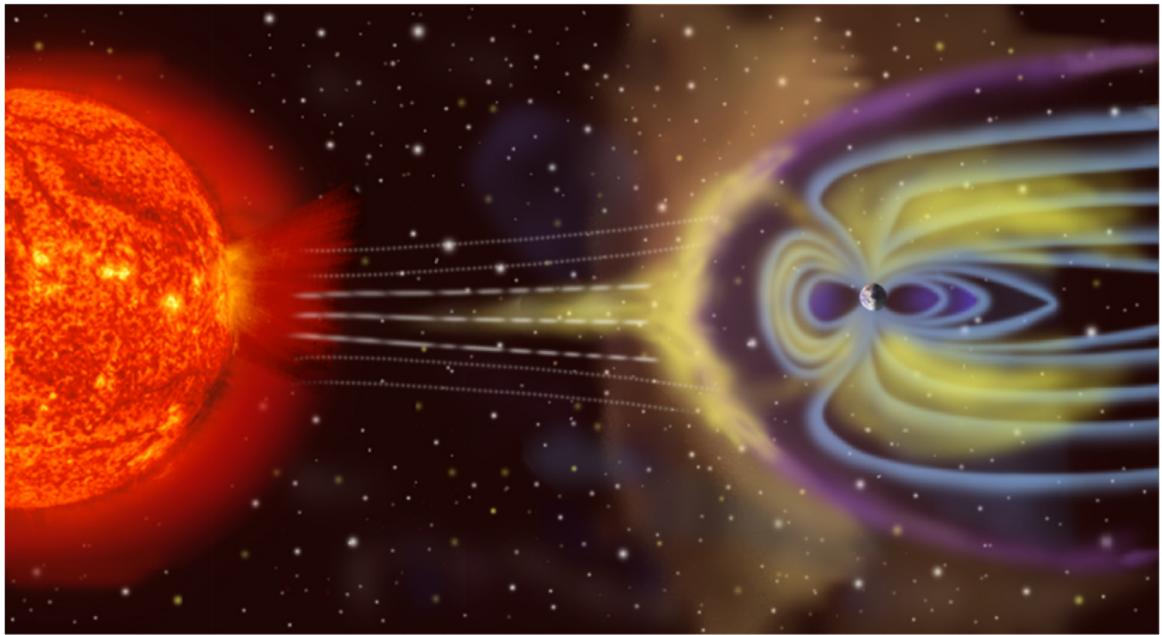


The EISCAT 3D project: Nordic Data Challenge



NORDIC E-INFRASTRUCTURE COLLABORATION

Solar wind and magnetosphere



Direct and indirect Sun-Earth connection through radiation, charged particles and magnetic fields

EISCAT: Studying interactions in the auroral ionosphere and magnetospheric cusp regions

Current EISCAT radars



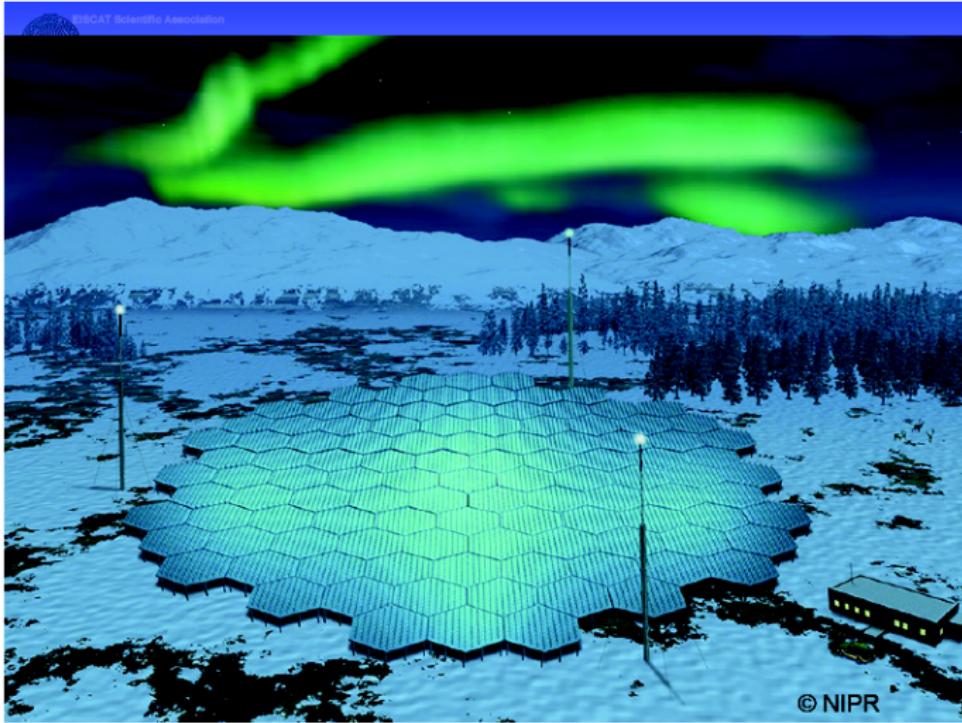
- Campaign operation, fixed schedules.
- Oldest system since 1981.
- Dataset since 1981
 $< 100 \text{ TB}$.

