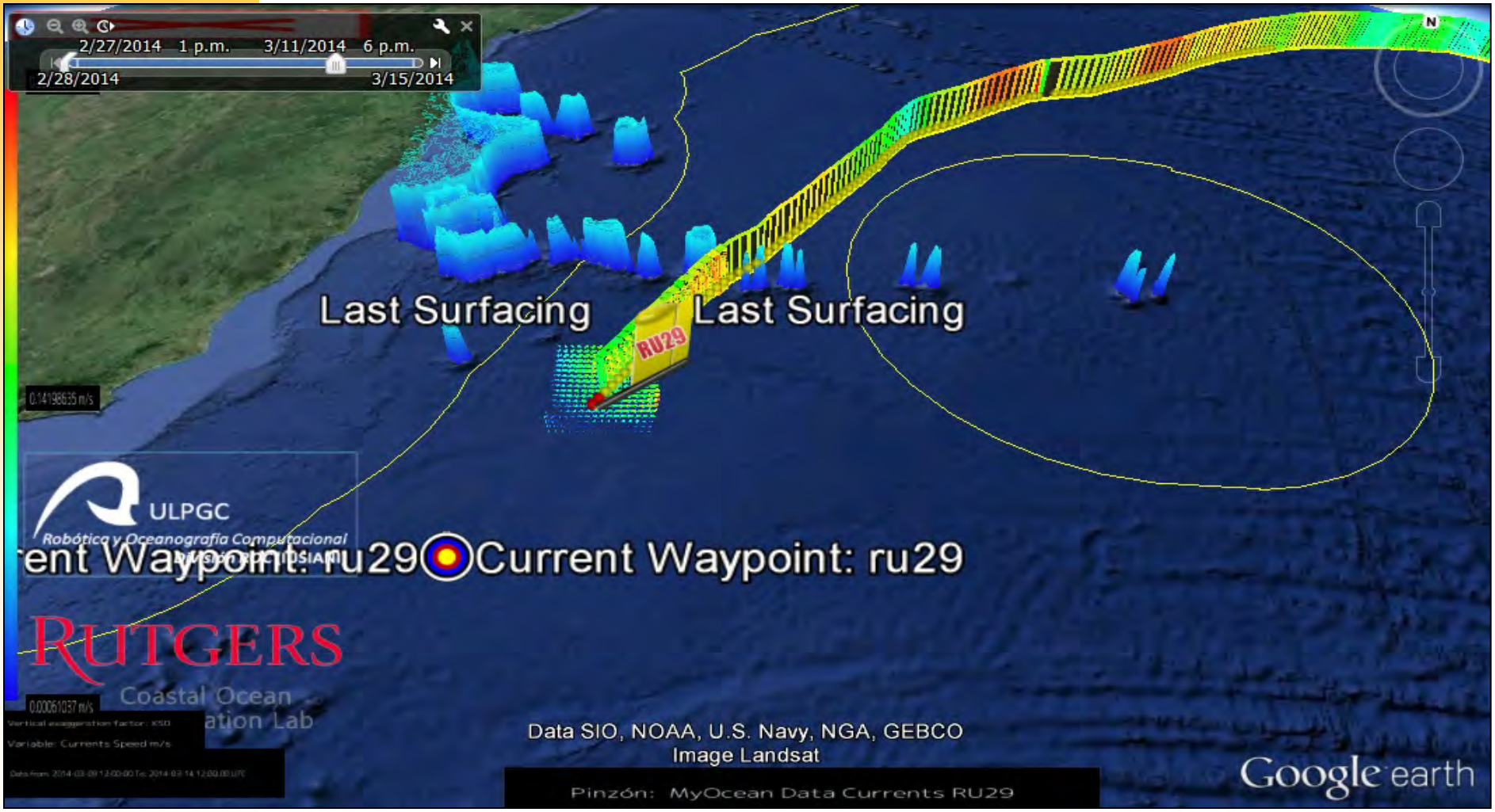
Capas visibles:
Vista 3-D - ----
Corrientes - ENE 21 2013
MasterCast - ENE 21 2013


yenda de Color de SSHa
40 cm
20 cm
0 cm
-20 cm
-40 cm
Altura Máxima
30.3 cm
Altura Mínima
-29.5 cm
Sin datos
Tierra
pas visibles:
Batimetría
MasterCast - ENE 18 2013
ULPGC
Robótica y Oceanografía Computacional
División ROC (IUSIANI)
RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY
SeaStar
GeoEye
Elevating Insight


3/23/2014 11 a.m.
3/6/2014
3/23/2014
S17°
S19°
S21°
Last Surfacing
W 49°
W 45°
W 41°
W 37°
W 33°
W 29°
W 25°
W 21
S23°
Trópico de Capricornio
S25°
S27°
ULPGC
Robótica y Oceanografía Computacional
División ROC (IUSIANI)
RUTGERS
Coastal Ocean
Observation Lab
Data SIO, NOAA, US Navy, NGA, GEBCO
Image Landsat
Google earth
3/6/2014
3/23/2014
Last Surfacing
Last Surfacing
RU29
Current Waypoint: ru29
Current Waypoint: ru29
ULPGC
Robótica y Oceanografía Computacional
División ROC (IUSIANI)
RUTGERS
Coastal Ocean
Observation Lab
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Google earth

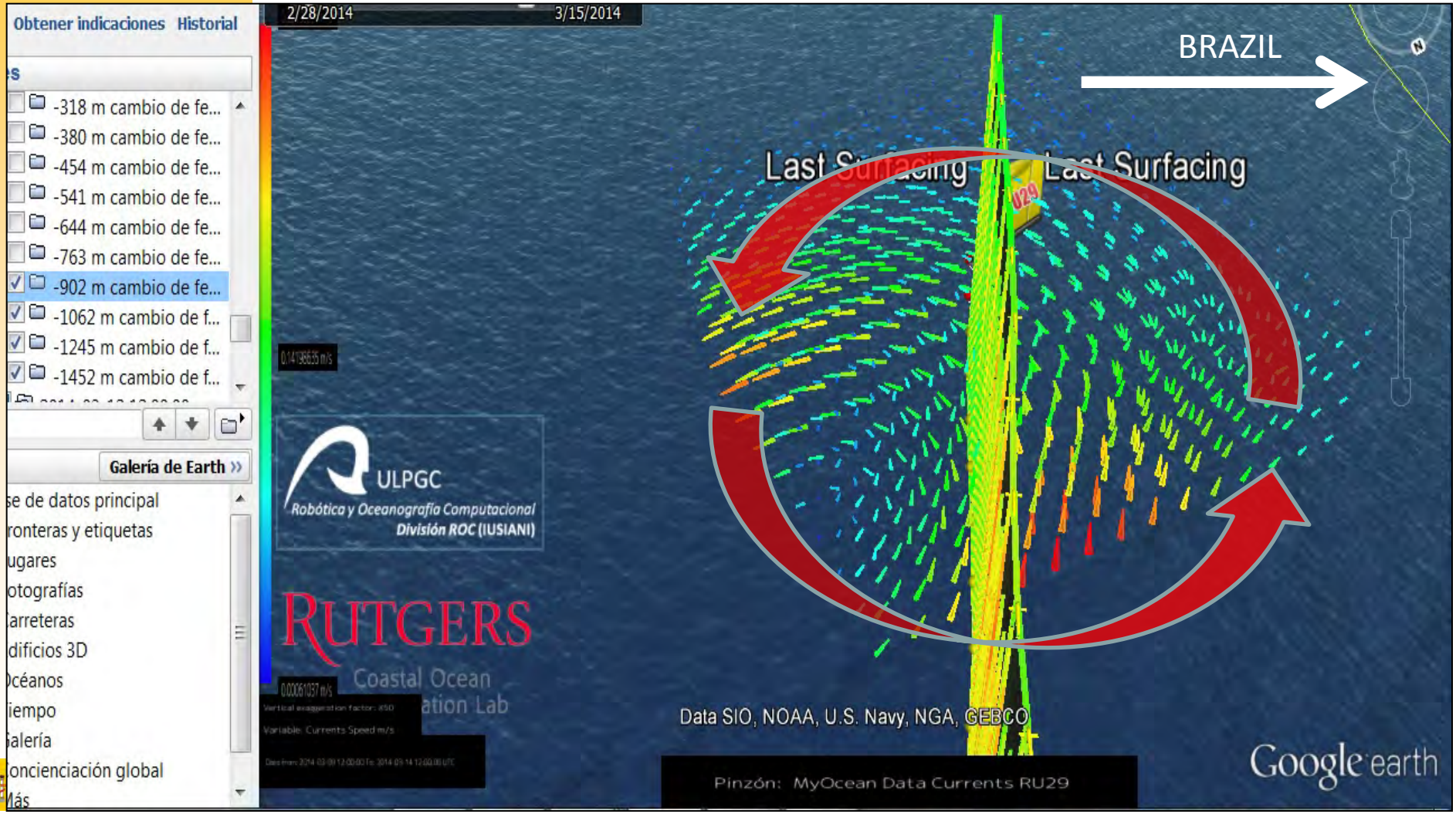

0.47389143 m/s
0.23725090 m/s
0.00061037 m/s
-31.319567,-17.10733
0.0 m
-300.7 m
-601.3 m
-902.0 m
-31.319567,-11.33647
0.47 3891 m/s @ 2015-10-29 21:48:57, -35.833332º, -16.5º, -10m
ULPGC
Robótica y Oceanografía Computacional
División ROC (IUSIANI)
-36.119567,-17.10733
0.0 m
-300.7 m
-601.3 m
-902.0 m
-36.119567,-11.33647
RUTGERS
Coastal Ocean
Observation Lab
Vertical exaggeration factor: X50
Variable: Currents speed
Data from: 2015-10-28 12:00:00 To: 2015-10-30 11:59:48 UTC
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data LDEO-Columbia, NSF, NOAA
RU29 Currents
Google earth

AFTER MORDOR….



