The Polar Environment Atmospheric Research Laboratory – Monitoring the Arctic Atmosphere and VY0ERC – Amateur Radio in Eureka

Pierre Fogal, Ph.D - VE3KTB

PEARL Site Manager

University of Toronto

Overview

- Introduction to Canadian Network for Detection of Atmospheric Change – CANDAC and the Polar Environment Atmospheric Research Laboratory – PEARL
  - Where, what, why...
- Brief introduction to Eureka and Joint/High Arctic Weather Stations – JAWS/HAWS
  - Location and history
- A bit about Amateur Radio in the Arctic
  - What does all of that have to do with this?

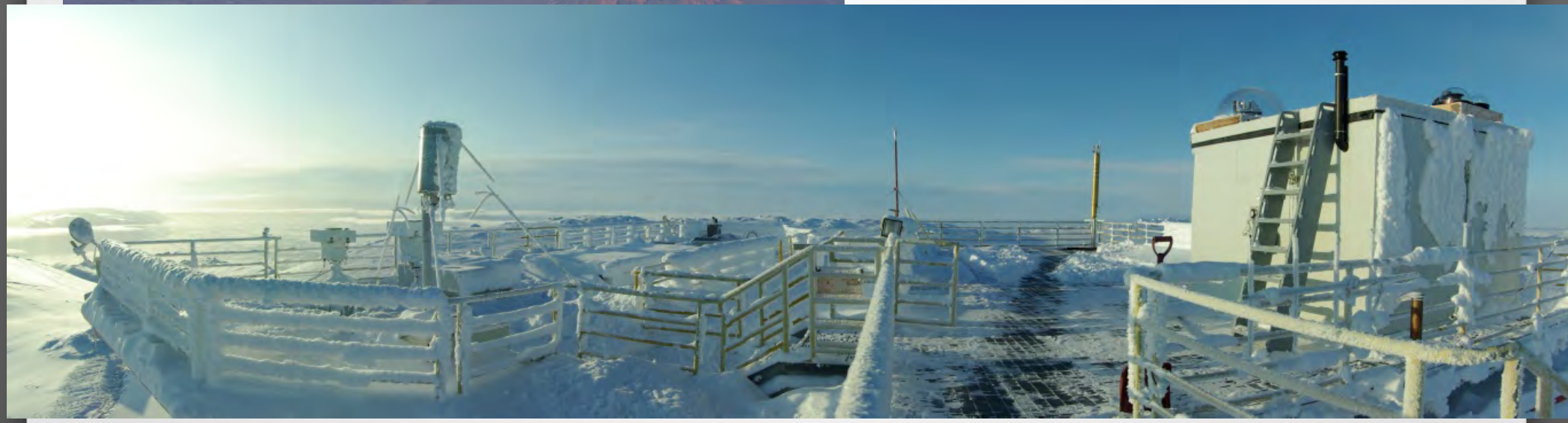
WHERE?? Getting there isn't easy...

- A minimum of 2 days
- Fly from Toronto to Yellowknife or Iqaluit on a commercial carrier
- Charter aircraft beyond those points
- 7-8+ hours on the turbo-prop
- LOUD! Cold ... cramped.
- Recent aircraft have been "nicer"

Interesting Facts About the Area

- Sun is not visible from 20 October to 20 February
- Sun is always visible from 10 April to 29 August
- Classified as a semi-arid desert region
  - Less than 30 cm of precipitation per year

