

Reviewer	Comment	Response
25	Offer to provide help in this effort from international institution.	Will draft letter of support.
26	In schematic and text, should use seasonal climate/hydroclimate prediction instead of seasonal hydroclimate prediction.	Agreed. (PKJ thought hydroclimate includes climate but that is not the common understanding.)
26	Line125: "climate predictions *and projections". Comment: I think it is important to maintain the distinction between shorter, initial condition-dependent predictions and longer-term projections to be consistent with usage elsewhere in this document, and also to promote general awareness of this distinction	Agreed.
26	line 238: comment would it be worth mentioning particularly the tropics which have a strong influence on Canada through the MJO and ENSO?	Agreed.
26	Other minor changes	Agreed.
24	...why (on bottom of page 7). "Fundamental ARR is concerned with processes that take place in natural systems ... that can be found in midlatitude and high-latitude regions worldwide". Is it possible to rephrase this in a way that the earth-climate system is viewed as one entity? The last phrase about where these systems are found can be either removed or extended to be more inclusive and comprehensive.	Agreed, rewritten.
27	thanks for putting this paper together, and I'd be happy to have my name put on it.  Browsing through the paper left me with a lack of clarity of exactly what its purpose is, because it is very general. It is good to show the general strategies, but more specific examples would certainly be helpful. However, I also realize the difficulties of actually prioritizing among the vast range of research topics and activities.  One of the expressed goals is to clarify research and related resource priorities. However, I am a little concerned that there is a lack of discussion of some important research themes which would be easy to prioritize also because they could comprise so many different approaches and sub-themes. For example, I searched the document for YOPP, Arctic-midlatitude connections, sea ice shrinkage, Arctic Amplification, Northwest Passage, Shipping, and black carbon, and couldn't find anything! I think it would be helpful to mention at least some of these high-profile topics in the document.	PKJ: Thank you for your support in principle. All the issues you identify are indeed important and of great interest to many, and would fall naturally under the Arctic priority area for partnership. But calling out specific examples would end up implicitly saying that we are seeking funding for those areas at the exclusion of others. The document is intended to identify this community but we are limited in the priorities we are mandated to set.
28	I congratulate you and your colleagues for having developed such a comprehensive plan. I'm not an atmospheric scientist but I thought I would take a few moments to convey to you, my thoughts concerning the importance of Atmosphere-Related Research from my perspective as a member of the forestry community, in my particular case, forest fire management.  I don't recognize most of your 41 signatories but both Rene Laprise and Francis Zweirs have made important contributions to forest fire management and they are better qualified than I, to articulate the research opportunities and needs specific to forest fires. Nevertheless, I thought I should touch on some topics you may not have fully explored.	Thank you for the support.
28	Seasonal and climate projection are of vital importance to the forest fire community. The first, because when fire managers evaluate strategies for dealing with specific fires, they need to consider what might happen and their fire suppression resource needs during the coming days, weeks and months – in fact, until the end of the fire season when the snow flies. Climate projections are also very important from both a fire management perspective (how should fire management organizations evolve to meet emerging challenges) and a strategic long term (100 years) forest planning perspectives. Most of the other fire-related topics that I think are important and call for collaboration with atmospheric scientists are related to your Atmosphere-related biogeochemical cycles priority. They are;  1. Growing concern about potential positive feedback loops related to climate change increasing fire activity in peat areas which in turn may lead to more carbon emissions and more warming. 2. The formation of pyro-cumululus convection columns over fires resulting from fire/atmosphere interaction that can result in non-linear increases in fire intensity. This is an important area that was studied by Professor Han-Ru Cho and some of his students many years ago but I believe Canada has since largely vacated this important research area. 3. Large fire activity garners media attention which in turn serves an important public education role and can make it easier to mobilize public support for social change to mitigate climate change. It's widely accepted that climate change will deliver more fire to our forested landscapes in the future but there is a need for more research to further our understanding of the extent to which forest fire activity (e.g., annual area burned) has been influenced by climate change.  My experience is that Canadian forest fire management agencies are very receptive to collaborating with researchers and I encourage you and your colleagues to explore how you might work with them to address your common research needs and interests.	About your comments, we have included an additional section (Appendix A) on linkages to other research communities including forestry. We don't have room to be detailed, but we gave tried to fold in some of your keys points in this section.  PK: More practically, I think it would be great if this initiative led to enhanced interactions between the climate modelling and forestry communities in Canada. Under the various emission and climate response scenarios being considered in climate projections, and looking at the impacts of 1.5-2 degrees warming under the COP21 targets, there needs to be a lot of work to sort out the implications for fires and related air-quality and climate impacts. Hopefully we will be able to use this organization effort to stimulate more support for this kind of work.
29	Introduction: not just business decisions, but personal, financial, economic decisions.	PK: added financial decisions.
29	Models of planetary atmospheres (e.g., Mars, Venus, Titan) test our knowledge of the underlying physics and chemistry under exotic conditions that help us understand the causes and impacts of extreme changes in climate.	PK: not sure if this community is included in our consultations so far. Could include in space and planetary physics community section.
29	For data assimilation, suggests changing wording to "our best estimate of the *current and future* state	Inversion/data assimilation techniques could be used for past, present, and future, so don't want to limit by identifying period.
29	Blending observation and models through data assimilation improves our prediction systems through insights into the processes controlling weather, climate, and air quality. Comment: I would argue that you do not always require data assimilation to predict future climate. There are many data-driven studies that have successfully made useful predictions without the use of an assimilation system	Rephrased to suggest that DA not required: Data assimilation provides the additional benefit of improving prediction systems through insights into the processes controlling weather, climate, and air quality.
29	Suggests adding "atmospheric carbon" to list of process studies in forest sites around line 203-210	agreed
29	Suggest adding "its Boreal forest" after Canada's land mass, with comment: Canada owns about 1/3 of the world's boreal forests, which until recent years were a carbon sink. That has been slowly shifting. Understanding the health of the boreal forest and the impact of disturbance (drought, forest fires, insects, etc.) is crucial for understanding its future role in mitigating climate change.	Concern is that we are getting too specific since boreal forest is located within Canada's land mass. Should we not then mention other biomes like prairie, mixed deciduous, etc..
