Brazilian oil spill 2019-2020: How did the oil arrive at the coast?

THE 2019 BRAZILIAN OIL SPILL: INSIGHTS ON THE PHYSICS BEHIND THE DRIFT

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What do we know about the oil spill?

18.6%
81.4%
The source was estimated to be located at around 10°S and 700 km away from the coast by LAMCE-COPPE.
Mercator as a reference for the ocean circulation

Good representation of the ocean circulation (currents speed and directions and meso-scale activity)

Very good representation of the circulation within the shelf

Data from SiMCosta - UFBA ADCP

$r^2 = 0.78$ / $eqm = 0.12\ m/s$ / bias = +26%
Atmospheric and Ocean Circulation

How to explain what we have observed
Large Scale Ocean and Atmospheric Circulation

Ocean Currents Seasonality

Brazil Current ~23 °S

Winds and Currents during the oil Spill

N-S Wind Component—CFSRv2

Near Surface Currents
bi-SEC Position
Possible source latitude

Monthly means
Several eddies and meanders; Not a continuous transport;
Cross-shore flows are about 10 times slower than along-shore flows.
Along-shore circulation

Meridional wind direction from CFSR

(+) SHELF FLOWS

(-)

Measured along-shore wind

JPS
REC
MAC
ARA
SSA

Speed (m/s)

0 5

Jul 2019
Aug Sep Oct Nov Dec
Cross-shore circulation

- Cross-shore currents speeds = 4 to 8 km/day
- Shelf width = 10 to 30 km
Cross-shore circulation

- First oil occurrence close to Salvador

Along-shore currents

- Northbound
- Southbound

Cross-shore currents

- Offshore
- Onshore

Along Shore wind

- Upwelling
- Relaxation
How deep was the oil?

- The arrival of oil at the Bahia North Coast coincided with upwelling situations and bottom flows towards the coast.

- The oil was transported below 15 m of depth.
Wind-driven circulation

Waves: The final push towards the coast

- Wind driven currents ceases far from the beach. Stokes drift acts in shallower regions.

Final Remarks

- Observed wind and current regimes suggest that the spill occurred within the reach of the southern branch of the SEC.

- Based on the atmospheric and ocean conditions the oil would only be advected towards the shore if it was flowing below the surface.

- We suggest that the upwelling circulation was the most liable process to advect oil onto the shelf.

- Light oil drifting on the surface would lead to small impacts on the coast.

- The timing and location of the spill lead to both northward and southward advection.

- Oil settled on the bottom might be reworked during storm events, but with little probability of large impact on the beaches.
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