RidgeLab



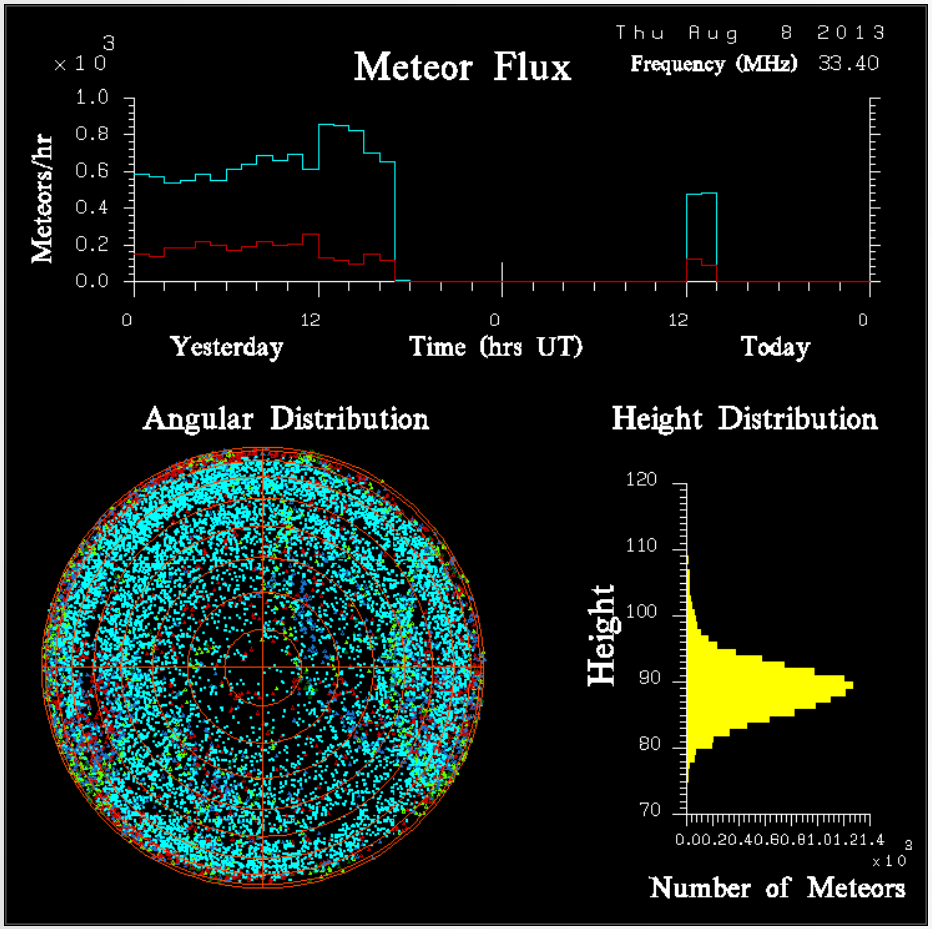
ØPAL

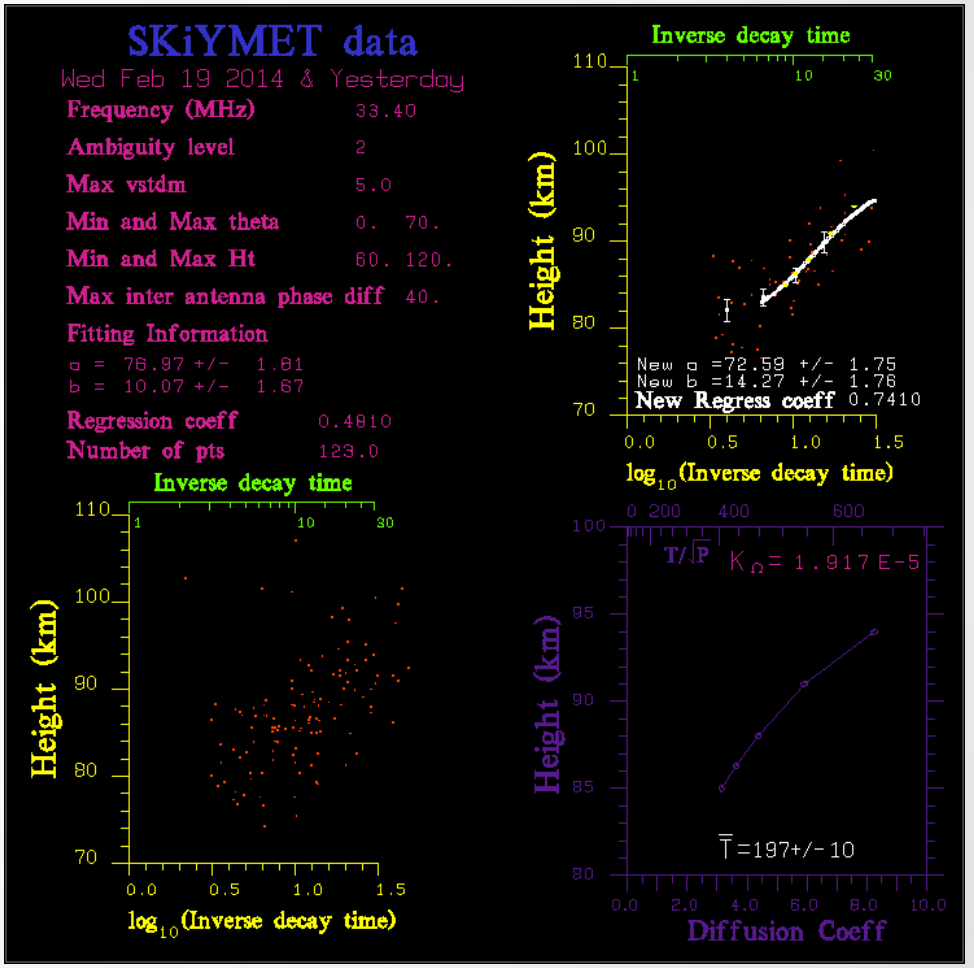
SAFIRE

PEARL Instruments by Location

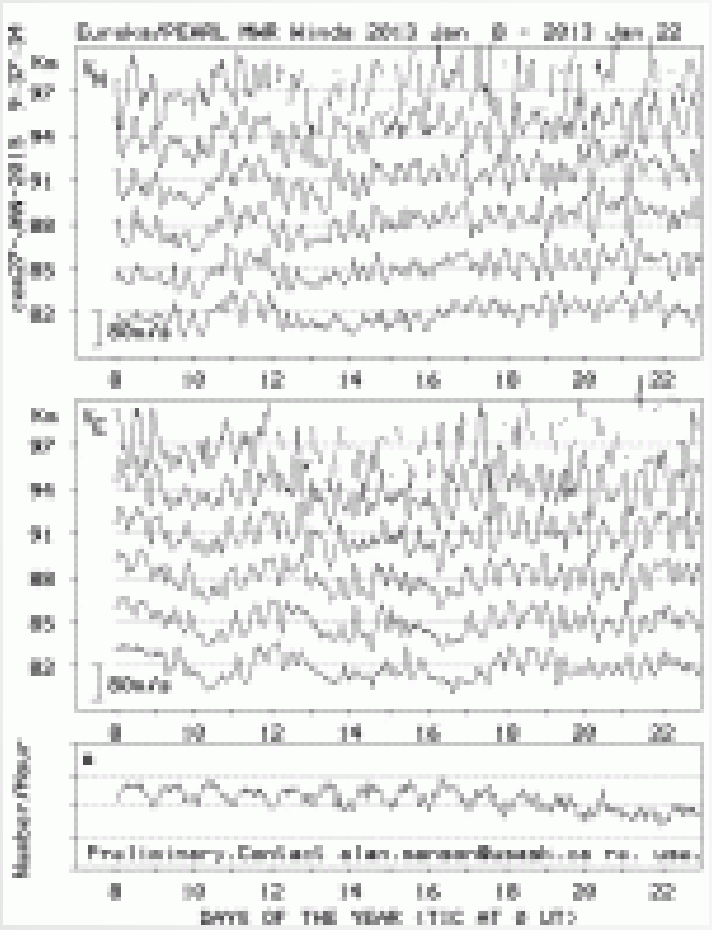
- RidgeLab
  - *Bruker IFS125HR FT spectrometer*
  - *2 UV-Vis grating spectrometers*
  - Aerosol mass spectrometer
  - *Cimel sunphotometer*
  - DIAL Lidar
  - **E-Region Wind Interferometer (ERWIN)**
  - **SATI**
  - All Sky Imager
- 0PAL
  - Millimeter wave cloud radar
  - Microwave water vapour radiometer
  - Extended-range Atmospheric Emission Radiometric Interferometer (E-AERI)
  - Precipitation Suite
  - Surface Ozone monitor
  - Raman Lidar (CRL)
  - **Tropospheric Ozone Lidar**
  - **Starphotometer**
- SAFIRE
  - Baseline Surface Radiation Network
  - Flux tower
  - VHF wind profiler/radar
  - Meteor Radar

