View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by University of Maine

The University of Maine
DigitalCommons@UMaine

University of Maine Office of Research and Sponsored Programs: Grant Reports

Special Collections

1-13-2006

ANYWHERE, ANYTIME, ANYSIZE, ANY SIGNAL: Scalable Remote Information Sensing and Communication Systems

George Markowsky
Principal Investigator; University of Maine, Orono, markov@maine.edu

Follow this and additional works at: https://digitalcommons.library.umaine.edu/orsp_reports


Part of the Systems and Communications Commons

Recommended Citation
Markowsky, George, "ANYWHERE, ANYTIME, ANYSIZE, ANY SIGNAL: Scalable Remote Information Sensing and Communication Systems" (2006). *University of Maine Office of Research and Sponsored Programs: Grant Reports*. 232.
https://digitalcommons.library.umaine.edu/orsp_reports/232

This Open-Access Report is brought to you for free and open access by DigitalCommons@UMaine. It has been accepted for inclusion in University of Maine Office of Research and Sponsored Programs: Grant Reports by an authorized administrator of DigitalCommons@UMaine. For more information, please contact um.library.technical.services@maine.edu.

Final Report for Period: 01/2002 - 08/2005 **Submitted on:** 01/13/2006
Principal Investigator: Markowsky, George . **Award ID:** 0210619
Organization: University of Maine

Title:
ANYWHERE, ANYTIME, ANYSIZE, ANY SIGNAL: Scalable Remote Information Sensing and Communication Systems

Project Participants

Senior Personnel

Name: Markowsky, George
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Bonito, Gregory
Worked for more than 160 Hours: Yes
Contribution to Project:
Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm. Actually, over 50 people participated in the two workshops.

Name: Egan, Dennis
Worked for more than 160 Hours: Yes
Contribution to Project:
Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Holm, Rich
Worked for more than 160 Hours: Yes
Contribution to Project:
Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Hughes, Dave
Worked for more than 160 Hours: Yes
Contribution to Project:
Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Kratz, Tim
Worked for more than 160 Hours: Yes
Contribution to Project:
Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Lane, William
Worked for more than 160 Hours: Yes
Contribution to Project:
Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Nagel, David
Worked for more than 160 Hours: Yes
Contribution to Project:
Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Nowak, Robert

Worked for more than 160 Hours: Yes

Contribution to Project:

Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Owens, Leslie

Worked for more than 160 Hours: Yes

Contribution to Project:

Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Smarr, Larry

Worked for more than 160 Hours: Yes

Contribution to Project:

Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Wilson, Jim

Worked for more than 160 Hours: Yes

Contribution to Project:

Speaker. Presentations and videos are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Brett, George

Worked for more than 160 Hours: Yes

Contribution to Project:

Contributor to the first report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Chritton, Michael

Worked for more than 160 Hours: Yes

Contribution to Project:

Contributor to the first report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Fall, Kevin

Worked for more than 160 Hours: Yes

Contribution to Project:

Contributor to the first report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Franz, David

Worked for more than 160 Hours: Yes

Contribution to Project:

Contributor to the first report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Gamble, Kevin

Worked for more than 160 Hours: Yes

Contribution to Project:

Contributor to the first report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Gilmore, James

Worked for more than 160 Hours: Yes

Contribution to Project:
Contributor to the first report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Morley, Richard
Worked for more than 160 Hours: Yes
Contribution to Project:
Contributor to the first and second reports which are available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Chepponis, Michael
Worked for more than 160 Hours: Yes
Contribution to Project:
Contributor to the second report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Cook, Gordon
Worked for more than 160 Hours: Yes
Contribution to Project:
Contributor to the second report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Gao, Robert
Worked for more than 160 Hours: Yes
Contribution to Project:
Contributor to the second report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Hendricks, Dewayne
Worked for more than 160 Hours: Yes
Contribution to Project:
Contributor to the second report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Lopez-Anido, Roberto
Worked for more than 160 Hours: Yes
Contribution to Project:
Contributor to the second report which is available on the website that I set up for this workshop: http://homeland.maine.edu/anywhere.htm.

