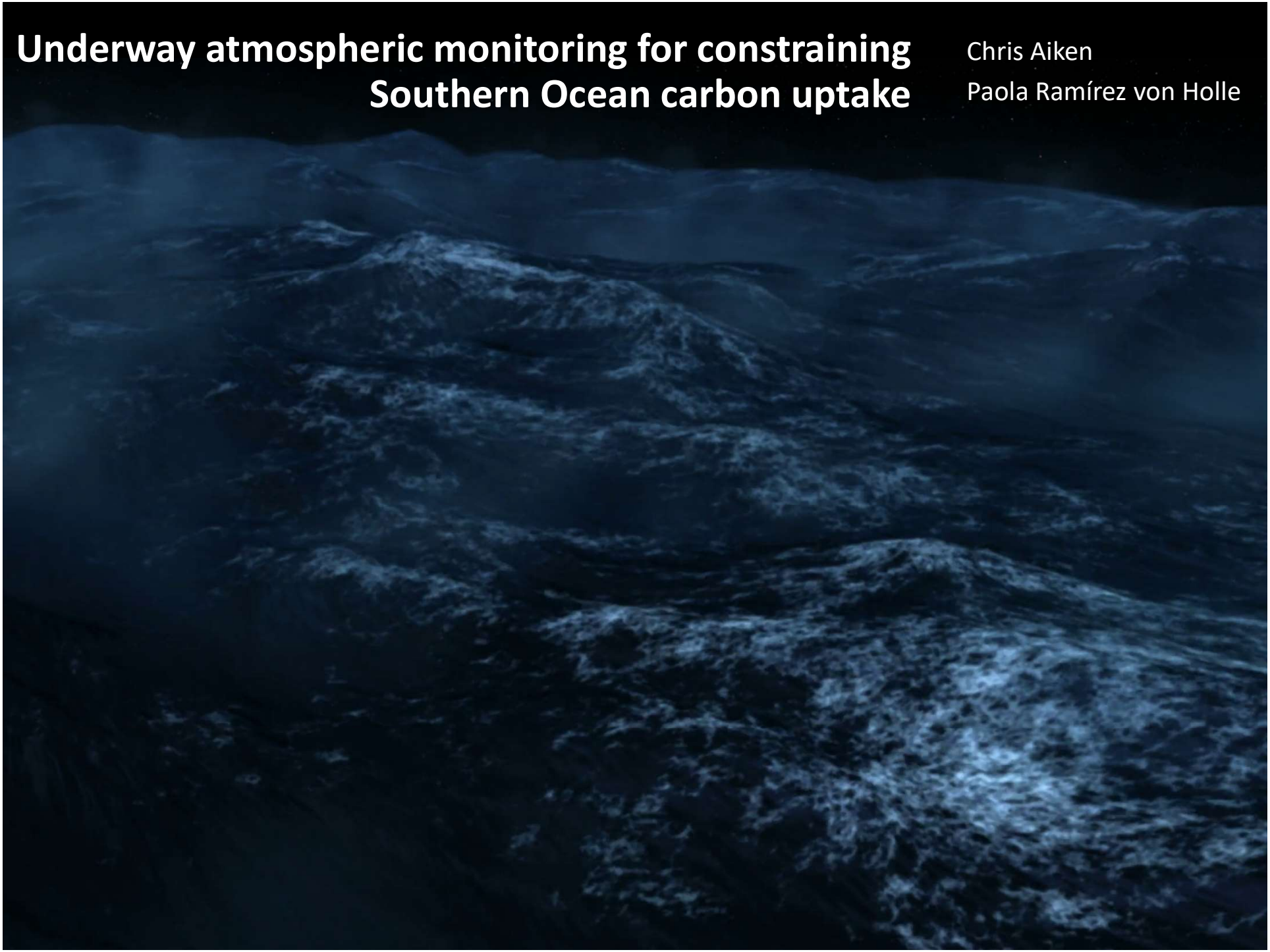
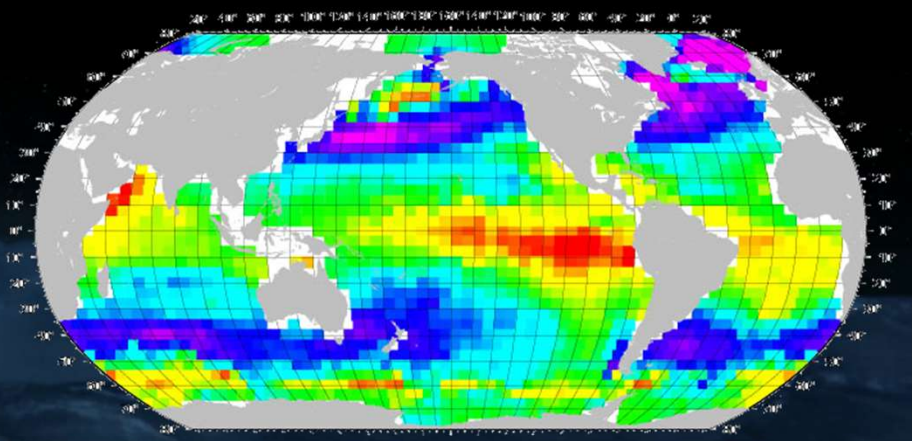
Underway atmospheric monitoring for constraining Southern Ocean carbon uptake

