

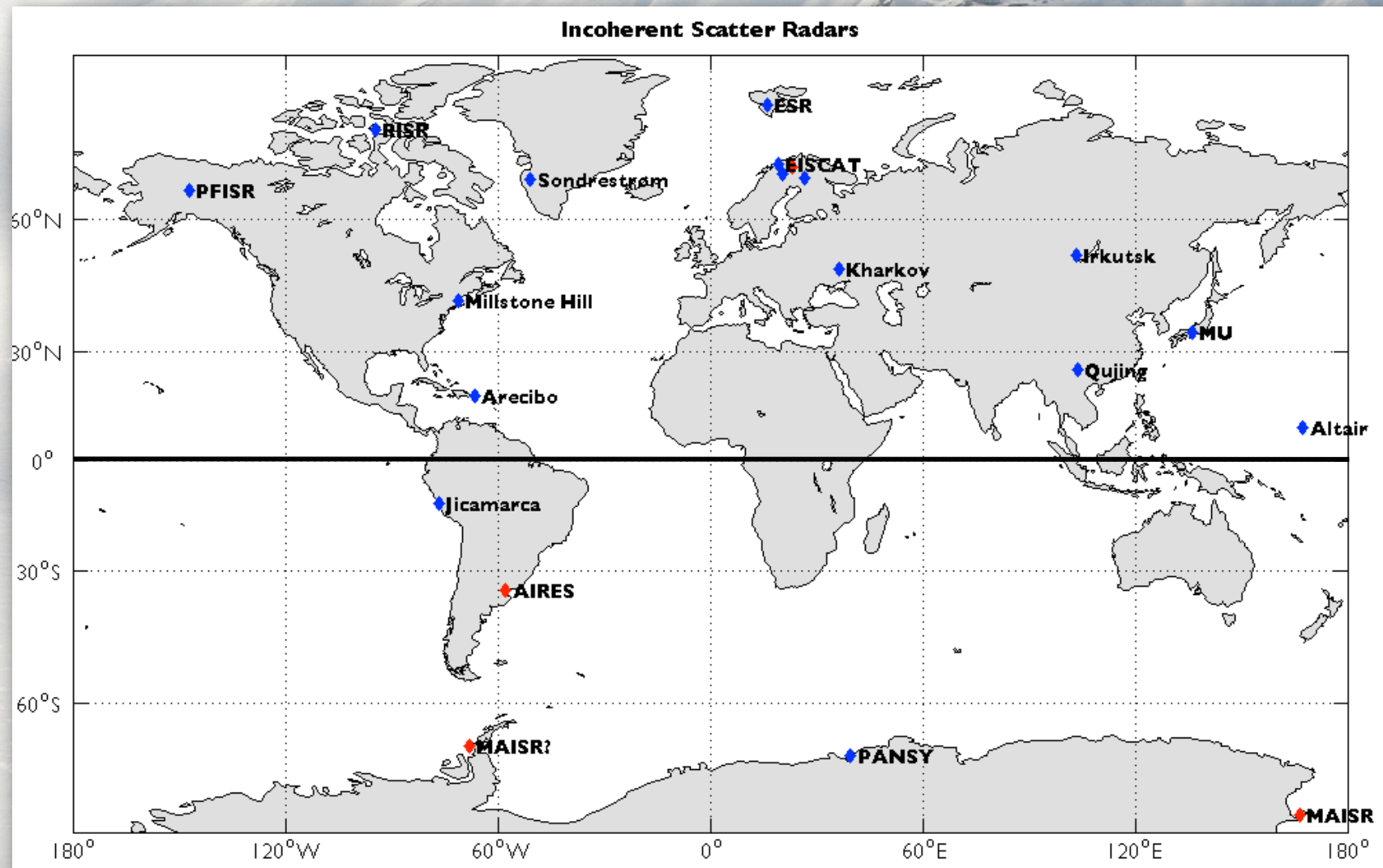
EISCAT

Scientific Association

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Sodankylä, Finland
thu@sgo.fi

• www.eiscat.se • www.eiscat3d.se

Incoherent Scatter Radars



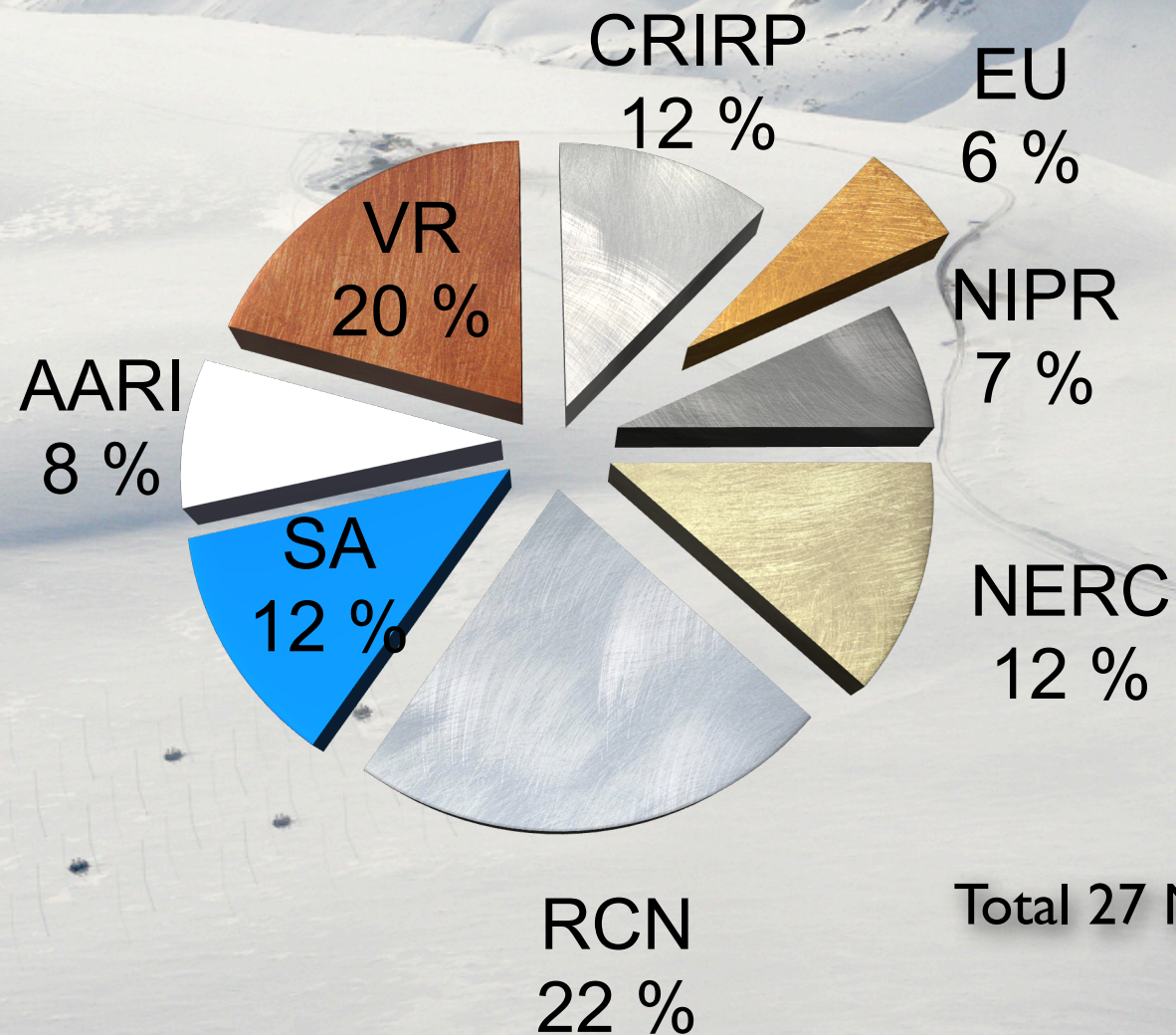
EISCAT

- Originally: ~~European~~ Incoherent SCATter.
- Since 1975.
- Operates 3 ISRs.
- Locations: Tromsø (NO), Kiruna (SE), Sodankylä (FI), Longyearbyen (Svalbard).
- Founding members: UK, DE, FR, NO, SE, FI.
- Members (2012):
UK, NO, SE, FI, JP, CN (+RU, FR, (UA)).
- August 2011: 30 years of measurements.



Photo: Thomas Ulich.

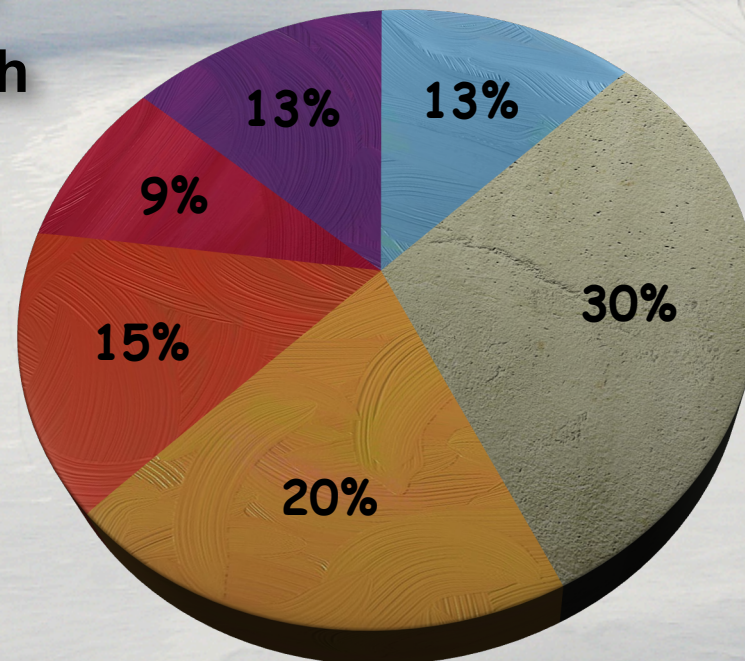
Budget 2012



Total 27 MSEK $\approx$ 3.2 M€

Operations 2012

- Total operating hours, incl. passive, 3124 h
- Common Programme 1200 h
- Special Programme 1200 h
- Time-buyer 174h
- **Peer-review 200h**



You can get Radar Time!

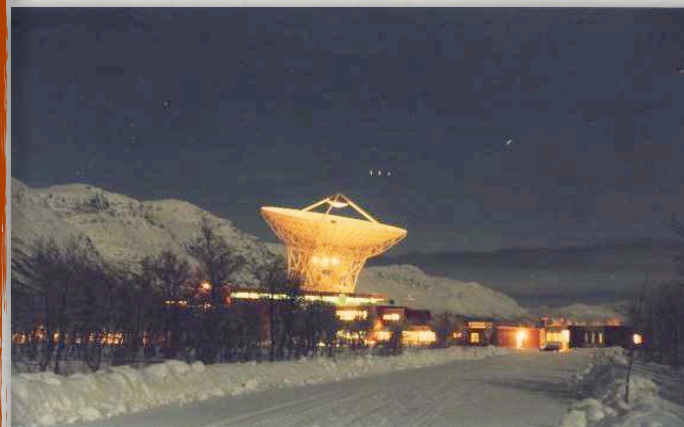
- EISCAT Peer-Review Programme
- EISCAT sets aside 200 hours of radar time per year (at the moment)
- Everyone can apply
- Decisions based on merit.
- If equal merit, new users and new countries have priority.

