

# Antarctic Climate Change and the Environment Decadal Synopsis – **Update to ATCM 45**

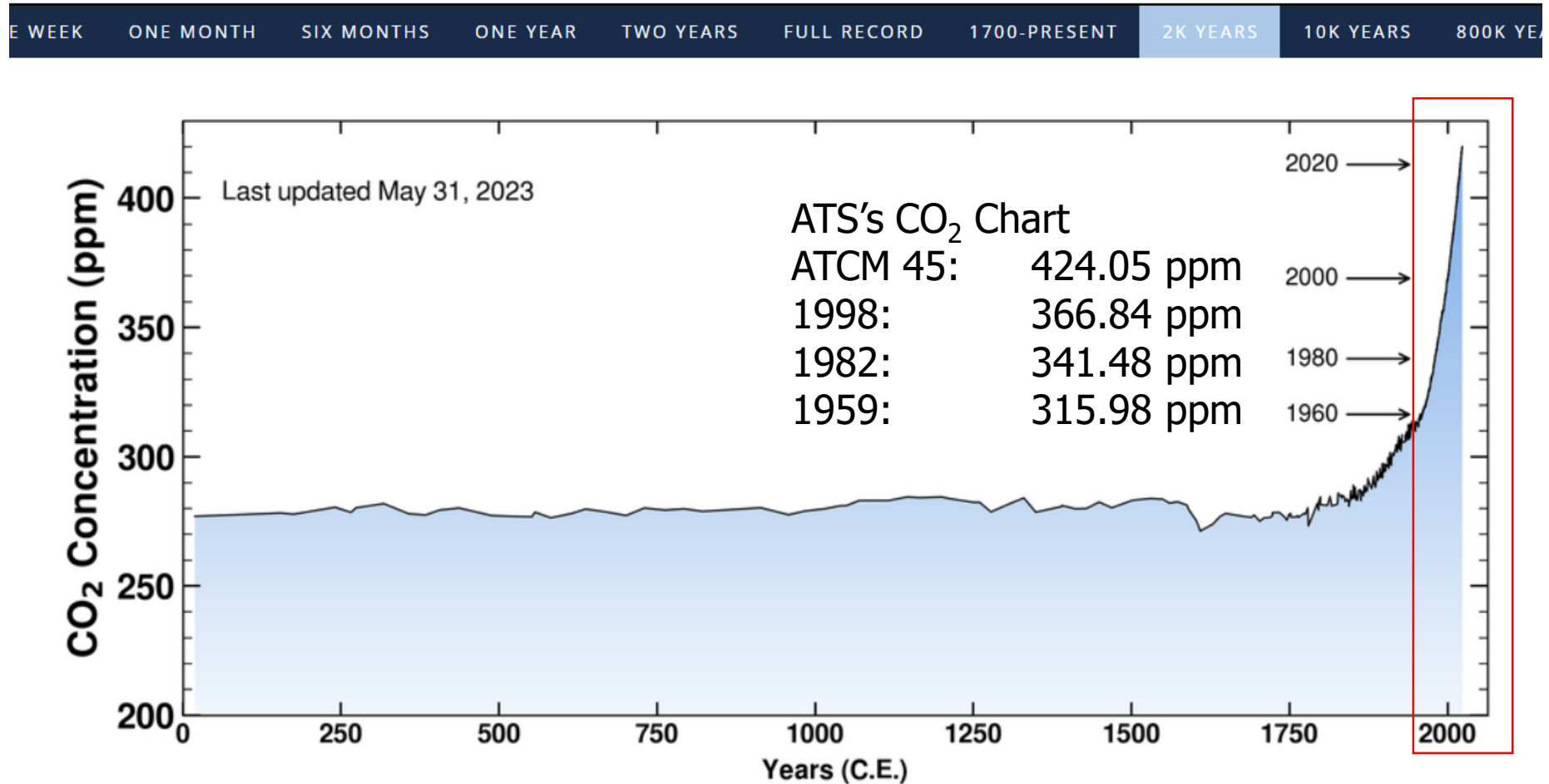
Steven L Chown

[www.arcsaef.com](http://www.arcsaef.com)



# #Delta108

\*Latest CO<sub>2</sub> reading: 424.05 ppm



\*MLO data from the most recent month is [preliminary](#)

# Antarctic Climate Change and the Environment

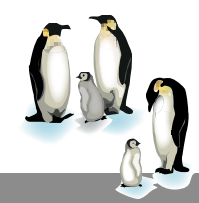
A DECADAL SYNOPSIS AND  
RECOMMENDATIONS FOR ACTION



