

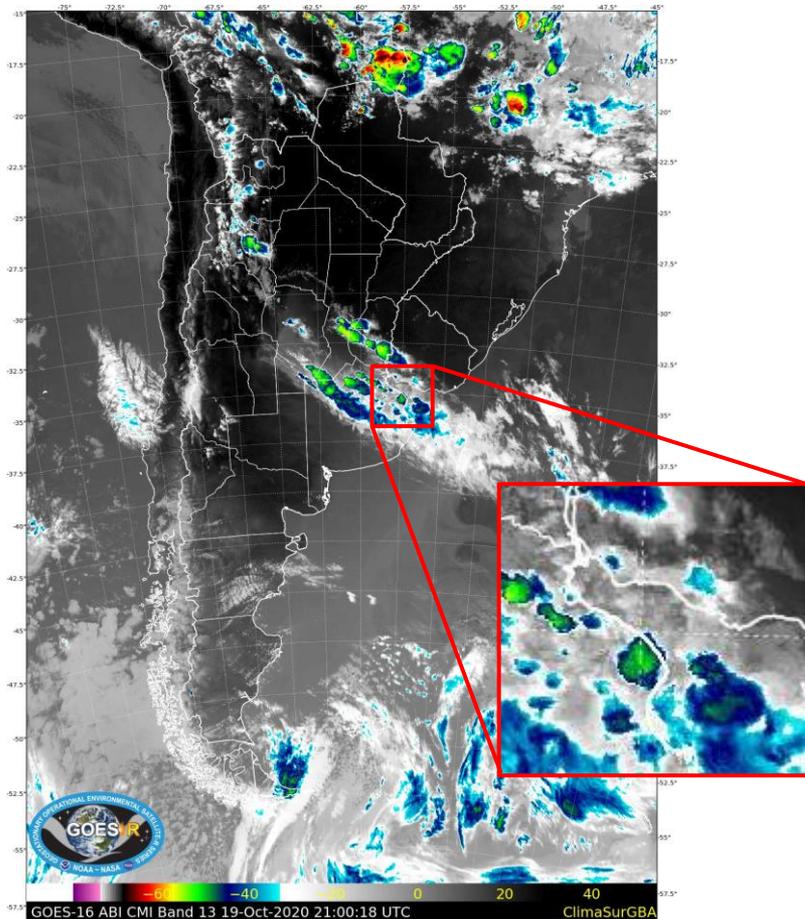
Reunión de la Comunidad SABIA-Mar

SINERGIA CON DATOS SAOCOM

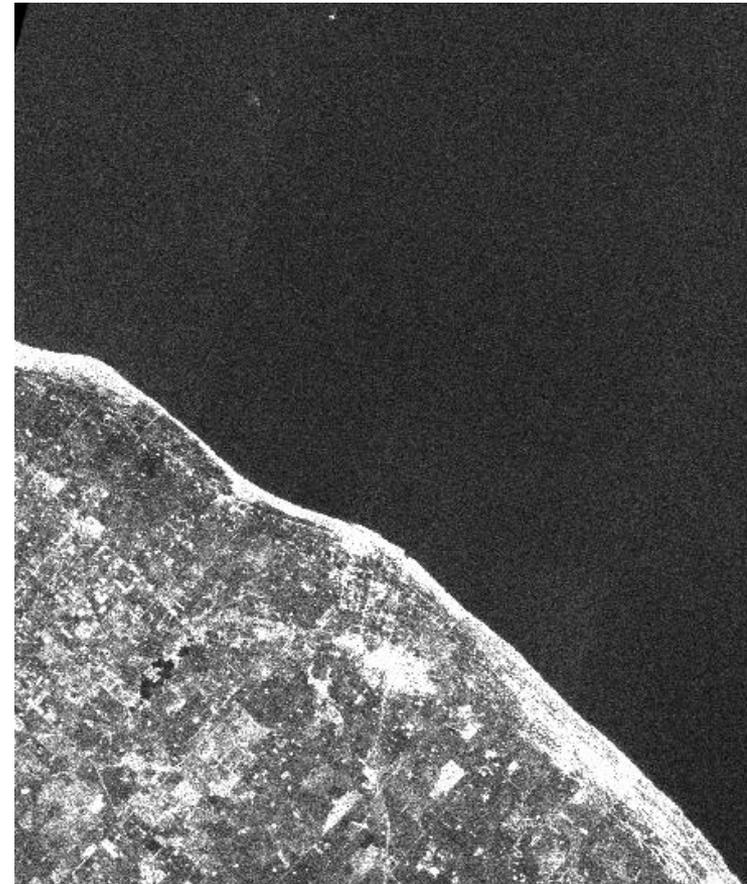
**Marcela Jáuregui, Mario Camuyrano y
Mauro López Gregori**
mglopez@conae.gov.ar

25 de Noviembre, 2022
Córdoba, Argentina

SAR



GOES-16 19/10/2020 - 21:00 UTC (NASA-NOAA)



SAOCOM 1A HV 19/10/2020 - 21:08 UTC

| Instrumento | SAR Banda L Polarimetrico |
|--------------------------------|---------------------------|
| Frecuencia. Central | 1.275 GHz |
| Ancho de Barrido | 20 – 350 km (según modo) |
| Resolución espacial | 10 – 100 m (según modo) |
| Rango de ángulos de incidencia | 20 – 50 ° (según modo) |
| Altura | 620 km |



Fuente: CONAE



Productos SAOCOM:

- Nivel 1 : A, B, C, D
- Nivel Superior: SAS, SIS, **SOS**

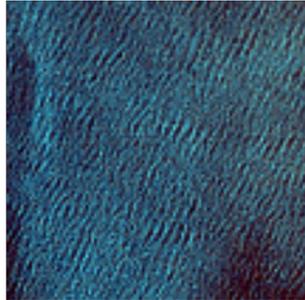


SAOCOM Oceanic System

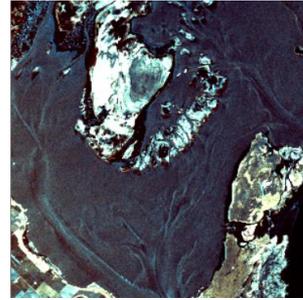
- Detección de embarcaciones
- Mapeo de viento
- Detección de derrames de petróleo
- Hielo Marino
- Otros..



Barcos



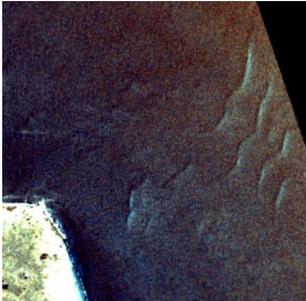
Olas



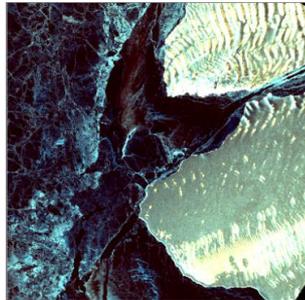
Áreas costeras



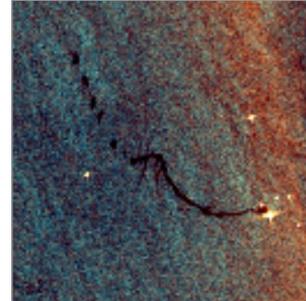
Procesos dinámicos



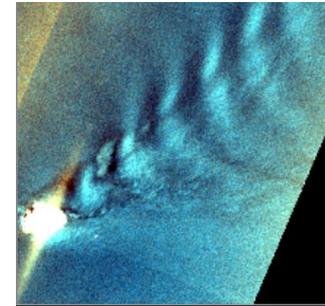
Formas de fondo



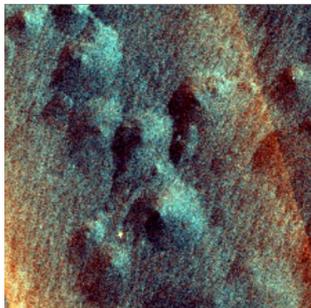
Hielo



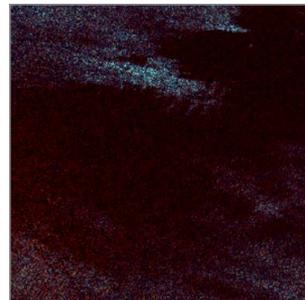
Potenciales derrames de petróleo



Ondas Atmosféricas



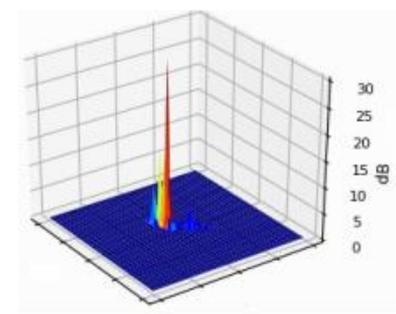
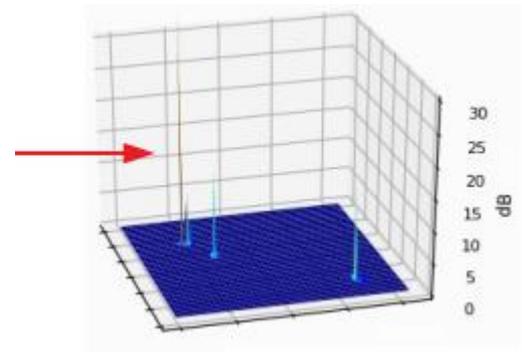
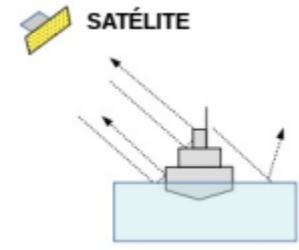
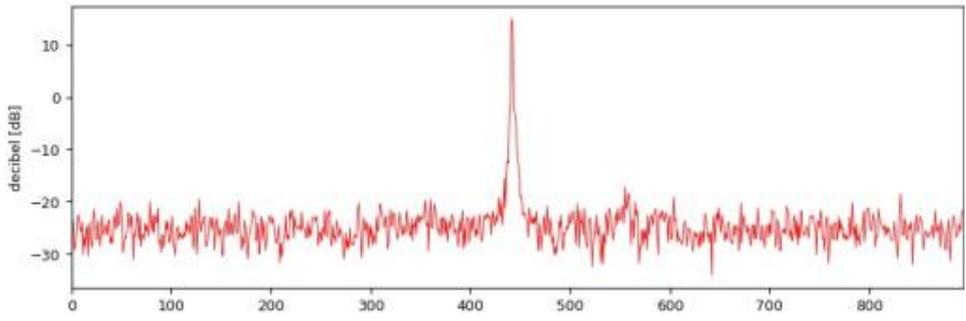
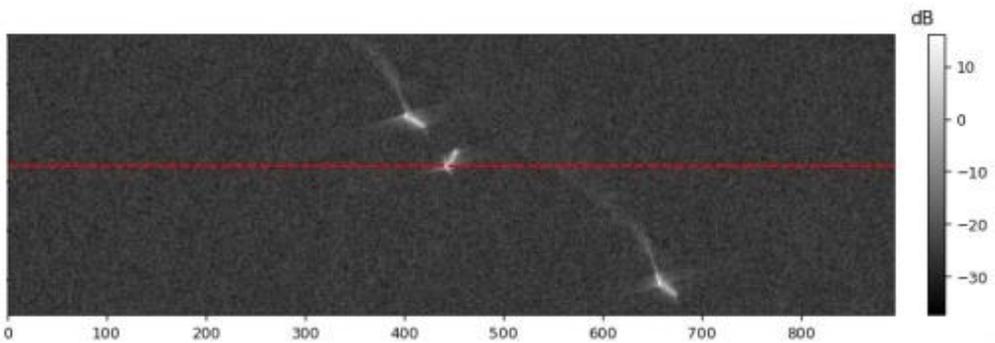
Celdas



