Open Science Conference

25-29 September 2022
hybrid in Cape Town, South Africa

Wamkelekile!
Welkom!

SOLAS
SOUTH AFRICA | 2022

www.solas-int.org

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Welcome to Cape Town for the 2022 SOLAS Open Science Conference!

We have an exciting and interesting programme lined up for our 8th installment of the SOLAS Open Science Conference, a hybrid event in Cape Town, South Africa. During the coming week, you have the opportunity to explore the full range of SOLAS sciences, from the core themes of the science plan during plenary lectures, to emerging issues in discussion sessions, to the future wave during the Early Career Scientists' Day. You will learn and exchange about cutting edge research in the field, present your own findings, and connect with colleagues from all over the world.

SOLAS is a bottom-up organisation, in which the scientific community sets the agenda, and since 2000, the SOLAS Open Science Conferences play a key role in that process.

Cape Town is the ideal coastal city to host the SOLAS OSC this week. South Africa's "Mother City" is surrounded by the Atlantic and Indian Oceans, which strongly influence the local climate, and is also a gateway city to the Southern Ocean and Antarctica. The Benguela upwelling system on South Africa's west coast is one of the world's most productive ecosystems, supporting a diversity of socio-economically important fisheries, and is the focus of active cross-cutting SOLAS research. To the east is the Agulhas Current, the strongest western boundary current on Earth, that transports heat and salt from the Indian to the Atlantic Ocean, thus playing a critical role in global ocean circulation. South Africa also has a strong geographic advantage for conducting research in the Southern Ocean, as many SOLAS scientists will know from time spent in Cape Town harbor before and after sampling expeditions. SOLAS scientists have explored the approximately 4000 km of open and ice-covered ocean that separate Cape Town from Antarctica in the context of all the SOLAS science themes. Additionally, the Cape Point Global Atmosphere Watch station, located 60 km south of Cape Town, hosts a variety of research platforms developed to investigate the marine atmosphere.

We want to thank all the sponsors and funders of this conference, as well as the sponsors of the international SOLAS programme (SCOR, Future Earth, iCACGP, and WCRP) for all their support over the years. We also thank the SOLAS International Project Office and the Local Organising Committee for their hard work and dedication in assuring that we have a fun and comfortable meeting this week, both for people on-site and remote. Finally, we thank you, the SOLAS community, for making SOLAS the productive, exciting, and important organisation that it is.

Enjoy!

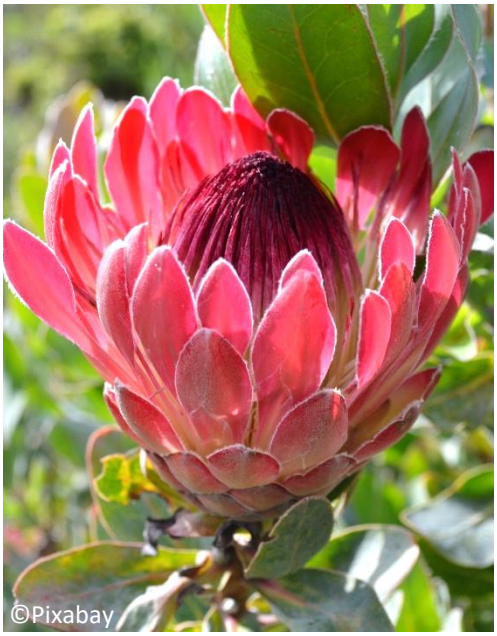
Cécile Guieu
Co-Chair, SOLAS Scientific Steering Committee

Minhan Dai
Co-Chair, SOLAS Scientific Steering Committee

Katye Altieri
Chair, SOLAS 2022 Local Organizing Committee

Scientific Organising Committee

Minhan Dai (SSC Co-Chair, China)
Cécile Guieu (SSC Co-Chair, France)
Katye Altieri (LOC chair, South Africa)
Thomas Bell (UK)
Marcela Cornejo D'Ottone (Chile)
Erik van Doorn (Germany)
Santiago Gassó (USA)
Maria Kanakidou (Greece)
Arne Körtzinger (Germany)
Mohd Talib Latif (Malaysia)
Andrew Lenton (Australia)
Anoop Mahajan (India)
Jun Nishioka (Japan)
Jurgita Ovadnevaite (Ireland)
Anna Rutgersson (Sweden)
Arvind Singh (India)
Guiling Zhang (China)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Local Organising Committee at University of Cape Town

Katye Altieri (South Africa)
Inge Deschepper (Canada)
Susanne Fietz (South Africa)
Brett Kuyper (South Africa)

Early Career Scientist Day Committee

Inge Deschepper (Canada)
Raquel Flynn (South Africa)
Moagabo Ragoasha (South Africa)
Asmita Singh (South Africa)
Sive Xokashe (South Africa)

SOLAS International Project Office

Chengcheng Gao (China)
Jessica Gier (Ireland)
Li Li (China)
Esther Rickert (Germany)

In memory of Mike Harvey

Mike Harvey (NIWA, New Zealand) has died recently after a short illness. Mikes early research in meteorology and atmospheric monitoring led him to marine aerosols in which he carried out a number of studies, both land and sea based. Mike played a coordinating role in SOLAS campaigns, including the SAGE iron release experiment, the SOAP (Southern Ocean Aerosol Production) study and the recent Sea2Cloud voyage. In addition, he had considerable input to SOLAS through his role as New Zealand representative, and he also attended many of the OSCs. Mike was never happier than when dealing with the technical challenges of making measurements in the field - quite literally, as his research also extended to ruminant emissions. He will be sadly missed, not just for his research but also for his good nature and the support he always gave to colleagues, students and friends.

Picture credit: Cliff Law

Dr. Cliff Law
National Institute of Water & Atmospheric Research Ltd (NIWA)
Wellington, New Zealand

In memory of James Lovelock

Jim Lovelock died this summer, on the day he turned 103. A world-class scientist, inventor (he developed, among many other things, the electron capture detector), thinker, writer, experimental and theoretical researcher, he built bridges across disciplines. He has had a huge influence on many of us in the SOLAS community, both pioneering research on trace gases emitted by the oceans (sulfur, halocarbons), providing a holistic view (Earth functioning and evolution) as context for ocean-atmosphere interactions, and sparking research into the role of marine aerosols in climate regulation. His research, results and concepts are more fundamental to climate and Earth System sciences than is often recognized. His long life has been driven by curiosity, passion for nature, a sense of humor and, above all, independence. Referent, inspiring, controversial, groundbreaking, Jim Lovelock leaves an enormous legacy for which we are forever grateful.

Picture credit: M. Steinke

Dr. Rafel Simó
Institut de Ciències del Mar (CSIC)
Barcelona, Spain

SOLAS and Conference Sponsors

We thank all our sponsors for their valuable contributions!

WESGRO
wesgro.co.za/convention-bureau/home

Elementa Science of the Anthropocene
elementascience.org

Future Earth, Research. Innovation. Sustainability futureearth.org

International Union of Geodesy & Geophysics (IUGG)
iugg.org/

Ocean-Land-Atmosphere Research, a Science Partner Journal (OLAR)
spj.sciencemag.org/journals/olar/

North Pacific Marine Science Organization (PICES)
meetings.pices.int/

Scientific Committee on Oceanic Research
scor-int.org

University of Cape Town
uct.ac.za/

SOLAS Funders and Sponsors

- all sponsors are listed in alphabetical order -

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Programme overview

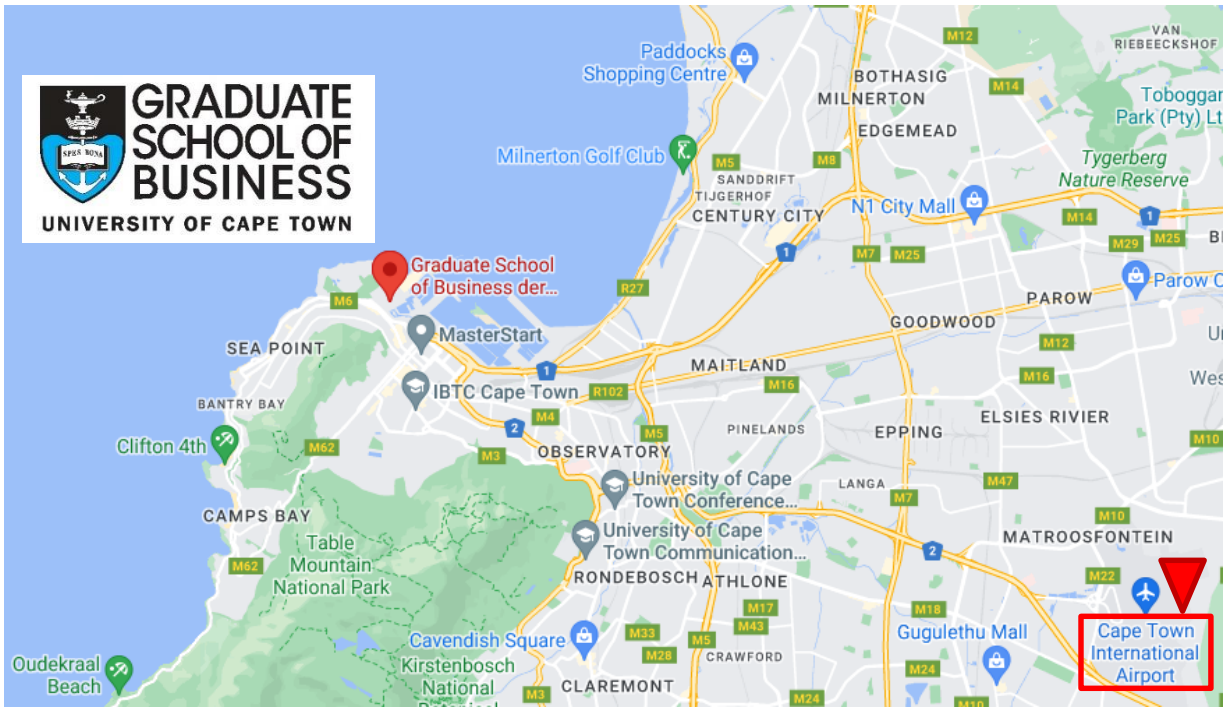
Time	Monday, 26 Sep	Time	Tuesday, 27 Sep
08:30	**Conference opening** Welcome / SOLAS introduction **K. Altieri** / **C. Guieu** and **M. Dai**	08:30	**Theme 2: Air-sea interface and fluxes of mass and energy** Introduction by sessions chairs: **T. Bell** and **A. Rutgersson**
8:40	**Theme 1: Greenhouse gases and the oceans** Introduction by session chairs: **M. Cornejo** and **G. Zhang**		
08:50	**P. Mongwe (South Africa)**: The impact of anthropogenic forcing on the Southern Ocean CO_2 sink - *on-site*	08:40	**M. Cronin (USA):** Large-scale Patterns of warm layer vs. cool skin corrections to bulk sea surface temperature and Reflections on the Observing Air-Sea Interactions Strategy (OASIS) - *on-site*
09:20	**M. Ahmed (Canada):** Undersaturation of oxygen in the subsurface waters of the Northwest Pacific during the wintertime convections from Argo-O_2 data - *online*	09:10	**S. Nicholson (South Africa):** Interrogating thermal biases in air-sea CO2 fluxes through top-down and bottom-up observational constraints - *on-site*
09:40	**S. Akande (Nigeria):** Modelling the Spatio-Temporal Variations of CO_2 and their Impacts on the Surface Oceans - *online*	09:30	**P. Rickard (UK):** Surface microlayer surfactant variability and air-water gas exchange - *on-site*
10:00	**J. Hauck (Germany):** Constraining regional and global ocean carbon fluxes in RECCAP2 - *online*	9:50	**O. Wurl (Germany):** HALOBATES: An autonomous research catamaran for high-resolution measurements of the sea-surface microlayer - *online*
		10:10	**Group picture / photo montage**
10:20	Coffee and tea break	10:20	Coffee and tea break
10:50	**Theme 3: Atmospheric deposition and ocean biogeochemistry** Introduction by session chairs: **S. Gassó** and **J. Nishioka**	10:50	**Polar Oceans** Introduction by session chair: **K. Altieri**
11:00	**M. Kurisu (Japan):** Application of Fe isotope ratios for a better understanding of the Fe cycle in the surface ocean and lower atmosphere - *online*	11:00	**O. Crabeck (Belgium):** Sea ice biogeochemistry and polar oceans: Important fact and challenge - *on-site*
11:30	**A. Milinković (Croatia):** Variabilities of biochemical properties of the sea surface microlayer: insights to the atmospheric deposition impacts - *online*	11:30	**H. Hayashida (Japan):** Bi-polar perspectives on projected changes in sea-ice algae blooms from a global sea ice-ocean coupled model - *online*
11:50	**A. Ito (Japan):** Aerosol bioaccessible iron supply from southern Africa to the Southern Ocean - *on-site*	11:50	**N. Steiner (Canada):** Coupling of ocean-ice-atmosphere processes: from sea-Ice biogeochemistry to aerosols and Clouds (CIce2Clouds) - *on-site*
12:10	**D. Hamilton (USA):** Earth, Wind, Fire, and Pollution: Aerosol Nutrient Sources and Impacts on Ocean Biogeochemistry - *on-site*	12:10	**R. Lampere (France):** Polar sea-salt aerosols in CMIP6 models - *online*
12:30	Lunch	12:30	Lunch
13:30	**Discussion sessions** **UN Decade of Ocean Science Proposal: Aerosol Exchange with Marine Ecosystems** - *Douglas Hamilton, USA; Cecile Guieu, France; Morgane Perron, France*	13:30	**Discussion sessions** **Strengthening Partnerships between OASIS and the Global South** - *Christa Marandino, Germany; Meghan Cronin, USA; Warren Joubert, South Africa; Seb Swart, Sweden*
14:50	Coffee and tea break	14:50	Coffee and tea break
15:00	**SOLAS Science & Society: building upon past achievements & future possibilities** - *Erik van Doorn & Christa Marandino, Germany*		**Differences and commonalities in air-ice-ocean processes in the Antarctic and Arctic** - Nadja Steiner, Canada; Jessie Creamean, USA; Jennie Thomas, France; Lisa Miller, Canada
16:20	Coffee and tea break (during poster session)		Coffee and tea break (during poster session)
16:20 - 19:00	**Poster session** *on-site on rooftop*	16:20 - 19:00	**Poster session** *online in gather.town*
19:30	**Representatives & Impl. team dinner** (invitation only)		

