POLAR POWER:

EDUCATION, OUTREACH AND COMMUNICATION AND THE INTERNATIONAL POLAR YEAR

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Concerning the International Polar Year

Before the Subcommittee on Research

Committee on Science

U.S. House of Representatives

September 20, 2006

Good morning Mr. Chairman and Members of the Committee. Thank you for the opportunity to speak to you today regarding IPY EOC, education, outreach and communication relating to the International Polar Year. My name is Mark McCaffrey. I am an Associate Scientist at the University of Colorado at Boulder and a member of the IPY EOC Subcommittee, which is currently made up of representatives from eleven of the 66 nations currently participating in IPY. I also have been involved with organizing several recent IPY EOC-related workshops and will share some of the findings of these workshops with you in a few minutes. What I'm really here to talk to you about today is polar power: the potential for IPY and polar people, places and science, to change the world, as it has in the past.

I am deeply honored to be here today with this esteemed group of polar scientists and distinguished individuals whose lives were in someway changed by the third IPY, the International Geophysical Year of half a century ago. But I confess I feel like an anomaly here. I am not really part of the polar research community. I've never been above the Arctic or Antarctic circles. My background is in environmental science education, and over the years I have worked with a variety to research scientists to develop strategies and programs to help translate their research for non-specialists and, hopefully, make it more accessible and meaningful to students, teachers, and the general public. But I've long been fascinated by the power of the polar realm to challenge us at deep emotional, intellectual, even, spiritual levels.

I am also a child of the IGY, and I remember watching some of the IGY films that the National Academies produced, and reading about scientists in Antarctica in my Weekly Reader newsletter in the early 1960s. I also recall it was a somewhat terrifying time, with "duck and cover" air-raid drills at school, and neighbors up the street building bomb

shelters in preparation for possible Soviet missile attacks. And in the midst of it all, scientists around the world embarked to the ends of the world, measuring change, sharing data, developing networks and relationships that led to massive jumps in our understanding of the Earth as a system, and fostered a robust international scientific community that, while still dependent on national support, transcends national agendas and benefits our global society.

In my opinion, the upcoming International Polar Year, if sufficiently funded and well coordinated at grassroots, national and international levels, will be a revolutionary catalyst for informing, engaging and inspiring a more scientifically savvy and literate society, forging new and strengthening existing national and international collaborations and partnerships, leveraging the 125 legacy of IPY-- the first, the original international year-- and building on the tremendous preparation and energy that has gone into planning the education, outreach and communication efforts for IPY.

But with less than six months before the launch of this International Polar Year, there is no guarantee that the rich potential will be realized. Without appropriate funding and coordination, the International Polar Year risks becoming yet another well-intentioned program insufficiently supported, yet another international year in a sea of other international years that will fail to live up to its potential. For IPY to make the splash that is could, that it should, for it to trigger a ripple effect lasting for generations to come, it is urgent that the United States, which has played a crucial, integral role in planning IPY research and EOC, steps up and enables this important endeavor to achieve its vision and goals.

IPY EOC is certainly about explaining what scientists know—and don't know—about the accelerated surge of melting snow and ice and its global significance. It is also all about learning from the experiences and insights of the over four million people living in the Arctic. And it is about examining the carbon cycle and how it relates to seasonal cycles, the hydrosphere, the biosphere, the atmosphere, and its intrinsic role in the global climate system, which is amplified in the polar regions due to their seasonal extremes.

Fundamentally, IPY EOC is about exploring how polar regions and polar research is vitally important to all people on Earth. But IPY is also about exploring the role of technology in our society, and demystifying and articulating how science itself is conducted, how data are collected, analyzed, modeled, reviewed and communicated. It is about showcasing the state of the art research and phenomenal technology of modern scientific research into the planet's complexities via high-definition television programs, 3D Imax movies, video logs and webcasts from teachers at the poles, radio programs, science center and children's museum exhibits, and good, old fashioned lectures from scientists and stories from polar people with their compelling, tales of adventure and insights into what they have learned about our changing planet.

