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Co-Chairs' Report from Antarctic Treaty Meeting of Experts on Implications of Climate Change for Antarctic Management and Governance

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Contents

Co-chairs' executive summary with advice for actions

The Antarctic Treaty Meeting of Experts on impacts of climate change for management and governance of the Antarctic region (ATME) was attended by 36 representatives of 15 Antarctic Treaty Parties, 8 invited experts from 4 organisations and one representative from the Antarctic Treaty Secretariat. The meeting took place in Svolvær, Norway on 7-9 April 2010. The ATME was convened in accordance with Decision 1 of ATCM XXXII which requested the meeting to examine the following topics relevant to the issue of climate change in Antarctica:

- key scientific aspects of climate change and consequences of such change to the Antarctic terrestrial and marine environment;
- implications of climate change to management of Antarctic activities;
- the need for monitoring, scenario planning and risk assessments;
- outcomes of the Copenhagen negotiations relevant for the Antarctic; and
- the need for further consideration of any of the above issues and manners in which this can be achieved.

Altogether 3 working papers and 13 information papers were submitted to the ATME and presented in plenary on the first day of the meeting. The wide-ranging contents of these papers were a major reason for the considerable progress that the ATME was able to make on the various issues. The work during the rest of the ATME was organised partly in working groups, partly in plenary. In the final plenary the Meeting reached agreement on all 30 recommendations in this report.

The Meeting underscored the importance of the SCAR's report on the Antarctic Climate Change and the Environment, the ACCE report, as a fundamental source of scientific information informing its deliberations, and the importance that the scientific knowledge presented in the report as well as its key findings should play in further consideration of topics related to climate change in the Antarctic.

The recommendations from the Meeting are listed below as a summary of the advice for actions by the Antarctic Treaty Consultative Parties:

Recommendation 1: The ATME recommends that the ATCM acknowledge and welcome the SCAR ACCE report as an important resource for its own deliberations and as an input to the wider global climate negotiations, e.g. the UNFCCC.

Recommendation 2: The ATME recommends that the ATCM considers developing an Antarctic climate change communication plan to bring the findings of the ACCE report to the attention of other decision makers, the general public and the media.

Recommendation 3: The ATME recommends that the ATCM consider how best to provide information about Antarctic climate change to fora discussing and negotiating global climate change.

Recommendation 4: The ATME recommends that Parties be requested to:

- acknowledge and encourage continuing efforts in developing and exchanging experience of energy efficiency and alternative energy practices so as to promote reduction of the carbon footprint of activities in Antarctica and cut fossil fuel use from stations, vessels, ground transportation and aircraft;
- solicit from COMNAP a report on progress on the implementation of its *Best Practice for Energy Management – Guidance and Recommendations* (endorsed by CEP X in Delhi), and ask for an update including details of best practices on energy efficiency and alternative energy deployment; and

- welcome the efforts of IAATO in working towards developing best practice towards reducing the carbon footprint of its tour ships.

Recommendation 5: Recognizing the importance of emission cuts in Antarctica and their symbolic value in the global context, the ATME recommends that the ATCM encourage COMNAP to work with national programmes to use consistent methods to quantify and publish savings made by energy efficiencies, and which contribute to both (a) reducing carbon footprint, and (b) reducing fuel consumption and operating costs.

Recommendation 6: The ATME recommend that Parties be advised to use atmospheric models to evaluate the wind regimes around their individual stations, to determine the potential for wind power as a means of cutting fuel costs and greenhouse gas emissions.

Recommendation 7: Welcoming the risk assessment approach taken by Australia to identify potential climate change implications for current and future Antarctic infrastructure, logistics and environmental values, the ATME recommends that Parties be encouraged to undertake and report on appropriate risk assessment processes.

Recommendation 8: In developing EIAs for new facilities, the ATME recommends that Parties be requested to take climate change considerations into account.

Recommendation 9: Noting that the WMO Executive Council Panel of Experts on Polar Observations, Research and Services, promotes and coordinates relevant programs carried out in the polar regions, the ATME recommends that the Panel and others be urged to increase the refinement of Antarctic climate models, and the WMO be invited to provide regular reports to the ATCM to update Parties on progress with outcomes of the Committee's activities.

Recommendation 10: The ATME recommends that Parties be advised to expand research that will refine and enhance our ability to predict future climate change with increasing accuracy on various temporal and geographical scales; and to encourage steps to link scientific research efforts to the activities of operational agencies involved in providing climate services and other related activities.

Recommendation 11: Given that the IPY has been very successful in significantly increasing the volume and interdisciplinary character of polar research, especially in relation to understanding climate change, the ATME recommends that national agencies be urged to maintain the momentum of that research as a key contribution to the IPY legacy.
Recommendation 12: The ATME recommends that Parties be requested to encourage the collaboration required to develop comprehensive and advanced integrated Earth System models capable of producing outputs at decadal scales and regional scales that can be used to assess the likelihood, timing and amplitude of climate change.

Recommendation 13: The ATME recommends that Parties be requested to encourage the space agencies to continue coordinated observations of the Antarctic region from space, in the context of improving the operation of observing systems for climate change, and to attend a future ATCM to give a demonstration of the use of modern space-based technologies for observing the Antarctic region in the context of climate change.

Recommendation 14: The ATME recommends that Parties be requested to continue to strongly encourage collaboration and development of sustained integrated observing systems using in situ, air and space-based techniques.

Recommendation 15: Recognizing that Parties are obliged under the Treaty to share scientific data and information, and that there is a great deal to be gained from working more closely together on the collection of observations of climate change and its effects, the ATME recommends that Parties be

requested to encourage greater collaboration in such collections, and to support access to such data through the Antarctic Master Directory.

Recommendation 16: The ATME recommends that Parties be requested to encourage national operators and SCAR to seek close cooperation and synergies with existing climate observing and assessment initiatives such as the Global Climate Observing System (GCOS) and the IPCC.

Recommendation 17: The ATME recommends that the ATCM encourages SCAR to incorporate identification of key regions, habitats and species at greatest risk from climate change effects into its research programmes.

Recommendation 18: The ATME recommends that ATCM and CEP give consideration to taking a more regional approach in the application of environmental management tools, in addition to the current continent-wide approach.

Recommendation 19: The ATME recommends that the CEP consider developing a climate change response work programme. Such a work programme should attempt to incorporate, *inter alia*:

- The need to continue to afford a high priority to the management of non-native species;
- A classification of existing protected areas according to climate change vulnerability;
- The need for more sophisticated and coordinated ecosystem monitoring, including the need for increased collaboration between CEP and SC-CAMLR;
- A review of existing management tools to assess their continuing suitability in a climate change context (e.g. EIA guidelines (particularly with regard to planned long-term activities), Specially Protected Species guidelines, the guide to the preparation of management plans).

Recommendation 20: The ATME recommends that the ATCM and CEP encourage national Antarctic programmes to undertake marine and terrestrial biodiversity surveys and to submit, as a matter of urgency, all relevant biodiversity data to appropriate databases (e.g. the Biodiversity Database). In conducting such surveys, priority attention should be paid to regions considered to be at high risk of climate change impacts as well as to existing protected areas established to protect biological values.

Recommendation 21: The ATME recommends that the CEP give consideration as to means for improving climate change related data and information management to support its environmental management responsibilities.

Recommendation 22: The ATME recommends that the CEP consider:

- using established methods of identifying a) Antarctic environments at high risk from establishment by non-natives and b) non-native species that present a high risk of establishment in Antarctica;
- implementing non-native species monitoring protocols at areas of high risk, as well as at protected areas;
- developing decision making tools to aid responses to identified establishments of non-native species.

Recommendation 23: The ATME recommends that Parties be encouraged to comprehensively and consistently implement management measures to respond to the environmental implications of climate change, particularly measures to avoid introduction and translocation of non-native species, and to report on their effectiveness.

Recommendation 24: The ATME recommends that CEP review the means of applying protected and managed area management tools to ensure sufficient flexibility to account for climate change effects. Such a review should consider:

- the need to ensure that climate change effects are assessed during each five-yearly review of management plans, including for example, the need to establish protected and managed area boundaries that are climate change resilient; and

- the potential to delist sites at which the original values to be protected have been lost or degraded.

Recommendation 25: The ATME recommends that the CEP consider a systematic approach to protected or managed areas to:

- protect species, or habitats identified to be of particular risk to climate change consequences (cf. Recommendation 18);
- accommodate areas that have potential to be environmental or climate refuges;
- set aside areas for future climate change related research, including reference areas.

Recommendation 26: The ATME recommends, recognising the responsibilities of and need to coordinate with CCAMLR, that the CEP consider, and advise the ATCM accordingly, as to means by which automatic interim protection might be afforded to newly exposed areas, such as marine areas exposed through ice-shelf collapse.