Programme overview

Time	Wednesday, 28 Sep	Time	Thursday, 29 Sep
08:30	**Theme 4: Interconnections between marine ecosystems, aerosols, and clouds** Introduction by session chairs: **M. Kanakidou** and **J. Ovadnevaite**	08:30	**Theme 5: Ocean biogeochemical control on atmospheric chemistry** Introduction by session chairs: **M. Kanakidou** and **T. Latif**
08:40	**B. Wang (China)**: Micro-spectroscopic characterization and ice formation potential of marine related aerosol particles - *online*	08:40	**M. Gali Tapias (Spain):** From weather to climate scales in ocean biogeochemistry-atmospheric chemistry studies: mind the gaps - *on-site*
09:10	**K. Fossum (Ireland)**: Marine aerosol-cloud interactions and investigations into typical degrees of air pollution over the Southern Ocean - *on-site*	09:10	**M. Peltola (Finland):** Marine aerosol formation and its chemical precursor species in coastal New Zealand - *on-site*
09:30	**M. Mallet, (Australia):** Contrasting aerosol, cloud, precipitation, and radiation interactions at low and high Southern Ocean latitudes - *online*	09:30	**S. Pongpiachan (Thailand):** Applying synchrotron radiation-based attenuated total reflection-fourier transform infrared to evaluate the effects of shipping emissions on fluctuations of PM10-bound organic functional groups - *on-site*
09:50	**K. Sellegri (France)**: Sea2Cloud: from biogenic emission fluxes to cloud properties in the South West Pacific - *on-site*	09:50	**L. Zhou (Germany):** Winter season Southern Ocean distributions of climate-relevant trace gases - *on-site*
10:10	Coffee and tea break	10:10	Coffee and tea break
10:40	**Indian Ocean / Upwelling** Introduction by session chairs: **A. Mahajan** and **A. Singh / M. Cornejo** and **A. Körtzinger**	10:40	**Climate Intervention / Science and Society** Introduction by session chairs: **E. van Doorn** and **A. Lenton**
11:00	**Z. Lachkar (UAE)**: Air-sea interaction and physical-biogeochemical coupling in the Indian Ocean: examples of recent advances and gaps in understanding - *on-site*	11:00	**N. Mengis (Germany):** Carbon Dioxide Removal measures - Feasibility, uncertainties, and their contribution to net-zero - *online*
11:30	**P. Panda (India)**: Atmospheric Dry deposition of Mineral Dust and associated nutrient supply and their solubility over the Indian Ocean during Vernal Summer months - *online*	11:30	**P. Monteiro (South Africa)**: Building a national integrated observational and modelling capability to support the assessment of ocean CDR in South Africa for robust policy development - *on-site*
11:50	**M. Ragoasha (South Africa)**: Eastern Boundary Upwelling Systems in a warming world: inconsistence trends - *on-site*	11:50	**E. Mahu (Ghana):** Putting Science to Action - *online*
12:10	**R. Oliveira (Brazil)**: The tropical and subtropical South Atlantic Ocean biogeochemistry responses for the IPCC AR5 future scenarios using EcoGEnIE 1.0 - *on-site*	12:10	**H. Liu (China):** Global shipping emission inventories with high spatial and temporal resolution - *online*
12:30	Lunch	12:30	**J. Dinasquet (USA)**: Sea-air transfer and dispersal of harmful sea spray aerosols - *on-site*
13:30	**Discussion sessions** **Crosswinds in Safe Landing Climates** - *Lisa Miller, Canada; Neil Harris, UK; Erik van Doorn, Germany*	12:50	**Conference closing**
14:50	Coffee and tea break		
15:00	**SOLAS science and global ship emissions – common challenges and next steps** - *Christa Marandino, Germany; Tom Bell, UK; Anna Rutgersson, Sweden; Zongbo Shi, UK*		
16:20	Coffee and tea break		
16:30 - 17:50	**Open Science and Publishing- Community Needs and Challenges** - *Jamie Males & Emma Archer, PLOS Climate, UK*		
18:00 - 19:00	**Virtual networking event on gather.town**		
19:30	**Conference banquet**		

Follow us on twitter @SOLAS_IPO

Welcome to the new University of Cape Town (Graduate School of Business (UTC GSB) Academic Conference Centre!



http://www.gsb.uct.ac.za/

UTC GSB Academic Conference Centre

9 Portswood Rd, Victoria & Alfred Waterfront, Cape Town

Registration desk This service will be situated in the foyer of the conference centre. Please collect your conference material when you arrive at the conference centre. If you require any assistance, please visit the registration desk.

Login details - join the virtual events!

All conference participants are invited to join the virtual events!

- **Plenary sessions and discussion sessions** 26-29 Sep will be held on Zoom.
- **Online poster session** 27 Sep at 4.20 pm will be held via the online platform gather.town.
- **Virtual networking event** 28 Sep at 4.30 pm will be held in gather.town.

How to join the online events?

The login details to join the virtual parts conference such the online presentations, the discussion sessions, the poster session as well as the virtual networking event have been sent by e-mail to you.
If you have not received the login details via email, please contact the registration desk on-site or send an e-mail to us, if you are attending the conference online.

We look forward to meeting you virtually!
See you soon on Zoom and in gather.town!

Cape Town International Airport

Cape Town International Airport (CPT) is the international airport in Cape Town, South Africa. It serves as a hub for South African Airways and is the tourist gateway to South Africa. It is the second largest airport in South Africa and is located 22 kilometers east of Cape Town's city center, foreshore and V&A Waterfront where most of the tourist accommodation, activity hubs, and business bubbles are located. For more information: www.capetown-airport.com

Airport Transfer

Taxis, **avoid unlicensed taxis** and taxi minibuses (typically Toyota Quantums 12 seaters) that operate without official routes, stops and timetable. They are not safe for tourist and most locals! We recommend to use the **MyCiTi bus system** and **Uber**, or ask your hotel to call you a taxi. For your own safety, please do not just hail a cab.

MyCiti bus system

MyCiti bus goes from/to Cape Town airport/V&A Waterfront in approx. 20 min drive and costs approx. R64, 3.60 €. MyCiti bus station in Cape Town Airport is located in the Transport Plaza (opposite the Central Terminal building). Info on this transport can be found on the MyCiti website see here: www.myciti.org.za/en/routes-stops/airport-services/

How to take the MyCiti bus: You need a myconnect card loaded with money from MyCiti Stations and participating retailers to travel with MyCiti busses. There are MyCiti bus stops at the airport and the Waterfront where you can buy and load a card.

Visit these websites to read about MyCiti bus:
www.myciti.org.za/en/discover-myciti/the-a-z-of-using-myciti/

Ulysses Tours

Ulysses Tours offers door-to-door airport transfers to/from the Cape Town airport. You will be picked up with a name board.
Book here:

Uber

Uber drivers are also providing airport transport. Airport transport to/from the V&A Waterfront costs approx. 10 €.

Further transport information

Getting Around - All your options for Cape Town locomotion
http://capetownblog.org/getting-around-cape-town/

MyCiti bus Airport Service

Catch a MyCiTi bus between the MyCiTi Airport bus station right outside the main Airport terminal, and the city centre, and transfer seamlessly to another MyCiTi route to reach your destination. Take a bus A01 from the airport to Civic Centre (depart every 20 min), change bus at Civic Centre and take a bus line to the Waterfront such as: 104, T01, T01X. If you take the yellow line 104, get off at Aquarium or Nobel Square, these stations are close to the conference center.

Source and further information:
www.myciti.org.za/en/routes-stops/airport-services/

MyCiti Airport Service Guide

Download the MyCiti Airport Service guide with the route map and detailed instructions on how to load the MyConnect card and other useful information as a handy PDF document.

Welcome reception

Join the Open Science Conference 2022 Welcome Reception at the rooftop terrace of the UCT GSB Conference Centre. Meet the other conference attendees and enjoy the breath-taking nighttime scenery from the rooftop terrace.

Finger-food (also vegetarian) and beverages will be served and are included in the conference fee. A 4 Piece Jazz Band will entertain us.

All conference participants are invited to the event!

Welcome reception
Sunday, 25 Sep, 6 pm.
Roof terrace, University of Cape Town,
Graduate School of Business Conference Centre

GRADUATE SCHOOL OF BUSINESS
UNIVERSITY OF CAPE TOWN

Information

Conference dinner

Pigalle Restaurant - 57A Somerset Rd, Green Point, Cape Town, 8051

By bus take MyCiti bus lines 108, 109 and T02X from UCT Graduate School of Business conference centre to the restaurant Pigalle. How the MyCiti bus system works is explained on page 11.

Pigalle CAPE TOWN

https://pigalle.capetown/

Restaurants in Cape Town at the V&A Waterfront

The V&A Waterfront is a 123-hectare mixed-use development, offering everything from residential to commercial property, hotels, retail districts, extensive dining, leisure and entertainment facilities. You find over 80 restaurants and eateries from which to choose in the V&A Waterfront. We created a list of recommended restaurants and café's for you, see below.

Best Seafood

Baía baiarestaurant.co.za/ - fine cuisine with harbour and ocean views.
Upstairs @ Quay Four quay4.co.za/ - nice views!
Willoughby & Co willoughbyandco.co.za/ - Japanese culinary experience.

