Release of SOCAT Version 2

SURFACE OCEAN CO_2 ATLAS

and international effort

Presented for the SOCAT team by

Benjamin Pfeil, University of Bergen/Bjerknes Centre for Climate Research

Background of the Surface Ocean CO_2 Atlas Project

- Initiated in 2007 at UNESCO with the two aims:
  - Global surface ocean data set of recalculated fCO_2 in a uniform format with 2nd level quality control
  - Global gridded product of monthly surface water fCO_2 means, with no temporal or spatial interpolation (i.e. bin averages).
- Those data products will be made public and all methods in SOCAT are fully documented and transparent.
- Regional and global groups were established

Background of the Surface Ocean CO_2 Atlas Project

- SOCAT V1.5 was made public in 2011 with 6.3 million fCO_2 data on > 1850 cruises covering the years 1968-2007

Earth Syst. Sci. Data, 5, 125–143, 2013
www.earth-syst-sci-data.net/5/125/2013/
doi:10.5194/essd-5-125-2013

A uniform, quality controlled S
CO_2 Atlas (SOCAT

B. Pfeil[1,2,3], A. Olsen[1,2,4,5], D. C. E. Bakker[6], S. Hankin[7], H. Koyuk[8], N. Metzl[11], C. L. Sabine[7], J. Akl[12,13], S. R. Alin[7], N. Bates[14], R. J. Boutin[11], P. J. Brown[6,18], W.-J. Cai[19], F. P. Chavez[20], A. Chen[2] R. A. Feely[7], M. González-Dávila[23], C. Goyet[24], B. Hales[25], N. Hardi M. Hood[27], M. Hoppema[28], C. W. Hunt[29], D. Hydes[30], M. Ishii[31], R. M. Key[33], A. Körtzinger[34], P. Landschützer[6], S. K. Lauvse A. Lourantou[11], L. Merlivat[11], T. Midorikawa[35], L. Mintrop[36] A. Nakadate[39], Y. Nakano[38], S. Nakaoka[40], Y. Nojiri[40], A. M. Oma K. Paterson[12,13], F. F. Perez[41], D. Pierrot[42], A. Poisson[24], A. F. R J. Salisbury[29], V. V. S. S. Sarma[43], R. Schlitzer[28], B. Schneide I. Skjelvan[1,2,16], T. Steinhoff[34], T. Suzuki[45], T. Takahashi[46], K. T H. Thomas[49], B. Tilbrook[12,13,50], J. Tjiputra[1,2], D. Vandemark[29], A. J. Watson[6], R. Weiss[52], C. S. Wong[53], and H. Y

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Global Data Products Help Assess Changes to Ocean Carbon Sink

PAGES 125–126

Net oceanic uptake of the greenhouse gas carbon dioxide (CO_2) reduces global warming but also leads to ocean acidification [*Intergovernmental Panel on Climate Change (IPCC)*, 2007]. Understanding and predicting changes in the ocean carbon sink are critical to assessments of future climate change. Surface water CO_2 measurements suggest large year-to-year variations in oceanic CO_2 uptake for several regions [*Doney et al.*, 2009]. However, there is much debate on whether these changes are cyclical or indicative of long-term trends. Sustained, globally coordinated observations of the surface ocean carbon cycle and systematic handling of such data are essential for assessing variation and trends in regional and global ocean carbon uptake, information necessary for accurate estimates of global and national carbon budgets.

The Carbon Dioxide Information Analysis Center (CDIAC) has been assembling ocean carbon data from international contributors since 1993. A large amount of relevant data, however, cannot be found at CDIAC, having been archived at other data centers or kept private. Furthermore, the data are in varied formats and often have insufficient documentation. All these factors have been effective barriers to generating global CO_2 synthesis products essential for assessing changes in the ocean carbon sink.

