



U N I V E R S I T Y   O F   B E R G E N

Geophysical Institute

Partner University of Bergen/Geophysical Institute

Scientific Committee member

Benjamin Pfeil  
Bjerknes Climate Data Centre





**1825**

Bergen Museum is established on the initiative of Wilhelm Frimann Koren Christie, who was president of the Norwegian parliament – Stortinget.



**1865**

The new Bergen Museum building opened. Today this is the main building of the University of Bergen.



**1948**

University of Bergen officially opens with three faculties in place: Faculty of Humanities, Faculty of Mathematics and Natural Sciences, and Faculty of Medicine.



**1970**

Two more faculties are established: Faculty of Social Sciences and Faculty of Odontology. The latter was fused with Faculty of Medicine in 2008.



**1980**

Another two faculties open: Faculty of Law and Faculty of Psychology. Today there are six faculties at the University of Bergen.



**2015**

The opening of the new assembly hall at the University Museum of Bergen. The new hall will become a meeting point between the university and the city of Bergen.





# Main Focus Areas: Ocean, Life, Society



Global Social Challenges



Marine Research



Climate and Energy Transition



1. MEDIA CITY BERGEN  
CLUSTER



2. KNOWLEDGE CLUSTER  
FOR HEALTHCARE  
DISCIPLINES



3. MARINE RESEARCH  
CLUSTER



4. CLIMATE RESEARCH  
CLUSTER



5. KNOWLEDGE CLUSTER  
FOR FUTURE ENERGY AND  
TECHNOLOGY SOLUTIONS



6. CLUSTER FOR  
MEDIEVAL RESEARCH





## Årets 2°C er her

2016-utgaven av 2°C er klar: Nullutslipp haster. Fossil energi må fases ut fra alle sektorer i raskt tempo hvis målene fra Paris-avtalen skal kunne nås.

[Les mer](#)


[ABOUT](#)
[DATA PORTAL](#)
[PROJECTS](#)
[SUBMIT](#)
[PARTNERS](#)
[NEWS](#)
[CONTACT](#)

### DATASET AUTHOR

[Olsen, Are](#) (161)  
[Johannessen, Truls](#) (113)  
[Wanninkhof, Rik](#) (98)  
[Omar, Abdirahman M](#) (93)  
[Skjelvan, Ingunn](#) (52)  
[Jutterström, Sara](#) (39)  
[Cosca, Catherine E.](#) (19)  
[Feely, Richard A.](#) (19)  
[Millero, Frank J.](#) (18)  
[Lauvset, Siv K](#) (14)

### PUBLICATION YEAR

[2014](#) (381)  
[2013](#) (30)  
[2007](#) (5)  
[2011](#) (2)  
[2010](#) (1)

### GEOGRAPHIC REGION

[Atlantic Ocean](#) (162)  
[North Atlantic Ocean](#) (140)  
[North Sea](#) (56)

>> Data Portal

#### Find Data

Query ([syntax help](#)):

Anywhere in data description:

#### Find Data

[Advanced Search](#) | [Show/Hide Query Window](#)

**Search Results:** 419 datasets found! (Query time: 0.008 s)

<< PREV | 1 | [2](#) | [3](#) | [4](#) | [5](#) | [6](#) | [7](#) | [8](#) | [9](#) | [10](#) | [NEXT](#) >>

#### 1. [Olsen, Are; Omar, A. \(2007\): CARINA H. Mosby 58AA19991003 cruise](#)

##### [Data Set](#)

*Data Center:* CDIAC: Carbon Dioxide Information Analysis Center

*Parameters:* ALKALI; CTDSAL; CTDTMP; NITRAT; NITRIT; PHSPHT; SALNTY; SILCAT; TCARBN

[Link](#) - Score: 100%

#### 2. [Johannessen, Truls; Olsen, Are \(2007\): CARINA G.O. Sars](#)



# ICOS

● ● ●  
INTEGRATED  
CARBON  
OBSERVATION  
SYSTEM

## RI ICOS Ocean Thematic Centre data management

Benjamin Pfeil, Truls Johannessen, Steve Jones & Camilla Stegen Landa

Geophysical Institute/University of Bergen  
Bjerknes Centre for Climate Research  
Bjerknes Climate Data Centre

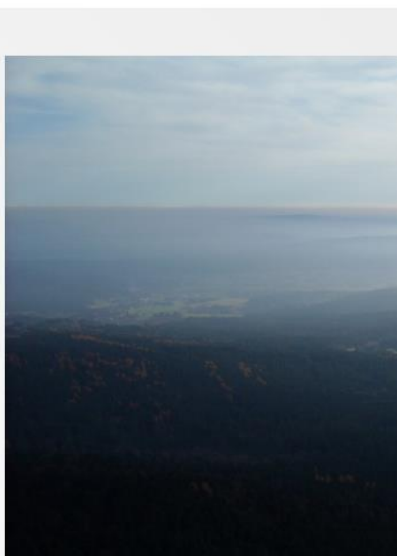




# UNRAVELING EARTH'S GREENHOUSE GAS BALANCE WITH MEASUREMENTS

ICOS RI IS A PAN-EUROPEAN  
SCIENTIFIC DATA ON CARBON  
AVAILABLE AT THE CARBON

*ICOS National Networks for atmosphere (a),  
ecosystem (b) and ocean (c) measurements*