Coffee shops & Light meals

Tashas Café - tashascafe.com/
Starbucks - starbucks.co.za/
COOKED V&A Waterfront inside Watershed - thecookedcook.co.za

Casual Dining

Gibson's Gourmet Burgers gibsonsburgers.co.za/ - gourmet burgers and ribs.
City Grill citygrill.co.za/gallery/ - showcasing South African Traditional food.
Kapstadt Brauhaus kapstadtbrauhaus.co.za/ - traditional German cuisine.
Karibu eatery kariburestaurant.co.za/food/food-menu/ - nice place with good food and very South African menus.
The Yard theyardatsilo.co.za/food/ - cool place on the other side of the Warfront known as the silo district.
Si cantina sociale sicantinasociale.co.za/menu/ - very nice high end tapas bar.

Halal Friendly

Colcacchio colcacchio.co.za/ - artisanal wood-fired pizzas, pastas and gourmet salads.

V & A Waterfront Cape Town
Pixabay

Various useful information

ATM All major South African banks and foreign currency converters can be found in the main V&A Waterfront mall, the V&A Watershed, as well as at the aquarium.

Café There are many nice café's at the waterfront mall as well as work space benches in the upper floor of the Waterfront mall during the week for those who prefer to work surrounded by people.

Covid-19 SOLAS recommends that all attendees wear a mask and follow hygiene measures. Covid-19 rapid test will be available at the registration desk. Covid-19 testing centre at the V&A Waterfront: Battery Park @ V&A Waterfront, 19 Dock Rd.

What to do when tested positive while staying in Cape Town, visit this website with useful information: www.capetown.travel/i-tested-positive-for-covid-19-while-on-holiday-in-cape-town-now-what/

Homelessness situation in Cape Town is currently probably at its worst and there is no way not to notice the large number of homeless people and tents all around town. If you want to help you can buy night shelter or meals via different apps. Homeless shelters in Cape Town:

Haven Night Shelters, buy a bed for someone here: haven.org.za/

U-turn, buy meals, showers, clothing or a bed for a night vouchers that you can then give to people instead of cash. homeless.org.za/vouchers/

Ladles of love donate money for the meal program. ladlesoflove.org.za/

LADLES OF LOVE
feeding the soul

Phone/Internet Get a virtual/digital sim card which enables your phone to work in the region traveling without roaming fees. Providers are e.g. *Worldsim*. www.airtel.in/blog/prepaid/what-is-virtual-sim-card-and-how-to-get-it/

Various useful information

Sightseeing with the hop on hop off **sightseeing red bus**. Not expensive and offers a good value if you use them for a full day. The nearest station is right in front of the Aquarium, down the stairs from the conference.
More here: www.citysightseeing.co.za/

Souvenirs At the Waterfront, 17 Dock Rd are many local craft and souvenir shops like: Wild Thing Africa, Siyakatala, Sunshine Crafts or V&A Waterfront Watershed and many more.

Tipping is common in the range of **10-15%** in a restaurant or any other larger service and many service providers rely on tipping. Also, petrol attendants and in smaller towns also tip official parking guards. Most people tip between R5 and R20, so, if you plan a road trip, keep some small change available.

Language guide - How to say the following sentences in Xhosa // Afrikaans:
Good day - Molweni // Goeie dag
How are you? - Ninjani? // Hoe gaan dit met jou?
Thank you - Enkosi // // Dankie
Have a good day - Nibenemi emnandi // Lekker dag vêrder

For further information, please visit the SOLAS conference website as well as the official Cape Town tourism website:
https://uctcmc.eventsair.com/solas-osc2022/general-information

https://www.capetown.travel/travel-wise/

CIce2Clouds Workshop

This two-day workshop is hold by the Scientific Committee on Oceanic Research (SCOR) working group #163 Coupling of ocean-ice-atmosphere processes: from sea-Ice biogeochemistry to aerosols and Clouds (CIce2Clouds). Invitation only!

CIce2Clouds Workshop Programme - **Friday, 23 Sep 2022**

08:00	Registration
08:30	Welcome and Introduction
09:30	Tutorial Talks: Atmospheric processes
10:30	Discussion: Atmospheric processes
11:00	*Coffee / tea break*
11:15	Tutorial Talks: Ocean & sea ice processes
12:15	Discussion: Ocean & sea ice processes
12:45	*Lunch*
13:45	Tutorial Talks: Exchange processes
14:45	Discussion: Exchange processes
15:15	*Coffee / tea break*
15:30	Keynote: C. Haas (AWI): Contrasting Arctic & Antarctic Sea-Ice
16:30	Discussion: Connection to CIce2Clouds
17:00	End first day

CIce2Clouds Workshop Programme - **Saturday, 24 Sep 2022**

08:00	Registration
08:30	Discussion: Processes from Day 1; Paper outlining & plans for compiling; Identify leads
10:30	*Coffee / tea break*
10:45	CIce2Clouds Sub-working Group Discussion: Building on keynote talk discussion and integration into ongoing synthesis papers
12:45	*Lunch*
13:45	CIce2Clouds Terms of Reference: Discussion and Next Steps
15:45	*Coffee / tea break*
16:00	Other business: Plans for next meeting; ECR field school; SOLAS discussion session
17:00	End of the CIce2Cloud workshop

Early Career Scientist Day (ECSD)

The SOLAS Early Career Scientist Day (ECSD) is an international, hybrid event that brings together around 30 in person and more online early career scientists and world-leading international scientists for a day of skill development and awareness workshops. In addition, we will do a tour to the Cape Point Nature reserve where we will have a tour of the Meteorological station and the area with stops along the way at either Boulders beach to see the African penguins* or at Chapmans Peak. *Please note: The schedule is very tight, Boulders beach with the penguins can only be visited if there is enough time left.

Sunday

ECSD Programme - **Sunday, 25 Sep 2022**

08:30	Registration at the conference venue at UCT New Academic Conference Centre, Breakwater Lodge Campus
09:00	Opening remarks by the ECSD organising committee
09:10	Workshop 1: Grant and proposal writing: tips and tricks
10:40	*Coffee and tea break*
11:10	Workshop 2: Equity, Diversity and Inclusion within our Scientific field
12:40	*Break and lunch collection*
13:00	Departure from Conference Centre by bus Excursion to the Meteorological Station and to Cape Point
14:30	Arrival at Cape Point, Cape Peninsula
15:00 - 17:00	Tour of the Meteorological Station and Cape Point
17:30	Departure from Cape Point, Cape Peninsula
19:00	Arrival at UCT for the Welcome Reception

Cape Point, South Africa.

Boulders beach with African penguins.

Daily overview - Monday

Times	Monday, 26 Sep
08:30	**Conference opening - Welcome & SOLAS introduction**
08:40	**Theme 1: Greenhouse gases and the oceans** Introduction by session chairs: **M. Cornejo** and **G. Zhang**
08:50	**P. Mongwe (South Africa)**: The impact of anthropogenic forcing on the Southern Ocean CO2 sink - *on-site*
09:20	**M. Ahmed (Canada)**: Undersaturation of oxygen in the subsurface waters of the Northwest Pacific during the wintertime convections from Argo-O2 data - *online*
09:40	**S. Akande (Nigeria)**: Modelling the Spatio-Temporal Variations of CO2 and their Impacts on the Surface Oceans - *online*
10:00	**J. Hauck (Germany)**: Constraining regional and global ocean carbon fluxes in RECCAP2 - *online*
10:20	Coffee and tea break
10:50	**Theme 3: Atmospheric deposition and ocean biogeochemistry** Introduction by session chairs: **S. Gassó** and **J. Nishioka**
11:00	**M Kurisu (Japan)**: Application of Fe isotope ratios for a better understanding of the Fe cycle in the surface ocean and lower atmosphere - *online*
11:30	**A. Milinković (Croatia)**: Variabilities of biochemical properties of the sea surface microlayer: insights to the atmospheric deposition impacts - *online*
11:50	**A. Ito (Japan)**: Aerosol bioaccessible iron supply from southern Africa to the Southern Ocean - *on-site*
12:10	**D. Hamilton (USA)**: Earth, Wind, Fire, and Pollution: Aerosol Nutrient Sources and Impacts on Ocean Biogeochemistry - *on-site*
12:30	Lunch
13:30	**Discussion sessions:** **UN Decade of Ocean Science Proposal: Aerosol Exchange with Marine Ecosystems** - *Douglas Hamilton, USA; Cecile Guieu, France; Morgane Perron, France*
14:50	*Coffee and tea break*
15:00	**SOLAS Science & Society: building upon past achievements & future possibilities** - *Erik van Doorn & Christa Marandino, Germany*
16:20	Coffee and tea break (during poster session)
16:20 -19:00	**Poster session** *On-site on roof top*
19:30	**National representatives & Impl. team dinner** (invitation only)

Plenary session
Theme 1: Greenhouse gases and the oceans

Session chairs: M. Cornejo and G. Zhang
Keynote speaker: Precious Mongwe

Precious Mongwe is a researcher at the Council for Scientific and Industrial Research (CSIR). He is interested in ocean biogeochemistry, mainly working on the ocean carbon cycle and ocean deoxygenation. Seeking to understand processes that regulate the ocean carbon cycle, the impact of climate change on the ocean CO2 sink and its implications to the biosphere. He recently started working on ocean deoxygenation within the context of marine ecosystems using metabolic theory. He uses ocean circulation models and Earth system models as the main tools to study the earth system.

Affiliation: Ocean and Climate dynamics | Council for Scientific and Industrial Research (CSIR) | Cape Town, South Africa

Monday

The dynamic of the nitrous oxide in the Humboldt Current System - *on-site*

The Southern Ocean takes up over 40% of the ocean's anthropogenic CO2. The business-as-usual climate scenario projects a warmer climate, higher atmospheric CO2 concentrations, and weakened ocean's CO2 buffering capacity in the future. This study investigated how the Southern Ocean CO2 sink will be affected by these conditions as simulated according to the socioeconomic pathway 585 climate scenario. We find that in addition to the increase in CO2 uptake, the largest CO2 sink region shifts from the Subtropical region (northern edge of the Southern Ocean) to the Antarctic region (southern edge) by the end of the century (2080 – 2099). In the future, CO2 uptake is nearly double in the Antarctic region relative to the region between 30oS and north of the polar front; the present climate shows the opposite. Because CO2 uptake is primarily regulated by temperature-driven solubility in the subtropical region, increased CO2 uptake during cooler seasons (winter-autumn) due to higher atmospheric CO2 in the future is nearly compensated by weakened CO2 solubility in warmer seasons (summer-spring) due to warming. Two factors influence the CO2 sink increase in the Antarctic region. First, warming-driven sea-ice melt enhances surface stratification and shoals ocean mixed layer depths, weakening subsurface DIC entrainment and enhancing seasonal surface cooling (& warming) rates; this strengthens solubility-driven CO2 uptake. Secondly, consistent with previous studies, we find that the lower CO2 buffering capacity strengthens biological-driven CO2 uptake, although long-term changes in primary production are not significant. Collective, these changes shift the Southern Ocean's dominant CO2 sink from the subtropical region to the Antarctic region in the future.

Undersaturation of oxygen in the subsurface waters of the Northwest Pacific during the wintertime convections from Argo-O2 data - *online*

Mohamed Ahmed[1], Roberta Hamme[1]
[1]*School of Earth & Ocean Sciences, University of Victoria, Victoria, Canada*

Trends of declining O2 (i.e., ocean deoxygenation) in our ocean are expected to increase in conjunction with the increase in ocean warming and acidification, primarily as a result of anthropogenic carbon emissions. One of these significant trends was observed in the North Pacific Intermediate Water (NPIW). As ventilation sites are rare, processes within them have the potential to control biological activity and biogeochemical processes over broad areas and time scales. However, recent observations and models suggest that dissolved gases in these locations do not come to equilibrium with the atmosphere. In this study, we estimate the O2 content in the newly formed NPIW and quantify the extent of oxygen disequilibria over time and space. Our findings will provide a better understanding of oxygen consumption in the subsurface water and will allow an additional constraint for biogeochemical models and global carbon budgets in the North Pacific.

