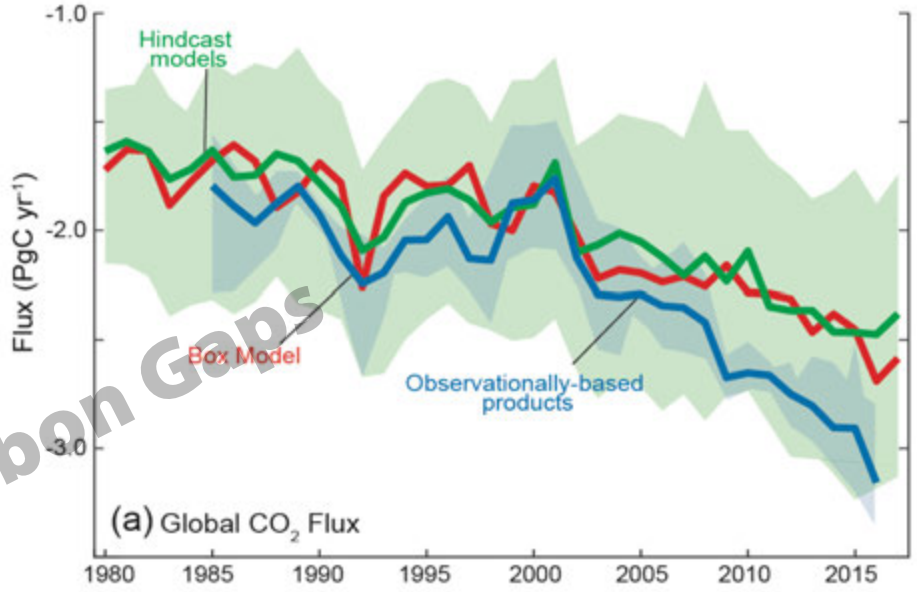
Galen McKinley
Professor
Columbia U. & LDEO

- *Global ocean carbon flux variability and trends*
- *Physical and biogeochemical mechanisms*
- *North Atlantic mechanisms*
- ***pCO_2 data analysis***
- ***Ocean and climate models***

Decadal variability in global ocean CO_2 sink can be explained by external forcing

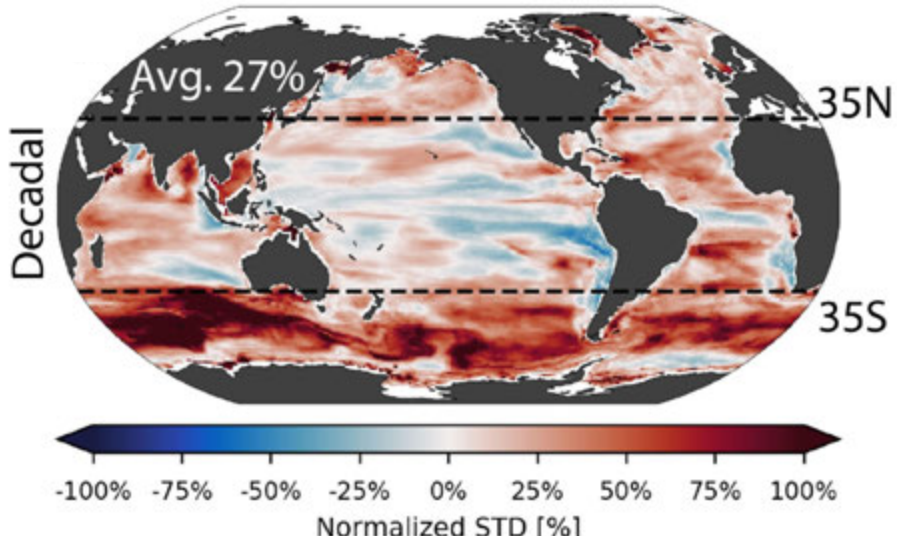
External forcing from pCO_2^{atm} and large volcanos



McKinley et al., AGU Advances, in press

Large Ensemble testbed to statistically assess Neural Network reconstruction (SOMFFN)

Low bias, good seasonality. Overestimates decadal variability <35S



Amplitude of reconstructed decadal variability compared to truth

Gloege, McKinley, Landschutzer et al., in review

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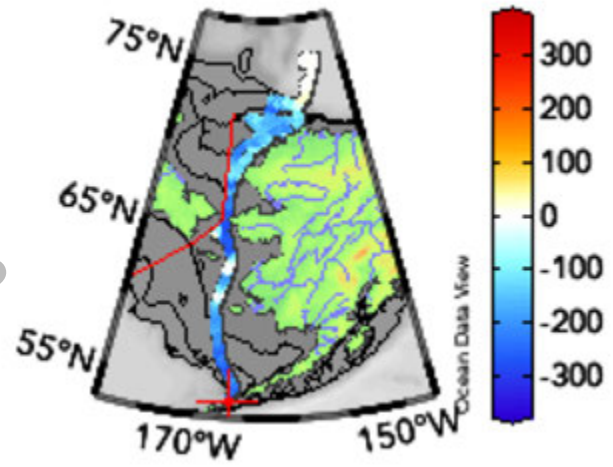
Jessica Cross

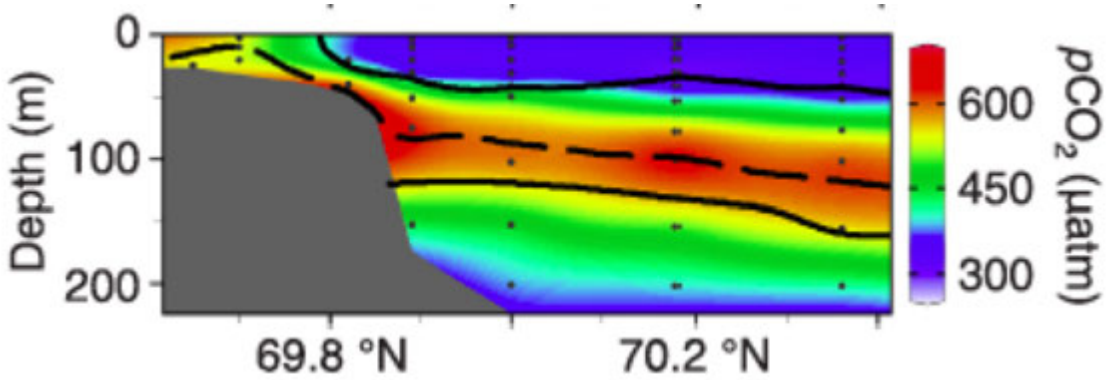
Research Oceanographer
NOAA-PMEL

- *CO_2 transport and long-term sub-surface CO_2 storage*
- *Pacific Arctic*
- *Technology development*
- *Ocean Acidification*

Ice melt is an efficient but small *sink of atmospheric CO2. A highly productive and efficient biological pump over the continental shelves facilitates* ***long-term storage in sub-surface Arctic Waters.***



However, these sub-surface ***reservoirs are not perfect****-- and climate change may lead to further destabilization.*



What does this mean for the Arctic Ocean Carbon Sink?