29	BGC research priority: mention anthropogenic sources and sinks	agreed
30	Please add my name to the list of supporting signatories.  A comment: I believe the following difficulty is expressed in many ways at most (if not all) Canadian universities offering degrees in atmospheric science.  At ... we face pressure ... to dilute or stop offering upper-level courses in atmospheric dynamics. The pressure arises because of small enrolment (6 per class is typical). Enrolment is small because of the difficulty of the subject material, and the need to have a thorough grounding in a number of topics in applied mathematics. I believe it is not possible to offer a proper atmospheric science degree without a solid grounding in atmospheric dynamics. This problem results in our having a smaller than optimum pool of applicants for graduate programs, which in turn makes it difficult to build well-qualified research teams.  I suspect your committee discussed this matter, but note it is absent in the document, which is otherwise outstanding.	Before "But new approaches ..." inserted "Advanced training in dynamical and other process fundamentals is required to build well-qualified research teams."  This is a topic for future discussion in the education focused meeting.
14	Abstract: enterprise suggests something that is centrally organized, which would make this effort unnecessary.	Agreed.
14	p.2: delete "more than a century" to avoid the suggestion of recapturing past glories	agreed. New wording: This resource is supported by a large research community of dedicated scientists in many professional settings including academia, government, and industry. This community's research ...
14	Asks if we have references to support the assertion about enhancing our prosperity on p.2.	There are studies on the economic benefits of forecasting and climate services. We have discussed whether to include such references in the paper, but PK does not have the time to do this. This is something to be included in a formal strategic planning document.

14	p.2: argues that stating that the White Paper is aiming to "synthesize a vision" contradicts the abstract which has more modest goals of initiating a planning process.	Agreed. Inserted: "begin an effort for this community to" before "synthesize a vision"
14	p.3 suggests that description of atmosphere as natural system etc. is awkward words, should be replaced by something like This seems like an awkward set of words. Maybe replace this with something like "which impacts us across a broad range of space and time scales through variations in the weather and the climate."	Agreed. Previous wording reflected a draft that was intended to be more accessible to the lay public.
14	Suggests replacing "chemical systems contributing to anthropogenic emissions, and the response of the atmosphere to changes in these emissions" with something like "the impact of emissions on atmospheric composition and aerosol loading, and the response of the atmosphere and climate to changes in these ..."	This was wording suggested by another researcher, will keep.
14	Suggests changes to Figure 1 from "Methods" to "Disciplines and infrastructure" and to mention in situ data and current and past climate change.	Agreed
14	p.5: exciting opportunities -> increasing interaction with non-academic research communities	Agreed
14	p.6: issue with data assimilation text: This doesn't give a good sense of how data assimilation works because it suggests two independent streams of information that are merged (from models and obs) whereas data assimilation really uses observations to constrain model solutions to produce analyses (that is models and obs do not have symmetrical roles, but rather the stream of obs guides the model).	Tweaked wording
14	p. 7: sentence on forest measurements seems to specific to BOREAS project.	The paragraph does include several examples - pollution, cloud droplet, other processes. So PK thinks it's ok if not ideal
14	p.7: more on examples: These are good examples, but they are both AQ examples ... It would be nice to see something a bit more generic (although I don't have good suggestions - the continuing increase in weather forecasting skill, our increasing ability to identify the causes of extreme events, etc.). Also, I imagine that it would be good to have examples where the dominate contribution is from the academic community.	Hard to fix at this point, should be ok.
14	p. 7: "satellites, field programs" replaced with "systematic observations, field programs". Comment: "One satellite would swallow up all of the resources available on the Canadian scale ... A fraction of that money spent in data rescue would have enormous benefit. Another fraction spent on maintaining current insitu observing networks would be similarly useful. Investing in the archiving and integration of weather radar data, etc, into useful climate products ... I think all of these things come ahead of satellites in my view."	PK: this is an interesting comment. Where should our resources be spent? Does "satellite" mean necessarily a solo effort by Canada on a satellite? This is a great discussion point. And it would be great if our community initiated a forthright discussion about this. Changed text to "satellites and other systematic observation efforts"
14	p. 7: last paragraph comment: It might be useful to make a sovereignty type of argument somewhere - only Canada will prioritize research that is specific to Canadian needs and objectives, and failure to maintain world class expertise across the AAR domain means that Canada will not have the intellectual clout needed to defend its interests in climate and other related international environmental negotiating and regulation processes (eg, whether it be climate, Great Lakes water, the Columbia River treaty, central Canadian air quality, etc)  I see now that there are some words below, which is good, but I think they could be strengthened a bit,	No specific change made, not clear what change should be made.
14	p.8: emphasize operational exchange of in situ data for international commitments	Agreed
14	p.9: delete "handful of"	Agreed
14	p.9: simplify wording around partnership/targeted support and fundamental/discovery research support	Agreed
14	p.10: end of prediction area: Solar-terrestrial is mentioned several times, but since the beginning of the industrial era, the predominant source of natural external forcing has been volcanic forcing rather than solar forcing. While solar-terrestrial is fundamentally important on longer timescales, I think we should not ignore the role of volcanic forcing in this document.	Changed to "natural external influences from solar and volcanic forcing"
14	p.11:  comment on regional climate and hydroclimate:  Suggested dropping references to "testing" and geochemical tracers.  Comment: There is so much "testing" research that lead us nowhere, except knowing that models and obs are different in some respect, so I would avoid specific reference to model testing,  Also, I would avoid plugging particular areas. I can imagine others... (Eg, the rapid emergence of convection permitting models that, I think, will open a wide swath of approaches for the development of parameterizations for lower resolutions (eg, think of a parallel to the development of radiation codes as implement in models, which are developed by making reference against detailed line-by-line codes that are taken to represent the truth), for process studies, and for the evaluation of regional model "added value".	PK - not sure I agree about the "testing" - sensitivity testing of climate models teaches us a lot in process understanding.  The remote sensing from space, geochemical tracers language was added after I requested comments from a couple of hydrologists. I think this enhances the broad appeal of this effort.
14	A sentence to say why AQ research is important in Canada (which we note has a small, dispersed population) would be a good idea.	PK: need some help from the committee on this.
14	Minor wording changes for Applied Research Section	Agreed
14	First bullet in topic list on p.13: "We should presumably consult with the partners to determine whether these 6 areas are the right areas, so should that be the topic of the initial workshop?"	PK: dropped "six" from sentence. But I don't think we should say so explicitly that we will ask whether these areas are the right ones. I expect partners will come forward without prompting with their own positions, and if several departments are involved these positions might not agree with each other, so the task of the workshop will be to synthesize more specific priorities.
14	p.13: comment about "online access" issue: "Is this really an issue? Or is it an excuse that we cite as a pretext for why interaction has not taken place. If it is the latter, are we use to repeat it here?"	:K: Yes, I think this is a specific issue related to data access for academic researchers.
