The Northern Lights

From myths to modern science

Pål Brekke

Norwegian Space Centre

EISCAT (Njål Gulbrandsen)

"No pencil can draw it, no colours can paint it, and no words can describe it in all its magnificence."

Austrian explorer Julius von Payer

Pål Brekke

A vengeful force

- In ancient times, most people were afraid of the lights.
- Children would be brought inside
- Northern lights were a vengeful force which killed those who mocked it. DO NOT WHISTLE TO IT!!!
- Many believed it was a message from the creator.
- An old tale from the Nordic countries said that, "God is angry when the aurora flames".
- An omen of war, or disasters or plagues

Aurora over Nurnberg 5 October 1591

Beliefs of Indigenous Peoples

- The Eskimos in the northernmost parts of Canada believe that the northern lights were created by spirits, which, dressed in the mystical light, are having fun because the Sun is missing.

- Rapidly moving aurora were called the dance of death.

- The Sami people calls it “guovssahas” - the light you can hear

Beliefs of Indigenous Peoples

- The Mandan Indians (North Dakota) explained the northern lights as fires over which the great medicine men and warriors of northern nations simmered their dead enemies in enormous pots.

Myths in Norway

Ulf Dreyer

Children waving with white clothing - intensity of waving increased the motion of the aurora!

The Viking name

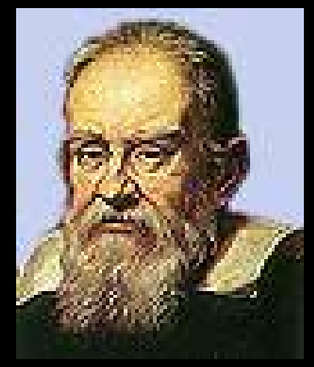
- It was the Vikings which christened the aurora «northern lights» or “Norðurljós” in old Norwegian.

The Name - Aurora Borealis

What does the name mean?

The Name - Aurora Borealis

- The scientific name for the phenomena is Aurora Borealis, which is Latin and translates into "the dawn of the north".
- It was the Italian scientist Galileo Galilei (1564-1642) who first used the expression. On the latitude where Galileo was living, northern lights consist of mainly red colour.



Galileo Galilei (1564-1642), Italian mathematician, philosopher and astronomer. Among his discoveries are the four Galiliean moons around Jupiter. Although he wasn't the first to see northern lights, he gave it it's scientific name.

The Name - if Galileo lived in Norway?

Lux Viridis Borealis - the green light in the North

The Name - Aurora Borealis
Who were first?

Pierre Gassendi, priest, mathematician and astronomer, (made the first observation of the transit of a planet, Mercury), has often been credietd to first use the notation «Aurora Borealis»

But according to G. L. Siscoe (EOS, 1987, p 994) he published this in 1649, where he descrives a strong aurora he obsevred in 1621.

The expression «Aurora Borealis» appears in a publication in 1619 in a work partly or completely authored by Galileo

"The Sky's on fire"

The Roman emperor Tiberius in 34AD was tricked into thinking the port of Ostia was on fire and he sent troops to deal with it. In fact, he was witnessing a red aurora.

"The Sky's on fire"

The New York Times
Wednesday January 26, 1938,
L + (Late City Edition) Page 25

«The ruddy glow led many to think half the city was ablaze. The Windsor Fire Department was called out in the belief that Windsor Castle was afire. …»

France, Jan. 25.—
«A huge blood-red beam of light … spread anxiety in numerous Swiss Alpine villages. Emblazoned in the northern sky the light brought thousands of telephone calls to Swiss and French authorities asking whether it was a fire, war or the end of the world. …»

26, 1938.

Aurora Borealis Startles Europe; People Flee in Fear, Call Firemen

Britons Thought Windsor Castle Ablaze— Scots See Ill Omen—Snow-Clad Swiss Alps Glow—Short-Wave Radio Halts

Special Cable to THE NEW YORK TIMES.
LONDON, Jan. 25.—The most bril- Grenoble said that a similar aurora borealis had not been seen in West

AURORA BOREALIS MISTAKEN FOR FIRE

BRILLIANT DISPLAY SEEN IN ENGLAND.

The most brilliant display of the Aurora Borealis for many years was seen throughout England and in many parts of the Continent, including Austria and Holland.

The display began in England soon after sunset and continued for several hours. Thousands gathered at vantage points to get a better view. Many people who were misled by the red glow telephoned the police and fire brigades. Some reported that Windsor Castle was ablaze. The phenomenon is attributad to the giant sunspot recently reported.

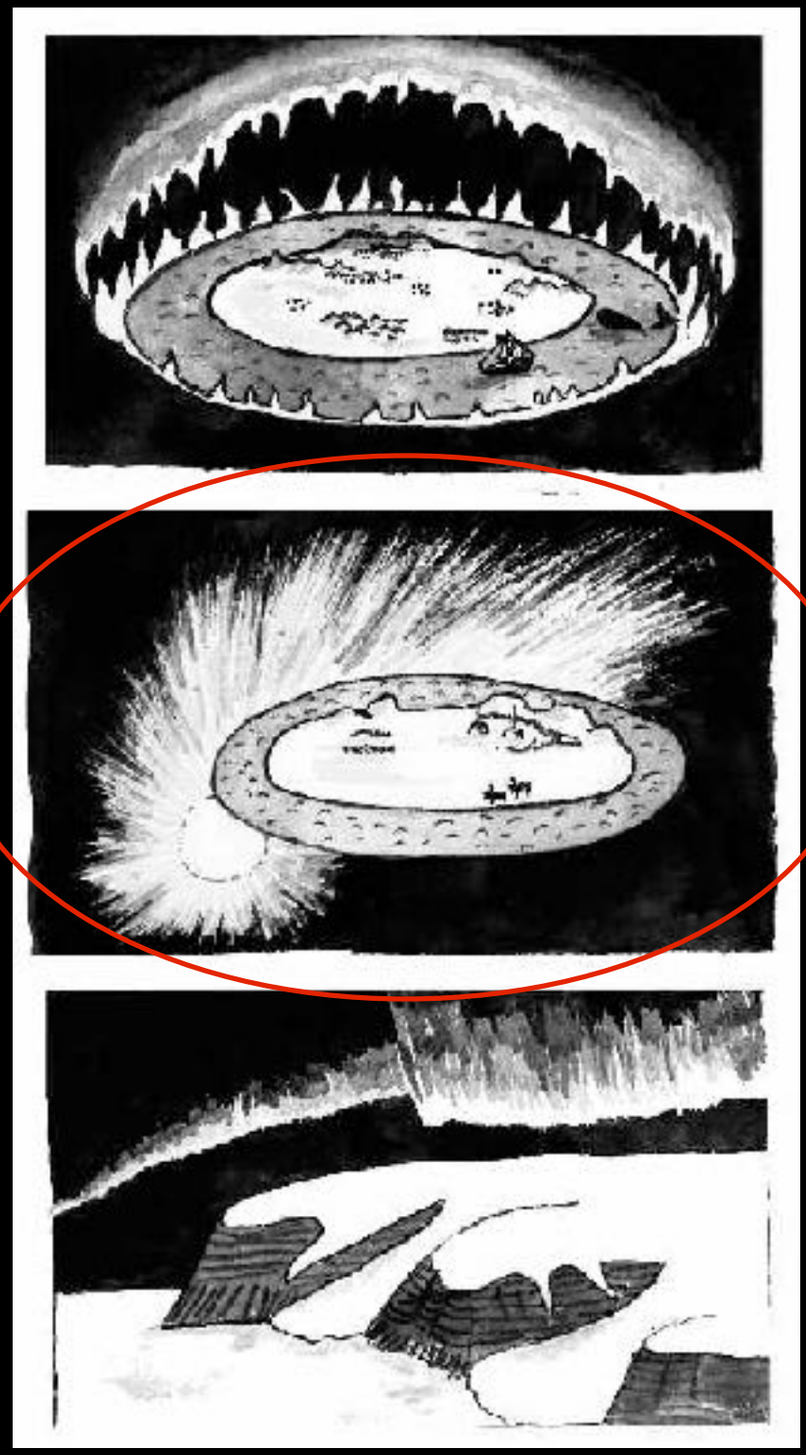
The beam service to Australia was interrupted and the Aurora played havoc with the cable service between London and New York.

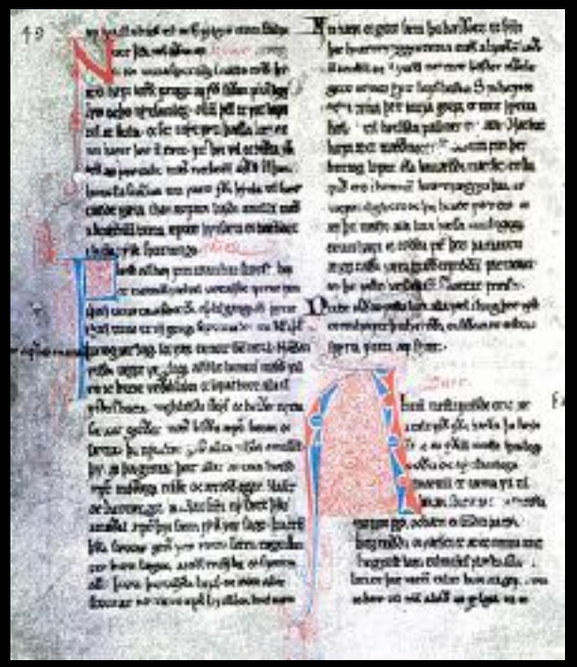
It also caused panic in parts of Europe where such a spectacle is unknown. Austrian villagers fell on their knees and prayed when night turned into day with a flaming coloured curtain across the sky.

Peaks 8000ft. high in the Swiss Alps were lit up by magnificent colours. The lights extended to South Portugal.

Aurora in Science

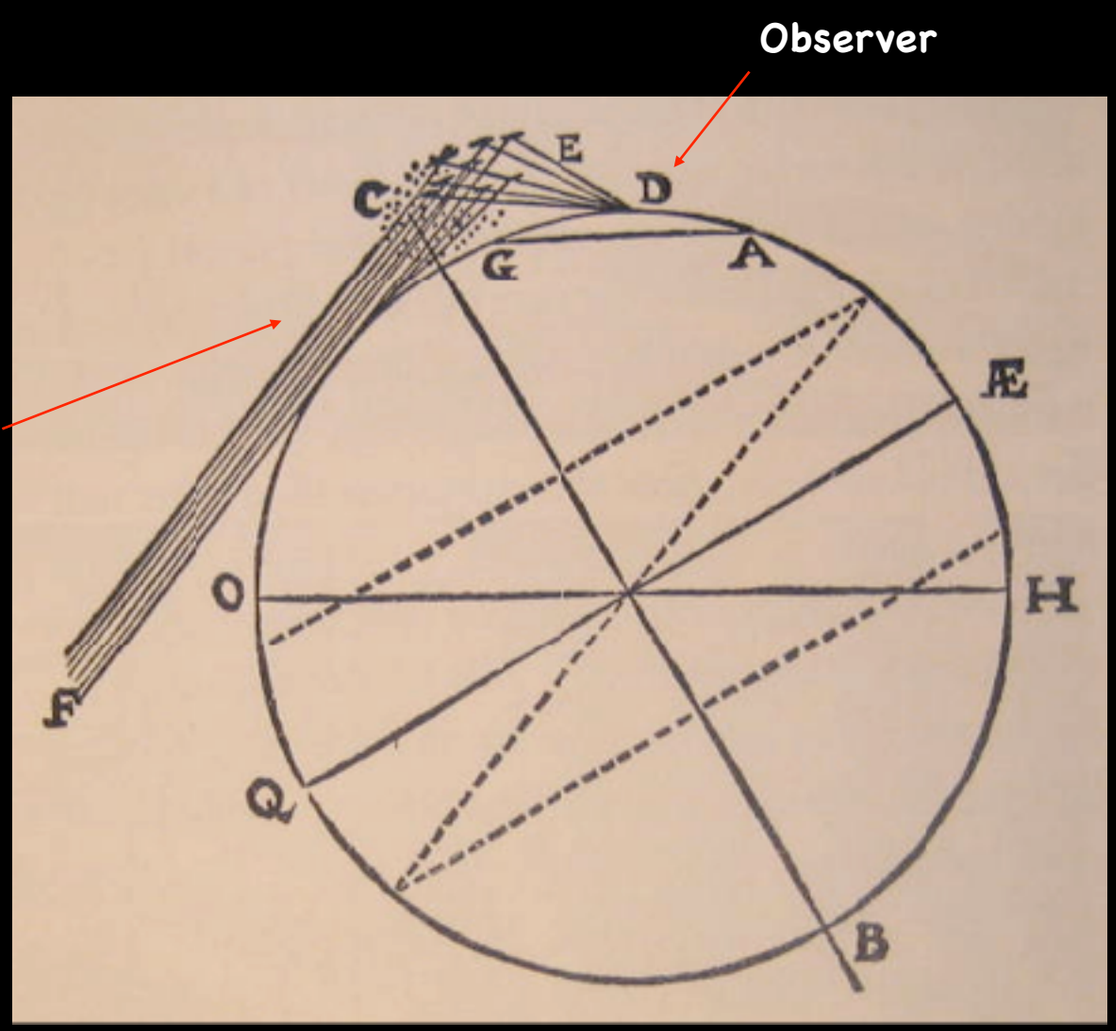
- The first realistic description of auroras is found in the Norwegian chronicle the King's Mirror from about 1230 AD. The book is originally written as a textbook, probably for the young King Magnus Lagabøte by his father.
- Reflected sunlight from below the horizon?, fires at Greenland?





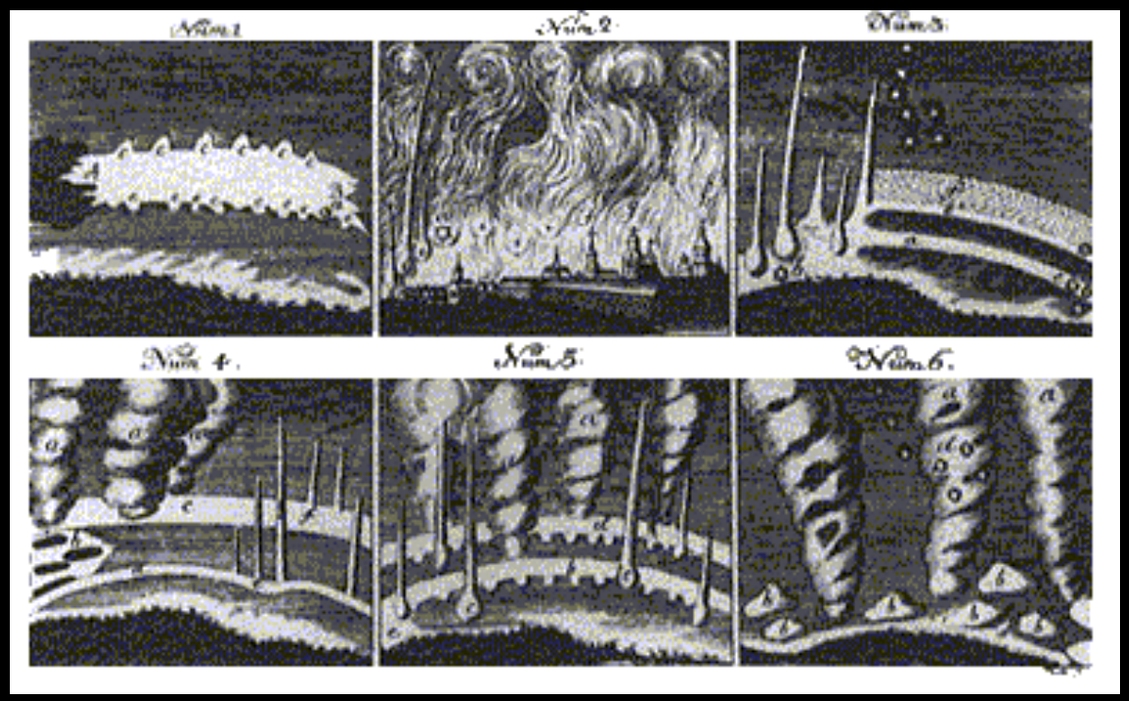
Early Aurora Science

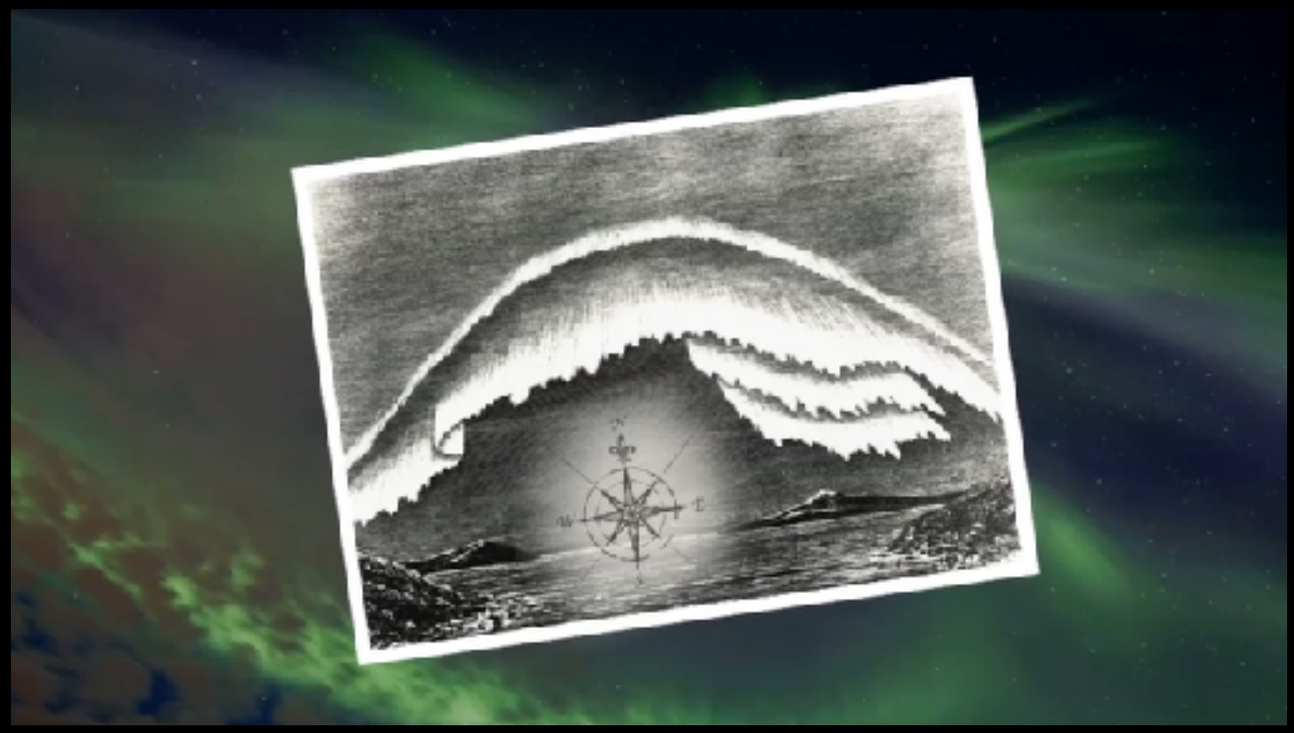
- Swedish Suno Arnelius (1681-1740) submitted his thesis in 1708 suggesting that solar rays were reflected off ice particles in the atmosphere
- Descartes also proposed a similar idea
- Later spectroscopic observations dismissed this theory



Early Aurora Science

The strong aurora on 6 March 1716 could be observed in large parts of Europe and gave birth to more modern science.

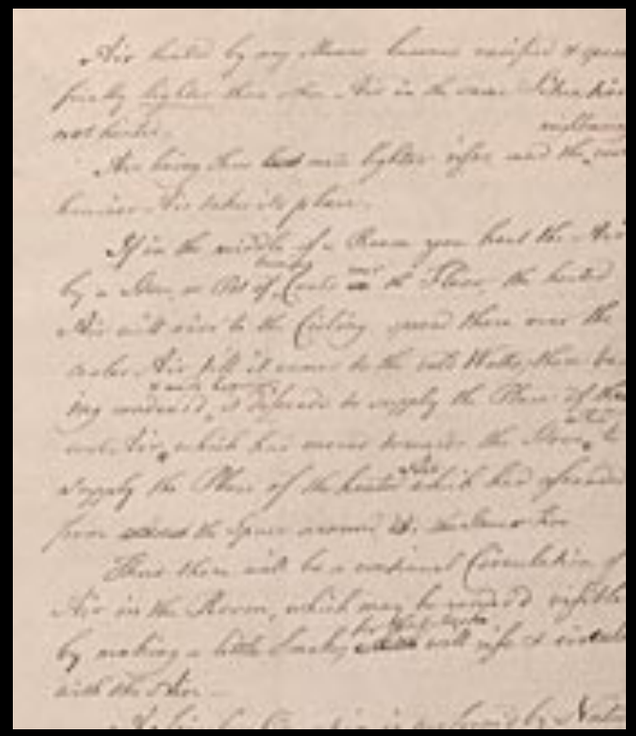




- Sir Edmund Halley published the first detailed description of the aurora in 1716.
  - He expressed that at an age of 60 years he had give up on experiencing this amazing phenomenon.
  - Argued that the top of the aurora arc did not point towards the North pole, but towards the magnetic pole
  - "Auroral rays are due to the particles, which are affected by the magnetic field; the rays are parallel to Earth's magnetic field" Magnetic licuid evaporationg from the polar regions

Benjamin Franklin (1706 - 1790)

- Benjamin Franklin's interest in the mystery of the "Northern Lights" is said to have begun on his voyages across the North Atlantic to England. He ascribed the shifting lights to a concentration of electrical charges in the polar regions intensified by the snow and other moisture. He reasoned that this overcharging caused a release of electrical illumination into the air.



In this essay, Franklin analyzed the causes of the Aurora Borealis. It was read at the French Académie des Sciences on April 14, 1779.

Birkeland- the first space scientist

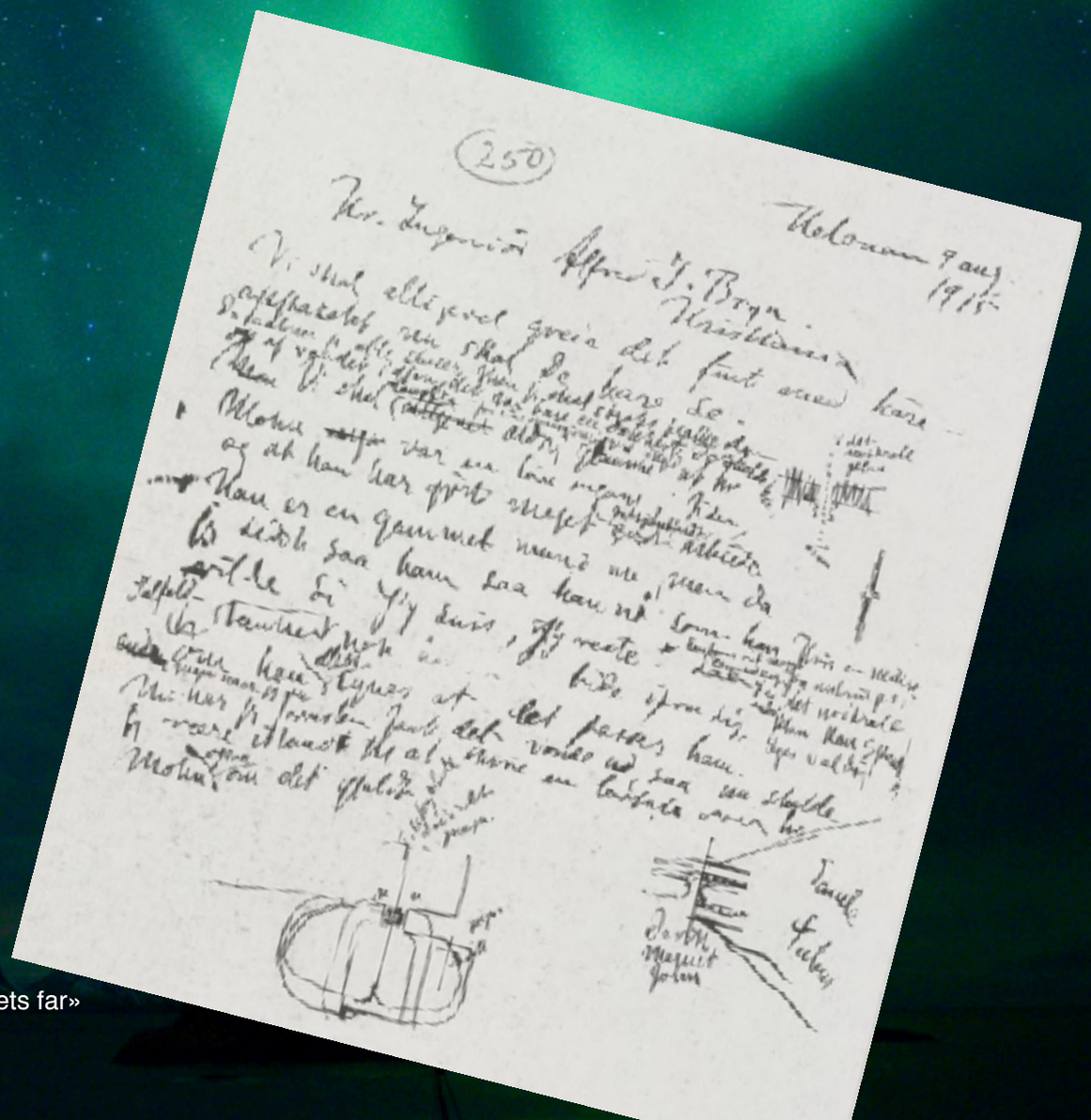
Birkeland - the Inventor

Birkeland worked on many applications (spinn offs) of his research.

About 60 patents came from his creative production.

- mechanical hearing-aid
- Caviar from cod-row
- radiotelefon
- power switches
- redistilling and refining crude oil
- hardening of fats
- margarine

From the book «Historien om Kristian Birkeland - Nordlysets far»

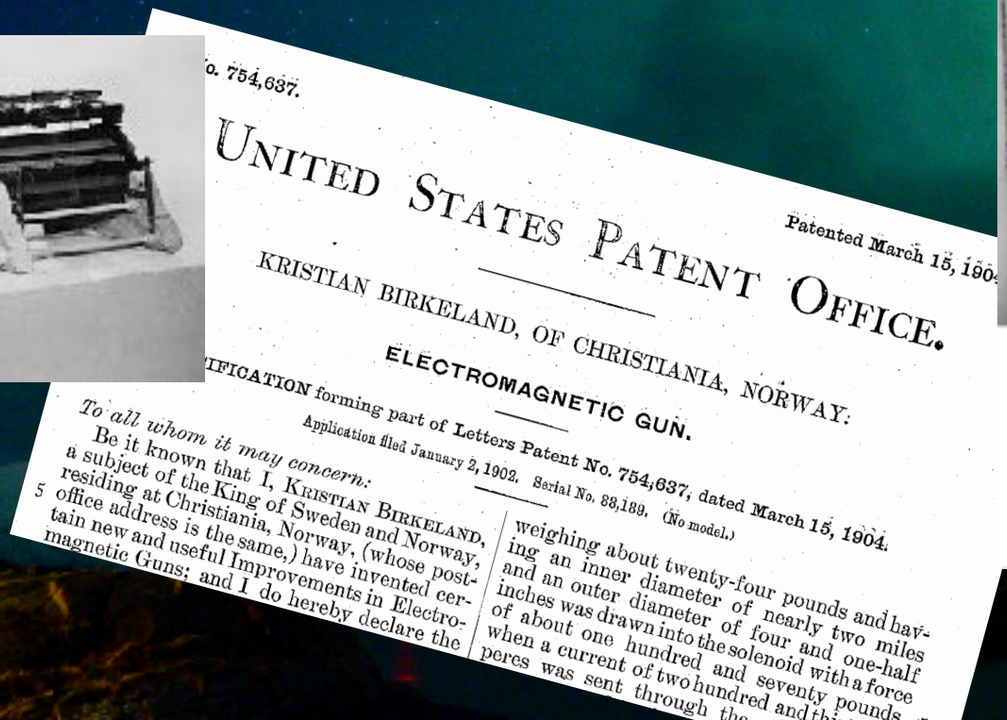


Birkeland - the Electromagnetic Cannon

Birkeland was regarded as one of the best experimental physicist of his time. And to find practical use of his research.

He developed the electromagnetic cannon - that he thought the military would buy. The banquet hall at the University of Oslo was filled with guests. Two ministers and Fritjof Nansen was observing from the front row.

Birkelands electromagnetic cannon



o. 754,637.

UNITED STATES PATENT OFFICE.

Patented March 15, 190

KRISTIAN BIRKELAND, OF CHRISTIANIA, NORWAY.

ELECTROMAGNETIC GUN.

IFICATION forming part of Letters Patent No. 754,637, dated March 15, 1904.

Application filed January 2, 1902. Serial No. 88,189. (No model.)

To all whom it may concern:

Be it known that I, KRISTIAN BIRKELAND, a subject of the King of Sweden and Norway, residing at Christiania, Norway, (whose post-office address is the same,) have invented certain new and useful Improvements in Electro-magnetic Guns; and I do hereby declare the

weighing about twenty-four pounds and having an inner diameter of nearly two miles and an outer diameter of four and one-half inches was drawn into the solenoid with a force of about one hundred and seventy pounds when a current of two hundred and

peres was sent through the

From the book «Historien om Kristian Birkeland - Nordlysets far»

Birkeland - the Industrial Man

Birkeland notice a large arc of light and the smell of nitrogen during the short circuits. He patented the technique to extract nitrogen from air and together with Sam Eyde he developed the Birkeland-Eyde oven.

This was the start of Norsk Hydro - and by 1908 they produced 7000 tons. A few years later the capacity was 28.000 tons

Birkeland-Eyde-oven at Hydro

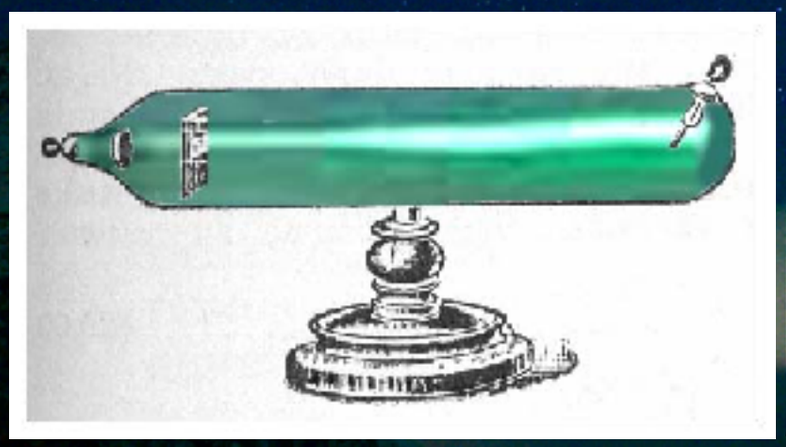
Hydro Patent no 1

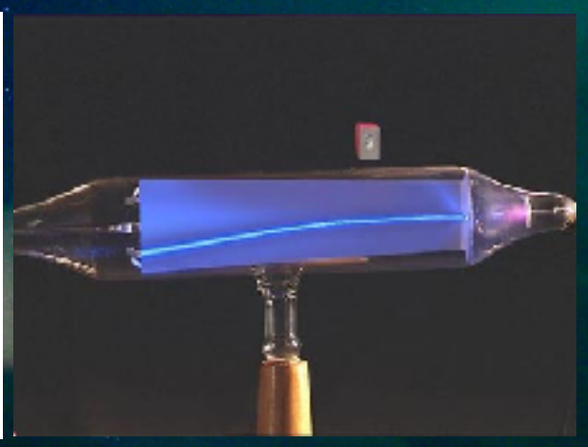
Birkeland - Cathode Rays

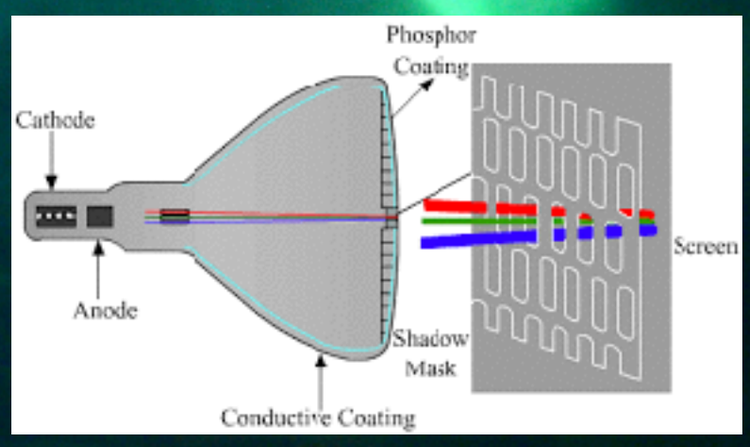
In 1895 he began pioneer studies of cathode rays, a stream of electrons in a vacuum tube that occurs through high voltage passing between negative and positive charged electrodes.