Meteor Radar measurements



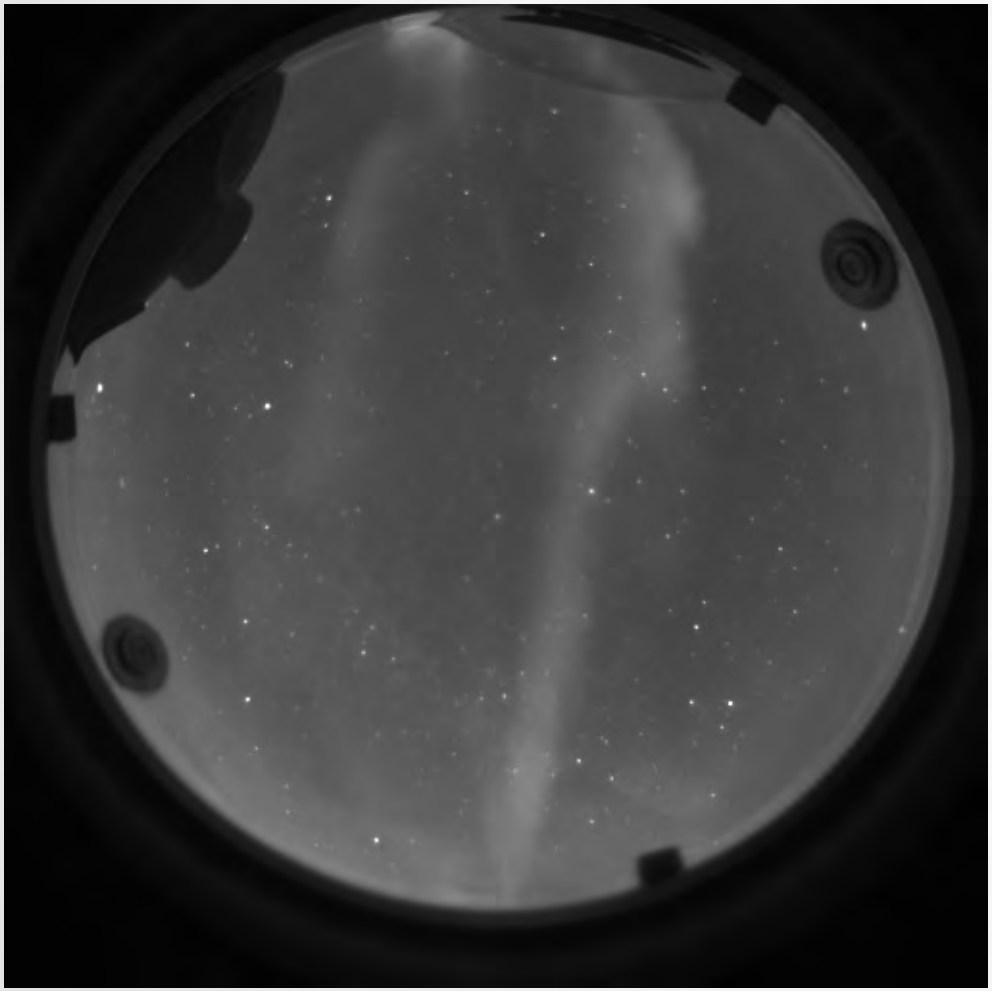


Meteor radar data products



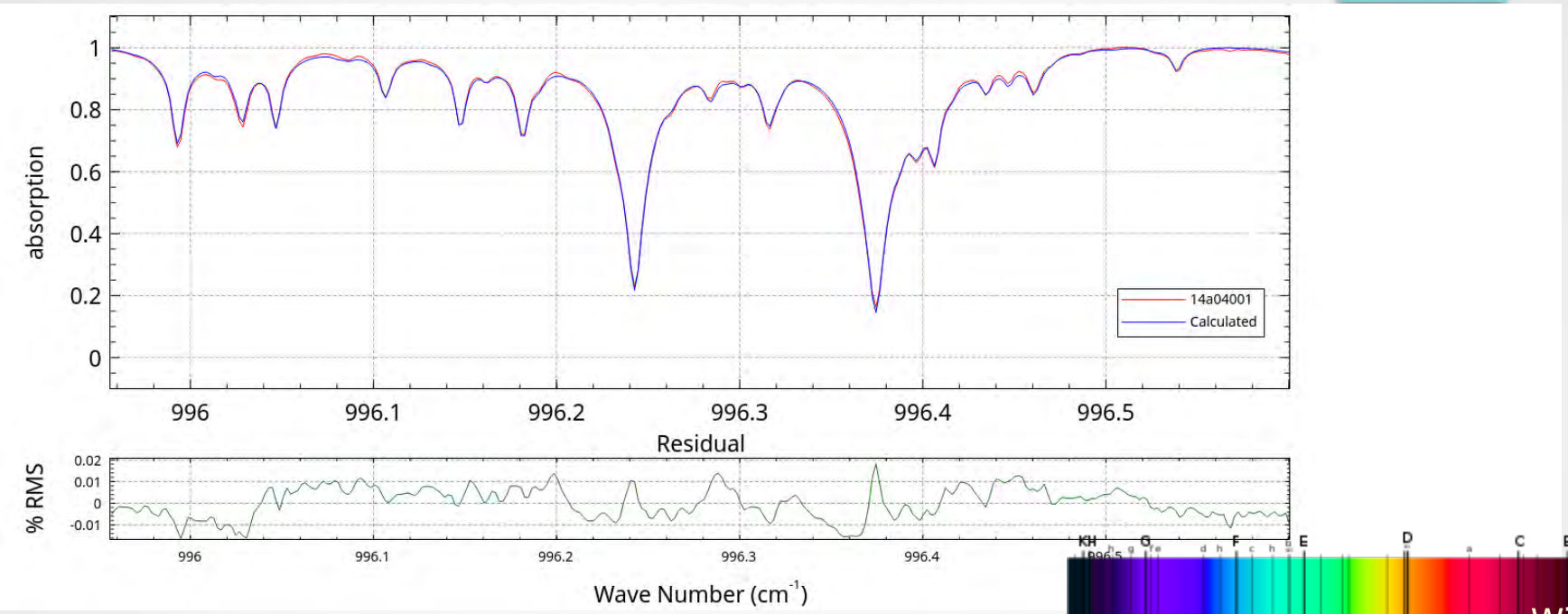
- Data from just after a Sudden Stratospheric warming
- Shows northward and eastward propagating mesospheric winds between 82 and 97 km altitude
- Daily meteor count typically between 4000 and 6000.

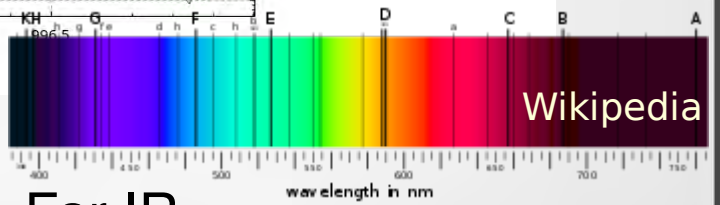
All Sky camera – Visible image



- Aurora not often seen at PEARL
- Often appear white in colour
- Filters in camera and post processing applied to look for wave and tidal signatures in OH

Infrared spectrum





- PEARL spectrometers cover from the UV to the Far IR
  - Can have near continuous step-wise spectral coverage
  - Includes atmospheric emission

Remote Operations and Communications

- We have an “operator” on-site 11 months of the year
- We have the world's most northern geo-stationary satellite ground station.
  - We have Internet and VoIP phone service
  - BUT ... given the expense we have LIMITED bandwidth
  - Requirements of satellite communication impact some connection types
- We've been striving for more remote operation capability
- Unfortunately, most popular remote connection techniques require TOO MUCH bandwidth
  - Includes remote desktop, team-viewer, vnc etc.
  - Occasional single use is possible, but problems arise quickly when multiple users on-line
  - Use of streaming video from web-cams saturates link

Why Have PEARL?

- Polar regions play extremely important roles in global atmospheric circulation
  - This impacts climate, weather, and composition
- They are (not surprisingly) very much under-sampled
- Understanding the polar atmosphere is critical to understanding, and therefore predicting, the global atmosphere
- The best way to measure that atmosphere is to put state-of-the-art instrumentation where it needs to be
- Visiting Arctic has many important benefits: sovereignty, natural beauty

Why not Satellites?