Next deadline anticipated
1st November 2012

ISRs, Heater, Dynasondes

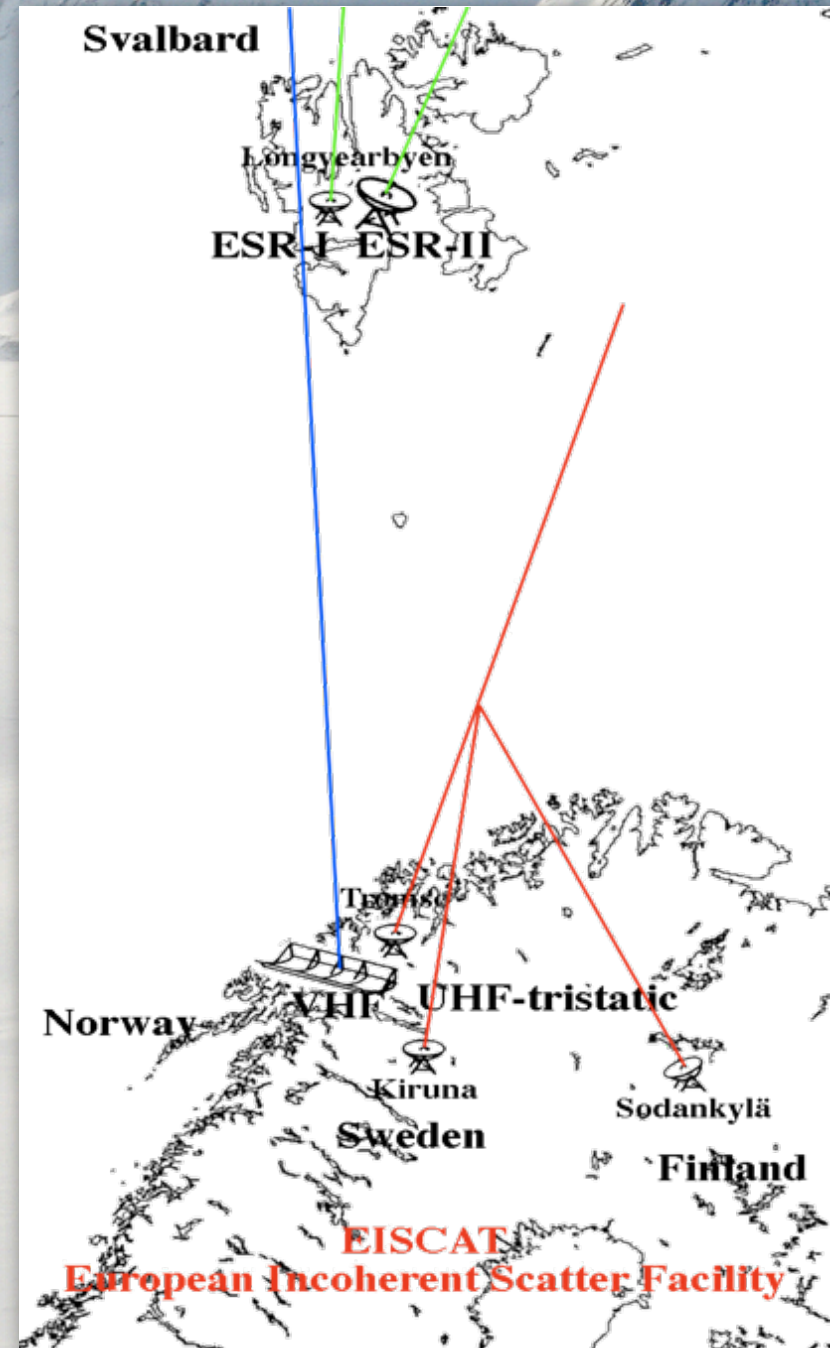


Tristatic UHF, 930MHz



Current EISCAT installations in Northern Scandinavia and Finland

Unique: tristatic IS radar!



Tri-static Data

Kiruna

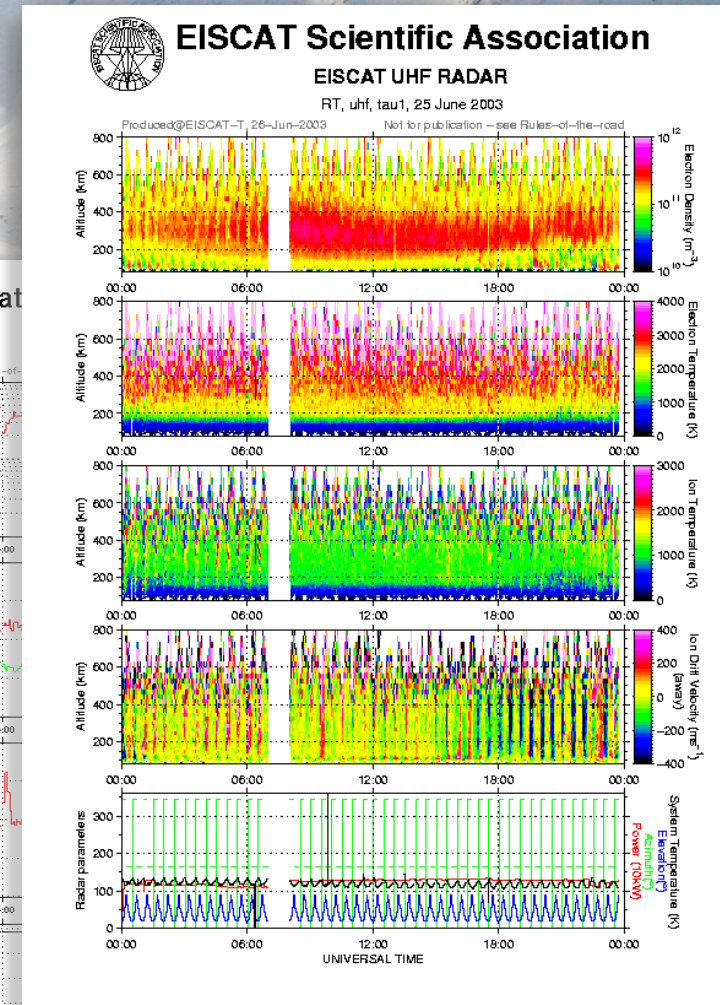
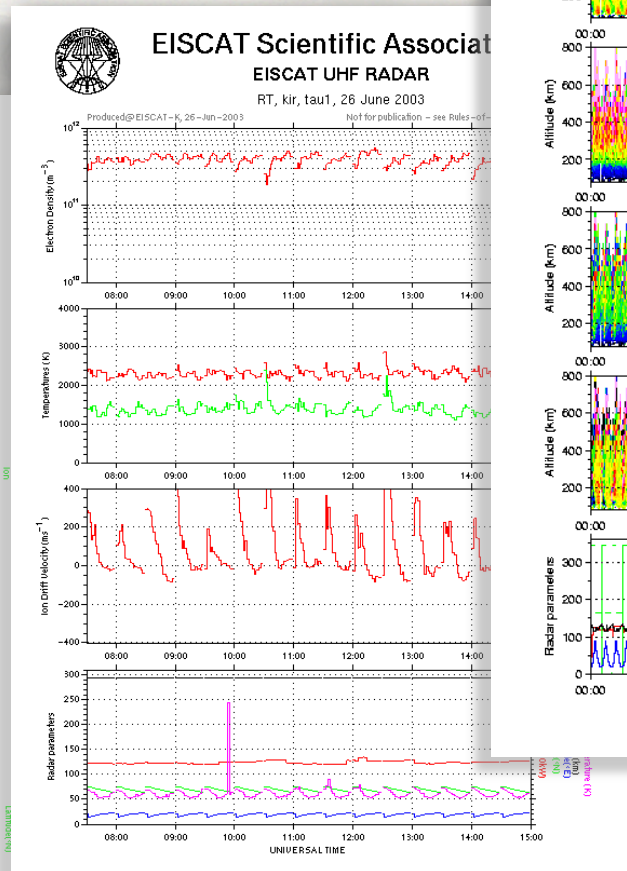
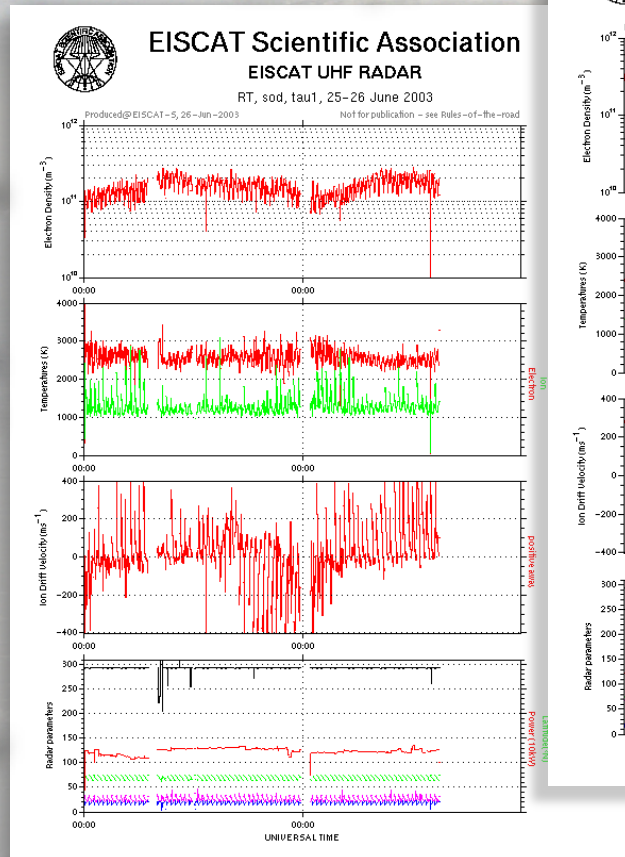
Sodankylä