Chris Aiken
Paola Ramírez von Holle

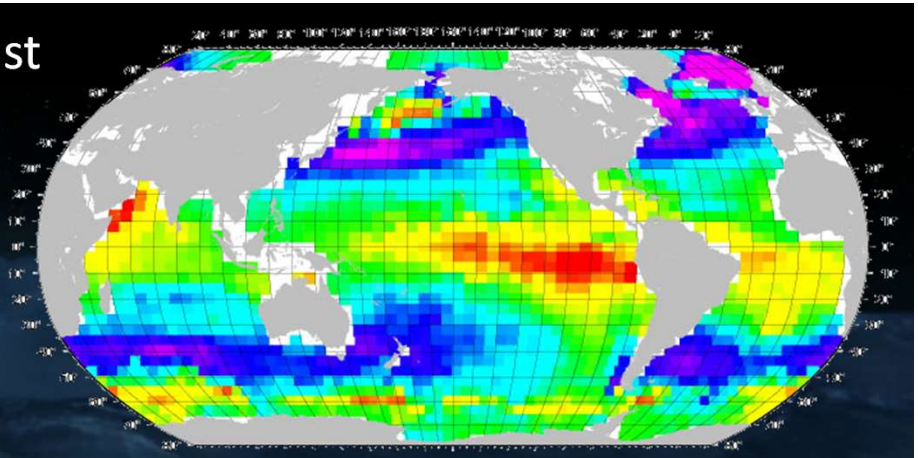


Why the Southern Ocean?

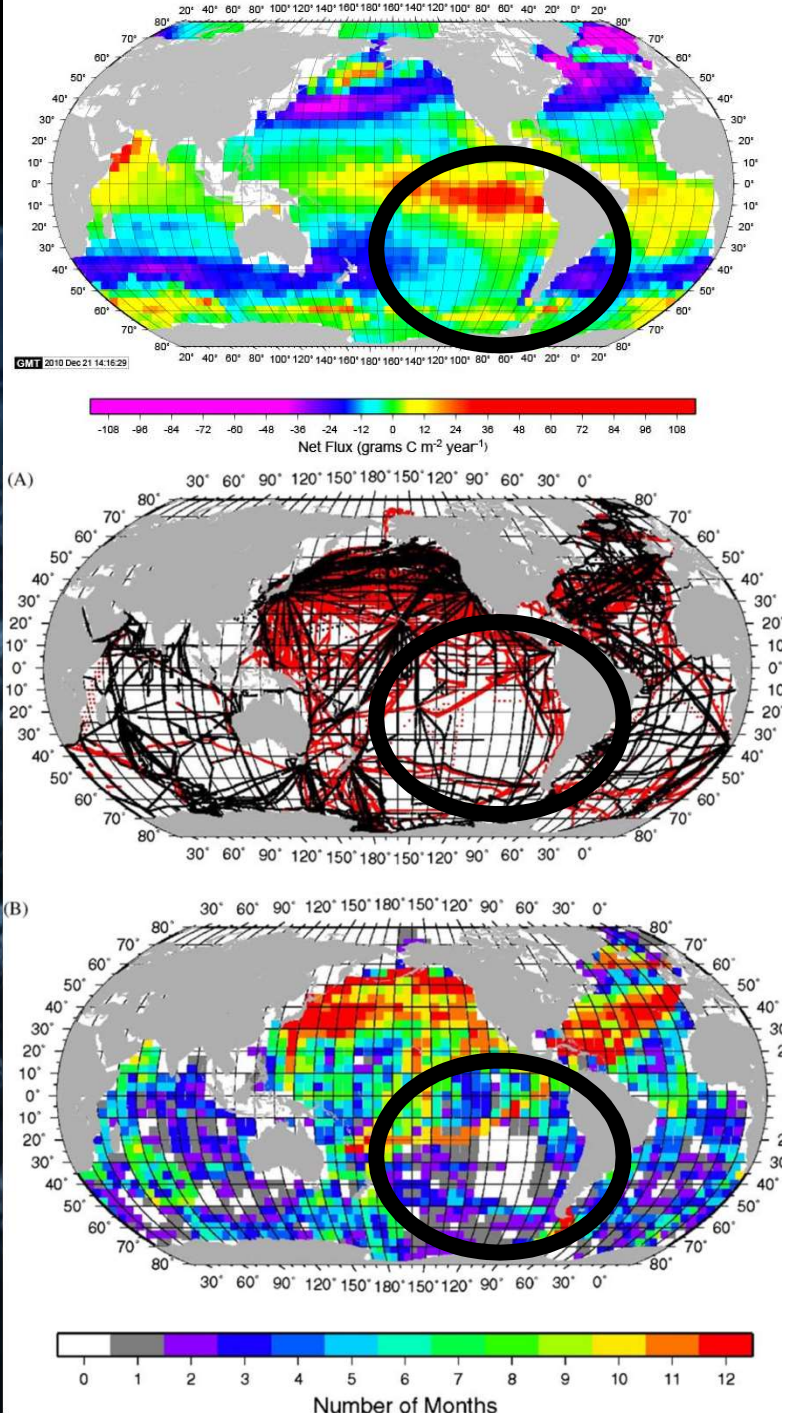


Annual mean air-sea CO2 flux, Takahashi et al (2009)

Apparent weak mean CO2 flux in the south east Pacific



Apparent weak mean CO2 flux in the south east Pacific based on **no observations**



