Underway Sulfur Dioxide measurements from R/V Tangaroa cruise VDT0410 in the South East of New Zealand, S.W. Bounty Trough in 2004 (SAGE project)

Website: https://www.bco-dmo.org/dataset/3334
Version: 02April2010
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Project
» Surface-Ocean Lower-Atmosphere Studies Air-Sea Gas Exchange (Experiment) (SAGE)

Programs
» Iron Synthesis (FeSynth)
» United States Surface Ocean Lower Atmosphere Study (U.S. SOLAS)

Contributors	Affiliation	Role
Cainey, Jill	Cape Grim Baseline Air Pollution Station, Australia (CGBAPS)	Principal Investigator
Gegg, Stephen R.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Dataset Description

Underway Sulfur Dioxide Measurements

Notes on Sulfur Dioxide Measurements made during the SAGE Cruise; 27 March to 15 April 2004
Measurements were made using an HPLC technique:
Saltzman, E.S., Yvon, S.A. and Matrai, P.A. 1993. Low-level atmospheric sulfur dioxide measurement using HPLC/fluorescence detection. J. Atmos. Chem., 17, 73-90

Measurements commenced on 01 April 2004
The following days there were no measurements made:
02 April 2004
07 April 2004
08 April 2004
10 April 2004
11 April 2004
12 April 2004

On these days either the weather was too bad for operation or deployment of the ship meant that sampling of the stack was highly likely. The inlet of the instrument was on the seaward side of the Atmospheric Container lab and it was imperative to ensure that seawater did not enter the inlet, since seawater would have acted as a sink for sulfur dioxide and would have damaged the nafion drier beyond repair. In poor weather waves were breaking over the container occasionally, the instrument was not operated in such conditions.

13 April 2004 was a dedicated "Atmospheric" day and sampling ran for 12 hours, commencing at 04:15am, to obtain pre-dawn levels of sulfur dioxide.

The cleanest days of the cruise, when the measurements were not significantly affected by ship emissions were 09 April and 13 April. 09 April 2004 was the cleanest day with all measurements likely to be from clean background air

A further assessment of how clean samples were, will be made using the CN data at a later stage.

The inlet was at a height of 2m from the deck and 1m from the rail.

Methods & Sampling

Refer to SAGE Voyage Report

Date and time here refers to the actual time air sampled, not when run.
Typically a maximum of 4 minutes prior to run time
Samples have been binned into the nearest quarter of an hour, since samples were run every 14 minutes So a sample run at 11:25am will have been collected between 11:21 and 11:25, this sample would be binned into 11:15am
No Standards, just air samples
Blank cells indicate a period when samples were not collected
BDL (below detection limits) indicates that no sulfur dioxide peak was detected.
The detection limit was 4 pptv.

Data Processing Description

BCO-DMO Processing Notes
Generated from original spreadsheet SAGESO2Data.xls

BCO-DMO Edits
- date/time split into seperate columns
- date reformatted to YYYYMMDD
- time reformatted to HHMMSS
- 'nd' added to blank cells
- parameter names modified to conform to BCO-DMO convention

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Data Files

File
SO2_Underway.csv (Comma Separated Values (.csv), 25.42 KB) MD5:d140bf00d3de9bd97cad304606dd14fe Primary data file for dataset ID 3334

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Parameters

Parameter	Description	Units
date	Date (???)	YYYYMMDD
time	Time (???)	HHMM
SO2_ALL	SO2 Concentration (all)	pptv
SO2_CLEAN	SO2 Concentration (clean)	pptv