Recommendation 27: The ATME recommends that the CEP and SC-CAMLR be encouraged to ensure that sufficiently frequent biodiversity surveys and adequate monitoring programmes are established to provide an understanding of climate change induced responses in species distribution and abundance.

Recommendation 28: The ATME recommends that CEP and SC-CAMLR continue to develop means for collecting and sharing data and information on the status and trends of species of interest to both bodies (seals, penguins and seabirds), including the need to cooperate with other experts bodies such as SCAR and ACAP.

Recommendation 29: The ATME recommends that the CEP remain alert to the development of climate change related conservation tools elsewhere in the world that may also have application in an Antarctic context (e.g. climate change adaptation plans, risk assessment tools and mechanisms for assisted translocation of endangered species).

Recommendation 30: The ATME recommends that Parties consider making climate change a separate agenda item on the ATCM and CEP agendas.

Concluding remarks

The Meeting agreed that climate change and the implications for governance and management in Antarctica is both a relevant and important topic to discuss under the Antarctic Treaty system. It was also noted that this is an extremely broad topic, and that this ATME has, despite its 30 recommendations, only skimmed the surface and has been able to visit only a few selected topics in depth.

The Meeting furthermore underscored the fact that the extensive and well-established cooperation in Antarctica will be a good foundation for achieving concrete results through concerted action (e.g. best practices, exchange of experiences and information with regard to logistics/infrastructure, environmental management, etc.). The Meeting noted the potential symbolic value of any actions taken in Antarctica, and the potential transferability of such actions to other regions of the world.

The Meeting emphasized that the Antarctic offers a unique environment for the study of climate change and the recommendations and scientific findings should be used to inform other bodies such as IPCC and UNFCCC.

The Meeting underlined that the importance of the topic of climate change justifies a separate item for the agendas of the CEP and ATCM.

Finally, the Meeting emphasized the importance of continuing the discussions on climate change issues in Antarctica. The Meeting encourages the ATCM to discuss/consider which of the recommendations of this meeting should be brought forward in further discussions in the first instance.

Svolvær, Norway 09.04.10

Professor David Clary

Chief Scientific Adviser to the UK Foreign and Commonwealth Office

Professor Jan-Gunnar Winther

Director, Norwegian Polar Institute

Report from ATME on climate change and implications for Antarctic management and governance

Introduction

1. The Antarctic Treaty Meeting of Experts on climate change and implications for Antarctic management and governance was held in Svolvær, Norway, 7-9 April 2010. The Meeting was held under Antarctic Treaty Recommendation IV-24, pursuant to Decision 1 (2009) and paragraph 52 of the Final Report of the XXXII Antarctic Treaty Consultative Meeting (ATCM; Baltimore, April 2009). Decision 1 (2009) is attached as Annex 1.

2. The Meeting was attended by representatives of the following Antarctic Treaty Consultative Parties: Argentina, Australia, Belgium, Finland, France, Germany, Japan, The Netherlands, New Zealand, Norway, Republic of Korea, Russia, Sweden, United Kingdom, United States of America.

3. In accordance with Decision 1 (2009) the following attended as expert bodies: The Scientific Committee on Antarctic Research (SCAR), Antarctic and Southern Ocean Coalition (ASOC) and the International Association of Antarctic Tour Operators (IAATO).

4. Noting that the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) is a key component of the integrated framework for governance and management of the Antarctic region and noting that climate change is an issue of mutual interest to the ATCM and CCAMLR Commission, a representative from CCAMLR was invited to the meeting at the initiative of the Chairs.

5. A list of participants is included at Annex 2.

Welcome and Opening

6. Polar Ambassador Karsten Klepsvik from Norway opened the meeting and welcomed the delegates, pointing *inter alia* to:
   - the utmost importance of the topic for this ATME and the need to focus on issues related to climate change in Antarctica;
   - the very impressive SCAR report on Antarctic Climate Change and the Environment and the importance of this body of science;
   - the need of the meeting to maintain focus on the implications of climate change within the Antarctic treaty Area;
   - the opportunity for the Antarctic Treaty Parties to lead by example;
   - the need to communicate what is happening in Antarctica more efficiently;
   - potential collaboration and cooperation with the Arctic Council

Election of Officers

7. Prof. Jan-Gunnar Winther, Director of the Norwegian Polar Institute and Prof. David Clary, Chief Scientific Adviser to the UK Foreign and Commonwealth Office, were elected as co-chairs of the Meeting. Mr. Neil Gilbert (New Zealand) was elected chair for working group on nature conservation. Mr. Colin Summerhayes (SCAR) was elected chair of working

group on human activities. Ms. Birgit Njåstad of the Norwegian Polar Institute and Mr. Stuart Doubleday of the UK Foreign and Commonwealth Office were appointed as head of the secretariat and chief rapporteurs of the meeting.

Adoption of Agenda

8. Ahead of the Meeting, Norway had circulated a draft agenda for consideration by participating delegations. No changes to the draft agenda were proposed. The Meeting therefore adopted the agenda as follows:

    1. Election of Officers
    2. Adoption of the agenda
    3. Key scientific aspects of climate change
    4. Key consequences of such change to the Antarctic marine and terrestrial environment
    5. Implication of such consequences to management of Antarctic activities
    6. The need for monitoring, scenario planning and risk assessment
    7. Outcomes of the Copenhagen negotiations relevant for the Antarctic
    8. The need for further consideration of any issues and manners in which this can be achieved
    9. Proposals and report for ATCM XXXIII

Agenda items 3-6 were imbedded in the discussion and not reported on separately, although all agenda items were covered thoroughly in the presentations and discussions.

Presentations and Documents

9. Colin Summerhayes (Scientific Committee on Antarctic Research - SCAR) provided a key note presentation summarizing the key findings of the SCAR Antarctic Climate Change and the Environment (ACCE) report, which examines past climate (geology and data from ice cores), present climate (the instrumental period since IGY 1957-58) and potential future development (the next 90 years). In his presentation Dr. Summerhayes also summarized implications of Antarctic climate change on the rest of the world. The key questions and responses he posed were:
    - How does the Antarctic climate system work? The Poles act as the world's refrigerator, locking ice away and keeping sea level low. The Antarctic and the Arctic exchange climate signals, which the Southern Ocean integrates from across the Atlantic-Pacific-Indian oceans.
    - How does climate change affect the Antarctic ecosystem? A reduction in sea ice would lead to the likely decline of certain species such as Adélie penguins on a warmer Antarctic Peninsula; seals, albatross and penguins producing fewer young and a reduction in krill and growth of salps in a warmer ocean.
    - What are the roles of greenhouse gases and the ozone hole? The ozone hole shields the continent from warming by strengthening the circumpolar winds.
    - Sea ice is melting in the Arctic – what about Antarctica? Sea ice is increasing in certain regions of Antarctica because of changes in large-scale atmospheric circulation. In other areas of the continent sea ice is decreasing.

- Is Antarctica growing or shrinking? 87% of glaciers on the Antarctica Peninsula are decreasing. Those that are increasing are doing so only due to increased regional precipitation.
- What will happen over the next 100 years as the world warms? As the ozone hole disappears sea ice is likely to decline by 33%, air temperature by 3°C, winter snow could increase by 20% and the ocean warm by 0.5-1.0°C.
- Why should we care? By 2100 West Antarctic ice sheet may discharge enough ice to raise sea level up to 1.4m (+) – a significant challenge for Antarctica and for coastal populations across the globe.

10. Neil Gilbert (Antarctica New Zealand, CEP Chair) gave a key note presentation on managing the consequences of a changing Antarctic environment; exploring climate change implications and possible response options for the management of Antarctica, with implications for the environment, national Antarctic programmes and Antarctic science, noting in particular:
    - the seminal nature of SCAR's ACCE report;
    - that it is crucial the Treaty System responds actively and positively to its findings in order not put at risk the environmental, scientific and political values we currently place on Antarctica;
    - if the Treaty System is to retain its integrity and achieve its objectives, it is essential that an effective response to the report is developed;
    - that climate change is given as high priority as possible on the ATCM/CCAMLR agendas;
    - current science efforts are enhanced with an improved science to policymakers dialogue;
    - that we develop clear climate change response programmes; and
    - that the ATCM and CCAMLR make clear their expectations and coordinate their activities.

11. Jan-Gunnar Winther (Norwegian Polar Institute) held a key note presentation on the implication of climate change in Antarctica in the global context, noting *inter alia*:
    - that the impacts of climate change in the polar regions over the next 100 years will exceed the impacts forecast for many other regions and will produce feedbacks with significant global consequences;
    - the value of developing Antarctic solutions on areas such as energy efficiency and preservation, the use of alternative energy and transfer of knowledge for climate change mitigation that can be used elsewhere; and
    - using Antarctic cooperation as an example for mechanisms useful for international collaboration and agreements.

12. Sixteen papers were submitted by delegations for consideration during the meeting. All were presented during the first day's plenary session and thereafter considered during discussion of the specific topics. A full list of papers and the agenda items under which they were considered is given in Annex 3. The meeting documents and relevant background documents from previous ATCMs will remain available through the ATME website (http://atme2010.npolar.no) until the end of ATCM XXXIII.

