

Thoughts on Imagining the Future with CubeSats

Prof. James W. Cutler
University of Michigan
jwcutler@umich.edu,
<http://exploration.engin.umich.edu>

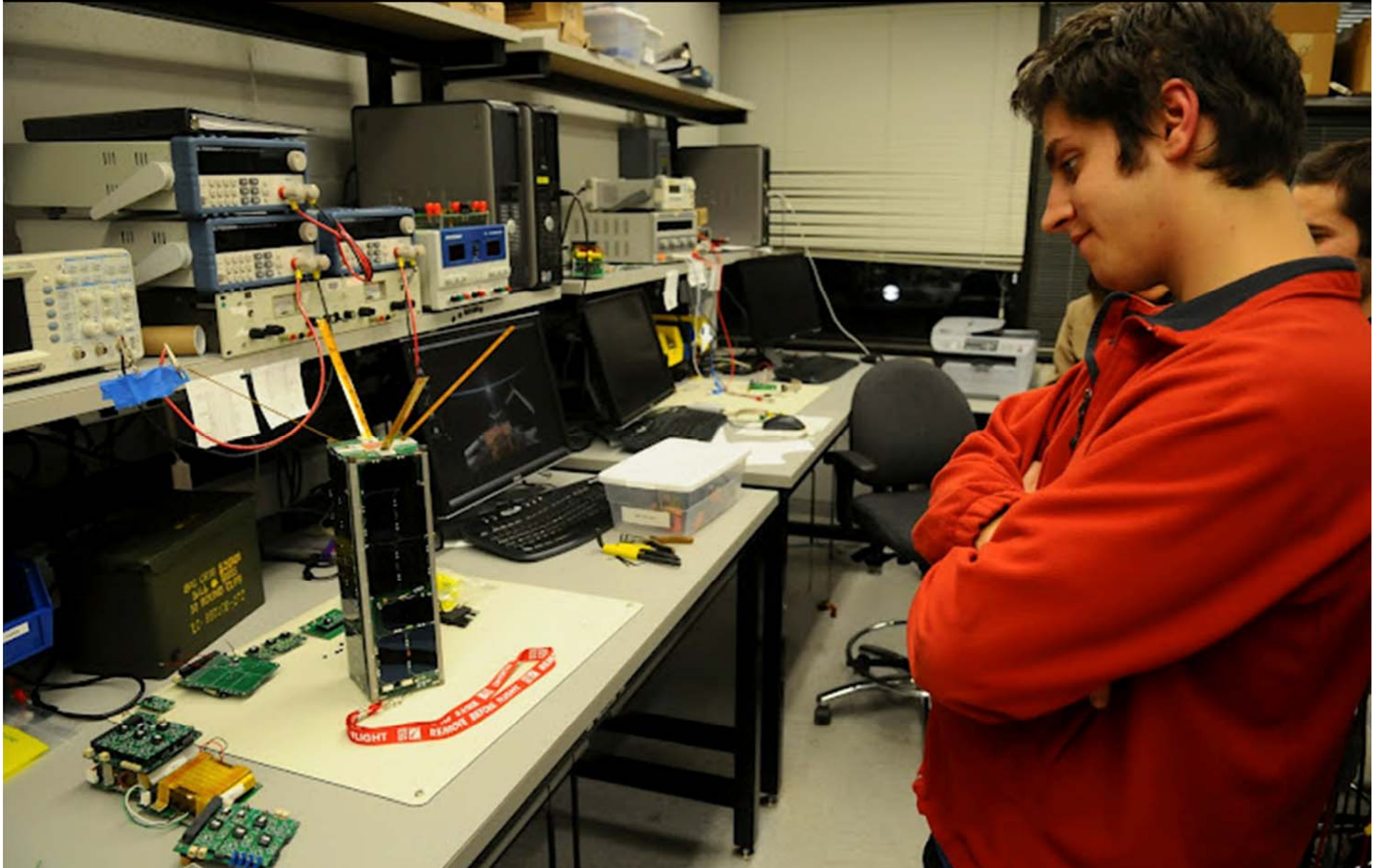
Inside all of us is an explorer...



