SCAR PPG	AnClimNow
Paper 9	Agenda Item 5
Person Responsible:	Tom Bracegirdle

SCAR Executive Committee Meeting 2019

Plovdiv, Bulgaria, 29-31 July 2019

Near-term Variability and Prediction of the Antarctic Climate System (AntClimNow)

Draft Science and Implementation Plan

For SCAR guidelines see Appendix
Guideline text for the Science and Implementation plan is in red below

Title Page (1 page)

Science and Implementation Plan for a proposed SCAR Scientific Research Programme

1. Name of the proposed SRP
Near-term Variability and Prediction of the Antarctic Climate System (AntClimNow)

2. Name(s) of the lead proponent(s) (including affiliations and contact information)
Tom Bracegirdle (UK), British Antarctic Survey, Cambridge, UK. E-mail
David Bromwich (USA), Byrd Polar & Climate Research Center, The Ohio State University, Columbus, Ohio 43210, USA.

3. Sponsoring SSG(s)
SCAR Physical Sciences Group (PSG)

4. Summary of the duration and budget request (in US$ per year)
Duration of 8 years. Budget under discussion.

5. Abstract (250 words or less)

Many of the most important questions in Antarctic and Southern Ocean climate science are related to understanding present-day climatic trends and estimating future change in the near term (present day to mid 21st century). This topic is a key gap in the scope of the current SCAR SRPs due to its importance to Antarctic stakeholders both from a global and regional perspective. It is timely to fill this gap due to recent advances and current developments in relevant areas of climate / earth-system modelling, observations, climate proxy reconstructions and data science.

In terms of the SCAR Strategic Plan, the proposed SRP would address a number of scientific priorities identified as part of the SCAR Horizon Scan. It would widen relevance to a broader spectrum of Antarctic climate scientists, connect communities and enhance progress across this spectrum. The proposed approach involves three main scientific objectives: (i) Quantify linkages between Antarctic climate variability and the rest of the planet, with a focus on links to the tropics; (ii) Explain the contemporary annual-to-decadal time-scale trends in the Antarctic climate system and (iii) Determine the near-term predictability of the Antarctic climate system.

A further two objectives are to (iv) enhance collaboration between the science disciplines and (v) develop effective communication of the latest scientific results to bodies, such as the CEP and CCAMLR, concerned with how a changing climate may impact the governance and management of the Antarctic.

The necessary expertise are represented in the core membership (Table 1), which currently comprises 31 members from 14 countries, representing the physical and biological sciences. Their range of expertise includes atmosphere, ocean, ice, chemistry and biology.

Proposal details (maximum of 10 pages of text)
(percentages below refer to adjudication significance)
a. Introduction - scientific objectives and statement of task (including contributions to SCAR's Strategic Plan) [10%]

Introduction
This proposed SRP concerns the currently-evolving state of the Antarctic[1] climate system, the impacts of these changes both regionally and globally, and predictability in the near term (on timescales in the range 1 to 30 years). These time scales are highly relevant across multiple disciplines and to a range of key stakeholders, whilst aligning strongly with scientific priorities identified as part of the SCAR Horizon Scan. The programme will be divided into the following themes:

Theme 1. Antarctic climate variability and the global climate system
Theme 2. Understanding present-day climate trends
Theme 3. Predictability of the Antarctic climate system
Theme 4. Global and regional cross-disciplinary impacts
Theme 5. Communication of results to stakeholders

As shown in Figure 1, the overarching goal (task) is to improve predictions of the Antarctic climate system in the near term. This will be achieved by utilising new observational and modelling datasets and analysing them by drawing both on new theoretical ideas and also on methods from the rapidly expanding field of data science. Communication of the latest science results to stakeholders is integral to the proposed programme.

