Integrating Climate and Ecosystem Dynamics in the Southern Ocean

Marine Ecosystem Assessment for the Southern Ocean

Workshop to finalise conclusions of first assessment (United Kingdom)
3-7 June, 2019

Announcement

MEASO is an activity of the IMBeR-SCAR program Integrating Climate and Ecosystem Dynamics in the Southern Ocean.

Overall Aim

The primary aim of the Marine Ecosystem Assessment for the Southern Ocean (MEASO) is to assess the risks to Southern Ocean marine ecosystems from climate change and related change processes, such as ocean acidification.

A MEASO is intended to provide the scientific synthesis needed for use by policy makers in managing the effects of climate change on Antarctic and Southern Ocean ecosystems. Figure 1 illustrates the MEASO process for developing a synthesis over a number of years and its regular uptake into management forums.

The first assessment is envisaged to

i) identify sources of data,
ii) establish methods for collation, synthesis and estimation of current and prospective change,
iii) establish methods for presenting time-scales and risks of change,
iv) deliver an initial risk assessment, based on Southern Ocean sectors (Figure 2), to key management forums and policy makers,
v) provide essential experience in the process for undertaking a full assessment by the Antarctic science community, and
vi) identify future priorities for data to be obtained, methods to be developed, and questions to be addressed in the next assessment.

Final Workshop

Aim: To finalise the recommendations and presentation of the first Marine Ecosystem Assessment for the Southern Ocean (MEASO), including specific outputs for the Scientific Committee for the Conservation of Antarctic Marine Living Resources

Dates: Monday 3rd June to Friday 7th June 2019

Location: WWF-UK, Living Planet Centre, Woking, GU214LL, United Kingdom (see Attachment 1)

Hosted by WWF Antarctic program

Sponsored by
Integrating Climate and Ecosystem Dynamics in the Southern Ocean
WWF Antarctic program
Southern Ocean Observing System
Antarctic Climate and Ecosystems Cooperative Research Centre

Contact
Andrew Constable (Co-convenor, MEASO)
Australian Antarctic Division, Australia.
Email: andrew.constable@aad.gov.au. Phone: +61 409 567 579

Need

General: National and international agencies need assessments of drivers of change in ecosystems in order to sustain natural systems and to maintain the delivery of services. Change may arise directly from human activities (e.g. fisheries), indirectly from local or global activities (cascading effects through food webs from fisheries, or changing environments from climate change and/or ocean acidification), or from naturally varying processes. Assessments that can attribute change to direct and/or indirect causes as well as highlight the urgency of management responses are important for managers to be effective in achieving conservation and sustainability objectives. This is particularly a challenge for managing the effects of climate change, which take decades to manifest following atmospheric inputs.

Assessments of change in habitats, species and/or foodwebs are currently compiled for at least ten different international organisations or processes (Table 1). The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and the Antarctic Treaty Consultative Meeting (ATCM) have requirements to conserve and sustainably manage Antarctic and Southern Ocean ecosystems south of the Polar Front and 60th southern parallel respectively.

A process is needed that harmonises, as much as possible, the scientific information on status and trends in Southern Ocean ecosystems used by the different organisations and processes (Table 1), and ensures the information is available in a timely manner. Marine Ecosystem Assessment for the Southern Ocean (MEASO) aims to be this process. Figure 3 illustrates the network of relevant international science programs, each of which have elements of work that can contribute to a MEASO. Involvement of this network in MEASO will help harmonise the advice given to management forums.

An international conference on a Marine Ecosystem Assessment for the Southern Ocean (MEASO) was held in Hobart, Australia on 9-14 April 2018 (http://www.measo2018.aq/). Its major sponsors were WWF and Pew Charitable Trusts. It was agreed at the conference to undertake the first MEASO over 2018-2019 with the view to providing the outcome to the Scientific Committee for the Conservation of Antarctic Marine Living Resources in 2019.

Details of the conference and post-conference activities to produce the first MEASO were reported to the Scientific Committee on Antarctic Research (SCAR) at their open science conference in June 2018. They were also reported to the Scientific Committee for the Conservation of Antarctic Marine Living Resources (SC-CAMLR) in October 2018 (Attachment 2).

Workshop: As indicated in the timeline of work (Attachment 2), a final workshop is planned for June 2019 to review the outcomes of the syntheses and assessments, to finalise the conclusions of the assessment and, in particular, to develop suitable summaries on the risks of the marine impacts of climate change in Antarctica and the Southern Ocean for use by policy-makers and management forums.

Workshop Plan

Participation: Up to 40 scientists and relevant policy makers and NGOs from a diversity of countries interested in Antarctica and the Southern Ocean, including early career scientists, will be able to attend the workshop. If interest is greater than 40 then attendance will be by a selection process to achieve this diversity. Interested scientists, policy makers and NGOs not able to attend will be able to participate through on-line forums as well as by making contributions through on-line editing facilities.

Preparation for the workshop: Information and analyses on habitat, species and ecosystem assessments are being assembled prior to the workshop. Attachment 3 outlines the documentation being developed. A habitat assessment is underway. Species-specific assessments are being based on the development of the summaries. Some species profiles are underway. Contributions of species profiles are invited from the Southern Ocean marine science community. These will be compiled for review by participants.

To date, a manuscript has been submitted for publication summarising available data, methods and existing syntheses for contributing to MEASO. Two important reviews are being undertaken at present, one relating to Antarctic krill and the other on krill fisheries in the South Atlantic, and will be available for MEASO.

People are encouraged to provide published and submitted papers for consideration in the assessment, as well as participating in the background preparations for the workshop.

People are encouraged to submit suggestions of text for a synthesis (summary) of status and trends of habitats, species and ecosystems as well as draft conclusions.

Expressions of confidence and uncertainty in the synthesis and conclusions will follow the framework provided by the Intergovernmental Panel on Climate Change Working Group II (2014).

Sufficient materials are expected to be available for the workshop. It is also expected that the workshop and this first MEASO process will be a means of identifying how better to undertake a MEASO in the future.

Plan and program: Table 2 outlines a draft program for the workshop. Submissions will form the basis for discussion at the workshop. Refined text for conclusions will be developed in small group and plenary discussions with the aim of having a set of conclusions by the end of Tuesday. Based on the agreed conclusions, the format for a synthesis report will be considered by the end of Tuesday, allowing synthesis text to be arranged, discussed in small-group setting and, where possible, drafted by Thursday. Content and layout of infographics will be considered in small-groups from Wednesday. A program of work to conclude and publish the report by the end of August will be discussed and agreed on Friday.

Outputs

General: The main report of the first Marine Ecosystem Assessment for the Southern Ocean will be peer-reviewed and published. It will be made ready for subsequent submission for inclusion as a supplementary report to the SCAR Antarctic Climate Change and Environment report.

At least one high profile peer-reviewed publication will be developed to summarise the results for the wider scientific community

Workshop: A specific output from the workshop will be an Executive Summary for policy makers of the first MEASO. Further, explanatory Synthesis Boxes and infographics will be developed at the workshop to facilitate understanding and uptake by policy-makers.

Summary documents on the assessments of risks of climate change impacts will be developed on each of the following specific areas, for use in CCAMLR, ATCM/CEP and other management bodies:

i) fisheries, particularly the Antarctic krill fishery, and time-frames for adapting to climate change impacts,
ii) biodiversity, with an emphasis towards identifying possible climate refugia, areas important to vulnerable habitat-forming benthic species ('vulnerable marine ecosystems'),
iii) recovering species, and potential climate-related changes that may alter their trajectories for recovery, and
iv) priorities on observations, assessment methods, and synthesis assessments for use in a second MEASO.

