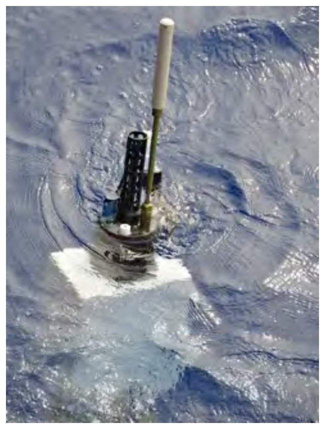
SOCLIM meeting
Villefranche-sur-Mer
18. Sept. 2017

CONTENT: Improved estimates of open ocean CO_2 parameters from T/S/O_2 data for underway and profile applications*: Application to the Austral Ocean

biogeochemical Argo



GO-SHIP

Henry C. Bittig, Tobias Steinhoff, Hervé Claustre, Björn Fiedler, Arne Körtzinger, Jean-Pierre Gattuso

LOV Laboratoire d'Océanographie de Villefranche, France / UPMC, Paris, France
GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Kiel, Germany

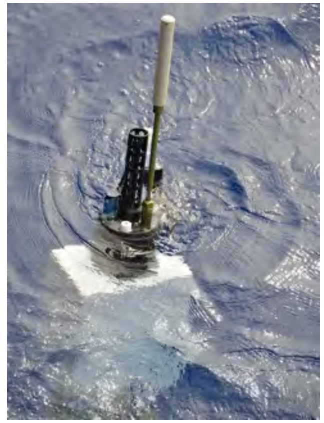
*(Bittig et al., in prep.)

AtlantOS UPMC SORBONNE UNIVERSITÉS remOcean LOV

How to benefit from & link both?

LOV

biogeochemical Argo



GO-SHIP

- Global Coverage
- Weekly Cycles
- 6 Key Parameters + T/S

→ ←

- Global Coverage
- Multiannual Repeat
- Extensive Parameter List

Wanted: Way to Transfer Information from One to Another

CANYON

CArbonate system and Nutrient concentrations from hYdrological properties and Oxygen using a Neural-network

frontiers in Marine Science

ORIGINAL RESEARCH
published: 22 May 2017
doi: 10.3389/fmars.2017.00128

Estimates of Water-Column Nutrient Concentrations and Carbonate System Parameters in the Global Ocean: A Novel Approach Based on Neural Networks

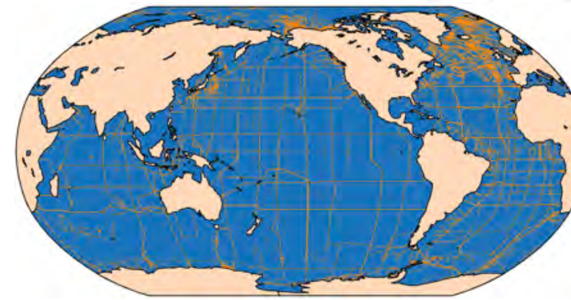
Raphaëlle Sauzède[1,2], Henry C. Bittig[1], Hervé Claustre[1], Orens Pasqueron de Fommervault[1,3], Jean-Pierre Gattuso[1,4], Louis Legendre[1] and Kenneth S. Johnson[5]*

Data Perspectives

Scattered Data View

→ GLODAPv2

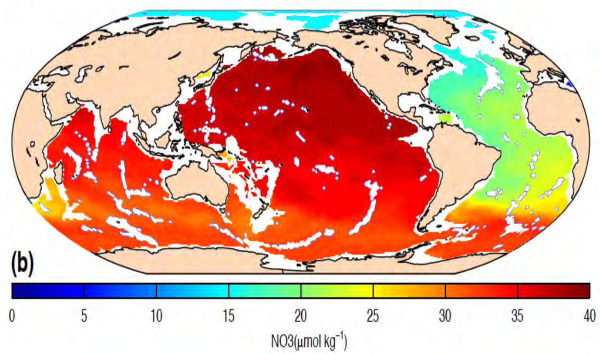
(Olsen et al., 2016)

