

# Arctic Space Weather Research in Alaska



**Bob McCoy**  
**Director, Geophysical Institute**  
**University of Alaska Fairbanks**

[www.gi.Alaska.edu](http://www.gi.Alaska.edu)  
[rpmccoy@Alaska.edu](mailto:rpmccoy@Alaska.edu)



## Major State-owned or University-owned Ionospheric Research Facilities

Suborbital .



Fairbanks ★ PFRR

★ HAARP

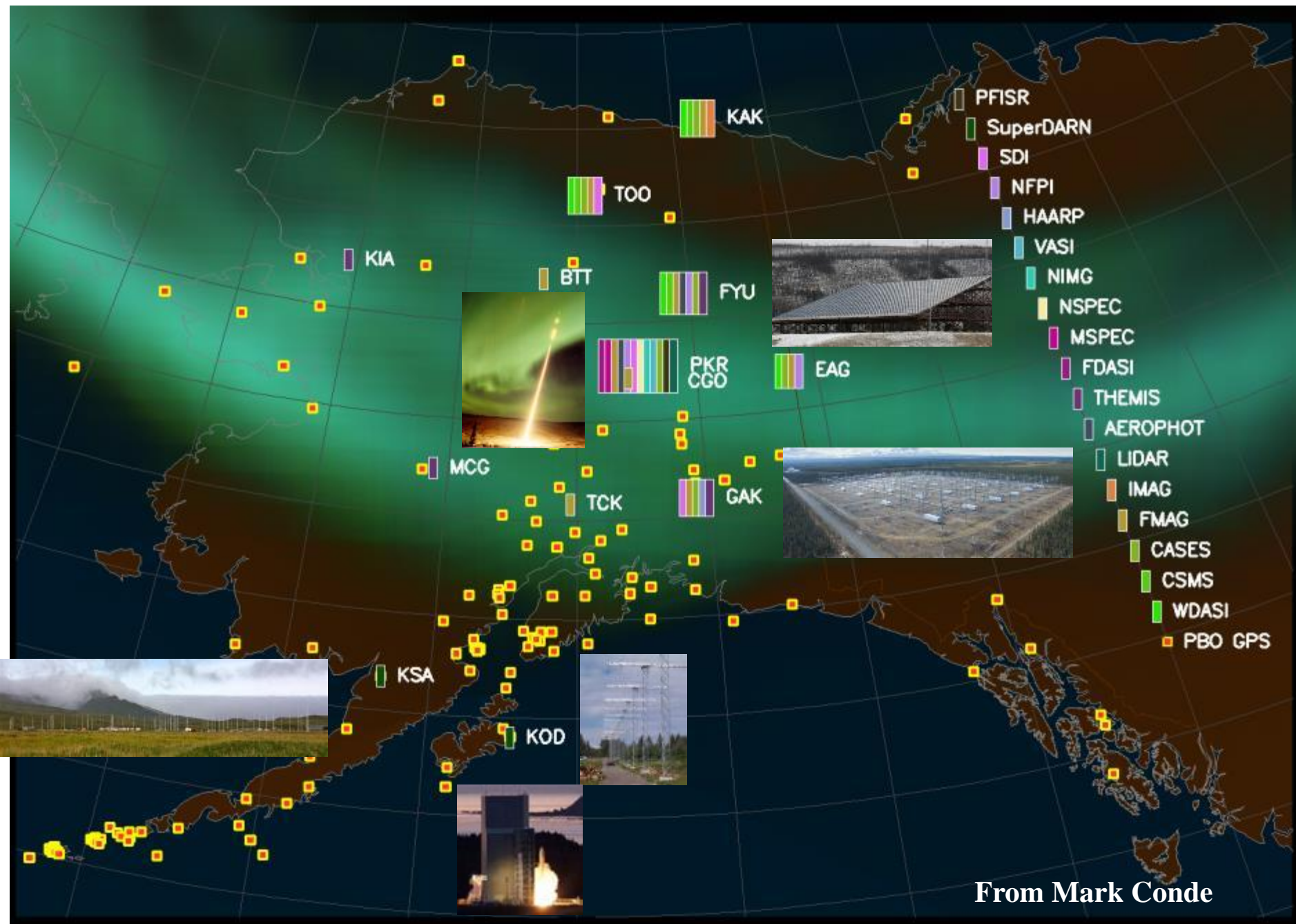


★ PSC-A

Suborbital & Orbital



- Poker Flat Research Range (PFRR)
- High-frequency Active Auroral Research Program (HAARP)
- Pacific Spaceport Complex Alaska (PSCA)