Velocidad y dirección de viento



Ondas Internas



REPORTE DE OBJETOS OCEANICOS DETECTADOS
Comisión Nacional de Actividades Espaciales (CONAE)
SAOCOM Oceanic System (SOS)

Fecha de Reporte: 28-07-2022 Hora de Reporte: 12:34 UTC

Fecha de Adquisición: 25-03-2022 Hora de Adquisición: 20:59 UTC

Satélite: SAO1A Modo - Nivel de Proc.: TN - L1C

ID Producto: EOL1CSARSAO1A4079988

| ID | Latitude | Longitude | Lat Lon (DMS) | Thumbnail |
|----|------------|------------|--------------------------------|-----------|
| 1 | -44.891422 | -60.427329 | 44°59'29.12 S 60°25'38.38 O | |
| 2 | -44.893496 | -60.439438 | 44°59'38.59 S 60°25'21.98 O | |
| 3 | -44.895834 | -60.435549 | 44°59'45.9 S 60°25'7.98 O | |
| 4 | -44.897652 | -60.402704 | 44°59'51.55 S 60°24'9.73 O | |
| 5 | -44.899617 | -60.447954 | 44°59'58.82 S 60°25'2.63 O | |
| 6 | -44.899221 | -60.422934 | 44°59'57.2 S 60°25'22.98 O | |
| 7 | -44.899604 | -60.412993 | 44°59'56.76 S 60°24'46.77 O | |
| 8 | -44.903526 | -60.384326 | 44°59'15.89 S 60°27'23.97 O | |

```
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    <Mode>TN</Mode>
    <Polarizations>VH-VV</Polarizations>
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  - <Product-Parameters>
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    <ProductsGenerationStartTime Time="UTC">2022-07-
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      <Lon unit="deg">-60.427329</Lon>
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      <Sample>5463</Sample>
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  </Target-Detected>