Ne

Te
Ti

v

par



Tromsø

Ne

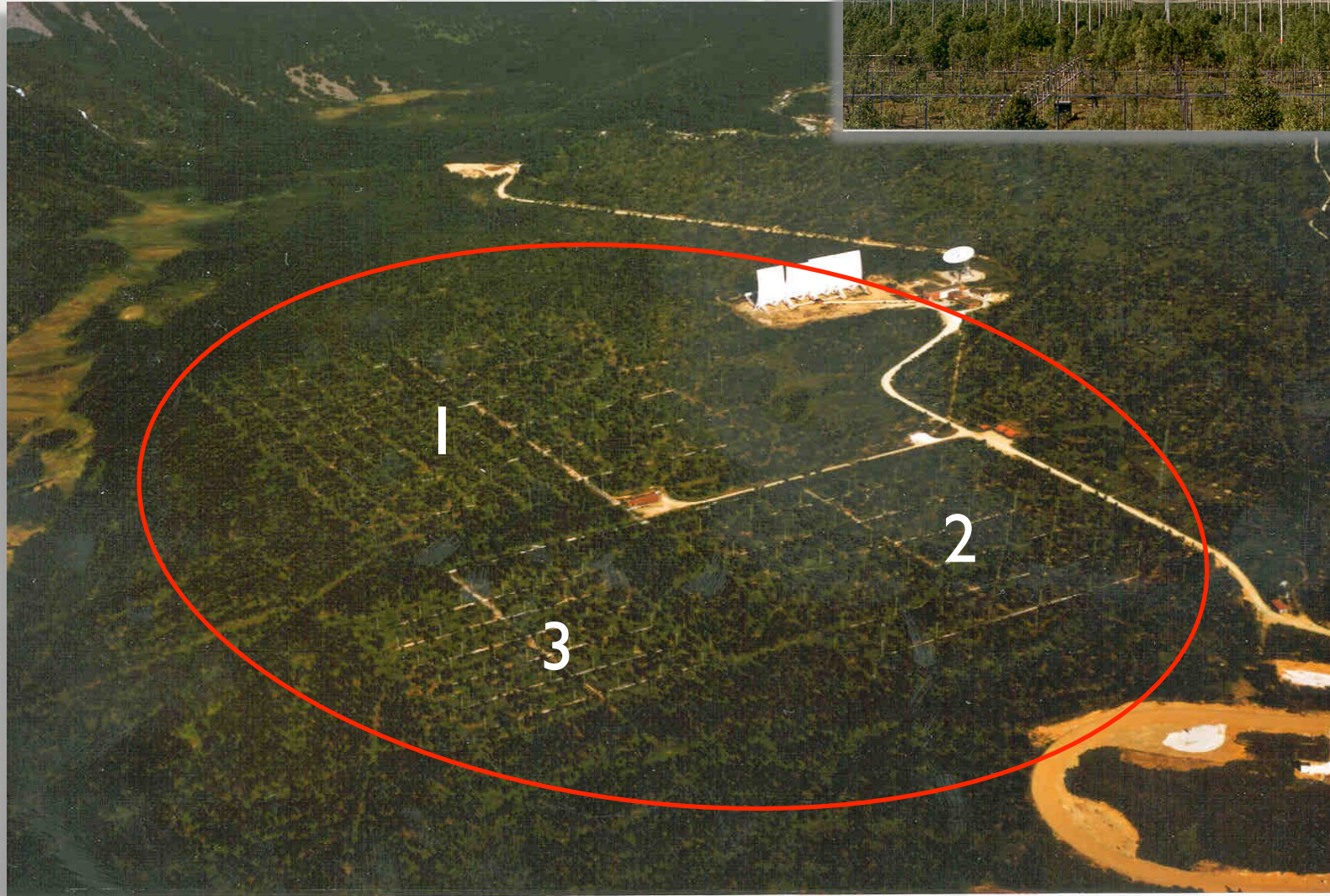
Te

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v

par

Ionospheric Heater 4-8 MHz



EISCAT VHF

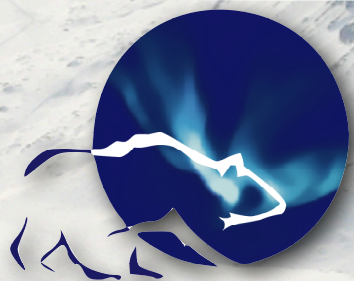




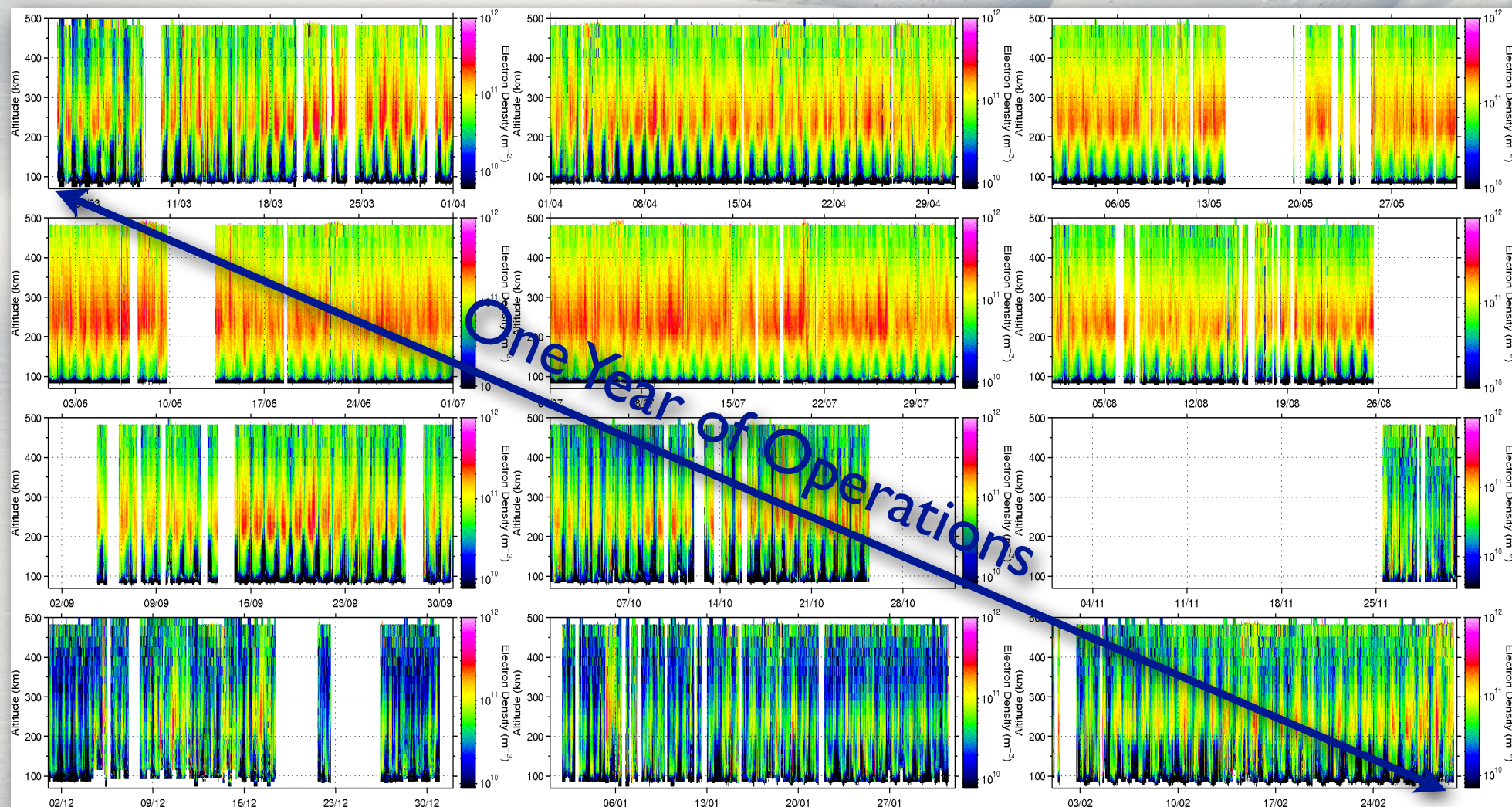
EISCAT is so sensitive that it could “see” this easily...
before it leaves its base in America.



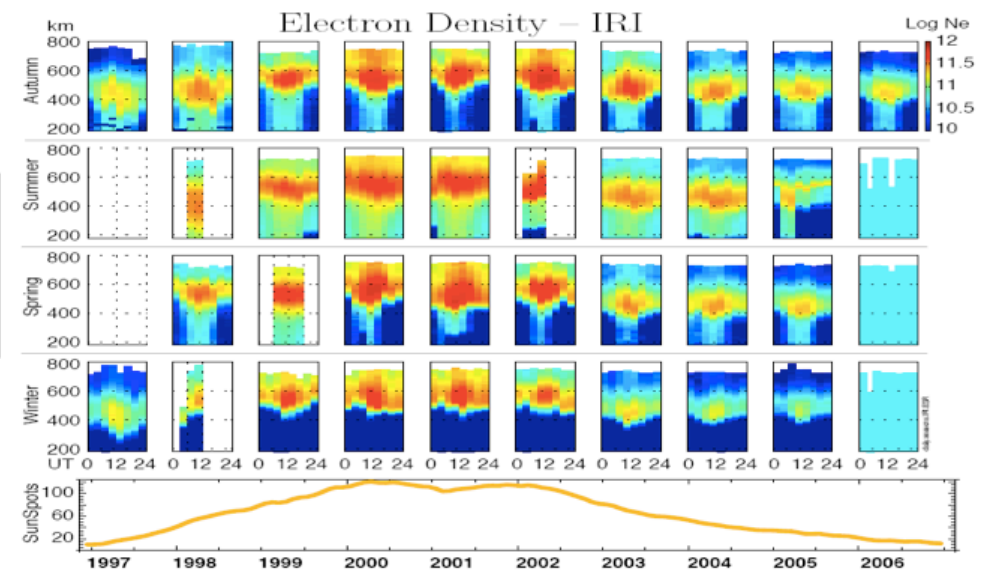
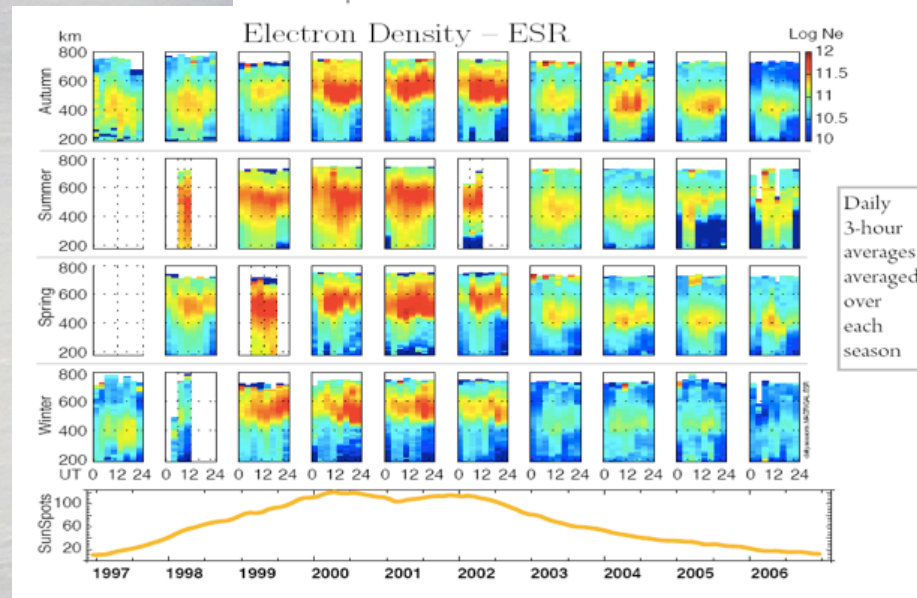
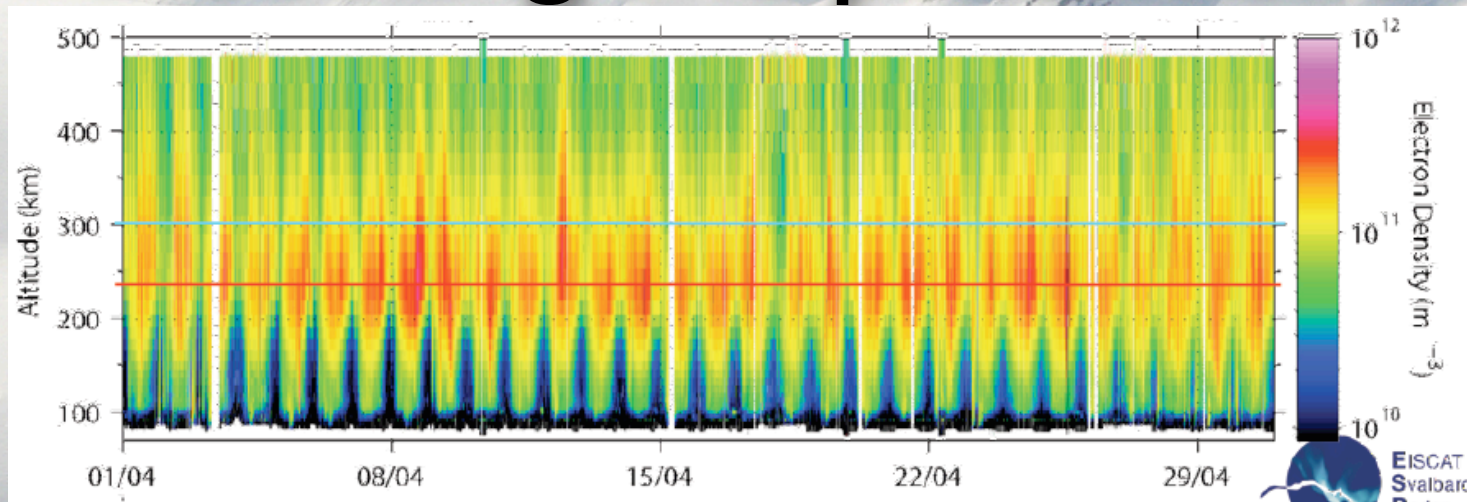
“Seeing” this thing will be considerably more difficult!