...reaching for the stars.



“Why don’t you like me?”, Dontchev. “You don’t do anything”, Cutler.
So Kiko built batteries for RAX and MCubed.

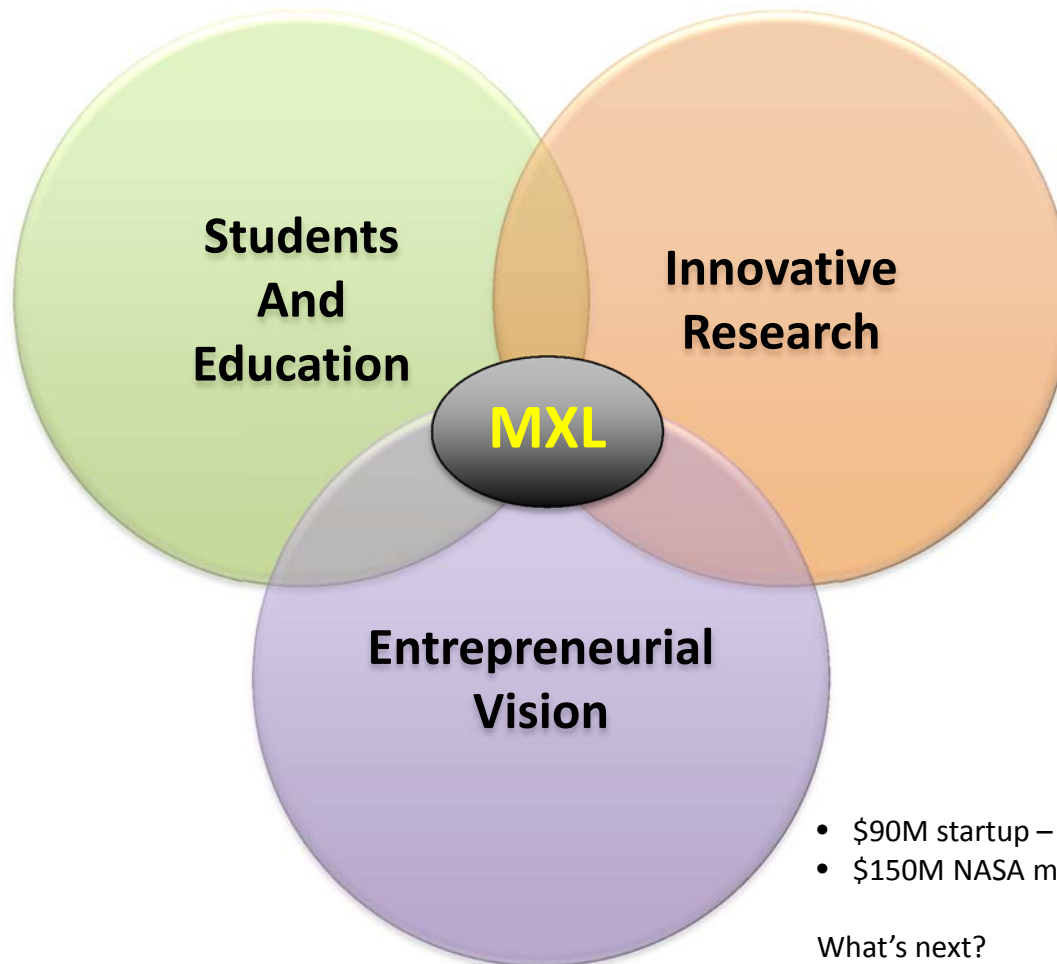


Kiko's next batteries are here..



UMich/Aero/MXL enable bold flight and science to extreme and remote environments.

