**Report of the Surface Ocean $CO_2$ Atlas (SOCAT) progress meeting,**
**3-5 July 2012, Epochal Tsukuba, Tsukuba, Japan**
*Version for SOCAT website by Dorothee Bakker (23/11/2012)*

**Welcome and Introduction:**
Dr Yukihiro Nojiri welcomes the participants (Appendix 1). The participants introduce themselves and their role in the Surface Ocean $CO_2$ Atlas (SOCAT).

**Update on SOCAT and Aims of the meeting (Dorothee Bakker, Benjamin Pfeil)**:
Dorothee Bakker provides an introduction to SOCAT and an update on recent activities. SOCAT version 1.5 has been made public on 14 September 2011. Regular updates to SOCAT are planned. Version 1.5 has 6.3 million surface water $fCO_2$ (fugacity of carbon dioxide) on 1851 cruises from 1968 to 2007. The $fCO_2$ data are in uniform format and have been subject to 2$^{nd}$ level quality control. The SOCAT methods are transparent and fully documented. There are three SOCAT products:

- Global surface ocean data set of recalculated $fCO_2$ in a uniform format with 2nd level quality control;
- Individual cruise files of recalculated $fCO_2$ (as 1);
- Global gridded product of monthly surface water $fCO_2$ means, with minimum interpolation.

SOCAT 1.5 has been accepted as a component/service of the *Global Earth Observation System of Systems (*GEOSS). Publication of an article in Eos has been accompanied by a press release (16 March 2012) (Appendices 3 and 4). Two technical papers describing the SOCAT database and operations were submitted in late June (Pfeil et al. 2012; Sabine et al. 2012, see Appendix 3). One peer-reviewed article using SOCAT has been published and two articles are in review (Appendix 3). SOCAT version 2 and automation for SOCAT version 3 are in progress (topics of this meeting).

The aims of the meeting are:

1. Set the SOCAT agenda for next 12-18 months
2. Set the time table for SOCAT version 2
3. Agree on automation plans for SOCAT version 3 (including time table)
4. Discuss and resolve outstanding SOCAT issues
5. Discuss suggestions made for future SOCAT versions

Action Item: Speakers and rapporteurs will send short report to Dorothee Bakker. Dorothee Bakker and Maciej Telszewski will collate a meeting report (Dorothee Bakker, Maciej Telszewski, August 2012).

**Session on SOCAT version 2**
**Update on Progress with Data Ingestion for version 2**
Benjamin Pfeil reports that data ingestion for SOCAT v2 is complete and that version 2 is almost ready for quality control (QC). Version 2 contains these new data: 4.4 million surface water $CO_2$ data from more than 1140 cruises, as well as $CO_2$ data from time series and CARIOCA buoys. Version 2 includes recent data from late 2011. Some cruises from SOCAT version 1.5 have been updated. Overall SOCAT v2 will contain more than 9 million $CO_2$ data from more than 2800 cruises. Identification and handling of multiple versions of data files has been problematic, but is being resolved. Various issues with the IT infrastructure in Bergen have slowed down the work on version 2.

**Update on the Live Access Server for version 2**
Kevin O'Brien provides an update on the Live Access Server (LAS):

- The LAS has a new login system for QC users to ensure that records of who QCs what data are kept.

- A number of new variables have been added to the LAS for SOCAT v2. Deprecated variables, i.e. variables which are no longer used in version 2, have been marked as such. Kevin agreed to make a full list of the new and deprecated fields available in a prominent position on the socat.info website. Deprecated variables will be relabelled as 'Version 1.5 only' for greater clarification. A new option has been added to the LAS for viewing coastal data that allows users to see the full extent of coastal cruises.

**Revised time table for SOCAT version 2 (Dorothee Bakker)**
The quality control on version 2 has been slightly delayed. A revised QC timetable is set for August to October 2012. After QC is complete, the version 2 data will be handed back to the global group to be processed for release. The release date for SOCAT v2 is revised from December 2012 to 31st January 2013.

Action Item: Meet the timetable for SOCAT version 2 (SOCAT participants, January 2013).

**A possible Arctic Group (Cathy Cosca, Ute Schuster)**
The Arctic Ocean is a unique region of large fresh water inputs and a high percentage of shelf area. Effective QC of Arctic data requires specialist knowledge which is not suited to the existing regional groups or the coastal groups. The group agrees that a new Arctic group is required from version 2 onwards. Jeremy Mathis (PMEL, Seattle) is identified as a strong candidate to lead the new Arctic Group. Cathy Cosca will approach Jeremy regarding this position. The limits for the region of the Arctic Ocean will need to be defined in conjunction with the lead of the Arctic group and Arctic scientists. The initial suggestion is to use the Bering Strait as the boundary in the North Pacific and Fram Strait at 78°N or 80°N in the Atlantic.

Action Item: Consult the prospective lead of the Arctic group. Create an Arctic group on the Live Access Server (Cathy Cosca, Kevin O'Brien, July 2012).