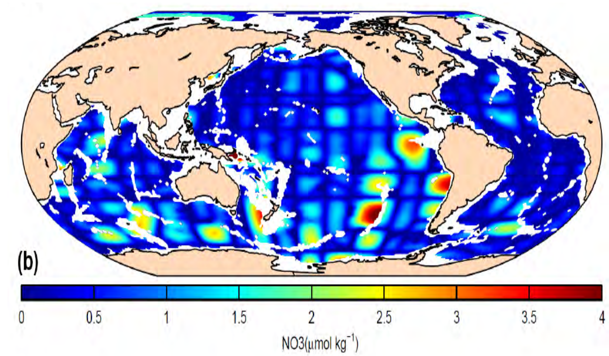


Climatological View

→ Spatial Mapping (+Mapping Error)

(Lauvset et al., 2016)





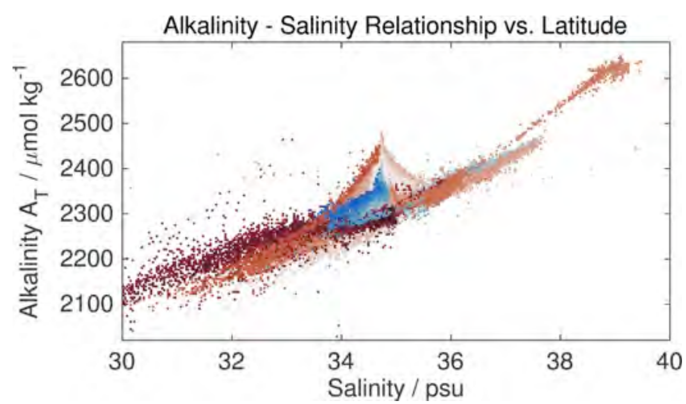
Parameter Interrelation View

→ Mapping from "Simple Parameters" to "Complex Parameters"

P, T, S, O_2, Location, Time

→ NO_3^-, PO_4^{3-}, $Si(OH)_4$, C_T, A_T, pH, $p$$CO_2$

(Sauzède et al., 2017; Carter et al., 2017)



Parameter Interrelations (thanks to GLODAP!)

CANYON

CArbonate system and Nutrient concentrations from hYdrological properties and Oxygen using a Neural-network

P, T, S, O_2, Location, Time → NO_3^-, PO_4^{3-}, $Si(OH)_4$, C_T, A_T, pH, pCO_2

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	NO_3^- / µmol kg^{-1}	PO_4^{3-} / µmol kg^{-1}	$Si(OH)_4$ / µmol kg^{-1}	C_T / µmol kg^{-1}	A_T / µmol kg^{-1}	pH	pCO_2
Accuracy	1.04	0.074	3.2	11	9	0.020	7.6 %

(based on GLODAPv2)

→ Parameterization of water mass properties, biogeochemical processes, and regional anomalies.

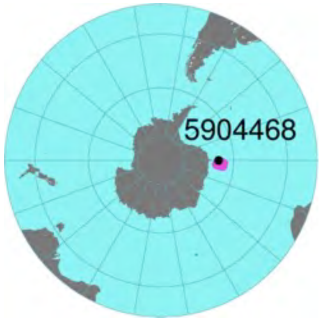
→ No inclusion of “unobserved” phenomena.

What can we learn from GO-SHIP?

BGC-Argo ← CANYON mapping ← GO-SHIP Data (collected in GLODAPv2)