Table 1: International forums needing assessments of status and trends in habitats, key species, and/or food webs in the Southern Ocean.

- Antarctic Treaty (AT): Protocol on Environmental Protection (AT-PEP), involving a Consultative Meeting (ATCM) and the Committee on Environmental Protection (CEP) (https://www.ats.aq/index_e.htm)
- Convention on the Conservation of Antarctic Marine Living Resources (CAMLR Convention), involving a Commission (CCAMLR) and its Scientific Committee (SC-CAMLR), see fishery reports (https://www.ccamlr.org/en/publications/fishery-reports);
- International Convention for the Regulation of Whaling (ICRW), involving its International Whaling Commission (IWC), which established a scientific committee (SC-IWC), see whale status and abundance reports (https://iwc.int/status ; https://iwc.int/estimate);
- Agreement on the Conservation of Albatross and Petrels (Convention on the Conservation of Migratory Species of Wild Animals) (ACAP), involving a Meeting of Parties (ACAP MOP) with scientific advice from working groups, see status reports (https://acap.aq/en/acap-species).
- UN Convention on Biological Diversity (CBD), involving a Conference of Parties (COP)(https://www.cbd.int/);
- UN Framework Convention on Climate Change (UNFCCC), involving a Conference of Parties with advice from its Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) and Subsidiary Body on Implementation (SBI) (http://unfccc.int/2860.php);
- Intergovernmental Panel on Climate Change (IPCC), which is an independent scientific body established in 1988 (four years prior to the UNFCC) and provides advice on scientific, technical and socio-economic impacts related to climate change to governments and to the UNFCCC through the SBSTTA (http://www.ipcc.ch/organization/organization_history.shtml);
- Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), which is an independent scientific body but tasked by the CBD to prepare the next global assessment on biodiversity and ecosystem services, to be launched in 2018 (https://www.cbd.int/sbstta/ipbes.shtml)
- United Nations General Assembly and its Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects (http://www.worldoceanassessment.org/)
- IUCN Red List of Threatened Species (http://www.iucnredlist.org/)((https://www.iucn.org/resources/conservation-tools/iucn-red-list-threatened-species)) and List of Threatened Ecosystems (https://www.iucn.org/theme/ecosystem-management/our-work/red-list-ecosystems)

Table 2: For discussion, indicative program for the workshop, subject to preparatory work and consideration by the scientific community.

Day	**Time**	**Plenary**	**Small Groups** **(Habitats, Species, Ecosystems, Future States)**
Prior to workshop		Submissions will form the basis for discussion at the workshop. Collated in the Southern Ocean Knowledge and Information (SOKI) wiki (http://soki.aq/display/MEASO)	
Monday	0900-0930	Welcome & Introduction	
	0930-1230	Presentations summarising progress and syntheses in advance of the workshop	
	1400-1530		Develop conclusions (and text) with the aim of having a set of conclusions by the end of Tuesday
Tuesday	0900-1030	Report and discussion on conclusions	
	1100-1230	Discussion of consistencies across groups plus overarching conclusions	
	1400-1530		Review and revise conclusions based on plenary discussion Discuss general presentation of results within the sections
	1600-1730	Initial discussion on the format for a synthesis report, infographics, and needs for specific Synthesis Boxes (providing policy makers with concrete, plain-English explanations)	
Wednesday	0900-1230		Development of infographics, specialist boxes, organisation of existing text and graphics for presentations in sections
	1400-1530	Summary presentations on layouts of sections. Presentation of draft infographics, key messages and conclusions.	
	1600-1730	General discussion on progress towards the assessment report.	

		Discussion on summary for policy makers (Executive Summary) and how to present risk assessments to SC-CAMLR and CEP.	
Thursday	0900-1230		Further development of infographics, specialist boxes, organisation of existing text and graphics for presentations in sections. Develop Executive Summary for policy makers
	1400-1530		Key gaps and priorities for the second assessment
	1600-1730	Report back on progress Review Executive Summary	
Friday	0900-1030	Planning	Plan program of work following workshop for delivering final report, publishing key findings in a high profile journal, and delivering relevant outputs to SC-CAMLR in 2019
	1100-1230	Further review Executive Summary	
	1400-1530	Report back on plans for completion. Finalise processes to conclude work by end of August where possible	

Figure 1: The processes and work flow in a Marine Ecosystem Assessment (MEA) using the MEA for the Southern Ocean (MEASO) regarding the management region around Antarctica as an example (Brasier et al, submitted). The dashed box in the lower right corner indicates the starting point of the first MEASO, to which Brasier et al (in prep) contributes by summarising available knowledge, data, syntheses and models. The dashed box in top left corner demonstrates the potential interaction of MEAs with policy-makers. Should MEASO be successful, it is envisaged to be an ongoing process to support regular international reviews, where each MEASO will advise on priorities for future research and monitoring to improve subsequent MEASOs.

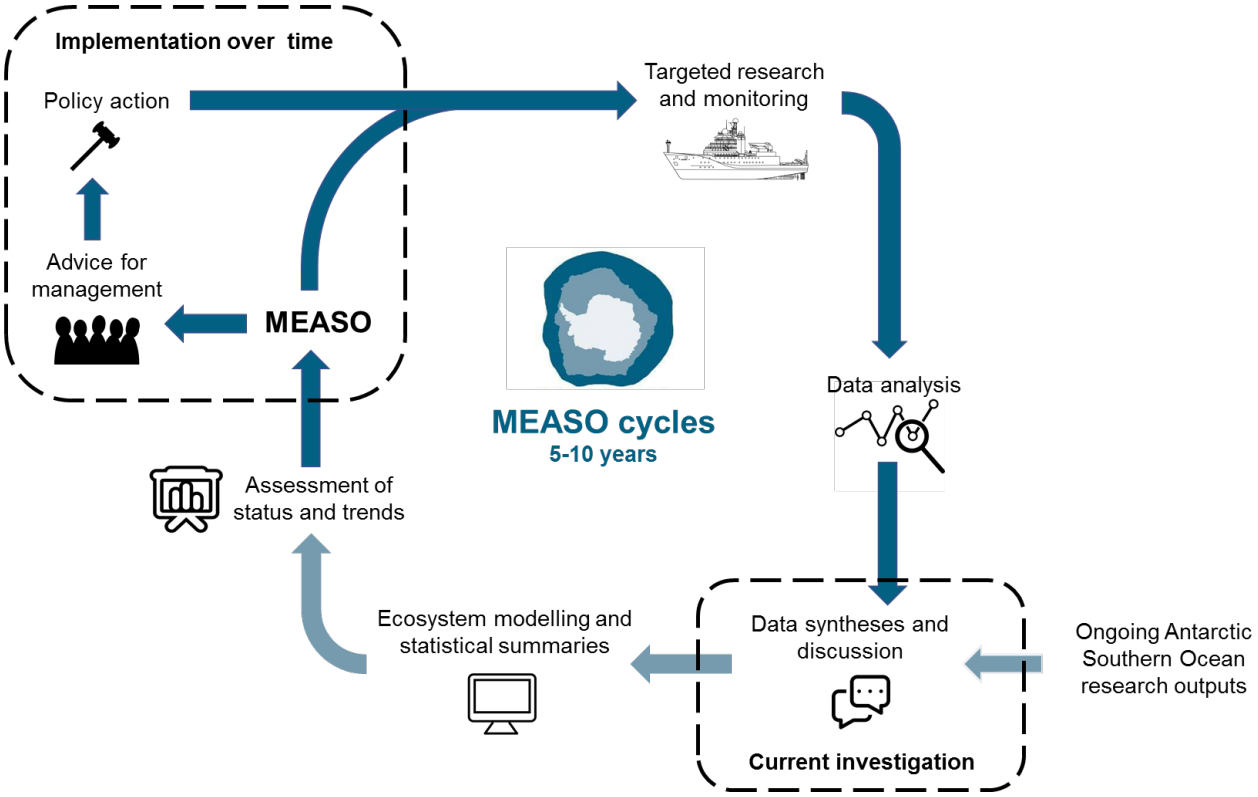


Figure 2: Map of Antarctic and the Southern Ocean showing the four major sectors to be assessed in the MEASO – East Pacific Sector, Atlantic Sector, Indian Sector, and West Pacific Sector. Key environmental features are labelled and indicated in the legend.