From Mark Conde



# Poker Flat Research Range

**Largest land-based rocket range**  
**Only rocket range owned by a university**  
**35 miles from campus**



**PF Incoherent Scatter Radar**



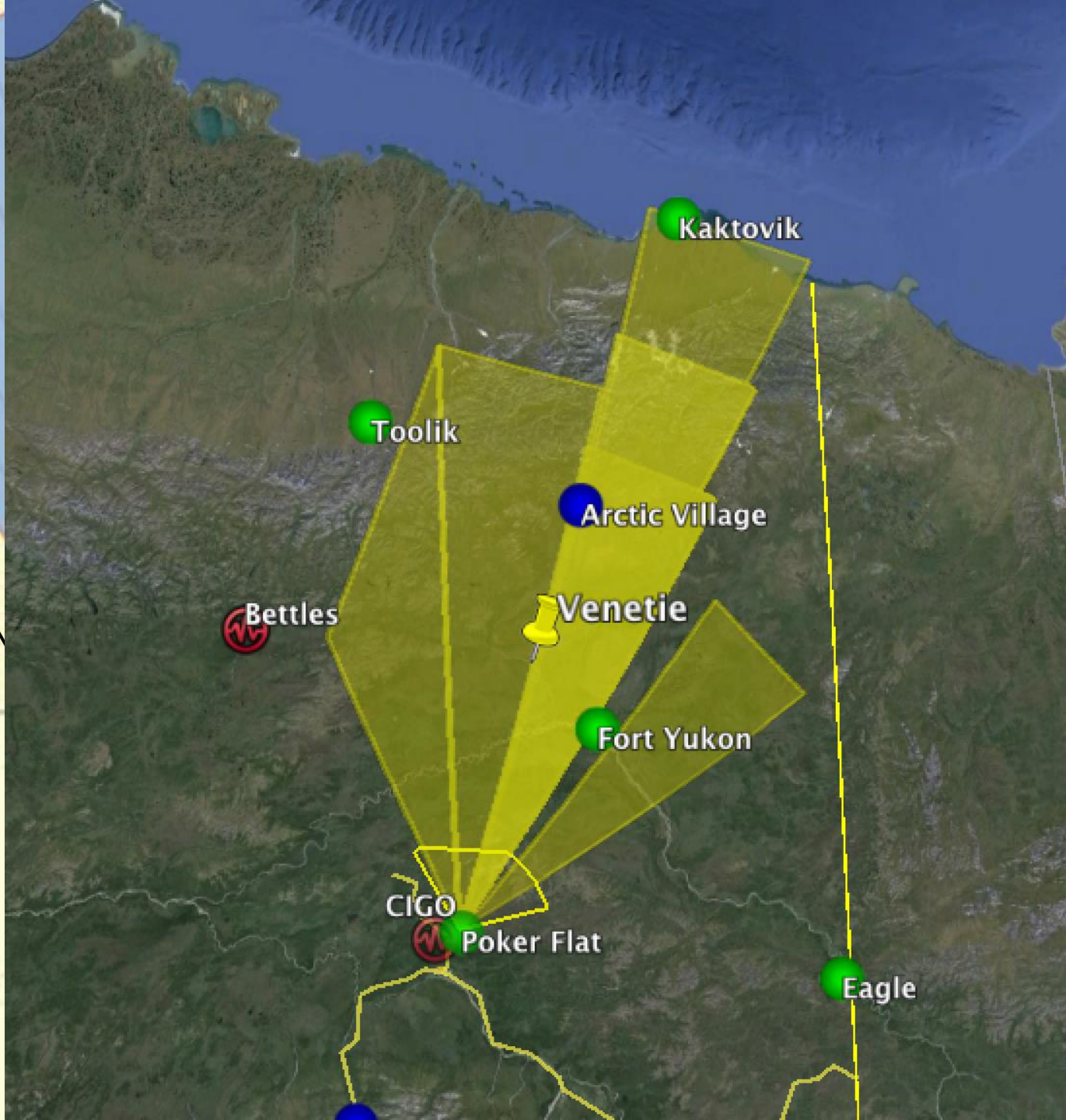