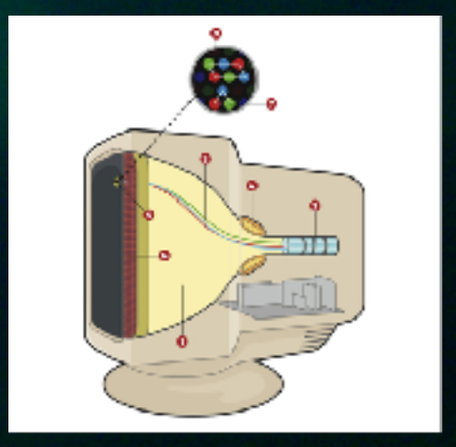
Birkeland concluded that the cathode rays consist of electrically charged particles and can be controlled by a magnetic field.

This would lead to his major scientific finding to explain the Northern Lights and its connection to the Sun.









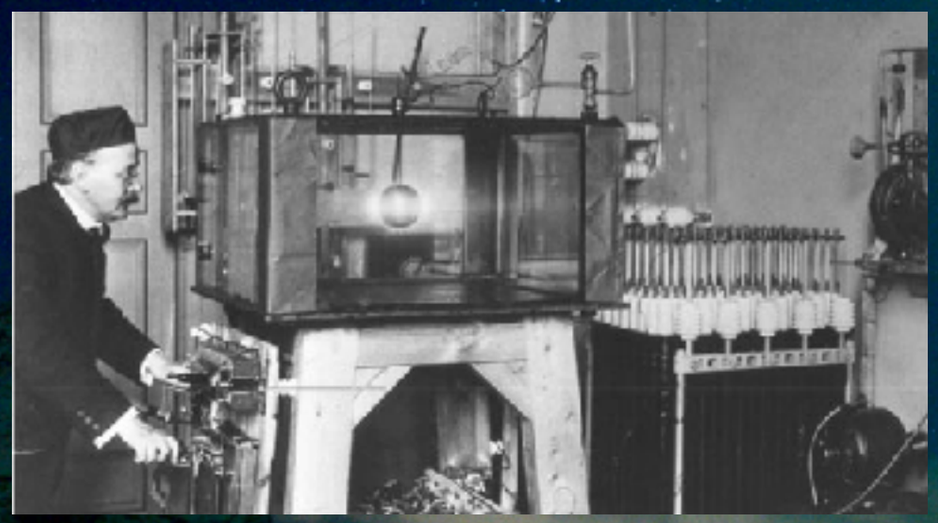
Birkeland - «The Solar Wind»

Already in 1896 Birkeland made the important assumption that the Sun continuously sends out cathode rays (charged particles) as well as photons. He based this on the continuous appearance of northern lights in the far north.

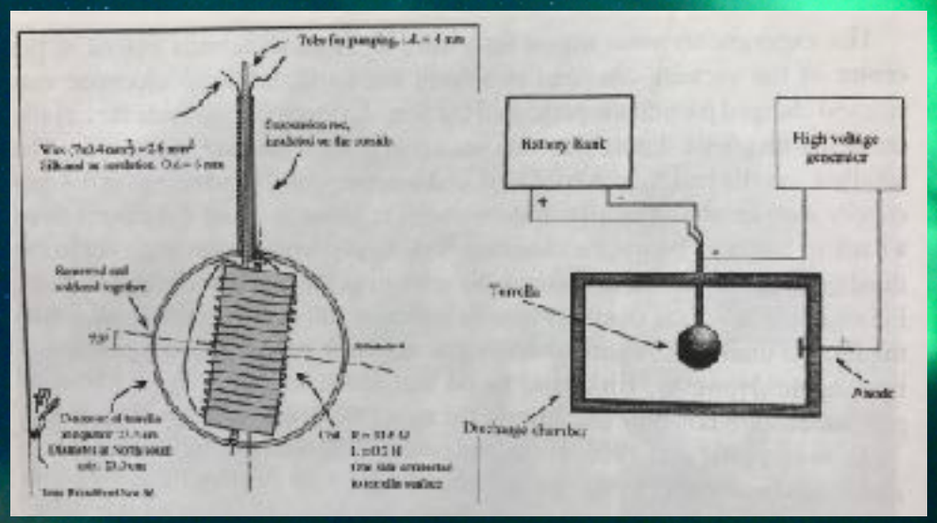
Birkelands Terrella-experiments

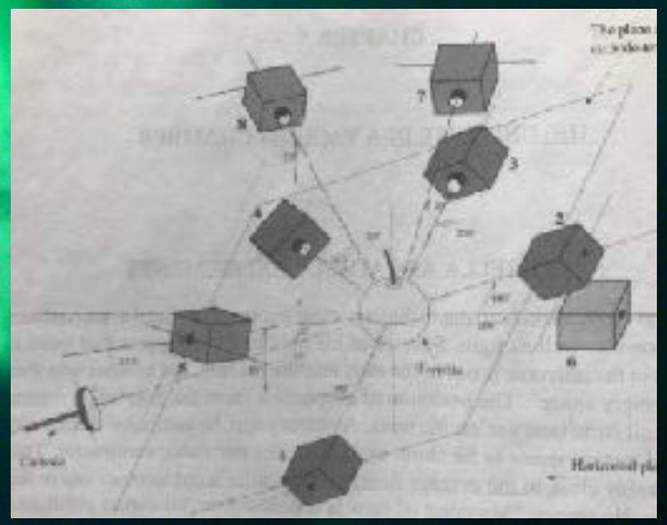
Using an electromagnet, he could create a magnetic field around the terrell mimicking Earth's magnetosphere.

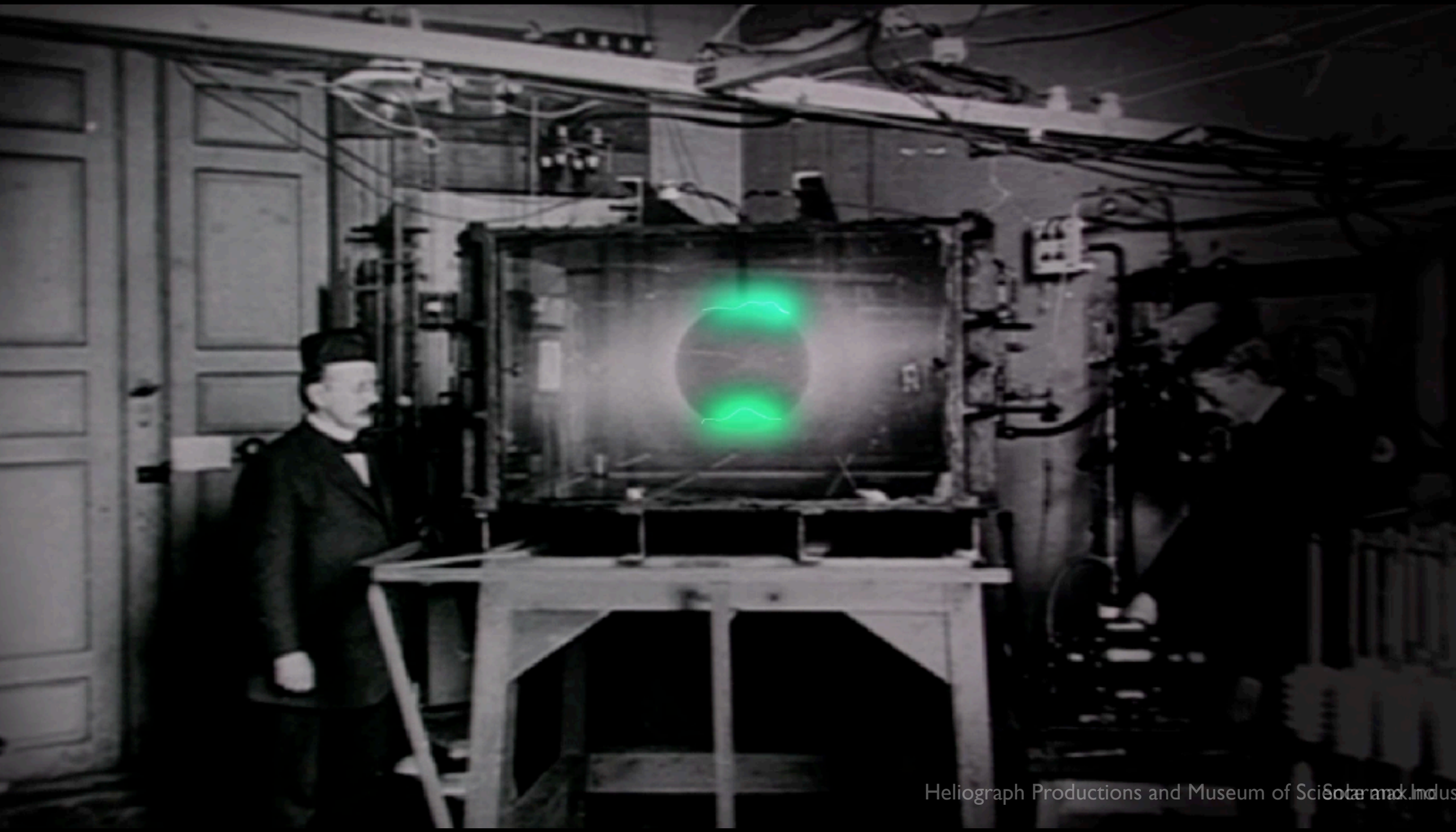
The atmosphere was a layer of fluorescent paint that would give off light when it was struck by charged particles.



The voltage was 25.000 volt

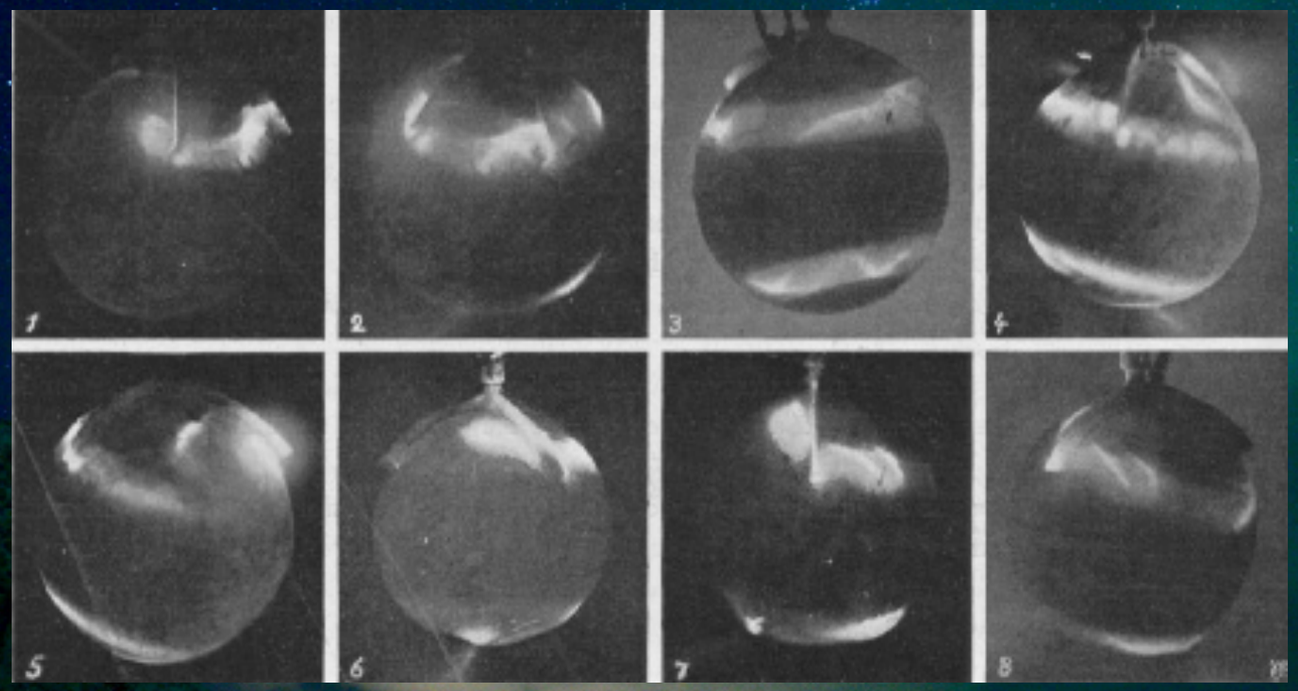


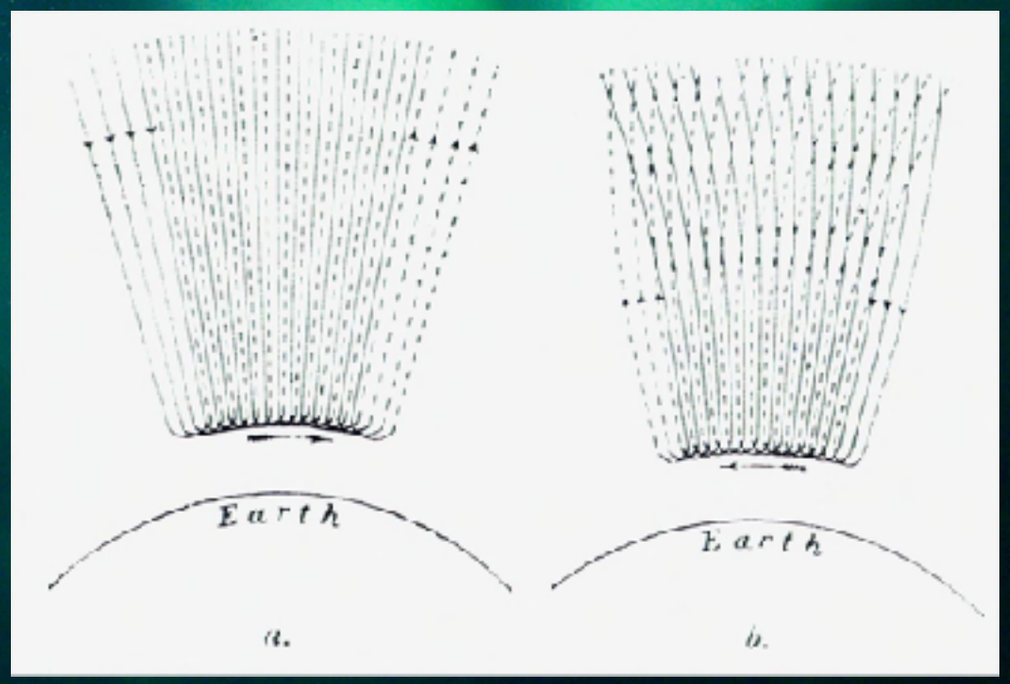



Heliograph Productions and Museum of Science and Indus
Solar mach

Birkeland Currents

Birkeland also launched an idea that the same particles that create the northern lights set up a system of electrical currents in the Earth's atmosphere. Such flows could explain the magnetic disturbances observed during strong auroras.





Haldde Observatory

One of Birkeland's greatest wishes was to establish the altitude of the aurora.

In 1899 he build two small observatories on the Haldde and Talvikstoppen mountains to solve this problems. Frequent storms, smoke inside, bad weather and a deadly avalanche in 1900 almost stopped the activities at the observatories. Also measuring the height was not successful.

Vi har herved den sorgelige pligt at bekjendtgjøre, at vor dygtige og af alle afholdte Kaptein

Adolf Richard Lange

forer af D/S Fortunatus omkom den 16de ds. ved ulykkestilfælde.

Begravelsen foregaar fra ***direktørboligen i Kaafjord tors-dag den 22de ds. kl. 3 eftm.***

Kaafjord den 19 marts 1900.

Altens kobbergruber
Fr. Schütz.

Roald Amundsen visited the observatory in 1902/3

The Permanent Haldde Observatory 1912-1926

Birkeland was for some years busy with developing the fertilising technique and industry development, but in 1912 after an expedition to Egypt he managed to raise money for building a larger permanent observatory.

Here several families with children worked and lived all year.

The new and larger observatory

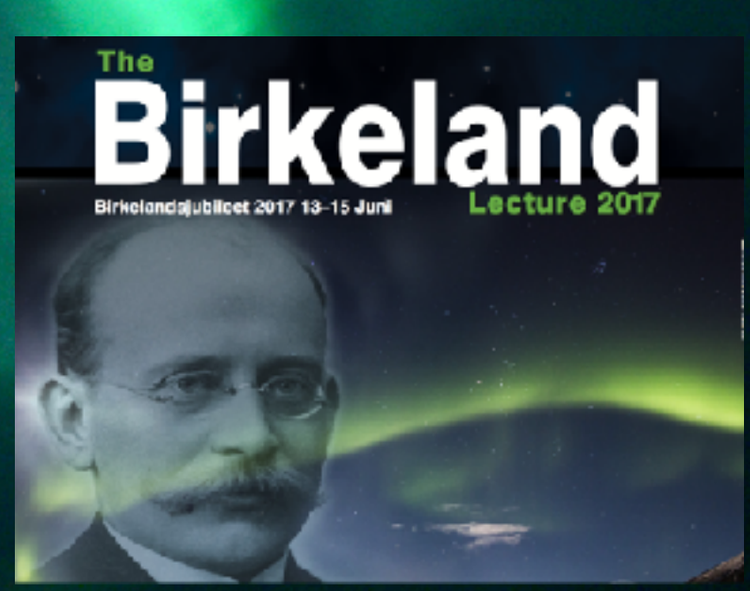
Setting up a magnetic observatory network

Birkeland's sad fate.

When he was going back to Norway it was difficult to travel the normal route due to the First World War. Thus he took a detour via Tokyo to work with some colleagues and visit friends.

At that time he was mentally unstable and ended his life in a hotel room 15th June 1917.

Birkeland dies in Hotel Seiyoken, Tokyo

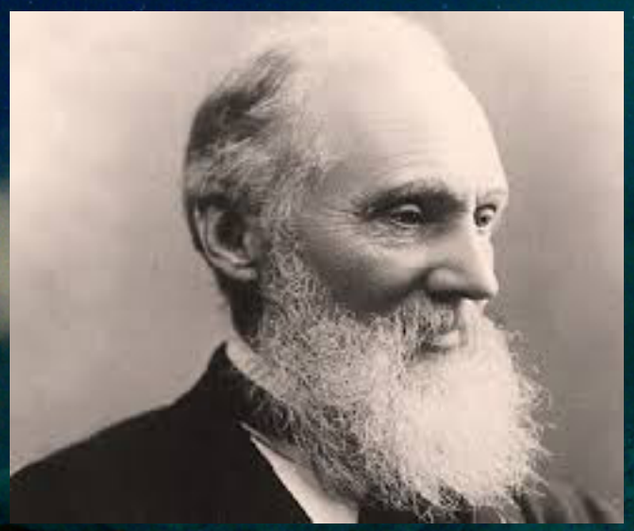


Birkeland - criticised by fellow scientists

Birkeland's theories about the northern lights and electrical currents in the atmosphere met great opposition among internationally renowned scholars such as Lord Kelvin and British scientist Sydney Chapman.

Lord Kelvin argued it was not possible that the Sun was responsible for the aurora - since space was «empty»

Chapman said that Birkeland expeditions to the arctic was unnecessary and his theory to way to «curious».



Lord Kelvin

Sydney Chapman

Satellites Confirms Birkeland Theories

In 1959 the Russian Luna 1 measured solar wind particles on the way to the moon. In 1962 NASAs Mariner II spacecraft on its way to Venus measured the presence of an electrified gas with speed up to 300-700 km/s. This proved that «empty» space was not empty at all but filled with particles - the solar wind

In 1966 a U.S. Navy navigation satellite observed magnetic disturbances near polar regions. This lifted Birkeland's name again.

Electrical currents were detected by satellites in 1967 and 1973 just like Birkeland proposed

Luna I

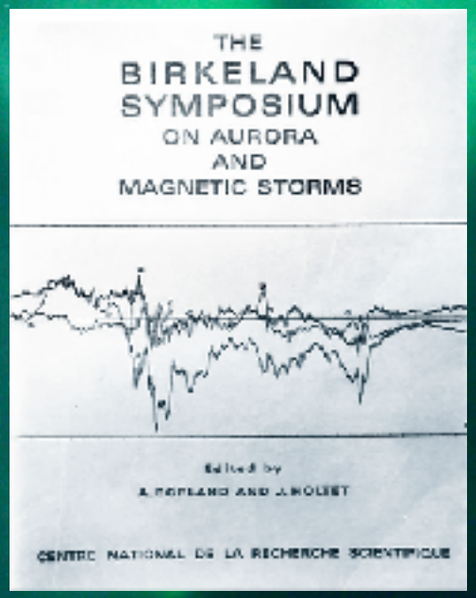
NASA Mariner II

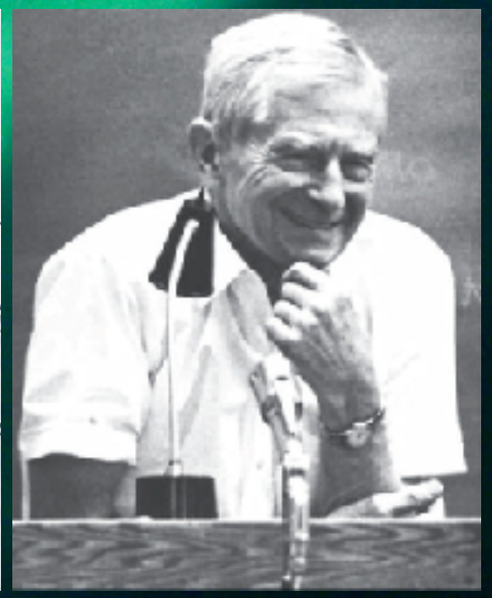
Chapman vs Birkeland

At the 50 year anniversary after the death of Birkeland a large symposium was organised in Norway. An international committee decided to name the observed currents Birkeland Currents

Even 50 years later (1967) Chapman stated this at a conference in Norway:

«Though Birkeland was certainly intensively interested in the aurora……it must be confessed that his direct observational contribution to auroral knowledge were slight»



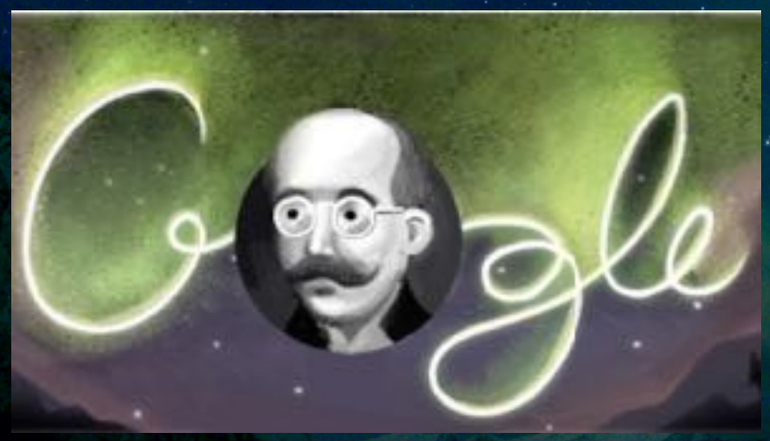


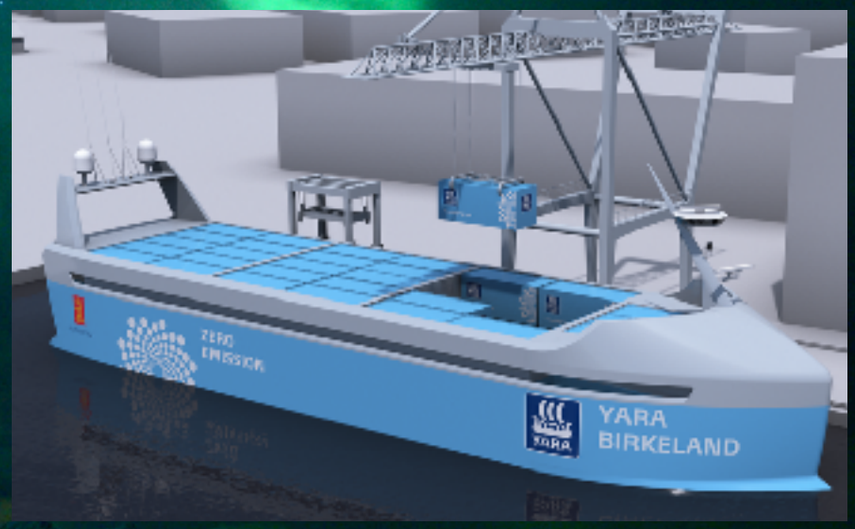
One young American scientist, Alex Dessler, questioned Chapman about Birkeland.

«I asked him wether Birkeland work had any influence on him at all»

«How could it? It was all wrong»

Just recently Birkeland got the honour he deserved





Science on a bill

- Aurora seen from below and the Polar star
- Big dipper and Little dipper
- Snow crystal - cold climate
- The Terella-experiment

- Map of the Arctic and the magnetic pole
- Aurora-oval
- Birkeland Current
- “Invisible” comet

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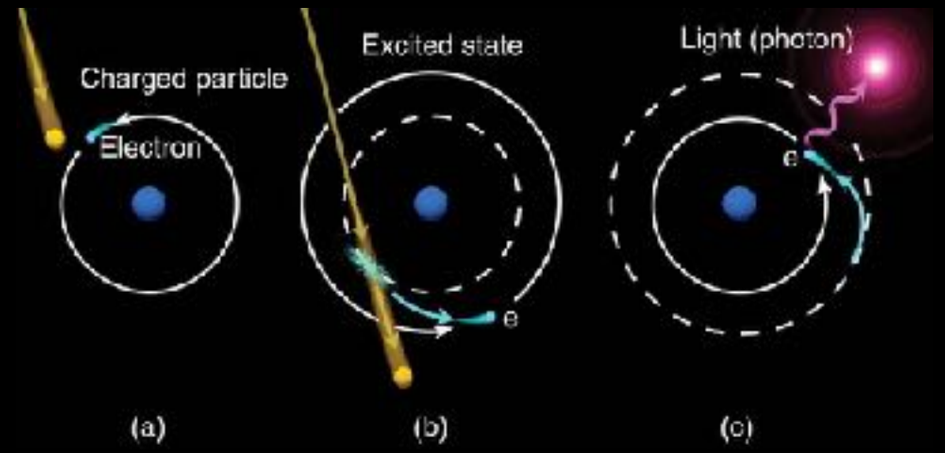
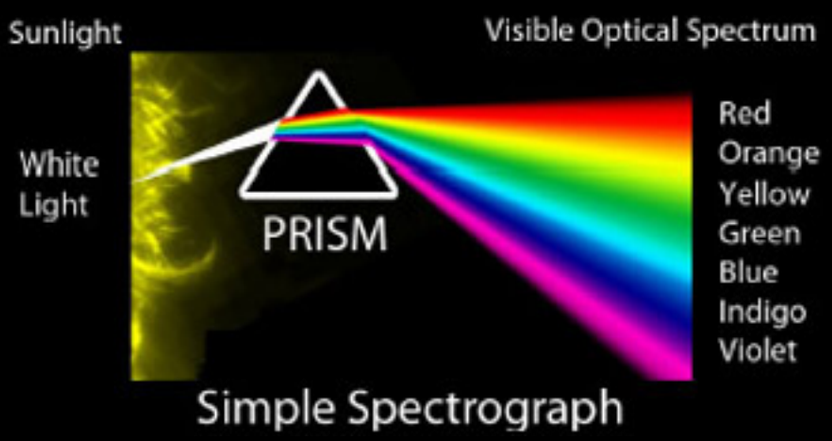
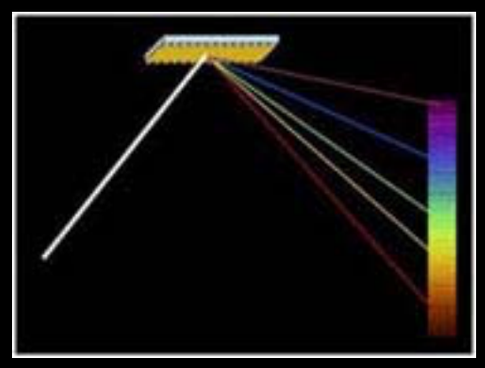
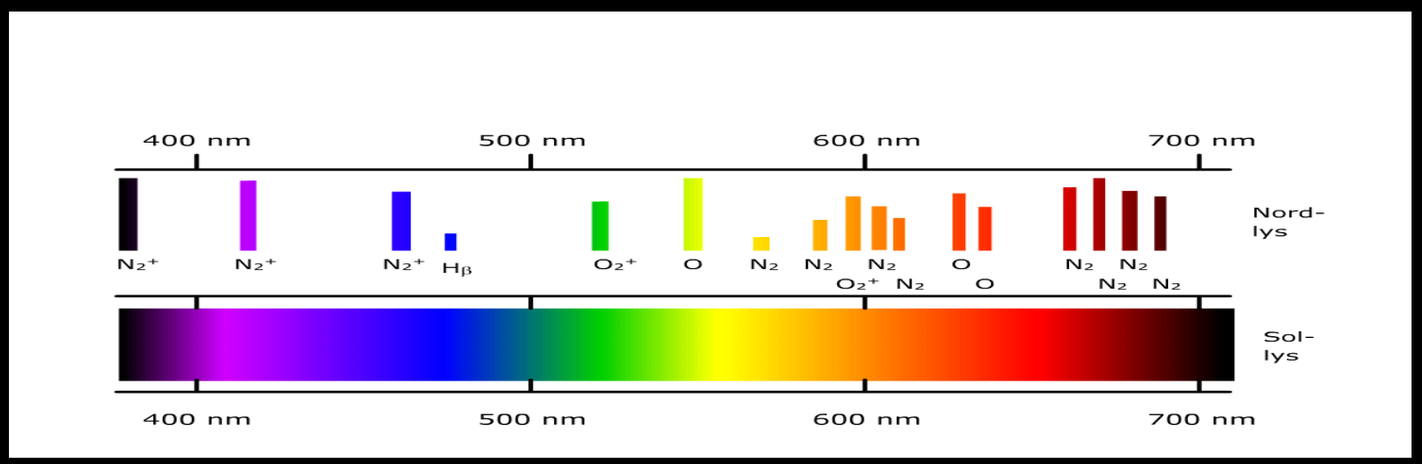
Lars Vegard (1880 - 1963)

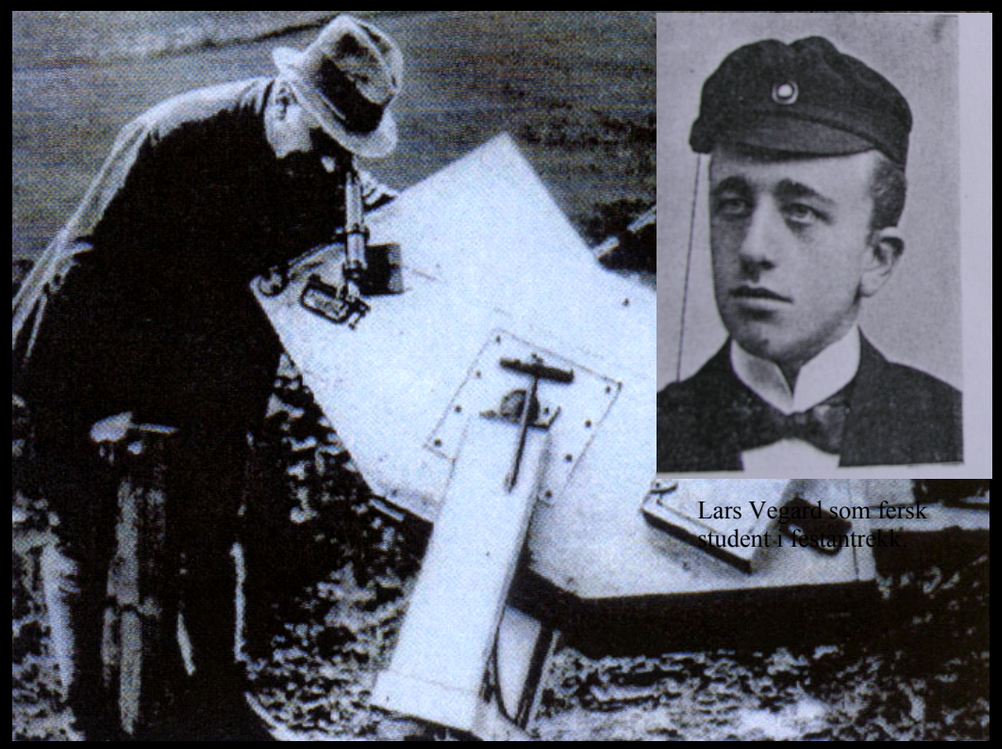
- The spectra of the aurora - the colors - the fingerprints
- First to observe the proton-aurora
- Composition of our atmosphere