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Deployments

VDT0410

Website	https://www.bco-dmo.org/deployment/57828
Platform	R/V Tangaroa
Report	http://bcodata.whoi.edu/Fe_Synthesis/SAGE/SAGE_Voyage_Report.pdf
Start Date	2004-03-17
End Date	2004-04-15
Description	Surface-Ocean Lower-Atmosphere Studies Air-Sea Gas Experiment Phytoplankton blooms, either natural or stimulated, provide effective natural laboratories in which to study the pronounced biogeochemical fluxes and gradients associated with their evolution and decline. These phytoplankton-mediated signals are mainly expressed in the ocean, but also result in enhanced fluxes of carbon dioxide (CO2), dimethylsulfide (DMS) and other biogenic gases across the air-sea interface. The Southern Ocean is a net sink region for atmospheric CO2, yet uncertainties remain in the strength of this sink because few measurements of the efficiency of ocean-atmosphere gas exchange have been made under turbulent windy open-ocean conditions. During SAGE, in a similar fashion to SOIREE in 1999, we proposed to stimulate a phytoplankton bloom through addition of iron fertiliser to iron-limited Sub-Antarctic waters. The fertilisation was marked with the addition of two inert dissolved gas tracers, sulfur hexafluoride (SF6) and Helium-3 (3He), creating a lagrangian patch/dual-tracer study with the tracer SF6 providing a control volume, vertical and lateral diffusion rates and estimates of air-sea gas exchange in association with 3He. The enhanced gas fluxes associated with the bloom should provide optimal conditions for measuring the rate of gas exchange and the key physical processes governing the exchange. These processes include near-surface turbulence (typically generated by breaking waves), temperature microstructure, stratification, wave field, wave breaking and wind speed. In conjunction with these patch scale and surface physics measurements, the micrometeorologic al relaxed eddy accumulation technique (REA) was deployed to make direct atmospheric measurements of gas fluxes. A combination of gas concentration measurement and REA flux potentially allows the efficiency of gas exchange to be calculated at the local scale. These local scale measurements can be compared with exchange rates derived from the dual tracer technique for the larger labelled patch. Experimental goals Determine drivers and controls of ocean-atmosphere gas exchange quantifying: - biological production and utilisation of climatic relevant gases in particular CO2 and DMS) - in the surface ocean - physical control of exchange across the interfaces of the surface mixed layer - production of aerosols resulting from interaction of biological and physical processes Objectives: This experiment combined seven main research objectives considering: 1. quantification of gas transfer fluxes and velocities for a variety of gases 2. physical processes affecting gas transfer 3. ecosystem interactions controlling dissolved DMS concentration and CO2 removal 4. the impact of iron availability upon phytoplankton productivity and its influence upon dissolved - gas concentration 5. the impact of photochemistry in the surface ocean on dissolved gas concentration and air-sea exchange 6. the fate of DMS in the atmosphere and aerosol condensation nuclei production from chemical - transformation in the atmospheric boundary-layer. 7. Role of aggregation in the timing and magnitude of export processes Additional objectives were the: 1. servicing of NIWA biophysical moorings: 41°11.28'S 178°28.62'E Northern Biophysical Mooring - (NBM) and approximately 46°38.202'S 178°33.486'E Southern Biophysical Mooring (SBM) 2. final release of 2 Carioca Buoys at SBM SAGE Cruise Track from SST data

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Project Information

Surface-Ocean Lower-Atmosphere Studies Air-Sea Gas Exchange (Experiment) (SAGE)

Website: http://www.niwascience.co.nz/rc/atmos/sage/

Coverage: South-East of New Zealand in the vicinity of the S.W. Bounty Trough; Sub-Antarctic waters near 46.5°S 172.5°E

While not officially funded as a U.S. SOLAS project, SAGE included significant U.S. participation and it's science themes were consistent with those of the International SOLAS program.

[from http://www.us-solas.org:8080/Plone/projects/the-us-solas-in-the-sage-study (26 may 2008)]
SAGE was a mesoscale Fe addition experiment run after the seasonal autumnal bloom of the sub-Antarctic showed a small biological response to Fe addition. The SF6/3He dual-tracer experiment extended the range of gas exchange measurement into stronger wind regimes typical of the Southern Ocean.

A goal of the SAGE project was to increase understanding of air-water Gas Exchange, Mixed Layer structure, skin/surface properties, biogenic gases and atmospheric fluxes. Core measurements included Carbon, N2/O2, noble gas, DMS(P), SO2, N2O, CO, CDOM CN and aerosol chemistry.

One cruise was conducted aboard the Research Vessel Tangaroa and instrumentation included CARIOCA pCO2 Buoys, Shipboard Gill R3A Anemometer mast, SAMI pCO2 sensors, SkinDeep vertical profiler, MAERI, SCAMP/TRAMP temperature microstructure profiler, sparbuoy, ADCP, S-band radar, FRRF, flow cytometer, primary production, nutrients, Fe, Meteorology and radiosondes.

from "DSR intro.doc"; by Mike Harvey described as in preparation for Deep Sea Research II
The SOLAS air-sea gas exchange experiment (SAGE) was a combined gas-transfer process study and iron fertilisation experiment conducted in sub-Antarctic waters of the south-west Bounty Trough (46.5°S 172.5°E) to the south-east of New Zealand between mid-March and mid-April 2004.

The experiment was designed as a lagrangian study of air-sea gas exchange processes of CO2, DMS and other biogenic gases associated with an iron-induced phytoplankton bloom. In conjunction with the iron fertilisation a dual tracer SF6/3He release served quantify both patch evolution and air-sea tracer exchange at the 10's of km's scale. Within this patch local/micrometeorological (100's m scale) gas exchange process studies quantified physical variables such as near-surface turbulence, temperature microstructure at the interface, wave properties and wind speed to enable development of improved gas exchange models for the frequently windy Southern Ocean.

After 15 days and four iron additions totalling 1.1 tonne Fe2+ there was a doubling in both column chlorophyll-a and primary productivity; a very modest response compared with other mesoscale iron enrichment. An investigation of factors limiting bloom development considered co-limitation by light, other nutrients, phyto-plankton seed-stocks and grazing regulation.

