



# PolySat

## Launch and Operations

Cubesat Developers' Summer Workshop

Logan, Utah

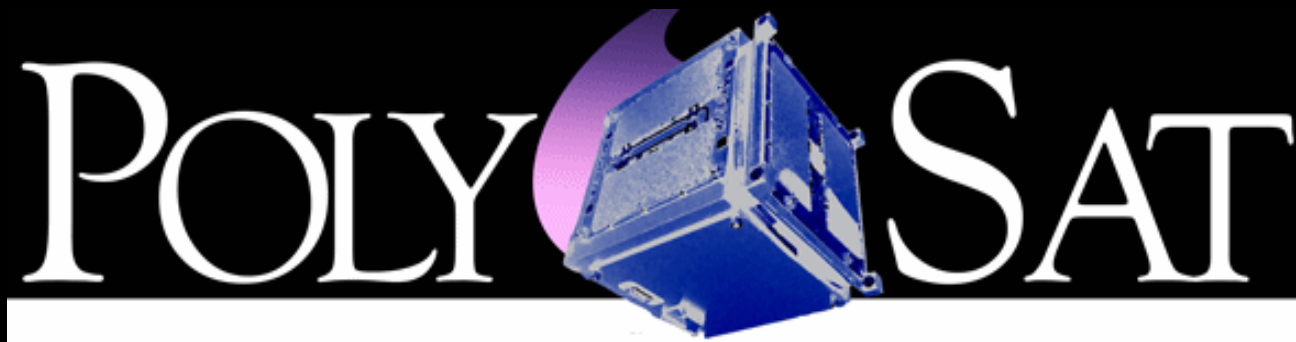
12 August 2007

**CAL POLY**

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# PolySat

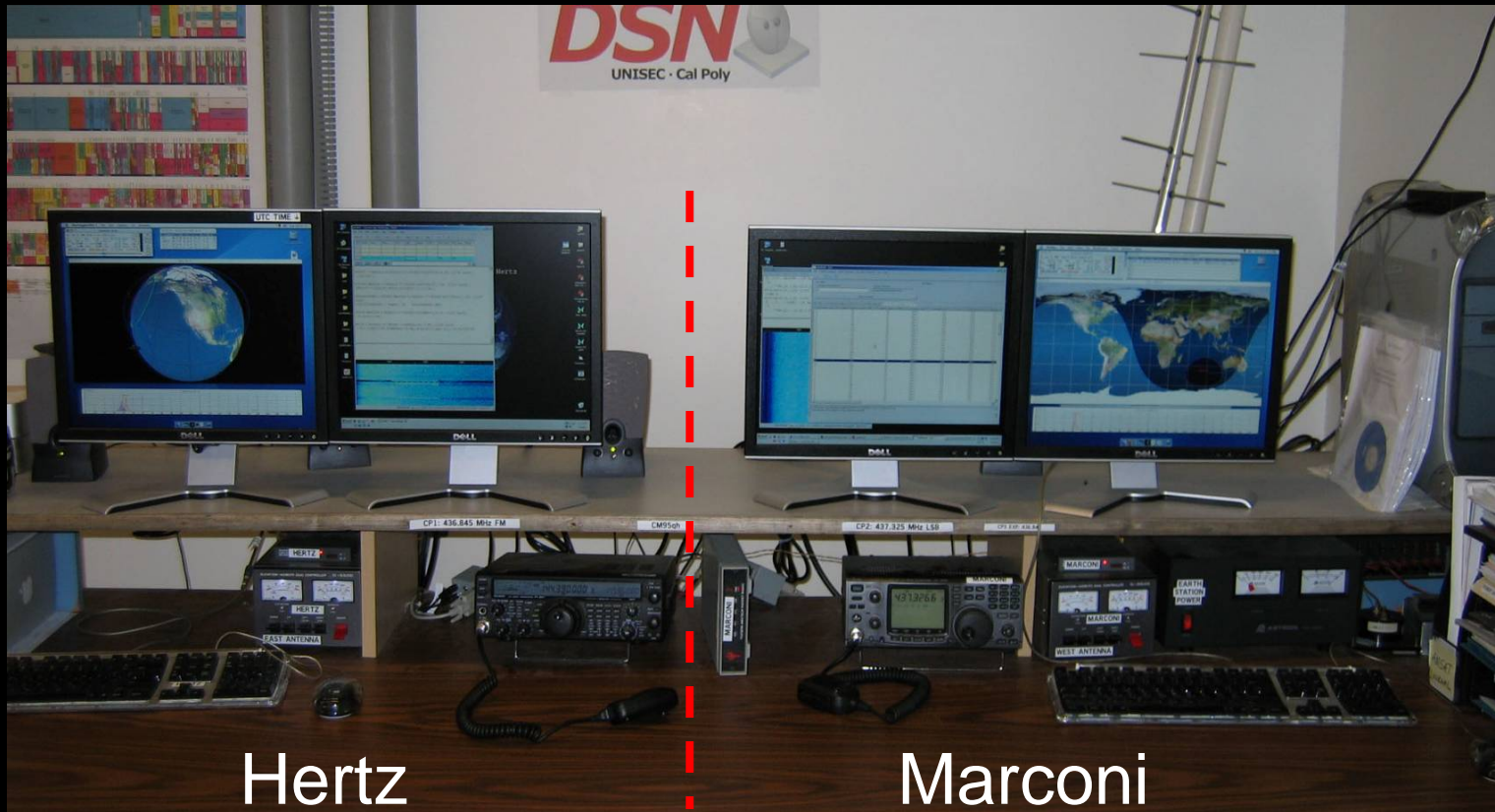
- Objective: Engineering Education
- Objective: Provide a reliable bus system to allow for flight qualification of a wide variety of small sensors and attitude control devices.