Name: Thot-Thompson, Janet
Worked for more than 160 Hours: Yes
Contribution to Project:
Participated in writing the first report.

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:

We produced many hours of video, one extensive report, many slide presentations and a summary of recommendations. For details see http://homeland.maine.edu/anywhere.htm.

Findings: (See PDF version submitted by PI at the end of the report)

We produced many hours of video, one extensive report, many slide presentations and a summary of recommendations. For details see http://homeland.maine.edu/anywhere.htm.

Training and Development:

We produced many hours of video, one extensive report, many slide presentations and a summary of recommendations. For details see http://homeland.maine.edu/anywhere.htm.

Outreach Activities:

1. I have maintained a website since the first workshop.

2. The website contains videos of all the presentations along with the powerpoint presentations.

3. We published the first report and distributed hundreds of copies, along with a CD that contains all the videos and powerpoint presentations.

4. We had a second workshop that produced a series of recommendations which we will upload and also display on We produced many hours of video, one extensive report, many slide presentations and a summary of recommendations. For details see http://homeland.maine.edu/anywhere.htm.

5. I traveled to the IDAACS 2005 meeting held in Sofia Bulgaria in September 2005 and ran slides from the first workshop and distributed copies of the first report.

6. I traveled to the TEHOSS 2005 meeting held in Gdansk Poland in October 2005 and ran slides from the first workhsop and distributed copies of the first report.

7. I created a video presentation setup in my homeland security lab to feature the presentations and videos generated by the workshops.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

URL(s):

http://homeland.maine.edu/anywhere.htm

Description:

Other Specific Products

Product Type:

Audio or video products

Product Description:

We produced videos of all the presentations and these are available on http://homeland.maine.edu/anywhere.htm.

Sharing Information:

Available on http://homeland.maine.edu/anywhere.htm. Also, hundreds of copies were distributed on CDs.

Contributions

Contributions within Discipline:

The materials on http://homeland.maine.edu/anywhere.htm provide a good overview of how field scientists and homeland security scientists have many concerns in common. Our workshop inspired a workshop held under the auspices of polar programs, for which I was asked to assist.

Contributions to Other Disciplines:

We had some influence on a polar workshop.

Contributions to Human Resource Development:

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Categories for which nothing is reported:

Organizational Partners

Any Journal

Any Book

Contributions: To Any Human Resource Development

Contributions: To Any Resources for Research and Education

Contributions: To Any Beyond Science and Engineering

Recommendations of the Sensors2 Workshop

The Sensors II Group

Bioterrorism **Public Response**

Brian Hanley
Peter Hilton
John Hackney?

Bioterrorism Detection

- Next Problem – engineered viruses (designer biological super weapons)
  - Current detection is observations of fatalities
  - Delayed fatality enables near 100% penetration of population
  - Many alternatives available
  - Limited cost and resources required

Bioterrorism Detection

- Needs
  - Detection of designer viruses and forward projection of possible effects on victims, particularly relative to potential fatalities
  - Responses appropriate to virus – sanitation and quarantine
  - Education of bio-defense community about designer bio-weapons
  - Education of healthcare community

Bioterrorism Detection

- Recommended actions
  - Communicate concerns to the Bio-defense community
  - Develop instruments for use in clinical settings to perform broad spectrum DNA/RNA sequence analysis of infectious organisms
  - Educate law enforcement concerning bio-weapons and productive prosecutions

The Public as First Responders

- Problem
  - Members of the public are most likely to be positioned to disrupt terrorist acts (Members of the public are the only ones who have actually foiled terrorist actions in process.)
  - The public does not feel it is its role to respond to terrorist events
  - The public is not educated to participate in terrorist detection and mitigation

The Public as First Responders

- Needs
  - Determine what the public should know and how they should respond to terrorist actions in various contexts
  - Position the public to be able and inclined to respond to mitigate terrorism events