31	Thank you for preparing this comprehensive document. I can see that a large amount of work has already gone into it and hence I am hesitant to comment. However, you have asked for feedback....	All feedback appreciated.
31	I really like the way you have positioned the document in terms of weather, climate and air quality. Further I appreciate how you have emphasized the integrative nature of AAR, highlighted the potential benefits in terms of health, and identified related biogeochemical cycles. In this regard I find the treatment of air quality related research to be quite narrow in that no research couplings are made to public health, public policy, and economics (other than in terms of potential benefits). Within the text on air quality, the emphasis seems to be on pursuing increased depth of knowledge along traditional lines (might the same text of air quality have been written a decade ago?) rather than promoting integrative links with these other fields, and exploring the related anthropogenic cycles. Improved understanding of controls on air quality is listed as the priority, which is fine, yet I don't see this come through as a central theme within the paragraph for research on air quality. No mention is made of better understanding of the mechanisms underlying resulting health impacts (e.g. ties between atmospheric processing and pathophysiological responses), suggesting that we should allow ourselves to be constrained by traditional disciplinary boundaries.  Bottom line is that I suggest that the recommendations for air quality related ARR be broadened so as to be more integrative and encourage exploration of the nexus between environment and health. There remain huge opportunities for discovery that will further the understanding of the links of exposure to air pollutants at key life stages, genetic vulnerability of individuals and the associations with a wide range of chronic disease outcomes.  These comments are based on a quick read through and thus I may have overstated points and not done this otherwise fine document justice. However, I hope that this helps	Have broadened the second sentence to: "This research priority includes the complex range of processes affecting atmospheric composition, including sources and sinks as well as interactions between trace gases, aerosols, clouds, and climate, from the surface to the middle atmosphere"  Have added the following penultimate sentence in the Air Quality section: The area includes research into environmental determinism of health, with integrative connections across public health, economics, and public policy.  Will draft a separate paragraph in another section including connections to other research areas and communities.
32	Thanks for sharing the draft white paper, it is well-written, providing a good overview of ARR within Canada.  From the perspective of industrial partnership, we would suggest highlighting the success of NSERC and other industrial grants (such as those available from MITACS) in supporting collaborative research partnerships between industry and academia. As you know we have partnered with ... in several projects where we have co-funded the project along with NSERC/Mitacs support, and those projects have assisted us greatly in our application development. Such funding reduces cost for the government and improves the likelihood of direct benefit to the Canadian private sector, and more incentives for the private sector to contribute and be a part of ARR (such as tax incentives) would be helpful to the overall goal.	Inserted the following under second bullet on p.13: Industrial partners have highlighted the importance of partnership support from NSERC and MITACS programs, for cost effective development of applications of direct benefit to the Canadian private sector.

32	<p>Finally in meeting the challenge of communication of ARR results, including communication to the public, our experience suggests that there is often a large gap between scientific communication and public understanding. It may be useful to consider the social science community as a key stakeholder, leveraging their knowledge of communication to maximize the results of ARR that can directly benefit the public.</p> <p>Thanks again for sharing!</p>	<p>Inserted the following at end of the last paragraph of the communication/outreach section: In these efforts to bridge the communication gap, we should consider better engaging the social science community, leveraging that community's communication capacity to maximize the results of ARR that can directly benefit the public.</p>
33	<p>Offer to provide formal endorsement from Canadian University research centre</p> <p>2 This reads OK - I have some minor comments that you might consider.</p> <p>1) It is very dense - in the way of academic material. If there is ever a public release some white space and pictures might relieve the visual monotony of the text.</p> <p>2) In the way of things megabytes give way to Gigabytes and so on - you might put multi-petabytes in there on page 3 line 103</p> <p>3) It struck me that another thing about our research is our reliance on historical data and its interpretation for real modern problems. I wondered if the following sentences on page 3 around line 100 might capture that.</p> <p>"ARR relies on historical data taken by previous generations of scientists to provide the context of the present and is keenly aware of the need to preserve and interpret historical data. As well ARR recognises that today's data must be archived in a form that can be used by tomorrow's research community."</p>	<p>will draft letter of support.</p> <p>1) Duly noted that format is dense. Probably ok for now. 2) petabyte-&gt;petabyte-to-exabyte (certainly exabyte is the aspiration now) 3) Inserted some wording to this effect.</p>
2	<p>4) I'm a bit worried about the use of the word "control" in "Research to improve understanding of controls on air quality." Control implies that we are responsible for it and able to control it. I thought "Research to improve understanding of drivers of air quality," or "Research to improve understanding of what controls air quality," or "Research to improve understanding of the processes that control air quality," might be better</p> <p>Happy to be associated with it - thanks for all the work and now let's get it out the door!!</p>	<p>4) PK thinks this is a minor issue, but it could be changed later.</p>
34	<p>mathematics references should be changed to applied mathematics for clarity.</p>	<p>Agreed</p>
34	<p>Points out lack of research on adapting research focus to processes that should be better understood as models reach increasingly fine scale.</p>	<p>Good point for further discussion.</p>
34	<p>Emphasize more strongly the need for strengthened NSERC DG program.</p>	<p>On p. 13, in "Strategic Planning through consultation", changed the text to the following: For university-based ARR to realize the two-way model of "Discovery to Application/Application to Discovery" requires two elements. First, it requires a continued commitment to fundamental research support through the NSERC Discovery Grants program. Second, it requires effective partnership with government and industry</p>
35	<p>The comments are from Marjorie Shepherd, Director, Climate Research Division, ASTD, ECCC: Thank you for the opportunity to continue following and comment on the ARRCU conversation.</p> <p>From my perspective as Director, Climate Research Division we remain supportive of this initiative, and the active self-organization efforts of the Canadian atmospheric research community.</p> <p>The identification of the iterative "discover to application" and "application to discovery" paradigm resonates strongly with our "research to operations" approach. The six ARR priority areas do align well with our program planning and interests broadly across the atmospheric research program in Environment and Climate Change Canada.</p> <p>Please let us know if you need anything more specific from us, Marjorie</p>	<p>We appreciate this endorsement and will be requesting a letter of support in the near future.</p>
