



# Fundamental element of the geodetic infrastructure – Struve Arc

Coordinating Committee meeting of the STRUVE  
Geodetic ARC

Dr.sc.ing., Mag.Phys. Jānis Kaminskis  
Asoc.Prof., Head of Geomatics department

Tallinn, September 7, 2016

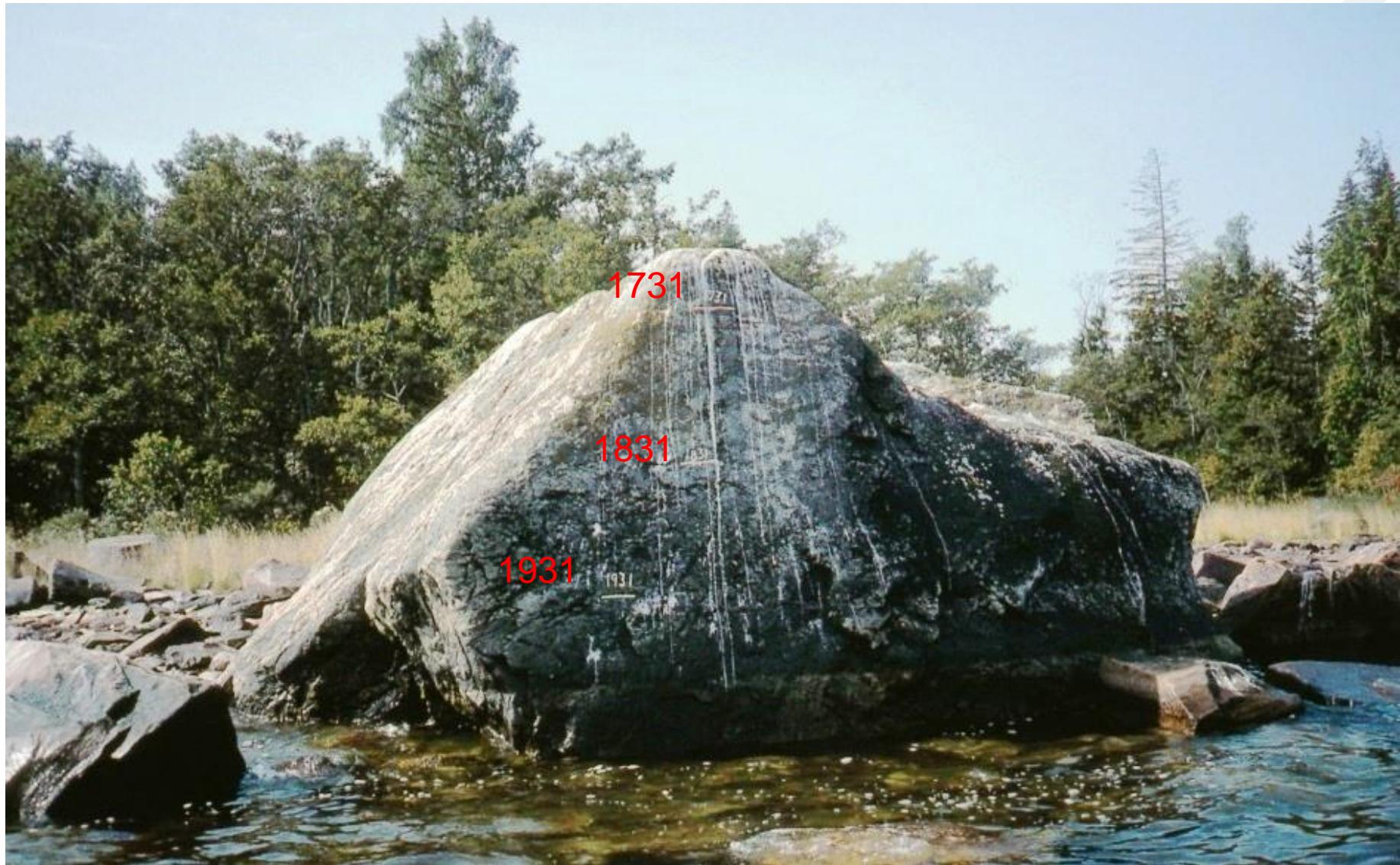


## Introduction - infrastructure

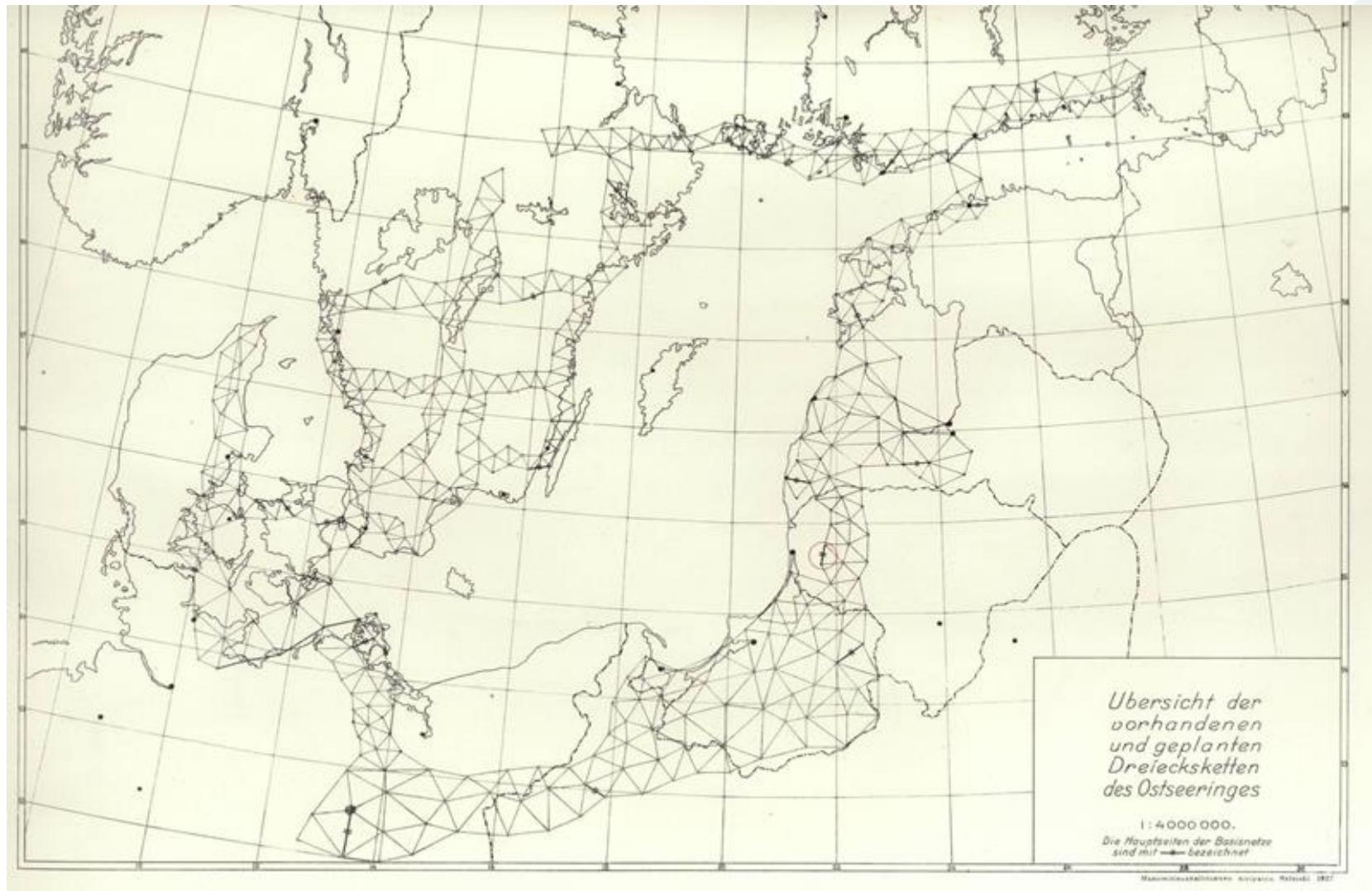
*Geodetic benchmarks as at least one of crucial infrastructure elements for precise geodesy we do recognize in our region since 19th century with the Struve geodetic arc. We are still practically using them for current geodetic reference network after 200 years or since 1816.*

*Nowadays we have many more accurate geodetic observation facilities available, such as VLBI, SLR, GNSS and gravity measurements that are correlating to all those mentioned natural changes. All precise geodetic observations give us detailed information, like if we would put our “finger” under microscope. However, in same time we must know all global relations to be sure about behavior of our “body” – Earth – impacting life of all forms on the planet.*

