**Serendipity in the strait**: The discovery of a natural oil seep in the Strait of Magellan through FerryBox surveys

#### Danilo Astorga-Gallano

Universidad Austral de Chile Institute of Marine and Limnological Sciences FONDAP-IDEAL Student

12<sup>th</sup> FerryBox Workshop – Helsinki, Finland

R. Giesecke, C. Galbán-Malagón, M. Salamanca, C. Chandia, C. Ruiz, S. Bahamondes, <u>D. Astorga-Gallano</u>









### Study Area and Background Magellan Region, southern chilean patagonia

- The largest region in the country with an area of ca 130,000 km<sup>2</sup> (the size of Greece).
- Complex coastal geomorphology due to the presence of numerous channels and fjords.
- Much of the territory is unexplored, little information about the coastal dynamics of fjords and channels, "hotspots" of biological productivity, limited information on the freshwater discharge to channels and fjords, recruitment sites for species of commercial interest, among others.
- Limited land connectivity, an important part of the transport is carried out by sea.
- High marine traffic, the second higher marine route Pacific Atlantic after Panama channel.
- Cyclops 7 sensor installed for Crude Oil Monitoring



# FerryBox system installed in late 2022 in a yaghan ferry SOOP



Sensors



Temperature (SBE 38) Thermo-salinograph (Seabird SBE45) Dissolved oxygen (Aanderaa 4835) pCO<sub>2</sub> (HydroC CO2FT) pH (SAMI Flow-Thru, AFT-pH) Chlorophyl-*a*, Turbidity, CDOM (Wetlabs Triplet) Nitrate analyzer (SUNA V2) Crude Oil (Turner Trios-Cyclops)

Water sampler (MaxxSampler TP5, 24x700ml)

Plug and Play for Imaging FlowCytobot - (Gutiérrez UdeC)

FerryBox I system (4H Jena) was financed by the National Agency of Science and Development (ANID) through the FONDEQUIP grant EQM190013 (RG), collaboration with FONDAP-IDEAL, Alfred Wegener Institut (Bernd Krock), ICBM (Oliver Zielinsky and Jochen Wollschläger), Helmholtz-Zentrum Hereon, Geesthacht (Wilhelm Petersen). For this research additional funding was provided by Anillo PIA- INACH- ACT-192057 and Fondecyt 1210946 (C. G-M).





# Serendipity! What we found?

During its initial tracks (September - October 2022), a recurrent spike in crude oil signal was detected near the mouth of the San Juan River, associated with low sea surface salinity.



# Correlation Between Oil Signals, salinity and other parameters

- Negative correlation bewteen sea Surface Salinity and crude oil signal intensity
- Salinity acts as a proxy for freshwater input from San Juan river.
- Regression analysis shows relationship between salinity and crude oil gets stronger with high river discharge (higher R)
- At checking for interference, during the entire sampling period and along the entire transect, optical interference of Chl-a, turbidity, and CDOM on crude oil measurements was not detected.



Sea surface salinity measured at the Strait of Magellan (gray dots) and San Juan River discharge (black line), during the sampling period.

Pärt et, al. 2021



### Crude Oil analysis

- Surface water samples were taken from near San Juan river Mouth, at two potential sources of crude oil (Rio San Juan and Mansa Bay) as well as a sample near the ferry route (Magellan Strait)
- Two liter water simples were collected using acid cleaned glass bottles, and stored in cold dark conditions.
- Filtered with GFF filters to remove bacteria
- Sample preparation acording EPA method 3510
- GC/MS with a RTX-5 capillary columna.
- The CPI (carbon preference index) was estimated followin Bray and Evans (1961)

 $Ratio \frac{odd}{even} = \frac{1}{2} \left( \frac{C_{25} + C_{27} + C_{29} + C_{31} + C_{33}}{C_{24} + C_{26} + C_{28} + C_{30} + C_{32}} + \frac{C_{25} + C_{27} + C_{29} + C_{31} + C_{33}}{C_{26} + C_{28} + C_{30} + C_{32} + C_{34}} \right)$ 



Sample	Crude oil [ug L-1]	CPI
Mansa bay	1.018	1.188
San Juan River	0.288	2.643
Magellan Strait	0.173	2.330

## Summary

- First Recorded Oil Seep Transport: The study documents the first instance of a natural crude oil seep plume transported by river discharge into the Strait of Magellan, detected using the FerryBox system from September to December 2022.
- Correlation with River Discharge: A strong negative correlation was found between sea surface salinity and crude oil signals, with significant oil plumes observed during periods of high river discharge (above 15 m<sup>2</sup>/s).
- Natural Origin of Hydrocarbons: Hydrocarbon analysis confirmed that the crude oil detected in the San Juan River and Strait of Magellan was of natural, biogenic origin, ruling out anthropogenic contamination.
- Environmental Influence on Plume Dispersal: Wind direction and river flow played a crucial role in the dispersal of the oil plume, with westward winds pushing the plume offshore.
- Long-term Ecological Impact: The discovery highlights the potential chronic exposure of marine ecosystems in the region to crude oil, with implications for local marine life, particularly during sensitive reproductive periods.