



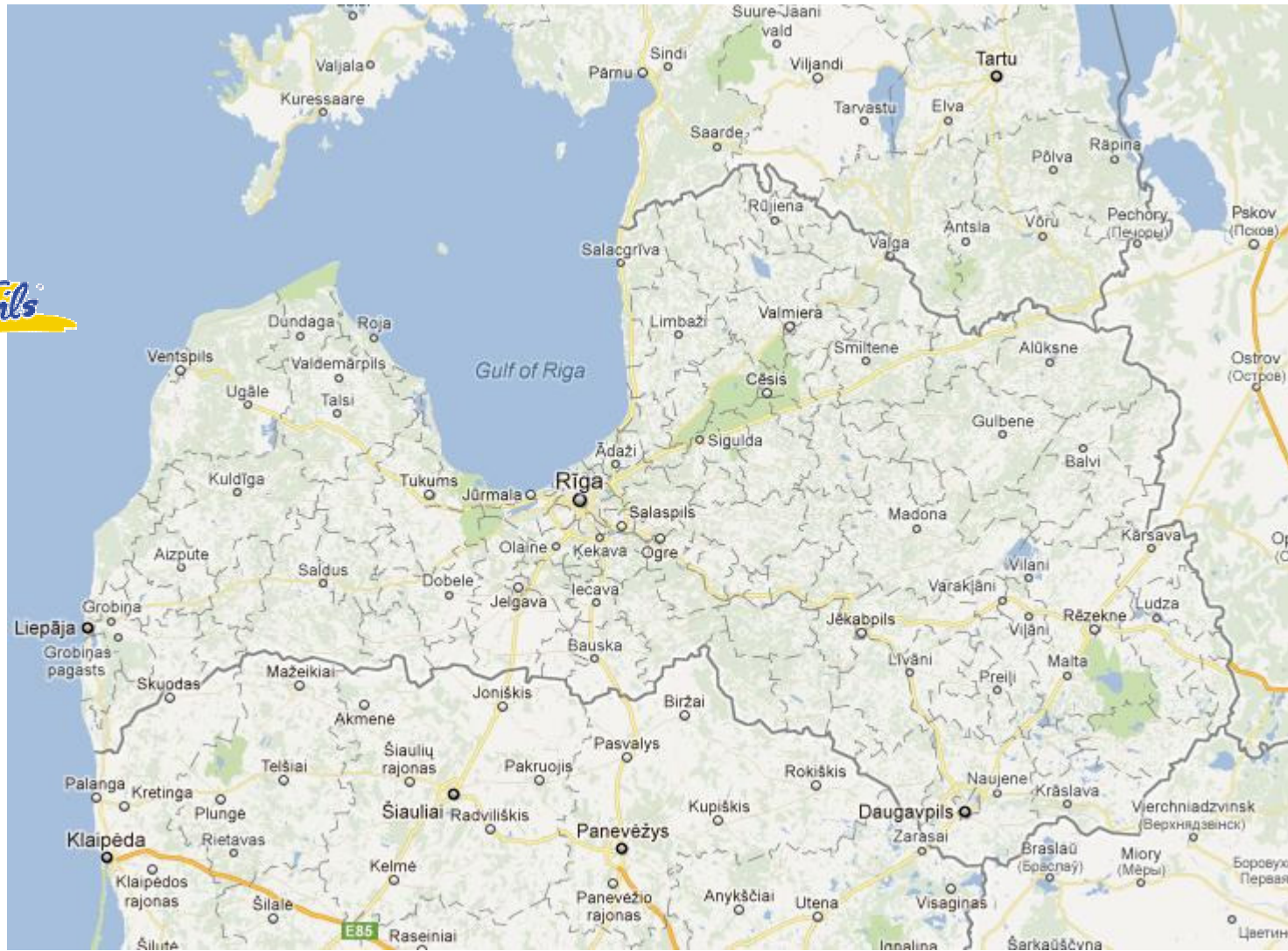
# Space related education and research in Ventspils University College

Valdis Avotiņš, Juris Freimanis

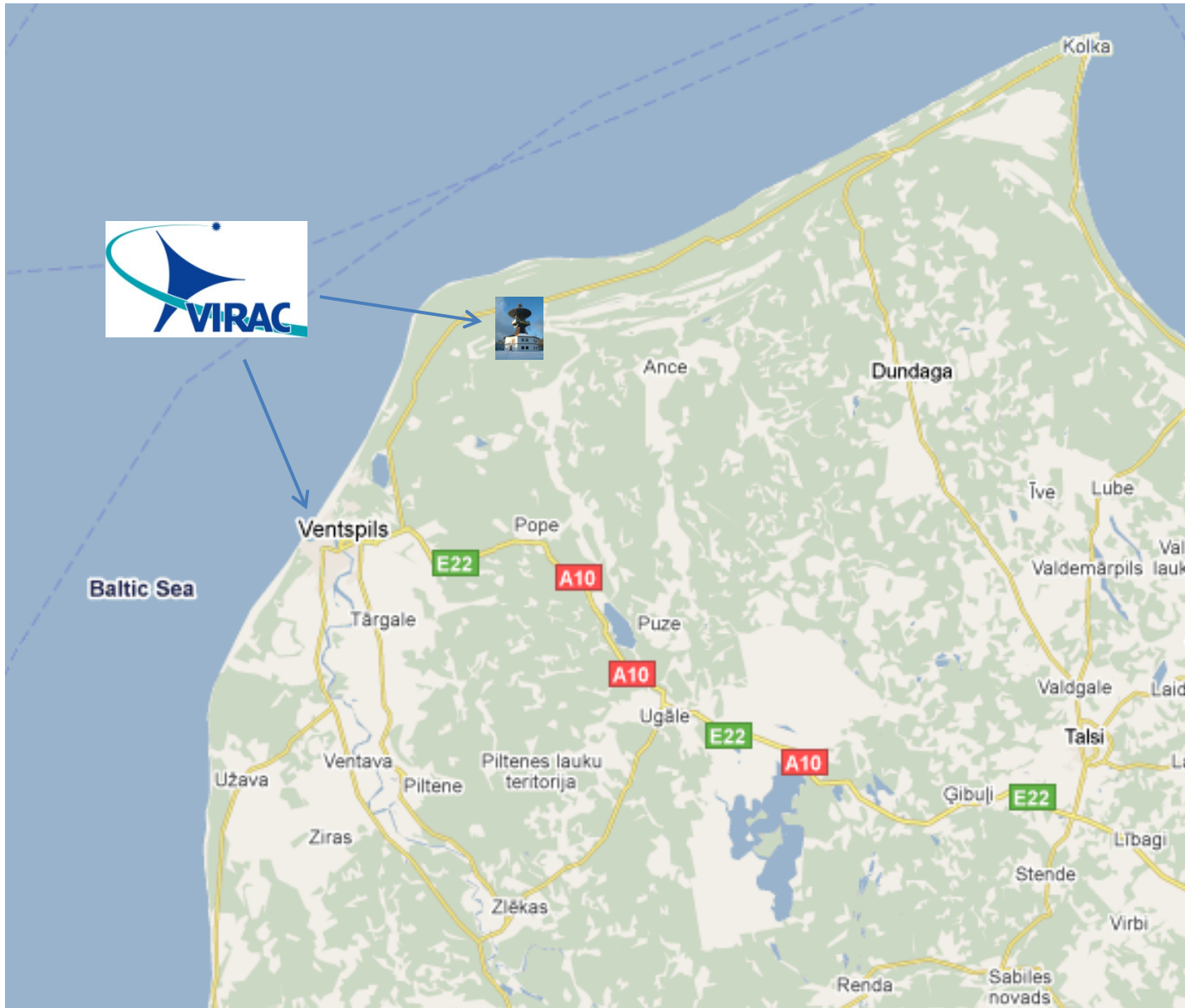
*Engineering research institute “Ventspils International Radio  
Astronomy Centre” of Ventspils University College  
(VIRAC)*

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United Nations/Latvia Workshop on the Applications of Global Navigation Satellite  
Systems, Riga, May 14 – 18, 2012



# Ventspils International Radio Astronomy Centre (VIRAC)





## Ventspils University College



Established in 1997 as the State University College.