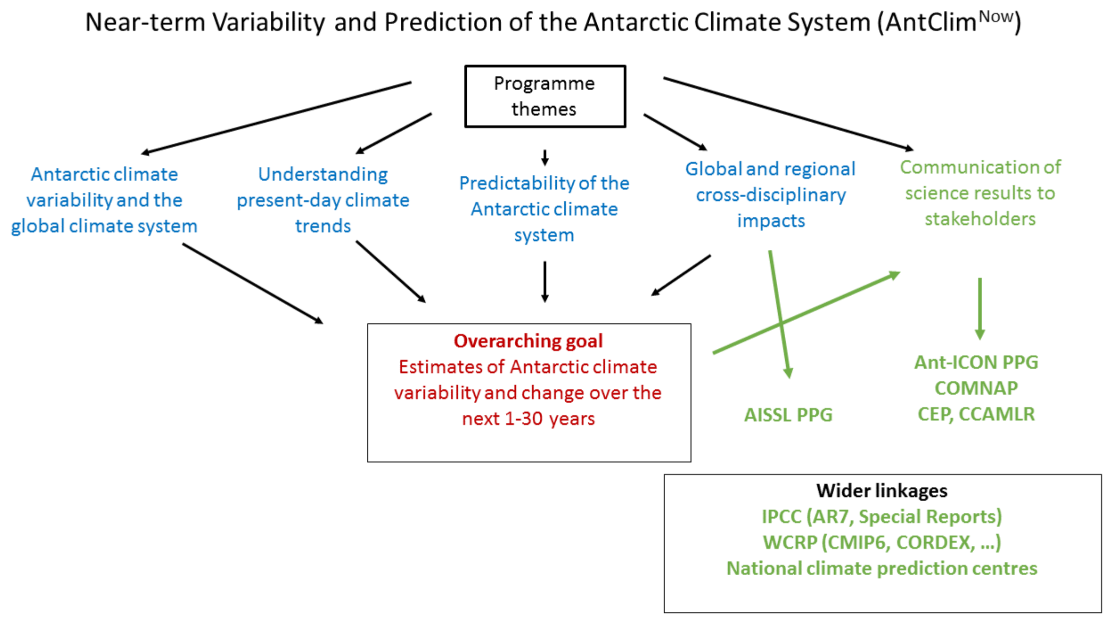

Figure 1. *Schematic overview of the science and implementation plan of AntClim^{Now}*

[1] SCAR's area of interest includes Antarctica, its offshore islands, and the surrounding Southern Ocean including the Antarctic Circumpolar Current, the northern boundary of which is the Subantarctic Front. Subantarctic islands that lie north of the Subantarctic Front and yet fall into SCAR's area of interest include: Ile Amsterdam, Ile St Paul, Macquarie Island and Gough Island.

The objectives of the proposed programme, listed below, reflect the above five themes. Their links to the SCAR Strategic Plan come both through relevance to a range of Horizon Scan questions (Kennicutt et al., 2014) (Objectives 1-4), through fostering interdisciplinary research activities (Objectives 4-5), and through strengthening collaborations with organisations and committees with interests in Antarctica (Objective 5).

- Objective 1: Quantify linkages between Antarctic climate variability and the rest of the planet, with a focus on links to the tropics. These include the atmospheric impact of the tropics on Antarctica, and the Southern Ocean's role in modulating global climate Relevant to Horizon Scan (HS) questions 1, 4, 6, 12, 13.
- Objective 2: Explain the contemporary annual-to-decadal time-scale trends in the Antarctic climate system. Relevant to HS questions 11, 12, 13, 19.
- Objective 3: Determine the predictability of the Antarctic climate system. Relevant to HS questions 7, 11, 15, 19.
- Objective 4: Collaborate across scientific disciplines to link scientific results from Objectives 1-3 to research programmes on impacts, for example, ecosystems or ice sheet dynamics.
- Objective 5. Develop a dialogue with key Antarctic stakeholders (e.g. bodies such as the Committee for Environmental Protection (CEP) and Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) concerned with how a changing climate may impact the governance and management of the Antarctic) with an emphasis on the effective communication of science advances and remaining challenges.

b. Scientific approach and rationale (including synergies with other SCAR programmes and products) [30%]

Scientific background

Estimating how the Antarctic environment may change in the near term (years-to-multiple decades) is a scientifically complex task that involves significant contributions from both externally forced (e.g. anthropogenic) background climate change and internally-generated climate variability on annual to multi-decadal timescales (Kirtman et al., 2013). In addition to primary meteorological parameters such as temperature, wind and precipitation, the wider environment (e.g. surface mass balance, sea ice and snow cover) is key in terms of relevance to impacts (e.g. Cavanagh et al., 2017).

The near-term response of the Antarctic environment to anthropogenic forcing is understood to depend largely on the relative strength of opposing impacts of stratospheric ozone recovery and greenhouse gas increases (Arblaster et al., 2011; Barnes et al., 2014). Recent trends provide evidence to support this. In particular the well-documented summer impacts of stratospheric ozone depletion (the Antarctic ozone hole) on the westerly winds over the Southern Ocean (Gillett and Fyfe, 2013; Thompson and Solomon, 2002) and resulting influences on ocean circulation and warming of the eastern Antarctic Peninsula (Fig. 3) (Marshall et al., 2006).

However, in addition to responses to external drivers, Antarctic climate trends have some of the largest contributions from internal variability in comparison to the rest of the globe (see Fig. 2, which is taken from Hawkins et al. (2016)). As a consequence of this large natural variability, Hawkins et al. (2016) found that even in a scenario of rapid global warming there is a high chance of observing a local multi-decadal Antarctic cooling trend generated purely by internal climate variability.