Welcome to the ICOS RI v

ICOS RI is an organisation of eleven member countries and over 100 greenhouse gases measuring stations aimed at quantifying and understanding the greenhouse gas balance of the Europe and

measurements system, says ICOS ERIC  
General Assembly Chair



# ICOS OTC network

The suggested network of stations for the ocean-network:

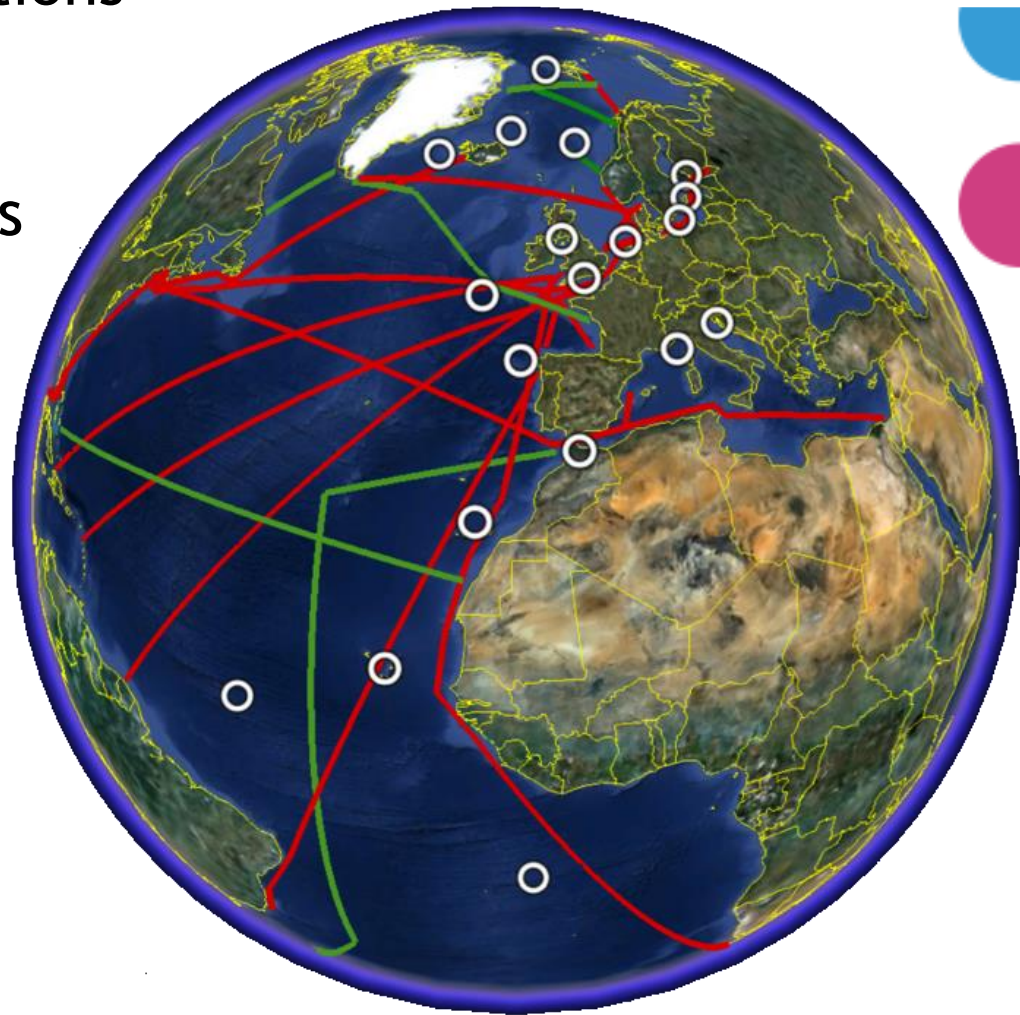
- 18 SOOP/VOS lines
- 22 fixed time series stations
- 7 repeat hydrographic sections

Data life cycle from NRT to QCed data and products

Red lines - Ships of Opportunities

Green lines - Repeat Sections

Circles - Fixed Ocean Stations





# ***Global Ocean Biogeochemistry Data Management***

*Benjamin Pfeil*

*IOCCP SSC member responsible for data and information management*

*Bjerknes Climate Data Centre @ University of Bergen*







# GOA-ON

Global Ocean Acidification  
Observing Network

*The Global Ocean Acidification Observing Network (GOA-ON) is a collaborative international approach to document the status and progress of ocean acidification in open-ocean, coastal, and estuarine environments, to understand the drivers and impacts of ocean acidification on marine ecosystems, and to provide spatially and temporally resolved biogeochemical data necessary to optimize modeling for ocean acidification.*

[Home](#)[References/Reports](#)[GOA-ON Activities](#)[Interactive Map](#)[Network Members](#)[Governance/Contact](#)[Pier2Peer](#)

## Approach and Goals

Detailed information about the GOA-ON background, design, implementation, and data strategy can be found here:

[Global Ocean Acidification Observing Network: Requirements and Governance Plan](#) (JA Newton, RA Feely, EB Jewett, P Williamson, J Mathis)

### GOA-ON high-level goals:

#### **Goal 1 - Improve our understanding of global OA conditions:**

- Determine status and spatial / temporal patterns in carbon chemistry, assessing the generality of response to ocean acidification.
- Document and evaluate variation in

## \* \* What's New \* \*

GOA-ON releases a new [Data Portal](#)

The GOA-ON Interactive map has a new format and many new features, including:

- the ability to find platforms based on regions, platform type, and variables;
- overlays of aragonite saturation state and surface CO<sub>2</sub> concentration;
- real-time display of data from participating platforms;
- and much more!

