

The Surface Ocean CO₂ Atlas enables quantification of the ocean carbon sink and ocean acidification



Ute Schuster
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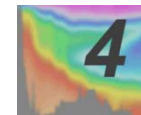
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and all >>100 SOCAT contributors



UK Ocean Acidification Research Programme



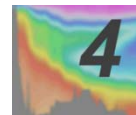
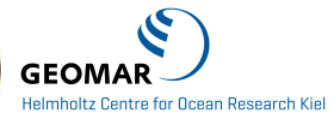
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The Global Carbon Budget (2005-2014)

Sources



Fossil fuel & cement sources
 $9.0 \pm 0.5 \text{ Pg C yr}^{-1}$ (91%)



Land-use change (9%)
 $0.9 \pm 0.5 \text{ Pg C yr}^{-1}$

Sinks



Atmosphere (44%)
 $4.4 \pm 0.1 \text{ Pg C yr}^{-1}$



Ocean sink (26%)
 $2.6 \pm 0.5 \text{ Pg C yr}^{-1}$



Land sink (residual)
 $3.0 \pm 0.8 \text{ Pg C yr}^{-1}$
(30%)

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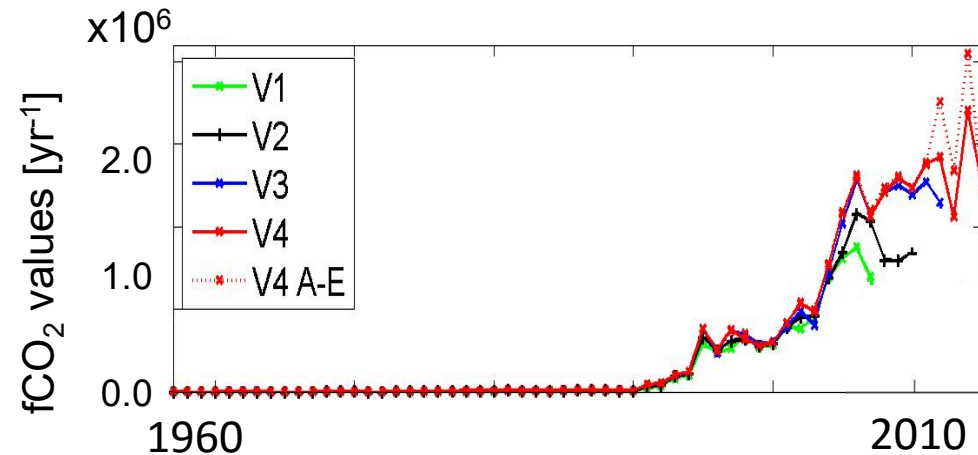
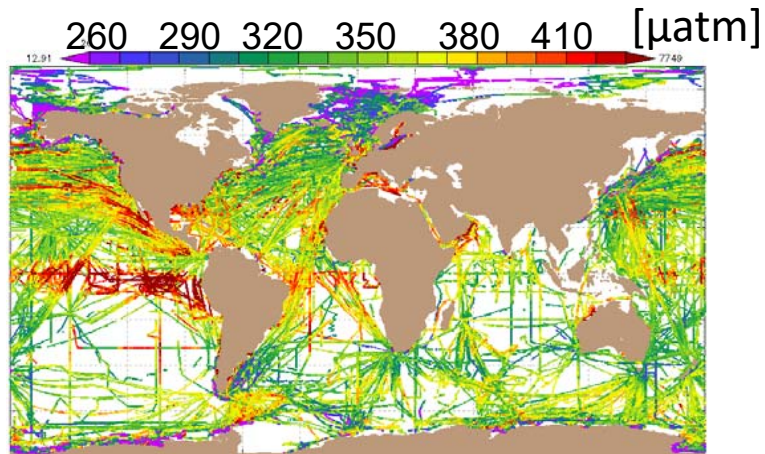


www.socat.info

(Bakker et al., 2016)

version 4

It's public !