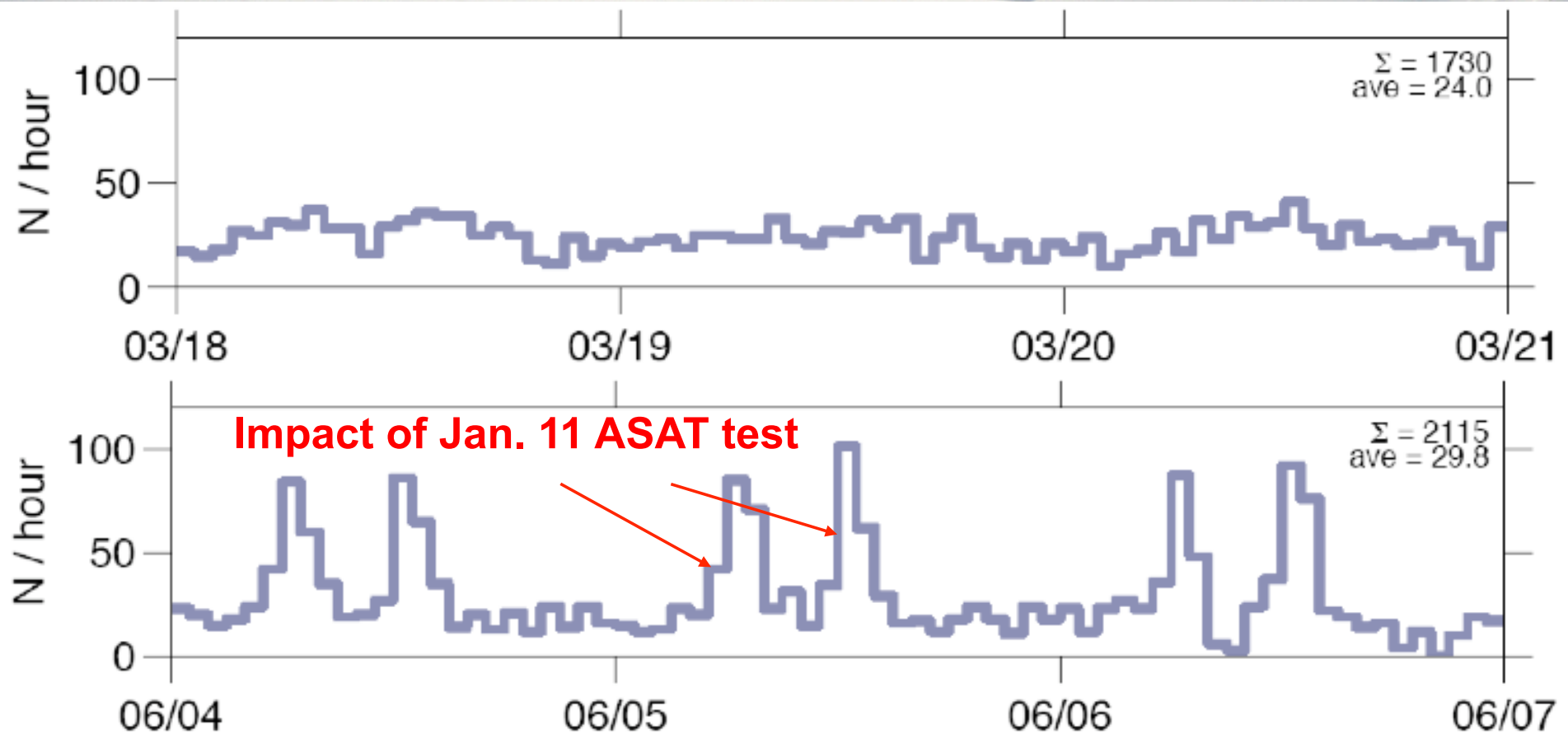
EISCAT Svalbard Radar



Space Weather: Modelling and predictions



EISCAT & Space Debris



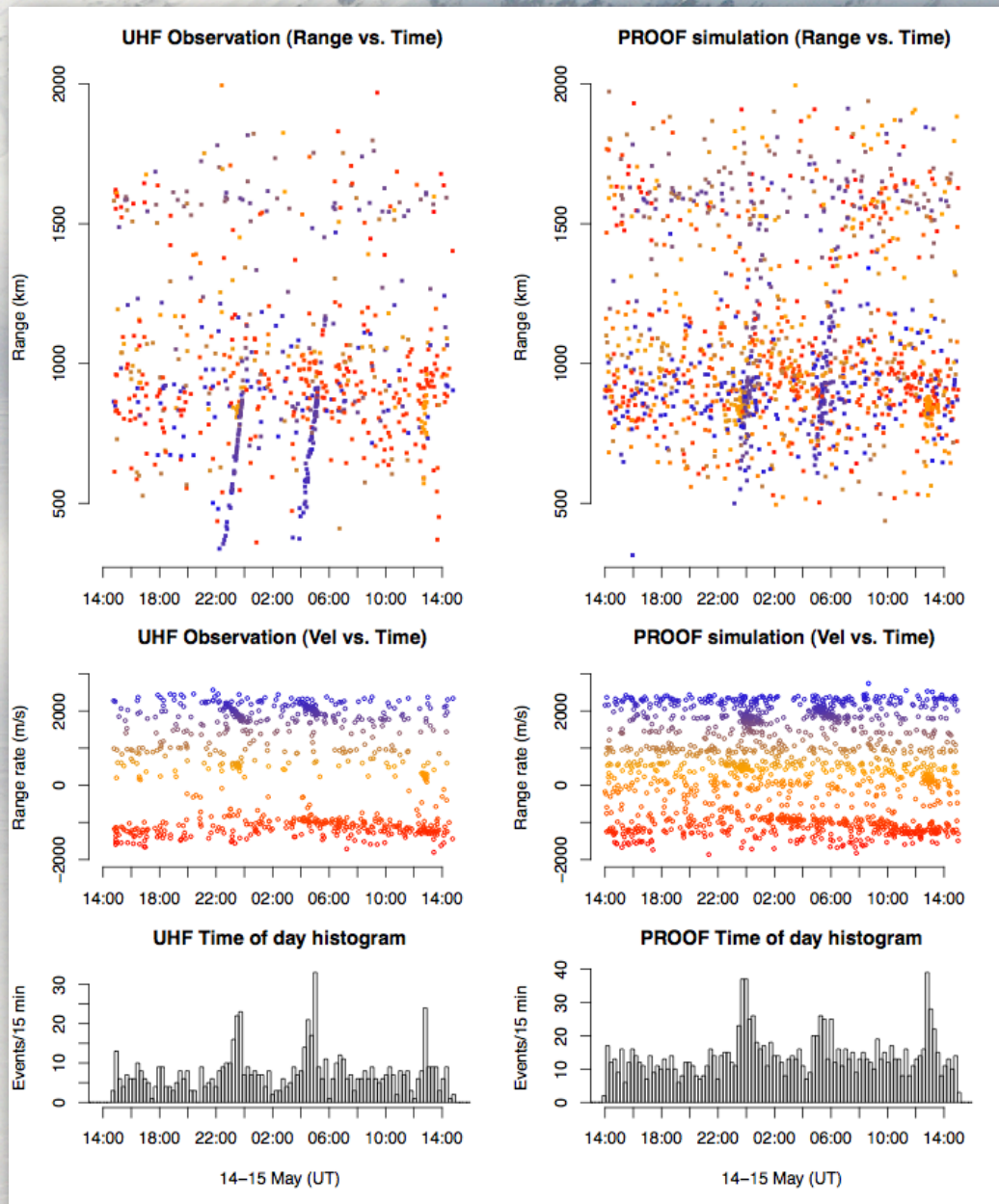
11 Jan 2007, Chinese anti-satellite missile test taking down Fengyun weather satellite.

Iridium-Cosmos Collision seen by EISCAT UHF radar



What happens when an unstoppable object hits an
indestructible barrier?