NASA via Wikimedia Commons, EISCAT

European Incoherent Scatter Scientific Association (**EISCAT**)

<https://www.eiscat.se/>

EISCAT_3D Project



Arrays of 9919 antennas. VHF 233 MHz. Solid state amplifiers.
Up to 100 simultaneous beams. 60° zenith angle

EISCAT_3D Project



Phase 1: One core station, two remote receiver sites.
Remote control and data access

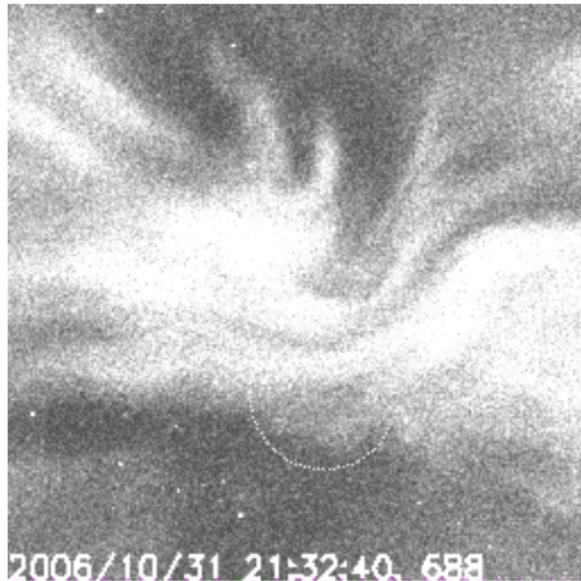
A “typical” aurora...



EISCAT_3D Kick-off, Tromsø, September 2017

Courtesy Thomas Ulich, SGO, Finland

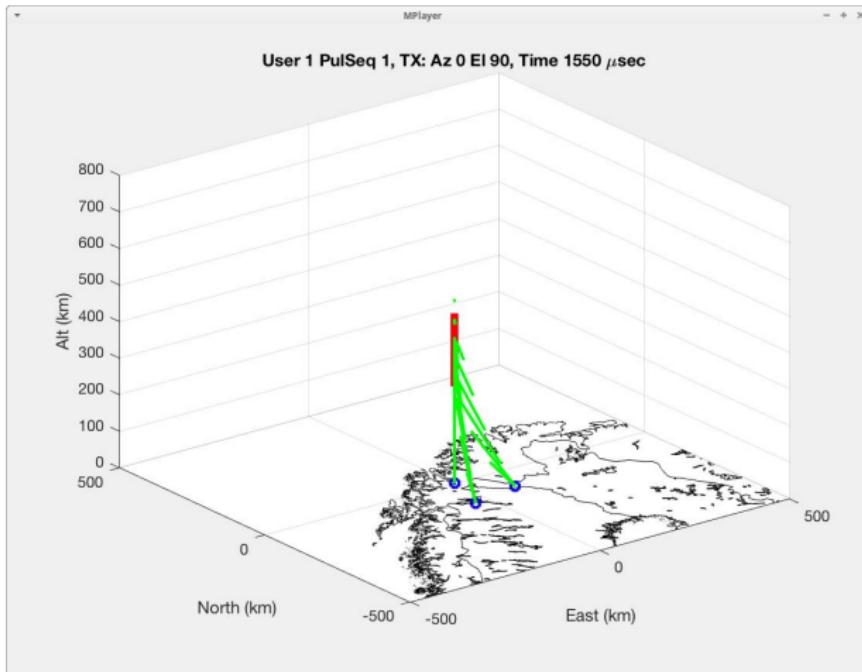
Why EISCAT_3D?



*ASK 3×3 degrees, EISCAT Tromsø site 31 Oct 2006
Courtesy Hanna Sundberg (formerly Dahlgren), KTH, Stockholm,
Now at Swedish Defence Research Agency*

