

**Data Science:  
a transformative force  
in the understanding, use, and  
management of the ocean**

**Stan Matwin, CRC**

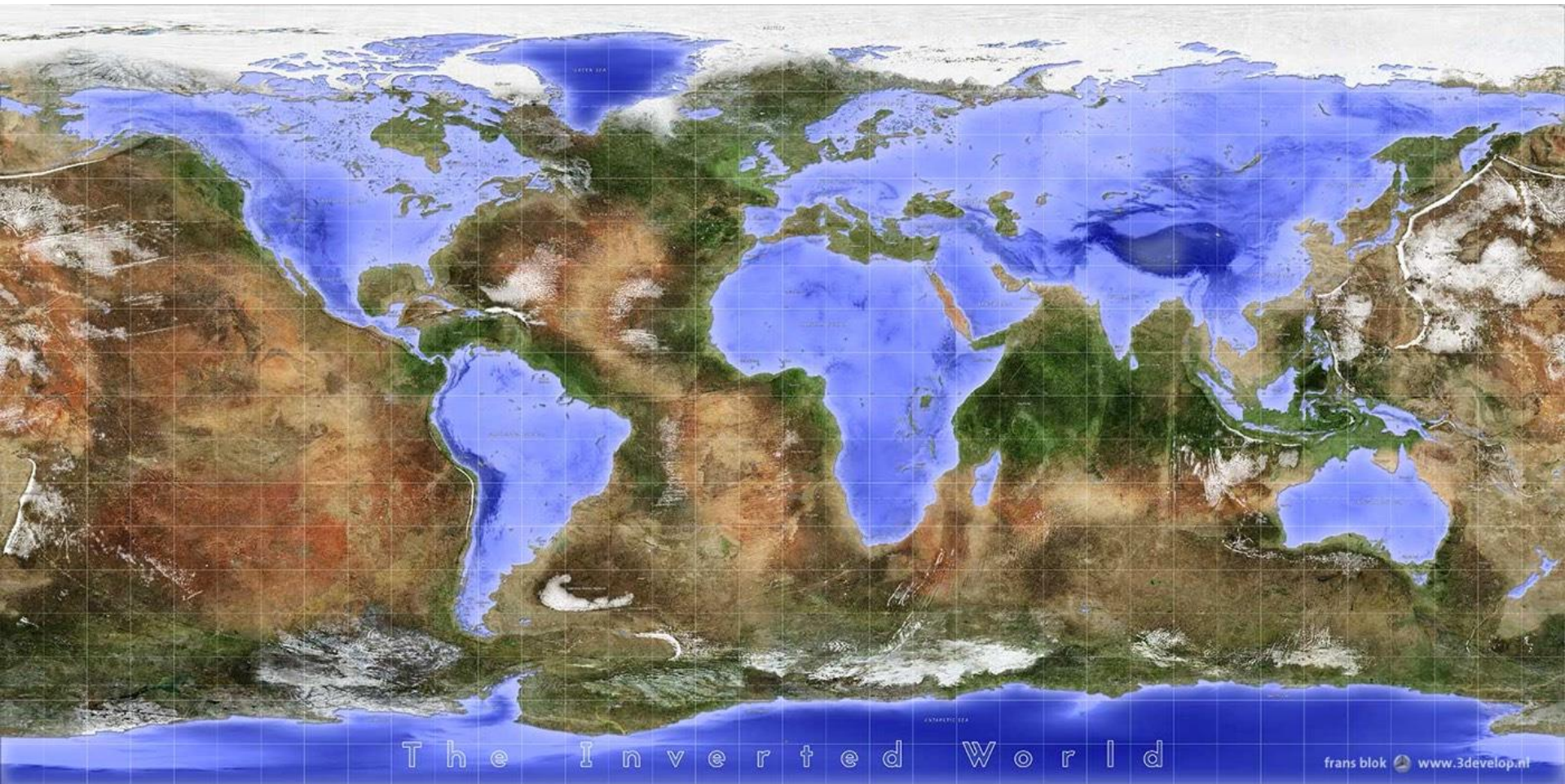
Institute for Big Data Analytics

Dalhousie University

Halifax, NS, CANADA



# The inverted world



# Ocean Big Data

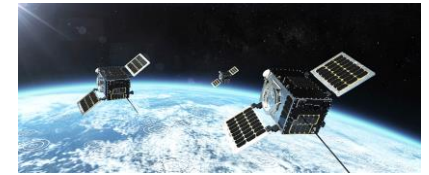


**PAM & Acoustic Telemetry**



## Monitoring from space

Radar imaging, RF detection, ...



AIS vessel tracking



Satellite imagery



**Machine Learning & Big Data Analytics**



**Ketos:** An open-source deep learning package that helps you develop your own underwater sound detection & classification models!