**Update on the Coastal Group**
The leads of the Coastal Group met briefly with Maciej Telszewski and Ute Schuster in Seattle in late June, but sadly none of them are at the Tsukuba meeting. Discussion revolved around what support could be given to best help the Coastal Group. An active coastal group is important due to the special challenges of dealing with coastal data. The main issues with the Coastal Group are perceived to be:
- It is a disparate group with members in all ocean regions;
- It requires strong leadership to keep the group working effectively;
- Input and training is desired for carrying out QC on the LAS.

In Seattle Wei-Jun Cai has suggested having a Coastal Group meeting. The possibility of a coastal meeting at PMEL during the QC period is discussed. This would act as a combined training meeting and a concentrated effort to complete most, if not all, the QC for the coastal group. The meeting should include PIs from other groups who have experience of the QC process to help out. The suggested time for this meeting is five days in the first week of October 2012. This has a number of benefits:
- It follows immediately from a meeting in Monterey, which at least some of the coastal group are likely to attend.
- It allows two months for much of the QC from other groups to be completed, thereby providing extra information to the coastal group.
- Three weeks of the QC period will remain after the meeting to clear up any outstanding QC issues.

The group decides to encourage a joint SOCAT coastal and Arctic group meeting with a focus on quality control, e.g. in early October 2012 at NOAA-PMEL, Seattle. Possible meeting participants are discussed. Ute Schuster and Cathy Cosca volunteer to join the meeting as advisers.

Action item: Maciej Telszewski will liaise with Simone Alin, Burke Hales, Wei Jun Cai, Jeremy Mathis, Cathy Cosca and Ute Schuster on a SOCAT coastal and Arctic group meeting (Maciej Telszewski, October 2012).

**Session on Automation for SOCAT version 3**

**Introduction to the automation structure**

Dorothee Bakker provides an introduction to the automation structure for SOCAT version 3, as discussed at NOAA-PMEL on 10 and 11 May 2012. A user interface will provide a single entry point for the data provider for metadata and data upload. Data files and the corresponding metadata will be identified by their Expocode, which is critical to the automated data submission.

**Metadata creation and management in version 3**

Alex Kozyr presents an overview of an updated OME interface for the online input of metadata. The metadata will provide all information necessary for SOCAT QC. The metadata forms will be saved and will be available for future use by the PI. Metadata can either be completed online (via the OME interface) or imported from the headers of data files (via the user interface, see below).

These points are discussed afterwards:

- The OME metadata interface is currently a work-in-progress. Alex Kozyr will add missing parameters, e.g. interpolated $fCO_2$air, …
- The end user will have the choice of creating a metadata file from scratch, or uploading a previously submitted file which can be edited, useful for subsequent cruises from the same ship/system.
- Users will be able to upload additional documentation (cruise reports, etc) to the OME metadata system and this documentation will be given easily available and clearly visible during QC.

**User interface for the submission of data and metadata in version 3**

Kevin O'Brien presents a vision for the automation user interface that will be the primary mode of data submission starting with version 3 of SOCAT. He demonstrates three common scenarios for a user submitting cruise files. 1) Submission of cruise files with complete metadata information, 2) Submission of cruise files with incomplete metadata, and 3) Submission of cruise files with metadata completely generated by the OME metadata system. In all cases, the submission process will include a tool that will review the data and metadata that is being submitted by the user. Any irregularities in the data (missing longitudes, etc.) will be noted and the user will be clearly informed of these. In terms of metadata entry, for files with incomplete or absent metadata, it will be possible to launch the online OME metadata editor to enter metadata or to recall metadata from a saved template or previous entry. For user convenience, the OME metadata editor will be seamlessly integrated with the data submission tool. The user will be able to see a complete list of data files entered and the status of those files. In addition, during submission, the user will have the opportunity to mark the files as available for public distribution, or the user may indicate they choose to be responsible for sending the data to the data archive of their choice. In this process, the user will soon find that submitting data files that contain complete metadata and valid data will ease the process considerably. The tool will allow the user to download files after a submission process has been successful. This will provide the user the opportunity to save a copy of their file, which can then be used as a template for future submissions.

**File formats and the file conformance tester in version 3 (Stephen Jones)**

Stephen Jones gives an overview of the required format for data files being uploaded to the automated SOCAT submission site. Files must consist of a header containing metadata information (at the very least this must contain sufficient information to construct an Expocode for the cruise), and the data itself. Users

may include as much or as little additional metadata as they please. Any portion of the metadata that can be extracted from the data automatically, such as the spatial extent of the measurements, will not need to be supplied by the user. When a data file is uploaded, it will be checked for basic errors such as missing or probably erroneous values. A summary of the checks performed and any errors encountered will be presented to the user. The final step is submission of the cruise data to SOCAT.

**Initial QC by data PI prior to submission in version 3 (Denis Pierrot)**
Denis Pierrot gives an overview of the process of initial data quality control prior to data submission. The system will create plots of the most common parameters for the data provider to review.