The Public as First Responders

- Recommendations
  - Develop guidelines for “successful” public response to terrorism incidents
  - Determine the most effective means of educating/training/communicating with the public to obtain the desired responses
  - Develop and implement educational programs to achieve these goals

The Power Group

Gordon Cook
Robert Gao
Dave Hughes
Jim Labrecque

Power

- Ubiquity of sensor distribution on the order of millions not possible without a power solution
- Researchers are aware of a power problem but all assume it’s the other guy's responsibility
- Solutions are there but research needed

Fuel Cells

- Fuel cells are becoming practical
- Case Western Reserve has small cells that can produce 10 mw using hydride fuel at one atmosphere of pressure
- Fuel cells demand replacement or recharging which creates a problem of scaling
- They do last longer than batteries and can deliver tiny long lived power sources
- Power density is higher

Power Harvesting

- To solve the problems of recharging batteries or fuel cells power harvesting from the environment is needed
- Need hybrid solutions that can use pressure, temperature, and solar sources
- Microbe activity also a possibility

Pressure Differential as a Means of Power Harvest

- Injection molding at u mass amherst using piezo ceramic chip has been demonstrated
- Mathematical calculations show that it is theoretically possible to use small changes in atmospheric pressure to generate small amounts of electricity that can be stored in a capacitor
- Using a membrane driven piezo device
- Research needs to be done to determine wide scale feasibility & cost

Thermocouple

- Work needs to be done to build thermocouples with large collection plates working over a low temperature differential that can gradually build up electricity to be stored in capacitors or other energy storage elements

Related Issues

- Millennial Net has interesting LOW power wireless devices
- Motorola has a HCS08 microcontroller that uses only 1.8 volts and 7.5 mAmp.
- Researchers must understand that power requirements are very different at the device level (milliwatt), cluster level(100 to 150 milliwatt) and infrastructure (connecting data from a cluster to the rest of the world -n watts).

An Integrated Sensor System

Michael Cheponis
Gautam Dasgupta
George Bernhardt

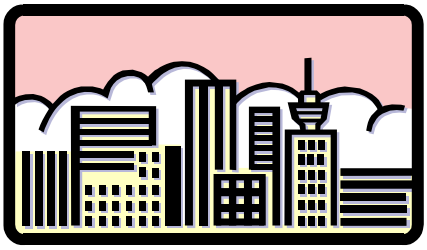
Outline

- Characteristics of Integrated System
- Issues needing consideration
- Recommendation

Characteristics

- Array will have many sensors measuring different fundamental quantities
- Redundant Array
- Searches for anomalies (Δx not x)
- Secure information

Issue One



- System must be dynamic
- Array will expand by adding sensors
- Array will expand functions by reprogramming

Issue Two

- Anomaly measured is dynamic
- After identification of event, data continues to come in
- New data further defines event

Issue Three

- Presentation of data
- Person must make sense out of data in order to make decision

Issue Three (Cont.)

- Presentation of data
- Computer controlling system could make decision based on current policy

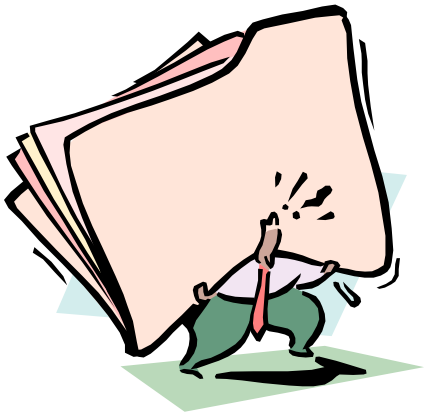
Issue Four

- System does not have to be for homeland security
- Could be safety/security system
- Homeland Security is an auxiliary use

Issue Five

- System should learn
- Record of false positives kept

Recommendation



- Look at current integrated sensor systems (Nuclear Power Plant)

Recommendation

- Talk to Insurance Company to help determine what should be examined
- Design an integrated sensor system using current technology (hardware and software)

Dick Morley's Virus

- Cell phone and laptop based sensors
- Statistical placement of sensors and systems
  - Airplanes over the Atlantic
  - Automobiles
  - Ham radios

Clearing House & Demonstration Facility Subgroup Report

George Markowsky

Don Mitchell

Dick Morley

Outline

- A Clearing House?
- A Demonstration Facility?
- The Importance of Persistence
- Building Communities
- Recommended Implementations
- Conclusions

A Clearing House?