**Example applications:**

- Vessel whale collision avoidance
  - Underwater noise monitoring
  - Detection of illegal fishing activity
- [1]

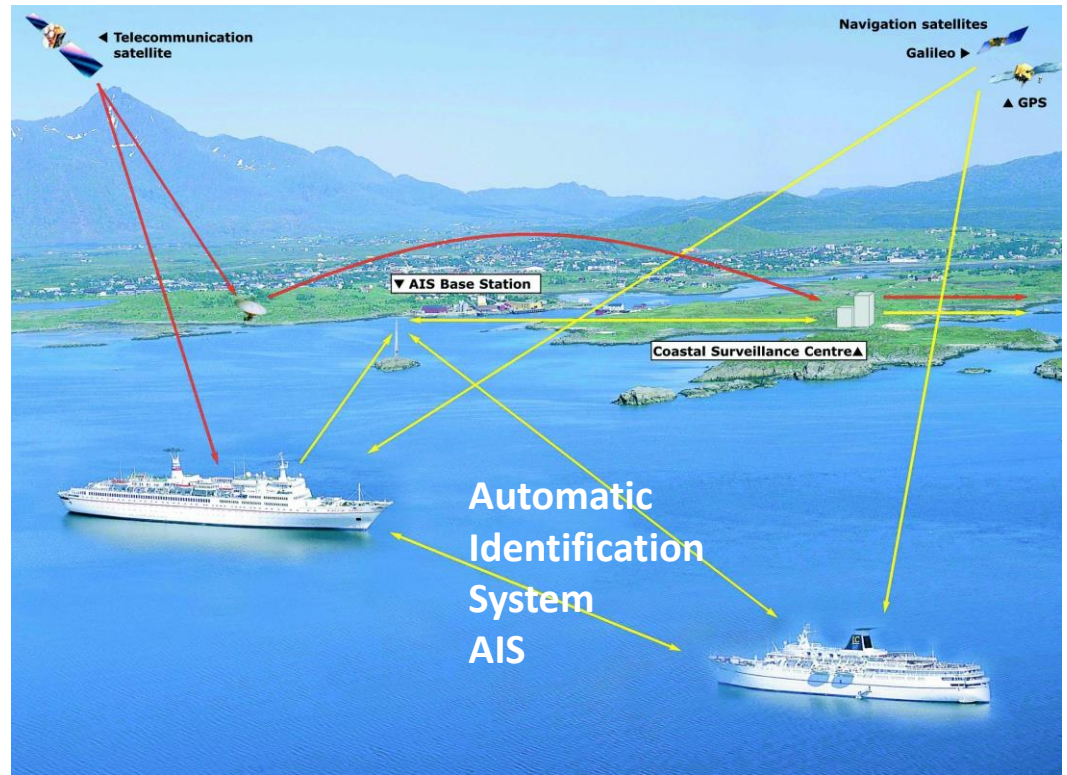
# Revolution of sensors in and above the water

- **BIG** data:
  - JASCO collects 100TB of data/year
  - An observatory generates 1TB/day



# Ship movement monitoring

Towards real-time, globe-wide data on ship movements



- Illegal, Unreported and Unregulated fishing (IUU)
- West Africa Task Force

# What's next in ship tracking?

- Radar SAR data



- RF data !