36	<p>Page 7 paragraph 3, suggest changing "AAR can happen in" to "AAR happens in". It might be good to list examples of these different disciplines: atmospheric &amp; oceanic sciences but also physics, applied mathematics, chemistry, geography, engineering, etc.</p> <p>- Could also emphasize that this diversity of departments/faculties with AAR is a huge benefit to the field, because we can draw on the strongest undergrads from a wide range of disciplines for HQP training. But it's also a recruiting challenge because undergrad students may not see AAR as an option.</p> <p>- Page 10 in the "prediction" blurb: "Systems of interest broadly include atmospheric physical and chemical systems...". This is fine but I worry that it might be seen to exclude dynamics if "physical" is read in the meteorological sense as everything-but-dynamics. Could consider changing to "atmospheric physical, dynamical, and chemical systems..."</p>	<p>We decided to stay away from listing disciplines and departments based on feedback from the meetings. The second point is valid but a bit complicated to communicate and might not be of sufficient general interest in a long document.</p> <p>For last point: tweaked wording.</p>
37	<p>...allow me to make the following from my perspective particularly Arctic climate change. In the applied research section it states</p> <p>"Activities in all these areas involve a mixture of research carried out entirely by members of the ARR community, as well as research requiring collaboration with other academic, government, and industrial groups within and outside academic ARR (e.g. oceanographers, agriculture and forestry scientists, engineers, economists, municipal and regional planners, etc.)."</p> <p>1) As far as the Arctic goes we need increasing collaboration with northern research groups (northern research/field stations, aboriginal organizations, hunters and trappers associations) etc etc. This is especially the case as it applies to developing northern resource extraction, and more generally northern transportation (increasing winds and sea ice, oil spills, marine navigation, air transport, blowing snow, ice roads) and the possibility that the economics of alternate energy in the north will change (ie wind turbines).</p> <p>2) There are still some very fundamental questions that need to be address about how models function in northern latitudes. Just about every aspect of surface hydrology and surface greenhouse gas exchange is scaled to leaf area index, but most of the northern plants which are sequestering carbon (mosses and lichens) HAVE NO LEAVES. Just thought I'd point out this conundrum which we've simply ignored. It deserves attention.</p>	<p>Address this is Appendix A, an additional section on connections to other research communities, e.g. Arctic stakeholders.</p>
11	<p>This version addresses most/all of my concerns. Please add my name to the list:</p>	<p>Thank you.</p>
38	<p>Thanks for forwarding this. The draft white paper does an excellent job of laying out a vision and a set of research challenges and priorities. However, it currently doesn't say much about the informatics challenges. In the intro, the paper acknowledges that this is a "big data" science, but is then rather quiet about this when enumerating the priority areas.</p> <p>I think there's a tendency to assume this comes under the "educational" part, and certainly there's a need to figure out how to improve the training of ARR researchers in the new and emerging tools of data science and the software development skills needed for constructing and validating computational models. I think some more wording on this could be added to the section on education and training, especially to acknowledge the special challenges of helping researchers keep up with rapid advances in data analytics and high performance computing. I'd certainly like to see more specific objectives (e.g. developing curricula and online courses) on equipping ARR scientists with the core software skills needed to develop and maintaining models and data (e.g. scripting, versioning, data transformation, etc).</p>	<p>Some text was added in the Education section that was combined with other suggestions to discuss the rapidly evolving training required for modern ARR practitioners. The revised text is: A need to review the current offerings for professional meteorology programs in light of current hiring by government departments was raised. This is because the role of the traditional meteorological forecaster at a desk is being transformed into that of a professional called on to provide client-tailored products in a wide range of settings. To support this, a need for ongoing updates to training to help students and researchers keep up with rapid advances in data analytics, high performance and cloud computing, citizen science and crowd-data sourcing was identified. In addition, more practical training is required that is directly oriented towards the needs of the commercial sector, for example in areas of air-quality assessment, insurance, etc.</p>

38	<p>But I also don't see this as purely an issue for education and training. Computational models and datasets play a core role in the ARR community as a focal point for cross-disciplinary collaboration. In fact, I would argue they are the main enabler for such collaboration, as they make explicit much of the tacit knowledge within each scientific specialty. When this is done well, it brings the community together, but when done badly it creates misunderstandings and slows down the science. At the moment, we still don't know how to solve core problems like how to make datasets and computational models self-describing, so that cross-disciplinary scientists can make valid inferences from them. We don't know enough about the principles of data integration and data cleaning needed to support working with data from multiple sources. We don't know enough about how to apply recent advances in machine learning and data mining for work with ARR data. And so on. I would argue this is important enough to be elevated to an additional priority research area, given the fundamental role it plays in achieving the vision for integrated research that the paper sets out.</p> <p>Anyway, hope this helps. I'm happy to provide more input on this if needed.</p>	Address this is additional section, Appendix A, on connections to other research communities: informatics/computer science.
39	<p>[This is input from Yongshen Chen of York University, cc'ing Gordon Shepherd, Victor Fomichev, others]</p> <p>Hi Paul,</p> <p>The white paper is well written. Thanks for the hard work. I feel we might become stronger if the community also includes upper atmosphere researchers.</p> <p>You may know Jack McConnell led the development of the upper atmospheric model (C-IAM). The main developer is Victor Fomichev. Recently, Gordon, Victor and I have been discussing how to further promote the importances of coupling the lower and upper atmosphere. Below is some comments that we suggest to be considered in the white paper. Please take a look and let us know if you have any questions or comments.</p> <p>Best regards,</p> <p>Yongsheng</p>	We do hope that the upper atmosphere community can identify roles through the various references to solar-terrestrial interactions, whole atmosphere, aerospace industry, prediction, etc.. We have added an additional section that discusses the upper atmosphere community which is covered by DASP in CAP.