Cameras

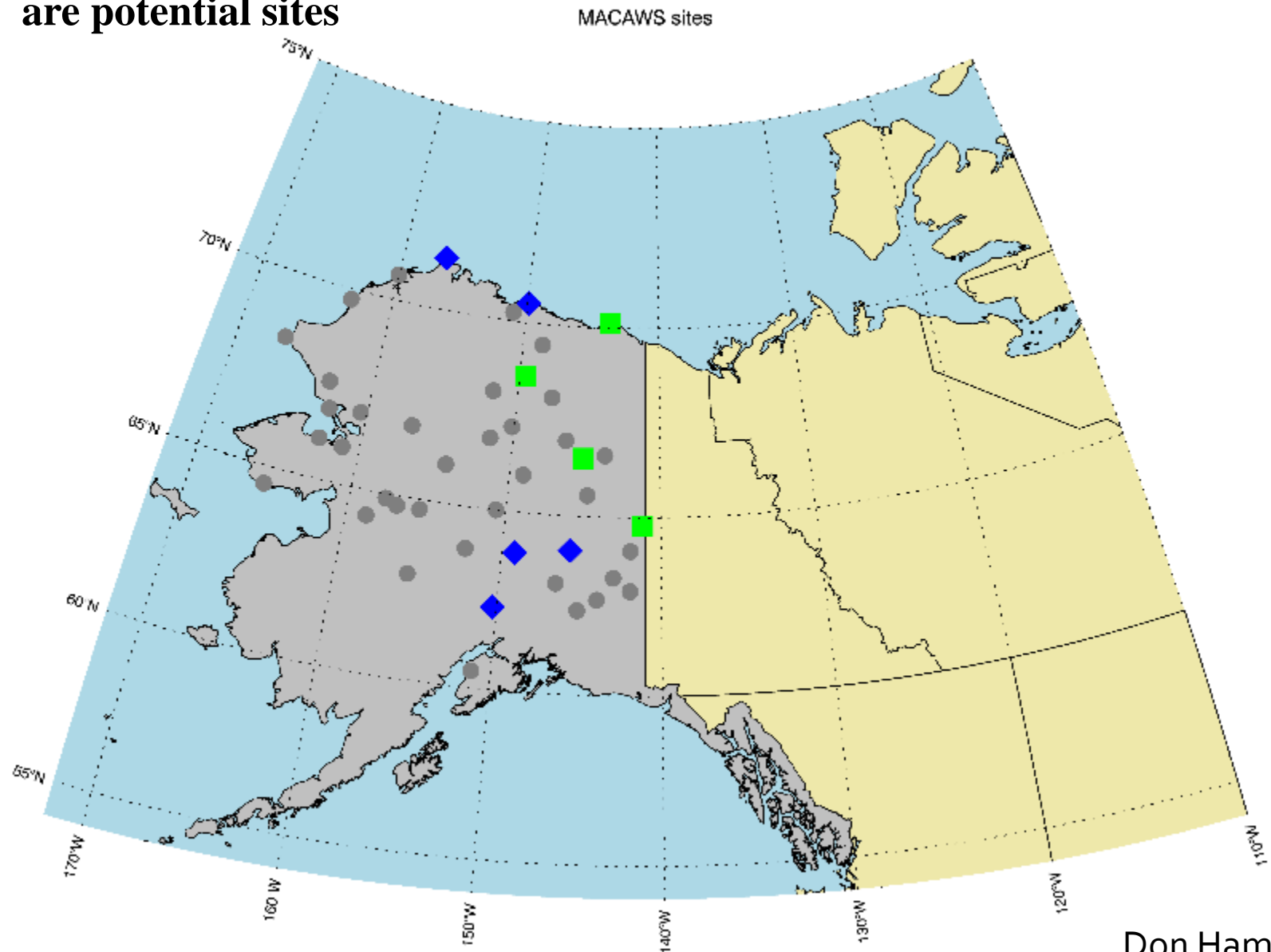
PFISR

SuperDARN

Rockets



**GNSS current status, green already installed, blue upcoming, gray are potential sites**



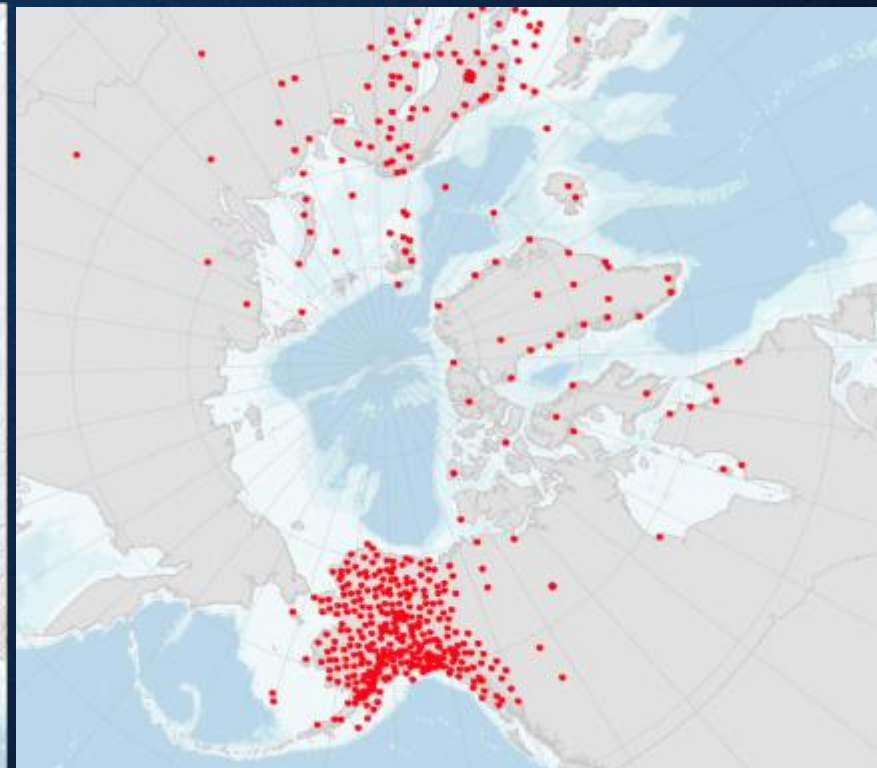