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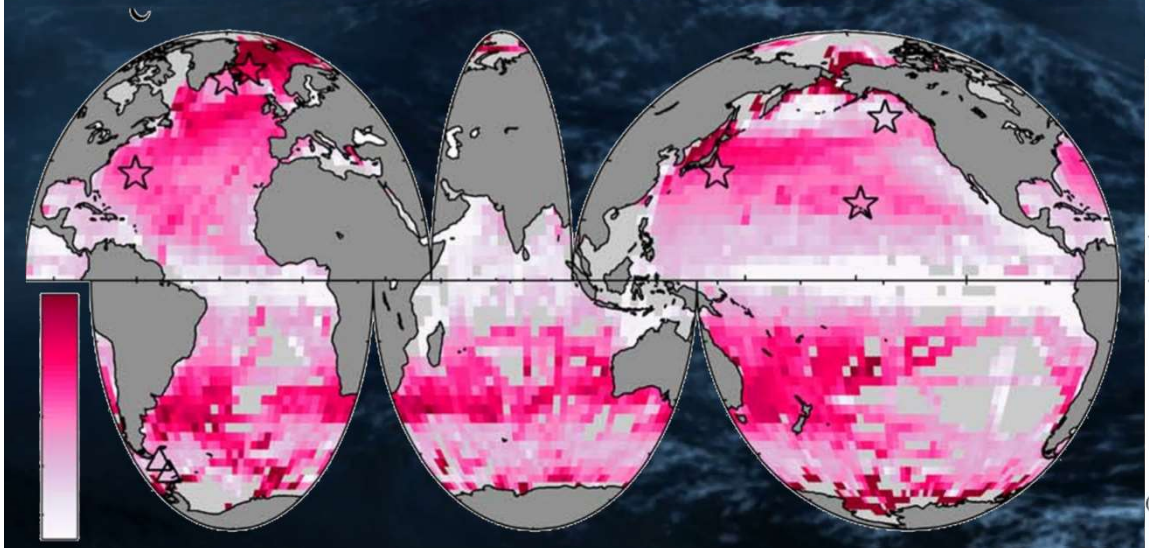
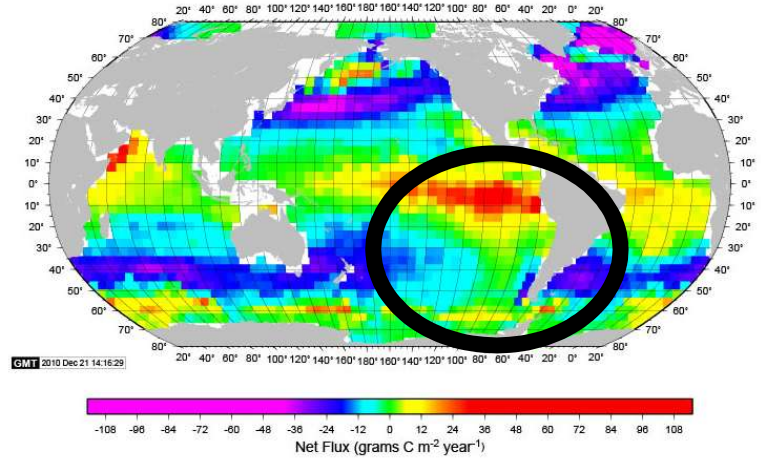
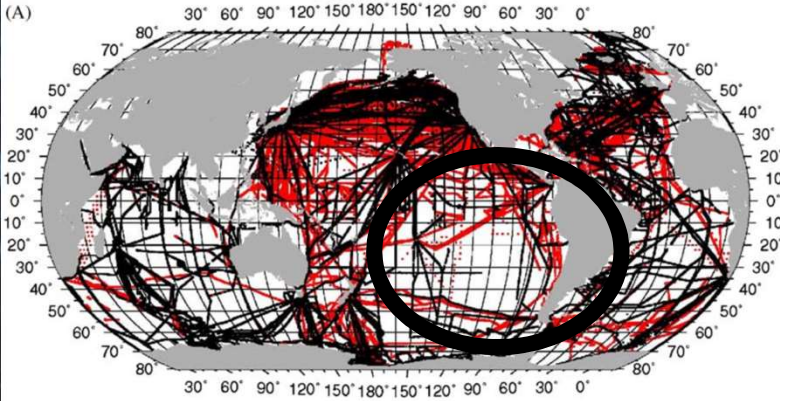
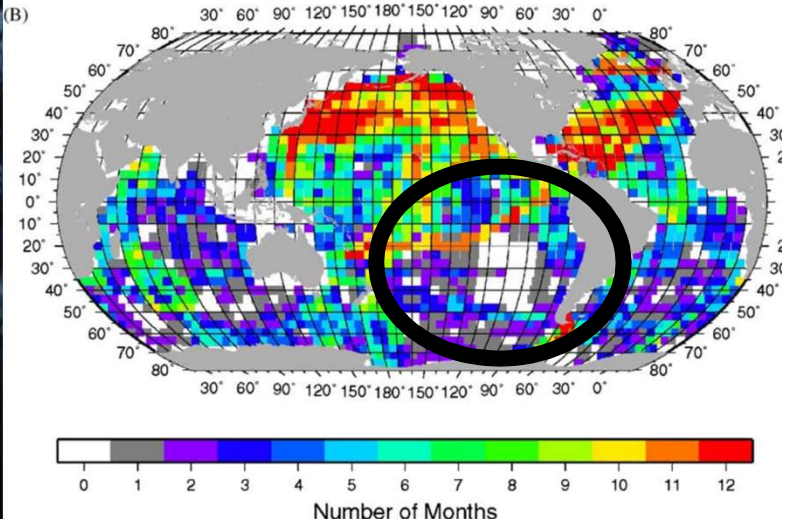


Annual mean surface pH , Fassbender et al (2017)