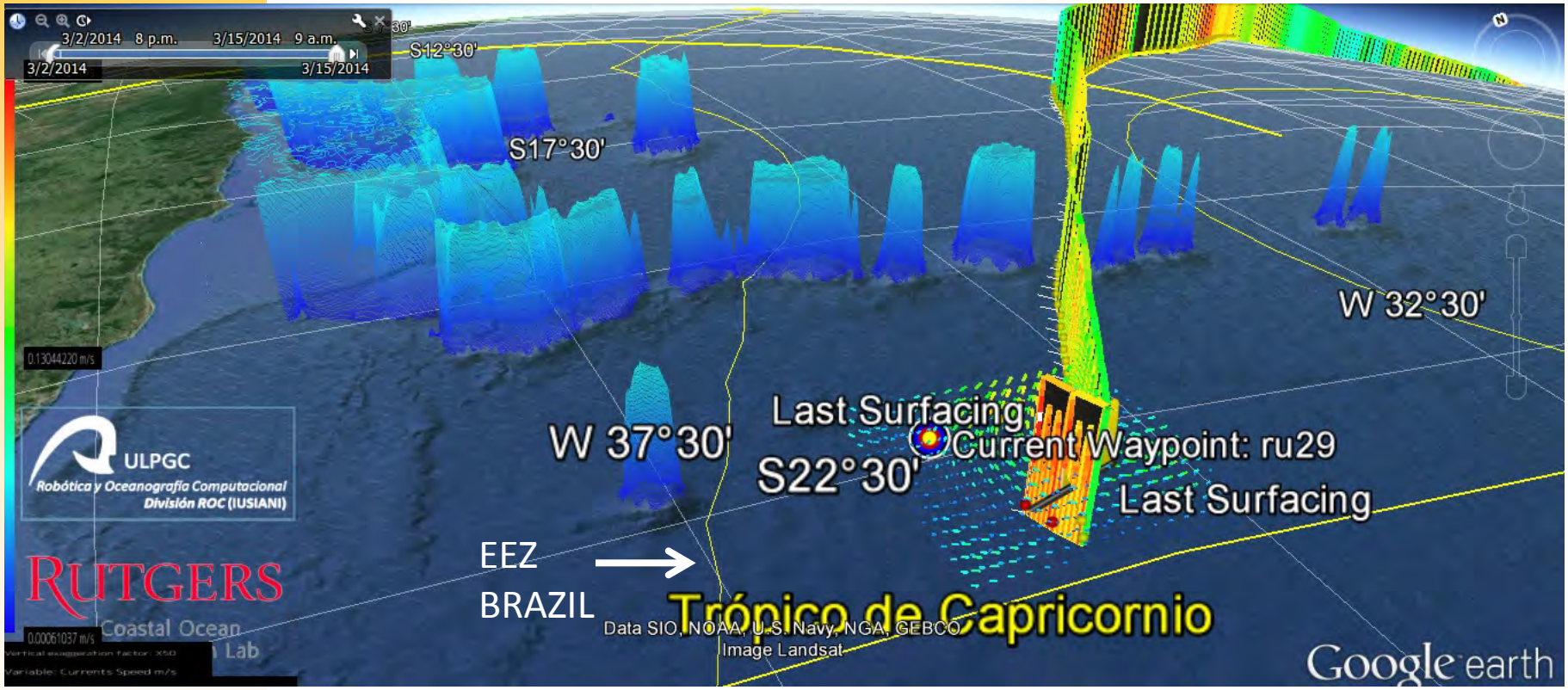
MYOCEAN (800m-1000m) *11 mar 2014*

(800m-1000m), 0.3 m/s

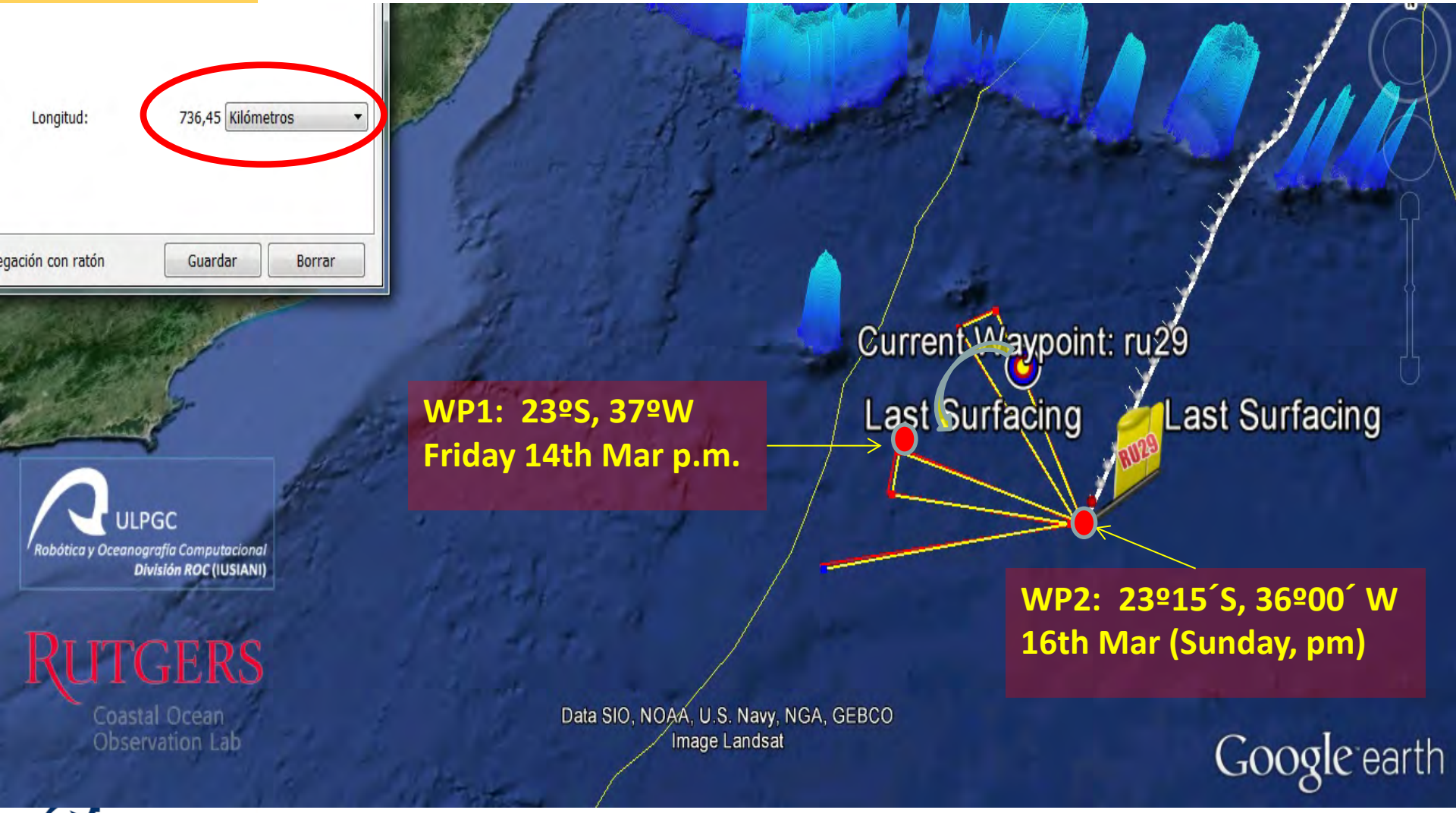


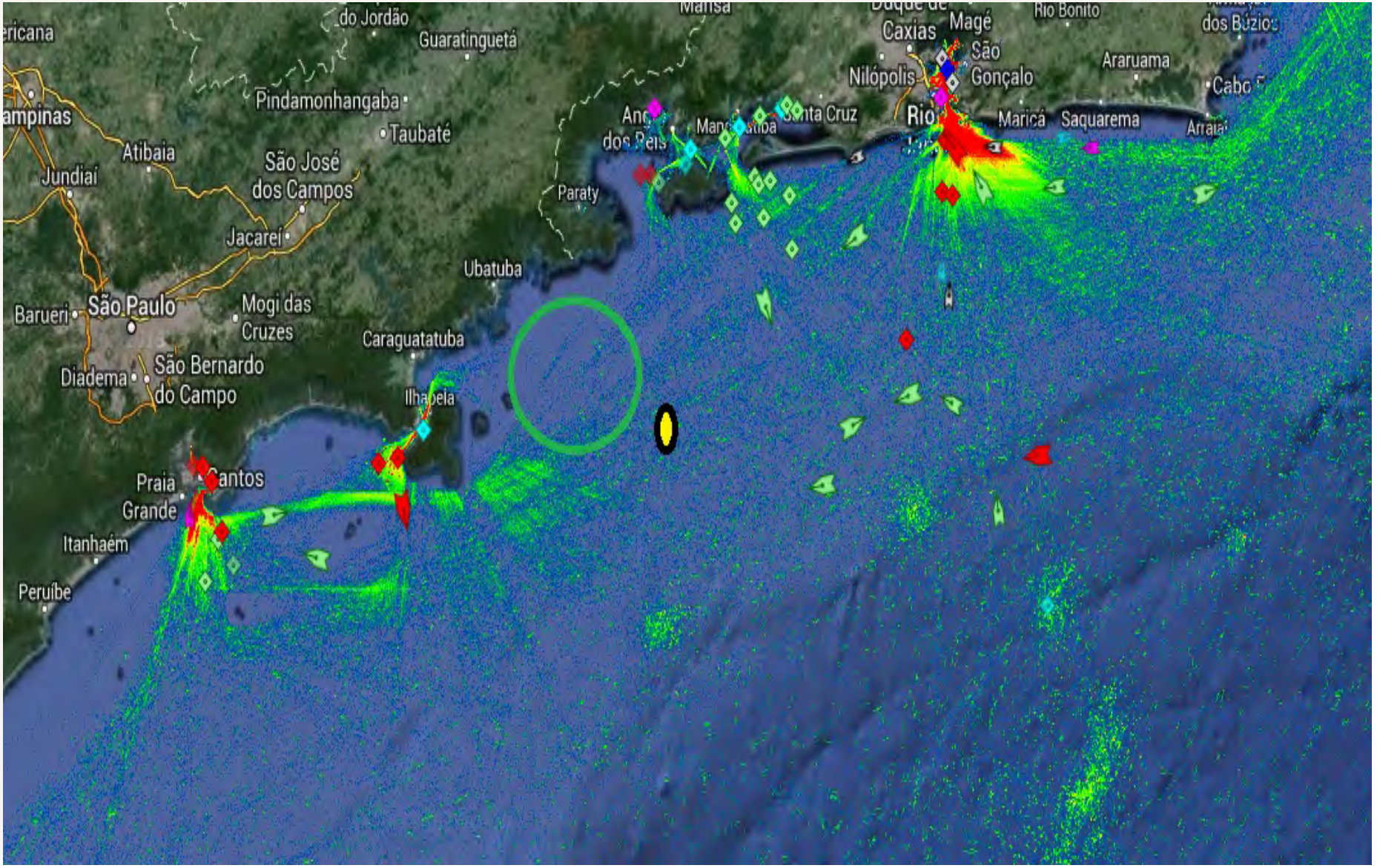
MYOCEAN (800m-1000m) *13 , 14 mar 2014*

A DEEP WARM EDDY >800m, 0.25 m/s

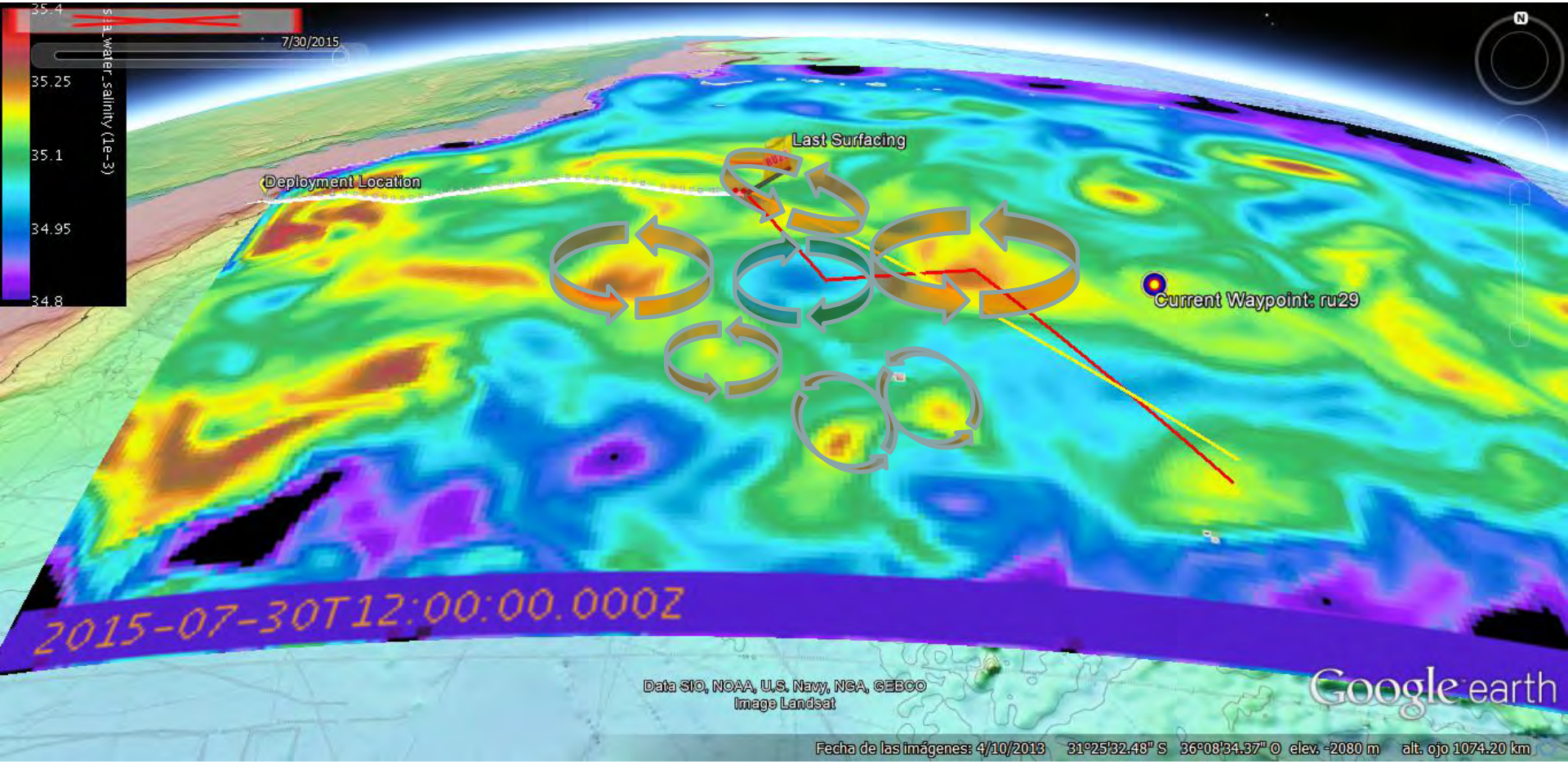


THE NEXT

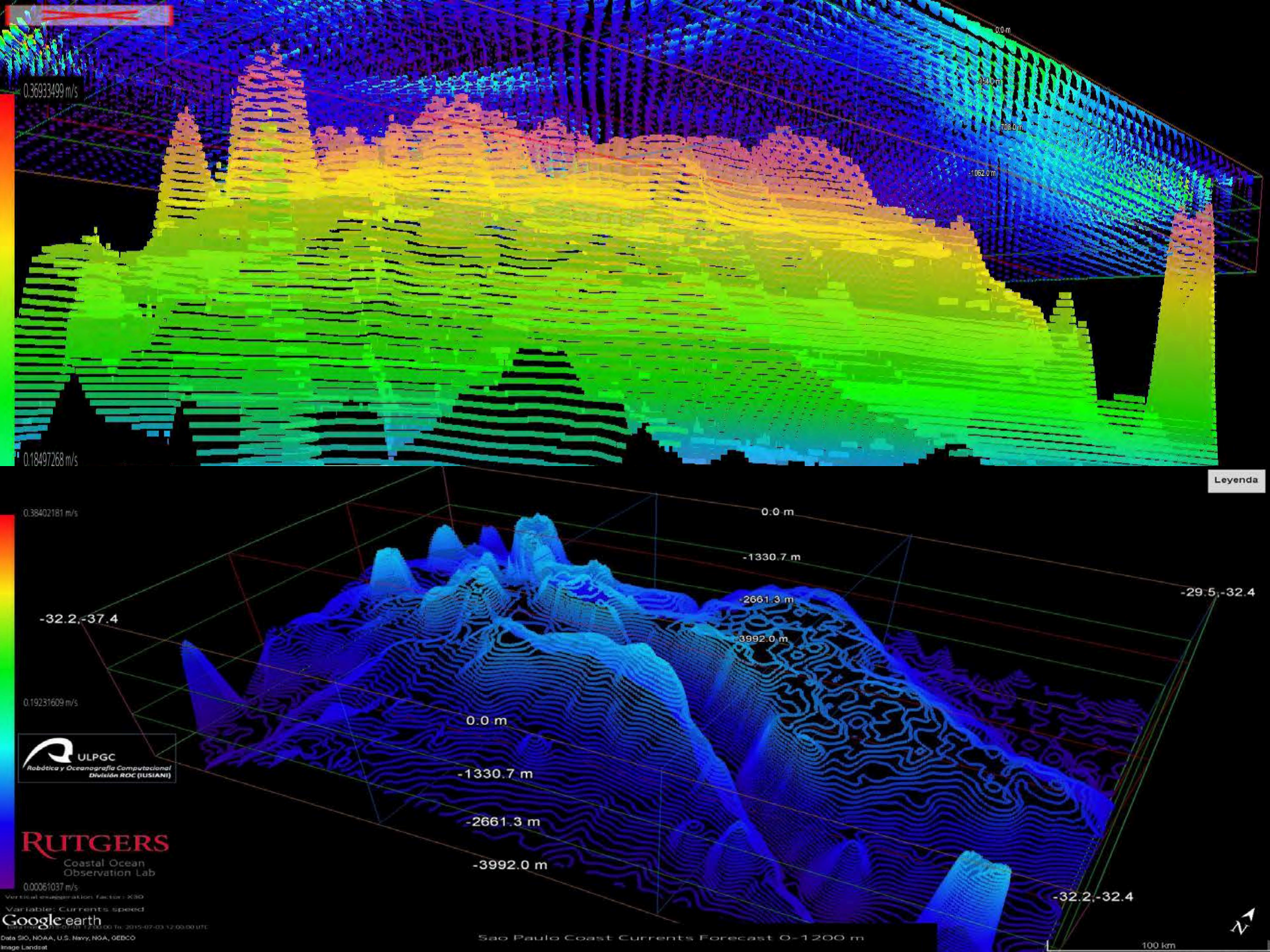

Longitud:
736,45
Kilómetros
egación con ratón
Guardar
Borrar
Current Waypoint: ru29
Last Surfacing
Last Surfacing
RU29
WP1: 23ºS, 37ºW
Friday 14th Mar p.m.
WP2: 23º15´S, 36º00´ W
16th Mar (Sunday, pm)
ULPGC
Robótica y Oceanografía Computacional
División ROC (IUSIANI)
RUTGERS
Coastal Ocean
Observation Lab
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Google earth