In response to this, the International ocean carbon research community initiated the Surface Ocean CO_2 Atlas (SOCAT; http://www.socat.info/) in April 2007 [*International Ocean Carbon Coordination Project (IOCCP)*, 2007]. This project aims to improve access to surface water fugacity of CO_2 (fCO_2, similar to partial pressure) data from all ocean areas, to optimize their documentation and quality control (QC), and to ensure their long-term storage.

SOCAT Framework, Quality Control, and Products

Approximately 50 international seagoing marine carbon scientists and data managers have generously donated their time and expertise to SOCAT. These participants were organized into seven regional groups and a global coordination group. Six international workshops were held to resolve data integration and QC issues. The scientists developed protocols, software, and an interactive Web-based tool for data QC. SOCAT procedures were designed to be transparent and fully documented. Many additional data not yet in CDIAC were retrieved from data originators, public Web sites, and other data centers. Regional group members checked the documentation accompanying the data and carried out data QC. Whenever the QC process highlighted problems, data were suspended for revision by the data provider. A quality flag was assigned to each data set, and only good-quality data were included in SOCAT products.

SOCAT version 1.5, public since September 2011, contains 6.3 million surface water CO_2 measurements from the global oceans and coastal seas. The data originate from 1851 voyages by research vessels, commercial ships, and moored as well as drifting platforms. Two SOCAT products have been created: (1) a global data set of surface ocean fCO_2 from 1968 to 2007 (Figure 1) recalculated using a uniform procedure and subject to QC checks and (2) a global, gridded, monthly mean surface water fCO_2 data product with minimal temporal and spatial interpolation. The SOCAT data products and individual cruise files can be downloaded from PANGAEA (http://www.pangaea.de/), an International Council for Science World Data System, and CDIAC (http://cdiac.ornl.gov/oceans/). The data products can also be accessed via an interactive data visualization and analysis tool, the Live Access Server, and Ocean Data View (links available at http://www.socat.info/).

Applications of Products and Future SOCAT

Currently, two types of global surface ocean CO_2 synthesis products are publicly available: the SOCAT products and the Lamont-Doherty Earth Observatory (LDEO) climatologies [*Takahashi*

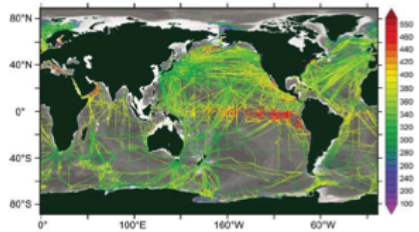


Fig. 1. Surface water fCO_2 (similar to partial pressure) measured in microatmospheres (µatm) in the global oceans and coastal seas from 1968 to 2007. Data are from Surface Ocean CO_2 Atlas (SOCAT) version 1.5. Note the uneven data distribution across the oceans and coastal seas.

Open Access Earth System Science Data

O_2 Atlas (SOCAT) gridded data products

oyuk[1,2], D. C. E. Bakker[3], B. Pfeil[4,5,6], A. Olsen[7,8], N. Metzl[9], A. Kozyr[10], J. Malczyk[11], J. Akl[12,13], S. R. Alin[1], R. G. J. Bellerby[14,4,*], A. Borges[15], [16], W.-J. Cai[17], F. P. Chavez[18], A. Chen[19], C. Cosca[1], R. A. Feely[1], oyet[22], N. Hardman-Mountford[23,**], C. Heinze[4,5,8,14], M. Hoppema[24], hii[27], T. Johannessen[4,5], R. M. Key[28], A. Körtzinger[29], P. Landschützer[3], . Lenton[13], A. Lourantou[9], L. Merlivat[9], T. Midorikawa[30], L. Mintrop[31], . Nakadate[34], Y. Nakano[33], S. Nakaoka[35], Y. Nojiri[35], A. M. Omar[8,14], K. Paterson[12,13], F. F. Perez[36], D. Pierrot[37], A. Poisson[22], A. F. Ríos[36], asiano[21], V. V. S. S. Sarma[38], R. Schlitzer[24], B. Schneider[39], U. Schuster[3], [5,14,4], T. Steinhoff[29], T. Suzuki[40], T. Takahashi[41], K. Tedesco[42,***], nas[44], B. Tilbrook[12,13,45], D. Vandemark[25], T. Veness[13], A. J. Watson[3], iss[46], C. S. Wong[47], and H. Yoshikawa-Inoue[33]

erously acknowledge the contribution of SOCAT investigators, regional rship, acknowledgment or reference to relevant papers as appropriate.