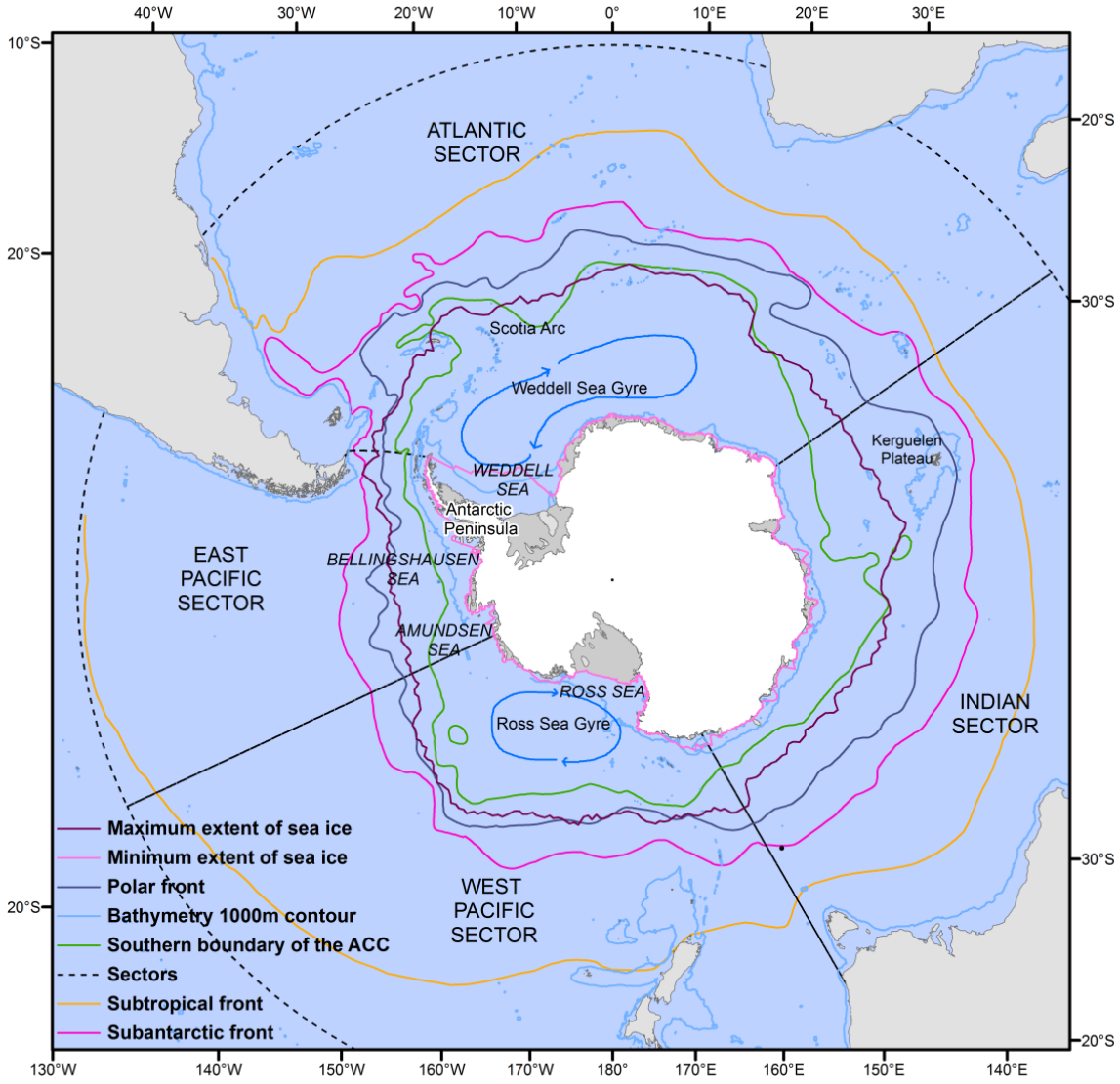
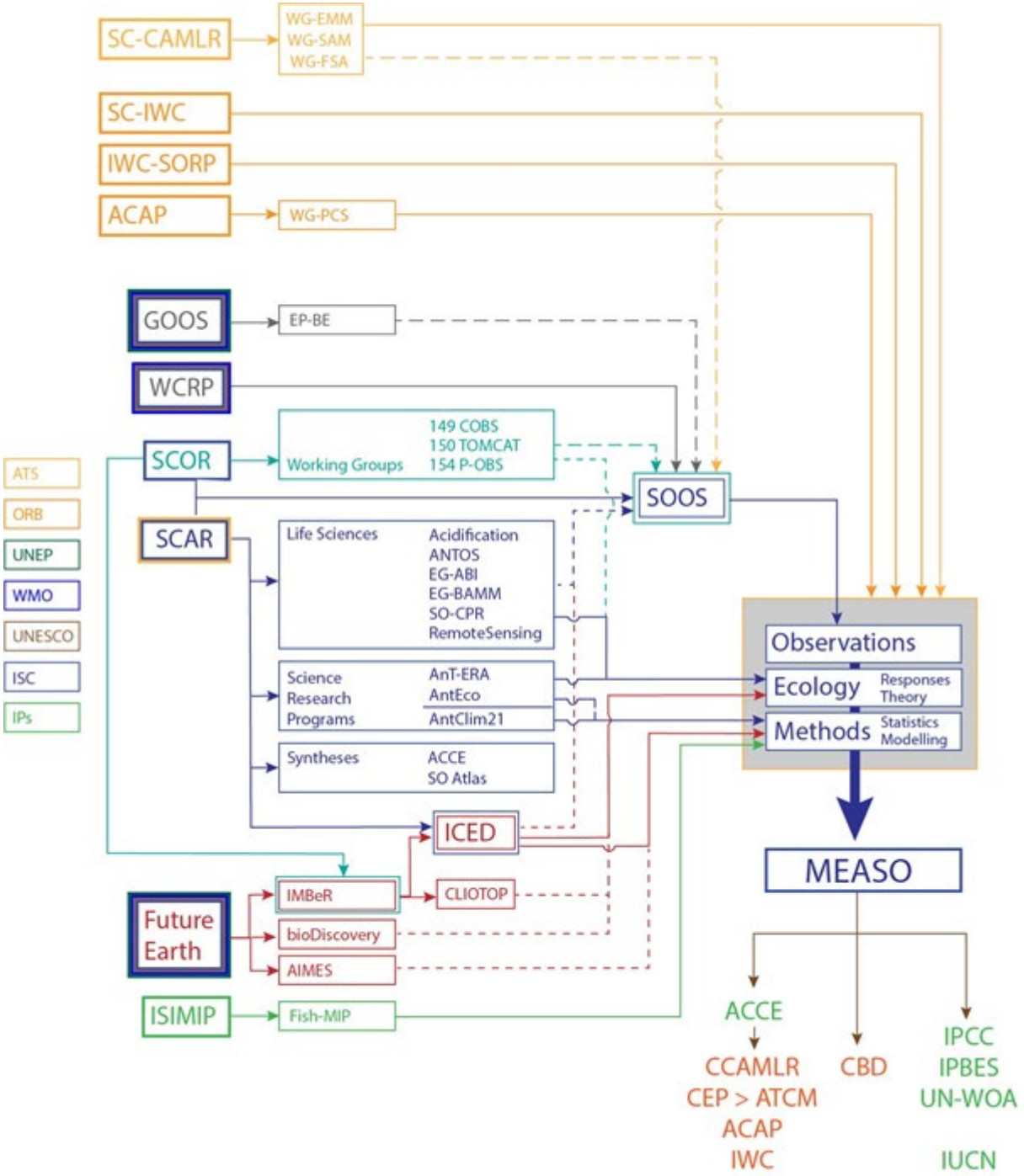


Figure 3: Illustration of the connectivity and relationships between science programs to deliver a MEASO. Flow chart showing the network of existing international bodies that are valuable to contribute to the three components of MEASO (observation, ecology and methods) (http://soki.aq/display/MEASO). The text following the figure provides the meaning of the acronyms in the diagram as well as URLs for their web sites.