- Center dealing with current information related to sensors, communication technology, and power, as used in field science, homeland security and citizen safety
- Include as much information as possible, references to current information – should include sources of supply
- Tools for searching information
- Will service the first responder, academic, international, government, consumer, industrial sectors

A Clearing House?

- Distributed
- Mechanism for building communities

A Demonstration Facility?

- A place where people can come and have hands-on experience with applicable technologies
- Vendors can come, test, demonstrate and develop their wares in-situ
- Consumers, e.g., first responders, can test procedures and technologies
- It is a environment where equipment is tested and demonstrated physically
- Prototype to set the stage for others
- Mobile centers

Characteristics of a Demonstration Facility

- Should be able to test marine and land-based systems
- Should have adequate land area for serious demonstrations

The Importance of Persistence

- People must be able to depend on this facility existing

Building Communities

- Tending to existing communities
- Build a new community to get different groups

Recommended Implementations

- Establish a clearing house with the initial prototype in a university environment
- Figure out a strategy for long-term support of the clearing house (at least 5 years)
- Establish a demonstration facility at an appropriate group of locations
- Figure out a strategy for long-term support of the demonstration facility (at least 5 years)

George Markowsky's Virus

- This is a presentation that I mentioned in my original e-mail.
- A presentation that I gave at the EPSCOR Cyberinfrastracture workshop in April 2003.

Global Connectivity

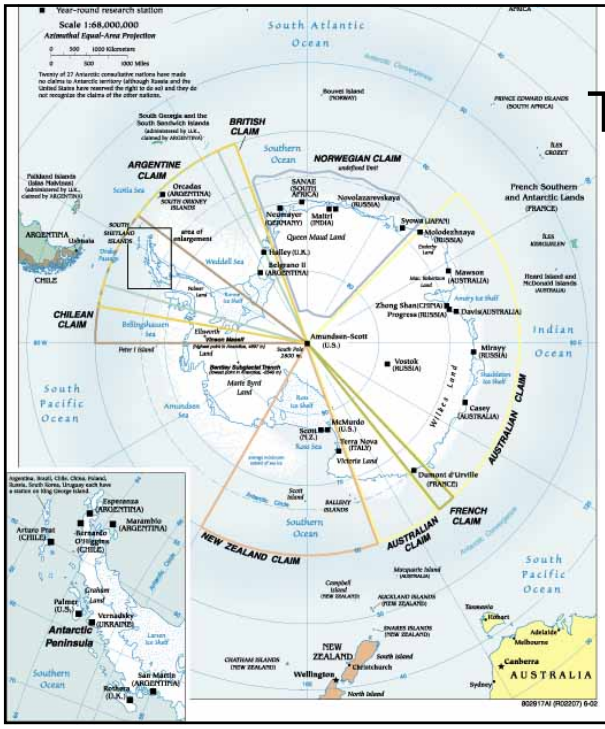
George Markowsky, Chair
Department of Computer Science
Department of Mathematics & Statistics
University of Maine

Connectivity & The Atkins Report

- (p. 35) ***Networks --*** *A major shift in computing has come from the practical availability of high-bandwidth data networks. Network connections up to 45 megabits are* ***easily*** *available, connections over 155 megabits/s are still aggressive, and some research institutions are beginning to connect at 2.5 Gb/s and faster.*

