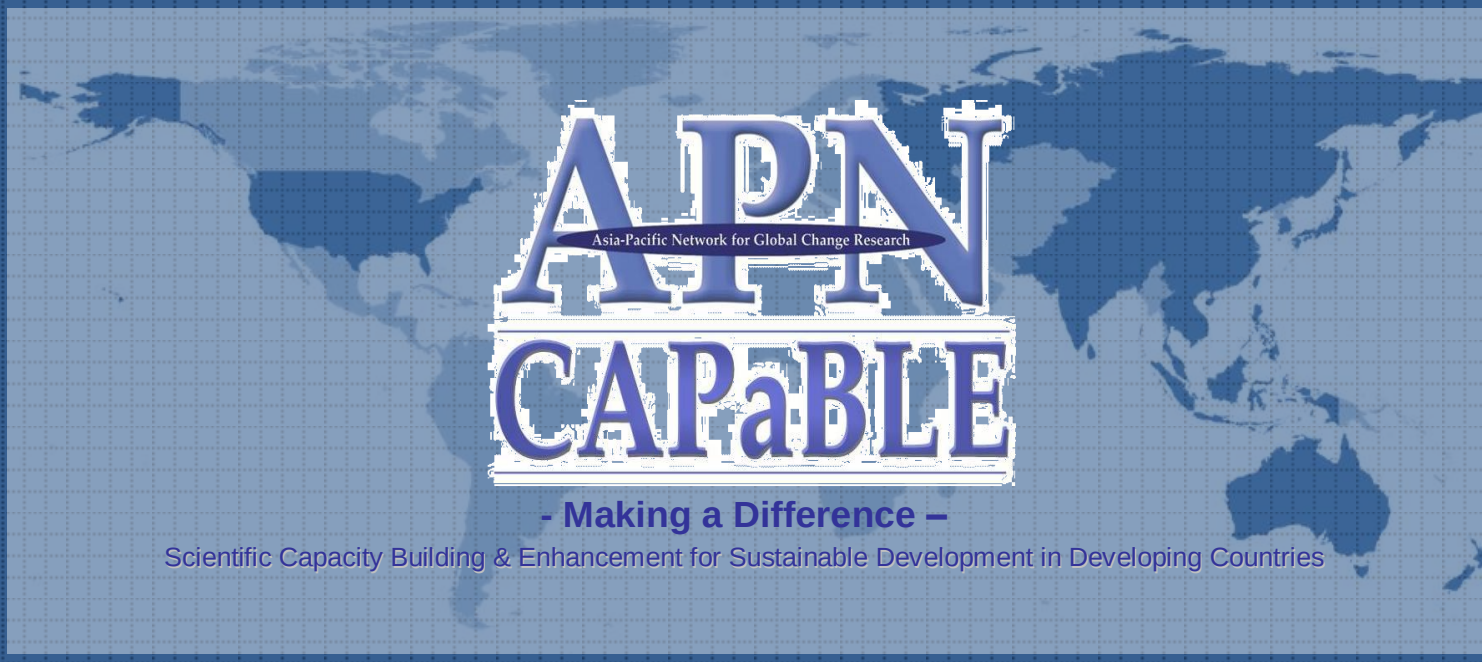
FINAL REPORT for APN PROJECT

Project Reference Number: CBA2013-08NSY-SOLAS

The 6th Surface Ocean-Lower Atmosphere Study (SOLAS) Summer School



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Final Report submitted to APN

OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

The SOLAS International Summer School (SSS) is a biennial, two week program designed to immerse early career scientists in SOLAS sciences and provide them with the skills necessary for their future scientific careers. SOLAS (Surface Ocean-Lower Atmosphere Study) is an international initiative aiming to understand the biogeochemical-physical interactions and feedbacks between the ocean and atmosphere.

Following 5 previous, highly successful summer schools held in France, in 2013 the program moved east, "Far East", and was held in Xiamen, Fujian Province, P.R. China from 23rdAugust to 2ndSeptember 2013. It was co-chaired by Dr. Véronique Garçon of CNES/LEGOS and Dr. Minhan Dai of Xiamen University. A total of 69 students from 23 different countries (33 of which came from APN member countries) attended the summer school along with 15 international and 6 domestic (China) scientists.

As with previous schools, the 6th SSS consisted of plenary lectures covering a diverse range of topics, student poster and oral presentation trainings, and hands on practicals which introduced students to techniques regularly employed in the field. Post-program evaluations from faculty and students indicated that the summer school was highly successful and an overwhelmingly positive experience.

Keywords

Surface Ocean Lower Atmosphere Study; summer school; international; interactive;

Objectives

The main objectives of the project were:

1. To equip international PhD candidates and early career scientists with the interdisciplinary skills and knowledge needed to understand the nature of air-sea interactions, including biogeochemical and physical processes and feedbacks
2. To broaden their understanding of the numerous aspects of global change research preparing them for the challenges ahead
3. To provide them with the opportunity to network, create, and strengthen future collaborations

Amount received and number years supported

The Grant awarded to this project was:
US$ 23,000 total

Activity undertaken

The SOLAS International Summer School (SSS) immerses early career scientists in SOLAS sciences and provides them with the skills necessary for their future scientific careers and can be divided into three sections. Section one, coinciding with week one, consisted primarily of plenary lectures covering a diverse range of topics. Section two coincided with the start of the second week when the school became more interactive. Working in small groups, students took part in hands on practicals that introduced them to techniques regularly employed in the field. Laboratory and fieldwork (aboard the local research vessel) rounded out the learning experience and reinforced themes covered during the plenaries.

In the final section of the summer school, in addition to lectures on more advanced SOLAS science topics, each student gave an oral presentation to the group, drawing on the skills and lessons they learnt just a few days earlier. Faculty and students each voted for their top three during these sessions and winners were announced at the closing ceremony.