(1) Validation / Calibration of Sensor Data

→ NO_3^- and pH Sensor Drift and Offset



Validation / Calibration of BGC-Argo Sensor Data

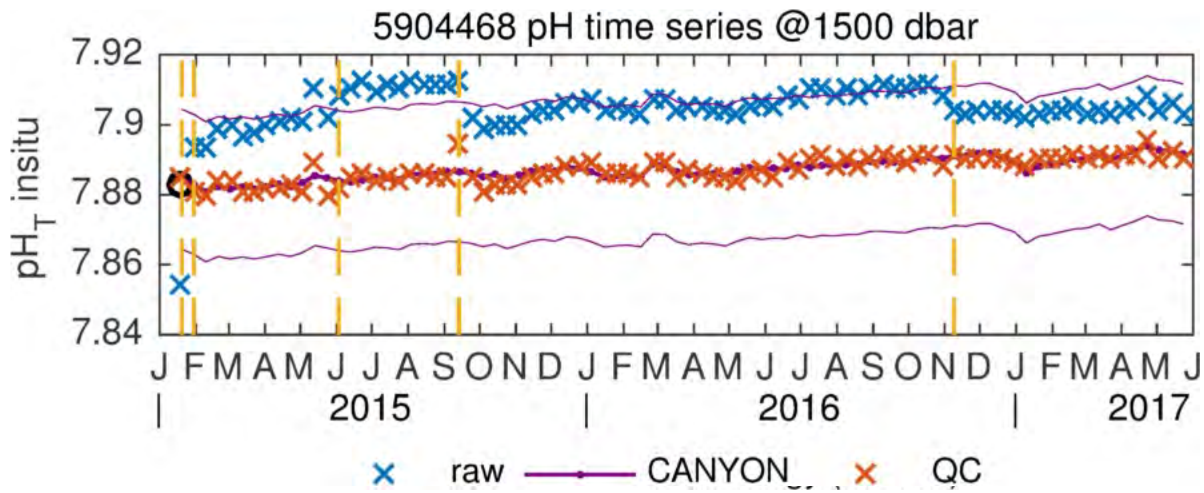
NO_3^- and pH Sensors prone to Drift (and Offsets)

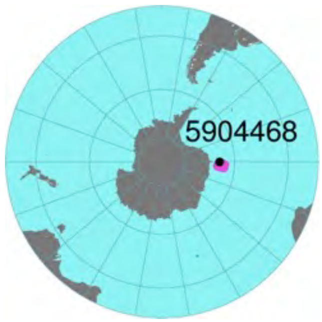
→ Correction on Deep Reference, e.g.,