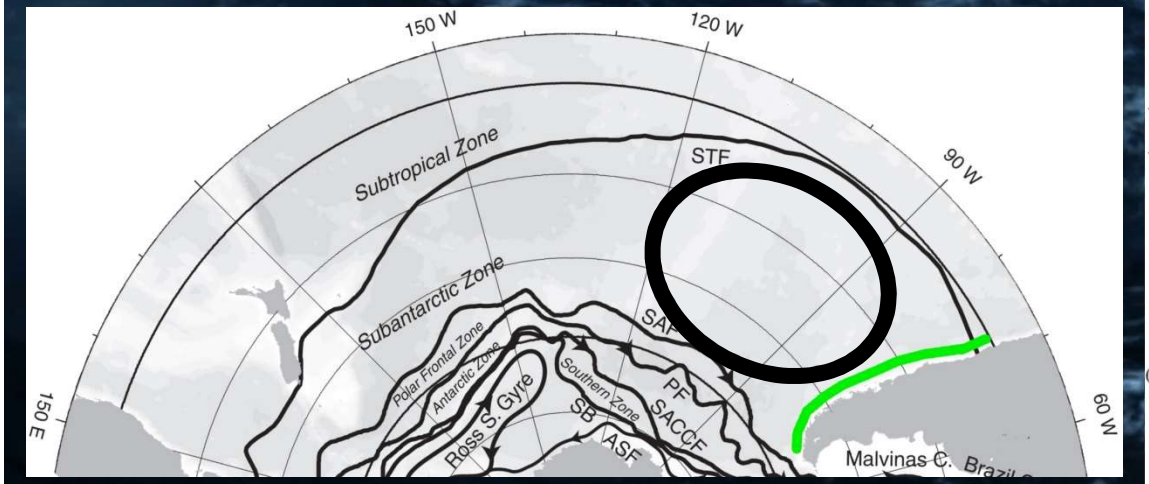


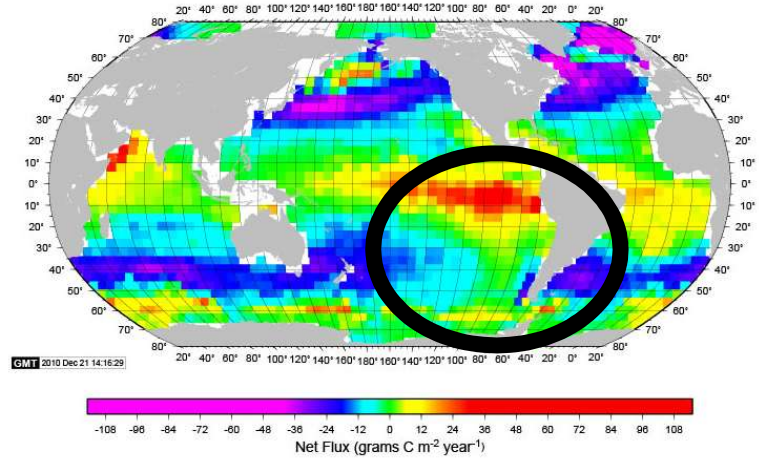


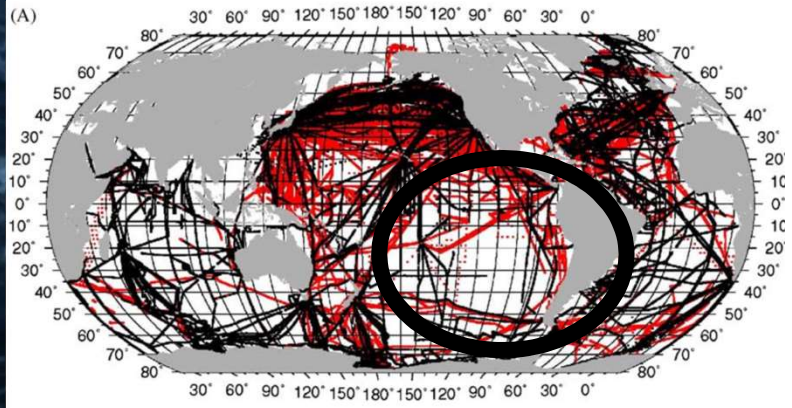


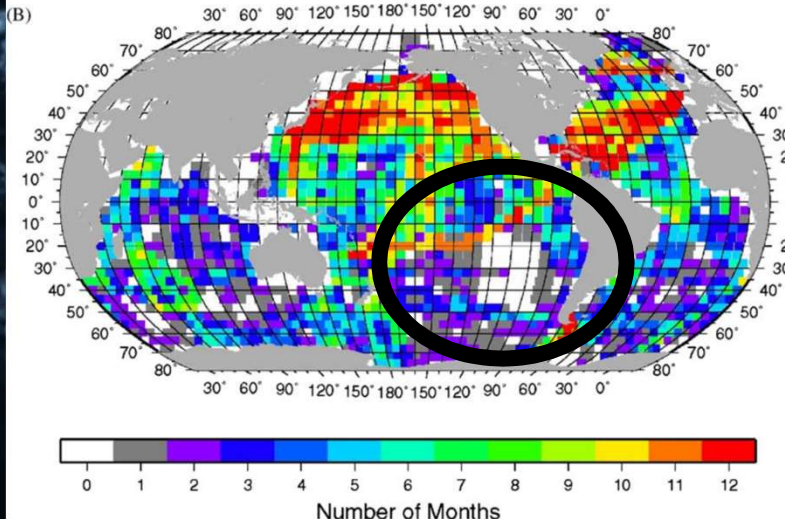
Apparent weak mean CO2 flux in the south east Pacific based on **no observations**