STEVEN L CHOWN  
RACHEL I LEIHY  
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SUSIE M GRANT

- Summary
- Environmental Change Summary
- Six Chapters on Change and Projections
- Nine Policy Recommendations
- Nine Research Recommendations
- Guide to Context and Report Use
- Specific Focus on Global and Regional Change and Responses
- <https://www.scar.org/policy/acce-updates/>



# **Antarctic Climate Change and the Environment Decadal Synopsis – Simple Messages**

Antarctica is Not a Side-Event

Urgency • Collaboration • Agency

# Why Antarctica is Not a Side-Event

## SEA LEVEL



Ice sheet contributions to global mean sea level rise have **increased**  
but the contribution so far has been small

Current expectations for 2100 Antarctic contributions are **UNCERTAIN**

Projections  
0.03 - 0.34 m



or  
0.02 - 0.56 m  
or  
 $\approx 0.7$  m



including non-linear processes

non-linear processes could lead to an increase of up to



13m

by 2300

## Global Mean Sea Level Rise

$\sim 2.0$  m by 2100?

13 m by 2300?

Loss of an entire territory or the exile of an entire population is unprecedented, introducing unparalleled scenarios of state dissolution and possible statelessness...

Hauer *et al.* 2020 *Nature Rev. Earth Env.*



DECLARATION ON  
PRESERVING MARITIME ZONES  
IN THE FACE OF  
CLIMATE CHANGE-RELATED  
SEA-LEVEL RISE





# Why Antarctica is Not a Side-Event

## ARTICLES

<https://doi.org/10.1038/s41561-019-0456-x>

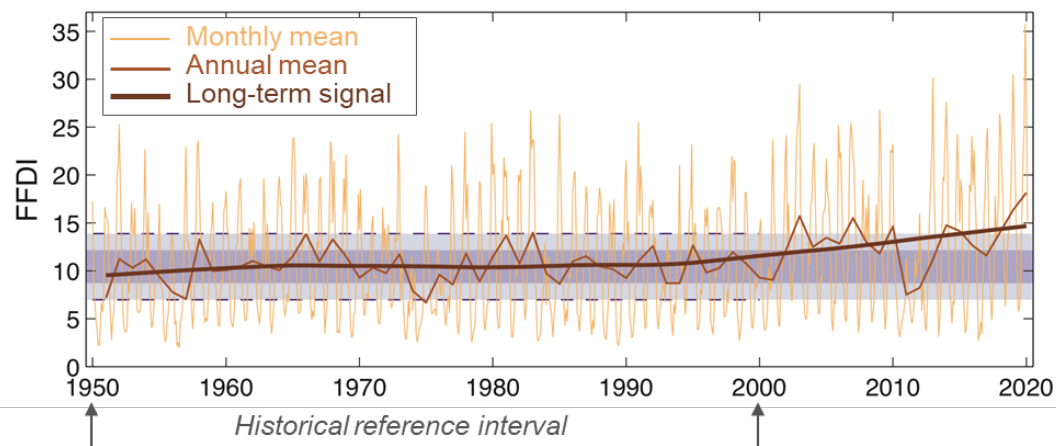
nature  
geoscience

## Australian hot and dry extremes induced by weakenings of the stratospheric polar vortex

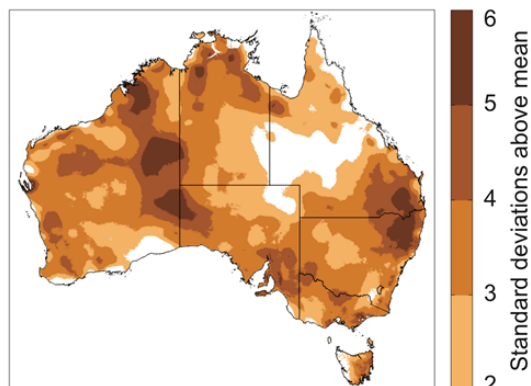
Eun-Pa Lim<sup>1\*</sup>, Harry H. Hendon<sup>1</sup>, Ghyslaine Boschat<sup>2,3</sup>, Debra Hudson<sup>1</sup>,  
David W. J. Thompson<sup>4</sup>, Andrew J. Dowdy<sup>1</sup> and Julie M. Arblaster<sup>2,3,5</sup>