Results

- Improved capacity of the participants to conduct sound and cutting-edge interdisciplinary scientific research within the context of SOLAS and global environment change issues
- Established a long lasting network among all attendees (participants and lecturers) at the international level and the level of the Asia-Pacific region
- Expanded SOLAS networks within the Asia-Pacific region

Relevance to the APN Goals, Science Agenda and to Policy Processes

- The contents of the 6th SOLAS International Summer School included fields related to the surface ocean and lower atmosphere, which fit into APN's science agenda by providing a lecture series and hands-on technical training.
- The project has strengthened the SOLAS network, through interactions between established and early career scientists, and between young scientists, from developed and developing nations, built capacity in the APN region, and brought greater understanding to the science agenda of APN.
- Participants of the summer school included several young scientists from APN member countries, who might pursue careers in governmental agencies or institutions. The interaction of participants has built capacity in the APN region, and brought the potential to influence policy decisions for decades.

Self evaluation

As this was the first time the Summer School was held outside of France, there were many unique challenges presented to the organizers. However, the local organizing committee and the SOLAS International Project Office worked closely for months before the program to ensure a smooth experience for all participants. This also involved the arrival of key international faculty a few days prior to the start of the program to work with local lab techs to calibrate equipment and troubleshoot. Unforeseen issues (i.e. the intense mosquito population during the summers in Xiamen, temporary colds, etc.) were also dealt with efficiently. The one major problem we faced during the 6th SSS was slow internet speeds; this was something that could not be dealt with as we were limited to the University's server. Overall, the transition of the school from France to China went smoothly and all involved were pleased with the program. The content and quality of the lectures and practicals were good and many students remarked at the program's end about how much they'd learned in the 2 weeks.

Potential for further work

The long-term legacy of this project remains to be seen, as the relationships developed will be instrumental in the development of research directions within the APN region and internationally for the next generation.

Publications (please write the complete citation)

- 6th International SOLAS Summer School Handbook, 23rd August – 2nd September 2013
- 6th International SOLAS Summer School Cruise and Laboratory Practical Workshops Handbook, 26th-28th August 2013, Xiamen University, China

References

Corinne Le Quéré and Eric S. Saltzman, Surface Ocean- Lower Atmosphere Processes, 2009, Geophysical Monograph Series, Volume 187, 350 pp., hardbound, ISBN 978-0-87590-477-1, AGU Code GM1874771

Acknowledgments

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TECHNICAL REPORT

Preface

The SOLAS Summer School (SSS) is a 2-week advanced international capacity-building program for early-career scientists and is an integral part of the SOLAS project. By providing excellent training in scientific techniques, soft skills, and an understanding of the issues surrounding global environmental change, it adequately prepares future scientists. Its comprehensive schedule provides the next generation of scientists the opportunities to interact and network with their peers and promotes and encourages research that can improve our understanding of global change.

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1.0 Introduction

Climate change is one of the most pressing environmental concerns facing the world today. Regardless of what one believes are the causes of it, few would contest that it is happening. However, given its complexity, much work still needs to be done in understanding the myriad components of climate change and how they all interact with one another. The International SOLAS project, Surface Ocean – Lower Atmosphere Study, focuses on one such area, namely the biogeochemical and physical interactions and feedbacks between the ocean and the atmosphere. The science being done is interdisciplinary and international in nature and SOLAS research involves hundreds of scientists from around the world. In order to build scientific capacities, in 2003 SOLAS instituted a biennial 2 week summer school program for PhD candidates and early career scientists. During the program, participants attend lectures and practical workshops conducted by leading international scientists in a variety of disciplines. They are taught the skills and knowledge needed to work in global climate research, in both the technical and interpersonal sense.

2.0 Methodology

Interested students were notified of the 6th International SOLAS Summer School (SSS) via conferences and symposia, the SOLAS website and member list serve, and through affiliated SOLAS scientists and encouraged to submit applications. The 213 applications were reviewed by the SOLAS International Project Office and the International Scientific Steering Committee and from them, 73 students were selected with 69 actually attending the program. Unlike previous iterations, the 6th school was held in Xiamen, Fujian Province, P.R. China at Xiamen University from 23rd August to 2nd September 2013.

The first week was dedicated primarily to plenary lectures covering a wide range of topics including an introduction to SOLAS, the carbon and iron cycles in the ocean, greenhouse/trace gases and the relationship to climate change, atmospheric chemistry and modelling, air-water gas exchange, ocean physics and coastal processes, remote sensing and time series observations, marine ecology, aerosols, marine genomics, macronutrients, solar radiation, and biogeochemical modeling over long time scales. Participants also attended special sessions focusing on ethics in science, scientists and the press, and the changing Earth (Table 1).

The second week was more interactive. Participants were divided into smaller groups (averaging 8-10 per) and took part in hands on practicals introducing them to techniques regularly employed in the field. Laboratory work focused on atmospheric and carbon cycle modeling, marine molecular ecology, and gas exchange. They also had the opportunity to collect, process, and analyse samples collected along the Jiulong River Estuary aboard Xiamen University's research vessel *Ocean II*. Fields covered on board included biological, chemical, and physical oceanography. Their results were then complied and presented before faculty and peers, thus providing participants with a chance to interpret their results and practice their communication skills before a highly diverse (both in terms of knowledge base and language) audience.

In addition, prior to their arrival, participants were told to prepare a 5 minute oral presentation and a poster on their research. Poster sessions were held during the first 3 days of the SSS and afterwards each student took part in a mandatory "Oral and Communications" workshop whereby faculty provided constructive criticisms and guidance on their posters and presentation skills. They were then given the chance to practice and refine their 5 minute oral presentations before delivering it in front of the entire SSS.