The “hole” falls within the Subantarctic Zone, associated with CO2 sequestration





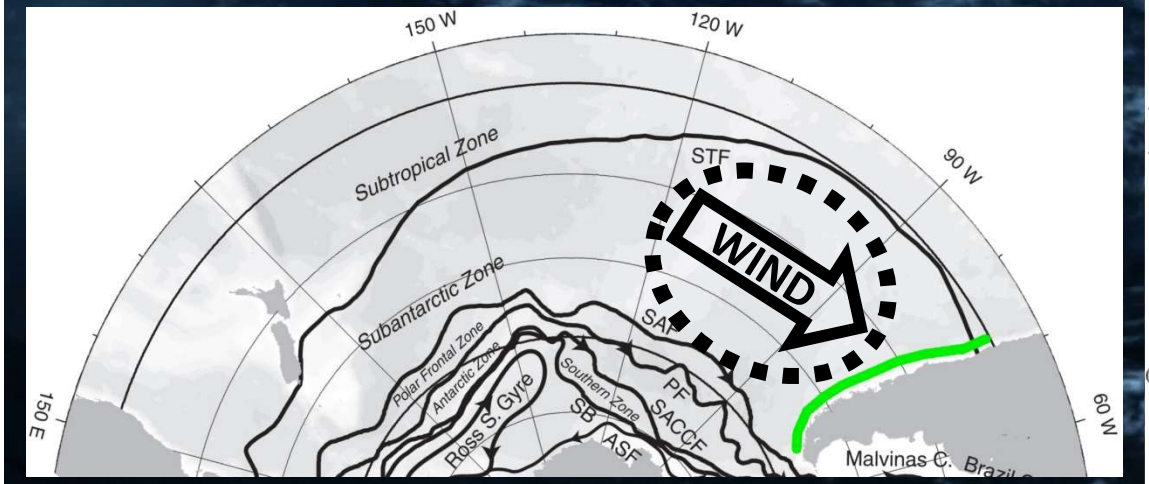


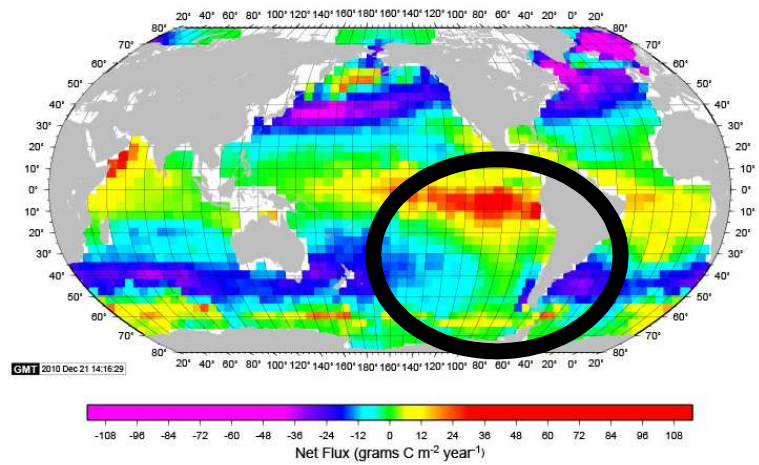


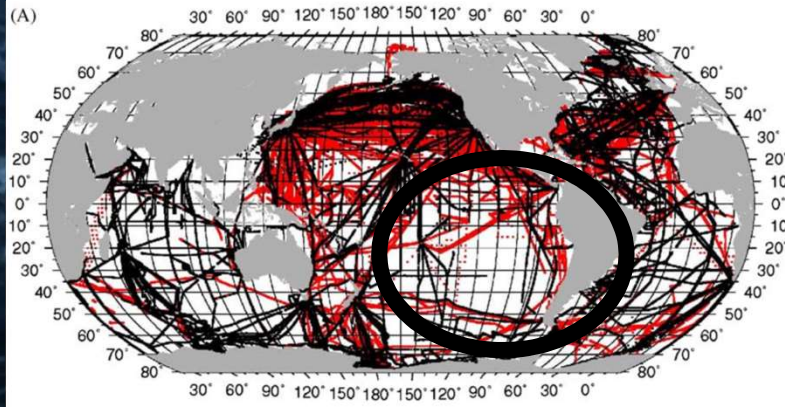
Apparent weak mean CO2 flux in the south east Pacific based on **no observations**

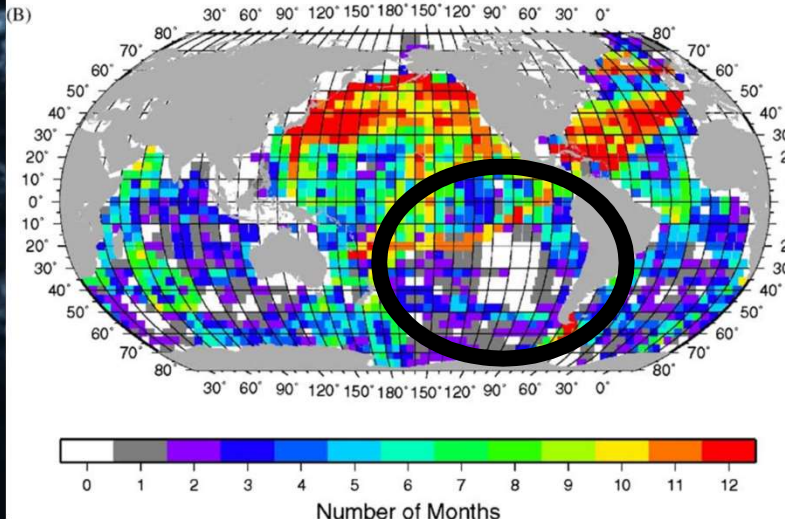
The “hole” falls within the Subantarctic Zone, associated with CO2 sequestration