# Multidisciplinary Space Technologies Laboratory



# Earth Station



- Yeasu FT-847 and Icom IC-910
- Yaesu G-5500
- MixW Software TNC
- Mac Doppler Pro for tracking

# Earth Station



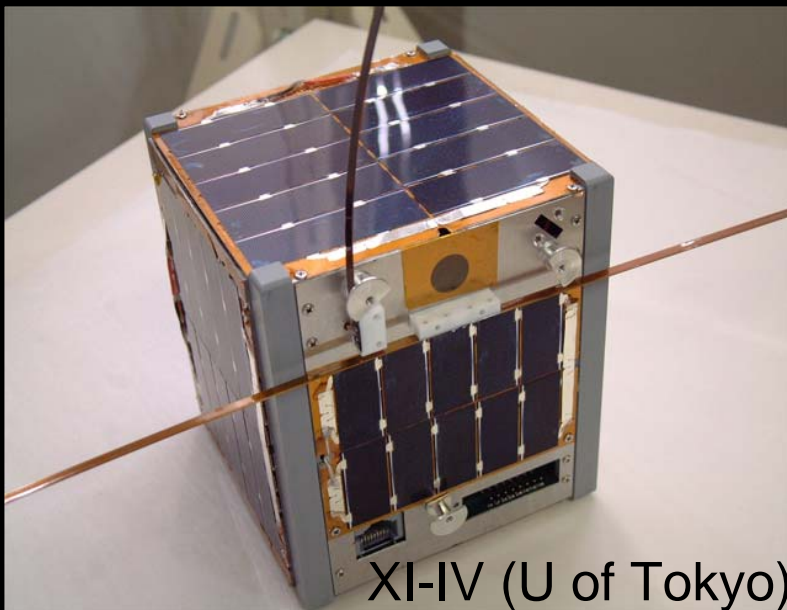
**Marconi**  
dual phased 70 cm yagis



**Hertz**  
2 m yagi  
70 cm yagi

# Operations Experience

- Training Objectives
  - Successfully make contact with a CubeSat
  - Download and decode AX.25 digital data.
- Collaboration with University of Tokyo
  - Experience gained with XI-IV





# CP1


- Magnetorquer developed by Cal Poly
- Third party Sun Sensor
- Valuable lessons learned
  - CubeSat development: challenges & logistics
  - Multiple Flight Units



# DNEPR 2 – April 17th 2007

- CP2.1 manifested as CP4  
  - Energy Storage and Dissipation Experiments
  - Test and Characterize CPBus



- CP3 
  - Attitude Determination using a suite of sensors
  - Attitude Control using Magnetorquers in each side panel
  - Observation Imagers: lots of data to download!