13. Papers were presented chronologically by their number without reference to agenda item as most papers were cross-cutting.

14. The UK and Norway presented an overview of the implications of climate change for management and governance in Antarctica, with the aim of highlighting and scoping relevant issues to be discussed by the meeting (WP 1). The Meeting thanked UK and Norway for drawing up this broad approach to the topic. It was noted that in addition to the issues raised in the paper the importance of the Southern Oceans in the carbon cycle need to

be considered. Questions were raised with respect to the practicalities of implementing remediation measures relating to non-native species and it was noted that no guidance currently exists with respect to when and how to implement such measures. It was suggested that it might be useful if guidelines were provided and made available to permitting authorities. The question was posed as to whether changes in future human activities would have synergies with climate change.

15. Australia presented WP 2 which reported on the outcomes of an internal Australian Antarctic Division (AAD) workshop to consider the management implications of climate change in the Antarctic region. The AAD had followed a standard qualitative risk assessment process to identify a range of climate change implications for current and future Antarctic environmental values, infrastructure and logistics. Australia recommended that other Parties undertake and report on similar risk assessments, which would assist in collective thinking on the implications of climate change for Antarctic management and that Parties should consider developing a system-wide risk assessment process involving all relevant organisations. The Meeting welcomed the information and noted its usefulness for its further deliberations. The Meeting also discussed the importance of timescales and modelling within its implications for in scenario planning and risk assessment.

16. The UK presented issues related to implications of climate change for the Antarctic Protected Areas System (WP 3), noting the need to ensure that the protected area system remains dynamic and flexible, with the ability to respond to changes in species distribution and regional characteristics which are a result of climate change. WP3 provided a series of recommendations on the development and review of the protected area system for consideration by the CEP. The Meeting welcomed the paper and felt that CEP should pay special attention to these recommendations. There was agreement that there is a need for future flexibility in the use of existing tools to meet the challenges of climate change and that the document provided a useful basis for discussion. One participant noted that ASPAs should not be so large to encompass large regions and not overlap. It was also pointed out that small and microbiotic creatures should not be forgotten when developing ASPAs. With regard to Marine Protected Areas (MPAs) it was noted that CCAMLR has identified 11 large-scale priority regions where work to identify MPAs should be focused.

17. SCAR presented a ten point summary of the ACCE report (IP 1), as well as a number of recommendations stemming from this work (IP 2), noting in particular the need for:
    - collection of more data on the continent (e.g. the Automated Weather Stations Programme, radiosondes), particularly long-term observing programmes (e.g. CryOS) and monitoring of biologically relevant variables;
    - interdisciplinary (ecological, physical, chemical, sea ice) observations are required as part of a Southern Ocean Observing System (SOOS);
    - increased used of satellite measurements;
    - further climate model development; and
    - substantial biological research.

18. IAATO provided information on its climate change working group, which aims to develop strategic actions that will raise awareness of climate change in Antarctica and mitigate its effects (IP 3). IAATO underlined in particular that it stands ready to contribute towards monitoring programs and communication processes. This was welcomed by the Meeting, which encouraged Parties to cooperate and collaborate with IAATO in this regard. The Meeting noted the potential for IAATO members, who often visit sites rarely visited by national programs, to assist in carrying out monitoring. IAATO was also congratulated on its work on assessing the carbon footprint of its operations, and it was noted that this could stand as an example to follow.

19. Australia informed the Meeting about the development of a new ten-year strategic plan to guide the national Australian Antarctic science program (IP 4). Climate change research continues to be a major priority in the new strategic plan. The Meeting welcomed this information.

20. Australia presented information on the Southern Ocean Sentinel, an international program to assess climate change impacts on marine ecosystems (IP 5). It reported on a workshop held in Hobart in April 2009 to discuss the manner in which assessments of current and predicted future climate change impacts on Southern Ocean ecosystems could be developed based on field monitoring programs and the ecosystem models. Australia noted that many aspects of the approach taken by the Sentinel program are of relevance to the meeting's consideration of the need for climate change monitoring The Meeting noted the positive cooperation with the Integrating Climate and Ecosystem Dynamics (ICED) and SOOS programs and encouraged continued interaction.

21. The United States presented energy management strategies for the US Antarctic Research Stations (IP 6), summarising the USAP energy management program. This included a description of energy conservation measures (ECMs), the results of implemented ECMs, and a description of future program direction/improvements. The Meeting was impressed by the work undertaken by USAP and the results achieved, and looked forward to discussing further in relation to using as a model for other operations.

22. The Antarctic and Southern Ocean Coalition (ASOC) presented a paper discussing the observed changes to and the future of the West Antarctic Ice Sheet (IP 7), recommending that Parties:
    - coordinate a response strategy from which to rapidly deploy personnel and equipment to observe and record changes in the ice sheets as they occur;
    - encourage the creation and establishment of an early detection system that could alert necessary actors when the West Antarctic Ice Sheet (WAIS) has experienced or is expected to imminently experience a local disintegration; and
    - strongly support expanding research efforts by Antarctic scientists studying the history, behaviour and future of the WAIS, so that the best available scientific evidence may continue to inform policy.

23. ASOC introduced a paper referring to a recently published article on the response of Antarctic penguins to habitat change as a result of the Earth's troposphere reaching 2°C above pre-industrial levels (IP 8). ASOC presented this paper as a complement to the findings of the SCAR ACCE report.

24. ASOC introduced a paper on the benefits of climate change mitigation and adaptation in Antarctica (IP 9), calling for the sharing of best practices in energy efficiency and alternative energy and drawing attention to the need of development of climate change adaptation plans.

25. ASOC introduced a paper on Antarctic krill fisheries and rapid ecosystem change (IP 10), emphasizing the need for more research and collaborative effort between CCAMLR and ATCM in sharing of information. The Meeting noted that the joint CEP/SC-CAMLR workshop in 2009 had acknowledged this and pointed to the need to operationalise this collaboration.

26. New Zealand introduced a joint paper with US on the collaborative effort of the two Parties in the Ross Island Wind Energy Project (IP 11). The Meeting greatly appreciated this information and noted the advantages in such collaboration.

27. The US informed the Meeting on directions and challenges in the United States National Science Foundation's climate research (IP 12), noting four collaborative programs that will deal with climate change: Decadal and Regional Climate Prediction Using Earth Systems Models (EaSM), Ocean Acidification Program, Dimension of Biodiversity Initiative and Climate Change Observations and the focus on climate change education. The Meeting welcomed this information.

28. New Zealand introduced a paper entitled Antarctica and global change – keeping up with the science (IP 13). The paper drew attention to the need for maintaining currency in ongoing scientific observations and analysis of climate change research both in the Antarctic and globally, both for scientists themselves and for managers and policy-makers. It emphasised the need for planning for worst case scenarios when developing policy.

29. Nick Owens (UK) made an intervention on climate change and consequences for the Antarctic marine environment, highlighting some key areas of concern for the marine environment, including the challenge of ocean acidification. The Meeting called for a commitment to sustained and co-ordinated multi-national observation campaigns and greater use of remote sensing.

Discussions and recommendations

The ACCE report

30. The Meeting recognized the importance of the ACCE report and underscored the need for the report to be formally presented to the ATCM for consideration and to be used as a basis for further climate change discussions, noting in particular the need to advise the ATCM on the most important findings for governance and management.

31. It was suggested that the Antarctic Treaty Secretariat could find an opportunity in the margins of the ATCM in Punta del Este, Uruguay for a presentation. SCAR gave its commitment to provide such a presentation.

32. It was also suggested that the findings of the ACCE report should be presented to a wider audience.

33. Recommendation 1: The ATME recommends that the ATCM acknowledge and welcome the SCAR ACCE report as an important resource for its own deliberations and as an input to the wider global climate negotiations, e.g. the UNFCCC.

34. SCAR noted that the ACCE report is only a first step in compiling a comprehensive scientific overview of the Antarctic climate system and underscored the need to develop science and fill knowledge gaps. The Meeting concurred with this point.

Communication

35. The Meeting discussed communication issues and the need to ensure appropriate transfer of scientific knowledge to managers and policy makers as basis for development of management tools and policy making, as well as to the general public.

36. References were inter alia made to the Arctic Council's *Arctic Climate Impact Assessment* (ACIA) report and its impact and success, noting in particular the role of the ACIA synthesis report (catered to decision makers and the public) in this regard. The Meeting noted that it could be appropriate to consider how the findings of the ACCE report could be presented in a similar manner, however noting the organisational and cost restrictions in this regard.

SCAR noted that its 10 point summary document based on the executive summary of the ACCE is already available and that this could be presented in a "user friendly" manner, although noting that this would require funding from interested parties.