Table 1. Subjects covered during the 6th SOLAS Summer School

Lecturer	Institution	Subject
Laurent Bopp	LSCE IPSL	Carbon Cycle Modeling (Practical) Global Carbon Cycle Greenhouse Gases and Climate Change
Phil Boyd	Institute of Marine and Antarctic Studies, University of Tasmania	Atmospheric and Oceanic Time Series Macronutrients in the Ocean Iron Cycle Scientists and the Press (Special Session)
Bingzhang Chen	State Key Laboratory of Marine Environmental Science, Xiamen University	Biology (Practical)
Véronique Garçon	CNRS LEGOS	Introduction to SOLAS Oceanic Biogeochemistry Modeling Oral and Communications (Practical)
Liguo Guo	State Key Laboratory of Marine Environmental Science, Xiamen University	Chemistry (Practical)
Xianghui Guo	State Key Laboratory of Marine Environmental Science, Xiamen University	Chemistry (Practical)
David Ho	University of Hawaii	Air-water Gas Exchange I&II Gas Exchange (Practical)
David Kieber	State University of New York	Solar Radiation in the Ocean
Phyllis Lam	University of Southampton	Marine Molecular Ecology (Lecture & Practical)
Kitack Lee	Pohang University of Science and Technology	Changing Earth (Special Session)
Maurice Levasseur	Université Laval	Marine Ecology I&II
I-I Lin	National Taiwan University	Remote Sensing I&II
Peter Liss	University of East Anglia	Gas Exchange (Practical) Trace Gases in Ocean and Atmosphere
KK Liu	Institute of Hydrological and Oceanic Sciences, National Central University (Taiwan)	Processes in the Coastal Zone - Biogeochemistry and Hydrology I&II
Min Liu	College of Ocean and Earth Sciences, Xiamen University	Cruise Coordinator
Zhiyu Liu	State Key Laboratory of Marine Environmental Science, Xiamen University	Cruise Leader
Alberto Piola	Servicio de Hidrografia Naval	Chemistry (Practical) Climate Change and Variability Introduction to Ocean Physics

Lecturer	Institution	Subject
Eric Saltzman	University of California, Irvine	Atmospheric and Oceanic Time Series Ethics in Science (Special Session) Introduction to Marine Aerosols Oral and Communications (Practical)
Zhenyu Sun	State Key Laboratory of Marine Environmental Science, Xiamen University	Physics (Practical)
Roland von Glasow	University of East Anglia	Atmospheric Chemistry Atmospheric Modeling (Lecture & Practical)
Mingxi Yang	Plymouth Marine Laboratory	Gas Exchange (Practical)
Meixun Zhao	Key Laboratory of Marine Chemistry Theory and Technology (OUC) of the Ministry of Education (China)	Biogeochemical-Ecosystem Changes Over the Past 50 Years

Unless otherwise noted, subjects were presented in plenary sessions.

3.0 Results & Discussion

A total of 69 students from 23 different countries (33 of which came from APN member countries, Table 2) attended the summer school along with 15 international scientists and 6 from within China. Four top posters were selected by the faculty and six best oral presentations were selected by faculty and participants (Tables 3 and 4).

Table 2. Breakdown of Summer School participants from APN member countries

Name	Country	Institution
Andrew Babbin	USA	Princeton University
Priyanka Bannerjee*	India	National Institute of Oceanography
Pratirupa Bardhan*	India	National Institute of Oceanography
Kausar Bepari*	India	National Institute of Oceanography
Brian Butterworth	USA	SUNY Albany
Hugh Doyle*	New Zealand	University of Otago
Chuanjun Du*	China	Xiamen University
Christopher Conrad	USA	University of Colorado, Boulder
Alexander Davies	USA	University of Delaware
Gijjapu Durgarao*	India	National Institute of Oceanography
Manab Dutta*	India	University of Calcutta
Natalie Freeman	USA	University of Colorado, Boulder
Shan Gao*	China	National Marine Environmental Forecasting Center
Elise Heiss	USA	Boston University
Qingjing Hu*	China	Ocean University of China
Rasiq Kelassanthodi*	India	National Institute of Oceanography
Joanna Kinsey	USA	SUNY

Name	Country	Institution
Kirill Kivva	Russia	Lomonosov Moscow State University
Young-Shin Kwon	South Korea	University of Science and Technology/Korean Polar Research Institute
Ying Liu*	China	Ocean University of China
Marc Mallet*	Australia	Queensland University of Technology
Yuko Omori*	Japan	National Institute for Environmental Studies
Oluwaseun Ogunro	USA	New Mexico Institute of Mining and Technology
Hilary Palevsky	USA	University of Washington
Cristina Romera-Castillo	USA	Florida International University
Cristina Schultz	USA	Woods Hole Oceanographic Institute
Leilani Solera*	Philippines	Marine Science Institute, University of the Philippines
Ming Sun*	China	Ocean University of China
Lan Wang*	China	Ocean University of China
Yan Jun Wang*	China	South China Sea Institute of Oceanology
Holly Winton	Australia	Curtin University
Jie Xia Zhang*	China	Xiamen University
Yujiao Zhu*	China	Ocean University of China

**indicates students who received support from APN funds provided in this grant.*

Table 3. Oral Presentation Winners

Name	Poster Titles	Institution
Neil Clark*	Copepods and their fecal matter - marine methane sources?	Scottish Association for Marine Sciences (UK)
Natalie Freeman*	Southern Ocean phytoplankton calcification estimated from satellite data	University of Colorado Boulder (USA)
Eva Mayol*	Abundance and fluxes of airbourne microorganisms over the ocean	Instituto Mediterráneo de Estudios Avanzados (IMEDEA) (Spain)
Raissa Philibert+	Comparison of nitrification rates in the Benguela upwelling and Southern Ocean	University of Cape Town (S. Africa)
Jana Schneiders+	Small-scale interfacial turbulence - properties and implications for heat transfer	Interdisciplinary Center for Scientific Computing (IWR) (Germany)
Shlomit Sharoni+	Characteristics of marine aerosol properties as a function of algal bloom dynamics	Weizmann Institute of Science (Israel)

** denotes faculty selected winners. + denotes student selected winners. Talks were based off their research and poster subjects, thus the poster title is cited.*

Table 4. Poster Session Winners

Name	Poster Title	Institution
Meri Eichner	Combined effects of different pCO_2 levels and N sources on a N_2-fixing cyanobacterium	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (Germany)
Hilary Palevsky	Quantifying the biological carbon pump: comparing *in situ* and satellite-based observations	University of Washington (USA)
Shlomit Sharoni	Characteristics of marine aerosol properties as a function of algal bloom dynamics	Weizmann Institute of Science (Israel)
Young-Shin Kwon	Modeling the budget of CO in the upper ocean of the Northwest Pacific and the Southern Ocean	University of Science and Technology/Korean Polar Research Institute (S. Korea)

The format of the Summer School remained largely unchanged from previous ones. By beginning with the plenary lectures, we are able to ensure that all participants have a sound and equal knowledge base before the hands-on portions. Furthermore, the poster sessions are held in the first three days of the school. Not only does this allow the students to learn about each other's research but it helps foster networking during the remainder of the program. It also allows faculty to see each participant's presentation skills prior to the Oral and Communications workshops so that they can provide individual constructive criticism as well as group suggestions.