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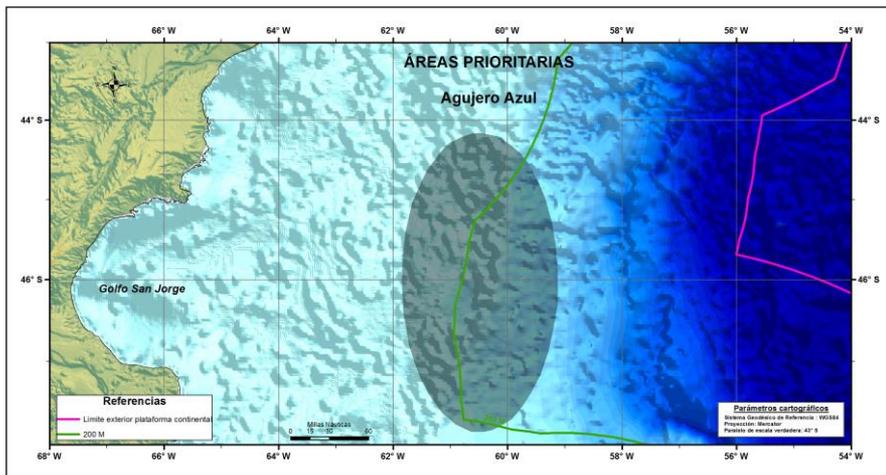
Product ID: EOL1CSARSAO1A4079988
Datetime: 2022-03-25 20:59:01 UTC
Latitude: -45.053088
Longitude: -59.584298

Cómo Ver: [Ajustar](#) - [Dejar](#)

Fecha de imágenes: 12/13/2015 lat: -45.522579° long: -58.865061° elevación: -1667 m alt. ops: 697.04 km

| TargetID | ProductID | Datetime | Latitude | Longitude |
|----------|----------------|-------------------|------------|------------|
| 1 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.891422 | -60.427329 |
| 2 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.893496 | -60.439438 |
| 3 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.895834 | -60.435549 |
| 4 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.897652 | -60.402704 |
| 5 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.899617 | -60.447954 |
| 6 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.899221 | -60.422934 |
| 7 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.899934 | -60.412993 |
| 8 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.903526 | -60.384326 |
| 9 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.904764 | -60.397131 |
| 10 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.908774 | -60.574517 |
| 11 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.908999 | -60.378674 |
| 12 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.913659 | -60.369369 |
| 13 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.916997 | -60.397258 |
| 14 | EOL1CSARSAO... | MAR 25, 2022 2... | -44.932133 | -60.495908 |

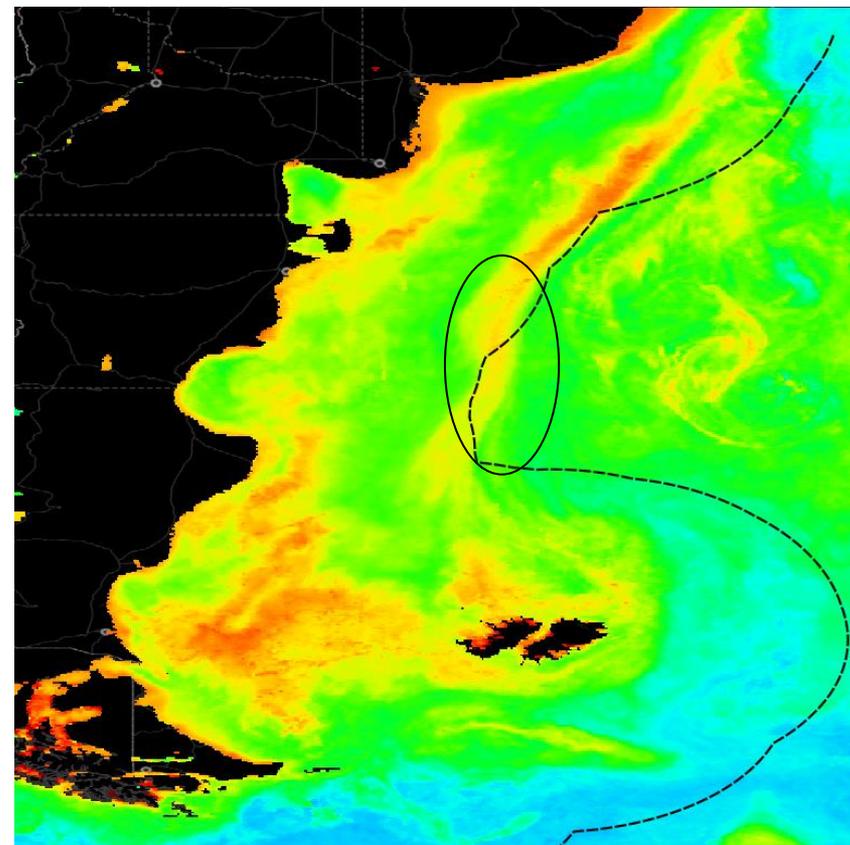
Mostrar todos los objetos espaciales