Deployment Bottle Data

GLODAPv2 Spatial Interpolation

GLODAPv2 NN / MLR Parameter Interrelation





→ Correction propagated on all other Depth Levels.

What can we learn from GO-SHIP?

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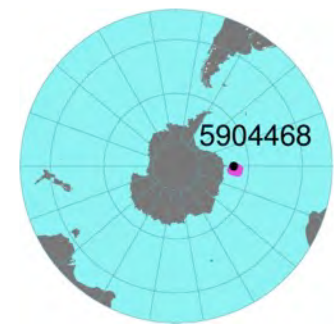
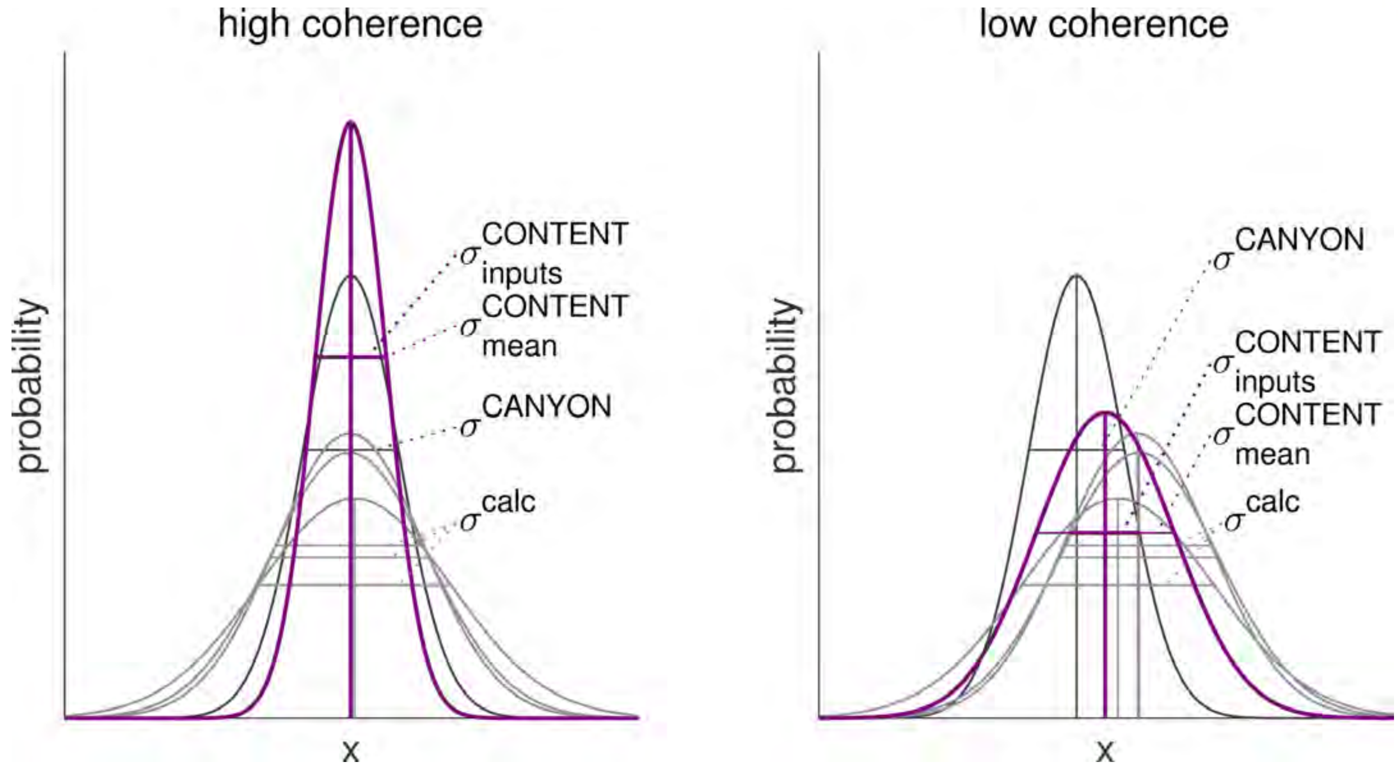