- PEARL (and ground-based measurements in general) are complementary rather than mutually exclusive
- You don't believe a satellite measurement until it's “validated” against another known data-set
- You don't apply a measurement from one point in time and space to other times and places until you understand its context
- PEARL provides satellite validation and satellites provide context for PEARL measurements

An Introduction to the Eureka Weather Station

- Eureka was one of the 5 Joint Arctic Weather Stations established in the late 1940's by Canada and the US
- US pulled out in the 1980's and these became known as the High Arctic Weather Stations (HAWS)
- They were Resolute Bay, Eureka, Alert, Isachsen, and Mould Bay
- Isachsen and Mould Bay have been closed
- Eureka has a permanent complement of 8 persons
  - SPM, 3 weather observers, cook, handy-person, mechanic, heavy equipment operator
  - Typical rotation is 3 months in, 3 months out
- Alert is a military base, so Eureka serves as the northern most accessible location and hence is often a “jumping-off” point for expeditions northwards
- It's where CANDAC/PEARL people stay when working in Eureka

Eureka Weather Station—Main building

Eureka Weather Station Details

- Headed by the Station Program Manager
  - Position shared between 3 individuals
- Water supply provided by run-off
- Powered by diesel generators. They work well but fuel delivery is a problem below -48C
- Can house up to 48 “transients”
- Costs:
  - Electrical power $0.74/kWh
  - fuel $5.00 per litre
  - Daily accommodation, $360/day

- Weather station operations
  - Hourly weather reports
  - Aviation weather
  - Two radio-sonde flights per day
  - One ozone-sonde flight per week
  - “Specials”
  - Ice and snow surveys in winter

HF Radio in the Arctic

- For many decades HF radio was the only means of communication to and from JAWS/HAWS and other sites like the DEW line
- Currently has fallen out of favour even for emergency or backup comms.
- They think “no one is listening”! :-)
- They prefer “reliable” comms such as Iridium sat phones
- Amateur radio has always been an important part of communications for Arctic stations

TCA: May 2017

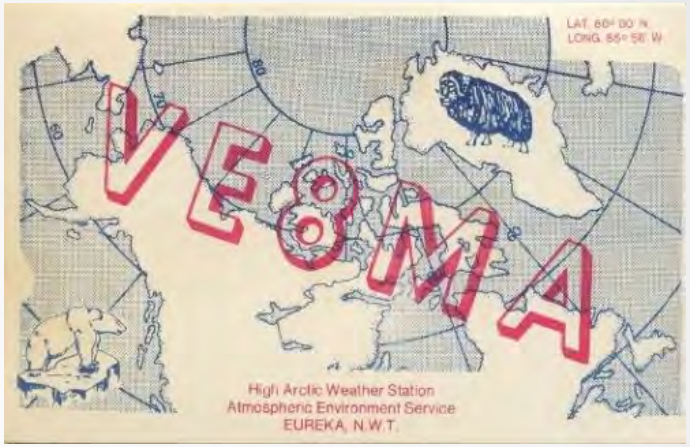
Eureka crew (from left): Stoen, Hatfield, Twombly, Trinko, Courtney, Tyrer and Dean. All but Twombly and Hatfield were in the first landing party on April 7, 1947.

70th Anniversary of Amateur Radio at Eureka Part I: The Original Station VE8MA

https://wp.rac.ca/wp-content/uploads/2019/05/PFogal_70th-Anniversary-Eureka-Part-1-MJ2017TCA.pdf

Amateur Radio at Eureka and other northern sites

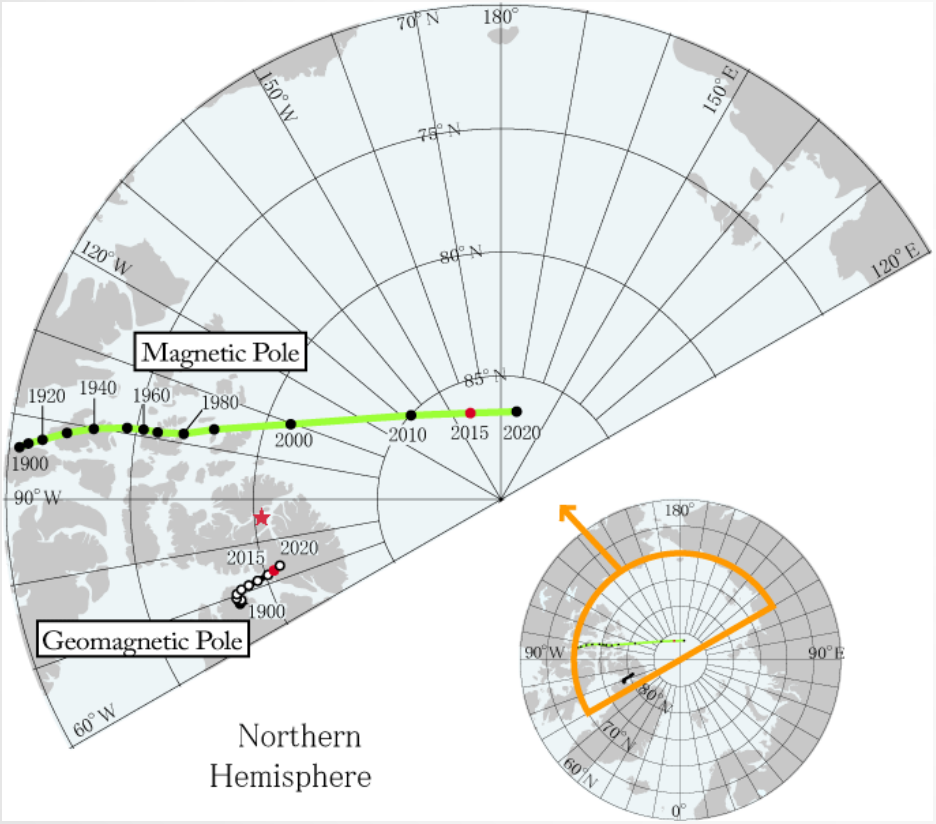
- Eureka is the home of the NCDXF beacon known as VE8AT
- We've logged over 15500 contacts since 2014, over periods of several weeks per year.
- Many operators and operations over the years
- Operation from other JAWS/HAWS
- Other islands
  - Such as VE3LYC as VY0M
- So, we are not the first by a long shot