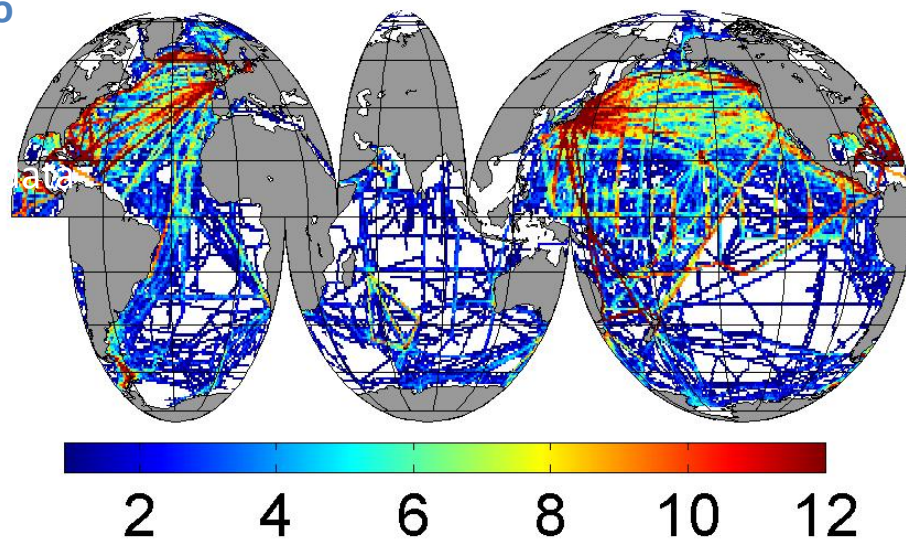
Global synthesis and gridded products of surface ocean fCO₂

- has uniform format, and is quality controlled;
- can be viewed interactively online;
- is publically available and freely downloadable;
- fair Data Use Statement;

Version 4:

- 18.5 x 10⁶ fCO₂ values, < ± 5 μatm from 1957-2015 (flags of A-D);
- plus calibrated sensor data, < ± 10 μatm (flag of E);

Future SOCAT versions



Months of the year with
fCO₂ values
(1970-2014)
(version 3)

(Bakker et al., 2016)

Version 5:

- **Data upload ends 15 January 2017;**
- **Quality control ends 31 March 2017;**
- Release in summer 2017;

Version 6:

- Version 5 dates + 1 year

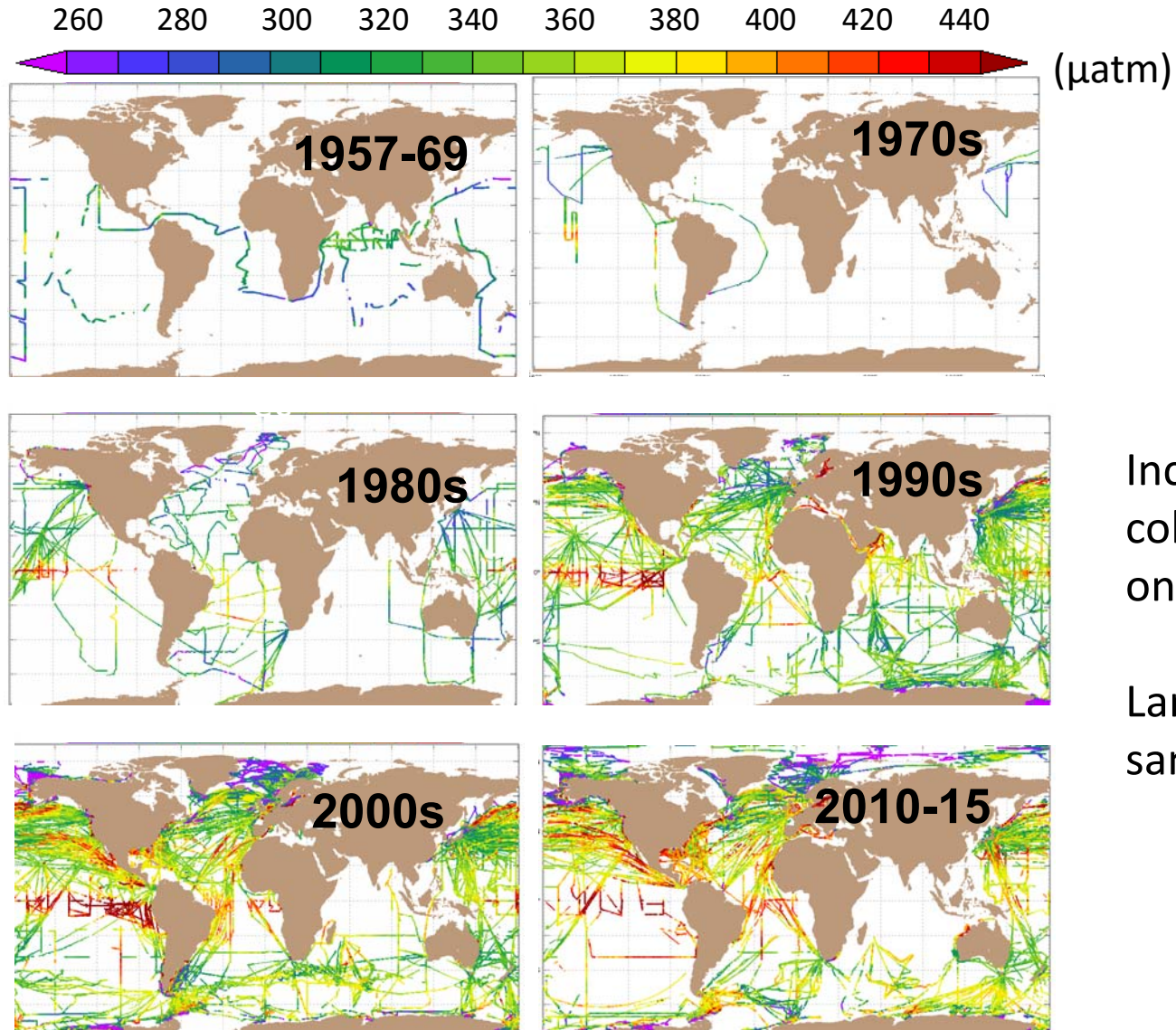
Sea surface temperature and salinity (not QC-ed).