Running from March 2007 to March 2009, the International Polar Year 2007–2008 will involve hundreds of projects and thousands of scientists and will leverage billions of dollars of infrastructure and prior research. Organizers of this IPY recognized from the start that ultimate success of the upcoming IPY would depend as much on effectively communicating the project's activities and findings to broad audiences as it would on the quantity or quality of the science. Just as IGY is remembered, at least in the United States, for helping to inspire a new generation of scientists through the films, media and posters as much as it is for launching the first Earth observing satellites and

breakthroughs in science and politics, the legacy and success of the upcoming IPY may be measured in the public realm by its societal impacts from EOC efforts more than it will its data archives or scientific publications.

I have been specifically asked to address three questions. The first is "what has been the impact of polar research and IPYs on students ad the public in the past?" Obviously, this is an enormous question which one could write a book about. And in fact, Michael Robinson, a history professor at the University of Hartford, has recently written a book entitled "The Coldest Crucible: Arctic Exploration and American Culture," which explores the phenomenon of "Arctic Fever" that was part of 19th century American culture. I am not a historian, but I do have a few thoughts about the legacy of the first IPYs. Most significantly, IPY is the original international year, dating back to the first IPY in 1882-83. Today, there are literally thousands of international years. A recent Google search on the phrase "international years" netted over 1.5 billion results, and down at number fifty-five was IPY.org, the homepage from the IPY Programme Office in Cambridge, UK, which links to the U.S. and other national IPY Web sites.

The concept of an international polar year, which has become the model for the proliferation of international years, was originally the vision of Lt. Karl Weyprecht, an Arctic explorer and scientist in the Austro-Hungarian navy. The idea was born out of the frustration that Weyprecht experienced on several Arctic expeditions when he realized that nationally led efforts to explore and acquire territory were not the ideal way to collect observational data of polar processes that would help scientists understand global climate dynamics. In Weyprecht's view, the only way to really understand polar regions and their global connections would be through a coordinated, international effort of at

least one full year of seasonal fluctuations that would include the extremes of winter, when solar radiation was minimal, and life in the cold and dark the most challenging.

Weyprecht called on nations to put aside their national agendas for the sake of scientific progress and an improved understanding of the natural world. While international scientific collaboration was not unheard of at the time, the concept of an intensive, coordinated, year-long research effort was. Participants agreed to share their data and use compatible formats. They built a network of Arctic stations with the aim of better understanding of global climate processes, polar geography and seasonal processes, and phenomenon such as auroras.

Weyprecht died in 1881 before he was able to see his vision of international year fulfilled, but others, especially Georg von Neumayer, kept the vision alive. In the United States, Abraham Lincoln's son, Robert Todd Lincoln, then Secretary of War, headed the U.S. activities during the first IPY, which included establishing several stations, one at Point Barrow, Alaska.

I mention the history of IPY and its 125 year legacy and lineage not only because it has become the model for the plethora of international years that have spun-off from Weyprecht's vision, but also because we can use the history of IPY science and technology to support the aims articulated in National Science Standards and other benchmarks and frameworks that emphasize the importance of inquiry and the history of science. The three past and upcoming IPYs themselves can serve as a conceptual scaffold and timeline to examine at how science and technology, and the world itself, has changed in a few short generations.

Incidentally, a complete analysis of the meteorological data collected during the first IPY in the Arctic has not been fully completed until recently when two NOAA Scientists, Kevin Wood and Jim Overland, completed a thorough analysis which will be published soon in the Bulletin of the American Meteorological Society. Their article, which will be an excellent outreach tool for the upcoming IPY, provides an superb overview of the first IPY and, for the first time, presents a detailed analysis of the combined Arctic data sets, offering a baseline of Arctic climate at the time. This analysis will make an excellent "data story" using the data from the first IPY as a baseline to compare subsequent data (See Wood & Overland, in press. Also see Luedecke 2004, The First International Polar Year (1882-83): A big science experiment with small science equipment.).

In the fifty years between the first IPY and the second in 1932-33, the world transformed in dramatic ways. Alternating current had begun to electrify the world and radio was an increasingly important communication medium. Internal combustion engines were revolutionizing transportation, including air-travel. The North and South poles had been reached in races that again drew widespread interest to the polar regions among young and old alike. The world, with a global population of two billion, had been through a Great War and devastating influenza pandemic. And during the second IPY, the United States and other nations were experiencing severe economic depression. Nevertheless, forty nations managed to participate in the second IPY and the development of an international network of stations and community of scientists monitoring weather, auroras and other processes was furthered.