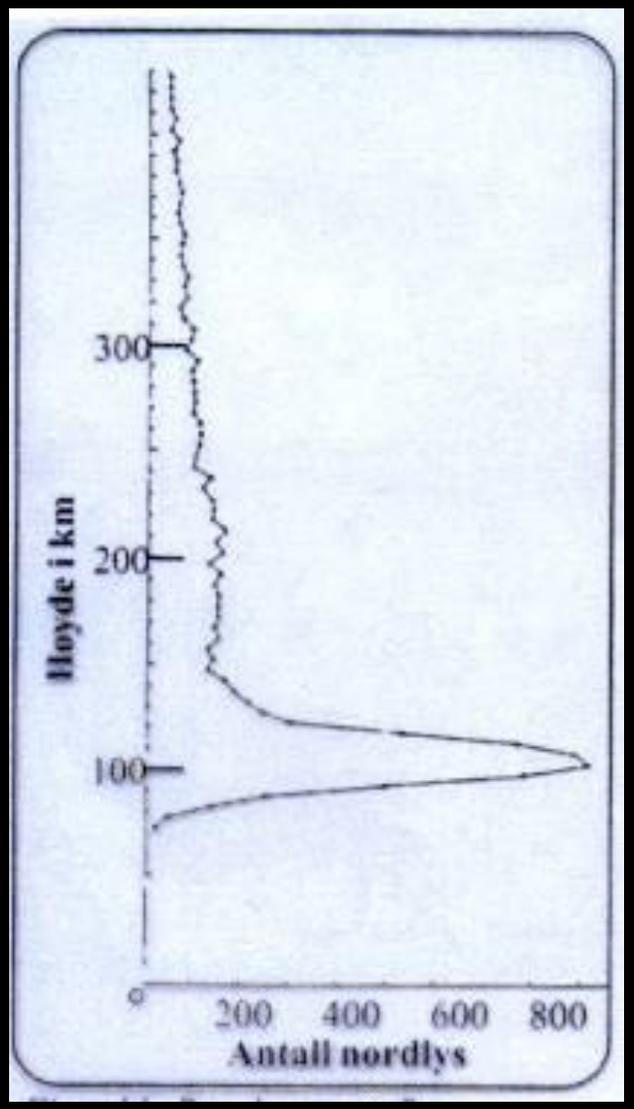




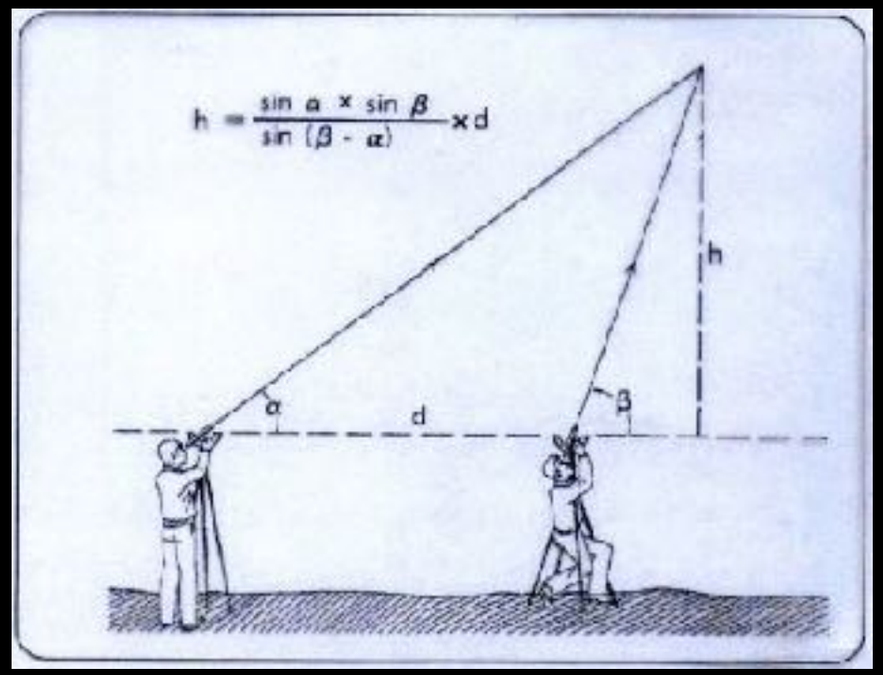
Professor Lars Vegard with this aurora-spectrograph

Carl Störmers (1874 – 1957)

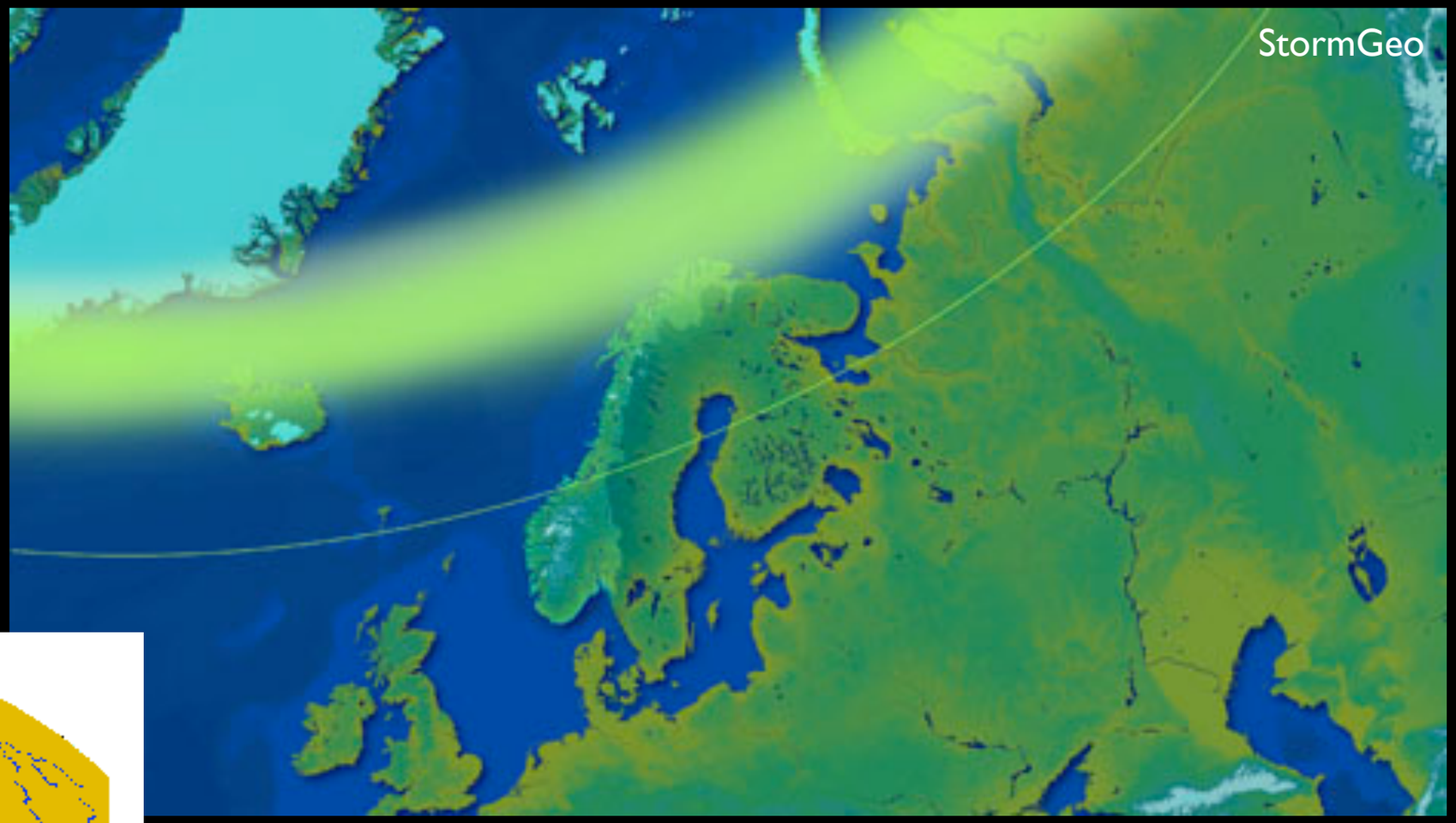
- Height of the aurora
- First aurora atlas (40,000 pictures)

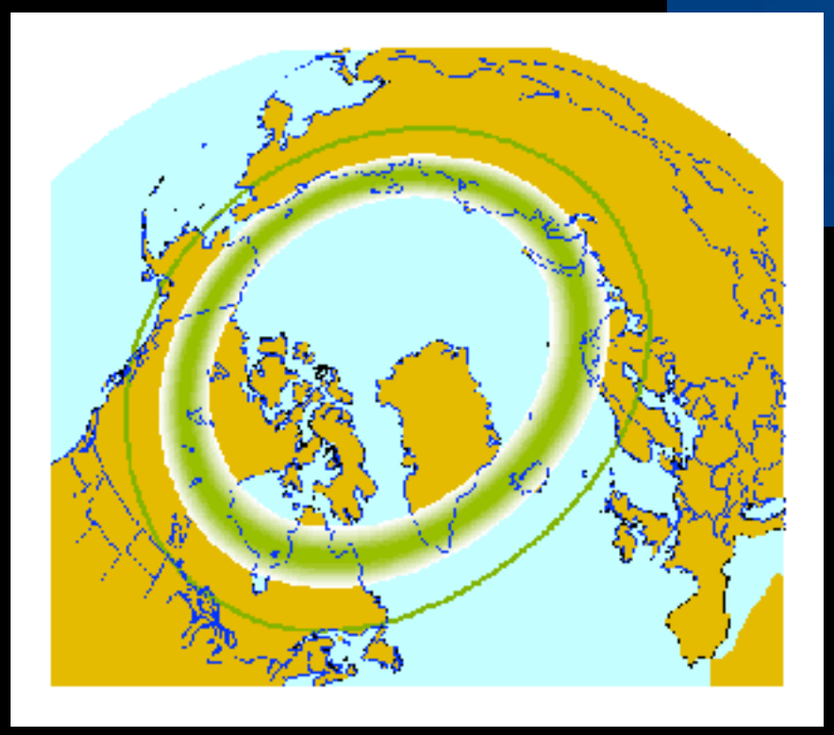


Professor C. Størmer and his assistant outdoors taking parallactic auroral pictures to calculate the altitude of auroras.



Norway tailor-made for Aurora Science



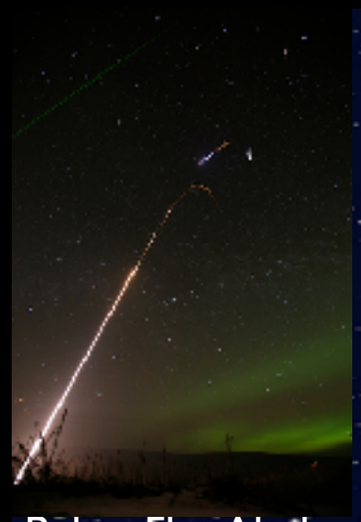


Why Norway is the best place to see the Aurora

The best place to see the auroras is, of course, at high latitudes. Auroras are present within a zone about 1000-3000 km from the magnetic poles every night. It stretches across the northern part of Scandinavia over to northern Russia, and then across Alaska and the northernmost parts of Canada, and further across southern Greenland and Iceland. Thus, all these countries are good for observing the aurora.

However, most places are hard to access with little or no infrastructure. In addition they are usually much colder than North-Norway.

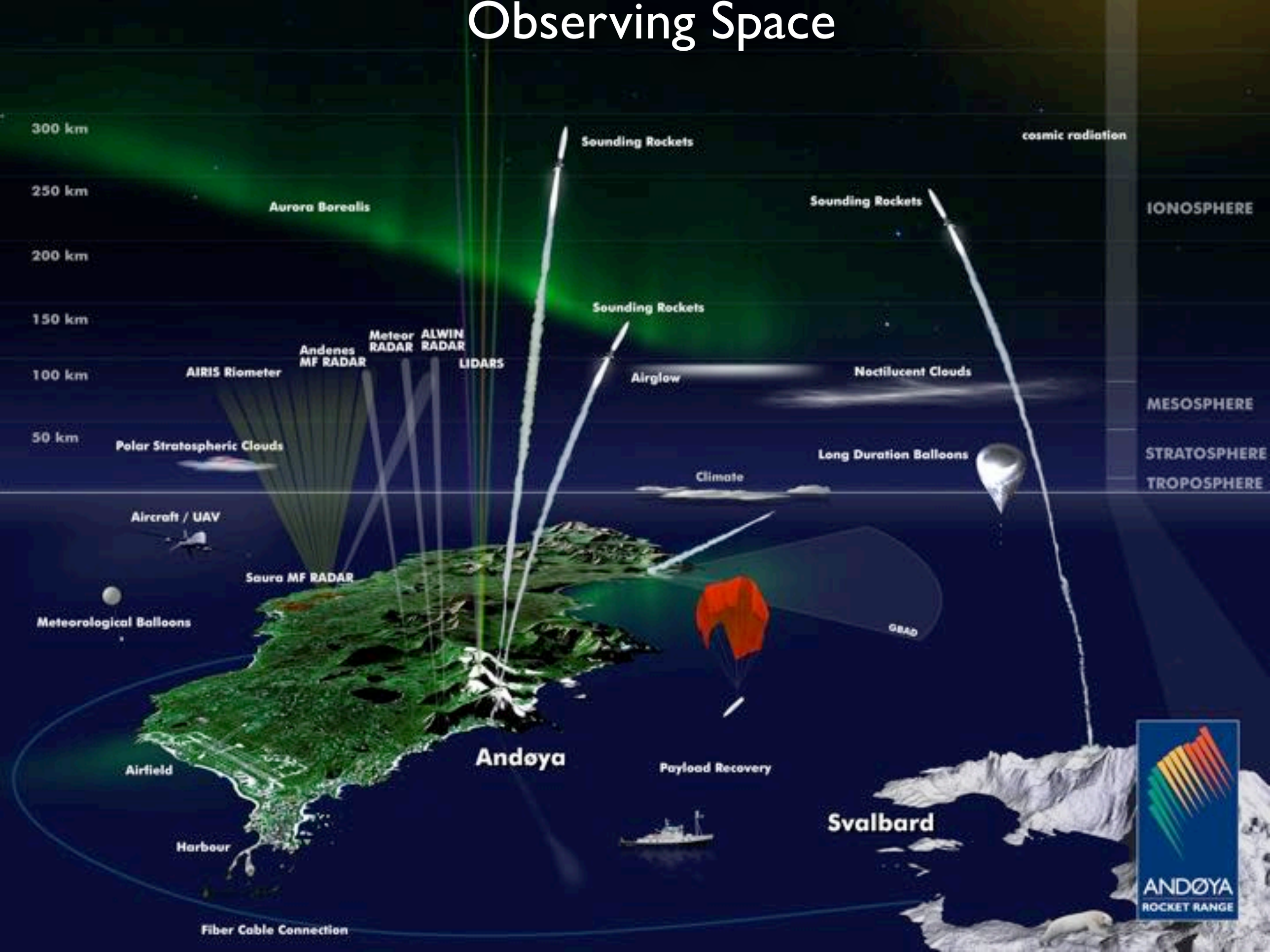
Modern Science Infrastructure



Poker Flat, Alaska

Kiruna Sweden

Observing Space



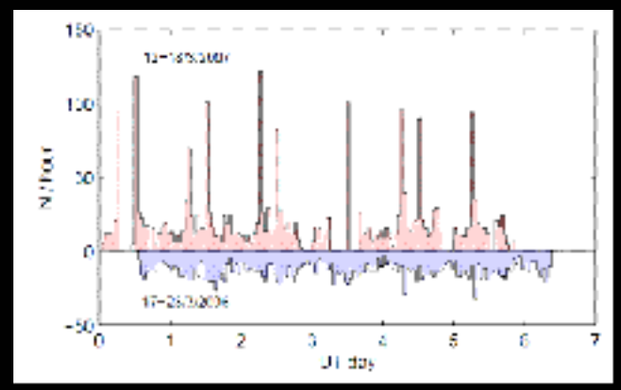
ICI-3 from Ny Ålesund

The research from this and the previous ICI flights will enable scientists to understand how space weather affects all types of radio communications.

Kjell Henriksen Observatory

The Minister of Research and Higher education, Tora Aasland, officially opened the observatory, in minus 35 degrees Celsius

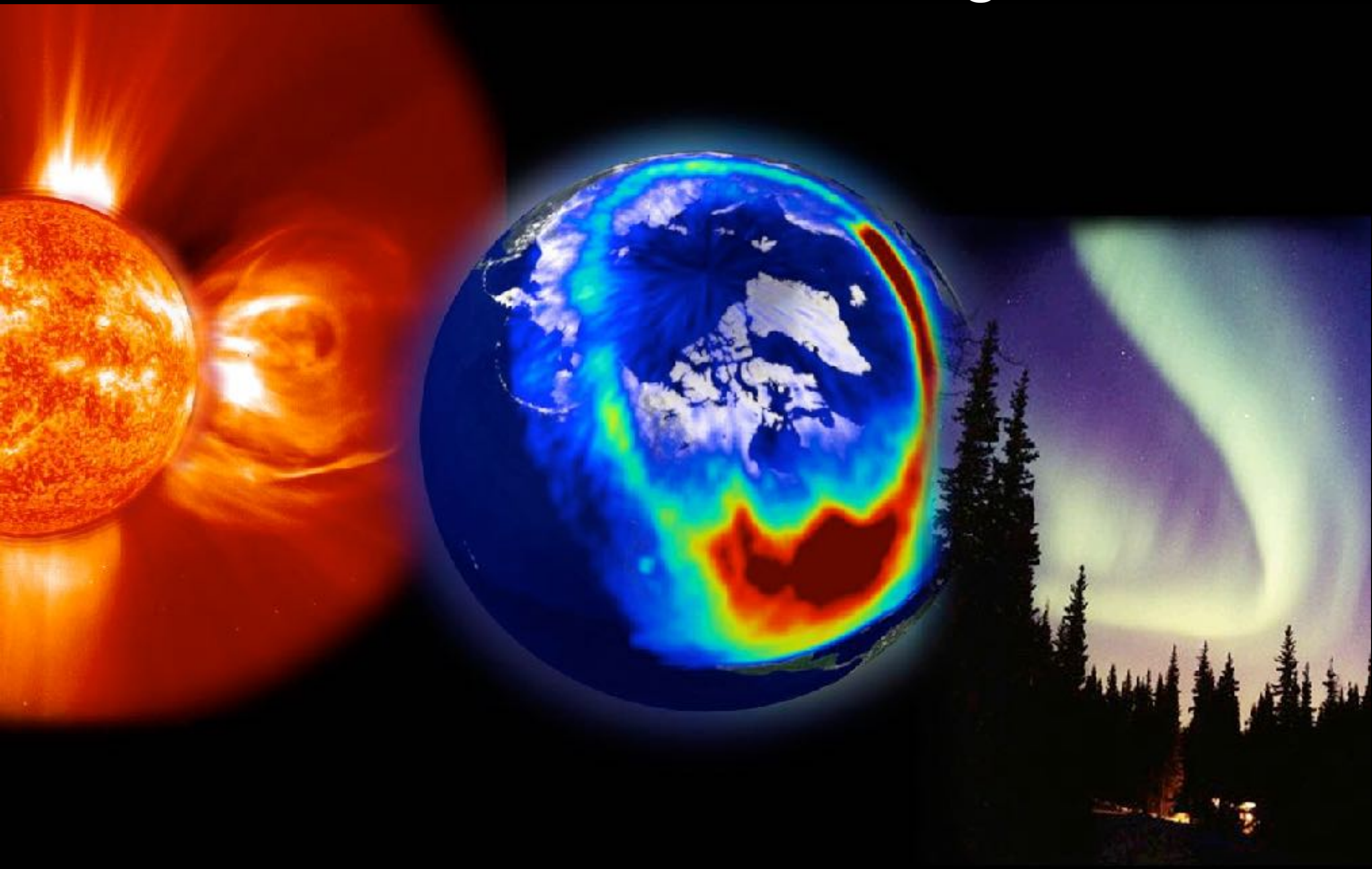
The EISCAT radars at Svalbard



EISCAT (European Incoherent Scatter) – studies the interaction between the Sun and the Earth (ionosphere, plasma clouds etc.)

Also useful for tracking space debris

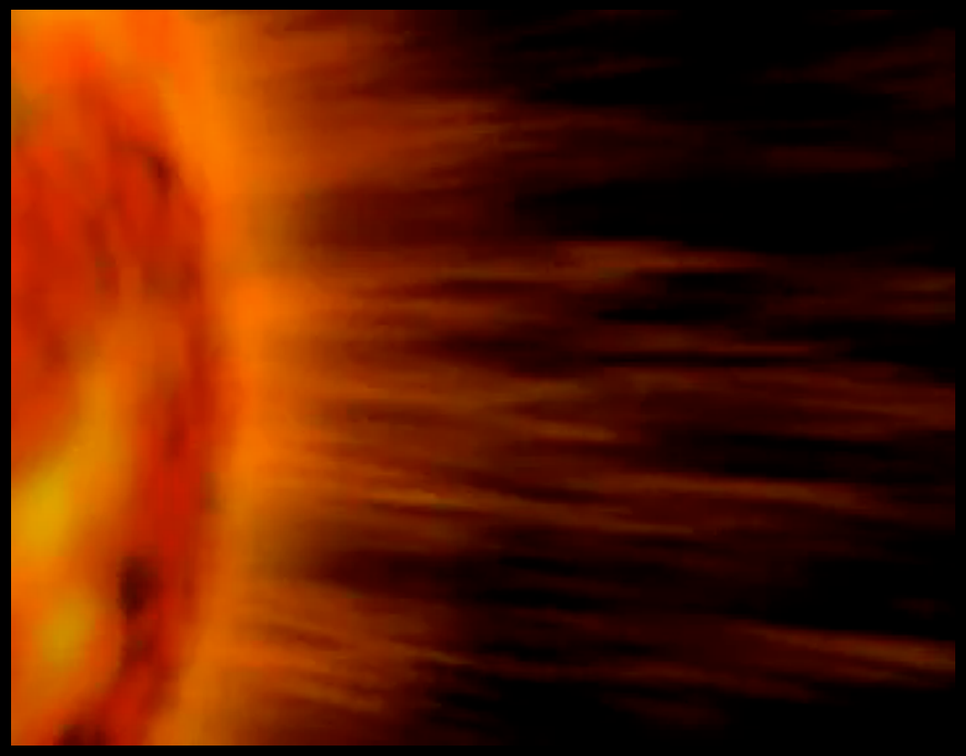
The Sun - The Aurora Engine

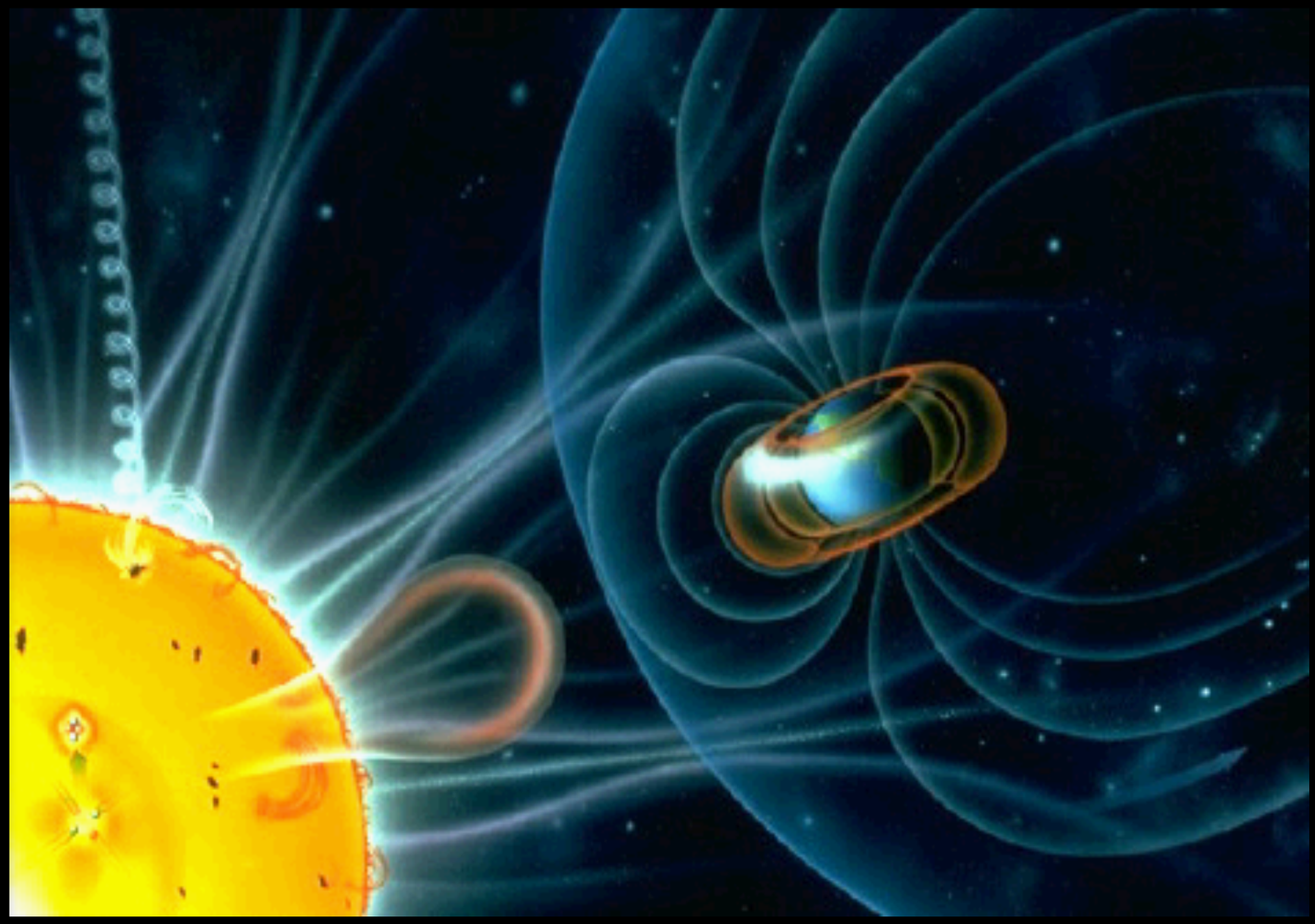


The Sun

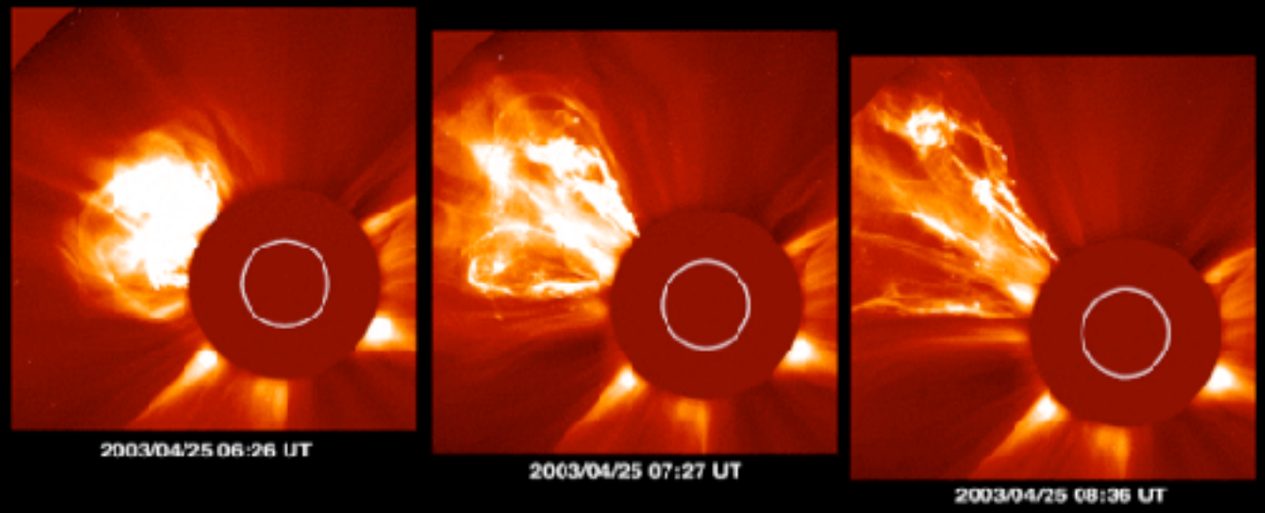
What is the Solar Wind?

- A constant stream of particles flows from the Sun's corona, with a temperature of about a million degrees and with a velocity of about 1.5 million km/h. The solar wind reaches out beyond Pluto's orbit (about 5900 million kilometres). The drawing shows how it pushes on and shapes the Earth's magnetosphere.

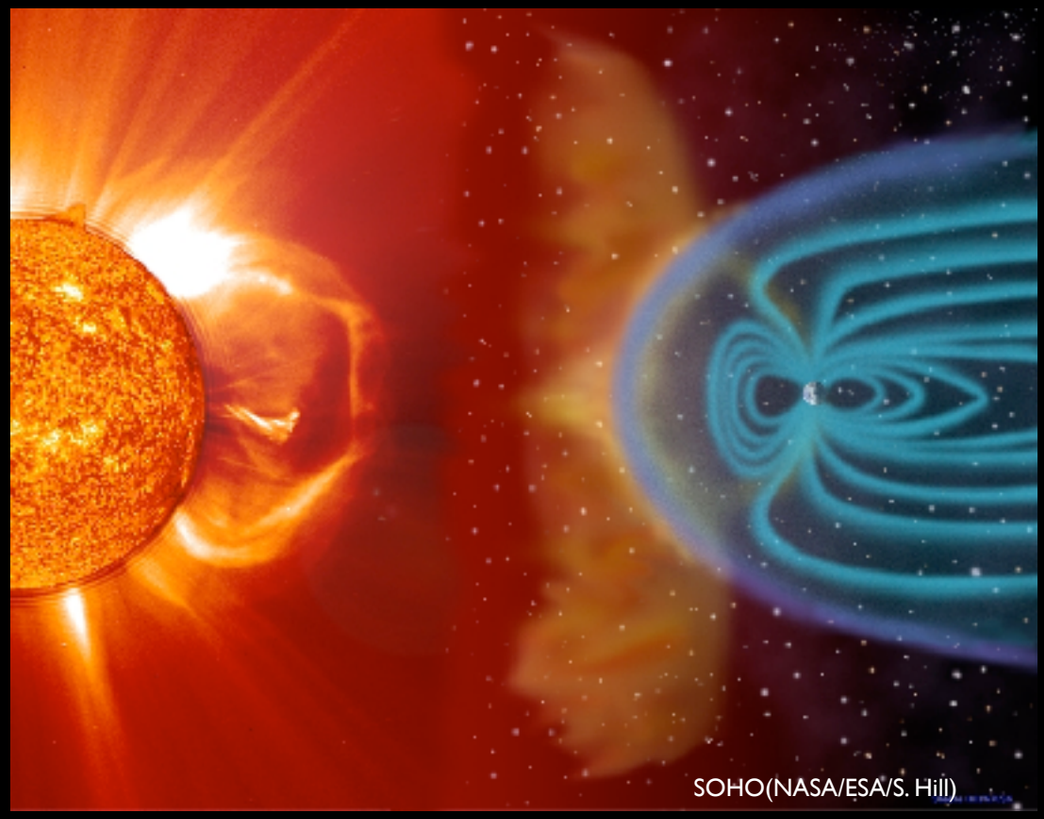




GAS ERUPTION ON THE SUN



SOHO(NASA/ESA/S. Hill)

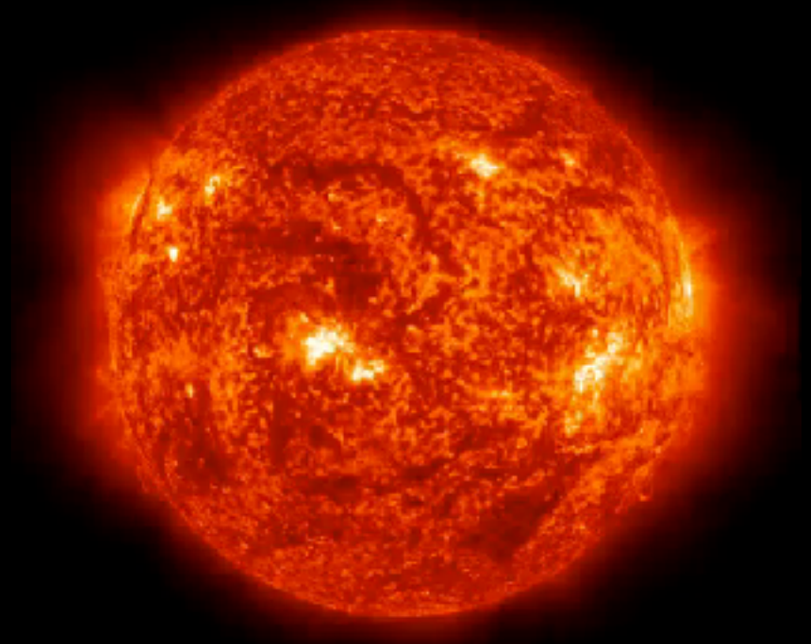


Sometimes large prominences can erupt and large amount of gas and magnetic fields are ejected out in space. The largest eruptions eject several billion tons of particles corresponding to 100,000 large battleships. Such eruptions are called Coronal Mass Ejections or CMEs for short. The bubble of gas will expand out in space and can reach velocities up to 8 million km/h. Still it would take almost 20 hours before it reach the Earth. Usually the solar wind spends three days on this journey.

