The EISCAT_3D radar system:

Conclusions from the Preparatory Phase

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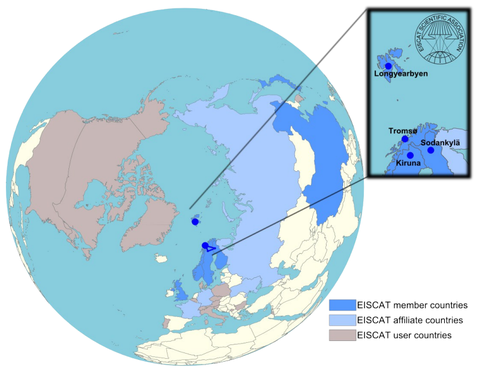


EISCAT Scientific Association

EISCAT is an international research organisation, conducting fundamental research into solar-terrestrial physics and atmospheric science.

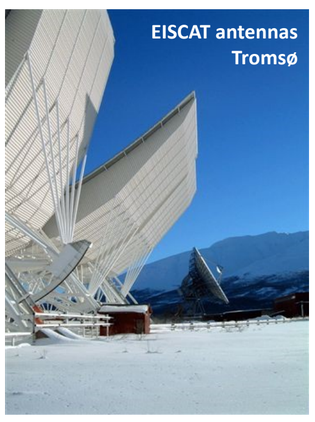
EISCAT was founded in 1976 and the first EISCAT data were obtained in 1981.

EISCAT operates three incoherent scatter radar systems (224 MHz, 500 MHz, 931 MHz) in northern Fenno-Scandinavia and on Svalbard.

The EISCAT systems are located in Tromsø (Norway), Kiruna (Sweden), Sodankylä (Finland) and Longyearbyen (Svalbard).

EISCAT also operates an ionospheric heater and supporting instruments such as dynasondes.

EISCAT is at the present funded by seven member organisations from six countries:



- Suomen Akatemia, Finland
- Solar Terrestrial Environment Laboratory, Nagoya, Japan
- National Institute of Polar Research, Japan
- China Research Institute of Radiowave Propagation, China
- Norges Forskningsråd, Norway
- National Environment Research Council, UK
- Vetenskapsrådet, Sweden

EISCAT receives additional funding from Russia, France, Ukraine and the EU.

EISCAT_3D

EISCAT, with international partners, is preparing to construct the next generation radar: EISCAT_3D.

It will consist of multiple phased arrays and use state-of-the-art signal processing and beam-forming techniques to become the world's most sophisticated research radar.

Five key capabilities of EISCAT_3D are:

- Resolution of space-time ambiguity.
- 3D volumetric capability.
- Sub-beam width measurements.
- Continuous monitoring of solar variability on terrestrial atmosphere and climate.
- Model validation for space weather and global change.

A unique set of capabilities of one single facility.

The Preparatory Phase

The EISCAT_3D Preparatory Phase was running from 2010 to 2014.

It had the objective to ensure that the EISCAT_3D project is sufficiently mature with respect to technical development, organisation and finances for the EISCAT_3D system to be realised.

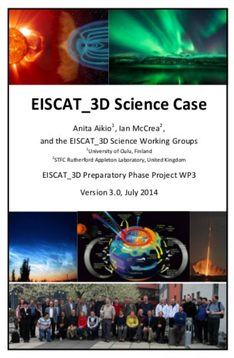
It was Funded by the European Commission under the call FP7-INFRASTRUCTURES-2010-1 *"Construction of new infrastructures: providing catalytic and leveraging support for the construction of new research infrastructures"*.

Timeline

The planned time-line for the EISCAT_3D system is:

2005 – 2009	FP6 Design Study (completed)
2010 – 2014	FP7 Preparatory Phase (completed)
2014 – 2021	Implementation Phase

Science Case



The EISCAT_3D Science Case document was updated annually.

Functions as a common document for the whole future EISCAT_3D user community.

Areas covered are:

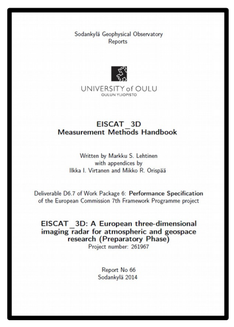
- atmospheric physics and global change
- space and plasma physics
- solar system research
- space weather and service applications
- radar techniques, new methods for coding and analysis.

Handbook

A Handbook of Measurement Principles was produced.

Summary and documentation of recently emerged innovative ideas in the theoretical studies of signal processing, coding, data handling and data analysis recently for incoherent scatter radars.

Evaluation of how these ideas can be applied with EISCAT_3D.



Stages of the implementation

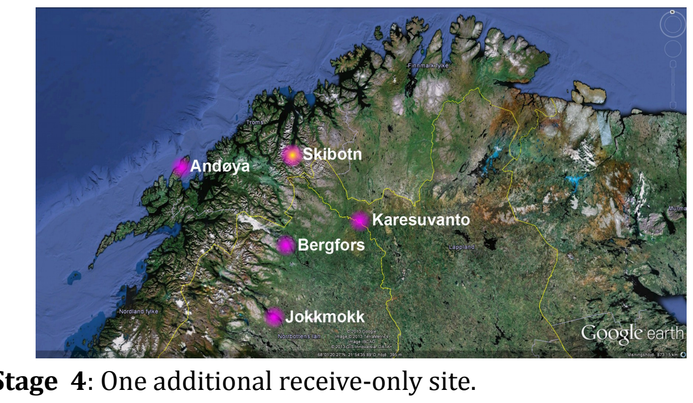
A four-stage approach to the construction and commissioning of the EISCAT_3D system has been prepared.