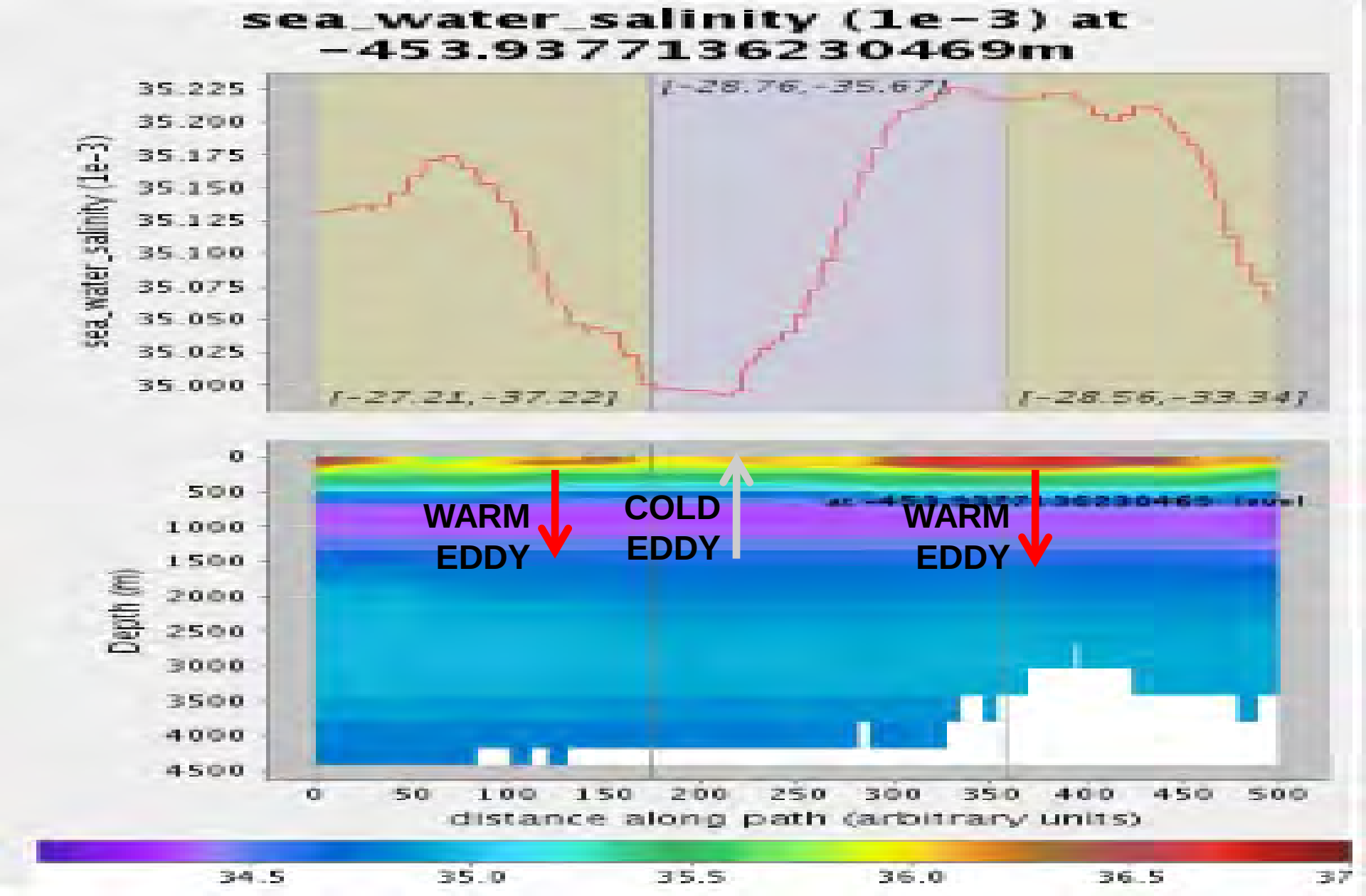

Pindamonhangaba
Taubaté
Atibaia
Jundiaí
São José dos Campos
Jacareí
Ubatuba
São Paulo
Barueri
Mogi das Cruzes
Caraguatatuba
São Bernardo do Campo
Diadema
Ilhabela
Santos
Praia Grande
Itanhaém
Peruíbe
Paraty
Caxias
Magé
Nilópolis
São Gonçalo
Araruama
Rio Bonito
Rio
Maricá
Saquarema

THE LORD OF THE RINGS……



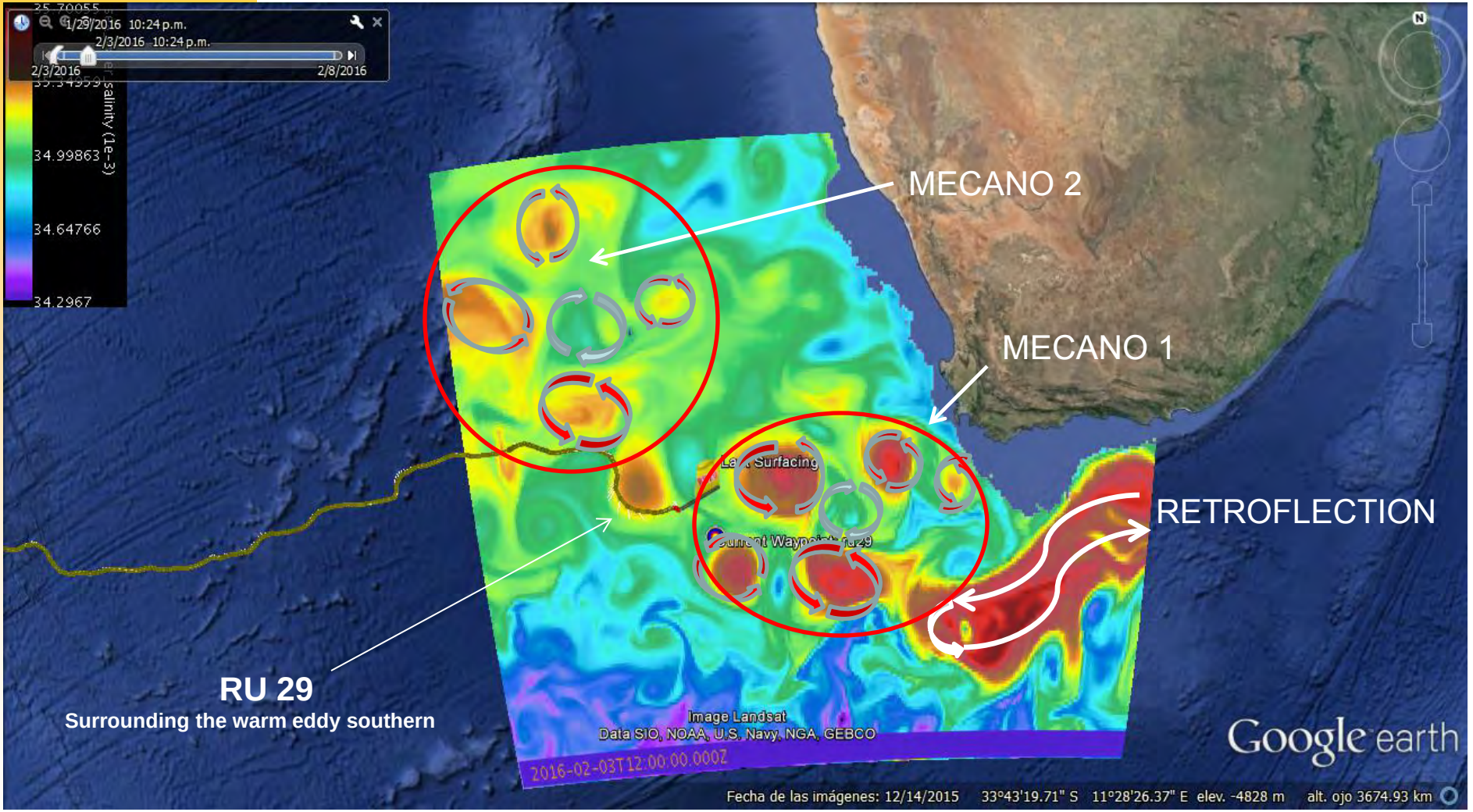
SALINITY FIELD (430m. Copernicus/MyOcean, 30july 2015)
Solar System (cold eddy + warm eddies).

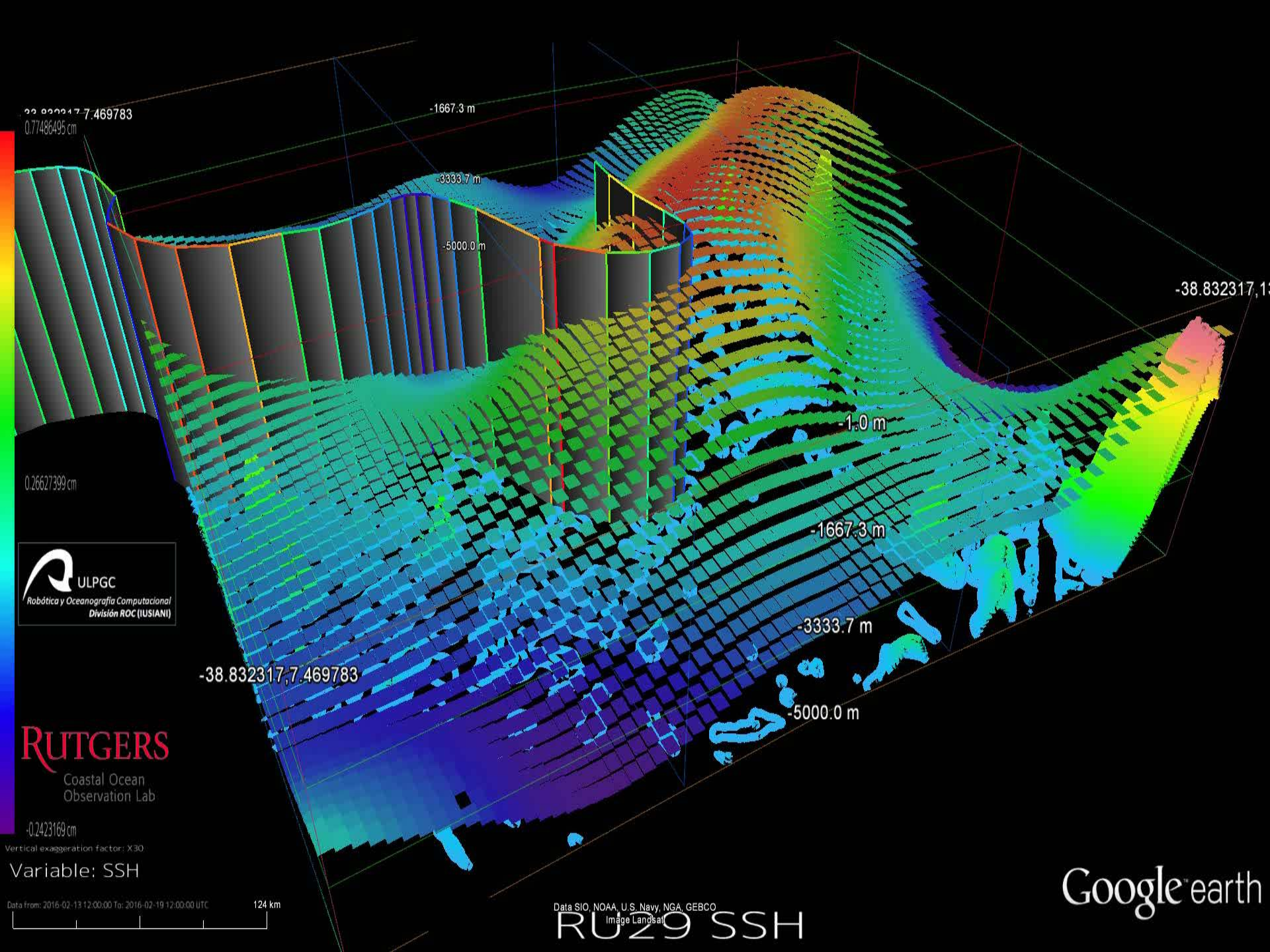

0.36933499 m/s
0.18497268 m/s
0.0 m
354.0 m
708.0 m
1062.0 m
Leyenda
0.38402181 m/s
0.19231609 m/s
0.00061037 m/s
0.0 m
-1330.7 m
-2661.3 m
-3992.0 m
-32.2,-37.4
-29.5,-32.4
-32.2,-32.4
ULPGC
Robótica y Oceanografía Computacional
División ROC (IUSIANI)
RUTGERS
Coastal Ocean
Observation Lab
Vertical exaggeration factor: X30
Variable: Currents speed
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Sao Paulo Coast Currents Forecast 0-1200 m
100 km