Here: 1.7 g Al sphere of 1.2 cm Ø at 6.8 km/s.

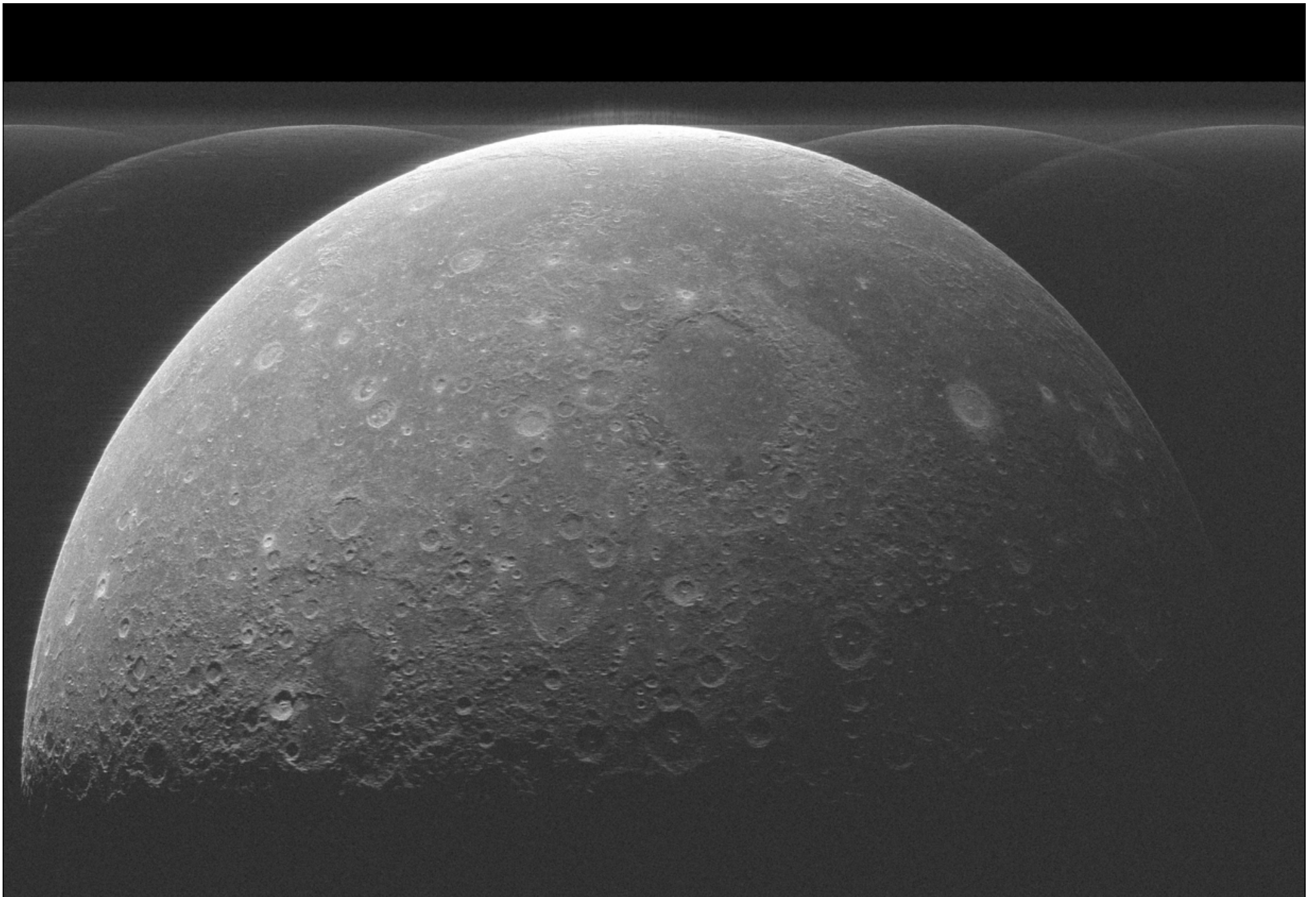


(Courtesy J Vierinen et al., 2009)

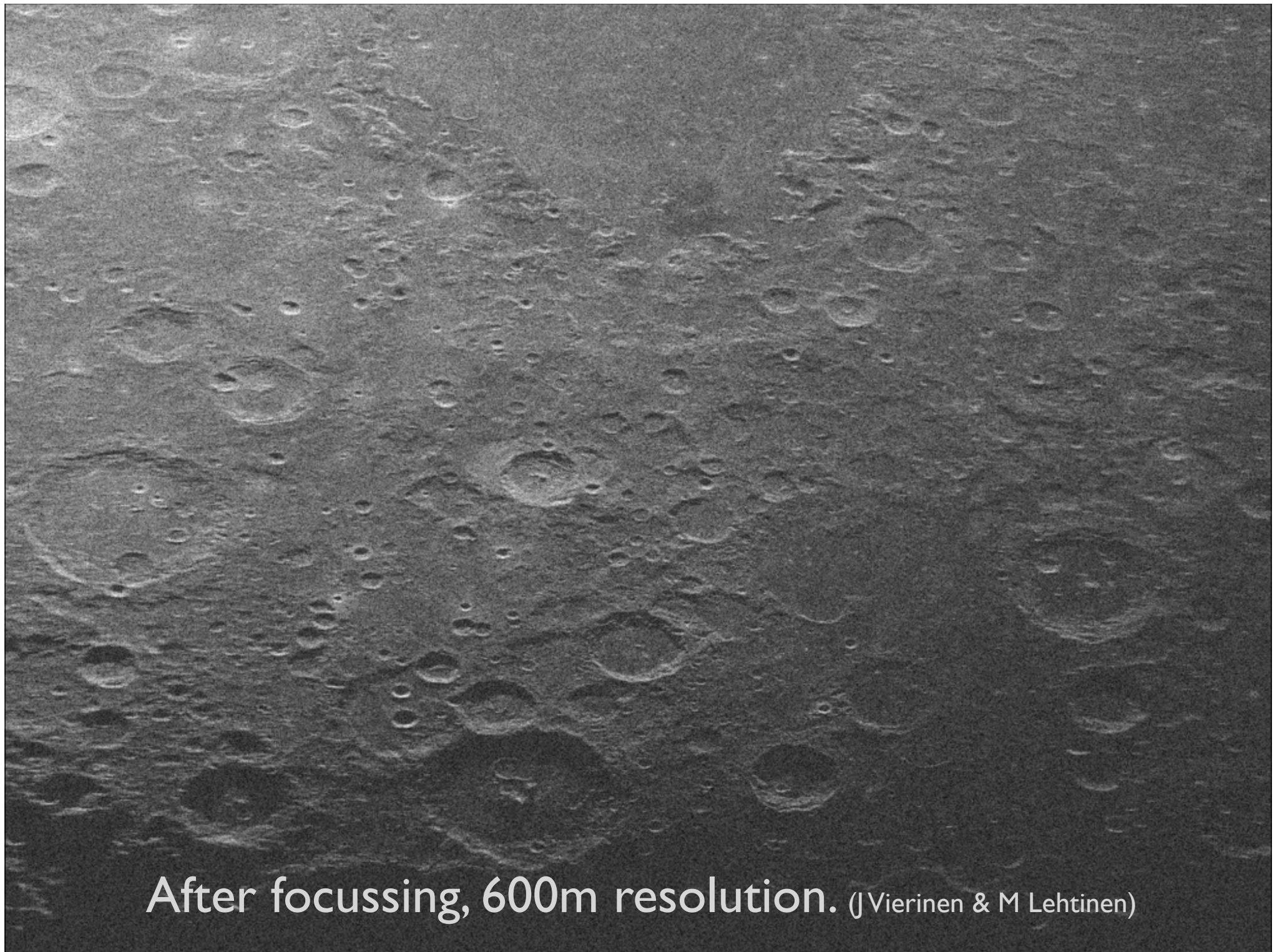


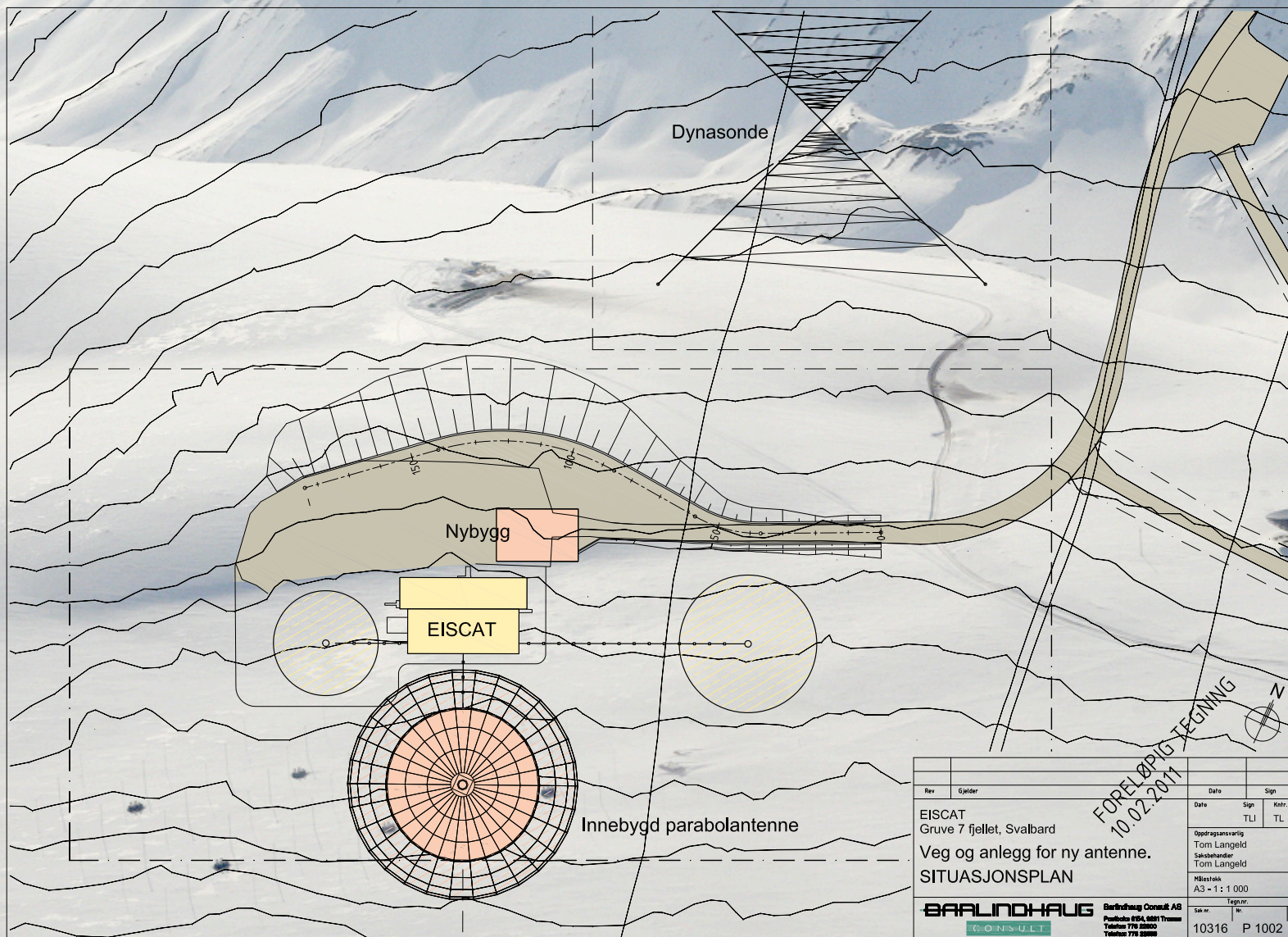
EISCAT Reaching for The Moon

Credits: Juha Vierinen and Markku Lehtinen, Sodankyla Geophysical Observatory, Finland



First radar image of the moon by EISCAT (J Vierinen & M Lehtinen)





Rev	Gjelder	Date	Sign	Kont.
			TLI	TL
EISCAT		Oppdragsansvarlig		
Gruve 7 fjellet, Svalbard		Tom Langelid		
Veg og anlegg for ny antenne.		Saksbehandler		
SITUASJONSPLAN		Tom Langelid		
		Målestokk		
		A3 - 1 : 1 000		
		Tegn.nr.		
		10316 P 1002		
		Rev.		