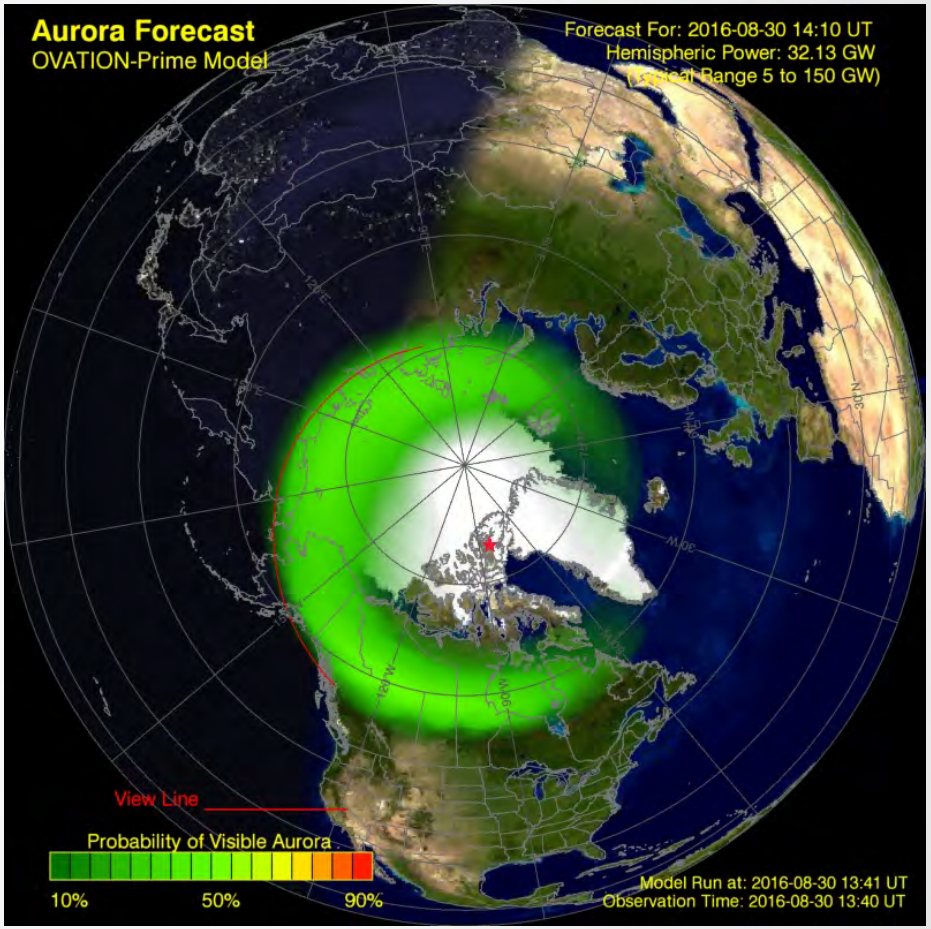


RBN Reports										Status	
DATE:	10	11	12	13	14	15	16	Bands	by	?	Notes
VE8AT	64	70	72	31	21	42	21	2	7	OK	

VE8AT was heard 21 times out of 2313 IBP beacon reports in 7 locations:
KM3T KM3T-2 KO7SS N6TV OH6BG ON5KQ VE2WU

But that doesn't make it any easier





The Founding of VY0ERC

- Founded by VE3KTB, Alexey Tikhomirov VE1RUS, and John Gilbert VE3CXL
- VY0ERC is the call-sign for the **E**ureka Amateur **R**adio **C**lub
  - VE1RUS is the trustee
  - Membership open to all at no cost
  - However, donations of any kind gratefully accepted!