A key question is the extent to which this large internal variability can be predicted and thereby provide skill in near-term climate change estimates. On timescales of less than ~10 years there is predictability in modes of internal climate variability such as El Niño–Southern Oscillation (ENSO), which due to their influence on high southern latitudes (Purich et al., 2016; Schneider et al., 2015) may potentially help to improve predictions for Antarctica. However, different ENSO events have been found to have contrasting impacts on Antarctica and more research is needed to improve our understanding of this link (e.g. Wilson et al., 2016). On decadal to multi-decadal timescales there is increasing evidence for strong variability generated internally by deep convection within the Southern Ocean (Zhang et al., 2019). This is relevant to predicting near-term change both within the Southern Ocean (and related trends in, for example, marine ecosystems (Cavanagh et al., 2017)) and terrestrial Antarctica, which is strongly influenced by the surrounding Southern Ocean (Bracegirdle et al., 2015; Holloway et al., 2016; Krinner et al., 2014). It is also relevant globally since the linkage between the upper and lower limbs of the Meridional Overturning Circulation takes place in the Southern Ocean by means of the formation of the dense Antarctic Bottom Water (AABW). AABW plays a key role not only in regulating the distribution of heat around the globe but in its uptake, together with the anthropogenic CO_2 (Thompson et al., 2018). The Southern Ocean is changing rapidly which could mean that in the near future its role in the regulation of climate could weaken or reverse given that the system is warming and freshening (Zhang et al., 2017).

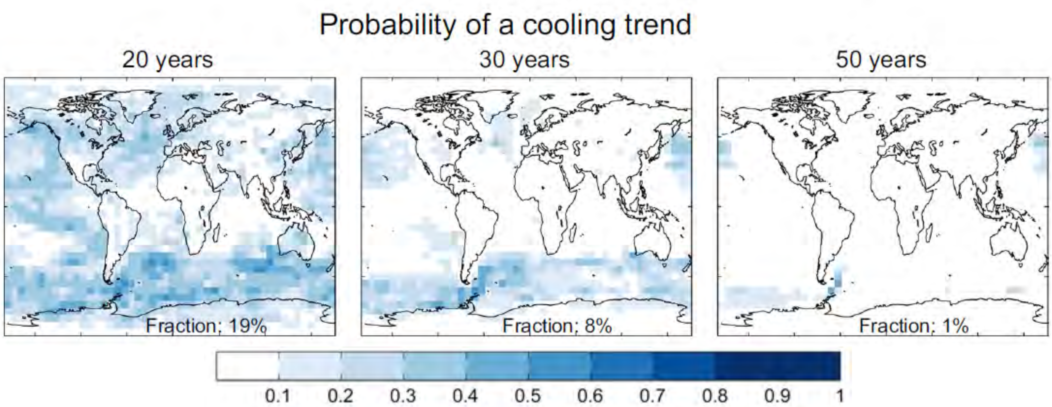

Figure 2. *Climate model estimates of the probability of the occurrence of a cooling trend in a warming world under a quadrupling of CO2 over 140 years for linear trends of 20, 30 and 50 years. From Fig. 5 of Hawkins et al. (2016).*
The probability maps shown are based on a simplified climate modelling framework which can provide a highly valuable picture of the relative importance of greenhouse gas-forced climate change and the impact of internal climate variability (or unforced noise). Reconstructions of past temperature (Fig. 3) are qualitatively consistent with output from climate model simulations, which exhibit large decadal variability evident over West Antarctica. The reliability of estimates of Antarctic climate in the near term depend strongly on whether climate models can reliably reproduce the observed multi-decadal climate variability, which is a major component of the trends evident in Fig. 3.