39	<p>The C-IAM and the White Paper</p> <p>This input pertains to one specific aspect of the White Paper and one specific model, the Canadian Ionosphere Atmosphere Model (C-IAM), which was initiated at York University under the leadership of Jack McConnell and whose development is now complete. This is a whole atmosphere model that covers the region from the Earth's surface through the ionosphere and into the magnetosphere. The development has been supported by the Canadian Space Agency as an applied project, even though the basis for it is well rooted in fundamental research. However, present directions (which may change) show the CSA being more focussed on applications and less on fundamental research. The draft White Paper covers much of the area of the C-IAM; for example on page 3 there is a reference to "solar terrestrial interactions". We believe that the addition of a few words here and there would make more clear the coupling of the lower atmosphere and the upper atmosphere (related areas including impacts on communications, GPS positioning, space weather) and so below suggest some words and locations that might be considered.</p> <ol style="list-style-type: none"> <li>Figure 1: In the blue space, for "Direct Applications", could add "Space Weather Forecasting". Under "Other Spinoffs" could add "GPS positioning error."</li> <li>Top of Page 6: Under "Building capacity and excellence in ARR", para 2, to the list (atmosphere, ocean, etc.) could add "solar influence", "interactions of the lower atmosphere and the ionosphere".</li> <li>Page 7: second paragraph. Under the list of applications could include "solar influence on climate", "errors in GPS positioning", "Impact of the lower atmosphere on the thermosphere and ionosphere".</li> </ol>	<p>We have tried to avoid references to specific products or models in the paper, or to agencies.</p> <ol style="list-style-type: none"> <li>Weather forecasting implicitly includes a lot of areas such as hazardous weather, marine shipping, UV index, aviation, etc., so explicitly listing "space weather" would appear to exclude these areas. "GPS positioning error" seems very specific.</li> <li>Added reference to Sun and volcanoes as natural external systems. This is a list of systems and "solar influence" is not a system, nor are "interactions of the lower atmosphere and ionosphere" a system.</li> <li>Not clear how the suggested applications fit here. Only two examples are given, involving a long-term research program. They are both in the air quality area and the list could/should be expanded in a longer paper. At this stage we have added the following language in the prediction targeted area section: Systems of interest broadly include atmospheric circulation, physical, and chemical systems from the surface through the whole atmosphere (including the troposphere, stratosphere, the mesosphere, the upper atmosphere, and couple interactions between these regions). These systems are themselves coupled to ocean, land, and sea ice systems. The context of global circulation and teleconnections, natural external influences from solar and volcanic forcing, investigations of past climate, and the influence of anthropogenic climate change on many aspects of environmental and climate prediction are also encompassed.</li> </ol>
39	<ol style="list-style-type: none"> <li>Page 8: In the WCRP bullets, perhaps the second one, "coupling of the lower atmosphere and the thermosphere and ionosphere".</li> <li>Page 9: With respect to "Priority Areas for Partnerships", we could mention the Canadian Space Agency. Something like, "The Canadian Space Agency provides a means for Canadian atmospheric researchers to place instrument of their conception in orbit, and also to make possible collaborations with other countries."</li> <li>Page 12: Under "Applied Research", could add "influence of energetic particle precipitation on atmospheric chemistry", and "space weather forecasting".</li> </ol>	<ol style="list-style-type: none"> <li>The WCRP areas are taken from the WCRP website and thermosphere/ionosphere coupling was not found there under the general themes. We did not list SPARC subprojects or the subprojects of the other WCRP projects like CLIC and GEWEX.</li> <li>We did not mention specific agencies in this paragraph, but we are certainly going to invite upper atmosphere related agencies (CSA, NRCan) to our workshops.</li> <li>The suggestions don't really fit in the current paragraph, there is no commercial product associated with the influence of energetic particle precipitation on atmospheric chemistry. The current reference to the aerospace sector is intended to include the space weather forecasting aspect. But again here specific domains of forecasting (e.g. aviation etc.) are not mentioned.</li> </ol>
40	<p>Comment from Gilbert Brunet of MRD/ASTD/ECCC:</p> <p>Sorry for this late response (holidays, ...). I am overall quite pleased with the document. It defines clearly your goals and especially I back your intent to develop a sustainable support for Canadian university-based ARR (e.g. the UK NERC) and partnership framework with the government and private sectors. A model for the latter could be the Met Office Academic Partnership (MOAP) where you have joint academic chairs and post-doctoral positions. I acknowledge your recognition of the importance of global linkages and their influence on you ARR priorities. The research priorities make lot of sense to me and are realistic. To review that list each 5-7 years is good.</p> <p>To recognize the integrative nature of climate-weather-environmental science is good, but it will need lot of effort to implement this. Especially to develop common modelling tools and software platforms to do research through the different research areas and organizations. It is the only cost effective way to insure the legacy of the research done in Canadian ARR into government operational products and services. My view is that ECCC could provide lot of this shared infrastructure if properly funded. I see this as the most challenging keystone of ARRCU-ECCC partnership.</p> <p>Of course I am available to participate to relevant meetings to support this effort.</p>	All these comments are worthwhile starting points for discussion for the fall 2016 meeting.
41	<p>Since climate change issues have gone beyond the boundaries of physical sciences, I think it is prudent (even from funding point of view) to approach this area of research as highly interdisciplinary. There have been opinion pieces in Nature, Science, etc. that have urged the physical science community to expand and include social sciences in a closely collaborative and integrative structure, since unlike some hard core physics, we do work in the area of physics that has immediate visible impact on the society, as well as other components of the climate system, as visibly demonstrated in various IPCC assessment reports. And since the relative importance of climate environment is determined largely by cultural perception, inclusion of the so-called "indigenous knowledge" is important, and politically wise. I have a graduate student right now working to help me out with a review of the impact of vector-borne diseases in northern communities as the Arctic region gets warmer. There certainly is no shortage of mosquitoes up north (well, not too far north), and as long as we have a pool of certain bird species migrating northward, we could end up with a lethal combination.</p> <p>I agree that a section, even very short one expressing the need to include explicitly other groups whose research is not directly related to the activities of ARR would be a good start, as you have suggested Paul.</p>	Address this is additional section on connections to other research communities, e.g. Arctic stakeholders.