Integrated Marine Biogeochemistry and Ecosystem Research

www.socat.info

SURFACE OCEAN CO_2 ATLAS

Welcome to SOCAT V1.5

A Collection of Underway Ocean CO_2 Observations Quality Controlled by the Science Community

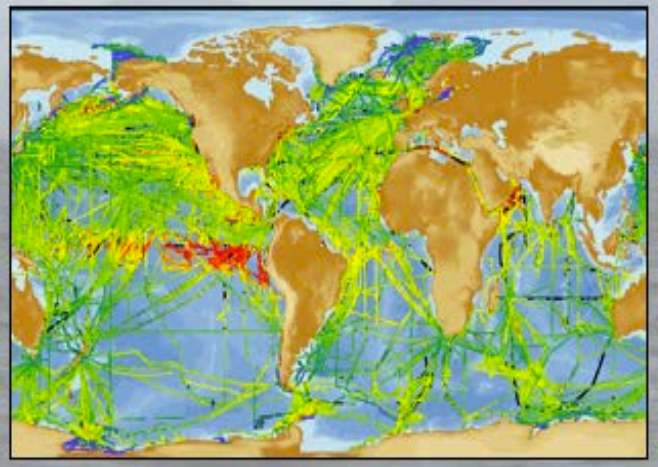
SOCAT Version 2

Since 2011
650 visits/month
160 visitors/month

SOCAT V1.5 Products:

- Cruise Data Viewer
- Gridded Data Viewer
- Table of Cruises V1.5
- Data Download
- Publications/Presentations

- SOCAT Credits V1.5



SOCAT Documentation:

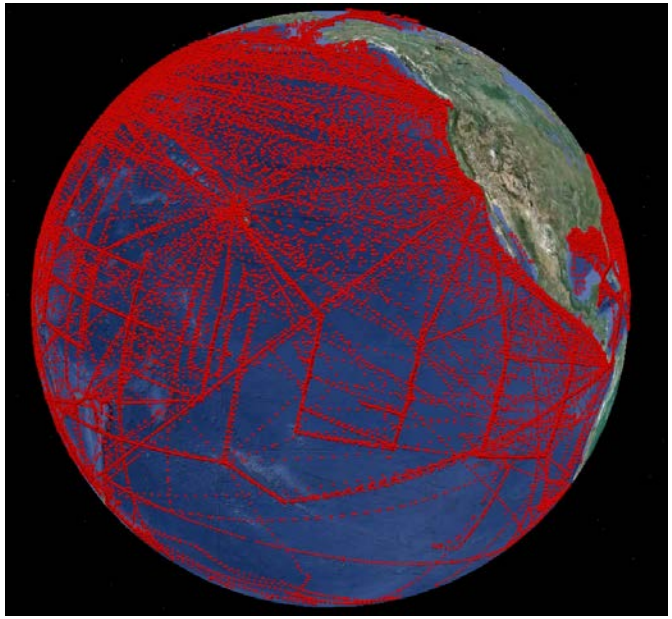
- About
- News
- Meetings
- Data Use Policy

SOCAT Help:

- Videos
- Frequently Asked Questions

SOCAT Version 2

- Started after the release of SOCAT Version 1
- Consists of 10.1 million fCO_2 data (+60 %) on > 2660 cruises covering the years 1968-2011
- Improvements were made e.g. more transparency, more consistency QCing data, better documentation
- All data is citable using DOI (individual cruise files, synthesis products, gridded products)
- D. Bakker is leading the SOCAT V2 ESSD paper