The hole is located directly upwind of Chile

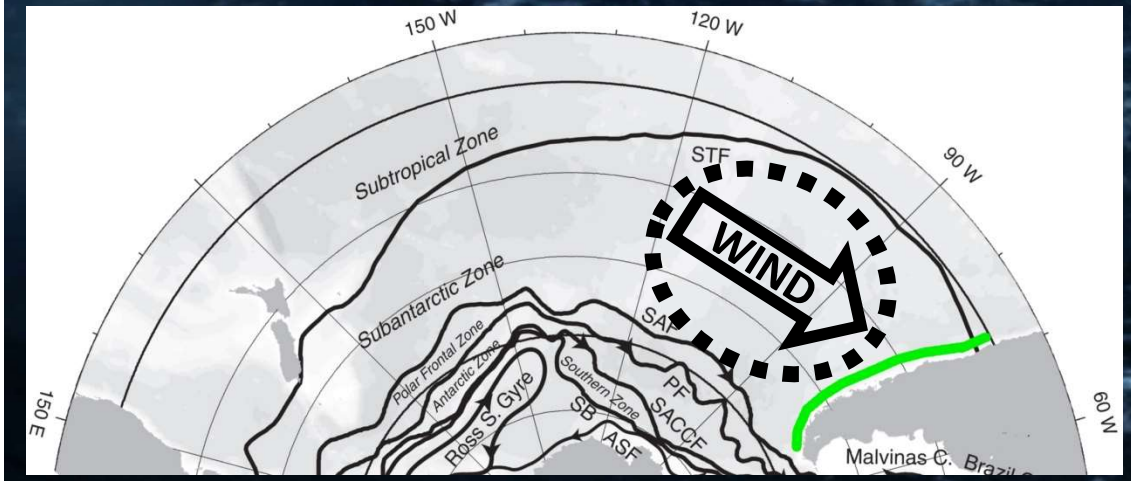






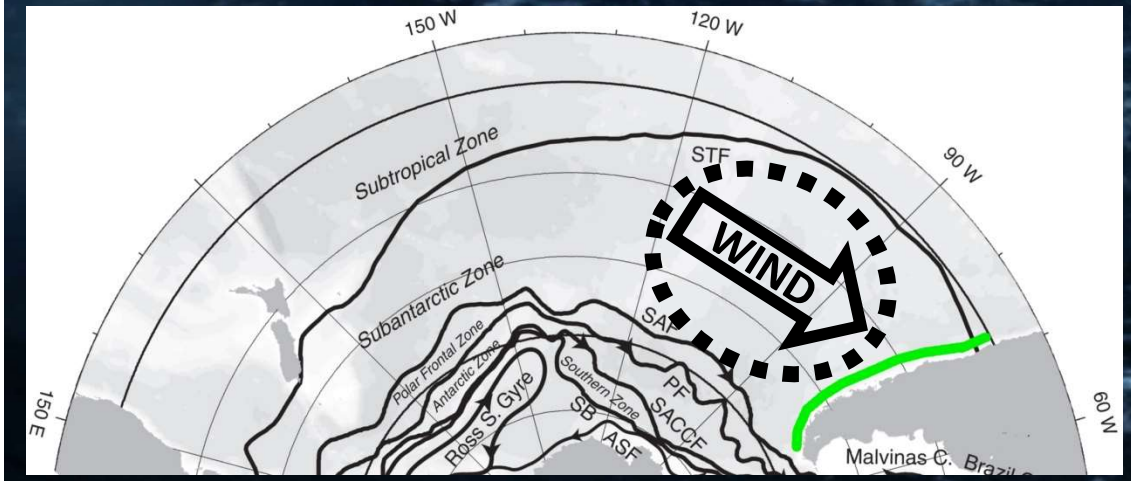


Can the air-sea carbon flux be deduced from downwind CO2?



Can the air-sea carbon flux be deduced from downwind CO2?

Using inverse methods it may even be posible
to infer spatial structure



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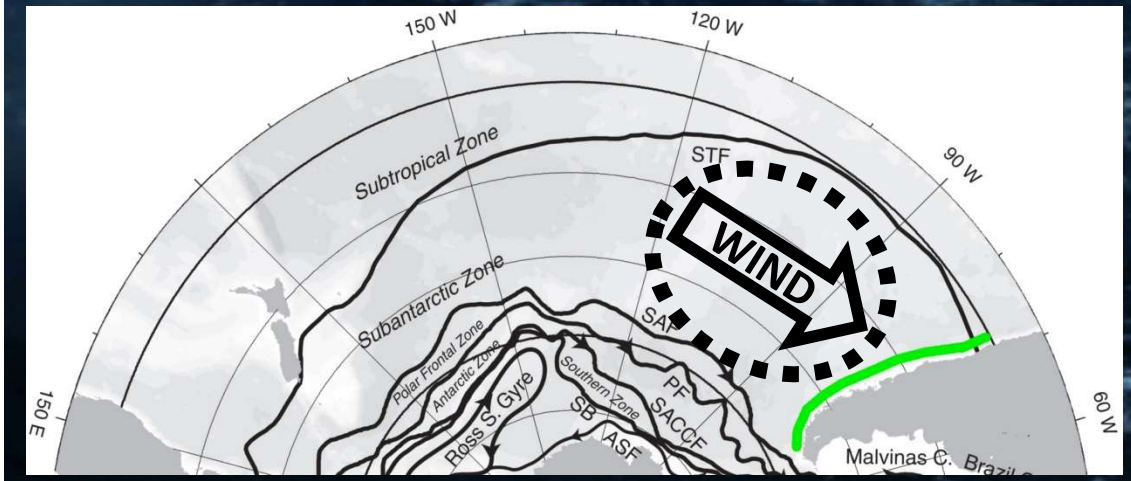