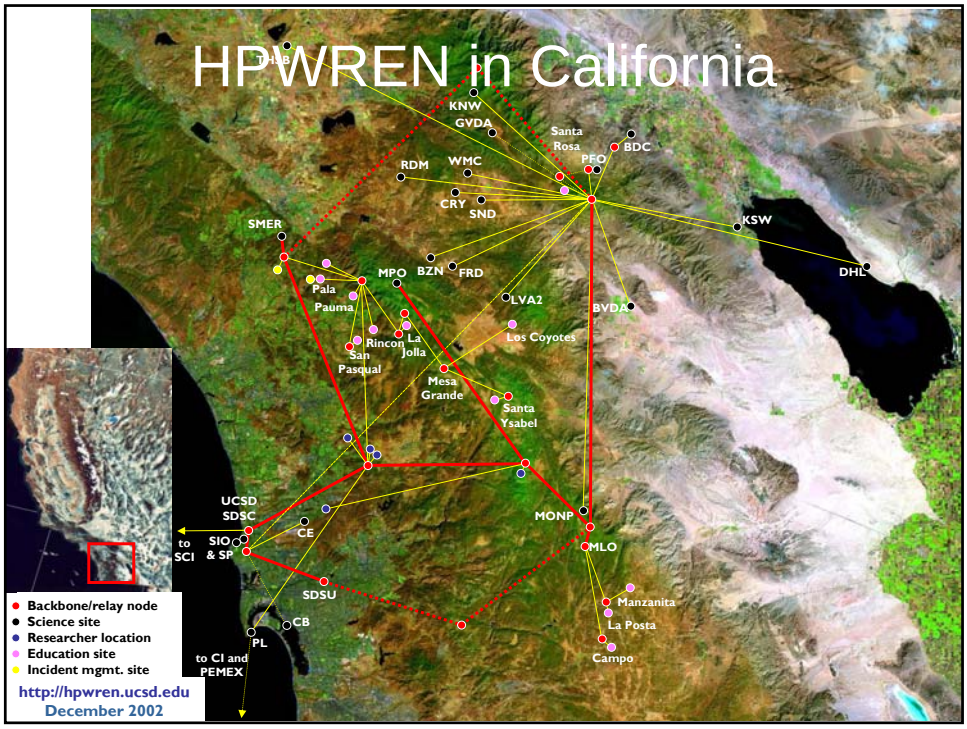
The Picture for Field Science is not that Rosy

- Just concluded an NSF-sponsored workshop between OPP (Office of Polar Programs) & CISE entitled -- Polar Science and Advanced Networking
- Connectivity is a real issue for polar research programs
- Antarctica & the Arctic are continental in size with marginal connections to the rest of the world