**Versioning of SOCAT data output files and doi-numbers (Benjamin Pfeil)**
Benjamin Pfeil describes the versioning process that will be used in all subsequent releases of SOCAT. Each cruise data set, which is submitted, will be assigned a doi-number. Cruise data that are updated and resubmitted will be assigned a new doi-number. The previous version of the cruise data will be retained with its original doi-number, but will information will be added that this data set was updated with a link to the new version of the data set. It is important that the doi-numbers used in previous SOCAT versions are retained.
An update to the metadata of a cruise does not trigger a new doi-number for that cruise. Each release of SOCAT will be assigned a doi-number for the entire data collection, including the metadata of the cruise data in the collection.

**Discussion of the automation structure for version 3**

- The SOCAT user interface, including the OME metadata interface, will be hosted at the SOCAT.info website.
- The unique 12-character Expocode (e.g. 06MT19920510) will be used for identification of cruise data. It consists of the 4-character NODC code (http://www.nodc.noaa.gov/General/NODC-Archive/platformlist.txt) and the start date (see below).
- Mandatory items in the header of each data file are the 4-character NODC code and the start date (see below). This information is required to create the Expocode.
- Common file formats, such as *.txt and *.csv, will be accepted.
- Examples will be provided for acceptable file formats and headers.
- The user interface will attempt to recognize column headings in data files necessary to calculate $fCO_2$. If column headings are not recognized, the headings will be displayed in a list, and the data provider will be able to select each column and describe its contents.
- A “Cancel” button will be added to the appropriate screens of the user interface.
- PI’s will be able to see and review the data files that have been entered by their staff.
- Matlab code for initial QC will be available via the user interface

Several suggestions are made for version 3:

- DOI-numbers should be included in data files downloaded from SOCAT, as currently is the case for version 1.
- Add a status indicator in the upload file table on the SOCAT user interface that indicates if a particular file has been successfully reviewed by the data PI.

**The start date in the Expocode**
The group recommends that these start dates should be used in the Expocodes for all SOCAT $CO_2$ data:

1) Research cruises and research vessels with (continuous) $fCO_2$ measurements: Use the official first day of each research cruise rather than the start of data collection. This is to ensure consistency with Expocodes for hydrographic and other data collected on the same cruise.
2) Voluntary Observing Ships: Use the date when the ship leaves port.
3) Moorings, gliders, drifters: Use the (re-)deployment or servicing date.
4) Weather stations: Use a pragmatic, systematic start date. E.g. the (re-)deployment or servicing date (as for moorings, gliders and drifters) or another systematic start date.

**Data submission policy for version 3**
Data providers will be asked if they agree to make their data public via CDIAC immediately, or with the subsequent release of SOCAT. If a PI decides not to make his/her data public via CDIAC, he/she will have to take responsibility (tick a box) for making the 'original' data and metadata public himself/herself (via a data centre of choice).

**Approval of the SOCAT automation structure and its time table (version 3)**
The group decides to proceed with automation of SOCAT for version 3. A meeting of automation specialists may be held in late 2012 or early 2013, if deemed necessary. A prototype will be ready in December 2012. Completion by March 2013. The subsequent time table for version 3, notably the target dates for data submission, data ingestion into Matlab, data ingestion on the LAS, quality control and the public release need further discussion.

Data submission for version 3 will not officially start until the automated submission system is up and running in March 2013. Benjamin will still accept emailed data submissions before March 2013, but SOCAT will not be actively seeking new data. Once the automated submission is available, emails will be sent asking for new data and strongly encouraging use of the automated system in preference to email submissions. Once the automated submission system is available, emailed data submissions will still be accepted, but replies will be sent asking for the submitter to use the automated system in future. All efforts to persuade people to use the automated system must include details of the benefits to the submitter in terms of ease of use and automatic data checking.

Action item: Complete SOCAT automation for version 3 by March 2013 (Steve Hankin, Kevin O'Brien, Alex Kozyr, Stephen Jones, Heather Koyuk, Denis Pierrot, Benjamin Pfeil).

**Quality control criteria and flags for version 2 (Bronte Tilbrook)**
The QC process for version 2 will be similar to the previous QC process, with A-F, and S flags for individual cruises, as well as a method to flag individual points within a data file (useful to identify fliers in cruise that would otherwise pass the QC process). Denis will provide Matlab code for additional plotting routines that will compare data with existing data in the region. The group would like to that repeat quality control (QC) entries can be entered for multiple cruises on the LAS.

The group discusses the characteristics of a cross-over to warrant an "A" quality control flag. The group decides that two ships must be in the same area at the same time. Cathy recommends that an entry on acceptable distances and acceptable time frames for such a cross-over is added to the cook book.