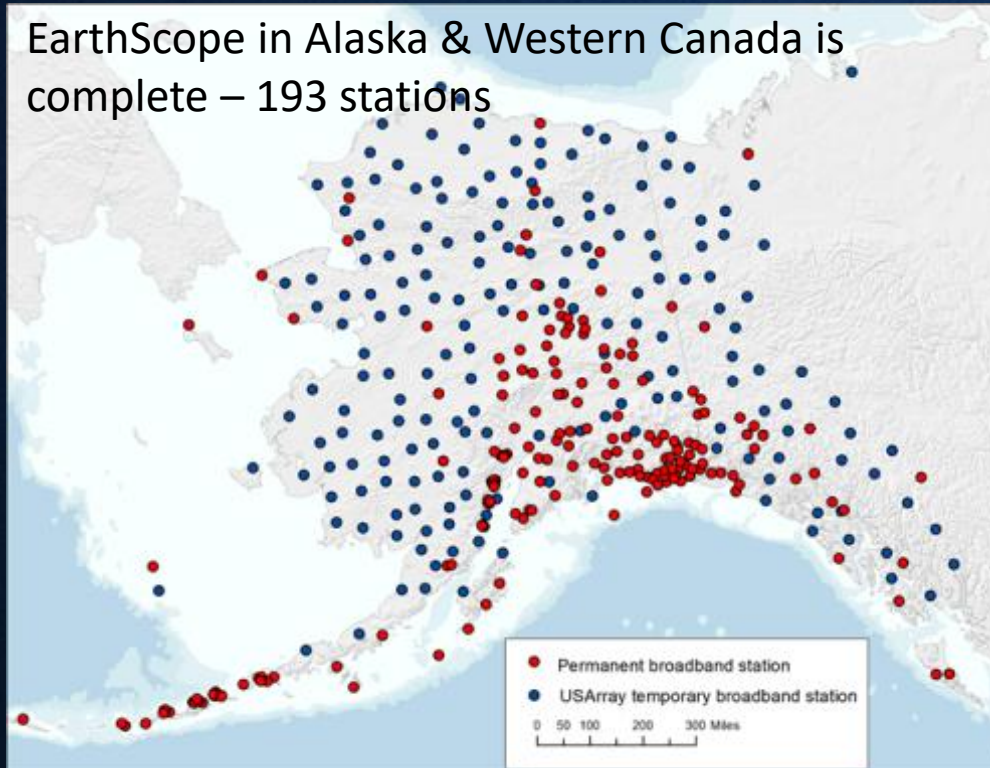
Don Hampton  
Anthea Coster

# Alaska Earthquake Center

*I,D*

- Report ~ 50,000 earthquakes/yr
- 50 earthquakes > M5; 6 > M6; M7 (every other year)
- Publishes Tsunami hazard maps for Alaska

