NAROM

Norwegian Centre for Space-related Education

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NAROM
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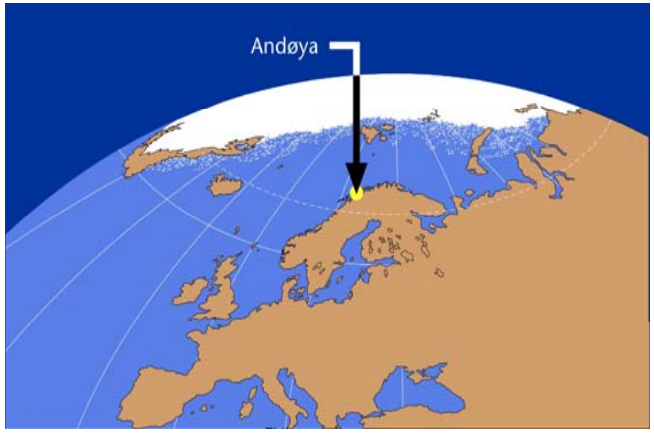
www.narom.no

NAROM
A field station for space-related education

- Opened in 2000 by the Norwegian Minister of Educational Affairs
- Located at Andøya Rocket Range
- Partly funded by the Norwegian Government
- Students attend lectures and perform experiments using the unique facilities at the range



Elementary to University levels

- **Courses for students and teachers from primary school to university level**

- **Theory combined with workshops and use of instrumentation at the range**

- **Space education material on the Internet illustrated with data from ARR-instruments**

Space Education

NAROM co-operate with:

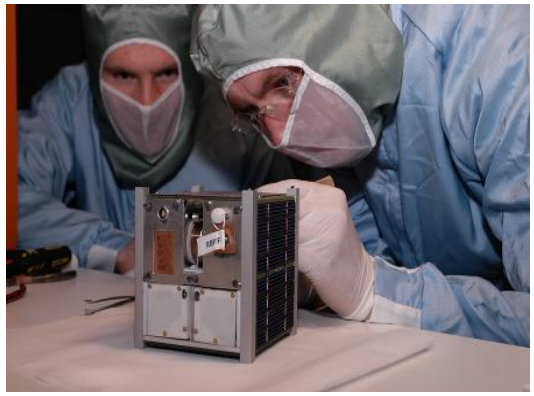
- **The Norwegian universities**
- **Norwegian university colleges of engineering and education**
- **The Norwegian Ministry of Educational Affairs**
- **The Research Council of Norway**
- **The Norwegian Association of Young Scientists**
- **The Norwegian Space Centre**
- **The Norwegian Industrial Forum for Space Activities**
- **ESA (European Space Agency)**
- **EURISY**
- **NASA**
- **Penn State University**
- **International Space University**

Status – activities 2005:

- ***67 courses/seminars***
- ***1813 students and teachers participated***
- ***Students from 10 nations (mainly Norwegians)***

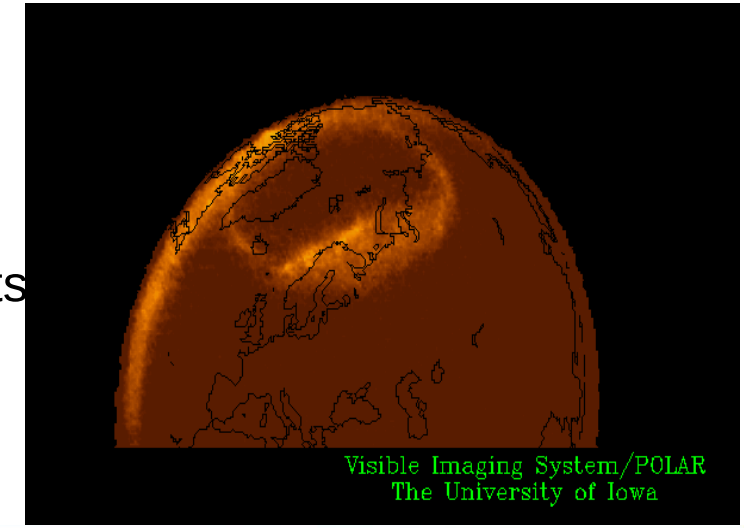
Examples of NAROM activities

- **Field courses for University students**
- **Space Technology - Andøy Upper Secondary School**
- **Space Physics and Space Technology for teachers**
- **www.sarepta.org – Space Education website**
- **Promoting ESA education activities and resources**
- **Theses for Master and Bachelor students**
- **NCUBE – student satellite program**
- **Space Camp for youths and teachers during the summer every year**