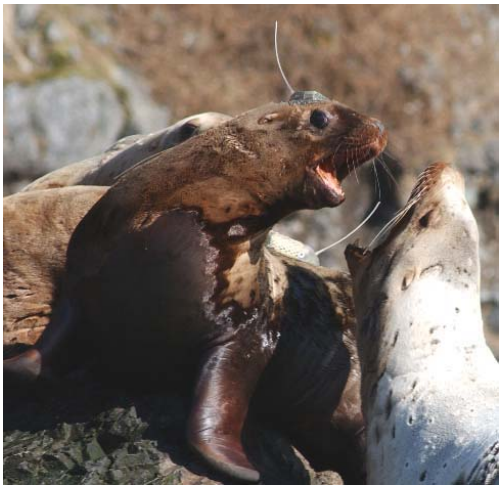
The Land that Connectivity Forgot

Another Land that Connectivity Forgot

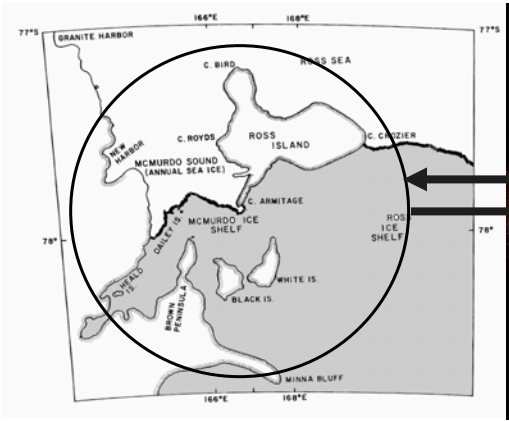


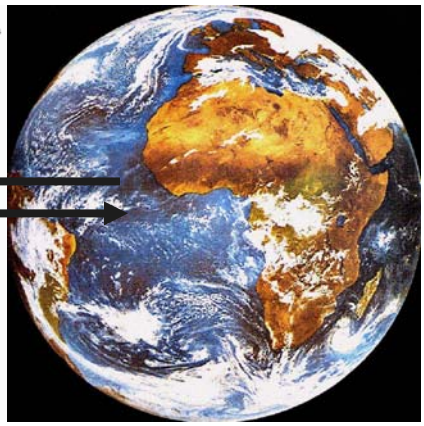
- AND=Andrews Experimental Forest
- ARC=Arctic Tundra
- BES=Baltimore Ecosystem Study
- BNZ=Bonanza Creek
- CAP=Central Arizona Phoenix
- CDR=Cedar Creek Reserve
- CWT=Coweeta Hydrologic Lab
- FCE=Florida Coastal/Everglades
- GCE=Georgia Coastal Ecosystems
- HBR=Hubbard Brook
- HFR=Harvard Forest
- JRN=Jornada Basin
- KBS=Kellogg Biological Station
- KNZ=Konza Prairie Reserve
- LUQ=Luquillo Experimental Forest
- MCM=McMurdo Dry Valleys
- NET=Network Office
- NTL=North Temperate Lakes
- NWT=Niwot Ridge
- PAL=Palmer Station
- PIE=Plum Island Estuary
- SBC=Santa Barbara Coastal
- SEV=Sevilleta
- SGS=Shortgrass Steppe
- VCR=Virginia Coast Reserve

Communications and Networking for Field Biologists: What we would like to have



Integrated system for seamless local area (50-100 mile radius) and global communications and networking





Motivation

The Problem

- Long term observed rise in sea level
- **Devastating consequences of sea level rise on populated coastal areas**

The Need

- Accurate determination of mass balance (the net gain or loss of glacial ice)
- Establish a better understanding of internal dynamic processes that control mass balance

The Approach

- Design and develop intelligent radar sensors for polar ice sheet measurements
- Implement a mobile data collection system that relies on robotics and innovative information technology.

http://science.nasa.gov/headlines/y2000/ast08sep_1.htm

Science @NASA

Inform Inspire Involve
science.nasa.gov
NASA Science News home

Record-setting Ozone Hole

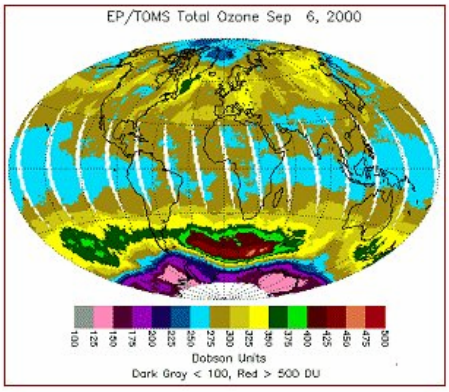
Antarctica's ozone hole has expanded to cover an area three times larger than the United States.

Listen to this story (requires RealPlayer)

Sept. 8, 2000 -- A NASA spectrometer has detected an Antarctic ozone "hole" (what scientists call an "ozone depletion area") that is three times larger than the entire land mass of the United States - the largest such area ever observed.

The "hole" expanded to a record size of approximately 28.3 million square kilometers on Sept. 3, 2000. The previous record was approximately 27.2 million square km on Sept. 19, 1998.