The higher parent funding bodies are on the left and are colour coded. The next column of beneficiary organisations are bordered by a box with a colour relating to the colour of the parent body. The third column of beneficiaries are coloured according to the colour of the text in the second column. The rows in the third column are meant to align in a logical way to their parent in the second column. Acronyms and explanations where needed are provided in the text that follows.

Column 1

This column indicates the overarching funding/supporting bodies of the scientific research. The colours used for each overarching body are used to colour the boxes surrounding the institutions in Column 2, indicating which overarching body is supporting which institution.

ATS: Antarctic Treaty System, including researchers involved with the Antarctic Treaty and its Protocol on Environmental Protection (https://www.ats.aq/index_e.htm), the Convention on the Conservation of Antarctic Seals (CCAS, https://www.ats.aq/e/ats_related.htm), the Convention on the Conservation of Antarctic Marine Living Resources (Convention on CAMLR, https://www.ccamlr.org/). The Scientific Committee on Antarctic Research (SCAR) is considered part of the ATS as well as the International Science Council (https://scar.org/).

ORB: Other regional bodies, including the International Whaling Commission (IWC, https://iwc.int/home), the Agreement on the Conservation of Albatross and Petrels (ACAP, https://acap.aq/)

UNEP: United Nations Environment Program (http://web.unep.org/about/)

WMO: World Meteorological Organization (https://www.wmo.int/pages/index_en.html)

UNESCO: United Nations Educational, Scientific and Cultural Organization (https://en.unesco.org/)

ISC: International Science Council (formerly International Council of Science, https://www.icsu.org/, & International Social Science Council, http://www.worldsocialscience.org/); (https://www.icsu.org/current/press/worlds-leading-bodies-of-social-and-natural-sciences-to-merge-in-2018-becoming-international-science-council)

IPs: International Partnerships, including the Inter-Sectoral Impact Model Intercomparison Project (https://www.isimip.org/).

Column 2

This column shows the institutions involving a broad spectrum of scientists. Each institution usually has smaller specialist groups. Solid lines indicate the institutions governing the specialist groups. Dashed lines indicate an affiliation or supporting role.

SC-CAMLR: Scientific Committee for the Conservation of Antarctic Marine Living Resources (https://www.ccamlr.org/en/science/science)

SC-IWC: Scientific Committee of the International Whaling Commission (https://iwc.int/scmain)

IWC-SORP: Southern Ocean Research Partnership (https://iwc.int/sorp)

ACAP: Agreement on the Conservation of Albatross and Petrels (https://acap.aq/en/advisory-committee)

GOOS: Global Ocean Observing System (http://www.goosocean.org/)

WCRP: World Climate Research Programme (https://www.wcrp-climate.org/)

SCOR: Scientific Committee on Oceanic Research (http://www.scor-int.org/)

SCAR: Scientific Committee on Antarctic Research (https://scar.org/)

Future Earth: Future Research - research for global sustainability (http://www.futureearth.org/)

ISIMIP: Inter-Sectoral Impact Model Intercomparison Project (https://www.isimip.org/)

Column 3

This column shows relevant specialist groups, some of which can contribute directly (solid arrows) or indirectly (dotted lines or arrows) to different parts of the MEASO.

SC-CAMLR Working Groups

WG-EMM: Working Group on Ecosystem Monitoring and Management (https://www.ccamlr.org/en/meetings/19)

WG-SAM: Working Group on Statistics, Assessments and Modelling (https://www.ccamlr.org/en/meetings/21)

WG-FSA: Working Group on Fish Stock Assessment (https://www.ccamlr.org/en/meetings/20)

ACAP Working Goup

WG-PCS: Population and Conservation Status Working Group (https://acap.aq/en/working-groups/population-and-conservation-status-working-group)

GOOS Expert Panel

EP-BE: Expert Panel - Biology and Ecosystems (http://www.goosocean.org/index.php?option=com_content&view=article&id=79&Itemid=273)

SCOR Working Groups:

149 COBS: Changing Ocean Biological Systems: How will biota respond to a changing ocean? (http://www.scor-int.org/SCOR_WGs_WG149.htm)

150 TOMCAT: Translation of Optical Measurements into particle Content, Aggregation & Transfer (http://www.scor-int.org/SCOR_WGs_WG150.htm)

154 P-OBS: Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs (http://www.scor-int.org/SCOR_WGs_WG154.htm)

SCAR Life Sciences:

Acidification: (https://www.scar.org/science/acidification/acidification/)

ANTOS: Antarctic Near-shore and Terrestrial Observing System (https://www.scar.org/science/antos/home/)

EG-ABI: Expert Group on Antarctic Biodiversity Informatics (https://www.scar.org/science/egabi/abi/)

EG-BAMM: Expert Group on Birds and Marine Mammals (https://www.scar.org/science/eg-bamm/home/)

SO-CPR: Southern Ocean Continuous Plankton Recorder Survey(https://www.scar.org/science/cpr/home/)

Remote Sensing: Remote Sensing of Birds and Animals (https://www.scar.org/science/remotesensing/remote-sensing/)

SCAR Scientific Research Programs:

AnT-ERA: Antarctic Thresholds - Ecosystems Resilience and Adaptation (https://www.scar.org/science/ant-era/home/)

AntEco: State of the Antarctic Ecosystem (https://www.scar.org/science/anteco/home/)

AntClim21: Antarctic Climate Change in the 21st Century (https://www.scar.org/science/antclim21/home/)

SCAR Synthesis Reports:

ACCE: Antarctic Climate Change and the Environment (https://www.scar.org/science/acce/acce/)

SO Atlas: SCAR Biogeographic Atlas of the Southern Ocean (https://www.scar.org/library/scar-publications/occasional-publications/3501-biogeographic-atlas-of-the-southern-ocean-selected-chapters/)

Future Earth projects:

IMBeR: Integrated Marine Biosphere Research (http://www.imber.info/)

bioDiscovery: (http://futureearth.org/projects/biodiscovery)

AIMES: Analysis, Integration and Modelling of the Earth System (http://futureearth.org/projects/aimes-analysis-integration-and-modelling-earth-system)

IMBeR programs:

ICED: Integrating Climate and Ecosystem Dynamics in the Southern Ocean (http://www.iced.ac.uk/)

CLIOTOP: CLimate Impacts on Oceanic TOp Predators (http://www.imber.info/Science/Regional-Programmes/CLIOTOP)

ISIMIP projects:

FISH-MIP: Fisheries and Marine Ecosystem Model Intercomparison Project (https://www.isimip.org/gettingstarted/marine-ecosystems-fisheries/)

Column 4

SOOS: Southern Ocean Observing System (http://soos.aq/)

Column 5

This column links the network to the three pillars of MEASO. The MEASO is then made available to the different end-users of a MEASO.