FFDI = Forest Fire Danger Index

### Southeast Australia FFDI



### 2019 FFDI



Lake Conjola, 31<sup>st</sup> December 2019  
Image by Matthew Abbott



COMMUNICATIONS  
EARTH&ENVIRONMENT

REVIEW ARTICLE

<https://doi.org/10.1038/s43247-020-00065-8>

OPEN

Check for updates

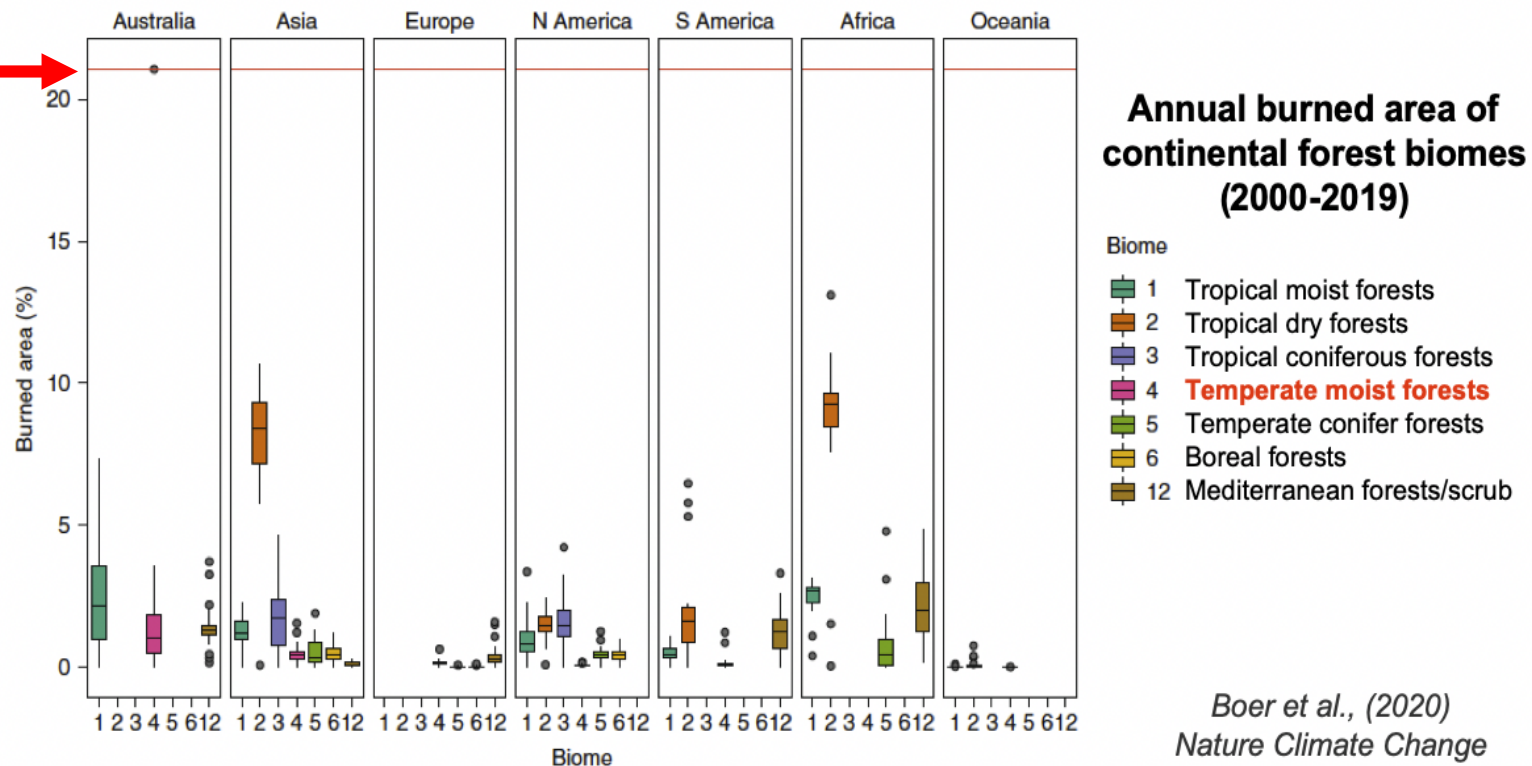
Connections of climate change and variability to large and extreme forest fires in southeast Australia