Mouse over the buttons below to see examples of the new functionality.

Filter by Platform Type  
or Variable

Overlay  
Aragonite Saturation

Real-time Data from  
participating platforms

## An International Effort

[See how GOA-ON has grown!](#)

**Network Members** - 330 Scientists from 67 countries are currently participating in the GOA-ON.

Interested in becoming a member?  
Contact us here: [info@goa-on.org](mailto:info@goa-on.org)

**Friends of GOA-ON** - a charitable fund administered by The Ocean Foundation to support the goals and activities of GOA-ON. Click here to [donate](#).

### Newsletters/Workshops/Activities

► [3rd GOA-ON Science Workshop, 8-10 May 2016, Hobart, Australia](#); attended by 130 scientists from 37 nations.

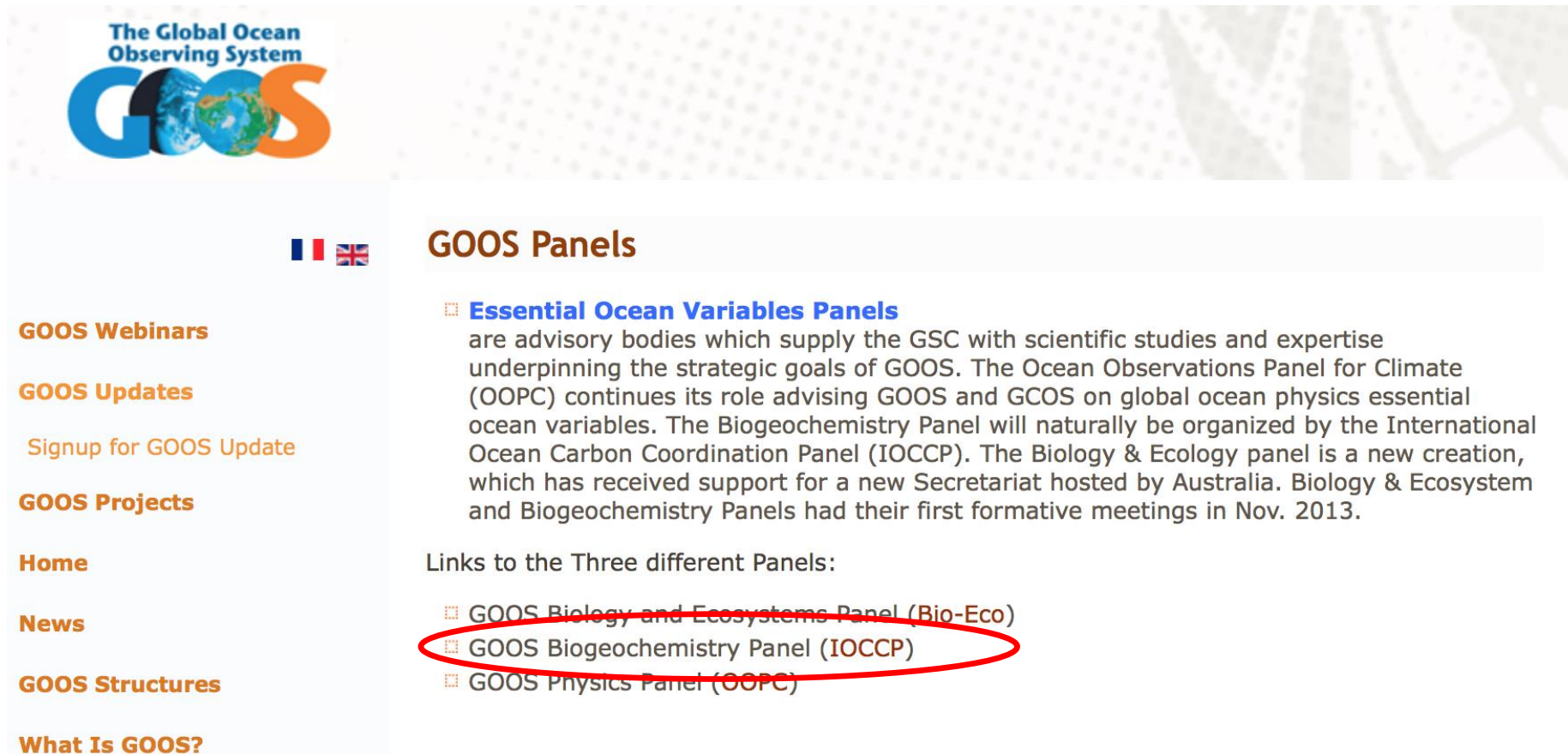
► [GOA-ON 2013 Workshop, St. Andrews, UK](#) attended by 87 participants from 26 countries