Modelling the Spatio-Temporal Variations of CO2 and their Impacts on the Surface Oceans - *online*

Samuel Akande[1], Temi Ologunorisa[1], Adekunle Osinowo[1]
[1]*Federal University Of Technology Akure, Akure, Nigeria*

The variability of surface ocean CO2 (SOCAT) data (between 1957 and 2021) were investigated across the North Atlantic Ocean using geo-statistical techniques over a variety of years, sizes, and lengths. As a result, developing and interpreting decadal ocean biogeochemical predictions has the potential to help civilization while also being beneficial to the ocean environment. Hence, geostatistical approaches produce more accurate results for the geographical and temporal variability of surface ocean pCO2 and, by extension, air-sea CO2 fluxes over the North Atlantic Ocean. Findings show that employing machine learning to combine model output with observations improves prediction accuracy somewhat. In addition, we highlight the learnt misfits' potential as a new model diagnostic tool for visualizing spatiotemporal pCO2 estimates. Taken together, this research has major implications for the development of carbon monitoring systems, which will benefit policymaking and improve our understanding of the air-sea CO2 sink's evolution.

Constraining regional and global ocean carbon fluxes in RECCAP2 - *online*

Judith Hauck[1], Nicolas Gruber[2], Masao Ishii[3] et al.
[1]*Alfred Wegener Institute, Helmholtz Centre For Polar And Marine Research, Bremerhaven, Germany,*
[2]*Environmental Physics, Institute of Biogeochemistry and Pollutant Dynamics, ETH Zürich, Zurich, Switzerland,*
[3]*Meteorological Research Institute, Japan Meteorological Agency, Tsukuba, Japan.*

Keeping global warming in line with the Paris Agreement requires rapid reductions in CO2 emissions. Tracking these reductions demands a thorough bookkeeping of natural and anthropogenic carbon fluxes. The second REgional Carbon Cycle Assessment and Processes (RECCAP2) activity of the Global Carbon Project aims to accurately assess land and ocean CO2 sources and sinks through the efforts of hundreds of scientists around the globe.
For the ocean component, regional budgets are developed for the global ocean and five large regions for the period 1980-2018. In addition, four 'special focus' themes, namely the biological carbon pump, the seasonal cycle, the coastal ocean and model evaluation are addressed. We use state-of-the-art ocean models and observation-based datasets to provide robust estimates of regional CO2 budgets and constrain their uncertainties. Here, we will provide an overview of RECCAP2 activities, and showcase key results focusing on mean ocean carbon fluxes, and their trends and variability.

Plenary session
Theme 3: Atmospheric deposition and ocean biogeochemistry

Session chairs: S. Gassó and J. Nishioka
Keynote speaker: Minako Kurisu

Minako Kurisu got her Ph.D. at the University of Tokyo, Japan in 2020. After working as a postdoctoral researcher at Research Institute for Global Change, JAMSTEC, Japan, she is currently a researcher at Research Institute for Marine Resources Utilization, JAMSTEC. She is interested in the cycles of trace metals in the atmosphere and surface ocean. Her research especially focuses on the atmospheric iron (Fe) deposition, including natural and anthropogenic Fe. She has been applied *Fe stable isotope ratios and X-ray absorption fine structure analysis for Fe source apportionment and characterization of Fe species in the atmosphere.*

Affiliation: Research Institute for Marine Resources Utilization | Japan Agency for Marine-Earth Science and Technology (JAMSTEC) | Yokosuka, Japan

Application of Fe isotope ratios for a better understanding of the Fe cycle in the surface ocean and lower atmosphere - *online*

Atmospheric deposition of nutrients including nitrogen, phosphorous, iron, and other trace elements has a large impact on primary production and carbon uptake in the surface ocean. In addition to natural dust, aerosols derived from human activity and biomass burning have recently been considered to be important nutrient sources. Atmospheric and oceanic models have been improved to estimate global nutrient depositions and their impacts on primary production, but observational and experimental information, such as the relative contribution of each aerosol source, solubility, deposition, chemical composition and alteration, and the role of organic ligands, is still necessary.

In this talk, I will focus on iron and its stable isotope ratios. The development of sampling methods with little contamination and analytical techniques lead to the high-precision isotope measurement of marine aerosols and seawater. It was found that Fe isotope ratios of combustion aerosols are much lower than that of natural aerosols due to different emission processes. Such low Fe isotope signals were also observed in the marine aerosols downwind of urban regions, and sometimes even in the surface ocean in the Pacific. These are applicable to distinguishing Fe sources in the atmosphere and even in the ocean. I will introduce the recent progress in studies related to Fe isotopes and Fe cycles in the surface ocean.

Variabilities of biochemical properties of the sea surface microlayer: insights to the atmospheric deposition impacts - *online*

Andrea Milinković[1], Abra Penezić[1], Ana Cvitešić Kušan[1], Valentina Gluščić[2], Silva Žužul[2], Sanda Skejić[3], Danijela Šantić[3], Ranka Godec[2], Gordana Pehnec[2], Dario Omanović[1], Anja Engel[4], Sanja Frka[1]
[1]Division for Marine and Environmental Research, Ruđer Bošković Institute, Zagreb, Croatia, [2]Institute for Medical Research and Occupational Health, Zagreb, Croatia, [3]Institute of Oceanography and Fisheries, Split, Croatia, [4]GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany

During a six-month field campaign within BiREADI CSF IP-2018-01-3105 project, a comprehensive measurements of atmospheric and sea surface samples were obtained at the Adriatic coastal area. A strong impact of local/regional open-fire biomass burning (BB) sources likely supplied a substantial amount of N species to the sea surface microlayer (SML) and promoted the development of autotrophic and heterotrophic organisms, leading to a shift in the biological community toward small cell organisms. Consequently, atmospheric deposition associated with BB emissions played an important role in organic matter enrichment in the SML, which could have strong implications for global biogeochemical processes mediated by SML. This work demonstrates the importance of studying the short-term scale interactions between the atmosphere and ocean compartments, which can lead to a significant improvement in understanding of the ocean-atmosphere system, with important implications for climate change.

Aerosol bioaccessible iron supply from southern Africa to the Southern Ocean - *on-site*

Akinori Ito[1], Takuma Miyakawa[1]
[1]JAMSTEC, Yokohama, Japan

Atmospheric emissions of leachable metals from anthropogenic, lithogenic, and pyrogenic origins represent important external sources of micronutrients to the open ocean. However, significant uncertainties remain in the source fluxes, partly due to a lack of source-specific evaluation of Fe-laden aerosols. In this presentation, we evaluate the aerosol chemical transport model (IMPACT), using ground-based datasets of trace elements. The model generally reproduced the observed data of bioaccessible Fe concentrations in fine particles at Fukue and Tasmania islands. The continuous monitoring data and these constrains on aerosol transport model offer improvements in the source apportionment of aerosol Fe. The improved global model may shed some light on an underestimation of bioaccessible Fe concentrations over the Southern Ocean. Further, the results are discussed in terms of future research needed to predict the effect of bioaccessible Fe aerosols from southern Africa to the Southern Ocean more accurately.

Earth, Wind, Fire, and Pollution: Aerosol Nutrient Sources and Impacts on Ocean Biogeochemistry - *on-site*

Douglas Hamilton[1], Morgane Perron[2], Tami Bond[3], Andrew Bowie[2], Rebecca Buchholz[4], Cecile Guieu[5], Akinori Ito[6], Willy Maenhaut[7], Stelios Myriokefalitakis[8], Nazlı Olgun[9], Sagar Rathod[3], Kerstin Schepanski[10], Alessandro Tagliabue[11], Robert Wagner[12], Natalie Mahowald[1]

[1]Cornell University, , USA, [2]Institute for Marine and Antarctic Studies, University of Tasmania, Australia, [3]Colorado State University, , USA, [4]Atmospheric Chemistry Observations and Modeling Laboratory, National Center for Atmospheric Research, USA, [5]Laboratoire d'Océanographie de Villefranche, Sorbonne Université, France, [6]Japan Agency for Marine-Earth Science and Technology, , Japan, [7]Ghent University, , Germany, [8]National Observatory of Athens, , Greece, [9]Istanbul Technical University, , Turkey, [10]Freie Universität Berlin, , Berlin, [11]University of Liverpool, , UK, [12]Leibniz Institute for Tropospheric Research, , Germany

Atmospheric deposition supplies vital nutrients to the phytoplankton that form the base of marine food webs. The large spatiotemporal variability in aerosols from myriad sources combined with the differential responses of marine biota to changing fluxes makes it crucially important to understand where, when, and how much nutrients from the atmosphere enter marine ecosystems. This presentation summarizes a recent review (with the same title) which brought together a diverse team of observationalists and modellers to evaluate the contribution and spatiotemporal variability of nutrient-bearing aerosols from desert dust, wildfire, volcanic, and anthropogenic sources, including the organic component, deposition fluxes, and their oceanic impacts. To explore the emerging role of wildfires in biogeochemical cycles, a case study of recent 2019-2020 megafire activity in Australia was undertaken and the interactions of fires and dust aerosol investigated.

UN Decade of Ocean Science Proposal: Aerosol Exchange with Marine Ecosystems

Co-conveners: Douglas Hamilton, USA; Cécile Guieu, France; Morgane Perron, France

Research priorities of SOLAS and other related programs (GEOTRACES, IMBER) and WGs (GESAMP WG38, 'RUSTED currently under review with SCOR') are at the heart of UN Decade of Ocean Science for Sustainable Development challenges #1, #5, #7, and #10, and ultimately #8. To help achieve these shared goals and contribute to the UN Ocean Decade, SOLAS aims to submit a proposal to the next relevant endorsement call.

To maximise the impact of a successful endorsement for the community this session will open discussion aimed at defining the most insightful project, its scope, and key partners. Science topics for inclusion are open for suggestion. One possible theme is fire emissions as a source of nutrients to different ocean basins. As fires are expected to increase in magnitude and frequency in different regions of the world, the impacts on ocean ecosystems and societies (economy and health) which depend on it require attention.

SOLAS Science & Society: building upon past achievements & future possibilities

Co-conveners: Erik van Doorn & Christa Marandino, Germany

Since the Open Science Conference in Kiel, SOLAS Science & Society has worked on how to increase interaction between natural scientists and social scientists on the one hand and the interaction with society as a whole – especially stakeholders – on the other. In this session, we would like to engage the broader SOLAS community in this work. We will introduce the achievements so far, mainly about three main topics: valuing carbon in the ocean, air-sea interaction and policy, and ship emissions. Moreover, we want to discuss if and how we could build upon these achievements by addressing different opportunities for co-operation. We would also like to start working on new topics such as harmful algae blooms and the effects of marine plastics at the ocean-atmosphere interface. There is evidently also the opportunity to elaborate on other topics that might need to be covered by SOLAS Science & Society in the future.

Poster session on-site

Monday 26 Sep, 4.20-7 pm, on-site at the rooftop

Poster sessions during the conference will be held on-site and online via the platform *gather.town*. On-site poster presenters, please come to the registration desk asap and pick up your individual poster board number and put up your poster. ALL poster presenters (on-site and online), are required to upload and present their posters in gather.town. Note that all posters will be visible on gather.town during the whole day of the virtual poster session. For login information see page 11.