Nerilie J. Abram<sup>1</sup> et al.<sup>#</sup>

# Why Antarctica is Not a Side-Event

## Unprecedented burn area of Australian mega forest fires

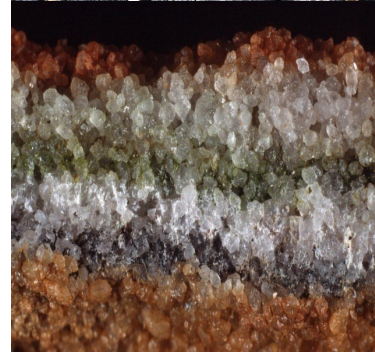
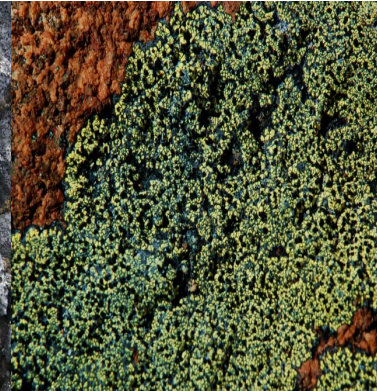
2019



>14 million hectares burned  
33 deaths  
>3 000 homes lost  
>1 Billion vertebrates killed



# Why Antarctica is Not a Side-Event





## Why Antarctica is Not a Side-Event

# Multiple energy sources and metabolic strategies sustain microbial diversity in Antarctic desert soils

Ortiz et al. [PNAS](#) 2021 Vol. 118 No. 45 e2025322118

The most abundant community members are metabolically versatile aerobes that use ubiquitous atmospheric trace gases to potentially meet energy, carbon, and, through metabolic water production, hydration needs.

The most abundant microbes in Antarctic desert soils can get everything they need – energy, food and water – from air!

Just air!

# Antarctic Climate Change and the Environment

A DECADAL SYNOPSIS AND  
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## Physical Science Updates

- Low minimum sea ice extent
- Extreme events and thresholds
- Atmospheric rivers affecting
  - Sea ice variation
  - Precipitation
  - Peninsula ice shelf stability
- Antarctic meltwater driving decline in Atlantic Meridional Overturning Circulation (think Gulf Stream) strength

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## Life Science Updates

- Silverfish population change along the Western Antarctic Peninsula associated with sea ice change and warming
- New range data for Emperor Penguin juveniles show additional requirements for protection
- Significant terrestrial impacts of even small non-native species, such as midges, that have become invasive on the continent
- High sensitivity of lake biota to warming and demonstration of need for more focus on lakes





# Urgency • Collaboration • Agency

## ACCE DS Recommendations Implementation

| Topic                                                | Recommendations |               |
|------------------------------------------------------|-----------------|---------------|
|                                                      | Research        | Policy        |
| Collaboration, Collaborative Research, Communication | RR1             | PR1, PR6, PR9 |
| Cryosphere Change and Implications                   | RR2, RR3, RR4   | PR2, PR3      |
| Climate Variability, Teleconnections, Impacts        | RR5             | PR5           |
| Ocean Change and Interactions                        | RR6             | PR4           |
| Biodiversity Change and Conservation                 | RR7, RR8, RR9   | PR7, PR8      |

