Where in the World is Ocean Carbon Data?

Mike Smit[1], Matthew Garvin[1], Guillaume Durand[1], and Anya Waite[1]

[1]Affiliation not available

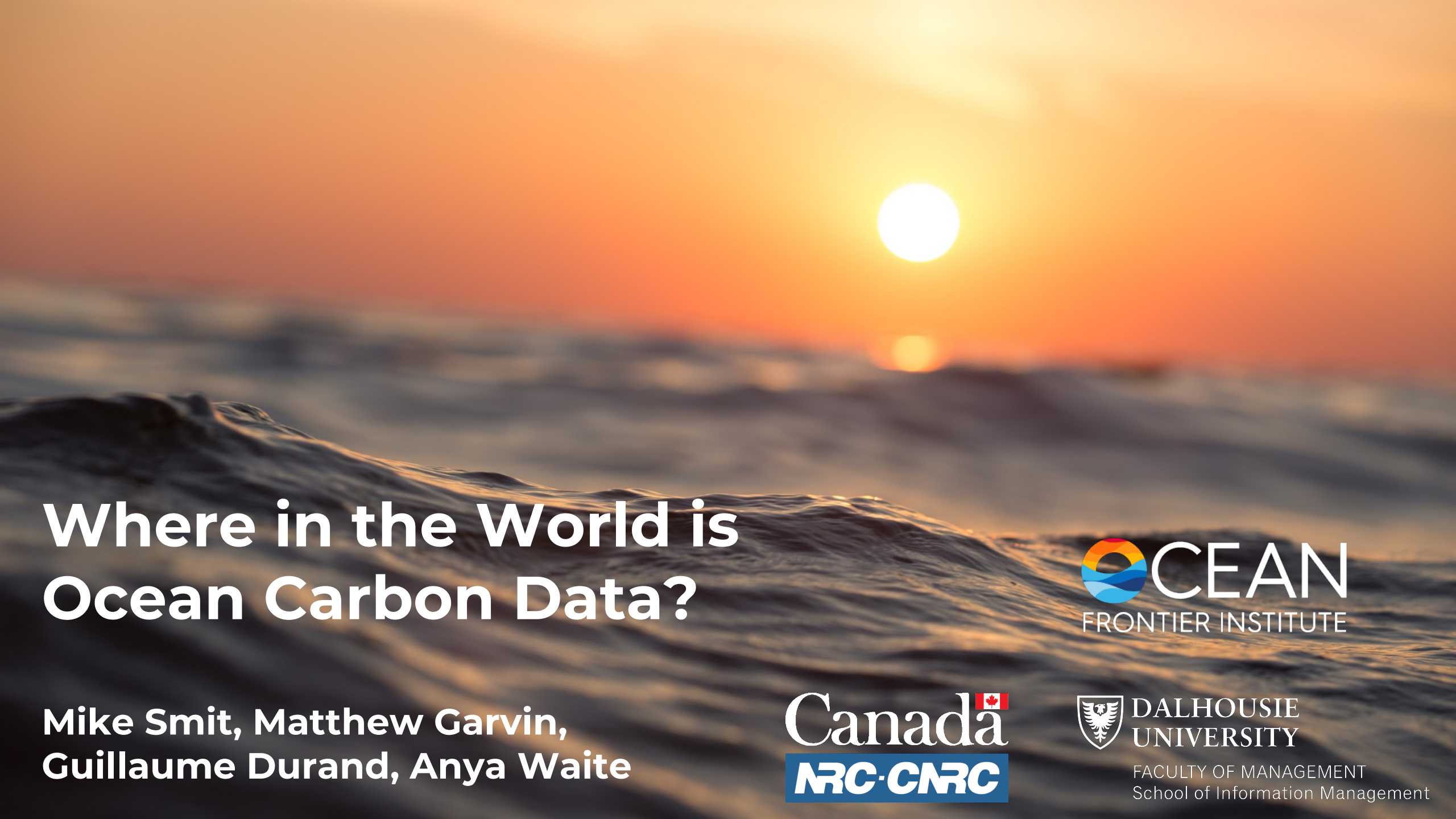
April 16, 2023

Abstract

Efforts to validate, monitor, and verify ocean-based carbon dioxide removal (CDR) will require a rich understanding of the ocean carbon system. Ocean observations anchor this understanding, but we know that some ongoing observations are precariously funded, that data products like SOCAT rely on volunteer effort, that regions essential to our understanding of the ocean carbon system are under-observed, and that some observation data is under-used. This presentation will be a progress report on our efforts to identify and document ocean carbon data flows using systematic literature reviews and examination of ocean data repositories. These data flows are essential to identify what data the scientific community already relies on; what data and observation gaps exist; and what data might be under-used. We examined variables of interest based on GOOS EOVs, including Oxygen (and supporting variables), Stable Carbon Isotopes (and supporting variables), Ocean Surface Stress (and supporting variables), and Ocean Surface Heat Flux (and supporting variables). Commonly observed supporting variables include O2, alkalinity, pCO2, pH, temperature, and near-surface air temperature, humidity, pressure, and wind speed.

Plain-language Summary

Efforts to validate, monitor, and verify ocean-based carbon dioxide removal (CDR) will require a rich understanding of the ocean carbon system. Ocean observations anchor this understanding, but we know that some ongoing observations are precariously funded, that data products like SOCAT rely on volunteer effort, that regions essential to our understanding of the ocean carbon system are under-observed, and that some observation data is under-used. We tried to identify what ocean observation data already exists, and how it is being used internationally. This will help us identify where we need more data in order to build a complete picture of the ocean carbon system.