At the least we can estimate the zonal mean poleward flux in the atmosphere

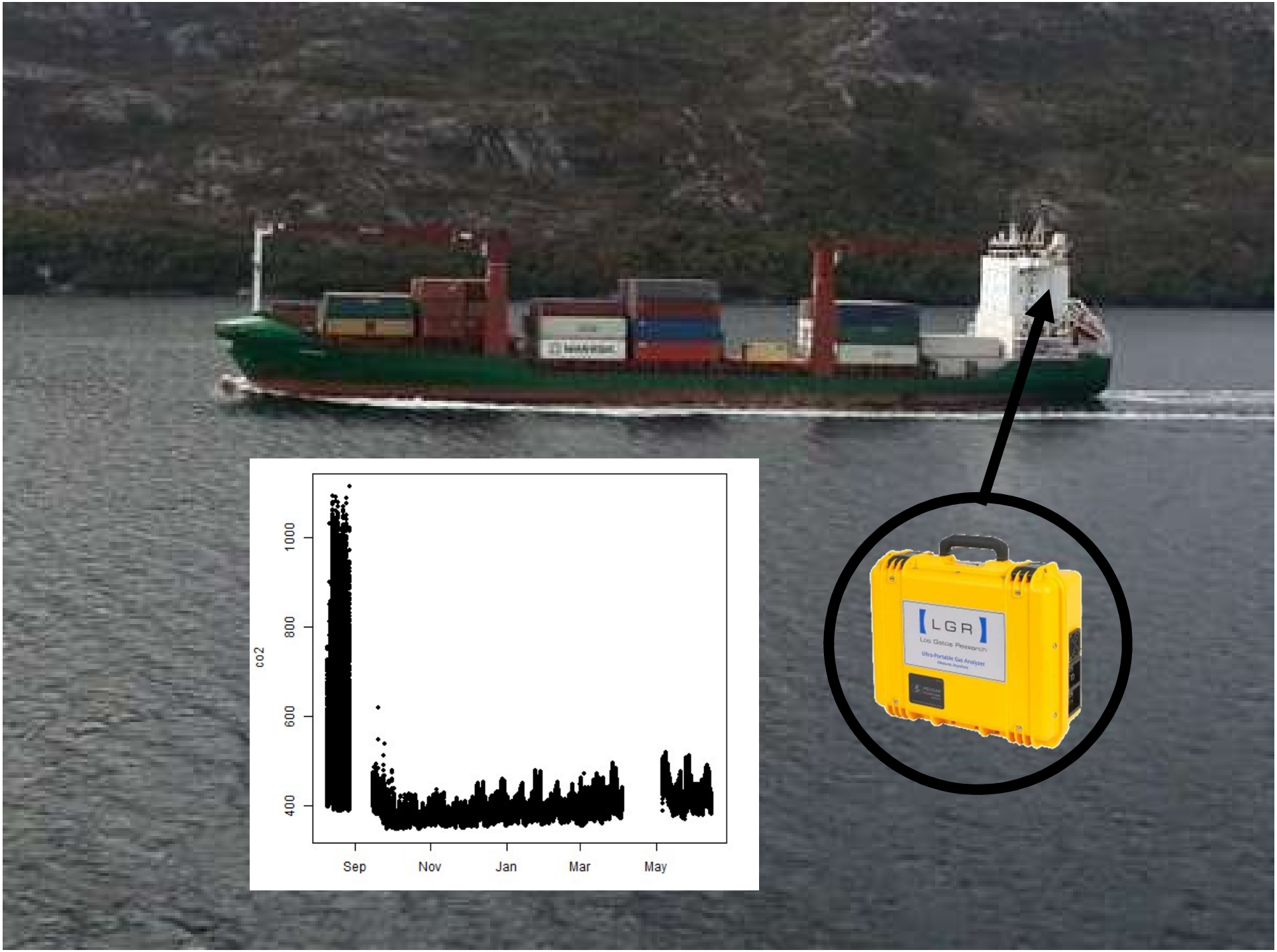
Continuously measure atmospheric CO_2 from the M/N Copihue