- Integrate into classes and co curricular activity.
- 40+ students involved

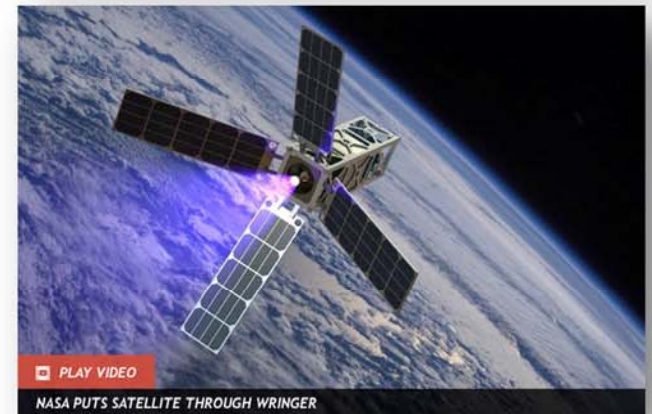
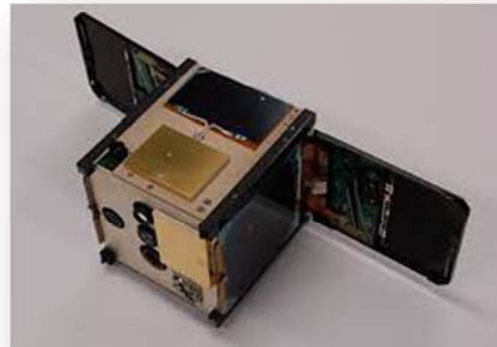
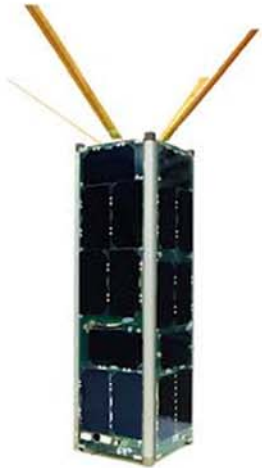


Harness multi disciplinary research to advance flight.

- \$90M startup – Skybox
- \$150M NASA mission – CYGNSS

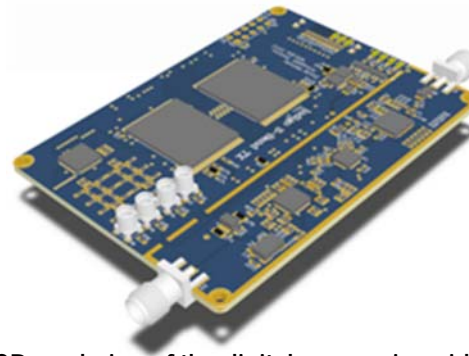
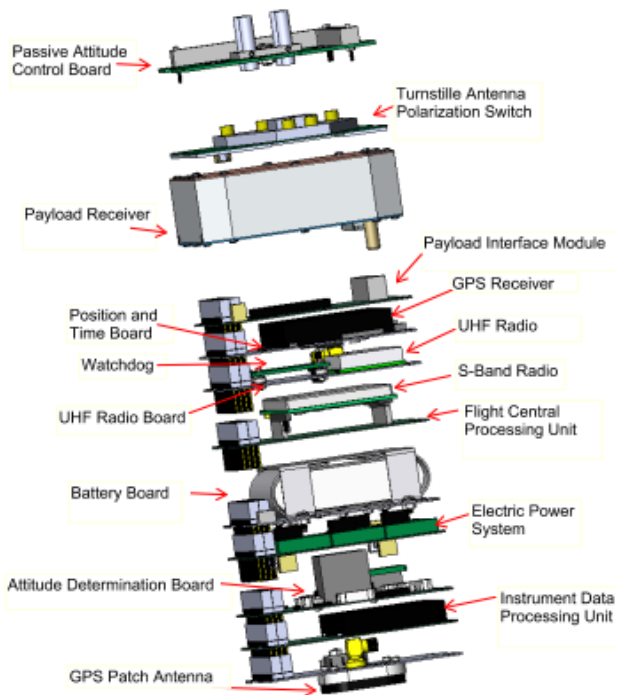
What's next?

The CubeSat paradigm is enabling innovation.