# Celsius stone more than 300 years ago



# Baltic Ring 1927

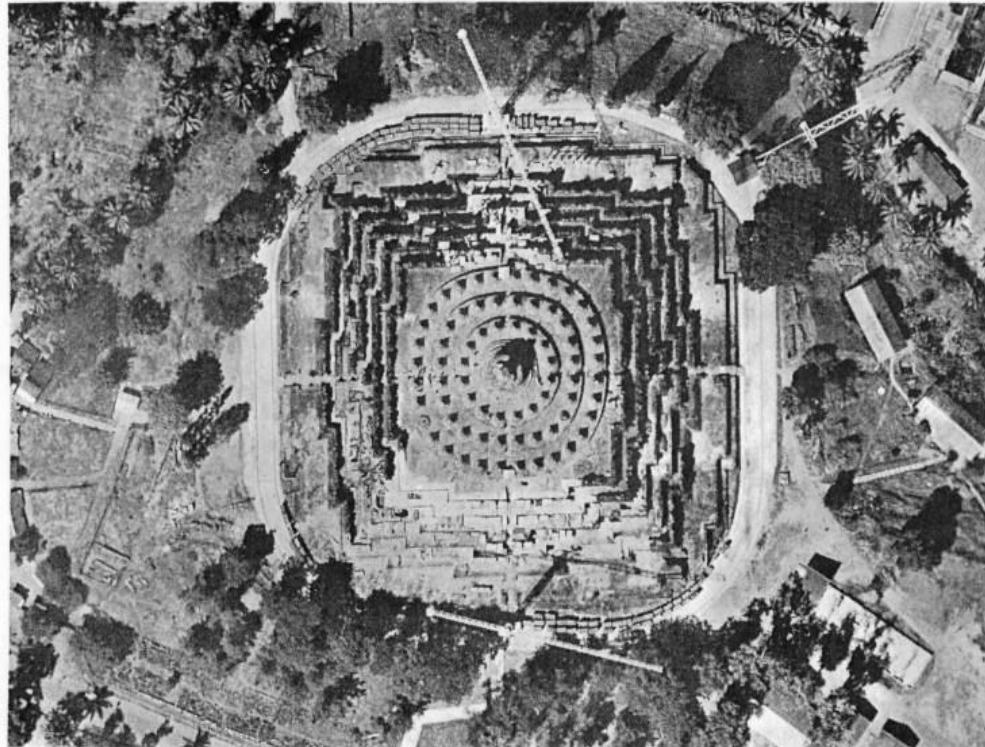


# Proceedings from 1977 at the FGI

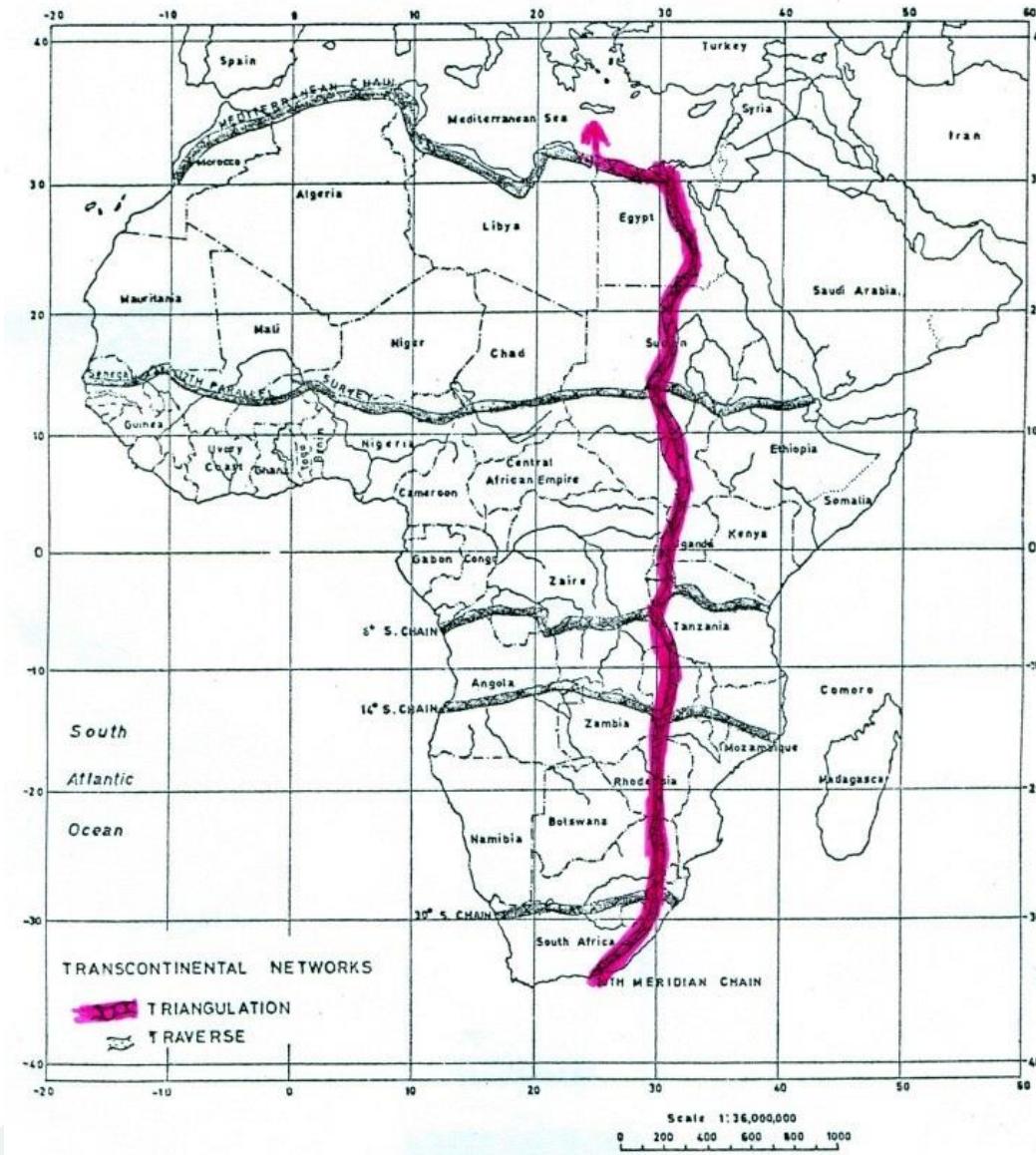
Proceedings  
of the  
International Geodetic Symposium  
on

## **REGIONAL GEODETIC NETWORKS FOR THE YEAR 2000**

BANDUNG ( Indonesia ), October 3 – 4, 1977.



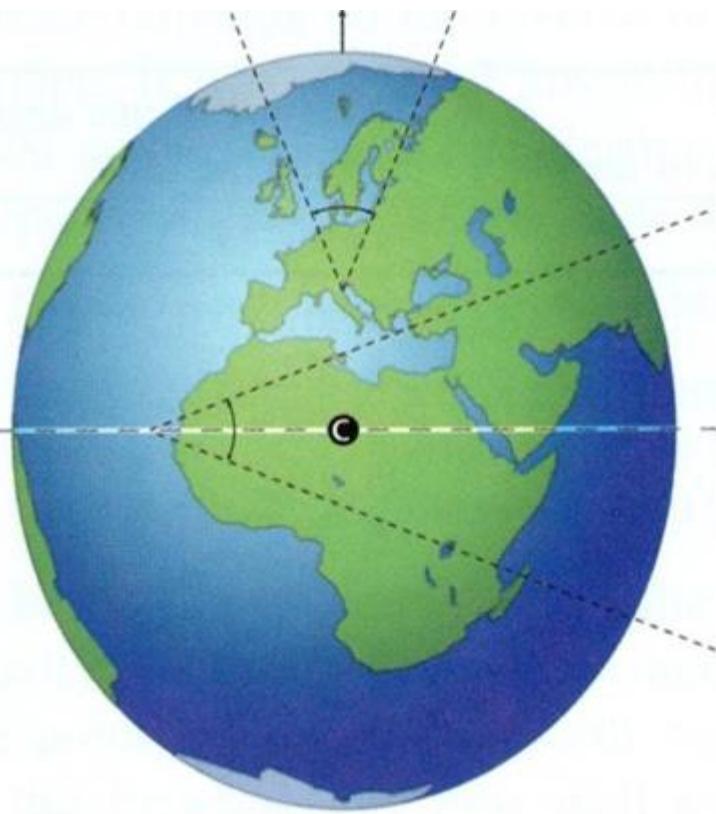
# Display of Struve Arc on the African Geodetic Networks from 1977