A significant focus of the Second IPY was the Earth's ionosphere and magnetosphere and their relationship to communication and electrical technologies, an issue that is extremely relevant today with our increased reliance on such technologies. We are

currently working with the Stanford Solar Center on a potential collaboration between IPY and the International Heliophysical Year, IHY (one of several international years overlapping with the upcoming IPY) to deploy hundreds, potentially thousands, of "sudden ionospheric disturbance" (SID) monitors to schools and science clubs around the world. Developed by the Stanford Solar Center, the SID monitors allow students and amateur scientists to measure the diurnal, seasonal and solar cycle variability of the ionosphere. Such a collaboration would link IPY history with one of the centerpieces of the upcoming IHY education and outreach efforts.

Twenty-five years after the third IPY, Weyprecht's IPY model was used in organizing the IGY, which focused on the polar and equatorial regions. Occurring in the middle of the Cold War, after a second World War and advent of the Atomic age, IGY not only served as the medium for the scientific and political breakthroughs previously mentioned, but also marked the beginning of the modern era of science education. The public read updates of IGY expeditions in newspapers and magazines, while students read about IGY in their Weekly Reader newsletters. During and after IGY, the National Academies, funded by NSF and the Ford Foundation, led the development of curriculum and outreach materials about IGY science, including a set of thematic posters, many which are proudly displayed in science institutions around the world, and a series of thirteen educational films shown in classrooms and on educational television throughout the nation. While behind the scenes these pioneering efforts were beset with challenges (Korsmo 2004, Korsmo & Sfraga 2003), they left an enduring impression on a generation of citizens and scientists around the world.

I have also been asked to address what education and outreach activities are planned for this IPY. Before getting into specifics, I would like to take a moment to reflect on how

the world has evolved significantly in the fifty years since IGY: the planet's population and energy usage has more than doubled; new tools, particularly the Internet and wireless technologies, offer revolutionary means of communication that will be harnessed for IPY, although, due to the sheer proliferation of media, such efforts will be competing for people's limited attention. Nevertheless, polar power has the ability to grab people's attention and hold it.

In recent years, in part due to NSF's emphasis on integrating research and education and the broader social impacts of science, there has been increased collaboration between research scientists, educators and various other media and communication experts. But numerous reports and commissions, including the 2001 U.S. Commission on National Security, warn of the long-term implications of neglecting our science education programs, and funding for such integrating efforts, including for the upcoming IPY, remain insufficient to meet the needs of the EOC community and the citizens they serve. Science educators, vying against each other for limited funds, face daunting odds in an ultra-competitive environment.

Planning to make EOC an integral part of IPY began at the outset, both at the national and international levels. Over the past two years, a series of workshops has helped to build the IPY EOC community inside and beyond the U.S., exploring the ways and means to maximize EOC impact. The first workshop, entitled "Bridging the Poles: Linking Education with Research," was funded by NSF OPP and organized by Robin Bell and Stephanie Pfirman of Columbia University's Lamont-Doherty Earth Observatory . Held in Washington, D.C., in June 2004, Bridging the Poles brought together polar researchers, science educators, and other polar enthusiasts to brainstorm potential strategies and resources. Participants recommended that EOC efforts build on the

strength of polar research by focusing on three elements: “a ‘sense of place’ for researchers, educators, students, and the general public; ‘pride of place’ for Arctic residents, especially indigenous Alaskans; and a sense of connectedness [and] relevance.” A full report on the workshop, which describes the vast potential of IPY EOC, is available online at http://*www.ldeo.columbia.edu/res/pi/polar_workshop/*.

One of the recommendations from the Bridging the Poles workshop was for the IPY community to tap the expertise and resources of the International Polar Foundation (IPF). Based in Brussels, Belgium, IPY has been actively involved with polar science and related education efforts, participating in all the IPY EOC workshops and assisting the IPY Programme Office in the development and translation of the IPY brochure and designing the IPY.org web site. In addition to offering a wealth of education materials available online and available on CD in multiple-language formats, IPF also been instrumental in the design the new Belgian zero-emission Antarctic station that will be constructed during IPY. (In the spirit of full disclosure, through a collaboration between IPF and CU-Boulder, 20% of my salary is covered by IPF, which allows me to continue to be involved in IPY activities.)