If such an eruption is directed towards the Earth the particles will be deflected by our magnetosphere. The cloud of gas will push and shake the Earths magnetic field and generate a kind of “storm” which we call geomagnetic storms.

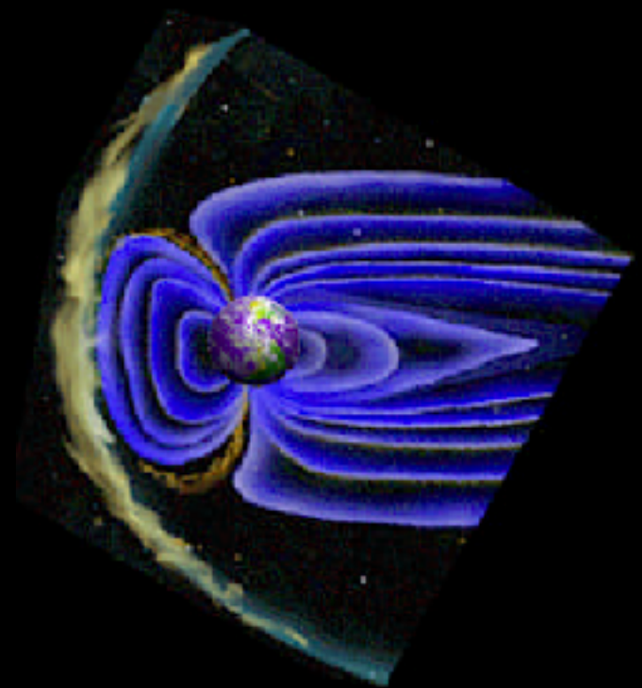
The Sun-Earth Connected System

We live in the extended atmosphere of a variable star



Varying

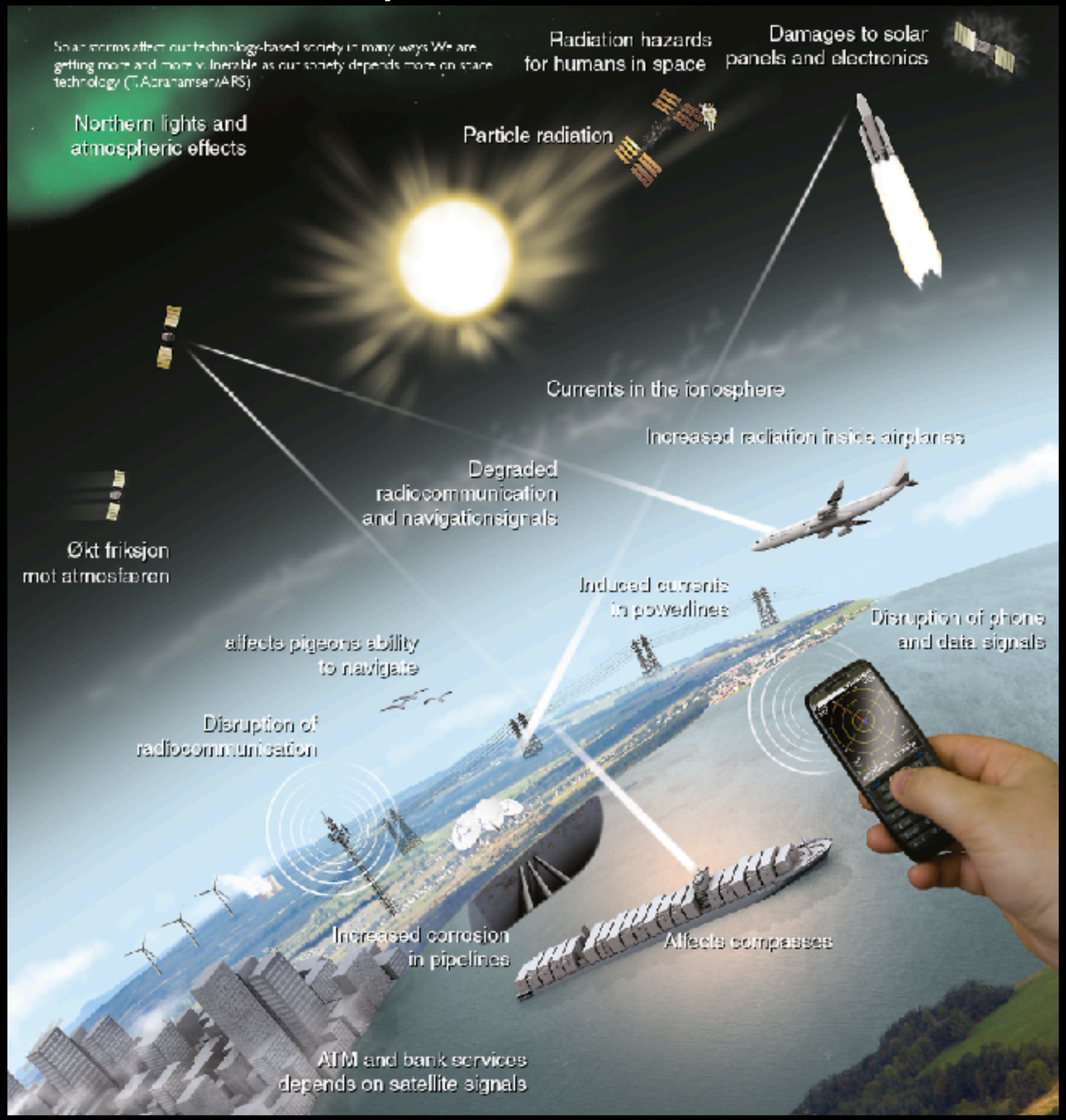
- **Radiation**
- **Solar Wind**
- **Energetic Particles**



Questions:

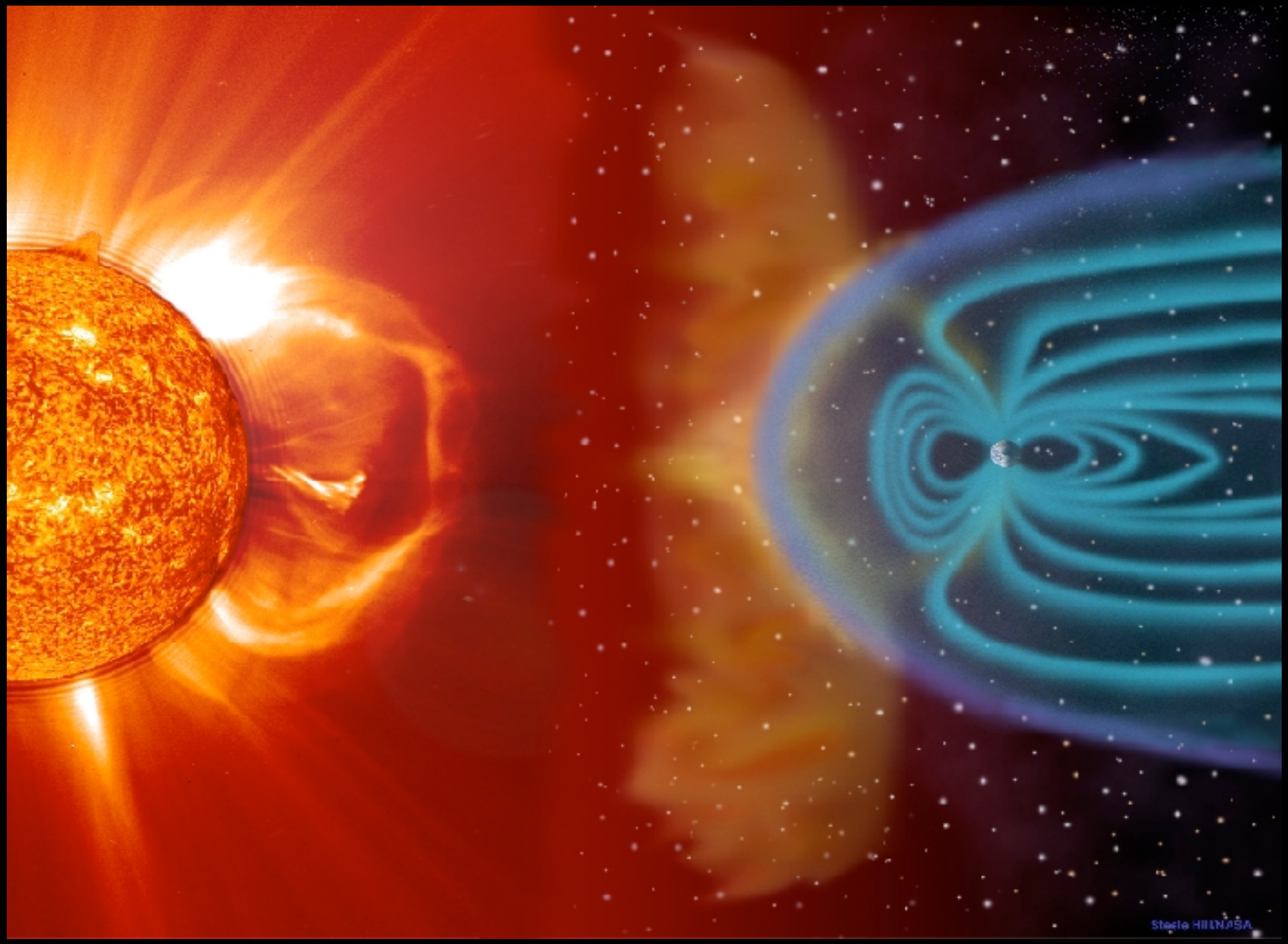
- How and why does the Sun vary?
- How does the Earth Respond?
- What are the impacts on humanity

Space Weather



From the book «Our Explosive Sun» (P. Brekke)

What causes the Northern Lights

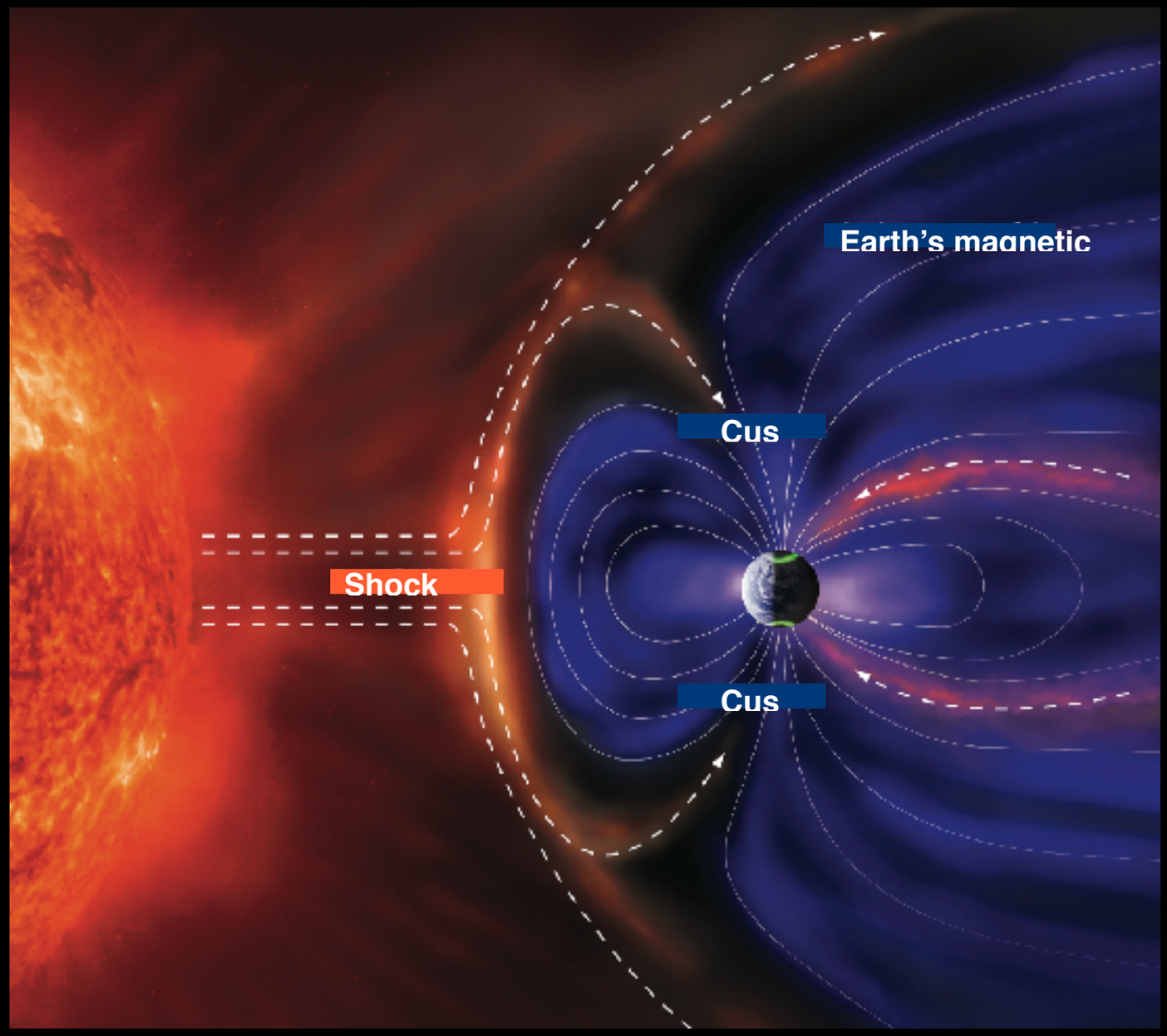


When the solar storm reaches Earth, something strange happens. It's as if it is deflected by an invisible shield – the Earth's magnetic field – the magnetosphere.

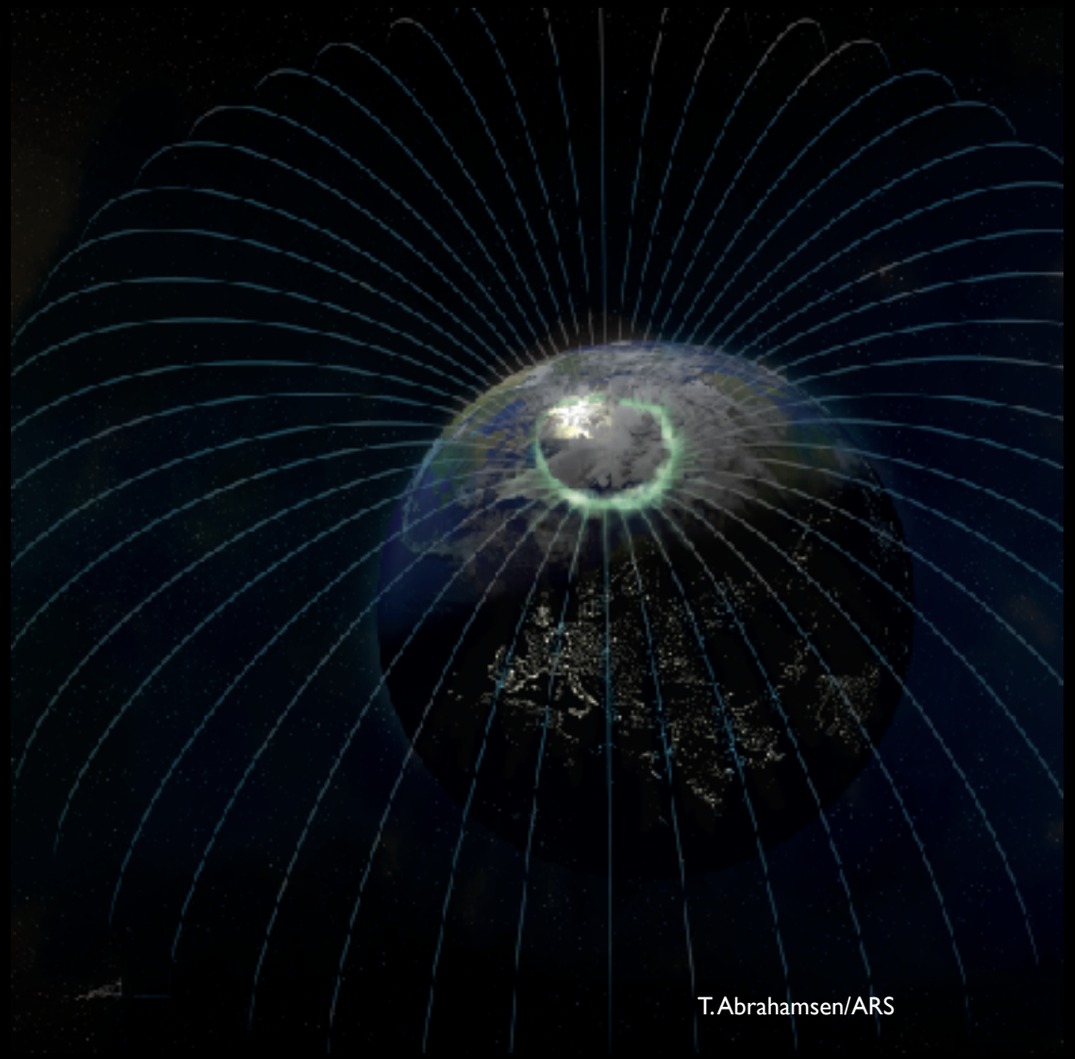
What causes the aurora

The magnetic fields couple together and create a funnel for the gas streams down on the daylight side of the pole. This is the daytime aurora, which our eyes cannot see.

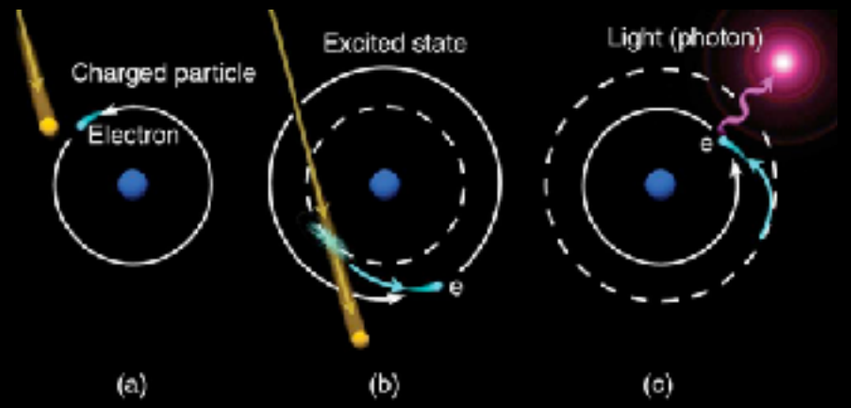
The magnetic fields stretch further rearwards and couple together. The magnetic fields, stretched like a rubber band, break, and gas from the solar storm streams back along the magnetic lines towards the polar regions on the night side. This is night-time aurora we can see.

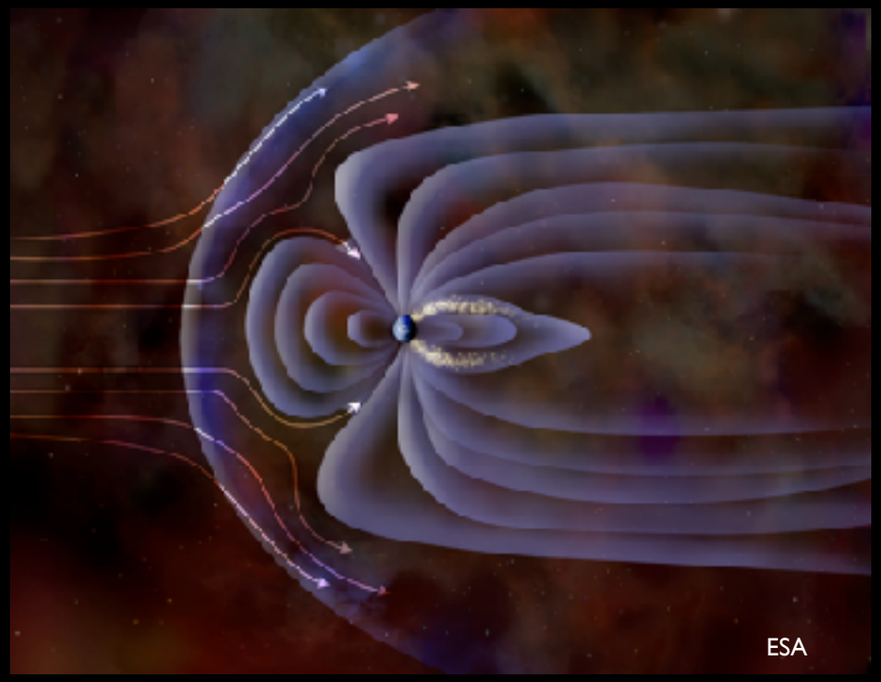


HOW ARE THE NORTHERN LIGHTS CREATED?



T.Abrahamsen/ARS





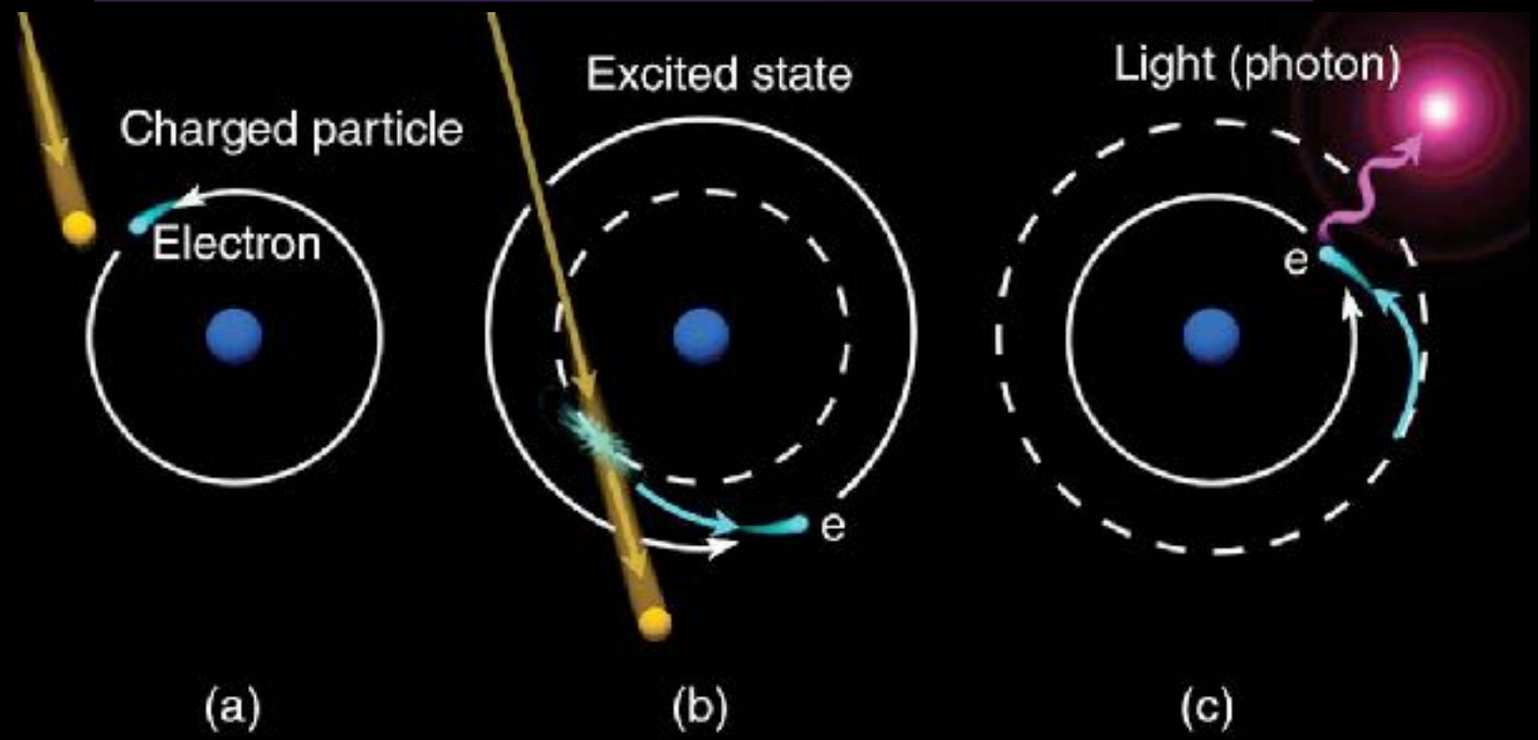
ESA

The aurora is formed when particles from the Sun interfere with our magnetosphere. Some particles manage to penetrate the magnetosphere on the night side (tail). When solar storms shakes up the magnetosphere particles inside this magnetic cocoon will be ejected back towards the Earth along the magnetic field lines. They are guided down towards the Polar Regions.

When they hit Earth's atmosphere they collide with oxygen and nitrogen. These collisions, which typically occur at altitudes between 80 to 300 km, transfer some energy to theses atoms (they get excited), and immediately send out light on a certain frequency or color.

The Colors of the Aurora

- The light from the Sun appears white but consist of all colors (e.g rainbow)
- The aurora light is composed of distinct colors that comes from certain gases in the Earths atmosphere.
- The colour composition of the aurora is the atmosphere's fingerprint.



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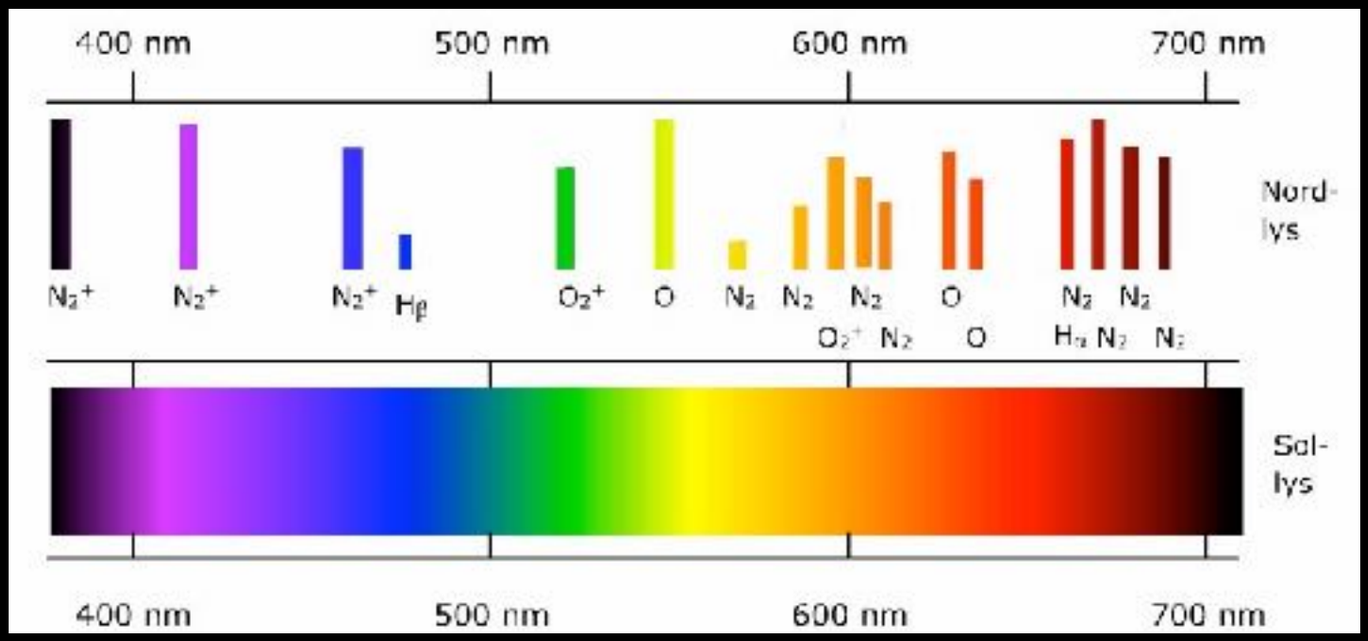
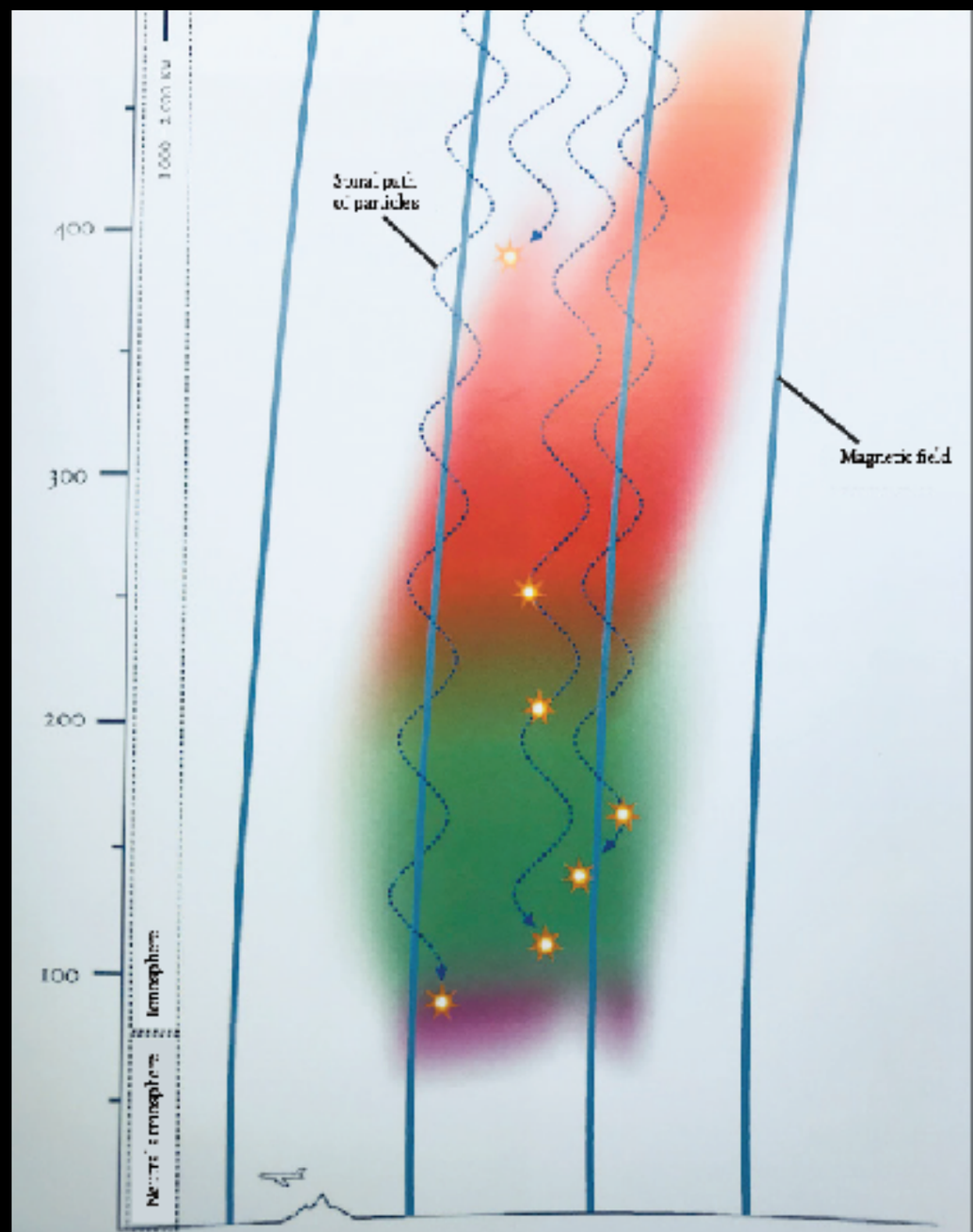
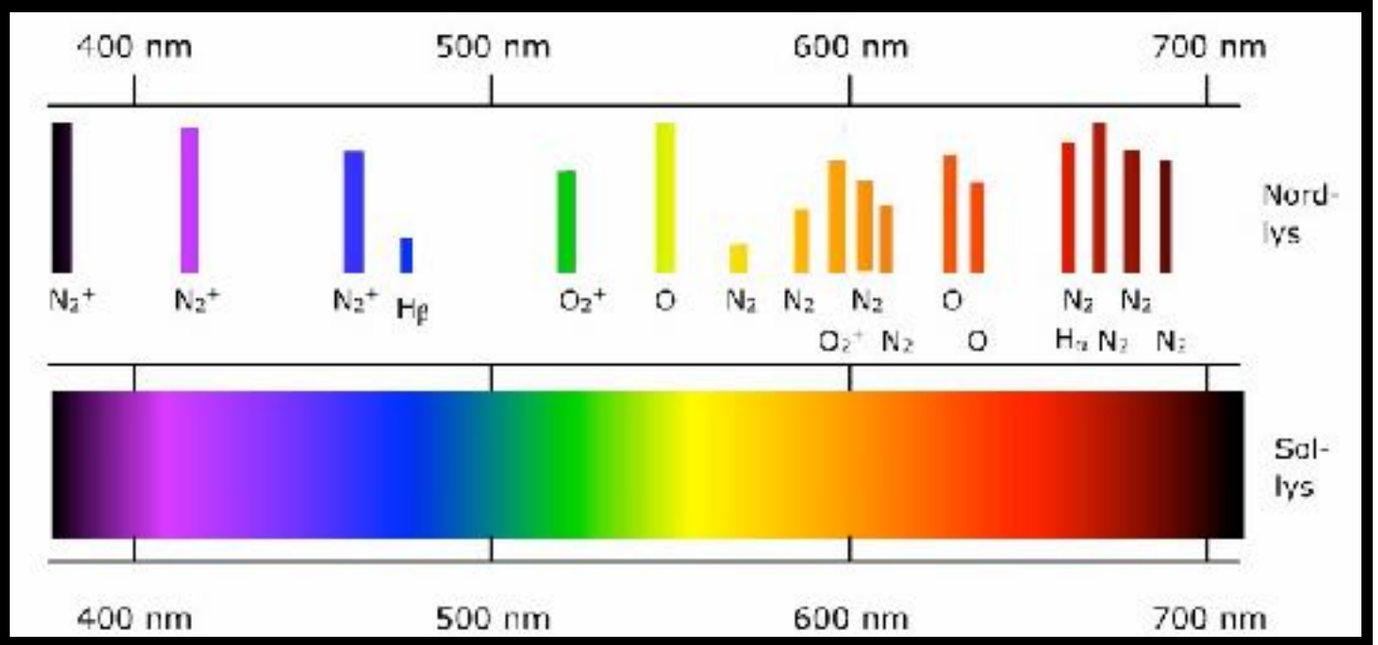