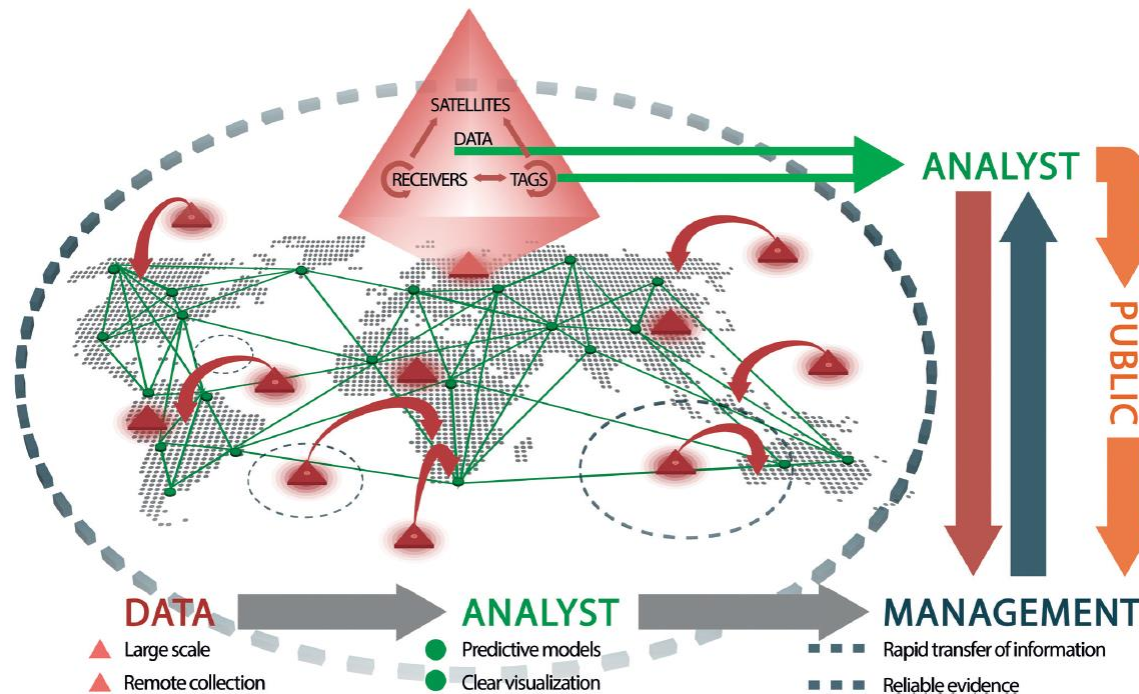
# Nanosatellites

- 10x10x10 cm, 1-10kg
- Commercial Off-The-Shelf components
- Close to Earth (500km), 15-16 polar orbits/day
- Sends
  - infrared
  - optical low-res images
- CubeSat standard
- Low cost earth stations
- Distributed system/data fusion philosophy



# Sensors – biotelemetry [2]

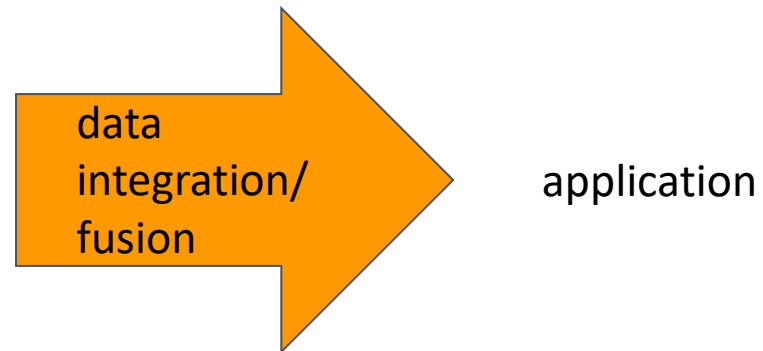
- monitoring the position, activity, and **physiology** of animals and the **environment**
- environmental variables can be collected using animals as
- auton



from [2]

# So:

- Sensors in the water
- Sensors in the air
- Non-sensor data

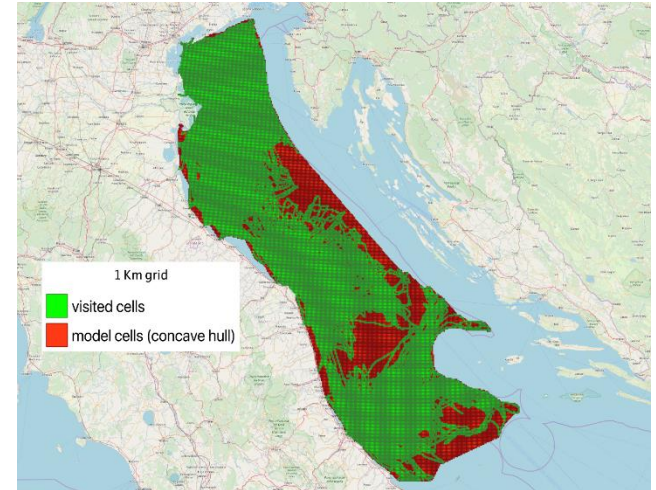


# Data integration

- Complete ship movement data (AIS ground-stations) - Italian *Guardia costiera*



- Chioggia landing reports
- Surface Sea Temperature
- Chlorophyll
- Wave height



- Goal: prediction of catch next year [4]

# Inspirational data management/data analytics challenges

- Deep learning –
  - data challenges
  - multimodal learning
- Squeezing models to go on deployed devices – edge computing
- Animal privacy?