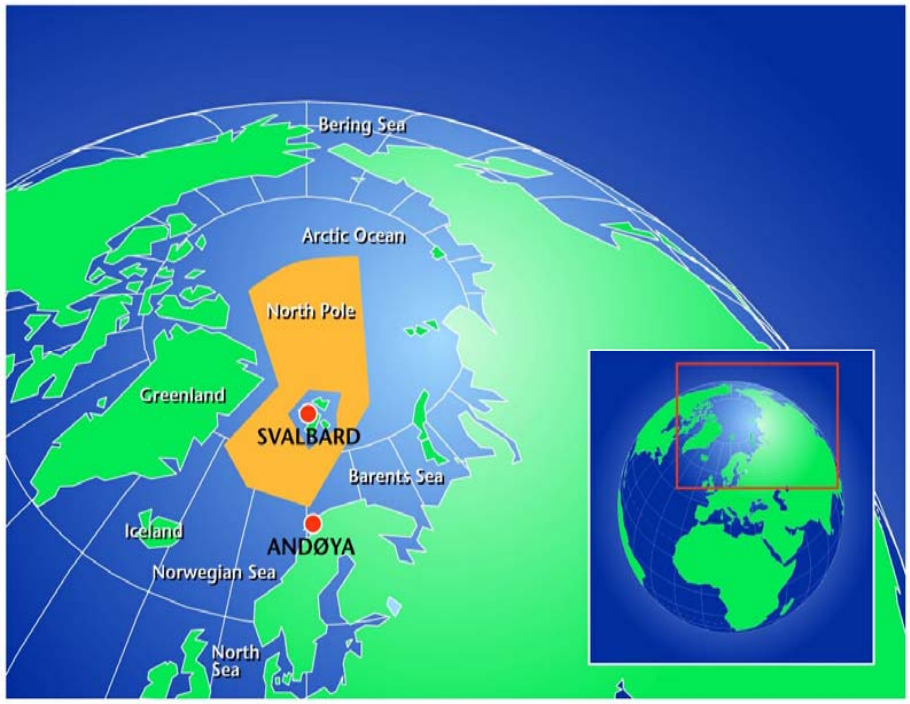
Competitive advantages

- **Geography**
  - Favourable geographic location
    - in the auroral oval
    - mild climate (”the green arctic”)
  - Large impact area for sounding rockets



- **Established**
  - Flexibility
  - Cost-effective
  - Expertise
  - Infrastructure
  - Network/relations

- **Andøya has**
  - Good communications
  - Good service/leisure activities



A Scientific Toolbox

ANDØYA
ROCKET RANGE

A Centre for Space Research

- Sounding rockets
- Stratospheric balloons
- Groundbased instrumentation

A Compact and Cost-effective Range

- Modern and flexible infrastructure
- Skilled and experienced personnel

Available for space research and education

Sounding Rockets

ANDØYA ROCKET RANGE

Modern & Flexible Infrastructure

- Several launch pads (launchers), capable of launching rockets up to 20 ton meters