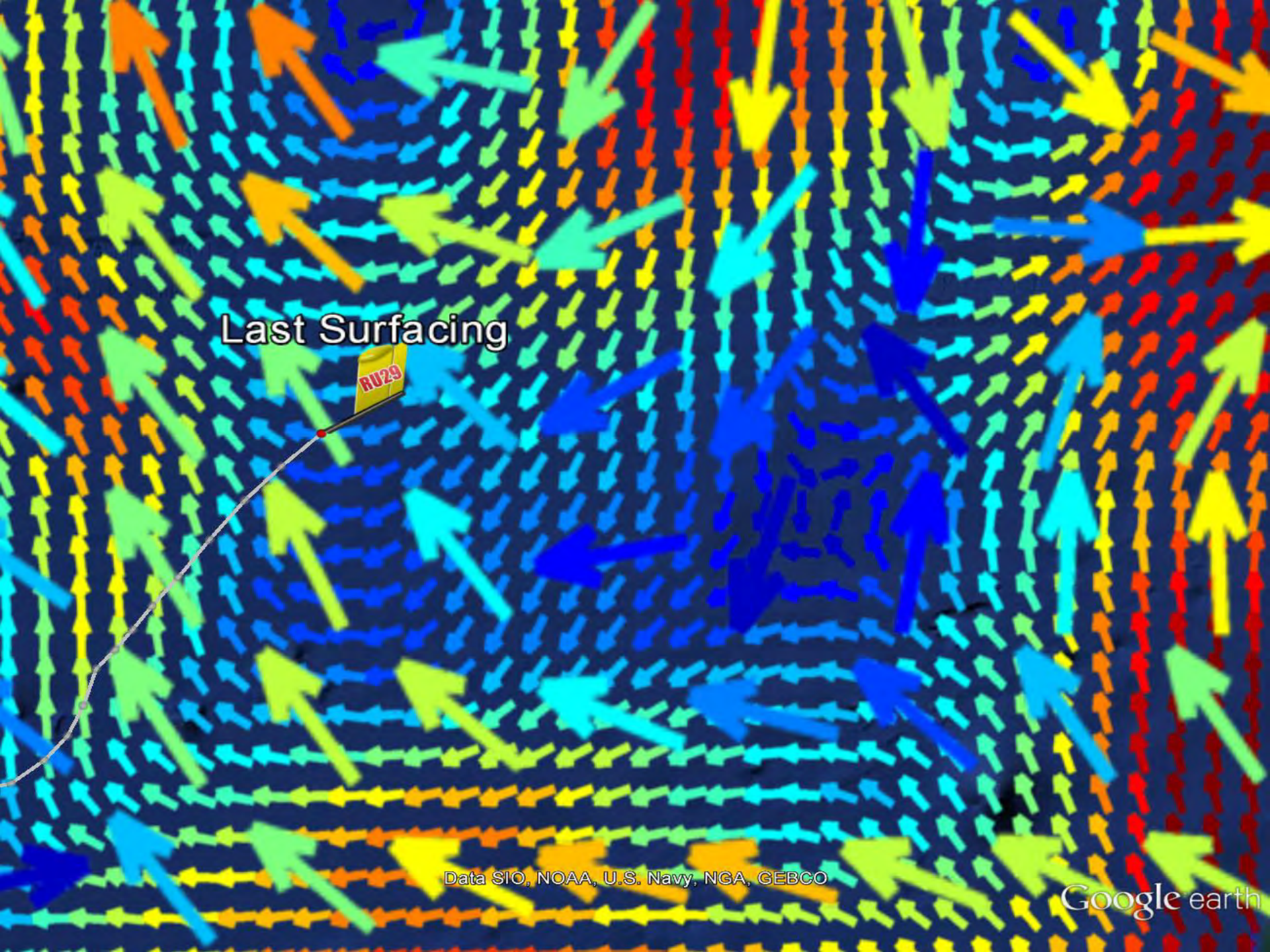


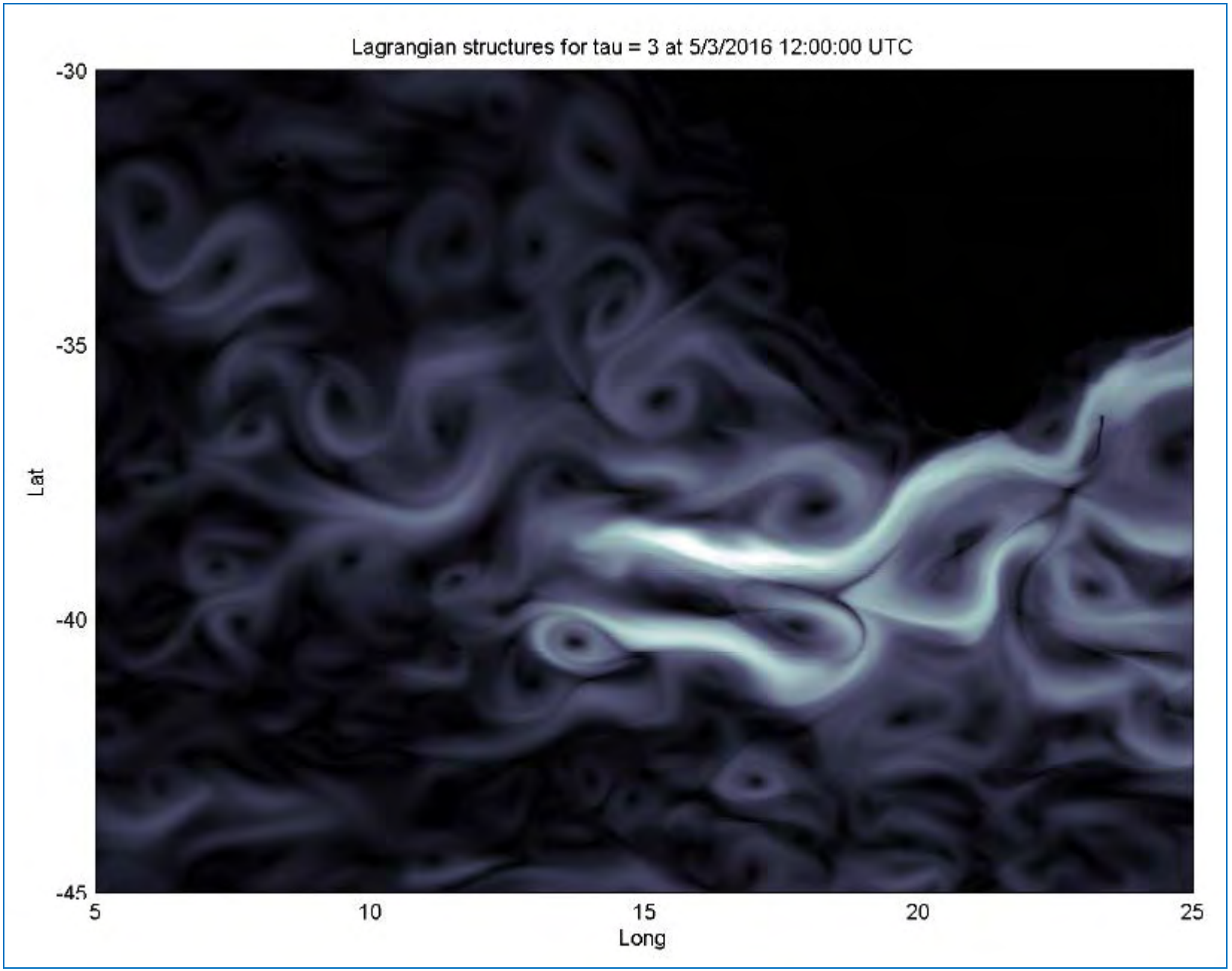
SALINITY Transect (red path) Copernicus/MyOcean, 30 July 2015)

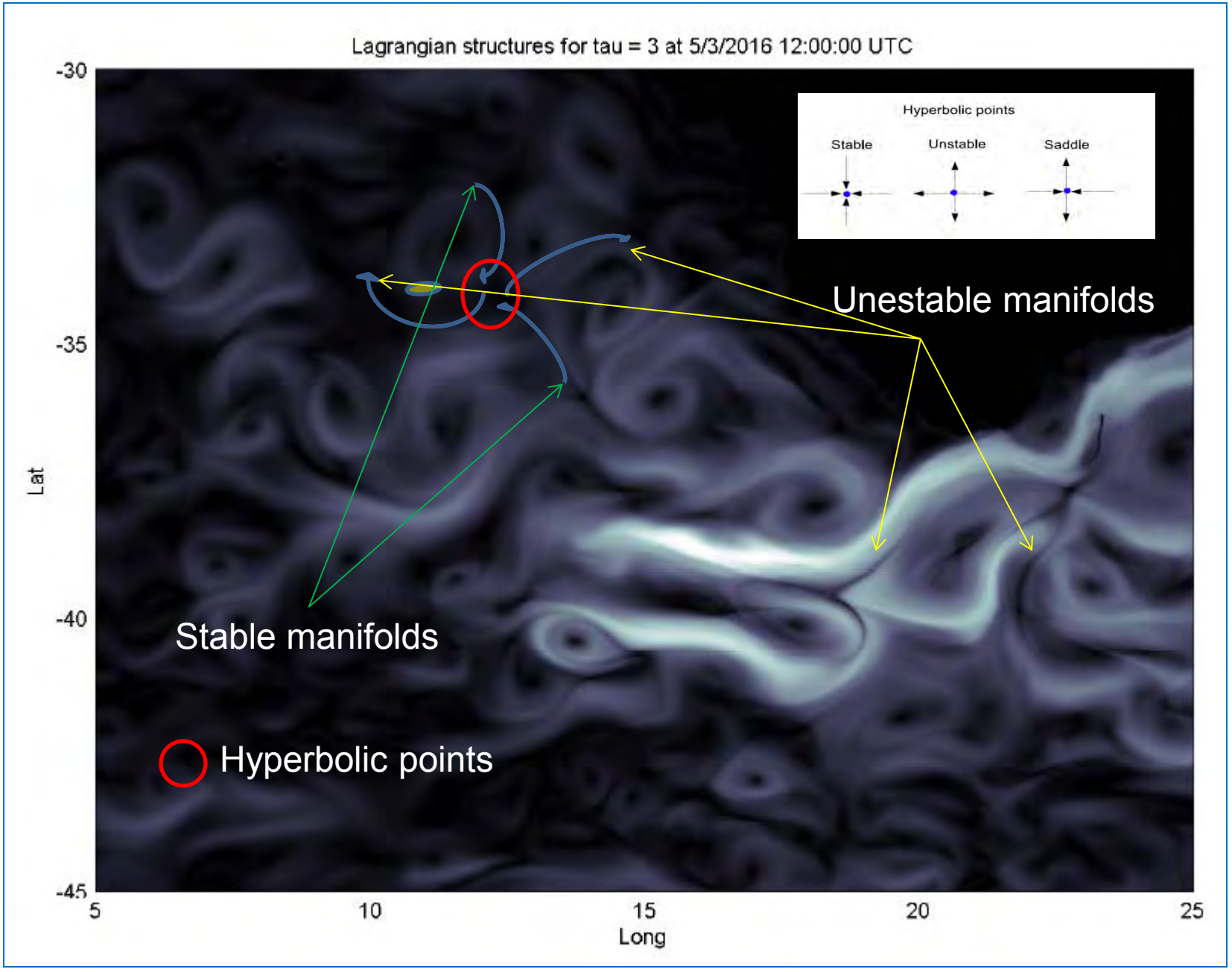
SALINITY FIELD 260m depth. 8th February 2016




-1667.3 m
-3333.7 m
-5000.0 m
0.77486495 cm
0.26627399 cm
-0.2423169 cm
-1.0 m
-38.832317,7.469783
ULPGC
Robótica y Oceanografía Computacional
División ROC (IUSIANI)
RUTGERS
Coastal Ocean
Observation Lab
Vertical exaggeration factor: X30
Variable: SSH
Data from: 2016-02-13 12:00:00 To: 2016-02-19 12:00:00 UTC
124 km
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Google earth
RU29 SSH


Last Surfacing
RU29
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google earth


Lagrangian structures for tau = 3 at 5/3/2016 12:00:00 UTC
-30
-35
-40
-45
Lat
5
10
15
20
25
Long