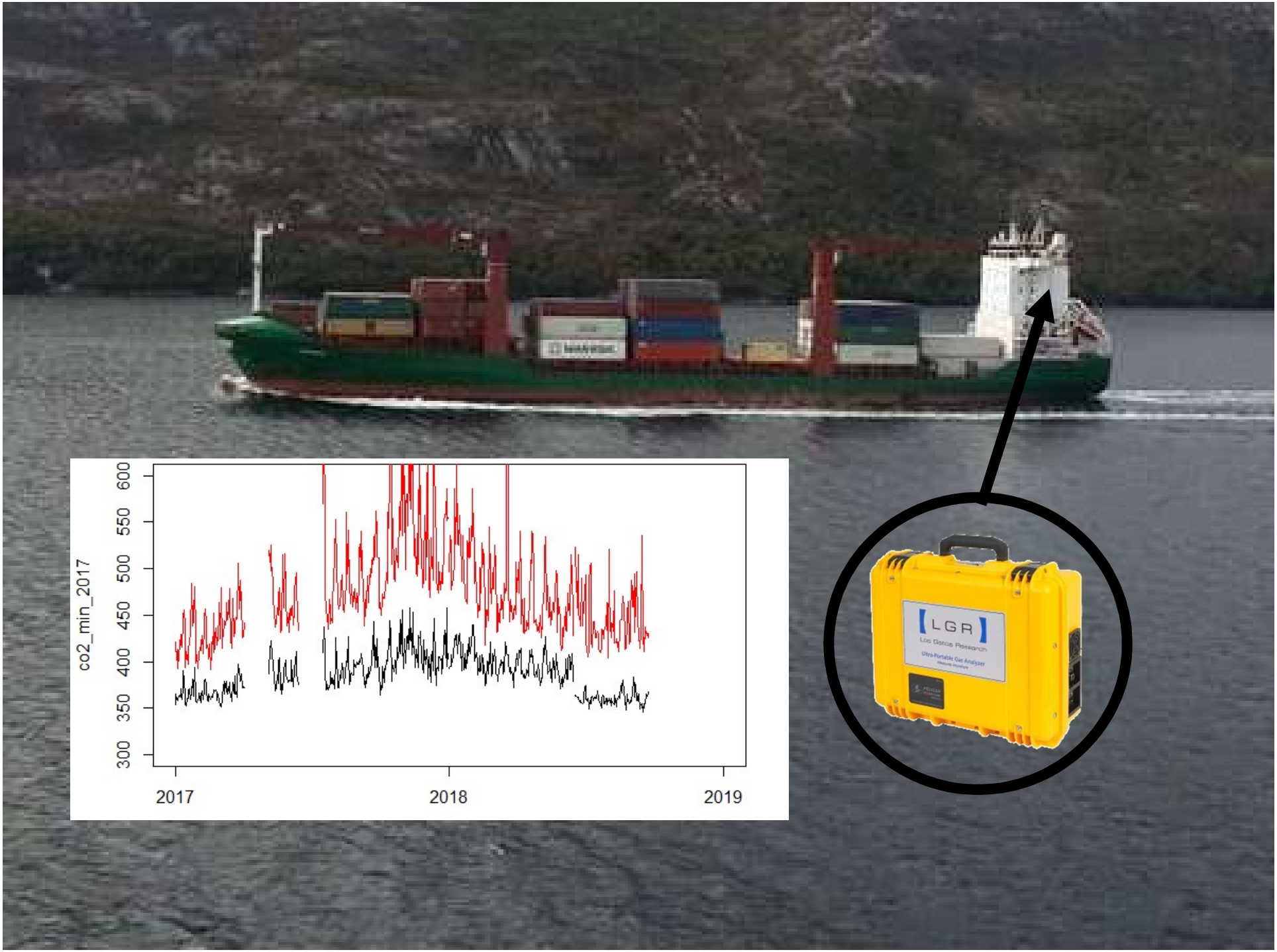
Weekly repeat meridional transects

Desirable to also measure pCO_2

Regional inversion – can we resolve spatial structure?


LGR
Los Gatos Research
Ultra-Portable Gas Analyzer


co2
400
600
800
1000
Sep
Nov
Jan
Mar
May
LGR
Los Gatos Research


co2_min_2017
300
350
400
450
500
550
600
2017
2018
2019
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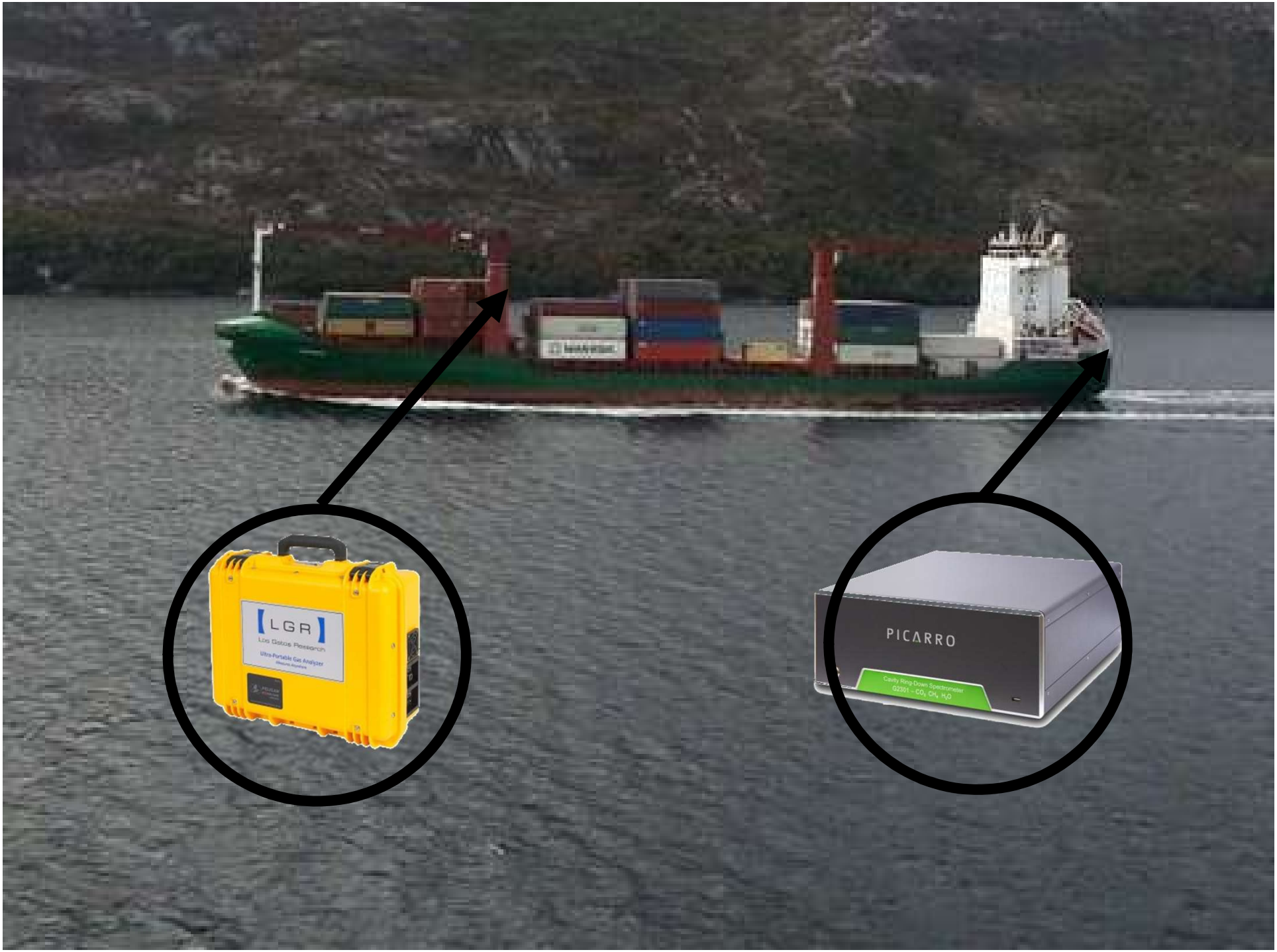
Ultra-Portable Gas Analyzer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PICARRO
Cavity Ring-Down Spectrometer
G2301 – CO2, CH4, H2O

Operational convenience of staying “within” ship’s circuit

Generate headspace by inducing cavitation

Semi permeable membrane located at cavitation point

Underway atmospheric monitoring for constraining Southern Ocean carbon uptake

The planned continuous atmospheric CO2 monitoring along a meridional transect may help constrain the global ocean's most uncertain air-sea carbon flux

The same data may help quantify the atmospheric polewards carbon flux

We hope to test an alternative pCO2 system