Where in the World is Ocean Carbon Data?

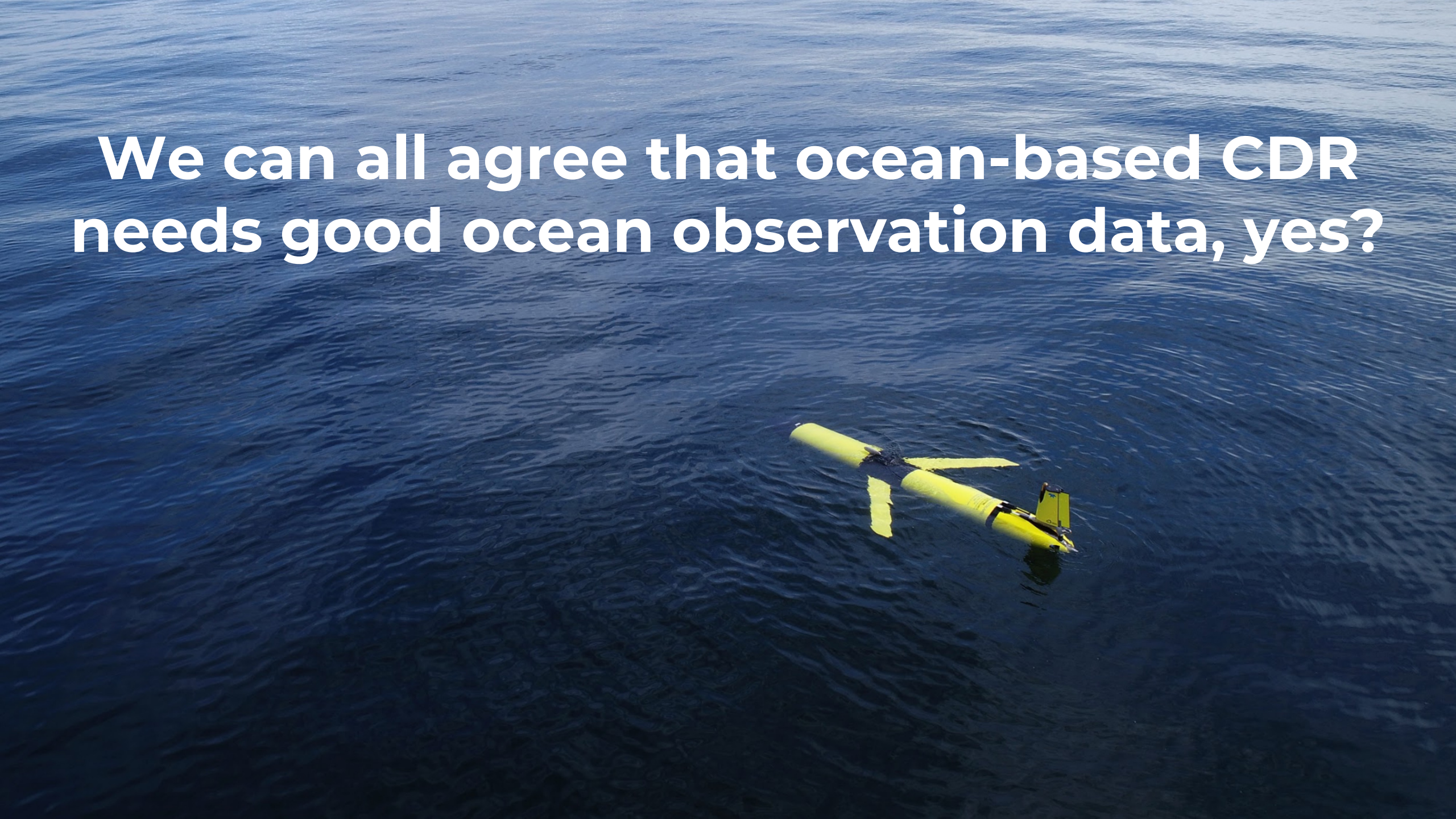
Mike Smit, Matthew Garvin, Guillaume Durand, Anya Waite

OCEAN FRONTIER INSTITUTE

Canada NRC·CNRC

DALHOUSIE UNIVERSITY
FACULTY OF MANAGEMENT
School of Information Management

We can all agree that ocean-based CDR needs good ocean observation data, yes?



What data does the scientific community rely on?

- Step 1: What publications use observation data relevant to the carbon cycle from the North Atlantic Ocean (past 10 years)?