Offers both academic and professional studies:

- Computer sciences (acad. BSc, acad. MSc);
- Electronics (acad. BSc; prof. MSc will start in 2012/2013);
- Business administration (Marketing, Logistics, Accounting, Finance) – acad. BSc, prof. MSc, joint PhD;
- Translation (English – Latvian - German/Russian, German – Latvian - English/Russian, English – Russian – German/French) – prof. BSc, prof. MSc, joint PhD.



## **The Masters degree study program in Natural Sciences: Computer Sciences (Mathematical Fundamentals of Computer Science and Satellite Information Data Processing Systems)**

Performed in the Faculty of Information Technologies of VUC since year 2006/2007. Two principal branches:

- i) Processing of digital images of the Earth obtained from satellites,
- ii) Mathematical modelling and high performance computing.

Lectures are related to mathematics, digital images processing, computer graphics, GIS etc., and they are delivered by both faculty and VIRAC staff. MSc Thesis are often prepared at VIRAC, and the best students are given job opportunities at VIRAC during their studentship already.

Graduates participate in the improvement of guiding and tracking software of VIRAC radio telescopes, creation and adaptation of VLBI software correlators etc. Other local job opportunities: Ventspils Elektronikas Fabrika Ltd., software companies in Ventspils, Ventspils City Council. Several graduates are at PhD studies abroad (one of them recently received PhD degree – in France).

## **The Bachelor degree study program in Electronics**

Performed in the Faculty of Information Technologies of VUC, Department of Electronics since year 2008/2009. Lectures and practical exercises are given in mathematics, physics, electronics and information technology; they are conducted by Faculty and VIRAC staff. BSc Thesis are done most often at the laboratories of the Faculty and at VIRAC.

Graduates receive job offers from Ventspils Elektronikas Fabrika Ltd., several smaller electronics companies in Ventspils, and VIRAC. The plant for production of liquid crystal 3D monitors is currently built in Ventspils; the beginning of its operation is planned in the late autumn this year.

VIRAC needs its own electronics engineers to maintain and upgrade radio receivers, amplifiers, data processing systems, and radio telescope control systems, as well to do applied research in satellite communication technology. Besides, VIRAC carries out applied research in electronics and mechatronics on commercial basis, after requests from commercial enterprises.



# Ventspils International Radio Astronomy Centre (VIRAC) of Ventspils University College



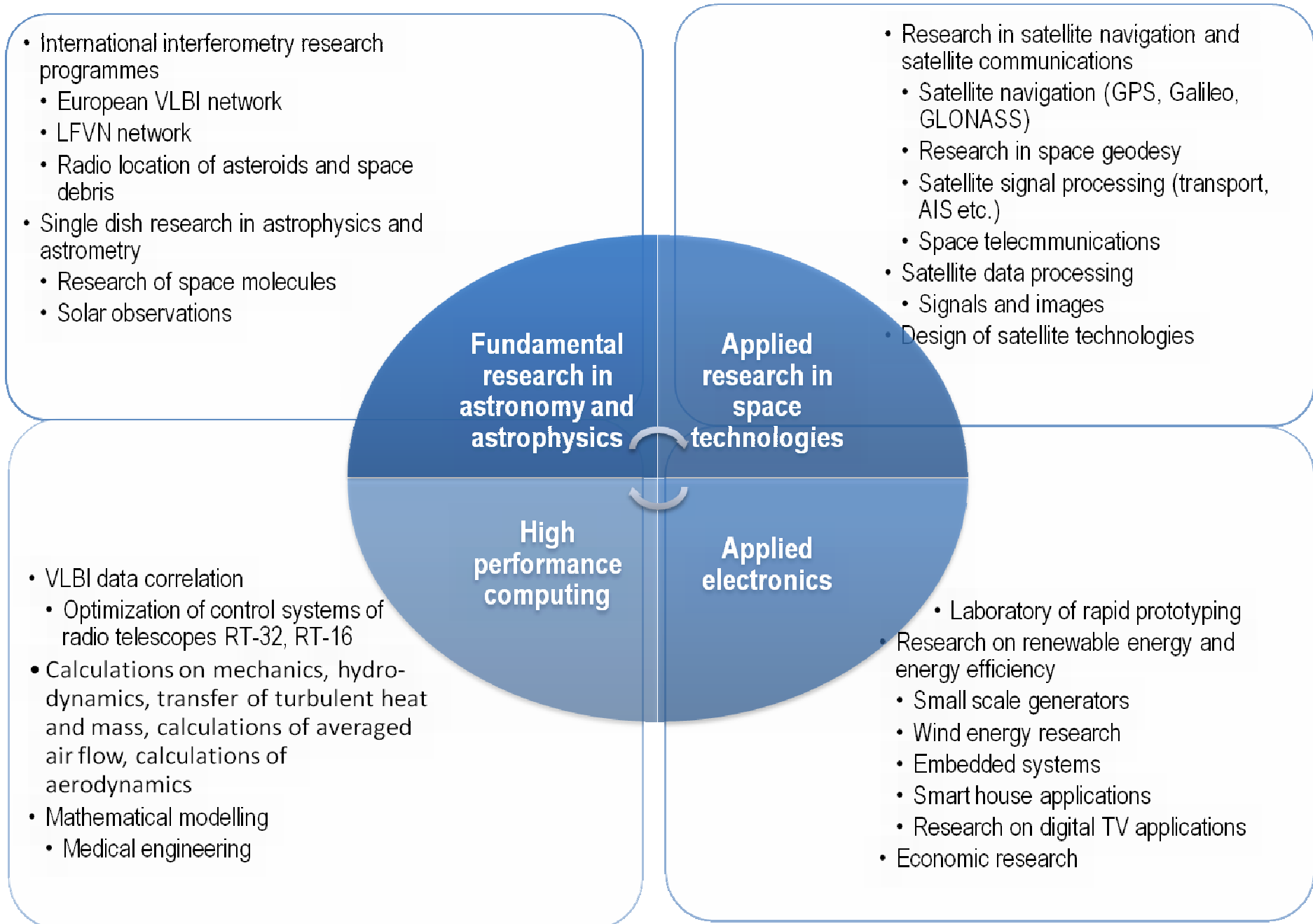
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# VIRAC: FIELDS OF RESEARCH





## **Research object: structure and topology of Solar magnetic fields, prediction of Solar activity, space weather**

Carried out by Dr.phys. **Boriss Rjabovs** and MSc, PhD student **Dmitrijs Bezrukovs**.

Radio observations – mainly from Nobeyama Radio Heliograph (Japan) and VIRAC RT-32. Other observations – Hinode (Japanese satellite, UV and X-rays), PROBA2 (ESA satellite) and others.

Active cooperation with: Pulkovo Observatory and Saint Petersburg State University (Russia), Solar Group of Nobeyama Radio Observatory (Japan).