Atmospheric CO₂ measurements accepted (no QC yet);

Extra surface water parameters (DIC, TA, ...) accepted, but **no QC planned**.

SOCAT-MEMENTO working group on N₂O, CH₄.

Surface water fCO₂ per decade (v4)

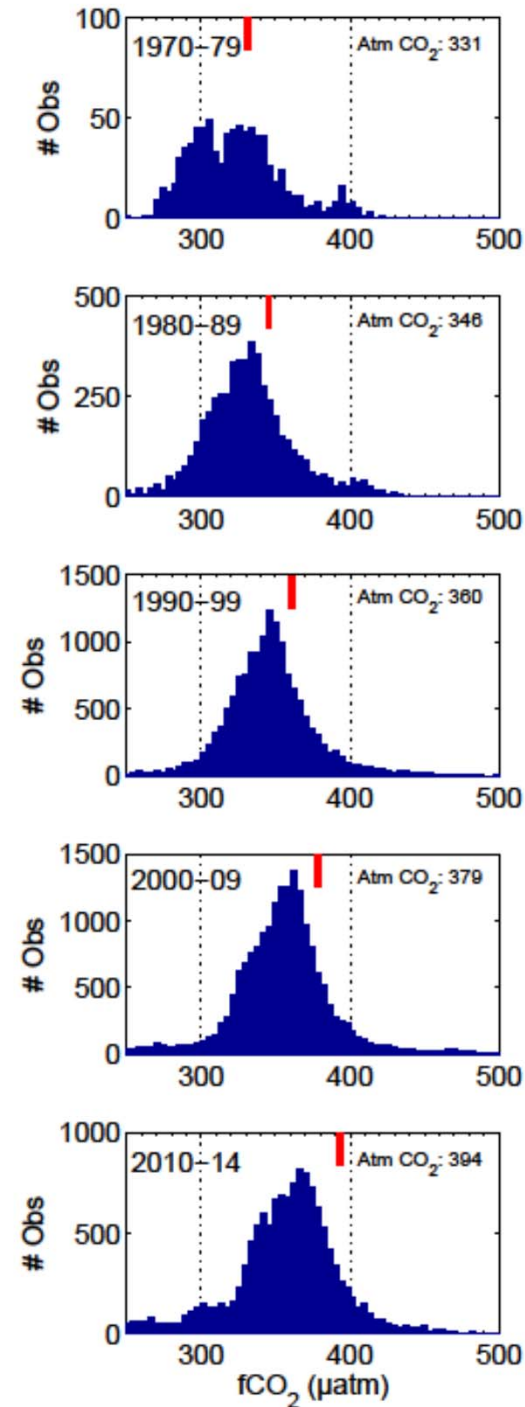


Increase in fCO₂ data collection from 1990s onwards.

Large regions are not sampled.