Can we do even better?

→ Use all 4 carbon CANYONs & combine with CO_2 system calc.s
  - (1) "Overdetermined" CO_2 system → Improve estimate
  - (2) Coherence of estimates → Provide confidence (locally!)

→ CONTENT: CONsisTency Estimation aNd amounT (Bittig et al., in prep.)

CONTENT Benefits



Parameter	A_T / μmol kg^{-1}	C_T / μmol kg^{-1}	pH_T	pCO$_2$
σ^{CANYON} (Sauzède et al., 2017)	9.4	11.2	0.020	7.6 % (30 μatm @ 400 μatm)
$\sigma^{\text{CONTENT}}_{\text{inputs}}$ ($\leq \sigma^{\text{CONTENT}}$) (Bittig et al., in prep.)	7.4	7.4	0.014	3.3 % (13 μatm @ 400 μatm)

CONTENT Validation

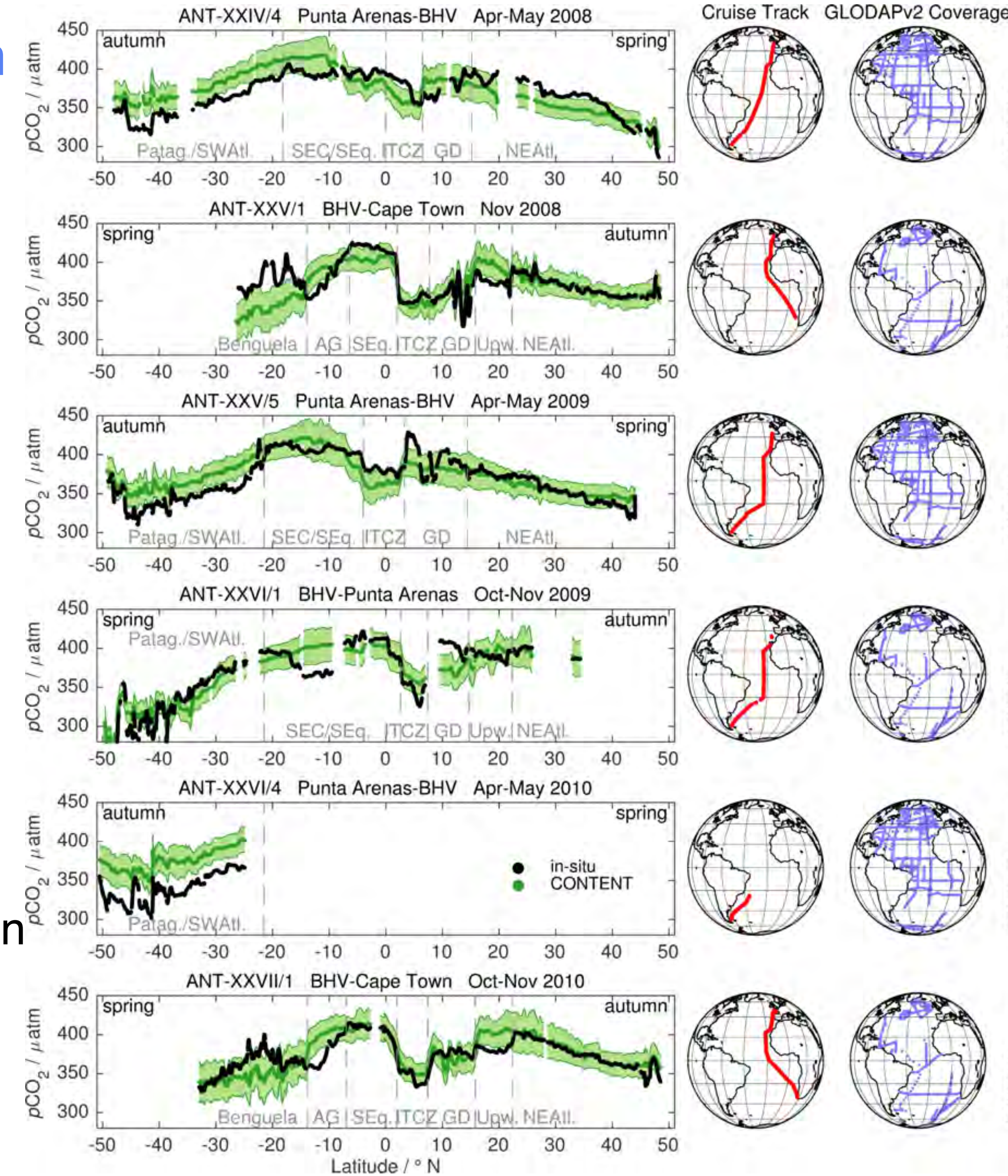
Surface underway pCO_2 and (calibrated!) O_2 data (Oceanet project)

Polarstern transits spring/autumn

pCO_2/O_2 gas exchange time scale: pCO_2 draw-down more persistent

Good prediction depends on good coverage and consistent parameterization

(Bittig et al., in prep.)



