

## Antarctic Sciences Division GPRA highlights, FY2008

### Ancient glaciers in Antarctica key to understanding climate change

Highlight ID: 14727, Version: AC/GPA

As the Earth gets warmer, we look to the geologic record for examples of what the planet might become. The last time that the earth transitioned from the glacial world like the present to a greenhouse world--free of ice--was over 250 million years ago! A paper published in the January 2007 issue of Science (Isabel P. Montañez, et al. Science 315, 87, 2007) documents the change using three lines of evidence: 1) chemical information that can tell us past temperatures; 2) fossil evidence of land plants, and 3) hard evidence from rocks in Antarctica to tell us whether or not there were ice sheets there at that time.

The results tell us two important things:

- First, atmospheric CO2 contents, global temperatures, and ice sheet occurrences are all strongly correlated, which is important because it gives further credence to the idea that anthropogenic increases in atmospheric CO2 will have major effects on global climate. Such large scale climactic variations are still poorly understood and difficult to model.
- Second, plants respond to climate change in a geologic instant! Europe went from warm, wet forests to dry, cold pine tree forests and then back again right along with climate change. All this was also accompanied by plant evolution.
- What does it mean? If things do continue heat up, in addition to hotter temperatures and sea level rise, we can expect big changes in the plants we're all familiar with, which would change everything about our crops, animals, and ecosystems in general.

*Primary Strategic Outcome Goal:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.) (AC/GPA selected)

*Secondary Strategic Outcome Goals:*

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

This research greatly advances our understanding of the earth's propensity for climate change. It also gives modelers hard numbers on which to constrain models, and helps society understand the potential impacts of climate change. Without multidisciplinary research like this, we won't know what can happen.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***

No

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

No

*What may be the benefits of the proposed activity to society?*

No

OPP/ANT 2008

*Program Officer:* Thomas Wagner

*NSF Award Numbers:*

[0440919](#)

Award Title: Collaborative Research: Reconstructing the High Latitude Permian-Triassic: Life, Landscapes, and Climate Recorded in the Allan Hills, South Victoria Land, Antarctica  
PI: John Isbell, [jisbell@uwm.edu](mailto:jisbell@uwm.edu)  
Institution Name: University of Wisconsin-Milwaukee  
State Code: WI  
PE Codes: 5112

[0126086](#)

Award Title: Collaborative Research: Late Paleozoic-Mesozoic Fauna, Environment, Climate and Basinal History: Beardmore Glacier Area, Transantarctic Mountains  
PI: John Isbell, [jisbell@uwm.edu](mailto:jisbell@uwm.edu)  
Institution Name: University of Wisconsin-Milwaukee  
State Code: WI  
PE Codes: 5112

*NSF Contract Numbers:*

*NSF Investments:* Climate Change

## **Sea Level Rise from Polar Ice Sheets: Societal Relevance and Broader Impacts**

Highlight ID: 14730, Version: AC/GPA

The Center for Remote Sensing of Ice Sheets (CReSIS) is an NSF-funded Science and Technology Center whose mission is to develop technologies, conduct field investigations, compile and analyze data to characterize ongoing rapid changes in polar ice sheets and to develop models that explain and predict ice sheet interactions with climate and sea level rise. One of the goals of CReSIS is to contribute to improvement of the Intergovernmental Panel on Climate Change (IPCC) assessment of future sea level rise. Progress toward this goal has recently been made with the publication of a paper in EOS, Transactions of the American Geophysical Union (EOS, v. 88, no. 9, p. 105) entitled "Risk of Rising Sea Level to Population and Land Area" by R.J. Rowley, J.C. Kostelnick, D. Braaten, X. Li and J. Meisel. The goal of this research was to simulate a theoretical global sea level rise of one to six meters with Geographic Information Systems (GIS) and to develop a number of products for visualizing the coastal inundation and its effect. This work has very important broader impacts. Not only does the work have societal relevance, because of the potential impacts on people living in coastal communities near sea level but the work was carried out by faculty and students involved in the Center, both from the University of Kansas and Haskell Indian Nations University. Through funding on a number of NSF funded awards (ANT-0424589, OPP-0122520 and HRD-0407827) the GIS lab was developed and has become a training ground not only for students but also for members of numerous American Indian tribes who have used the laboratory. Faculty and students at Haskell are training members of Native American tribes using the techniques employed in the NSF-funded research. This contributes to the scientific literacy of citizens exercising stewardship over land natural resources.

*Primary Strategic Outcome Goal:*

- Science & Technology Centers (AC/GPA selected)

*Secondary Strategic Outcome Goals:*

- Public Understanding of Science and Lifelong Learning

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

This work is advancing the frontiers of knowledge in an important area of climate change research, the impact of the polar ice sheets on sea level rise. The results of the research will have broader impacts due to both the societal relevance of the topic and because the research is training the next generation of scientists and engineers, some of whom are from under-represented groups. The Center is working closely with two-minority serving institutions and this work was published along with students from one of those schools (Haskell Indian Nations University).

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***

Yes

This work, and related activities of the Center, could revolutionize our understanding of the polar ice sheets and how they contribute to sea level change. The technologies being developed, including the UAV and the specialized radars, will provide a new way of remotely sensing the ice sheets and enhancing our understanding of how they contribute to, and are affected by global climate change.

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

Yes

A major focus of the Center is to broaden participation of under-represented groups in the field of glaciology. Students from both an historically black college (Elizabeth City State University) and a tribal college (Haskell Indian Nations University) have been involved in the research supported by the Center. The work described here was carried out by faculty and students both from the University of Kansas and Haskell Indian Nations University. Through funding on a number of NSF funded awards (ANT-0424589, OPP-0122520 and HRD- 0407827) the GIS lab was developed and has become a training ground not only for students but also for members of numerous American Indian tribes who have used the laboratory. Faculty and students at Haskell are training members of Native American tribes using the techniques employed in the NSF-funded research. This contributes to the scientific literacy of citizens exercising stewardship over land natural resources.

*What may be the benefits of the proposed activity to society?*

Yes

Sea level rise is an important topic of interest to society. The main goal of this Center is to understand and predict the role of ice sheets in sea level change.

