Ice911: Developing an effective response to climate change in Earth's cryosphere

A global problem:

Earth's icy regions are responding rapidly to climate change and there is widespread consensus that we need to slow this trend in order to avoid potentially catastrophic results.

Emergency climate response approaches—also known as geo-engineering—have recently attracted more interest as possible tools to slow climate change and thereby avoid or abate damage to fragile and important ecosystems such as the world's polar regions, glaciers, permafrost, and even seasonal snow areas. If we could slow warming trends, with the long-term goal of reducing some of the effects of rapid climate change, we could possibly enhance the preservation of threatened species, ensure more predictable availability of drinking water, and perhaps bring about a reduction in the Ice-Albedo Feedback Effect (which currently acts to accelerate climate change already in process).

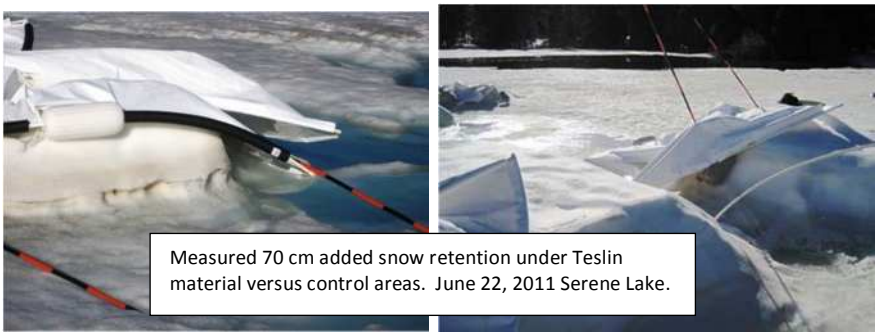
Albedo adjustment is gaining attention as an important strategy in slowing global warming, with specific techniques ranging from cool roofs to white pavements. One localized option used by Ice911 is surface albedo modification, which may be especially valuable in a polar environment. Because of the complex nature of climate effects, such a localized and reversible technique poses fewer environmental risks and seems likely to encounter less political opposition than more diffuse and irreversible de-localized solutions. Surface albedo modification could eventually become a useful part of a toolbox of emergency climate response techniques.

How Ice 911 fits in: Working toward a localized and ecologically respectful "planetary band-aid."

Ice911 Research Corporation's charitable mission is the development and rigorous scientific evaluation of an engineering approach to slow one of the far-reaching effects of global warming. The technique aims to preserve polar and glacial ice, snow, permafrost, and polar habitat using a localized and ecologically respectful "planetary band-aid" that can be put in place quickly, and can be removed once it is no longer needed. (The late Professor Steve Schneider, a prominent expert on climate change, invented the term "eco-engineering" to describe the Ice911 project.) This specific approach is designed to reduce warming, and to be rapidly deployable when needed at strategic chosen locations; as such, it is well suited, but not necessarily restricted, to polar regions. The overriding constraint imposed is that any change introduced must not lead to new environmental harm, and as a part of that it is best that any materials introduced be easily removable later.

What we've done to date: On donated time and small budget, Ice911 has moved this concept forward, and has undergone successful winter and spring demonstrations in the field.

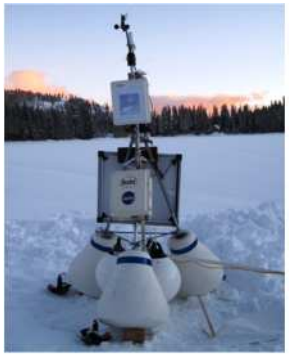
We have field tested the technique for three seasons at sites including one of the Serene Lakes near Lake Tahoe in the Sierra Nevada Mountains; at Sugar Bowl (a nearby ski area); and on Miquelon Lake near the University of Alberta in Edmonton, Canada. In our field tests we have benefited from



Measured 70 cm added snow retention under Teslin material versus control areas. June 22, 2011 Serene Lake.

informal collaborations with instrumentation expert Satish Chetty and polar experts Professor Christian Haas and Justin Beckers at the University of Alberta.

The work has progressed with a handful of generous private donations and with help and samples from two materials companies. In each succeeding year Ice911 has fielded larger tests, each time deploying and testing improved instrumentation and materials. The instrumentation package has been under continual development, aiming to remotely monitor the changes induced by surface modifications with removable materials. The instruments monitor and transmit information on ice thickness, weather, and insolation using a solar powered data gathering system of robust and upgradeable design built on a floatable buoy system to allow the package to continue gathering data even during the challenging and critical period of the spring melt. Some of our greatest challenges in the field this past season have come from record-breaking snowfalls and very high winds; to face these and other challenges, the development of the instrumentation package and the materials and methods of deployment are ongoing.