37. Reference was also made to the *Arctic Report Cards* (www.arctic.noaa.gov/reportcard), noting that something similar for the Antarctic could be a manner in which to keep the CEP/ATCM, as well as the general public, informed (possibly on an annual basis) on the observed changes in the climate system. SCAR noted that it would be worthwhile to provide an annual update along this line. It was, however noted that there are issues that need further consideration before such an initiative is moved forward, for example related to communication of long-term trends rather than annual observations and communication related to regional observations. It was also noted that not all issues might need annual updates. It was emphasised that it is fundamental that development of such reporting systems must be underpinned by a strong body of science.

38. Recommendation 2: The ATME recommends that the ATCM considers developing an Antarctic climate change communication plan to bring the findings of the ACCE report to the attention of other decision makers, the general public and the media.

Antarctic climate change in the global climate negotiation context

39. The Meeting noted the effects/importance of climate change in Antarctica as additional impetus for the international work on climate change mitigation and noted the need to focus on conveying teleconnections between what is happening in the polar regions and the global implications of these changes.

40. The Meeting noted several arenas where knowledge about climate change in Antarctica could be brought forward into the policy making arena, *inter alia* the 2010 IPY legacy workshop to be held in conjunction with the IPY Oslo Science Conference and the 3rd IPY conference on "From Knowledge to Action" to be held in Montreal, Canada in 2012.

41. The question was also raised whether it would be useful to arrange polar side events at the United National Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP) 16, noting the positive focus such an event had received at COP-15. It was, however, noted, that the COPs might not be the best arena for such outreach activities, and rather it would be better to find other mechanisms (publications/events) that could influence parties and the public in forming their positions intersessionally. ATCM representatives could also increase communication with their national climate negotiation representatives and discuss with them the most appropriate and effective means of introducing Antarctic information into the global climate change discussion.

42. Recommendation 3: The ATME recommends that the ATCM consider how best to provide information about Antarctic climate change to fora discussing and negotiating global climate change.

Energy efficiency

43. The Meeting discussed issues related to energy efficiency, and noted that use of alternatives (e.g. wind, solar, biofuels, etc) to imported fuel oil and gasoline are desirable. The Meeting noted the benefits of evaluating the potential for wind power around each station. Given the complex topography around individual stations, mesoscale models and downscaling techniques are needed to explore the spatial distribution of wind conditions in the present climate. Climate models can be used for continental scale evaluation of future wind regimes.

44. The Meeting further noted that operators would benefit from more exchange of experience of energy efficiency and renewable energy practices, which would in turn help to reduce the carbon footprint and cut fossil fuel use. Ideally one should aim for implementation of best practice in all human activities. COMNAP might be able to assist in attaining these goals, and already began providing advice (on energy use) in its report *Best Practice for Energy Management – Guidance and Recommendations* which was endorsed by CEP X in New Delhi, India. COMNAP will be holding an energy management workshop to disseminate best practice. Participants questioned how much adherence to this there had been, and the Meeting noted the need for COMNAP to report back to CEP on implementation.

45. The point was made that per year the average number of national program personnel on the continent is around 1000 in winter and 4000 in summer. Activities in Antarctica are not a major cause of climate change, but can provide the world with information about changes in the Antarctic region which can affect the rest of the planet. They could also be setting an example of behaviour.

46. The point was made that aside from considering the role of emissions of carbon in relation to climate change, consideration also needs to be given to short-lived climate forcing from black carbon, aerosols, methane, and sulfur dioxide, noting, however, that these all have a bigger impact in the Arctic, which is closer to the major industries and population centres that source these materials.

47. Recommendation 4: The ATME recommends that Parties be requested to:

- **acknowledge and encourage continuing efforts in developing and exchanging experience of energy efficiency and alternative energy practices so as to promote reduction of the carbon footprint of activities in Antarctica and cut fossil fuel use from stations, vessels, ground transportation and aircraft;**
- **solicit from COMNAP a report on progress on the implementation of its Best Practice for Energy Management – Guidance and Recommendations (endorsed by CEP X in Delhi), and ask for an update including details of best practices on energy efficiency and alternative energy deployment; and**
- **welcome the efforts of IAATO in working towards developing best practice towards reducing the carbon footprint of its tour ships.**

48. Recommendation 5: Recognizing the importance of emission cuts in Antarctica and their symbolic value in the global context, the ATME recommends that the ATCM encourage COMNAP to work with national programmes to use consistent methods to quantify and publish savings made by energy efficiencies, and which contribute to both (a) reducing carbon footprint, and (b) reducing fuel consumption and operating costs.

49. Recommendation 6: The ATME recommend that Parties be advised to use atmospheric models to evaluate the wind regimes around their individual stations, to determine the potential for wind power as a means of cutting fuel costs and greenhouse gas emissions.

<u>Infrastructure</u>

50. Issues related to Antarctic infrastructure were discussed by the Meeting. It was noted that different programmes will face different challenges with regard to impacts on infrastructure as the level and type of climate change will vary across the continent. In general, there is a cooling tendency in East Antarctica in accord with the ACCE report observations, while the Peninsula is warming.

51. The Meeting noted that consideration needs to be given to the possible effects of global warming on waste management and water supply. Water supply tends to be reliant on snowmelt; less snow could affect station viability. These considerations are, as they should be, part of best management practice.

52. The ATME furthermore noted the potential for localised release of contamination from past waste disposal sites, abandoned work sites through increased melting, and the need to ensure such sites were cleaned up in accordance with the provisions of the Protocol.

53. The Meeting further noted that sea level change effects need to be considered in management responses. Extra height was built into Rothera quay and runway 15 years ago to accommodate possible change. For Australia – wharf facilities on small islands may become cut off from the base. Sea level rise could be an opportunity because some harbours have shallow approaches that will become deeper so one can get ships closer to stations.

54. The benefits of shared stations were discussed. As some stations become untenable it is sensible to consider consolidating bases. This has the advantages of minimising impact/footprint, reducing energy consumption and making cost savings for operators.

Transport

55. The Meeting discussed transport issues in a climate change context. The Meeting took note of the International Maritime Organisation (IMO) action banning heavy fuel usage by ships in the Southern Ocean south of 60ºS from 2011. Treaty parties need to acknowledge that action in relation to potential oil release from shipping accidents.

56. It was noted that warming may create potential problems arising from the effects on the fast ice close to the coast (e.g. some operators are reliant on fast ice for unloading of ships). Additionally, more iceberg production could have implications for shipping operations.

57. The Meeting noted that more efforts are needed (regardless of global warming) to predict changes in the movement of sea ice caused by natural variability in the climate system, so as to diminish challenges to marine transportation. Sea ice modelling is difficult because sea ice is at the interface between atmosphere and ocean, and there is a need to establish the forcing fields, which in turn demands sustained and more detailed observations e.g. for winds. As for forecasting wind at stations (above) sea ice models would need to be circumpolar with regional ones embedded in them for local detail.

58. Participants identified potential problems with (hence risks to) the future management of ice-based runways, where tolerances are tight in terms of the temperatures at which they can operate. Runways may have to be moved at some point in the future if they become untenable where they are, or alternative forms of transport may have to be used.

59. The Meeting discussed the possible benefits of sharing and consolidating air transport infrastructure in key secure locations as existing runways become unusable through climate change effects. It was noted that, in the Dronning Maud Land Air Network (DROMLAN), climate change may see Novo affected parts of the summer season due to temperature increase, whereas Troll, located at a higher elevation, will be affected less It was noted that there would be safety issues in operating with only one regional runway and that ideally there would be two runways in the region.

60. It was noted that there also are potential problems with the sustainability of inland transportation, e.g. where climate change causes crevasses develop across previously used routes.

61. It was noted that it could be useful to use electric cars (golf-carts) for transportation in and around larger stations (e.g. McMurdo in order to cut down on emissions and limit the need for fuel.

Science

62. The question was raised whether there might be more science done in Antarctica in future because of climate change, including as a consequence of increased investment in polar science during and following the IPY. Some participants felt that with increasing fuel costs there might be a trend to increased utilisation of remote sensing.

63. The point was made that science is the main purpose for Parties having stations in Antarctica, and that science is needed to understand Antarctica's role in the Earth System. While activities in the Antarctic region make a minor contribution to the global causes of climate change, Antarctic operators should work to see how the goals of the Treaty can be achieved whilst minimizing environmental impacts and emissions.

Tourism

64. Consequences of climate change on tourism were discussed. Tourism may be affected by changing sea ice distribution, e.g. where diminished sea ice opens up new channels that have not yet been surveyed hydrographically. Equally, shrinking snow and sea ice may open up new sites to visit, which may require flexibility in the geographic application of area management tools, possibly including the development of new ASPAs and /or new site guidelines. It was also noted that some current tourist sites might no longer be interesting if the features present are affected by climate change.