Advanced search

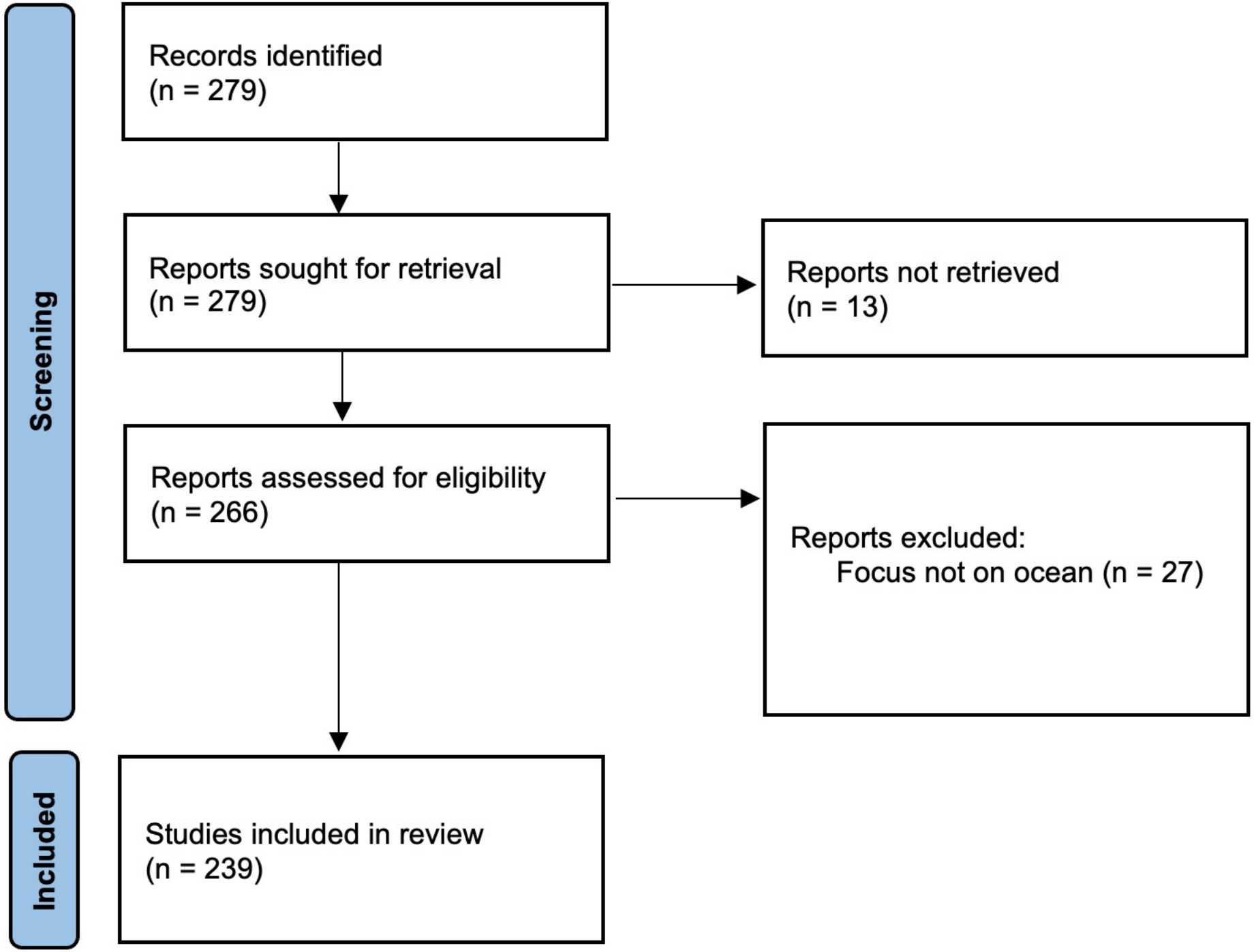
Basic Search | Advanced

Search tips

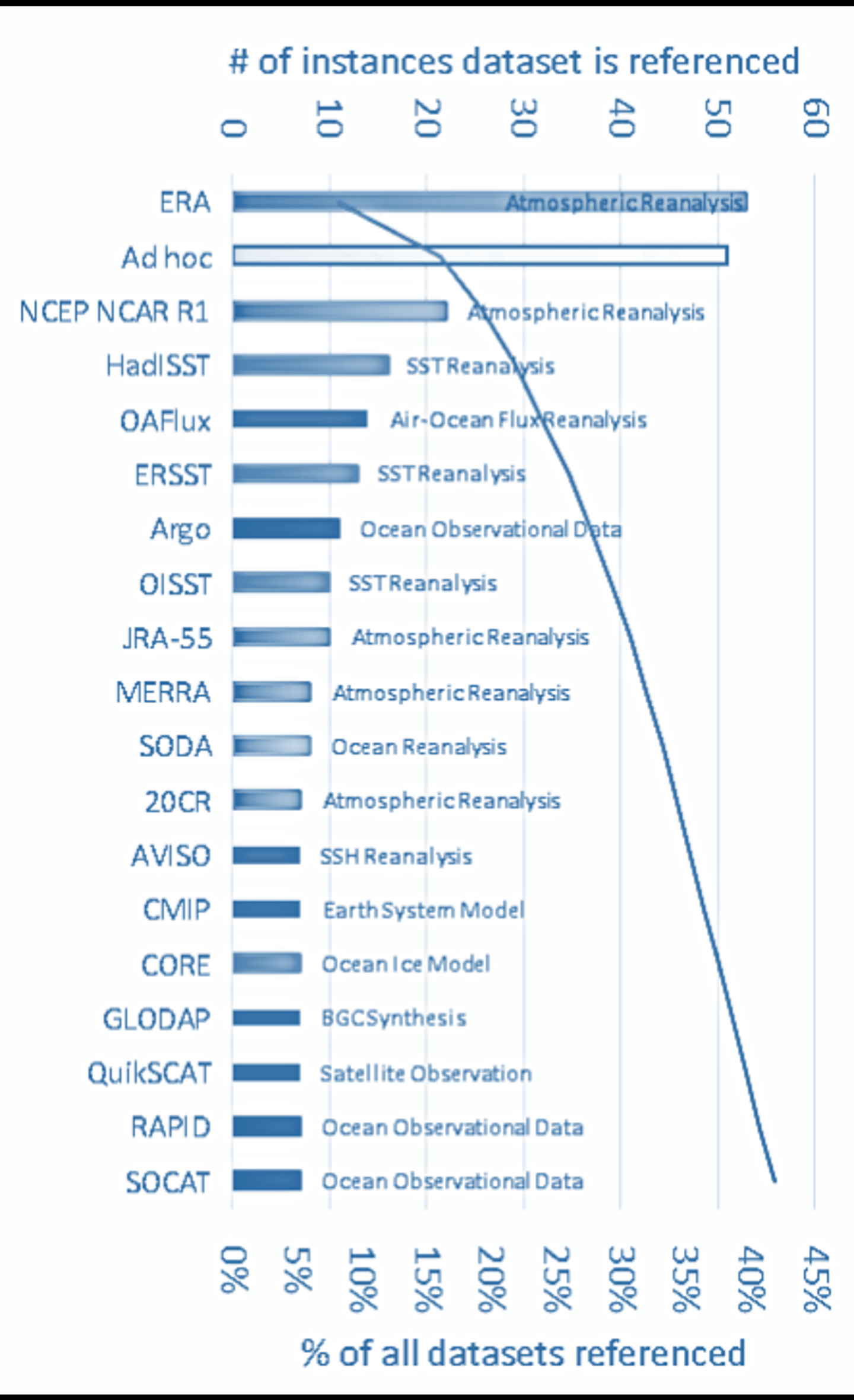
Enter query string

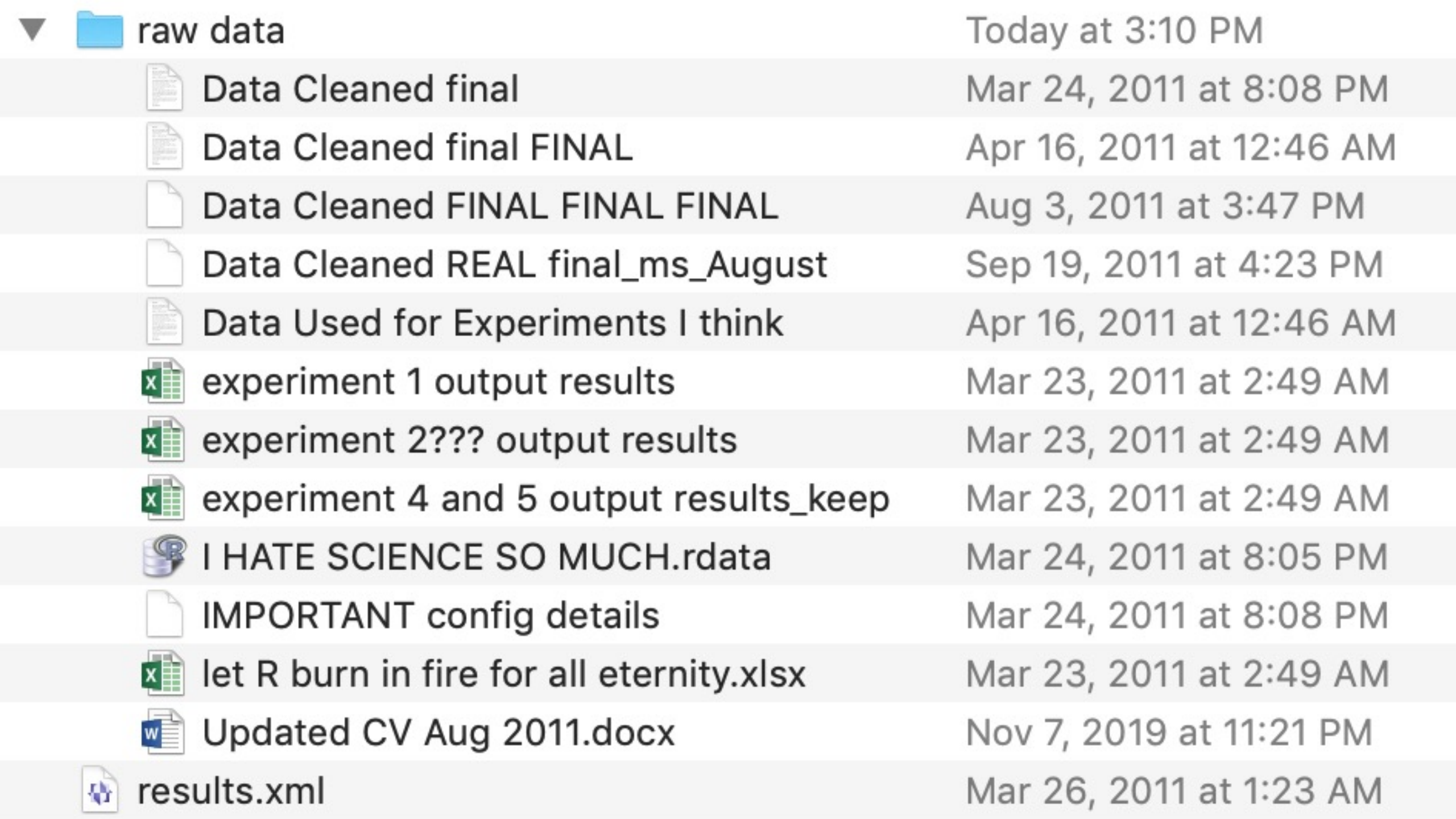
```
( ( ( KEY ( "Atlantic Ocean (North)" OR "North Atlantic" OR "North Atlantic Ocean" OR "Labrador Sea" ) ) AND ( TITLE-ABS-KEY ( ( carbon PRE/0 dioxide ) OR ( atmospheric PRE/0 co2 ) OR ( anthropogenic PRE/0 co2 ) OR ( dissolved PRE/0 ( oxygen OR "O2" ) ) OR ( stable PRE/0 carbon PRE/0 isotope ) OR ( inorganic PRE/0 carbon ) OR ( isotope W/2 "13C" ) OR ( "carbon-13" PRE/0 isotope ) OR ( dissolved PRE/0 inorganic PRE/0 carbon ) OR ( partial PRE/0 pressure PRE/1 "CO2" ) OR ( "pCO2" ) OR ( carbon PRE/0 dioxide PRE/0 partial PRE/0 pressure ) OR "fCO2" OR ( fugacity PRE/1 carbon PRE/0 dioxide ) OR ( surface PRE/2 stress ) OR ( wind PRE/1 stress ) OR ( vector PRE/0 stress ) OR ( heat PRE/0 flux ) OR ( ( carbon OR "CO2" ) PRE/0 ( flux* OR sink* OR flow* OR system OR cycle ) ) OR ( dissolved PRE/0 carbon ) OR ( carbonate OR bicarbonate ) ) AND ( ( atmospheric PRE/0 pressure ) OR ( air PRE/0 pressure ) OR ( barometric PRE/0 pressure ) OR ( sea PRE/0 level PRE/0 pressure ) OR ( atmospheric PRE/0 humidity ) OR ( wind PRE/0 velocity ) OR ( wind PRE/0 speed ) OR ( vector PRE/0 wind ) OR ( surface PRE/0 ocean PRE/0 "CO2" PRE/0 atlas ) OR "SOCAT" OR ( air PRE/0 temperature ) OR ( sea PRE/0 surface PRE/0 temperature ) ) OR acidification OR acidity OR "pH" OR alkalinity OR "Hydrogen-Ion Concentration" ) OR ( ocean PRE/0 albedo ) OR ( sea PRE/0 water PRE/0 temperature ) ) AND ( dataset OR ( data PRE/0 set ) ) ) AND ( LIMIT-TO ( PUBYEAR , 2022 ) OR LIMIT-TO ( PUBYEAR , 2021 ) OR LIMIT-TO ( PUBYEAR , 2020 ) OR LIMIT-TO ( PUBYEAR , 2019 ) OR LIMIT-TO ( PUBYEAR , 2018 ) OR LIMIT-TO ( PUBYEAR , 2017 ) OR LIMIT-TO ( PUBYEAR , 2016 ) OR LIMIT-TO ( PUBYEAR , 2015 ) OR LIMIT-TO ( PUBYEAR , 2014 ) OR LIMIT-TO ( PUBYEAR , 2013 ) OR LIMIT-TO ( PUBYEAR , 2012 ) ) AND ( EXCLUDE ( EXACTKEYWORD , "Paleoclimate" ) OR EXCLUDE ( EXACTKEYWORD , "Paleoceanography" ) OR EXCLUDE ( EXACTKEYWORD , "Paleoenvironment" ) OR EXCLUDE ( EXACTKEYWORD , "Paleotemperature" ) OR EXCLUDE ( EXACTKEYWORD , "Late Pliocene" ) OR EXCLUDE ( EXACTKEYWORD , "Mid-pleistocene Transition (MPT)" ) OR EXCLUDE ( EXACTKEYWORD , "Pliocene" ) OR EXCLUDE ( EXACTKEYWORD , "Miocene" ) )
```