42	<p>The following is input solicited at the second review stage from Dr. Michel Béland.</p> <p>Preamble: In my simple-minded view on the planning and management of any S&amp;T program, there are three criteria which should be satisfied, if one is to measure whether or not the program has been successful, particularly in the eyes of those who funded it. These are Excellence, Relevance and Impact. Thus any S&amp;T strategic and/or implementation plan should indicate clearly how it will meet these criteria, indicating with some level of detail the expected results it is proposing to achieve. And this should apply to academic research, as well as to mission-oriented research. There is thus still work to do on this draft document, as it is not entirely clear how these three criteria will be satisfied for the different activities planned for the Canadian ARRCU.</p>	<p>We thank you very much for your thoughtful remarks which will greatly assist us in our strategic planning. It is clear that the S&amp;T strategic plan should contain the measures of excellence, relevance, and impact. But at this stage we face real difficulties in introducing the ideas you have outlined: ARRCU is a self-organized effort bringing together what has been a fragmented community. It covers a broad range of topics and has not been given a mandate to draft a full fledged S&amp;T plan, nor identify priorities, nor propose deliverables. The ARRCU-WG committee does not have a mandate or resources to deliver. Instead, we are focused on the group of professional academics doing research and education in a wide range of fields that share many common elements.</p> <p>Measuring excellence in terms of HQP training, bibliometrics, funded grants etc. requires research which itself requires a mandate, resources, time. Thus this is the beginning of a long-term organizational effort which has not been seriously undertaken in Canada. At this stage, we feel it most practical to quickly publish a document that the co-signators agree to, and then proceed with more strategic planning. The final S&amp;T plan needs to be a cross cut document in which academic, government, and industry roles are clearly delineated, and in which excellence, relevance, and impact are addressed.</p> <p>To partially address your comments, we have inserted the following text in our current document: The strategic plan we develop will need to establish measures of excellence, relevance, and impact, focusing on the concrete contributions that can be made by the academic community across ARR domains. Establishing such measures will require an effort to document our capacity and impact in HQP training, bibliometrics, funded research etc., on an ongoing basis. We will need to appeal to recent examples of successful outcomes in our research partnerships, career tracks of HQP, and international impact of our research, to make a strong case for enhanced and sustained support of academic ARR. We will need to draw on available strategic planning documents across ARR domains in this effort.</p>
42	<p>1) Addressing excellence: in the document, a few examples are provided for past successes, but they are getting a bit old. I could think of more recent ones that should have been included. Some of the excellence has been the result of collaborations between academic and government labs: these should also be highlighted. There are also many different ways of measuring excellence: all of these should be considered, not just traditional ones such as prizes and refereed papers: for example, the fact that the present operational global and mesoscale modeling suite run at the Canadian Meteorological Centre, now integrated with the Regional Climate Modeling Canadian tool, is one of the best in the world (it ranks 3rd best amongst 12 global prediction centres worldwide, including the US National Weather Service is a clear indication of the excellence of the academic and government R&amp;D that developed it.</p> <p>One key mission of universities is the training of highly qualified scientific personnel. It is indeed a very important mission, and is closely related to excellence, as well as to relevance and impact. Data should be provided on this mission, both past results and the proposed evolution: for example, over the last years, what have been the hiring profiles of the graduates when they left their academic institutions? Have they gone to prestigious research institutes or government funded labs? Have some of them become internationally recognized?</p>	<p>If we singled out a more recent example from, for example, the weather service, there would be a large group of ARRCU who would point out that we appear to be excluding them. The two examples provided are rather limited but are sufficient for the current white paper.</p> <p>If we are able to obtain more resources to study hiring and personnel issues, we agree that we should focus on a study of HQP training in ARR in Canada. The questions you ask are excellent ones and have been very challenging to obtain information about. (And yes, many of our Ph.D. graduates are entrained into government labs and research institutions.) Many academics provide information of this kind to NSERC, for example, and this could be a potential source of information.</p>
42	<p>2) Addressing relevance: this is the main reason I have attached the three papers, namely the international S&amp;T strategic and implementation plans (some components still in development) for weather and atmospheric chemistry, and the proposed evolution, recently adopted by the WMO Executive Council two weeks ago, for the Global data Processing and Forecasting System (GDPFS) over the next 15 years: these three documents provide a 10-15 year or so outlook on the priorities which should be addressed by international research in the fields of not only weather and atmospheric chemistry, but also climate and hydrological services, impact-based forecasting and risk-based warnings, and an ever expanding suite of environmental products, tightly coupled to GPC's core modeling suites, and GCM's. The ARRCU will be well advised to take note, and link its own strategic vision to these three « visions », as the Meteorological Service of Canada is supporting this vision. In particular, the GDPFS document, supporting the transition to seamless and integrated modeling, proposes a vision of the state of operational environmental services 15 years from now, discussing the impacts of advanced IT tools, such as big data, cloud computing, broad band communications, crowd data sourcing, etc..., expanding commercialization, the role of academic activities, etc...</p> <p>Three similar documents exist for the WCRP, GCOS and GOOS, in different states of preparation (the last WCRP strategic plan ends around 2015 I believe, but the list of the WCRP Grand Challenges are well described on its web site). Similar documents exist for the WMO Global Observing System (GOS, and WIGOS), the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS). You will note I have not referred to the Future Earth initiative: I have some issues with it, particularly on its capacity to deliver on the services and policy aspects. But that is my own personal view...</p> <p>The point I am making here is the following: either the ARRCU strategic plan is tightly linked with all these major international initiatives, and defines the niches in which it will contribute significantly, not only for the benefits of the science (excellence), but also for the benefits of Canada and the world (relevance), or it sails its own boat, at great risk of failure.</p>	<p>Thank you for providing these references, which will provide critical input for the next stage of strategic plan development. The implementation of all these plans, and the role of academic sector researchers within it, should be at the forefront of future discussions.</p>
42	<p>3) Addressing impact : In curiosity-based research endeavours, it is often difficult to predict impacts, and quite often, these will only materialize decades later. This is of course not the case for mission or services oriented research programs. The ARRCU document discusses the importance of defining a strategy that will result in technology transfers to private sector and public sector. This will require much closer collaborations, from all players than has been the case so far. The document should come up with proposals on how to effect these. The academic sector would obviously benefit from finding out what are the priorities and the science gaps in both the relevant private and public sector activities. It could then be in a better position to define or measure the eventual (positive) impacts of funding or prioritizing a number of program components as opposed to others. This would also undoubtedly have a positive impact on the training of students, which could then face better job prospects.</p>	<p>Within this document, the concrete proposal to hold workshops on partnership with government and industry is a first step towards developing the strategy. Many such proposals have been discussed including a joint academic/government/industry program on hiring of postdoctoral fellows in ARR, increased coordination in graduate training, etc... A critical component of the strategic plan would also be metrics for success.</p>