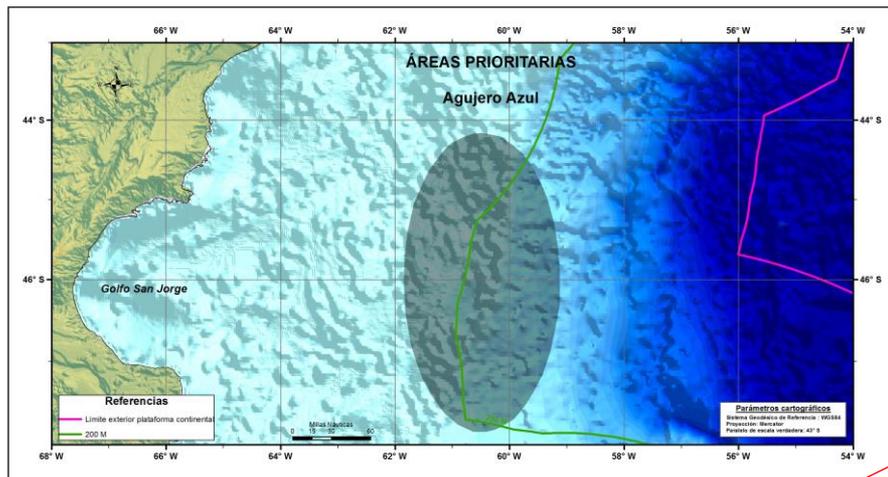
Fuente: Pampa Azul

- Área del Talud Continental a 500 km al este de Golfo San Jorge
- Superficie del orden de 6600 km
- Alta productividad biológica
- **Sector Oriental en aguas internacionales**

Fuente: www.pampaazul.gov.ar



Concentración superficial de la clorofila-a MODIS AQUA.
Resolución: 4 km. Fuente: NASA Ocean Color



Fuente: Pampa Azul

- Área del Talud Continental a 500 km al este de Golfo San Jorge
- Superficie del orden de 6600 km
- Alta productividad biológica
- **Sector Oriental en aguas internacionales**

Fuente: www.pampaazul.gob.ar

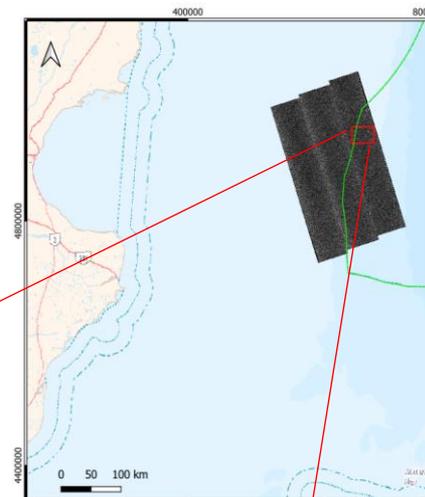
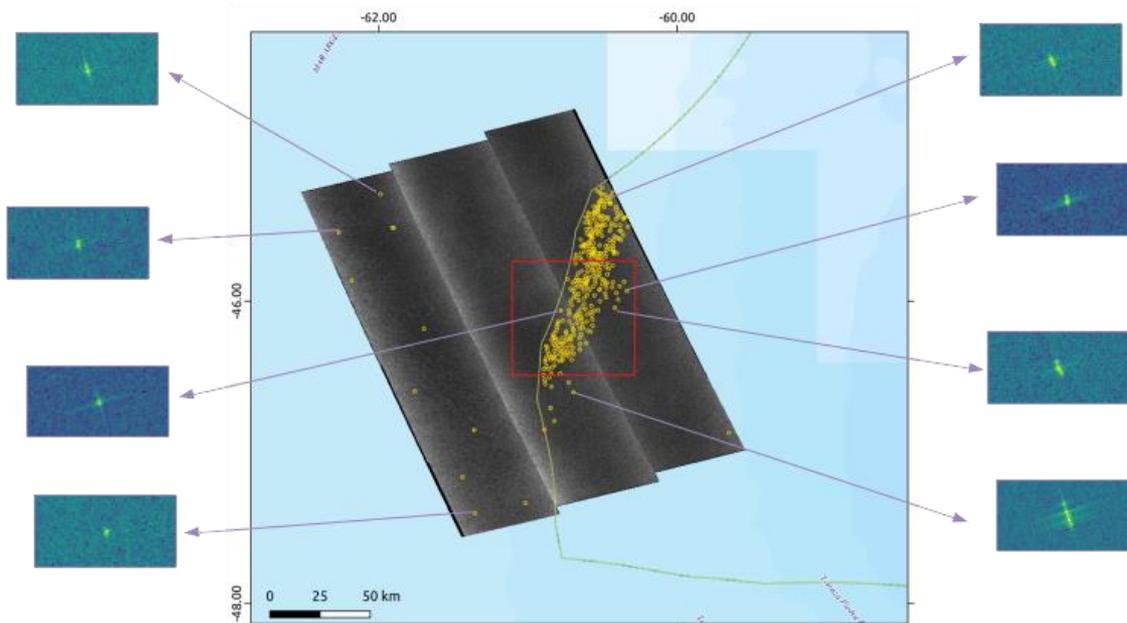
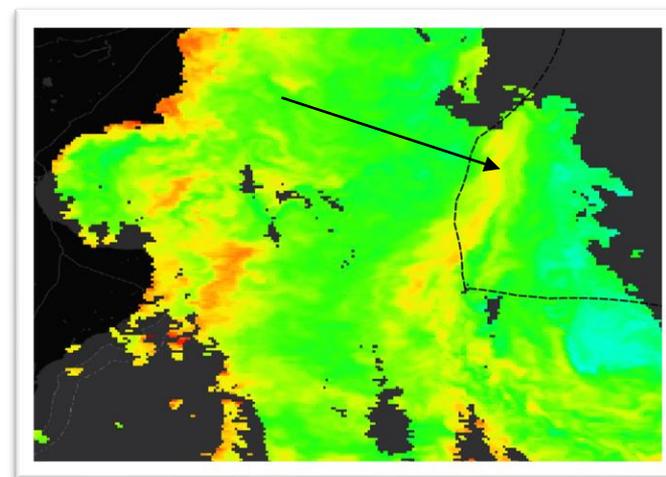
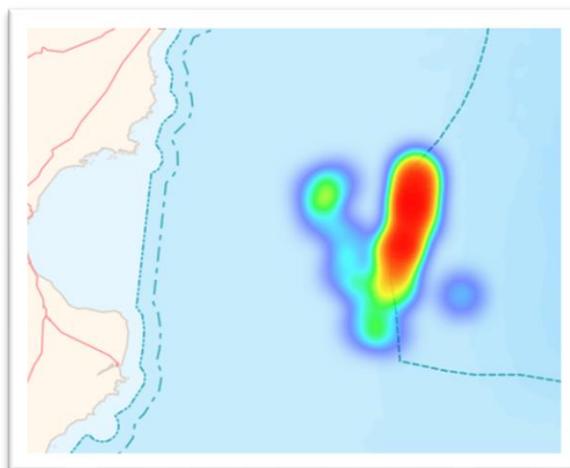


Imagen SAOCOM
TopSAR Narrow 1A VH
16-02-2021 11:01 UTC.
UTM 20S

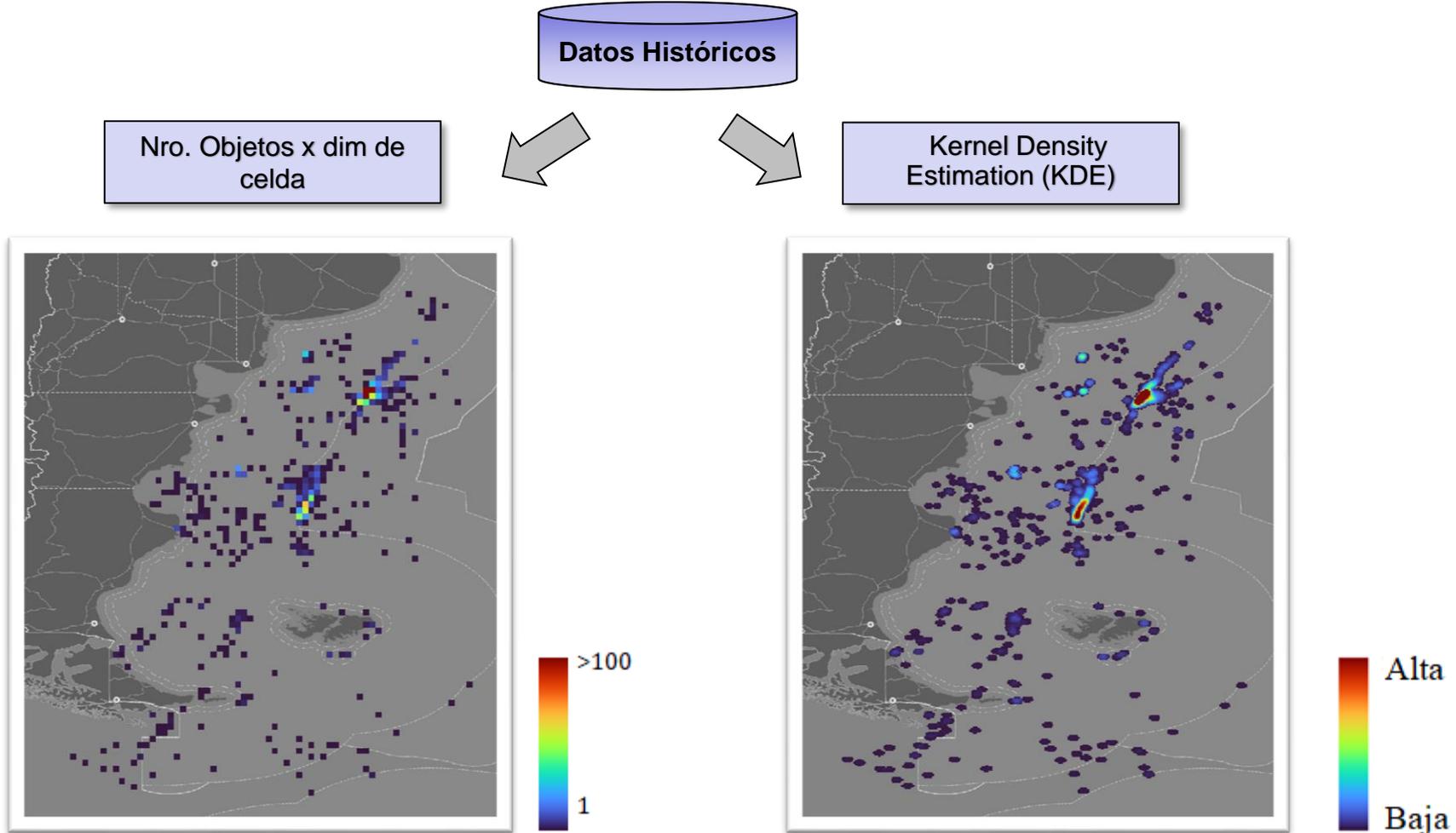


Detecciones resultantes del procesamiento de imagen SAOCOM 1A con Sistema de Detección de Objetos del SOS. Algoritmo: II-2PCFAR Mapabase Argenmap.

Mapa de calor realizado con resultados de la detección. Mapabase Argenmap.



Concentración de Cl-a. Producto diario 16-02-2021. MODIS AQUA. Resolución espacial: 4 km. Fuente: NASA Ocean Color

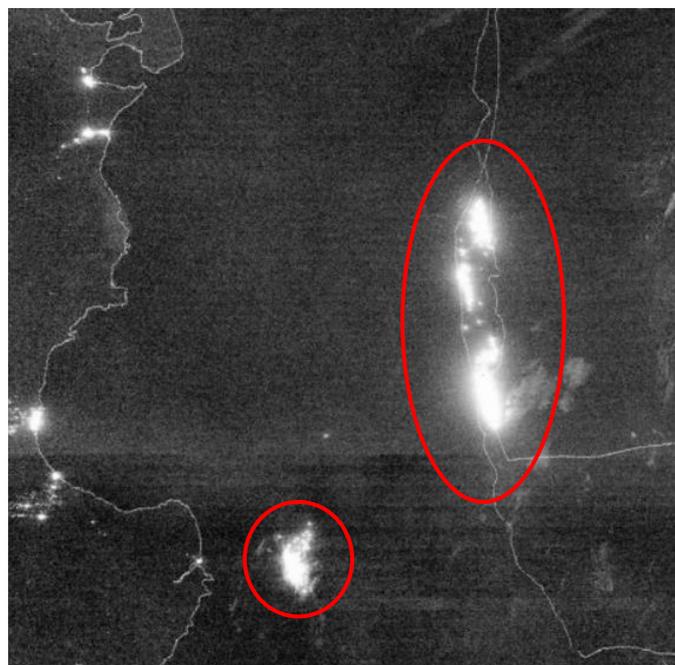
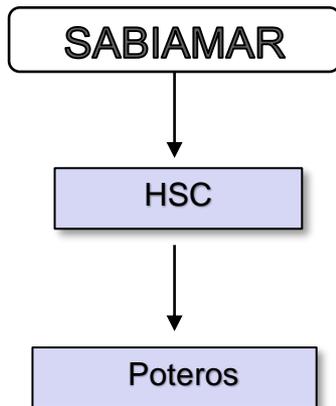


Número de objetos detectados por celda (0,25° x 0.25°) – **No normalizada por cobertura**

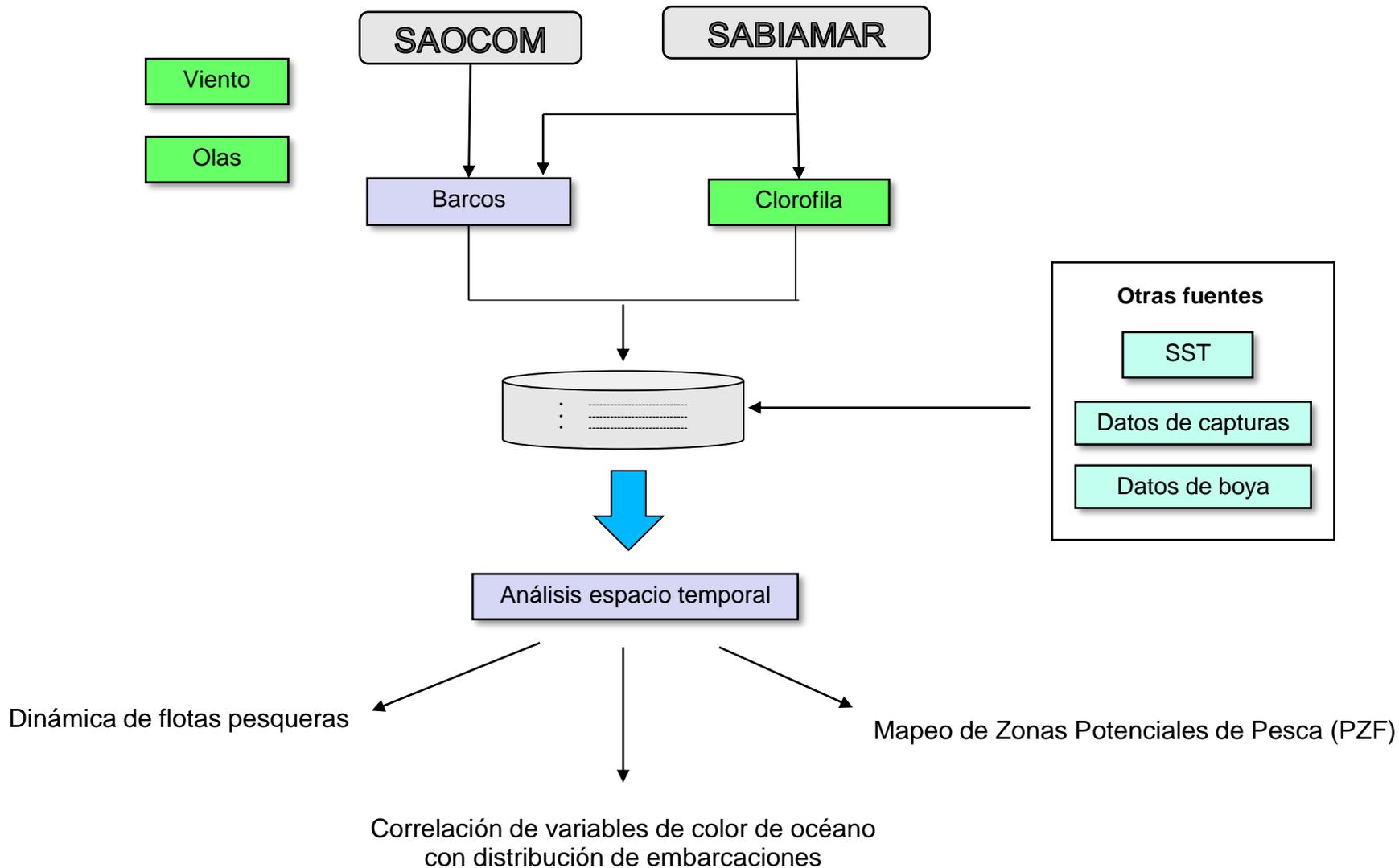
Mapa generado con KDE- Resolución: 0.05 x 0.05
Kernel: Gaussiano – Ancho de banda: 15 km
No normalizada por cobertura

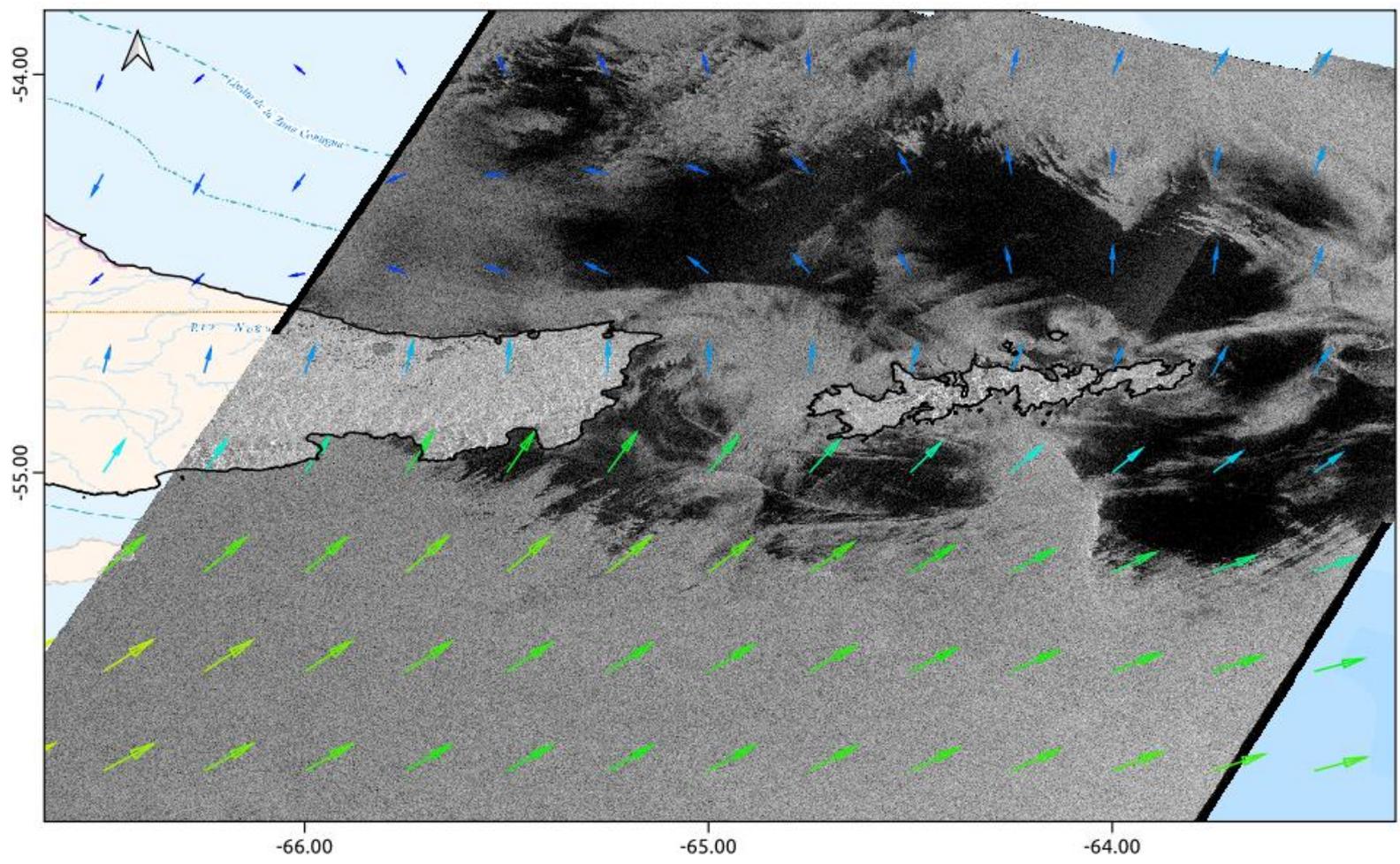