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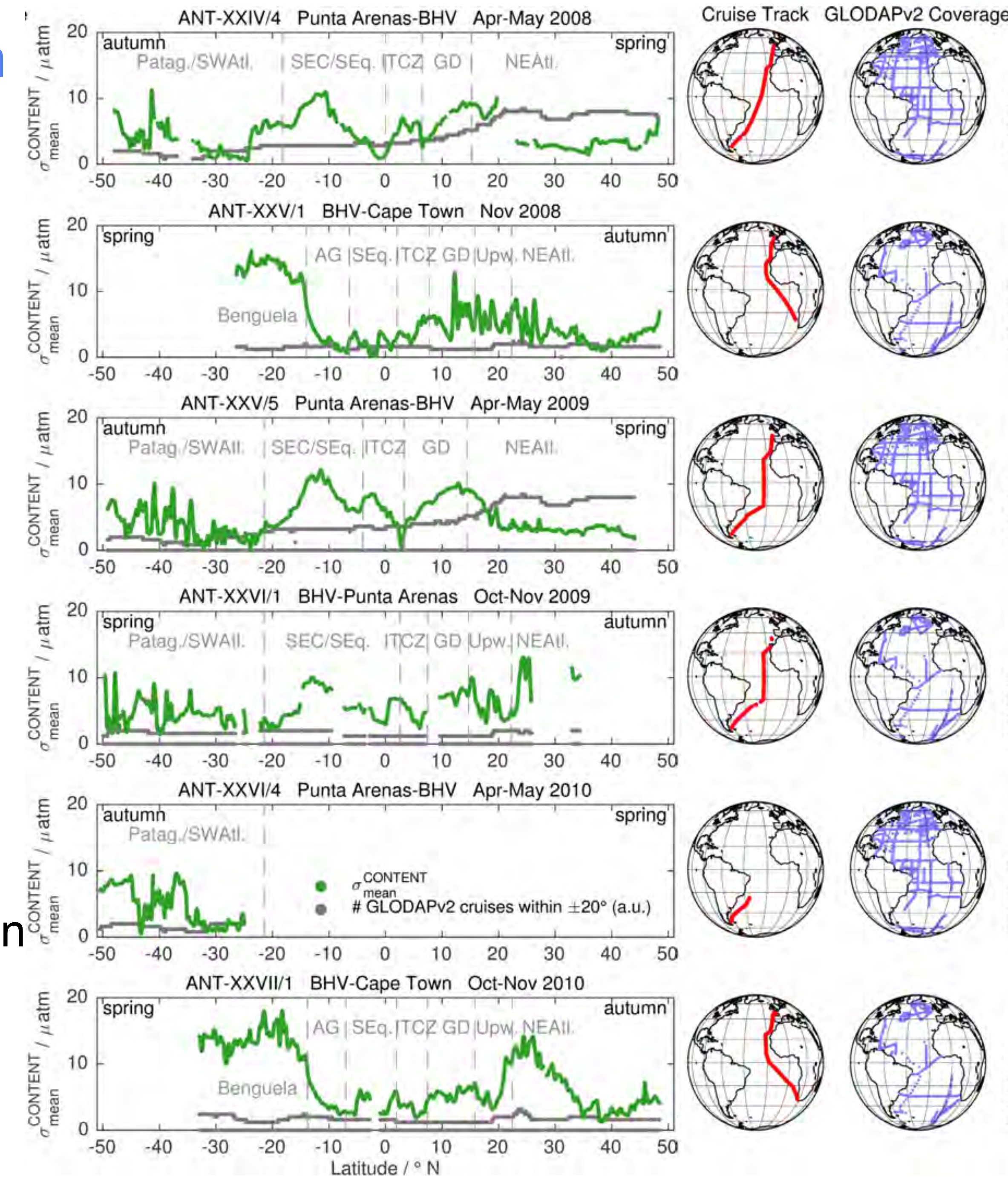


What can we learn from BGC-Argo?

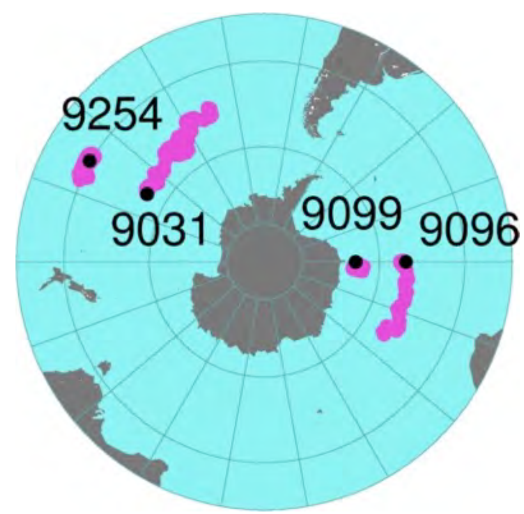
~~CANYON~~ CONTENT mapping

BGC-Argo → GO-SHIP Data (collected in GLODAPv2)

(1) Temporal and Spatial Resolution

(2) Observational Gaps

→ Surface pCO_2 estimates from SOCCOM Floats in the Southern Ocean (mid-2014 – end 2016)



(Bittig et al., in prep.)