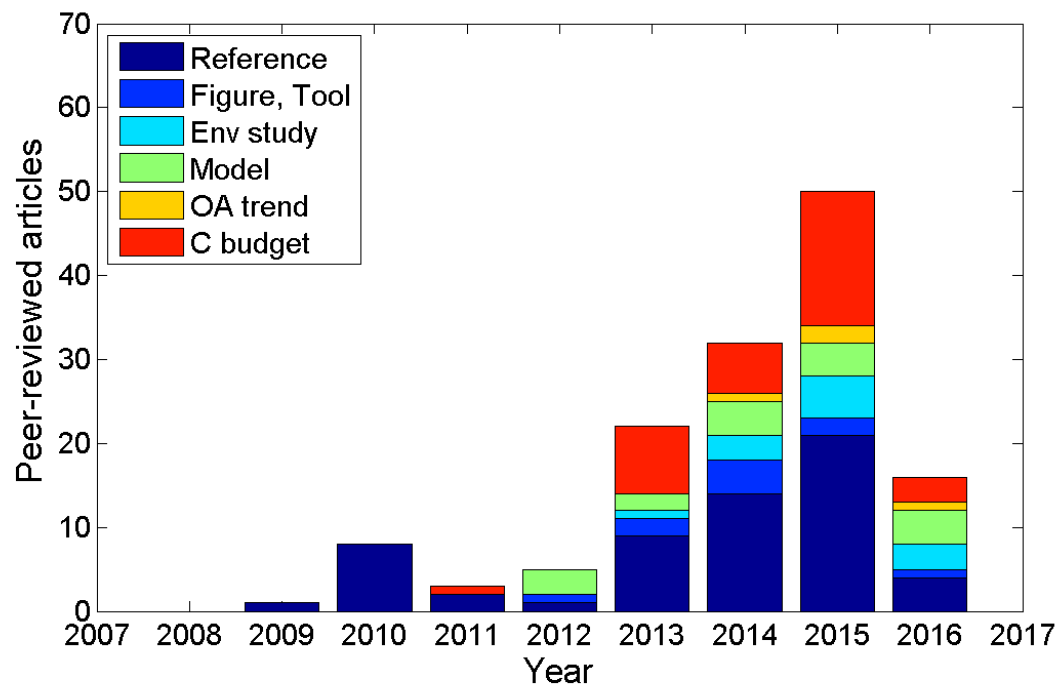
(after Bakker et al., 2016)

Increasing surface water fCO₂ over time (v3)



(Bakker et al., 2016)

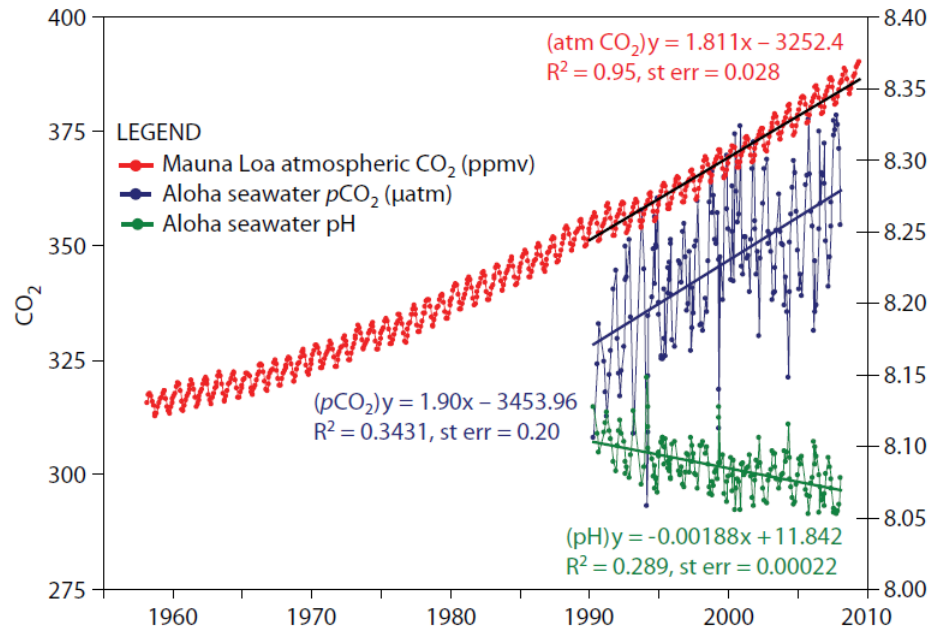
Applications of SOCAT in peer-reviewed articles