- Parallell campaign capability

- Network of groundbased instruments

Large Impact Area

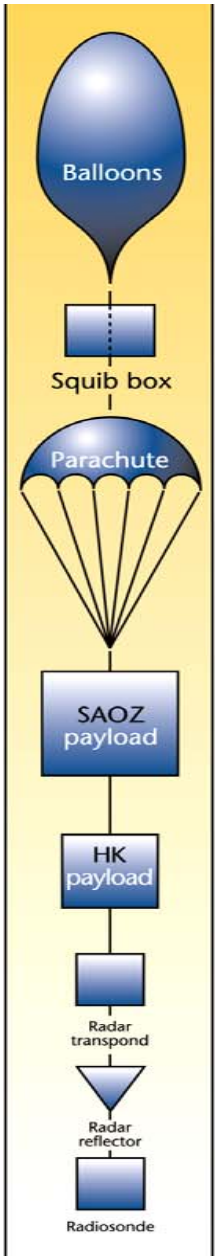
- Large impact area

- No need for expensive and weight-consuming guidance systems

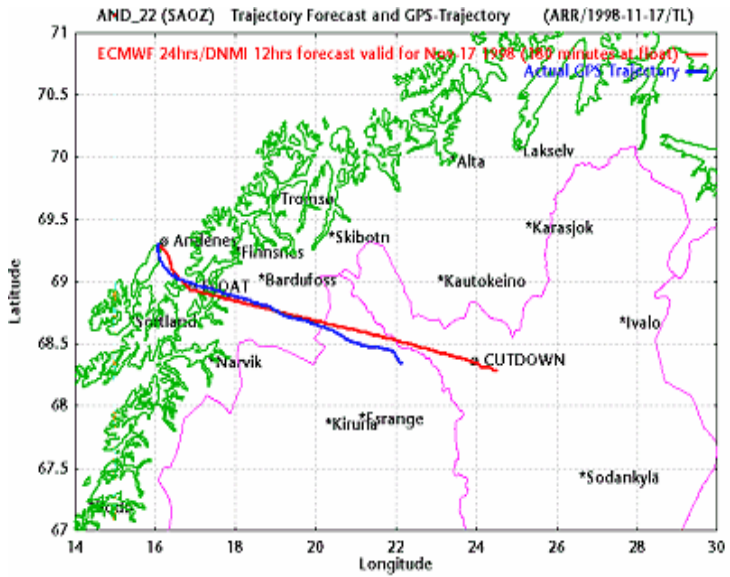
- Wide variety of trajectories possible

- Impact distances up to 2 000 km.

Stratospheric balloons



- **Launches from Andøya or other sites in Northern Norway with**
  - ARR housekeeping & flight-trains
  - ARR launch support equipment
  - ARR stationary & mobile TM systems
  - ARR TM & launch crew
- **Important co-operation with Andøya Air Force Base**
- **Favourable trajectories & optimal flight times**
- **Easy recovery by helicopter**
- **Short turnaround time**



Arctic LIDAR Observatory

ALOMAR

ANDØYA ROCKET RANGE

Basic parameters:

- Atmospheric density
- Temperature
- Wind
- Momentum transport
- Aerosols
- Ozone
- Cloud particle content

Available instruments:

- Lidars (RMR, Sodium and Ozone)
- Radars (MST and MF)
- Airglow
- Spectrometer's (UV-VIS)
- All-sky camera
- Ionosonde
- Riometers
- Magnetometers
- Meterological balloon launch facility

Facts:

- Owned and operated by Andøya Rocket Range

- Instrumentation provided by Norwegian and foreign institutions

- Operational since 1994

Science Campaign Headquarter

- Computer and network facilities for monitoring of science conditions / launch conditions

- The aim is to support the principal investigator, help to decide when to launch the sounding rocket under the most desired atmospheric conditions

- Flexible, easy to change setup to satisfy specific campaign needs

Student satellite

www.ncube.no

NCUBE
NORWEGIAN STUDENT SATELLITE

- **Participants**
  - Norwegian University of Science and Technology (NTNU)
  - University of Oslo (UiO)
  - The Norwegian University of Life Sciences (UMB)
  - Narvik University College (HiN)
  - Andøya Rocket Range (ARR)
  - NAROM
  - Norwegian Space Centre (NRS)
  - Kongsberg Satellite Services (K-Sat)
- **Launch**
  - 27 Oct 2005 and 27 Jul 2006

Student satellite

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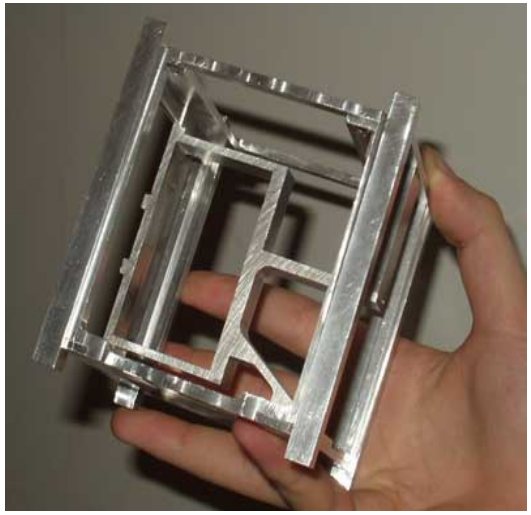
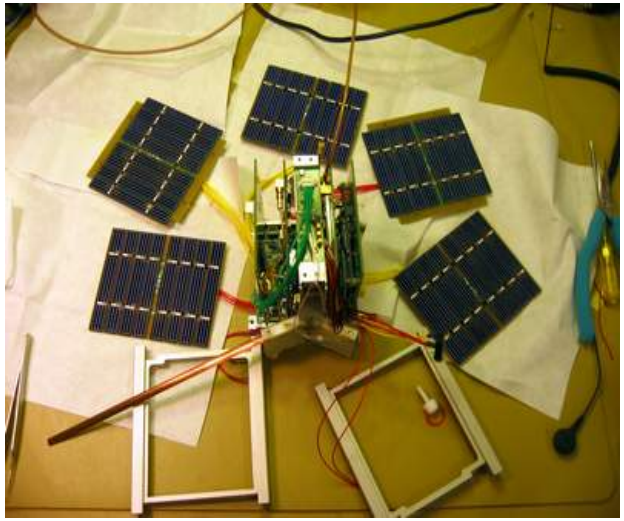
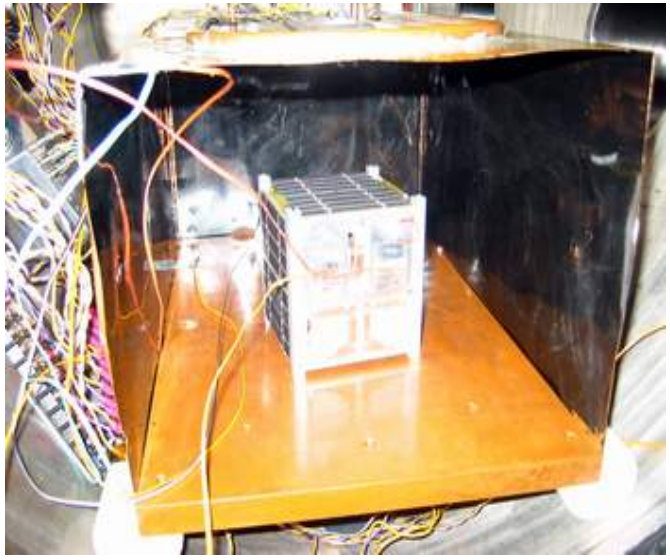