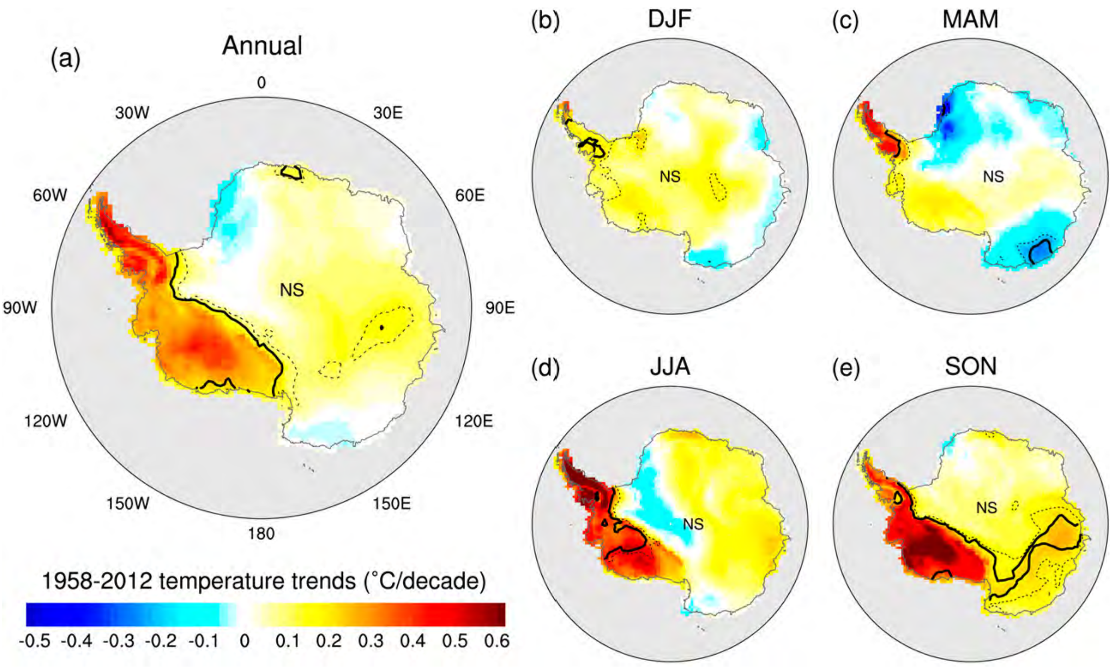

Figure 3. *Reconstructed linear trends of 2-m air temperature over Antarctica from station observations from 1958-2012 (Figure 4 from Nicolas Bromwich (2014)). Notice the strong warming over West Antarctica, and little or no change over East Antarctica.*

Rationale / justification (why now?)

- There is an urgent need to provide policy-makers, and those tasked with mitigating future climate, with estimates on how Antarctic climate may change in the near term.
- One of the Grand Challenges of the World Climate Research Programme (WCRP) is Near-term Climate Prediction.
- A wide range of recent observational and modelling studies (https://journals.ametsoc.org/topic/connecting_tropics_to_polar) has set the stage for rapid advances in understanding and predicting annual to multi-decadal climate variability in Antarctica.
- The latest version of WCRP Coupled Model Inter-comparison Project (CMIP6) is producing results including new decadal prediction simulations and simulations targeted at understanding the causes and consequences of polar climate change.
- New syntheses providing reconstructions of past Antarctic climate and its variability are being produced that are potentially highly valuable in evaluating climate model skill in representing natural variability and thus indicating the reliability of model-derived envelopes of possible near-term conditions over Antarctica.
- Improved ocean observations from initiatives such as the Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM) project which is part of the Southern Ocean Observing System (SOOS) are currently providing a wealth of new information that is highly important for improving process understanding and for climate model evaluation.

Synergies with other SCAR initiatives

- The Integrated Science to Support Antarctic and Southern Ocean

Conservation (Ant-ICON) PPG
The topic of near-term climate prediction is highly relevant to this PPG. There is clear potential for collaboration.

- The Antarctic Ice Sheet Dynamics and Global Sea Level (AISSL) PPG
  Collaborate on areas of science that are related, such as tropical linkages and estimates of future conditions to 2050.
- International Partnership in Ice Core Sciences (IPICS)
  Work with the international ice core community to promote the targeted collection and synthesis of proxy data suitable for model comparison.

Non-SCAR projects

- Mass2Ant - http://www.climate.be/php/users/klein/Mass2Ant/
- PARAMOUR - http://www.climate.be/php/users/klein/PARAMOUR/index.html
- SIPN-South - http://www.climate.be/users/fmasson/SIPN-South_20170621.pdf
- CLIVASH2K - http://pastglobalchanges.org/ini/wg/2k-network/projects/clivash

c. Experimental section and methodologies [15%]

To address the science objectives, key questions have been identified where there are clear opportunities for progress. These opportunities come from a combination of new modelling/observational capabilities and datasets alongside new analysis techniques in the rapidly-developing field of data science / machine learning. Answering all the key questions in full would require additional funding and/or support. AntClimNow would aim to coordinate efforts to gain support for research contributing to achieving the proposed objectives.

Major datasets and analysis tools that will be fundamental to answering the key questions are as follows:

- The WCRP Coupled Model Inter-comparison Project Phase 6 (CMIP6). Within which the key sub-projects are:
  - The Decadal Climate Prediction Project (DCPP).
  - The Antarctic component of the Coordinated Regional Downscaling Experiment (CORDEX).
- Decadal prediction systems (e.g. the UK Met Office DePreSys).
- Climate reconstructions based on in situ observations and climate proxies.
- Data science and machine learning.
- Reanalysis products

Key question 1: How large is real-world multi-decadal variability of the Antarctic climate system, and how well represented is it in the current generation of climate / earth-system models? Can we make better use of existing satellite remote sensing data and work to prepare better for new datasets? This relates to Objectives 1, 2 and 3.
<u>Methodology</u>**:** Utilise current advances in proxy reconstructions of Antarctic climate and surface mass balance variability in recent centuries and develop cross-disciplinary collaborations to help make the best use of such information in the evaluation of climate models. Identify priorities for new observations and use these and existing data to the improvement representation of important and/or missing processes in models.

Key question 2: What are the main drivers of annual-to-multi-decadal variability of Antarctica, the Southern Ocean and its ice-atmosphere interactions? This question relates both to Objectives 1 and 2.
Methodology**:** Key approaches to addressing this question are: (i) Use data science techniques (i.e. a range of statistical methods including recent advances in machine learning) to identify potential internal and extra-polar drivers of variability from observational and climate model datasets. (ii) Examine causality inferred from statistical results by conducting model-based sensitivity studies. (iii) Test the realism of climate model depictions through targeted investigations of new and existing in-situ and proxy observational datasets. (iv) Evaluate, and promote the development of, coupled high-resolution models of the Southern Ocean and Antarctica which for example are important for simulating internal modes of variability in the Southern Ocean.