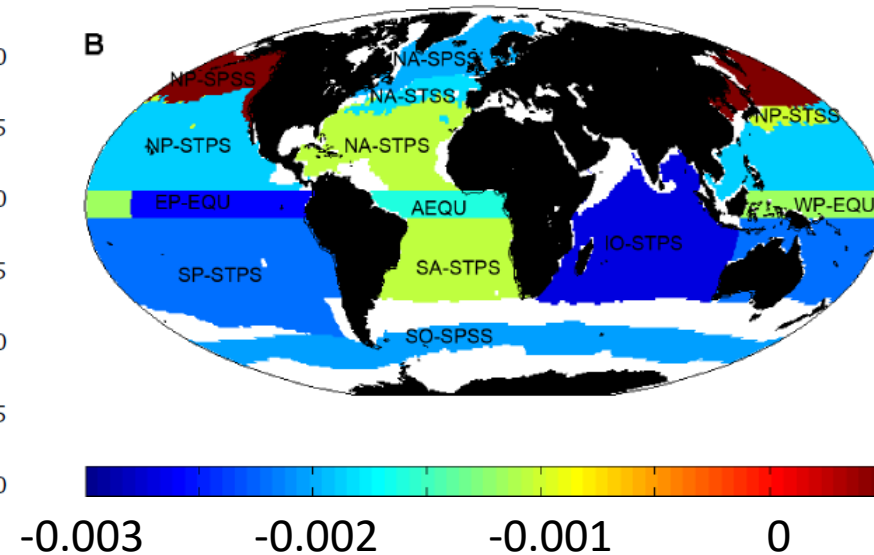
SOCAT is named or cited in
>>140 peer-reviewed articles:

- Reference to SOCAT,
- Figures or tools,
- Environmental studies,
- Modelling,
- Ocean acidification studies,
- Carbon budgeting.

Figure of 22 April 2016



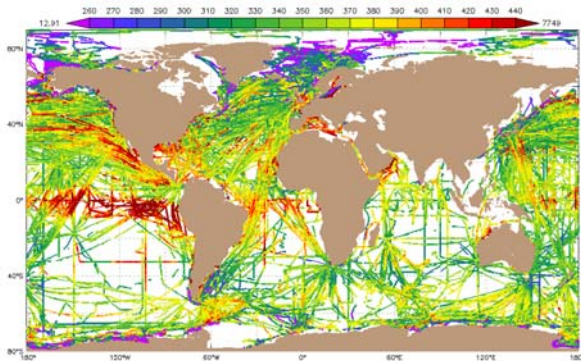
Surface ocean pH change for 1991 to 2011 per biome



- Combine SOCAT fCO₂ with salinity-derived alkalinity
- Mean pH decrease of 0.002 units per year from 1991 to 2011
- SOCAT enables quantification of regional trends in surface ocean pH

(Feely et al., 2009; Lauvset et al., 2015)

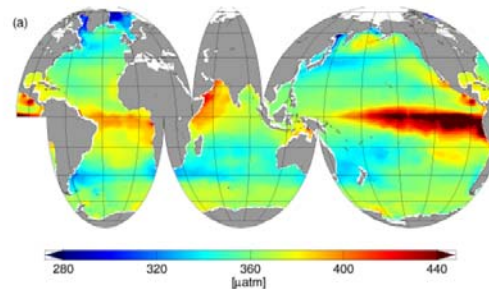
Mapping (gap filling) of surface ocean pCO₂ observations



A synthesis data product
(here SOCAT v4)



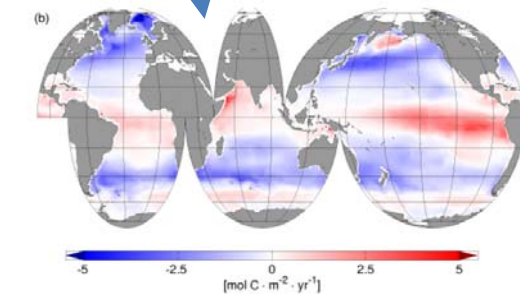
Mapping technique



Surface water pCO₂
(here 1998-2011)



