→ ATLANTIC FROM SPACE WORKSHOP

23–25 January 2019
National Oceanography Centre
Southampton, UK

Ocean data analysis and dynamical systems: applications and perspectives

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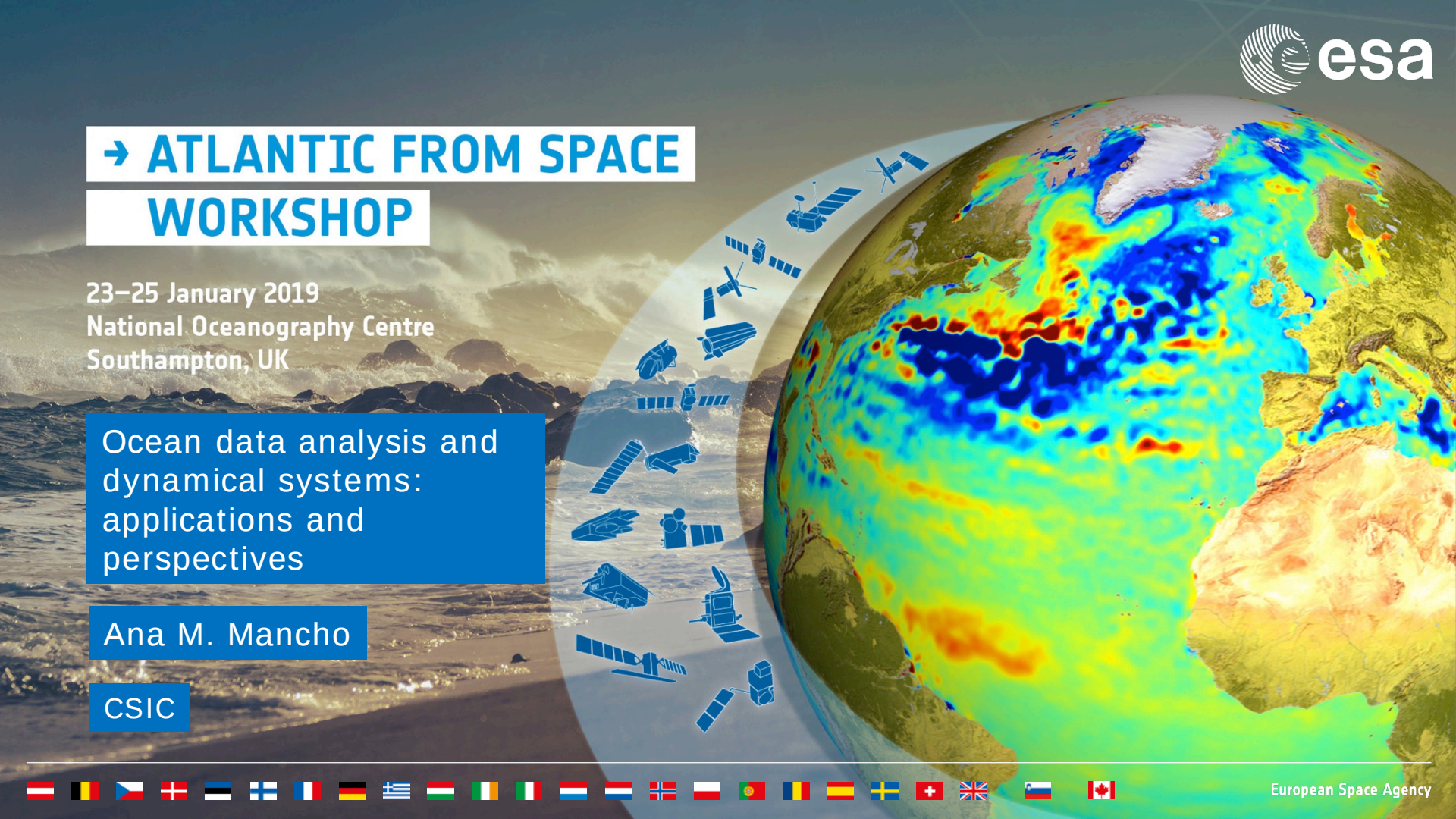
CSIC



Introduction

➢ **The Copernicus Marine Environment Monitoring Service offers through the Copernicus portal http://marine.copernicus.eu/**

- **Reliable ocean data**
- **Open access data**

➢ **The use of dynamical systems tools on accurate ocean velocity data sets, complemented with satellite images open new possibilities to address important ocean challenges.**

Accurate Ocean Data + **Dynamical System Tools**

Applications (I)

V. J. García-Garrido, A. Ramos, A. M Mancho, J. Coca, S. Wiggins. A dynamical systems perspective for a real-time response to a marine oil spill. Marine Pollution Bulletin 112, 201-210 (2016).