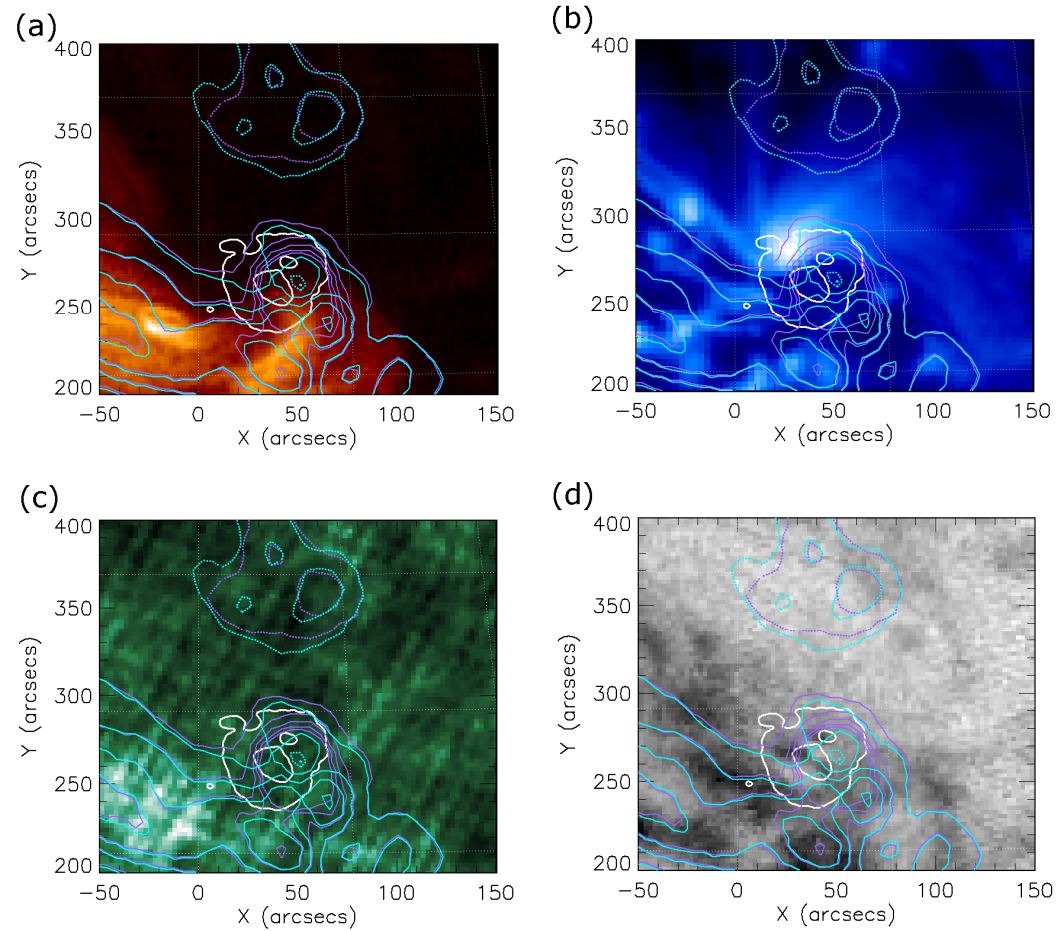


Figure 1. A “dark coronal corridor” is revealed nearby a large isolated sunspot on the Sun in soft X-ray (XRT onboard PROBA2, a) and extreme ultraviolet emission (SWAP onboard PROBA2, b). The depressed coronal emission is accompanied by the lowered radio brightness at 17 GHz (Nobeyama Radio Heliograph, color contours), 34 GHz (NoRH, c) and in chromospheric absorption line He I 10830 Å (CHIP in the MLSO, d).