Yukihiro Nojiri suggests having a separate quality flag for the coastal regions, because the data here can often be outside the standard calibration ranges (unlike data from the open ocean), and therefore could cause a cruise to be flagged as questionable/bad, even though the coastal data are valid. Various options are discussed, including allowing different flags for each region of a cruise and/or choosing the lowest flag if different flags are given for the same cruise. Ultimately, the meeting decides that the current system should be maintained, whereby conflicting cruise flags trigger an alert and the different groups must communicate to determine the final flag assigned to the cruise.

Action item: Implement repeat quality control entries on the LAS for version 2, if possible, or otherwise for version 3 (Kevin O'Brien, Heather Koyuk, March 2013).
Action item: Add an entry on cross-overs to the cookbook (Are Olsen and others, March 2013).

**User access to coastal data in version 2**
Coastal and non-coastal data in SOCAT are defined according to a coastal mask created for version 1. However, the definition of this mask is not easily available to users. The group agrees that the coastal mask used by SOCAT should be added to the socat.info website, so users can see which areas qualify as coastal and therefore use that same mask in their own work. Bronte Tilbrook asks, if a new query could be added to the LAS and other data downloads, so users can ask for measurements within a specified distance of land. Benjamin and Kevin respond that the required data is already stored in the SOCAT database, so a suitable function could be added to the LAS relatively easily.

Action item: Add the coastal mask to the SOCAT web site (Benjamin Pfeil, August 2012).
Action item: Add a query to the LAS for a specified distance from land (Kevin O'Brien, March 2013)

**Cavity Ringdown Spectrometer $CO_2$ measurements (Bronte Tilbrook)**
The group decides that Cavity Ringdown Spectrometer (CRDS) measurements with daily gas calibration will be added to the list of acceptable instruments for meeting the criteria for flags A and B. CRDS data may be included in SOCAT version 2 and may receive a flag A, B, C or D, depending on whether (other) SOP criteria were followed.

Action item: Update the QC cookbook to include CRDS analysis (Dorothee Bakker, Are Olsen, July 2012).

**Should $CO_2$ data from moorings, gliders and drifters be included in SOCAT? (Bronte Tilbrook)**
The group decides to develop a vision on whether to include $fCO_2$ data from moorings, and drifters, as measured by infrared analysis and spectrometry, in SOCAT version 3. If these data are included, what flags should be used and which quality control criteria should apply to these data for obtaining specific flags? Rik Wanninkhof and Adrienne Sutton are mentioned as possible leads for developing such a vision. Subsequently SOCAT participants would need to be consulted on this vision.
Later addition: Data from drifters are unlikely to be included, as SOCAT only has surface data.

Action item: Develop a vision on whether to include $fCO_2$ data from moorings, gliders and drifters in SOCAT version 3 (Rik Wanninkhof?, Adrienne Sutton?, Denis Pierrot, Dorothee Bakker, December 2012).

**Seconds for all new and existing data in version 3 (Benjamin Pfeil)**
Seconds will be added to all new data in version 2. Seconds will be added to all existing data from version 1.5 by version 3.

**Inclusion of additional parameters? (Ute Schuster)**
The group decides to delay the inclusion of extra parameters (calculated $fCO_2$, dissolved inorganic carbon (DIC), total alkalinity (TA), pH, nutrients, oxygen, oxygen/argon, etc.) in SOCAT until SOCAT version 4 or later. Parameters should only be included in future SOCAT versions, if they can be quality controlled and if sufficient manpower and/or automation are in place to carry out such extra quality control. Flexibility will be added to the SOCAT automation for future inclusion of parameters. No action required.

**SOCAT personnel and recruitment (Dorothee Bakker, regional group leads)**
Dorothee expressed the desire to update and strengthen the membership of the global group and leads of the regional groups. The group agrees that it would be good to strengthen the global and regional groups.

Action item: Update the membership of global group and leads of regional groups (Dorothee Bakker, Denis Pierrot, Cathy Cosca, July 2012)

**Future meetings of SOCAT key players (Ute Schuster, Cathy Cosca)**
A 2-3 day SOCAT meeting of the global group, regional group leads and key participants will be held as required and only if required, e.g. in late 2013. Possible topics include: Review of automation experience, Inclusion of extra parameters. If suitable, combine the meeting with other meetings in the same period, to reduce travel (time, expenses) and increase efficiency. Possible meeting venues are NOAA-PMEL, Amsterdam, IOCCP and UEA.

Action item: Investigate the need for a meeting of the global group, regional group leads and key participants (Maciej Telszewski, Dorothee Bakker, June 2013).

**SOCAT website (Maciej Telszewski , Benjamin Pfeil)**
Benjamin Pfeil gives a demonstration of the Google Analytics service that has been added to the front page of the socat.info web site. This tool provides statistics and other information regarding the site's usage. The group agreed that such statistics gathering should be added to as much of the SOCAT web sites as possible (including data download statistics and usage information from the LAS), so we can record how often the data is being used and in what countries/institutions where possible. This will provide valuable supporting data to provide to funders of the SOCAT project.