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Poster session on-site

Monday 26 Sep, 4.20-7 pm, on-site at the rooftop

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Daily overview - Tuesday

Time	Tuesday, 27 Sep
08:30	**Theme 2: Air-sea interface and fluxes of mass and energy** Introduction by sessions chairs: **T. Bell** and **A. Rutgersson**
08:40	**M. Cronin (USA):** Large-scale Patterns of warm layer vs. cool skin corrections to bulk sea surface temperature and Reflections on the Observing Air-Sea Interactions Strategy (OASIS) - *on-site*
09:10	**S. Nicholson (South Africa):** Interrogating thermal biases in air-sea CO2 fluxes through top-down and bottom-up observational constraints - *on-site*
09:30	**P. Rickard (UK):** Surface microlayer surfactant variability and air-water gas exchange - *on-site*
09:50	**O. Wurl (Germany):** HALOBATES: An autonomous research catamaran for high-resolution measurements of the sea-surface microlayer - *online*
10:10	**Group picture / photo montage**
10:20	Coffee and tea break
10:50	**Polar Oceans** Introduction by session chair: **K. Altieri**
11:00	**O. Crabeck (Belgium):** Sea ice biogeochemistry and polar oceans: Important fact and challenge - *on-site*
11:30	**H. Hayashida (Japan):** Bi-polar perspectives on projected changes in sea-ice algae blooms from a global sea ice-ocean coupled model - *online*
11:50	**N. Steiner (Canada):** Coupling of ocean-ice-atmosphere processes: from sea-Ice biogeochemistry to aerosols and Clouds (CIce2Clouds) - *on-site*
12:10	**R. Lapere (France):** Polar sea-salt aerosols in CMIP6 models - *online*
12:30	Lunch
13:30	**Discussion sessions:** **Strengthening Partnerships between OASIS and the Global South** - *Christa Marandino, Germany; Meghan Cronin, USA; Warren Joubert, South Africa; Seb Swart, Sweden*
14:50	Coffee and tea break
15:00	**Differences and commonalities in air-ice-ocean processes in the Antarctic and Arctic** - *Nadja Steiner, Canada; Jessie Creamean, USA; Jennie Thomas, France; Lisa Miller, Canada*
16:20	Coffee and tea break (during poster session)
16:20 -19:00	**Poster session** *Online in gather.town*

Plenary session
Theme 2: Air-sea interface and fluxes of mass and energy

Session chairs: T. Bell and A. Rutgersson
Keynote speaker: Meghan Cronin

Meghan Cronin co-leads the Observing Air-Sea Interactions Strategy (OASIS) programme of the UN Decade of Ocean Sciences for Sustainable Development. A Research Oceanographer at NOAA's Pacific Marine Environmental Laboratory, she leads the Ocean Climate Stations group that maintains two OceanSITES moorings in the North Pacific — the Kuroshio Extension Observatory (KEO) and the NOAA surface mooring at Station Papa. Both monitor the air-sea exchanges of heat, moisture, and momentum, and upper and bottom ocean physical conditions.
Partners have sensors on the moorings and nearby to monitor air-sea CO2 fluxes, ocean acidification, wave-induced bubbles, carbon export and other parameters. Meghan is also lead Principal Investigator of a pilot study testing use of Saildrone Uncrewed Surface Vehicles within the Tropical Pacific Observing System.

Affiliation: National Oceanic and Atmospheric Administration (NOAA) | Seattle | *USA*

Tuesday

Large-scale Patterns of warm layer vs. cool skin corrections to bulk sea surface temperature and Reflections on the Observing Air-Sea Interactions Strategy (OASIS) – *on-site*

Air-sea exchanges of heat, momentum and gasses (e.g., water vapour, CO2 and O2) depend upon the ocean skin temperature, which is generally cooler, but can occasionally be warmer, than the bulk Sea Surface Temperature (SST) measured by in situ sensors. Differences between the skin, bulk and foundation SSTs will be discussed and evaluated in the fifth generation European Centre for Medium-Range Weather Forecasts (ERA5) atmospheric reanalysis. I then will show how daily-averaged warm layer can be estimated from daily-averaged air-sea fluxes and daily-averaged SST. This then allows use of the satellite-based J-OFURO3 fluxes to explore patterns of the warm layer effect in relation to large scale fronts and atmospheric weather patterns, and their potential impacts on gas fluxes. Stepping back, I will then reflect upon the first year of the “Observing Air-Sea Interactions Strategy (OASIS)” and the next steps for this UN Decade of Ocean Sciences for Sustainable Development programme.

Interrogating thermal biases in air-sea CO2 fluxes through top-down and bottom-up observational constraints - *on-site*

Pedro Monteiro[1], **Sarah Nicholson[1]**, Brian Ward[2], Mr Mutshutshu Tsanwani[3], Sebastiaan Swart[4], Marcel du Plessis[4], Christo Whittle[5], Jean-Baptiste Sallée[6]

[1]Southern Ocean Carbon-Climate Observatory (SOCCO), CSIR, Cape Town, South Africa, [2]School of Physics and Ryan Institute, University of Galway, Galway, Ireland, [3]Department of Forestry, Fisheries and the Environment, Cape Town, South Africa, [4]Department of Marine Sciences, University of Gothenburg, Gothenburg, Sweden, [5]Earth Obs, CSIR, Cape Town, South Africa, [6]Sorbonne Université CNRS/IRD/MNHN, LOCEAN, IPSL, Paris, France

Recent work has highlighted a potentially important source of uncertainty in global air-sea flux of CO2 (FCO_2) estimates due to uncorrected errors associated with the small differences between the ocean skin, foundation and bulk temperatures mechanistically linked to heat and momentum fluxes. Understanding the CO_2-heat-momentum flux nexus in the mixed-layer is therefore a key challenge to improving model dynamics and uncertainties in observational flux constraints. We present preliminary results from a pilot experiment BENFLEx-21 designed to investigate the role of momentum and heat fluxes on daily-synoptic scale variability of surface ocean pCO_2 and the resulting calculation of FCO_2. Bottom-up high-resolution (mm-scale) thermal profiles measured by fast-response thermistors on a Slocum are coupled with high-frequency top-down surface observations of pCO_2 via Wave Glider and ocean skin temperature from an ISAR instrument on the RS Algoa ship in pseudo-mooring mode. We propose a mechanistic understanding of the physics behind the calculated FCO_2.

Surface microlayer surfactant variability and air-water gas exchange - *on-site*

Philippa Rickard[1], Ryan Pereira[1], Robert Upstill-Goddard[2], Guenther Uher[2], Erik Sahlée[3], Leonie Esters[3,4]

[1]Heriot-Watt University, Edinburgh, United Kingdom, [2]Newcastle University, Newcastle upon Tyne, United Kingdom, [3]Uppsala University, Uppsala, Sweden, [4]University of Bonn, Bonn, Germany

Our work in coastal systems demonstrates that previous assumptions of specific sinks are flawed due to the complexity of the surfactant pool; while photodegradation of surfactant components has been documented, photoproduction of total surfactant activity (SA) occurs in SML samples, in addition to a temperature effect. Moreover, our freshwater system research suggests that SML SA behaviour varies seasonally over windspeeds of ~1-11 m/s, possibly due to total surfactant pool composition (i.e. in/soluble surfactant dominance). The microbiological community is a known surfactant source, and our upcoming work will investigate microbial surfactant processing in oceanic regions and under controlled environmental forcing variables.
Integrated multidisciplinary approaches and widespread sampling are central to improving our understanding of SML ecosystem function and its role in modulating air-water gas exchange.

HALOBATES: An autonomous research catamaran for high-resolution measurements of the sea-surface microlayer - *online*

Oliver Wurl[1], Mariana Ribas-Ribas[1], Lisa Gassen[1], Sven Emig[1], Ewald Judith

[1]*University Of Oldenburg, Wilhelmshaven, Germany*

The sea-surface microlayer represents the boundary layer between the ocean and the atmosphere. Due to its interfacial (thickness < 1mm) and dynamic nature, representative observations are challenging, for example, for a mechanistic understanding of the role of the microlayer in the interaction between the ocean and the atmosphere. To fill this gap, we have developed the catamaran HALOBATES for autonomous operation over distances up to 10 km at moderate sea states. We integrated the rotating glass disk technique for continuous collection of the microlayer and sensor packages into a flow-through system to provide high-resolution observations at both spatial and temporal scales. A control station on the vessel allows switching to different modes of operation, and data are transmitted onboard for mission planning. We will present preliminary data on temperature and salinity anomalies in the microlayer together with freshwater flux observations.

Plenary session
Integrated topic: Polar Ocean and Sea Ice

Session chair: K. Altieri
Keynote speaker: Odile Crabeck

Odile Crabeck received her PhD degree in sea ice biogeochemistry from the Centre of Earth Observation Sciences (CEOS) University of Manitoba, Canada. Her research focuses on the different transport pathways of carbon dioxide through sea ice and the role of sea ice in polar ocean ecosystems. She has worked as a scientific coordinator for the Roland von Glasow-air-sea ice chamber facility at the University of East- Anglia, United Kingdom. In 2020, she was awarded a Fonds de la Recherche Scientifique (FNRS) fellowship to work at the University of Liège, Belgium, on micro-scale processes occurring in the sea ice matrix. Odile is involved in several international working groups, notably BEPSII (Biogeochemical exchange processes at sea-ice interfaces). BEPSII's objective is to understand the role of sea ice on biogeochemical processes occurring in polar oceans.

Affiliation: Université de Liège , Liège, Belgium

Sea ice biogeochemistry and polar oceans: Important fact and challenge - *on-site*

At the interface between the ocean and atmosphere, sea ice modifies strongly the surface of the ocean properties and forms a seasonal, biogeochemically active ecosystem which impacts both the underlying seawater and the atmosphere. Sea ice increases the albedo and modifies light transmission pathways, sea ice forms physical barriers to momentum and heat exchange between the ocean and atmospheres. Sea ice processes also affect the atmospheric composition by decreasing air-sea fluxes of gases and aerosols with the potential for significant climate feedback through direct and indirect (cloud) forcing mechanisms. Sea ice is biologically active thanks to brine inclusions which are habitats for large communities of algae, with sea-ice biomass concentrations among the highest observed in marine environments. Sea ice is now recognised to also play a key role in the polar food web and the carbon and sulphur cycle of the polar oceans. Today, the response of the sea ice ecosystem to ongoing change in polar oceans is uncertain because of insufficient understanding of biogeochemical processes, and an inadequate description of these processes in models. I propose to give a broad overview of the role of sea ice biogeochemistry processes in the polar ocean and present how the sea ice communities tackle the challenges.

Bi-polar perspectives on projected changes in sea-ice algae blooms from a global sea ice-ocean coupled model - *online*

Hakase Hayashida[1,2], Nadja Steiner[3,4]

[1]*Japan Agency For Marine-earth Science And Technology, Yokohama, Japan,* [2]*University of Tasmania, Hobart, Australia,* [3]*Environment and Climate Change Canada, Victoria, Canada,* [4]*Fisheries and Oceans Canada, Sidney, Canada*

The Arctic and Antarctic regions are both similar and different in many ways in which biogeochemical species are exchanged across the atmosphere, ocean, sea ice, snow, and land. How these similarities and differences play a role in projections of future changes, however, remains unknown. This study compares common sea-ice and snow properties at both poles simulated by a global sea ice-ocean coupled model that has recently incorporated sea-ice algae, the foundation of the sympagic ecosystem. The findings of this study can be used as a basis for describing how sea-ice properties control biogeochemical exchange processes and constraining projections of future changes.

Coupling of ocean-ice-atmosphere processes: from sea-Ice biogeochemistry to aerosols and Clouds (CIce2Clouds) - *on-site*

Nadja Steiner[1], Megan Willis[2]

[1]*Fisheries and Oceans Canada, Sidney, Canada*
[2]*Colorado State University, USA*

We will be introducing the newly established SCOR working group CIce2Clouds which aims at addressing key uncertainties in the biological and chemical controls on atmospheric chemistry, aerosol and clouds in polar ocean environments. We will present the key goals of the working group as well as current and ongoing efforts: 1) prioritizing key coupled biological and chemical systems that drive atmospheric reactive trace gas, aerosol, and cloud properties in polar ocean environments. 2) Identifying similarities and differences in controls on exchange processes between the Arctic and Antarctic Ocean-Sea Ice-Snow-Atmosphere (O-SI-S-A) systems. 3) Developing a conceptual model of exchange processes in O-SI-S-A systems, focusing on key reactive trace gas and aerosol species (as prioritized). 4. Developing interdisciplinary campaign planning recommendations to guide future studies and address model and measurement gaps. 5. Facilitating capacity building opportunities for sustainable multidisciplinary science at the O-SI-S-A interface.