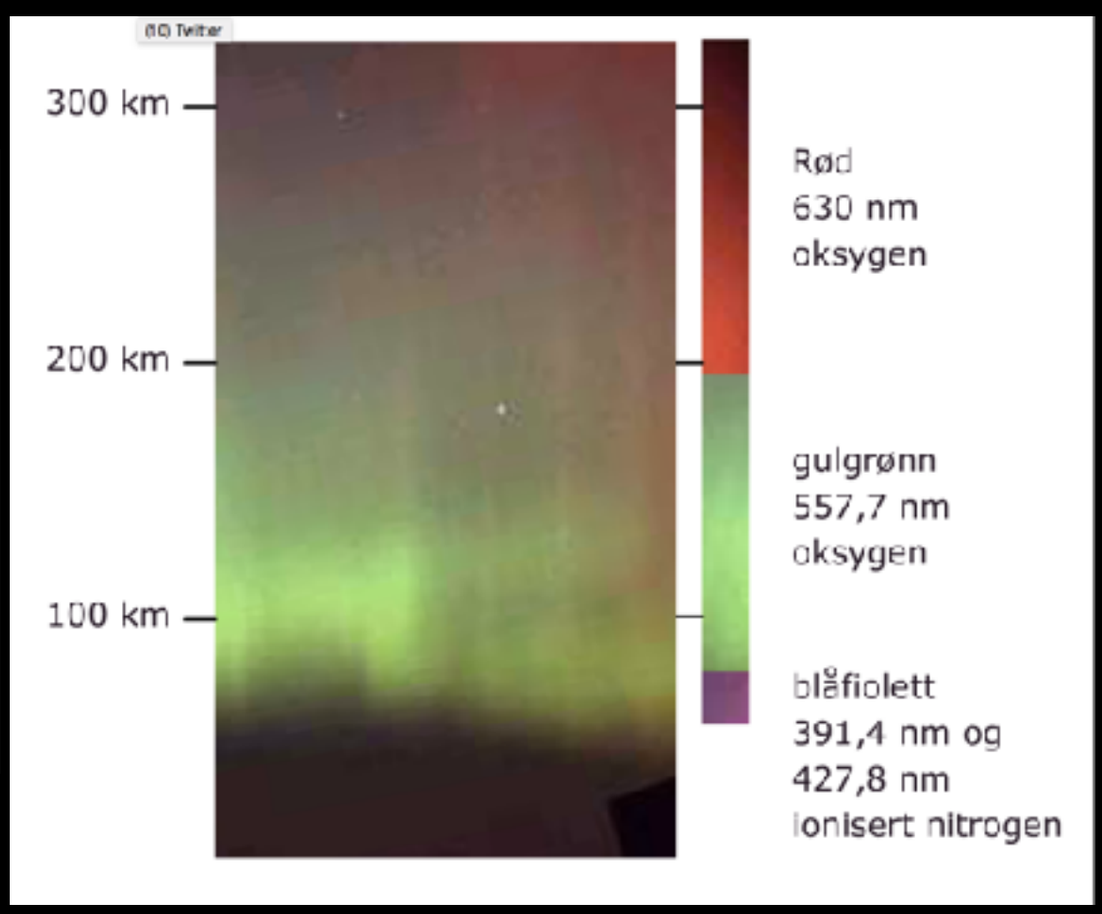


The Colors of the Aurora

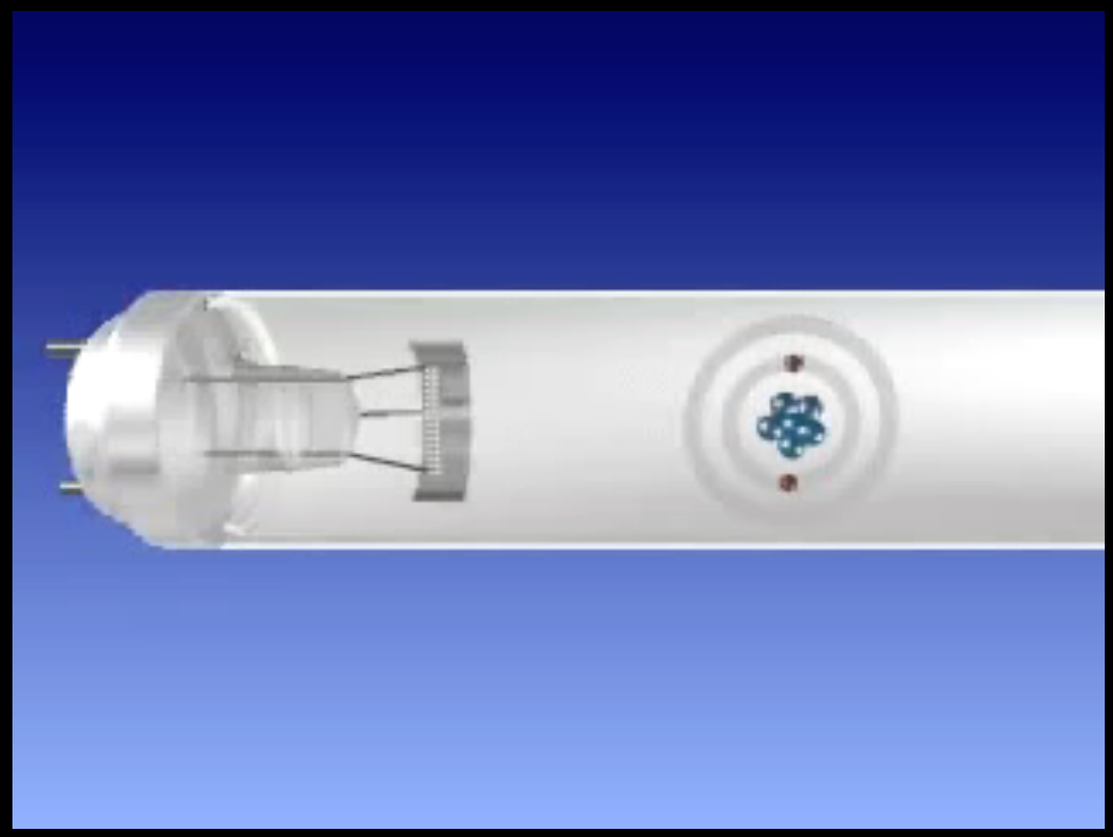
The color of the aurora depends on the wavelength of the light emitted. This is determined by the specific atmospheric gas and its electrical state, and the energy of the particle that hits the atmospheric gas. The atmosphere consists mainly of nitrogen and oxygen, which emit the characteristic colors of their respective line spectra. Atomic oxygen is responsible for the two main colors of green (wavelength of 557.7 nm) and red (630.0 nm). Nitrogen causes blue and deep red hues.

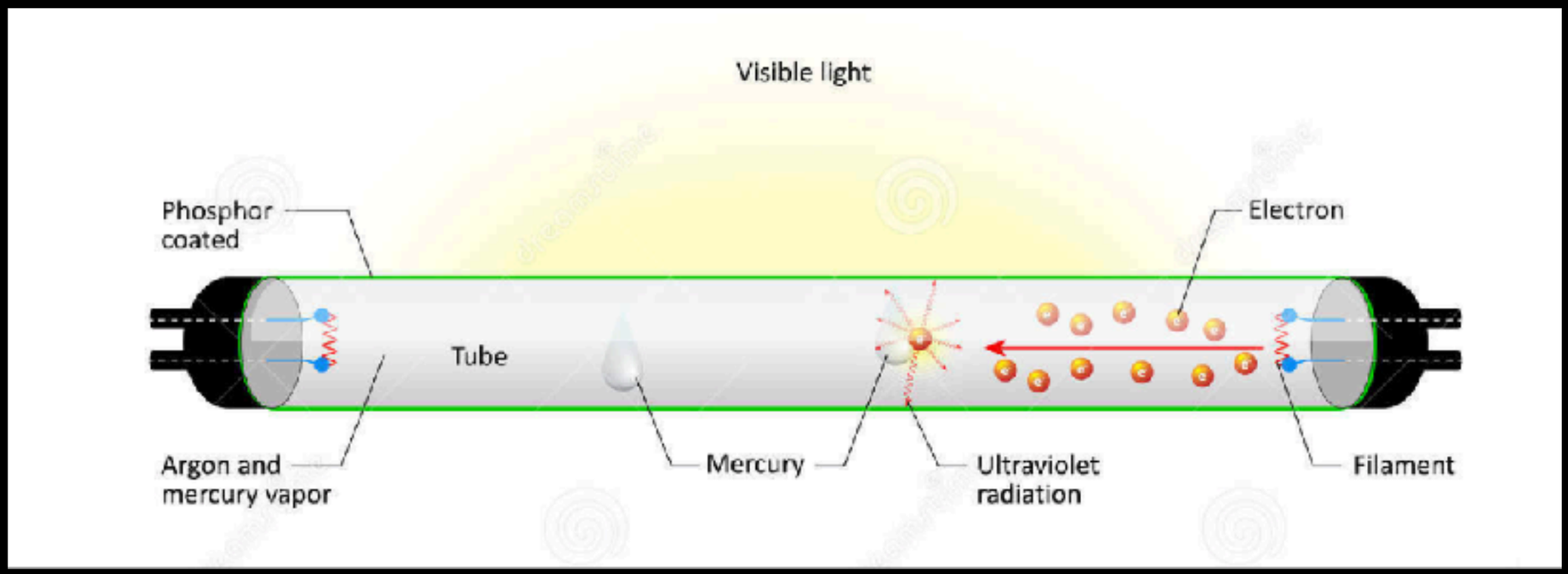
Most of the auroral features are greenish-yellow, but sometimes the tall rays will turn red at their tops and along their lower edges. On rare occasions, sunlight will hit the top part of the auroral rays to create a faint blue color. Pink hues may also be seen in the lower area of the aurora



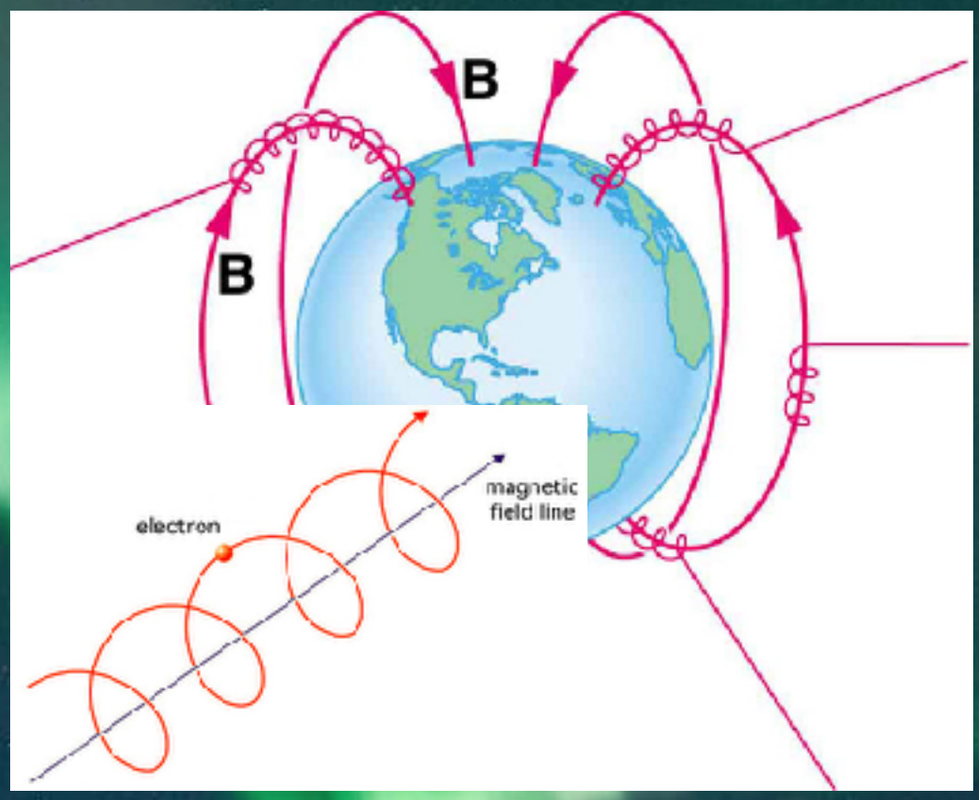


The aurora - A gigantic neon sign





The structures



Most visible aurora comes from precipitating electrons. Both electrons and protons are charged particles, and they are not free to move in just any direction.

The curtain shapes of aurora results from this restriction on the motion of charged particles.

When an electron spirals along the magnetic field into the atmosphere, it stays on or near this field line even when it makes a collision. Therefore the aurora looks like rays or curtains.

The structures

Rays

Homogeneous arc

Corona

Arc with ray structure

Drapes

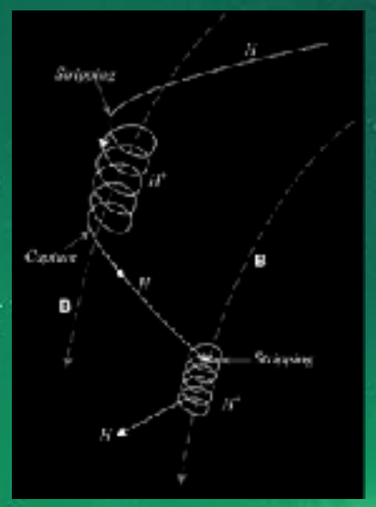
Homogeneous band

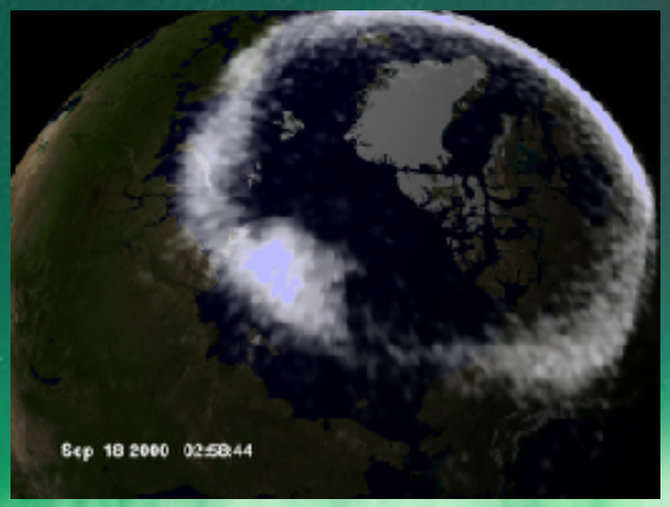
Band with ray structure

The structures

Example of corona where we are looking straight up along the magnetic field (Ø. Bertelsen).

The Proton-aurora





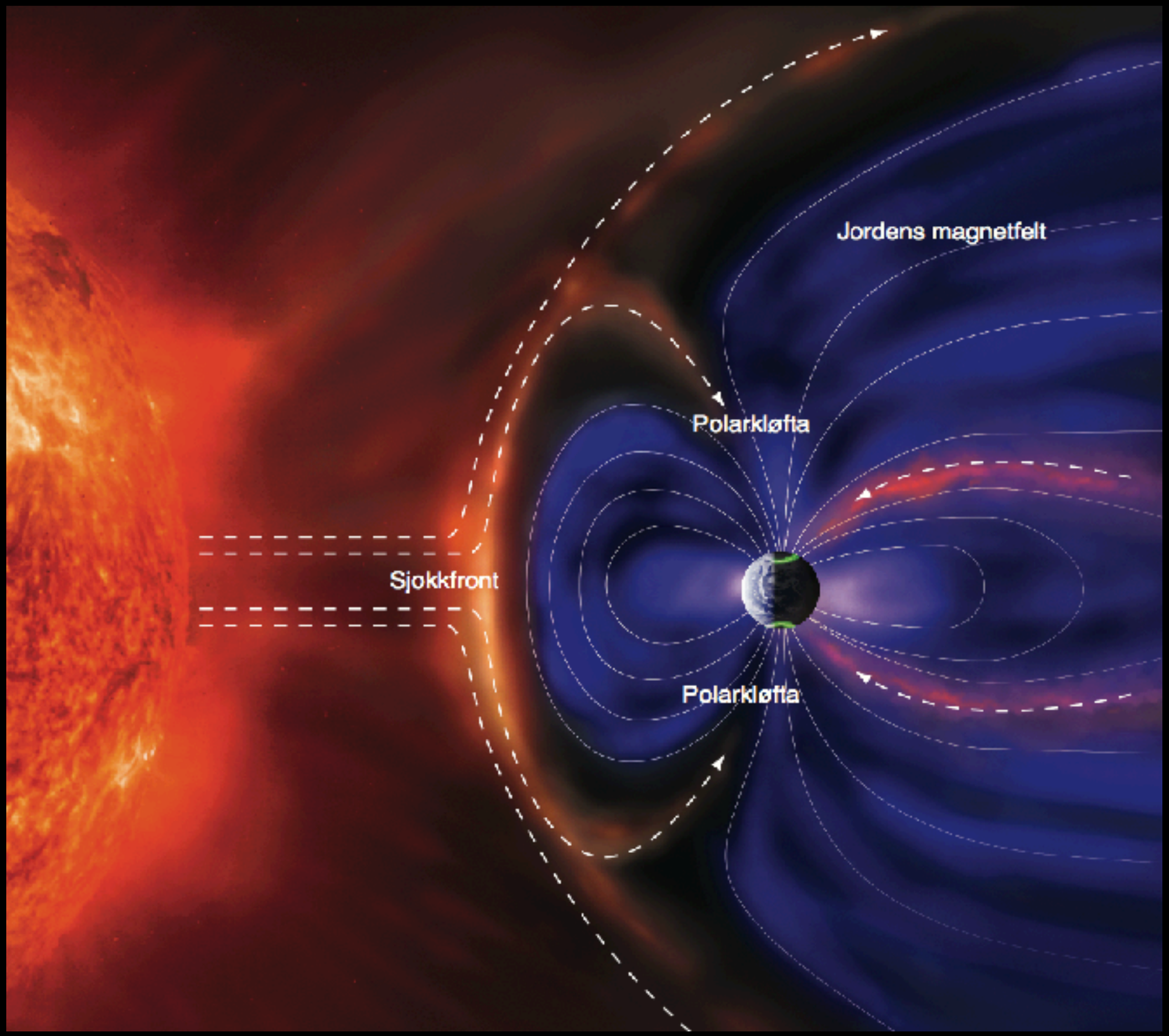
When a proton spirals into the atmosphere along a field line it is just as restricted in its motion. In a collision, however, the proton can catch an electron from the atom or molecule that it collides with, and it is then a neutral hydrogen atom (i.e. a proton and an electron bound together). This hydrogen atom is free to travel in any direction, independent of the magnetic field.

It may again turn into a proton in a subsequent collision, and be bound to travel along the direction of the magnetic field.

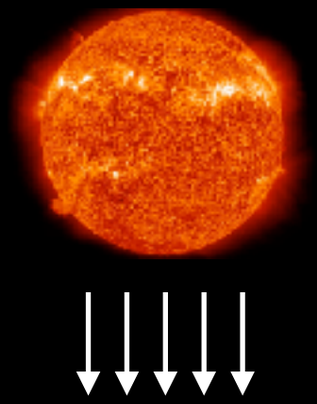
This process can repeat itself several times before all the energy of the initial proton is spent. The effect of this meandering path is that the proton aurora is spread out and gives a very diffuse glow rather than the confined curtains of electron aurora.

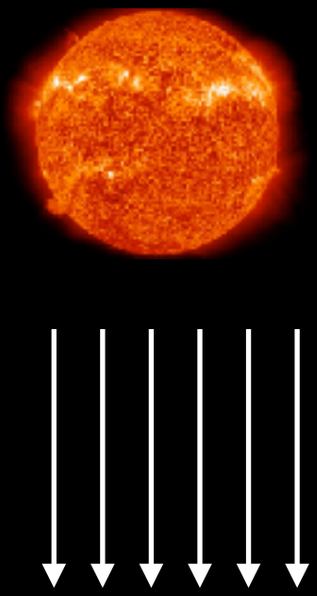
Because it is so spread out, proton aurora is usually not bright enough to be visible to the human eye. Sensitive instruments and cameras, however, can see this aurora.

Svalbard and the Dayside-aurora

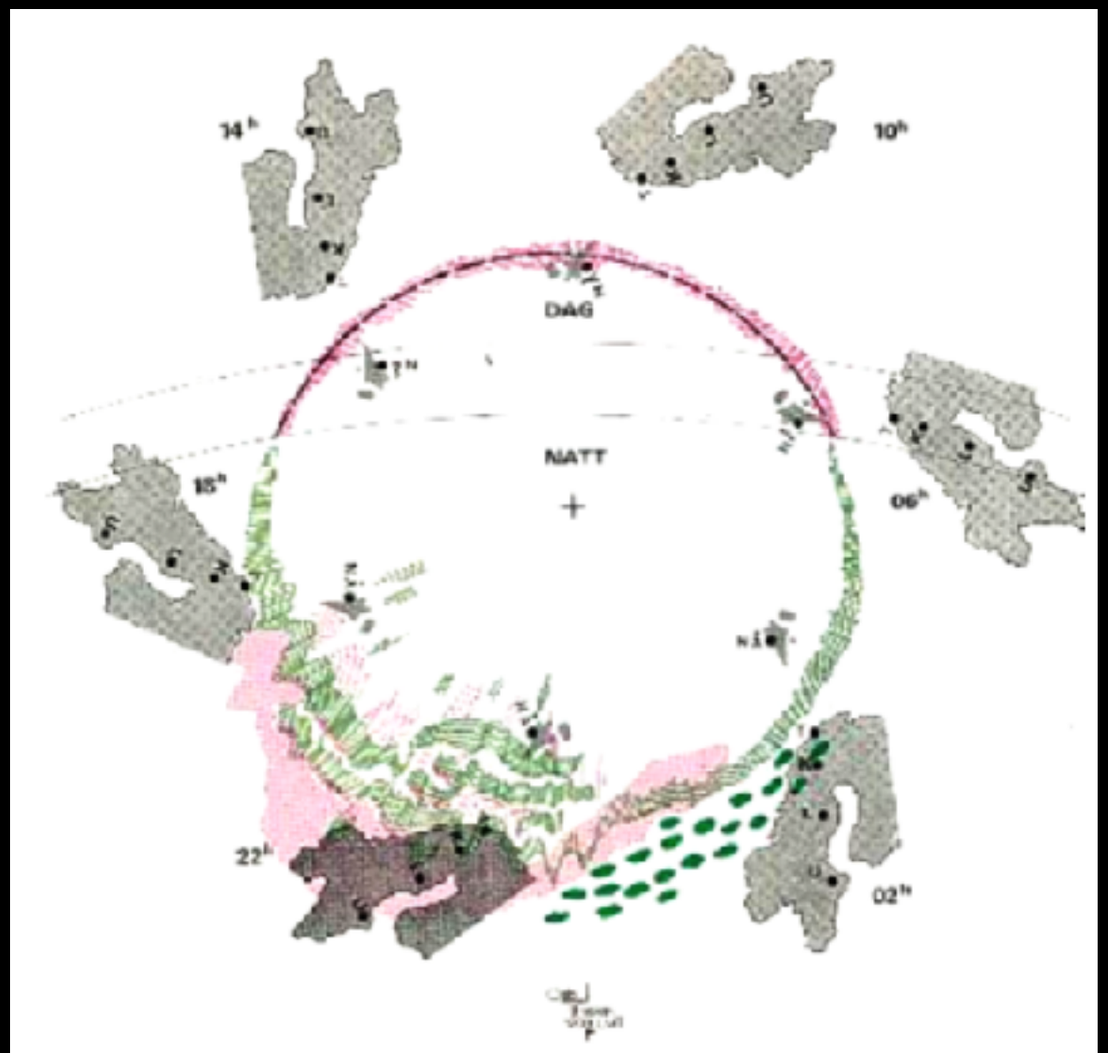


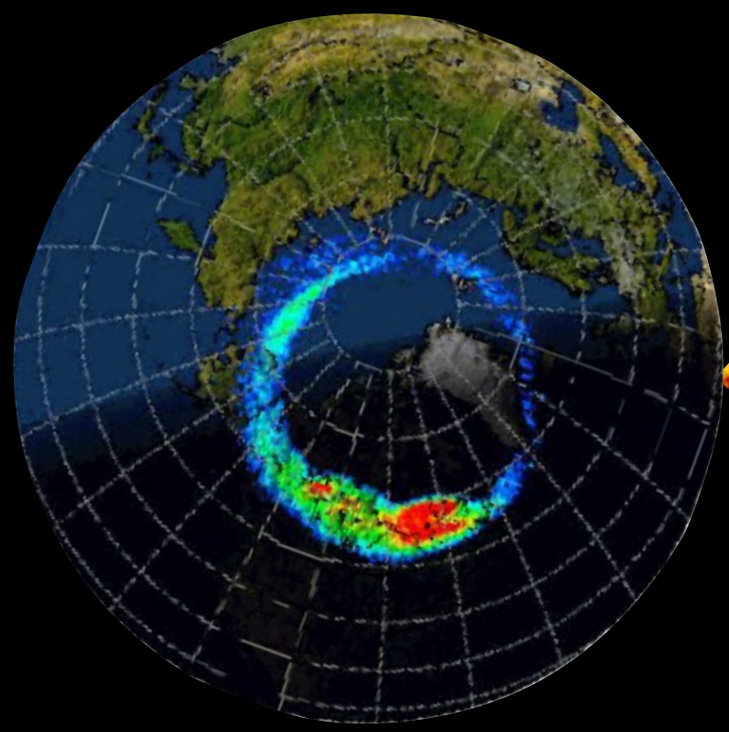
Svalbard and the Dayside-aurora

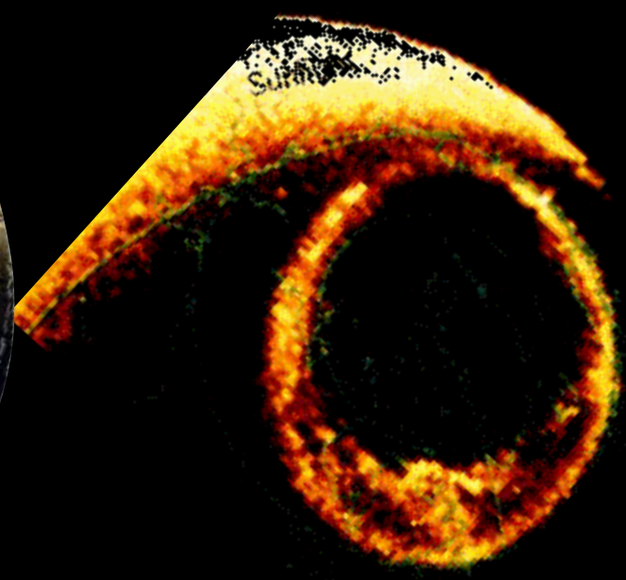




Dag Lorenzten



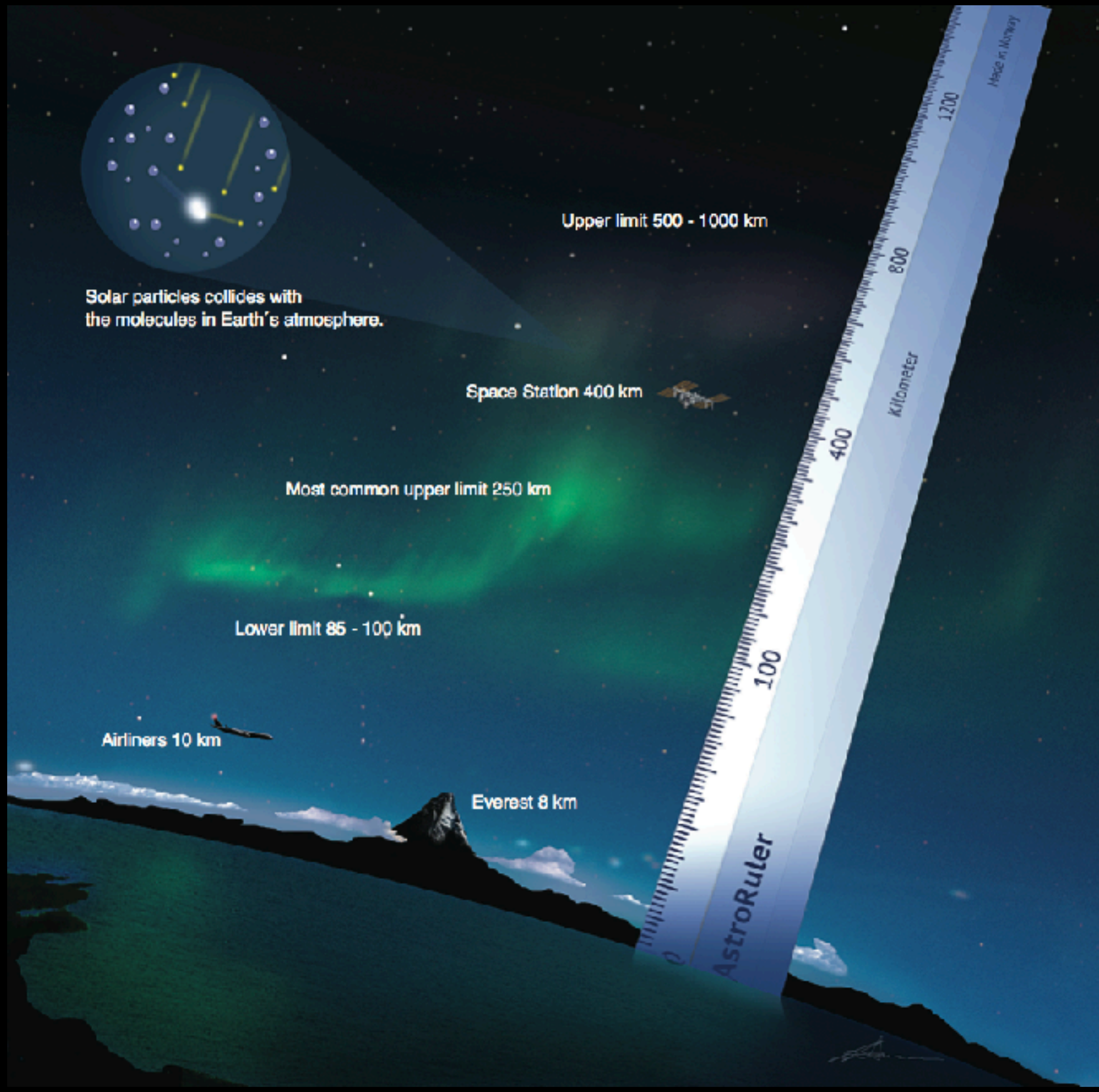




Daytime Aurora KHO

The Height of the Aurora

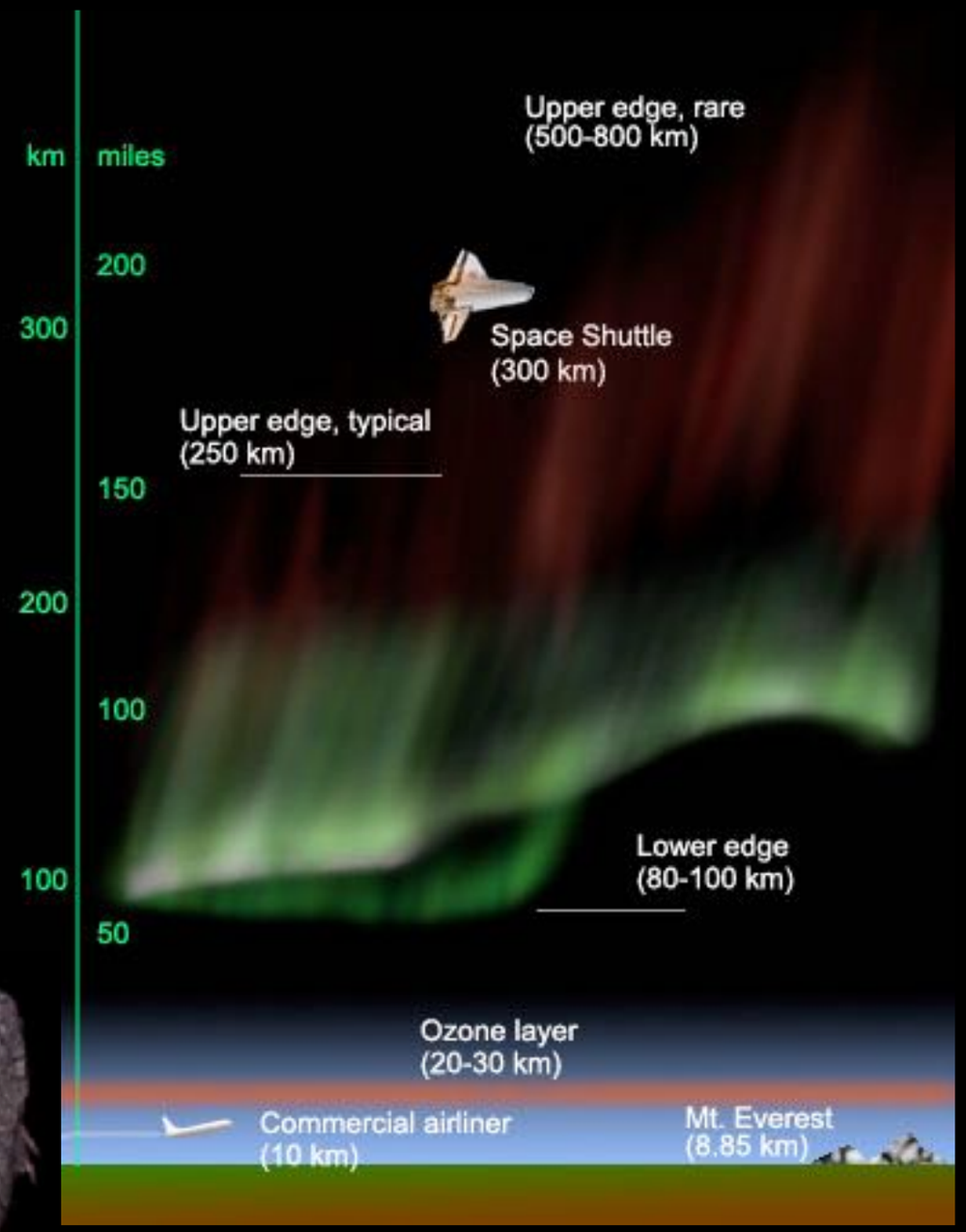
- The Aurora extends from about 80 km to about 250 km and sometimes up to over 500
- Thus, the aurora is not a weather phenomenon