SOCAT Version 2 Groups

Global group: **D.Bakker**, N. Metzl, S. Hankin, A. Olsen, B. Pfeil, A. Kozyr, D. Pierrot, M. Telszewski

North Atlantic: U. Schuster

Tropical Atlantic: N. Lefevre

North Pacific: Y. Nojiri

Equatorial Pacific: C. Cosca

Artic: J. Mathis

Indian Ocean: V.V.S.S. Sarma

Southern Ocean: B. Tilbrook and N. Metzl

Coastal Ocean: S. Alin, B.Hales, W.-J. Cai

Automation: S. Hankin, S. Jones, K. Smith, A. Kozyr, B. Pfeil, D. Pierrot, K. O'Brien, A. Manke

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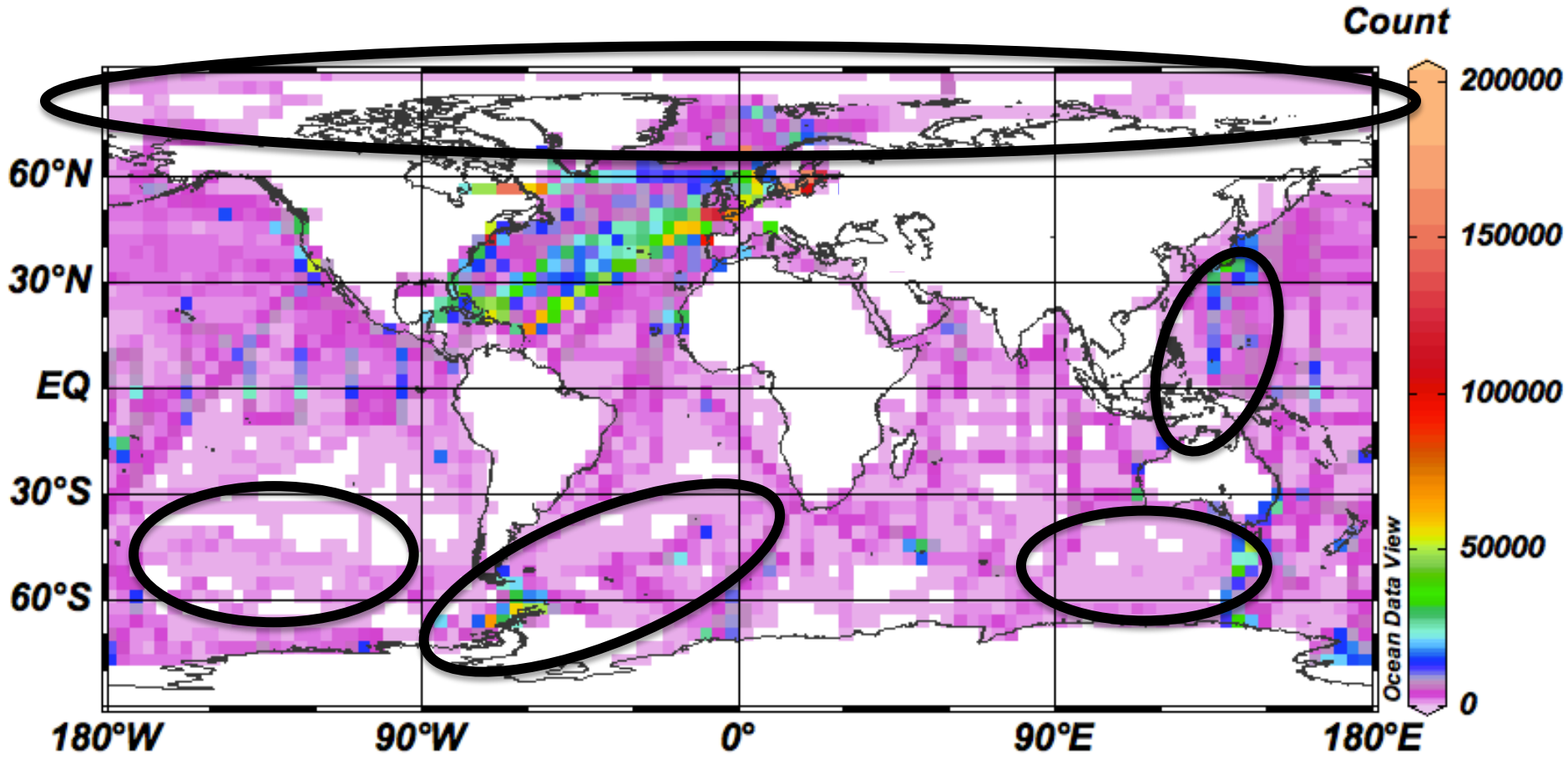