To build on the momentum of Bridging the Poles and re-access the potential for IPY EOC, a second workshop, “Poles Together: Coordinating IPY Outreach and Education,” was held in Boulder, Colorado, in July 2005. Organized by the University of Colorado’s Cooperative Institute for Research in Environmental Science (CIRES), with in-kind support from NOAA and numerous volunteers, the workshop drew more than 100 participants including researchers, teachers, representatives from U.S. federal agencies (NOAA, NSF, USGS and NASA), and representatives from the International Antarctic Institute in Hobart, Australia, the International Polar Foundation, and members of the

Canadian, Swedish, Dutch, and German national IPY committees. David Carlson, who had recently become Director of the International Polar Year Programme Office (IPO) based in Cambridge, U.K., gave the keynote address and discussed plans for IPY in general and EOC in particular.

The core of the workshop was a series of breakout discussions, focusing initially on IPY science themes and key audiences. One idea for EOC communication that emerged was identifying and addressing common misconceptions about the Polar Regions, such as the differences between Arctic and Antarctic geography, the real effect of Earth's axial tilt on seasonal change, and the reason why polar bears don't eat penguins.

Other recommendations included the call for a coordination office for U.S. EOC efforts, and the development of a framework for polar literacy, with key concepts and messages that could help in correlating IPY activities and polar science to education standards and benchmarks.

One of the participants, Stan Ruttenberg, who had worked as a science writer for many of the IGY films, commented that he was impressed by the degree of excitement and enthusiasm of the participants. Where IGY education efforts had been very much top-down, it was clear to Stan that IPY EOC was, above all, tapping a tremendous energy at the grass-roots level.

Some participants of the Poles Together workshop expressed concern that, without sufficient funding for IPY, all the enthusiasm would lead not only to failure of IPY EOC goals, but to disappointment and disillusionment among the IPY science education community. A representative of the NSF attending the workshop indicated that NSF, the

lead U.S. agency for IPY, would be able to fund only one to two million dollars of education and outreach projects for fiscal year 2006. (As it turns out, nearly $6 million was made available, meaning that the over 80% rate of proposals not funded could have been far higher.) In order to seek a solution to the funding conundrum, a group of interested individuals was formed to explore funding options from corporations and foundations to augment IPY EOC projects that NSF would not be able to fund. Several meetings were held in the fall of 2005 to explore funding options through corporate or foundations, but after Hurricane Katrina, donor fatigue in the foundation community made it necessary to put plans to seek alternative funding for IPY EOC activities on the back burner. A full report of the workshop, funded through support from the National Science Foundation Office of Polar Programs (OPP) and NOAA Office of Education (OED), is available at *http://cires.colorado.edu/education/k12/ipyoe/*.

To further the preparation for IPY EOC and prepare for the NSF IPY solicitation, with it's strong focus on formal and informal education and related coordination, the Integrated Collaborative Education (ICE) workshop, (funded by NSF OPP and NOAA OED) was held in virtual space in an asynchronous environment, allowing participants from around the world and with varied work-schedules, to participate at their convenience. More than 200 individuals from around the world participated between March 17 and 31, using tools developed and facilitated by the Virginia-based College of Exploration, which has worked with NOAA and National Geographic in developing ocean literacy priorities.

Like all the prior workshops, ICE served as an incubator for collaboration and networking, helping to inspire and inform the broad community of participants. Organized on a few weeks notice, ICE's ambitious goals included the development of an

initial framework for polar literacy that could be linked with related ocean and environmental literacy programs.

Participants focused on ten themes they considered integral to such a framework: the uniqueness of the Polar Regions; the complex interconnections of Earth systems; global climate change; the importance of the Polar Regions to science; their history and culture; places of extremes; new models of land ownership/stewardship, international collaboration, and cooperation; the need and opportunity to study holistically; "what we don't know" (i.e., the spaces between disciplines and the gaps in our knowledge); and people and stories. While these themes in many cases overlap with "official" IPY themes and other science education frameworks, the community-based process itself was valuable. A final report of the ICE workshop is available at *http://coexploration.net/ipy*.