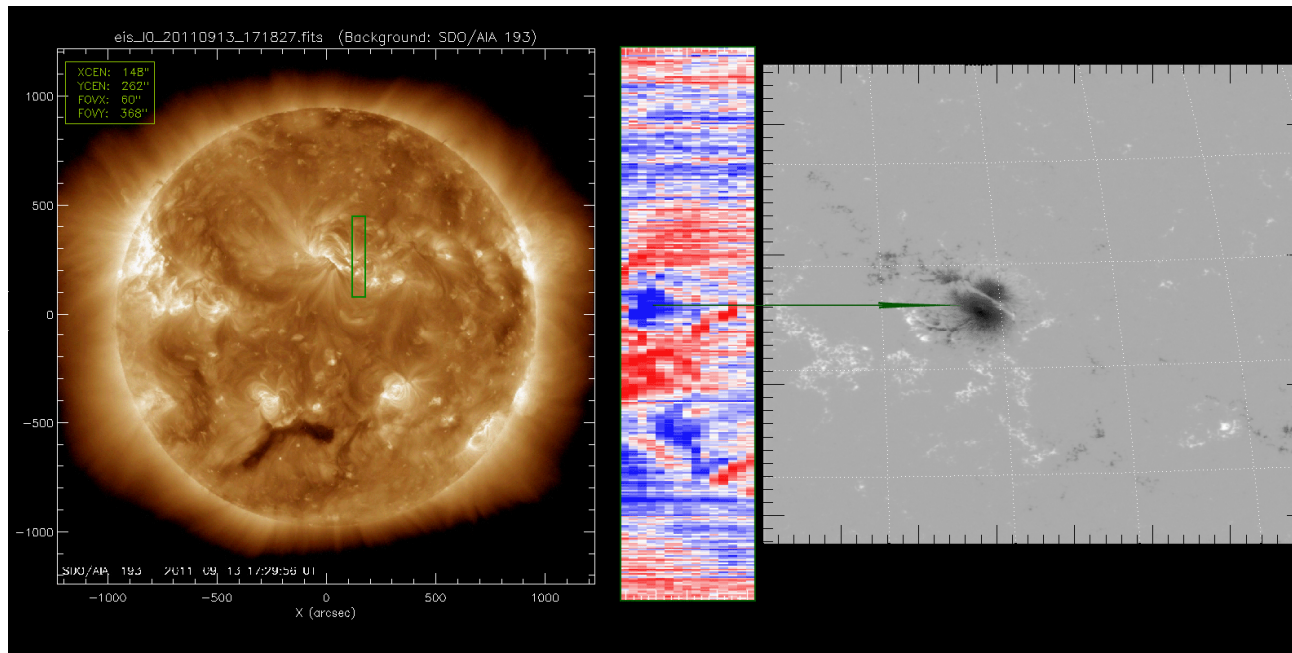
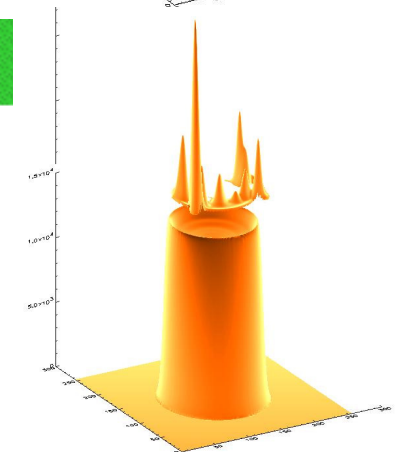
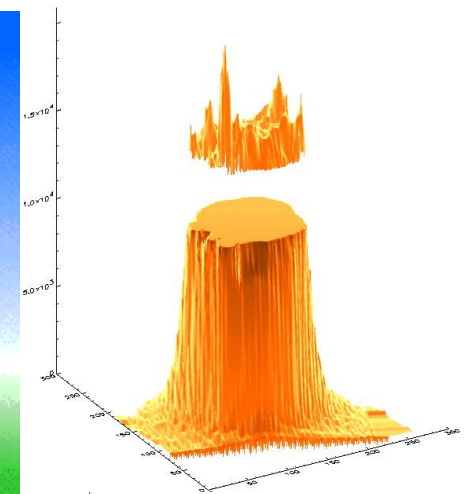
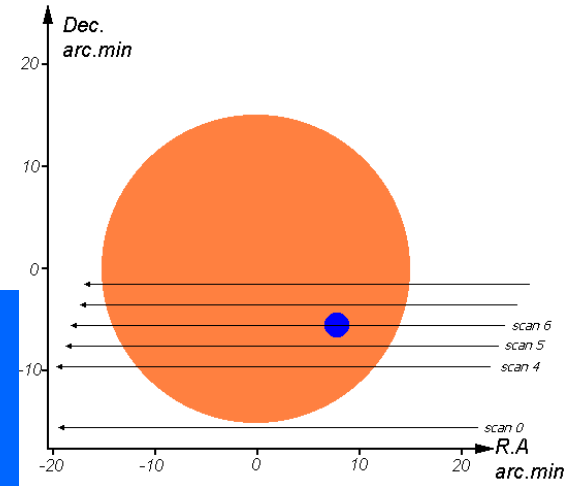
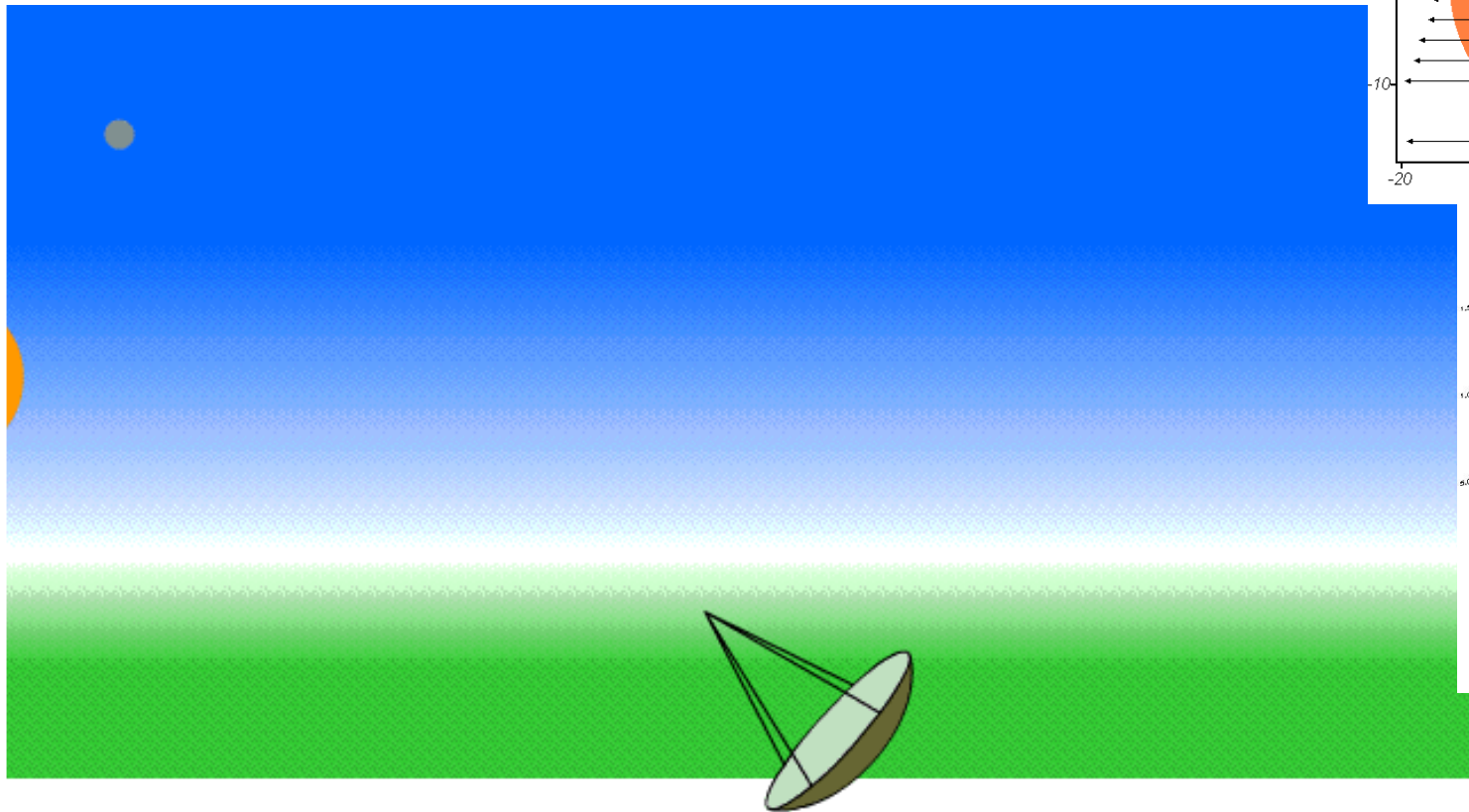


Figure 2. With the help of the EIS (Extreme Ultraviolet Imaging Spectrometer) onboard Solar-B (“Hinode”) a plasma outflow up to 13 km/s is revealed just in the “dark coronal corridor” nearby a large isolated sunspot.

# Sample: Solar activity measurements



## **Research object: radio emission of galactic and extragalactic objects, their structure and evolution**

Carried out by group lead by Dr.phys. **Ivars Šmēlds**. Other key members: **Vladislavs Bezrukovs, Juris Kalvāns**.

VLBI and single dish radio observations using VIRAC RT-32, and their theoretical interpretation.

Active cooperation with JIVE (Netherlands), Onsala Space Observatory (Sweden), Nicolaus Copernicus Astronomical Center in Torun (Poland), Radiophysical Institute (Nizhny Novgorod, Russia), and others.