65. The Meeting noted that IMO are discussing a *Mandatory Code for Vessels Operating in Polar Waters* dealing with risks in polar waters, to be completed by 2012, and is dealing with plans for changing fuel use and decreasing emissions, and IHO is continually looking at hydrography. There are clear search and rescue implications – complicated by the perceived "right to roam" and "expectation of rescue". There is a need for Parties to implement existing agreements for contingency planning and insurance for tour operators.

66. It was noted that on the plus side, expanded access to sites could provide increased opportunity for outreach (not forgetting that tourism is a great source of potential ambassadors for Antarctic conservation and science).

67. The Meeting also noted that tourism can also be more useful for science in the future, in that tour ships can collect information on oceanic and atmospheric properties, provided this is done in accordance with standard methods. In addition there are instances of tourists alerting operators to alien species occurrences, mass mortality events etc. WMO already has observing systems aboard some cruise ships. The question of instrumenting cruise ships is under discussion between SCAR and IAATO in relation to the Southern ocean Observing System (SOOS). Automated data collection requires funding. It was noted that in the Arctic, community based monitoring has been successfully developed using science based measurement plans. SCAR and COMNAP could work with IAATO to take this initiative forward.

Risk assessment in the context of human activity in Antarctica

68. The Meeting welcomed the Australian paper (WP 2) as a useful example of how a standard approach to risk assessment could help to identify potential climate change implications for existing or new infrastructure. Some Parties are already undertaking appropriate risk assessments of this kind for their Antarctic activities; other Parties are undertaking them in their home countries and could extend them to cover their Antarctic operations.

69. As outlined in WP 2, the Australians workshop on management implications of climate change followed a standard risk assessment approach. This involved assessing risk as a

combination of the likelihood of an event occurring (on a scale from rare to almost certain), and the resultant consequences (on a scale from insignificant to critical). During the workshop this approach was used to determine how, for any particular element, like station infrastructure, one could identify risks and opportunities (e.g. for water supply or fuel storage) arising from climate change causes like increases/decreases in show accumulation or melt days. The risk assessment took into account measures currently in place to manage risks (e.g. manual clearing of snow drift) and identified additional treatment options (e.g. elevation of roads, changing construction methods for new structures, and so on) as well as further information requirements (e.g. surveys of existing infrastructure; application of digital elevation models). One example of potential high risk was that if increased snowfall eventuates then runway clearing would require additional effort. This was just one of a number of risks and opportunities identified through this valuable process.

70. The Meeting questioned whether COMNAP and national programmes or operators could do some scenario planning and explore potential risks, also looking at opportunities. The SCAR-ACCE report goes out to 100 years, but we need planning on the 10-15 year horizon. The different IPCC scenarios may be useful in helping to see different views of the evolution of the ice sheet under climate change in the short term. Monitoring of key environmental variables is needed to improve input data for IPCC scenarios. Increasingly integrated regional models of the kind produced by Earth System modellers are needed at decadal scales and regional scales. Producing decadal scale outputs may not be especially helpful because many natural phenomena have 5, or 10, of 15 year cycles that may be in or out of phase, and may trend in the opposite direction (or in parallel to) underlying global warming. Climate is generally taken to mean the statistics of weather over the 30-year time frame. Weather and climate models are run differently. WMO is developing climate service products at fine scale (periods of a few years ahead).

71. Recommendation 7: Welcoming the risk assessment approach taken by Australia to identify potential climate change implications for current and future Antarctic infrastructure, logistics and environmental values, the ATME recommends that Parties be encouraged to undertake and report on appropriate risk assessment processes.

72. Recommendation 8: In developing EIAs for new facilities, the ATME recommends that Parties be requested to take climate change considerations into account.

<u>Knowledge gaps, research needs and modelling in the context of human activity in Antarctica</u>

73. The information provided to the meeting by SCAR and others underscored the need for further research and modelling efforts with the aim to improve our understanding of the Antarctic climate changes. Modelling is a crucial tool for policy makers. This was elaborated upon in order to consider how best to encourage and develop new and existing modelling systems.

74. The Meeting noted that useful advice could come from groups such as the WMO Executive Council Panel on Polar Observations, Research and Services. It was noted that WMO does not usually attend ATCMs, and attempts might be made to remedy that in view of the expertise that WMO could bring to bear on climate change in the Antarctic context. The recommendations of the ACCE report call for more automated weather stations and more radiosondes (giving balloon-based profiles of meteorological data though the atmosphere) to be made routinely available to improve the input to weather forecasts and climate analyses and projections. These data are also needed by operators for weather forecasts for field operations and flights.

75. With climate change, the vulnerability of different parts of Antarctica will change. These regional changes need to be understood and anticipated. While good general predictive models are available, they are not accurate enough to give the detail of what will happen in individual areas or at specific research stations. This means we have to operate within a high degree of uncertainty. For example, the potential loss of the Pine Island glacier is a high impact uncertain risk event for which the time scale is perhaps hundreds of years.

76. Recommendation 9: Noting that the WMO Executive Council Panel of Experts on Polar Observations, Research and Services, promotes and coordinates relevant programs carried out in the polar regions, the ATME recommends that the Panel and others be urged to increase the refinement of Antarctic climate models, and the WMO be invited to provide regular reports to the ATCM to update Parties on progress with outcomes of the Committee's activities.

77. Recommendation 10: The ATME recommends that Parties be advised to expand research that will refine and enhance our ability to predict future climate change with increasing accuracy on various temporal and geographical scales; and to encourage steps to link scientific research efforts to the activities of operational agencies involved in providing climate services and other related activities.

78. Recommendation 11: Given that the IPY has been very successful in significantly increasing the volume and interdisciplinary character of polar research, especially in relation to understanding climate change, the ATME recommends that national agencies be urged to maintain the momentum of that research as a key contribution to the IPY legacy.

79. Recommendation 12: The ATME recommends that Parties be requested to encourage the collaboration required to develop comprehensive and advanced integrated Earth System models capable of producing outputs at decadal scales and regional scales that can be used to assess the likelihood, timing and amplitude of climate change.

<u>Data sharing and monitoring in the context of human activity in Antarctica</u>

80. The Meeting discussed the benefits and example of the Sustained Arctic Observing Network (SAON) in improving observations and monitoring in the Arctic, as well as more regional variations such as the Svalbard Integrated Arctic Earth Observing System (SIOS). It was suggested that a similar observing network could be established by Treaty Parties. The Southern Ocean Observing System (SOOS) was discussed as an example of a marine observing network, as was the Australian Integrated Marine Observation System. The Meeting felt that a call for more coordination among observing stations would be beneficial.

81. The ATME discussed the need for international standards/formats in data and calibration and in this context discussed collaboration with space agencies and the availability of data through the Antarctic Master Directory.

82. The ATME noted that Cryosat-2 had launched successfully during its discussions on 8 April, and hoped it would provide further and useful data for Antarctic climate studies.

83. Recommendation 13: The ATME recommends that Parties be requested to encourage the space agencies to continue coordinated observations of the Antarctic region from space, in the context of improving the operation of observing systems for climate change, and to attend a future ATCM to give a demonstration of the use of modern

space-based technologies for observing the Antarctic region in the context of climate change.

84. Recommendation 14: The ATME recommends that Parties be requested to continue to strongly encourage collaboration and development of sustained integrated observing systems using in situ, air and space-based techniques.

85. Recommendation 15: Recognizing that Parties are obliged under the Treaty to share scientific data and information, and that there is a great deal to be gained from working more closely together on the collection of observations of climate change and its effects, the ATME recommends that Parties be requested to encourage greater collaboration in such collections, and to support access to such data through the Antarctic Master Directory.

86. Recommendation 16: The ATME recommends that Parties be requested to encourage national operators and SCAR to seek close cooperation and synergies with existing climate observing and assessment initiatives such as the Global Climate Observing System (GCOS) and the IPCC.

Nature conservation

87. The ATME considered the findings of SCAR's ACCE report with regard to climate change implications for Antarctic marine, terrestrial and freshwater biota. The ATME noted that such implications included:
    - Ecologically key species (such as planktonic snails) are expected to be negatively affected by progressive ocean acidification, with cascading consequences through the ecosystem;
    - Marine species may be able to adapt to increasing ocean temperatures, but may become extinct if their physiological and ecological limits are exceeded;
    - Increasing seawater temperatures may open the door to a variety of alien species;
    - A climate induced shift in the marine food regime will lead to a decrease in the rich Antarctic seabed biodiversity;
    - Warmer temperatures and a shift from snowfall to rain has contributed to a rapid expansion of native plant communities across the Antarctic Peninsula;
    - The increased likelihood of introduced non-native species becoming established (human activity has already introduced non-native organisms to the Antarctic Peninsula;
    - Loss of sea-ice west of the Antarctic Peninsula has caused changes in algal growth which in turn has lead to significant declines in krill stocks; and
    - Distribution of Adelie penguins has changed with many populations on the northern Antarctic Peninsula declining, whilst in the Ross Sea and East Antarctica populations are generally stable or expanding.