OPP/ANT 2008

*Tags:* FY09 OMB Budget Request, Societal Benefits

*Program Officer:* Julie Palais

*NSF Award Numbers:*

[0407827](#)

Award Title: Mathematics: Keystone for Success

PI: Carole Tomlinson, [ctomlinson@haskell.edu](mailto:ctomlinson@haskell.edu)

Institution Name: Haskell Indian Nations University

State Code: KS

PE Codes: 1744

Award Title: Mathematics: Keystone for Success

PI: Myra Alexander-Starr, [malexander-starr@haskell.edu](mailto:malexander-starr@haskell.edu)

Institution Name: Haskell Indian Nations University

State Code: KS  
PE Codes: 1744  
Award Title: Mathematics: Keystone for Success  
PI: Michael Tosee, [mtosee@haskell.edu](mailto:mtosee@haskell.edu)  
Institution Name: Haskell Indian Nations University  
State Code: KS  
PE Codes: 1744  
Award Title: Mathematics: Keystone for Success  
PI: Linda Warner, [president@haskell.edu](mailto:president@haskell.edu)  
Institution Name: Haskell Indian Nations University  
State Code: KS  
PE Codes: 1744

[0122520](#)

Award Title: ITR/SI+AP: A Mobile Sensor Web for Polar Ice Sheet Measurements  
PI: S. Prasad Gogineni, [pgogineni@ku.edu](mailto:pgogineni@ku.edu)  
Institution Name: University of Kansas Center for Research Inc  
State Code: KS  
PE Codes: 9150, 8394, 8393, 5116, 1688, 1687, 1640

[0424589](#)

Award Title: Center for Remote Sensing of Ice Sheets (CReSIS)  
PI: S. Prasad Gogineni, [pgogineni@ku.edu](mailto:pgogineni@ku.edu)  
Institution Name: University of Kansas Center for Research Inc  
State Code: KS  
PE Codes: 7555, 5280, 5116, 5111, 1297

*NSF Contract Numbers:*

*NSF Investments:* Climate Change, International Polar Year (IPY)

## **New Satellite Map of Antarctica**

**Highlight ID: 14962, Version: AC/GPA**

This award supported development of the most detailed satellite map ever produced of Antarctica. The Landsat Image Map or LIMA combines more than 1,100 hand-selected Landsat satellite scenes digitally compiled to create a single, seamless, cloud-free image. This map is the first major outcome of the International Polar Year 2007-2009. It represents the true spirit of the IPY that it is an international collaboration between the U.S. and the United Kingdom, and the map and raw data are freely available to the world community of scientists, educators, and the general public. LIMA is available via the worldwide web from the USGS, the NSF-supported Antarctic Geospatial Information Center, and other resources such as Google Earth.

In addition to being the new standard geographic reference for Antarctica, LIMA is a critical snapshot of Antarctica's ice sheets that is a fundamental tool for scientists. It will be used in every discipline from biology to geology to glaciology, both to answer scientific questions and to plan fieldwork in the vast unexplored tracts of Antarctica. For educators, students, and the general public, LIMA will bring to life the Antarctic continent like nothing before it.

The project was entirely supported by NSF, but was implemented by the USGS and NASA. The portion of the map that covers the Antarctic peninsula was contributed by the British Antarctic Survey.

*Primary Strategic Outcome Goal:*

- Networking and Computational Resources Infrastructure and Services (formerly Shared Cyberinfrastructure Tools) (AC/GPA selected)
- Research Resources (minor facilities, infrastructure and instrumentation, field stations, museum collections, etc.) (AC/GPA selected)

*Secondary Strategic Outcome Goals:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)
- International Collaborative Research
- K-12 Education
- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research
- Public Understanding of Science and Lifelong Learning

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

This outcome uses cyberinfrastructure to increase access to satellite imagery over Antarctica.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***  
No

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

No

*What may be the benefits of the proposed activity to society?*

Yes

This new map will be used to improve our understanding of the impacts of global warming on sea level rise.

OPP/ANT 2008

*Tags:* 2010 Transition Team and 2010 Budget

*Program Officer:* Thomas Wagner

*NSF Award Numbers:*

[0233246](#)

Award Title: Antarctic Mapping, Geodesy, Geospatial Data, Satellite Image Mapping and Antarctic Resource Center Management

PI: Jerry Mullins, [jmullins@usgs.gov](mailto:jmullins@usgs.gov)

Institution Name: UNITED STATES DEPT OF GEOLOGICAL SURVEY

State Code: VA

PE Codes: 5116, 5112, 5111, 1647

*NSF Contract Numbers:*

*NSF Investments:* Climate Change, Cyber-enabled Discovery and Innovation (CDI), International Polar Year (IPY), Environment (including the importance of fresh water and dynamics of water processes)

## **Icebergs as oases of life**

**Highlight ID: 15620, Version: AC/GPA**

Scientist Ken Smith, of the Monterey Bay Aquarium Research Institute, and his collaborators have discovered that free-drifting icebergs are hotspots of biological and chemical enrichment in the surface waters of the Weddell Sea. Data collected from two large icebergs show high levels of chlorophyll and terrigenous material, and elevated abundances of krill and seabirds within a several kilometer radius of the iceberg edges, relative to areas distant from icebergs. The high productivity may relate to micronutrient release associated with terrigenous and detrital material embedded in ice. Calculations of the number and areal extent of icebergs suggest that nearly 40% of the surface ocean in the Weddell Sea may be similarly affected. The results suggest that icebergs may represent an important, but unaccounted for, area of increased production and cycling of organic carbon.

*Primary Strategic Outcome Goal:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

*Secondary Strategic Outcome Goals:*

- Graduate Education and Graduate Student Research

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

The research represents an interdisciplinary effort to examine physical, chemical, and biological processes in the surface ocean. The discovery is important because it identifies a previously unaccounted for source and sink of organic carbon in the Southern Ocean. The Southern Ocean carbon cycle is an important element in the global carbon budget, but data to inform these models is relatively scarce.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***

Yes

The research is transformative because it merges disciplines and changes our perception of the carbon budget in the Southern Ocean. It was funded initially via an SGER.

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

Yes

The authors of the study include an Hispanic female and a male from an EPSCOR state.

*What may be the benefits of the proposed activity to society?*

Yes

Understanding climate change is an important societal benefit.

OPP/ANT 2008

*Program Officer:* Roberta Marinelli

*NSF Award Numbers:*

[0529815](#)

Award Title: Free Drifting Icebergs: Influence of Floating Islands on Pelagic Ecosystems in the Weddell Sea.  
PI: Kenneth Smith, [ksmith@mbari.org](mailto:ksmith@mbari.org)  
Institution Name: University of California-San Diego Scripps Inst of Oceanography  
State Code: CA  
PE Codes: 5111

[0650034](#)

Award Title: Free Drifting Icebergs: Influence of Floating Islands on Pelagic Ecosystems in the Weddell Sea.  
PI: Kenneth Smith, [ksmith@mbari.org](mailto:ksmith@mbari.org)  
Institution Name: Monterey Bay Aquarium Research Institute  
State Code: CA  
PE Codes: 5111

*NSF Contract Numbers:*

*NSF Investments:* Climate Change, Environment (including the importance of fresh water and dynamics of water processes)

## **South Pole ACBAR instrument accomplished refining the current cosmological model**

Highlight ID: 16222, Version: AC/GPA

The Arcminute Cosmology Bolometer Array Receiver (ACBAR) operated on the 2.1 meter VIPER telescope at the U.S. Amundsen-Scott South Pole Station during the 2001, 2002, 2004, and 2005 austral winter seasons. An analysis of the complete data set has been used to produce a Cosmic Microwave Background (CMB) temperature anisotropy power spectrum with an unprecedented combination of sensitivity and resolution. These are the most precise measurements to date where the spectrum uncertainties have been reduced by more than a factor of two on angular scales encompassing the third to fifth acoustic peaks and the spectrum damping tail (Figure 1). The fourth and fifth acoustic peaks are detected for the first time in these data. As demonstrated in Figure 2, the combination of observational results from ACBAR, WMAP3 (NASA satellite), and BOOMERanG03 (long duration balloon) give confidence to the resulting model parameter values. Compared to the WMAP3 results alone, the ACBAR data favor higher median values of the regular matter power normalization and the dark matter density due to an improved determination of the third acoustic peak.