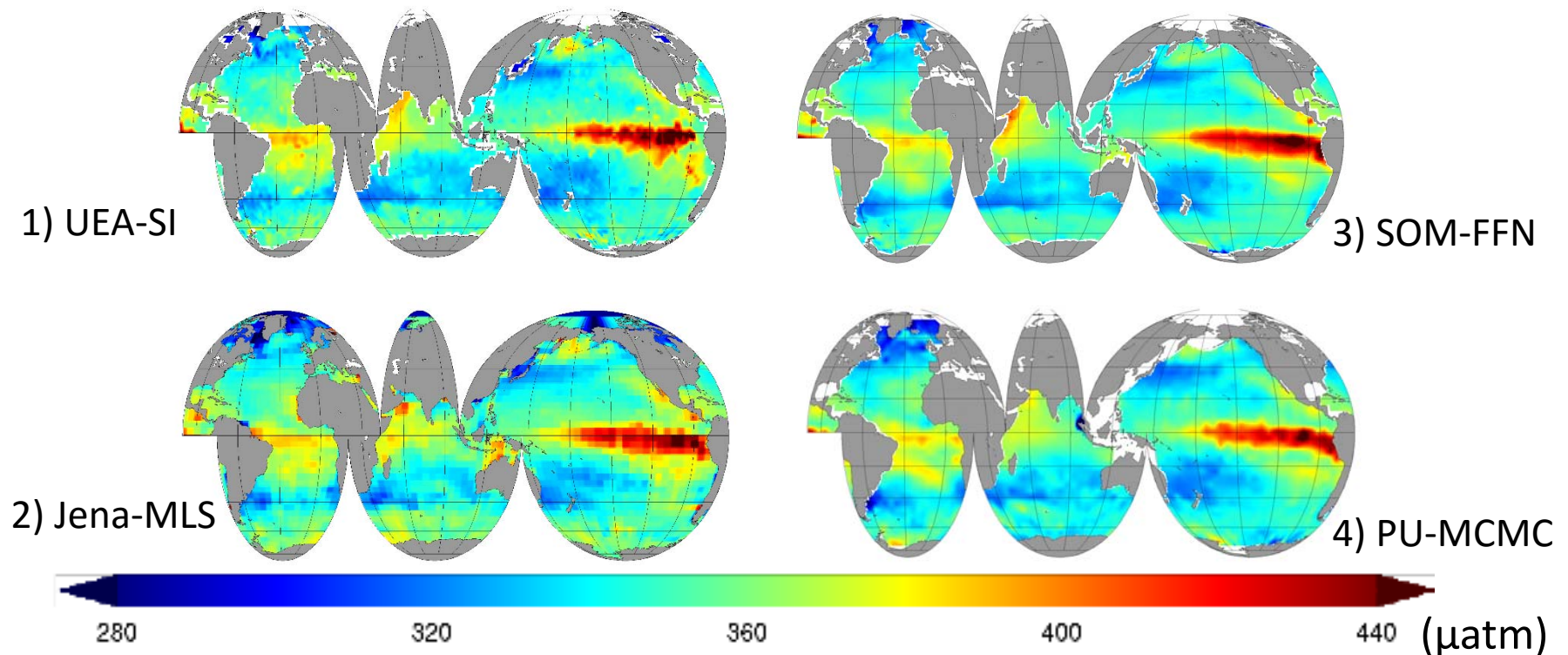
Flux calculation



Sea to air CO₂ flux
(here 1998-2011)

(Bakker et al., 2016; Landschützer et al., 2014; Rödenbeck et al., 2015)