Lagrangian structures for tau = 3 at 5/3/2016 12:00:00 UTC
Hyperbolic points
Stable
Unstable
Saddle
Unestable manifolds
Stable manifolds
Hyperbolic points
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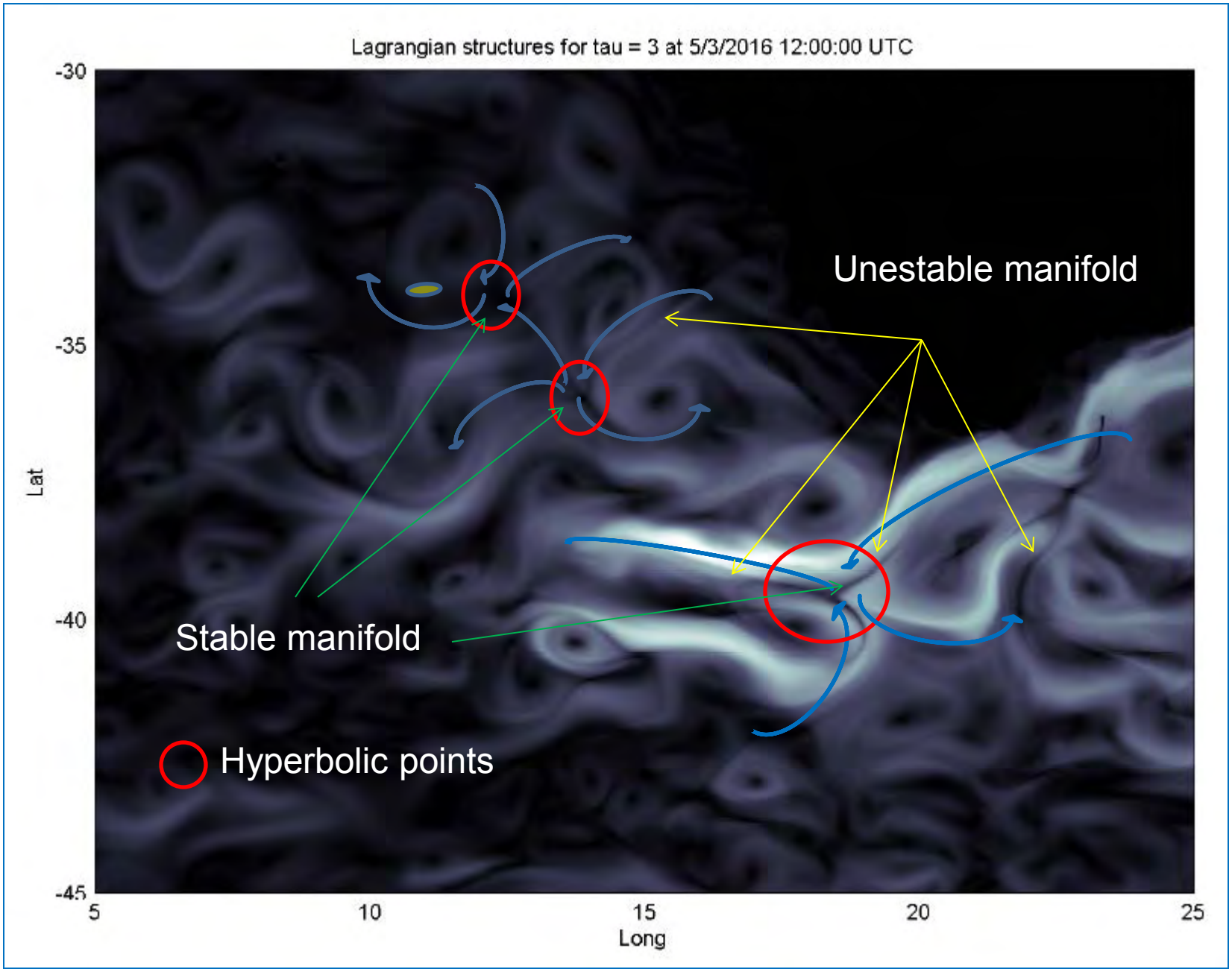
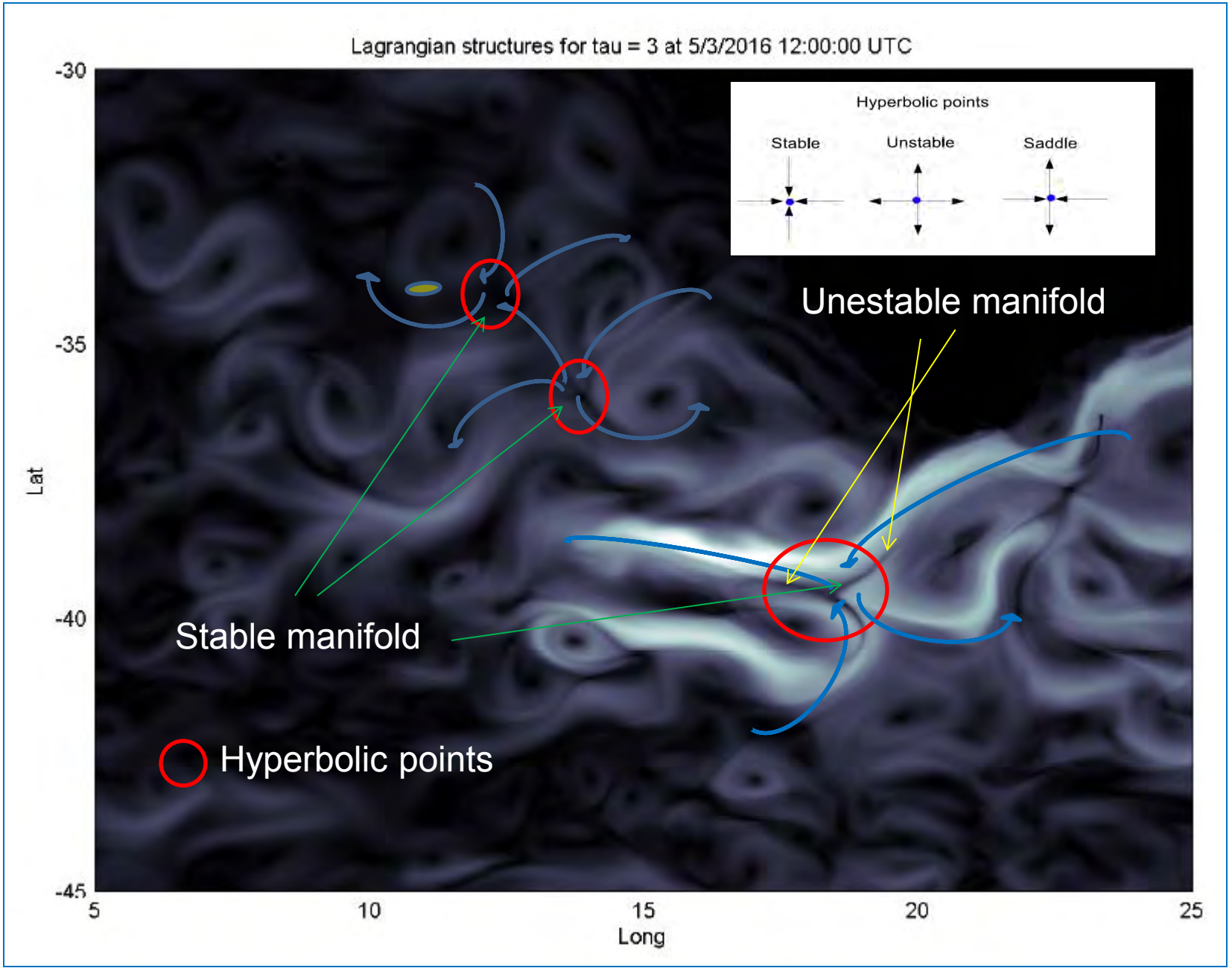
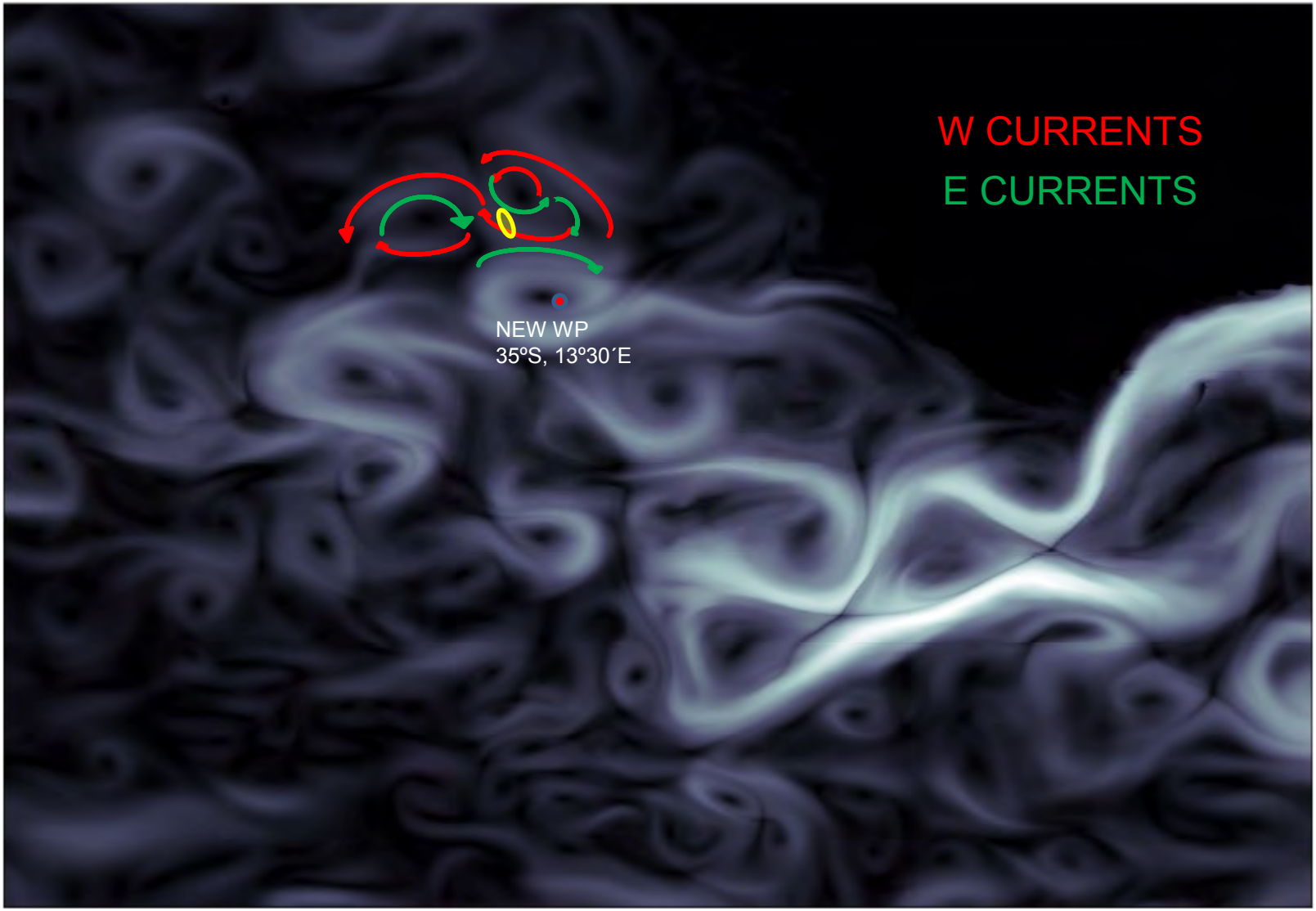
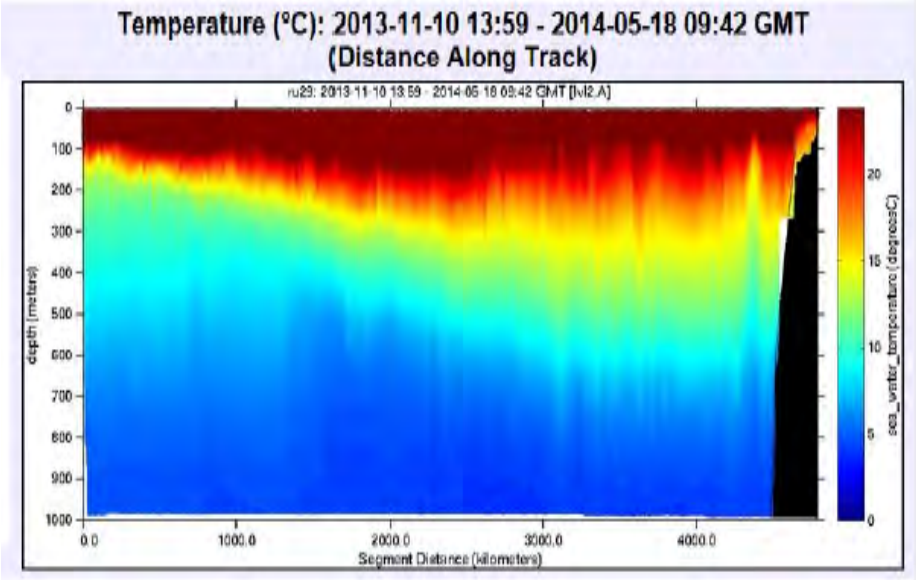
-35
-40
-45
Lat
5
10
15
20
25
Long

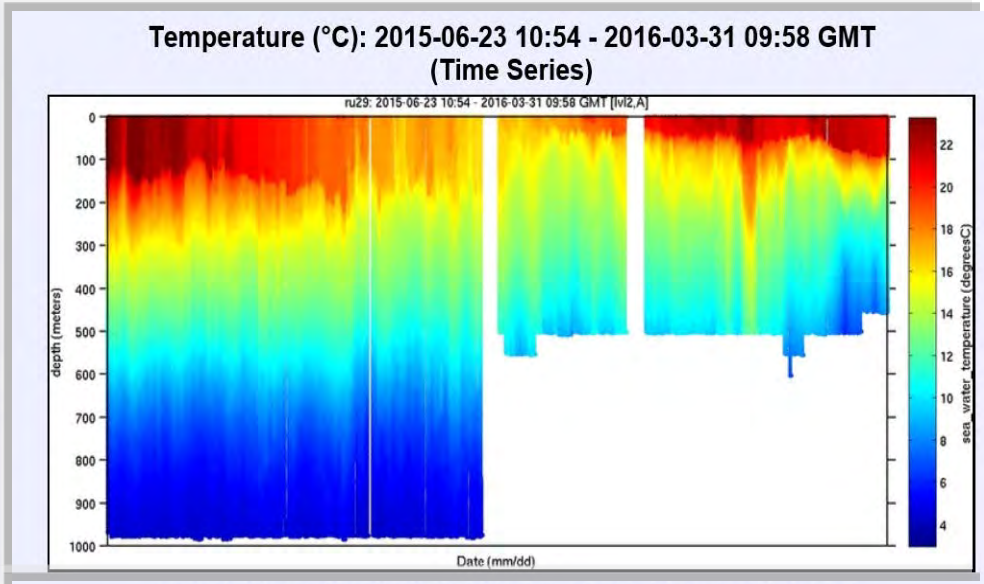

Lagrangian structures for tau = 3 at 5/3/2016 12:00:00 UTC
-30
-35
-40
-45
Lat
5
10
15
20
25
Long
Unestable manifold
Stable manifold
Hyperbolic points

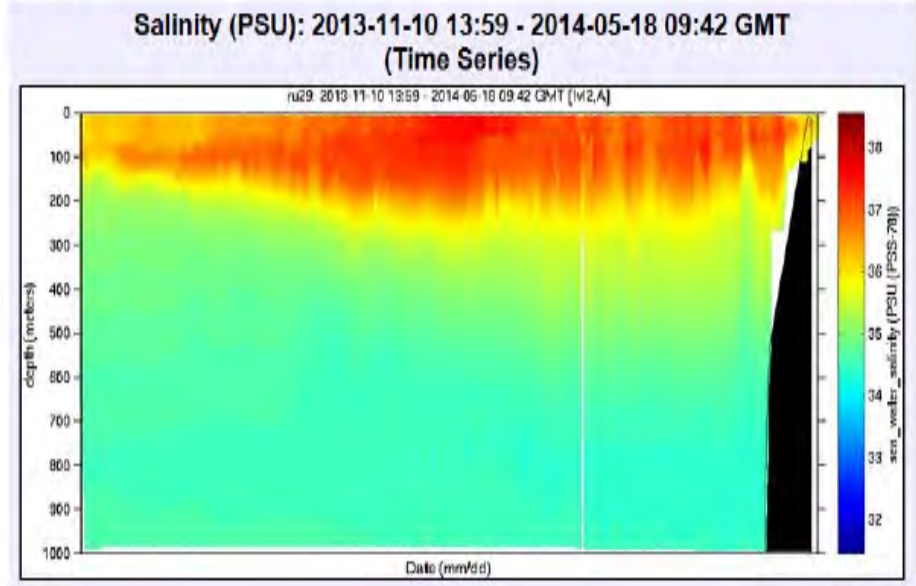

Lagrangian structures for tau = 3 at 5/3/2016 12:00:00 UTC
Hyperbolic points
Stable
Unstable
Saddle
Unestable manifold
Stable manifold
Hyperbolic points
-30
-35
-40
-45
Lat
5
10
15
20
25
Long

