Mixed Layer Depth (MLD) and Sulphur Hexafluoride (SF6) parameters at CTD stations 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/3322
Version: 24March2010
Version Date: 2010-03-24

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
Law, C.S.	Plymouth Marine Laboratory (PML)	Principal Investigator
Stevens, Craig	New Zealand National Institute of Water and Atmospheric Research (NIWA)	Co-Principal Investigator
Gegg, Stephen R.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Table of Contents

Dataset Description

Mixed Layer Depth (MLD) and SF6 parameters at CTD stations

Note:
SAGEtime/ExperimentDay time zero (0.0000) is:
25 March 2004, 19:00 Local Time (NZST) from
SAGE Voyage Report, Voyage Timetable, Pages 5-6

Methods & Sampling

Refer to SAGE Voyage Report

CTD-related instrumentation consisted of:
- a Seabird Electronics (SBE) 911plus CTD with:
- SBE-5 pumped SBE-3 temperature, SBE-4 conductivity and SBE-43 dissolved oxygen sensors.

- SBE-5 pumped secondary SBE-3 temperature and SBE-4 conductivity sensors.
- Seapoint Sensors, Inc. SCF chlorophyll fluorometer.
- 25-cm Wetlabs C-star transmissometer.
- Biosherical Instruments Inc. photosynthetic ally active radiation (PAR) sensor, model QSP200L4S.
- Datasonics sonar altimeter, model PSA-900D.
- a SBE 32 24x10-litre Carousel water sampler.
- Ocean Test Equipment Standard BES external-spring Niskin-type water-sampling bottles.
- Salinity sample bottles.
- CTD winch with 10-km 10.5-mm single-core seacable.

Performance: With the exception of issues noted below, the CTD-related instrumentation apparently functioned to specification and was operated essentially according to accepted practices for the duration of the voyage. A total of 85 one-cast CTD stations were completed, labelled u3502 to u3743.

PAR Sensor: The initial CTD PAR sensor experienced an intermittent fault that manifested as a time variable offset, both cast to cast and, less evidently, within casts. It was eventually replaced with a formally identical spare unit for station u3719 cast 1 and subsequent casts.

Secondary Conductivity Sensor: The initial secondary conductivity sensor eventually developed a clear fault (during station u3740 cast 1). It was replaced with a formally identical spare unit for station u3740 cast 1 and subsequent casts. The development of this fault was perhaps somewhat progressive, as possibly indicated by slight shifts in the primary-secondary conductivity difference on casts before station u3740 cast 1.

Data Processing Description

BCO-DMO Processing Notes
Generated from original spreadsheets SAGE_MLDs.xls and SAGE_casts050502.xls

BCO-DMO Edits
- "Cast" changed to "station_CTD" for compatibility with other datasets
- lat signed negative for South
- date reformatted to YYYYMMDD
- time reformatted to HHMM
- comments in individual data cells incorporated into comment fields
- parameter names modified to conform to BCO-DMO convention

[table of contents | back to top]

Data Files

File
CTD_MLDs_SF6.csv (Comma Separated Values (.csv), 9.33 KB) MD5:4d8e357a2608dd4e2f788ffb978acb70 Primary data file for dataset ID 3322

[table of contents | back to top]

Parameters

Parameter	Description	Units
station_CTD	SAGE CTD station identifier	text
date_NZST	Date (NZST)	YYYYMMDD
time_local	Time (NZST)	HHMM
ExpDay	Custom project time pre/post 25March2004 19:00 Local Time (NZST)	dd.xx
lon	Station longitude (West is negative)	decimal degrees
lat	Station latitude (South is negative)	decimal degrees
Station_designation_based_on_SF6	Station designation/description based on SF6 concentration	text
SF6_Max	Highest SF6 concentration within cast	fM
SF6_Max_depth	Depth of highest SF6 concentration in cast	meters
TLD	Tracer Layer Depth (TLD) - Depth at which SF6 decreased to 25percent of concentration at 15m (No value reflects limited depth resolution in the profile or no decline in SF6 across depth range sampled)	meters
Comments_on_SF6_Profile	Comments on SF6 Profile	text
z_max	Depth of the maximum buoyancy frequency Nmax	meters
Tz_diff	Tz_diff - although misnamed - this is my proportional approach..calculate the average sig above the max buoyancy frequency... this depth is that at 1/4 of this avg	meters
depth_sigT_minus_SSD	depth at which sigT-surface sigT >0.01 kg/m3 Thomson&Fine Jtech 2003	meters
Comments_on_structure_from_CTD	Comments on structure from CTD	text

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	CTD Seabird 911
Generic Instrument Name	CTD Sea-Bird 911
Dataset-specific Description	CTD-related instrumentation consisted of: - a Seabird Electronics (SBE) 911plus CTD with: - SBE-5 pumped SBE-3 temperature, SBE-4 conductivity and SBE-43 dissolved oxygen sensors. - SBE-5 pumped secondary SBE-3 temperature and SBE-4 conductivity sensors. - Seapoint Sensors, Inc. SCF chlorophyll fluorometer. - 25-cm Wetlabs C-star transmissometer. - Biosherical Instruments Inc. photosynthetic ally active radiation (PAR) sensor, model QSP200L4S. - Datasonics sonar altimeter, model PSA-900D. - a SBE 32 24x10-litre Carousel water sampler. - Ocean Test Equipment Standard BES external-spring Niskin-type water-sampling bottles. - Salinity sample bottles. - CTD winch with 10-km 10.5-mm single-core seacable.
Generic Instrument Description	The Sea-Bird SBE 911 is a type of CTD instrument package. The SBE 911 includes the SBE 9 Underwater Unit and the SBE 11 Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). More information from Sea-Bird Electronics.

[table of contents | back to top]

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

[table of contents | back to top]

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)*

[table of contents | back to top]

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.

Oceanographers and atmospheric scientists are working together to improve understanding of the fate, transport, and feedbacks of climate relevant compounds.

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

[table of contents | back to top]

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

[table of contents | back to top]