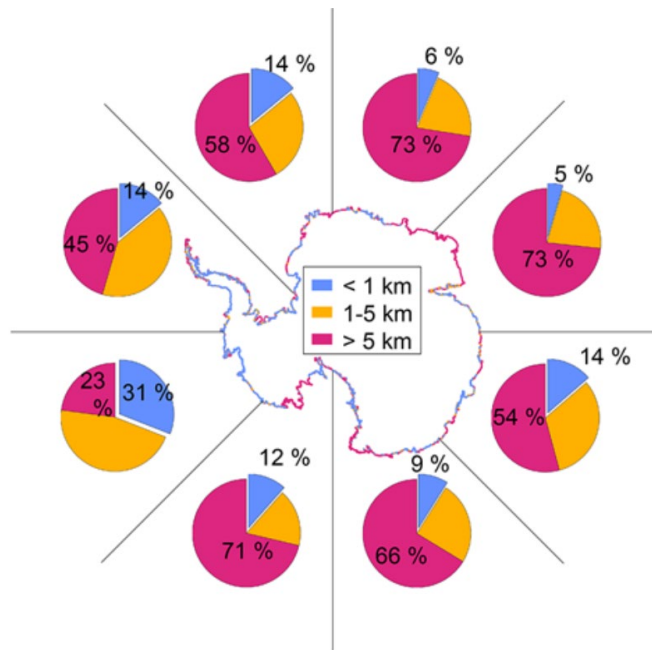
**ATCM 45 – Antarctica InSync**

# Implementation of ACCE DS Recommendations

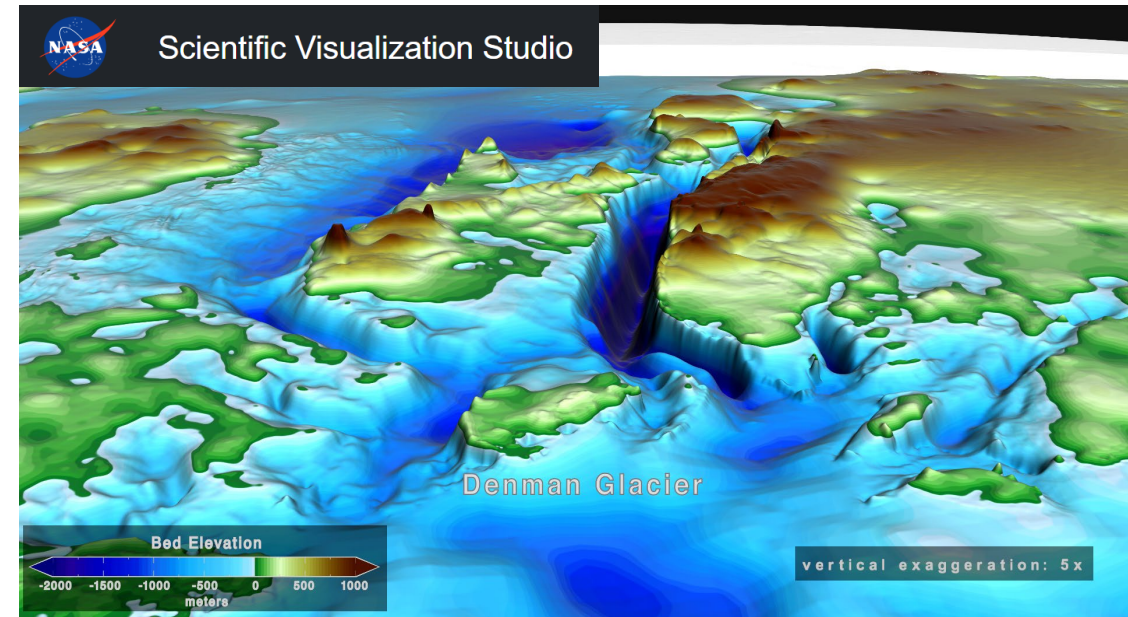
## Research at Scale for Antarctic Ice Sheet Change Projections



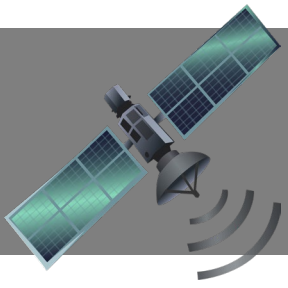
Ice thickness for more than half of the Antarctic margin is insufficiently sampled for the purposes of estimating ice discharge with a high degree of confidence



Radar measured bed elevation  
Matsuoka, K. *et al.* 2022, *Eos*  
<https://doi.org/10.1029/2022EO220276>



Implementation Actions to address:  
**PR2, PR3, PR4**  
**RR2, RR3, RR4**



# Implementation of ACCE DS Recommendations

## Data Transfer from Remote Sites



## Antarctic Roadmap Challenges Project

Once observations...are collected, a wide range of **cyber-infrastructure**, information and geospatial analysis technologies will be needed to retrieve, **process**, synthesize, preserve and **transmit** data (e.g. from remote locations on the continent, *in situ* instruments, remote sensors and observatories, and on ships).