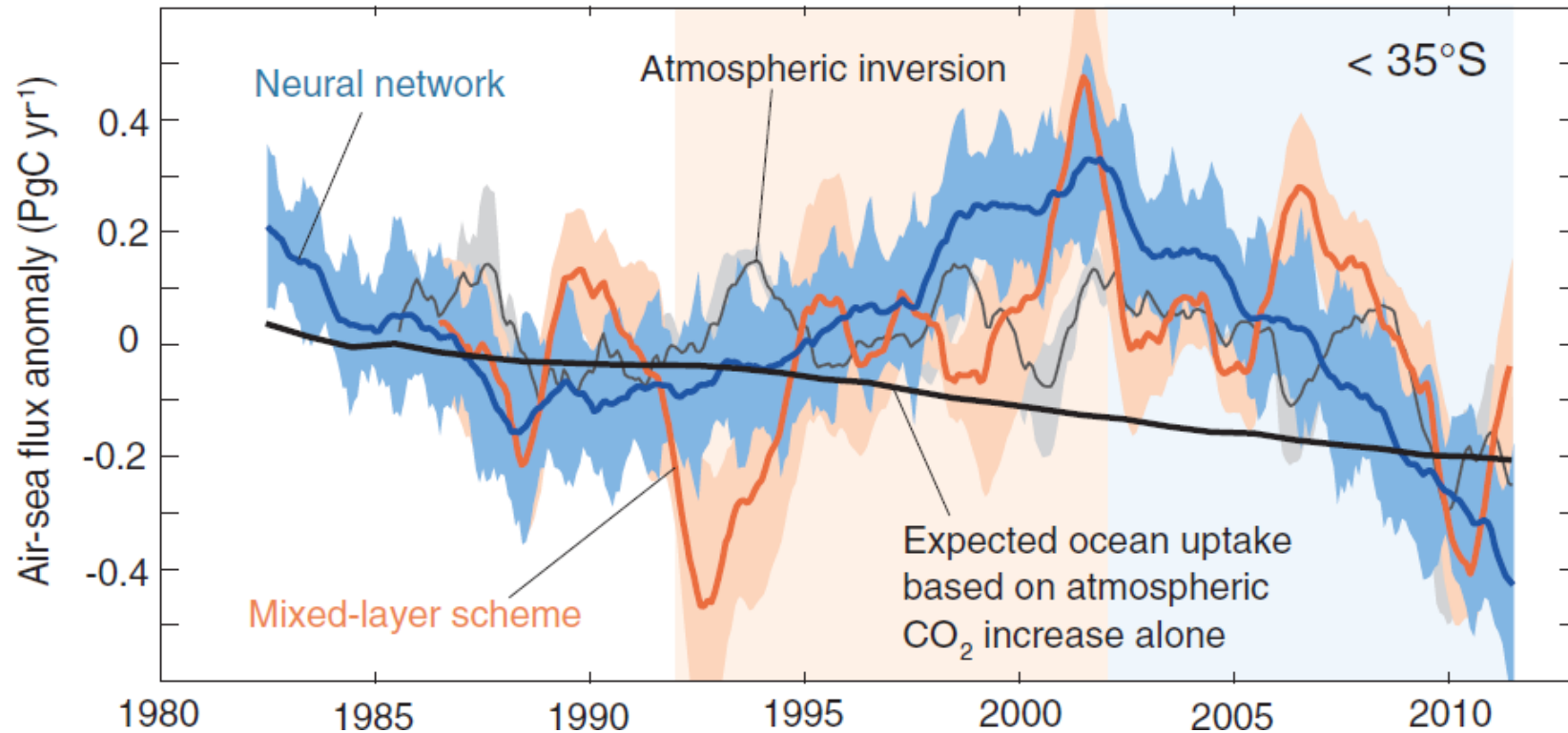
Mean surface ocean pCO₂ (2000-2009)



Data-based mapping of the ocean carbon sink provides **priors for atmospheric inversion, thus aiding quantification of the land sink**

(Van der Laan et al., 2014; Jones et al., 2015; Rödenbeck et al., 2014, 2015)