*Primary Strategic Outcome Goal:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

*Secondary Strategic Outcome Goals:*

- Graduate Education and Graduate Student Research

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

The research represents discovery across the frontier of cosmology and astrophysics, connected to

learning, innovation, and education. This enables people who work at the forefront of discovery to make important and significant contributions to science and engineering knowledge, and serve to society.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***  
No

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

Yes

A female postdoctoral candidate was responsible for the maintenance and operation of the telescope and receiver during the 2005 Austral winter.

*What may be the benefits of the proposed activity to society?*

No

OPP/ANT 2008

*Program Officer:* Vladimir Papitashvili

*NSF Award Numbers:*

[0542606](#)

Award Title: Analysis of Data from the ACBAR experiment

PI: William Holzapfel, [swlh@cfpa.Berkeley.EDU](mailto:swlh@cfpa.Berkeley.EDU)

Institution Name: University of California-Berkeley

State Code: CA

PE Codes: 5115, 1217

[0232009](#)

Award Title: High Resolution Observations of the Cosmic Microwave Background (CMB) with Arcminute Cosmology Bolometer Array Receiver (ACBAR)

PI: William Holzapfel, [swlh@cfpa.Berkeley.EDU](mailto:swlh@cfpa.Berkeley.EDU)

Institution Name: University of California-Berkeley

State Code: CA

PE Codes: 5115

*NSF Contract Numbers:*

*NSF Investments:* None Applicable

## **New 10-meter South Pole Telescope to investigate Dark Energy**

Highlight ID: 16282, Version: AC/GPA

A new, 10-meter dish telescope - South Pole Telescope, SPT - was successfully deployed at the U.S. Amundsen-Scott South Pole Station after only four years of design and fabrication, achieving "first light" on February 17, 2007. The remarkable construction effort at the South Pole was accomplished through close cooperation of the Chicago-led SPT science team, NSF management, and RPSC support. Over 200 tons of structural components were transported from the U.S. to South Pole and assembled during a single austral summer season. The precision off-axis primary mirror is composed of 218 aluminum reflecting panels mounted on a extremely rigid and thermally stable carbon fiber reinforced plastic backup structure (see photo). Eight adjustable assemblies are used to

precisely position and finely tune the shape of each panel. After iterating between surface adjustments and measurements using photographic and radio holographic techniques, the average deviations of the dish surface from a perfect parabola are less than 20 microns. The SPT camera consists of a one-meter secondary mirror cooled to 10 degrees Kelvin and a 960-element bolometric focal plane made of superconducting transition-edge-sensors (TES) cooled to 0.25 degree Kelvin. The SPT is set to investigate the nature of the mysterious Dark Energy that dominates the Universe and is causing its expansion to accelerate. The SPT was designed to detect small angular scale features in the Cosmic Microwave Background (CMB), the fossil radiation from the Big Bang. The SPT's first key project is to measure the evolution of Dark Energy by its impact on the growth of large structure through cosmic time. Specifically, the SPT will be used to measure the Sunyaev-Zel'dovich (SZ) effect, a small spectral distortion of the CMB caused by scattering of the CMB photons by the hot gas contained in clusters of galaxies. As these clusters are the largest bound objects in the Universe and their formation extends over the entire age of the Universe, the abundance and evolution of galaxy clusters is critically sensitive to the dynamics of the evolution of the Universe. The large area SZE survey planned by the SPT team will therefore detect all galaxy clusters above a certain mass threshold independent of how far away the clusters are from us. Due to the finite speed of light, the observations of distant clusters probe the Universe at a much earlier time. The SPT team will therefore discover when galaxy clusters first formed in the Universe and how their abundance has evolved. The team will effectively assemble a timeline for the growth of structure in Universe.

The telescope was successfully operated by two winterover scientists throughout the 2007 austral winter season with the remote aide of team members in the United States who were inspecting and analyzing over five terabytes of data that were sent back to the University of Chicago via satellite over the entire season. The first part of the season was dominated by commissioning tasks, soon thereafter starting the Phase I science observations of the SZ effect toward known galaxy clusters (see figure). The season was accomplished by the deep initial SZ-survey integration, resulting in detection of exciting structure in the sky images. A careful analysis of approximately 50 square degrees of the sky is currently ongoing. In the 2007/2008 austral summer season, more highly optimized detectors were installed in the SPT camera, allowing more powerful and faster SZE survey observations to be conducted through the 2008 austral winter.

*Primary Strategic Outcome Goal:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

*Secondary Strategic Outcome Goals:*

- Graduate Education and Graduate Student Research

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

The research represents discovery across the frontier of cosmology and astrophysics, connected to learning, innovation, and education. This enables people who work at the forefront of discovery to make important and significant contributions to science and engineering knowledge, and serve to society.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***

Yes

The SPT will conduct sensitive images of one tenth of the southern sky in three wavelength bands and with unprecedented angular resolution. The potential for discovery of new phenomena and new classes of astronomical objects is enormous. The SPT investigation of the nature of Dark Energy through its impact on the growth of large cosmic structure (when compared with measurement through other techniques such as the brightness of distant supernova) could lead to transformative shifts in our understanding of the Dark Energy and of the Universe evolution.

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

No

*What may be the benefits of the proposed activity to society?*

Yes

Basic research in understating of Dark Energy may lead to advances in general physics of the Universe's birth and evolution.