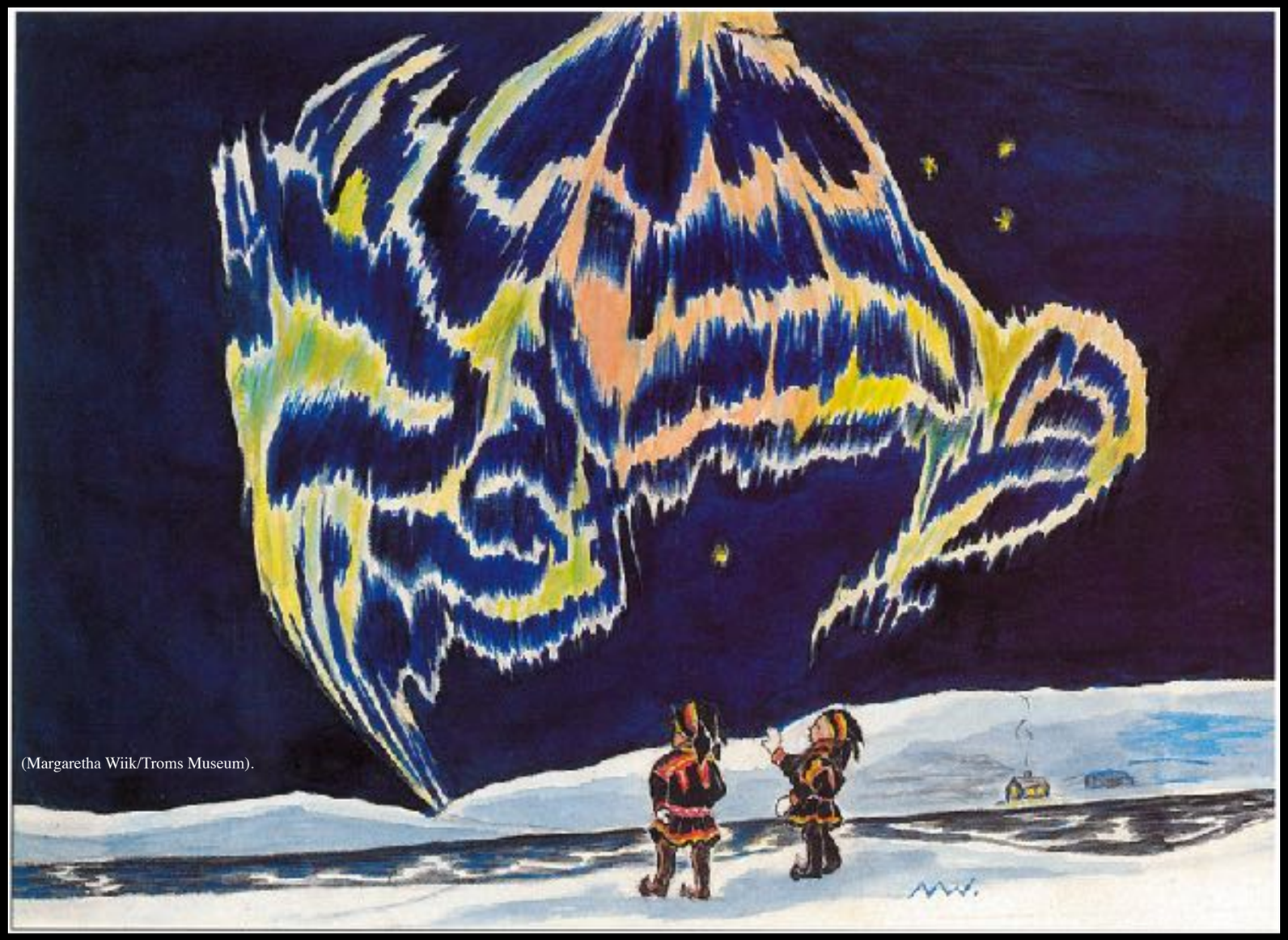
T. Abramhamsen/ARR

Can you hear the Aurora?

Sound waves are pressure waves which travel about 340 metres per second in air at ground level. At altitudes between 80 and 500 kilometres, where the aurora occurs, we have a near-vacuum, so it is not possible for sound waves to propagate.



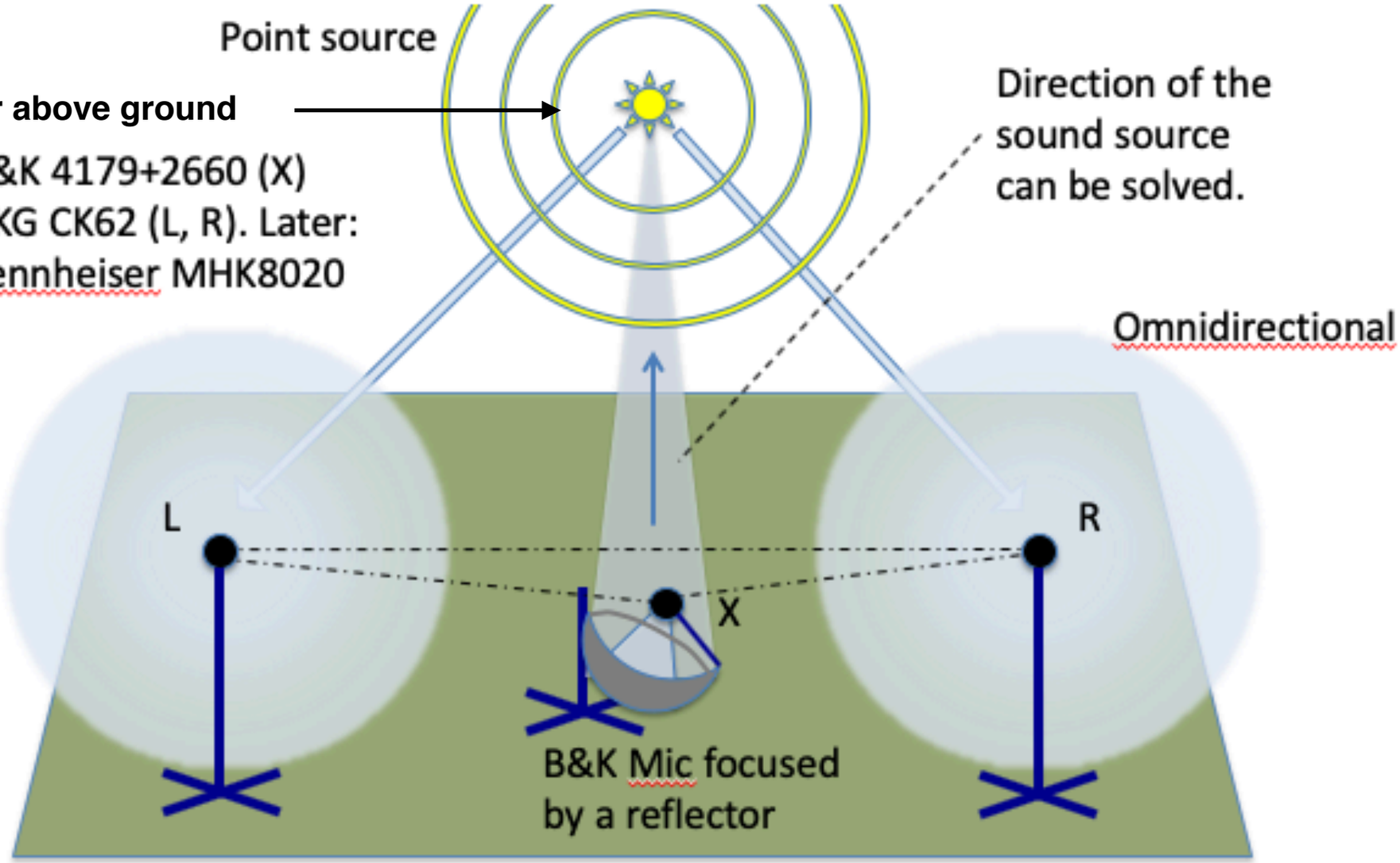
Sound from the aurora?


(Margaretha Wiik/Troms Museum).

The Sami people called it guovssahas, the light you can hear. Many people still argue that they can hear some crackling sounds – often synchronised with the movements of the aurora. Since sound waves cannot propagate in space it should be impossible for sound to travel down to the ground. Scientists are still working on explaining this phenomenon.

Observed sounds

Improved 3-Mic-system (2013)



TDOA method = Time Difference of Arrival

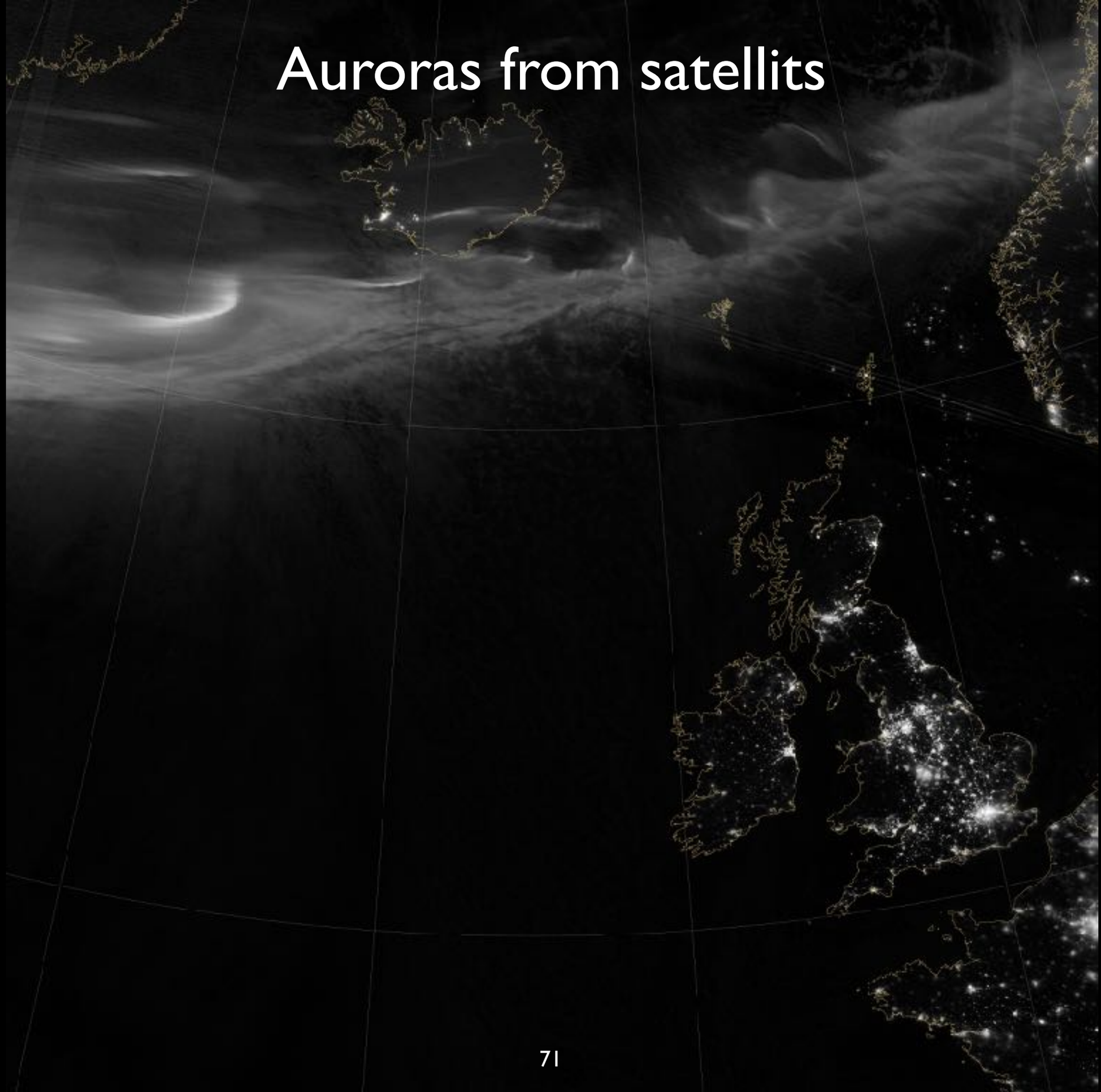
Altitude ≈ (speed of sound)*(time difference between magnetic and sound pulses)

Unto Laine (Finland)

Auroras from ISS

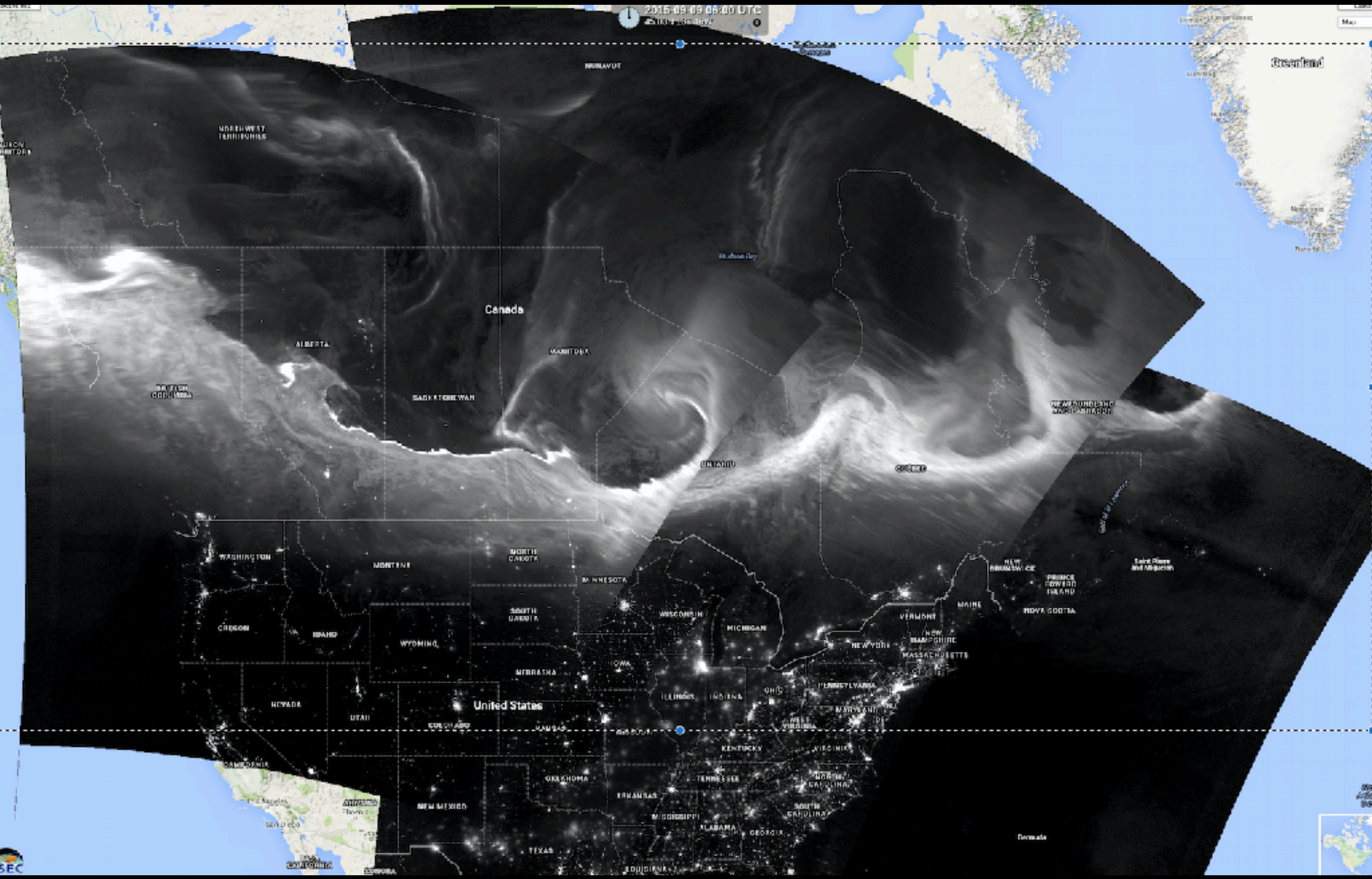
NASA

Auroras from satellits

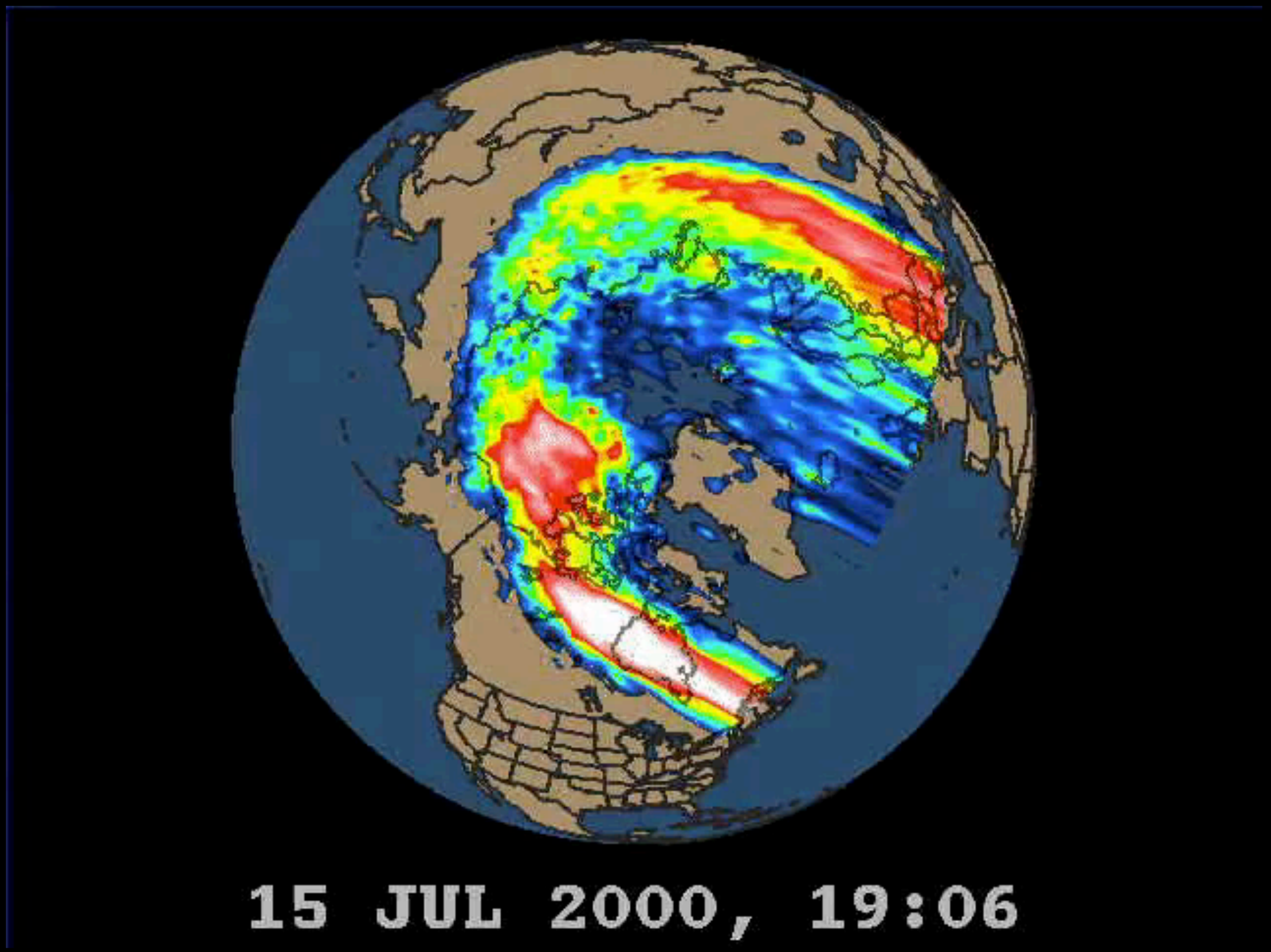


NASA

Auroras from satellits

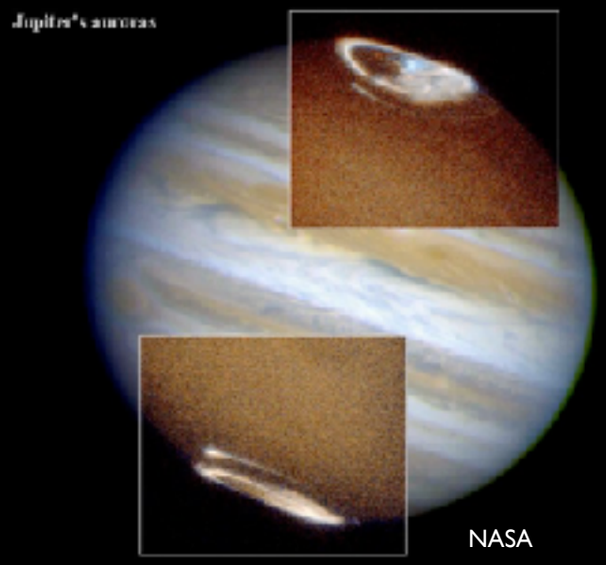


Aurora from satellites



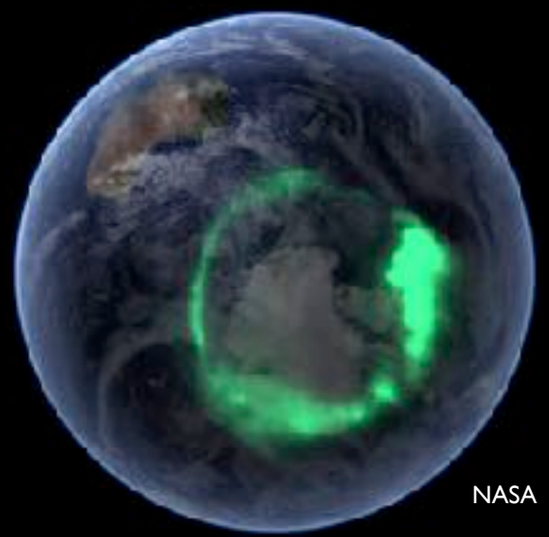
NASA

POLAR LIGHTS ON OTHER PLANETS



NASA

NASA



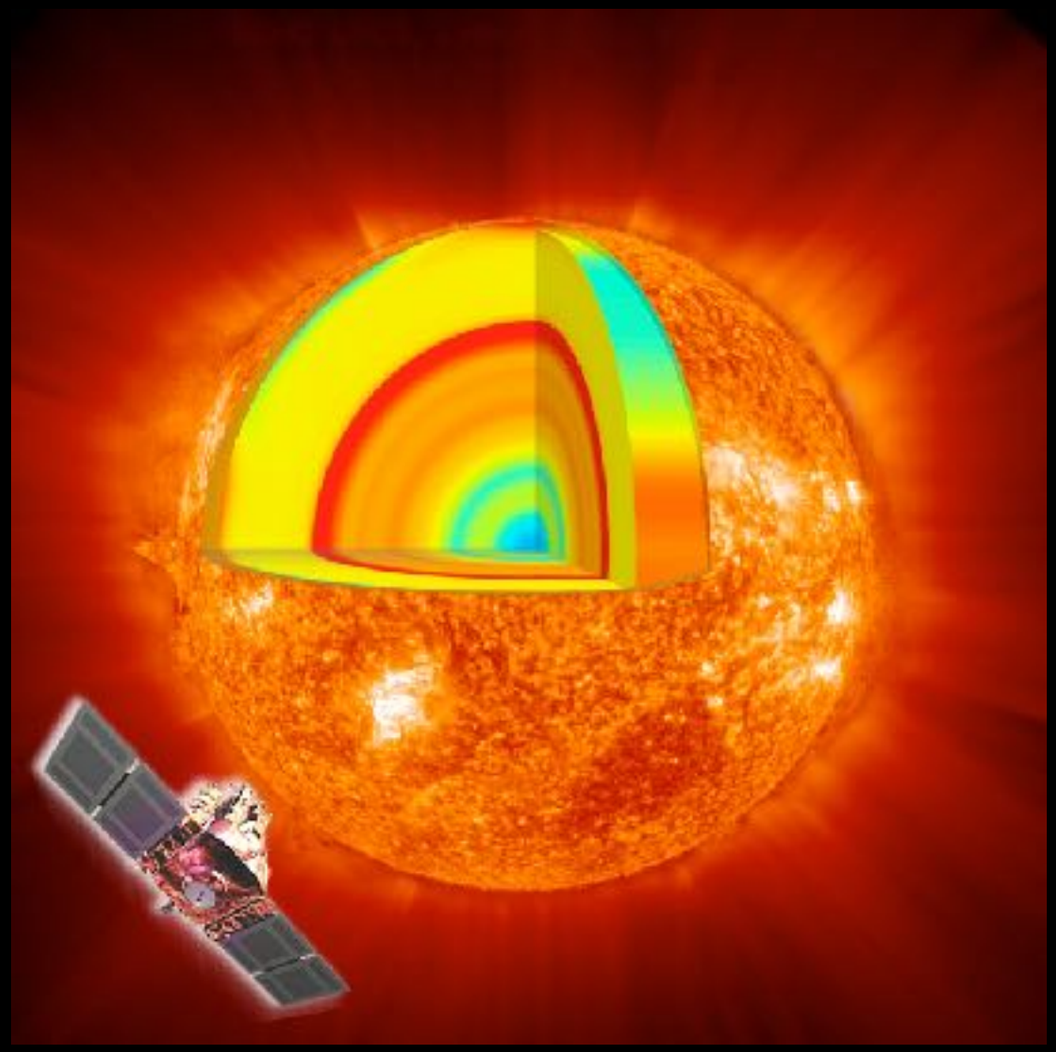
NASA

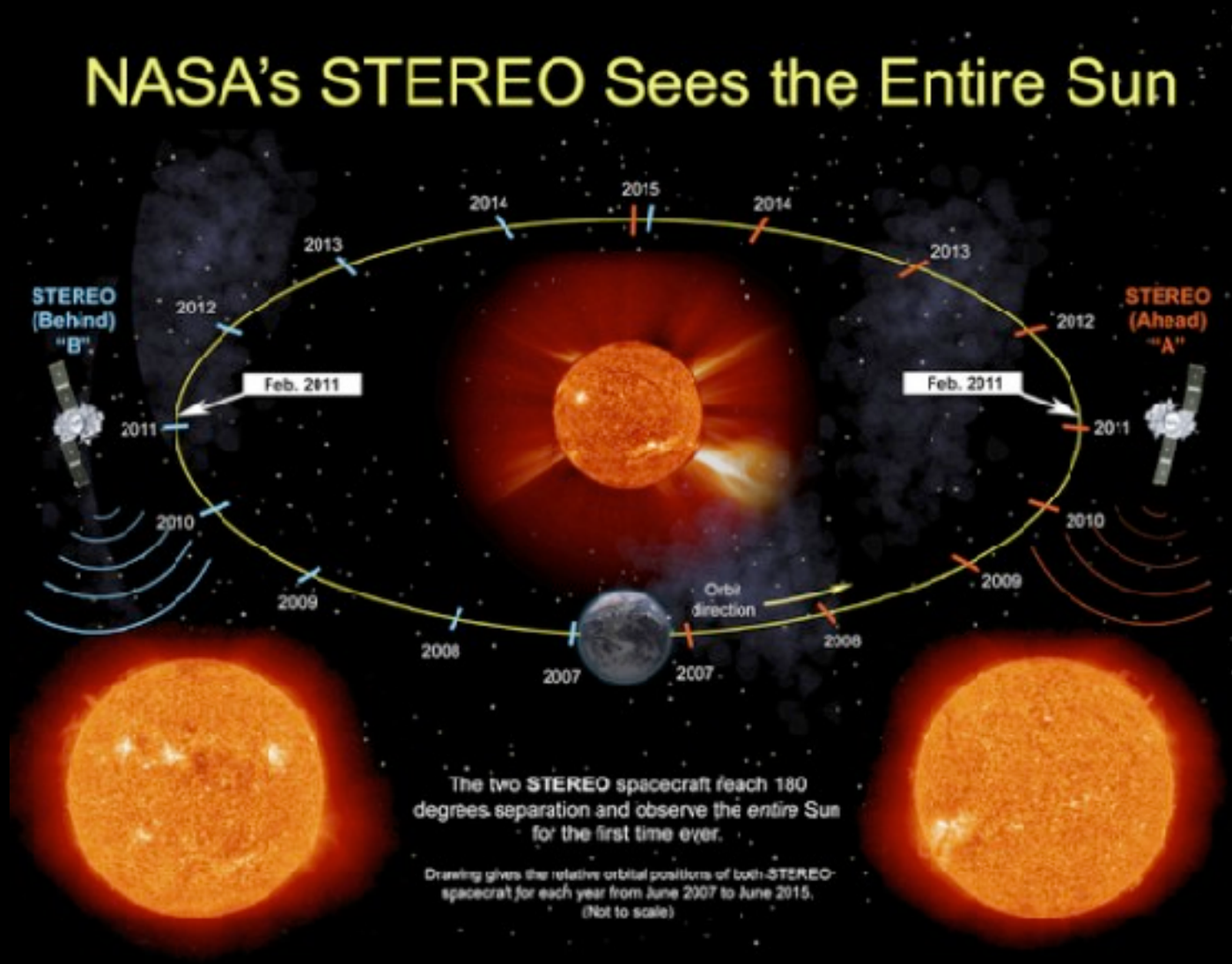
Is it only the Earths that is experiencing polar lights? No, in fact it can be observed on many other planets such as Jupiter, Saturn, Uranus and Neptune. These are all gaseous planets with an atmosphere and magnetic fields. The polar lights on these planets are caused by the same mechanism.