The ozone hole's size currently has stabilized, but the low levels in its interior continue to fall. The lowest readings in the ozone hole are typically observed in late September or early October each year.



Anywhere, Anytime, Any Size, Any Signal:

Scalable Remote Information Sensing and Communication Systems

Sponsored by the NSF

January 14-15, 2002

George Markowsky
Chair, Computer Science Department
Chair, Mathematics Department
University of Maine

Connectivity was also an issue cited in this earlier workshop that brought together field scientists and homeland security researchers

Global Connectivity Needed for

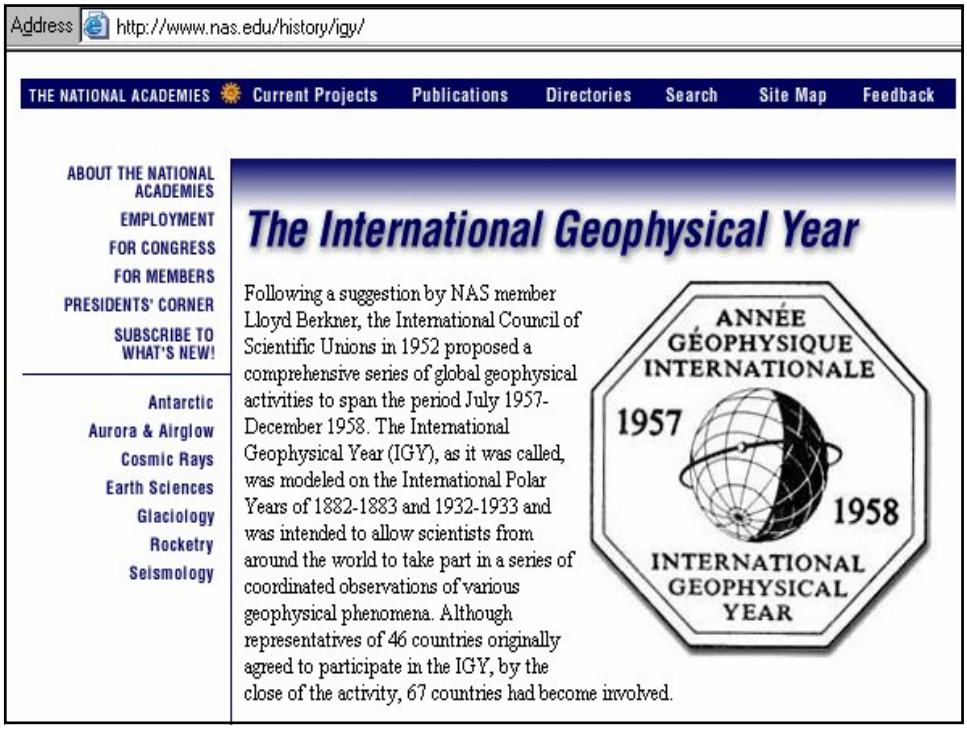
- Scientific Research
- Education
  - Distance education & connection to field scientists needs more emphasis
- Governmental Uses
- Telemedicine
- Public
- Homeland Security
- Economic Development

Global Connectivity

- Not so hot -- just ask Guy Cormier and others here
- I propose that the EPSCOR states rally around an effort to bring a true global network into being that provides ubiquitous connectivity so that a researcher or educator can get reasonable connectivity **anywhere** in the world!

The Atkins Report

- (ES 2) *The emerging vision is to use cyberinfrastructure to build more ubiquitous, comprehensive digital environments that become interactive and functionally complete for research communities in terms of people, data, information, tools, and instruments and that operate at unprecedented levels of computational, storage, and data transfer capacity.*



ISTY 2007

- We should have an ***International Science & Technology Year*** in 2007 to support all field science
- We need to start now so that by 2007 we can have a truly global network in place to support ISTY 2007
- The EPSCOR states should be the stewards of this effort! Adopt a pole and/or an island!

Dewayne Hendricks's Virus

- This was done on my own initiative, but I thought it is relevant.