The group recommends updating the SOCAT website. Meeting reports and key SOCAT presentations should be added, as well as links to SOCAT publications and SOCAT in the media. The participants of the global and regional groups should be updated. Logos might be added to the credits page, as requested by several SOCAT participants. A figure of the SOCAT regions and a coastal mask should be added to the download page for SOCAT users. A video might be created on the use of the online viewers and LAS tools.

Action item: Update the SOCAT website (Benjamin Pfeil, Dorothee Bakker, Kevin O'Brien, August 2012).

**SOCAT profile (Bronte Tilbrook)**
The group recommends raising the profile of SOCAT by emphasising the scientific uses and the societal benefits of SOCAT. Societal benefits include the SOCAT model of a community effort and the use of SOCAT in global carbon budgets (e.g. Global Carbon Project). Scientific users of SOCAT include ocean carbon modellers and ocean acidification community. The group would like to encourage a SOCAT presence at ICDC9 by submission of scientific abstracts on version 1.5 and release information on version 2.

Action item: Create a 2 page mission statement of SOCAT (Dorothee Bakker, Denis Pierrot, October 2012).
Action item: Promote submission of SOCAT abstracts to ICDC9 (Dorothee Bakker, January 2013).

**Practical Salinity Unit versus Practical Salinity Scale (Dorothee Bakker)**
The salinity scale used does not really matter for SOCAT, as salinity has a very small influence on the $fCO_2$ recalculation (Pfeil et al. 2012).

**Reporting of $pCO_2$ versus $fCO_2$ to SOCAT (Dorothee Bakker)**
Some PI's report $pCO_2$, others $fCO_2$. Does SOCAT want to promote a particular solution? *Are Olsen commented 'SOCAT should promote PIs to submit enough parameters to ensure that recalculation of $pCO_2$/$fCO_2$ can be carried out' (by email on 26/06/2012).* The group agrees with Are Olsen's statement.

**Submission of time series data to SOCAT**
Bronte Tilbrook asks which format is required for submitting time series data to SOCAT. Alex Kozyr responds that there already is a PMEL standard for these submissions which can be used for SOCAT. Benjamin Pfeil agrees to send the format specification and an example file to Bronte Tilbrook. This should also be disseminated to other PIs who are likely to submit time series data in future.

**Summary of the breakout group on the 2 page SOCAT mission statement**
*Participants: Denis Pierrot, Dorothee Bakker*
The duo discusses items for inclusion in the 2 page mission statement.

**Summary of the breakout group on the Coastal and Arctic meeting**
*Maciej Telszewski, Cathy Cosca, Ute Schuster*
The group discusses the potential participants of the Coastal and Arctic meeting.

**Summary of the automation breakout**:
*Participants: Kevin O'Brien, Stephen Jones, Alex Kozyr, Benjamin Pfeil.*
In the breakout meeting, the automation team decided upon the following:

- Alex Kozyr will encourage people to submit directly to SOCAT through a link on his OME system. Should people still submit to OME, Alex will either send data to Benjamin or submit the data himself through SOCAT automated interface.
- The team will provide FAQ, videos and examples for version 3 automation.
- Stephen Jones will add logic into the sanity checker, such that it will also have a check for the start date used in the Expocode and compare this start date to actual results to ensure that observational dates are within 2 weeks of the Expocode start date.
- An automation prototype will be ready by Mid-December 2012.
- The automation will require the NODC code. These codes can be looked up at NODC. The automation team will provide the link.
- The team reviewed XML syntax to be used for sanity checking. This will need further discussion, iteration, and refinement.

**Summary of presentations:**
**Recent surface ocean carbon activities (Denis Pierrot)**
About 200,000 new measurements have been made in the Gulf of Mexico since 2007 using 2 NOAA ships (R/V Gordon Gunter and R/V Ronald H. Brown) and 2 cargo ships (M/V Las Cuevas and M/V Barcelona Express). The spatial coverage is mostly restricted to the northern part of the Gulf. The temporal coverage has improved greatly in the last 2 years, providing data throughout the year in 2008 and 2009. Flux calculations show that the area is a source in the summer and a sink in the winter. In contrast with the results from Takahashi, 2009, the region has a very small negative net annual flux (-0.02 mol C/$m^2$/year). The second part of the presentation presented the results of a study by Geun-Ha Park and Rik Wanninkhof on the trend of the $CO_2$ sink in the western tropical North Atlantic, using the RCCL Explorer of the Seas data collected from 2002 to 2009. In the region studied, the results show a large increase in the $CO_2$ sink over

the period. The result can be partially explained by a lack of increase in the $fCO_2$(sw) over the winter months, thus increasing the air-sea influx of $CO_2$ in winter. This lack of increase is due to El Nino events in 2002-2003 raising the $fCO_2$(sw) (winter) values. Not enough data is available to explain why the $fCO_2$(sw) values in the summer were also increasing less than the atmosphere. This trend is different than the ones found in other studies in other parts of the Atlantic but agrees with McKinley et al. (2011) in the subtropical gyre.