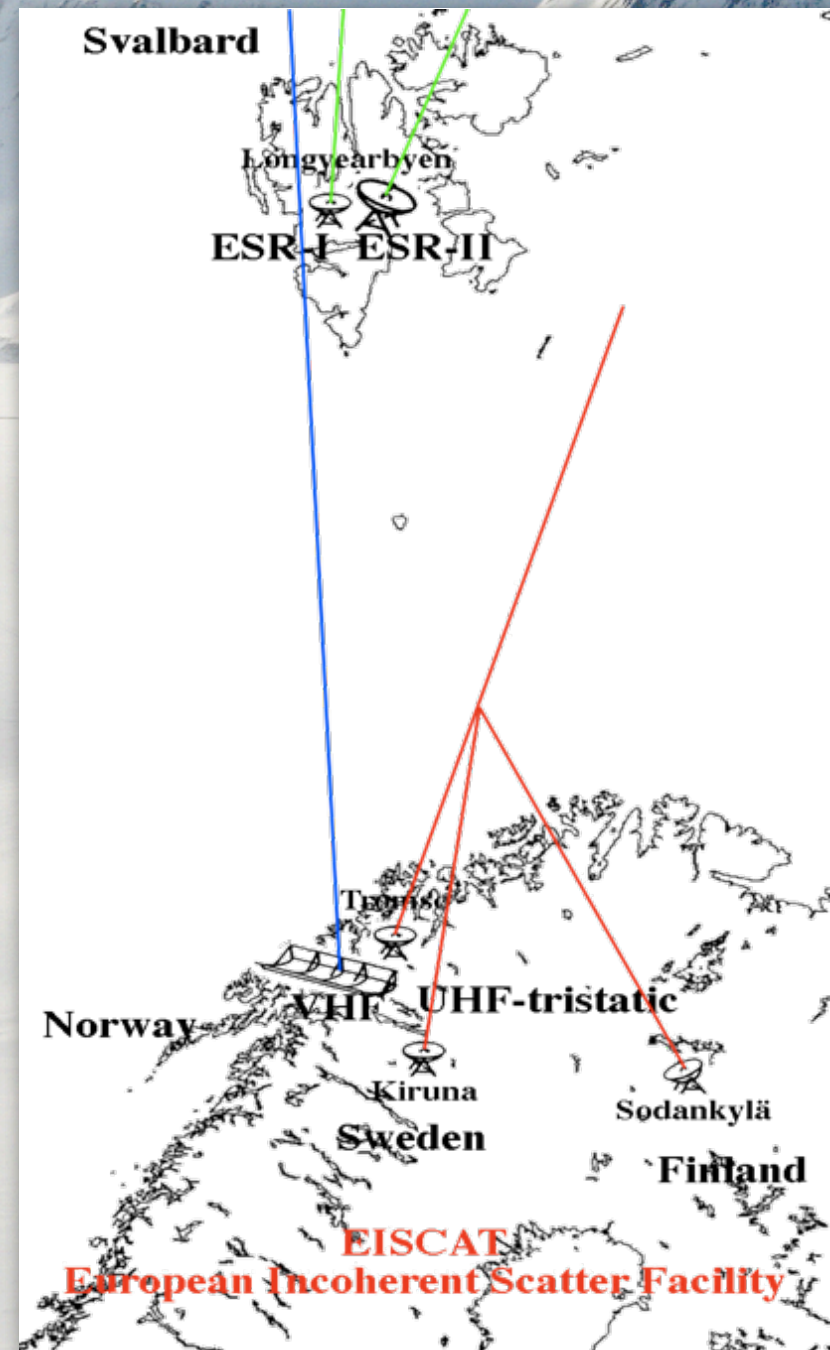
BARLINDHAUG
CONSULT

Barlindhaug Consult AS
Postboks 654, 6001 Tromsø
Telefon 776 28800
Telefax 776 28806

Unique: tristatic IS radar!

But: UHF at 930 MHz; now too much GSM interference.

Also: single point 3D only, leading to space-time ambiguities.



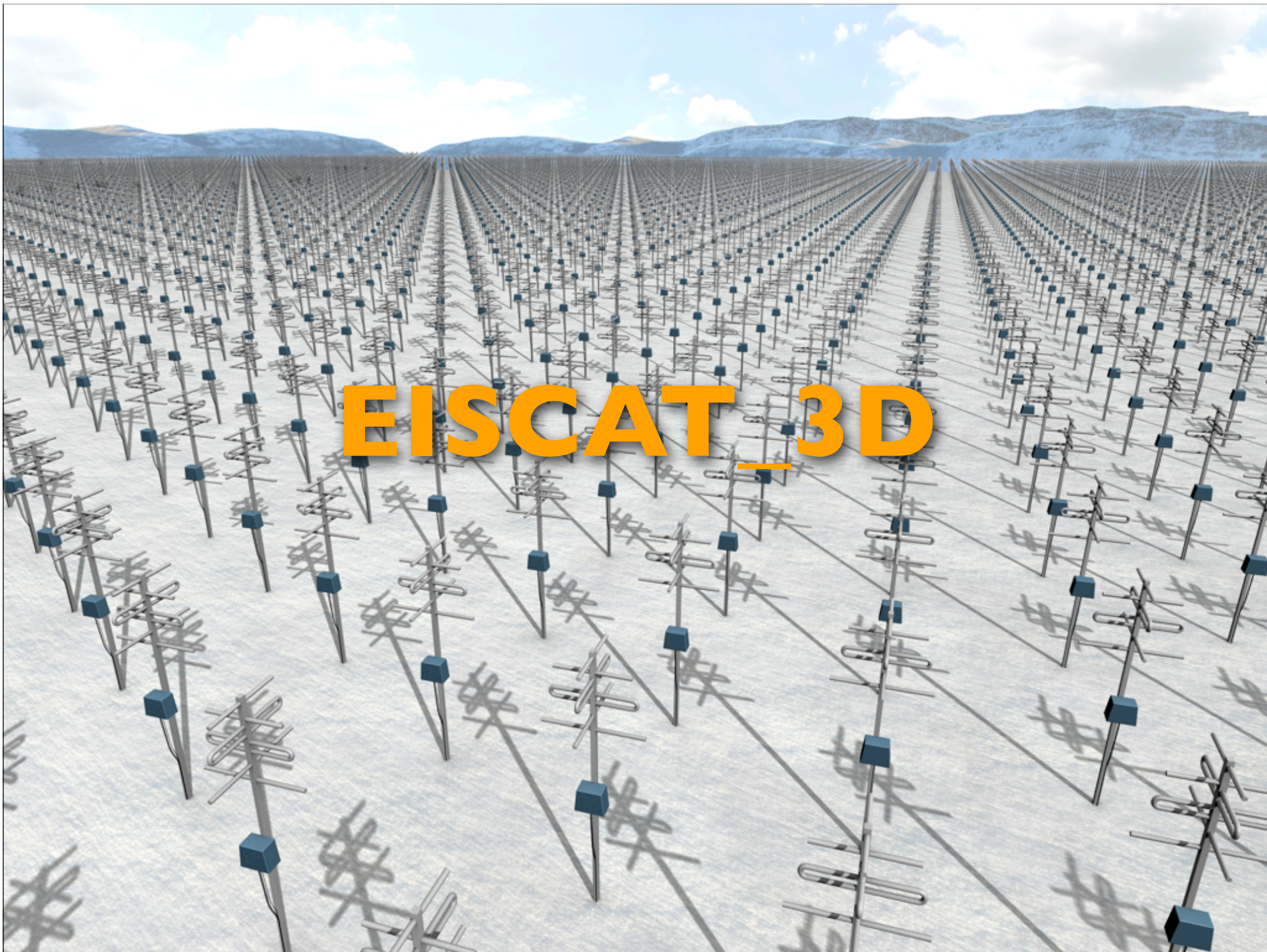
A photograph of a dirt path winding through a rocky, grassy landscape. The path is marked with tire tracks and footprints. The terrain is covered in green grass and scattered dark rocks. In the background, a small body of water is visible. The text "Where to go from here?" is overlaid in white, bold font in the center of the image.