Large eruptions on the Sun are causing disturbances in their magnetic fields and pumps particles into their atmosphere, which then glow as giant neon tubes. When aurora are observed by satellites, we can see that the polar lights on the planets are very similar to that on the Earth.

Aurora forecast: Monitoring the Sun

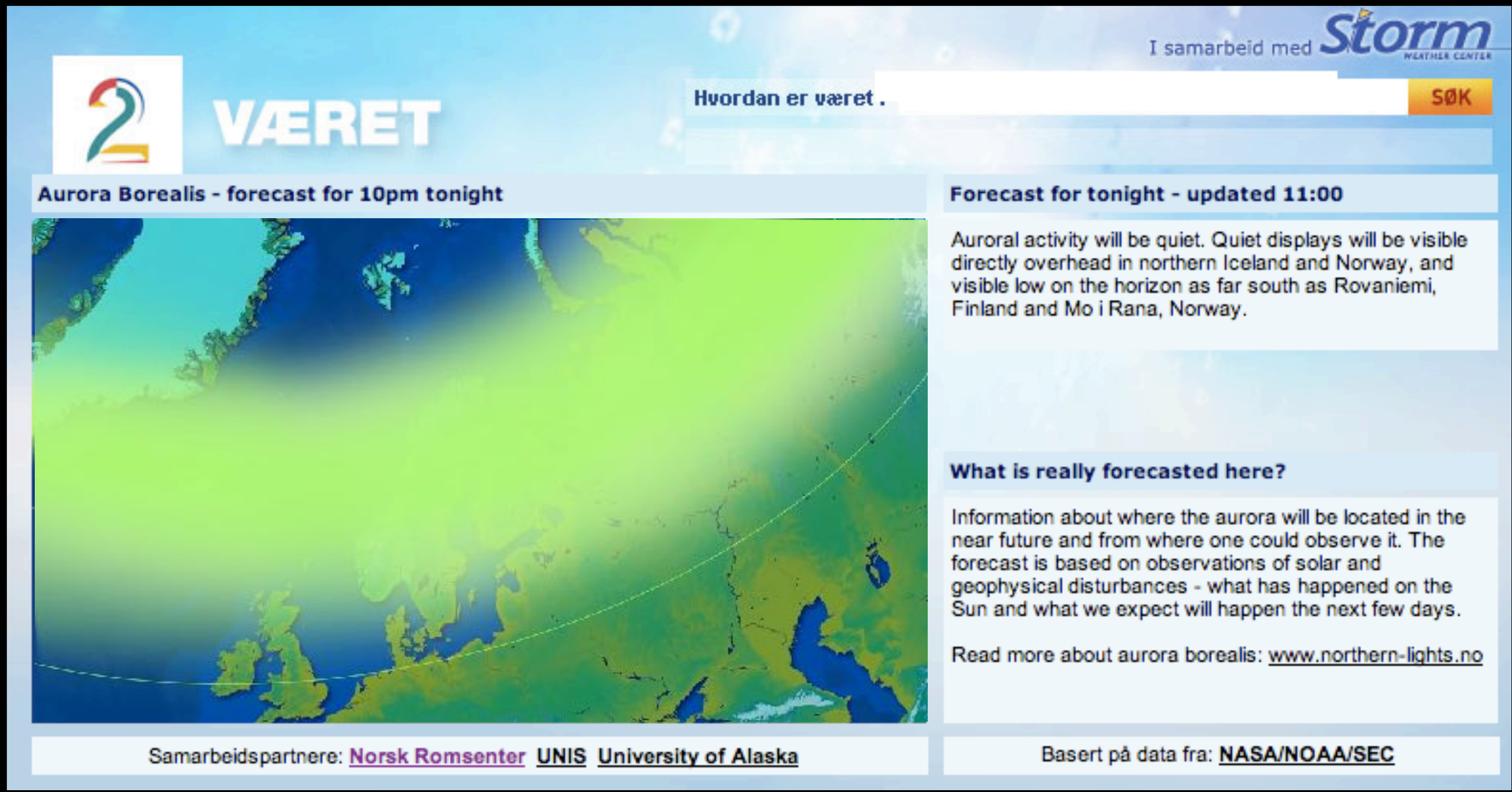
http://soho.nascom.nasa.gov/data/realtime-images.html

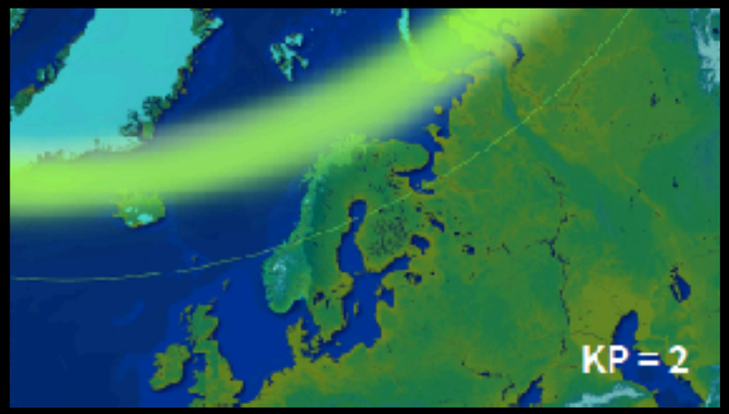




Aurora forecaster in Norway

http://www.storm.no/nordlys/

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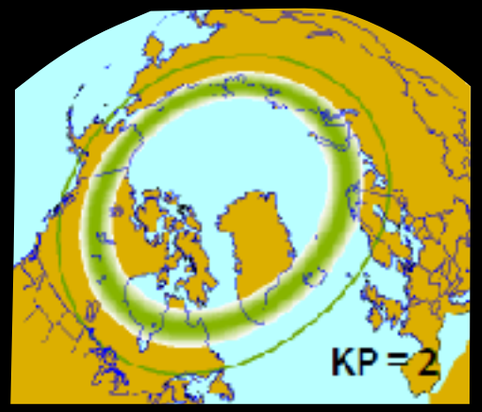
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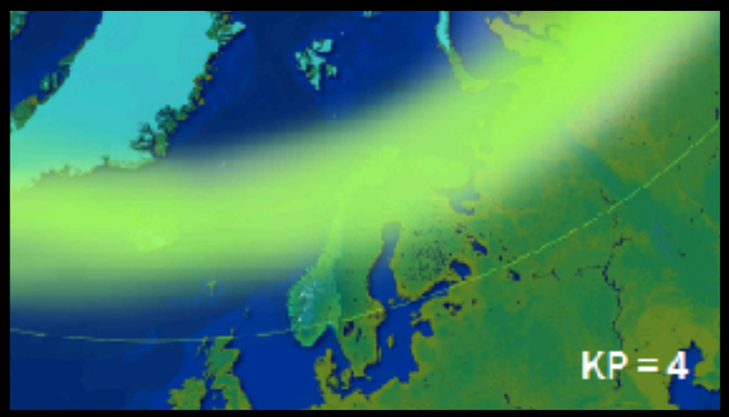
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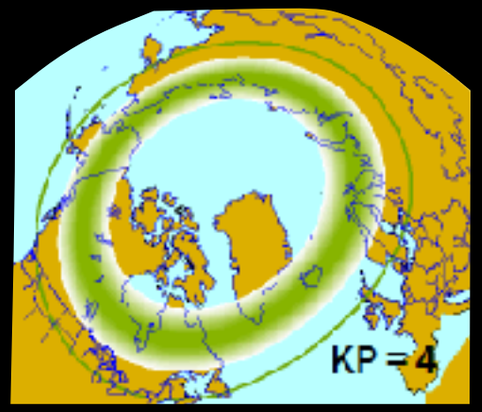
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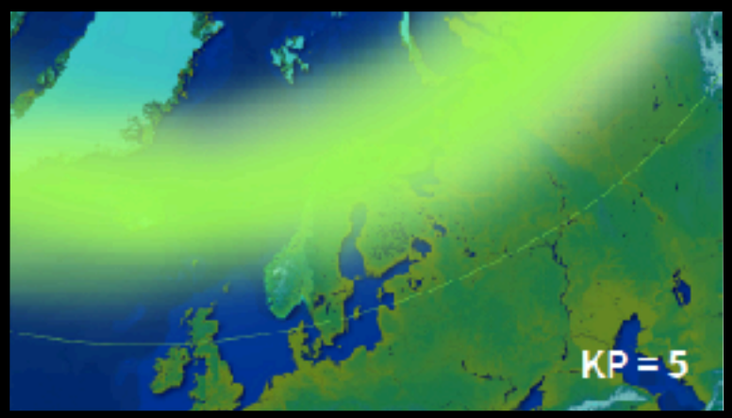
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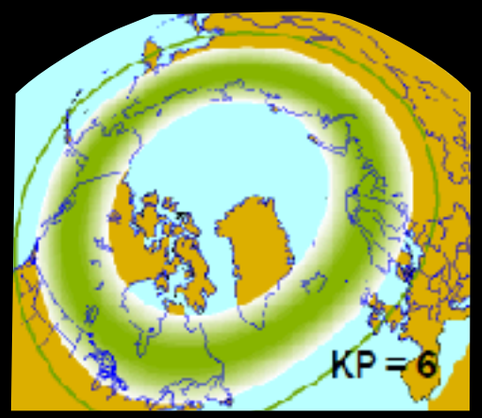
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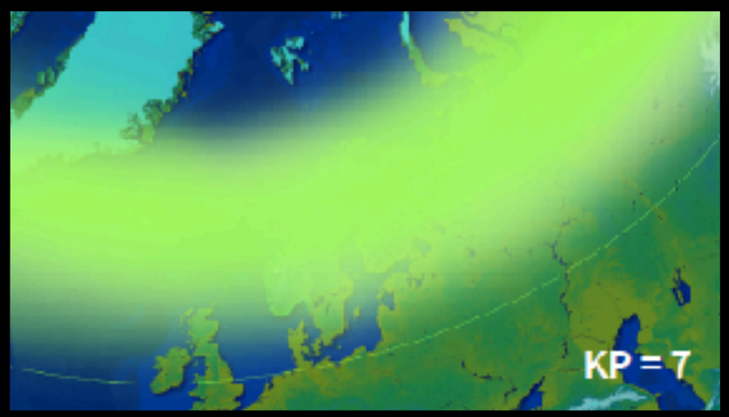
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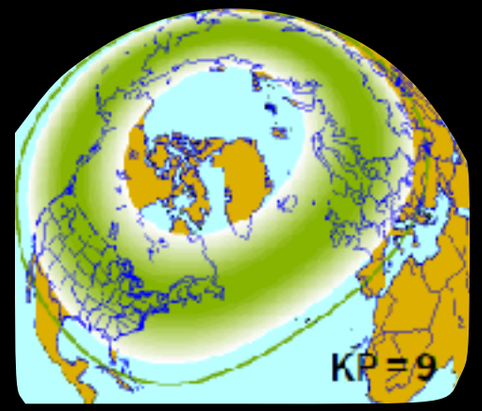
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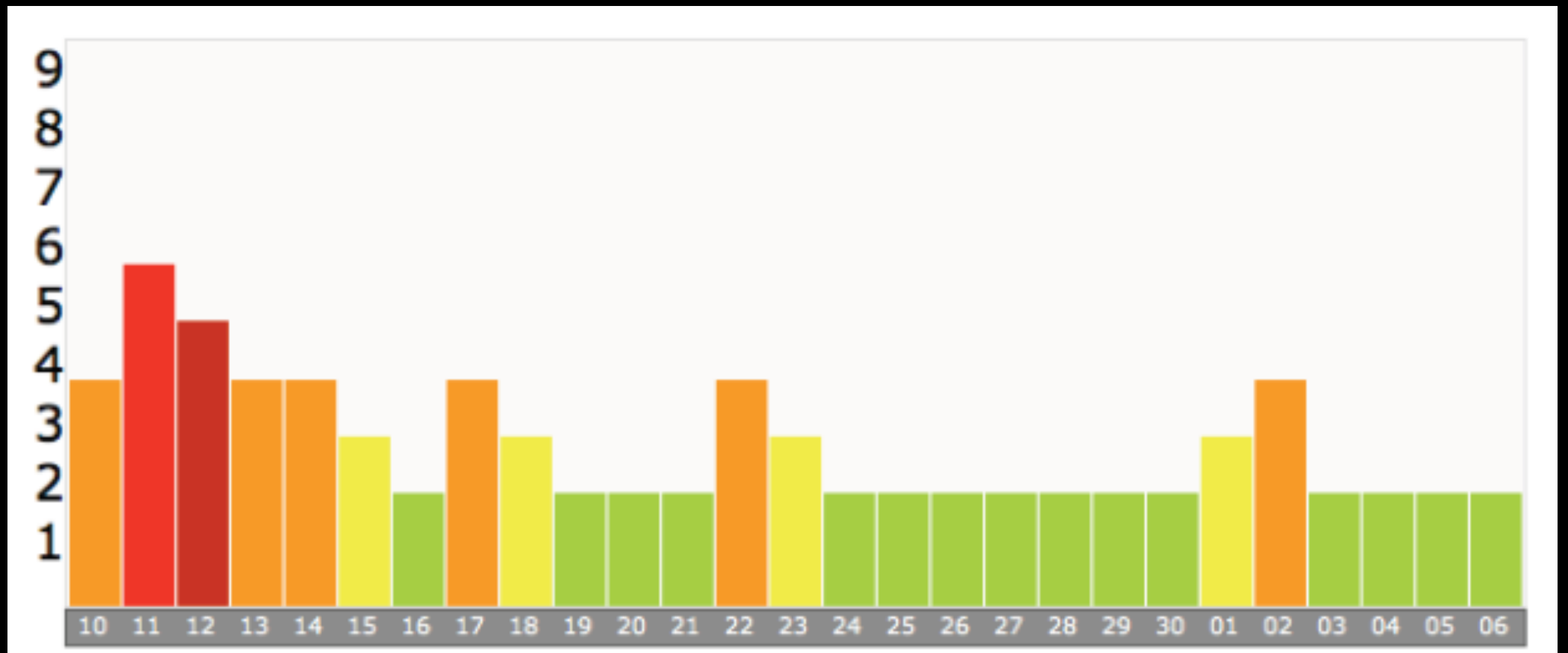
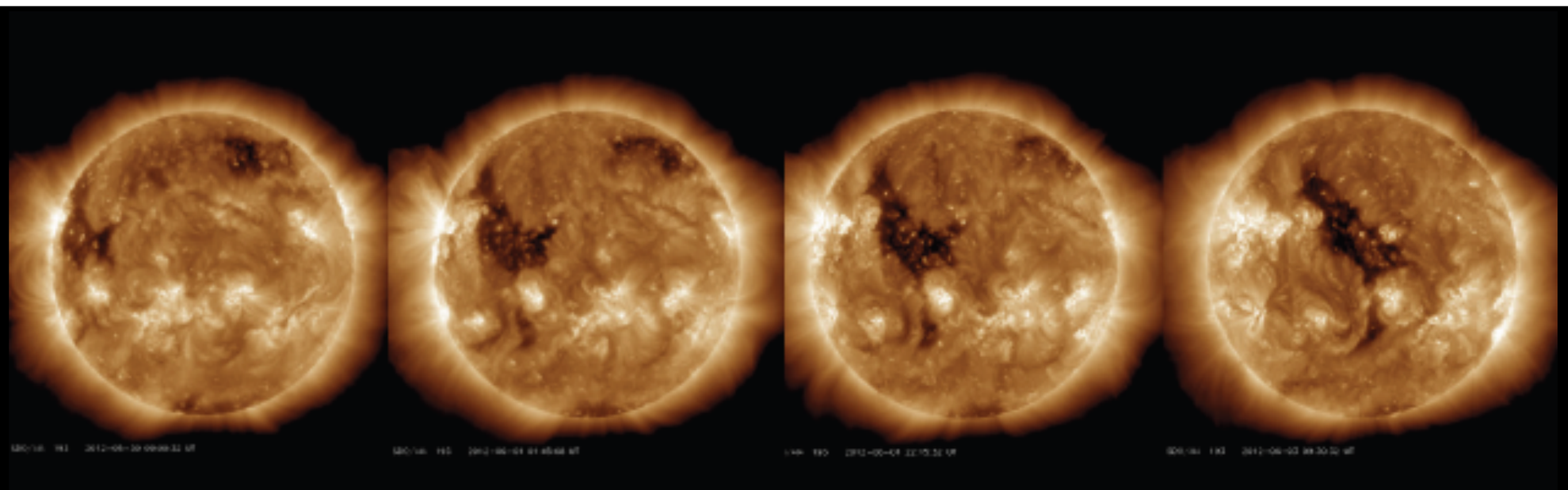
Long term forecasting





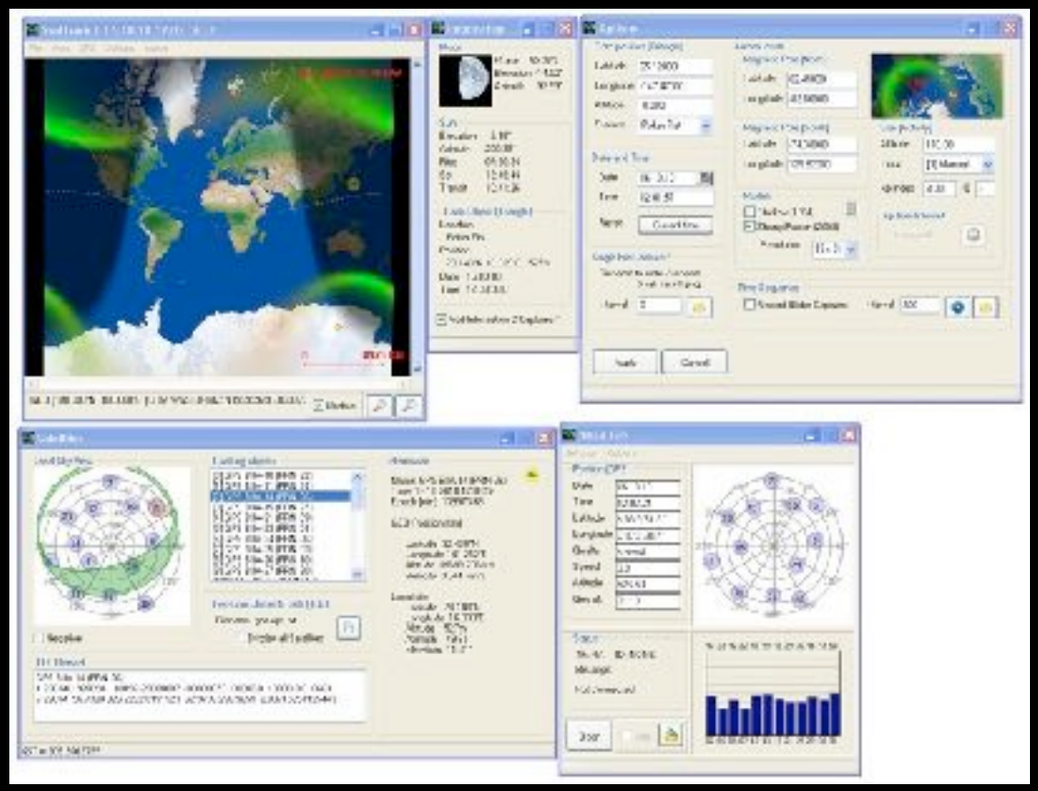
The UNIS Aurora forecaster

Real time aurora oval forecasting - SvalTrackII

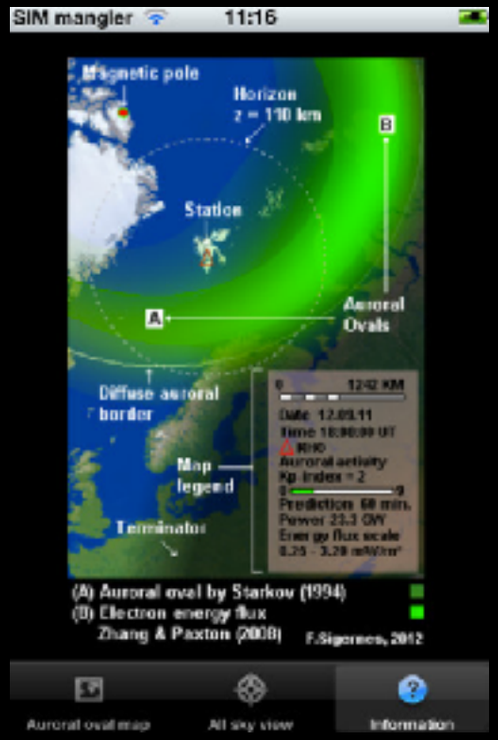
F. Sigernes [1], M. Dyrland [1], P. Brekke [2], E. K. Gjengedal [1], S. Chernouss [4], D. A. Lorentzen [1], K. Oksavik [1] and C. S. Deehr [5]

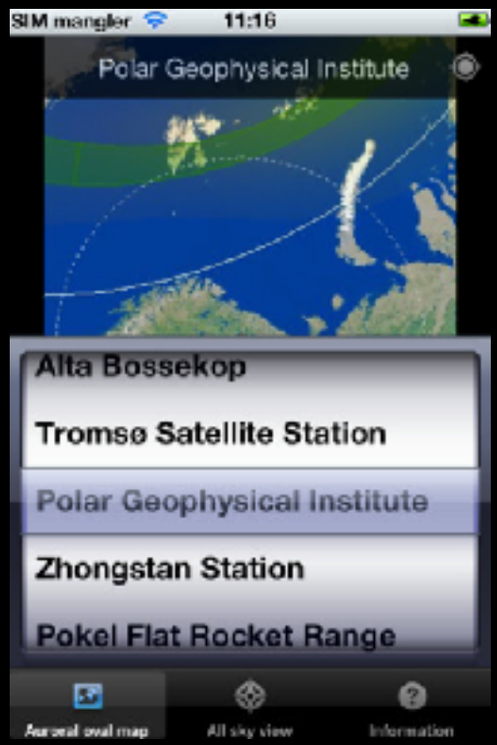
The 37th Annual European Meeting on Atmospheric by Optical Methods, Valladolid, Spain, 23 - 27 August 2010.

Download at: http://kho.unis.no/



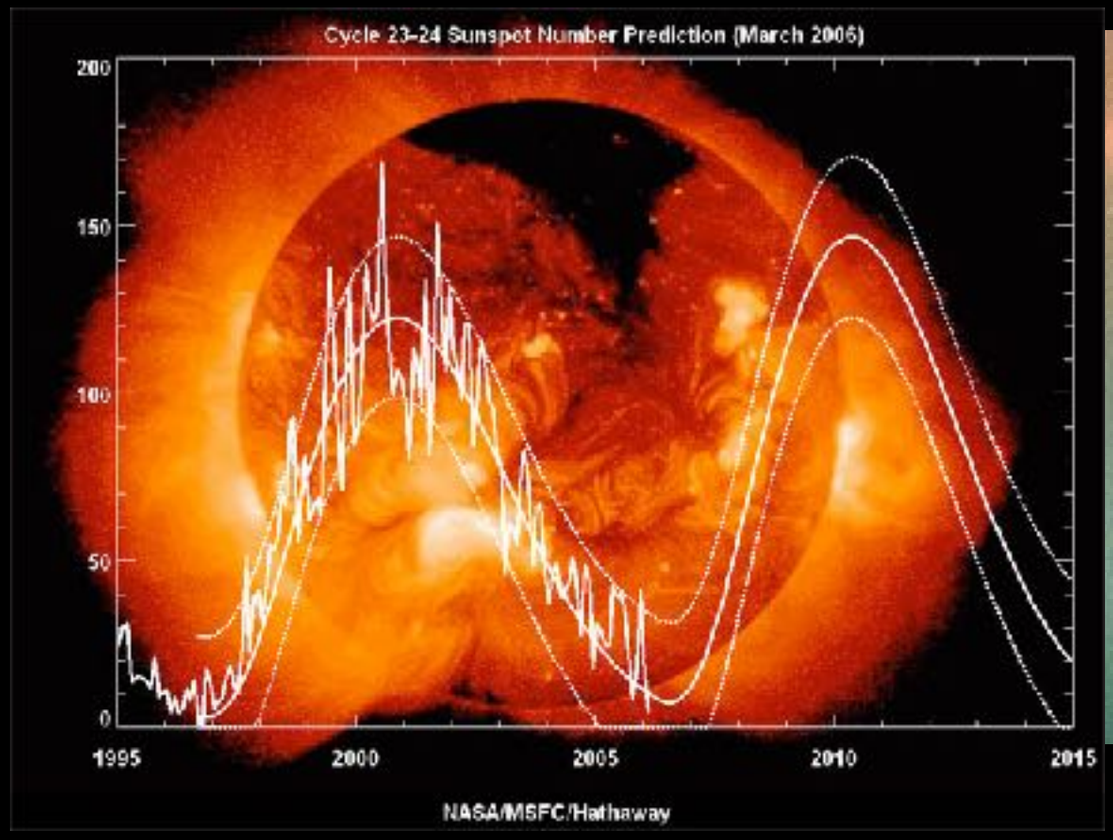
«Auroral Forecast» - an iPhone/Android App



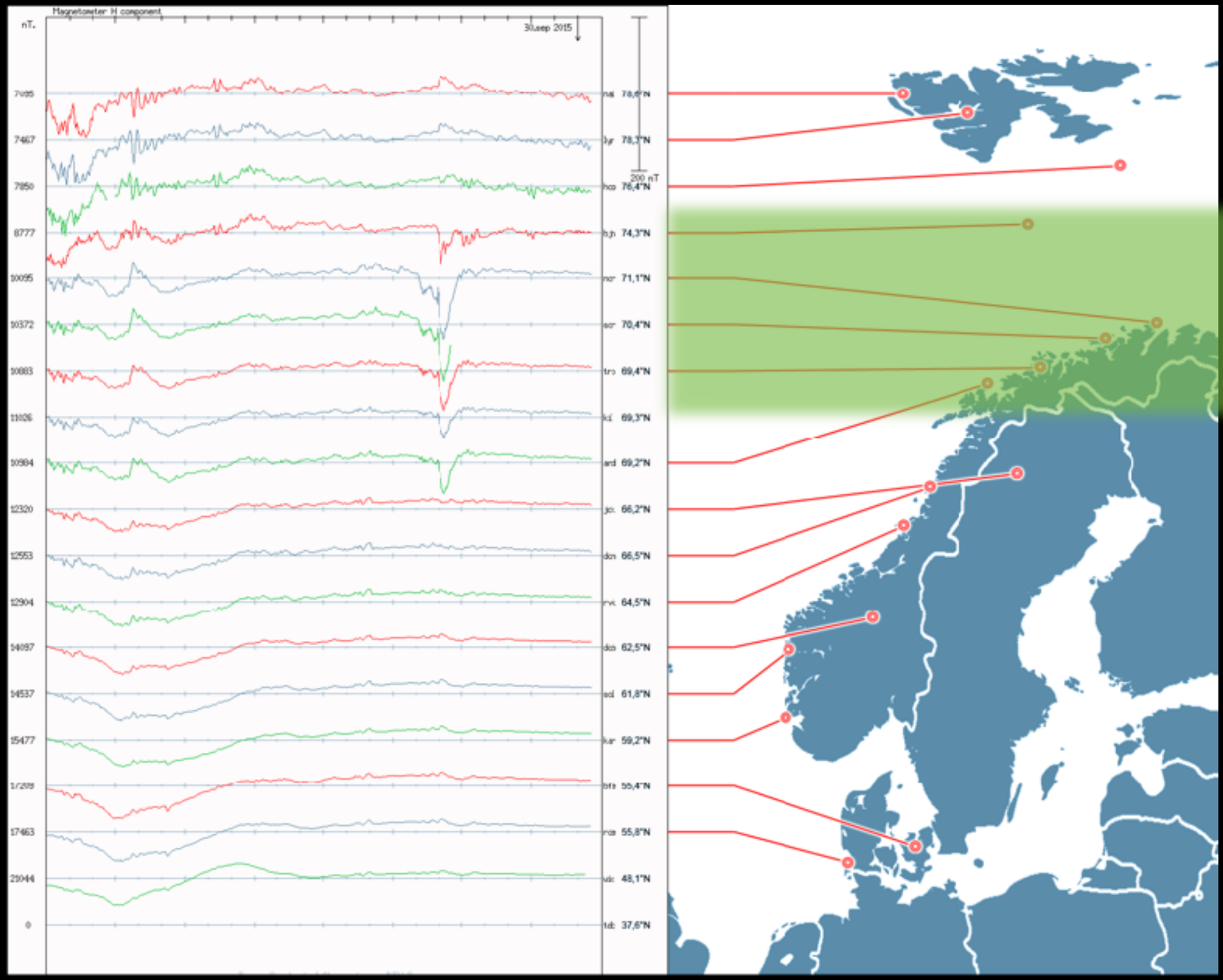


How often can we see it?