Key question 3: How predictable is the Antarctic climate system on annual-to-decadal timescales? This relates to Objective 3 and 4.
Methodology**:** Planned ways of addressing this question are: (i) Assess output from the latest decadal prediction systems from leading weather and climate modelling centres. (ii) Complement dynamical modelling with statistical / machine learning approaches. (iii) Improve estimates of future change at high spatial resolution over key parts of Antarctica using high-resolution climate modelling and downscaling, for example in collaboration with Antarctic-CORDEX.

Key question 4: How can the uncertainties inherent in prediction for the near term be best communicated to policy decision-makers and what information can be provided that would improve decision making? This relates to Objective 5.
Methodology**:** Facilitate discussions and workshops at which policymakers and scientists can discuss the issues and involve experts in the communication of scientific information/uncertainty to non-experts.

Deliverable outcomes from the proposed programme

- Develop clear coherent messages from within the climate science community to the wider community and stakeholders on the latest science on near-term climate prediction.
- Bring together scientists from a range of backgrounds to develop a community focussed on near-term Antarctic climate prediction.
- Use this community to facilitate scientific advances in near-term climate change estimates for Antarctica.
- Improved communication between Antarctic stakeholders and climate scientists through links with the proposed Ant-ICON SRP.

d. Management and reporting (including a Scientific Steering Committee) [10%]

TBD

e. Milestones, outcomes, outputs[2], and benefits (including metrics of performance) [15%]
TBD

f. Data management plan [10%]
SCADM will be consulted in developing plans for data collection and management. For paleoclimate data we will follow standards proposed by the PAGES community.

Existing data sources relevant to AntClimNow include:

1. The CMIP6 dataset. In particular (but not restricted to) the sub-projects:
    a. DCPP - Decadal Climate Prediction Project (DCPP);
    b. ScenarioMIP - future climate forcing scenario projections;
    c. FAFMIP - Flux-Anomaly-Forced Model Intercomparison Project;
    d. CORDEX - Coordinated Regional Climate Downscaling Experiment; and
    e. PMIP - Palaeoclimate Modelling Intercomparison Project.
2. Atmosphere and ocean re-analysis products, details TBC.
3. Satellite remote sensing products of the ocean/atmosphere/ice system, details TBC.
4. In-situ observational datasets, details TBC.

g. Capacity building, education and training plan [10%]
We will work with the Association of Polar Early Career Scientists (APECS), ensuring participation of early career researchers at all events and encouraging more senior members to act as APECS mentors.

Encourage and support the participation of researchers from developing countries in ANtClimNow events and activities.

Outreach activities (webinars, youtube videos, talks, brochures, etc) in collaboration with other SRP's.

h. References
Arblaster, J. M., G. A. Meehl, and D. J. Karoly, 2011: Future climate change in the Southern Hemisphere: Competing effects of ozone and greenhouse gases. *Geophysical Research Letters*, **38,** L02701.

Barnes, E. A., N. W. Barnes, and L. M. Polvani, 2014: Delayed Southern Hemisphere Climate Change Induced by Stratospheric Ozone Recovery, as Projected by the CMIP5 Models. *Journal of Climate*, **27,** 852-867.

Bracegirdle, T. J., D. B. Stephenson, J. Turner, and T. Phillips, 2015: The importance of sea ice area biases in 21st century multimodel projections of Antarctic temperature and precipitation. *Geophysical Research Letters*, **42**.

[2] Note that where possible the outreach activities and associated outputs from the SRP should be produced in collaboration with the other SRPs ; joint outreach activities and outputs are encouraged

Cavanagh, R. D., and Coauthors, 2017: A Synergistic Approach for Evaluating Climate Model Output for Ecological Applications. *Frontiers in Marine Science*, **4**.

Gillett, N. P., and J. C. Fyfe, 2013: Annular mode changes in the CMIP5 simulations. *Geophysical Research Letters*, **40,** 1189-1193.

Hawkins, E., R. S. Smith, J. M. Gregory, and D. A. Stainforth, 2016: Irreducible uncertainty in near-term climate projections. *Climate Dynamics*, **46,** 3807-3819.

Holloway, M. D., L. C. Sime, J. S. Singarayer, J. C. Tindall, P. Bunch, and P. J. Valdes, 2016: Antarctic last interglacial isotope peak in response to sea ice retreat not ice-sheet collapse. *Nature Communications*, **7**.

Kennicutt, M. C., II, and Coauthors, 2014: Polar Research: Six priorities for Antarctic science. *Nature*, **512,** 23-25.

Kirtman, B., and Coauthors, 2013: Near-term Climate Change: Projections and Predictability. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press.