OPP/ANT 2008

*Program Officer:* Vladimir Papitashvili

*NSF Award Numbers:*

[0638937](#)

Award Title: Cosmological Research with the 10 meter South Pole Telescope

PI: John Carlstrom, [jc@kicp.uchicago.edu](mailto:jc@kicp.uchicago.edu)

Institution Name: University of Chicago

State Code: IL

PE Codes: 5115, 1217

[0130612](#)

Award Title: South Pole Observations to Test Cosmological Models

PI: John Carlstrom, [jc@kicp.uchicago.edu](mailto:jc@kicp.uchicago.edu)

Institution Name: University of Chicago

State Code: IL

PE Codes: 5115, 1218

*NSF Contract Numbers:*

*NSF Investments:* None Applicable

## **Very Low Frequency waves recorded at Palmer Station, Antarctica, help understanding better Earth's Radiation Belts**

Highlight ID: 16373, Version: AC/GPA

Near-Earth space is a dynamic region of streaming energetic particles, electromagnetic waves, and variable large-scale electric and magnetic fields. One electromagnetic wave that is naturally generated in near-Earth space in the range of a few kilohertz is known as "chorus" (Figure 1). Chorus is of particular scientific interest due to its interaction with highly energetic electrons that form the Earth's radiation belts. Chorus is typically generated near the equatorial region at altitudes of greater than 20,000 km. Once generated, these waves can propagate along magnetic field lines to the surface of the Earth where they can be recorded using Very Low Frequency (VLF) radio receivers. Stanford University operates one such receiver at the U.S. Palmer Station in Antarctica. Recent analysis of an entire year's worth of wave data recorded at Palmer reveals new insight into the occurrence patterns of chorus. The geomagnetic field line from Palmer maps to the equatorial plane at an altitude of only about 10,000 km. Thus, it was thought that chorus would be observed at Palmer only during very large disturbances in near-Earth space driven by intense solar storms. These disturbances can cause the chorus generation region to extend to lower altitude where the waves can then propagate to the ground near Palmer. Surprisingly, our analysis revealed that chorus was observed on 154 out of 303 days for which data was available during 2003 (46% of days; (Figure 2). This suggests that extremely intense solar disturbances are not necessarily required to generate chorus at lower altitudes.

For many years, the leading theory of charged particle acceleration in the magnetosphere assumed their radial transport to regions closer to the Earth. More recently, it has been shown that

electromagnetic chorus waves can also contribute to the acceleration of electrons through cyclotron resonant wave-particle interactions. Acceleration of electrons by chorus is particularly effective when the chorus generation region is close to the Earth. Our findings may have significant impact on radiation belt studies, suggesting that chorus may play an even larger role in the formation of the outer zone of electrons than was previously thought. The recorded occurrence statistics can be incorporated into global models of radiation belt dynamics in order to compare chorus generation with other leading theories of electron acceleration.

*Primary Strategic Outcome Goal:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

*Secondary Strategic Outcome Goals:*

- Graduate Education and Graduate Student Research
- Postdoctoral Education, including International Postdoctoral Fellowships

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

The research represents discovery across the frontier of aeronomy and space physics, connected to learning, innovation, and education. This enables people who work at the forefront of discovery to make important and significant contributions to science and engineering knowledge, and serve to society.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***  
Yes

This research may lead to a paradigm shift in understanding of the Earth's radiation belts. Specifically, this research indicates that the electron acceleration by chorus waves may contribute to generation of "killer electrons" that damage electronics in satellites upon which society depends. *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

No

*What may be the benefits of the proposed activity to society?*

Yes

This research will lead to better physical understanding of the dynamics of Earth's radiation belts. This knowledge is a key to predicting radiation belt enhancement intervals and ultimately mitigating the damaging effects on space assets such as geostationary satellites, etc.

OPP/ANT 2008

*Program Officer:* Vladimir Papitashvili

*NSF Award Numbers:*

[0233955](#)

Award Title: Global Thunderstorm Activity and its Effects on the Radiation Belts and the Lower Ionosphere

PI: Umran Inan, [inan@nova.stanford.edu](mailto:inan@nova.stanford.edu)

Institution Name: Stanford University

State Code: CA

PE Codes: 5115

[0538627](#)

Award Title: ELF/VLF Observations of Lightning Discharges, Whistler-mode waves and Electron Precipitation at Palmer Station, Antarctica.  
PI: Umran Inan, [inan@nova.stanford.edu](mailto:inan@nova.stanford.edu)  
Institution Name: Stanford University  
State Code: CA  
PE Codes: 7298, 5115

*NSF Contract Numbers:*  
*NSF Investments:* None Applicable

## **Paleorecord reveals Antarctic food web dynamics and points to critical role of krill**

Highlight ID: 16419, Version: AC/GPA

Stable isotopes of carbon and nitrogen can reveal food web linkages in ecosystems, because the tissues of consumers tend to reflect the isotopic value of the foods they eat. Researchers Steve Emslie of the University of North Carolina, Wilmington and Bill Patterson of the University of Saskatchewan analyzed the stable isotopes of Adelie penguin egg shells in colonies that are currently occupied and colonies that were abandoned as long as 38000 years ago. The isotopic values in egg shells were compared to isotopic values in food currently available to Adelies. Radiocarbon dating provided the dates of penguin occupation of their study sites. Isotopic values of prey are assumed to be relatively similar over time.

Emslie and Patterson's results reveal that, unlike the present, Adelie penguin diets consisted largely of fish in the geologic past. The isotopic evidence suggests that krill became an important dietary component only within the last 200 years. Their findings are consistent with the "krill surplus hypothesis", which argues that krill became abundant in the Southern Ocean when historic whaling removed large numbers of krill-eating whales and seals. With the removal of large krill predators, krill abundance increased, and Adelie penguins appear to have switched their food preferences in response to the available krill.

The results have important implications for fisheries, food webs and climate. Harvesting in the Southern Ocean is in a state of flux, with a decline of Southern Ocean fish stocks, and increasing demand on the krill fishery. At the same time, declining sea ice has been linked to warming climate and poor krill recruitment in some areas of the Southern Ocean. With an increasing competition for food resources, further declines in krill populations could therefore have dramatic consequences for Adelie penguin populations, and ecosystem dynamics in the Southern Ocean.

*Primary Strategic Outcome Goal:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

*Secondary Strategic Outcome Goals:*

- Graduate Education and Graduate Student Research
- International Research Experiences for Undergraduate & Graduate Students

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

The research involves cross-disciplinary studies of paleobiology and modern ecosystem dynamics. The discovery is important because it provides a window into the ecological past that has significant bearing on the ecological future, with respect to fisheries and climate change.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***

Yes

The research involves an interdisciplinary approach that connects the geologic past with the ecological future, and has important implications for human activities in a relatively pristine environment.

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

Yes

The research represents an international collaboration, with scientists from Canada (William Patterson), Italy (Carlo Baroni), and Poland (Jerzy Smykla). The project includes a primarily undergraduate institution (University of North Carolina, Wilmington), and involved the assistance of undergraduates (Michael Polito, Stephen Loiacano, and Mary Strickland) and a graduate student (Ed Cavallerano) in fieldwork.

*What may be the benefits of the proposed activity to society?*

Yes

Understanding the ecosystem and potential human impacts on ecosystem function and fisheries are important societal benefits.