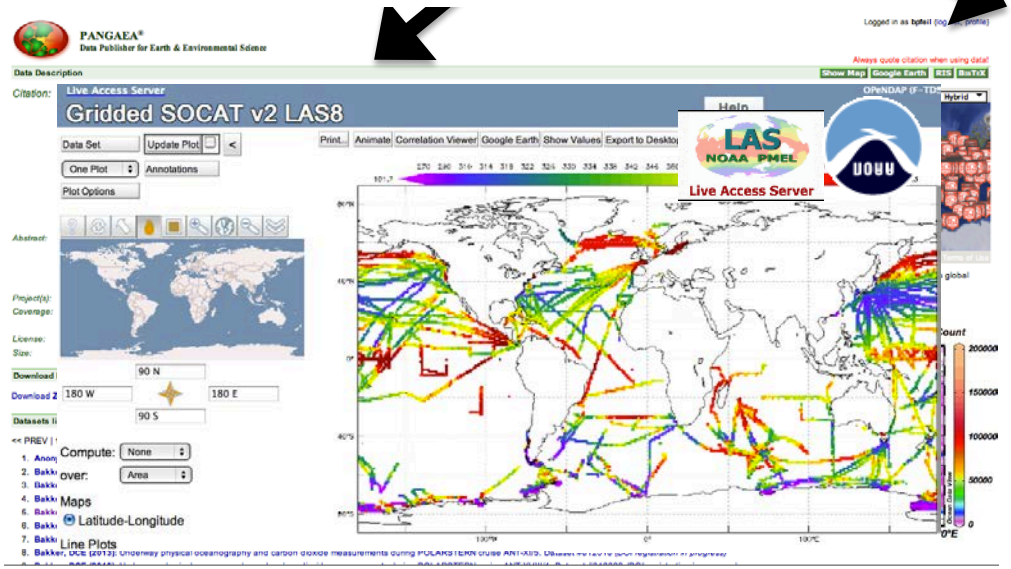
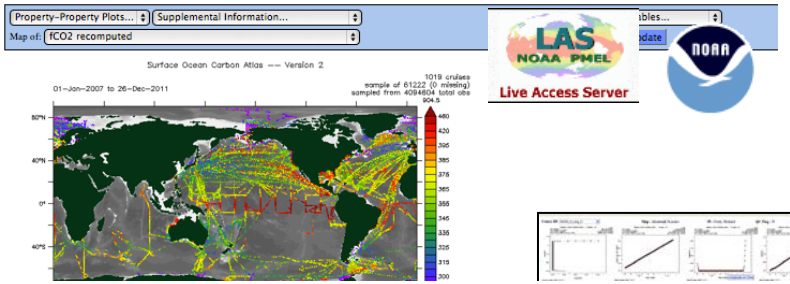
SOCAT Version 2

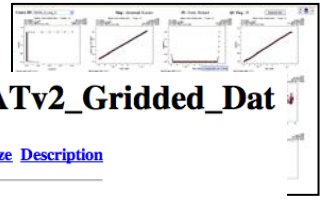


SOCAT Version 2 Products

Gridded data







Index of /ftp/oceans/SOCATv2/SOCATv2_Gridded_Dat

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SOCAT_tracks_gridded_decades_v2.nc.zip	30-May-2013 10:59	1.0M	
SOCAT_tracks_gridded_month_clim_v2.nc.zip	30-May-2013 11:00	2.3M	
SOCAT_tracks_gridded_monthly_v2.nc.zip	30-May-2013 11:00	8.2M	
SOCAT_tracks_gridded_yearly_v2.nc.zip	30-May-2013 11:01	2.9M	