Krinner, G., C. Largeron, M. Menegoz, C. Agosta, and C. Brutel-Vuilmet, 2014: Oceanic Forcing of Antarctic Climate Change: A Study Using a Stretched-Grid Atmospheric General Circulation Model. *Journal of Climate*, **27,** 5786-5800.

Marshall, G. J., A. Orr, N. P. M. van Lipzig, and J. C. King, 2006: The impact of a changing Southern Hemisphere Annular Mode on Antarctic Peninsula summer temperatures. *Journal of Climate*, **19,** 5388-5404.

Nicolas, J. P., and D. H. Bromwich, 2014: New Reconstruction of Antarctic Near-Surface Temperatures: Multidecadal Trends and Reliability of Global Reanalyses. *Journal of Climate*, **27,** 8070-8093.

Purich, A., and Coauthors, 2016: Tropical Pacific SST Drivers of Recent Antarctic Sea Ice Trends. *Journal of Climate*, **29,** 8931-8948.

Schneider, D. P., C. Deser, and T. T. Fan, 2015: Comparing the Impacts of Tropical SST Variability and Polar Stratospheric Ozone Loss on the Southern Ocean Westerly Winds. *Journal of Climate*, **28,** 9350-9372.

Thompson, A. F., A. L. Stewart, P. Spence, and K. J. Heywood, 2018: The Antarctic Slope Current in a Changing Climate. *Reviews of Geophysics*, **56,** 741-770.

Thompson, D. W. J., and S. Solomon, 2002: Interpretation of recent Southern Hemisphere climate change. *Science*, 895-899.

Wilson, A. B., D. H. Bromwich, and K. M. Hines, 2016: Simulating the Mutual Forcing of Anomalous High Southern Latitude Atmospheric Circulation by El Nino Flavors and the Southern Annular Mode. *Journal of Climate*, **29,** 2291-2309.

Zhang, L. P., T. L. Delworth, W. Cooke, and X. S. Yang, 2019: Natural variability of Southern Ocean convection as a driver of observed climate trends. *Nature Climate Change*, **9,** 59-+.

Zhang, L. P., T. L. Delworth, X. S. Yang, R. G. Gudgel, L. W. Jia, G. A. Vecchi, and F. R. Zeng, 2017: Estimating Decadal Predictability for the Southern Ocean Using the GFDL CM2.1 Model. *Journal of Climate*, **30,** 5187-5203.

Supporting information (2 pages)

i. Short biosketch and homepage URL for proposed Chief Officer(s) and lead investigator(s)

These details are still to be decided.

ii. Justification for SCAR sponsorship (why does SCAR support add value?)

SCAR provides a number of benefits to a research programme of this type. In particular by:

1. facilitating collaboration across disciplines;
2. helping to raise the profile of the proposed research themes and thus supporting efforts to secure funding in these areas;
3. providing a valuable link between science and Antarctic stakeholders;
4. supporting the development of the next generation of scientists; and
5. providing a voice to bring major science findings or priorities to the attention of global bodies such as the IPCC and the World Climate Research Programme.

As the proposal if finalised, specific benefits relating to the Key Questions and Objectives will be clarified.

iii. International involvement and partnerships

There are 14 countries represented across the 38 members of the AntClimNow PPG. This highlights the strong international appetite for a programme on near-term climate change and variability. Six of these 38 are new members who joined during the May-June consultation phase.

Table 1. Core membership as of 15 June 2019. The Asterisks denote early-career researchers. In total there are 14 different countries represented.

Name		Country	Expertise
Nerilie	Abram	Australia	Atmo variability from proxies
Erik	Behrens	NZ	Physical ocean modeller
Nancy	Bertler	NZ	Climate variability from ice cores
Azizan	bin Abu Samah	Malaysia	Atmospheric dynamics (TATE)
Tom	Bracegirdle	UK	Meteorology (physical sciences)
David	Bromwich	USA	Atmo trends and variability

Rachel	Cavanagh	UK	Marine ecologist (Ant-ICON and ICED)
*Sheeba	Chenoli	Malaysia	Atmospheric dynamics (TATE)
Raul	Cordero	Chile	In situ radiation / ozone (YOPP)
Stuart	Corney	Australia	Marine physical and ecosystem modeller
Matt	England	Australia	Physical ocean modeller
Ryan	Fogt	USA	Atmo trends and variability
John	Fyfe	Canada	Ocean/atmos trends and processes
Christophe	Genthon	France	Surface and atmosphere observations
Günther	Heinemann	Germany	Remote sensing sea ice, atmo modelling
Will	Hobbs	Australia	Sea ice trends and variability
Scott	Hosking	UK	Environmental data scientist
Julie	Jones	UK	Atmo variability
*Alia	Khan	USA	Chemical pollutants and aerosols
Seong-Joong	Kim	Republic of Korea	Atmospheric dynamics (modeller)
*Jasmine	Lee	Australia	Terrestrial ecologist
*Jan	Lenaerts	USA	Surface mass balance atmo modelling
*Francois	Massonnet	Belgium	Sea ice trends and prediction
Martin	Menegoz	France	Climate var decadal forecasts
Andrew	Orr	UK	Atmospheric high resolution modelling
Steven	Phipps	Australia	Climate modeller and palaeoclimatologist
*Ariaan	Purich	Australia	Ocean/atmosphere trends
Marilyn	Raphael	USA	Sea ice modelling and observations
James	Renwick	NZ	Patterns of atmospheric variability
Joellen	Russell	USA	Southern Ocean modeller
Jiuxin	Shi	China	Ice-ocean interactions
Doug	Smith	UK	Decadal prediction and atmo variability (UK Met Office)
Craig	Stevens	NZ	Physical oceanographer