OPP/ANT 2008

*Program Officer:* Roberta Marinelli

*NSF Award Numbers:*

[9909274](#)

Award Title: Investigations of Abandoned Penguin Colonies in Antarctica

PI: Steven Emslie, [emslies@uncw.edu](mailto:emslies@uncw.edu)

Institution Name: University of North Carolina at Wilmington

State Code: NC

PE Codes: 5111

[0125098](#)

Award Title: Occupation History and Diet of Adelie Penguins in the Ross Sea Region

PI: Steven Emslie, [emslies@uncw.edu](mailto:emslies@uncw.edu)

Institution Name: University of North Carolina at Wilmington

State Code: NC

PE Codes: 7459, 5111

*NSF Contract Numbers:*

*NSF Investments:* Climate Change, Environment (including the importance of fresh water and dynamics of water processes)

## **Surprising Connection between Alaskan Storm and Antarctic Iceberg Calving**

Highlight ID: 16480, Version: AC/GPA

Seismometers were deployed on the Ross Ice Shelf and a number of icebergs adrift in the Ross Sea. The data reveal that the dominant seismological signal is generated by sea swell in the tropical and extra-tropical Pacific Ocean. In one case a severe storm that occurred in the Gulf of Alaska generated an ocean swell that caused the break up of a giant iceberg floating near the coast of

Antarctica more than 8,300 miles away. The results of this work were published in Geophysical Research Letters and picked up widely by the media. The importance of this work is that it provides evidence, for the first time, that ocean storminess in parts of the World which are far from Antarctica could still have an impact on the ice sheet. The question posed by the researchers is whether or not global warming could lead to greater storminess which could then have an impact on the ice sheet that had never been thought of before. Previous work in the North Atlantic showed that a large amount of iceberg calving took place all around the edge of the North Atlantic ocean simultaneously. This discovery of the link between storms in one part of the global ocean and iceberg calving in another part of the globe could provide a mechanism to explain this discovery. The global teleconnection between climate in the region beyond Antarctica and iceberg calving is an exciting discovery.

Additional contributions include the verification of the source of harmonic tremor associated with icebergs. Results of this work could help shed light on the processes that take place when an ice shelf undergoes break up and disintegration. Seismic and hydro-acoustic tremor generated by colliding icebergs has been observed using these seismological techniques and should provide a method to study, perhaps remotely, these processes.

*Primary Strategic Outcome Goal:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

*Secondary Strategic Outcome Goals:*

- Major Research Instrumentation (MRI) Program

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

Research instrumentation provided by PASSCAL (Program for Array Seismic Studies of the Continental Lithosphere), and technology developments as part of this program have enabled new discoveries to be made regarding the seismic signals generated by icebergs. New technology developed as part of this program has also enabled the study of the collision zone on large icebergs. Images, taken daily with a Stardot camera are transmitted to the University by Iridium modem.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***  
No

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

Yes

One female PhD was graduated and mentored to the point where she received employment at a prestigious NASA laboratory.

*What may be the benefits of the proposed activity to society?*

Yes

This work has relevance to a better understanding of the Antarctic ice sheet and how icebergs and ice shelves affect and are affected by global climate.

OPP/ANT 2008

*Tags:* 2010 Transition Team and 2010 Budget

*Program Officer:* Julie Palais

*NSF Award Numbers:*

[0229546](#)

Award Title: Collaborative Research of Earth's Largest Icebergs

PI: Douglas MacAyeal, [drm7@midway.uchicago.edu](mailto:drm7@midway.uchicago.edu)

Institution Name: University of Chicago  
State Code: IL  
PE Codes: 5116

[0229492](#)

Award Title: Collaborative Research of Earth's Largest Icebergs  
PI: Emile Okal, [emile@earth.northwestern.edu](mailto:emile@earth.northwestern.edu)  
Institution Name: Northwestern University  
State Code: IL  
PE Codes: 5116

[0230028](#)

Award Title: Collaborative Research of Earth's Largest Icebergs  
PI: Charles Stearns, [chucks@ssec.wisc.edu](mailto:chucks@ssec.wisc.edu)  
Institution Name: University of Wisconsin-Madison  
State Code: WI  
PE Codes: 5116

*NSF Contract Numbers:*

*NSF Investments:* Climate Change, Environment (including the importance of fresh water and dynamics of water processes)

## **Studying Lakes Beneath the Antarctic Ice: News from the Field**

**Highlight ID: 16519, Version: AC/GPA**

The recent discovery of a large, semi-permanent subglacial water system under the Antarctic ice sheet has lead glaciologists to re-examine their understanding of the subglacial hydrologic system beneath the large ice sheets and to develop research projects to better understand the mechanisms that control the flow of glaciers toward the sea. One of these projects is studying what are called Elevation Change Anomalies (ECAs) beneath the West Antarctic ice sheet. Surface changes of up to 1-2 centimeters per day have been observed and are thought to result from filling and draining of multi-kilometer scale subglacial water pockets. They represent an unprecedented view into the subglacial drainage dynamics beneath the modern Antarctic ice sheet.

The conventional wisdom holds that water is produced in a slow and steady manner and then is drained away slowly through a continuous basal water film or a channelized drainage network. Recent evidence from a number of studies suggests, on the other hand, that the process is more time-variable than was previously thought. If this turns out to be the case then glaciologists will have a mechanism to explain the time-varying rate of glacier flow. While the existence of water beneath the ice streams and glaciers of the West Antarctic ice sheet has been known for a long time, the surprising discovery is the amount of water and the speed with which it flows between reservoirs under the ice. The study of the ECA's will lead to a better understanding of the mechanisms of fast glacier flow, ice sheet mass balance and potentially the stability of polar ice sheets.

*Primary Strategic Outcome Goal:*

- Public Understanding of Science and Lifelong Learning

*Secondary Strategic Outcome Goals:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

Public understanding of science is clearly a major part of this project. Not only have the PIs participated in outreach from the field through the Exploratorium program called Ice Stories; Dispatches from Polar Scientists, but they were accompanied in the field by an embedded journalist who chronicled their research. Finally one of the PIs is participating in the Polar Science Weekend at the University of Washington on March 6-9 at the Pacific Science Center where he and his students will interact with 5000+ children and adults who attend the event.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***  
No

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

Yes

This project provides advanced training opportunities to (1) two Ph.D. students, including one female student of Latino-Caucasian background, (2) two undergraduate students, including one female student of Middle Eastern background.

*What may be the benefits of the proposed activity to society?*

Yes

The societal relevance is a better understanding of the water under the Antarctic ice sheet and how this might impact global sea level. These subglacial lakes are believed to play a role in large-scale ice dynamics.