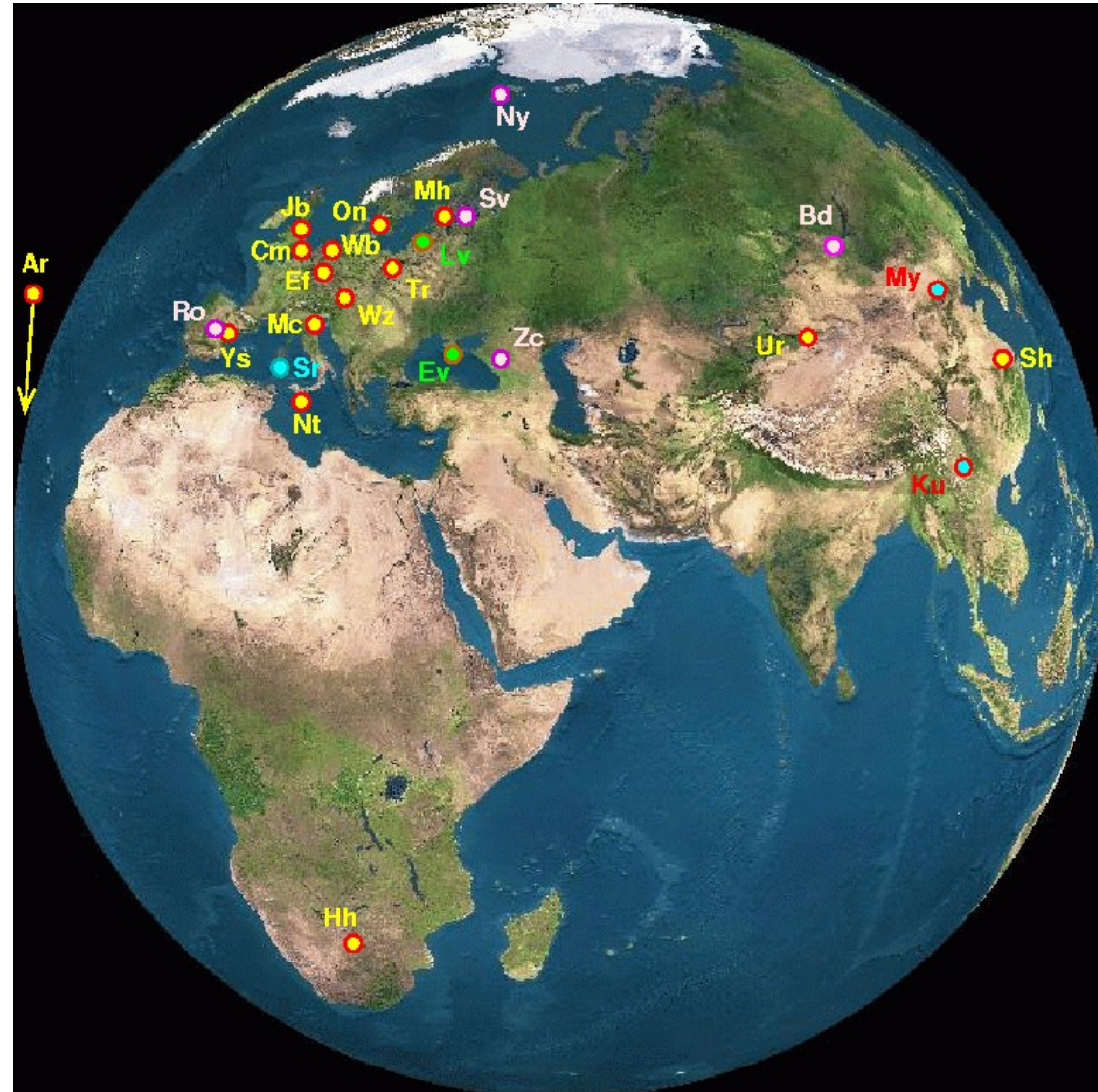
The European VLBI Network (EVN) is an interferometric array of radio telescopes spread throughout Europe (and beyond) that conducts unique, high resolution, radio astronomical observations of cosmic radio sources. It is the most sensitive VLBI array in the world, thanks to the collection of extremely large telescopes that contribute to the network.



Consortium for Very Long Baseline Interferometry in Europe



<http://www.evlbi.org/gallery/images.html>





# VIRAC TODAY



Image by Paul Boven (boven@jive.nl). Satellite image: Blue Marble Next Generation, courtesy of Nasa Visible Earth (visibleearth.nasa.gov).



# Low Frequency VLBI Network Project (LFVN)

## Radio Telescopes:

- Bear Lakes RT-64
- Pushchino RT-22
- Zimenki RT-15
- St. Pustyn RT-14 (Russia)
- Evpatoria RT-70
- Simeiz RT-22 (Ukraine)
- Noto RT-32
- Medicina RT-32 (Italy),
- Urumqi RT-25 (China),
- **Ventspils RT-32 (Latvia).**

## Frequencies:

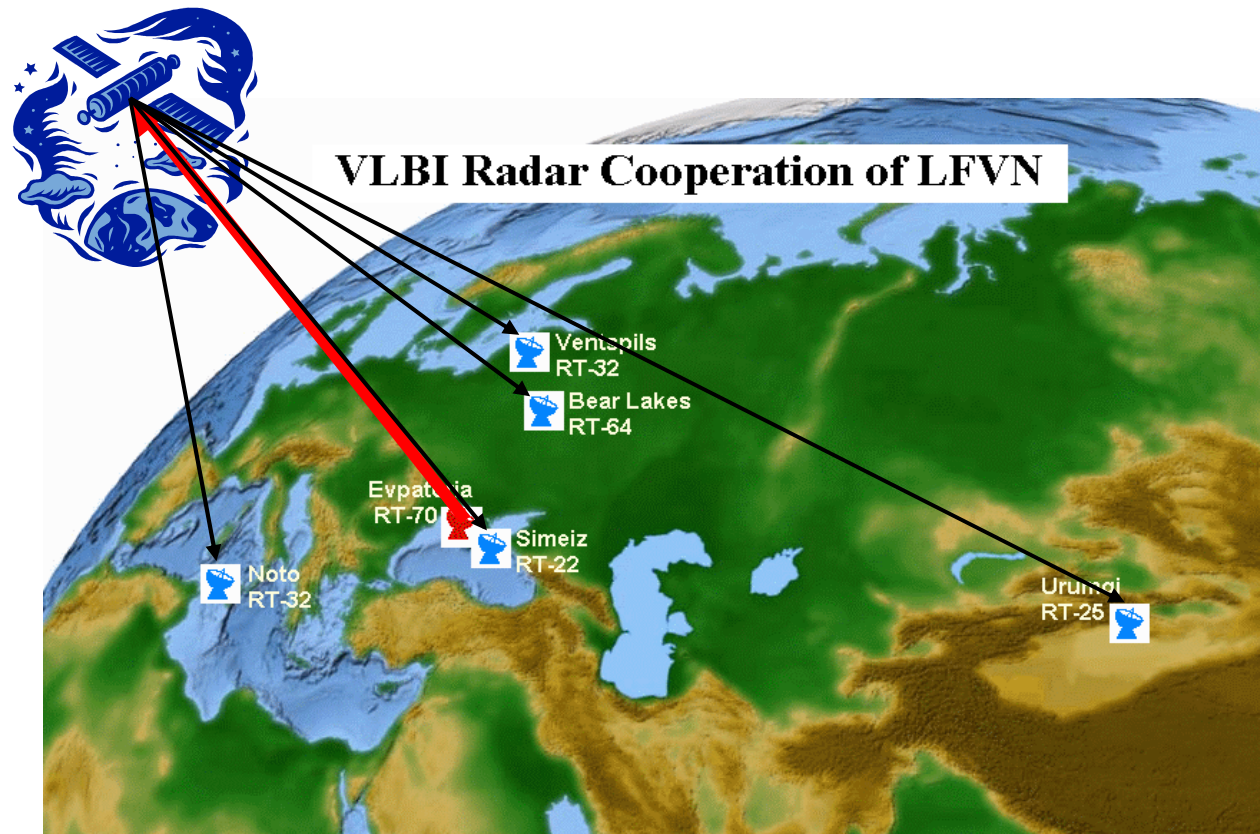
- **92 cm, 18 cm, 6 cm.**

## Recording systems:

- **TN16, MK-2, NRTV, MK-V.**

## Activities:

- Investigations of solar wind, solar spikes, AGN, OH-masers, active stars and radar research of Earth group planets, **close asteroids and space debris objects.**