**Action Items**

Action item: All speakers and rapporteurs will send their reports and talks to Dorothee Bakker. Dorothee Bakker and Maciej Telszewski will create a meeting report (Dorothee Bakker, Maciej Telszewski, August 2012).

Action item: Consult the prospective lead of the Arctic group. Create an Arctic group on the Live Access Server (Cathy Cosca, Kevin O'Brien, July 2012).

Action item: Meet the timetable for SOCAT version 2 (SOCAT participants, January 2013).

Action item: Maciej Telszewski will liaise with Simone Alin, Burke Hales, Wei Jun Cai, Jeremy Matthis, Cathy Cosca and Ute Schuster on a SOCAT coastal and Arctic group meeting (Maciej Telszewski, October 2012).

Action item: Complete SOCAT automation for version 3 by March 2013 (Steve Hankin, Kevin O'Brien, Alex Kozyr, Stephen Jones, Heather Koyuk, Denis Pierrot, Benjamin Pfeil).

Action item: Implement repeat quality control entries on the LAS for version 2, if possible, or otherwise for version 3 (Kevin O'Brien, Heather Koyuk, March 2013).

Action item: Add entry on cross-overs to the cookbook (Are Olsen, March 2013)

Action item: Add the coastal mask to the SOCAT web site (Benjamin Pfeil, August 2012).

Action item: Add query to LAS for a specified distance from land (Kevin O'Brien, March 2013)

Action item: Update the QC cookbook to include CRDS analysis for version 2 (Dorothee Bakker, July 2012).

Action item: Develop a vision on whether to include $fCO_2$ data from moorings, gliders and drifters in SOCAT version 3 (Rik Wanninkhof?, Adrienne Sutton?, Denis Pierrot, Dorothee Bakker, December 2012).

Action item: Update membership of global group and leads of regional groups (Dorothee Bakker, Denis Pierrot, Cathy Cosca, July 2012)

Action item: Update the SOCAT website (Benjamin Pfeil, Dorothee Bakker, Kevin O'Brien, August 2012).

Action item: Create a 2 page mission statement of SOCAT for the SOCAT website (Dorothee Bakker, Denis Pierrot, October 2012).

Action item: Promote submission of SOCAT abstracts to ICDC9 (Dorothee Bakker, January 2013).

Action item: Investigate the need for a meeting of the global group, regional group leads and key participants in late 2013 (Maciej Telszewski, Dorothee Bakker, June 2013).

**Appendix 1 Participants**

| | | |
|---|---|---|
| 1. Dorothee Bakker | (global group, UEA, UK) | d.bakker@uea.ac.uk |
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**Apologies from**: Simone Alin (coastal co-lead), Wei-Jun Cai (coastal co-lead), Dick Feely (tropical Pacific lead), Burke Hales (coastal lead), Steve Hankin (global group), Heather Koyuk (global group), Nathalie Lefèvre (tropical Atlantic lead), Are Olsen (global group), Chris Sabine (global group), Rik Wanninkhof (Atlantic)

**Appendix 2 Agenda**

**Tuesday 3 July 2012 (Day 1)**

**SOCAT version 2 and other updates**

*Chair Ute Schuster, Rapporteur Stephen Jones*

09:00 Welcome, Introduction of all participants and their role in SOCAT (Dorothee Bakker)

09:30 Update on SOCAT and Aims of meeting (Dorothee Bakker)

09:45 **SOCAT version 2**

- Update on progress (Benjamin Pfeil, Kevin O'Brien)
- Discuss, adjust and approve time table for SOCAT version 2 (Dorothee Bakker, all)
- Do we need an Arctic group or can Arctic quality control be done by the North Atlantic and North Pacific groups? (Cathy Cosca, Ute Schuster)

10:30 Coffee, tea

11:00 SOCAT version 2 (continued)

- How can we promote active participation by the coastal group? Would a meeting of the coastal group be useful? (Maciej Telszewski, Dorothee Bakker)
- Other issues (e.g. seconds for new data, ...) (Dorothee Bakker)

12:30-13:30 Lunch

**Automation for SOCAT version 3**

*Chair Dorothee Bakker, Rapporteur Cathy Cosca*

13:30 Introduction to automation structure, as discussed at PMEL (10 & 11 May 2012) (Dorothee Bakker)

13:50 Metadata creation and management (Alex Kozyr)

14:10 User interface & Submission of data and metadata (Kevin O'Brien)

14:30 File formats and file conformance tester (Stephen Jones)

14:50 Initial quality control by data PI prior to submission (Denis Pierrot)

15:10 Versioning of SOCAT data output files and doi-numbers (Benjamin Pfeil)

15:30 Tea, coffee

16:00 Discussion of the SOCAT automation structure

16:30 Discuss whether to approve the SOCAT automation structure with any modifications.