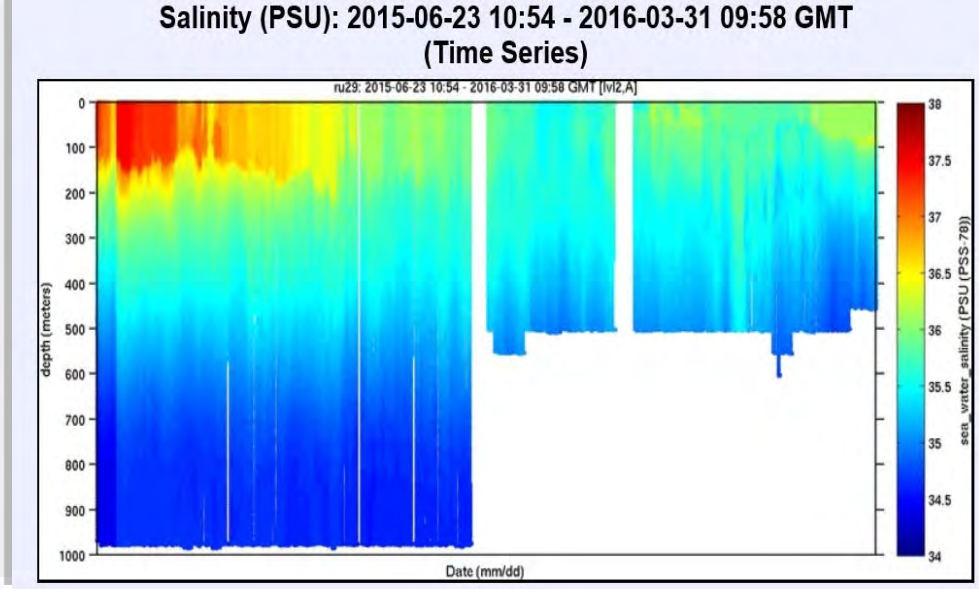
M. LAGRANGIAN FUNCTION 23 MARCH 2016











TO WEST

TO EAST

>5000 CTD profiles

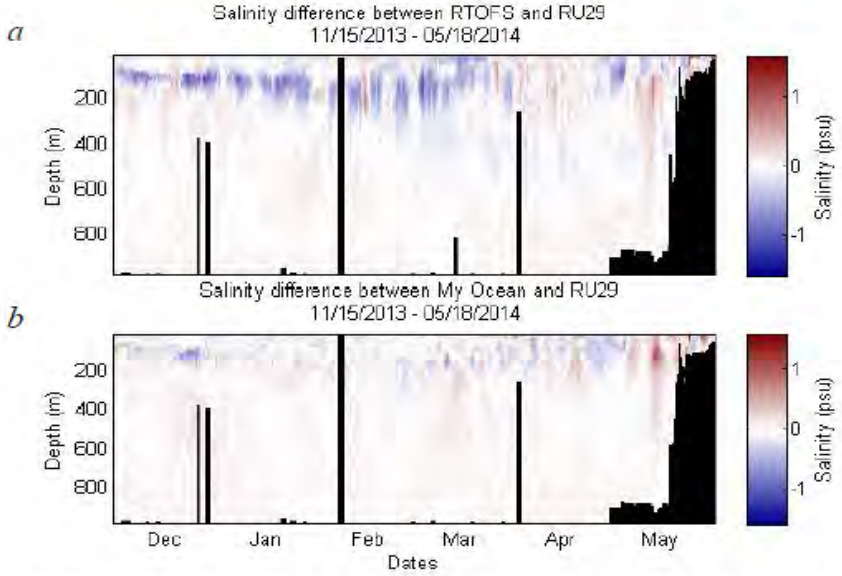
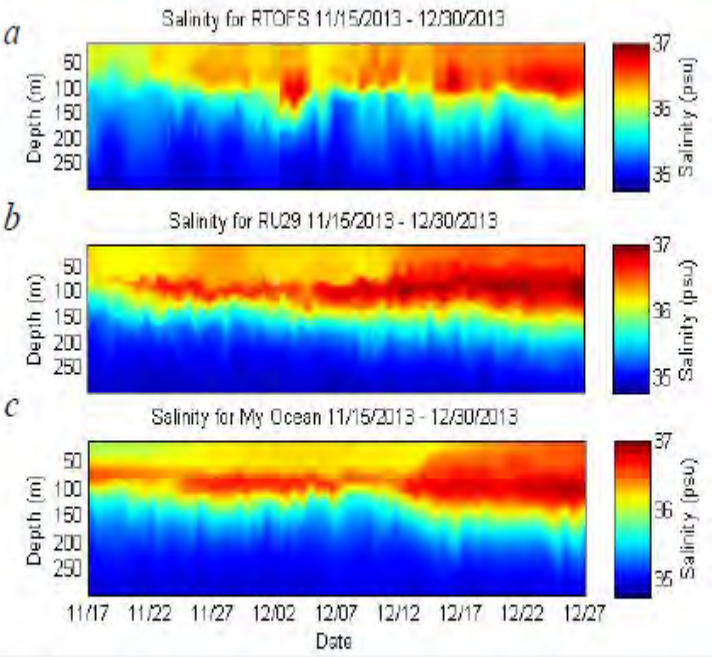


Figure 8: The difference in salinity between the RTOFS model with RU29 (a) and the MyOcean model with RU29 (b).



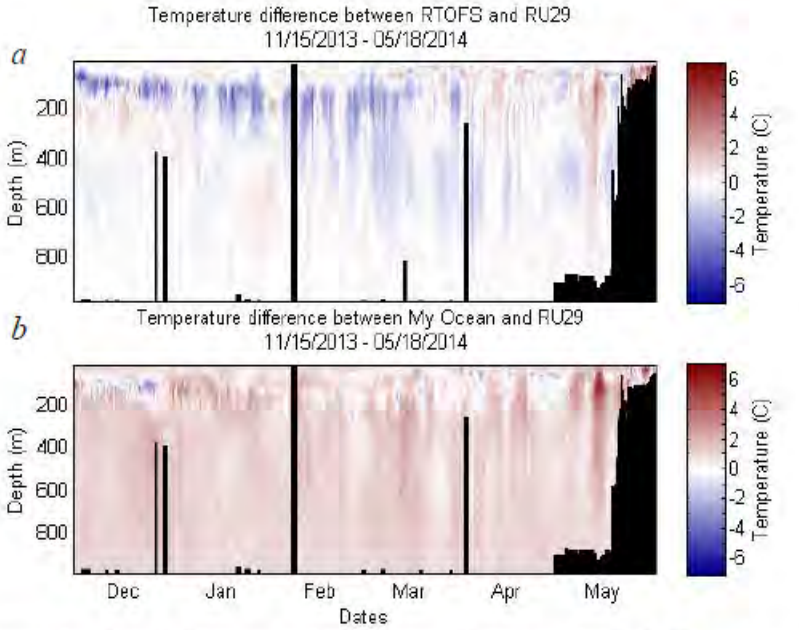


Figure 6: The difference in temperature between the RTOFS model with RU29 (a) and the MyOcean model with RU29 (b).

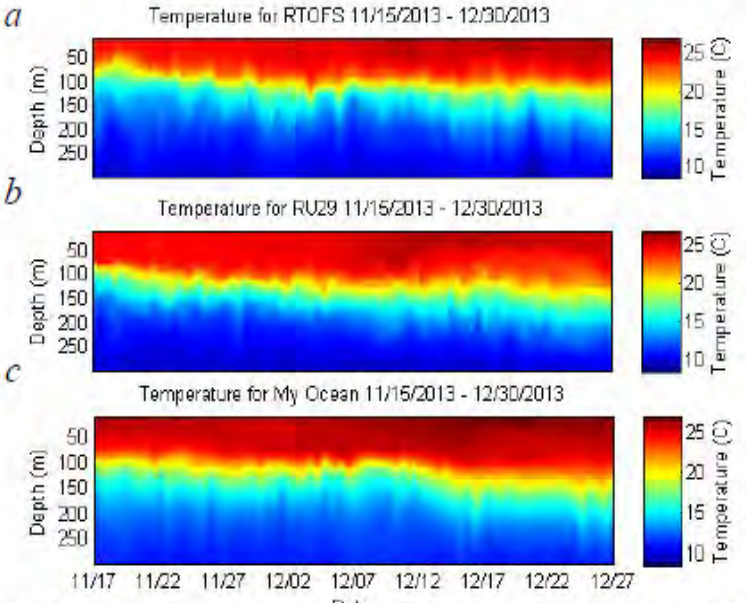
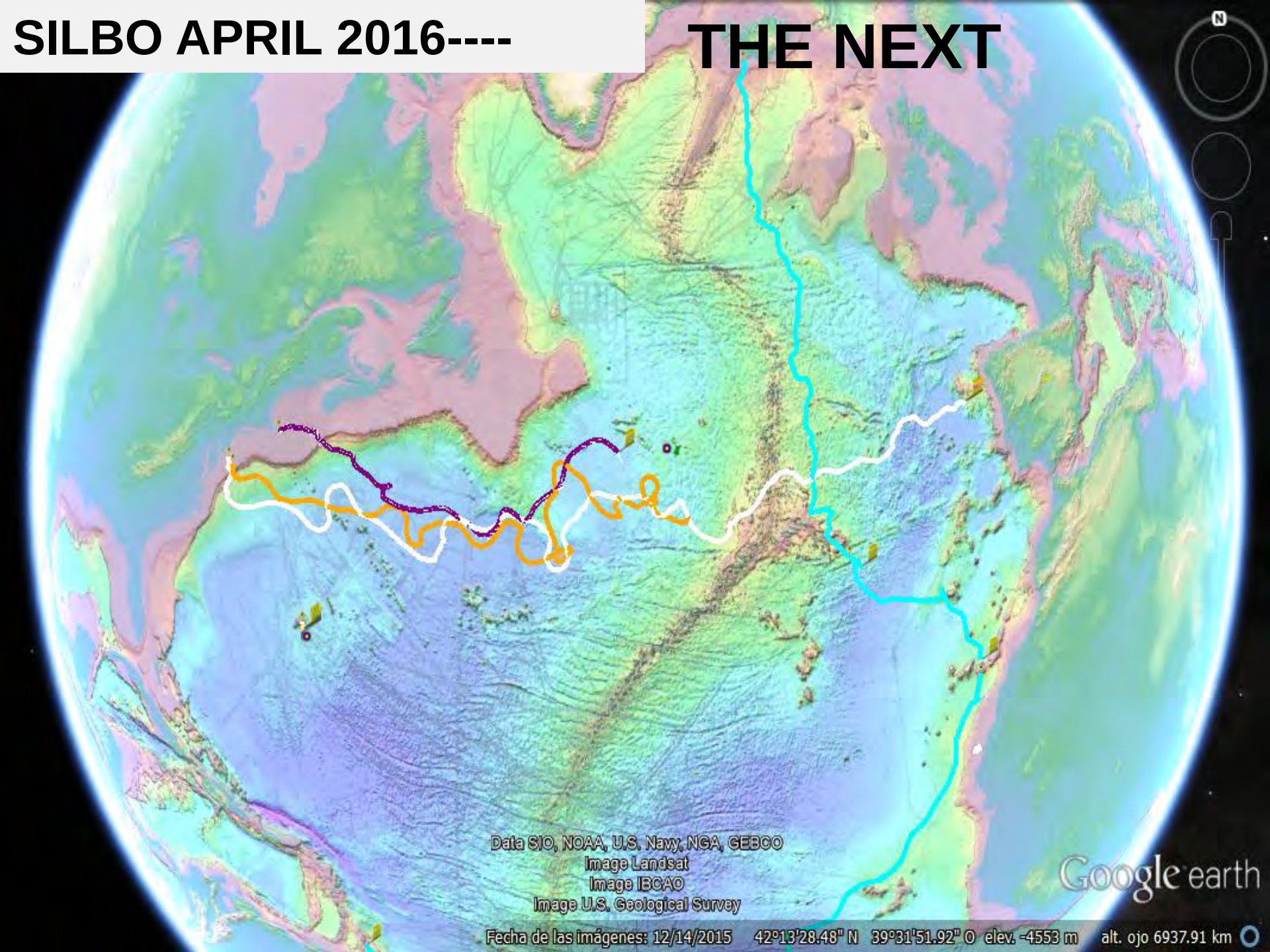


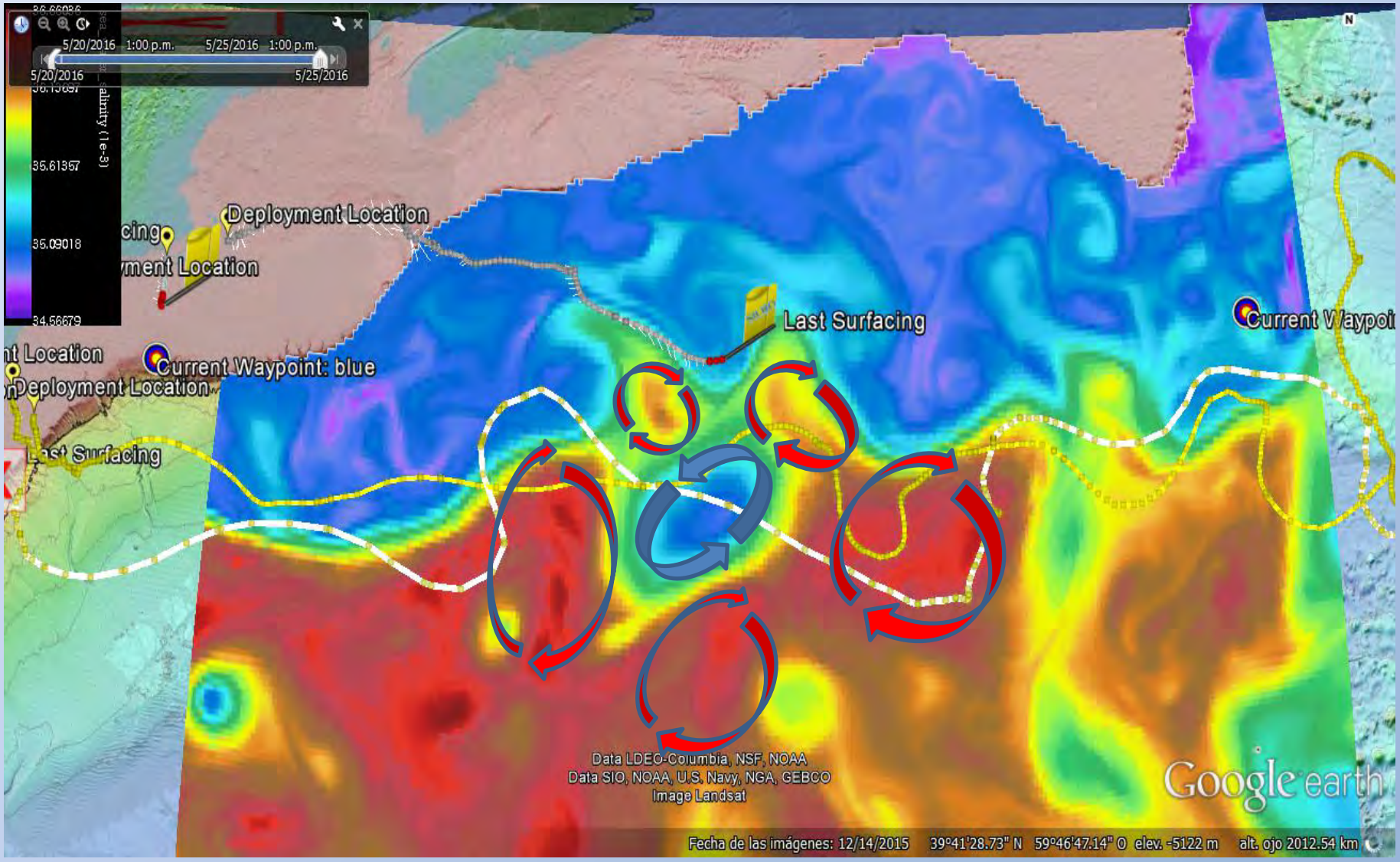
Figure 10: Temperature comparison between RTOFS (a), RU29 (b), and MyOcean (c) for the Turtle Tracks.