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Cross et al., 2018. Formation and Transport of corrosive water in the Pacific Arctic Region. Doi: 10.1016/j.dsr2.2018.05.020. See also: Anderson et al., 2013; Qi et al., 2017; Manizza et al., 2019; Zhang et al., 2020;

Tim DeVries

Associate Prof.
UC Santa Barbara

- *Global ocean carbon cycle*
- *Anthropogenic CO_2*
- *Biological carbon pump*
- *Ocean inverse modeling*
- *Carbon cycle models*

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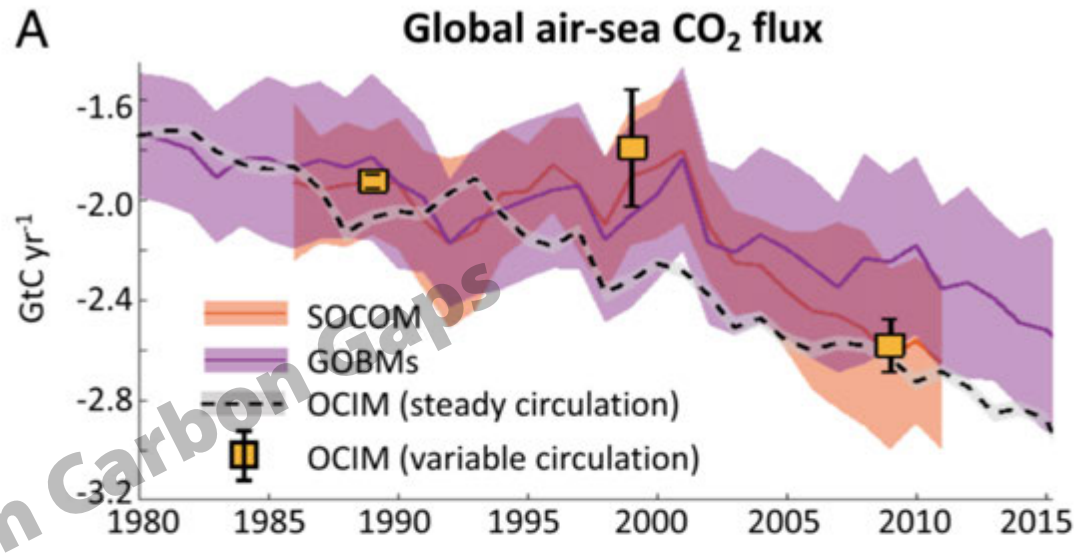
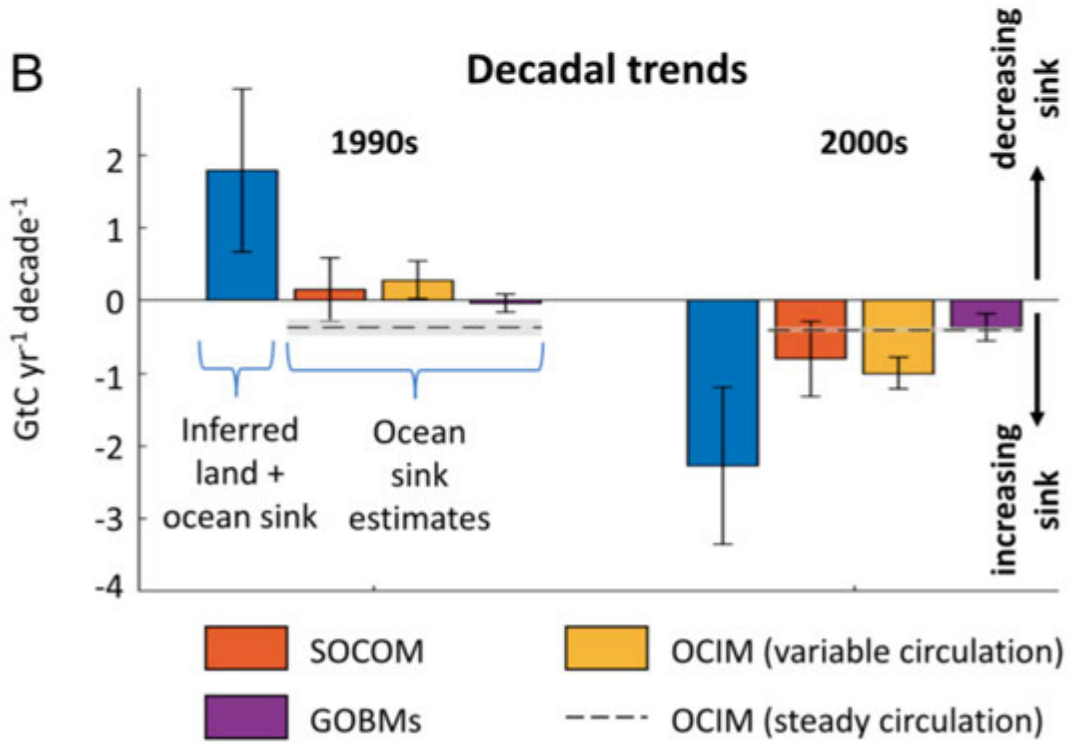
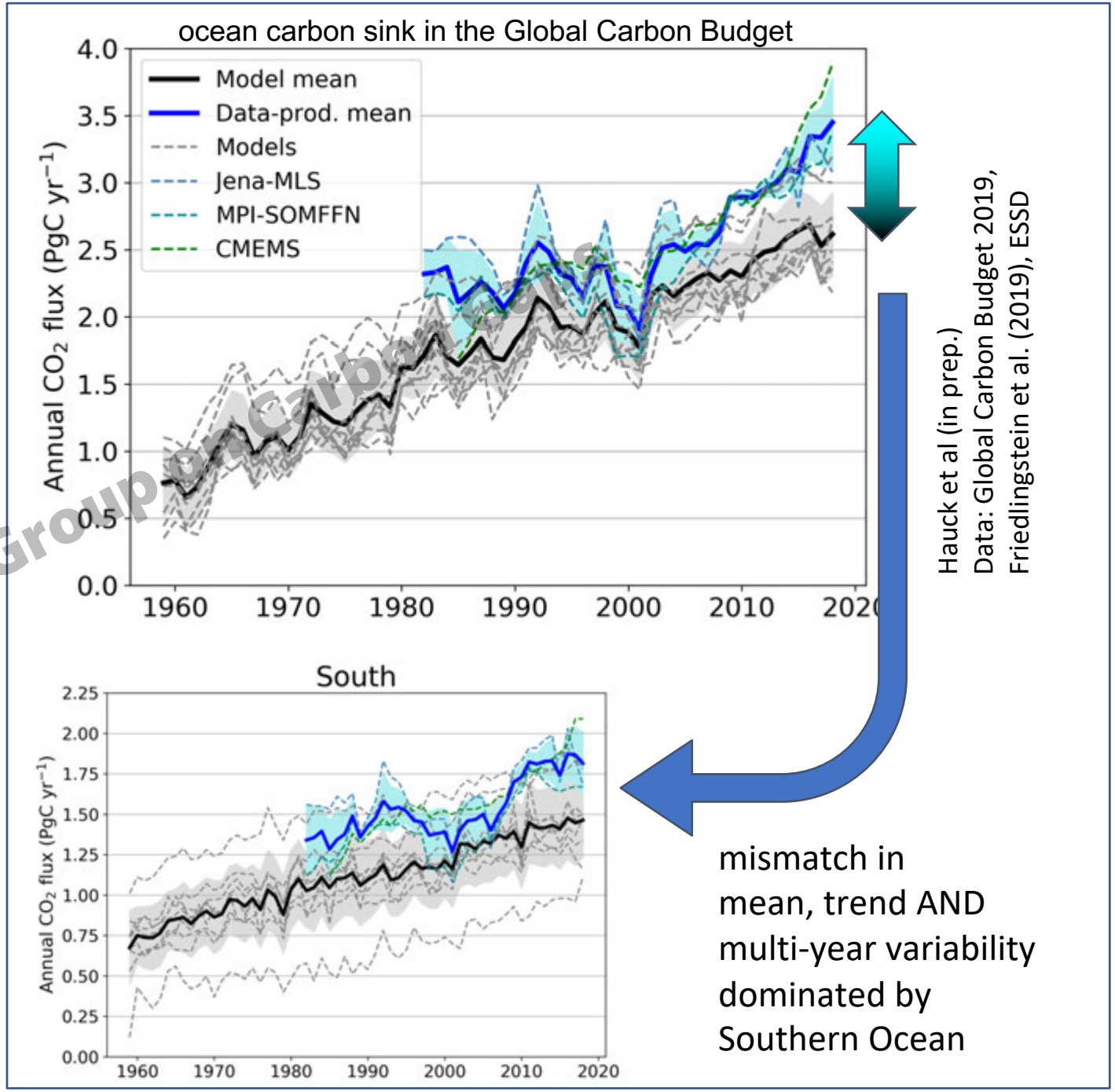
DeVries et al. (2019), Decadal trends in the ocean carbon sink