# Framework for Ocean Observing

## Approved governance structure

# GOOS Steering Committee



The screenshot shows the GOOS website. At the top left is the logo for 'The Global Ocean Observing System' with the acronym 'GOOS' in large blue and orange letters. Below the logo is a navigation menu with links: 'GOOS Webinars', 'GOOS Updates' (with a sub-link 'Signup for GOOS Update'), 'GOOS Projects', 'Home', 'News', 'GOOS Structures', and 'What Is GOOS?'. To the right of the menu is a section titled 'GOOS Panels'. Under this section, there is a sub-header 'Essential Ocean Variables Panels' followed by a paragraph describing their role. Below the paragraph are three links: 'GOOS Biology and Ecosystems Panel (Bio-Eco)', 'GOOS Biogeochemistry Panel (IOCCP)', and 'GOOS Physics Panel (OOPC)'. The second link, 'GOOS Biogeochemistry Panel (IOCCP)', is circled in red.

**The Global Ocean Observing System**  
**GOOS**

**GOOS Panels**

**Essential Ocean Variables Panels**  
are advisory bodies which supply the GSC with scientific studies and expertise underpinning the strategic goals of GOOS. The Ocean Observations Panel for Climate (OOPC) continues its role advising GOOS and GCOS on global ocean physics essential ocean variables. The Biogeochemistry Panel will naturally be organized by the International Ocean Carbon Coordination Panel (IOCCP). The Biology & Ecology panel is a new creation, which has received support for a new Secretariat hosted by Australia. Biology & Ecosystem and Biogeochemistry Panels had their first formative meetings in Nov. 2013.

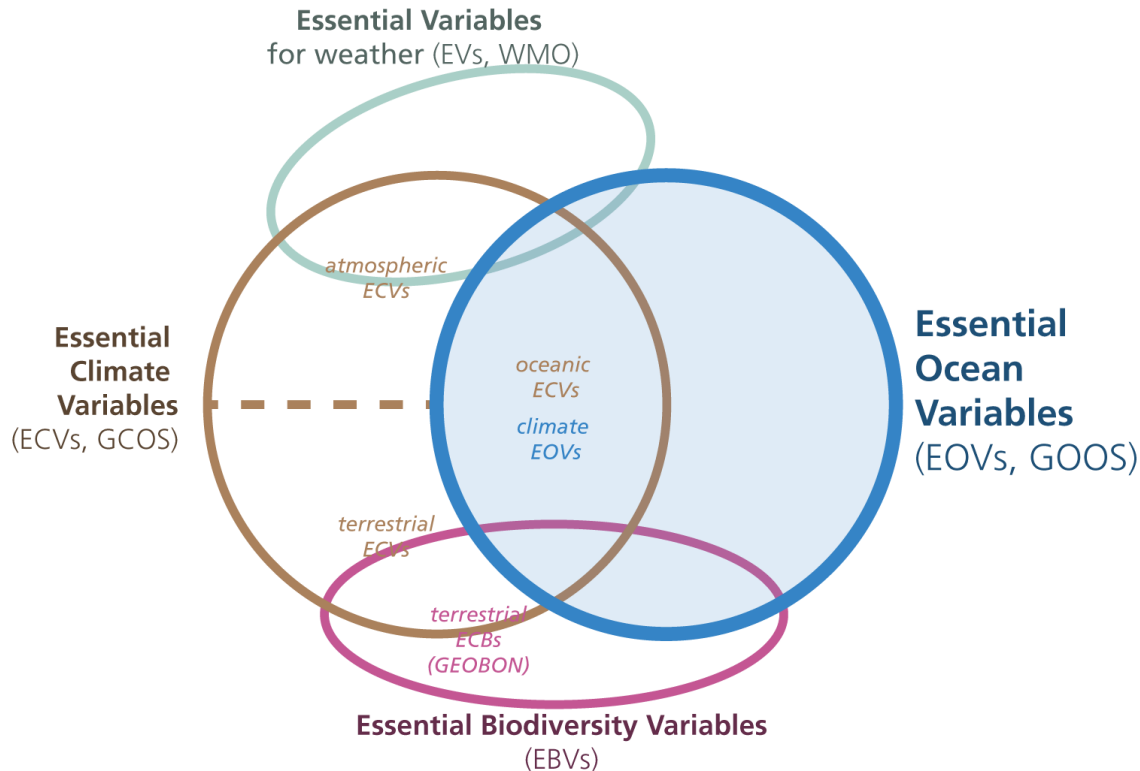
Links to the Three different Panels:

- ☐ ~~GOOS Biology and Ecosystems Panel (Bio-Eco)~~
- ☐ **GOOS Biogeochemistry Panel (IOCCP)**
- ☐ ~~GOOS Physics Panel (OOPC)~~

(Observing technologies and networks,  
Variable focus: data and products, synthesis, link to models)