SILBO APRIL 2016----

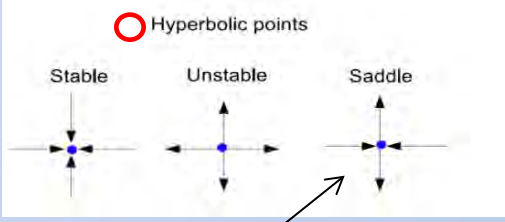
THE NEXT

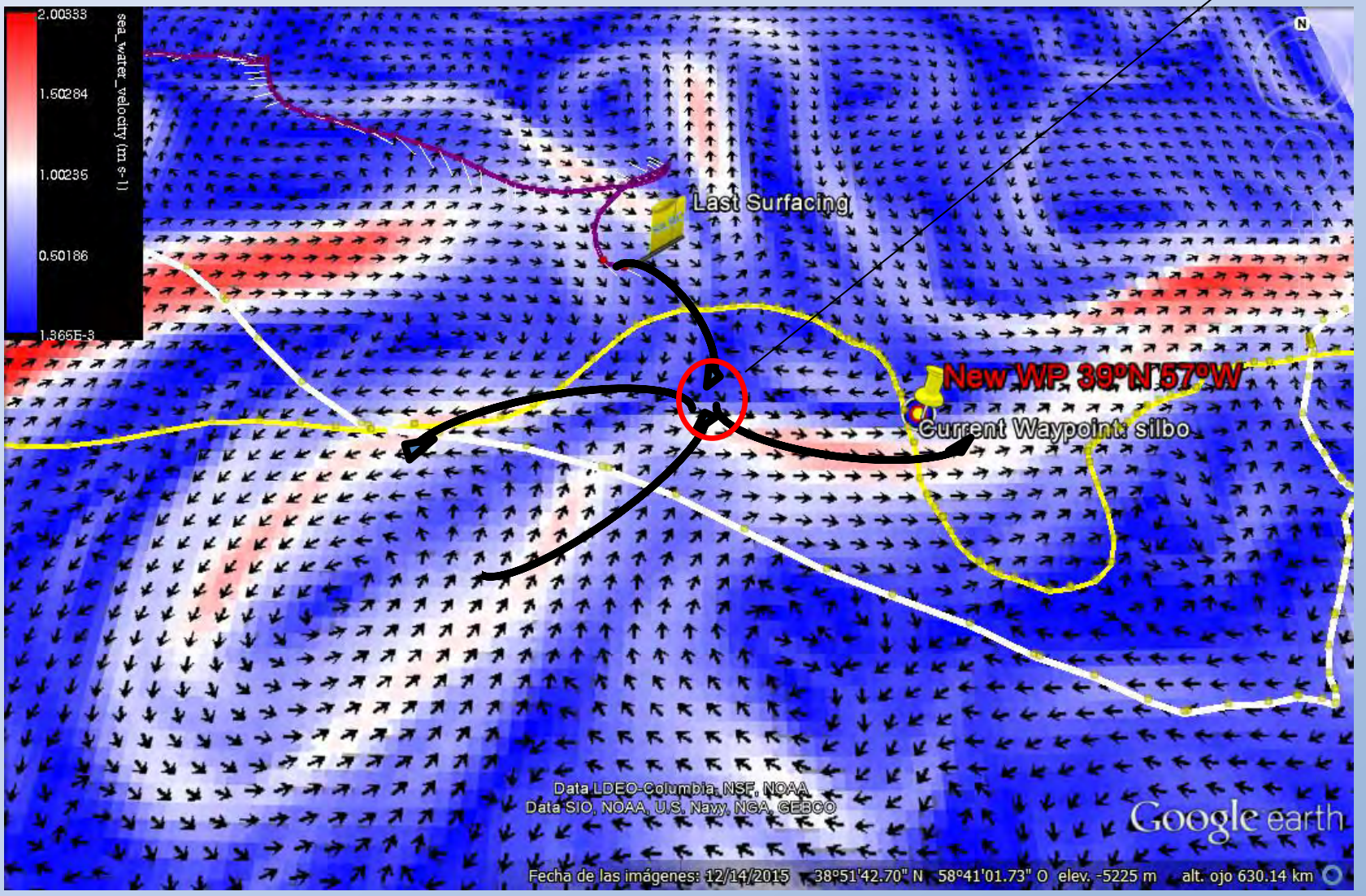


Salinity field COPERNICUS (540m depth). Solar System. 20-25 May 2016.

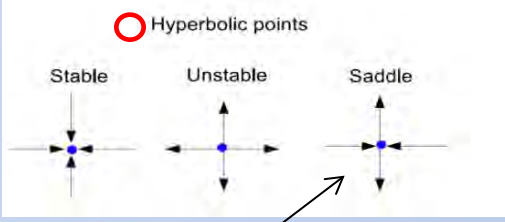


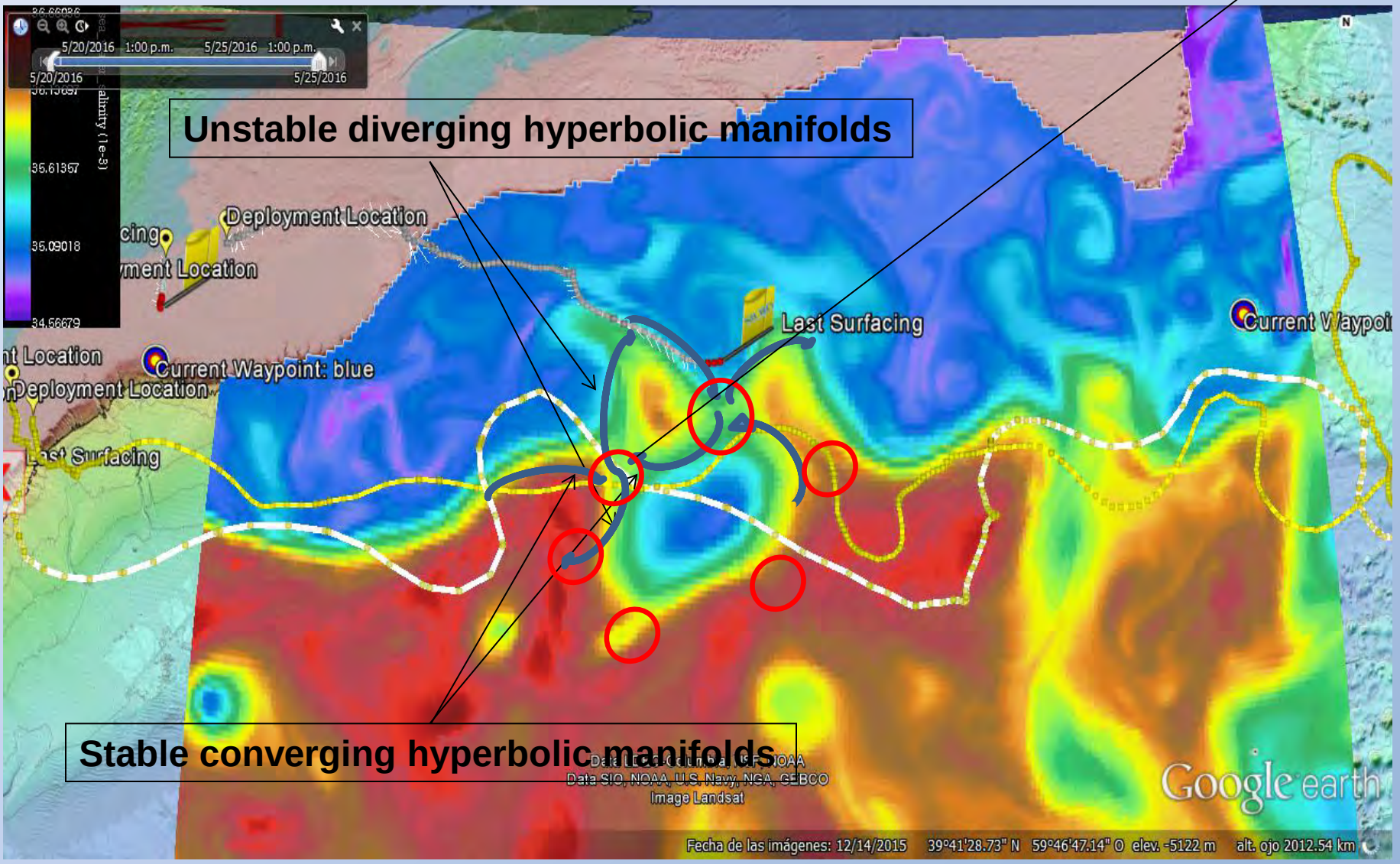
Current field COPERNICUS (0m).
Hyperbolic Saddle point. 30 May 2016.



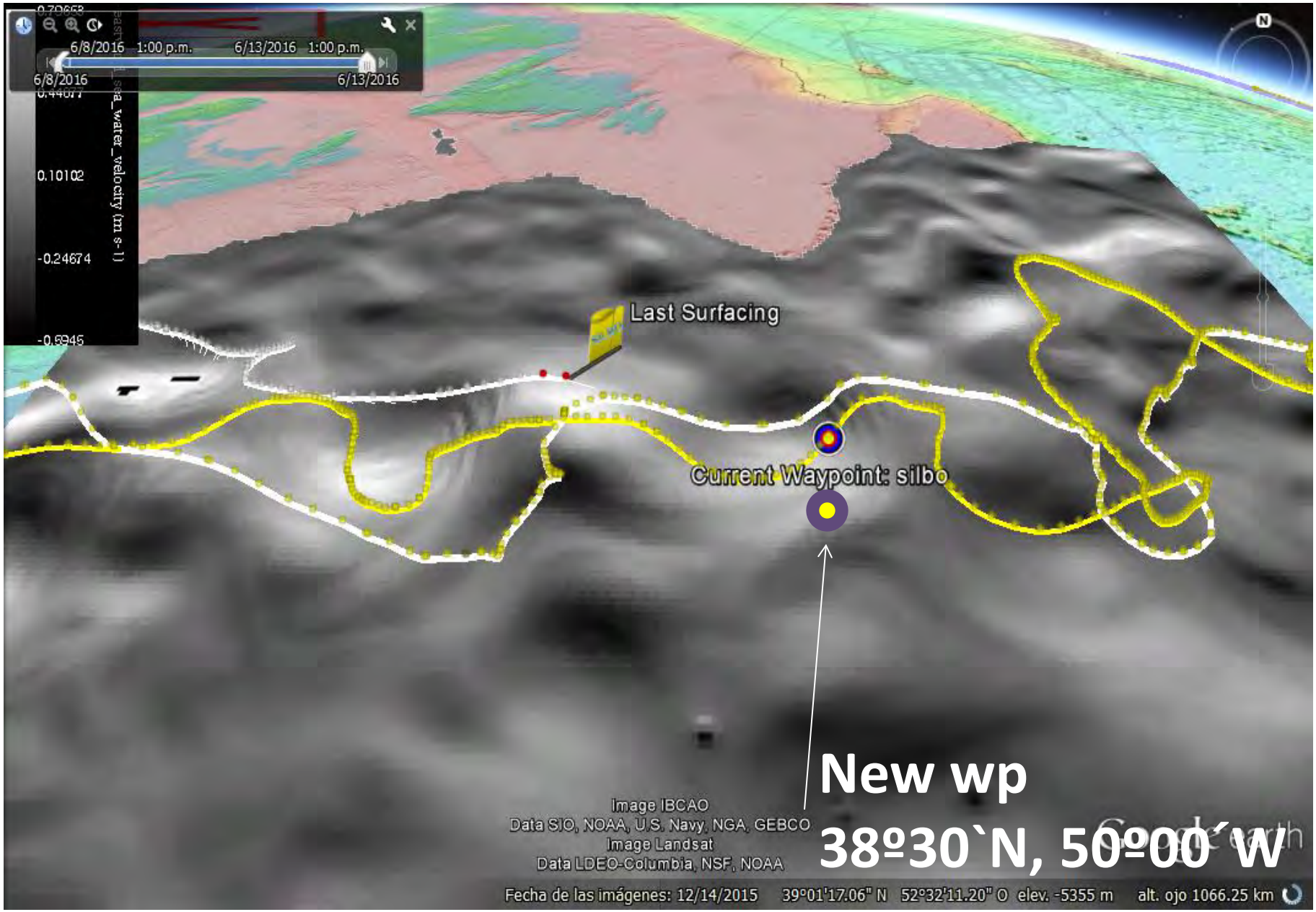


Salinity field COPERNICUS.
Hyperbolic points 1-5. 20-25 May 2016.