Kennicutt, Kim, Rogan-Finnemore *et al.* 2016. *Antarctic Science*

Support for Implementation Actions



# Implementation of ACCE DS Recommendations

## Research at Scale for Teleconnections

**PNAS**

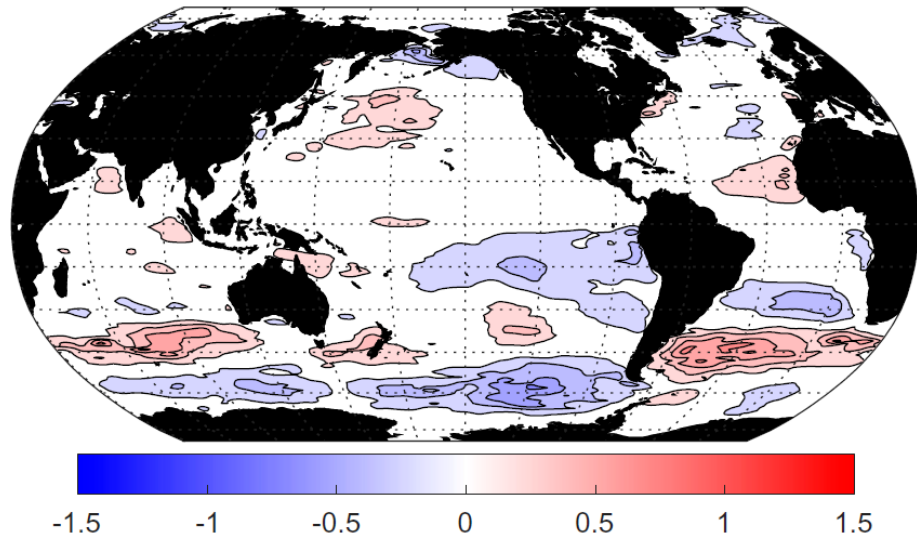
RESEARCH ARTICLE

EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

### The Antarctic ozone hole and the pattern effect on climate sensitivity

Dennis L. Hartmann<sup>a,1</sup>

SST SAM Response October-March



**Fig. 3.** Response of October–March monthly SST to the monthly SAM index, based on ERA-5 data (38). Contour interval is 0.15 K; zero contour is not plotted.

The SST cools in the southern Indian and Pacific Oceans in response to positive surface wind anomalies at 60°S, ...

In addition to these expected responses in high latitudes, cooling of SST is shown in the tropical eastern Pacific south of the equator.

These results are subject to uncertainty, ... but the weight of evidence ... suggests that some significant part of the cooling in the eastern tropical Pacific may be triggered by westerly wind accelerations associated with the Antarctic ozone hole.

Implementation Actions to address:

**PR5**

**RR5**

# Implementation of ACCE DS Recommendations

## Monitoring Tools for Management

DOI: 10.1111/cons.12884

PERSPECTIVE

Conservation Letters  
A Journal of the Society for Conservation Biology  
Open Access WILEY

### High-resolution satellite imagery meets the challenge of monitoring remote marine protected areas in the Antarctic and beyond

Michelle LaRue<sup>1,2</sup>  | Cassandra Brooks<sup>3</sup>  | Mia Wege<sup>1,4</sup>  | Leonardo Salas<sup>5</sup>  | Natasha Gardiner<sup>1,6</sup> 



Biodiversity Data Journal 11: e101476  
doi: 10.3897/BDJ.11.e101476



Data Paper

### Antarctic Penguin Biogeography Project: Database of abundance and distribution for the Adélie, chinstrap, gentoo, emperor, macaroni and king penguin south of 60 S

Christian Che-Castaldo<sup>‡</sup>, Grant Humphries, Heather Lynch<sup>‡</sup>

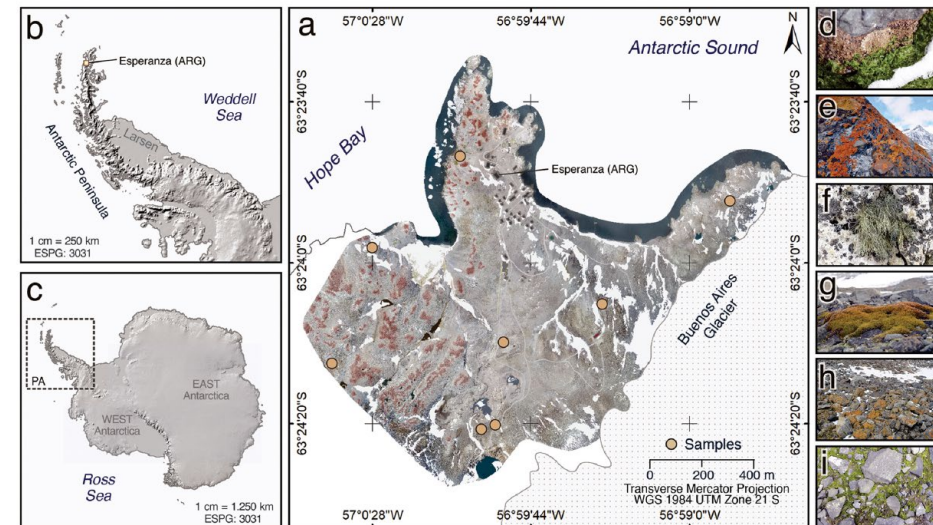
Ecological Informatics 71 (2022) 101768

### UAV-based classification of maritime Antarctic vegetation types using GEOBIA and random forest

Maria E. Sotille<sup>a,b,\*</sup>, Ulisses F. Bremer<sup>b,c</sup>, Gonçalo Vieira<sup>d</sup>, Luiz F. Velho<sup>b,e</sup>, Carina Petsch<sup>b,f</sup>, Jeffrey D. Auger<sup>b</sup>, Jefferson C. Simões<sup>b</sup>

M.E. Sotille et al.