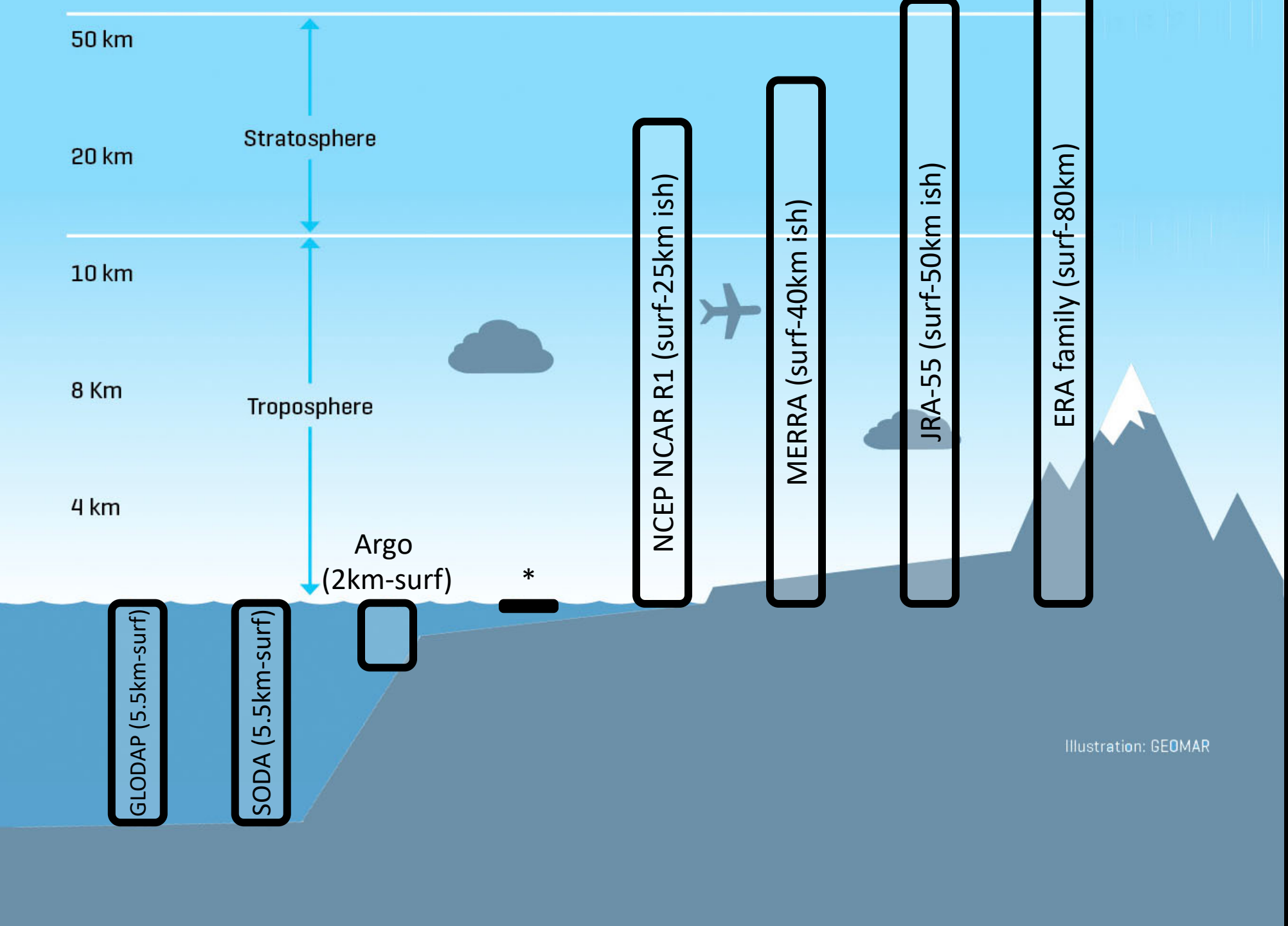
Outline query | Add Author name / Affiliation | Clear form | Search