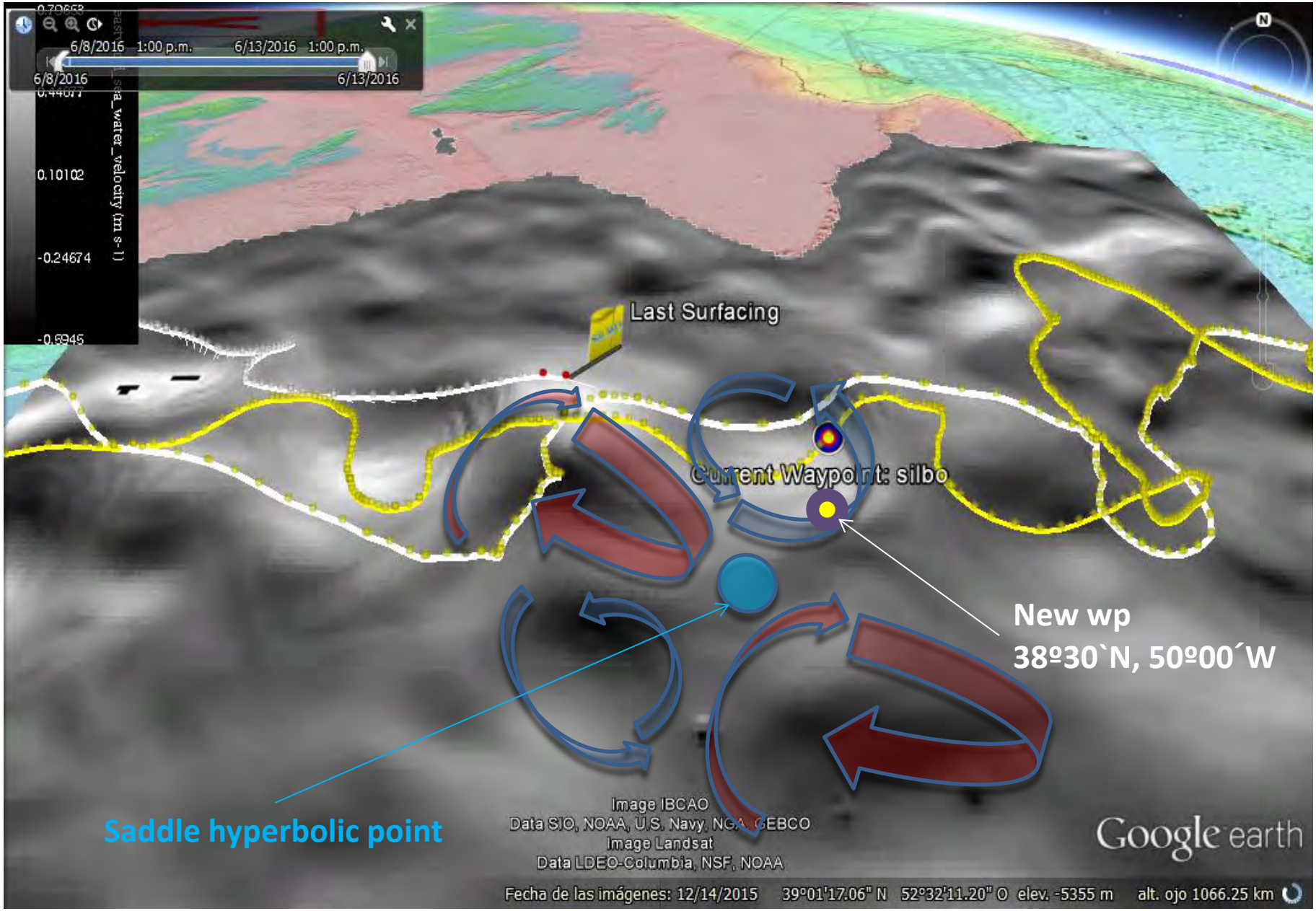




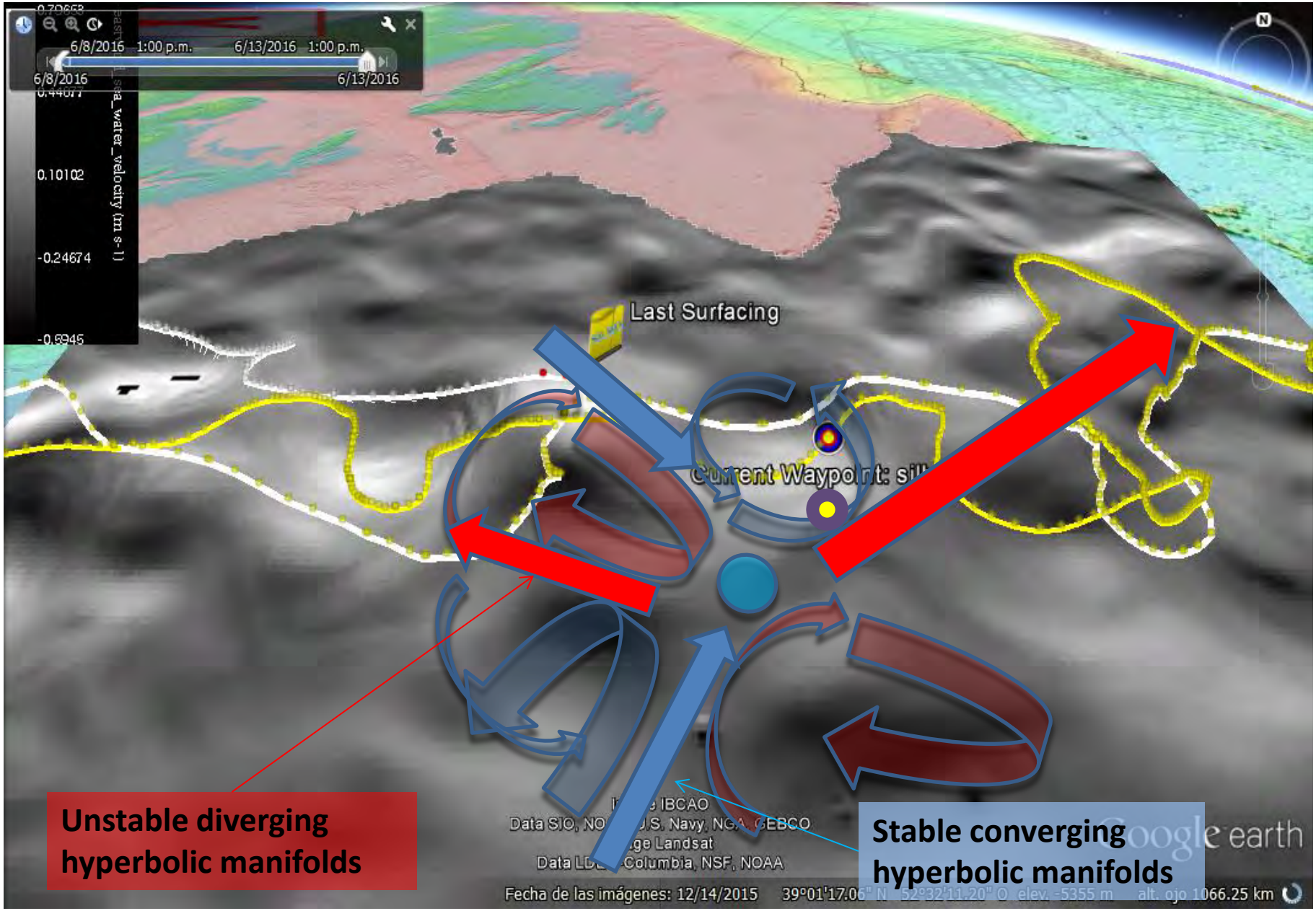
COPERNICUS zonal U current component (z=540m) (8-12 Jun 2016)



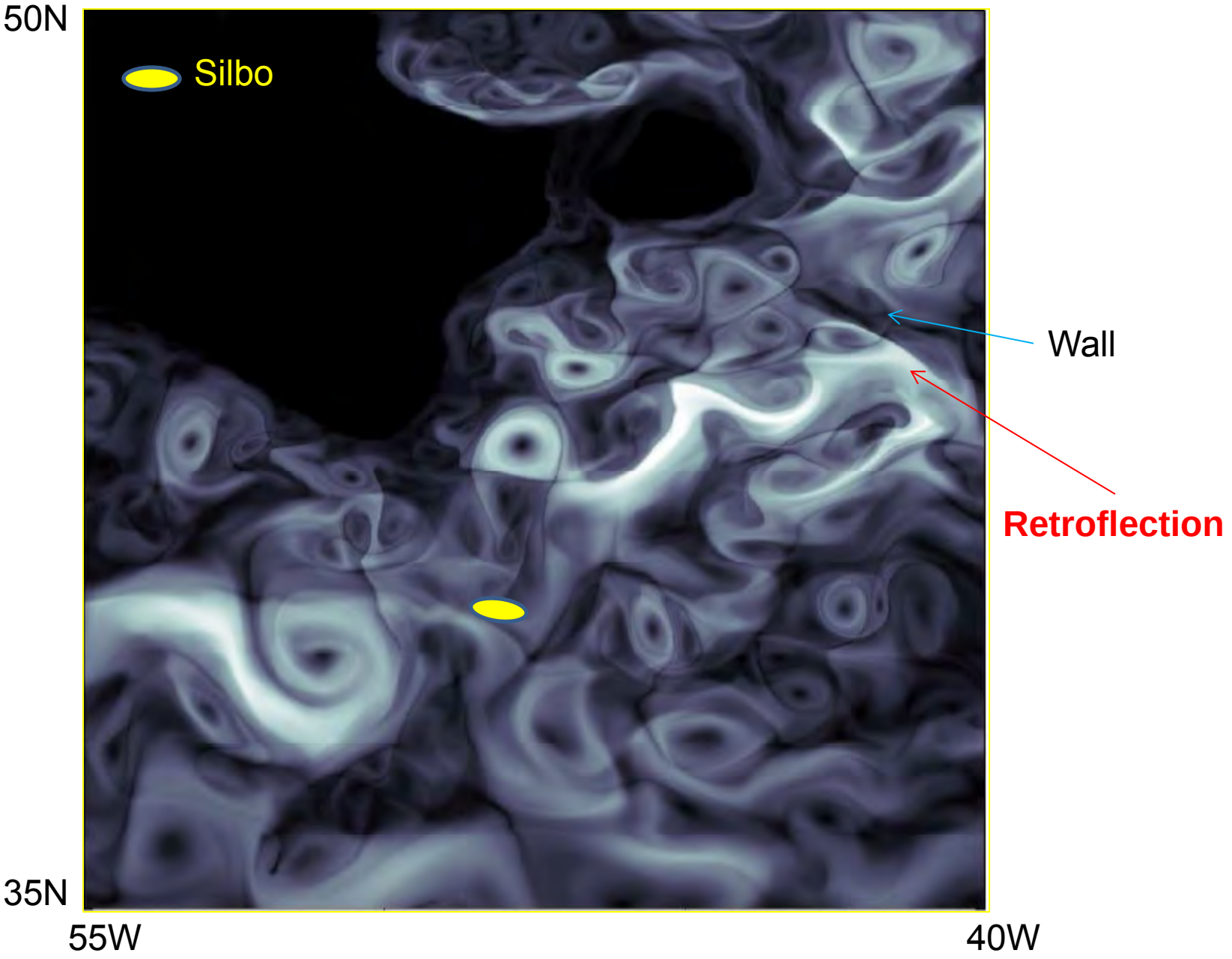
COPERNICUS zonal U Current Component (z=540m) (8-12 Jun 2016)

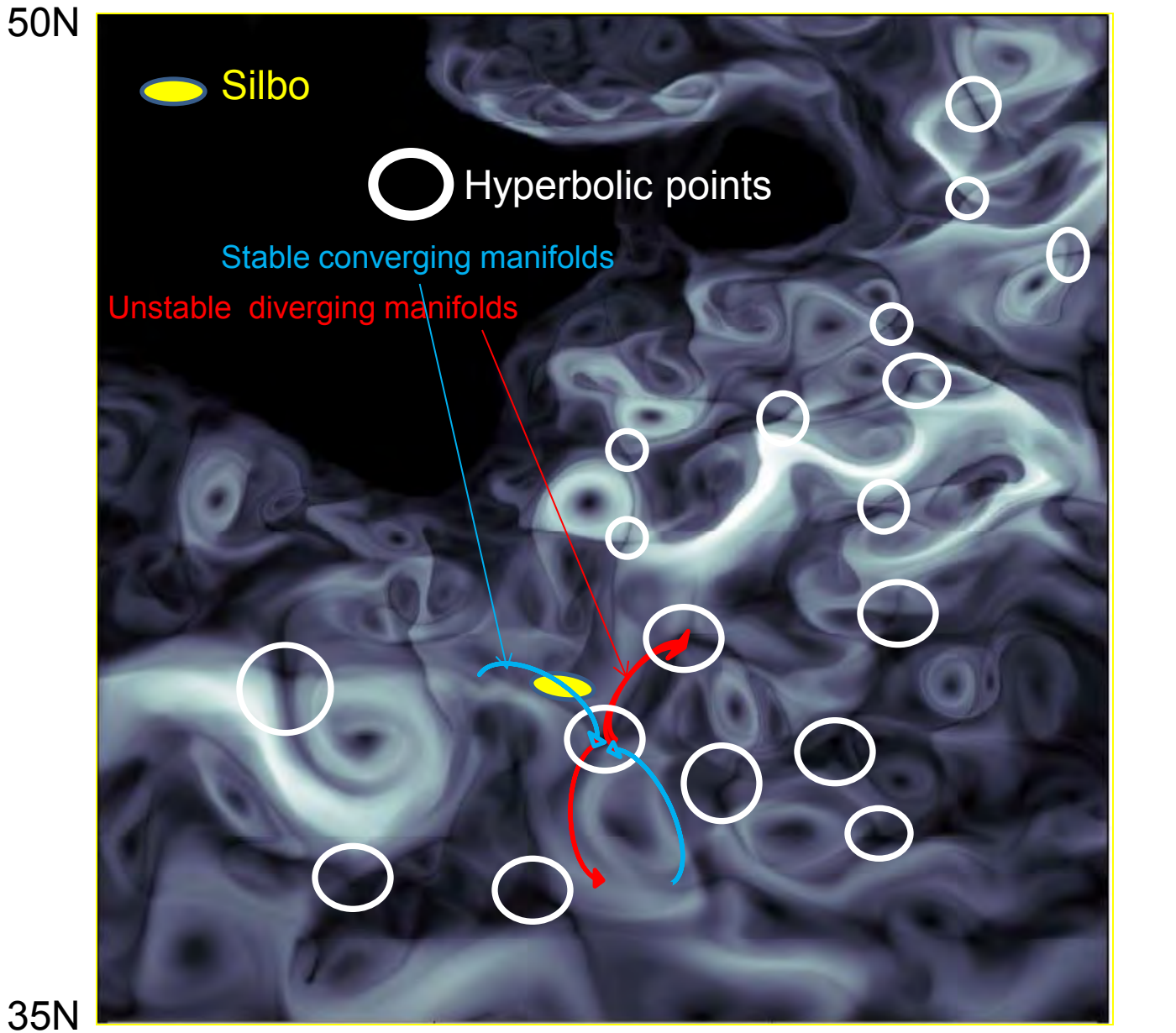


COPERNICUS zonal U Current Component (z=540m) (8-12 Jun 2016)

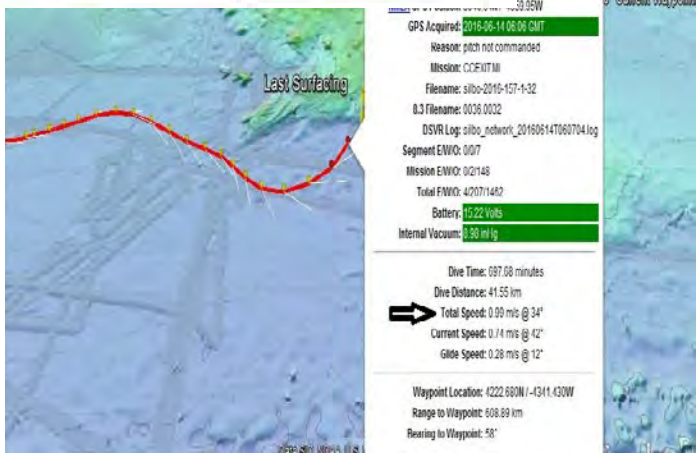


***M Function* 450m. Tau 5. 18-22 June 2016.**




50N
Silbo
Hyperbolic points
Stable converging manifolds
Unstable diverging manifolds
35N
55W
40W

SPEED RECORD : 1 m/s
Usain SIL-BOlt



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Cape of Good Hope . R/V Algoa. 28 March 2016
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