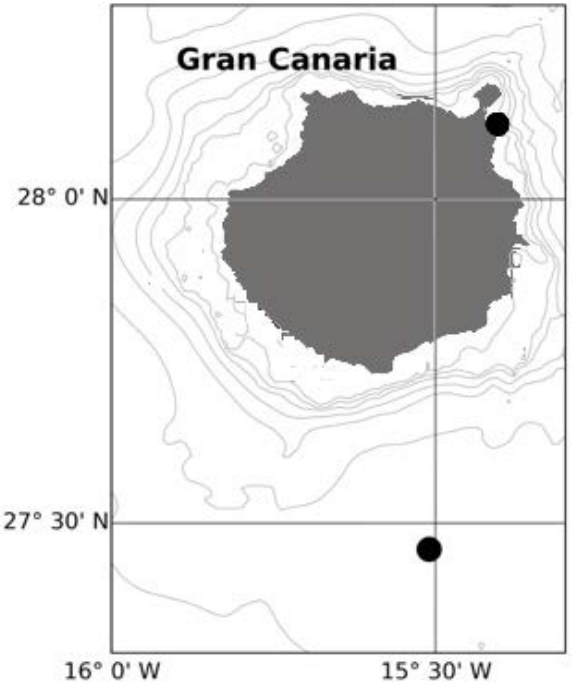
Oleg Naydenov

- **Oleg Naydenov caught fire on Saturday 11th April 2015 in Las Palmas Port**

Applications (I)

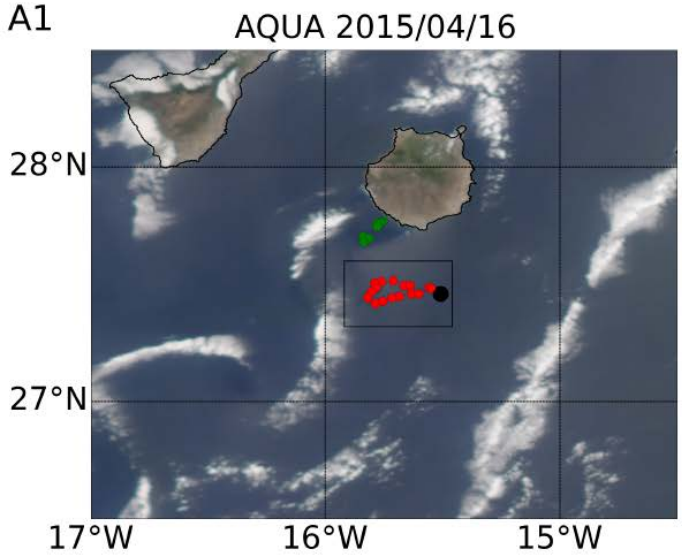
Oleg Naydenov

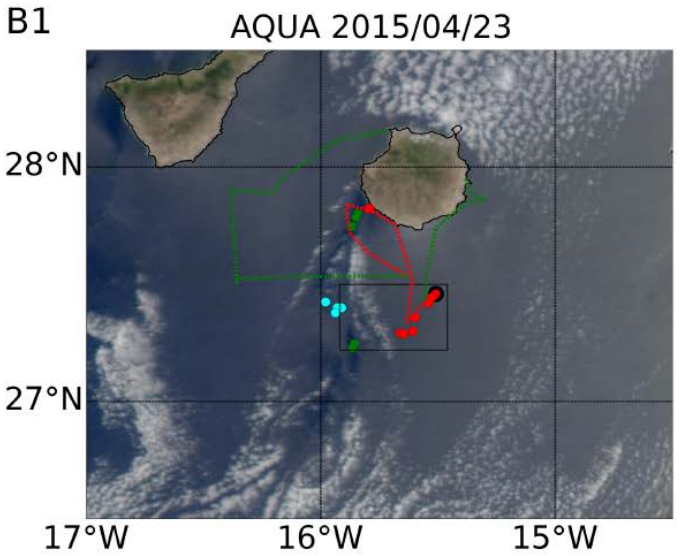
- Spanish authorities towed the ship out of the port of La Luz
- The fishing ship eventually sank on the night of the 14th April in waters 2700 m deep
- On the 16th of April, several oil slicks were spotted on the sea surface