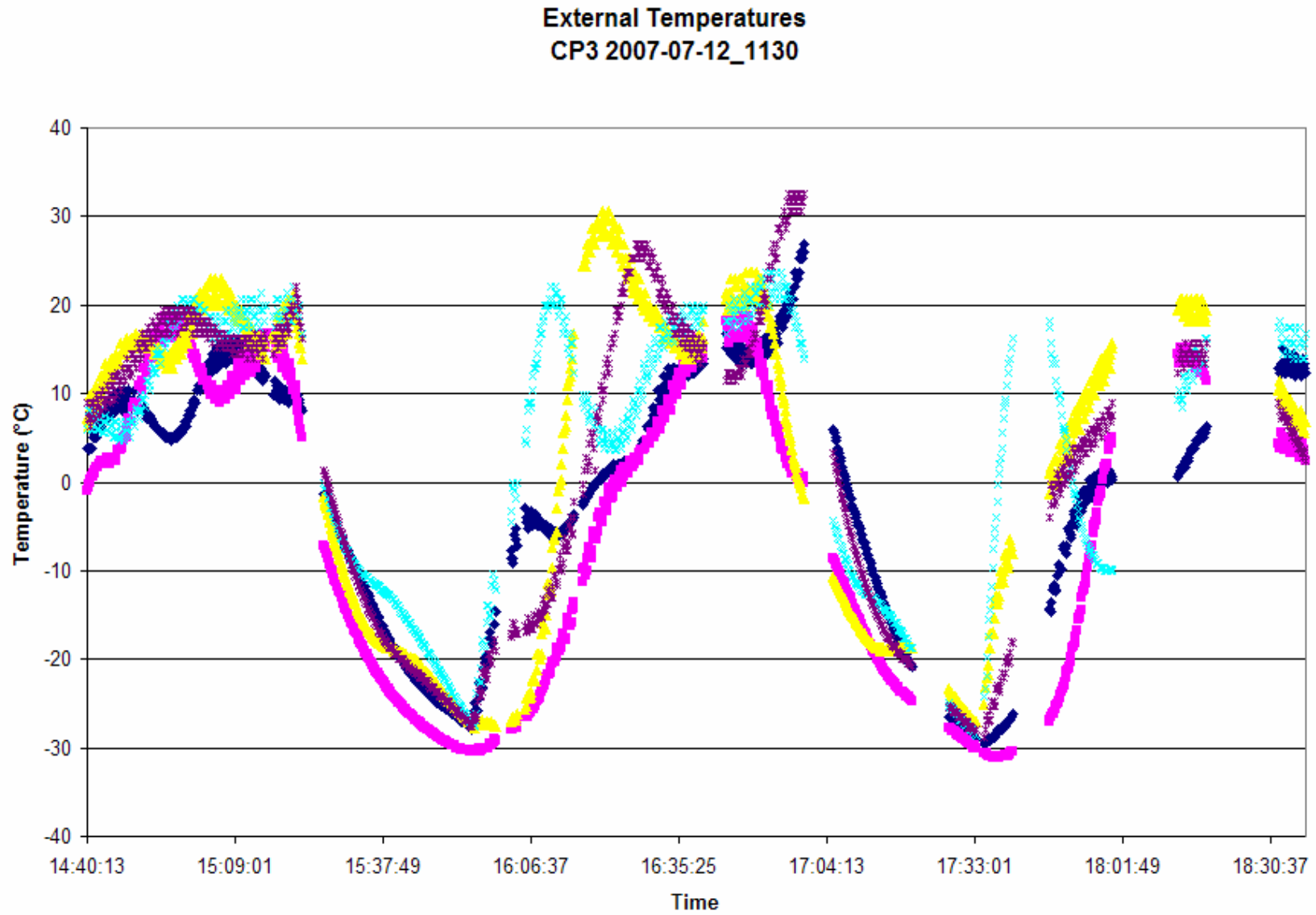


A world map showing the continents of North America, South America, Europe, and Africa. The map is dark, with the landmasses in shades of green and brown. The title 'Lessons Learned' is overlaid on the top left of the map.