- **Northern lights can be observed this often on the following places during solar maximum:**
- **Andenes, Norway** Almost every dark and clear night
- **Fairbanks, Alaska** Five to ten times a month
- **Oslo, Norway** Roughly three nights a month
- **Northern Scotland, Great Britain** Roughly once a month
- **US/Canadian border** Two to four times a year
- **Mexico and Mediterranean countries** Once or twice a decade

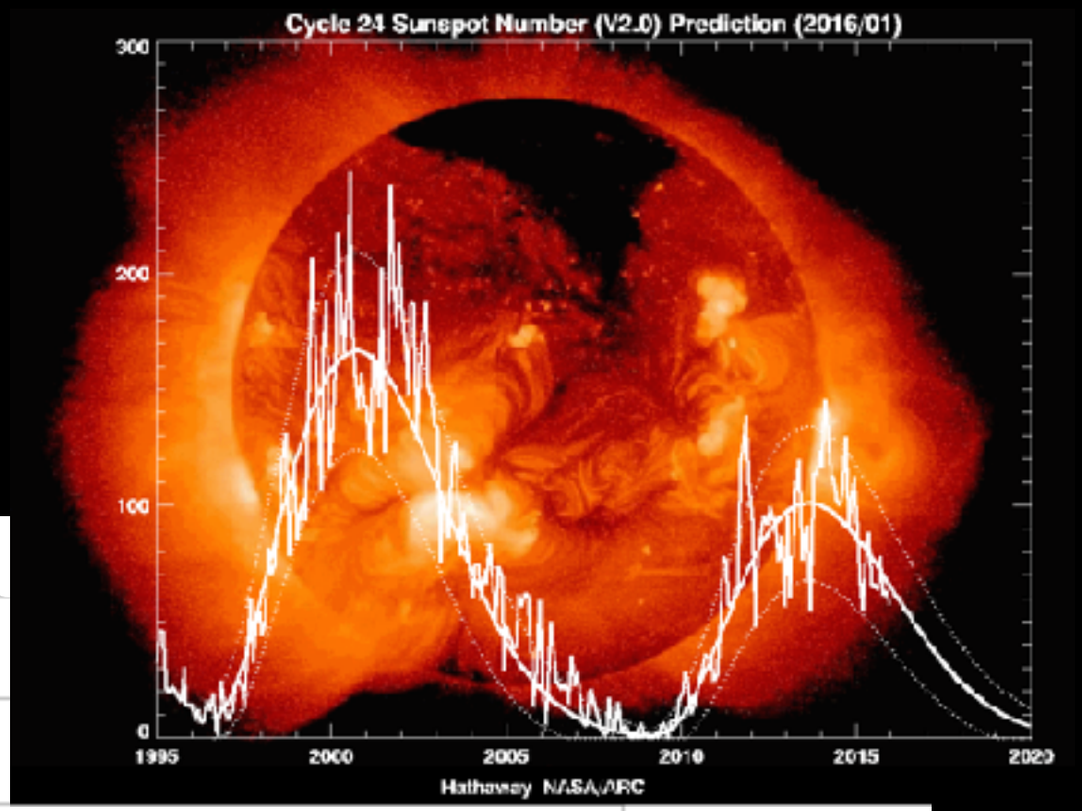


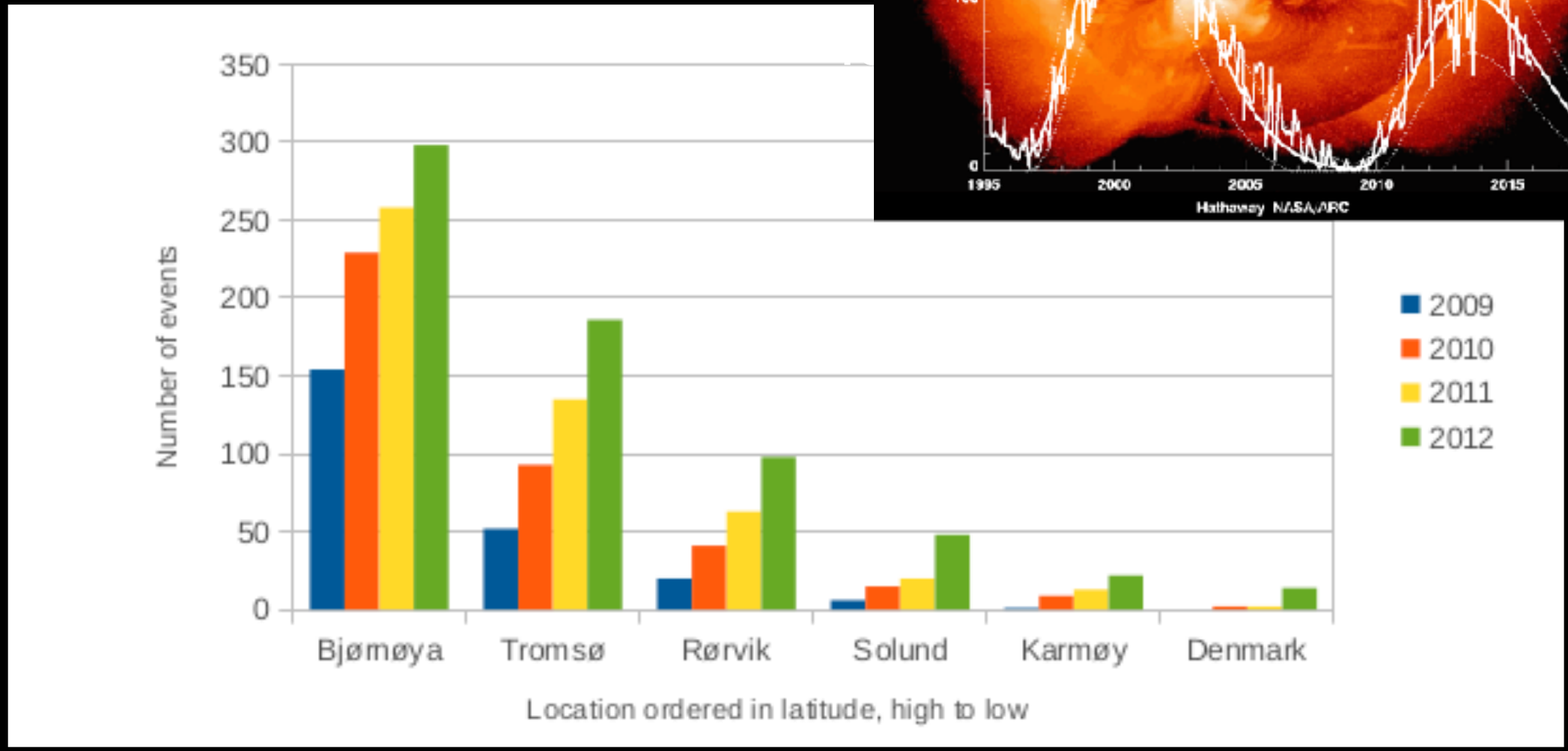
How often can you see the Auroras



How often can you see the Northern lights?

The diagram shows how many days you have the aurora over head at different latitudes and how this vary with the solar cycle - 2009 being close to solar minimum, 2012 closer to solar maximum.





Where best to view it in the high north

- Away from city lights
- On a summit or open country
- With a clear view of the horizon, especially to North
- Avoid the full moon
- Best time is before midnight.

Pål Brekke

How to take pictures of the Aurora

How to take pictures of the Aurora

- DSLR camera (Manual mode)
- Tripod
- Fast wide angle lens 10-35mm (f/2.8, or lower)
- ISO ca 800-1600
- exposure time 8-30 seconds

Fredrik Broms

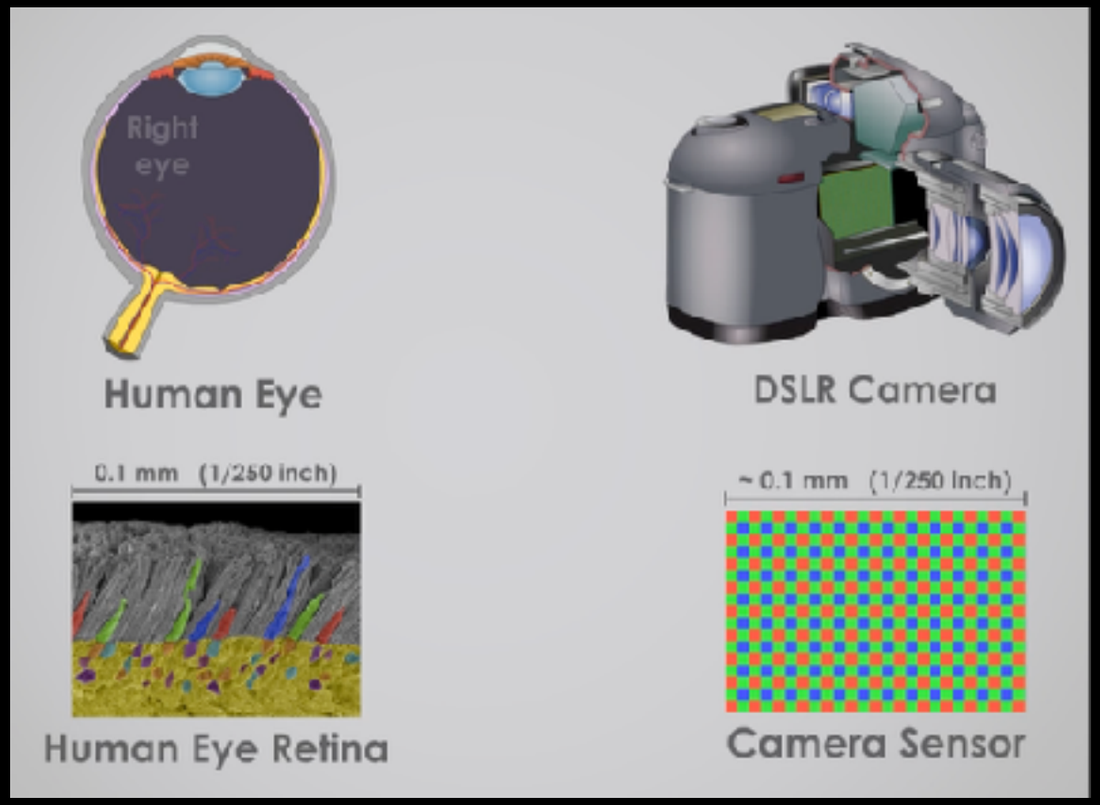
Human eyes vs cameras

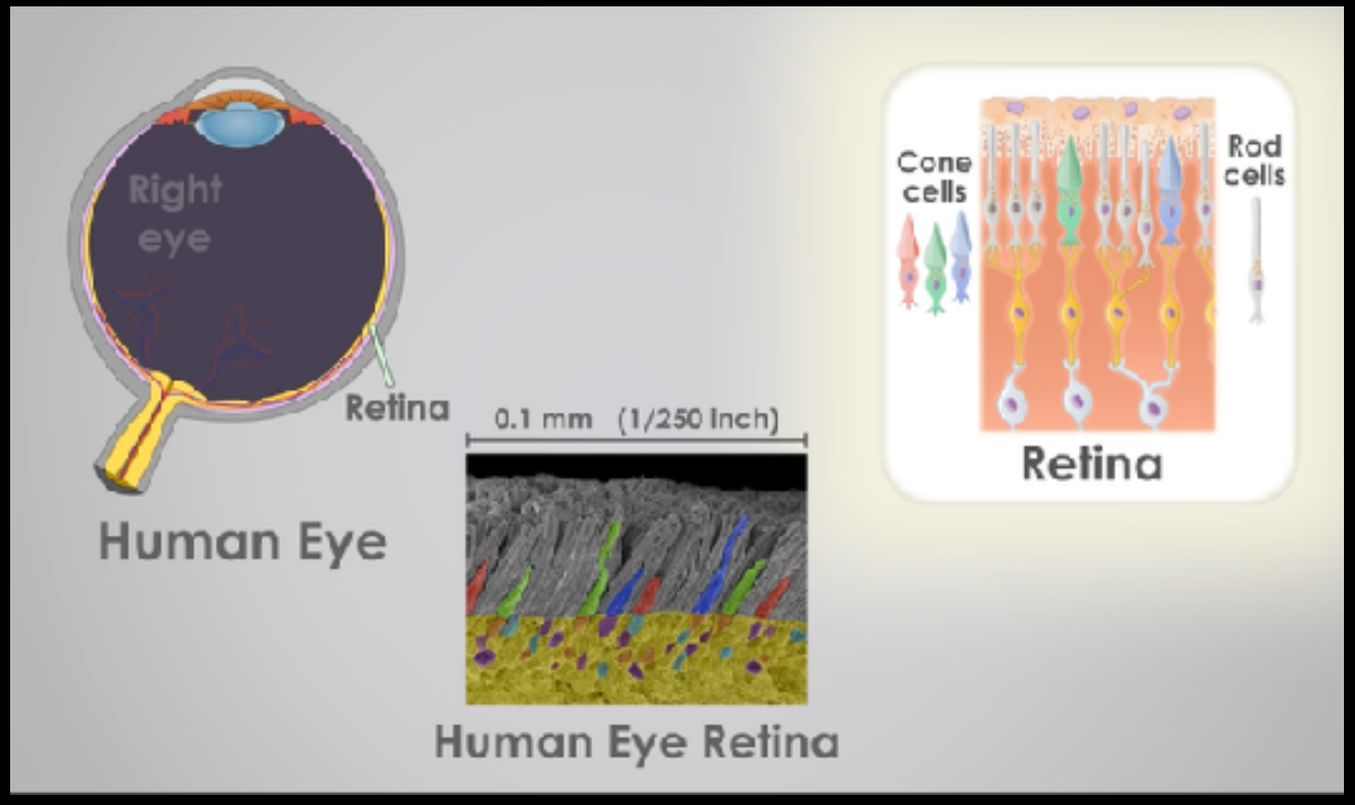
Many people will be somewhat dissapointed when they see the Northern light - with less bright green colors compared to the postcards and images online. SOme photographers tweak the coloers to much, but the main reason is that our eyes are not designed for night vission and low light conditions.

Human eyes has nmeny rod cells that gives good night vission but no colors. We have fewer of the cone cells that provide color vision. That is why we see less colors in dark condition - and why the northern lights often looks more whitish than bright green.

Cameras also have the advantage of being able to accumulate light for a long time (long exposures) in addition to being more sensitive to colors.

Some people can see more colors in dark konditions that others - but during very strong northern lights activity most people can se many coloers - like pruple, blue and red.





Credit: Paul Jensen

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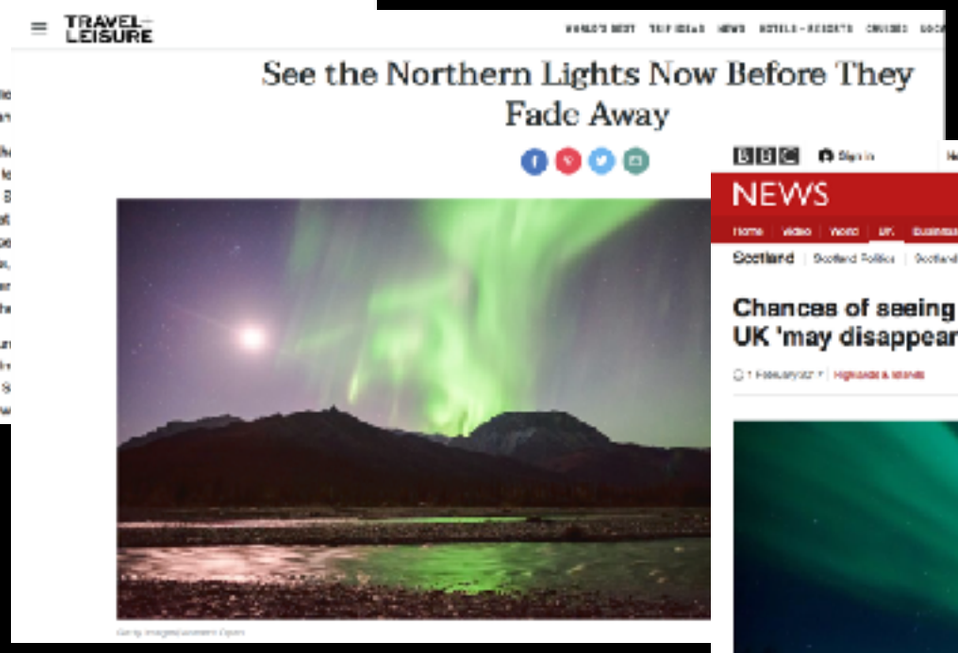
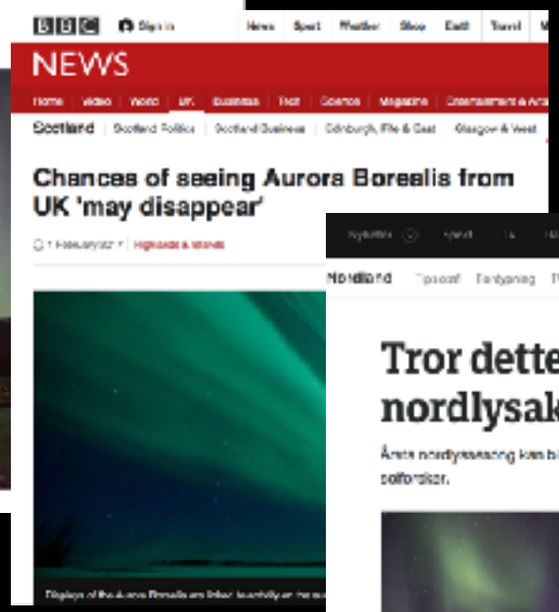
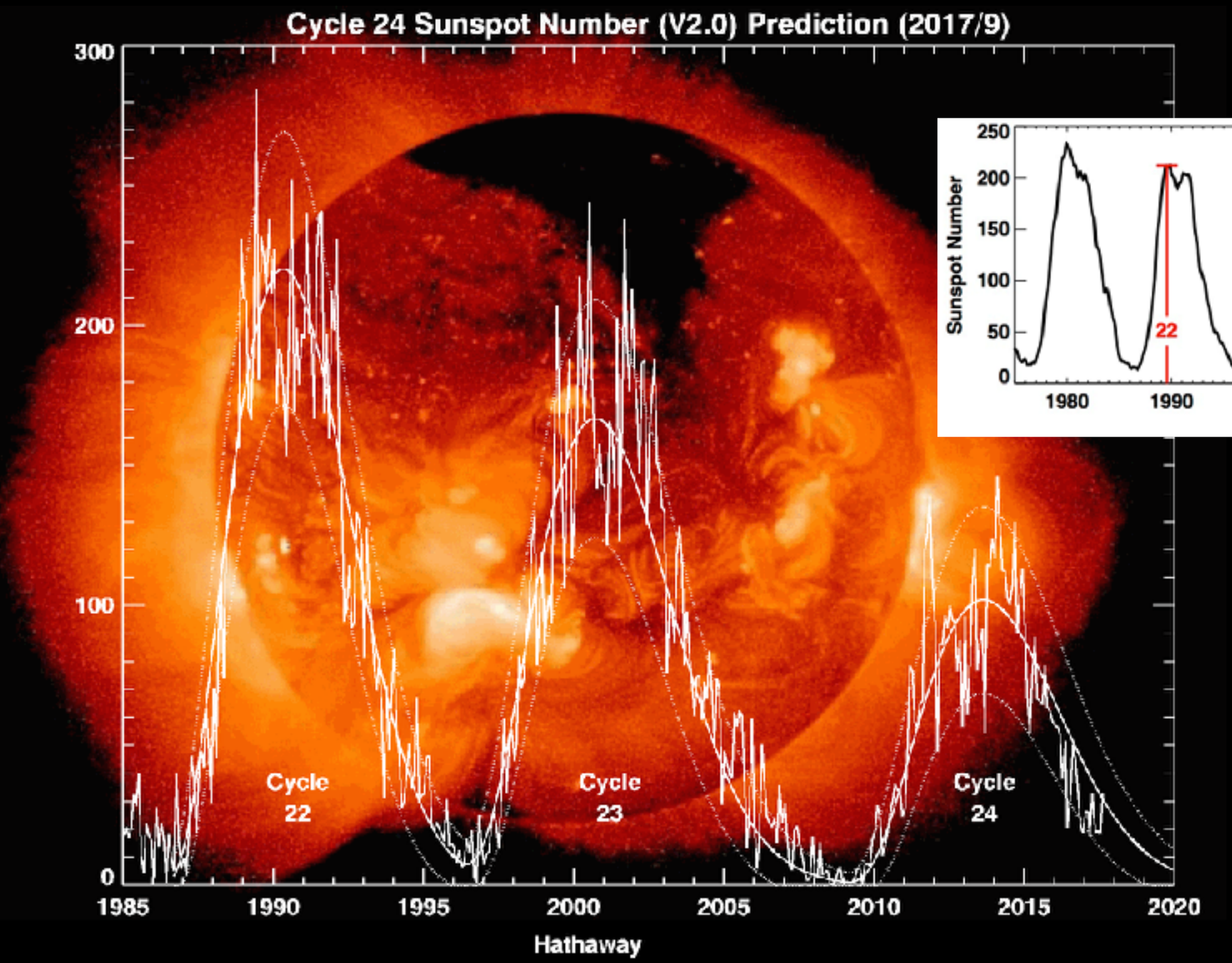
Credit: Paul Jensen

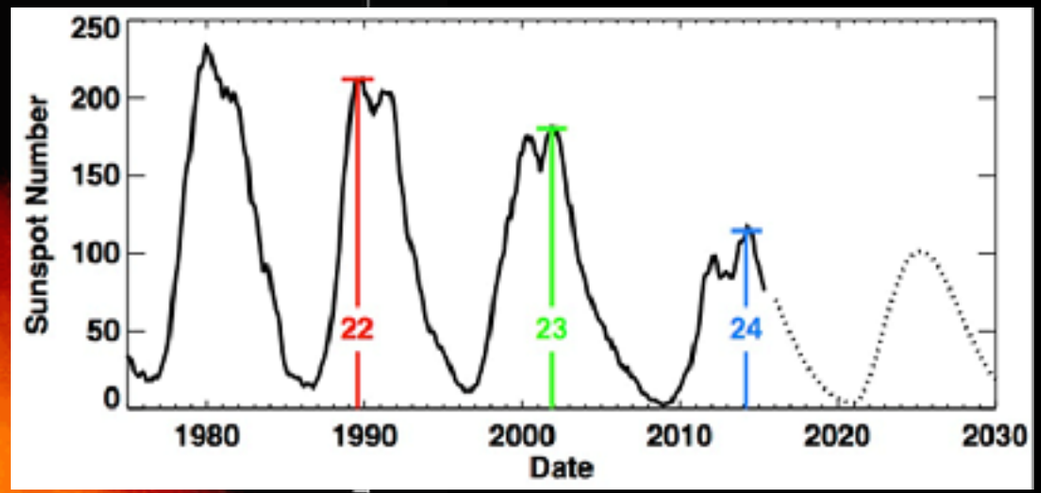
Will the aurora disappear?



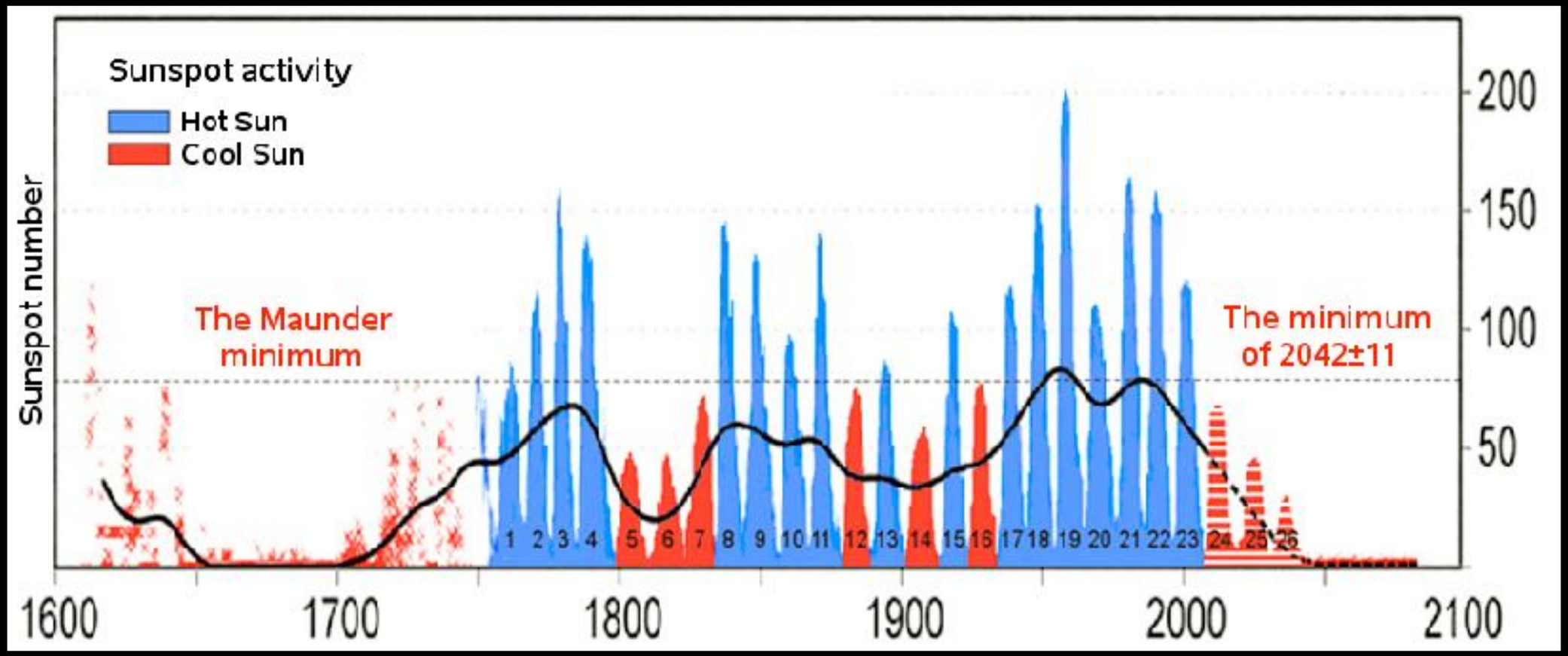


Cycle 24 Sunspot Number (V2.0) Prediction (2017/9)



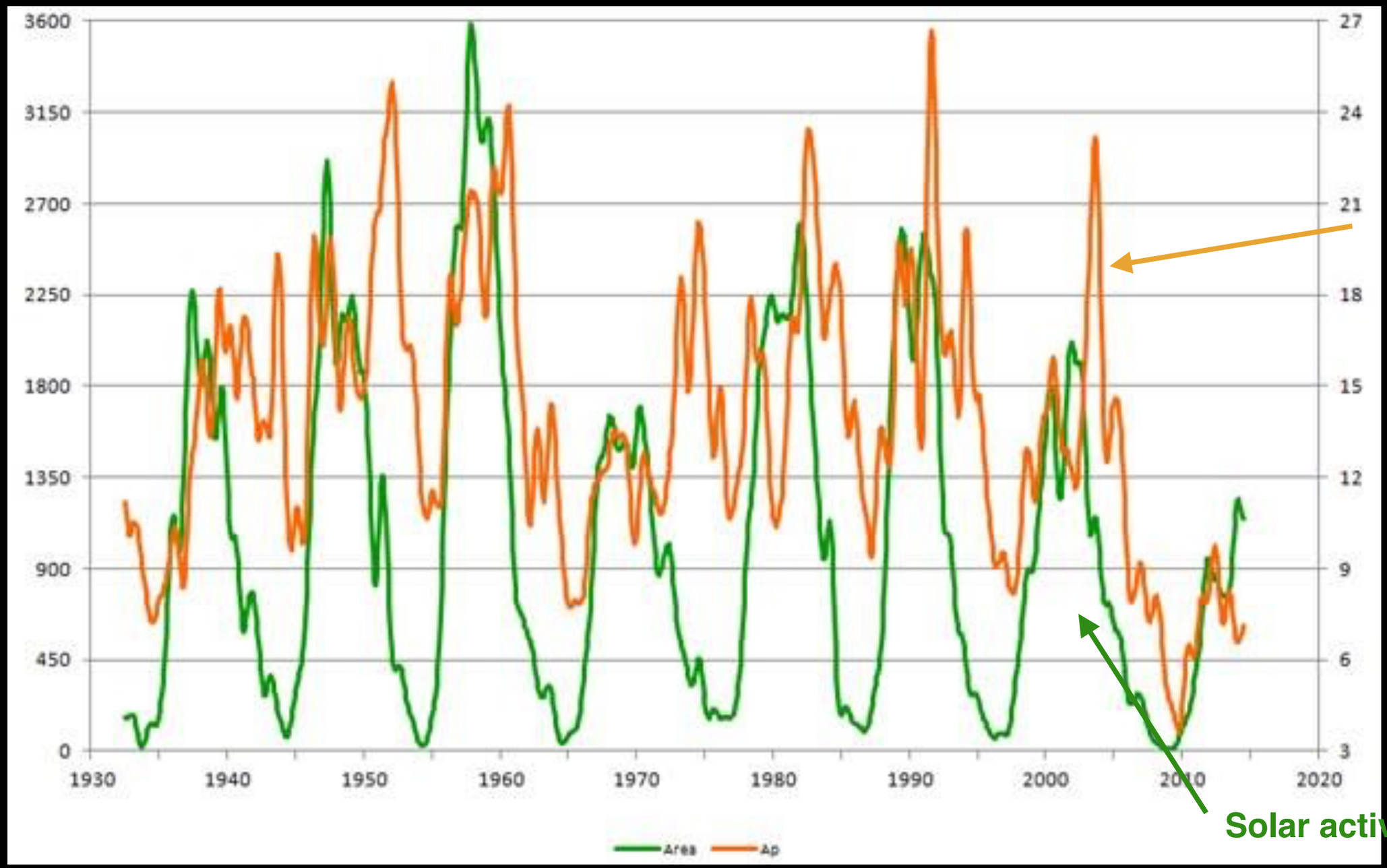


Solar activity predictions



E.g. H. Abdussamatov (2009), Lockwood et al. (2010)

Aurora activity vs solar activity



Aurora activity

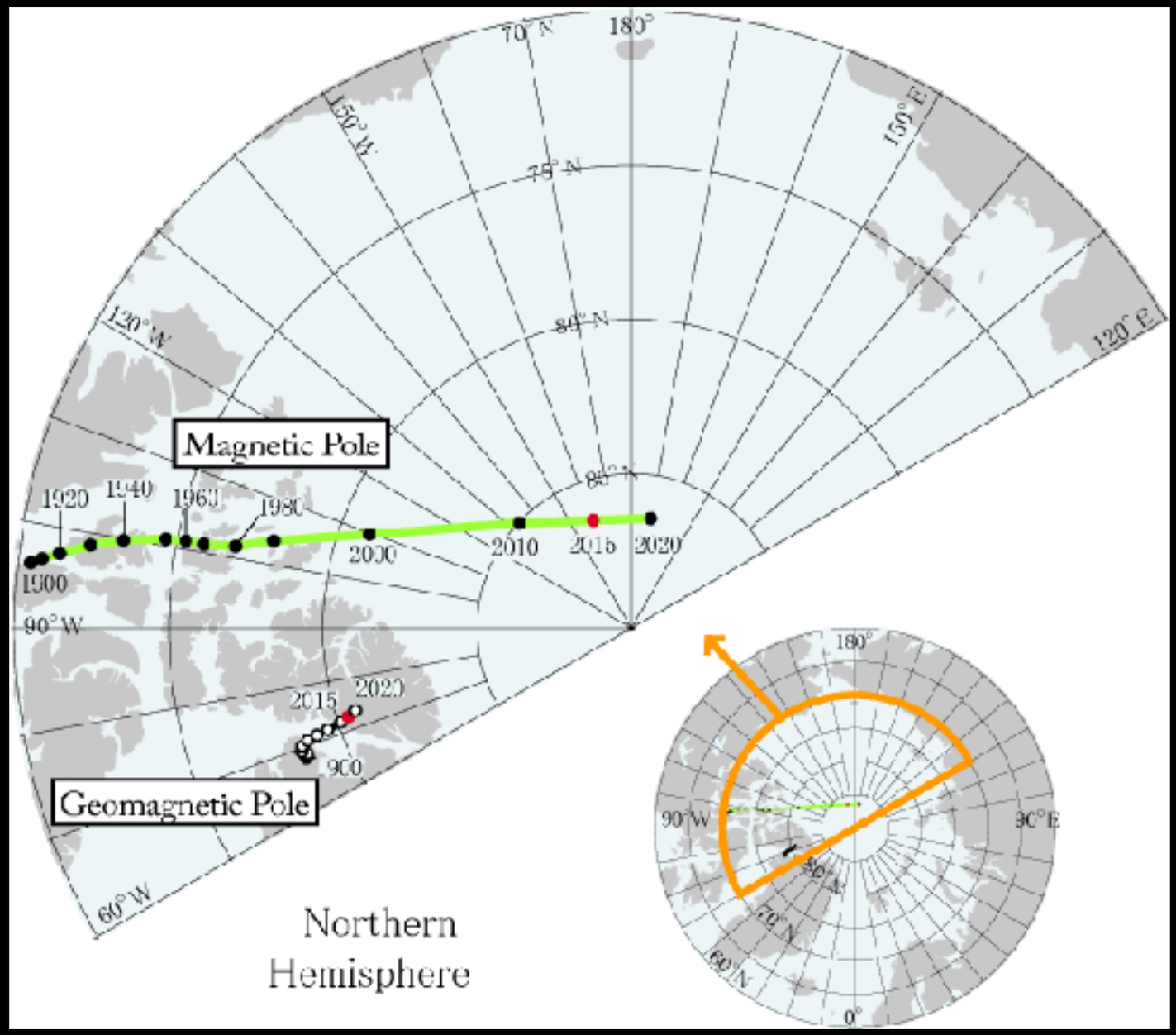
Solar activity /sunspots

Will the aurora move south??

The Earth has several poles, not just two. It has geographic north and south poles, which are the points that mark the Earth's axis of rotation. It also has magnetic north and south poles, based on the planet's magnetic field. When you use a compass, it points to the magnetic north pole, not the geographic North Pole.

The North Magnetic Pole moves over time due to magnetic changes in the Earth’s core. It is now moving rapidly towards Siberia. Speculations has been put forward that this will shift the aurora oval - so that we will see northern lights in South Norway - and not in North Norway.

Will the aurora move south??
No says experts



Two pairs of poles can be defined for the geomagnetic field: the geomagnetic poles and the magnetic poles. Read more here (will not be asked for at the exam).
http://wdc.kugi.kyoto-u.ac.jp/poles/polesexp.html

Books


DAYSIDE AURORA
- THE FINGERPRINT OF THE POLAR ATMOSPHERE
Dag Arne Lorentzen and Alv Egeland


THE STORY ABOUT THE
NORTHERN LIGHTS
PÅL BREKKE
SOLARMAX