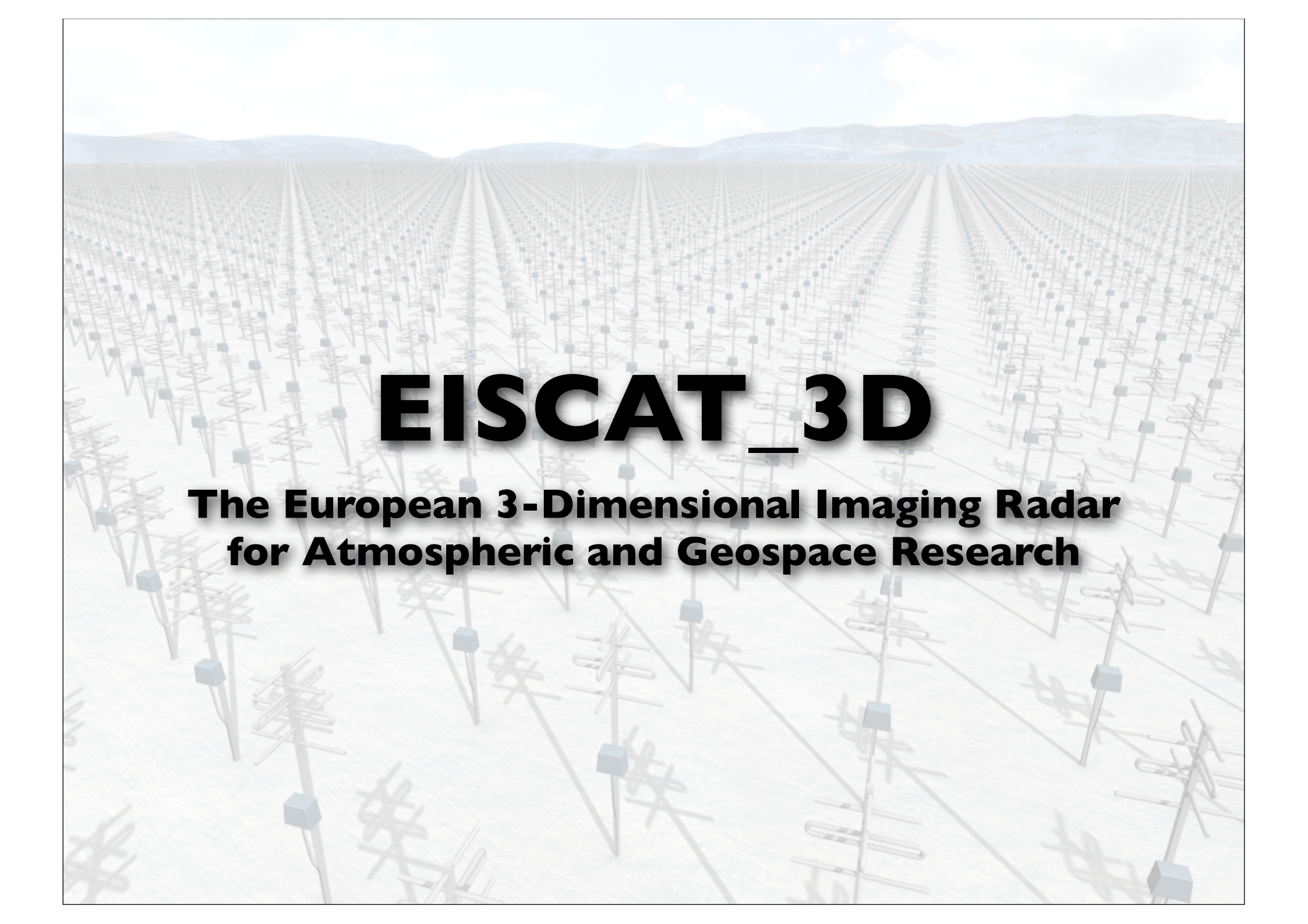
Where to go from here?

Conversion UHF–VHF



Replace small mirror with a dipole ring feed for 224 MHz.



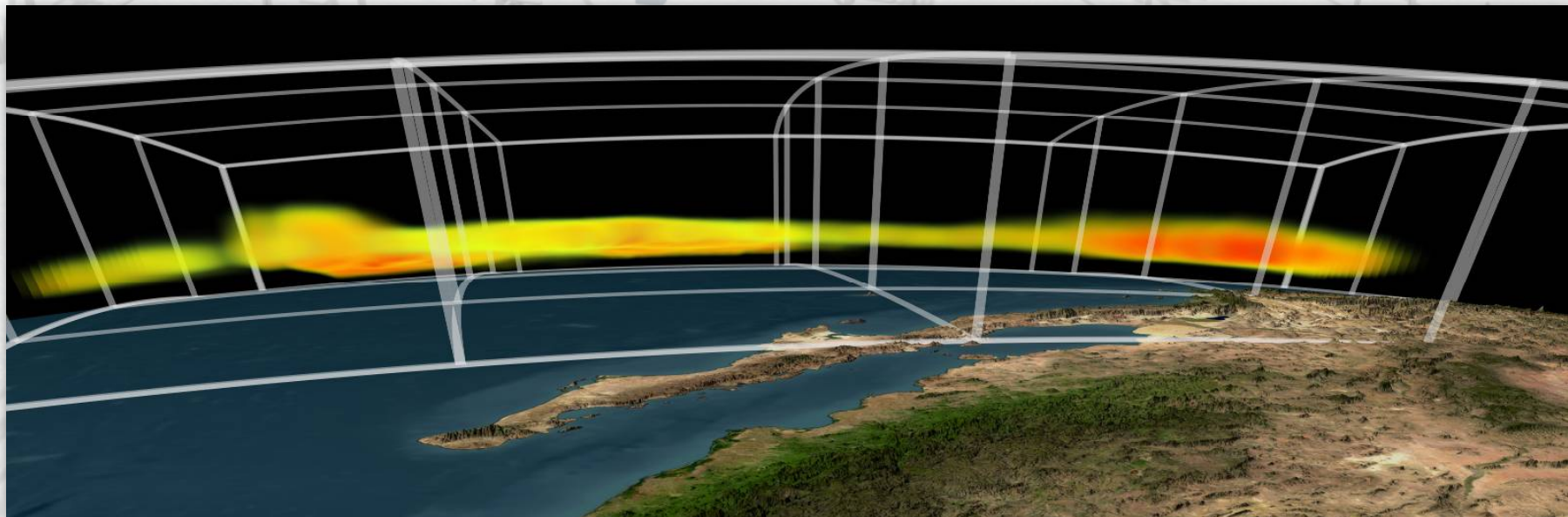
A wide-angle, low-perspective shot of a vast field filled with hundreds of radar antennas. The antennas are arranged in a precise grid pattern, stretching far into the distance towards a range of low mountains under a bright, slightly cloudy sky. Each antenna consists of a vertical pole with a horizontal cross-arm and a small blue square sensor at the end. The perspective creates a strong sense of depth and scale.

EISCAT_3D

**The European 3-Dimensional Imaging Radar
for Atmospheric and Geospace Research**

EISCAT_3D - The Idea

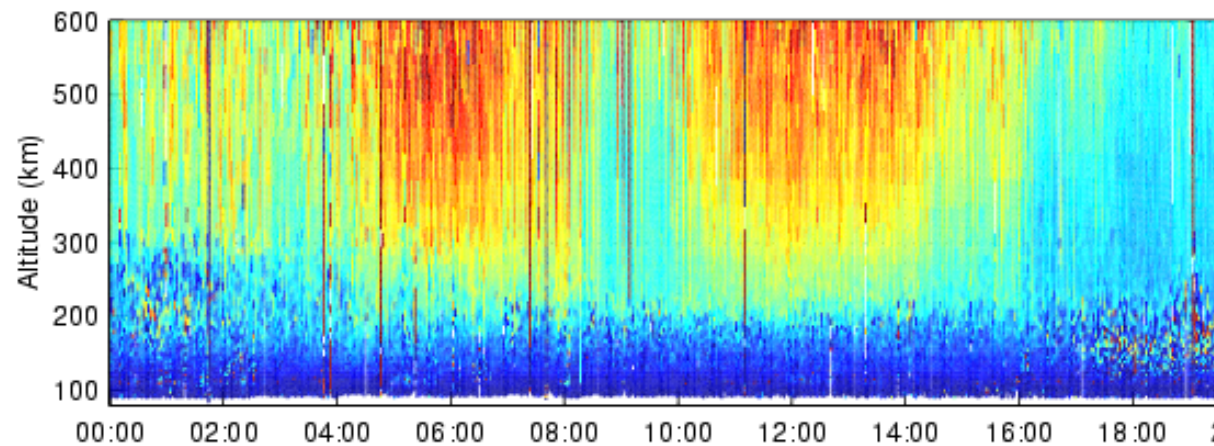
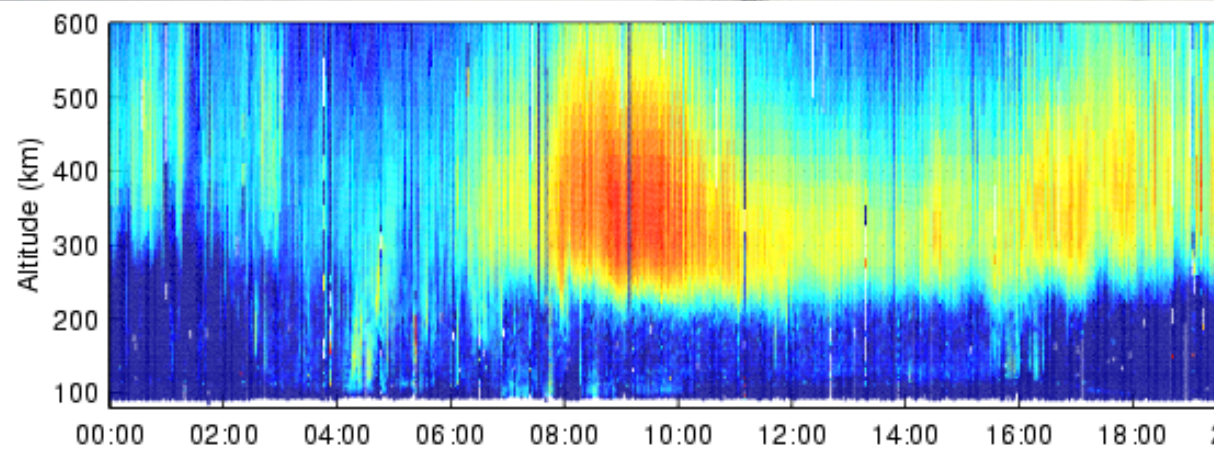
- EISCAT UHF: tristatic, but 1D
- AMISR: 1D volumetric
- EISCAT_3D: 3D volumetric