# Lessons Learned

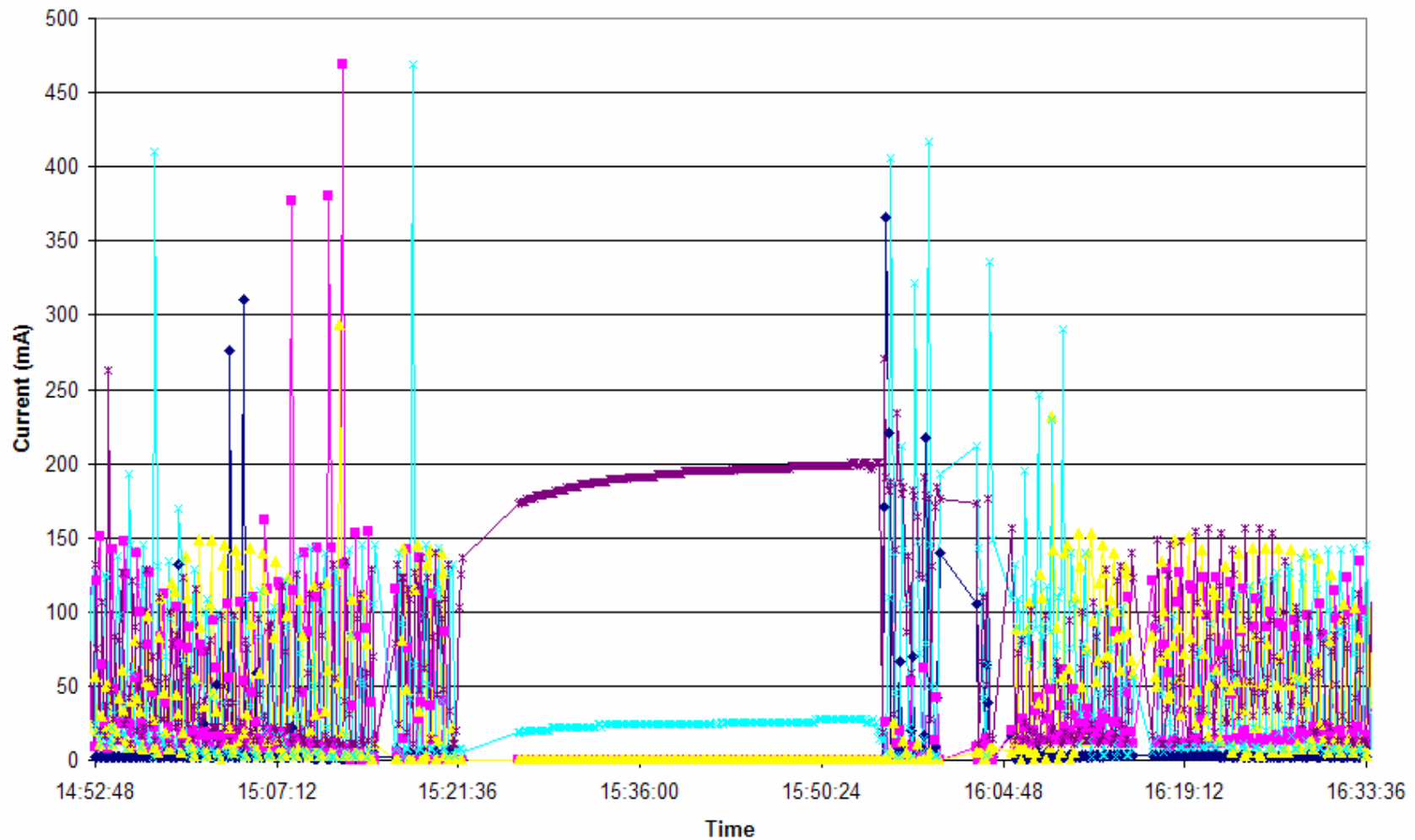
- Beacons
  - Object identification
  - Immediate data
- RF power
- Solar panel efficiency
- Contingency plan

# On-Orbit Data



# On-Orbit Data

Solar Panel Currents  
CP3 2007-07-12\_1130



A satellite-style map of the Earth, showing continents and oceans. The map is dark, with green and brown tones for land and blue for water. The title 'Amateur Radio Involvement' is overlaid in white text.