- **Structure**
  - Made by University of Oslo
- **Solarcells**
  - Made by Institute for Energy Technology (IFE)
- **System integration test**
  - Performed at NTNU
- **Vacuum test**
  - Performed by CalPoly



All photos: Bjørn Pedersen, NTNU

Student satellite

www.ncube.no

- **Objective**
  - Track reindeerherds at Hardanger mountain plateau
  - Track ship traffic around the Norwegain coastline
- **Solution**
  - Using the ground based ship-tracking system Automated Identification System (AIS)
  - This is also a test for using AIS by transmitting and recieving signals via satellite

All photos: Petter Kittelsen,

Student satellite

www.ncube.no

- **AIS**
  - **Ground based tracking-system for identifying large ships**
    - all tankships
    - cargo vessels > 300 gross tonnage
    - passenger ships > 300 gross tonnage
    - fishing vessels > 300 gross tonnage
  - **Has a range of about 20 Nautical Miles off the coast of Norway**
  - **The possible use of satellites in addition may make this system a global tracking system of large vessels**

Source: Norwegian Coastal Administration www.kystverket.no

Student satellite

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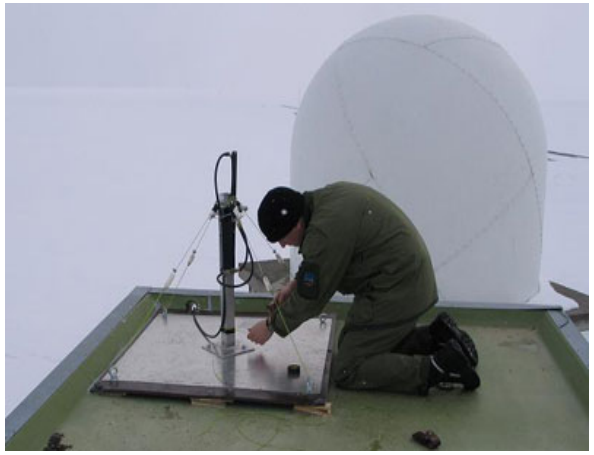

- **Groundstations**
  - **Narvik University College (68°N)**
    - Rx antenna crossed yagi 435 MHz
    - Tx antenna crossed yagi 145 MHz
  - **Svalbard (78°N)**
    - Rx antenna crossed yagi 437 MHz
    - Tx antenna dipole 145 MHz
- **Callsign in the amateur radio system is LA1CUB and operates at 437.305 MHz**

Student satellite

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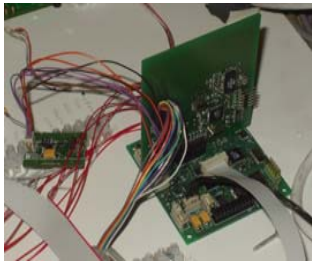
NAROM
NASJONALT SENTER FOR ROMRELATERT OPPLÆRING

National Student Satellite Program

- Norwegian Space Centre (NSC) is the main financial contributor
- Each institution has to pay for their own payload and/or other equipment in the satellite
- Project ends in 2011, with 4 satellites built and launched
- Launches are hopefully going to be free of charge, with cooperation with ESA-launches
- Instituitions has to compete between eachother to participate in the project