Total objetos: 2145 - **Número de días:** 18 (30/08/2021 al 19/05/2022) Mapa base: Argenmap (oscuro) - IGN

Datos Históricos



Ejemplo de barcos poteros en Mar Argentino. NPP VIIRS



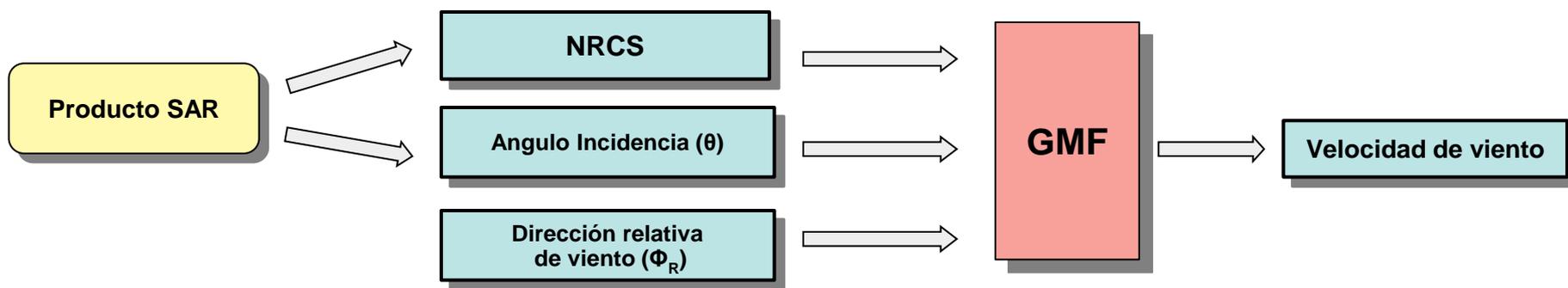


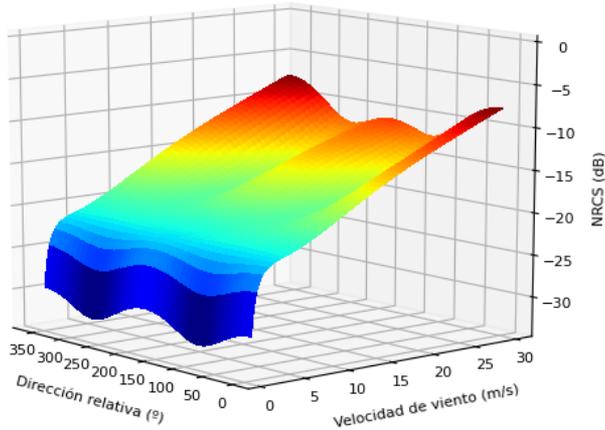
SAOCOM 1A Pol. VV. Isla de los Estados 02-04-2021 21:07 UTC. Los vectores viento corresponden a datos de reanálisis ERA-5 -ECMWF 02-04-2021 21:00 UTC.

➤ Geophysical Model Function (GMF)

$$NRCS = A_0(w, \theta) (1 + A_1(w, \theta) \cos \phi + A_2(w, \theta) \cos 2\phi)$$

$$A_n(n = 0,1,2) \rightarrow \text{func}(w_{10}, f, \text{pol}, \theta)$$



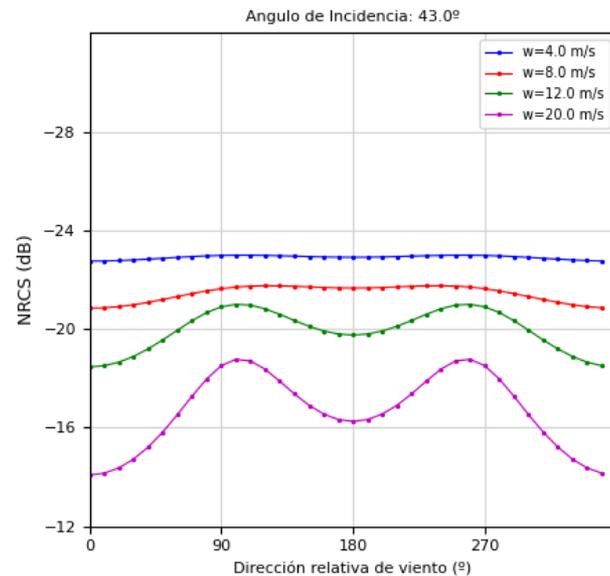
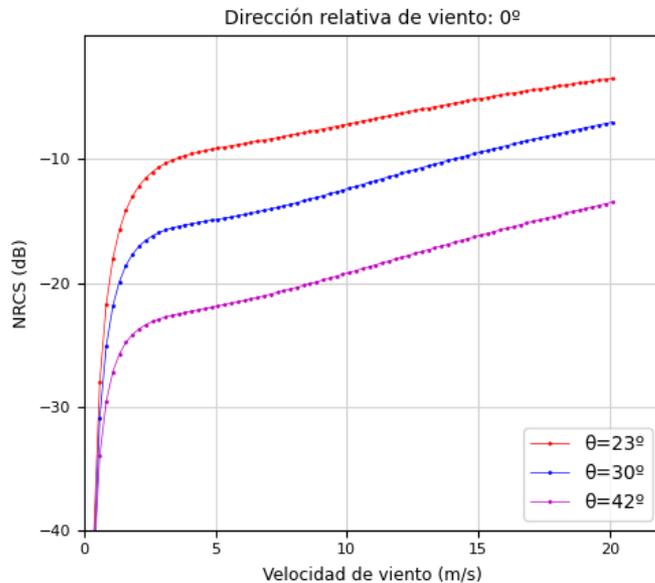


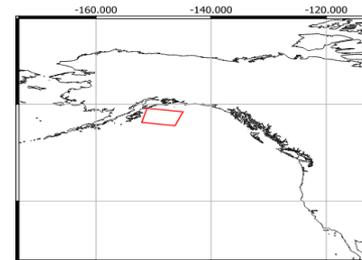
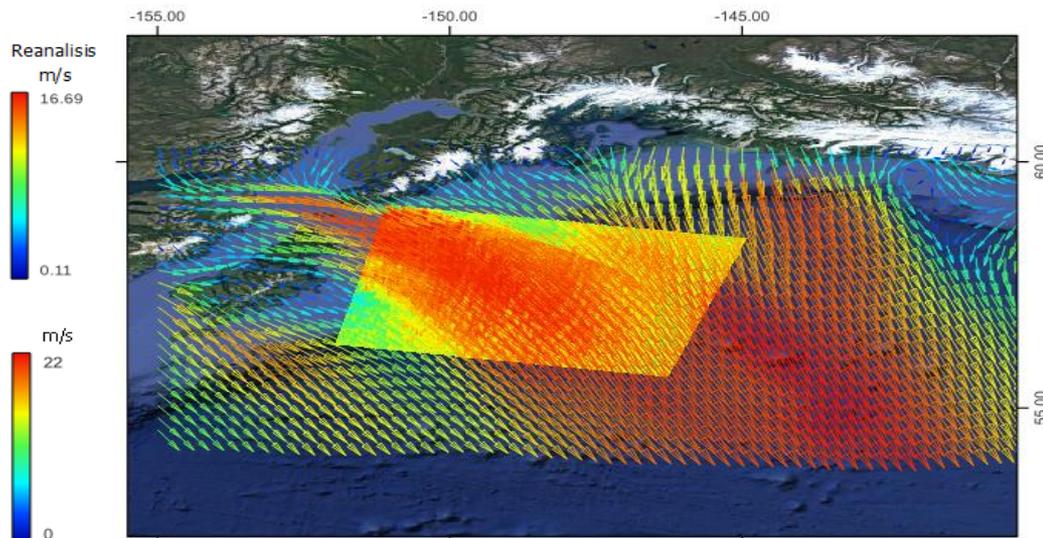
$$\sigma_{HH} = A_0(w, \theta) (1 + A_1(w, \theta) \cos \phi + A_2(w, \theta) \cos 2\phi)$$

- ✓ Realizado con **ALOS PALSAR** y ASCAT
- ✓ Velocidades < 20 m/s (~38.8 kts)
- ✓ $17^\circ < \theta < 43^\circ$
- ✓ RMS: 1,87 m/s (boyas) – 1,85 m/s (ASCAT)

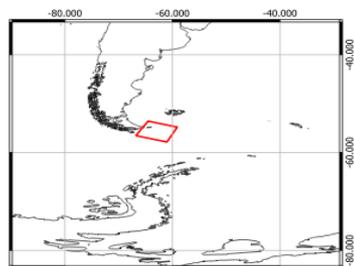


ALOS – Fuente: JAXA

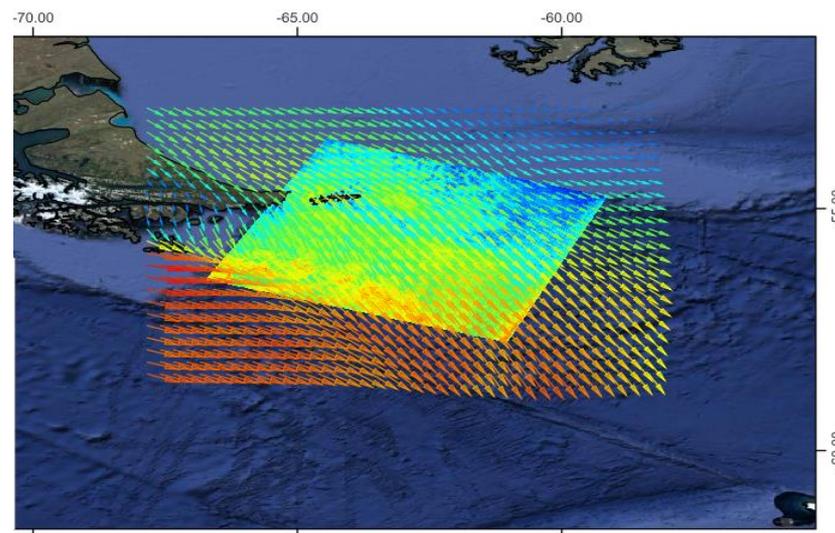




Mapa de viento con ALOS PALSAR HH. Golfo de Alaska 26-02-2007 20:49 UTC. © JAXA / METI 2007. Los vectores viento corresponden a datos de reanálisis ERA-5 -ECMWF 26-02-2021 21:00 UTC.



Mapa de viento con ALOS PALSAR HH. Tierra del Fuego e Isla de los Estados, Argentina 18-09-2009 13:28 UTC. © JAXA / METI 2007. Los vectores viento corresponden a datos de reanálisis ERA-5 -ECMWF 26-18-09-2009 13:00 UTC.



* Conjunto de datos: © JAXA / METI ALOS PALSAR L1.5. Consultados a través de ASF DAAC Agosto de 2021