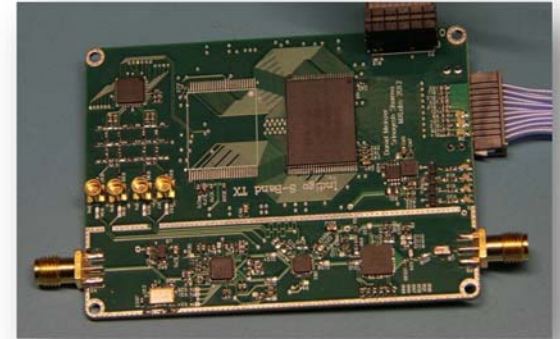


Can they also enable innovation in ground systems?

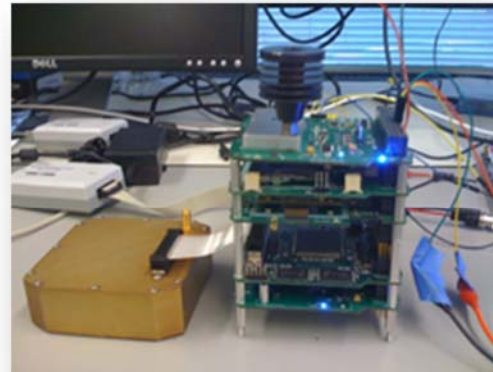
Approach: End to End Missions



PCB rendering of the digital processing side.



Prototype radio under testing.



Flight computers.



Custom data loggers and flash storage.

Approach: Enabling spare aperture.



Peach Mountain – upgrading a 26 meter dish for high gain or deep space ops.

Approach: How do we measure capacity and schedule?