Applications (I)

Oleg Naydenov: Remote Sensing observations

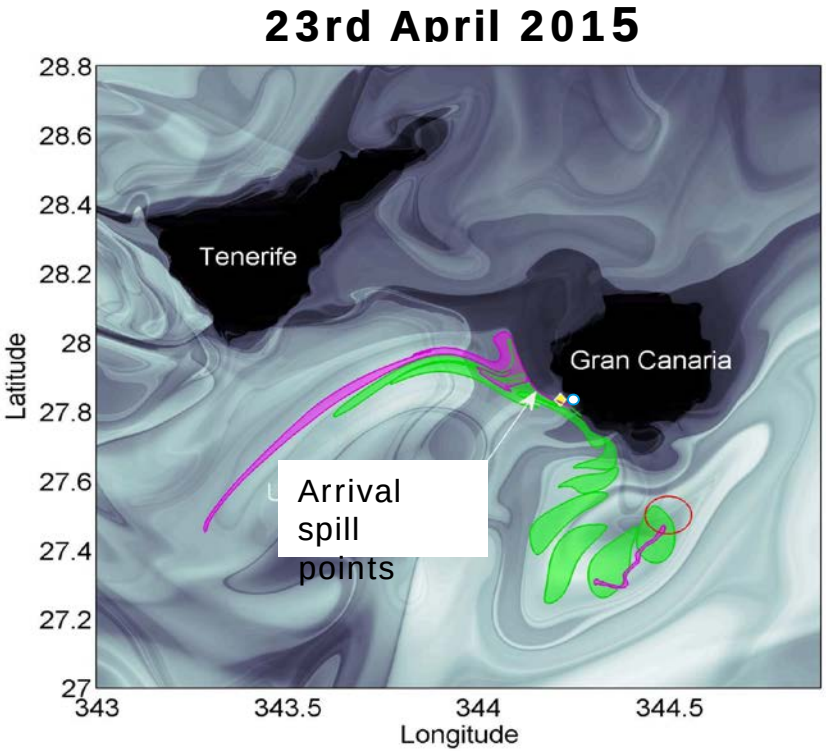




- **MODIS Aqua and Terra quasi true color images**
  - **Red points: confirmed oil spill points**
  - **Green points: clean points**
  - **Cyan points: doubts**

Applications (I)

Oleg Naydenov



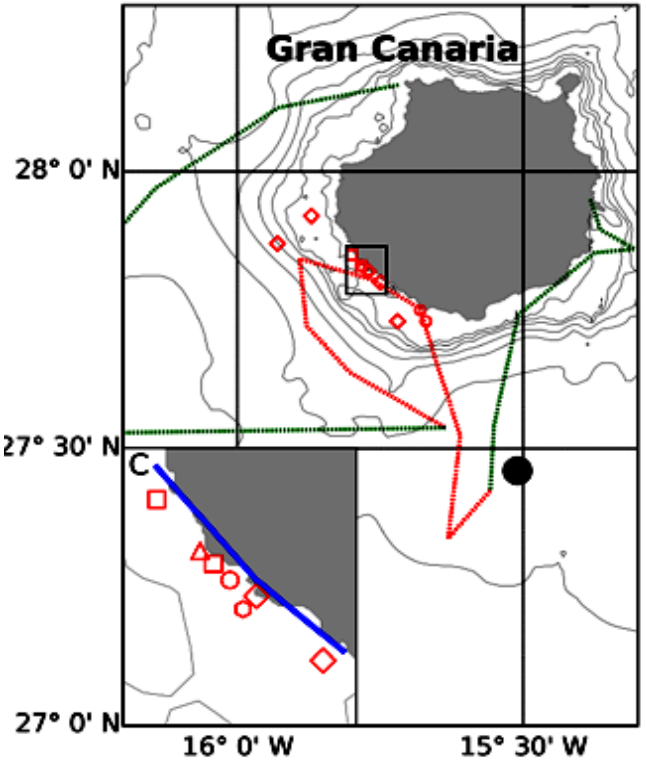
Applications (I)

Oleg Naydenov

In situ observations

- Flight paths from the 23rd April until the 10th May.
  - * Green sections correspond to regions where no oil was reported
  - * Red color accounts for sections in which oil spill was reported.