Aleks	Terauds	Australia	Ecologist and link to Ant-ICON
Liz	Thomas	UK	Climate variability from ice cores
John	Turner	UK	Atmo dynamics
Ilana	Wainer	Brazil	Atmo/ocean modeller modern/paleo
Takashi	Yamanouchi	Japan	Atmo physics, polar climatology

iv. Budget justification (other potential sources of funds)

TBC

v. Other information (information useful to evaluators)

APPENDIX: SCAR guidelines

Selection and Evaluation of Scientific Research Programmes

February 2019

Scientific Research Programmes (SRPs) are transformative scientific initiatives that address compelling issues and emerging frontiers in Antarctic or Southern Ocean science of regional and global importance. SRPs are SCAR's highest level of investment in science. SRPs advance scientific questions that are expected to require sustained efforts by international teams of scientists and researchers for six to eight years. SRPs are developed and proposed by Programme Planning Groups (PPGs) fostered by one or more Scientific Groups (SGs). A PPG develops a proposal for an SRP based on wide consultation with the community.

SCAR can only financially support a finite number of SRPs. All SRP proposals are subject to an extensive and rigorous evaluation and selection process to ensure the highest quality. The selection process is managed by the Secretariat in consultation with the Executive Committee with final approval by the Delegates.

To ensure a transparent, objective, and equitable evaluation and selection process, all SRP proposal submissions must follow the instructions below.

1. The Programme Planning Group

The SRPs will be developed and proposed by **Programme Planning Groups** (PPGs) fostered by one or more of SCAR's **Scientific Groups**.

Before an PPG is established, the fostering body or bodies will submit a title and brief (1-2 page) outline of the proposed **Scientific Research Programme** (SRP), plus a suggested chief officer and initial core membership for the SPPG, for consideration by **the SCAR executive.** Outline bids are required 6 weeks before the meeting of the relevant review body. The Executive will review these bids, decide on priorities, and agree which ones to approve for further development. They will inform the SCAR Delegates of their decisions. In the years of SCAR Delegates meetings, the Executive may elect to request PPG bids to be presented to Delegates for their perspectives. For those bids approved, a **Programme Planning Group (PPG)** will be established and the level of any SCAR funding needed to support the work of the PPG will be set.

The PPG will first produce a Science and Implementation Plan for the proposed SRP. The plan should follow the structure and provide the information outlined below in section 2. The plan will be subject to a review and selection process managed by the SCAR Executive with the support of the SCAR Secretariat and set out in section 3.

2. Content and structure of the Science and Implementation Plan for a proposed SCAR Scientific Research Programme.

The Science and Implementation Plan is prepared by the Science Programme Planning Group for the activity. The plan should ideally be no longer than 15 pages in total (including diagrams, and at no smaller than 12 pt font, except for references which may be in 10 pt font).

3. Selection of Scientific Research Programmes

The timeline for the submission of proposals in 2020 is shown in the table below.

Deadline	Action	Notes
- 6 weeks before July 2019 executive committee meeting	PPG submits draft science and implementation plan to SCAR Secretariat. Secretariat in consultation with SCAR Excom, seeks review as appropriate.	At this stage the draft plan should focus on scientific aspects of the proposal rather than implementation aspects.
July 2019 executive committee meeting	One-day workshop for chief officers of PPGs	
	PPG presents draft plan to SCAR Executive committee and receives feedback	
-23 weeks before 2020 Delegates meeting	PPG submits a 'letter of intent' to the SCAR Secretariat declaring the intention to submit a proposal to the 2020 Delegates' Meeting. PPG identifies a minimum of 6 external reviewers for consideration by EXCOM.	
- 12 weeks (minimum)	Final proposals submitted to the SCAR Secretariat. Secretariat seeks external evaluations of the plan in consultation with the SCAR Executive Committee. Proposals are forwarded to SCAR Delegates for consideration. Proposals are also circulated to COMNAP for information and informal comments.	