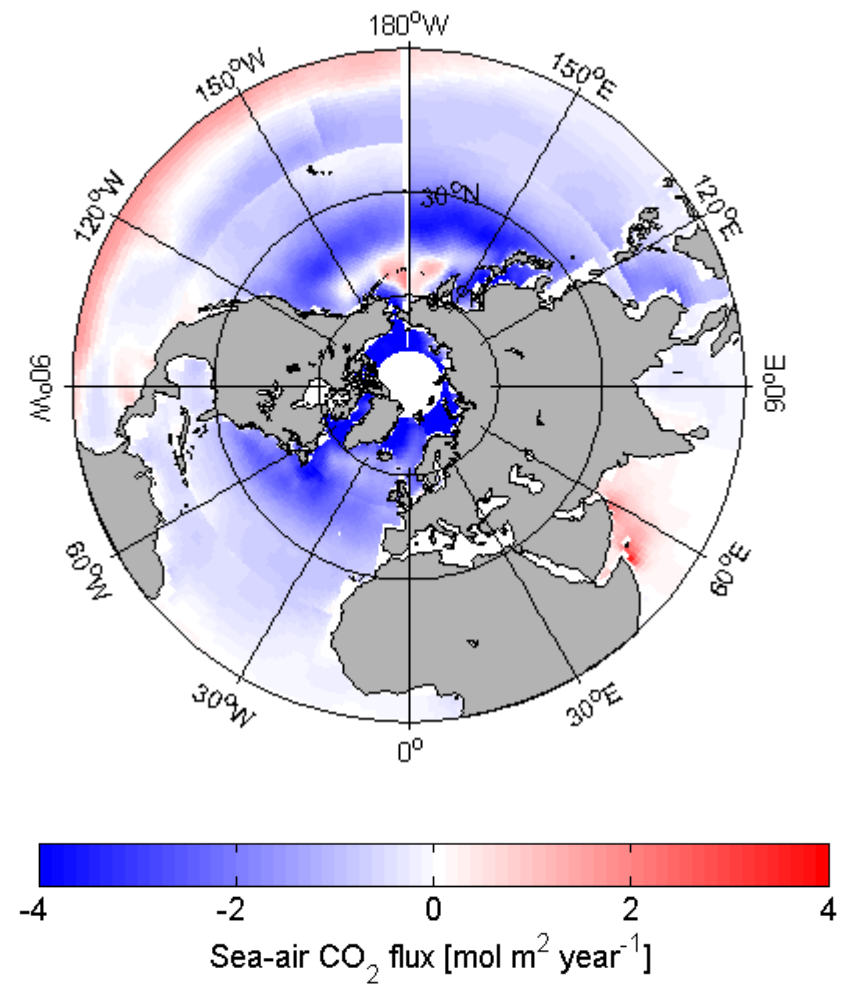
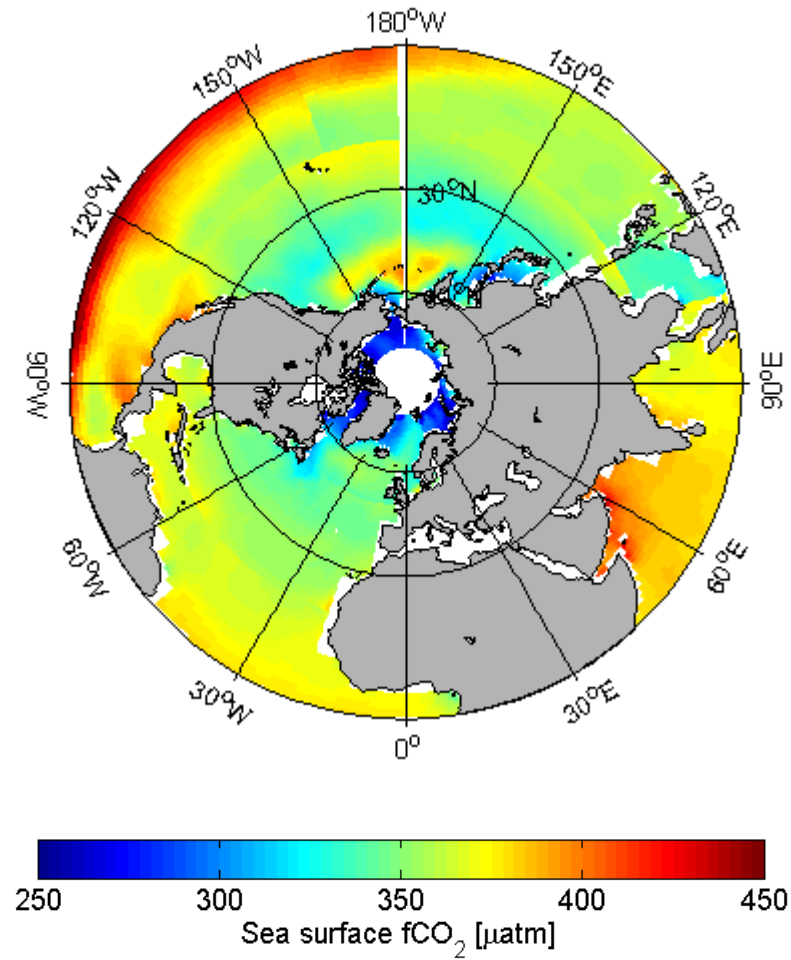
Reinvigoration of the Southern Ocean carbon sink



2 methods using SOCAT version 2;
 $\Delta p\text{CO}_2$ trends dominate the sink variability;
 $\Delta p\text{CO}_2$ trends lead to a sink increase of $>0.5 \text{ PgC/yr}$.

(Landschützer et al., 2015)

Northern Hemisphere ocean carbon



(Schuster et al., in prep)



Acknowledgements

SOCAT has >> 100 contributors and numerous funding agencies.

Acknowledge the **contribution of the data providers**, e.g. by invitation to co-authorship, notably in **regional studies**, and by citation of relevant scientific publications.

Version 5 data upload ends 15 January 2017 & V5 QC ends 31 March 2017.

Sustained funding for data collection and synthesis is key.

SOCAT needs **quality controllers!**

User feedback essential.

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