Screening
Records identified
(n = 279)
Reports sought for retrieval
(n = 279)
Reports not retrieved
(n = 13)
Reports assessed for eligibility
(n = 266)
Reports excluded:
Focus not on ocean (n = 27)
Included
Studies included in review
(n = 239)

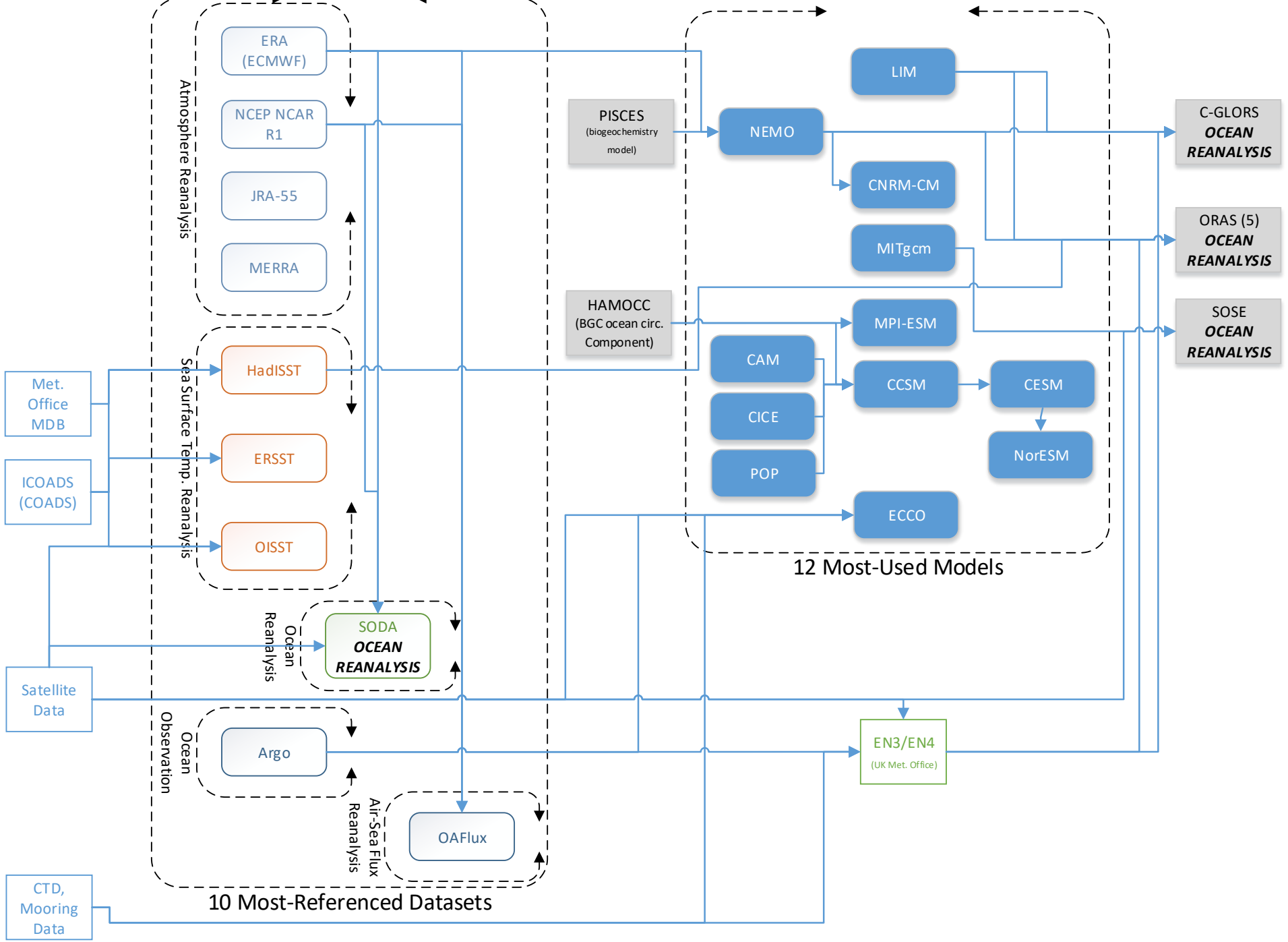
- 281 unique identifiable datasets.
  - Not counting data used only for that paper