In addition to on board sampling and lab work, we added a post cruise data analysis and presentation session to each of the 3 cruise days. Participants had to compile the results from each of the three areas examined (biological, chemical, physical) and present their findings and analyses to the group and faculty. Because each cruise sampled along, roughly, the same transect as the day before, students were able to see their results in light of the bigger picture and many students who participated in the first and second cruises, came and listened to the findings of subsequent ones. This addition was remarked upon by faculty experienced with previous summer schools as being highly beneficial for participants as it helped put results and data in perspective with the bigger picture.

There were still some unique challenges to organizing the 6th Summer School. Whereas previous participants hailing from European or Western countries potentially had fewer difficulties in obtaining French visas, obtaining Chinese visas required local organizers to handle each participant and international faculty on a case by case basis to ensure that the correct documents were obtained and provided. The same can be said for funding allotments as it had to go through two separate departments at Xiamen University before we were able to redistribute where needed. Furthermore, even minor things such as meals provided challenges as students were not able to cook for themselves in the accommodations provided and local restaurants do not take into account many of the dietary needs of non-Chinese. However, advanced preparation and planning by the local organizers helped ensure a smooth experience on the ground for all participants and faculty, and many expressed what a positive cultural experience the summer school was.

Another aspect of the Summer School that's rarely discussed is the varied opportunities for networking it provided for up and coming scientists, even outside of the classroom. By hosting the SSS in China, the majority of faculty and students were put outside the familiar or their comfort zones. As such, everyone was bonded together by these shared feelings and experiences which helped to create networks and linkages that are critical to the interdisciplinary and collaborative nature of science today.

4.0 Conclusions

In short, the 6th International SOLAS Summer School was a success and on par with the previous five. Sixty-nine PhD candidates and early career scientists from 23 countries participated along with 15 international and 6 domestic (China) scientists. Over the course of the 2 week program, participants were taught the fundamentals needed to understand the nature of air-sea interactions, including biogeochemical and physical processes and feedbacks, both in and out of the classroom. Networking was encouraged from the start as evidenced by the school format and was further enhanced by the location; even for those participants that had travelled abroad before, China was still a uniquely foreign environment. The shared experience of being in China thus helped to further networking and bonding among and between faculty and participants. The SOLAS International Summer School is unique in that it provides a forum by which early career scientists can not only get the skills and knowledge necessary for their future careers but it also presents climate change within a truly global perspective.

5.0 Future Directions

As climate change research continues to make new discoveries, scientists working in the field will have to adapt and change as well. This means not only acknowledging past discoveries but embracing the new. The SOLAS project and its associated Summer School are the perfect platforms to do just that. In the future we hope to be able to incorporate more past Summer School participants as lecturers (such as Mingxi Yang this year) as well as branch out to other host sites (something we are currently doing as the 2015 SSS will be held in Kiel, Germany). We also want to continue to encourage the participation of early career scientists from APN member nations, many of which will be the first to feel the direct impacts of climate change. We will continue to adjust the format and content so that participants are provided with a good base of knowledge while still learning about the most cutting edge developments in global change research.

References

Asia-Pacific Network for Global Change Research - Overview, www.apn-gcr.org

Surface Ocean - Lower Atmosphere Study, http://www.solas-int.org/

SOLAS Summer School 2011, http://www.solas-int.org/summerschool/2011.html

Appendix

Agenda of the 6th SOLAS International Summer School

Day 1		Thursday 22 August	
	18:30	Icebreaker and Welcome	
Day 2		Friday 23 August	
	9:00	Welcome	Minhan Dai
	9:15	Introduction to SOLAS	Veronique Garcon
	10:00	Coffee Break	
	10:30	Greenhouse Gases and Climate Change	Laurent Bopp
	11:30	Marine Ecology I: Phytoplankton and Primary Production	Maurice Levasseur
	12:30	Lunch	
	15:00	Atmospheric Chemistry I	Roland von Glasow
	16:00	Coffee Break	
	16:30	Air-water Gas Exchange I	David Ho
	17:30	Poster Session I	
Day 3		Saturday 24 August	
	9:00	Global Carbon Cycle	Laurent Bopp
	10:00	Coffee Break	
	10:30	Marine Ecology II: Bacterioplankton, Respiration and Other Microbiological Processes	Maurice Levasseur
	11:30	Atmospheric Chemistry II	Roland von Glasow
	12:30	Group Photo and Lunch	
	15:00	Air-water Gas Exchange II	David Ho
	16:00	Coffee Break	
	16:30	Introduction to Ocean Physics	Alberto Piola
	17:30	Poster Session II	
Day 4		Sunday 25 August	
	9:00	Atmospheric Modelling	Roland von Glasow
	10:00	Coffee Break	
	10:30	Trace Gases in Ocean and Atmosphere	Peter Liss
	11:30	Marine Molecular Ecology	Phyllis Lam
	12:30	Lunch	
	15:00	Practicals Briefing	Practical Leaders
	15:30	Special Session I: Ethics in Science	Eric Saltzman
	16:00	Coffee Break	
	16:30	Climate Change and Variability	Alberto Piola
	17:30	Poster Session III	
Day 5		Monday 26 August	
	7:00	Cruise Practical Collection Session (AM)	
	8:30	Practical Session (26 AM)	
	10:30	Coffee Break	
	11:00	Practical Session (26 AM)	
	12:00	LUNCH	
	13:30	Practical Session (26 PM)	