Judith Hauck
Group leader
Alfred-Wegener-Institut (AWI)

- **marine carbon cycle modelling and model development (FESOM-REcoM)**
- **polar regions**
- **Global Carbon Budget: ocean carbon sink estimate**
- **RECCAP2 (REgional Carbon Cycle Assessment and Processes)**



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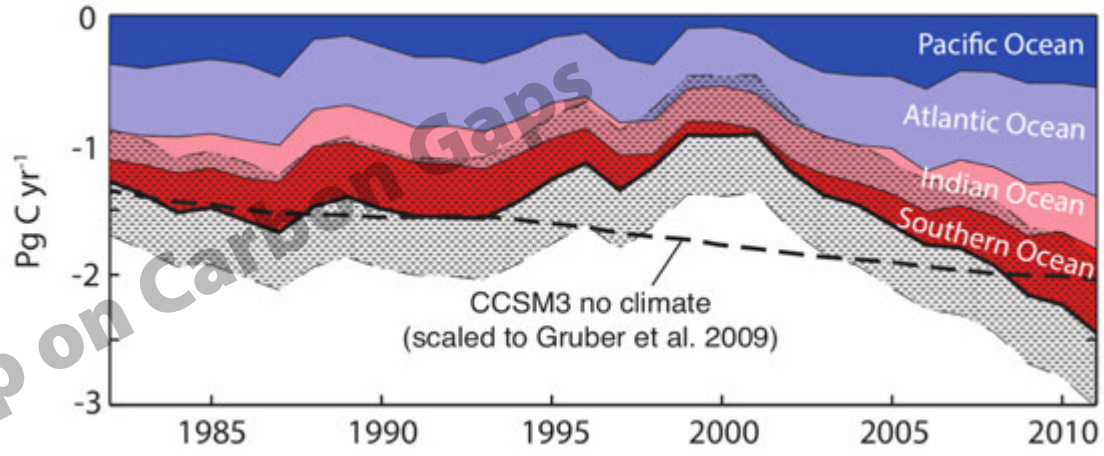
Peter Landschützer
Group Leader
Max Planck Institute
for Meteorology

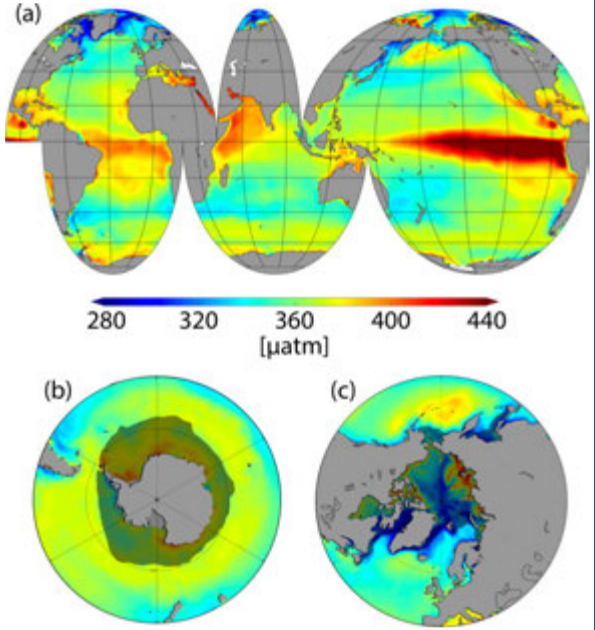
- Observation-based estimates of the global ocean carbon sink and its variability
- Artificial neural networks
- Ocean Carbon Cycle
- Data analysis and synthesis

Reconstructions of the ocean carbon sink based on surface pCO2 measurements suggest strong variations on decadal timescale
(Landschützer et al 2016, GBC)



Combining open ocean and coastal ocean pCO2 to represent the full aquatic continuum in observation-based air-sea flux estimates

(Landschützer, Laruelle et al submitted to ESSD)



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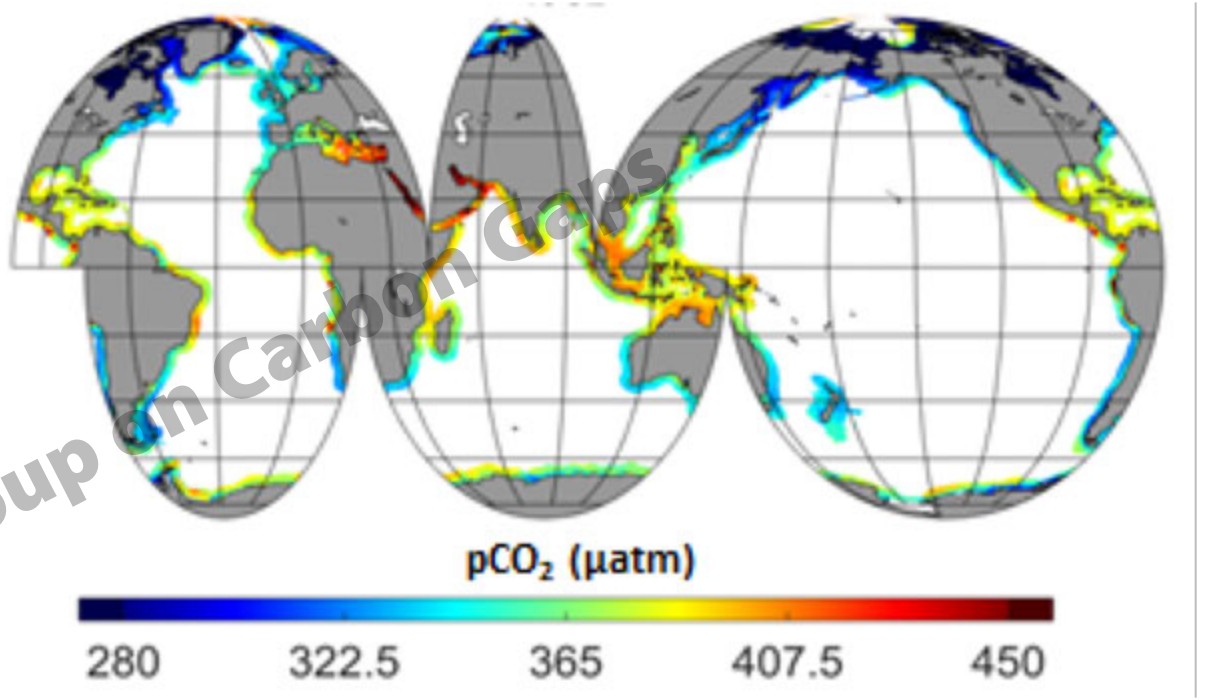
Goulven Laruelle
Research Associate
Université Libre de Bruxelles - FNRS

- CO2 exchange at the air-water interface in coastal seas and estuaries
- High resolution coastal data-products
- Estuarine modeling and dynamics



Climatological mean pCO2 over the 1998-2015 period derived from a two-step artificial neuron network (Laruelle et al., 2017)