Driven by requirements, negotiated with feasibility

# Essential Ocean Variables



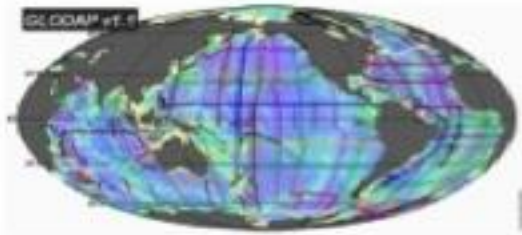
- **We cannot measure everything, nor do we need to**
- Basis for including new elements of the system, for expressing requirements at a high level
- Driven by requirements, negotiated with feasibility
- Allows for innovation in the observing system over time



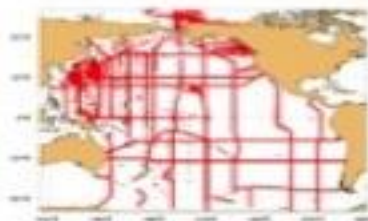


# IOCCP Major Activities – Hydrographic Sections

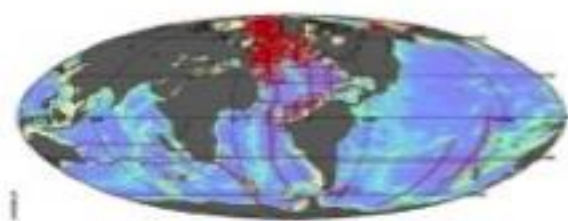
GLODAP



PACIFICA



CARINA



Add new data

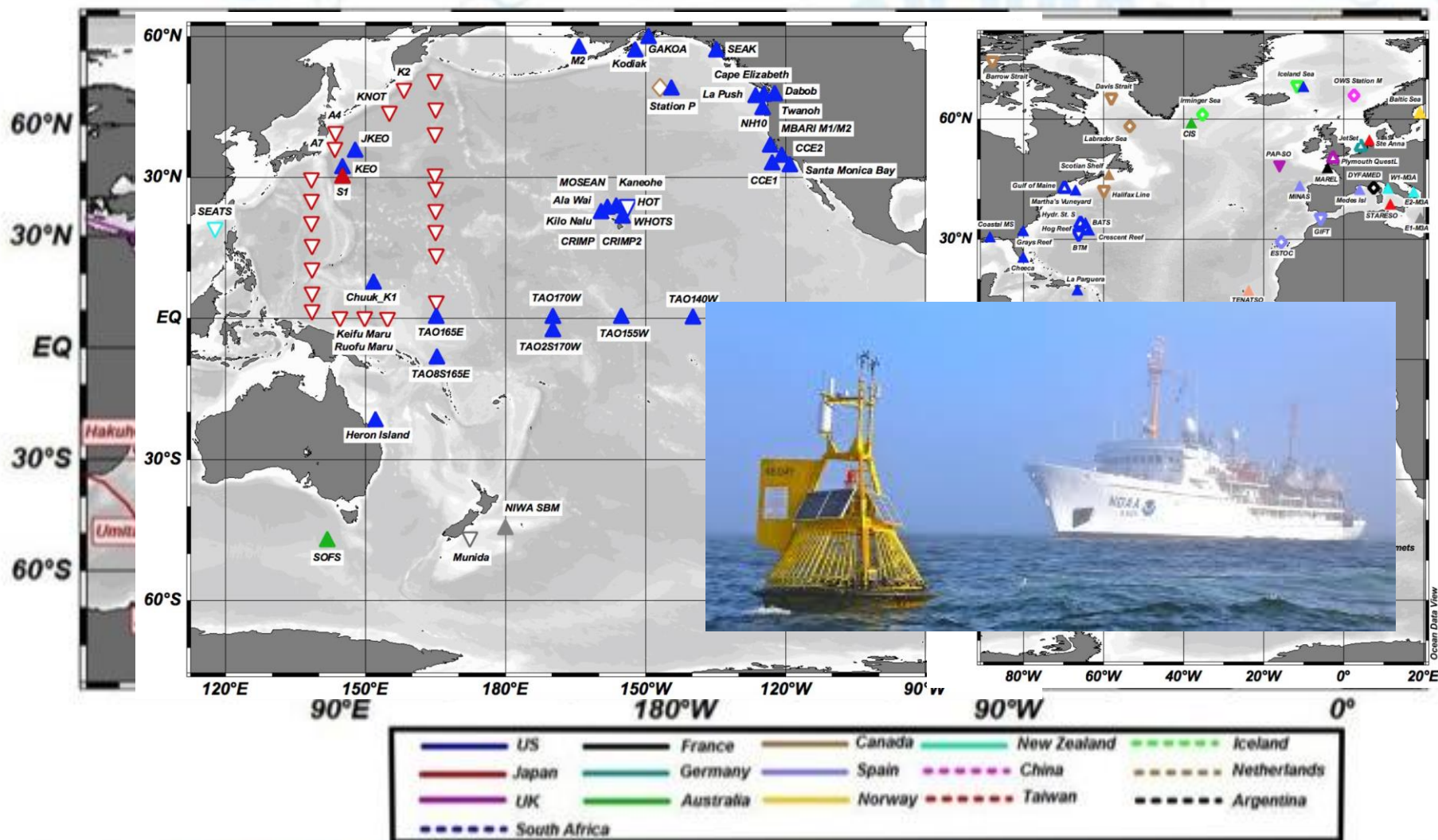
GLODAPv2



**glodap**<sub>v2</sub>  
Global Ocean Data Analysis Project

GLODAP  
office will  
move to UiB  
in 2017

# IOCCP Major Activities – Surface Ocean



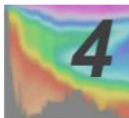
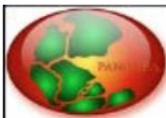
Source: CDIAC