OPP/ANT 2008

*Program Officer:* Julie Palais

*NSF Award Numbers:*

[0636970](#)

Award Title: COLLABORATIVE RESEARCH: Elevation Change Anomalies in West Antarctica and Dynamics of Subglacial Water Transport Beneath Ice Streams and their Tributaries

PI: Slawek Tulaczyk, [tulaczyk@pmc.ucsc.edu](mailto:tulaczyk@pmc.ucsc.edu)

Institution Name: University of California-Santa Cruz

State Code: CA

PE Codes: 5116

[0636719](#)

Award Title: COLLABORATIVE RESEARCH: Elevation Change Anomalies in West Antarctica and Dynamics of Subglacial Water Transport Beneath Ice Streams and their Tributaries

PI: Ian Joughin, [ian@apl.washington.edu](mailto:ian@apl.washington.edu)

Institution Name: University of Washington

State Code: WA

PE Codes: 5116

[0733048](#)

Award Title: Ice Stories: A Public Educational Resource for IPY  
PI: Mary Miller, [marym@exploratorium.edu](mailto:marym@exploratorium.edu)  
Institution Name: Exploratorium  
State Code: CA  
PE Codes: 7259, 5208, 5130

*NSF Contract Numbers:*

*NSF Investments:* Climate Change, Environment (including the importance of fresh water and dynamics of water processes)

## **Ocean Acidification and Polar Ecosystems**

Highlight ID: 16601, Version: AC/GPA

Ocean Acidification arises due to the ocean's absorption of carbon dioxide, followed by a series of naturally-occurring equilibrium reactions involving carbonate, bicarbonate, and the hydrogen ion, all of which constitute the carbonate cycle. One outcome of these equilibrium reactions is an increase in hydrogen ion concentration, i.e. lower pH, and a decrease in the carbonate ion available for the formation of calcium carbonate. Calcium carbonate is an important skeletal component for many marine organisms, including coral and shell-bearing invertebrates. Undersaturation of oceanic waters, with respect to carbonate, could promote shell dissolution or inhibit shell formation. The implications for marine organisms, ecosystems and biogeochemistry of "ocean acidification" are potentially profound. If shell-bearing species cannot form skeletons, or if organisms with shells encounter undersaturated waters, then marine biodiversity, food web structure, and biogeochemical function are potentially affected. Non-shell-bearing organisms also may be at risk, as pH influences physiological processes and metabolic reactions in metazoans, as well as sorption-desorption reactions of metals and toxins.

Polar ecosystems are particularly vulnerable to ocean acidification because cold water holds more carbon dioxide, and therefore surface waters in the polar oceans are closer to the "tipping point" of undersaturation. Models predict that the southern ocean could become undersaturated with respect to aragonite, a fragile biogenic form of calcium carbonate, by the year 2100. Polar ecosystems include critical members (e.g. pteropods, coccoliths) that depend on calcium carbonate formation for skeletal or protective components. Food web structure and carbon burial may be substantially altered.

Researchers Vicky Fabry, of California State University, San Marcos, Brad Seibel of the University of Rhode Island, and Gretchen Hofmann, of the University of California, Santa Barbara, are taking a multipronged approach to determining the response of Southern Ocean pteropods, an important group of zooplankton, to ocean acidification. Fabry and Seibel are quantifying the impact of elevated carbon dioxide, and carbonate-undersaturated seawater, on rates of shell-formation and sub-lethal effects on organism energetics. Hoffman is investigating the response of pteropods, at the genetic level, to calcification stress. Her research on sea urchin larvae shows that shell-forming genes have highly elevated activity, and larval skeletons are less developed, when the larvae are subjected to undersaturated seawater consistent with IPCC (Intergovernmental Panel on Climate Change) scenarios of ocean conditions in the future. Hofmann is now using gene microarrays to examine the genomic response of Antarctic pteropods to elevated atmospheric CO<sub>2</sub>, and undersaturated seawater, in concert with Fabry and Seibel's calcification and energetic studies. Hofmann's work has been featured in online Science Magazine features, and Fabry is giving the Sverdrup lecture at the joint ASLO-AGU meeting in Orlando, 2008. The investigators have been noted for their groundbreaking research that links environmental change and organismal response at the level of the genome, and for educating the public and legislators about the ocean acidification problem.

*Primary Strategic Outcome Goal:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

*Secondary Strategic Outcome Goals:*

- Graduate Education and Graduate Student Research
- Postdoctoral Education, including International Postdoctoral Fellowships
- International Research Experiences for Undergraduate & Graduate Students

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

Ocean acidification may have dramatic consequences for marine organisms and ecosystems. Its importance has only recently been appreciated, and its impacts are not readily predicted from present models of organism or ecosystem function.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***

Yes

Ocean acidification research spans many disciplines, from environmental genomics to physical oceanography. The researchers are using novel techniques to investigate an important interdisciplinary problem. One of the projects was funded as an SGER.

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

Yes

The research includes undergraduates (Lauren Huber-Green, Leanne Birden, John Tollison), graduate students (Tansey Hall, Ramona Gonzalez), and a post doc (Anne Todgham). It also involves multiple institutions (URI, UCSB, Cal State San Marcos -a primarily undergraduate college).

*What may be the benefits of the proposed activity to society?*

Yes

The ecological function of the ocean has important services associated with it, including moderation of climate and provision of fisheries and recreational resources.

OPP/ANT 2008

*Tags:* 2010 Transition Team and 2010 Budget

*Program Officer:* Roberta Marinelli

*NSF Award Numbers:*

[0538710](#)

Award Title: Collaborative Research: Impacts of Elevated pCO<sub>2</sub> on a Dominant Aragonitic Pteropod (Thecosomata) and its Specialist Predator (Gymnosomata) in the Ross Sea

PI: Victoria Fabry, [fabry@csusm.edu](mailto:fabry@csusm.edu)

Institution Name: California State University San Marcos Foundation

State Code: CA

PE Codes: 5111

[0538479](#)

Award Title: Collaborative Research: Impacts of Elevated pCO<sub>2</sub> on a Dominant Aragonitic Pteropod (Thecosomata) and its Specialist Predator (Gymnosomata) in the Ross

Sea  
PI: Brad Seibel, [seibel@uri.edu](mailto:seibel@uri.edu)  
Institution Name: University of Rhode Island  
State Code: RI  
PE Codes: 5111

[0808947](#)

Award Title: Science of Opportunity: A SGER proposal to support the development of genomic resources for Antarctic pteropods  
PI: Gretchen Hofmann, [hofmann@lifesci.ucsb.edu](mailto:hofmann@lifesci.ucsb.edu)  
Institution Name: University of California-Santa Barbara  
State Code: CA  
PE Codes: 5111

*NSF Contract Numbers:*

*NSF Investments:* Climate Change, Environment (including the importance of fresh water and dynamics of water processes)

## Construction of the IceCube Neutrino Telescope reached halfway point

Highlight ID: 16660, Version: AC/GPA

The IceCube MREFC project exceeded the 2007-08 seasonal goal (14 strings) deploying 18 detector strings, instrumented with 60 digital optical modules (DOMs) each, at the U.S. Amundsen Scott South Pole Station. This number (40 strings total) marks the halfway point in the construction of the IceCube Neutrino Telescope that will detect neutrinos with energies exceeding tera-electron volts (TeV). The IceCube drilling and deployment teams were able to drill 2500-m deep holes at the South Pole and deploy strings at the rate of about one hole every 50 hours, creating a detector that now has a volume of one half of a cubic kilometer. This was the fourth drilling season at the South Pole and it represents a significant increase in the number of strings that can be deployed each season. In addition, IceTop tank deployment aligned with string deployment so that now each of the 40 strings has two IceTop tanks, containing two DOMs each. IceTop is a surface array to detect high-energy cosmic rays and to provide a veto for particle generated in atmospheric showers that interfere with neutrino detection within the IceCube volume. There are now 2400 DOMs in the ice and 160 DOMs on the surface at the South Pole Station. IceCube will reach a cubic-kilometer-per-year exposure within two years - long anticipated milestone of neutrino astronomy.