Instrument now at EISCAT Svalbard site <http://ask1.esr.eiscat.no/>

EISCAT_3D Operation



Volume imaging. Maximum data rate after beamforming > 50 Gb/s

https://www.eiscat.se/about/eiscat3d/eiscat_3d-operation-illustration/

EISCAT Data

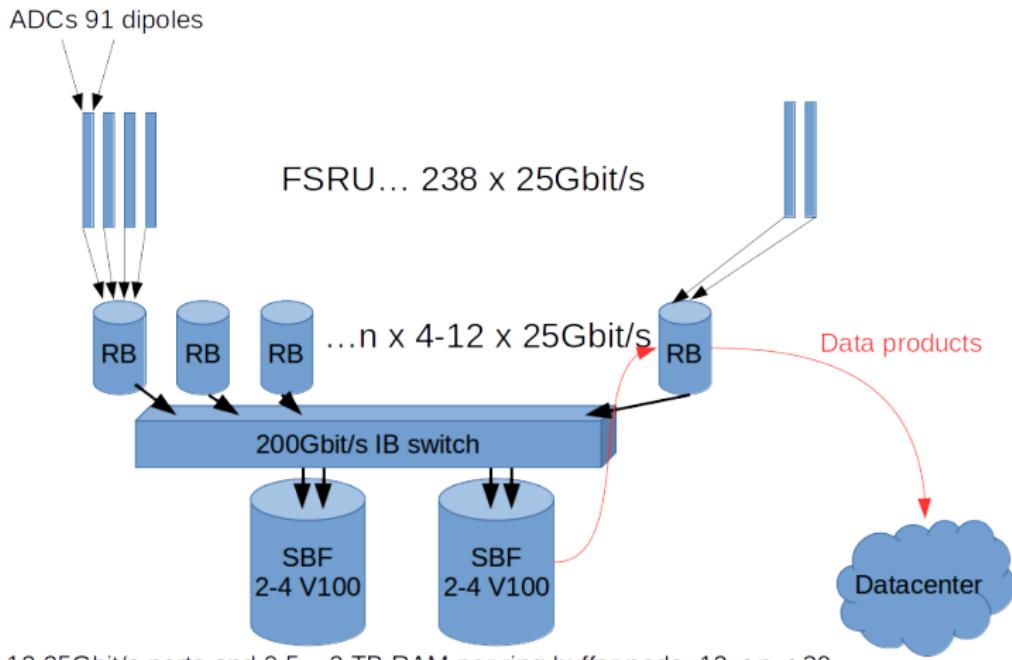
- EISCAT_3D is a project of the EISCAT Scientific Association, therefore:
- Governed by the EISCAT rules ¹
- EISCAT data policy governed by blue book ²(2015)
- Low-level data from each experiment embargoed for defined periods (typically 1 year for EISCAT member carrying out experiment, 3 years within EISCAT membership) .
- Data should be archived at two redundant Data Centres.
- Analysis of data either close to Data Centres or “spare” on-site computing.

¹<https://www.eiscat.se/scientist/document/governing-rules/>

²Page 39 onwards of https://www.eiscat.se/wp-content/uploads/2017/06/BlueBook_Edition2015.pdf



EISCAT_3D Online Computing



4-12 25Gbit/s ports and 0.5 – 2 TB RAM per ring buffer node, $12 < n < 30$
Loss of a single RB node is “acceptable degradation”
Second stage Beam Former computing on GPU

See: https://wiki.neic.no/wiki/EISCAT_3D_Data_Solutions#Deliverable_1

EISCAT Data Levels

Level	Type	Produced by	Storage	Format	Rate
1a	Ring buffer data	1 st stage beam former	4 months*	UDP stream/ HDF5	$\leq 4 \text{ Tb/s}$ ³
1b	Beam-formed data	2 nd stage beam former	4 months*	HDF5	64 Gb/s
2	Time integrated correlated data	All sites	Archived	HDF5	
3a	Physical parameters	All sites	Archived	HDF5	
3b	3D-voxel parameters	Operations centre	Archived	HDF5	
4	Derived geophysical parameters	Users	Users	Publications etc	$\approx 1 \text{ Gb/s}$

- The EISCAT_3D Data Centres will receive, serve and archive all data at levels 2 and 3.
- Data used in research should be given Persistent Identifiers (PIDs) according to a common standard such as DOI, DataCite, or similar, to be unambiguously citable in publications.
- A 4 months period is selected as this is the estimated time required to perform a “real-time” analysis on low-level data.
- A portion of the level 1 data will also be archived permanently, on the order of 1% of the level 1 data rate, e.g. one beam per site and/or bandwidth-limited data.

³At full 52 Msamples/s from each FSRU

EISCAT FAIR Data

Strong recommendation to follow ENVRI-FAIR principles
FAIR = **F**indable, **A**ccessible, **I**nteroperable, **R**eusable

- Will use PIDs or similar.
- Data stored in standard format (e.g. HDF5).
- Data model using standard vocabulary.
- Standard file and metadata catalogues.
- Standard data management system e.g. from LHC projects.
- Metadata always accessible and associated with provenance.
- AAI (EGI checkin implemented).

References

Open Information Linking for Environmental science:

<http://oil-e.net/ontology/>

ENVRI Reference Model:

<https://wiki.envri.eu/display/EC/ENVRI+Reference+Model>

EISCAT_3D Data Model:

<https://drive.google.com/open?id=0B83vmItCJRAYMktBdEoxdmlyMjA>

Thank you Questions?

Produced with \LaTeX