- Coast guard helicopter track from the 23rd April until the 10th May: blue line

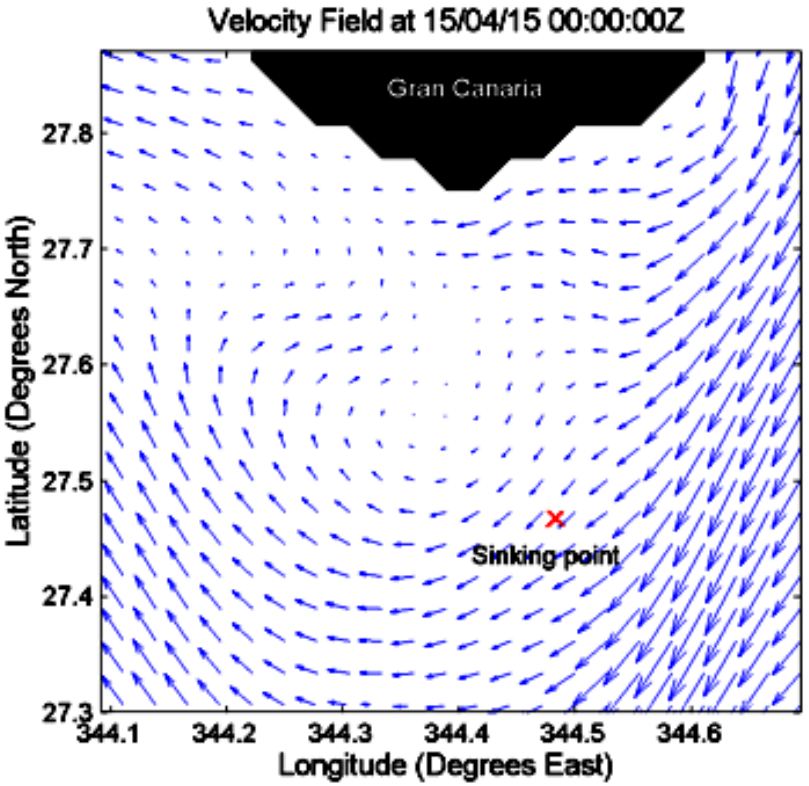


Applications (I)

Oleg Naydenov

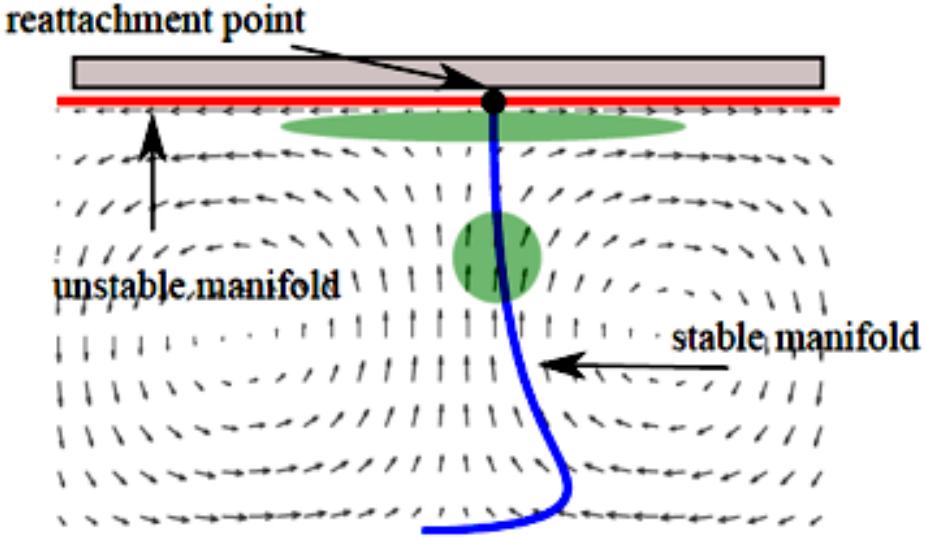
- Instantaneous velocity fields do not provide an idea of the potential danger of the sinking point

- Dynamical systems tools provide a template that helps to understand the long-time behavior of fuel blobs