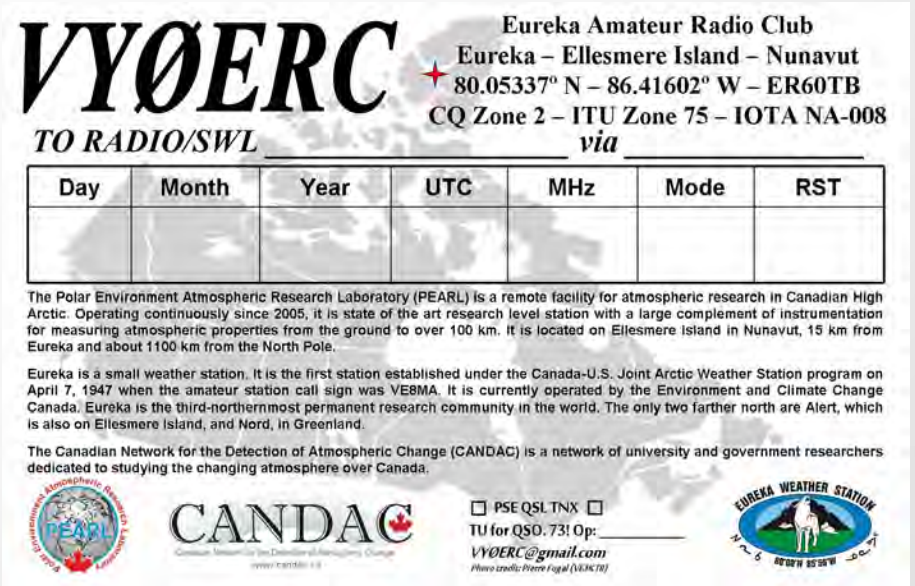
VY0ERC station/site details

- Current station set-up
  - single radio
  - Kenwood TS-480HX
  - Vectronics 3-500Z amplifier
  - 20m Moxon, R5 10-20m,
  - AP-8 added for 40 and 80m
- Located at PEARL RidgeLab
- CQ Zone 2
- ITU zone 75
- IOTA NA-008
- Grid ER60
- We cannot cause any RFI to instruments
- We must accept all RFI from instruments
- Must not be in the field-of-view of instruments
- So far we've been limited to 40m and up
- Added 80m this year
- Antennas don't survive if left in place

Operating modes

- Modes:
  - SSB
  - RTTY
  - FT8, JT65, WSPR
  - PSK31
  - CW
  - FM Satellite and soon SSB satellite

- SSB operation probably 80% of the time
- To date, over 13500 qsos from Eureka since 2015 in limited operating


VYØERC

Eureka Amateur Radio Club
Eureka – Ellesmere Island – Nunavut
80.05337° N – 86.41602° W – ER60TB
CQ Zone 2 – ITU Zone 75 – IOTA NA-008

TO RADIO/SWL _____ via _____

Day	Month	Year	UTC	MHz	Mode	RST

The Polar Environment Atmospheric Research Laboratory (PEARL) is a remote facility for atmospheric research in Canadian High Arctic. Operating continuously since 2005, it is state of the art research level station with a large complement of instrumentation for measuring atmospheric properties from the ground to over 100 km. It is located on Ellesmere Island in Nunavut, 15 km from Eureka and about 1100 km from the North Pole.

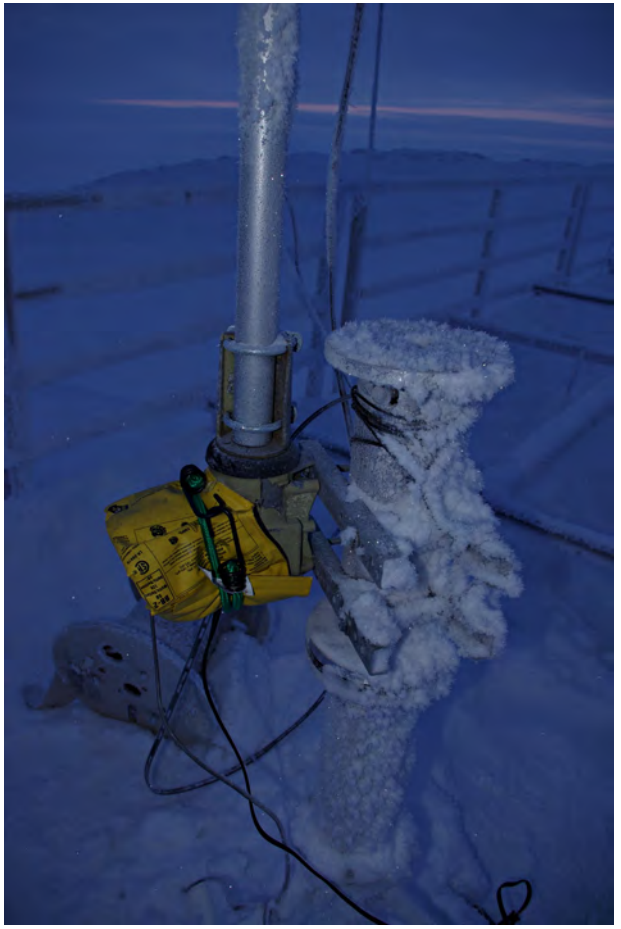
Eureka is a small weather station. It is the first station established under the Canada-U.S. Joint Arctic Weather Station program on April 7, 1947 when the amateur station call sign was VE8MA. It is currently operated by the Environment and Climate Change Canada. Eureka is the third-northernmost permanent research community in the world. The only two farther north are Alert, which is also on Ellesmere Island, and Nord, in Greenland.