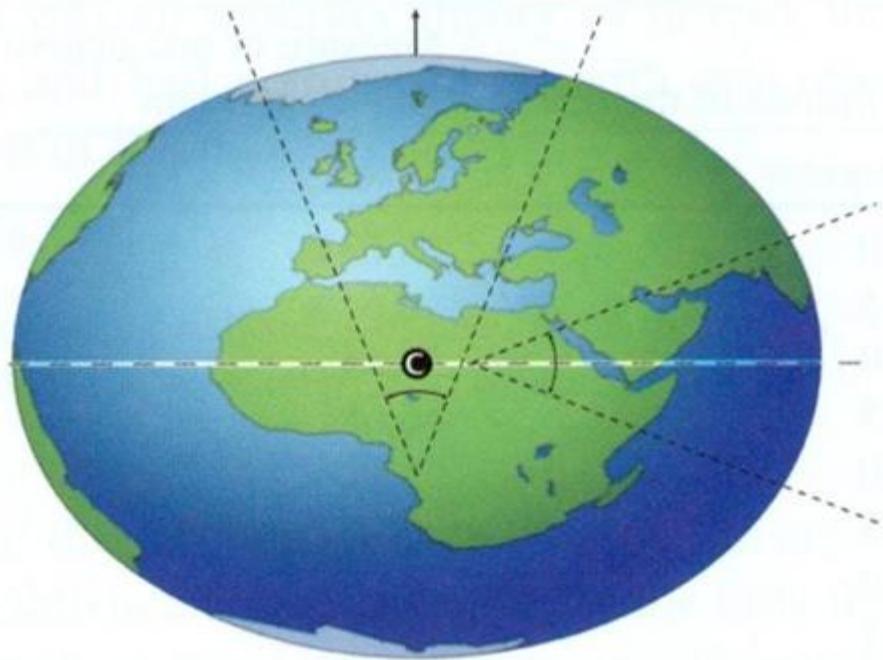
## Problems before or still

- ❖ Traditionally each country has its own geodetic reference system resulting in non compatible Coordinates systems between countries;
- ❖ Maps in neighboring countries do not match at the national boundaries;
- ❖ Very important is cooperation in new situation of technical development

# Two different positions about age old question



Dž.Kasīni  
(1625 – 1712)



Ī.Ņūtons  
(1643 – 1727)

# Geodesy – one of the oldest sciences

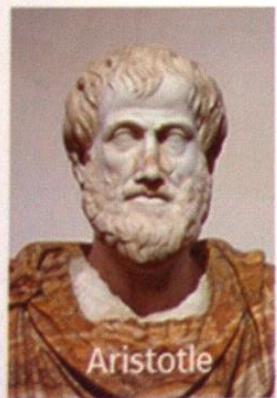


Thales of Miletus

624–546 BC *Thales of Miletus*: **Geometry** (Earth measurement)  
“The Earth is floating on the ocean”

Prediction of the solar eclipse on May 28, 585 BC

580–500 BC *Pythagoras of Samos*: The **Earth is a sphere**  
levitating in space (for esthetical reasons)



Aristotle

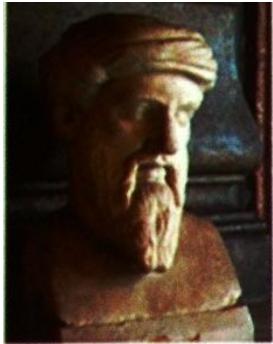
384–322 BC *Aristotle*: **Geodesy** (Earth division, partitioning)  
“Application of geometry in practice”

310–230 BC *Aristarchus of Samos*: **Heliocentric system**  
“The Sun in the centre of a very large universe”



276–195 BC *Eratosthenes of Cyrene*: **Measurement of the Earth's radius** (astronomic-geodetic method)

# Geodesy – one of the oldest sciences



Pythagoras



Eratosthenes



Ptolemy

(wikipedia.org)

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100–160 AD *Claudius Ptolemy*: **Geocentric coordinates**  
of ~1000 stars and ~8000 locations on Earth

**This system is valid until the end of the Middle Ages.**

# IAG / IUGG for GGOS portal



The screenshot shows the GGOS Portal homepage. At the top, the IAG logo is on the left and the text "Global Geodetic Observing System GGOS Portal" is in the center, with the IAG logo on the right. Below this is a navigation bar with links: Home, GGOS Themes, Topics, Discovery, Viewer, GGOS Products, and GIAC. The main content area features a large image of a surveyor using a theodolite, overlaid with a map of the world and a satellite in orbit. To the left, there's a sidebar with "SCIENCE APPLICATIONS" and "GEODETIC APPLICATIONS" sections, and a "Geodetic Applications" button. To the right, there are sections for "SATELLITE MISSIONS", "TECHNIQUES", and "SERVICES". The central text area says "The Global Geodetic Observing System Portal (GGOS Portal)". Below it, a paragraph describes GGOS and its purpose. A "Search" bar is at the bottom left.

Global Geodetic Observing System  
**GGOS Portal**

Home GGOS Themes Topics Discovery Viewer GGOS Products GIAC

SCIENCE APPLICATIONS

Geodetic Applications

More ...