Related files

SAGE precruise Science Plan
SAGE precruise Voyage Plan
SAGE Voyage Report
SAGE Release Times
SAGE Surface Physics Metadata Report

SAGE Cruise Track from SST data (.jpg image)
Note:
SAGEtime/Experiment time zero (0.0000) is: 25 March 2004, 19:00 Local Time (NZST) *(from SAGE Voyage Report, Voyage Timetable, Pages 5-6)*

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Program Information

Iron Synthesis (FeSynth)

Coverage: Global

The two main objectives of the Iron Synthesis program (SCOR Working Group proposal, 2005), are:
1. Data compilation: assembling a common open-access database of the *in situ* iron experiments, beginning with the first period (1993-2002; Ironex-1, Ironex-2, SOIREE, EisenEx, SEEDS-1; SOFeX, SERIES) where primary articles have already been published, to be followed by the 2004 experiments where primary articles are now in progress (EIFEX, SEEDS-2; SAGE, FeeP); similarly for the natural fertilizations S.O.JGOFS (1992), CROZEX (2004/2005) and KEOPS (2005).

2. Modeling and data synthesis of specific aspects of two or more such experiments for various topics such as physical mixing, phytoplankton productivity, overall ecosystem functioning, iron chemistry, CO2 budgeting, nutrient uptake ratios, DMS(P) processes, and combinations of these variables and processes.

SCOR Working Group proposal, 2005. "The Legacy of *in situ* Iron Enrichments: Data Compilation and Modeling".
http://www.scor-int.org/Working_Groups/wg131.htm

See also: SCOR Proceedings Vol. 42 Concepcion, Chile October 2006, pgs: 13-16 2.3.3 Working Group on The Legacy of *in situ* Iron Enrichments: Data Compilation and Modeling.

The first objective of the Iron Synthesis program involves a data recovery effort aimed at assembling a common, open-access database of data and metadata from a series of *in-situ* ocean iron fertilization experiments conducted between 1993 and 2005. Initially, funding for this effort is being provided by the Scientific Committee on Oceanic Research (SCOR) and the U.S. National Science Foundation (NSF).

Through the combined efforts of the principal investigators of the individual projects and the staff of Biological and Chemical Oceanography Data Management Office (BCO-DMO), data currently available primarily through individuals, disparate reports and data agencies, and in multiple formats, are being collected and prepared for addition to the BCO-DMO database from which they will be freely available to the community.

As data are contributed to the BCO-DMO office, they are organized into four overlapping categories:
1. Level 1, basic metadata
(e.g., description of project/study, general location, PI(s), participants);
2. Level 2, detailed metadata and basic shipboard data and routine ship's operations
(e.g., CTDs, underway measurements, sampling event logs);
3. Level 3, detailed metadata and data from specialized observations
(e.g., discrete observations, experimental results, rate measurements) and
4. Level 4, remaining datasets
(e.g., highest level of detailed data available from each study).

Collaboration with BCO-DMO staff began in March of 2008 and initial efforts have been directed toward basic project descriptions, levels 1 and 2 metadata and basic data, with detailed and more detailed data files being incorporated as they become available and are processed.

Related file

Program Documentation

The Iron Synthesis Program is funded jointly by the Scientific Committee on Oceanic Research (SCOR) and the U.S. National Science Foundation (NSF).

United States Surface Ocean Lower Atmosphere Study (U.S. SOLAS)

Website: http://www.us-solas.org/

Coverage: Global

The Surface Ocean Lower Atmosphere Study (SOLAS) program is designed to enable researchers from different disciplines to interact and investigate the multitude of processes and interactions between the coupled ocean and atmosphere.

Oceanographers and atmospheric scientists are working together to improve understanding of the fate, transport, and feedbacks of climate relevant compounds, and also weather and hazards that are affected by processes at the surface ocean.

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Physical, chemical, and biological research near the ocean-atmosphere interface must be performed in synergy to extend our current knowledge to adequately understand and forecast changes on short and long time frames and over local and global spatial scales.

The findings obtained from SOLAS are used to improve knowledge at process scale that will lead to better quantification of fluxes of climate relevant compounds such as CO2, sulfur and nitrogen compounds, hydrocarbons and halocarbons, as well as dust, energy and momentum. This activity facilitates a fundamental understanding to assist the societal needs for climate change, environmental health, weather prediction, and national security.

The US SOLAS program is a component of the International SOLAS program where collaborations are forged with investigators around the world to examine SOLAS issues ubiquitous to the world's oceans and atmosphere.

Â» International SOLAS Web site

Science Implementation Strategy Reports

US-SOLAS (4 MB PDF file)
Other SOLAS reports are available for download from the US SOLAS Web site

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Funding

Funding Source	Award
New Zealand International Science and Technology Fund (ISAT)	unknown SAGE ISAT
New Zealand Foundation for Research, Science and Technology (FRST)	C01X0204
New Zealand Foundation for Research, Science and Technology (FRST)	C01X0223
National Science Foundation (NSF)	unknown SAGE NSF

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