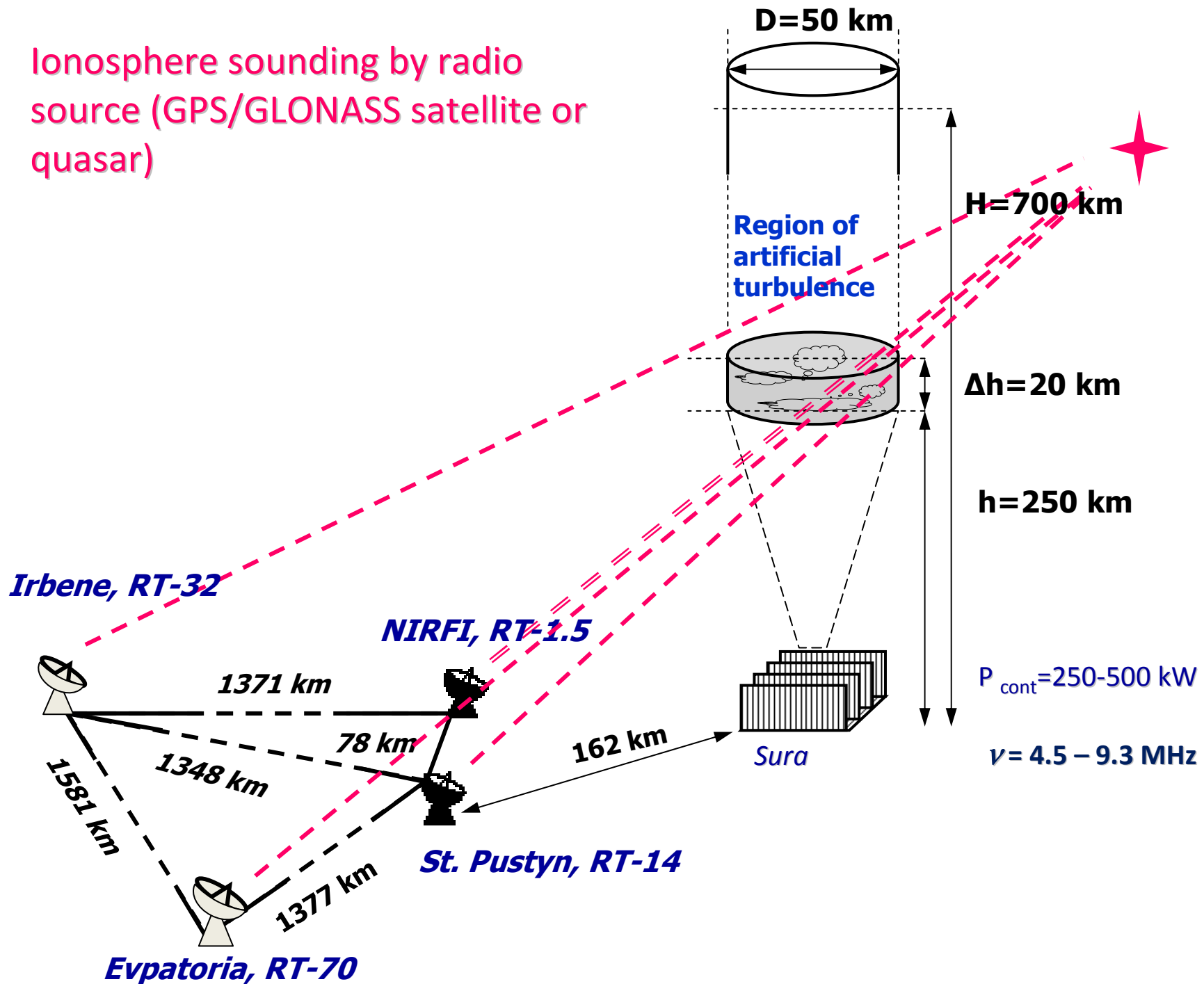


## Research object: ionosphere of the Earth

Carried out by Dr.phys. **Maria Nechaeva**, Dr.phys. **Ivars Šmēlds**,  
**Vladislavs Bezrukovs**.

VLBI radio observations using VIRAC RT-32. The interpretation – until now mainly by Radiophysical Institute (Nizhny Novgorod, Russia). Perspective collaboration with European consortium EISCAT.

Ionosphere sounding by radio source (GPS/GLONASS satellite or quasar)

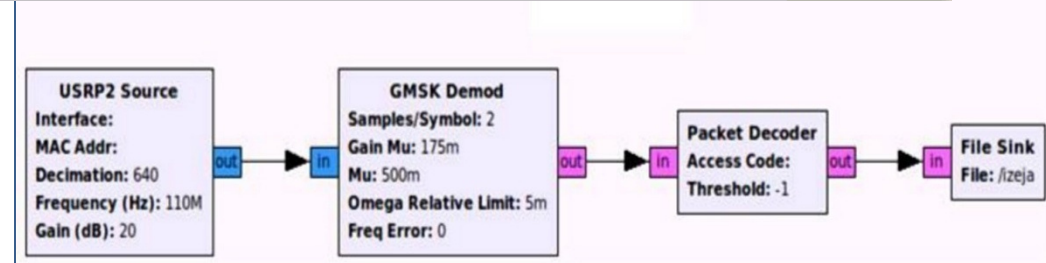
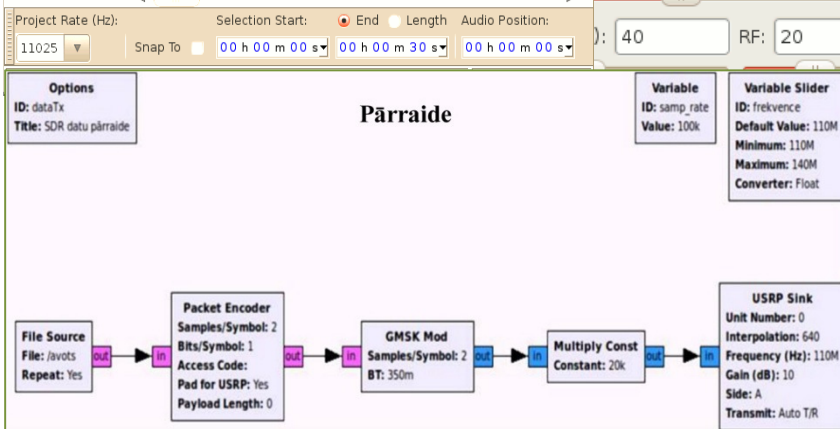
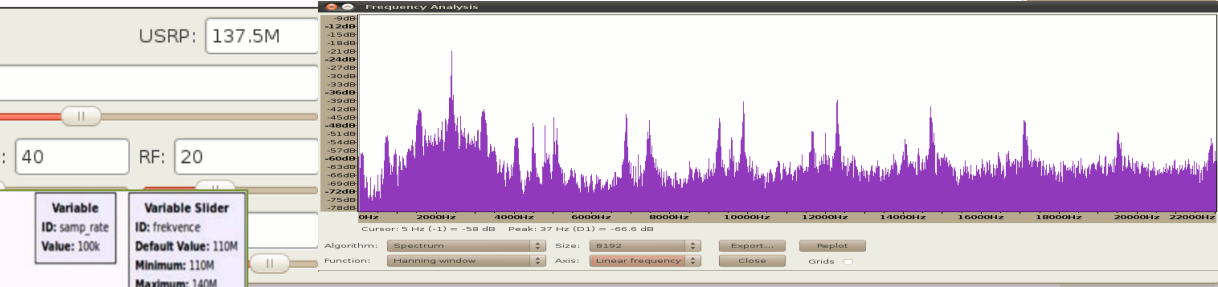
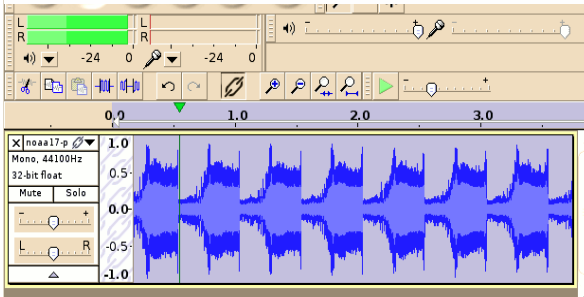
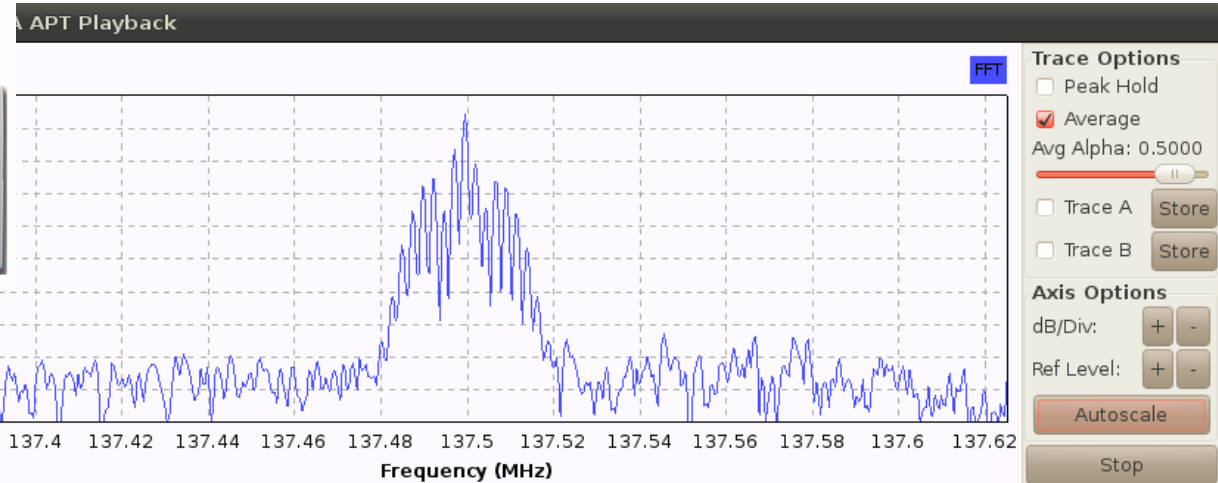
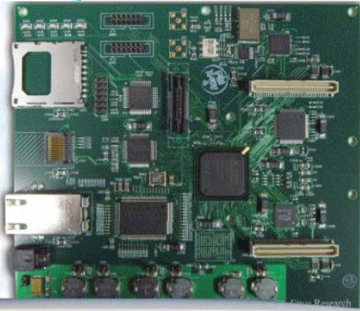