Geodetic Applications

Home

Home

Home

GGOS Themes

Topics

Discovery

Viewer

GGOS Products

GIAC

News GGOS Portal

The Global Geodetic Observing System Portal (GGOS Portal)

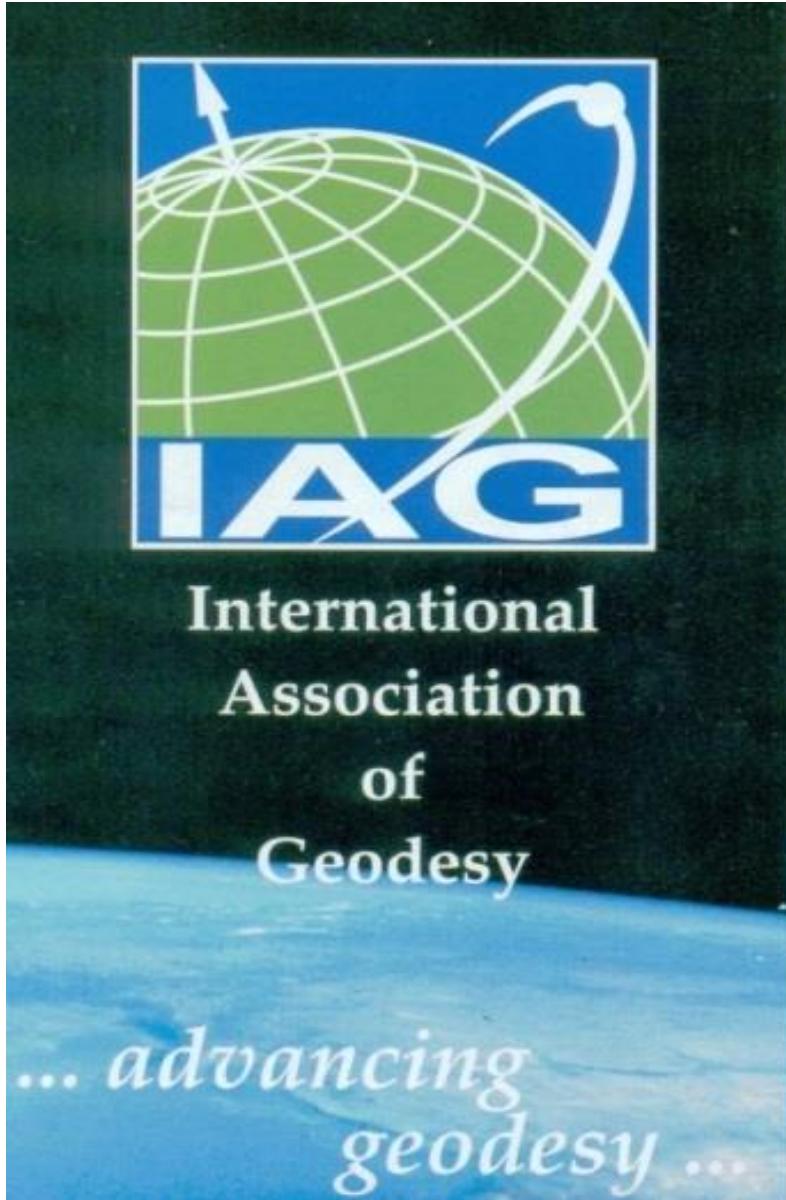
GGOS is the Observing System of the International Association of Geodesy (IAG). GGOS works with the IAG components to provide the geodetic infrastructure necessary for monitoring the Earth system and for global change research.

The GGOS Portal provides a unique access point to all geodetic products. Thus, the Portal will emphasize Geodesy's contribution to Earth Observation for assessing geohazards and reducing disaster. The Portal consists of information to GGOS topics, a metadata catalog including a search engine and an editor, a map viewer, and a list of GGOS products.

Search

Web: [www.ggos.org](http://www.ggos.org)

# From our surveying roots to nowadays



Triangulation tower ("ground reference point") in the Struve Chain, a member on UNESCO's World Heritage List

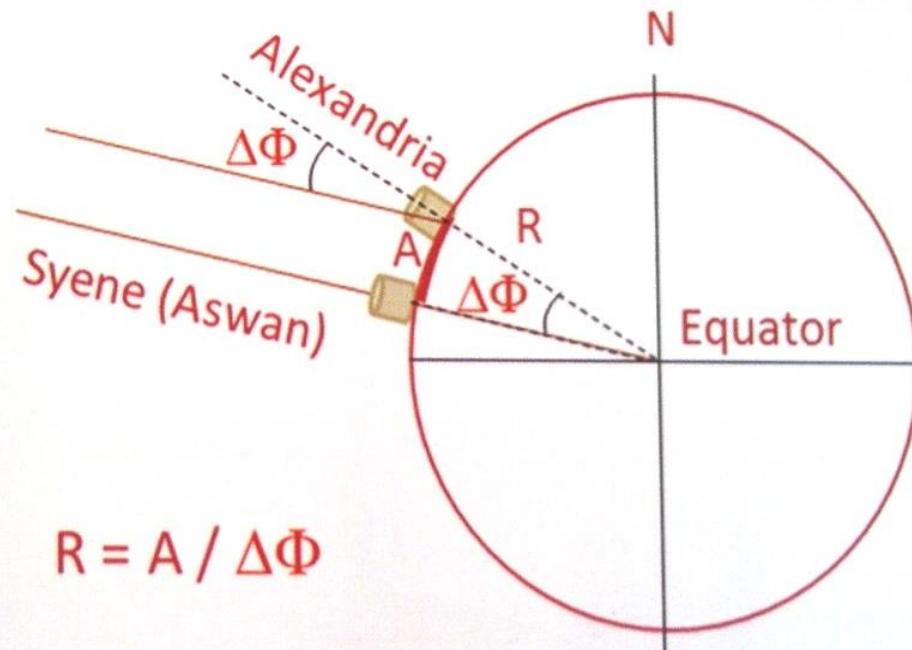
# Geodesy for the determination of Earth's radius

**Astronomic-geodetic method of Eratosthenes:** At summer solstices (June 21) the sun is mirrored in a well in Syene (latitude  $\Phi = 23.4^\circ$  N, today's Aswan High Dam), but in Alexandria ( $\Phi = 31.1^\circ$  N) the sun is casting a shadow with a length corresponding to an angle  $\Delta\Phi = 7.7^\circ$ .