	15:00	Coffee Break	
	15:30	Practical Session (26 PM)	
	17:30	Practical Sessions (26 Eve)	
Day 6		Tuesday 27 August	
	7:00	Cruise Practical Collection Session (AM)	
	8:30	Practical Session (27AM)	
	10:30	Coffee Break	
	11:00	Practical Session (27 AM)	
	12:00	LUNCH	
	13:30	Practical Session (27 PM)	
	15:00	Coffee Break	
	15:30	Practical Session (27PM)	
	17:30	Practical Sessions (27 Eve)	
Day 7		Wednesday 28 August	
	7:00	Cruise Practical Collection Session (AM)	
	8:30	Practical Session (28AM)	
	10:30	Coffee Break	
	11:00	Practical Session (28 AM)	
	12:00	LUNCH	
	13:30	Practical Session (28PM)	
	15:00	Coffee Break	
	15:30	Practical Session (28PM)	
	19:30	Banquet	
Day 8		Thursday 29 August	
		Rest Day	
Day 9		Friday 30 August	
	9:00	Introduction to Marine Aerosols	Eric Saltzman
	10:00	Coffee Break	
	10:30	Iron Cycle	Phil Boyd
	11:30	5-Minute Oral Student Presentations	
	12:30	Lunch	
	15:00	Remote Sensing I	I-I Lin
	16:00	5-Minute Oral Student Presentations	
	16:45	Coffee Break	
	17:15	5-Minute Oral Student Presentations	
Day 10		Saturday 31 August	
	9:00	Atmospheric and Oceanic Time Series Observations	Eric Saltzman and Phil Boyd
	10:00	Coffee Break	
	10:30	Solar Radiation in the Ocean	Dave Kieber
	11:30	5-Minute Oral Student Presentations	
	12:30	Lunch	
	15:00	Processes in the Coastal Zone: Biogeochemistry and Hydrology I	KK Liu
	16:00	5-Minute Oral Student Presentations	
	16:45	Coffee Break	
	17:15	5-Minute Oral Student Presentations	

Day 11		Sunday 1 September	
	9:00	Macronutrients in the Ocean	Phil Boyd
	10:00	Coffee Break	
	10:30	Biogeochemical /Ecosystem Changes Over the Past 50 Years	Meixun Zhao
	11:30	5-Minute Oral Student Presentations	
	12:30	Lunch	
	15:00	Special Session: Scientists and the Press	Phil Boyd
	15:45	5-Minute Oral Student Presentations	
	16:45	Coffee Break	
	17:15	5-Minute Oral Student Presentations	
Day 12		Monday 2 September	
	9:00	Oceanic Biogeochemistry Modelling	Veronique Garcon
	10:00	Coffee Break	
	10:30	Processes in the Coastal Zone: Biogeochemistry and Hydrology II	KK Liu
	11:30	Special Session: Changing Earth	Kitack Lee
	12:30	Lunch	
	15:00	Remote Sensing II	I-I Lin
	16:00	Coffee Break	
	16:45	Closing Ceremony	Minhan Dai and Veronique Garcon

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Funding sources outside the APN

Other funding sources	Amount
Centre National d'Etudes Spatiales, France (CNES)	15,000 EUR
EUR-OCEANS Consortium	20,000 EUR
Greencycles II	6,000 GBP
National Natural Science Foundation of China (NSFC)	200,000 RMB
National Science Council of Taiwan (NSC)	One Taiwan lecturer's travel cost
Natural Environment Research Council , UK(NERC)	8350 GBP
North Pacific Marine Science Organization (PICES)	24,493 RMB
Ocean Acidification International Coordination Centre (OA-ICC)	2,208 EUR
Ocean Carbon & Biogeochemistry Program (OCB)	10,000 USD
Pohang University of Science and Technology (POSTECH)	One Korean lecturer's travel cost
Satlantic	1,000 USD
Scientific Committee on Oceanic Research (SCOR)	2,388 RMB
State Key Laboratory of Marine Environmental Science (MEL)	Room and facilities, man power
State Oceanic Administration of China (SOA)	100,000 RMB
Surface Ocean - Lower Atmosphere Study (SOLAS) International Project Office	80 copies of SOLAP text books Announcement poster printing and delivery Man power
Xiamen University (XMU)	150,000 RMB

Participants list

Surname	Forename	Institution	Country	Email	Poster Title
AREVALO MARTINEZ	Damian L	Helmholtz Centre for Ocean Research Kiel (GEOMAR)	Germany	darevalo@geomar.de	Underway N_2O, CO and CO_2 measurements in the equatorial Atlantic Ocean
BABBIN	Andrew	Princeton University	USA	babbin@princeton.edu	Rapid cycling of nitrous oxide in the Eastern Tropical North Pacific oxygen deficient zone
BANERJEE	Priyanka	National Institute of Oceanography, Dona Paula, Goa	India	pbanerjee@nio.org	Towards understanding the dust-phytoplankton relation in the Arabian Sea during the Winter Monsoon
BARDHAN	Pratirupa	National Institute of Oceanography, Dona Paula, Goa	India	pbardhan@nio.org	The Biogeochemistry of the Western Indian Continental Shelf during seasonal anoxia: A stable isotope perspective
BEPARI	Kausar	National Institute of Oceanography, Dona Paula, Goa	India	kbepari@nio.org	The spatial and temporal variation in the biogenic sulfur compounds in two estuaries along the west coast of India
BERTHELOT	Hugo	Mediterranean Institute of Oceanography	France	hugo.berthelot@ univ-amu.fr	The fate of nitrogen fixed by diazotrophs during a mesocoms experiment in the New Caledonia lagoon
BINETTI	Umberto	University of East Anglia	UK	u.binetti@uea.ac.uk	Seasonal variability in dissolved oxygen in the North Atlantic. A time series using gliders
BURGOS MARTIN	Carmen Macarena	University of Cadiz	Spain	macarena.burgos@uca.es	Greenhouse gases emissions in coastal systems in the Bay of Cadiz (SW Spain)
BUTTERWORTH	Brian	Atmospheric Sciences Research Center, State University of New York, Albany	USA	bbutterworth@ albany.edu	Air-sea fluxes of carbon dioxide at high wind speeds in the Southern Ocean
CLARK	Neil	Scottish Association for Marine Science	UK	neil.clark@sams.ac.uk	Copepods and their fecal matter - marine methane sources?