Clustered Satellite P-POD Launch

AeroCube3, CP6, HawkAat Orbital Parameters

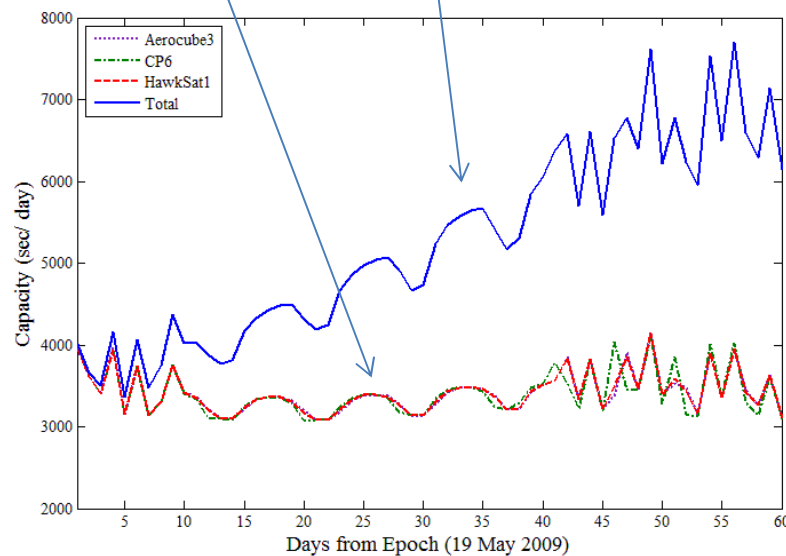
$i - 40.5^\circ$

$e_{avg} = 0.003$

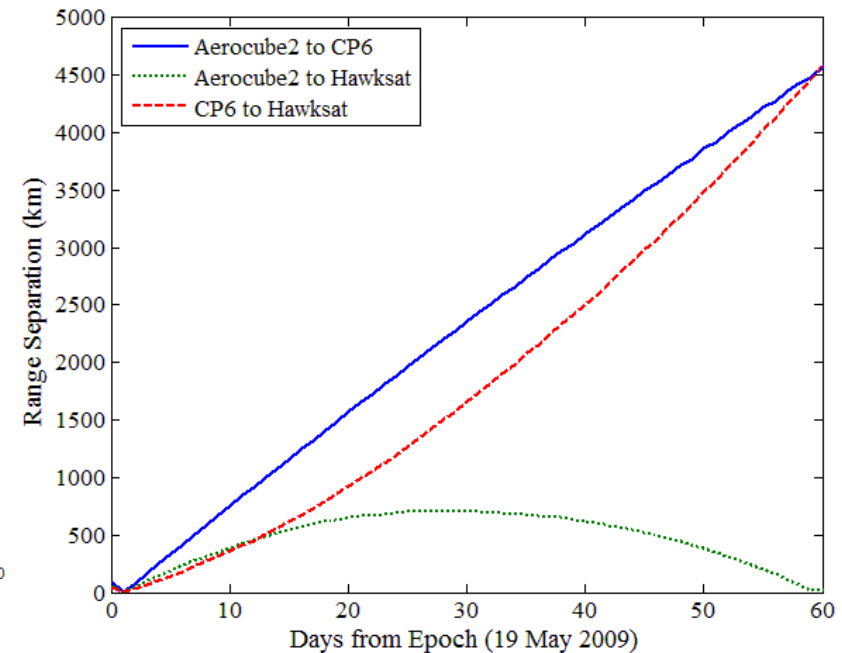
$a = 6.83 \cdot 10^3 km$

1 station, 3 satellites

Individual and Total Network Capacity



Separation of Satellite Pairs

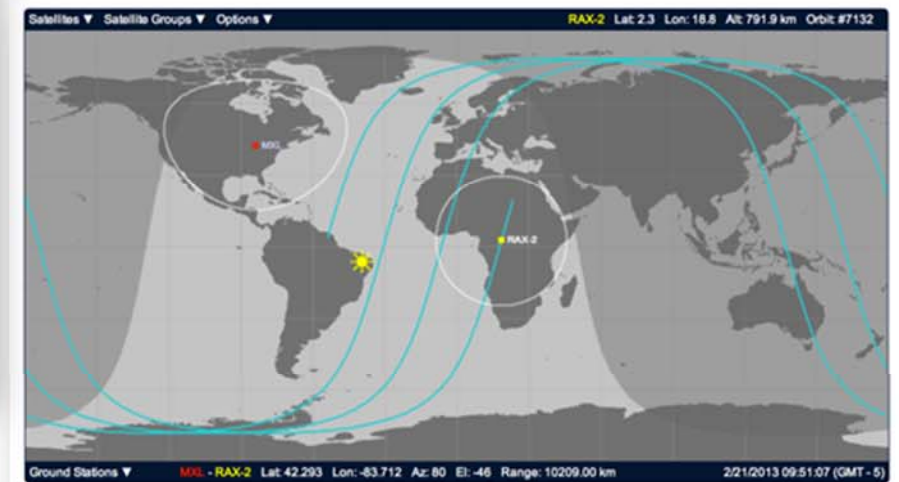
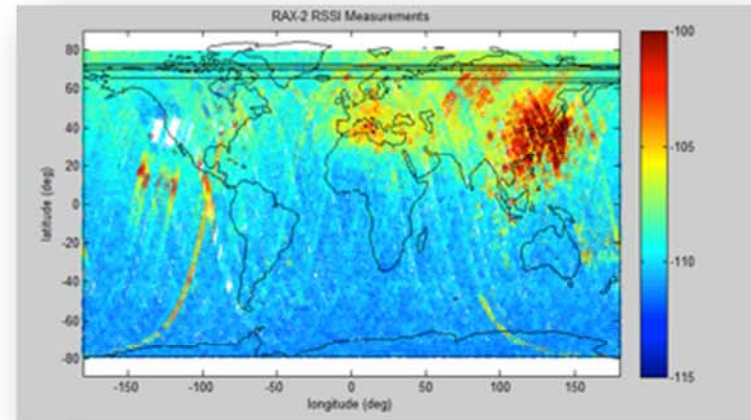


3 satellites from P-POD TacSat3 launch vehicle from Minotaur I
Ann Arbor Ground Station (Latitude: 42.27 N, Longitude: 83.74 W)