Polar sea-salt aerosols in CMIP6 models - *online*

Rémy Lapere[1], Jennie L. Thomas[1], Louis Marelle[2]

[1]Institut des Géosciences de l'Environnement, de l'Université Grenoble Alpes, CNRS, IRD, Grenoble INP, Grenoble, France, [2]LATMOS/IPSL, Sorbonne Université, UVSQ, CNRS, Paris, France

We present an inter-comparison of simulated sea-salt aerosols (SSA) in CMIP6 models including an evaluation compared to station observations in the Artic and Antarctic regions. Historical and future trends are also explored and connected to their driving mechanisms. Comparisons suggest (i) a large inter-model spread in SSA surface concentrations and optical depth, (ii) an overestimation of SSA surface concentrations compared to measurements, and (iii) difficulties in properly capturing the annual cycle of SSA at both poles. A generally increasing trend in SSA concentrations is found in CMIP6 over the last decades. For future scenarios, models show different trends amongst them and between poles for the period 2015-2100. The rationale for these large differences is investigated, possible consequences for the reliability of CMIP6 polar climate are discussed, and the sensitivity of the radiative budget to SSA in CMIP6 is assessed.

Strengthening Partnerships between OASIS and the Global South

Co-conveners: Christa Marandino, Germany; Meghan Cronin, USA; Warren Joubert, South Africa; Seb Swart, Sweden

Observing Air-Sea Interactions Strategy (OASIS) works over many channels to build a sustainable air-sea observations network, complete with FAIR data and products. Observations of air-sea interactions are used to forecast floods, droughts, marine heatwaves, severe storms, and climate variability, as well as to monitor ocean CO2 absorption and resulting impacts on marine ecosystems. This network will revolutionize our ability to interrogate impacts from multiple stressors on ecosystems and build state-of-the-art ecological forecasts. However, we must work together to achieve these goals. Our "Theory of Change" turns the challenge of measuring multiple co-located parameters into a transformative opportunity to co-design a fit-for-purpose observing system. Multifunctional platforms are not only more economical than multiple single-function platforms, they also encourage collaborations across expertise. By developing best practices and technical readiness procedures, and a culture of mentorship and partnership, the capacity of the observing system could be significantly expanded while providing opportunities for Early Career Ocean Professionals and scientists from the Global South, as well as to engage industry partners.

Differences and commonalities in air-ice-ocean processes in the Antarctic and Arctic

Co-conveners: Nadja Steiner, Canada; Jessie Creamean, USA; Jennie Thomas, France; Lisa Miller, Canada

Polar regions are experiencing rapid climatic changes, causing the coupled physical and chemical ocean-sea ice-snow-atmosphere system to transition to an unprecedented and uncertain regime. Sea ice and snow are key features at the ocean-atmosphere interface. This interface controls chemical, physical, and biological drivers of atmospheric gases and aerosols, and resulting cloud properties, which impact the surface energy balance, sea ice melt and freeze-up processes, and atmospheric deposition to sea ice environments. Many processes, conditions, and drivers are different for Arctic versus Antarctic icescapes (e.g., freeze/melt processes, snow accumulation, atmospheric composition), leading to differences in ice and snow microstructure and biogeochemistry, which in turn impact exchange processes between the ocean and atmosphere. However, such processes can be poorly represented in models. To improve numerical model parameterizations and reproduce observed changes at both poles, including climate and Earth System Models (ESMs), we need to understand how these differences impact the earth system.

Poster session online

Tuesday, 27 Sep , 4.20-7 pm, online in gather.town

All attendees (also the on-site ones) are invited to attend the online poster session!
Online poster sessions during the conference will be held via the platform *gather.town*. ALL poster presenters (on-site and online), are required to upload and present their posters in gather.town. Note that all posters will be visible in gather.town during the whole day of the online poster session. For login information see page 11.

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Poster session online

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Poster session online

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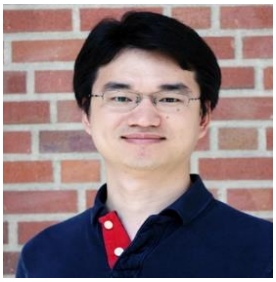
Daily overview - Wednesday

Time	Wednesday, 28 Sep
08:30	**Theme 4: Interconnections between marine ecosystems, aerosols, and clouds** Introduction by sessions chairs: **M. Kanakidou** and **J. Ovadnevaite**
08:40	**B. Wang (China):** Micro-spectroscopic characterization and ice formation potential of marine related aerosol particles - *online*
09:10	**K. Fossum (Ireland):** Marine aerosol-cloud interactions and investigations into typical degrees of air pollution over the Southern Ocean - *on-site*
09:30	**M. Mallet (Australia):** Contrasting aerosol, cloud, precipitation, and radiation interactions at low and high Southern Ocean latitudes - *online*
09:50	**K. Sellegri (France):** Sea2Cloud: from biogenic emission fluxes to cloud properties in the South West Pacific - *on-site*
10:10	Coffee and tea break
10:40	**Indian Ocean / Upwelling** Introduction by session chairs: **A. Mahajan** and **A. Singh** / **M. Cornejo** and **A. Körtzinger**
11:00	**Z. Lachkar (UAE):** Air-sea interaction and physical-biogeochemical coupling in the Indian Ocean: examples of recent advances and gaps in understanding - *on-site*
11:30	**P. Panda (India):** Atmospheric Dry deposition of Mineral Dust and associated nutrient supply and their solubility over the Indian Ocean during Vernal Summer months - *online*
11:50	**M. Ragoasha (South Africa):** Eastern Boundary Upwelling Systems in a warming world: inconsistence trends - *on-site*
12:10	**R. Oliveira (Brazil):** The tropical and subtropical South Atlantic Ocean biogeochemistry responses for the IPCC AR5 future scenarios using EcoGEnIE 1.0 - *on-site*
12:30	Lunch
13:30	**Discussion sessions:** **Crosswinds in Safe Landing Climates** - *Lisa Miller, Canada; Neil Harris, UK; Erik van Doorn, Germany*
14:50	Coffee and tea break
15:00	**SOLAS science and global ship emissions – common challenges and next steps** *- Christa Marandino, Germany; Tom Bell, UK; Anna Rutgersson, Sweden; Zongbo Shi, UK*
16:20	Coffee break (during poster session)
16:30 – 17:50	**Open Science and Publishing- Community Needs and Challenges** *- Jamie Males & Emma Archer, PLOS Climate, UK*
18:00 – 19:00	**Virtual networking event on gather.town**
19:30	**Conference banquet**

Plenary session
Theme 4: Interconnections between marine ecosystems, aerosols, and clouds

Session chairs: M. Kanakidou and J. Ovadnevaite
Keynote speaker: Bingbing Wang



Bingbing Wang received his Ph.D. degree in Marine and Atmospheric Sciences at Stony Brook University, USA. He is interested in atmospheric aerosol and their environmental and climatic impacts. His research focuses on lab simulation and field observation for the characterization, multiphase chemistry, and phase transitions of atmospheric particles from different sources and environments. Recently, his group is working on the physicochemical characteristics of marine related aerosol particles based on single particle analysis and their abilities to serve as ice nuclei and potential parameterizations for cloud modeling.

Affiliation: Xiamen University | Xiamen | China

Micro-spectroscopic characterization and ice formation potential of marine related aerosol particles - *online*

Aerosol particles can serve as cloud condensation nuclei and ice nuclei to form clouds and impact on the Earth's energy budget and thus on climate. The ability of marine aerosol particles to form clouds are related to their physicochemical properties, which are affected not only by marine emissions but also by atmospheric aging processes. Here we present micro-spectroscopic characterization of the field collected and laboratory generated marine related particles. Their abilities to form ice crystals were determined at typical conditions for cirrus cloud formation. Single particle techniques were applied to hundreds of individual particles to obtain information on the particle composition and mixing state. Ice nucleating particles were identified and characterized for comparison to particle population. Potential parameterization of the experimentally determined ice nucleation data will also be discussed for cloud modeling.

Marine aerosol-cloud interactions and investigations into typical degrees of air pollution over the Southern Ocean - *on-site*

Kirsten Fossum[1], Jurgita Ovadnevaite[1], Darius Ceburnis[1], Jana Preissler[1,6], Dantong Liu[2], Michael Flynn[3], Jefferson Snider[7], Ru-Jin Huang[1,5], Andreas Zuend[4], Colin O'Dowd[1]

[1]University of Galway, Galway, Ireland, [2]Zhejiang University, Hangzhou, China, [3]University of Manchester, Manchester, UK, [4]McGill University, Montreal, Canada, [5]Chinese Academy of Sciences, China, [6]Leosphere, Vaisala, , France, [7]University of Wyoming, Laramie, USA

Marine aerosol affects global climate significantly by forming haze and cloud layers over dark ocean surfaces, enhancing albedo. While sulfate typically dominates the submicron cloud condensation nuclei (CCN) over remote oceans, it is unclear how important this abundance is over sea-spray CCN activation efficiency in marine cloud formation. Aerosol measurements from the PEGASO cruise (2015) were used to investigate marine aerosol physico-chemistry. Refractory black carbon measurements were used to create a statistical method to assess the degrees of pollution in Southern Ocean air and separate out polluted measurements. An extensive study of the CCN in the clean air masses in the Southern Ocean showed a systematic inverse relationship between sea-salt cloud nuclei and boundary layer cloud peak superstation, despite the abundance of sea-salt CCN being 10 times lower than sulfate CCN. This sea-salt effect can theoretically alter the albedo of marine boundary layer clouds by as much as 30%.

Contrasting aerosol, cloud, precipitation, and radiation interactions at low and high Southern Ocean latitudes - *online*

Marc Mallet[1], Branka Miljevic[2], Ruhi Humphries[3,1], Simon Alexander[4,1], Alain Protat[5,1], Gerald Mace[6]

[1]Australian Antarctic Program Partnership, Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia, [2]School of Earth and Atmospheric Sciences, Queensland University of Technology, Brisbane, Australia, [3]Climate Science Centre, Oceans and Atmosphere, CSIRO, Melbourne, Australia, [4]Australian Antarctic Division, Kingston, Australia, [5]Bureau of Meteorology, Melbourne, Australia, [6]University of Utah, Salt Lake City, United States of America

Most climate models exhibit biases in the amount of surface shortwave radiation in the Southern Ocean. The biological and physical sources of aerosol and their influence on clouds, precipitation, and radiation around the Southern Ocean is a key component of this problem. This issue has motivated a number of recent and upcoming field campaigns in the Southern Ocean. Here we present findings from the summertime CAPRICORN-2018 study that took place in the western Pacific sector of the Southern Ocean. We explore the relationship between biogenic aerosol properties, cloud condensation nuclei, and cloud droplet number concentrations, and show how this relationship varies at lower and higher latitudes. The abundance of supercooled liquid water clouds and relative lack of precipitation at higher latitudes, possibly due to lower concentrations of ice-nucleating aerosol particles, has possible implications for boundary layer aerosol size distributions and cloud condensation nuclei concentrations.

Sea2Cloud: from biogenic emission fluxes to cloud properties in the South West Pacific - *on-site*

Karine Sellegri[1], *Cliff Law[2], Mike Harvey[2], Maija Peltola[1], Theresa Barthelmess[3], Manon Rocco[1], Erin Dunne[4], Alexia Saint-Macary[2], Guillaume Chamba[1], Clémence Rose[1], Evelyn Freney[1], Clément Bazantay[1], Olivier Jourdan[1]*

[1]Lamp-cnrs, Clermont-Ferrand, France, [2]NIWA, Wellington, New-Zealand, [3]GEOMAR, Kiel, Germany, [4]CSIRO, Melbourn, Australia

The goal of the Sea2Cloud project is to study the interplay between surface ocean biogeochemical and physical properties, fluxes to the atmosphere and ultimately their impact on cloud formation under minimal direct anthropogenic influence. Here we present an interdisciplinary approach, combining atmospheric physics and chemistry with marine biogeochemistry, during a voyage between 41 and 47°S in March 2020. In parallel to ambient measurements of atmospheric composition and seawater biogeochemical properties, we describe semi-controlled experiments to characterize nascent sea spray properties and nucleation from gas-phase biogenic emissions. The experimental framework for studying the impact of the predicted evolution of ozone concentration in the Southern Hemisphere is also detailed. After describing the experimental strategy, we will present a short overview of first results, comparison to measurements performed at the Baring Head Research station, NZ and potential extend to the regional scale using satellite data and modelling tools.