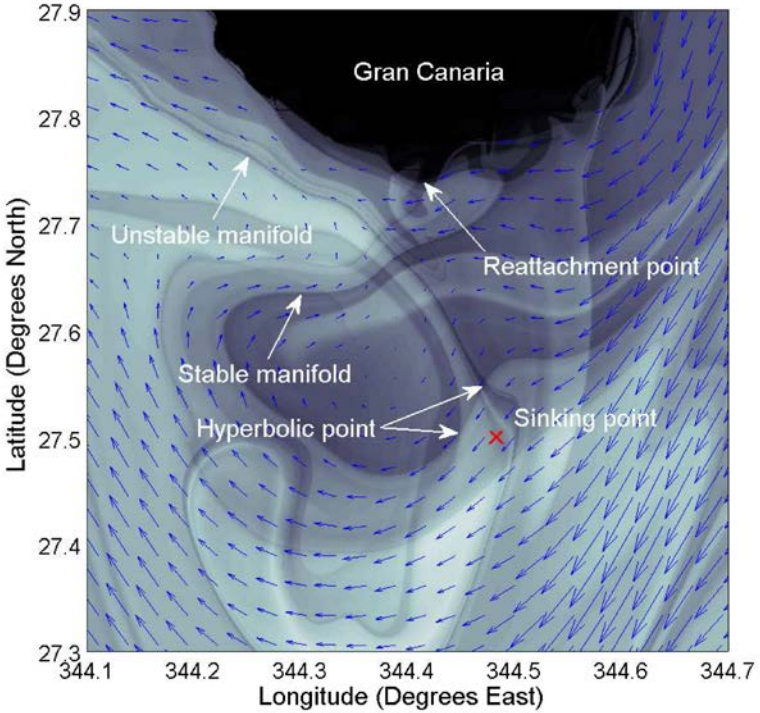
Applications (I)

Oleg Naydenov



Applications (I)

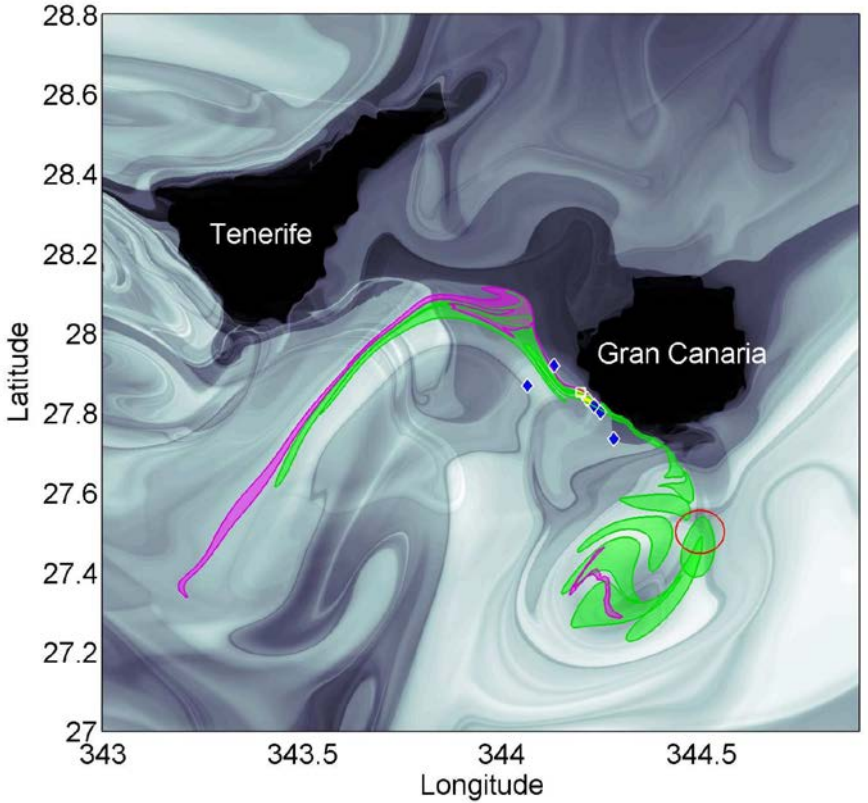
Oleg Naydenov



Applications (I)