Ocean CO_2 CDIAC

Please, cite the gridded SOCAT products as:

Bakker, D. C. E., B. Pfeil, K. Smith, S. Hankin, A. Olsen, S. R. Alin, C. Cosca, B. Hales, S. Hara
B. Tilbrook, C. Wada, J. Akl, L. Barbero, N. Bates, J. Boutin, W.-J. Cai, R. D. Castle, F. P. Cha
R. A. Feely, A. Fransson, Z. Gao, N. Hardman-Mountford, M. Hoppema, W.-J. Huang, C. W. Hunt, B. Hu
Sara Jutterström, V. Kitidis, A. Körtzinger, S. K. Lauvset, N. Lefèvre, A. B. Manke, J. T. Mathis,
G.-H. Park, K. Paterson, D. Pierrot, A. F. Ríos, C.L. Sabine, S. Saito, J. Salisbury, V. V. S. S.
S. C. Sutherland, T. Suzuki, A. J. Sutton, C. Sweeney, T. Takahashi, J. Tjiputra, N. Tsurushima,
R. Wanninkhof and A. J. Watson (2013) An update to the Surface Ocean CO2 Atlas (SOCAT version 2).

LAS and ODV Products will be available in 10 days!

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SOCAT Version 2 Transparency

14 xCO2water_equ_dry [µmol/mol]	15 pCO2water_SST_wet [µatm]	16 fCO2water_SST_wet [µatm]	17 Algorithm	18 Flag [#]
245.700	240.600	239.965	1	2
247.200	242.600	241.430	1	2
248.100	243.300	242.309	1	2
248.600	243.700	242.797	1	2