Surname	Forename	Institution	Country	Email	Poster Title
CONRAD	Christopher	University of Colorado Boulder	USA	christopher.j.conrad@colorado.edu	The relationship between wind stress and surface carbonate chemistry in the Southern Ocean
DAVIES	Alexander	University of Delaware	India	ardavies@udel.edu	Atmosphere-Ocean CO_2 Exchange and Carbon Sequestration Processes
DOYLE	Hugh	University of Otago	New Zealand	hdoyle@chemistry.otago.ac.nz	Recent advances in the measurement of seawater pH
DU	Chuanjun	State Key Laboratory of Marine Environmental Science, Xiamen University	China	cjdu@stu.xmu.edu.cn	Impact of the Kuroshio intrusion on the nutrient inventory in the upper northern South China Sea: Insights from an isopycnal mixing model
DURGARAO	GIJJAPU	National Institute of Oceanography	India	grao@nio.org	Nitrous oxide (N_2O) emissions from Indian monsoonal estuaries
DUTTA	Manab Kumar	University of Calcutta	India	manabdutta.1987@gmail.com	Dynamics and exchange fluxes of methane in a mangrove dominated estuarine environment of Sundarbans, NE coast of Bay of Bengal, India: A box model study
EICHNER	Meri	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research	Germany	meri.eichner@awi.de	Combined effects of different pCO_2 levels and N sources on a N_2-fixing cyanobacterium
EVANS	Susan	Scottish Association for Marine Science	UK	susan.evans@sams.ac.uk	DMSO loss pathways in the Oceans: The next big question in DMS biogeochemistry
FISHWICK	Matthew	University of Plymouth	UK	matthew.fishwick@plymouth.ac.uk	Dissolution of aerosol derived iron in North Atlantic seawater
FRANCO-NOVELA	Ana Cristina	ETH Zurich	USA	franco.novela@gmail.com	Shallow carbonate saturation horizon in the oxygen minimum zone off Mexico
FREEMAN	Natalie	University of Colorado Boulder	USA	natalie.freeman@colorado.edu	Southern Ocean phytoplankton calcification estimated from satellite data

Surname	Forename	Institution	Country	Email	Poster Title
FUHLBRÜEGGE	Steffen	Helmholtz Centre for Ocean Research Kiel (GEOMAR)	Germany	sfuhlbruegge@geomar.de	Exchange of halocarbons in the marine boundary layer with the free troposphere during the SHIVA-SONNE campaign in the South China and Sulu Seas
GALI	Marti	Institute de Ciencies del Mar (CSIC), Barcelona, Catalonia	Spain	mgali@icm.csic.es	A meta-analysis of oceanic dimethylsulfidee cycling
GAO	Shan	National Marine Environmental Forecasting Center (NMEFC), SOA	China	gaos@nmefc.gov.cn	Modelling and forecasting the spatial distribution of nutrients and chlorophyll-a in the Pacific Ocean
GAZIHAN AKOGLU	Ayse	Institute of Marine Science, Middle East Technical University	Turkey	ayse@ims.metu.edu.tr	Ecological footprints of fisheries in Turkey
GEMAYEL	Elissar	Universite de Perpignan Via Domitia; National Centre for Marine Sciences	Lebanon	elissar.gemayel@univ-perp.fr	Quantification and forecast of CO_2 fluxes over the air-sea interface across the Mediterranean Sea
HASSOUN	Abed El Rahman	National Council for Scientific Research, Batroun, Lebanon; Universite de Perpignan Via Domitia, IMAGES Laboratory	Lebanon	abedhassoun@gmail.com	Analysis and Modelling of Acidification in the Mediterranean Sea
HEISS	Elise	Boston University	USA	emheiss@bu.edu	Marine nitrification processes respond differently to *in situ* conditions
HU	Qingjing	Ocean University of China	China	11111011027@ouc.edu.cn	Potential origins of atmospheric ammonia in winter in downtown Toronto
KELASSANTHODI	Rasiq	National Institute of Oceanography	India	rasiqk@nio.org	Seasonal dynamics of phytoplankton pigment along the west coast of India

Surname	Forename	Institution	Country	Email	Poster Title
KINSEY	Joanna	State University of New York	USA	jdkinsey@syr.edu	Effects of irradiance on *Phaeocystis antarctica* organsulfur and acrylate production
KIVVA	Kirill	Lomonosov Moscow State University	Russia	kirill.kivva@gmail.com	Net community production in the western Bering Sea based on autumn nutrient data from 2010 and 2012
KOTTMEIER	Dorothee Marie	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research	Germany	dorothee.kottmeier@awi.de	*Emiliania huxleyi's* carbon source for photosynthesis is governed by pH
KRUG	Lilian Anne	University of Algarve	Portugal	lakrug@ualg.pt	Linking phytoplankton variability and climate forcing off SW Iberia
KWON	Young-shin	University of Science and Technology / Korean Polar Research Institute	Korea	kwonys@kopri.re.kr	Modelling the budget of CO in the upper ocean of the Northwest Pacific and the Southern Ocean
LASBLEIZ	Marine	Mediterranean Institute of Oceanography	France	Marine.lasbleiz@univ-amu.fr	The biogenic silica cycle in relation with hydrodynamics in the area of interaction between the Antarctic Polar Front and the Kerguelen Plateau (KEOPS 2)
LI	Xuefeng	University Libre de Bruxelles	Belgium	xuefli@ulb.ac.be	Combined effects of pCO_2 and dust deposition on diatom *Chaetoceros socialis*
LIU	Ying	Ocean University of China	China	11111011014@ouc.edu.cn	Responses of Chlorophyii-α to added nutrients, Asian dust and rainwater in an oligotrophic zone of the Yellow Sea
LLORT JORDI	Joan	LOCEAN/CNRS - UPMC - Paris	France	jellod@locean-ipsl.upmc.fr	Biological response to altered stratification due to climate change in the Southern Ocean
MALLET	Marc	International Laboratory for Air Quality and Health,	Australia	marc.mallet@student.qut.edu.au	The characteristics of primary marine aerosols from bubble bursting water in the Great Barrier Reef