88. Further the ATME noted that the SCAR ACCE report had noted several recommendations pertinent to understanding and managing Antarctica biota in a changing climate. These included:
    - There is an urgent need for the establishment of longer-term monitoring of biologically relevant microclimatic variables and the subsequent modelling effort to integrate patterns at the macro- and micro-scales.
    - Fundamentally important baseline biodiversity and biogeographic survey data are still lacking across most of the continent and parts of the surrounding Southern Ocean–those data and systematic and robust monitoring programmes across a network of representative locations are required.
    - The Protocol on Environmental Protection to the Antarctic Treaty provides guidelines for the protection of the Antarctic environment and underscores its value to scientific

research. Conservation measures should focus on achieving a better knowledge of the structure and functioning of Antarctic ecosystems and of the long-term effects of persistent contaminants in Antarctic organisms and food chains, and in developing continental-scale monitoring programmes based upon a network of carefully selected flagship sites.

- Greater spatial and temporal resolutions are also imperative if biological processes, particularly on land, are to be integrated into future generations of climate models. Advanced integrative and spatially explicit ecosystem modelling is needed to predict the future of the marine ecosystem. Such an approach demands widespread samples of ecological key species that are representative for ecological sub-systems, such as plankton, benthos or apex predators and long-term measurements of ecological key processes such as the response to acidification, warming and changes in ice cover and food regime.
- Continued long-term and large-scale observations of functional and structural changes in ecosystems are essential to assess the sensitivity of ecological key species. The establishment of a series of core long-term biological monitoring sites would be extremely beneficial both in documenting biological responses and trends, and allowing explicit tests of predictive hypotheses.
- More data on the marine biota are required for especially poorly studied areas like the Amundsen Sea, as the basis for the simulation of the impact of a warming ocean on marine biodiversity.
- Physiological and genomic studies currently interpreted as indicating vulnerability of certain Antarctic marine biota need placing in more ecologically realistic (longer term) timescales.
- Individual and species level responses (including resilience/resistance) to environmental variability and change require integration across communities, trophic webs and ecosystems.
- Biological colonisation routes and processes require identification and quantification in both terrestrial and marine environments, as does the relative importance of natural and human-mediated contributions to this process.
- Comparisons should be made between southern and northern polar processes to shed light on evolutionary pressures and provide insight into gene selection.
- A better understanding of ecological driving forces within Antarctic ecosystems (terrestrial and marine) must serve as the basis for developing predictive models of the response of the Antarctic biota to climate change.

89. The ATME also recognised the obligations of Parties to the Environmental Protocol with regard to the comprehensive protection of the Antarctic environment and dependent and associated ecosystems, and agreed that despite the significant challenges involved, key principles to guide future work might include: the importance of maximising the resilience of the environment to climate change; and of acting in a precautionary manner to minimise climate change risks for the environment, while at the same time obtaining relevant information to reduce uncertainty.

90. The ATME reflected on the need for improved data and information on status, trends and distribution of Antarctic biota and the pressing need to identify key regions, habitats and species at greatest risk from climate change effects. Such high risk areas might include, for example, the Antarctic Peninsula, low-lying habitats, and newly exposed terrestrial or marine areas (e.g. due to glacier retreat and ice shelf disintegration).

91. In undertaking assessments to identify species at particular risk from climate change the Meeting noted the need to also consider benthic marine invertebrates and macro-algae that might otherwise be overlooked.

92. Recommendation 17: The ATME recommends that the ATCM encourages SCAR to incorporate identification of key regions, habitats and species at greatest risk from climate change effects into its research programmes.

Management tools

93. The current practice with regard to environmental management measures agreed by the ATCM is to attempt their continent-wide application. However, the Meeting noted the significant variability in environmental and climate change across the Antarctic, which is already affecting, and will continue to impact Antarctic biota differently in different regions of the continent. Consequently, climate change response actions may not be able to be applied uniformly across the whole of the continent, and new approaches may need to be considered to ensure that appropriate management actions are taken in different regions of Antarctica and in response to different climate change scenarios.

94. Recommendation 18: The ATME recommends that ATCM and CEP give consideration to taking a more regional approach in the application of environmental management tools, in addition to the current continent-wide approach.

95. The significance and longevity of climate change consequences for Antarctic biota demands that a long-term and strategic approach is taken to ensure the Parties continue, to the extent practicable, to fulfil their obligations under the Environmental Protocol.

96. In this regard the ATME noted the functions of the CEP provided for under Article 12 of the Protocol, which included the need to advise the ATCM on, inter alia:
    - the effectiveness of measures taken pursuant to the Protocol;
    - procedures for situations requiring urgent action;
    - the operation and further elaboration of the Antarctic protected Area system;
    - the collection, archiving, exchange and evaluation of information related to environmental protection;
    - the state of the Antarctic environment; and
    - the need for scientific research, including environmental monitoring.

97. The ATME noted that in addition to affording the issue of climate change as a high priority on the agendas of both the ATCM and CEP (cf. Recommendation 30), it will be essential for the Parties, and the CEP in particular to develop a prioritised programme of work taking in to account the findings and recommendations of the SCAR ACCE report.

98. The ATME agreed that in developing such a programme of work, the CEP should give particular attention to:
    - the prevention and management of non-native species (considered further below);
    - areas already identified as important due to their protected and managed area status;
    - the development and comprehensive implementation of monitoring measures, and
    - a review of existing management tools to ensure their suitability for managing the consequences of a changing climate.

99. Recommendation 19: The ATME recommends that the CEP consider developing a climate change response work programme. Such a work programme should attempt to incorporate, inter alia:
    - **The need to continue to afford a high priority to the management of non-native species;**
    - **A classification of existing protected areas according to climate change vulnerability;**

- **The need for more sophisticated and coordinated ecosystem monitoring, including the need for increased collaboration between CEP and SC-CAMLR; and**
- **A review of existing management tools to assess their continuing suitability in a climate change context (e.g. EIA guidelines (particularly with regard to planned long-term activities), Specially Protected Species guidelines, the guide to the preparation of management plans).**

100. The SCAR ACCE report makes clear the pressing need for Antarctic biodiversity and biogeographic surveys in terrestrial, freshwater and marine systems. The ATME noted the importance of gathering relevant data and information on Antarctic biota to ensure that policy discussions and decision-making were as informed as possible.

101. The ATME noted that several international databases, particularly the Biodiversity Database maintained by the Australian Antarctic Division on behalf of SCAR, were important resources in this regard, and that there is a need for these to be populated with existing and future data to maximise their utility.

102. Additional biodiversity monitoring programmes and surveys are also needed to ensure an adequate oversight of the conservation status of Antarctic species. Such monitoring and surveys need particularly to be undertaken in areas identified as being at high risk of climate change impacts, as well as areas of particular biological importance such as existing protected areas.

103. The ATME also recognised the need for the CEP, in particular, to consider innovative ways of ensuring that relevant and up-to-date information is available to support its discussions and the advice it provides to the ATCM.

104. Recommendation 20: The ATME recommends that the ATCM and CEP encourage national Antarctic programmes to undertake marine and terrestrial biodiversity surveys and to submit, as a matter of urgency, all relevant biodiversity data to appropriate databases (e.g. the Biodiversity Database). In conducting such surveys, priority attention should be paid to regions considered to be at high risk of climate change impacts as well as to existing protected areas established to protect biological values.

105. Recommendation 21: The ATME recommends that the CEP give consideration as to means for improving climate change related data and information management to support its environmental management responsibilities.

Non-native species

106. The ATME recognised that the CEP is already undertaking a substantive programme of work on the issue of non-native species and that this had been given highest priority in the CEP's five year work plan. The ATME noted that several non-native species had now become established in Antarctica and that some of these had survived several seasons. The Meeting agreed that the introduction, establishment and spread of non-native species represented the most immediate threat to native Antarctic biodiversity as a result of a changing (more benign) Antarctic climate.

107. The Meeting recognised that the risk of new species becoming established in Antarctica was not equal across all areas, and that there was a pressing need to identify regions and environments that are at particular risk.

108. Further the Meeting noted that methodologies already exist to identify those species most likely to take advantage of certain environments or conditions in Antarctica. For example, it is likely that a number of Patagonian vascular plants would be able to survive Antarctic

conditions in certain locations should they be transported to the area. The relatively recent discovery of *Nassauvia magellanica* on Deception Island was noted as a case in point.

109. The ATME therefore saw virtue in the CEP undertaking an assessment of those species likely to be high risk with regard to potential establishment in Antarctica.

110. The ATME also noted the complexities involved in responding to the detection of new species. It will not always be possible to determine the means by which new species arrive in Antarctica and whether human activity or natural vectors have been the cause. As a result response actions will need careful consideration. In some instances removal may well be appropriate, but it would also be necessary to consider the provisions of Annex II which require consideration of whether such removal actions would have a greater adverse environmental impact. The ATME therefore agreed that response protocols needed to be developed to assist with consistent approaches. The Meeting recognised that such guidance had been developed for areas outside of Antarctica and that such material would be a useful resource in developing Antarctic-specific approaches.