250.100	245.200	244.262	1	2
251.100	246.100	245.239	1	2
251.400	246.500	245.507	1	2
253.500	248.600	247.558	1	2
254.800	250.000	248.827	1	2
255.300	250.300	249.291	1	2
256.000	251.000	249.974	1	2
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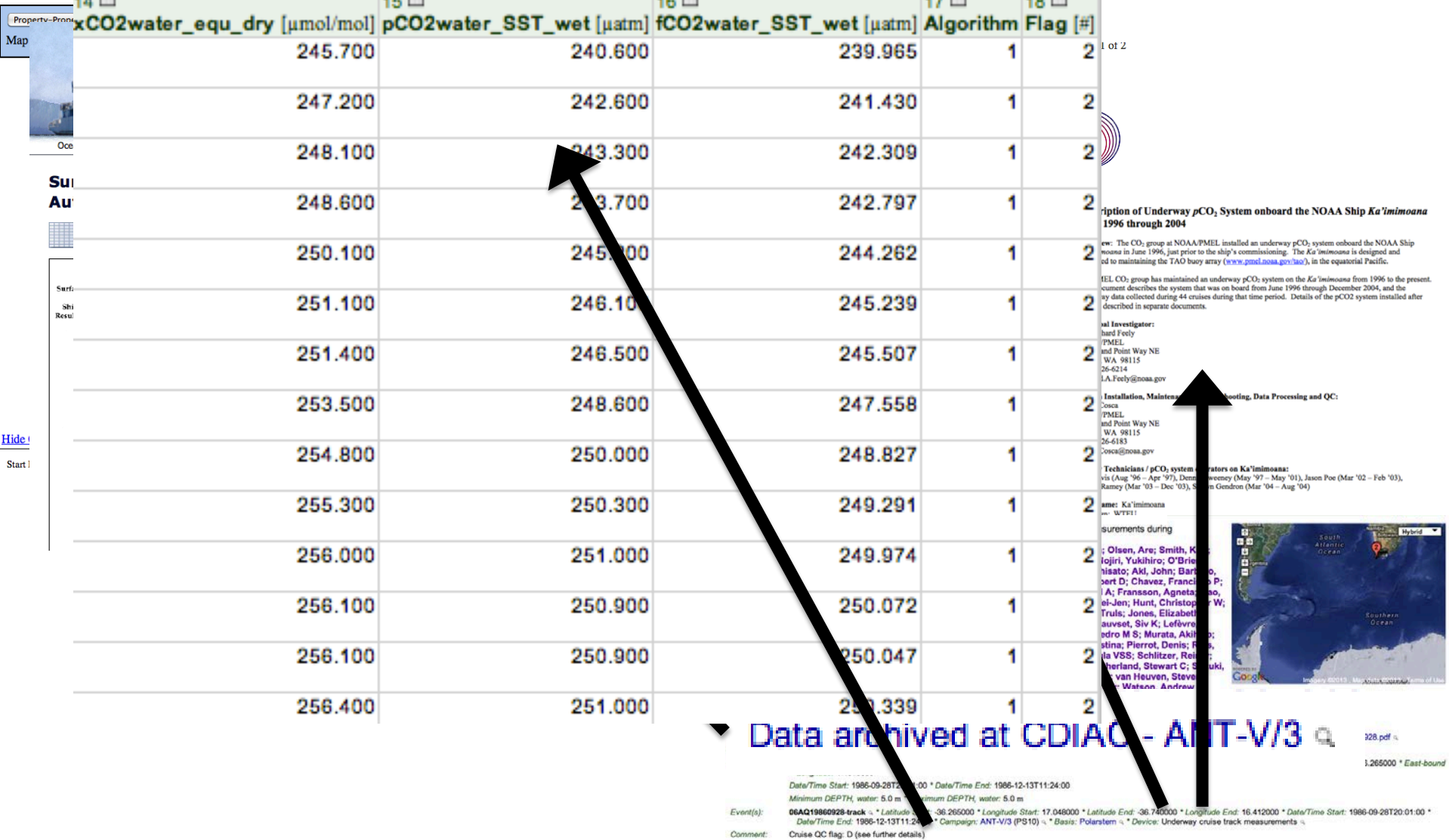


2013 – Version 2 of SOCAT is released.
20XX – X version of SOCAT will be released?
2015 – Version 3 of SOCAT will be released?
Main difference:
Lack of central funding
2011 – Version 1 of SOCAT is released.
2007 – SOCAT is initiated.

For more information visit www.SOCAT.info

SURFACE OCEAN CO. ATLAS

Welcome to SOCAT

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Quality Controlled by the Science Community

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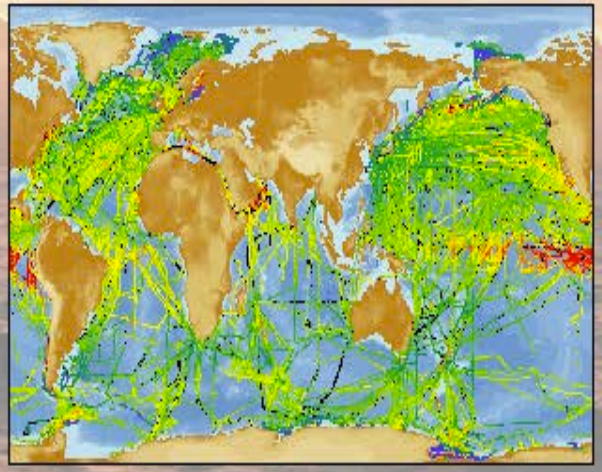
- SOCAT Version 1.5



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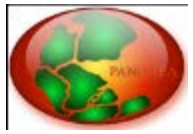


I would like to thank data contributors, the SOCAT team especially regional and global group leaders, members and data centers involved!
Special thanks to SOCAT Global Group leader Dorothee Bakker!