A Sustainable Partnership Between NASA & NSF
for Planetary Science & Astrobiology Research in Antarctica

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“Recognizing that it is in the interest of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord;

Acknowledging the substantial contributions to scientific knowledge resulting from international cooperation in scientific investigation in Antarctica;

Convinced that the establishment of a firm foundation for the continuation and development of such cooperation on the basis of freedom of scientific investigation in Antarctica as applied during the International Geophysical Year accords with the interests of science and the progress of all mankind;

Convinced also that a treaty ensuring the use of Antarctica for peaceful purposes only and the continuance of international harmony in Antarctica will further the purposes and principles embodied in the Charter of the United Nations”

-Preamble to the Antarctic Treaty, 1959

Key Recommendation: Antarctica is a place of unique value for not only Earth Science, but also for Planetary Science. At the same time, the challenges of operating in Antarctica deserve appropriate respect and best efforts must be made to provide a sustainable pathway for collaboration in Antarctica between NASA and NSF. At present, policies regarding proposals to conduct NASA PSD funded research in Antarctica vary from program to program and change over time. Several processes would help preserve a role for planetary science and astrobiology research in Antarctica that can be conducted in a sustainable partnership with polar sciences, USAP and the NSF. At the top of the recommendations is establishing formal processes that can improve proposal reviews whereby science (and sometimes technological) value to both NSF and NASA can be assessed and shared review of logistics is possible.

Introduction:

Antarctica is not only the most remote continent on the planet, but also one of the most important. It is a place relatively free of direct human influence, critical to understanding the Earth system, and rapidly changing under global climate change. For planetary science there is unique value in Antarctica. The Dry Valleys represent one of the best analogs for Mars. The fracture processes in, and melting and freezing at the bottom of thick ice shelves represent the only places to study physical processes in ice on scales anywhere close to the icy satellites.

Antarctica is also dangerous. The weather is virtually unpredictable, violent and extreme. Its remote location makes everything more difficult, from the simplest tasks to those involving cutting edge technologies. As a result, it is a place that deserves respect and special attention.

Antarctica is protected by global agreements in the form of the Antarctic Treaty, which was signed in 1959, with the United States among the signatories. This agreement now involves 50 nations across the globe. The treaty preserves Antarctica for peaceful use, the pursuit of scientific research, and the preservation of the continent. Among the agreements, the wide sharing of science, data and personnel is a central commitment as well. More details can be found here: <http://www.ats.aq/>

Because Antarctica has critical value to planetary science and astrobiology and at the same time any utilization of Antarctica necessitates respect for and preservation of the continent, the Antarctic treaty, and responsible consideration of the resources that it takes to conduct work there, a sustainable path forward for collaboration between NASA and NSF should be sought.

Here I summarize some of the current issues complicating NASA PSD work in Antarctica:

Access Policies: Currently, access to Antarctica for NASA Planetary Science Division (PSD) proposals varies from program to program, but not systematically. Moreover these policies change over time. There are many reasons for this—funding levels change, NASA programs change, NSF policies change, and many others. However, the end effect is that researchers who work in or want to work in Antarctica on topics that are motivated primarily by planetary science or astrobiology questions and secondarily (or in some cases without) Earth science can be unexpectedly unable to conduct important work. This unpredictability risks the loss of key science across many areas of planetary science and astrobiology.

Resources: NASA proposers are often new to Antarctica, or unaware of the potential impact of their work. NSF reviews proposals first for their scientific value, and then for their logistical impacts. Every effort is made to fund top proposals, however, logistical considerations are also reviewed and proposals can be delayed or rejected based on implementation. This same process is difficult to achieve for PSD proposals since they are outside of the NSF review process. Thus, what may look like a simple project—a few instruments delivered to an interesting place on the continent, or a test of a technology that needs access to ice—could end up being immensely more expensive or untenable than the core research. Moreover, resources in a given year (i.e. vehicles or numbers of people on station) can be relatively fixed for USAP, and USAP is charged with conducting many activities, not all of which are directly supporting scientific investigations. This means that a relatively minor part of a PSD funded program could inadvertently utilize a substantial fraction of the annual resources for USAP science support, which can have many effects. Chiefly however, the risk is that with USAP already operating near its operational limits, a NASA proposal could bump out NSF high priority science for a particular year, or that the costs to NASA to support the implementation of the PSD-funded fieldwork may be so high as to negatively impact the number of proposals the NASA program

can then fund. At present, it is difficult for NASA to assess this before selecting a proposal, or for NSF to relay this information to NASA during the standard proposal review process—since logistical reviews happen at a particular time of the year set by NSF/USAP internal deadlines and the resources in a particular year may already have been allocated. Surely, there could be a better thought out system that would allow both NASA and NSF to collaborate on these efforts.

Access: Even for NSF proposals, fieldwork in Antarctica is reserved for work that can only be accomplished in Antarctica. Every proposal requesting Antarctic fieldwork must demonstrate why working in Antarctica is needed. This is critically important for considering PSD's policies on Antarctic access. There are many projects that could take place in Antarctica. However, the increased cost, risk, and aforementioned potential to bump out other critical science all necessitates that Antarctic access be treated with care.