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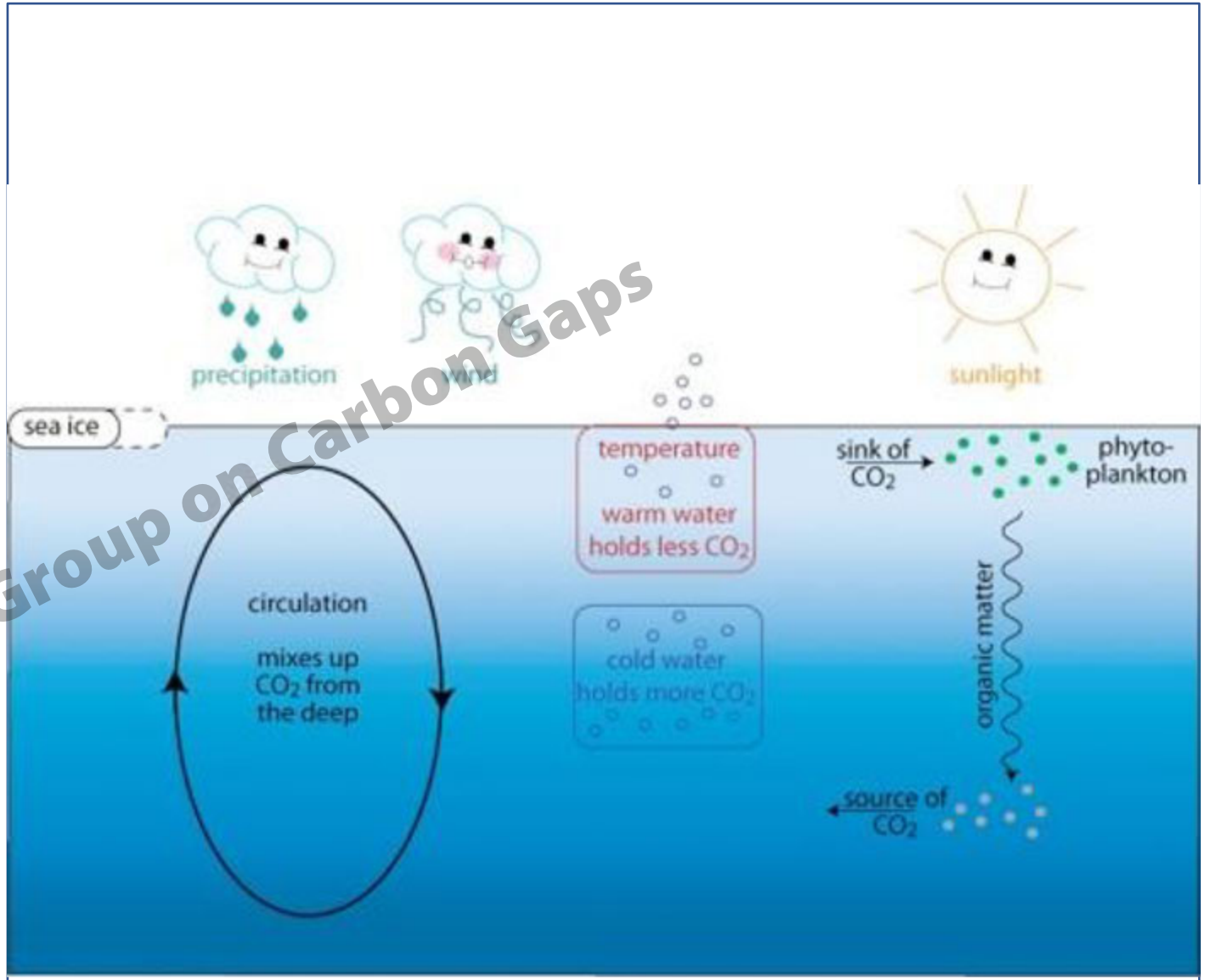
Nicole Lovenduski
Associate Professor
U Colorado Boulder

- role of the ocean in the global carbon cycle
- interpreting output from models in the context of observations
- the Southern Ocean has a special place in my heart



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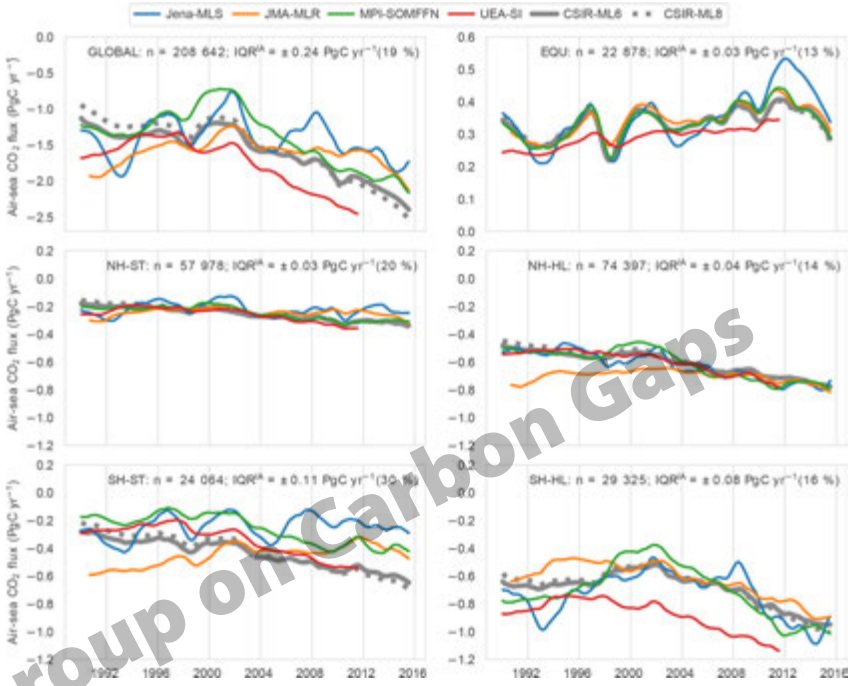
Pedro M.S. Monteiro

Head: Southern Ocean Carbon – Climate Observatory (SOCCO)
CSIR, South Africa

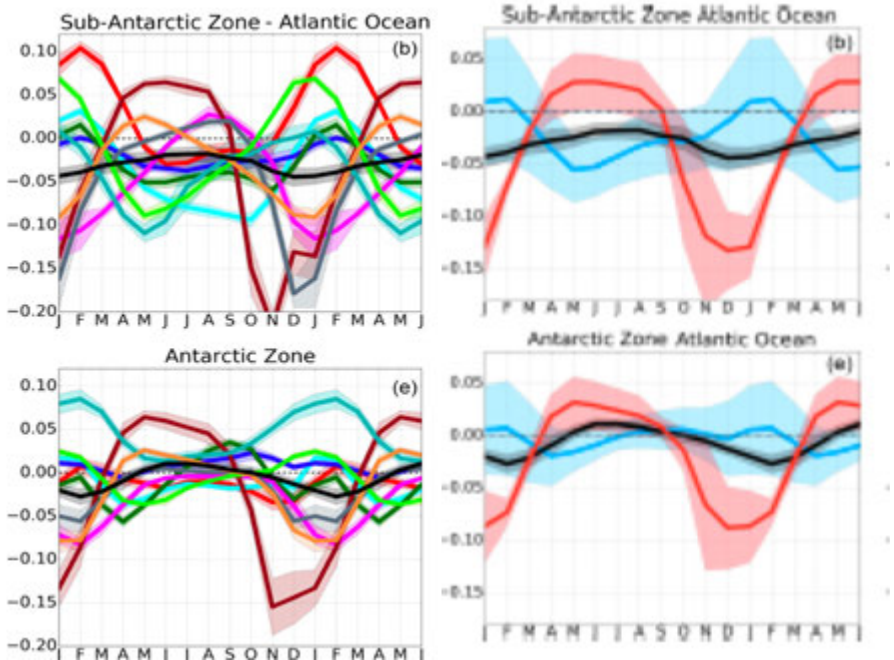
SOCCO

- **The variability and trends of Southern Ocean CO_2 fluxes (seasonal cycle – to decadal scales and meso to sub-mesoscales)**
- **Prognostic model biases – the fine scale ocean physics gap**
- **The need for high resolution** (seasonal scale) **and confidence CO_2 model constraints**
- **Sensitivity to Climate of the Southern Ocean biological carbon pump**