17:00 End of Day 1

**Wednesday 4 July 2012 (Day 2)**

*Chair Denis Pierrot, Rapporteur Ute Schuster*

09:00 Summary of day 1 (Dorothee Bakker)

09:15 Quality control criteria and flags (Bronte Tilbrook)

09:30 Seconds for all new and existing data in version 3 (Benjamin Pfeil).

09:45 Additional parameters in version 3: scientific and technical needs and challenges. The plan (by the automation task team) is to include atmospheric $CO_2$ in version 3. Should version 3 also include dissolved inorganic carbon (DIC), total alkalinity (TA), pH, nutrients, oxygen etc? Which parameters should be quality controlled? (Ute Schuster)

10:15 SOCAT personnel and recruitment (Dorothee Bakker, regional group leads)

10:30 Coffee, tea, group photo

*Chair Dorothee Bakker, Rapporteur Ute Schuster*

11:00 Frequency and type of SOCAT meetings (annual? regional?) (Ute Schuster, Cathy Cosca)

11:15 Funding for SOCAT (Bronte Tilbrook)

11:30 Links with IOCCP, IMBER, SOLAS. Possible links with GOOS, ESA, ...? (Bronte Tilbrook).

11:45 SOCAT website (Maciej Telszewski)

12:00 Additional issues (Dorothee Bakker, Alex Kozyr):

- Practical Salinity Unit versus Practical Salinity Scale. Does this matter for SOCAT?
- PI's reporting the $pCO_2$ versus $fCO_2$. Does SOCAT want to promote a particular solution? *Are Olsen (26/06/2012): 'SOCAT should promote PIs to submit enough parameters to ensure that recalculation of $pCO_2$/$fCO_2$ can be carried out.'*

12:30-13:30 Lunch

13:30 Breakout groups on:

- Automation (Kevin O'Brien, Stephen Jones, Alex Kozyr, Benjamin Pfeil)
- 2 page SOCAT mission statement (Denis Pierrot, Dorothee Bakker)
- Coastal and Arctic meeting (Maciej Telszewski, Cathy Cosca, Ute Schuster)

15:30 Tea, coffee

*Chair Bronte Tilbrook*

16:00 Global distribution of changes in $pCO_2$ and Ω-aragonite based on the SOCAT database (Yosuke Iida)

16:20 Recent surface ocean carbon activities (Cathy Cosca)

16:40 QC in SOCAT version 1.5 and submission for SOCAT version 2 (Yukihiro Nojiri)

17:00 End of Day 2

**Thursday 5 July 2012 (Day 3)**

*Chair Stephen Jones; Rapporteur Denis Pierrot*

09 :00 Recent surface ocean carbon activities (VVSS Sarma)

09:20 Recent surface ocean carbon activities (Denis Pierrot)

09:40 Recent surface ocean carbon activities (Ute Schuster)

10:00 Recent surface ocean carbon activities (Bronte Tilbrook)

10:30 Coffee, tea

*Chair Cathy Cosca; Rapporteur Denis Pierrot*

11:00 A Neural Network intercomparison experiment using SOCAT (Shin-ichiro Nakaoka)

11:20 Summary of breakout groups,

11:40 Overview of decisions and Wrap up

12:30 End of meeting

**Appendix 3 SOCAT publications**

**Submitted**


Pfeil, B., Olsen, A., Bakker, D.C.E., Hankin, S., Koyuk, H., Kozyr, A., Malczyk, J., Manke, A., Metzl, N., Sabine, C.L., Akl, J., Alin, S.R., Bellerby, R.G.J., Borges, A., Boutin, J., Brown, P.J., Cai, W.-J., Chavez, F.P., Chen, A., Cosca, C., Fassbender, A.J., Feely, R.A., González-Dávila, M., Goyet, C., Hardman-Mountford, N., Heinze, C., Hood, M., Hoppema, M., Hunt, C.W., Hydes, D., Ishii, M., Johannessen, T., Jones, S.D., Key, R.M., Körtzinger, A., Landschützer, P., Lauvset, S.K., Lefèvre, N., Lenton, A., Lourantou, A., Merlivat, L., Midorikawa, T., Mintrop, L., Miyazaki, C., Murata, A., Nakadate, A., Nakano, Y., Nakaoka, S., Nojiri, Y., Omar, A.M., Padin, X.A., Park, G.-H., Paterson, K., Perez, F.F., Pierrot, D., Poisson, A., Ríos, A.F., Salisbury, J., Santana-Casiano, J.M., Sarma, V.V.S.S., Schlitzer, R., Schneider, B., Schuster, U., Sieger, R., Skjelvan, I., Steinhoff, T., Suzuki, T., Takahashi, T., Tedesco, K., Telszewski, M., Thomas, H., Tilbrook, B., Tjiputra, J., Vandemark, D., Veness, T., Wanninkhof, R., Watson, A.J., Weiss, R., Wong, C.S.,Yoshikawa-Inoue, H. (2012) A uniform, quality controlled Surface Ocean $CO_2$ Atlas (SOCAT). Earth Syst Sci Data Disc (submitted 24/06/2012)

Rödenbeck, C., Keeling, R.F., Bakker, D.C.E., Metzl, N., Olsen, A., Sabine, C.L., Heimann, M. (2012) Sea-air $CO_2$ flux estimated from SOCAT surface-ocean $CO_2$ partial pressure data and atmospheric $CO_2$ mixing ratio. Ocean Science Discussions 9: 2273-2326, www.ocean-sci-discuss.net/9/2273/2012/, doi:10.5194/osd-9-2273-2012.