Science Return: Technology is an area where NASA can contribute uniquely to operations and science in Antarctica. But technology designed for planetary science does not automatically take the place of Earth science, or do it better than would be done by a field team using traditional methods. While certain kinds of development are needed for planetary exploration, for example landers for Mars, melt probes for Ocean Worlds, or astronaut training, these activities do not necessarily benefit the science of Antarctica, nor can these only be uniquely tested in Antarctica. This point is very important—the technology must be also in service to the science of Antarctica, otherwise the test is just more expensive, more resource heavy, and more dangerous than if conducted in other parts of the planet.

Moreover, returned science versus cost is an important consideration. For example, subglacial lakes are discussed regularly as important possible targets for subsurface exploration both for astrobiology and for Earth science. Exploration of these lakes in Antarctica currently involves hot water drilling programs that open boreholes through the ice and allow many investigations to occur—many liters of water returned to the surface for analysis, sediment cores and samples retrieved, borehole loggers deployed, profilers installed, and many other measurements. These allow large teams of scientists to be involved directly, data to be archived and shared, and for these groups to study the full system. Because these features are remote, deep, and challenging to access, it is critical that as much science as possible be conducted when they are accessed. On the other hand, an engineering test of a planetary probe is unlikely to be able to accomplish all of this science—so while a potentially interesting technological step, it is not correct to assume that our spacecraft-motivated PSD objectives can or should replace campaigns that gather massive amounts of critical data for the Earth system, especially when these activities may take similar resources to traditional expeditions. Technology can be developed with both Earth and planets in mind and many examples exist—but it is important that PSD scientists are honest about the limitations that our technologies can have with regards to the study of the Earth, and if targeting Antarctica, to do our best to make appropriate changes or find another test site.

Ideas for a Sustainable NASA-NSF Partnership

Below I describe a few ways that the issues raised above may be mitigated in the hopes they inspire new ways to enable more polar science within PSD.

Establish a joint NASA-NSF Working Group

NASA and NSF and USAP program representatives should form a working group that can regularly communicate and help establish processes that are mutually beneficial to the programs. This group could establish policies and programs as outlined below, or that can solve similar problems and enable better cooperation for the advancement of all science in Antarctica.

Joint Review of Proposals or Proposal Elements

Currently, NASA and NSF have different responsibilities to the United States, different science motivations, different operations and different review processes. However, joint reviews of proposals could bridge many of these gaps. Having an NSF program manager or USAP representative participate in the review of Antarctic proposals to NASA programs (and potentially the same for NSF proposals that overlap NASA interests) is a possible change that would allow for cross-program discussions. Another possible implementation could follow the mechanism used at present to facilitate international collaboration, such as the NSF-UK NERC collaborations that enabled the International Thwaites Glacier Collaboration program. In this model, the proposer seeks international partners for their proposal, and the international organization provides a support letter stating that they will consider the proposal if funded by NSF. For example, NASA PSD could require that any proposers considering Antarctic field work consult with an NSF program manager and/or USAP logistics coordinator to get a preliminary letter of support or understanding regarding the field work. A similar process is currently used for proposing work in Greenland, and could be extended for Antarctica.

Currently, NSF polar programs has a rolling deadline, whereas PSD is only now considering such a strategy. However, NSF suggests a deadline of 18 months prior to the deployment date for proposed fieldwork to be reviewed for science and logistics

New Proposal Requirement: Benefit to Earth Science

Whether or not simultaneous joint review of proposals is possible, a new section should be required for NASA proposals requesting Antarctic access regarding benefits to Earth science. Because the science and conservation of Antarctica is an international commitment different from other areas of field work, and because of the aforementioned complexities regarding review and resource allocation, it is important that even PSD proposals have relevance to the scientific understanding of Antarctica. Having an additional section would solve a few of the issues noted above. First and foremost, it would require PSD proposers to consider their benefit to Antarctic science. Second, because joint discussions of resource use and prioritization will need to take place between NASA and NSF, such a section would allow NSF to review NASA proposals (which may be centrally motivated by questions that are not primary to

NSF) for overlap with NSF priorities or also for fundamental issues in the science or technical approach described in the proposal (as there may be areas of research or past work that PSD proposers are less familiar with). This would also allow NSF scientists to comment on programs that claim fidelity to Earth science.

Logistics and Resource Consideration and Reduction

All NASA PSD proposals for Antarctic access should explain how environmental and resource impact of the work that is being proposed has been considered and mitigated. Relatively simple activities at low latitudes are challenging at the poles, and every resource utilized ripples through the whole system. As stakeholders in Antarctic science and operations, PSD scientists also need to be part of the solution for sustainable use of Antarctica. A NASA PSD level logistics review process should be established that makes it clear to proposers how decisions may be made, and that allows NASA to make plans and avoid significant cost growth or surprises in the implementation of Antarctic field work.

Regular Opportunities and Communicating the Process

Whatever is agreed upon, NASA policies regarding Antarctic access should be reviewed, streamlined, and communicated to the science community. Changing deadlines, changing policies, and skipping programs puts this critical scientific research at risk despite its value. The community would benefit from regular and clearly communicated opportunities to propose for field work in Antarctica.

Conclusion:

Antarctica is a unique and special place, a world almost in itself with immense value, both scientific and otherwise. It is a life changing experience to work there, and a true honor. It is in the best interest of all stakeholders that responsible, sustainable partnerships for scientific study of Antarctica from all perspectives be maintained. The ideas here are not the only possible answers, but are offered as food for thought for important conversations that should occur in order to continue this important work, such that “the substantial contributions to scientific knowledge resulting from international cooperation in scientific investigation in Antarctica” continues to extend beyond the reaches of our own planet.