Surname	Forename	Institution	Country	Email	Poster Title
		QUT			
MARREC	Pierre	Station Biologique de Roscoff	France	pmarrec@sb-roscoff.fr	Spatial-temporal dynamics of biogeochemical parameters and air-sea CO_2 fluxes in the western English Channel (WEC)
MAYOL	Eva	Instituto Mediterraneo de Estudios Avanzados (IMEDEA)	Spain	emayol@imedea.uib-csic.es	Abundance and fluxes of airborne microorganisms over the ocean
MONGWE	Precious	CSIR; University of Cape Town	South Africa	PMongwe@csir.co.za	Why Southern Ocean uptake of anthropogenic CO_2 may be decreasing?
MORGAN KWIATKOWSKI	Lester	University of Exeter	UK	lk244@exeter.ac.uk	What spatial scales are believable for climate model projections of sea surface temperature?
MULLUNGAL	Muhammed Nayeem	University of Otago	New Zealand	nmullungal@chemistry.otago.ac.nz	Exploring the role of nitrous oxide in southwest Pacific Ocean using stable isotopic techniques
MURASHIMA	Yoshiko	Atmosphere and Ocean Research Institute	Japan	murashimay64@aori.u-tokyo.ac.jp	Elemental composition of suspended particulate matters in the Pacific Ocean
NICHOLSON	Sarah-Anne	University of Cape Town and UPMC	South Africa	sarahanne.n@gmail.com	Primary production in the Southern Ocean: sensitivities to sub-mesoscale dynamics and sub-seasonal atmospheric forcing
OGUNRO	Oluwaseun	New Mexico Institute of Mining and Technology	USA	oogunro@nmt.edu	Macromolecular sources of marine organic aerosols
OLIVA	Norma	Universidad Autonoma de Baja California	Mexico	norma.oliva@gmail.com	Evaluation of the saturation state of Aragonite, off the Baja California Coast, Mexico
OMORI	Yuko	National Institution for Environmental Studies	Japan	omori.yuko@nies.go.jp	Air-sea flux of dimethyl sulfide measured by the gradient flux technique in the Pacific Ocean

Surname	Forename	Institution	Country	Email	Poster Title
OSTLE	Clare	University of East Anglia	UK	c.ostle@uea.ac.uk	Phytoplankton influence on CO_2 uptake in the North Atlantic
PALEVSKY	Hilary	University of Washington	USA	palevsky@u.washington.edu	Quantifying the biological carbon pump: comparing *in situ* and satellite-based observations
PHILIBERT	Raissa	University of Cape Town	South Africa	raissa.philibert@uct.ac.za	Comparison of nitrification rates in the Benguela upwelling and Southern Ocean
QU	Zihan	Universite Pierre et Marie Curie	France	zihan.qu@lisa.u-pec.fr	Origin and chemical properties of continental aerosol transported over the Southern Ocean: trace metals acting as micro-nutrients
RATTEN	Jenni	Dalhousie University	Canada	jenni.ratten@dal.ca	Biogeographical distribution of marine nitrogen fixers in the Sargasso Sea
RENAUT	Sophie	International Joint Laboratory Takuvik, Universite Laval	Canada	sophie.renaut@takuvik.ulaval.ca	The variability of Arctic ice edge blooms and the implications for the biological pump in a period of declining ice cover
ROMERA CASTILLO	Cristina	Florida International University	USA	cromerac@fiu.edu	Structural association of colored dissolved organic matter
SCHNIEDERS	Jana	Interdisciplinary Centre for Scientific Computing (IWR)	Germany	jana.schnieders@iwr.uni-heidelberg.de	Small-scale interfacial turbulence - properties and implications for heat transfer
SCHULTZ	Cristina	National Institute for Space Research	Brazil	cristina.schultz@cptec.inpe.br	Biogeochemical Modelling and air-sea CO_2 exchanges in the Southwestern Atlantic Ocean
SHARONI	Shlomit	Weizmann Institute of Science	Israel	shlomit.sharoni@weizmann.ac.il	Characterization of marine aerosol properties as a function of algal bloom dynamics
SOLERA	Leilani	Marine Science Institute, University of Philippines-Diliman	Philippines	leilani.solera@gmail.com	Observing Kelvin wave propagation from the Pacific Ocean into the Philippine archipelago

Surname	Forename	Institution	Country	Email	Poster Title
SUN	Mingshuang	Ocean University of China	China	mvsovara@gmail.com	Dissolved methane in Sanggou Bay - implication of *in situ* production in an aquaculture area of China
WANG	Yanjun	South China Sea Institute of Oceanography	China	yanjun_wang82@yahoo.com.cn	Distributions and air-sea fluxes of nitrous oxide (N_2O) in the Yangtze River estuaries and its adjacent marine areas
WANG	Lan	Ocean University of China	China	wanglan_19890312@163.com	Study the mechanism for long-term variability of primary production in the North Pacific
WINTON	Victoria Holly	Curtin University; University of Tasmania	Australia	holly.winton@postgrad.curtin.edu.au	Seasonality of soluble iron and black carbon in the Ross Sea and Southern Ocean
WITKOWSKA	Agnieszka	University of Gdansk	Poland	a.witkowska@ug.edu.pl	Exchange of carbon between the sea and the atmosphere in the coastal zone of the Baltic Sea
ZAVARSKY	Alexander	Helmholtz Centre for Ocean Research Kiel (GEOMAR)	Germany	azavarsky@geomar.de	Eddy covariance air-sea exchange measurements of trace gases in the tropical Atlantic
ZHANG	Jiexia	Third Institute of Oceanography; Xiamen University	China	597401056@qq.com	Nitrous oxide in the surface water from Bering Sea to the Southern Ocean: latitude distribution and sea-to-air flux
ZHU	Yujiao	Ocean University of China	China	conan@ouc.edu.cn	Comparing new particle formation events between in highly and less polluted atmosphere: implication of a critical role of anthropogenic pollutants in growing new particles to CCN size