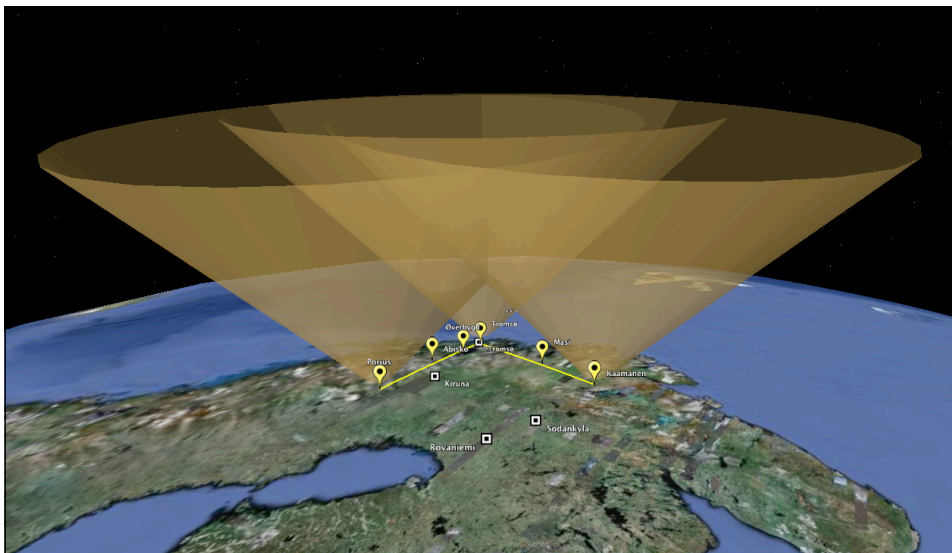


EISCAT_3D - The Idea

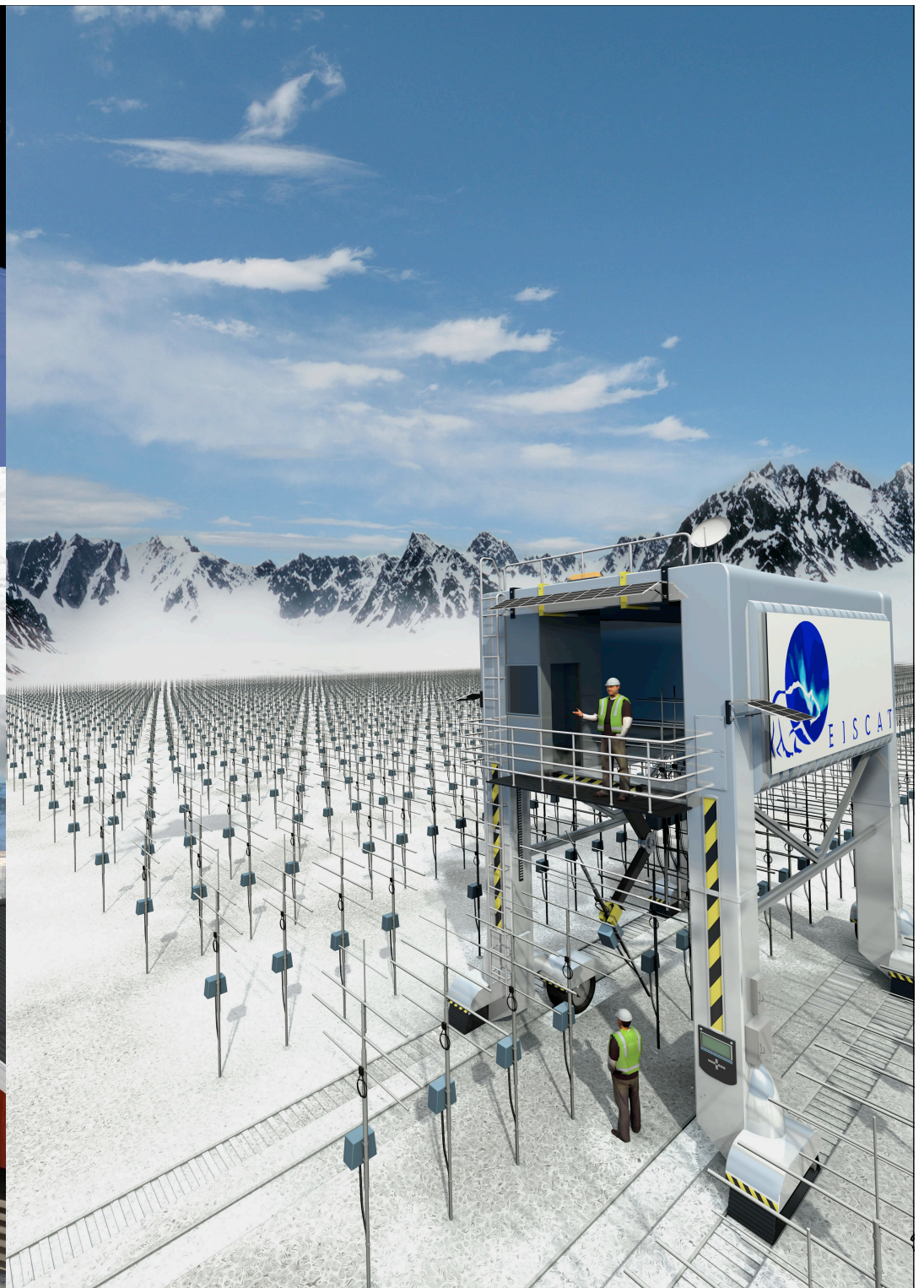
- Volumetric radar, capable of imaging an extended spatial area with
- simultaneous full-vector drift velocities,
- continuous operation modes,
- short baseline interferometry for sub-beamwidth scales,
- real-time data access.

Space-Time Ambiguity





EISCAT_3D - Visions



European Strategy Forum on Research Infrastructures

The logo consists of a dark blue square with the white text "ESFRI" inside it.

ESFRI

December 2008

EISCAT_3D, the European Next Generation Incoherent Scatter Radar was accepted on the ESFRI Roadmap of Large-Scale European Research Infrastructures for the next 20-30 years.

The Svalbard Integrated Arctic Earth Observation System SIOS was also accepted to the ESFRI Roadmap. The EISCAT Svalbard Radar is an essential part of SIOS.

EUROPEAN ROADMAP
FOR RESEARCH
INFRASTRUCTURES

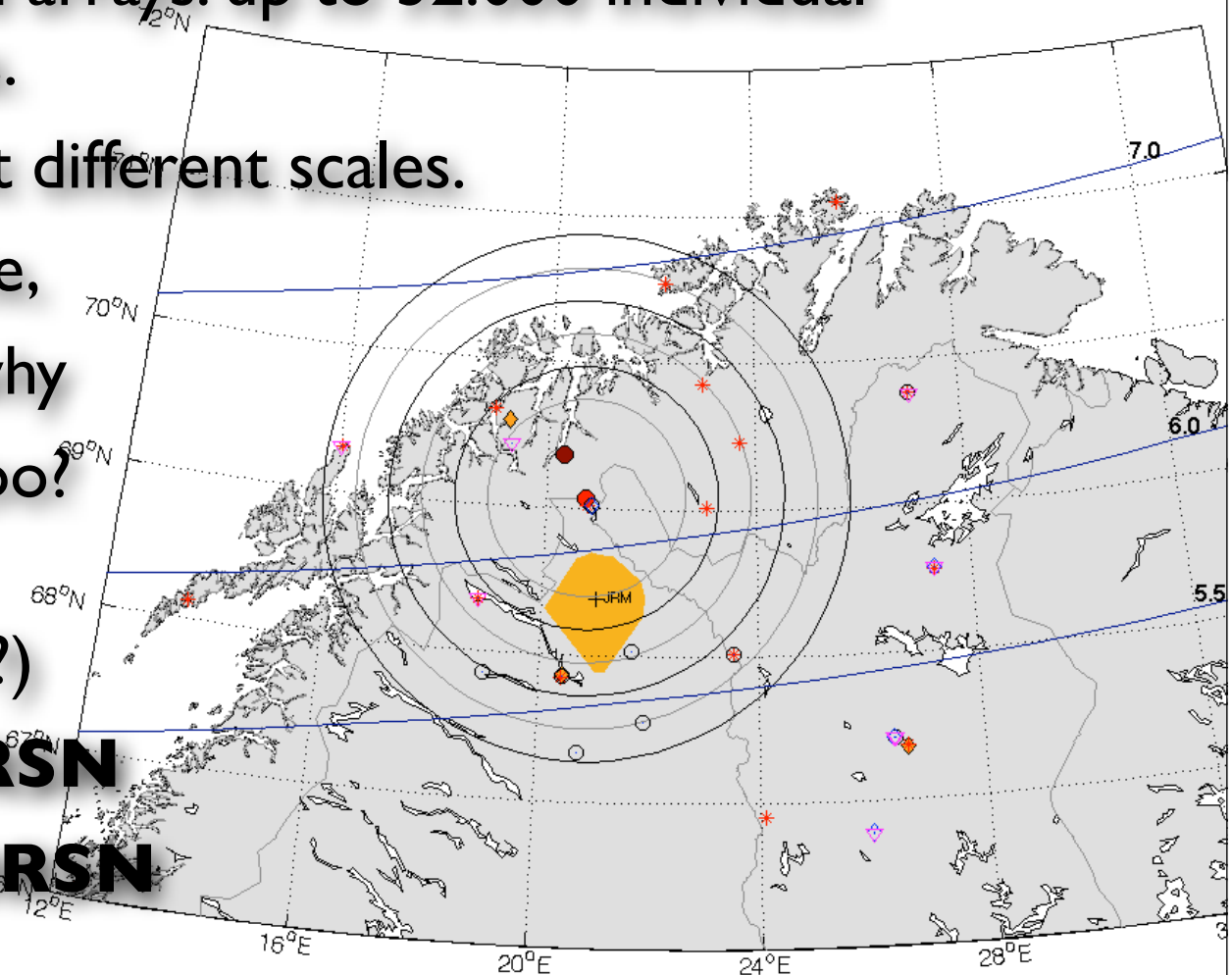
Roadmap 2008

Current Projects

- **FP7 Preparatory Phase Study:**
4.5 M€, began October 2010, 4 years
- **European Regional Development Funds:**
Sodankylä Geophysical Observatory has received 400k€ for EISCAT_3D theoretical development.
- **University of Oulu Infrastructure Funds:**
SGO was granted a 635k€ project to build a remote VHF receiver. Construction summer 2011/12.
- **Swedish research council planning grant:**
EISCAT has been granted 760k€ over 2 years for establishing a project office for E3D

EISCAT_3D - System

- Very large phased arrays: up to 32.000 individual antenna elements.
- Modular design at different scales.
- Central Tx/Rx site, remote Rx, but why not remote Tx, too?
- VHF $\approx 230\text{MHz}$
(and MF for MST?)
- Locations **TBDRSN**
- Tech Specs **TBDRSN**



Think big! Think extendable! Think modular!

EISCAT_3D - Science

- Influence of natural solar-terrestrial variability on climate.
- Long-term anthropogenic change.
- Coupling between atmospheric layers.
- Space plasma physics, including active experiment.
- Measurements of the solar wind and solar corona.
- Effects of meteors and energetic particles on atmospheric chemistry.

EISCAT_3D - Science

- Monitoring of space weather.
- Space situational awareness.
- Ground-based support for future space missions.
- Orbit determination of space debris and meteors.
- Radar-mapping of near-Earth objects.
- Development of radar and information technology.

EISCAT_3D - Timeline

- 2005-2009: Design Study (completed)
- 2010-2014: Preparatory Phase
- 2014-2015: Start of Construction
- 2016-2045: Operation

EISCAT_3D 2015-2045+

- Continuous development.
- World-class high-latitude space science, space weather, radar technology and radio science.
- State-of-the-Art Education of Space Scientists, Electrical & Radio Engineers, IT Engineers, Mathematicians at all levels.

Outreach

● KAIRA

- Blog:
kaira.sgo.fi
- Twitter:
twitter.com/KairaProject

● EISCAT_3D

- Blog:
blog.eiscat3d.org
- Twitter:
twitter.com/EISCAT_3D
- Facebook:
facebook.com/EISCAT3D