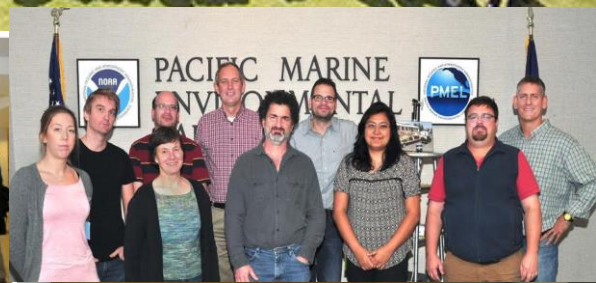
# The Surface Ocean CO<sub>2</sub> Atlas enables quantification of the ocean carbon sink and ocean acidification



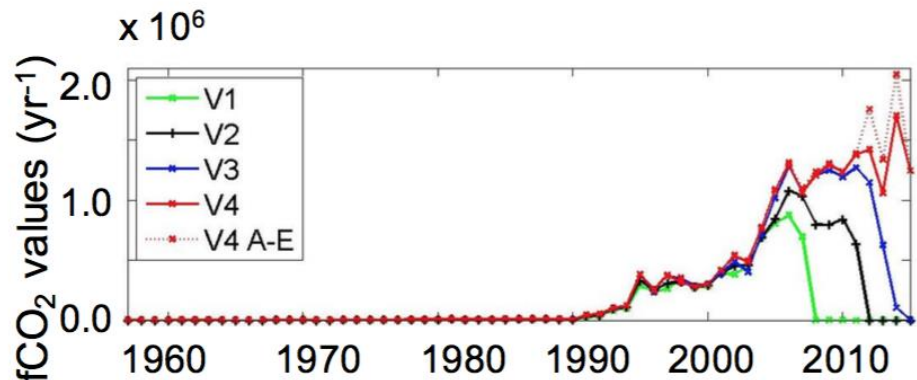
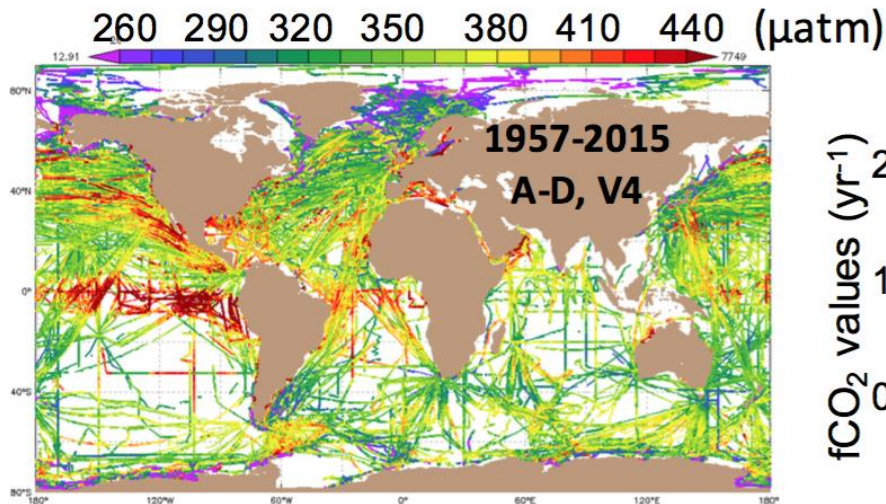
Dorothee Bakker ([d.bakker@uea.ac.uk](mailto:d.bakker@uea.ac.uk)), Benjamin Pfeil, Karl Smith, Simone Alin, Kim Currie, Steve Jones, Alex Kozyr, Camilla Landa, Peter Landschützer, Siv Lauvset, Nathalie Lefèvre, Nicolas Metzl, Shin-ichiro Nakaoka, Yukihiro Nojiri, Kevin O'Brien, Are Olsen, Christian Rödenbeck, Ute Schuster, Maciej Telszewski, Bronte Tilbrook, Chisato Wada, Rik Wanninkhof and all >100 SOCAT contributors











**Global synthesis and gridded products of surface ocean fCO<sub>2</sub> (fugacity of CO<sub>2</sub>)**  
in uniform format with quality control;

V4: 18.5 million fCO<sub>2</sub> values, accuracy < 5 μatm from 1957-2015 (flags of A-D);

Plus calibrated sensor data (< 10 μatm, flag of E);

Online viewers;

Downloadable (text, NetCDF, ODV, Matlab);

Documented in ESSD articles;

Fair Data Use Statement;

Community activity with >100 contributors worldwide.

Earth Syst. Sci. Data, 6, 383–413, 2016  
www.earth-syst-sci-data.net/6/383/2016/  
doi:10.5194/essd-6-383-2016  
© Author(s) 2016. CC Attribution 3.0 License.