42	<p>Finally, the following constitute my overall comments on the present draft. It should be visionary, exciting and enthusiastic, and it should be short. Not the case so far... It should acknowledge the absolute necessity of sustainable development for the survival of mankind and the world, pointing out the key and central role played by atmospheric and related sciences in eventually coming up with policies and services that will help attain that objective. It should point out the rapid convergence of earth system sciences, something which has already become a reality in a number of operational weather and climate services. It should recognize the maturity of NWP and the increasing automation of the forecasting process in a number of advanced weather services; this has led to the disappearance of the traditional meteorological forecaster at the desk, and its transformation into a full-fledged meteorologist, interacting with stakeholders from both the private and public sectors on the provision of an ever expanding suite of environmental client-tailored products: the ARRCU community will adjust to this transformation, particularly in the training of the future generation of meteorological scientists. It should, in line with the above, stress the major socio-economic benefits brought about by operationalization of ever more accurate environmental services, pointing out that this will depend critically on a solid and sustainable national R&amp;D effort. It should also point out that although Canada can rely up to a point on foreign R&amp;D activities, in the end, it absolutely needs to maintain and further develop its own national expertise, to solve its own national problems: this will not be done by any other countries.</p>	<p>The document is admittedly dry and stylistically imperfect, but at this stage we will need to leave it more or less in its current form.</p> <p>We have included some language around climate change but there is not a strong consensus in the group about the degree to which we should emphasize sustainable development and related environmental positions. What this means is that if the strategic plan involves collaboration between government, academics, and industry a statement of sustainable development will need to be developed in consultation with all these sectors.</p> <p>The convergence of earth system sciences, maturity of NWP, automation of forecasting, development of climate and environmental services, etc., are all important issues that will provide excellent input into the subsequent strategic planning stages. In the meantime, we have added some language in the training section to reflect yours and other's comments.</p> <p>The sovereignty argument could be strengthened and we have endeavoured to do so: at the end of the "framing research priorities" subsection we have inserted: "Finally, we recognize that although Canada can rely up to a point on international contributions to research and development in ARR, in the end, it must maintain and further develop its own national expertise, to solve its own national problems: this will not be done by other countries."</p>

43	<p>I have spent some time going through the ARRCU draft and appreciate the time you have spent in putting it together. I have a few comments.</p> <p>1) It still isn't clear from the document whether you intend the list of priority areas to be intended for the partnerships program or fundamental research in atmospheric sciences in general. This is especially the case in the abstract to the draft.</p> <p>a. I am concerned if the intention is to direct activity in fundamental (from your email of June 17 it appears this is not the case). I think that fundamental research activities (through NSERC Discovery grants and strategic research grants) should be selected simply through their excellence on the international stage. This ensures that future innovations will be developed and supported thereby ensuring that future government and industrial activities remain competitive.</p> <p>b. If these activities are intended for partnership possibilities, then I would like to see the distinction between fundamental and partnership research activities made more clearly especially in the abstract.</p> <p>2) I still see the priority areas as being too restrictive and prescriptive. I understand that this will always be an issue for any scientific community. However it is especially difficult for the atmospheric community where there are so many different perspectives and research approaches and activities. From my point of view, I would like to see the following included:</p> <p>a. Coupling processes from the troposphere to the mesosphere (dynamical, chemical, radiative, transport) remain a topic of significant research and importance. In addition, the influence of the lower atmosphere on the ionosphere is now being recognized as significant. I am not suggesting this latter topic be made one of the priority areas but it would be good to be aware of this connection and that it is another important link for atmospheric research. However, I would like to see Coupling Processes included especially if these priority areas are interpreted as representing directions for fundamental research in Canada. They are very relevant for climate change and perhaps with a sentence or two could be included there.</p>	<p>1) Regarding this point, we have introduced language in the abstract and in the text that this initiative is not intended to direct priorities in fundamental research. About the NSERC Strategic programs, it is not clear whether NSERC would agree that sole criterion for selection is excellence on the international stage, when the terms of the NSERC Strategic partnerships are intended to benefit Canadian partners. However, the Discovery Grants are clearly in the mold you suggest.</p> <p>2) In abstract have added reference to whole atmosphere from troposphere to thermosphere, and interface with research on space (among other systems).</p> <p>Detailed reference to coupling processes in different parts of the upper atmosphere would be at a level of detail that is not present for other areas in the document. For example, it would be easy to add a lot of language about coupling between sea ice and the atmosphere, snow and biogeochemical cycles, etc... The list of priorities does not exclude the areas you suggest here, and we have introduced language related to solar and volcanic forcing. At this stage we have included the following in the "prediction" priority area: Systems of interest broadly include atmospheric circulation, physical, and chemical systems from the surface through the whole atmosphere (including the troposphere, stratosphere, the mesosphere, the upper atmosphere, and coupled interactions between these regions). These systems are themselves coupled to ocean, land, and sea ice systems. The context of global circulation and teleconnections, natural external influences from solar and volcanic forcing, investigations of past climate, and the influence of anthropogenic climate change on many aspects of environmental and climate prediction are also encompassed.</p>
43	<p>3) The term applied research is also not clearly defined. I would tend to see the reverse cycle (vertical arrow) in Figure 1 as having two components. One would be the development of specific applications based on the needs of government/industry which requires the expertise of the research community and the other would be the generation of more general open questions that the research community could start devoting attention to.</p> <p>4) I appreciate the attention you are paying to outlining the relationship between research activities and the tools and information the general public takes for granted. This is something that needs to be continually emphasized but is difficult since one cannot demonstrate the usefulness of things that have not yet been conceived.</p> <p>Thanks for your work in putting this together. At this point, I am supportive of the process in general and can be included as a co-signatory in this sense. However, I am a little worried about this as it would seem to imply that I approve of the identified priority areas which at this point I don't. Perhaps I can discuss this further with you.</p>	<p>3) It is not clear what specific revision is required, however the idea of proposing two-way links between fundamental and applied research has been generally well received.</p> <p>4) We have tried to identify a couple of examples of success and have been told on several fronts that we could come up with better examples. The final strategic plan will likely have some more compelling and up to date examples.</p>
44	Add CORDEX as WCRP project	Agreed.
44	p. 4: Point out that academic ARR not only improves but develops products	Agreed, changed "improving" to "developing and improving"
44	p. 5: Suggested addition: "These HQPs are in most part engaged by ECCC and other public and private organizations working in ARR."	PK: Disagree - we don't have good statistics on how our HQP are engaged, as far as I am aware.
44	p.7, in paragraph starting "Well integrated ARR", suggests adding "The use of weather and climate up to date models improves our capacity to identify key physical factors responsible for the occurrence of extremes and atmospheric hazards. This contributes to disaster risk reduction in Canada and abroad, as meteorological (high frequency) conditions are regularly affected by rapid changes in climate (low frequency) conditions"	PK: This sentence didn't really work here, but I added after the "Montreal protocol" sentence: "In addition, the use of state of the art weather and climate models improves our capacity to identify key physical factors responsible for the occurrence of extremes and atmospheric hazards. This contributes to disaster risk reduction in Canada and abroad."