111. The ATME also acknowledged that greatest effort should be placed on preventing the introduction of non-native species, and on minimising the risk of human assisted introductions through national programmes and tourism activities. It stressed the importance of ensuring comprehensive implementation of new measures to address this risk.

112. Recommendation 22: The ATME recommends that the CEP consider:

- **using established methods of identifying a) Antarctic environments at high risk from establishment by non-natives and b) non-native species that present a high risk of establishment in Antarctica;**
- **implementing non-native species monitoring protocols at areas of high risk, as well as at protected areas;**
- **developing decision making tools to aid responses to identified establishments of non-native species.**

113. Recommendation 23: The ATME recommends that Parties be encouraged to comprehensively and consistently implement management measures to respond to the environmental implications of climate change, particularly measures to avoid introduction and translocation of non-native species, and to report on their effectiveness.

Protected areas system

114. From a biological perspective, the ATME agreed that protected or managed areas demand close attention in the lieu of climate change, as many of these areas already have been identified for their biological importance which could be further stressed under a changing climate.

115. The Meeting recognised the CEP's efforts to embed the current collection of protected and managed areas within a systematic environmental geographic framework and noted that climate change consequences will impact the "environmental" component of such a framework. As a result careful attention will need to be given to monitoring the values for which current sites have been designated, recognising that these may well change, or be lost as a result of a changing climate. Consequently, decisions may need to be made over time as to whether or not certain sites should retain their protected or managed area status. The ATME agreed that the retention of sites as protected areas under conditions where the original values for protection had been lost or degraded had potential to devalue the protected areas system itself.

116. In this context the Meeting agreed on the concept of ensuring adequate flexibility in the application of the protected areas system, given the potential rate and variability of climate change that is anticipated in Antarctica. Such increased flexibility might also include the potential to develop means for immediate interim protection that might be applied under certain conditions, such as to protect the scientific value of marine benthic areas exposed as a result of ice shelf collapse.

117. The ATME also agreed that the designation of protected and managed areas provides a useful tool that may assist in increasing the resilience of the environment to climate change effects by mitigating potentially antagonistic human impacts. Further, within the development of a systematic approach to the designation of protected and managed areas, consideration may need to be given to designating sites identified as being: actual or potential climate refuges; sites for future climate change related research, or reference areas.

118. Recommendation 24: The ATME recommends that CEP review the means of applying protected and managed area management tools to ensure sufficient flexibility to account for climate change effects. Such a review should consider:
- **the need to ensure that climate change effects are assessed during each five-yearly review of management plans, including for example, the need to establish protected and managed area boundaries that are climate change resilient; and**
- **the potential to delist sites at which the original values to be protected have been lost or degraded.**

119. Recommendation 25: The ATME recommends that the CEP consider a systematic approach to protected or managed areas to:
- **protect species, or habitats identified to be of particular risk to climate change consequences (cf. Recommendation 18);**
- **accommodate areas that have potential to be environmental or climate refuges;**
- **set aside areas for future climate change related research, including reference areas.**

120. Recommendation 26: The ATME recommends, recognising the responsibilities of and need to coordinate with CCAMLR, that the CEP consider, and advise the ATCM accordingly, as to means by which automatic interim protection might be afforded to newly exposed areas, such as marine areas exposed through ice-shelf collapse.

<u>Key species</u>

121. The ATME considered the matter of individual species management in the context of climate change impacts. The Meeting recognised that it would not be possible to monitor the status and trends of all Antarctic species. Nevertheless, the Meeting agreed that consideration should be given to identifying and implementing appropriate monitoring for marine and terrestrial climate change indicator species, or species considered to be more susceptible to climate change.

122. In developing and implementing such monitoring, it would be important to ensure a high level of coordination among those bodies with an interest in the conservation status of Antarctic species, not least, SC-CAMLR, CEP, ACAP and SCAR.

123. The need for improved data collection, use of existing databases and the potential need for additional data and information management resources were also noted in this regard.

124. The ATME also recognised the considerable if not impossible challenges involved in attempting to respond to significant reductions in the distribution and abundance of Antarctic species. It was recognised that options for active intervention in the face of significant declines in the conservation status of certain species, as is predicted to occur

either on a regional or Antarctic-wide basis, would be limited. Nevertheless, it would be important for the Treaty Parties (at the very least) to be able to demonstrate their awareness of change in Antarctic biodiversity and to maximise resilience to the extent possible through the considered use of current or novel environmental management tools.

125. **Recommendation 27: The ATME recommends that the CEP and SC-CAMLR be encouraged to ensure that sufficiently frequent biodiversity surveys and adequate monitoring programmes are established to provide an understanding of climate change induced responses in species distribution and abundance.**

126. **Recommendation 28: The ATME recommends that CEP and SC-CAMLR continue to develop means for collecting and sharing data and information on the status and trends of species of interest to both bodies (seals, penguins and seabirds), including the need to cooperate with other experts bodies such as SCAR and ACAP.**

127. **Recommendation 29: The ATME recommends that the CEP remain alert to the development of climate change related conservation tools elsewhere in the world that may also have application in an Antarctic context (e.g. climate change adaptation plans, risk assessment tools and mechanisms for assisted translocation of endangered species).**

Other environmental issues

128. The Meeting briefly touched upon the topic of geo-engineering, e.g. iron fertilisation, possibly also in the Antarctic region. The point was made that such action would be subject to existing EIA procedures under the Environmental Protocol, but that it was not completely clear that geo-engineering projects were currently prohibited under the Treaty. The ATCM would, however, no doubt be interested in seeing the results of further research and evaluation of such projects from elsewhere in the world. Many considered any attempt at geo-engineering to be essentially taking a risk with the environment.

129. The ATME noted that there may be impacts of climate change on heritage values, such as permafrost impact on structures of heritage value.

130. Also the potential for increased long range transport of pollutants in to Antarctica as a result of changing climatic conditions was brought up in the discussions, and could be an issue that merits further consideration.

131. The Meeting considered that ocean acidification must come high on the list of climate change related issues most likely to have maximum impact, likely as it is to have significant and ‘rapid’ impacts for management. Questions were raised about what were the best indicators and specifically which species have to be observed to follow ocean acidity. The ATME also noted that ocean acidification will likely become an additional stressor for certain marine species and that monitoring the response of key aragonite-dependent species may also be important.

Concluding remarks

132. The Meeting agreed that climate change and the implications for governance and management in Antarctica is both a relevant and important topic to discuss under the

Antarctic Treaty system. It was also noted that this is an extremely broad topic, and that this ATME has, despite its 30 recommendations, only skimmed the surface and has been able to visit only a few selected topics in depth.

133. The Meeting furthermore underscored the fact that the extensive and well-established cooperation in Antarctica will be a good foundation for achieving concrete results through concerted action (e.g. best practices, exchange of experiences and information with regard to logistics/infrastructure, environmental management, etc.). The Meeting noted the potential symbolic value of any actions taken in Antarctica, and the potential transferability of such actions to other regions of the world.

134. The Meeting emphasized that the Antarctic offers a unique environment for the study of climate change and the recommendations and scientific findings should be used to inform other bodies such as IPCC and UNFCCC.

135. The Meeting underlined that the importance of the topic of climate change justifies a separate item for the agendas of the CEP and ATCM.

136. Finally, the Meeting emphasized the importance of continuing the discussions on climate change issues in Antarctica, The Meeting encourages the ATCM to discuss/consider which of the recommendations of this meeting should be brought forward in further discussions in the first instance.

137. Recommendation 30: The ATME recommends that Parties consider making climate change a separate agenda item on the ATCM and CEP agendas.

Annexes

Annex 1: Decision 1 (2009)

MEETING OF EXPERTS ON CLIMATE CHANGE

The Representatives,

Decide to:

1. convene a Meeting of Experts under the provisions of Recommendation IV-24, with the aim of discussing relevant matters related to implications of climate change for management and governance of the Antarctic region;
2. request the Meeting of Experts to examine the following topics relevant to the issue of climate change in Antarctica:
    - key scientific aspects of climate change and consequences of such change to the Antarctic terrestrial and marine environment,
    - implications of climate change to management of Antarctic activities,
    - the need for monitoring, scenario planning and risk assessments,
    - outcomes of the Copenhagen negotiations relevant for the Antarctic,
    - the need for further consideration of any of the above issues and manners in which this can be achieved;
3. encourage attendance at the Meeting by representatives from Consultative Parties and invite experts from Non-Consultative Parties, the Scientific Committee on Antarctic Research (SCAR), the Council of Managers of National Antarctic Programs (COMNAP), the International Association of Antarctica Tourist Operators (IAATO), the Antarctic and Southern Ocean Coalition (ASOC), the International Union for the Conservation of Nature (IUCN), the International Maritime Organization (IMO), the International Hydrographical Organization (IHO), the World Meteorological Organization (WMO), the Intergovernmental Panel for Climate Change (IPCC) and the United Nations Environment Programme (UNEP);
4. accept the offer of the Norwegian Government to host the Meeting of Experts in Norway, which should be held in advance of ATCM XXXIII (potentially Week 14, around 6-9 April 2010);
5. in accordance with Recommendation IV-24, request Norway to submit a report of the Meeting of Experts to ATCM XXXIII for consideration.