Plenary session
Integrated topic: Indian Ocean

Introduction by session chairs: A. Mahajan and A. Singh
Keynote speaker: Zouhair Lachkar

Zouhair Lachkar is a senior scientist at New York University Abu Dhabi, United Arab Emirates, since 2014. He received his Ph.D. from University Pierre and Marie Curie, France, and worked as a research scientist at the Swiss Federal Institute of Technology of Zurich, ETH Zurich, Switzerland, between 2007 and 2014. His research interests are in the areas of climate and marine biogeochemistry. In particular, he has been investigating the marine oxygen and carbon cycles in major upwelling syst tems and their sensitivity to climate perturbations using a hierarchy of numerical models applied to various regions of the World Ocean, with a recent focus on the Arabian Sea and the Indian Ocean at large.

Affiliation: Arabian Center for Climate and Environmental Sciences (ACCESS) | New York University Abu Dhabi |Abu Dhabi | United Arab Emirates

Air-sea interaction and physical-biogeochemical coupling in the Indian Ocean: examples of recent advances and gaps in understanding - *on-site*

Uniquely influenced by ocean-atmospheric coupling through seasonally reversing monsoon winds, the Indian Ocean also impacts the earth's climate through varying physical and biogeochemical processes operating on multiple timescales. On the timescale of the climate change perturbation, the Indian Ocean plays an important role in taking up anthropogenic CO2 from the atmosphere and modulating the global natural carbon and nitrogen cycles. For instance, hosting the world's thickest oxygen minimum zone (OMZ), the Arabian Sea in the northern Indian Ocean is a hotspot of biogeochemical transformations and a major denitrification area, where bio-available nitrogen is depleted and nitrous oxide, a potent greenhouse gas, is produced. While our understanding of the dynamics of the Indian Ocean biogeochemistry and air-sea exchanges has recently advanced through coordinated international efforts, the Indian Ocean remains one of the most poorly sampled ocean regions with respect to inorganic carbon, oxygen and nutrients. Here, I will briefly overview some recent advances in our understanding of the Indian Ocean biogeochemistry and will illustrate with examples from the northern Indian Ocean (i.e., Arabian Sea and Bay of Bengal) the importance of air-sea interactions for regional biogeochemistry as well as describe how recent changes in atmospheric conditions (warming and wind variability) are altering local environments, in particular through changes in dissolved O2, and how this in return may impact regional and global climate on longer timescales.

Atmospheric Dry deposition of Mineral Dust and associated nutrient supply and their solubility over the Indian Ocean during Vernal Summer months – *online*

Prema Piyusha Panda[1,2], Ashwini Kumar[1]

[1]CSIR-National Institute of Oceanography, Doan Paula, India, [2]The School of Earth, Ocean and Atmospheric Sciences, Goa University, Goa, India, Taleigao Plateau, India

The importance of aerosol as a source of nutrients and its role in altering surface marine-biogeochemistry is well known. Mineral dust and nutrients (N-species, Fe, Mn, Cu) were measured in aerosols collected during two cruises along meridional transit over the Indian ocean (IO) starting from Indian coast up to 13°S latitude. Our result shows relatively higher dust concentration over the North Indian Ocean in contrast to its southern counterpart with a decreasing trend towards south. Almost similar trend is displayed by all nutrients during the two campaign. Organic-nitrogen account for ~76% of total-nitrogen over IO. Large variability is seen in fractional Fe solubility (0.04-3.9%) with partial influence from anthropogenic emission. However, higher solubility of Mn (1.2-64%) and Cu (4-92%) along with higher enrichment factor signifies a mix origin of these elements over IO. The average deposition flux (in nmol.m-2.d-1) of Fe, Mn and Cu was 4965±5148, 1476±3447 and 1.0±1.7 respectively.

Plenary session
Integrated topic: Upwelling

Introduction by session chairs: M. Cornejo and A. Körtzinger
Keynote speaker: Moagabo Ragoasha

Moagabo Ragoasha holds a co-badged PhD in physical oceanography between the University of Cape Town (UCT), South Africa, and The University of Western Brittany, France (Université de Bretagne Occidentale, UBO). After her PhD, she did one year of postdoctoral research at UCT and the South African Environmental Observation Network (SAEON) Egagasini Node before being appointed lecturer in the Department of Oceanography. She has been recognized by the 2020 Mail & Guardian as a Top 200 Young South African in the Science and Technology category. She is currently a New Generation of Academics Programme (nGAP) lecturer at the Department of Oceanography with research interests including ocean and atmospheric modelling of the South African EEZ, the physical connectivity between Agulhas and the Benguela system, and the anthropogenic influences on the coastal environment.

Affiliation: University of Cape | Town Cape Town | South Africa

Air-sea interaction and physical-biogeochemical coupling in the Indian Ocean: examples of recent advances and gaps in understanding - *on-site*

Uniquely influenced by ocean-atmospheric coupling through seasonally reversing monsoon winds, the Indian Ocean also impacts the earth's climate through varying physical and biogeochemical processes operating on multiple timescales. On the timescale of the climate change perturbation, the Indian Ocean plays an important role in taking up anthropogenic CO2 from the atmosphere and modulating the global natural carbon and nitrogen cycles. For instance, hosting the world's thickest oxygen minimum zone (OMZ), the Arabian Sea in the northern Indian Ocean is a hotspot of biogeochemical transformations and a major denitrification area, where bio-available nitrogen is depleted and nitrous oxide, a potent greenhouse gas, is produced. While our understanding of the dynamics of the Indian Ocean biogeochemistry and air-sea exchanges has recently advanced through coordinated international efforts, the Indian Ocean remains one of the most poorly sampled ocean regions with respect to inorganic carbon, oxygen and nutrients. Here, I will briefly overview some recent advances in our understanding of the Indian Ocean biogeochemistry and will illustrate with examples from the northern Indian Ocean (i.e., Arabian Sea and Bay of Bengal) the importance of air-sea interactions for regional biogeochemistry as well as describe how recent changes in atmospheric conditions (warming and wind variability) are altering local environments, in particular through changes in dissolved O2, and how this in return may impact regional and global climate on longer timescales.

The tropical and subtropical South Atlantic Ocean biogeochemistry responses for the IPCC AR5 future scenarios using EcoGEnIE 1.0 - *on-site*

Raquel Oliveira[1], Malin Ödalen[2], Jamie Wilson[3], Francisco Virissimo[4], Helen Affe[1], Leticia Cunha[1]

[1]Rio de Janeiro State University, Rio de Janeiro, Brazil, [2]GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany, [3]University of Bristol, Bristol, England, [4]National Oceanography Centre, Southampton, England

The South Atlantic Ocean receives the discharge from some of the largest world rivers and its eastern margin holds important upwelling systems (Mauritania and Benguela). These systems directly affect the regional biogeochemical and planktonic community, largely responsible for the regional carbon cycle, which also has an impact on the climate. The goal of this study is to assess the plankton groups by their different size classes (pico, nano and micro), and their relation to the sea surface temperature, surface nutrients, chlorophyll concentration, and other biogeochemistry parameters, under the IPCC's scenarios RCP4.5 and RCP8.5, and in a scenario without additional anthropogenic carbon, between 2095-2100, using the global model EcoGEnIE 1.0, a trait-based plankton ecosystem model coupled with an Earth System Model of Intermediate Complexity. The novel results of this work will contribute to the understanding of its biogeochemical cycles according to future scenarios.

Crosswinds in Safe Landing Climates

Co-conveners: Lisa Miller, Canada; Neil Harris, UK; Erik van Doorn, Germany

The World Climate Research Programme (WCRP) has launched a lighthouse activity on Safe Landing Climates to explore routes to "safe landings" for future human and natural systems. The Safe Landing Pathways working group is formulating a climate gaming exercise to synthesize the feedbacks, trade-offs, and co-benefits in climate change mitigation and adaptation and is gathering insights from different sectors of the climate change research community to inform the development of this research and teaching tool. The first phase has involved compiling information about existing work using gaming for climate problems. The second phase is gathering expert input on aspects of the Earth/climate system to be considered in upcoming exercises.

In this discussion session, the WCRP wants to hear the SOLAS community's hopes and fears about ocean-atmosphere interactions in the coming decades, as we try to navigate towards a safe global climate.

SOLAS science and global ship emissions – common challenges and next steps

Co-conveners: Christa Marandino, Germany; Tom Bell, UK; Anna Rutgersson, Sweden; Zongbo Shi, UK

Shipping is the most widely used medium for transport of goods internationally and, although it is a carbon-efficient transport medium, there is an increasing focus on its broader environmental consequences. Ship exhausts are a significant source of sulfur, nitrogen, and other gaseous pollutants, as well as sulfur(S)-containing aerosols, to the marine atmosphere and to the ocean. Global modelling suggests ship emissions cause a negative radiative forcing by forming sulfate aerosols and by modifying cloud properties. The range of SOLAS endorsed ship emissions projects seek to investigate the role of these emissions on atmospheric and oceanic processes. Because this topic has both economic and legal aspects, the proponents seek to engage a range of stakeholders (e.g., shipping companies, ports, policy-makers), with mixed success. Lessons learned within the community could help other researchers facing the same challenges. In addition, there appears to be significant interest within the SOLAS community on this topic and we could benefit from an open discussion on results to-date and future perspectives.

Open Science and Publishing - Community Needs and Challenges

Co-conveners: Jamie Males & Emma Archer, PLOS Climate, UK

Whilst there is increasing recognition of the value of Open Science, more widespread funder mandates and more stringent community expectations, there remain challenges and constraints around the adoption of Open Science practices. We propose to hold a dialogue with the purpose of identifying these barriers as they pertain to the SOLAS community, with a particular focus on transparency and data/code sharing as part of peer-reviewed publication. We will discuss whether there are actions that researchers, publishers and other stakeholders in the research ecosystem should take to facilitate wider and more meaningful engagement with Open Science, and whether new approaches are needed to maximise the accessibility and relevance of research outputs to key decision-makers.

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Time	Thursday, 29 Sep
08:30	**Theme 5: Ocean biogeochemical control on atmospheric chemistry** Introduction by session chairs: **M. Kanakidou** and **T. Latif**
08:40	**M. Galí (Spain)**: From weather to climate scales in ocean biogeochemistry-atmospheric chemistry studies: mind the gaps - *on-site*
09:10	**M. Peltola (Finland)**: Marine aerosol formation and its chemical precursor species in coastal New Zealand - *on-site*
09:30	**S. Pongpiachan (Thailand)**: Applying synchrotron radiation-based attenuated total reflection-fourier transform infrared to evaluate the effects of shipping emissions on fluctuations of PM10-bound organic functional groups - *on-site*
09:50	**L. Zhou (Germany)**: Winter season Southern Ocean distributions of climate-relevant trace gases - *on-site*
10:10	Coffee and tea break
10:40	**Climate Intervention / Science and Society** Introduction by session chairs: **E. van Doorn** and **A. Lenton**
11:00	**N. Mengis (Germany):** Carbon Dioxide Removal measures - Feasibility, uncertainties, and their contribution to net-zero - *online*
11:30	**P. Monteiro (South Africa):** Building a national integrated observational and modelling capability to support the assessment of ocean CDR in South Africa for robust policy development - *on-site*
11:50	**E. Mahu (Ghana):** Putting Science to Action - *online*
12:10	H**. Liu (China):** Global shipping emission inventories with high spatial and temporal resolution - *online*
12:30	**J. Dinasquet (USA):** Sea-air transfer and dispersal of harmful sea spray aerosols - *on-site*
12:50	**Conference closing**

Plenary session
Theme 5: Ocean biogeochemical control on atmospheric chemistry

Introduction by session chairs: M. Kanakidou and T. Latif
Keynote speaker: Martí Galí

Martí Galí is an environmental scientist interested in the interaction between marine plankton and climate, which he studies by means of experimental and sea-going studies, analysis of Earth observation data and models. Over the last 15 years, most of his research has revolved around the biogeochemical cycling of dimethylsulfide (DMS) and related compounds in the upper ocean. He also developed remote sensing algorithms for the estimation of marine DMS emission, which prompted frequent collaboration with atmospheric chemists. Other research areas he is interested in are the biogeochemistry of polar environments and the biological carbon pump. Bio-optics, light-driven processes, microbial ecology and biogeochemical budgets are cross-cutting themes in his research.