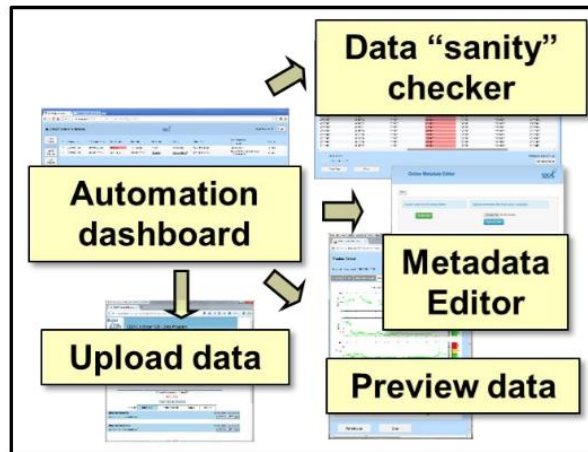
Earth System  
Science  
Data

A multi-decade record of high-quality fCO<sub>2</sub> data in  
version 3 of the Surface Ocean CO<sub>2</sub> Atlas (SOCAT)

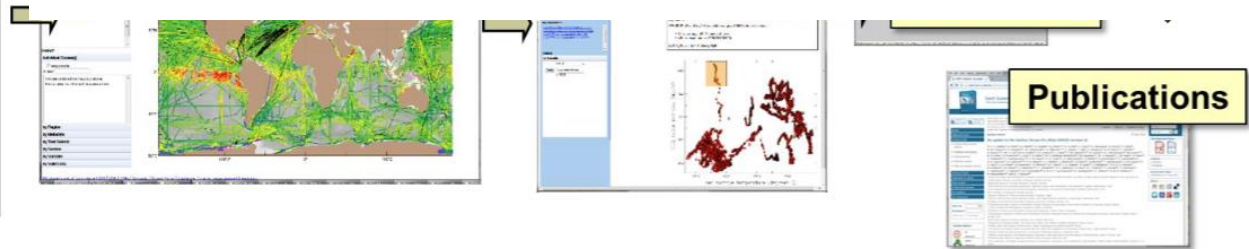
Dorothea C. E. Bakker<sup>1</sup>, Benjamin Pfeil<sup>2</sup>, Corinne S. Lamb<sup>3</sup>, Nicolas Metzl<sup>4</sup>, Kevin M. O'Brien<sup>5</sup>,  
Ann O'Hara<sup>6</sup>, Karl Smith<sup>7</sup>, Cathy Costa<sup>8</sup>, Susanna Buitera<sup>9</sup>, Stephen D. Jones<sup>10</sup>,  
Shin-ichiro Nakamura<sup>11</sup>, Yoshikazu Nojima<sup>12</sup>, Ute Schuster<sup>13</sup>, Fabian Winkler<sup>14</sup>, Catherine Weaver<sup>15</sup>,  
Tara Takahashi<sup>16</sup>, Emma Tiberius<sup>17</sup>, Chikara Wada<sup>18</sup>, Erik Wanninkhof<sup>19</sup>, Shumei R. Allen<sup>20</sup>,  
Cathie E. Roberts<sup>21</sup>, Lorien Barbero<sup>22</sup>, Nicholas R. Bates<sup>23</sup>, Akijunori A. Bando<sup>24</sup>,  
Frederic Bonnet<sup>25</sup>, Jacqueline Boutin<sup>26</sup>, Tania Buato<sup>27</sup>, Eugene F. Byrne<sup>28</sup>, Wei-Jun Cai<sup>29</sup>,  
Robert D. Castle<sup>30</sup>, Lip Chang<sup>31</sup>, Melissa Chivers<sup>32</sup>, Kim Currie<sup>33</sup>, Wiley Evans<sup>34</sup>,  
Charles Featherston<sup>35</sup>, Richard A. Feely<sup>36</sup>, Agneta Fominov<sup>37</sup>, Catherine Gault<sup>38</sup>,  
Naomi Greenwood<sup>39</sup>, Luke Gregg<sup>40</sup>, Steven Hameed<sup>41</sup>, Nick J. Hardman-Mountford<sup>42</sup>,  
Jerome Harte<sup>43</sup>, Judith Harck<sup>44</sup>, Mark Hopwood<sup>45</sup>, Matthew P. Humphrey<sup>46</sup>,  
Christopher W. Hunt<sup>47</sup>, Barry Hunt<sup>48</sup>, J. Nevenius P. Buntin<sup>49</sup>, Irfan Johansson<sup>50</sup>,  
Ralph Keeling<sup>51</sup>, Yasuhiro Kikuchi<sup>52</sup>, Amy Körtgen<sup>53</sup>, Alex Korte<sup>54</sup>, Evangelia Kravtsovitch<sup>55</sup>,  
Akiko Kuroki<sup>56</sup>, Peter Lamborg<sup>57</sup>, Shi R. Liang<sup>58</sup>, Verónica Llorente<sup>59</sup>, Chao Lu<sup>60</sup>,  
Andrey Makhit<sup>61</sup>, Jeremy J. Mathis<sup>62</sup>, Lilian Merilaita<sup>63</sup>, Frank J. Millero<sup>64</sup>, Pedro M. S. Monteiro<sup>65</sup>,  
David B. Myers<sup>66</sup>, Akshita Murty<sup>67</sup>, Timothy Newberger<sup>68</sup>, Kallanathan M. Omer<sup>69</sup>,  
Teresa Ono<sup>70</sup>, Antonia Pateron<sup>71</sup>, David Pinner<sup>72</sup>, Dean Pinner<sup>73</sup>, Lisa L. Robbins<sup>74</sup>, Shu Naito<sup>75</sup>,  
Jon Salby<sup>76</sup>, Rene Schuster<sup>77</sup>, Roland Schneider<sup>78</sup>, Rainer Siegel<sup>79</sup>,  
Jozsef Szekeles<sup>80</sup>, Kevin J. Sullivan<sup>81</sup>, Stewart C. Sutton<sup>82</sup>, Edwina J. Sutton<sup>83</sup>,  
Kazuki Takahashi<sup>84</sup>, Maciej Tschirwitz<sup>85</sup>, Matthias Tuma<sup>86</sup>, Steven M. A. C. van Heerde<sup>87</sup>,  
Dong Yundtmark<sup>88</sup>, Brian Ward<sup>89</sup>, Andrew J. Watson<sup>90</sup>, and Jiaxing Xu<sup>91</sup>