Annex 2: Participants

Consultative Parties

Country	Last name	First name	E-mail	Affiliation
Argentina	Mansi	Ariel	rpc@mrecic.gov.ar	Ministry of Foreign Affairs
Australia	Clifton	Robb	robb.clifton@aad.gov.au	Australian Antarctic Division
	Worby	Tony	tony.worby@aad.gov.au	Australian Antarctic Division
	McIvor	Ewan	ewan.mcivor@aad.gov.au	Australian Antarctic Division
Belgium	Vanderstraeten	Martine	vdst@belspo.be	Federal Science Policy Office
Finland	Vihma	Timo	timo.vihma@fmi.fi	Finnish Meteorological Institute
France	Robert	Delmas	delmas@lgge.obs.ujf-grenoble.fr	French National Center for Scientific Research
Germany	Reppe	Silvia	silvia reppe@bmu.bund.de	Federal Ministry for the Environment
Japan	Akimoto	Meguru	meguru_akimoto@env.go.jp	Ministry of the Environment
	Fujimoto	Masami	masami.fujimoto@mofa.go.jp	Ministry of Foreign Affairs
The Netherlands	van Zeijst	Vincent	vincent-van.zeijst@minbuza.nl	Ministry of Foreign Affairs
New Zealand	Gilbert	Neil	n.gilbert@antarcticanz.govt.nz	Antarctica New Zealand
	Barrett	Peter	Peter.Barrett@vuw.ac.nz	Victoria University
	Walker	James	james.walker@mfat.govt.nz	Ministry of Foreign Affairs and Trade
Norway	Halvorsen	Svein Tore	sth@md.dep.no	Ministry of the Environment
	Holten	Inger	iho@mfa.no	Ministry of Foreign Affairs
	Klepsvik	Karsten	kkl@mfa.no	Ministry of Foreign Affairs
	Korsvoll	Marie Helene	mhk@md.dep.no	Ministry of the Environment
	Njåstad	Birgit	njaastad@npolar.no	Norwegian Polar Institute
	Rosenberg	Stein Paul	stro@mfa.no	Ministry of Foreign Affairs
	Winther	Jan-Gunnar	winther@npolar.no	Norsk Polarinstitutt
	Ingebrigtsen	Hanne-Margrethe	hmi@jd.dep.no	Ministry of Justice
Republic of Korea	Yoon	Young Jun	yjyoon@kopri.re.kr	Korea Polar Research Institute
Russian Federation	Kasatkina	Liudmila	Yastreboval@mail.ru	Ministry of Foreign Affairs

	Klepikov	Alexander	Klep56@gmail.com	Arctic and Antarctic Research Institute

Country	Last name	First name	E-mail	Affiliation
Sweden	Ödmark	Helena	helena.odmark@foreign.ministry.se	Ministry for Foreign Affairs
	Lillieskiöld	Marianne	Marianne. lillieskold@naturvardsverket.se	Swedish Environmental Protection Agency
United Kingdom	Clary	David	David.Clary@fco.gov.uk	Foreign and Commonwealth Office
	Doubleday	Stuart	stuart.doubleday@fco.gov.uk	Foreign and Commonwealth Office
	Owens	Nicholas	jale@bas.ac.uk	British Antarctic Survey
	Rumble	Jane	jane.rumble@fco.gov.uk	Foreign and Commonwealth Office
USA	Bloom	Evan T.	bloomet@state.gov	U.S. Department of State
	Erb	Karl	kerb@nsf.gov	National Science Foundation
	Foster	Harold	fosterhd@state.gov	U.S. Department of State
	Milne	Peter	pmilne@nsf.gov	National Science Foundation
	Penhale	Polly A	ppenhale@nsf.gov	National Science Foundation

Invited Experts

Organisation	Last name	First name	E-mail
ASOC	Barnes	James	jimbo0628@mac.com
	Tin	Tina	tinatintk@gmail.com
	O'Reilly	Jessica	jessyo@gmail.com
SCAR	Chown	Steven	slchown@sun.ac.za
	Sparrow	Michael	mds68@cam.ac.uk
	Summerhayes	Colin	cps32@cam.ac.uk
IAATO	Crosbie	Kim	kimcrosbie@iaato.org
CCAMLR	Reid	Keith	keith@ccamlr.org

Others

Organisation	Last name	First name	E-mail
ATS Secretariat	Reinke	Manfred	manfred.Reinke@ats.aq
ATME Secretariat	Storhaug	Ingrid	Ingrid.storhaug@npolar.no

Annex 3: List of documents

#	Agenda Item	Submitted by	Title
WP 1	2, 4, 5, 6	No/UK	Implications of climate change for management and governance of the Antarctic region – an overview
WP 2	4, 5, 6	Aus	Management implications of climate change in the Antarctic region – an initial Australian assessment
WP 3	4, 5	UK	The Implications of Climate Change for the Antarctic Protected Areas System
IP 1	3, 4	SCAR	Antarctic Climate Change and the Environment: Key Findings
IP 2	6, 3	SCAR	Antarctic Climate Change and the Environment: Recommendations
IP 3	6, 5	IAATO	IAATO's Climate Change Working Group
IP 4	3, 4, 6	Aus	Australian Antarctic Climate Change Research Priorities
IP 5	6	Aus	Southern Ocean Sentinel: an international program to assess climate change impacts on marine ecosystems
IP 6	5	US	Energy Management Strategies for U.S. Antarctic Research Stations
IP 7	3, 4, 6	ASOC	The Future of the West Antarctic Ice Sheet: Observed and Predicted Changes, Tipping Points, and Policy Considerations
IP 8	4	ASOC	Antarctic Penguin Response To Habitat Change As Earth's Troposphere Reaches 2°C Above Pre-Industrial Levels
IP 9	5	ASOC	Environmental and Economic Benefits of Climate Change Mitigation and Adaptation in Antarctica
IP 10	5	ASOC	Antarctic Krill Fisheries and Rapid Ecosystem Change: The Need for Adaptive Management
IP 11	3	NZ/US	Ross Island Wind Energy Project: Sustainability through collaboration
IP 12	5	US	Directions and Challenges in the United States Antarctic Program's Climate Research
IP 13		NZ	Antarctica and Global Change – keeping up with the Science

Annex 4: Background documents

ATCM Documents

ATCM XXII (Baltimore, USA)

- ATCM XXXII WP 38 (United Kingdom): Climate change and the Antarctic environment: Management implications
- ATCM XXXII IP 5 (SCAR): SCAR's Antarctic Climate Change and the Environment (ACCE) review report
- ATCM XXXII IP 35 (ASOC): Policy implications arising from SCAR's report: Antarctic climate change and the environment

ATCM XXXI (Kiev, Ukraine)

- ATCM XXXI WP 35 (Norway/United Kingdom): Antarctic Climate Change Issues
- ATCM XXXI IP 47 (Russia): Variability of Antarctic Climate
- ATCM XXXI IP 50 (United Kingdom): Antarctic Peninsula: rapid warming in a pristine environment
- ATCM XXXI IP 51 (United Kingdom): Antarctic Peninsula: Ice shelf status
- ATCM XXXI IP 56 (ASOC): Impacts of Climate Change on Antarctic Ecosystems
- ATCM XXXI IP 62 (SCAR): Antarctic Climate Change and the Environment: A Progress Report

ATCM XXX (New Dehli, India)

- ATCM XXX WP 28 (Norway): Climate Changes
- ATCM XXX IP 5 (SCAR): State of the Antarctic and Southern Ocean Climate System (SASOCS)
- ATCM XXX IP 82 (ASOC): The Antarctic and Climate Change
- ATCM XXX IP 124 (SCAR): SCAR Lecture. "Climate Change and the Antarctic: What Next?" (Attachment)
- ATCM XXX IP 138 (UK): Antarctica and climate change – implications for governance

ATCM XXIX (Edinburgh, UK)

- ATCM XXIX IP 47 (New Zealand): Conference on Climate Change and Governance, Wellington, March 2006 (Speakers abstracts)
- ATCM XXIX IP 62 (ASOC): The Antarctic and Climate Change
- ATCM XXIX IP 76 (SCAR): Climate Change: an Antarctic Perspective
- ATCM XXIX IP 89 (SCAR): Plans for an Antarctic Climate Assessment – Trends and Impacts

Other relevant background documents

- SCAR: Antarctic Climate Change and the Environment (2009)