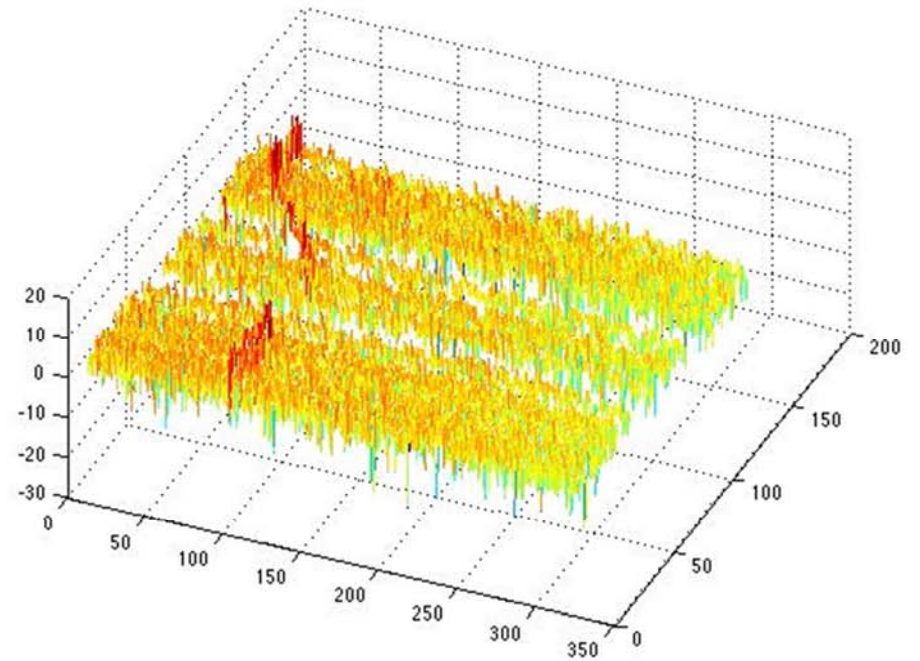
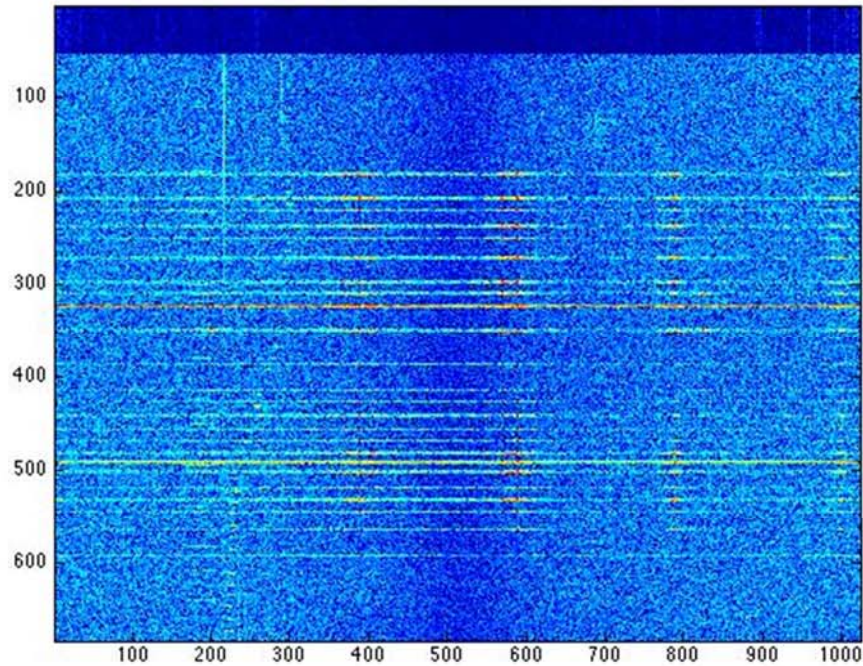
Approach: Federated networks

Can we leverage existing, under-utilized stations to talk to satellites 24/7?

Open source network software to support.



Approach: Automated tracking and ID.



Potential questions for the working group

- Why are people still building their own networks?
- What are the barriers to innovation?
- What challenges should we pose to the CubeSat community?
- How can we enable the CubeSat community to imagine and implement the future?
- Can GSAW help lead the ground ops side of OPSSAT?