EarthScope in Alaska & Western Canada is complete – 193 stations







**Missile Defense Agency (MDA)  
Long Range Discrimination Radar  
LRDR  
Clear Air Force Station**





# High-frequency Active Aurora Research Program (HAARP) Reaching Out & Touching the Ionosphere



- Gakona AK - 62.39 deg, 145.15 deg (West)
- 33 acre phased HF transmitter array;
- 2.8 to 10 MHz;
- Multiple beams & transmission to 30 elevation angle
- 5 x 3600 hp diesel engines; 3.6 MW;
- \$290M (half Congressional earmarks + half AFRL, ONR & DARPA)

# HF Ionospheric Heating

**ULF, ELF, VLF  
wave injection**

**Heating**

**Duct creation**

**Airglow**

**Wave generation**

**Currents**

**Chemistry**

**Plasma resonances**

**Instabilities**

**Turbulence**

**Rotating  
beams**

**Multiple  
beams**





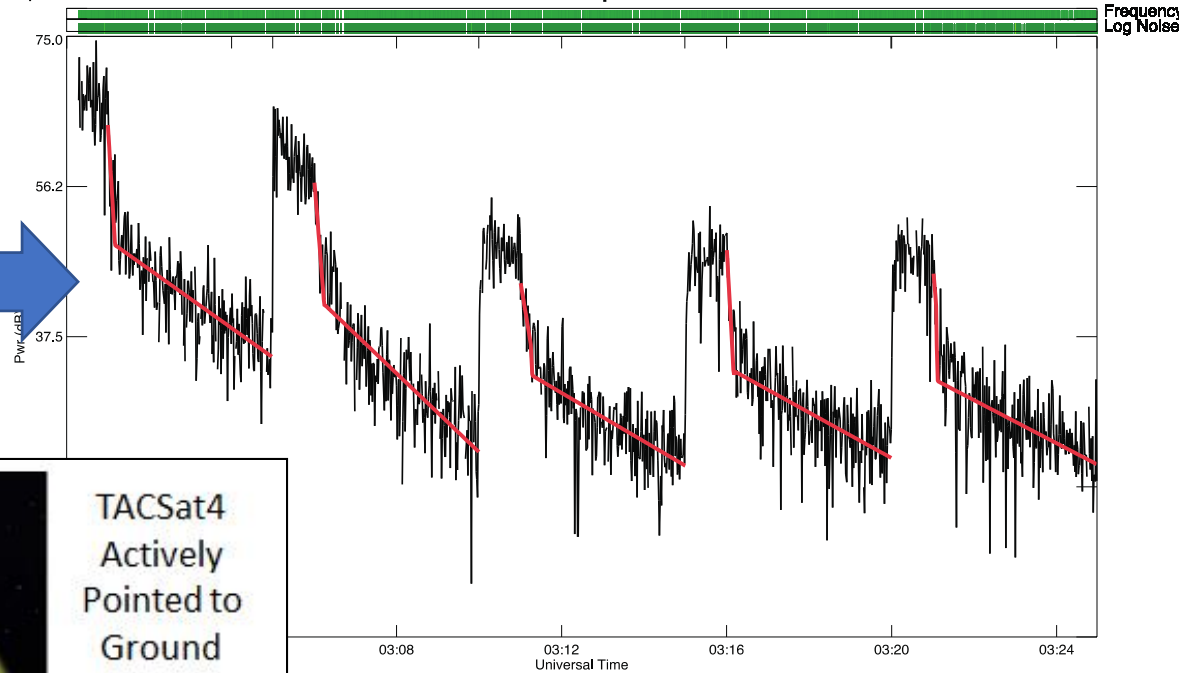
# Previous HAARP Results

**Bristow – Decay rates of scattered power related diffusion of the neutral atmosphere.**

start: 201010300300  
stop: 201010300325

kod : p\_l

beam: 9



COMMX  
Working  
with  
HAARP

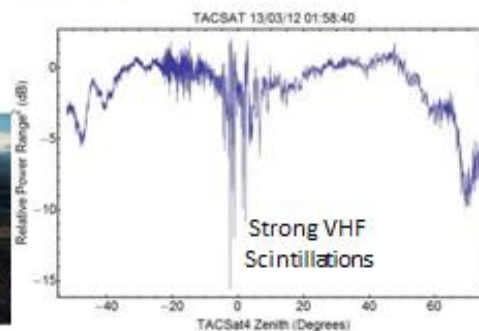


TACSat4  
Actively  
Pointed to  
Ground  
Receiver

Modified  
Region