## Research topic: satellite communication

This is an applied research carried out by group lead by Dr.phys. **Jānis Trokšs**. Main directions: i) Software defined radio (SDR), ii) automatic identification systems (for ships, but in principle they can be used for cargo containers on railways and trucks as well).

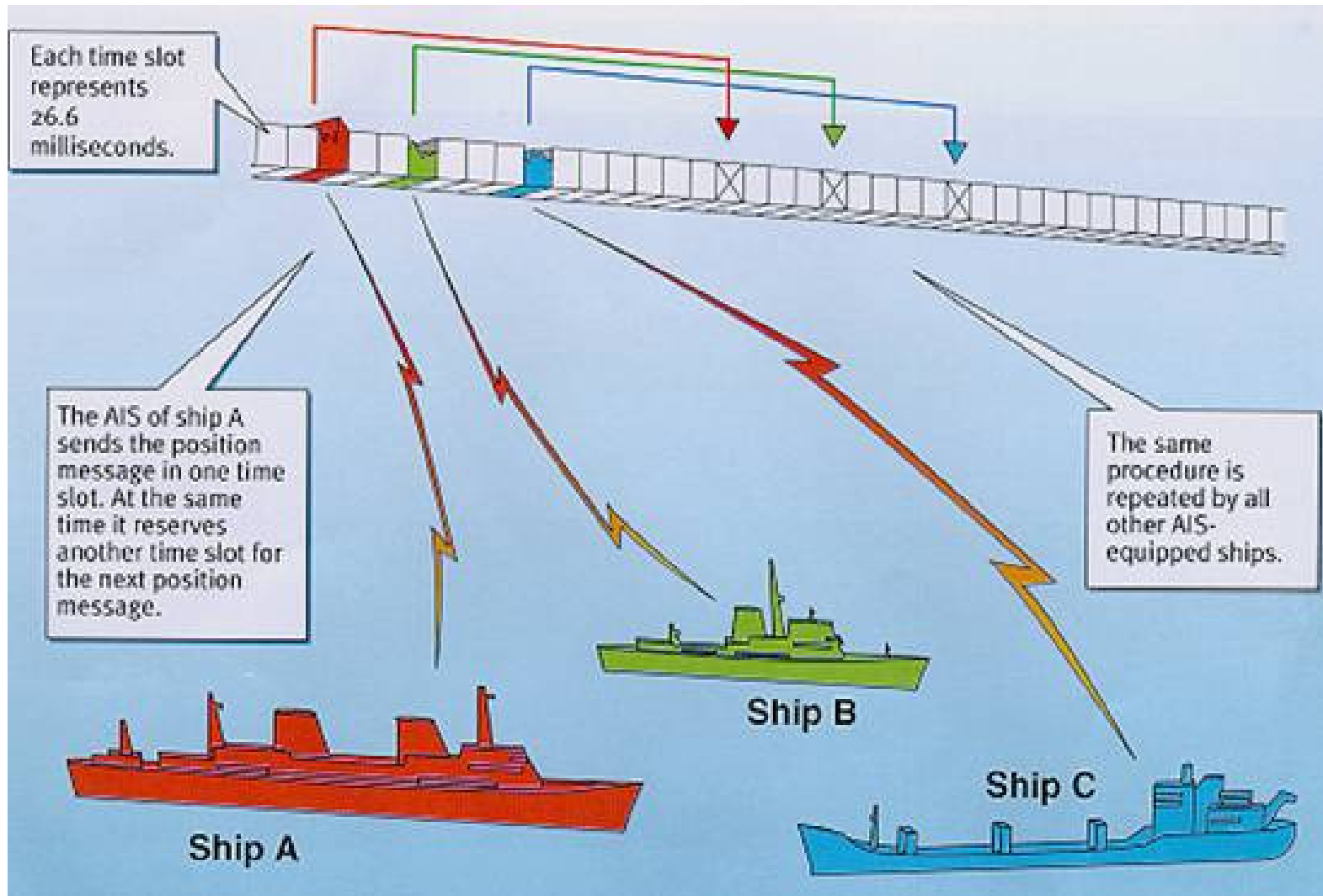
# Software defined radio (SDR)



# AIS

- AIS – Automatic Identification System
- Marine and land based
- Application – safety and data gathering
- Transmits position, heading, speed etc.
- 161.75MHz and 162.25MHz frequency bands
- 9.6kbps GMSK modulation
- TDMA – Time Division Multiple Access

# AIS



# AIS

- AIS in Space
  - Covers large areas
  - Enables accessibility of remote waters
- Problems
  - Low signal-to-noise ratio
  - Doppler shift
  - Packet collision



## Research topic: processing of satellite images

Conducted by several young Masters of Science (**Kārlis Zālīte**, **Linda Gulbe**, **Inese Jaunzeme**) under supervision by Dr.habil.phys. **Juris Roberts Kalniņš**.

The main objects of research: forests and other ecosystems.