Outputs from 6 empirical model approaches showing contrasting trends for global and regional air-sea fluxes

Gregor et al., - GMD



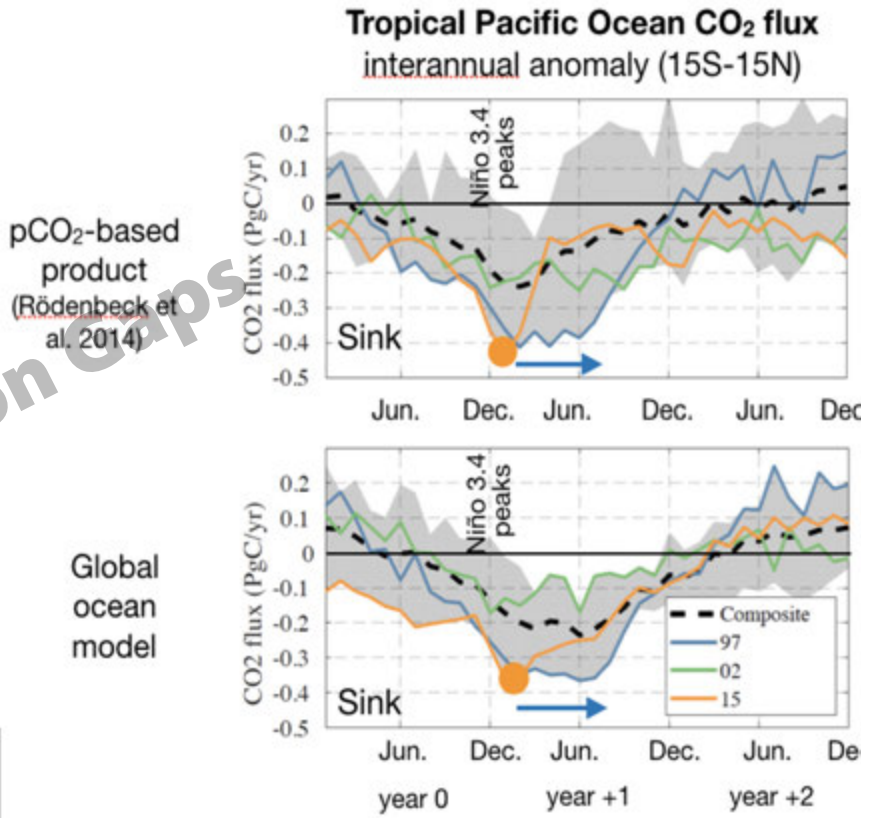
ESM Biases:
Seasonal Cycle bias for FCO2 in CMIP5 models in the Southern Ocean

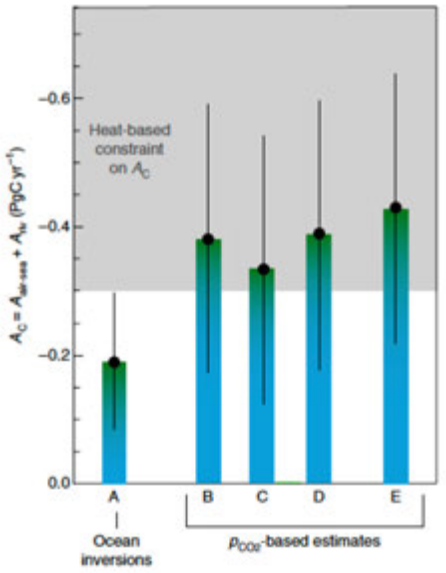
Mongwe et al., 2018 - BGS

Laure Resplandy
Assistant Professor
Princeton University

- *Bio-physical coupling global scale to submesoscale*
- *Ocean carbon and oxygen cycle: variability, trends and mechanisms*
- *Land-ocean continuum*
- *Indian Ocean and Pacific Ocean*

Ocean anomalous CO2 drawdown during El Niño events. Timing and amplitude tied to equatorial response and Ekman transport poleward amplification.
Liao et al, submitted.





Heat based global constraint on north-south carbon transport and river-driven natural ocean outgassing.
Resplandy et al 2018

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Christian Rödenbeck
MPI Biogeochemistry
Jena

Data-based carbon cycle quantification:

- **pCO_2**-based ocean CO_2 fluxes
- Focus: **IAV and its drivers**
- Atmospheric Potential Oxygen (APO) as ocean flux constraint
- Atmospheric CO_2 inversion

Jena CarboScope

OCB Working Group: Filling the gaps in observation-based estimates of air–sea carbon fluxes

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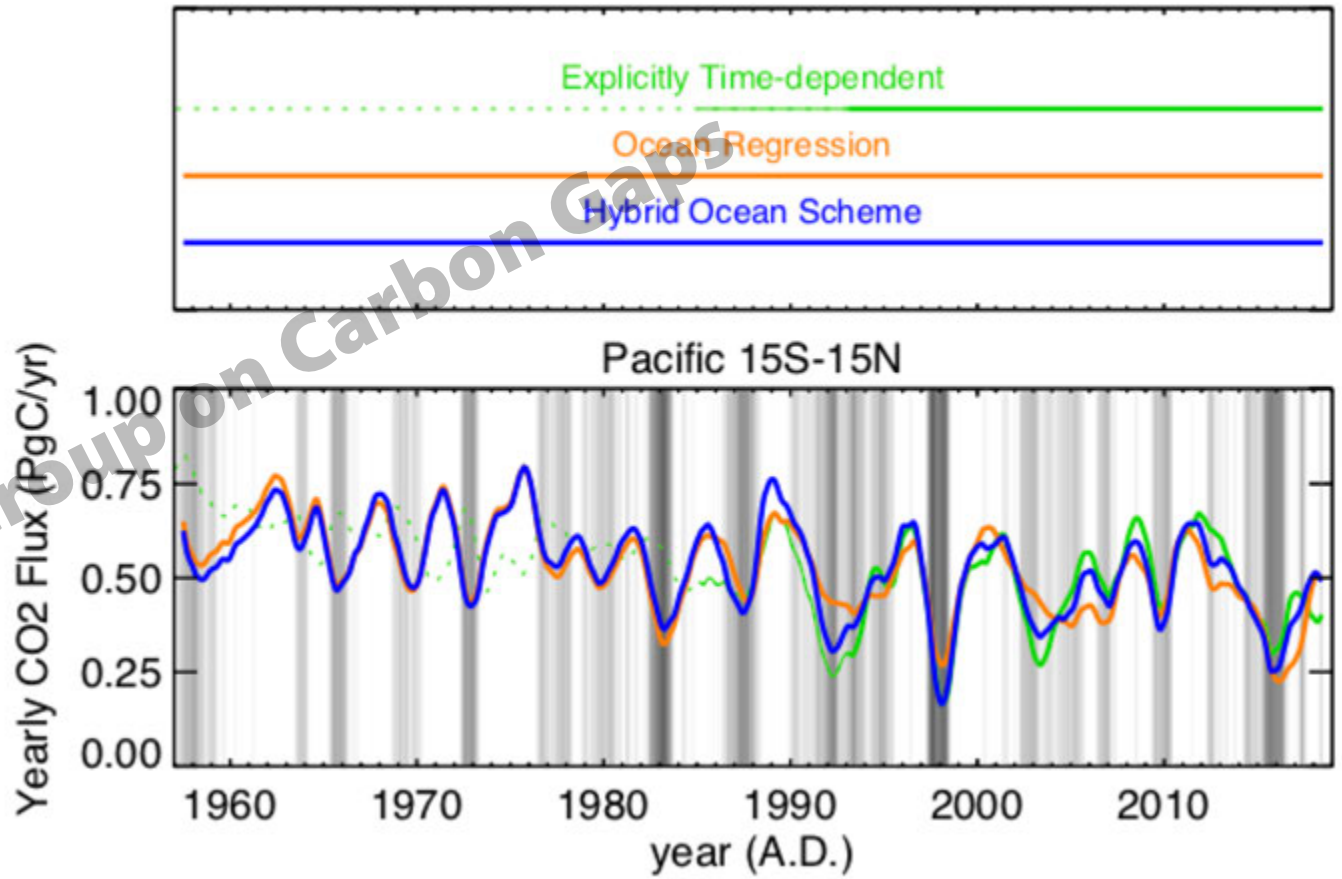
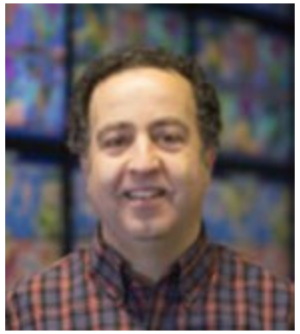
Filling the "early decades" gap:





Raymond Najjar
Prof. of Oceanography
The Pennsylvania State University

Current research:

- Coastal zone carbon and oxygen cycling
- Estuarine metabolism
- Climate change impacts on coastal waters

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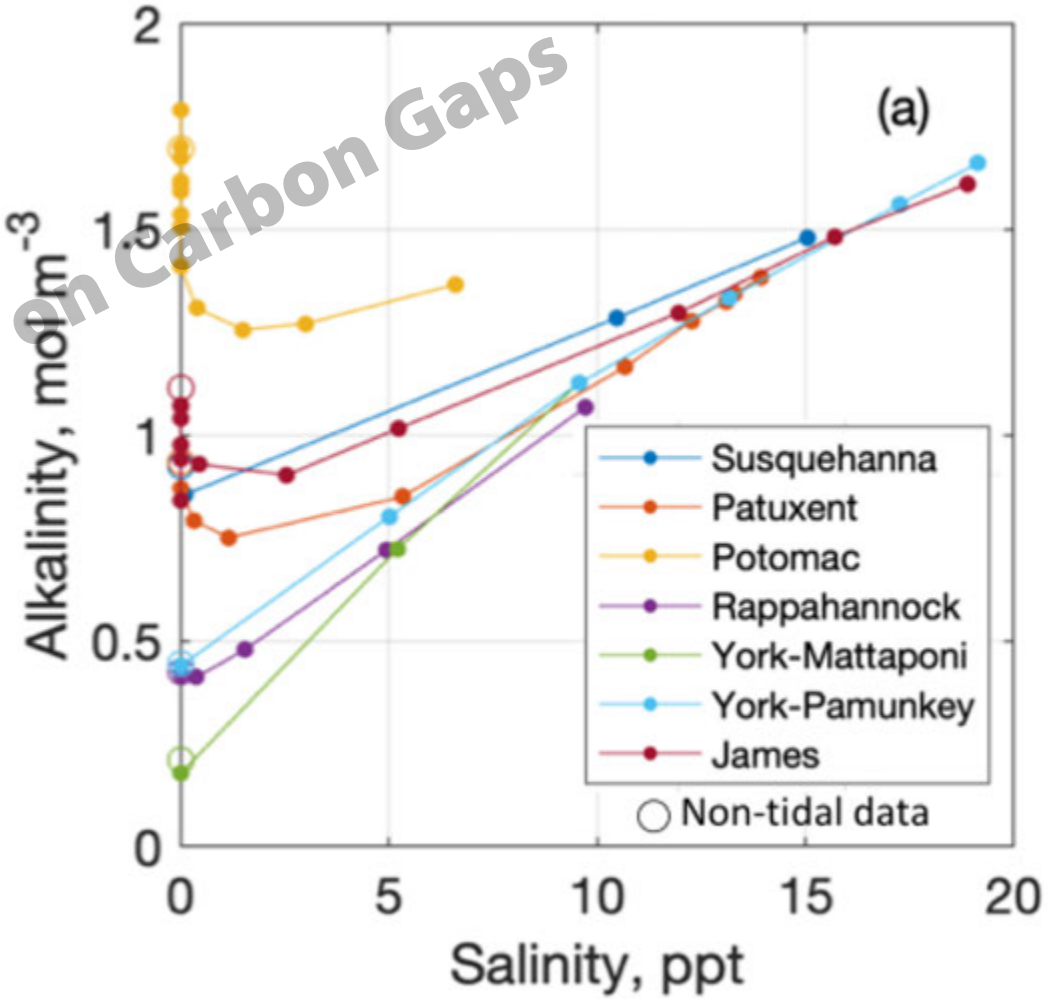
In a single estuarine system (Chesapeake Bay), alkalinity varies greatly among riverine endmembers and shows varying degrees of non-conservative behavior



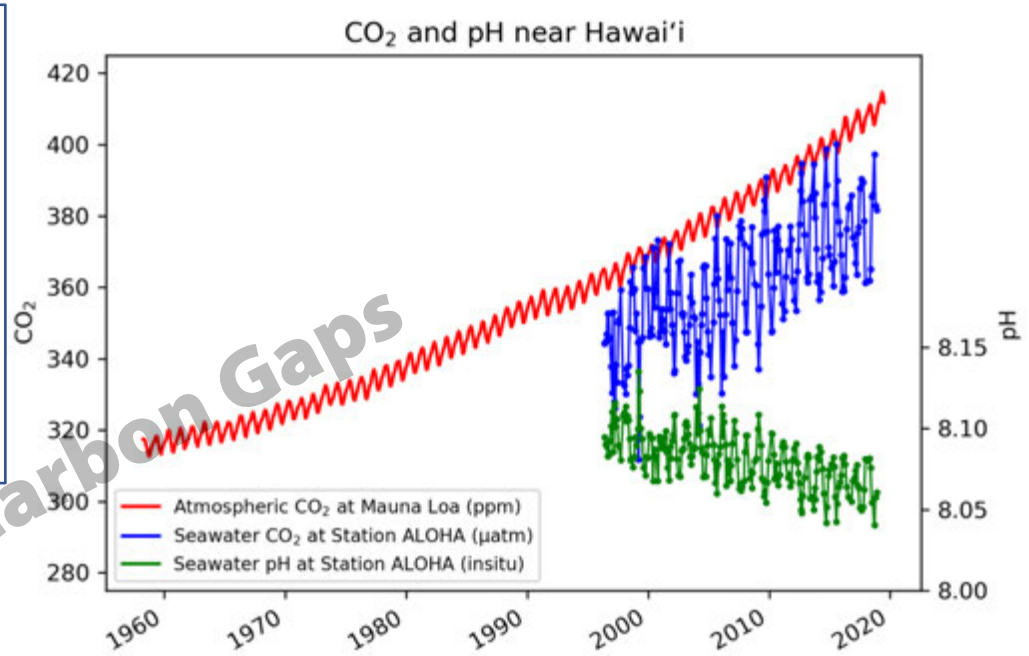
Najjar et al., 2020, J. Geophys. Res: Oceans