# CRISPR

- **C**lustered **R**egularly **I**nterspaced **S**hort **P**alindromic **R**epeats
- Genetic technique of intentionally changing a genome.
- 2020 Nobel Prize to [Emmanuelle Charpentier](#) and [Jennifer Doudna](#)
- Allows fabricating modified or synthetic organisms:
- Aquaculture?
- A solution for food for 10B world?
- Consider potential pitfalls



...and growth

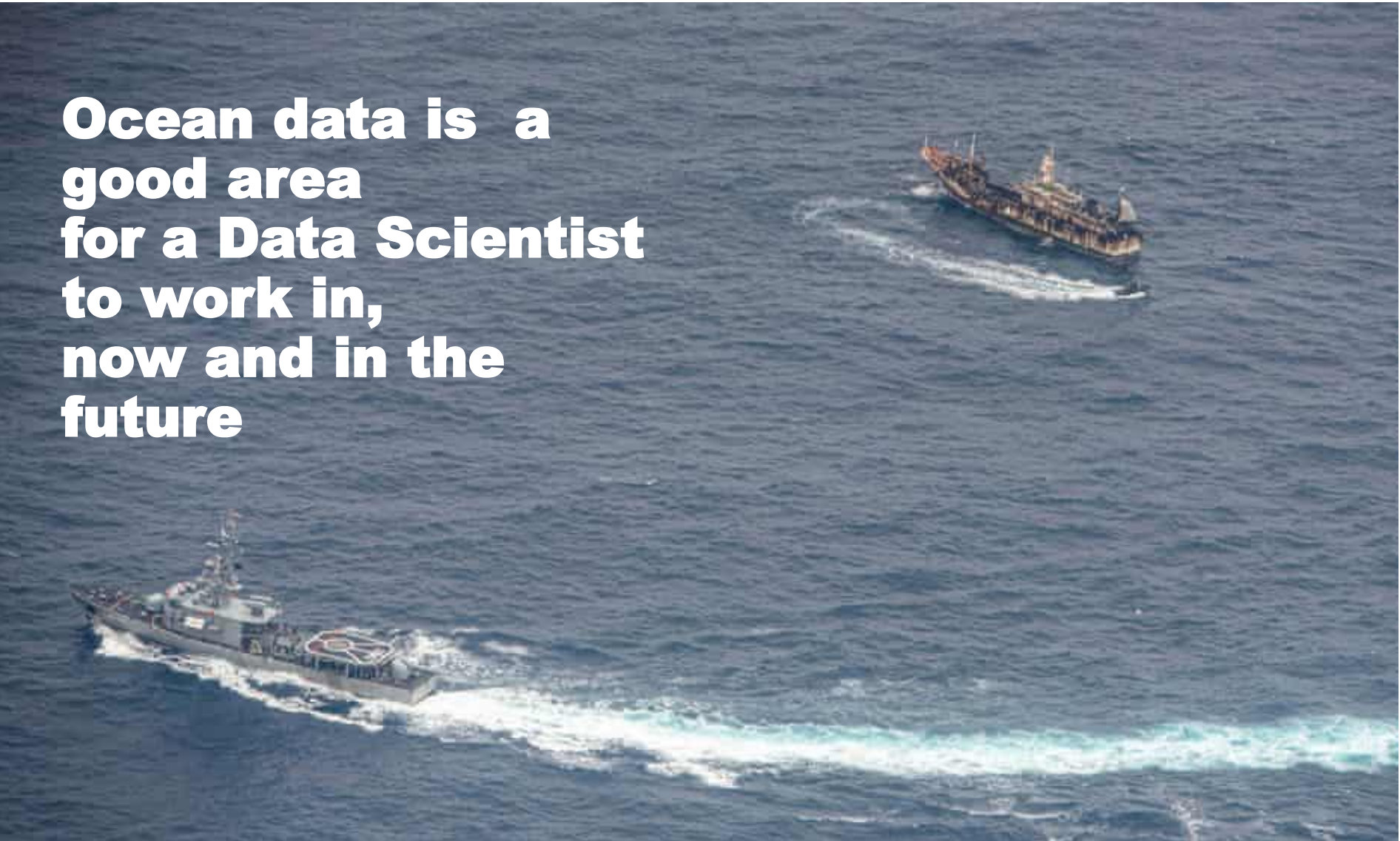


AI Meets Oceans  
MAIPL  
MERIDIAN 2.0

# Team!



**Ocean data is a  
good area  
for a Data Scientist  
to work in,  
now and in the  
future**



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[1] Kirsebom et al. "Performance of a deep neural network at detecting North Atlantic right whale upcalls", The J. Acoust. Soc. Am 2020

[2] Lennox et al., Envisioning the Future of Aquatic Animal Tracking: Technology, Science, and Application, BioScience 2017

[3] Lennox et al. A Novel Framework to Protect Animal Data in a World of Ecosurveillance, BioScience 2020

[4] Rovinelli, Matwin, Pranovi, Russo, Silvestri, Simeoni, Raffaetà: Multiple aspect trajectories: a case study on fishing vessels in the Northern Adriatic sea. EDBT/ICDT Workshops 2021

[5] Le Journal du Quebec  
[https://www.dropbox.com/s/oc7k0wado6lphse/J\\_du\\_Que\\_090421\\_E.pdf?dl=0](https://www.dropbox.com/s/oc7k0wado6lphse/J_du_Que_090421_E.pdf?dl=0)



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