In the case of the Antarctic Treaty System, MEASO becomes part of the reporting from the SCAR-ACCE.

End users listed are:

Antarctic Treaty System

CEP > ATCM: Committee for Environmental Protection delivers to the Antarctic Treaty Consultative Meeting (https://ats.aq/e/cep.htm)

CCAMLR: Commission for the Conservation of Antarctic Marine Living Resources (https://www.ccamlr.org/)

SCAR-ACCE: SCAR report on Antarctic Climate Change and the Environment (https://www.scar.org/science/acce/acce/)

Other Regional Bodies:

ACAP: Agreement on the Conservation of Albatross and Petrels (https://acap.aq/en/meeting-of-the-parties)

IWC: International Whaling Commission (https://iwc.int/home)

Global Conventions:

CBD: Convention on Biological Diversity (https://www.cbd.int/)

Global reporting bodies:

IPCC: Intergovernmental Panel on Climate Change (http://www.ipcc.ch/)

IPBES: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (https://www.ipbes.net/)

UN-WOA: United Nations World Ocean Assessment - regular process for global reporting and assessment of the state of the marine environment including socio-economic aspects (http://www.worldoceanassessment.org/)

Other international bodies:

IUCN: International Union for the Conservation of Nature (https://www.iucn.org/)

Citation

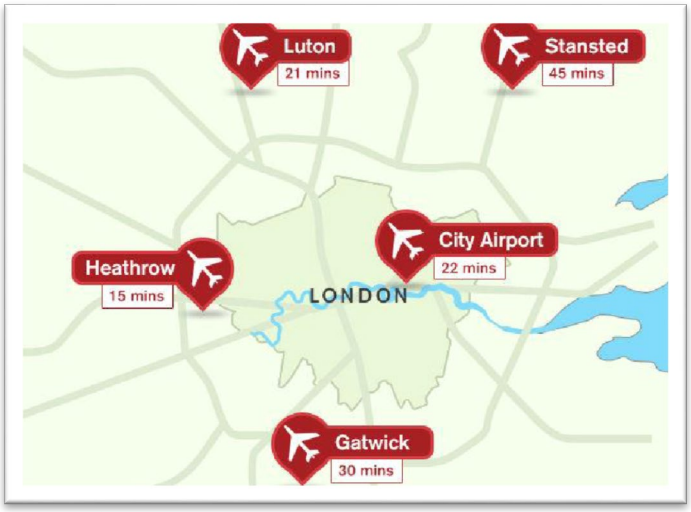
Constable, A.J. (2018) MEASO Science Network - MEASO - Confluence, SOKI, Antarctic Climate and Ecosystems Co-operative Research Centre. Page last modified: Sunday 17 Jun 2018. Accessed: Monday 14 Jan 2019 <http://soki.aq/x/M4D-Ag>.

Attachment 1: Information on the location of the MEASO Workshop at WWF-UK Living Planet Centre, UK

WWF Antarctic Program
WELCOME PACK

WWF-UK, Living Planet Centre
Woking, GU214LL, United Kingdom

1. AIR TRANSPORT FROM LONDON AIRPORTS TO WOKING AND LONDON



1.1. From Heathrow Airport

If you are travelling from Heathrow Airport directly to Woking, the National Express bus is the fastest and cheapest public transport option. Alternatively, if you need to travel via London the Heathrow Express takes you directly to London Paddington.

National Express - *Buses go to Woking from Heathrow Terminals every hour*. The timetable is available here (PDF)

The bus tickets cost approximately £15 and can be bought on the day at the bus terminal – *they do need to be purchased before you get on the bus*. The journey takes 45 minutes to an hour depending on traffic. When the bus arrives at Woking you will disembark at the main entrance to Woking train station.

Heathrow Express Train – *This is a fast train service that runs from Heathrow directly to London Paddington.* A single ticket costs approximately £25. If you're arriving at Terminals 2 or 3, follow signs to the Heathrow Express station. From there, take a Heathrow Express service to London Paddington – transfer time is 15 minutes.

In Terminal 5 the station is at basement level and reached by lift or escalator. All trains call at Heathrow Terminals 2 and 3 and then run non-stop to London Paddington – total transfer time is 21 minutes. In Terminal 4, take the free transfer to Heathrow Terminals 2 and 3 (departures every 15 minutes, travel time four minutes). From there, take a Heathrow Express service to London Paddington – transfer time is 15 minutes.

Once arrived at London Paddington you will need to get the tube to London Waterloo and then a train onto Woking, tickets for this section of the journey will cost approx. £15.00.

1.2. From Gatwick Airport

Gatwick Express Train — *The Gatwick Express is a non-stop train service to London Victoria.* It runs every 15 minutes with a journey time of 30 minutes. Tickets and timetable available here: www.gatwickexpress.com. Then catch the London Underground from London Victoria to Waterloo, and then the South West Train from Waterloo to Woking.

2. GENERAL RAIL TRANSPORT

Trainline UK is a great website to use if you have side meetings in London and surrounding areas, it's easy to use and will show train schedules, travel time and cost quickly.

Transport for London Journey Planner is another useful website for planning journeys in and around London via the underground tube.

3. ACCOMMODATION

3.1.1. The main hotels used by WWF-UK in Woking are:

Premier Inn Woking Town Centre - a 10-minute walk to the WWF Living Planet Centre (LPC), see map below.

Address: Eurobet House, 10-24 Church St W, Woking GU21 6HT

Double Tree Hilton in Woking – a 5-minute walk to WWF Living Planet Centre, see map below.

Address: Victoria Way, Woking GU21 8EW

Other hotel options:

Inn Keepers Lodge in Woking – 2 mins walk to our office

Travelodge in Woking – 5-7 mins walk to our office

4. Travel from Woking Train Station to the WWF Living Planet Centre –

Address: WWF UK The Living Planet Centre Rufford House, Brewery Rd, Woking GU21 4LL