The angle of the shadow is identical with the latitude difference Alexandria-Syene:

$$R = A / \Delta\Phi$$



# Meridian of Tartu

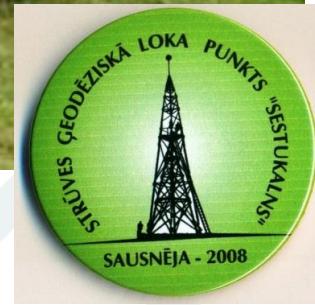




**Struve conference in Jekabpils, August 22, 2008**



Struve conference in Sestukalns, August 23, 2008





<http://www.failiem.lv/list.php?i=gfzuwx>



## Итоги

### Завершилась экспедиция «Миссия Струве»

Экспедиция на трех внедорожниках стартовала 19 июля 2011 г. из Одессы и пройдя 245 км в 17 ч 32 мин по московскому времени достигла южного пункта Геодезической дуги Струве «Старо-Некрасовка/STARONEKRASSOWKA», в селе Старая Некрасовка (Украина). Далее маршрут экспедиции проходил по территории Молдавии (пункт «Водолуй/Wodolui»), Украины («Кременец/Kremenetz»), Белоруссии («Белин/Belin»), Латвии («Немеж/Nemesch», «Якобштадт/JACOBSTADT»), Эстонии («Дерпт/DORPAT Tartu Observatory»), Финляндии («Торнио/TORNEA Alatornion kirkko»), Швеции («Авасакса/AVASAKSA», «Пуллинки/PULLINKI»), Норвегии («Бельяц-ваара/BALJATZ-VAARA», «Фугленес/FUGLENAES»). «Фугленес» — самый северный пункт «Геодезической дуги Струве», расположенный в городе Гаммерфест на берегу Норвежского моря, экспедиция достигла 31 июля 2011 г. в 20 ч 30 мин по московскому времени.

Пройдет немного времени, эмоции поутихнут, мысли выстроются в ряд и обязательно появится подробный рассказ и фотоотчет о путешествии. А пока хотим поблагодарить всех тех, кто оказал помощь и поддержку на различных этапах подготовки и проведения экспедиции:

Санкт-Петербургское общество геодезии и картографии и его секретаря В.Б.Капцюга (Россия , Санкт-Петербург)

ЗАО «Геостройизыскания» (Россия , Москва)

Группу компаний «М2М Телематика» (Россия , Москва)

ОАО «Мобильные ТелеСистемы» (Россия , Москва)

ООО «Лентерра» (Россия , Москва)

Дилерский центр «Ниссан на Таганке» (Россия , Москва)

КБ Панорама (Россия , Москва)

ГК «Геотехнологии» (Россия , Москва)

Интерактивный канал TV2.0 (Россия , Москва)

## Итоги

О проекте

Цели экспедиции

Маршрут экспедиции

Уникальность

Историческая справка

Пресс-релиз

Справка

Маршрут

Никому не известная Дуга, повесть в 11 частях. Том 1

Никому не известная Дуга, повесть в 11 частях. Том 2

## Другие проекты



25 апреля 2014

### Грузия

Двухнедельная экспедиция в Грузию. Общий маршрут - 5200 км. Сотни километров городских трасс, пересеченной местности и горных перевалов. Каждая точка на карте пробега связана с богатым историческим наследием страны.

<http://itoc.su/rus/items/missiya-struve/itogi.php>



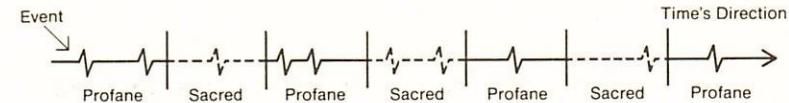
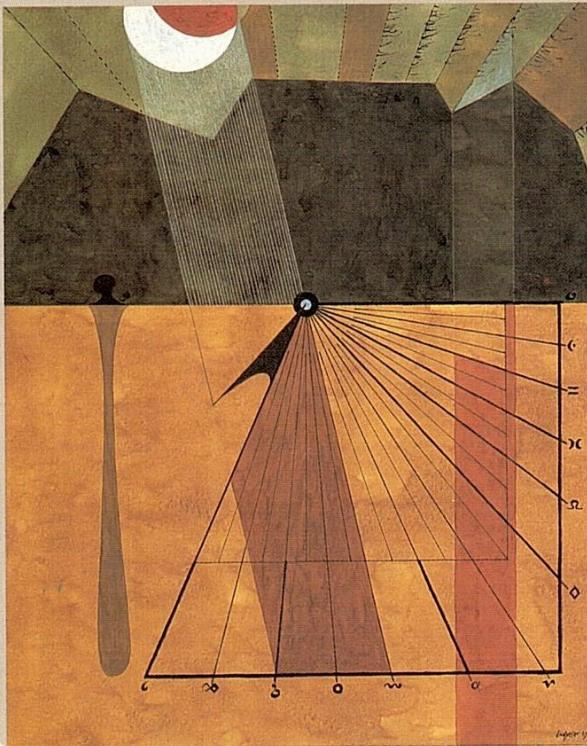
# Roots from 16th century in Latvia