Inspired by the Poles Together workshop, the European Polar Board of the European Science Foundation hosted a workshop in Brussels in mid-March of 2006 to engage the European polar research and education community. The workshop sparked later discussions of the EOC subcommittee on how education, outreach and communication can be more fully integrated since, all too often, they are considered separate, unrelated domains.

The IPY Framework document called for the IPY Programme Office to establish an Education, Outreach and Communication Subcommittee of the ICSU-WMO Joint Committee, which would review EOC-related proposals, help coordinate and integrate activities, and assist in establishing the IPY Web site. The Subcommittee, made up of representatives from eleven nations that will be expanded as IPY gets underway, began meeting in early 2006 through monthly teleconferences and is focused on coordinating

launch events, developing the IPY.org web site, and supporting international EOC collaborations.

The discussions at the Brussels European Polar Board workshop in March, 2006 on linking education, outreach and communication helped to inform the development of the IPY EOC Action Plan (still in development), which explores how information from a particular IPY research project—say, a study of seasonal and longer-term sea ice fluctuations or of caribou migrations—might be customized and repurposed for different audiences. Over the years, the terms "education," "outreach," and "communications" have become separate, specialized domains, rarely overlapping or collaborating. The concept of using IPY as an opportunity to begin to integrate these different, sometimes competing realms while recognizing the unique needs and expertise required to be effective in each area, has been an emerging goal of the IPY EOC subcommittee. For example, we envision that:

• A short media summary of the research goal and its methods used by public affairs or media specialists could also be used to help a classroom teacher see at a glance whether a specific project is relevant and of interest to her students.

• A "who, what, where, when, why, and how" narrative description or "data story" in non-technical language could help a teacher, exhibit designer or curriculum developer develop strategies for contextualizing the data.

• A database of high-definition video clips could be used by journalists, students, teachers, and exhibit developers alike.

• A blog from graduate students in the field could assist students in the classroom virtually participate in the project by providing a human context to how the research is conducted and data are collected.

• Mapping the science of the project to science standards and frameworks, taking into account related misconceptions, could help scientists calibrate their own communication with non-technical audiences.
• Reviewing and annotating existing background materials and learning activities and linking them with standards and curriculum could have benefits far beyond the formal education realm.

To facilitate the integration of information that public affairs and media relations officers, researchers, educators and students and other polar enthusiasts can access, the IPY Programme Office is developing a database that will include short summaries of IPY projects, longer descriptions of the "who, what, where, when, why, and how" involved, and, once funded and deployed, can be augmented with audio and video clips, blogs and journals, relevant curriculum and education standards, and so forth. Ideally, this database will be integrated into the IPY Data Information Service, or IPYDIS, which is a U.S. led proposal headed by Mark Parsons of the National Snow and Ice Data Center.

Dr. Bell has talked about the famous "honeycomb chart," and I'd like to share it with you again. It is in itself an invaluable outreach tool and is included as an attachment to my written statement. Of the 233 proposals, many of them made up of numerous smaller projects, the U.S. is involved in 183 of them, or 82% of the total, roughly 20% as the lead, in red on the chart (51) , and 60% as a key partner, in yellow (122). Again, I'd like to point out the IPY Data Information Service as an integral part of the big plan, which the U.S. is the lead on.

All of these cells of the honeycomb, which combine in some cases multiple nationally funded projects, are subject to funding through their national agencies. But there is no

guarantee that they will be funded at all, especially when budgets are tight and review criteria between national and international programs differ. We now know that some of the proposals approved at the international level will not be funded by NSF, at lest at this time, and we can anticipate that the honeycomb chart will look significantly different a year from now.

The main point I'd like to make here is that those who did go through the international process and were endorsed by the IPY Joint Committee had to address the basic IPY EOC criteria, meaning they needed to have a plan of how they would address EOC goals identified in the IPY Framework document. They also needed to be international to some degree, including the education proposals, of which there are 54, the majority of which involve U.S. partners or leads. All have international linkages and partners.