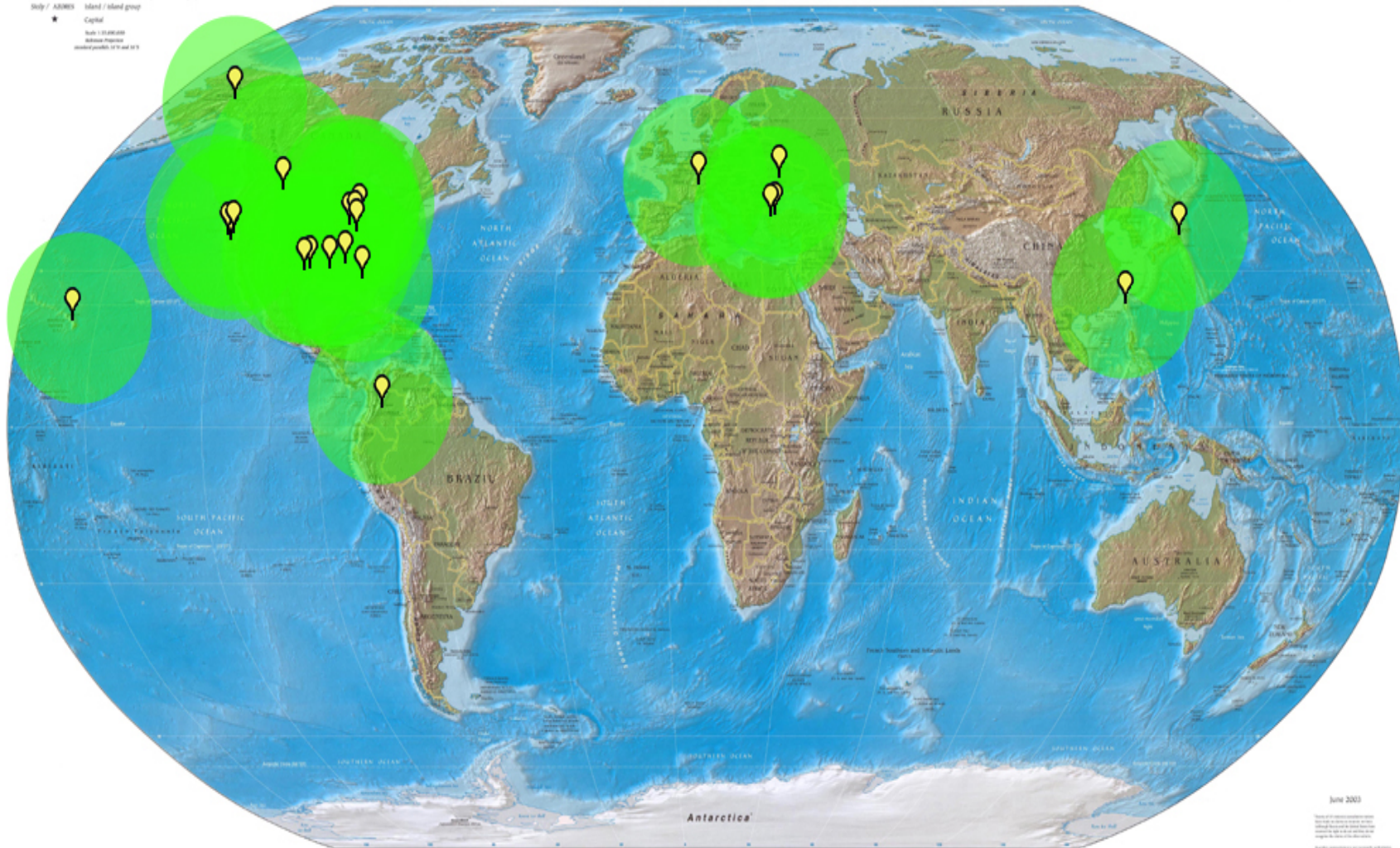
# Amateur Radio Involvement

- 80% of lab personnel are hams
- Training the next generation of satellite builders and operators
- Huge community of active listeners
  - Colin Hurst and Mike Rupprecht

# The Ground Station Network

Physical Map of the World, June 2003

▲ AUSTRALIA Independent state  
■ Bermuda Dependency or area of special sovereignty  
● Italy / AZORES Island / island group  
★ Capital  
Scale: 1:10,000,000  
Reference: Equator  
Coordinates: 10° N and 10° S



June 2003  
Scale: 1:10,000,000  
Reference: Equator  
Coordinates: 10° N and 10° S

# GENSO Background

- Global Educational Network for Satellite Operators
- Originally started with the Japanese to combat interference (GROWS)
- Started under the International Space Education Board, a collaboration between CSA, ESA, JAXA, and NASA
- Approved on 5 October 2006 for 2 years
- Project to link low-cost earth stations

Canada

元素



A satellite-style map of the Earth showing continents and oceans, serving as a background for the slide. The map is centered on the Atlantic Ocean, with North and South America visible on the left and Europe and Africa on the right.

# GENSO Background

- A system to link ground stations using the internet
- Only 1200/9600 baud data for now
- Three parts:
  - Central server
    - Authentication and registration
  - Mission Control Client
    - Scheduling of Ground Station Servers
    - 1 MCC per satellite developer
  - Ground Station Servers
    - Actual interface between rotors/radio and internet

A world map is visible in the background, showing the continents of North America, Europe, and Africa. The map is dark and serves as a backdrop for the text.