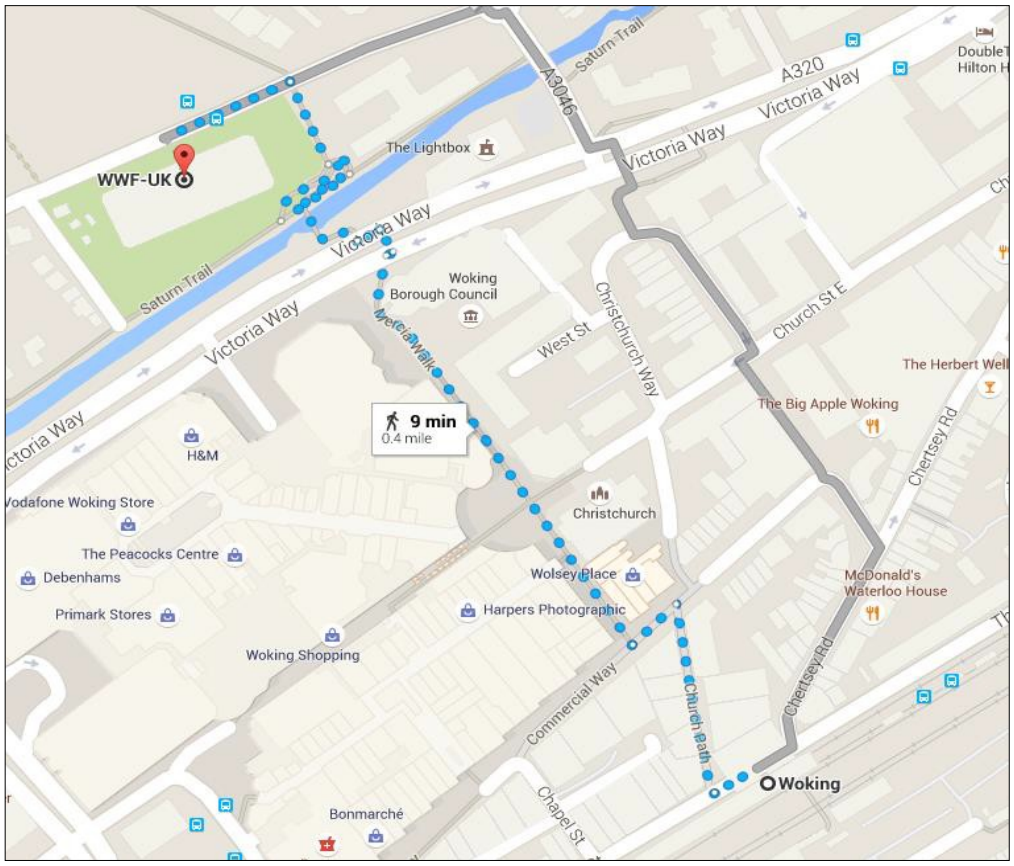
Phone: 01483 426444

To get to the LPC, you will need to walk through Woking train station to Town Centre side, and exit by Platform 1 and walk through the town centre following the route shown in the map below - go straight over the pedestrian crossing at the station and take the pedestrian street to the left of the parade of shops in front of you. There are map boards with the building marked to help with your journey.

At the end, turn left onto Commercial Way and immediately right, through the Wolsey Place covered walkway (between Carluccio's and Fox Estate Agent) and into the town square. In the town square, you will see the Peacocks Centre on your left and Café Rouge directly in front of you. Head straight to Café Rouge and then take the path to the right.

Then cross over a dual carriage way via the pedestrian crossing, walk over the canal foot bridge and you will see the Living Planet Centre ahead of you, go up a small number of steps and our entrance is in front of you.

Please see map on next page.



Please visit www.tfl.gov.uk and www.nationalrail.co.uk for up-to-date travel information to help plan your journey.

Information about our Living Planet Centre office in Woking

WWF-UK offices operates a full non-smoking policy.

The Oasis room in our building is set aside for quiet reflection and prayer. If you would like to book this room, please let your host know.

5. GENERAL INFORMATION

Electricity: The power supply in the UK is 220 volts. Stakeholders should bring 3-pin plug adaptors for electrical equipment.

Currency and credit cards: The UK currency is the Pound Sterling (£). Major credit cards are accepted in hotels, restaurants, shops and ATMs.

Accommodation directory and travel and transport information: www.VisitBritain.com

5.1. Useful Links:

Trainline UK

Transport for London Journey Planner

BBC Weather Woking

National Rail (for Gatwick to Woking train travel)

National Express (for Heathrow to Woking bus travel)

Visit Surrey

Station Map of Working

5.2. WOKING

Just a stone's throw from London, in England's south-east corner, Woking offers a great diversity of accommodation and things to do as well as restaurants, cafes and pubs that cater for all tastes. Below are just a few suggestions:

The Lightbox:

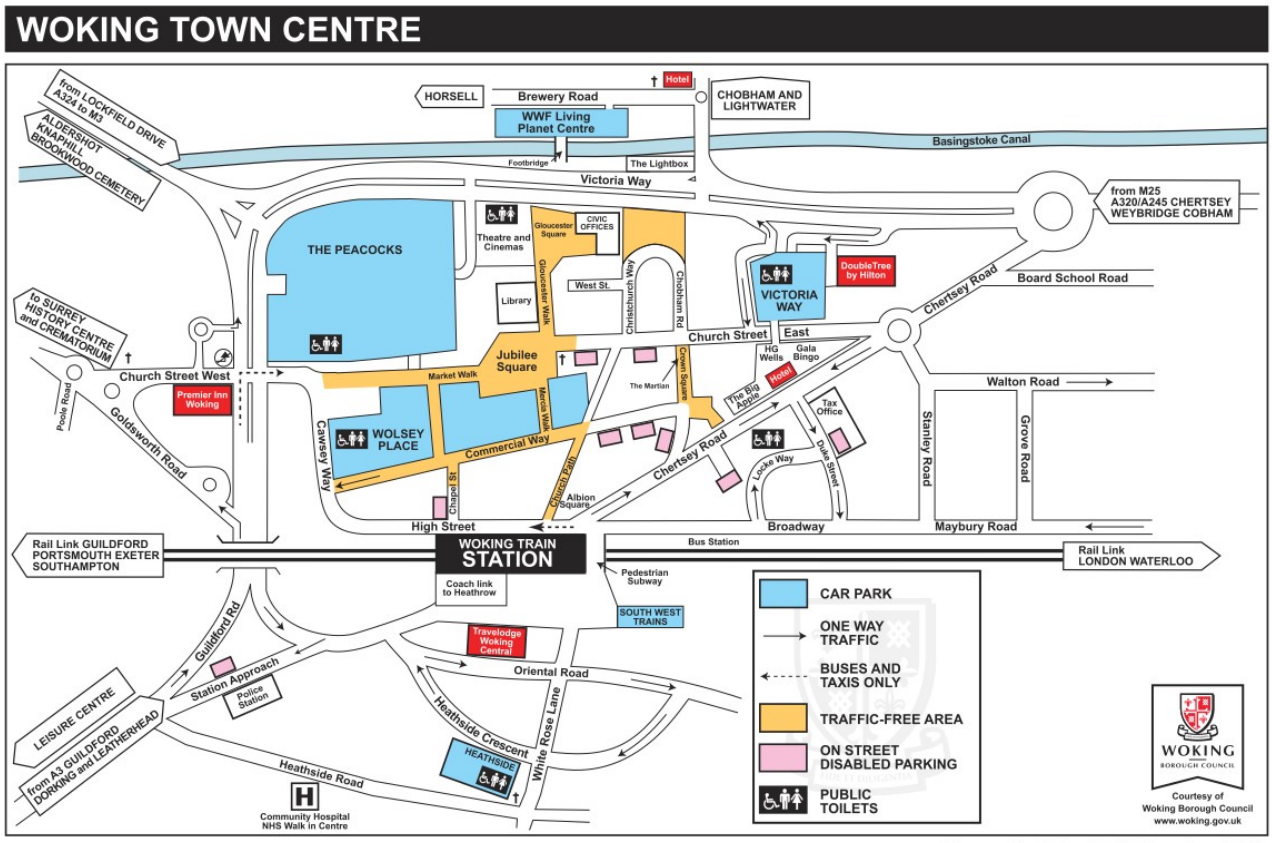
The Lightbox gallery and museum in Woking is one of the most exciting cultural spaces in the South East. Three stunning galleries host a huge range of exhibitions, changing regularly. The building is also home to Woking's Story, an interactive museum of the town's history. You can also enjoy a coffee and slice of delicious cake or lunch in their canal side Café. Afterwards you can browse for a special gift or memento of your visit in the Gift Shop. NB: it is not open on Mondays.

Woking Shopping:

In the heart of Woking presides The Peacocks and Wolsey Place shopping centres, combined they provide over 170 shops and restaurants, 2 theatres and 6 cinemas. Whether enjoying some retail therapy, stepping out for a bite to eat or taking in a show, The Peacocks and Wolsey Place have plenty to offer.

Restaurants / Eateries:

Woking has a number of popular restaurants and eateries, to name a few; Café Class, Carluccios, Bills, Las Iguanas, Jeitta, and Cellar Magneval.