Oleg Naydenov

25th April 2015

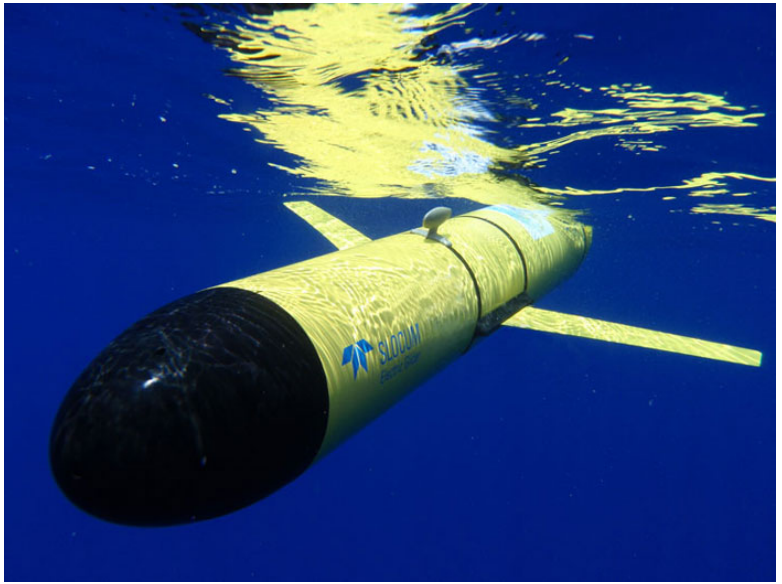


Applications (II)

A. G. Ramos, V. J. García-Garrido, A. M. Mancho, S. Wiggins, J. Coca, S. Glenn, O.Schofield, J. Kohut, D. Aragon, J. Kerfoot, T. Haskins, T. Miles, C. Haldeman, N. Strandskov, B. Allsup, C. Jones, and J. Shapiro. Lagrangian coherent structure assisted path planning for transoceanic autonomous underwater vehicle missions. Scientific Reports. 8, 4575 (2018).

Slocum Gliders are Autonomous Underwater Vehicles (AUVs)

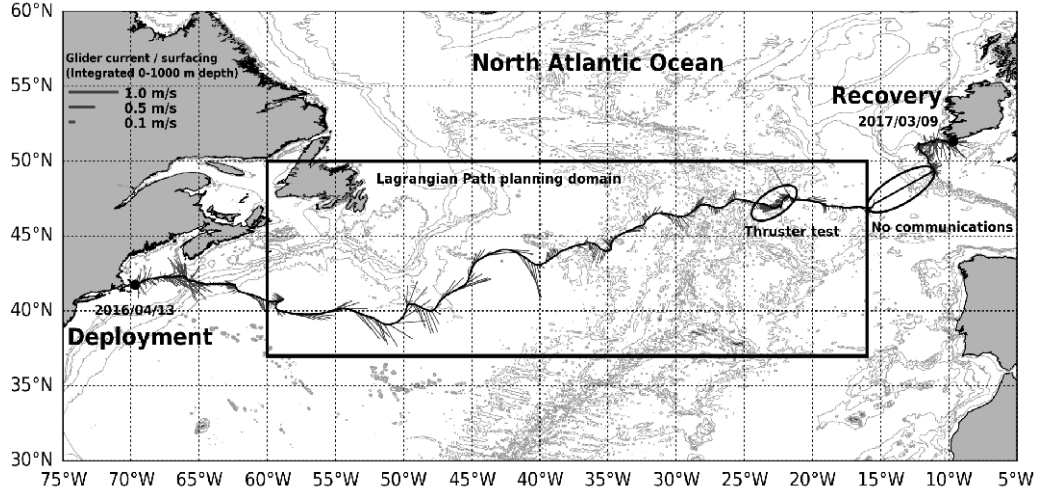
- **These vehicles use buoyancy changes for self-propulsion and consume very low energy. Have great possibilities to explore the ocean at low cost.**
- **Acquire data in otherwise non accessible areas:**
  - **Below ice in Arctic regions**
  - **Below tropical cyclones**



Applications (II)

AUVs path planning in long distance missions

- **Silbo Mission: a trans-Atlantic crossing from Massachusetts to Ireland between the 13th April 2016- March 9th 2017**



- **In Silbo Mission waypoints were placed with the support of the Lagrangian Coherent Structures ocean landscape computed from COPERNICUS Global Model.**

Conclusions & Recommendations

- **Dynamical systems tools provide remarkable insights on transport problems and offers sharp responses to important ocean challenges.**
- **These tools applied to the Oleg Naydenov oil spill case provided very valuable information such as the date and point of arrival of fuel to the coast.**
- **Making these tools more operational can offer business opportunities to deal with the management of coastal environmental problems:**
  coastal waste, oil spills in harbors, algae blooms
- **Implementing these tools in coastal areas require building downscaled models which in turn require space products products for validation, providing high resolution bathymetries, etc.**
- **Dynamical systems tools can be applied also for studying atmospheric transport processes. Some important applications in the Atlantic area:**
  Transport process across the West African Monsoon
  Understanding causes of drought periods in Sahel
  Sahara dust contamination episodes in Europe
  Humid air transport processes seeding Atlantic hurricanes

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