44	other typos, minor changes	agreed
45	<p>These are comments from Elizabeth Boston, director of Mathematical, Environmental, and Physical Sciences at NSERC:</p> <p>I very much appreciate the work that you and your colleagues have put into this comprehensive document, as well as your active participation in the evaluation of the CCAR program over the last few months.</p> <p>The White Paper certainly looks like a worthy contribution to the Fundamental Science Review currently underway. The strong support for discovery research as the foundation for application/innovation aligns very well with NSERC's Strategy, and the message of "discovery to application and back to discovery" resonates very well with our Strategy's goal of "Discovery to Innovation". I also like the approach of identifying a limited number of broad themes and priorities for a more targeted/partnership approach.</p> <p>My one comment is that perhaps you might think about mentioning in the Introduction other factors, such as the commitments laid out in many of the ministerial mandate letters that refer directly to climate change, as well as Canada's commitments under the Paris Agreement. These all support arguments for sustained support for ARR and closer partnerships between the academic and partner/stakeholder communities.</p> <p>Thanks again for all your work, and let's keep in touch on next steps.</p>	<p>Thank you, the encouragement of NSERC is extremely important to this process. We have added reference to the ministerial letters and the Paris Agreement.</p>
10	<p>1. The links in the pdf don't work (squarespace, see below); the breaks in your file make the hyperlink incomplete, in case that trips anybody else up just copy/paste the full link in your browser.</p> <p>2. good to see more mention of the middle/upper atmosphere. Can we get some mention of "space weather" in Fig 1, maybe as "environmental prediction" and explicitly put "ionosphere/magnetosphere" under "to study coupled."</p> <p>3. also in Fig 1, can we get "ozone forecasts (warnings?)" or something like that explicitly under "Direct applications". There is some discussion of ozone but since it is a topic well known to any lay reader and resonates with people I don't see where we can mention it to much? Also seems to me that since we are talking so much about "good" ozone and also talking about air quality, should "bad" ozone (surface) be explicitly mentioned, I don't think it is?</p> <p>3. Appendix 2: ionosphere is misspelled.</p>	<p>For 2 and 3, have added detail to Environmental prediction point as follows.</p> <p>Environmental prediction (e.g. hydrological, marine, stratospheric and tropospheric ozone, space weather)</p> <p>To keep focused we should leave ionosphere and magnetosphere under "atmosphere". No room in table to distinguish stratospheric and tropospheric ozone.</p> <p>Typo corrected.</p>
46	Comment on first couple of sentences of introduction: "These products are all primarily developed within government."	PK: Aspects of this are recognized in the document and a delineation between activities inside and outside governments is outlined. In fact Universities contribute to products in weather, climate and air quality, for example the regional modeling efforts in Canada have a strong University based component.
46	p4: Exabytes is an exaggeration. CMIP6 output will be a few Pb. ECCC archives are measure in Pb, not Eb.	Agreed
46	pp5-6: Three overarching aims: "Of the 3 items on the list, it is really only item 3 which the Canadian academic community in ARR can do itself. Items one and two are aims that it supports, but it is really for others others to act on these recommendations."	<p>PK: These recommendations relate to university based ARR and training, and does not encompass all ARR or training in government and industry.</p> <p>As stated, capacity building in "university-based ARR" is really the responsibility of the university community. The balance between university-based ARR and ARR in government and industry is something that needs to be decided at a higher level. Also, our viewpoint is that to develop sustainable models of university-based ARR is something that the university community, within this document, should endeavour to do. We do not expect other sectors to do this for us.</p>
46	Comment on p.7, "investment in large scale infrastructure ...": Presumably this should be balanced against the need for investment in people to exploit this infrastructure to carry out research in ARR and deliver the benefits described in this document.	PK: Yes, good point. Text added to this effect.
46	Point about strategic planning with partners not having been undertaken before: reviewer points out that such planning has taken place within some divisions of ECCC.	PK: Clarified language to suggest that no strategic planning including academic, government and industry has taken place.

46	Suggests breaking CCAR out of bulleted list on p.9 because it should be the focus of the document, and benefits of CCAR should be enumerated.	PK: CCAR evaluation not yet completed ; strategic planning extends beyond CCAR; many researchers did not receive CCAR funding.
46	Table and research priority for partnerships: predictions -> predictions and projections, and clarify multidecadal timescales are only amenable to projections.	Agreed
46	Atmosphere related bgc: As far as I know the cryosphere isn't an important reservoir of carbon or nitrogen. [Later] And ocean ecosystems and biogeochemistry? These are important for climate too.	Agreed in principle but we are trying to stay out of ocean-related BGC because this is the subject of other initiatives (e.g. C-CORU).
46	Applications area: This priority area does seem superfluous, given that the whole document is focused on applied research in ARR – further up the text indicates that 'the ARRCU initiative is not intended to direct priorities in fundamental ARR'. I would have thought that much of the research discussed in the preceding priority areas would be of interest to government and industry on a 5-7 year timescale.	PK: Understood but will retain. This allows a separate area for commercialization, development of products in partnership with NGO, more operational activities carried out within university sector.
46	p.14: This is a bigger issue than the availability of online analysis tools. Direct access for academic scientists to government networks is limited for security reasons. But efforts are being made to share relevant datasets on publicly available websites in line with the government's open data policy.	PK: Understood; this is shorthand. The principle is that ARRCU is trying to aim for access through partnership agreements (if open access is not possible) but there was not room in the document to really explore this.
46	p.15: "citizen science/crowd sourcing": Are these really needed as components of training for a meteorological forecaster?	PK: I believe this was identified in our consultations as relevant skills for today's work environment.
47	Abstract: sentence about not directing fundamental research: Confusing sentence. The first half sounds like fundamental research is the objective of this document, but the second half rules that out	PK: Agreed, split into two and started new paragraph below.
47	p.4: insert aircraft based observations after space based obs	Agreed
47	p.8: sentence on teleconnections: Might be worth adding here that such concerns motivate ECCC to run global weather and climate forecasts	PK: Good science linkage but a bit too detailed.
47	Priority areas for partnership: General concern about disproportionate emphasis on air quality/chemistry versus areas of meteorology.	PK: Difficult to get the balance properly. That being said, the linkage to air quality (bridging for example CMOS and CSC) is perhaps one of the main innovations of this effort. It bridges us away from physical climate into earth system science.  In my view it reflects the reality of existing hiring trends, field campaigns, industry interest. So it is emphasized with a view to partnerships. It would be much better if there were more partnership opportunities in particular areas of met you mentioned.  These areas of partnership will not dictate what ECCC or other partners offer - they will let us know, presumably. A critique we heard about the CCAR programs is that they did not support weather reeseach even though this area is a huge government and international priority.
11	Why US disaster on p.1, why not another Canadian one? Why two air-quality examples?	PK: I would not want to change the Sandy example since it is such an important event for North American awareness of climate issues and could be a harbinger of the future; air quality examples could be improved but they will have to do for now.
11	Requests clarification on ARRCU membership.	PK: About ARRCU membership - we are not incorporated, so we can't have a membership. We have two mail lists, one that is exclusively university faculty and the other that is broader to include adjuncts, gov't, industry. We have tried to make sure only to invite people who are full time budgetary university appointments, but I am a bit worried that I might have made mistakes. This is far from ideal but again will do as far as release of the White Paper.