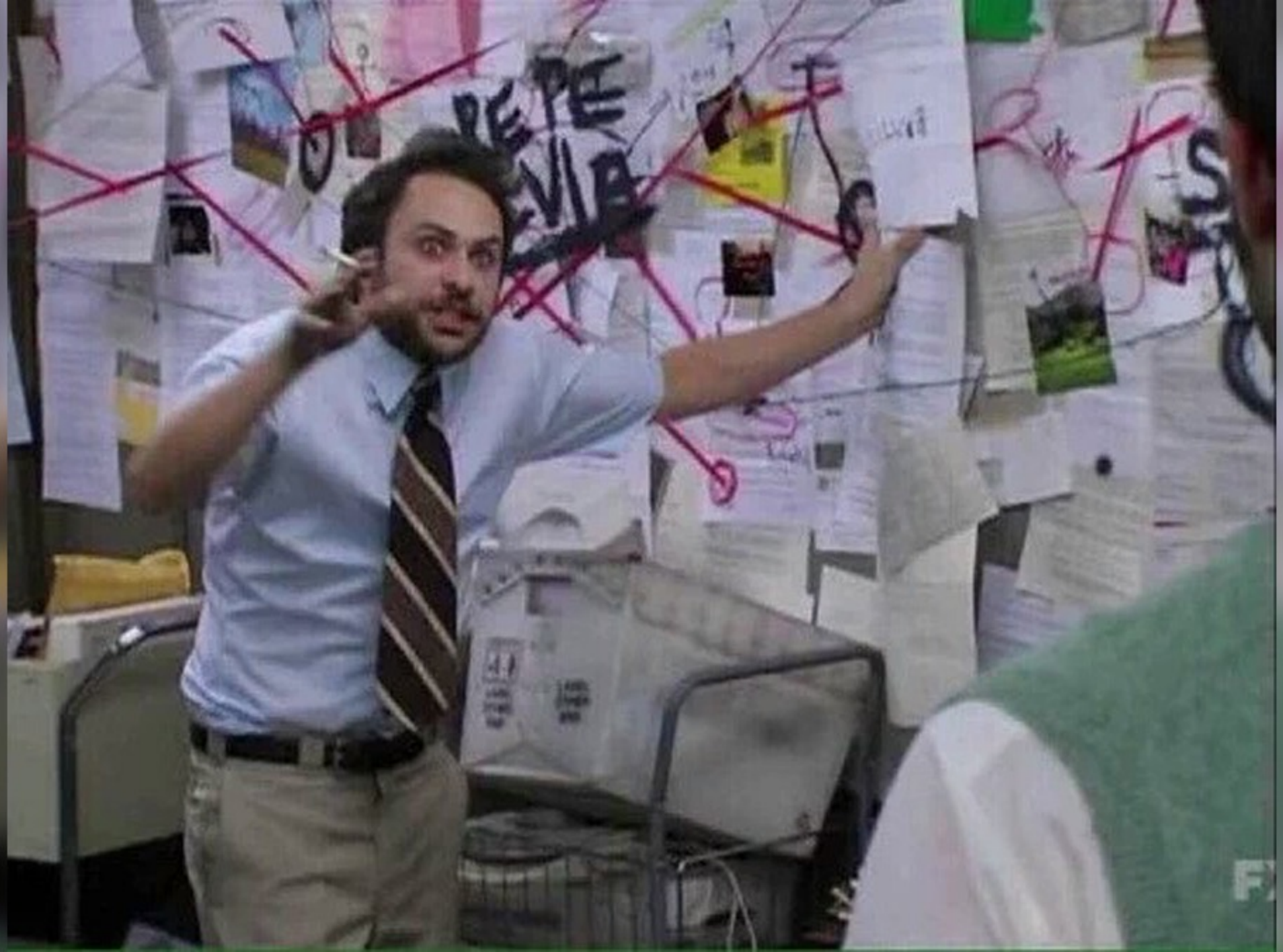

# of instances dataset is referenced
0
10
20
30
40
50
60
ERA
Atmospheric Reanalysis
Ad hoc
NCEP NCAR R1
Atmospheric Reanalysis
HadISST
SST Reanalysis
OAFlux
Air-Ocean Flux Reanalysis
ERSST
SST Reanalysis
Argo
Ocean Observational Data
OISST
SST Reanalysis
JRA-55
Atmospheric Reanalysis
MERRA
Atmospheric Reanalysis
SODA
Ocean Reanalysis
20CR
Atmospheric Reanalysis
AVISO
SSH Reanalysis
CMIP
Earth System Model
CORE
Ocean Ice Model
GLODAP
BGC Synthesis
QuikSCAT
Satellite Observation
RAPID
Ocean Observational Data
SOCAT
Ocean Observational Data
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
% of all datasets referenced


raw data
Today at 3:10 PM
Data Cleaned final
Mar 24, 2011 at 8:08 PM
Data Cleaned final FINAL
Apr 16, 2011 at 12:46 AM
Data Cleaned FINAL FINAL FINAL
Aug 3, 2011 at 3:47 PM
Data Cleaned REAL final_ms_August
Sep 19, 2011 at 4:23 PM
Data Used for Experiments I think
Apr 16, 2011 at 12:46 AM
experiment 1 output results
Mar 23, 2011 at 2:49 AM
experiment 2??? output results
Mar 23, 2011 at 2:49 AM
experiment 4 and 5 output results_keep
Mar 23, 2011 at 2:49 AM
I HATE SCIENCE SO MUCH.rdata
Mar 24, 2011 at 8:05 PM
IMPORTANT config details
Mar 24, 2011 at 8:08 PM
let R burn in fire for all eternity.xlsx
Mar 23, 2011 at 2:49 AM
Updated CV Aug 2011.docx
Nov 7, 2019 at 11:21 PM
results.xml
Mar 26, 2011 at 1:23 AM