Which brings us to a question: Should EOC for IPY be only addressed at the national level? The conventional wisdom seems to be, "yes," that every nation has their own education systems and unique communities with needs. But the decade-old GLOBE program, which has just funded an IPY-related project looking at seasonal changes, suggests otherwise. Indeed, learning from the experience of GLOBE, and perhaps leveraging its network and those of the space science education community of IHY, IPY EOC has the potential to forge a new, robust international education network that will live on long after IPY is completed. Rather than have every nation approach IPY EOC exclusively internally, this is an opportunity for "soft diplomacy" that could, in the spirit of Weyprecht's vision, truly transcend national agendas and make a robust contribution to global awareness and cooperation.

Some nations, such as Canada and Norway, require that proposals seeking funding for IPY first go through the international process, which mandates international partnerships. The U.S. and most other nations did not require IPY international endorsement. Funded projects that did not go through the international process will still have an opportunity to become part of the honeycomb, but they will be required to go through the review process and either be linked with an existing program in the honeycomb, or be endorsed as a new cell.

The final question I have been asked to address is: what are the goals and expected societal benefits of these activities? At the level of the Joint Committee, the U.S. National Committee, and NSF, the goals have been primarily olar science-specific: "to attract and develop the next generation of polar scientists, engineers and to leaders and to capture the interest of the public and decision-makers," (ICSU 2004a) , to increase "public understanding and participation in polar science" (NRC 2004) and "educate the public about the polar regions" (NSF 2006).

But to many involved at the grassroots level of IPY EOC, including many participants in workshops and on the IPY EOC Subcommittee, polar science is merely the tip of the iceberg in terms of the potential for this international endeavor to go beyond simply showcasing polar science and its global relevance. As the recent draft IPY EOC Action Plan suggests, IPY can also "demonstrate the scientific process in real-time by engaging the public with an exciting, enormous, and diverse, interdisciplinary scientific investigation. It is an opportunity for an open dialogue between scientists and society that will demystify and increase accessibility of science. This will strengthen the public's perception, understanding, and appreciation of science and therefore empower them in making valid assessments of scientific information." (IPY EOC 2006)

The goals of promoting polar science and recruiting new polar scientists is, frankly, the easy part. The far broader goals of fostering a more scientifically savvy society and forging new science education partnerships at every level is much more daunting, and will require robust funding and support to achieve the inherent potential of IPY as a catalyst for positive change. There is a very small window—right now-- to seize this opportunity, devote the necessary, leadership, resources and people power to meet the challenge, and set the wheels in motion to allow IPY live up to its vast potential.

There is tremendous power in the polar realm to inspire, inform and engage people of all ages and walks of life. At a gut level, the extremes of the polar environment challenge us in terms of basic survival; ask any child who has seen "The March of the Penguins" or "Eight Below." It has been suggested that in the first two IPYs, survival required 90% of the time and energy with science requiring the remaining 10%. Polar regions will always remain dangerous, forbidding places, no matter how sophisticated the technologies. Now, with increased concern about human impacts on the Earth's climatic and environmental systems, people look to the poles to gain information about and insights into the survival of the planet itself.

Polar power also has tremendous emotional resonance, appealing to our sense of beauty and wonder. The stories and experience of people from polar communities, including the millions of Arctic residents and the scientists, explorers and teachers who have spent time in Antarctica, are a powerful way of bringing a human dimension and personal touch to IPY activities.

And, finally, the polar perspectives offer a unique way to engage and challenge our intellects, whether at the cutting edge of the scientific frontier, or addressing common misconceptions that students have about the reason for seasonal change. I would love to see posters of the spectacular polar "night" and "day" images from NASA Goddard, part of the Blue Marble series, in every grade schools everywhere with the title: "What's Wrong With This Picture?" These wonderful photo-mosaics can leave the impression that the sun is shining directly down on, or is directly behind, the north or south pole, when in fact, that never occurs. There is never a time of day, or time of year, when there is so much sunshine….or darkness…in the north or south hemispheres. Realizing this, students can then consider how the axial tilt impacts polar seasons.

There are countless international years but only one IPY. For IPY to be more than just another international year in a crowded field and live up to its huge potential, the support and leadership of the U.S., working in close collaboration with our international partners, is imperative. The time for IPY is now.

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