Ecological Informatics 71 (2022) 101768



Implementation Actions to address:  
PR6, PR8, PR9  
RR1, RR7, RR9

# Implementation of ACCE DS Recommendations

## Action to Support Annexes II and V of the Protocol

scientific **data**

## Introduced and invasive alien species of Antarctica and the Southern Ocean Islands

Rachel I. Leihy<sup>1,2</sup> , Lou Peake<sup>3</sup> , David A. Clarke<sup>3</sup> , Steven L. Chown<sup>1</sup>   
& Melodie A. McGeoch<sup>3</sup> 

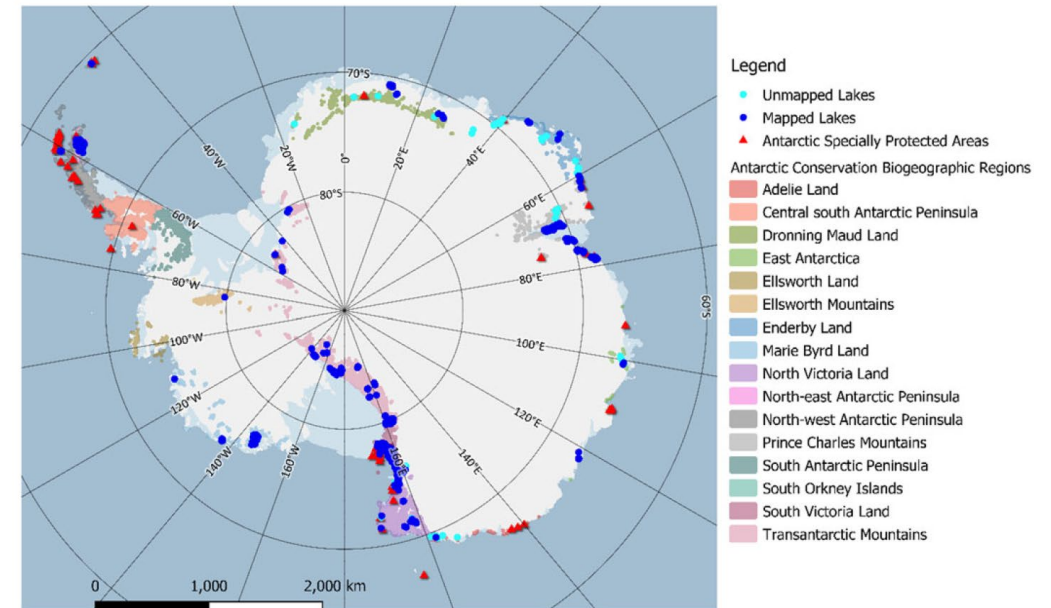
### The need for increased protection of Antarctica's inland waters

IAN HAWES<sup>1</sup> , CLIVE HOWARD-WILLIAMS<sup>2</sup>, NEIL GILBERT<sup>3</sup>, KEVIN A. HUGHES<sup>4</sup> , PETER CONVEY<sup>4,5</sup>   
and ANTONIO QUESADA<sup>6</sup> 

*Antarctic Science* 35(2), 64–88 (2023)

78

IAN HAWES *et al.*



Implementation Actions to address:

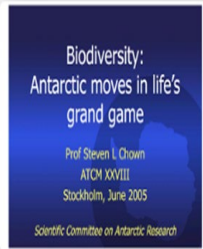
PR7, PR8

RR1, RR9



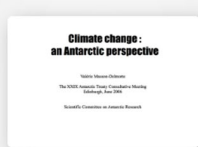
# SCAR – Providing Evidence and Advice

www.scar.org



SCAR Lecture 2005:  
Biodiversity: Antarctic  
Moves in Life's Grand  
Game

ATCM XXVIII and CEP  
VIII 2005, Stockholm,  
Sweden



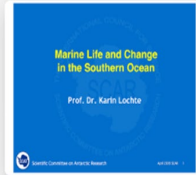
SCAR Lecture 2006:  
Climate Change: an  
Antarctic Perspective

ATCM XXIX and CEP IX  
2006, Edinburgh,  
Scotland

Lecture Slides

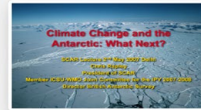
IP076: SCAR Lecture:  
Climate Change: an  
Antarctic Perspective  
(Lecture Slides)

by Valérie Masson-  
Delmotte



SCAR Lecture 2009:  
Marine Life and  
Change in the  
Southern Ocean

ATCM XXXII and CEP  
XII 2009, Baltimore,  
United States



SCAR Lecture 2007:  
Climate Change and  
the Antarctic: What  
Next?