* Sea surface datasets include OAFlux, HadISST, ERSST, OISST, SOCAT


ERA (ECMWF)
NCEP NCAR R1
JRA-55
MERRA
Atmosphere Reanalysis
HadISST
ERSST
OISST
Sea Surface Temp. Reanalysis
Met. Office MDB
ICOADS (COADS)
SODA OCEAN REANALYSIS
Ocean Reanalysis
Satellite Data
Argo
Ocean Observation
OAFlux
Air-Sea Flux Reanalysis
CTD, Mooring Data
10 Most-Referenced Datasets
PISCES (biogeochemistry model)
HAMOCC (BGC ocean circ. Component)
NEMO
LIM
CNRM-CM
MITgcm
MPI-ESM
CAM
CICE
POP
CCSM
CESM
NorESM
ECCO
12 Most-Used Models
C-GLORS OCEAN REANALYSIS
ORAS (5) OCEAN REANALYSIS
SOSE OCEAN REANALYSIS
EN3/EN4 (UK Met. Office)



We're not done yet…

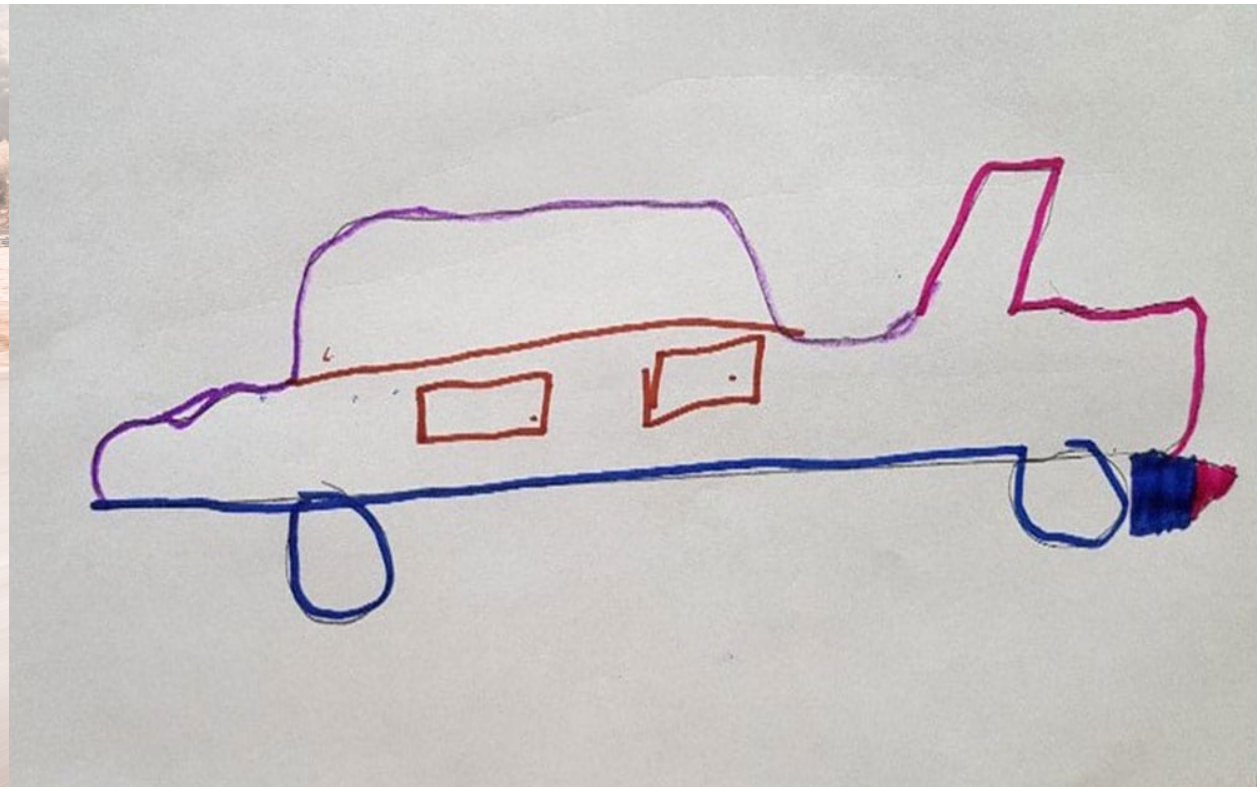
- Now looking for data "in the wild" (in a repository but not a paper)
- Talking to people with more expertise about the "why"
  - Would you like to be one of them?

But I have some early thoughts…

- … on the implications for ocean data systems in the context of ocean CDR.

Co-opetition.

Standards: don’t let the perfect be the enemy of the good.



This is a slide about

The Global Ocean Observing System

CIOOS
CANADIAN INTEGRATED OCEAN OBSERVING SYSTEM

…. and the other under-resourced individuals and organizations that work to make open data widely available for public good.

Data Trusts

For when open data just isn’t possible.

Go Big

North Atlantic Carbon Observatory

Transform Climate Action

transformclimateaction.ca

Thank you!

Mike Smit
Mike.Smit@dal.ca

NSERC CRSNG
CIOOS CANADIAN INTEGRATED OCEAN OBSERVING SYSTEM
Fisheries and Oceans Canada | Pêches et Océans Canada
OCEAN FRONTIER INSTITUTE
MEOPAR
Social Sciences and Humanities Research Council of Canada | Conseil de recherches en sciences humaines du Canada
Canada