IceCube scientists are now evaluating each DOM to determine that it survived the deployment and "freeze-in" process. This testing and calibration effort continues after the last members of the IceCube construction team left the South Pole Station at the beginning of February 2008. Two IceCube winterover scientists have taken over the job of incorporating the new DOMs into the local data acquisition system. So far 99 % of the deployed DOMs that have been powered on are working; the testing and calibration is continuing. Analysis of the data from the DOMs deployed in previous years began in May 2007; the forty-string data analysis period will begin on April 1, 2008.

The International Polar Year (IPY) features the IceCube as one of the projects related to Ice Sheets (<http://www.ipy.org/index.php?ipy/detail/icecube>). This page contains a brief description of the IceCube project and links to the IceCube websites, and a profile of an IceCube scientist. IceCube team members participated in two IPY-related webcasts from the South Pole Station as part of the Exploratorium's "Dispatches from Polar Scientists" on December 28, 2007, and January 12, 2008. IceCube scientists shared their South Pole experiences via websites and blogs, being interviewed by their hometown newspapers, and visiting schoolrooms and participating in various science fairs and exhibitions after the field season.

*Primary Strategic Outcome Goal:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

*Secondary Strategic Outcome Goals:*

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research
- Graduate Education and Graduate Student Research
- Postdoctoral Education, including International Postdoctoral Fellowships
- Public Understanding of Science and Lifelong Learning
- Major Multi-User Facilities ([definition](#))

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

The IceCube Neutrino Observatory is a discovery instrument that will provide quantitatively novel information about astronomy and astroparticle physics, cosmic ray physics, and the physics of neutrinos that is not available using other detection methods. The engineering and science associated with the IceCube project represents an exciting opportunity to engage learners of all ages in that discovery process.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 1.30: Transformative Research](#)***  
Yes

The IceCube Neutrino Telescope opens a new window for extragalactic astronomy and astrophysics, exploring a range of neutrino energies that are not available from any terrestrial source built by nuclear and particle physicists. IceCube discoveries have the potential for an improved understanding of the Universe content and evolution, for instance, discovering the nature of Dark Matter.

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

Yes

IceCube scientists and staff eagerly shared the excitement of their experiences at the South Pole Station and of the discovery potential of this project with people of all ages, genders, and underrepresented groups. The mystique of the South Pole environment and the transformative science are an alluring mix.

*What may be the benefits of the proposed activity to society?*

No

OPP/ANT 2008

*Tags:* 2010 Transition Team and 2010 Budget

*Program Officer:* Vladimir Papitashvili

*NSF Award Numbers:*

[0636875](#)

Award Title: Initial Analysis of IceCube Data at UW-Madison

PI: Francis Halzen, [halzen@icecube.wisc.edu](mailto:halzen@icecube.wisc.edu)

Institution Name: University of Wisconsin-Madison  
State Code: WI  
PE Codes: 7316, 5115, 1643

[0639286](#)

Award Title: IceCube Neutrino Observatory Maintenance and Operations  
PI: Francis Halzen, [halzen@icecube.wisc.edu](mailto:halzen@icecube.wisc.edu)  
Institution Name: University of Wisconsin-Madison  
State Code: WI  
PE Codes: 006F

[0236449](#)

Award Title: IceCube Startup and Construction Project  
PI: Francis Halzen, [halzen@icecube.wisc.edu](mailto:halzen@icecube.wisc.edu)  
Institution Name: University of Wisconsin-Madison  
State Code: WI  
PE Codes: 5281, 005F

*NSF Contract Numbers:*  
0000373

*NSF Investments:* None Applicable

## **Werner Herzog Explores Antarctica in His Latest Film, "Encounters at the End of the World"**

Highlight ID: 16769, Version: AC/GPA

On a mission to create a documentary film about the Antarctic landscape and people who live and work there, Werner Herzog, world-renowned filmmaker, traveled to Antarctica in late 2006 with an in-kind grant from the National Science Foundation's Antarctic Artists and Writers Program. The grant provided Herzog and his cameraman, Peter Zeitlinger with access to the United States Antarctic Program's (USAP) researchers and facilities in support of the film project. Herzog's experiences and contemplation of the continent are documented in his latest movie, *Encounters at the End of the World*. The film portrays Herzog's travels to the Antarctic community of McMurdo Station, on Ross Island, the headquarters for the USAP and home to eleven hundred people during the austral summer (October to February.) Beyond the settlement, he ventures through a science fiction-like landscape, from the under-ice depths of the Ross Sea, to the brink of the Mount Erebus volcano. The critically acclaimed, feature-length film was released by Discovery Films at the 2007 Telluride Film Festival, kicking-off the film's run at numerous film festivals around the world. Preparations are underway by Discovery Films for the theatrical release scheduled for June 2008. The film's release in theaters will be followed by the televised Discovery Channel release in the autumn of 2008.

Filmed in crisp high-definition video, the footage drew praise from producers at Discovery Films, sparking a secondary project. A one-hour Discovery Science Channel show called, *Mega Lab Antarctica* is currently in production and due out with the television release of Herzog's movie. The *Mega Lab* television show is an outreach and science education component, created as a companion piece to Herzog's movie. The show will feature several NSF-funded Antarctic researchers and a few select artists previously supported by the Antarctic Artists and Writers program.

*Primary Strategic Outcome Goal:*

- Public Understanding of Science and Lifelong Learning

*Secondary Strategic Outcome Goals:*

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

The Antarctic Artists and Writers Program supported Herzog film, "Encounters at the End of the World" is directly tied to the strategic goal of "Learning", specifically as it pertains to "expanding the scientific literacy of all citizens." The film offers real-life glimpses of Antarctic researchers working in the field, the pristine beauty of the continent, and wildlife. The film and supporting "Mega Lab Antarctica" productions provide the opportunity to inspire the quest for knowledge and to positively influence career choices in a new generation of future scientists and engineers. The production and release of this film during the height of International Polar Year is also significant.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***  
No

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

Yes

The film, which will be available in theaters and on television has the potential to reach a broad audience, which includes individuals who might not otherwise have the opportunity to learn something about the continent of Antarctica and the United States Antarctic Program; the research, operations and logistics, thereby inspiring interest in both science and engineering.

*What may be the benefits of the proposed activity to society?*

Yes

This program complements Antarctic research by supporting creative and meaningful artistic and literary projects that foster new understandings in the role and outcomes of Antarctic research. The program emphasizes the broader impacts of both the scientific discovery as interpreted by artists and writers and subsequently the resulting artistic and literary works made available to significant public audiences.