Instrumentation package, at deployment & June 22, 2011 Serene Lake.

The Research Plan's next steps:

1. **Laboratory characterization:** In addition to the field work done to date, measurements are underway to determine optical characteristics and vapor transmissivity of various proposed surface covering materials. Also needed are tests directly related to ice and snow retention performance of the various materials under controlled laboratory conditions to give further information on the materials characteristics that lead to the best and most cost-effective performance.
2. **In situ field testing:** Further development and testing are still needed at the current sites at California's Serene Lakes and Sugar Bowl ski area. In addition, great benefits are foreseen in starting fieldwork for Ice911 in an area that is currently under study by other climate scientists and which could lead to collaborations with them (an ideal area would be one which also has access to nearby glaciers and permafrost areas). One such area is Spitsbergen Island in Norway, which hosts an active research center, and borders the Arctic Ocean, the Norwegian Sea, and the Greenland Sea.
3. **Publishing scientific results:** Publication of the work to date in a high-impact, peer-reviewed journal is a current high priority.
4. **Outreach to further potential supporters:** We would like to hire a marketing/fundraising consultant to develop a concentrated fundraising strategy to further the work.

Budget: An investment in a more stable climate

Ice911 will continue as rapidly as funding allows to further improve and augment the test materials and instrumentation, to do testing over larger areas, and to eventually conduct experiments in polar regions — all work intended to yield the most rigorous, relevant, and conclusive data possible in order to further develop and evaluate this technique to slow one important effect of climate change.

Additional funding of $50,000 - $100,000 as soon as possible would allow Ice911 to continue work for the upcoming winter/spring testing season. Funding would cover incremental equipment, travel, some field and laboratory testing, and some custom materials development. Work would continue to be done on a time-constrained and largely volunteer basis, with hope that we could afford in the future to bring on paid professionals in the area of instrumentation and deployment to enhance current operations.

Additional funding of $1 Million over a two-year period would allow Ice911 to greatly accelerate the work beyond our current volunteer ranks by adding one to three dedicated employees and paid consultants to carry forward the work as rapidly as possible. The funding would also cover equipment, travel, custom materials development, as well as the marketing necessary for enhanced funding and deployment. This level of funding would allow for staffing on a more stable basis and attract the needed talent to bring the current effort to the next level.

Ice911 is in the process of becoming approved as a 501(c)3 nonprofit corporation. Currently, Ice911 can accept tax-deductible donations through the Philanthropic Ventures Foundation.

Team Qualifications

- **Founder and CEO, Governing Board: Leslie Field, Ph.D.** has been inventing, developing, and testing the Ice911 concept for the last several years, and has brought her wide-ranging experience in engineering, industrial R&D, consulting, invention, and entrepreneurship to the task. Dr. Field teaches a popular graduate-level course in Engineering and Climate Change at Stanford University, where she is a Consulting Professor in Electrical Engineering. She earned degrees from MIT (BS and MS in Chemical Engineering) and UC Berkeley (MS and PhD in Electrical Engineering with a MEMS specialization). She has worked at HP Labs/Agilent Labs and Chevron Research, and has founded and runs two successful technical consulting companies.

- **Governing Board**
  - **Armond Cohen** is Executive Director of the Boston-based Clean Air Task Force, a nonprofit organization dedicated to reducing atmospheric pollution through research, advocacy, and private sector collaboration.
  - **Nicole Kerness, Ph.D.** is the Secretary of Ice911 and is a Director of Technology Research and Development at Maxim Integrated Products.
  - **Steve Payne** is Managing Partner of Stinson Ventures, a technology and investment advisory firm.
- **Advisors**
  - **Satish Chetty** is Ice911's volunteer instrumentation specialist. He is the CTO of Beyond 66, a veteran of the Antarctic development and deployment of the very successful Polarbot, and specializes in polar instrumentation and open source solutions.
  - **Ellen Baum** is a Senior Scientist with the Clean Air Task Force.
  - **Professor Roger Howe** is in the Electrical Engineering Department, Stanford University.
  - **Professor Terry Root** is a Biologist at Woods Institute for the Environment, Stanford University.
  - **B. Stephen Toben** is the President of the Flora Family Foundation.
  - **Eric Redman** is the Managing Director of the Summit Power Group.
- **Legal Counsel**
  - **Wilson Sonsini Goodrich & Rosati** provides both paid and pro bono legal services to Ice911.