-6 weeks	External and Delegate Evaluations due to the Secretariat. Evaluations are distributed to the Delegates, SGs, Standing Committees, and PPG.	
-2 weeks	Deadline for written comments from SCAR Delegates on proposals	
-1 week	Proponents present proposals to the SG plenary and provide responses to evaluations.	
-1 week	SGs and SCs provide proposal evaluations in reports to the Delegates	
0 weeks	Final proposals to the SCAR Delegates followed by decision	

External reviews by experts will be solicited. The SGs and Standing Committees will evaluate SRP proposals and report their evaluations to the Excom for transmission to the Delegates. The Delegates will be given the opportunity to consider and comment on proposals prior to the Delegates' Meeting. Proponents will be provided evaluation comments and afforded an opportunity to respond to comments during the biennial meetings' presentations.

The Delegates will be provided with the proposals, all evaluations, and responses to evaluations as available. SSG leadership (or proponents) will present their programs to the Delegates and answer questions followed by approval or rejection of proposals by the Delegates.

Evaluation criteria

• Scientific merit and quality + rationale for SCAR involvement (sections a and b)

- Does the SRP address fundamental scientific objectives that will produce transformative results?

- How will the SRP advance knowledge in keeping with global priorities, leading questions in the field of study, and SCAR's strategic plan?
- How does this SRP topic compare with other important research in the polar regions?
- Is innovative and high quality science proposed that builds on previous knowledge in the field?
- Is SCAR's support for the SRP critical to the success of the research?
- Will frontiers in science be advanced at the conclusion of the SRP?
- Will the SRP enhance and/or improve the profile and global relevance of SCAR science?
- Does the SRP materially contribute to SCAR's Strategic Plan? LINK TBC
- Does the SRP strengthen SCAR's scientific portfolio?
- Does the SRP fill a gap in SCAR's scientific activities?

• **Soundness of the approach, likelihood of success and impact (section c and d)**
- How likely is success in addressing the scientific objectives?
- Are there significant barriers to success not recognized by the proponents?
- Is the SRP feasible from an operational and technical viewpoint?
- Do the data/observations exist to support the program objectives?
- How significant and practical are the proposed interdisciplinary elements?
- Is there significant activity or proposed activity in this area by National Antarctic Programs that will ensure the success of the program?
- Is there adequate leverage of SCAR funds with other sources of funding?
- Are the management and reporting mechanisms practical and proportionate?

- Scientific outcomes – including international partnerships (section e)
    - Are plans to communicate SRP outcomes to a wider audience sufficient?
    - Will scientific outcomes support scientific advice to policy and decision makers?
    - International Involvement and Partnerships
        - Does the SRP involve, or have the potential to involve, multiple SCAR nations and/or nations beyond SCAR?
        - Are there significant links to relevant international programmes external to SCAR?
        - Is a substantial community involved in and likely to benefit from the program's outcomes?

• **Data Management Plan** (section f)
- Does the plan adequately address issues of data archiving and access?
- Are data management plans sufficient to ensure preservation of data and wide availability?
- Does the plan support the SCAR Data and Information Management Strategy? LINK TBC
- Is there a direct link to SCADM?
- Are SCAR products utilized when relevant?

• **Capacity Building, Education and Training Plan (section g)**
- Does the proposal adequately address issues of capacity building, education and training?
- Does the program support the SCAR CBET Plan?
- Are nations with less well developed Antarctic Programmes likely to participate and contribute?

- Are Early Career scientists likely to participate?

Evaluation Classification

Based on the above criteria, evaluators are asked to classify each proposal into one of the three categories:

A. THE SRP SHOULD BE APPROVED- Excellent science in terms of quality, importance and timeliness with a good “fit” to SCAR’s Strategic Plan. Data management, CBET, and outreach plans are in place and likely to succeed. The SRP will raise SCAR’s international profile and be an important addition to the SCAR science portfolio. The SRP as described is feasible and is likely to enhance international and interdisciplinary connections and partnerships. The SRP also has the potential to deliver policy-relevant science (where appropriate). There may be some minor revisions or clarifications needed (communicated to the proponents), but the SRP is ready to proceed.
B. THE SRP SHOULD BE CONDITIONALLY APPROVED - Excellent science in terms of quality, importance and timeliness with a good “fit” to SCAR’s Strategic Plan. Data management, CBET, and outreach plans are in place and likely to succeed. BUT there are some improvements that have been suggested by evaluators that must be addressed. SCAR Delegates or the next SCAR Executive Committee meeting, whichever comes first, should be provided with a revised proposal for re-evaluation. The SRP is fundable, but is not ready to proceed in its present form.
C. THE SRP SHOULD NOT BE APPROVED-The plan does not meet the standards required to justify SCAR’s support or endorsement. The SRP needs significant revision based on the evaluations before resubmission. A resubmission will be subjected to the entire evaluation and selection process. The SRP is not fundable in its present form.

Because SCAR can only financially support a limited number of SRPs, evaluators will also be asked their opinion as to whether the proposed program rises to the level of a SCAR SRP (from the perspective of scientific objectives, scope, community served, participation, and impact). Could the same results be realized through alternative mechanisms (e.g., Action Group, Expert Group) Additional written comments from evaluators are valued and encouraged as they will greatly assist proponents in responding to any perceived deficiencies in the proposals.