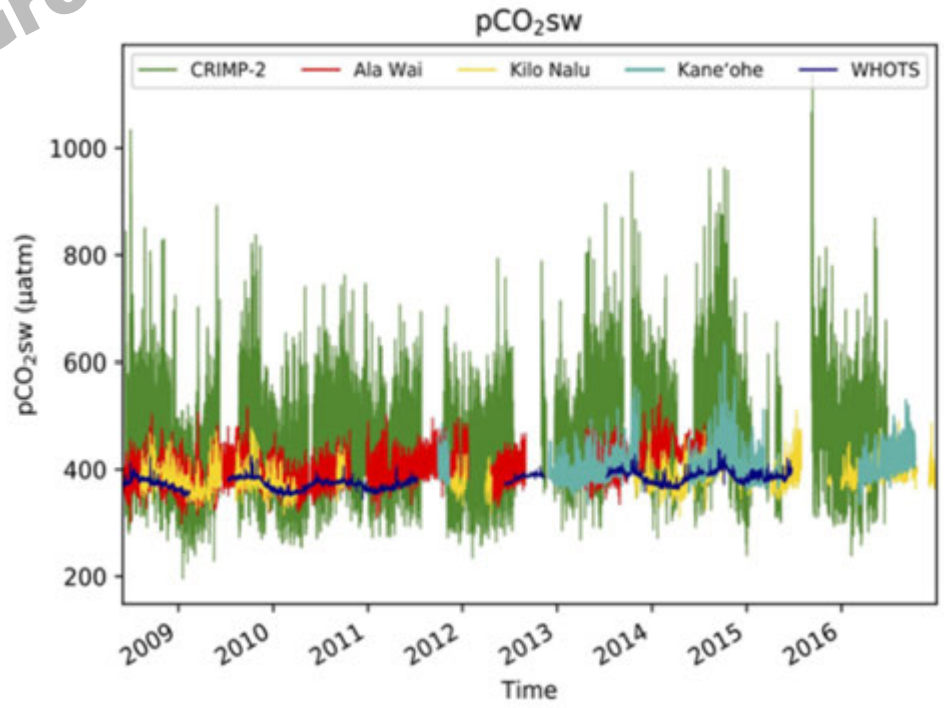
Christopher Sabine
Associate Dean
Univ. of Hawaii

- role of the ocean in the global carbon cycle
- interpreting ocean inorganic carbon measurements
- understanding ocean acidification

co-chair of IOC/UNESCO Integrated Ocean Carbon Research working group (IOC-R)

Data from: Dore, et al. (2009) plus http://hahana.soest.hawaii.edu/hot/products/HOT_surface_CO2.txt





Terlouw, et al. (2019)

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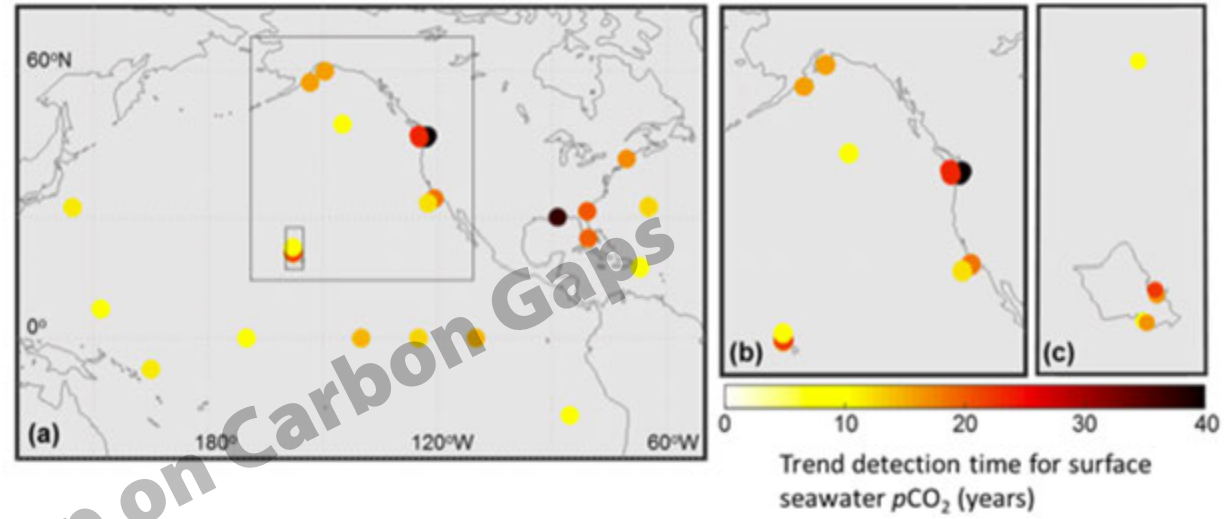
Adrienne Sutton

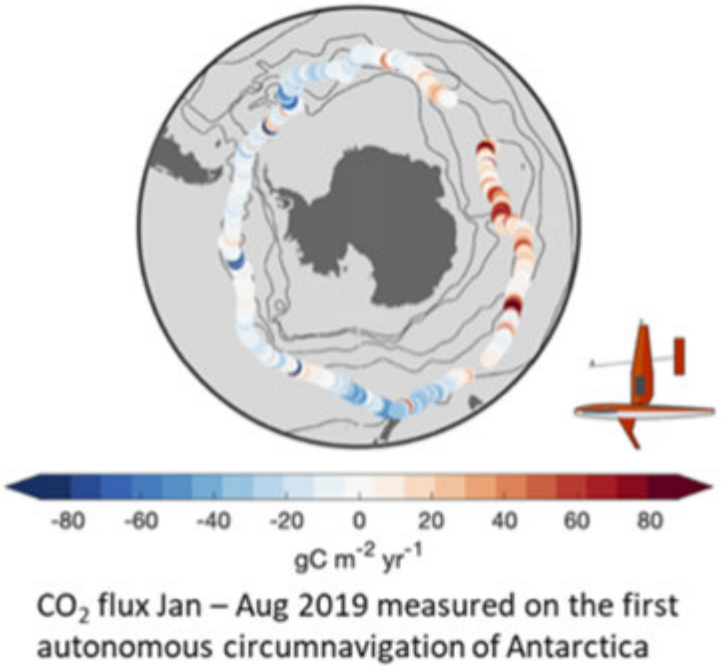
Oceanographer
NOAA PMEL

- global air-sea CO_2 and ocean acidification time series observations
- ocean carbon sensor development
- autonomous surface vehicles
- ocean observing systems (e.g., OceanSITES, TPOS 2020, PIRATA)
- best practices for measurements and analyses

Sutton et al. 2019, ESSD: air-sea CO_2 and pH time series data product



Sutton, Williams et al. in prep: Saildrone air-sea CO_2 Southern Ocean observations



CO_2 flux Jan – Aug 2019 measured on the first autonomous circumnavigation of Antarctica

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Rik Wanninkhof
Senior Scientist
NOAA/AOML/Miami

- **Member IOCCP SC (surface water CO_2 measurements)**
- **Operational SOOP-CO2 network**
- **SOCONET reference network ships and moorings (including MBL measurements) [Soconet.info]**
- **Best Practices**
- **Creating data products (SOCAT) [SOCAT.info] and GLODAP [Glodap.info]**
- **Co-chair IOC-R "thinktank" (IOC/UNESCO)**