Close cooperation with Tartu University (K.Zālīte is at Tartu now, as PhD student). Other partners – Institute of Mathematics and Computer Science, University of Latvia; JSC “Latvijas valsts meži”; The Slītere National Park.

# Satellite images used

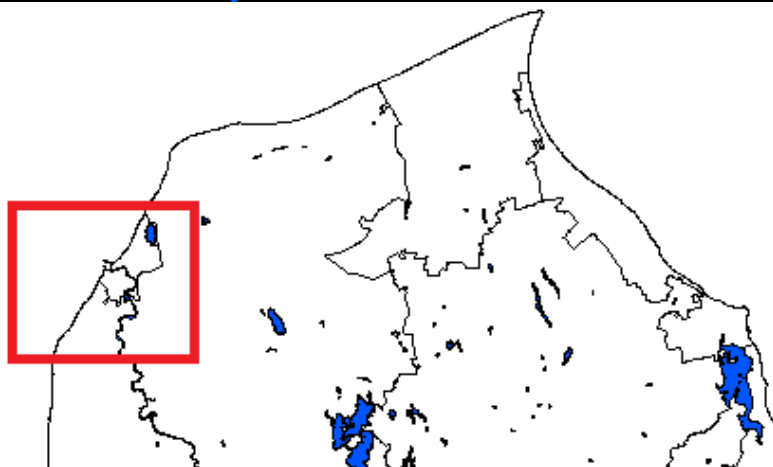
**Medium spatial resolution (30 m):  
Landsat TM and Landsat ETM+**



**High spatial resolution (5 m):  
RapidEye**



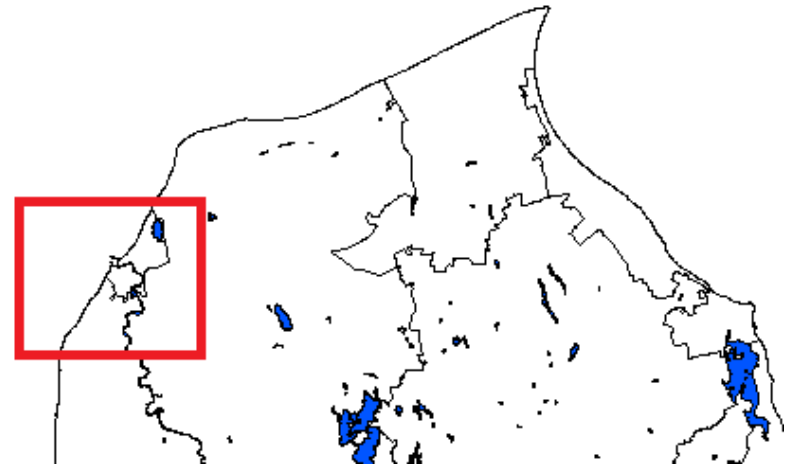
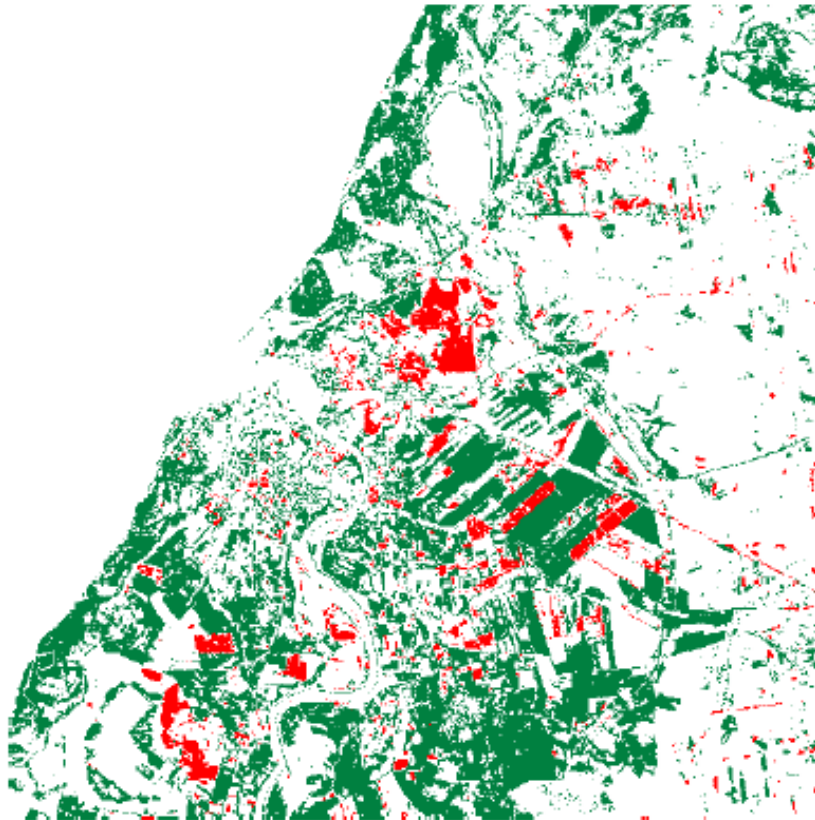
## Detection of changes of coastline and water basins



Blue – recession of coastline

Red – progression of coastline,  
or eutrophication of the water basin

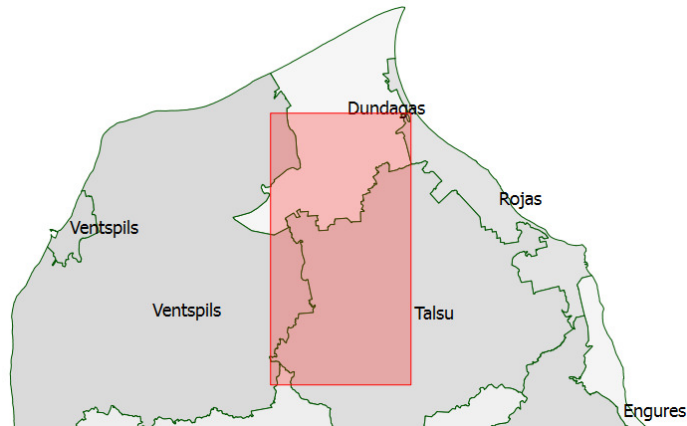
# Biomass mapping



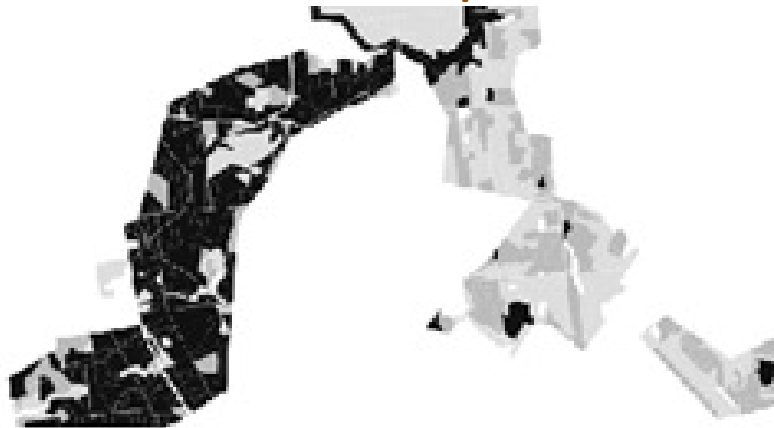
Green – enlargement of forest territories

Red – diminishing of forest territories

# Forest inventory



Reference data map



The result of classification



■ Parastā priede

■ Parastā egle

■ Bērzu sugas



Thank you for your attention!