OPP/ANT 2008

*Program Officer:* Kim Silverman

*NSF Award Numbers:*

[0538072](#)

Award Title: Documentary Film - ANTARCTICA: THE INNER LANDSCAPE

PI: Werner Herzog, [hkaiser@mindspring.com](mailto:hkaiser@mindspring.com)

Institution Name: Herzog Werner

State Code: CA

PE Codes: 5130

*NSF Contract Numbers:*

*NSF Investments:* International Polar Year (IPY)

# Antarctic plateau as a photochemically active surface

Highlight ID: 16776, Version: AC/GPA

## Antarctic plateau as a photochemically active surface:

Analysis of the results of a multi-investigator airborne measurement campaign (ANTCI: Antarctic Tropospheric Chemistry Investigation) continues to challenge our understanding of the chemistry of the air over Antarctica and how it interacts with sunlit snowpack and ice surfaces of the continental plateau. A working hypothesis that arose from the ANTCI 2003-2004 ground based measurements at South Pole was the sunlit driven production of oxidizing gaseous species (e.g., OH, NO<sub>x</sub>, O<sub>3</sub>) serving to form a natural oxidizing canopy over the entire plateau during the sunlit summer months. These oxidizing species serve to cleanse the Antarctic atmosphere, thus making the continent the home of some of the clearest air on earth. Observations from a series of Twin Otter sampling flights conducted along routes over the plateau and along the coast have recently been compared to detailed chemical transport model simulations, in an effort to better assess our understanding of snow NO<sub>x</sub> emissions. Interest in the photolysis of snowpack nitrate is also needed to understand the record of this chemical species recorded over time in ice cores.

### Primary Strategic Outcome Goal:

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

### Secondary Strategic Outcome Goals:

- Teacher Education and In-service Professional Development

How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?

Climate change

**Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)**

Yes

Transformative research is invariably a process rarely an event. Continued understanding of the oxidizing capacity of the Antarctic atmosphere and the future intended recovery of the polar ozone hole is a scientific goal of the Montreal Protocol, and is needed for more accurate IPCC global climate change scenarios.

How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)

No

What may be the benefits of the proposed activity to society?

Yes

Changes in atmospheric chemical composition are drivers of global climate change. Global climate change has massive economic and societal implications.

OPP/ANT 2008

Program Officer: Peter Milne

NSF Award Numbers:

[0230246](#)

Award Title: Collaborative Research: Antarctic Tropospheric Chemistry Investigation (ANTCI)

PI: Fred Eisele, [eisele@ncar.ucar.edu](mailto:eisele@ncar.ucar.edu)

Institution Name: GA Tech Research Corporation - GA Institute of Technology

State Code: GA  
PE Codes: 5113

*NSF Contract Numbers:*

*NSF Investments:* Climate Change, Environment (including the importance of fresh water and dynamics of water processes)

## What is happening to the Antarctic sea ice cover?

Highlight ID: 16777, Version: AC/GPA

We know that the area and thickness of the Arctic sea ice cover has been decreasing over the last few decades. What about the Antarctic? Like the Arctic, the Antarctic sea ice cover is affected by a complex combination of solar heating and atmospheric pressure patterns and ocean currents. Unlike the Arctic until now at least, Antarctic sea ice largely disappears on a seasonal basis. The total amount of Antarctic sea ice in a given year doesn't seem to be changing dramatically but there have been big changes in particular regions. Previous studies have shown pronounced contrasting trends in annual sea duration and monthly concentration in two regions of the Southern Ocean: decreases in the western Antarctic Peninsula and southern Bellingshausen Sea and increases in the Western Ross Sea region. This recent analysis of satellite observations from 1979-2004 shows that sea ice is retreating a month earlier and advancing a month and a half later in the former region and is retreating a month later and advancing a month earlier in the latter region. These trends are strongly correlated to changes in atmospheric pressure patterns. A simple way to think about it is that there is a recurrent band of low pressure or storminess that affects the sea ice edge particularly in the spring and in the fall. Larger scale pressure systems push this band of storminess around. When these larger scale systems are analyzed statistically it appears that there is a hemispheric pressure pattern that changes on timescales of decades and is periodically perturbed by El Nino/La Nina climate patterns. Ozone losses and greenhouse gases both of which affect Earth's interaction with sunlight are thought to be driving changes in the Southern hemisphere pressure patterns that are connected to the sea ice changes. Based on current understanding, continued greenhouse gas release would be expected to reinforce and perhaps expand these regional ice trends to larger areas.

*Primary Strategic Outcome Goal:*

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

*Secondary Strategic Outcome Goals:*

- Graduate Education and Graduate Student Research
- Postdoctoral Education, including International Postdoctoral Fellowships

*How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?*

The media has been confused about why the Antarctic ice cover is not retreating in the same way as for the Arctic. Some reports have even suggested that increases of ice in areas of the Antarctic signal that global warming is a hoax. This study is a significant advance in the scientific understanding of the complex issue and suggests we can expect further regional change in the Antarctic sea ice cover under global warming. The understanding developed through this research contributes to the societally pressing issue of climate change.

***Does this highlight represent transformative or potentially transformative research? If so, please explain why. For more information, see [Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008](#) and [Important Notice 130: Transformative Research](#)***

No

*How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

Yes

This collaborative work was spearheaded by a female as part of her graduate and postdoctoral studies. The collaborators include another female. Females are significantly underrepresented in the domains of physical oceanography & climate studies.

*What may be the benefits of the proposed activity to society?*

Yes

This study provides a basis for making clear to the public what has been a confusing issue regarding global climate change.

OPP/ANT 2008

*Tags:* 2010 Transition Team and 2010 Budget

*Program Officer:* Kelly Falkner

*NSF Award Numbers:*

[0230284](#)

Award Title: U.S./Chinese Ship of Opportunity Sampling Program Phase II

PI: Xiaojun Yuan, [xyuan@ldeo.columbia.edu](mailto:xyuan@ldeo.columbia.edu)

Institution Name: Columbia University

State Code: NY

PE Codes: 5113

[0217282](#)

Award Title: LTER: PALMER, ANTARCTICA LTER: Climate Change, Ecosystem Migration and Teleconnections in an Ice-Dominated Environment

PI: Hugh Ducklow, [hducklow@mbi.edu](mailto:hducklow@mbi.edu)

Institution Name: College of William & Mary Virginia Institute of Marine Science

State Code: VA

PE Codes: 7381, 5111, 1647, 1195, 1128

[0538516](#)

Award Title: Sea Ice Mass Balance in the Antarctic-SIMBA Drift Station

PI: Stephen Ackley, [stephen.ackley@utsa.edu](mailto:stephen.ackley@utsa.edu)

Institution Name: Clarkson University

State Code: NY

PE Codes: 5113

*NSF Contract Numbers:*

*NSF Investments:* Climate Change, Environment (including the importance of fresh water and dynamics of water processes)