Attachment 2: Report to SC-CAMLR 2018 on the international conference on the Marine Ecosystem Assessment for the Southern Ocean

Marine Ecosystem Assessment for the Southern Ocean (MEASO)

By

Andrew Constable[1,2,3], Jess Melbourne-Thomas[1,2], Rowan Trebilco[2], Madeleine Brasier[2]

[1] Australian Antarctic Division, Channel Highway, Kingston, Tasmania, 7050. Australia
[2] Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Tasmania, 7001. Australia
[3] Contact email: andrew.constable@aad.gov.au

Abstract

A first Marine Ecosystem Assessment for the Southern Ocean (MEASO) is under development. MEASO aims to provide a forward-looking assessment of what trends in Southern Ocean ecosystems are happening now and into the future, and what may need to be planned for, in terms of research and management. The aim is to have a quantitative assessment that enables managers to achieve consensus in adapting their management strategies to ecosystem change. MEASO officially began at an international conference held in Hobart in early April 2018 (http://www.measo2018.aq/). The conference provided an opportunity to share relevant science, enhance community input into the design and planning of the MEASO, and to develop a work plan. Since the conference, summaries of information available for a MEASO have been compiled in order to determine what can be used to assess status and trends within the Southern Ocean on regional and circumpolar scales. This review includes a record of field programmes and ecological surveys, current Southern Ocean syntheses, model coverage and assessments. The types of biological data collected from the field programmes are also being summarised, based on an open, international survey of researchers. For this survey, an indication of where and when national research programmes have conducted field work were requested, particularly for measures of density (abundance) for different taxonomic and functional groups within the benthos, pelagos and plankton as well as birds and marine mammals. To date 12 countries have contributed to the data survey, coverage of which can be viewed on the Southern Ocean Knowledge and Information wiki: http://soki.aq/display/MEASO/MEASO+Data+Availability. The work program for the first assessment is detailed in the paper.

Introduction

A Marine Ecosystem Assessment for the Southern Ocean (MEASO) is a quantitative assessment of the status and trends of habitats, species and food webs in different regions. It aims to provide a common foundation for all end-users on which science can be developed, and policies and decisions can be made. It is intended to enable managers to achieve consensus in adapting their management strategies to ecosystem change, in order to continue to achieve their objectives for ecosystems. A recent analysis by the Antarctic Climate and Ecosystems Cooperative Research Centre (illustrated to the right) explains the importance of a MEASO (Constable et al, 2017; http://acecrc.org.au/publication/southern-ocean-ecosystems/). In this paper we summarise the MEASO conference, the first assessment and its four pillars, the timetable of the first assessment (first presented to WG-EMM-18/14), and a brief description of progress of the review of information available to undertake the first assessment

The MEASO Conference

The Conference on a Marine Ecosystem Assessment for the Southern Ocean (MEASO was held in Hobart, Australia on 9-13 April 2018. It was hosted by the Australian Antarctic Division and the Antarctic Climate and Ecosystems Cooperative Research Centre. Major sponsors were SOOS, ICED, Pew Charitable Trusts, and WWF. Other sponsors included COLTO, Austral Fisheries, Australian Longline, Tasmanian Polar Network, CSIRO, IMAS, NIPR. The aims, background, themes, program and abstracts can be obtained from the conference web site: www.measo2018.aq. The Local Organising Committee included Andrew Constable, Phil Boyd, Indi Hodgson-Johnston, So Kawaguchi, Stacey McCormack, Klaus Meiners, Jess Melbourne-Thomas, David Reilly, Kerrie Swadling, Wenneke ten Hout, Rowan Trebilco, and Jake Wallis. International program support was provided by Andrew Constable, Dan Costa, Karen Evans, Huw Griffiths, Julian Gutt, Eileen Hofmann , Nadine Johnston, Ian McDonald, Eugene Murphy, Yan Ropert-Coudert, Oscar Schofield, and Jan Strugnell. Supporting Organisations included ICED; SCAR; SOOS; SCOR; IMBeR; and IMOS.

The conference addressed four themes of a MEASO over 4 days: (1) assessments, (2) responses of biota to change, (3) modelling and analytical methods, and (4) observations for underpinning assessments. A one-day policy forum considered the delivery of science into policy.

173 people attended from 23 countries. (75 women, 98 men). Early careers researchers (APECS) were well represented (57) and contributed greatly.

MEASO-I and its four pillars

A first MEASO is to proceed in 2018 and early 2019. It will build on existing reviews (e.g. Constable et al 2014; Gutt et al 2015), SCAR's Antarctic Climate Change and Environment report (Turner et al 2009) and the SCAR Biogeographic Atlas of the Southern Ocean (de Broyer et al 2014). It will collate knowledge and assessments ready to hand, particularly to assist the Commission for the Conservation of Antarctic Marine Living Resources and to provide community input to the Intergovernmental Panel on Climate Change.

The process will then be reviewed to enable improvements in a second cycle over 5-7 years.

The four pillars to deliver a MEASO are: (i) methods for facilitating delivery of the information to non-scientific end-users, (ii) ecologies of key taxa in the ecosystem and their responses to changing habitats, (iii) field observations of status and, where possible, trends in biota, and (iv) methods for analysing distribution, status and trends as well as for modelling the past, present and future.

MEASO-I Timetable

June-July 2018
- design summary reports
- compile summaries of survey activities
- manuscript on MEASO approach

June-August 2018
- science strategy for MEASO (manuscript)
- taxa summaries using templates (status, ecology)
- literature on status of Southern Ocean ecosystems

September-November 2018
- progress report to SC-CAMLR
- feasible analyses & projections of change
- regional reports - habitats, species and food webs

December 2018 - January 2019
- peer-review of reviews and analyses

February-March 2019
- complete drafts following review
- summaries of results for end-users

April-May 2019
- reviews and feedback on draft report

June 2019
- ICED Workshop on MEASO-I and Benchmarking (UK)
- submission of report for publication

Review of available data and information

Since the conference, summaries of information available for a MEASO have been compiled in order to determine what can be used to assess status and trends within the Southern Ocean on regional and circumpolar scales. This review includes a record of field programmes and ecological surveys, current Southern Ocean syntheses, coverage of ecological models and assessments. The types of biological data collected from the field programmes are being summarised, based on an open, international survey of researchers. For this survey, an indication of where and when national research programmes have conducted field work were requested, particularly for measures of density (abundance) for different taxonomic and functional groups within the benthos, pelagos and plankton as well as birds and marine mammals. To date 12 countries have contributed to the data survey, coverage of which can be viewed on the Southern Ocean Knowledge and Information wiki:

http://soki.aq/display/MEASO/MEASO+Data+Availability.

Contributors at present include: Irene Schloss (Argentina), Philippe Ziegler, John Kitchener, Karen Westwood, John van de Hoff, Colin Southwell, Nicole Hill (Australia), Evgeny Pakhomov (Canada), Cesar Cardenas, Humberto Gonzalez (Chile), Yan Ropert-Coudert (France), Julian Gutt, Santiago Pineda Metz. Bettina Meyer, Angelika Brandt, Helen Herr (Germany), Parli Bhaskar (India), Lillo Guglielmo, Iole Leonori, Marino Vacchi, Silvia Olmastroni (Italy), Tsuneo Odate (Japan), Matt Pinkerton (New Zealand), Azwianewi Makhado (South Africa), Martin Edwards, Phil Trathan, Sophie Fielding, Angus Atkinson (United Kingdom), Eileen Hoffman, Christian Reiss, Oscar Schofield, Jefferson Hinke (USA).

Contributors will be approached to participate in regional working groups later in the MEASO process.