● PRODUCTO SAOCOM:

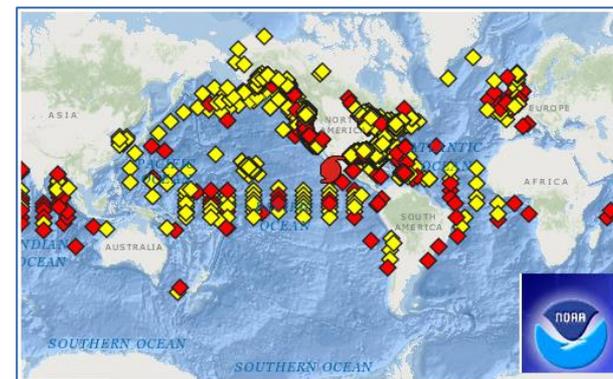
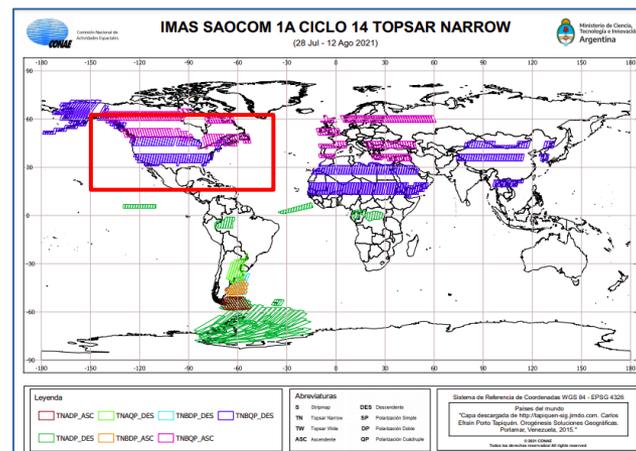
- Nivel 1B TOPSAR Narrow QP
- Resolución Nominal: 50 x 50 m
- Ancho de barrido: ~108 km
- Rango ángulos de Incidencia: **17.6° – 27.3° (TNA)**
y **27.2° – 35.5° (TNB)**

● DATOS In-Situ: Boyas

- Datos de la National Data Buoy Center de la NOAA, EEUU
- Velocidad y dirección de viento
- Resolución temporal: horaria
- LIMITACIÓN → Ausencia de datos en el Hemisferio Sur

● DATOS DE DIRECCIÓN DE VIENTO

- Componentes U_{10N} y V_{10N} de viento
- Resolución temporal: Horaria
- Resolución: $0.25^\circ \times 0.25^\circ$ (~30 km)
- Cobertura Global
- Climate Data Store (CDS)





Boya 44007 (h=4.1 m)
Fuente: NDBC-NOAA



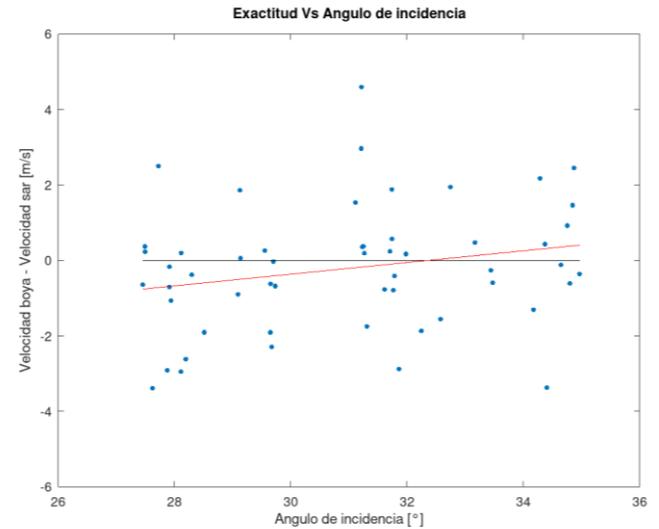
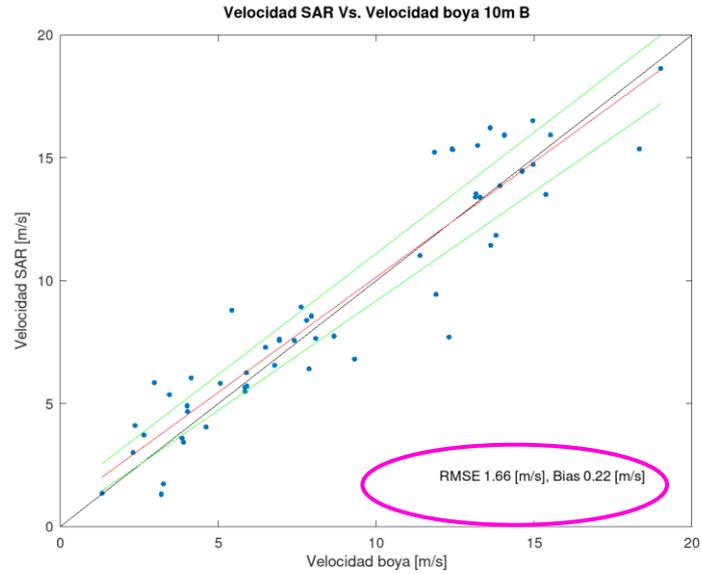
Boya 46029 (h=3.2 m)
Fuente: NDBC-NOAA

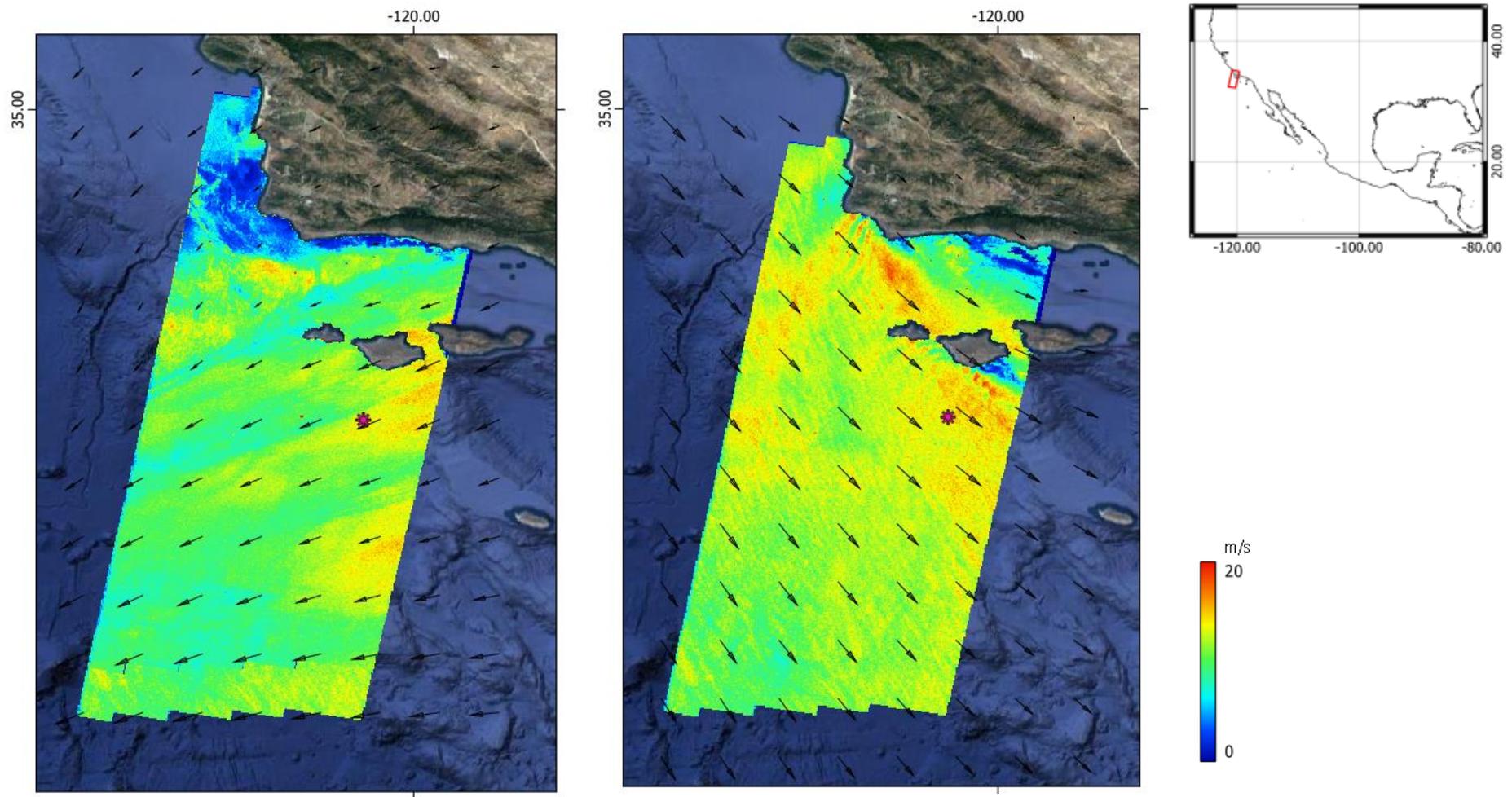


- Diferencia temporal SAR/Boya: **30 mins**
- Radio para extracción de datos de viento SAR: **3 km**

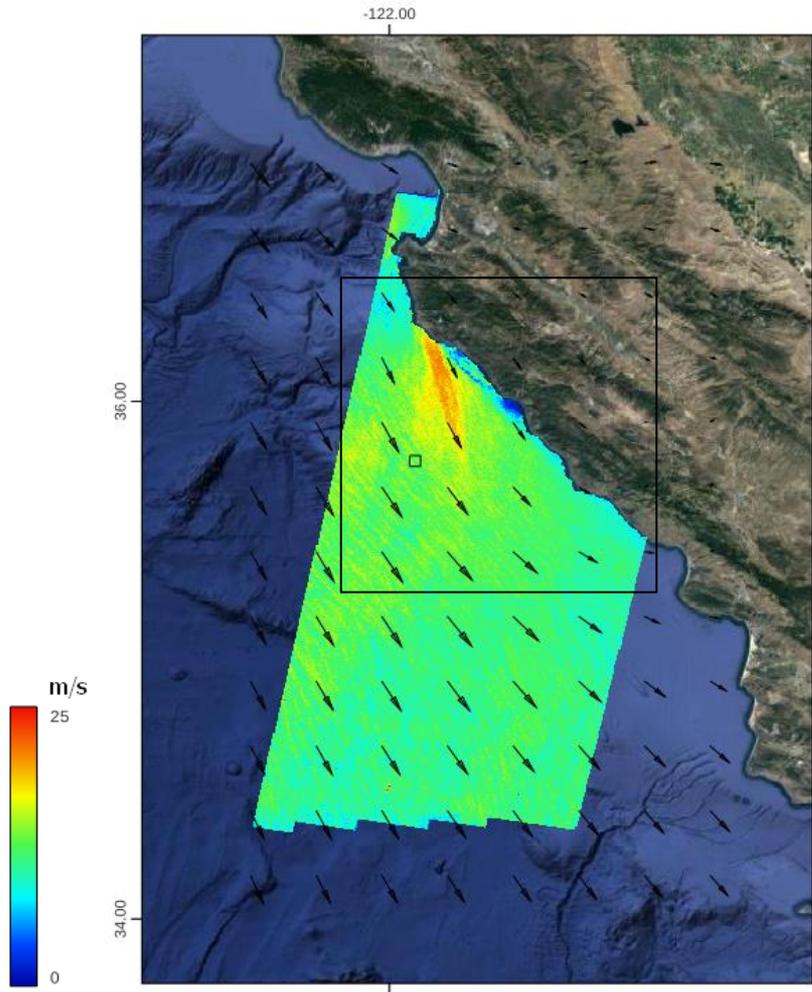


Transformación de V_{HANM} a V_{10N}

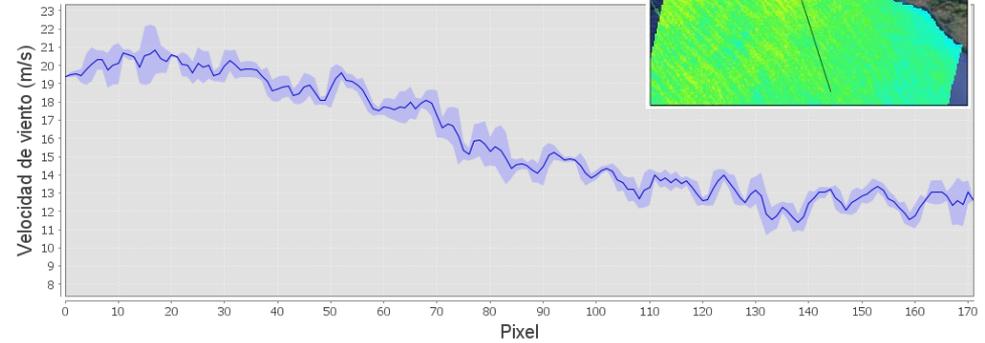
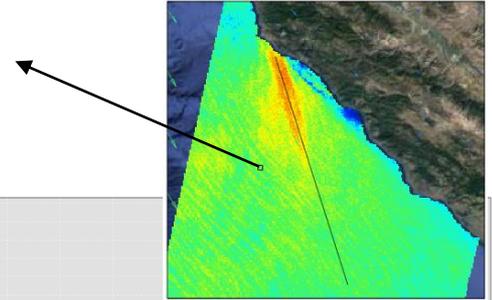




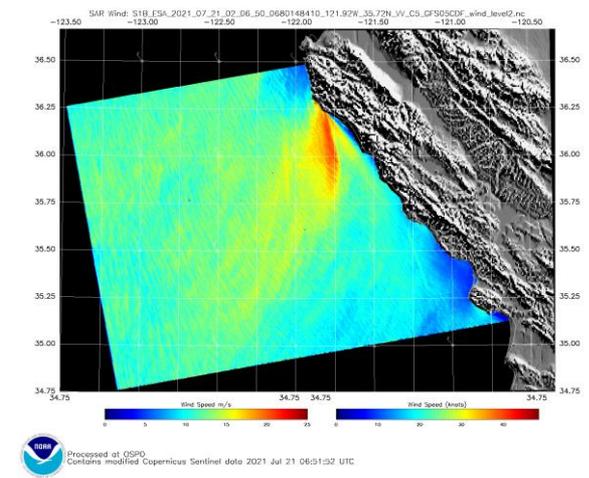
Velocidad de viento con SAOCOM 1A utilizando L-band 2009. California, EEUU. a- 20-01-2021 02:04 UTC b- 28-05-2021 02:04 UTC.. Los vectores viento corresponden a datos de reanálisis ERA-5 -ECMWF 02:00 UTC



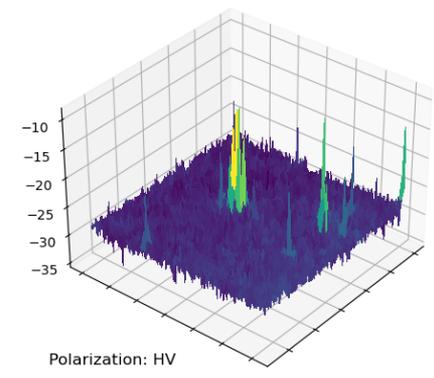
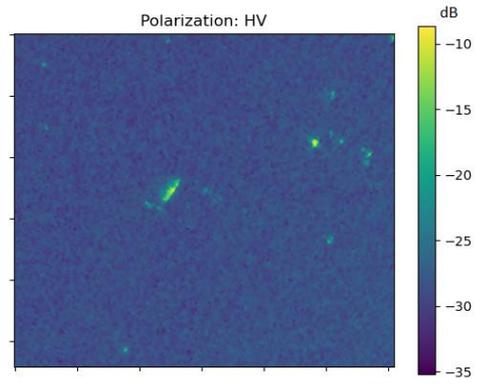
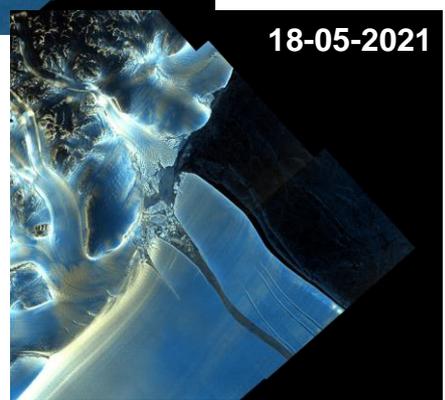
| | | |
|-------|------|----------------------|