Testimonials

Clare Ostle

University of East Anglia, UK, c.ostle@uea.ac.uk

Poster title: Phytoplankton influence on CO_2 uptake in the North Atlantic

"The SOLAS summer school was a great example of international collaboration and expert teaching. The set up of the school was a great learning experience both personally and professionally. The staff at the university made the experience unforgettable and thoroughly enjoyable and the teaching was at the highest level. I would recommend a similar programme to anyone in the scientific field."

Lilian Anne Krug

University of Algarve, Portugal, lakrug@ualg.pt

Poster title: Linking phytoplankton variability and climate forcing off SW Iberia

"This training was a unique opportunity to learn fundamentals on subjects I will approach on my thesis. I am certain the knowledge acquired during these 2 weeks, through lectures, field and practical studies, will be applied not only on my thesis but throughout my professional career and ultimately for the ocean science in Portugal and my home country. Moreover, I have expanded my network by meeting and interacting with new colleagues from over 30 countries as well as renowned scientists in the ocean and atmosphere sciences."

Carmen Macarena BURGOS MARTIN

University of Cadiz, Spain, macarena.burgos@uca.es

Poster title: Greenhouse gases emissions in coastal systems in the Bay of Cadiz (SW Spain)

"It was my pleasure joining the Summer School. I made new friends with similar interest with me, working in related research fields, going after the same achievement: a better understanding about the ocean as well as becoming an oceanographer/researcher. But friendships not only came from students, also from scientists. We enjoyed great lessons and labs from ocean-science experts, feedbacks exposing our job and thus a unique experience very useful for the rest of our professional way. For instances, I attended a conference some weeks ago and I was glad finding some of this colleagues, both students and teachers. I think the Summer School was the beginning of many promising friendships, and who knows it maybe involves research collaboration projects in the near future.

Besides, from my point of view the Summer School has several implications. In one hand, it was didactic. I have been immersed in the enormous science world listening from high amount of works. On the other hand, it has made me growing as a young scientist through checking that other people are also worried about the ocean; we are all together quantifying risks, looking for a greater knowledge and/or giving solutions (at least trying).

Finally, I must mention the country where the Summer School took place: China. I had the opportunity of testing a completely different culture, visiting beautiful places, trying exotic foods, meeting nice people…

In summary I can say the SOLAS Summer School has made a difference in my professional life."

Pratirupa Bardhan (APN funded)

National Institute of Oceanography, India, pbardhan@nio.org

Poster title: The Biogeochemistry of the Western Indian Continental Shelf during seasonal anoxia: A stable isotope perspective

"SOLAS Summer School 2013 has truly been a life-changing experience for me. The faculty devoted a great amount of personal effort and interests to the classes, both theory and practical. The hosts and the organisers were a helpful bunch! I understand this is the first time SOLAS Summer School was held in China. However, the efficiency of the entire team made it look like they have been doing it for a hundred years!

Career-wise, the summer school has been very significant in that I got to know many prominent researchers in my field. I got critical feedback for my poster and oral presentations which , I feel, is truly essential at this early stage of my career. Not to mention, the talks on scientific ethics and writing workshops that were definitely needed. I am also grateful for the introduction to modelling studies, especially since my work always involves a lot of field and cruise activities.

Personally, I am thankful for the cultural exposure offered by the Summer School. Had it not been for the Summer School, I would not have met so many warm and friendly people from all over the world. I cherish the new friends I made. Also, Xiamen is a lovely little place to be in."

Priyanka Banerjee (APN funded)

National Institute of Oceanography, India, pbanerjee@nio.org

Poster title: The Biogeochemistry of the Western Indian Continental Shelf during seasonal anoxia: A stable isotope perspective

"The SOLAS Summer School 2013 provided an excellent opportunity for me to interact with the students and leading scientists in the field of ocean-atmosphere sciences from several institutions across the world. Classes taken up by the scientists and discussions with other participants have made me aware of the recent developments in this field. This has particularly helped me in my present PhD research as I got critical evaluation of my work. Special beneficial were the sessions on ethics in science and how to communicate science with people efficiently in which each participant was individually assessed. I believe that the knowledge gained and the trainings given will go a long way in developing a career in ocean-atmosphere science."

Hilary Palevsky

University of Washington, USA, palevsky@u.washington.edu

Poster title: Quantifying the biological carbon pump: comparing *in situ* and satellite-based observations

"The SOLAS Summer School in Xiamen, China did a fantastic job of introducing students from a broad array of academic backgrounds to a diverse set of research areas and skills, from atmospheric modelling to molecular analysis of marine microbes. The two-week school mixed lectures, small group hands-on practical sessions with the lecturers and opportunities for the students to share our research with the lecturers and each other through poster sessions and oral presentations. For me, the opportunity to interact with a diverse group of young scientists from all over the world was the highlight of the experience. My network of peers has broadened significantly, a valuable resource for continued advice as I apply the new data analysis and modelling techniques I was exposed to at the summer school."

Teaching materials uploaded to the summer school website and accessible to all participants.

Student Handbook and Cruise and Laboratory Practical Workshops Handbook:

Link: http://mel.xmu.edu.cn/solassummerschool/news_info.asp?id=31

Lecturers' presentations:

Link: http://mel.xmu.edu.cn/solassummerschool/news_info.asp?id=33

Password: solasxiamen2013

Lecture handouts:

Link: http://mel.xmu.edu.cn/solassummerschool/news_info.asp?id=32

Password: solasxiamen2013