"A fascinating book about what makes time tick." —A.L.A. Booklist

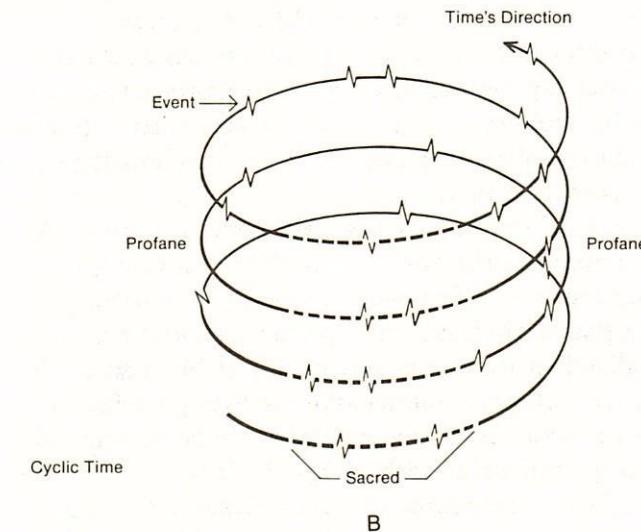
# EMPIRES OF TIME

*Calendars, Clocks, and Cultures*



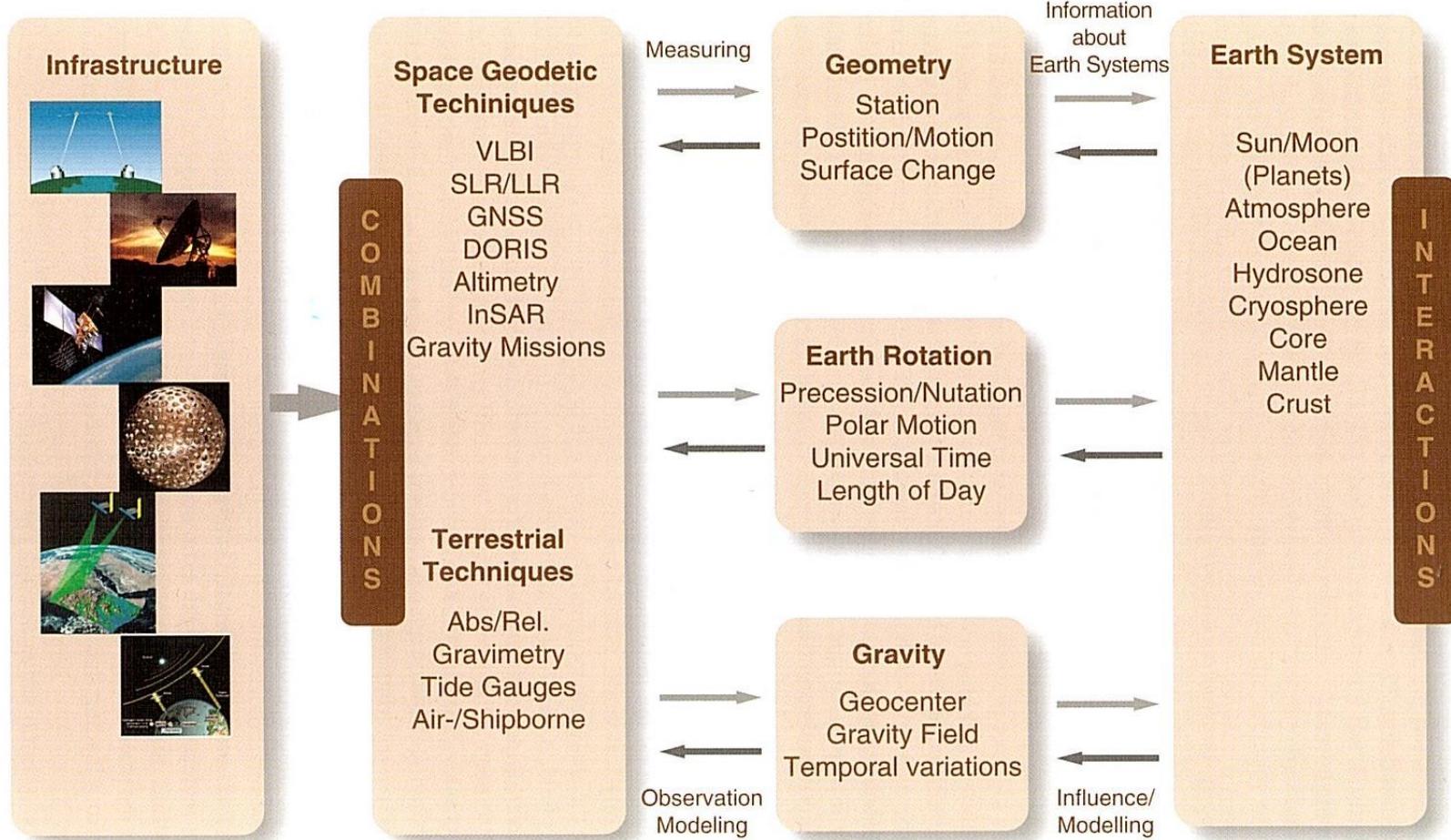
Linear Time

A



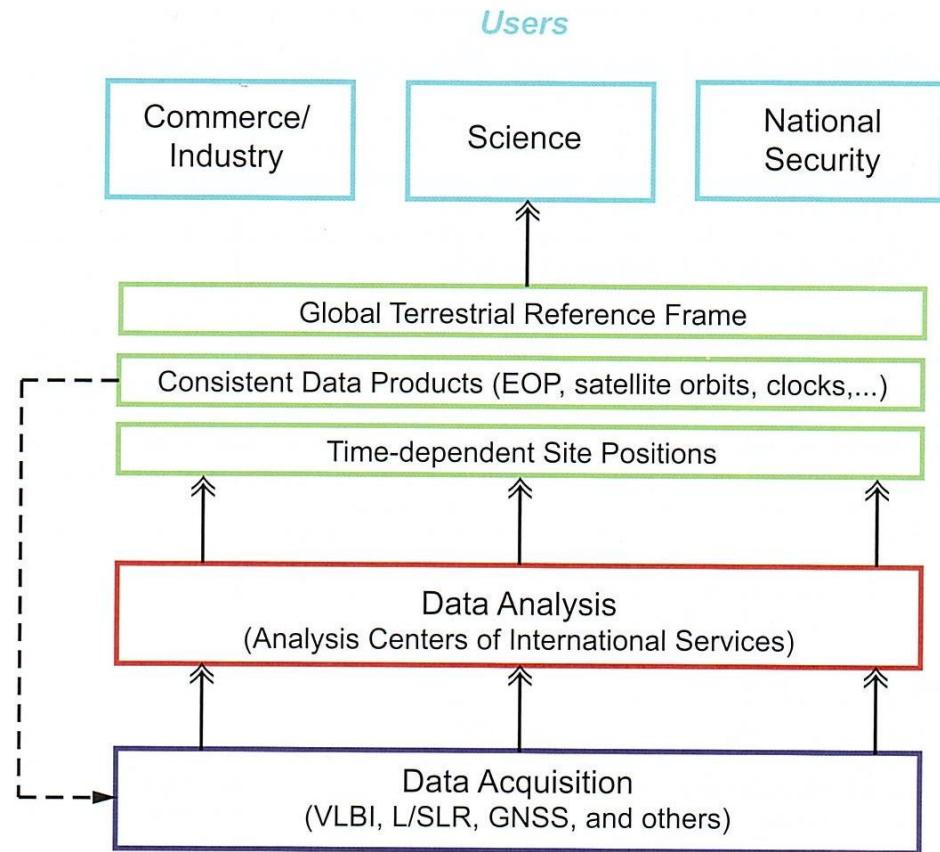
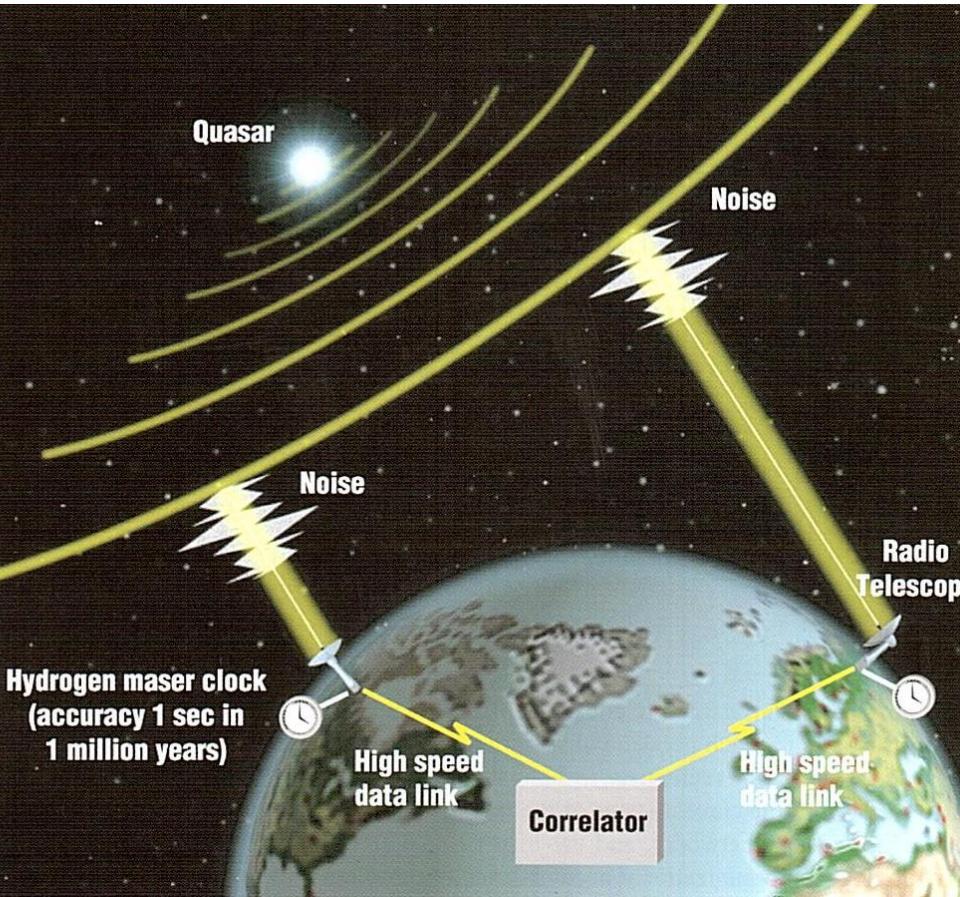
**Cyclic time: profane  
or sacred; with events**

# Geodetic infrastructure



**All time-dependent elements, also triangulation**

# Geodetic infrastructure for users



## Also in «deep» space with quasars (like C273)

# Our opinion about Earth in space age



# Monument in Struve's park, Jekabpils



## The evocative comparison with mission on Mars





Welcome on board

# Thank You for Your attention!



«Struve Geodetic Arc – 11 Years in UNESCO World Heritage List»

E-mail:

[janis.kaminskis@rtu.lv](mailto:janis.kaminskis@rtu.lv)