Student satellite

www.ncube.no

National Student Satellite Program

- **Main goals of the project**
  - **Develop multidiciplinary qualifiactions for students**
  - **Give students experience in team-work related to space industry**
  - **Hands on training**
  - **Give students the opportunity to make networks, both domestic and international**
  - **Achieve expertise in both ground and space segments for future satellite activities**
  - **Build competence at ARR in satellite technology**

Student satellite

www.ncube.no

National Student Satellite Program

- **Project continuity**
  - **1 or 2 professionals at each institution is coordinating and reporting to management**
  - **Students are beeing involved at an early stage of the project, and is motivated during the whole period**
  - **Communication is kept simple (e-mail, phone calls)**
  - **Status-meetings every week (maybe via IRC)**
  - **Workshops 1 to 2 each year**
  - **Docuement all important work, and update everybody on continously**

Efficient use of Andøya Rocket Range

NAROM efficiently uses the unique laboratories and instruments at the Andøya Rocket Range

- ensure recruitment
- promote appreciation for the benefits of space activities
- stimulate the interest for science in general

More information and contact adress:
www.narom.no

Company Structure

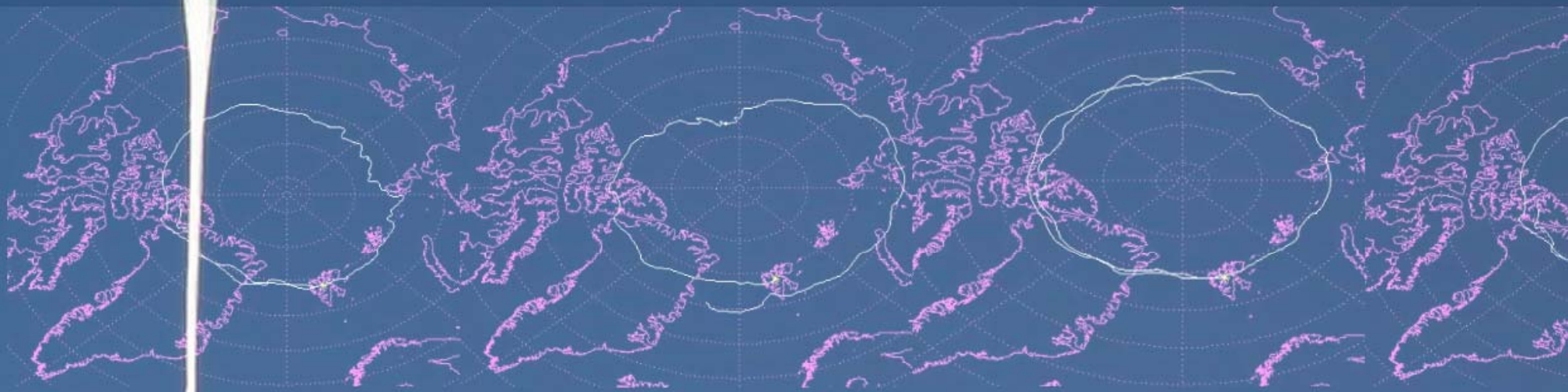
Ministry of Trade and Industry

- Norwegian Space Centre
- NHD: 50 %, KDA: 50 % — Kongsberg Satellite Services AS
- NHD: 90 %, KDA: 10 % — Andøya Rocket Range AS
  - Andøya Test Center AS
  - NAROM AS
  - Nordlyssenteret AS

Learn more about the Northern Lights ?

www.northern-lights.no

Long Duration Balloons



- Launch from Svalbard
- Good conditions for circumpolar flights
- Recovery from Svalbard or Greenland

Advantages

- Extended scientific discoveries
- Safe location away from populated areas

Sounding Rockets From Svalbard

ANDØYA ROCKET RANGE

Favourable for Studies of..

- Dayside aurora borealis
- Magnetospheric boundary layer processes
- Magnetic cleft, cap and cusp

SvalRak Launch Site

- Ny-Ålesund at 79º North
- Operational since 1997
- Mild climate, good communications
- Network of supporting, scientific instruments available (in Longyearbyen, Ny-Ålesund and in the Nordic countries)
- Owned and operated by Andøya Rocket Range

Payload Recovery

ANDØYA ROCKET RANGE

Sea recovery by ship

Payload cleaning / refurbishing

24 hours turnaround time

Cost-effective re-use of payload

Andøya Rocket Range

The Cost-effective Entrance to Space

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