Sabine, C.L., Hankin, S., Koyuk, H., Bakker, D.C.E., Pfeil, B., Olsen, A., Metzl, N., Kozyr, A., Fassbender, A., Manke, A., Malczyk, J., Akl, J., Alin, S.R., Bellerby, R.G.J., Borges, A., Boutin, J., Brown, P.J., Cai, W.-J., Chavez, F.P., Chen, A., Cosca, C., Feely, R.A., González-Dávila, M., Goyet, C., Hardman-Mountford, N., Heinze, C., Hoppema, M., Hunt, C.W., Hydes, D., Ishii, M., Johannessen, T., Key, R.M., Körtzinger, A., Landschützer, P., Lauvset, S.K., Lefèvre, N., Lenton, A., Lourantou, A., Merlivat, L., Midorikawa, T., Mintrop, L., Miyazaki, C., Murata, A., Nakadate, A., Nakano, Y., Nakaoka, S., Nojiri, Y., Omar, A.M., Padin, X.A., Park, G.-H., Paterson, K., Perez, F.F., Pierrot, D., Poisson, A., Ríos, A.F., Salisbury, J., Santana-Casiano, J.M., Sarma, V.V.S.S., Schlitzer, R., Schneider, B., Schuster, U., Sieger, R., Skjelvan, I., Steinhoff, T., Suzuki, T., Takahashi, T., Tedesco, K., Telszewski, M., Thomas, H., Tilbrook, B., Vandemark, D., Veness, T., Watson, A.J., Weiss, R., Wong, C.S., Yoshikawa-Inoue H (2012) Gridding of the Surface Ocean $CO_2$ Atlas (SOCAT) Gridded data products. Earth Syst Sci Data Disc (submitted 26/06/2012)

Schuster, U., McKinley, G. et al. (2012) RECCAP article on Atlantic and Arctic. Biogeosciences Disc..


**Published, peer-reviewed**


Chierici, M., Signorini, S.R., Mattsdotter-Björk, M., Fransson, A., Olsen, A. (2012) Surface water $fCO_2$ algorithsm for the high-latitude Pacific sector of the Southern Ocean. Remote Sensing of Environment 119:184-196.

Lourantou, A., and N. Metzl, 2011. Decadal evolution of carbon sink within a strong bloom area in the subantarctic zone. Geophys. Res. Lett., doi:10.1029/2011GL049614


**Published, non-peer reviewed**


Bakker, D.C.E., Pfeil, B., Olsen, A., Sabine, C., Metzl, N., Hankin, S., Koyuk, H., Kozyr, A., Malczyk, J., Manke, A., Telszewski, M. (2012) Global data products help assess changes to the ocean carbon sink. Eos, Transactions American Geophysical Union, 93(12):125-126. doi:10.1029/2012EO120001.

**Appendix 4 SOCAT in the media**

A joint press release in the UK (UEA lead), Norway, US and France accompanied the publication of the *Eos* article on 16 March 2012. Below is a list of SOCAT in the media, following this press release. The press interest in Norway exceeded that elsewhere.

**Norway**

- http://www.forskning.no/artikler/2012/mars/316545
- http://www.aftenbladet.no/energi/klima/Klimaforskarar-lettar-pa-sloret-2944241.html#.T2grmpiEbao
- http://nyheter.uib.no/?modus=vis_nyhet&id=50778
- Stavanger Aftenblad, 16/03/2012, http://www.aftenbladet.no/energi/klima/Klimaforskarar-lettar-pa-sloret-2944241.html
- Forskning.no, 19/03/2012, http://www.forskning.no/artikler/2012/mars/316545
- Sciencenordic.com (Nordic online research news), March 20th:
- http://sciencenordic.com/co2-map-provides-quality-control-climate-research
- Dagens Næringsliv, 21/03/2012, http://www.dn.no/talent/article2355631.ece

**UK**

- East Anglian Daily Times, Waves of concern over the future of world's oceans. 24/03/12.

**Italy**

- http://daily.wired.it/foto/2012/03/16/socat-atlante-oceani-19444.html
- http://oggiscienza.wordpress.com/2012/03/19/un-database-pubblico-sulla-salute-degli-oceani/

**Slovenia**

- Balkans.com, 24/04/12. http://www.balkans.com/open-news.php?uniquenumber=143006