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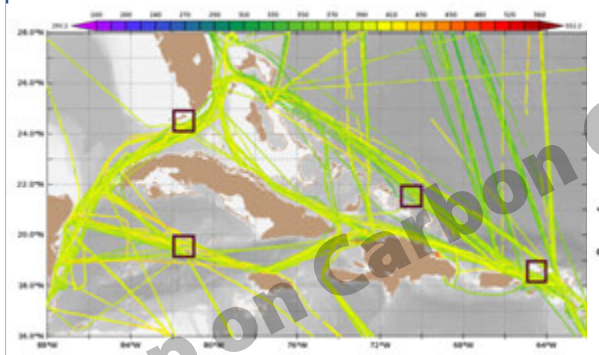
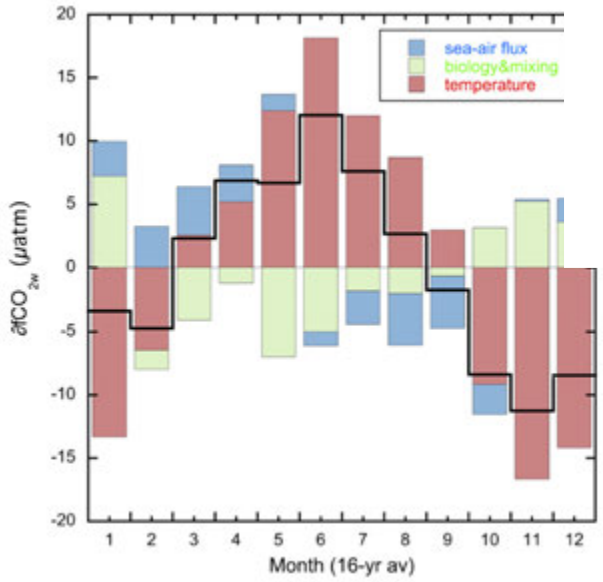
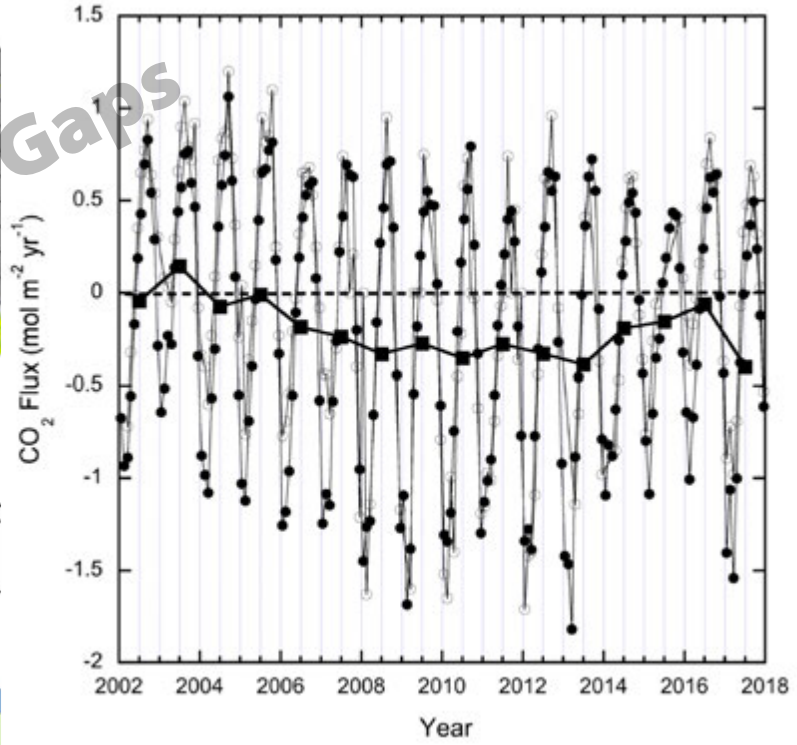
Large Decadal Changes in Air-Sea CO2 Fluxes in the Caribbean Sea, Rik Wanninkhof, Joaquin Triñanes, Geun-Ha Park , Dwight Gledhill, and Are Olsen, JGR, 2019, 10.1029/2019JC015366







1.13 million, data point 2002-2018

9924 grid cells with observations

(1° by 1° by mo)

10 % of monthly grid cells filled

Nancy Williams
Assistant Professor
Univ of South Florida

- Southern Ocean's role in the global carbon cycle and climate (SOCCOM)
- seasonality of carbonate chemistry now and in the future
- uncertainty analysis
- autonomous platforms/sensors (BGC Argo, Saildrone)
- derived carbonate system variables
- using in situ data to evaluate earth system models

Calculating surface ocean pCO2 from biogeochemical Argo floats equipped with pH: An uncertainty analysis (Williams et al., 2017)

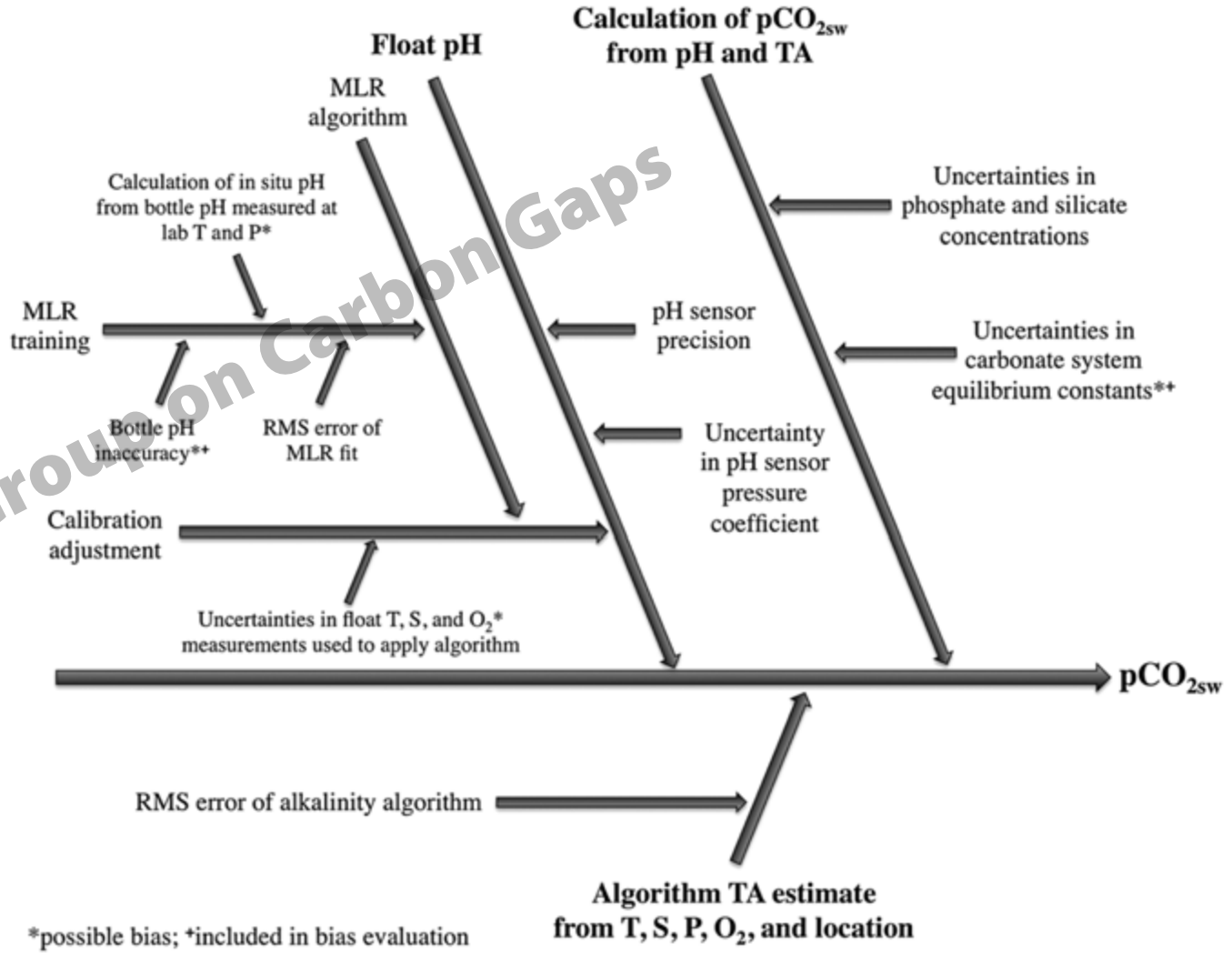


Figure 2. Diagram of contributions to the uncertainty in float-calculated pCO_{2sw} (pH, TA) using float pH and an algorithm TA estimate.

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