ATCM XXX and CEP X  
2007, New Delhi,  
India

Lecture Slides

IP124: SCAR Lecture  
Climate Change and  
the Antarctic: What  
Next?

by Chris Rapley,  
President of SCAR,  
Member of the  
International Polar  
Year 2007-2008 Joint  
Committee, Director of  
the British Antarctic  
Survey



SCAR Lecture 2014:  
Back to the Future:  
Past Antarctic  
Climates, Ice Sheet  
History & Their  
Relevance for  
Understanding Future  
Trends

ATCM XXXVII and CEP  
XVII 2014, Brasilia,  
Brazil

Lecture slides

SCAR Lecture 2014:  
Back to the Future:  
Past Antarctic Climates,  
Ice Sheet History &  
Their Relevance for  
Understanding Future  
Trends

C. Escutia, Spanish  
Research Council,  
Granada, Spain & the  
SCAR PAIS Steering  
Committee



SCAR Lecture 2017:  
What does the United  
Nations Paris Climate  
Agreement mean for  
Antarctica?

ATCM XL and CEP XX  
2017, Beijing, China

SCAR Lecture 2017:  
What does the United  
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Slides)

Tim Naish

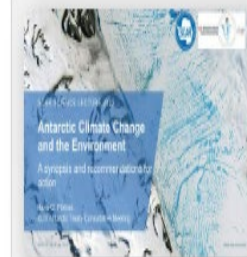


SCAR Lecture 2019:  
What does the Paris  
Climate Agreement  
Mean for Antarctic and  
Southern Ocean  
Environmental  
Protection?

ATCM XLII and CEP XXII  
2019, Prague, Czech  
Republic

SCAR Lecture 2019:  
What does the Paris  
Climate Agreement  
Mean for Antarctic and  
Southern Ocean  
Environmental  
Protection? (Lecture  
Slides)

Steven Chown



SCAR Lecture 2022:  
Antarctic Climate  
Change and the  
Environment A  
Synopsis and  
Recommendations for  
Action (Lecture Slides)



ANTARCTIC CLIMATE CHANGE AND  
THE ENVIRONMENT

A contribution to the International Polar Year 2007-2008

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Antarctica is not ours to keep.

But it is ours to lose.

# Acknowledgments



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## Images and Graphics

ACCE DS cover image by Chown, S.L., Leihy, R.I., Naish, T.R., Brooks, C.M., Convey, P., Henley, B.J., Mackintosh, A.N., Phillips, L.M., Kennicutt, M.C. II & Grant, S.M. (Eds.) (2022) *Antarctic Climate Change and the Environment: A Decadal Synopsis and Recommendations for Action*. Scientific Committee on Antarctic Research, Cambridge, United Kingdom. [www.scar.org](http://www.scar.org)

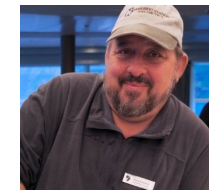
Firefighter image from Shutterstock. Vanderford Glacier by Dr Felicity McCormack. SCAR ExCom 2019 and SCAR/COMNAP at ATCM 2022 by SCAR. Emeritus Professor Dr Chuck Kennicutt by The Polar Initiative. Laura Phillips by LP. Climate protest by Dr Helena Baird. Lake Conjola image by Matthew Abbott. Marine organisms from SCAR and the Australian Antarctic Division. *Belgica antarctica* from Professor Rick Lee. Lichens by Dr Jennifer Lee. Seabirds in part by Professor Peter Ryan. Endolithic life by SCAR. Springtail by Charlene Janion-Scheepers. Other images by SL Chown.

Graphics drawn from publications as cited, and from Professor Nerilie Abram (bushfires). Logos by organisations.



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*In May, when the ATCM participants arrive in Finland, the Arctic tern, *Sterna paradisaea*, will also return from Antarctica to nest on our northern shores, as a greeting from the South Pole and a subtle reminder of the interconnected nature of our planet.*