# Central Server

- 3 central servers located around the world
  - Europe
  - California (Cal Poly or SRI)
  - Japan
- Tasked with Authentication and Registration only
  - Registration of IP addresses of GSS and MCC
  - Statistics
- All other functions (scheduling, data transfer) will go peer-to-peer between Mission Control Clients and Ground Station Servers
  - This keeps the load off a single server when system scales up





# Mission Control Client

- A program that runs on a personal computer that can control Ground Station Servers
- Uses the Central Servers to get IP addresses for individual GSS, then contacts the GSS's directly to:
  - Schedule an active session
  - Download decoded data
  - Control the radios and rotors to track a satellite during an active session
  - IRC Client ?
  - Skype Client?

A satellite map of the Earth showing the Americas, Europe, and Africa. The map is dark with green and brown landmasses and blue oceans. A thin green line is visible on the left side, possibly representing a satellite orbit or a specific location.

# Ground Station Server

- Compatible with a majority of ground stations currently operating
- “Passive” tracking:
  - Will continuously track all satellites it can decode
  - Will forward data on to MCC
- “Active” tracking:
  - Someone at a MCC is actively controlling the rotors and radio, looking at the decoded data, and listening to the audio
  - Must be scheduled prior to satellite pass and cleared with GSS
  - Requires offline interaction and parties that know each other
- Store audio/data locally and stream to MCC as bandwidth allows
- IRC and/or Skype client?

A satellite-style map of Earth showing the Americas, Europe, and Africa. Several green and red lines represent orbital paths or signal beams across the globe.

# “Standard” Earth Station

- Icom IC-910 radio with computer interface
- M<sup>2</sup> OR2800P-DC for Azimuth and MT-1000 for elevation
- Symek TNC 31S
  - Possibly software in future
- Antennas:
  - 2MCP22 for 145 MHz
  - 436CP42UG for 437 MHz
  - 1 meter dish for S-band (downlink only)

A satellite-style world map is visible in the background, showing the Americas on the left and Europe and Africa on the right. The map is dark and serves as a backdrop for the text.

# Workshop IV

- At Cal Poly 2-6 July 2007
- Completed PDR
- Documentation Finished
- Started to work on the code
- Initial testing slated for late summer

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### Latest Events

Sun, Aug 12th, 2007

**CubeSat Workshop**

Mon, Aug 13th, 2007

**SmallSat**

### Welcome to cubesatalumni.com!

Written by Site Administrator

Tuesday, 31 July 2007

A while back, a number of us were sitting around, reminiscing about the good old college days, and all the great times we had while in the CubeSat Program. As we were talking about where everyone was, and what they were doing, a couple of interesting things came up.

1. In addition to created many great experiences, the CubeSat Program also produced many strong and lasting relationships.
2. Those that had (finally) graduated were very successful at finding great jobs and working on

### Polls

How well did the CubeSat Program prepare you for industry?

- Extremely  
 Reasonably  
 Somewhat  
 Poorly

### Syndicate

[RSS](#) 0.91

[RSS](#) 1.0

[RSS](#) 2.0

[ATOM](#) 0.3

[OPML](#) [SHARE IT!](#)

A satellite-style world map is visible in the background, showing continents and oceans. The map is slightly faded and serves as a decorative backdrop for the text.

# Spring Workshop

- April 2008 (possibly 10-12 April)
- Huntington Beach, CA
- Looking for presenters and sponsors
- Contact Riki, Lori, Matt D, or Dr. P
- [cubesat-workshop@atl.calpoly.edu](mailto:cubesat-workshop@atl.calpoly.edu)

A satellite-style world map showing the Americas, Europe, and Africa, with a dark blue background. The map is slightly faded and serves as a background for the text.

# Announcements

- SmallSat Conference
  - Booth upstairs in 7U and 8U
  - Inside Room 311
- Camera Charger
- Thanks for coming to this workshop
- Presentations are online at [cubesat.org](http://cubesat.org)
- This room is open

A satellite-style map of Earth showing the continents and oceans. Several thin, colored lines (green, yellow, red) represent orbital paths or trajectories across the globe, primarily concentrated over the Americas and Europe.

Thanks!

[polysat.calpoly.edu](http://polysat.calpoly.edu)  
[cubesat.org](http://cubesat.org)

Justin Foley  
[jfoley@calpoly.edu](mailto:jfoley@calpoly.edu)

Bryan Klofas  
[bklofas@calpoly.edu](mailto:bklofas@calpoly.edu)