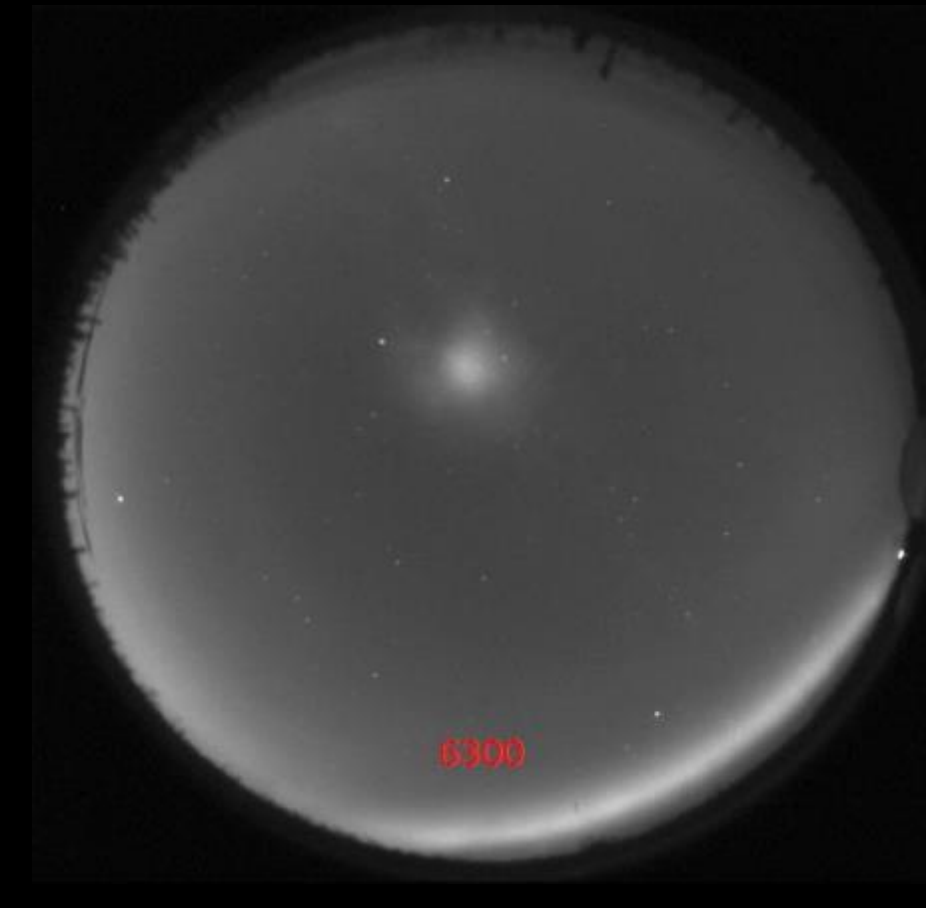
F-Layer Ionosphere

Courtesy Paul Bernhardt  
NRL



**Bernhardt – Triggered scintillation used to sever space-to-ground UHF communication**

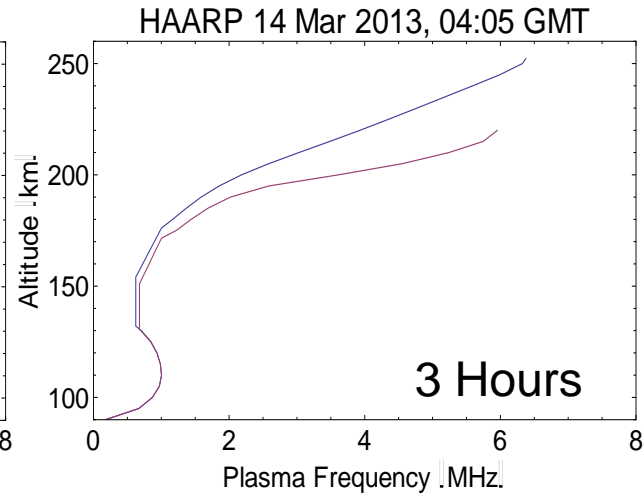
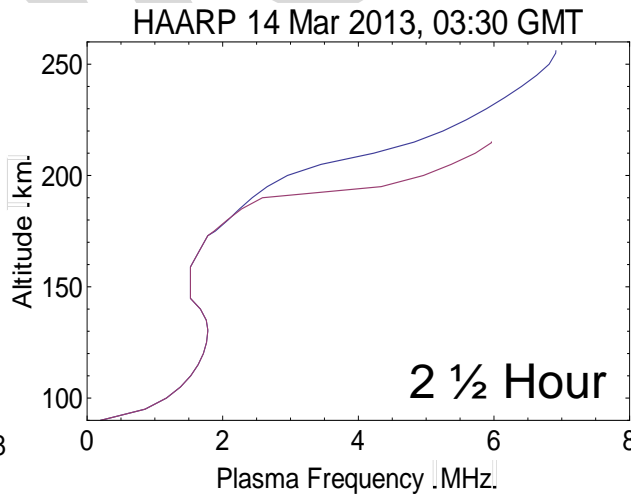
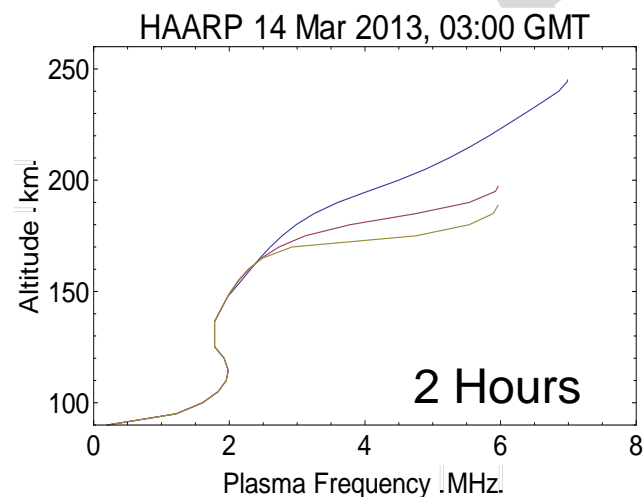
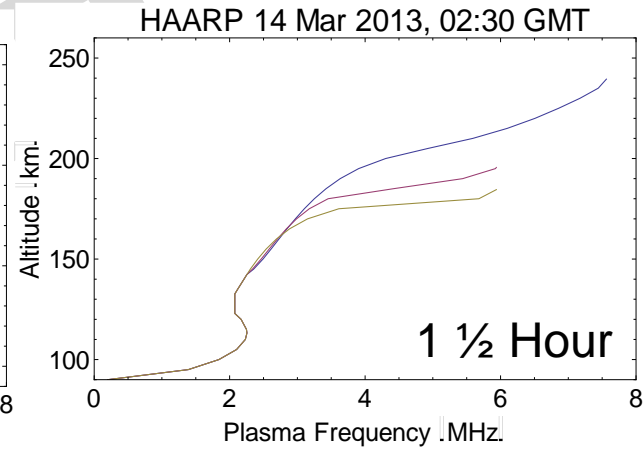
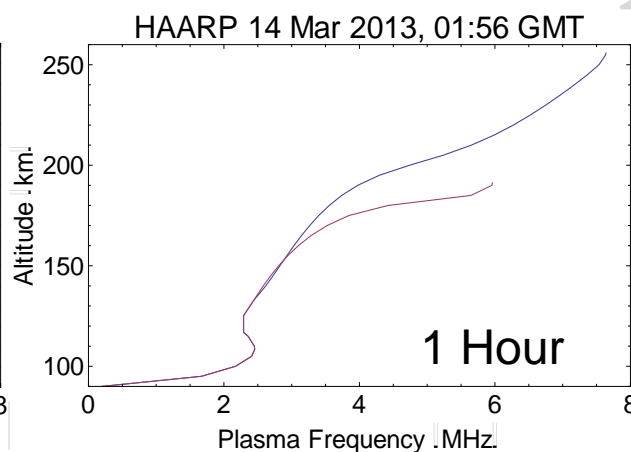
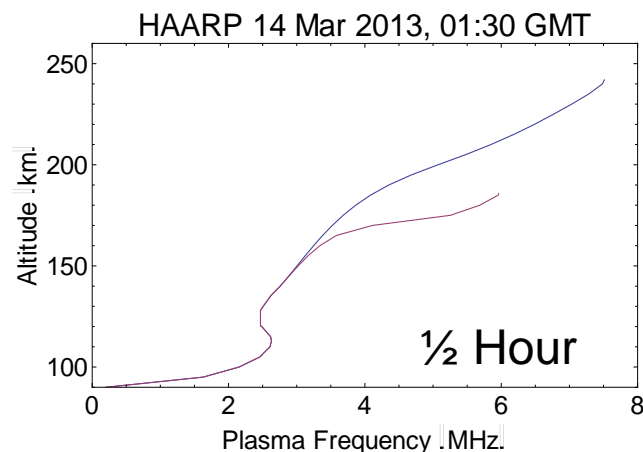
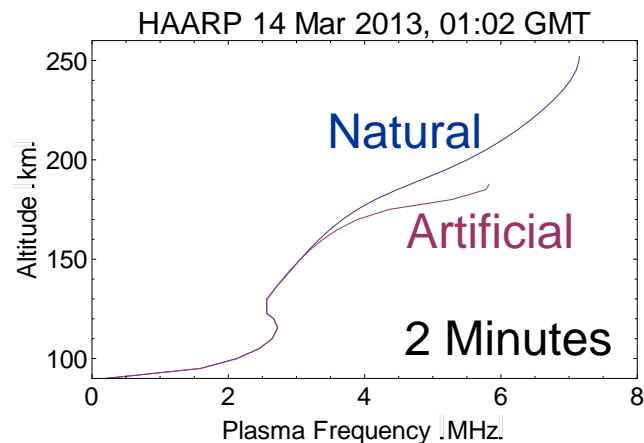
# Chris Fallen Experiment: First simultaneous high-power HF radio aurora and SSTV broadcast, Sep 2017