Affiliation: Institut de Ciències del Mar (ICM, CSIC) |Barcelona | Spain

From weather to climate scales in ocean biogeochemistry-atmospheric chemistry studies: mind the gaps - *on-site*

It is commonplace to state that ocean biogeochemistry (OBGC) and atmospheric chemistry (AC) interact across a wide range of spatiotemporal scales. However, some scales are better studied than others. In this talk, I argue that, mainly because of historical logistic constraints, scales where relevant variability and interactions reside remain underexplored. In particular, I make the case for studying in greater depth how the weather timescale, where synoptic events take place, successively shapes intraseasonal and interannual variability. Understanding and predicting OBGC-AC interactions at these scales has become a pressing need because climate change is altering the frequency and magnitude of extreme events and shifting the mean seasonal cycles. In some regions, these perturbations are pushing the coupled ocean-atmosphere system beyond critical thresholds. Ongoing advances in Earth observation from remote and in situ autonomous platforms, numerical modeling and data science are making the understudied scales accessible at unprecedented resolution. In this talk, I will explore these ideas and illustrate them with examples drawn from both the literature and my own research, centred mostly on upper-ocean dimethylsulfide cycling and its impact on aerosols in polar regions. Finally, I will propose some pathways for advancing this research program, which will benefit from incorporating concepts and approaches developed in neighbouring research fields (e.g. weather/climate prediction, ecology) and from intensifying the collaboration between the ocean and atmosphere communities.

Marine aerosol formation and its chemical precursor species in coastal New Zealand - *on-site*

Maija Peltola[1,2], Clémence Rose[2], Jonathan Trueblood[2], Sally Gray[3], Mike Harvey[3], Karine Sellegri[2]

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Despite the importance of oceans in regulating global climate, marine aerosol measurements are scarce. To better constrain climate models, more information is needed to understand the role and sources of secondary marine aerosols.
We measured the aerosol size distribution and chemical composition of ambient ions at the Baring Head station in coastal New Zealand over several months. The station regularly receives air masses arriving from the Southern Ocean and passing over the biologically active Chatham Rise area before arriving at the station. We used the data to study secondary aerosol formation and its chemical precursor species in clean marine air.
We observed sub-10 nm particles and growth of nucleation mode particles frequently in the marine boundary layer. These particles were likely formed from sulfur and iodine species. Studying the seasonal variations and geographical source regions of different chemical compounds abled connecting different chemical compounds to marine biogeochemical sources.

Applying Synchrotron Radiation-based Attenuated Total Reflection-Fourier Transform Infrared to Evaluate the Effects of Shipping Emissions on Fluctuations of PM10-Bound Organic Functional Groups - *on-site*

Siwatt Pongpiachan[1], Kanjana Thumanu, Chulalak Chantharakhon, Chunmanus Phoomalee, Chaisri Tharasawatpipat, Ronbanchob Apiratikul, Saran Poshyachinda

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The intense light of synchrotron radiation, with the assistance of infrared spectroscopy, allows for the measurement of extremely low levels of organic functional groups. In this study, PM10 samples (n = 84) were collected at three air quality observatory sites strategically situated on the periphery of the seaport, residential zone, and industrial area of Laem Chabang, Thailand from May 27 to June 23, 2020. Aliphatic carbons, carbonyl species, organo-nitrates, aromatic nitro compounds, ammonium ions, carbonate, nitrate ions, sulfate species, and calcium carbonate were successfully characterised in all PM10 samples. Sulfate and aliphatic carbons were the two dominant chemical species detected at all monitoring sites. While aliphatic carbons, organo-nitrates, and aromatic nitro compounds were closely related to shipping activities, sea salt aerosols and fertiliser dust can be considered as two potential sources of sulfate and ammonium, respectively.

Winter season Southern Ocean distributions of climate-relevant trace gases - *on-site*

Li Zhou[1], Dennis Booge[1], Miming Zhang[2], Christa Marandino[1]

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Climate-relevant trace gas fluxes exert an important control on air quality and climate, especially in remote regions of the planet such as the Southern Ocean. However, almost all of the measurements there are skewed to summer months. It is essential to expand our measurement database over greater temporal and spatial scales. Therefore, we report measured concentrations of dimethylsulphide (DMS, and related sulphur compounds) and isoprene in the Atlantic sector of the Southern Ocean during winter to understand the spatial and temporal distribution in comparison to current knowledge and climatological calculations for the Southern Ocean. The observations of isoprene are the first in the winter season in the Southern Ocean. We find that concentrations and fluxes of DMS and isoprene in the investigated area are generally lower than those presented or calculated in currently used climatologies and models. More data is needed to better interpolate climatological values and validate process-oriented models.

Plenary session
Climate Intervention

Introduction by session chairs: : E. van Doorn and A. Lenton
Keynote speaker: Nadine Mengis

Nadine Mengis is an Emmy Noether Independent Junior Research Group Leader at GEOMAR Helmholtz Centre for Ocean research Kiel since October 2021. Her project 'FOOTPRINTS - From carbon removal to achieving the Paris Agreement's goal: temperature stabilisation' aims to investigate the Earth systems response to net-zero CO2 pathways. Nadine is trained in climate physics and holds a PhD in Earth system modelling. She worked on the impact of non-CO2 climate forcing agents on the remaining carbon budget, and the assessment of national net-zero solution with a focus on carbon dioxide removal and carbon accounting. Since 2021, Nadine is a member of GESAMP WG41, where she contributes to the development of a comprehensive assessment framework for marine climate interventions.

Affiliation: GEOMAR - Helmholtz Centre for Ocean Research Kiel | Kiel | Germany

Carbon Dioxide Removal measures - Feasibility, uncertainties, and their contribution to net-zero - *online*

"In order to achieve the long-term temperature goal set out in Article 2 [of the Paris Agreement (PA)], Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, […] and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, […]." (Article 4, Paris Agreement, UNFCCC).
Based on this statement carbon dioxide removal (CDR) are considered a key element to achieve the PA long-term temperature goal. However, considering the scale at which CDR deployment is envisioned in ambitious mitigation pathways, significant environmental, social, ethical and institutional implications are to be expected and need to be included in their assessments. The implementation, and accordingly the potential of CDR measures, furthermore, depends on site specific conditions, such as biophysical conditions, availability of infrastructure, social acceptance, regulatory frameworks and policy instruments in place.
In this talk, I will present an overview of CDR options currently being considered in the debate, their possible contribution to net-zero on the example of Germany. I will continue by discussing challenges concerning their feasibility, monitoring and evaluation on the example of ecosystem-based marine CDR options. Finally, it has been shown that reductions in energy and or food demand could reduce the need for CDR. And while there is some reluctance to discuss such societal changes, I will argue that policy measures enabling societal changes are not necessarily ethically problematic. Moreover, doing so can be beneficial in ways other than reducing emissions.

Building a national integrated observational and modelling capability to support the assessment of ocean CDR in South Africa for robust policy development *- on-site*

Sandy Thomalla[1], **Pedro Monteiro[1]**, Precious Mongwe[1], Siya Hamnca[1], Sarah Nicholson[1], Nicolette Chang[1], Mutshushu Tsanwani[3], Warren Joubert[4]

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The ocean is likely to play a central role towards achieving negative emissions through Carbon Dioxide Removal (CDR). However we need to understand the complex feedback-mitigation interactions in order to assess and execute effective mitigation scenarios. The Southern Ocean Carbon-Climate Observatory (SOCCO) recognises a major gap in our current national capability to adequately address the science and policy needs around proposed CDR interventions. SOCCO will start to address this gap by 1) putting in place a high confidence baseline through national coastal CO_2 observations and machine learning products that resolve the seasonal cycle and build on the observational synergies of national partners, namely DFFE (ships), SAEON (coastal moorings) and SOCCO (gliders), and 2) Conduct well considered forced ocean high resolution (1-10 km) modelling experiments, co-designed with the national policy entities, to evaluate sensitivities of the regional ocean carbon system to proposed CDR technologies. Here we present these capabilities and ambitions.

Plenary session
Science and Society

Introduction by session chairs: : E. van Doorn and A. Lenton
Keynote speaker: Edem Mahu

Edem Mahu is a Marine Biogeochemist and climate scientist at the Department of Marine and Fisheries Sciences of the University of Ghana. Her research interests span Paleoclimatic and environmental reconstructions of marine ecosystems, Marine Pollution (nutrients, microplastics, heavy metals and their fate in the marine environment), understanding redox processes in coastal ecosystems and nature-based solutions. She has received research supports from the IFS, UNESCO-OWSD, The Royal Society, the Meer Wissen Initiative among others. She is a member of the Board of Trustees for the Partnership for Observation of the Global Ocean (POGO), a steering committee member of CoastPredict, a co-lead of both EQUISEA and the Global Ocean Corps and Conveyor. She a member of the American Geophysical Union among other networks.

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Putting Science to Action - *online*

Science has contributed significantly to our understanding of societal evolution. The need for impactful science has been amplified in the 21st century, when the world is confronted with complex socio-environmental challenges that call for urgent lasting solutions. Yet, several scientific research findings remain unused in decision-making to inform societal well-being. To ensure that research findings benefit society, scientists must strengthen their connections with the public. The talk will explore ways by which science can effectively contribute to addressing immediate and unforeseen societal challenges. Key thoughts for deliberation would include how to do science to impact society, success stories and approaches, going beyond the linear scientific method to make impact, output-oriented and outcome-oriented science, deep science, steps to make science impactful, actors in the science and society arena, communicating science effectively to yield results. The talk would improve our understanding on science that connects with society and set the tone for dialoguing further in the field.

Global shipping emission inventories with high spatial and temporal resolution - *online*

Huan Liu[1], Xiaotong Wang[1], Wen Yi[1]

[1]*Tsinghua University, China* [2]*State Environmental Protection Key Laboratory of Sources and Control of Air Pollution Complex, Beijing, China*

The AIS-based shipping emission inventory has greatly improved the spatiotemporal resolution and provided several new findings of the emission characteristics. Recently, we updated our shipping emission model (SEIM) through data updating and algorithm improvement. We found that although containers accounted for the 31% of global shipping CO2 emissions in 2016, the major contributor differs among oceans. The contributions of containers exceeded 40% in waters off the Chinese coast, ro-ro ships account for notably high proportions in many European waters, and the bulk carriers contributed the most in the southern hemisphere. The global shipping CO2 emissions continued to increase from 2016 to 2018, but they decreased by 3.9% in 2019 possibly due to the freight decrease caused by the tense situation of international trade. On a daily scale, the fleet iteration can be clearly observed in the emission composition, e.g., the proportion of LNG ships and newly-built ships are both increasing.

Sea-air transfer and dispersal of harmful sea spray aerosols - *on-site*

Julie Dinasquet[1], Eva Ternon

[1]*Scripps Institution of Oceanography, USA*

Hippocrates wrote (460–370 B.C.) “Taken as baths seawater is good for skin itching and prickning; it is also good under the form of vapours”. But sea sprays, generally considered therapeutic, can also be harmful to coastal ecosystems and populations. Current anthropogenic activities are changing the natural balance of ocean-atmosphere interactions not only affecting aquatic biogeochemistry and climate feedback, but also increasing the risk of toxic aerosols emission. Combining state-of-the-art ocean-atmosphere simulators and in situ measurements of ambient coastal aerosols, we show compelling mechanistic evidence of effective sea-to-air transfer and aerial dispersal of opportunistic marine pathogens and phytoplanktonic toxins. These results highlight the importance to further study how exposure to harmful sea spray aerosol will change and increase in the future, in order to better predict societal (e g. food security and public health) and economic outcomes.

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