Whilst reviewing major ecological syntheses, lead authors for chapters in the SCAR Biogeographic Atlas of the Southern Ocean were approached to summarise new findings since its publication in 2014. General themes presented by respondents included the acknowledgement of an improved understanding of the evolution of Antarctic fauna and environmental factors that influence species distribution. With an increase in the number of genetic-level investigations, many new species have since been discovered and/or described. With these results some biogeographic data presented in the Atlas may need updating. Contributors of summary information of what may need to be updated in the SCAR Biogeographic Atlas of the Southern Ocean included: Sèverine Alvain, Dave Barnes, Narissa Bax, Simone Brandão, J. Alistair Crame, Rachel Downey, Kai H. George, Julian Gutt, Graham Hosie, Falk Huettmann, Stefanie Kaiser, Juliana H.M.

Kouwenberg, Susanne Lockhart, Sophie Mormède, Ute Mühlenhardt-Siegel, Alix Post, Ben Raymond, Yan Ropert-Coudert, Thomas Saucède, Kerrie M. Swadling, Josè Xavier, Wolfgang Zeidler.

This review is intended to help highlight, as part of MEASO, what gaps in knowledge might be priorities for addressing in the future.

What people can do

Contact MEASO using: measo2018@acecrc.org.au

All Antarctic and Southern biological/ecological researchers are encouraged to be involved in MEASO. The MEASO report will be developed in a part of the Southern Ocean Knowledge and Information (SOKI) wiki (www.soki.aq). Parts of the MEASO pages are in the public domain: http://soki.aq/display/MEASO

Interested people can help with content by signing up to SOKI and working in the fully protected space. Sign up by request through the MEASO email above.

References

Turner, J., R. Bindschadler, P. Convey, G. di Prisco, E. Fahrbach, J. Gutt, D. Hodgson, P. Mayewski and C. Summerhayes, Eds. (2009). Antarctic climate change and the environment. SCAR, Cambridge, UK.

De Broyer, C., P. Koubbi, H. Griffiths, B. Raymond, C. d'Udekem d'Acoz, A. Van de Putte, B. Danis, B. David, S. Grant, J. Gutt, C. Held, G. Hosie, F. Huettmann, A. Post and Y. Ropert-Coudert (2014). Biogeographic Atlas of the Southern Ocean. SCAR, Cambridge UK.

Constable, A. J., J. Melbourne-Thomas, S. P. Corney, et al. (2014). Climate change and Southern Ocean ecosystems I: how changes in physical habitats directly affect marine biota. Global Change Biology 20(10): 3004-3025.

Constable, A. J., J. Melbourne-Thomas, R. Trebilco, A. J. Press and M. Haward (2017). Managing change in Southern Ocean ecosystems. Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Australia.

Gutt, J., N. Bertler, T. J. Bracegirdle, A. Buschmann, J. Comiso, G. Hosie, E. Isla, I. R. Schloss, C. R. Smith, J. Tournadre and J. C. Xavier (2015). The Southern Ocean ecosystem under multiple climate change stresses - an integrated circumpolar assessment. Global Change Biology 21(4): 1434-1453.

Attachment 3: Marine Ecosystem Assessment for the Southern Ocean: draft outline

Antarctica has been identified as a key region for the early identification of climate change impacts on ecosystems but as yet there is little certainty about (i) which components of the ecosystem are most vulnerable and (ii) the likely mechanisms through which changes in the physical environment will bring about change in the biological world.

Climate change is will impact Southern Ocean ecosystems through changes induced in physical and chemical features of the environment. Potential mechanisms of change include increasing temperatures, changes in ocean chemistry, and changes to the distribution or abundance of some species. Among other potential effects, predicted implications of these changes include reduced extent and duration of sea ice, increase energetic costs for biota -- which may affect the ability of many plankton (including bacteria, photosynthetic diatoms and flagellates, and zooplankton such as krill) to grow and reproduce, and both direct or indirect effects of species upon one another as distributions and abundances change. Moreover, temporal shifts in the dynamics of some taxa in response to changes in timing of physical phenomena may cause shifts in ecosystem dynamics overall. Although the physical changes to the environment can now be predicted with high confidence, the consequent ecosystem impacts are much less certain. For example, the historical view that krill will remain but the productivity of the ecosystem will generally decline with the loss of sea-ice may no longer be correct. Emerging science is showing that the effect on productivity of the system is uncertain and that the development of a pelagic system without sea-ice may result in the structure of the food web shifting from a krill-based food web to a fish-based food web.

The Marine Ecosystem Assessment for the Southern Ocean aims to provide an initial risk assessment of climate change impacts on the biology of the Southern Ocean.

The primary objective of the Marine Ecosystem Assessment for the Southern Ocean is to assess the risks to Southern Ocean marine ecosystems from climate change and related change processes, such as ocean acidification. This will be achieved by collating and modelling the relationships between individual species or functional groups and key environmental processes as the basis for predicting ecosystem responses to projected change in physical and chemical environmental variables.

The following questions are important for policy makers:

1. Are some species more sensitive or more vulnerable than others to climate change?
2. Are some species critical for triggering ecosystem changes, such as changes to trophic structure?
3. What are the critical thresholds to ecosystem change and how close is the ecosystem to such tipping points?
4. Will changes be different in different regions of Antarctica?
5. Will harvested populations (e.g. krill and finfish) or species of high conservation value, such as whales, be adversely affected?
6. What changes may arise in areas of high conservation value?
7. Are there areas that could be regarded as climate refugia?

The outline below provides a structure for collating the information required to make a first attempt at answering these questions (and for identifying key gaps in our capacity to address them).

Draft Outline

1) Status, trends and impacts

a) Physical habitats
    i) General description of Southern Ocean habitats
    ii) Methods
    iii) Status and trends of habitats
        (1) Global phenomena causing spatio-temporal variability in the Southern Ocean
        (2) Light and atmosphere
        (3) Bathymetry, topography
        (4) Geomorphology
        (5) Ocean currents, fronts, gyres and nutrients
        (6) Winds, Eddies, waves and mixed layers
        (7) Ice shelves, bergs, fast ice and marginal ice zone
b) Southern Ocean taxa
    i) Synopsis of available information on Southern Ocean taxa
    ii) Approach to assessing ecological status and trends in Southern Ocean taxa
    iii) Primary producers
    iv) Other Microbes
    v) Benthos
        (1) Habitat-forming taxa
        (2) Other filter feeders
        (3) Detritivores
        (4) Autotrophs
        (5) Herbivores
        (6) Carnivores
    vi) Pelagos
        (1) Herbivorous Zooplankton
        (2) Carnivorous Zooplankton
        (3) Salps
        (4) Krill
        (5) Squid
        (6) Icefish
        (7) Toothfish
        (8) Silverfish
        (9) Myctophids
        (10) Bathylagids
        (11) Other
    vii) Sea ice assemblages
    viii) Air breathers
        (1) Fur seals
        (2) Elephant seals
        (3) Pack ice seals
        (4) Pygoscelid penguins
        (5) Aptenodytid penguins
        (6) Eudyptid penguins
        (7) Widely-ranging flying birds
        (8) Coastal flying birds
        (9) Baleen whales
        (10) Toothed whales
c) Ecosystems
    i) Species pool
    ii) Food web connectivity, stressors and phenology

iii) Relative importance of energy pathways
iv) Maintenance of higher trophic levels
v) Extreme events
vi) Fisheries production
vii) General

2) Future states
   a) Models and their efficacy
   b) Scenarios
      i) Climate change and ocean acidification
      ii) Fisheries
   c) Future trajectories
   d) Shifting habitats and productivity
   e) Functional groups and vulnerabilities
   f) Ecosystem structure and function
   g) Risks
   h) Food web vulnerabilities
   i) Spatial climate risks and refugia
   j) Ecosystem services