Incremental, yet ground-breaking, scientific capabilities at each of the implementation stages have been identified.

Stage 1: 5 MW transmitter at Skibotn, two receive-only sites.

Stage 2: Transmitter upgraded to 10 MW.

Stage 3: One additional receive-only site.



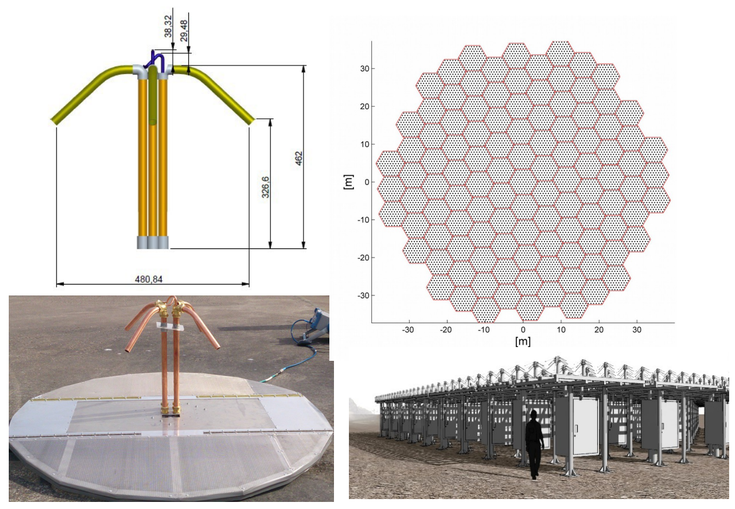
Stage 4: One additional receive-only site.

Performance Specification

System performance requirements for EISCAT_3D are driven by a combination of influences such as the Science Case and the Handbook of Measurement Principles.

A summary of the most important specifications:

- One core site and four distant remote sites equipped with antenna arrays, supporting instruments, and high data rate internet connections.
- Location of the core site (with full transmitting and receiving capability) within roughly 100 km of 69°N 20.5°E, preferably in the valley near Skibotn, Norway.
- Phased-array antenna with about 10,000 crossed-dipole elements at each site.
- Transmitter centre frequency at 233 MHz.
- Peak output power per crossed dipole of 1 kW.

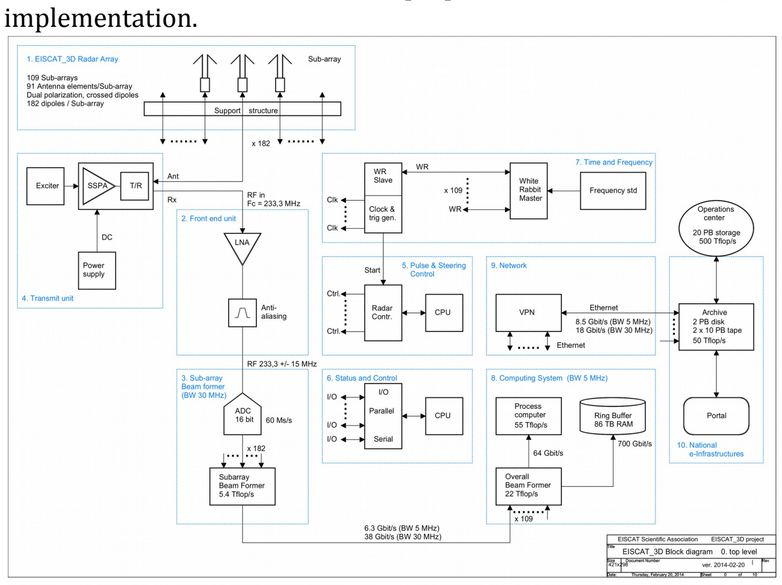


Technical work

Design of the hardware elements and work on technical integration of these subsystems were the focus of much of the effort during the Preparatory Phase.

Specialised software both for the system control and for the signal processing and beam-forming were prepared.

A plan was developed with e-infrastructure providers in the host countries for their involvement in preparation for the EISCAT_3D implementation.



Costs

Required investment (100 SEK ≈ 10.83 €)

Stage 1: 685 MSEK
Stage 2: 176 MSEK
Stage 3: 155 MSEK
Stage 4: 155 MSEK

Full system: 1171 MSEK

Operation costs will increase from 32 MSEK/year today, to 57 MSEK/year when EISCAT_3D is fully operational

Organisation

EISCAT_3D will be an integral part of EISCAT Scientific Association, which will have the overall project responsibility for the implementation.

All current EISCAT partners and affiliated partners have indicated their interest in pursuing EISCAT_3D.

Specific funding commitments are still under negotiation.

Much more information

Documentation about EISCAT and EISCAT_3D:

About EISCAT: *www.eiscat.se*

About EISCAT_3D: *www.eiscat3d.se*