| 46028 | 322° | 11.8 m/s (13,14 m/s) |
| SAR | | 13.4 m/s |



Velocidad de viento con SAOCOM 1A utilizando L-band 2009. California, EEUU. 07-05-2021 02:10 UTC .Los vectores viento corresponden a datos de reanálisis ERA-5 -ECMWF 02:00 UTC



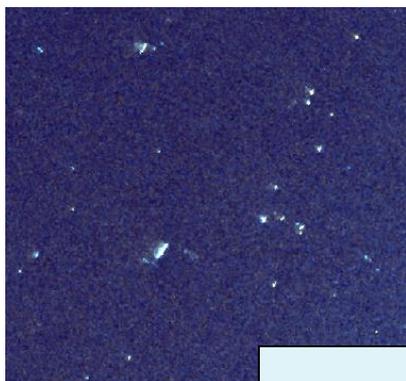
Mapa de viento Sentinel 1. 21-07-2021 06:06 UTC. Fuente: OSPO -NOAA



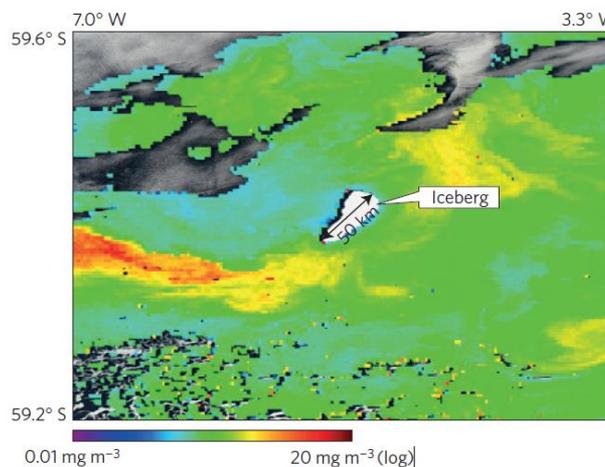
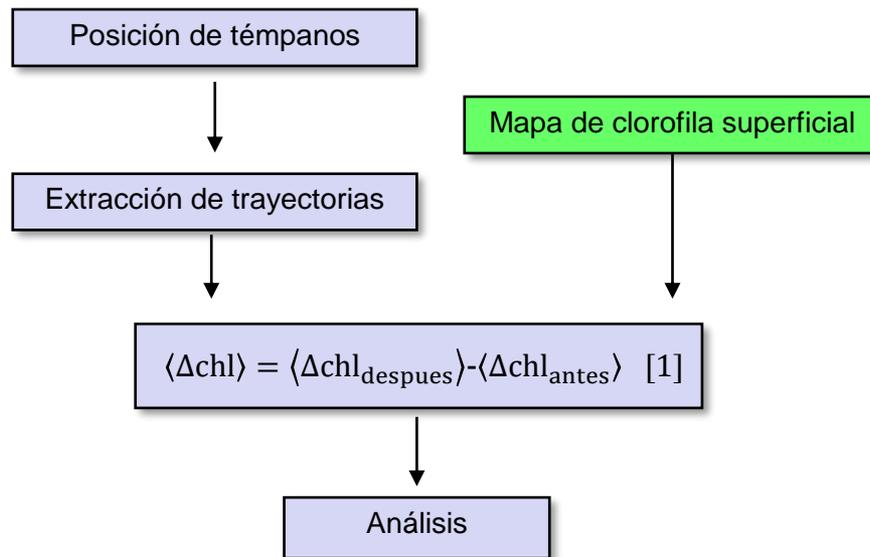
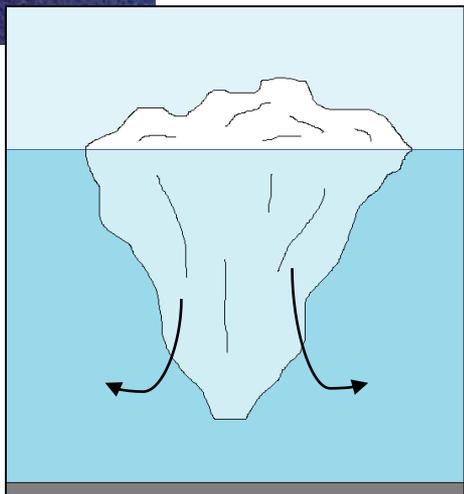
Desprendimiento de la barrera de hielo de Ronne



Desprendimiento de la barrera de hielo Brunt



Témpanos en imagen SAOCOM
Modo: TW Pol: HH-HV



Concentración de clorofila-a MODIS AQUA. Témpano C16

Fuente:
Duprat, L. P., Bigg, G. R., & Wilton, D. J. (2016). Enhanced Southern Ocean marine productivity due to fertilization by giant icebergs. *Nature Geoscience*, 9(3), 219-221.

[1] Schwarz, J. N., & Schodlok, M. P. (2009). Impact of drifting icebergs on surface phytoplankton biomass in the Southern Ocean: Ocean colour remote sensing and in situ iceberg tracking. *Deep Sea Research Part I: Oceanographic Research Papers*, 56(10), 1727-1741.



Desprendimiento en la barrera de hielo Larsen C

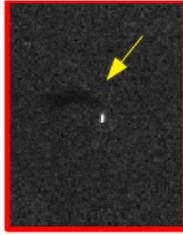
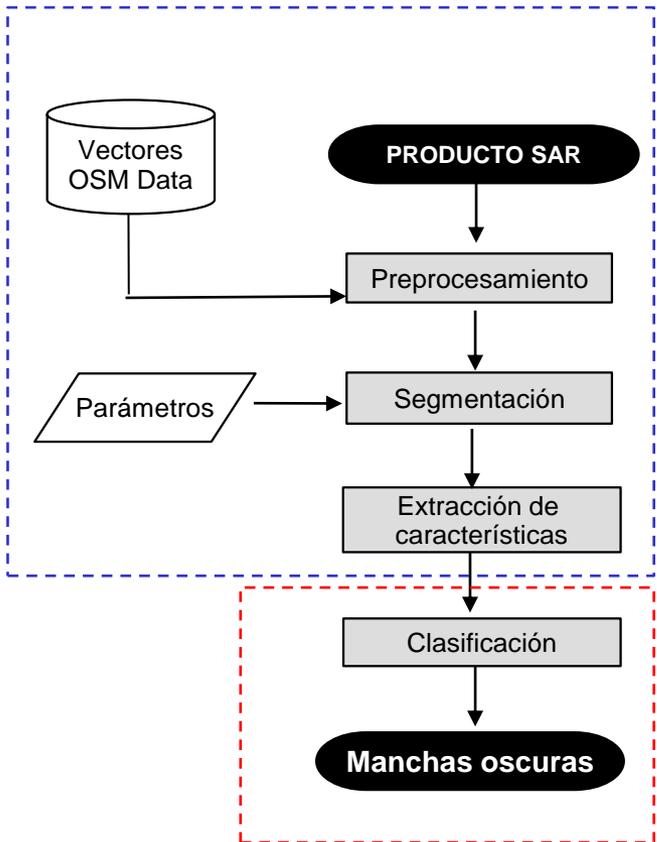


Imagen SAOCOM1A
TOPSAR WIDE
Polarización HH
Descendente
14/04/2020 17:47 UTC
Ubicación: Mar Argentino

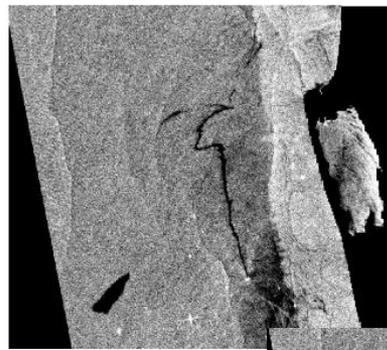
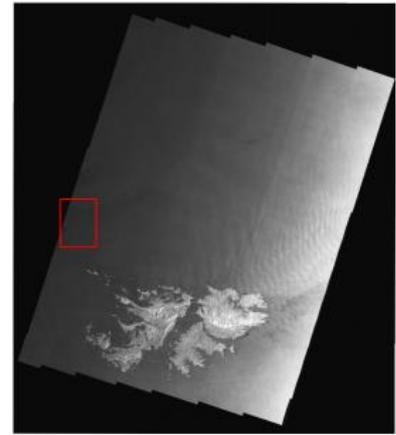
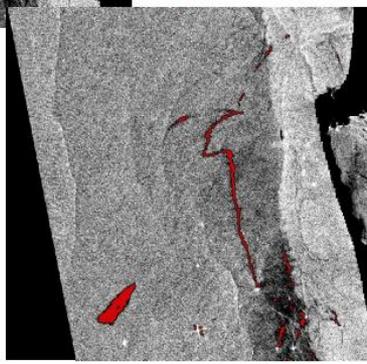
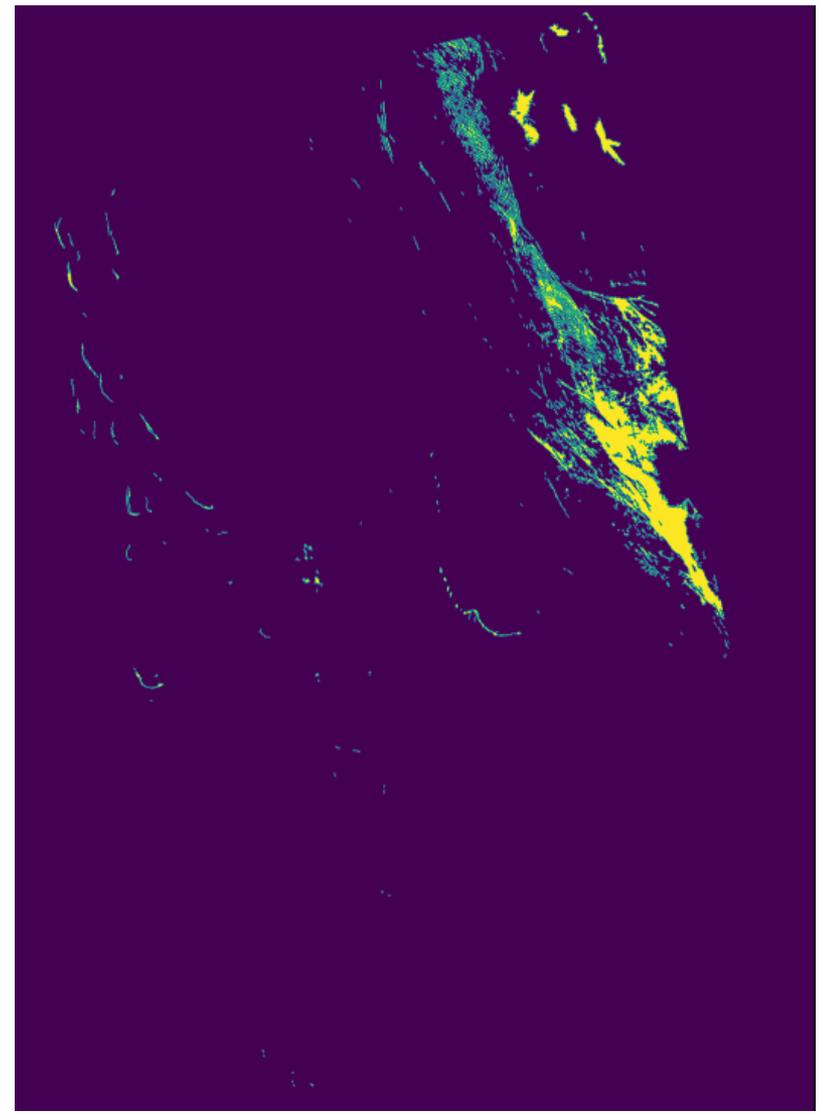
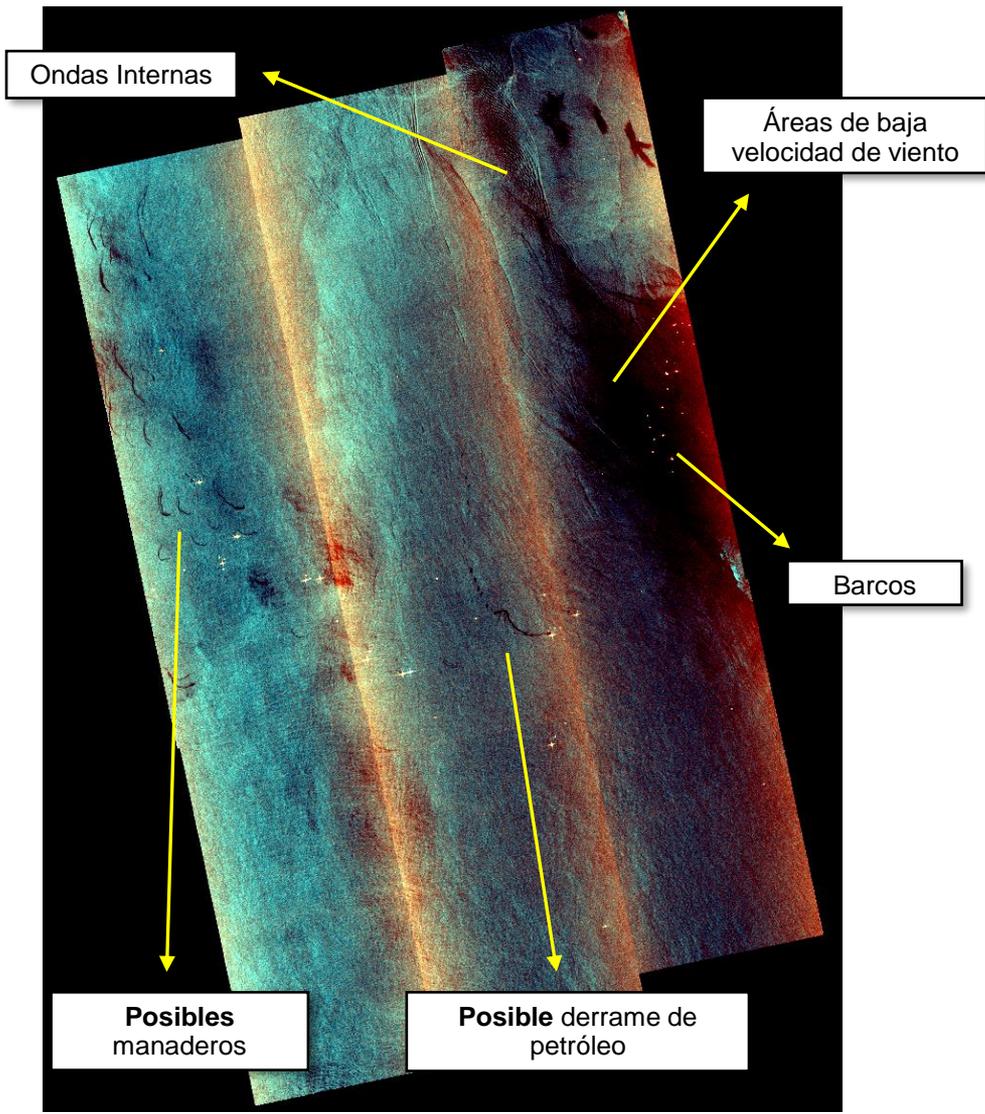
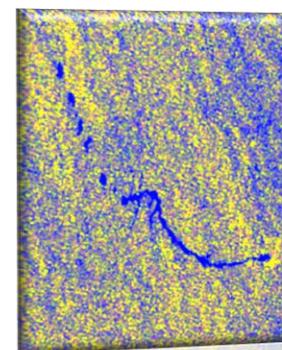