The Canadian Network for the Detection of Atmospheric Change (CANDAC) is a network of university and government researchers dedicated to studying the changing atmosphere over Canada.

CANDAC

☐ PSE QSL TNX ☐
TU for QSO. 73! Op: _____
VYØERC@gmail.com

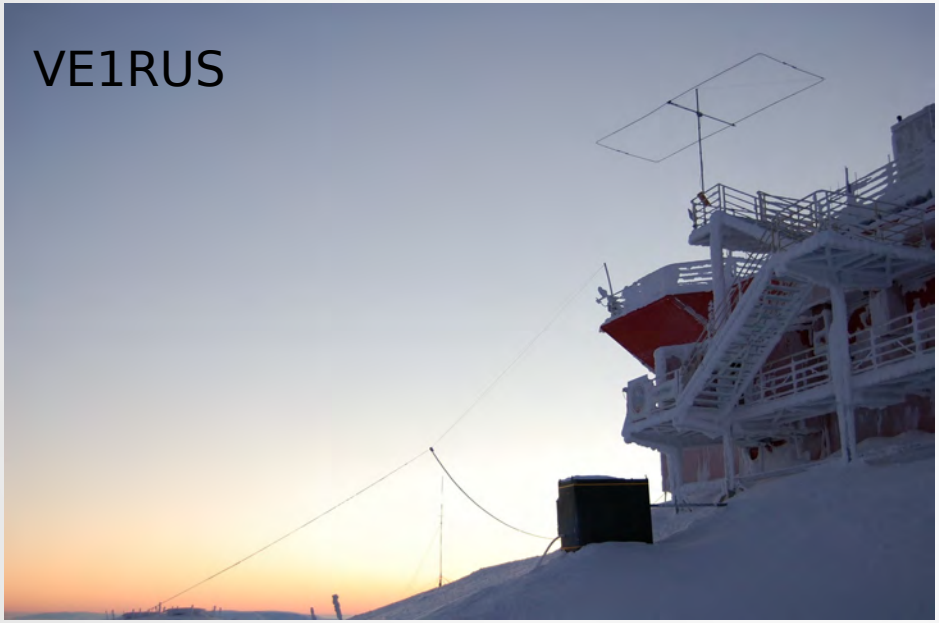
Operating Challenges: Weather



Summer not any kinder to antennas

We spend a lot of time fixing antennas

Vertical for 40m and 80m



- Antennas are difficult to put up and keep up
- Atmospheric noise dominates, so often verticals as good or better
- Looking to build 40m and 80m 4-square arrays
- Lots of requests for Zone 2 on 40m and 80m

Contest Participation

- 2017
  - Contest Class Power Score
  - ARRLDX SSB M/S LP 15,360
  - CQWW SSB M/S HP 179,820
  - IARU Jul 8 SOAB(A)SSB LP 30,450
  - JARTS Oct 21 MOMT LP 31,188
  - NAQP RTTY Feb Single Op LP 3,480
  - NAQP RTTY July Single Op LP 1,250
  - UR DX Nov 4 M/S HP 11,118
  - WAE RTTY Nov 11 M/S HP 1,200
  - WPX SSB Mar 25 SO(A)SB20 LP 156,510
- 2018
  - Contest Class Power Score
  - ARRLDX SSB M/S HP 64,050
  - BARTG SOAB-6 HP 98
  - IARU SOAB(A)Mixed HP 156,561
  - NAQP RTTY Feb Single Op LP 70
  - NAQP RTTY Jul Single Op LP 49
  - RTTY WPX M/S HP 160,383
  - Rus DX SO SSB HP 4,293
  - WPX SSB SO(A)AB HP 61,746
  - CQWW SSB M/S HP 409,262
  - SS CW Nov 3 Multi-Op HP 1,656

How to work us ... Please do!

- Polar Night
  - We have a small signal so we'll be hard to hear
  - Ironically, we don't seem to get spotted much
  - Our best band BY FAR is 20m
  - During polar night best conditions are between1700-2100 UT
  - 40m also available then
  - Pointless to ask us to move to 10m to see if it's open
  - 15m may open very briefly around 20 October and 20 February
- Polar Day
  - Our signal tends to be stronger
  - 15m will also open longer
  - 40m available at this point in the cycle?
    - Seemingly only due south
  - 10m might be...
  - 20m still rules!

Only possible with the co-operation of many

- Alexey Tikhomorivov VE1RUS and John Gilbert VE3CXL
- Thanks to Principal Investigator Prof. James Drummond and CANDAC/PEARL/PAHA Co investigators
- Staff of Eureka Weather Station
- And most of all, Theresa, Alex(VA3LML), Andre, and Serena!
- Thanks to all the hams around the world that want to have a qso with us
  - Not much point if no one is interested!
- And thank-you all for the opportunity to talk and for your attention!

Some other points of interest ... Wolves

Musk Ox

Caribou

rention

Birds—Snow Bunting

Nesting Time

Arctic Hare

Arctic Fox

Flowers

Ice

Ice and water

Antennas!

Thank-you for your attention ... questions?