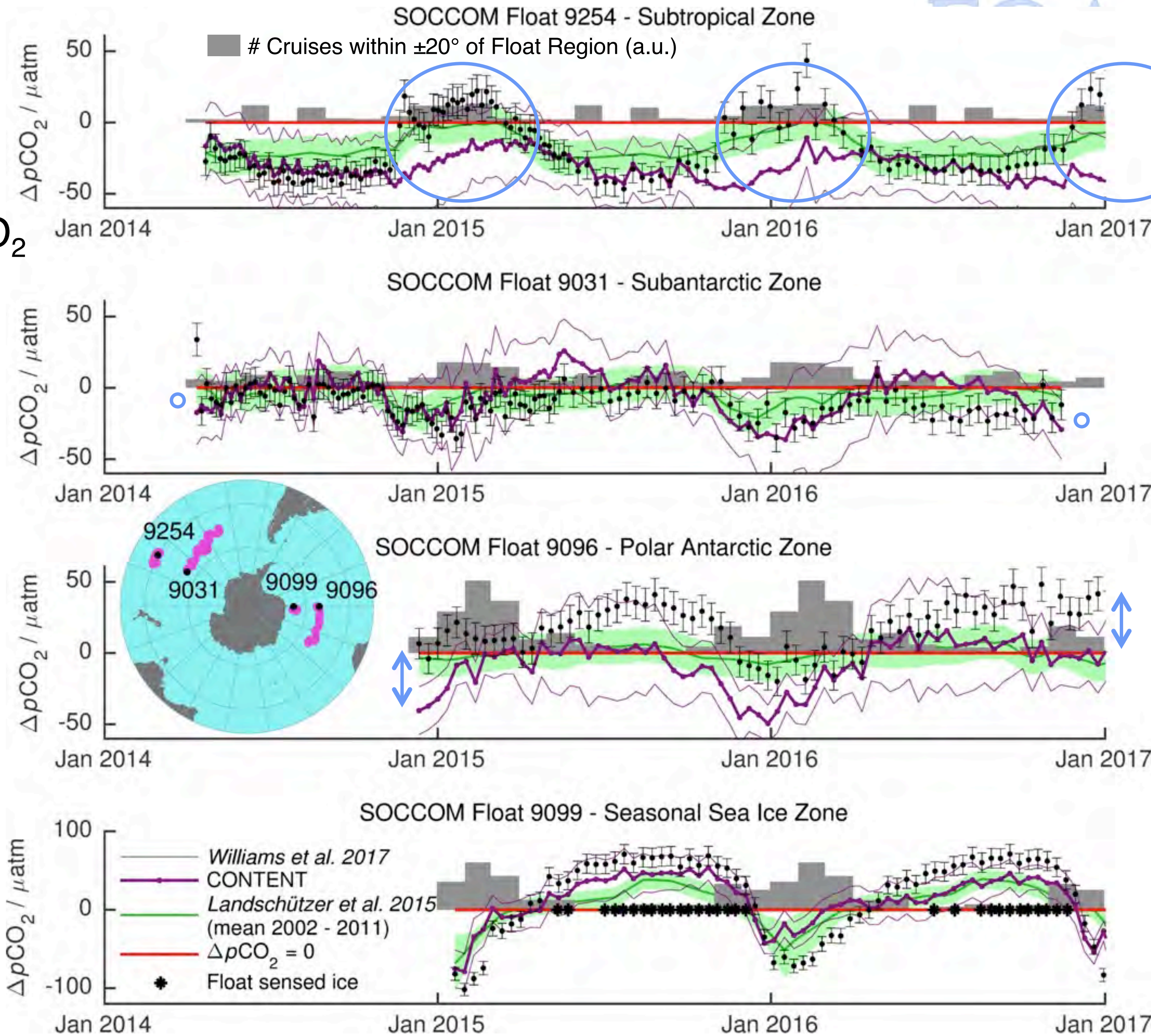
Southern Ocean surface pCO_2 estimate

Climatology
(Landschützer et al. 2015)

CONTENT / Argo-O_2
~ GO-SHIP mapping
(Bittig et al., in prep.)

pH CO_2 System Observation
(Williams et al. 2017)

Disagreement
→ Coverage Issue?!



(Bittig et al., in prep.)

SOCLIM floats (preliminary! No O_2 drift checks..)