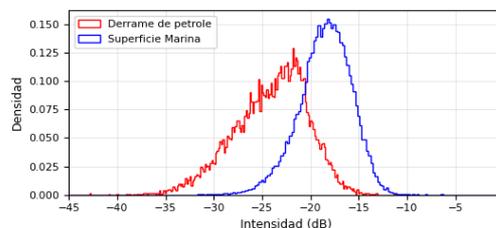
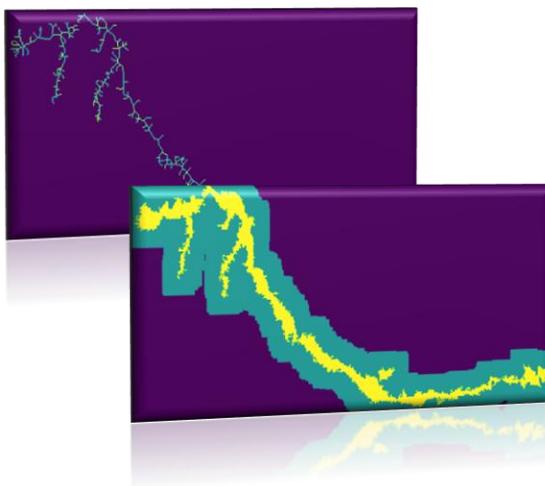
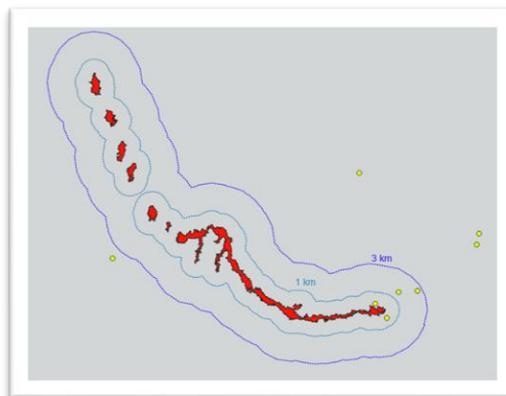


Imagen SAOCOM1A
StripMap
Polarización VV
Ascendente
06/06/2021 00:57 UTC
Ubicación: Costa Sri Lanka

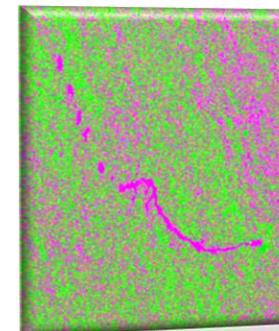




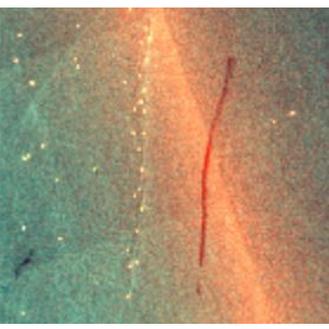
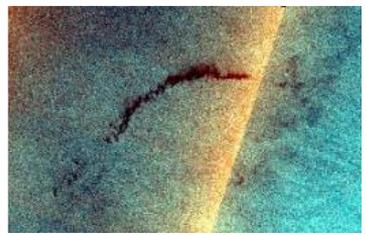
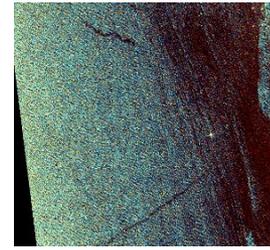
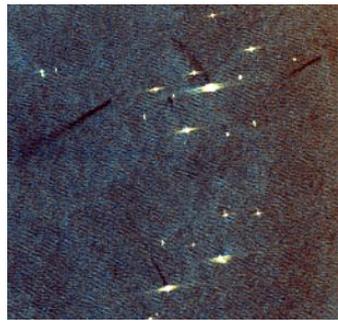
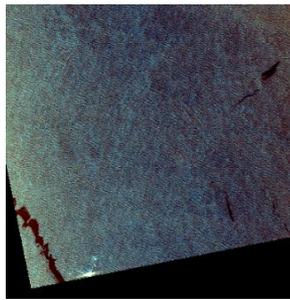
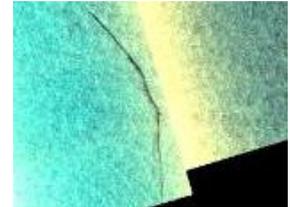
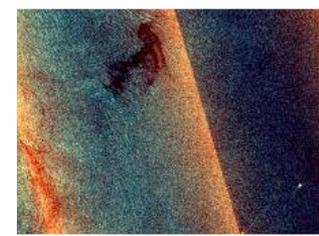
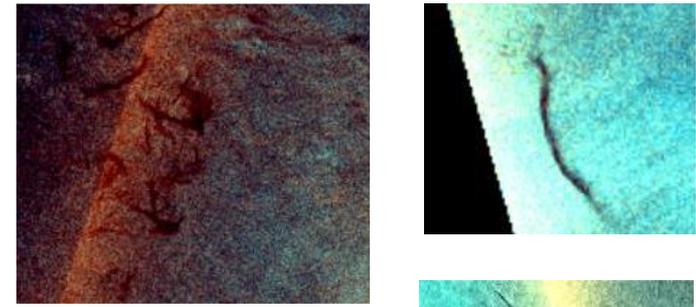
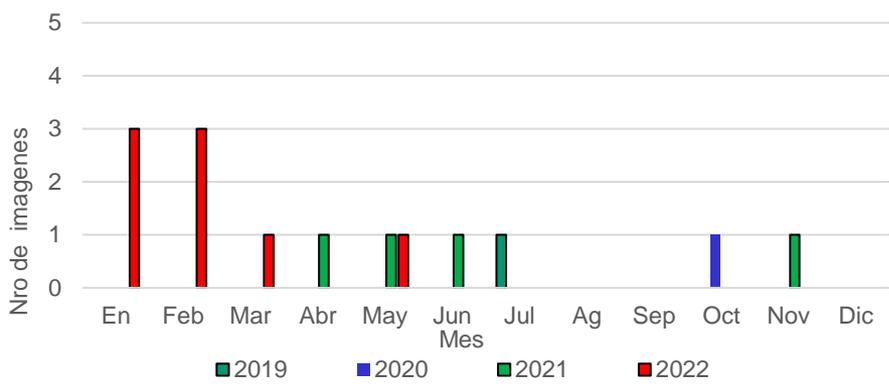
| Geométricas | Espectrales | Contextuales | Texturales |
|---------------------------------|---------------------------------|---------------------------------------|--------------|
| Área (A) | μ de la mancha | Distancia a la costa | Contraste |
| Perímetro (P) | σ de la mancha | Número de manchas vecinas | Disimilitud |
| A/P | μ del fondo | Nro. barcos vecinos | Homogeneidad |
| Complejidad (CK,CF,CS) | σ del fondo | Total manchas en la escena | ASM |
| Excentricidad (ϵ) | Combinaciones de las anteriores | Distancia a mancha oscura mas próxima | Energía |
| Eje mayor (λ_{Mayor}) | | | Entropía |
| Eje menor (λ_{Menor}) | | | Media |
| Factor de forma (F) | | | Varianza |
| A_{ds} / A_{box} | | | Correlación |
| A_{ds} / A_{SK} | | | |



Media (R) Disimilitud (G)
y Homogeneidad (B)



Homogeneidad (R)
Entropía (G) y ASM (B)



Ejemplo de manchas oscuras Atlántico Sudoccidental, Costa de África, Mar Caspio y Mar Negro



Muchas Gracias!!!

mglopez@conae.gov.ar