# 14 March 2013 01:30 to 04:00 GMT Extended Artificial Ionization with 5.8 MHz Twisted Beam

Courtesy Paul Bernhardt  
NRL



8 MHz

## Potential Over the Horizon Radar Coverage with HAARP Phased Array





# Alaska's "Railbelt" Grid

A series of nested and interconnected microgrids

Most of the state has  
isolated microgrids  
Great potential for  
nuclear micro-reactors

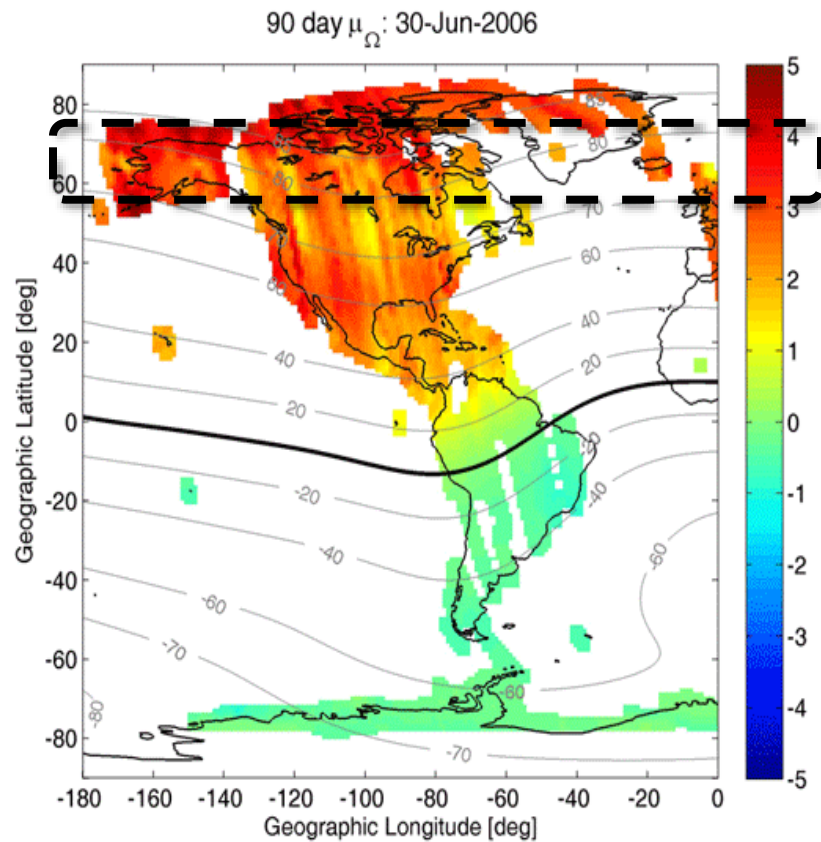


- 6 interconnected utilities
- Battery / flywheel
- Hydro
- Natural Gas
- Landfill syngas
- Coal
- Diesel

George Roe  
Alaska Center for Energy & Power

# Opportunities: SAR as a Source of Ionospheric Information

Continental-Scale information on average ionospheric behavior



Ionospheric parameters from ~750,000 L-band images



**Alaska  
Satellite  
Facility**







**ALASKA**  
**AEROSPACE**  
CORPORATION



Thanks, questions?