(Bakker et al. 2016, ESSD)

# Annual releases upon automated data upload (v4)



Automation for **glodap<sub>v2</sub>** is funded and will be done at the BCDC



Automation of data upload, initial data checks speeds up data submission and enables annual, public releases of SOCAT.

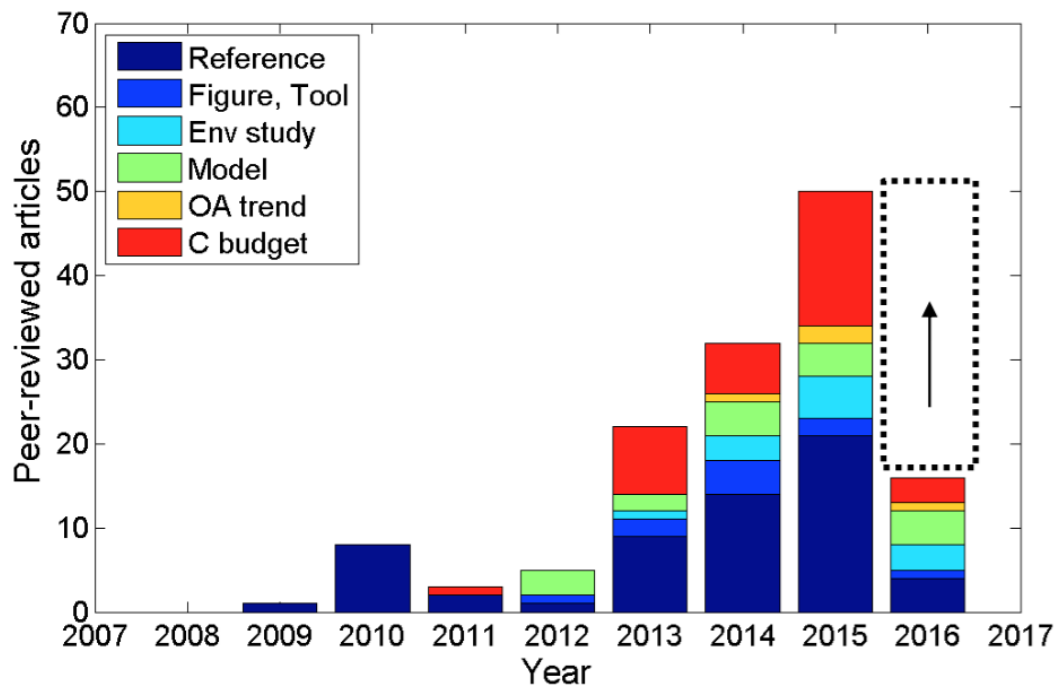
SOCAT data is discoverable, accessible and citable.

Future: Automation of metadata upload.

(O'Brien et al., in prep.)



# Applications of SOCAT in peer-reviewed articles



SOCAT is named or cited in  
 >>150 peer-reviewed articles

- **Ocean carbon budgets,**
- **Ocean acidification studies,**
- **Model evaluation,**
- Environmental studies,
- Figures or tools,
- Reference to SOCAT.

Figure of 22 April 2016

Courtesy of D. Bakker

# The Global Carbon Budget (2006-2015)

## Sources



Fossil fuel & cement sources  
9.3 Pg C yr<sup>-1</sup> (91%)



Land-use change (9%)  
1.0 Pg C yr<sup>-1</sup>

## Sinks



Atmosphere (44%)  
4.5 Pg C yr<sup>-1</sup>



Ocean sink (26%)  
2.6 Pg C yr<sup>-1</sup>



Land sink (residual)  
3.2 Pg C yr<sup>-1</sup>  
(31%)

# Work so far for SDC

- EOVS Carbonate System (standardized vocabs)
- Setup of a sharing NOD
- Automation on how to convert all SOCAT files (4250 cruises)
- challenges were found with NEMO and MIKADO and solved in collaboration with Ifremer colleagues
- Plan on sharing more data (GLODAP, ICOS)
- Expect to have all SOCATv4 data as CDIs within the next weeks



# Thank you!



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