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Struve Geodetic Arc as a Tool for Spatial Thinking and Cooperation Developer

8th Meeting of Coordinating Committee of the Struve Geodetic Arc

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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 some 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.

It is part of world heritage under UNESCO.

80% of the existing info can be geo-localised

Demographic

Economic

Social

Cultural

SOCIO-ECONOMIC

Transport

Municipal

Tourism Leisure

Education

Health

INFRASTRUCTURE FACILITIES

Modernity for all rural areas:
Geoportal with digital cadastre and geo-localized information about territory

Soil

Air

Water

Fauna

Natural resources

ENVIRONMETAL RESOURCES

Area boundaries

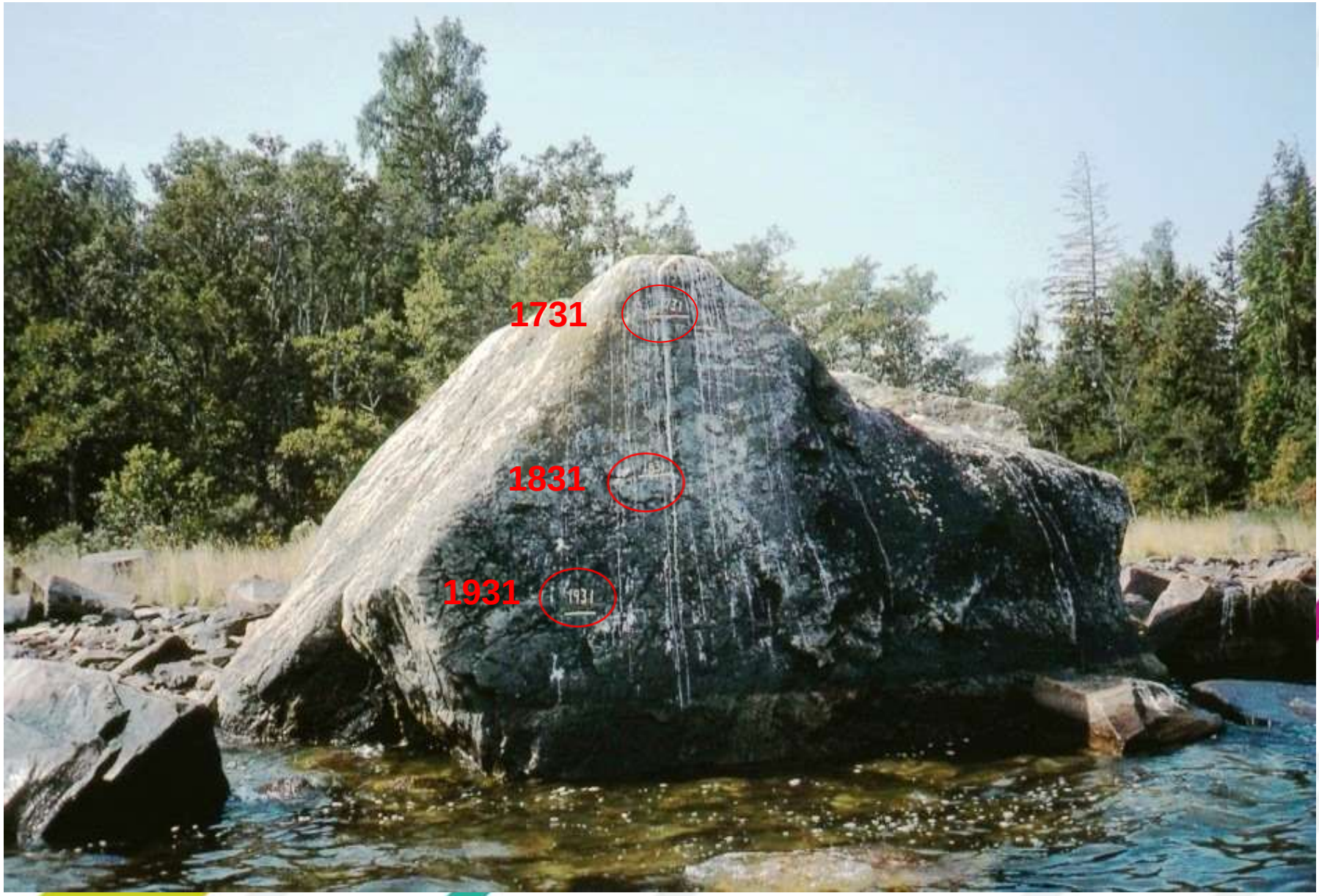
Development, zoning, status

Registration

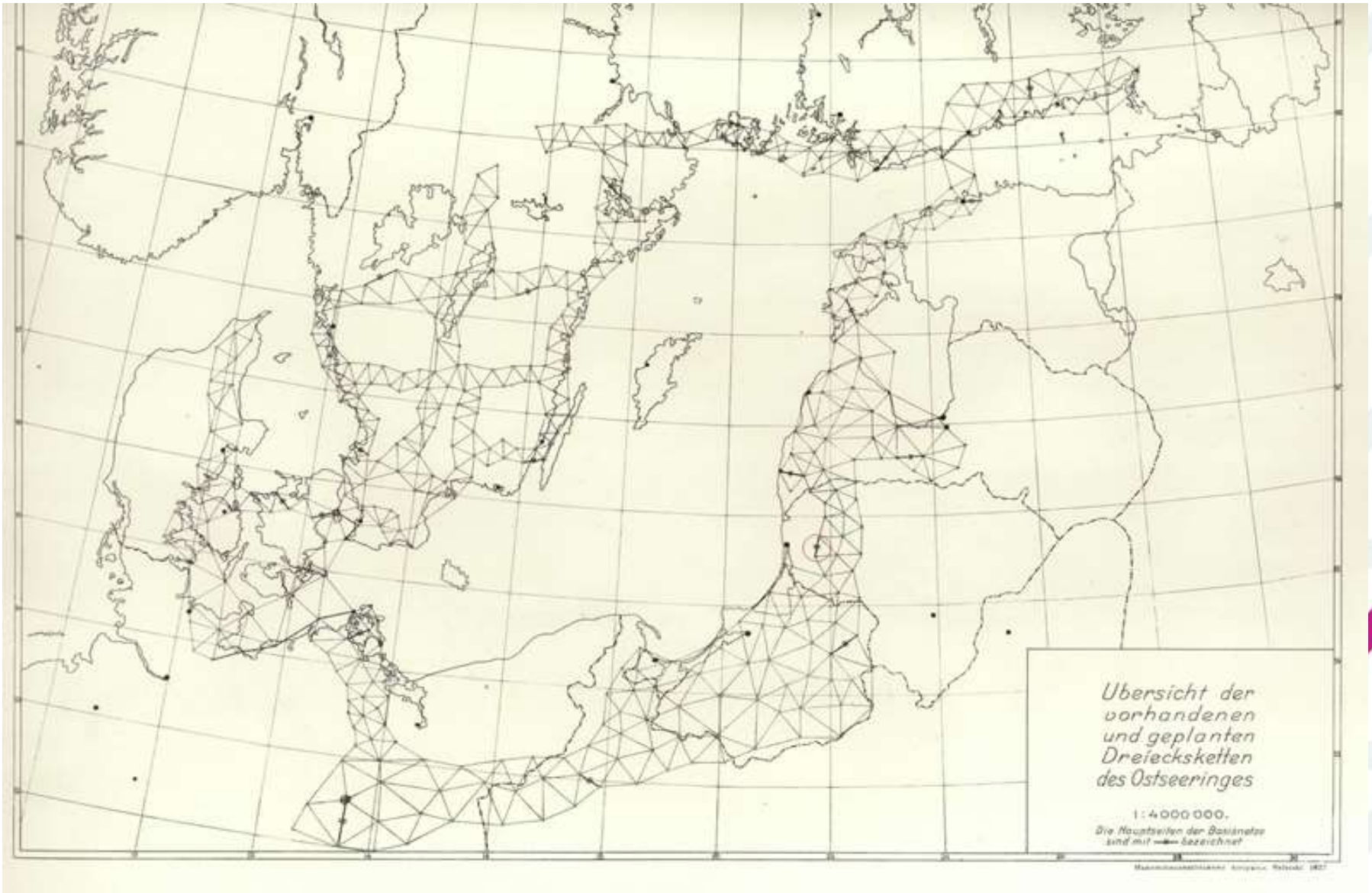
Public sector

LEGAL

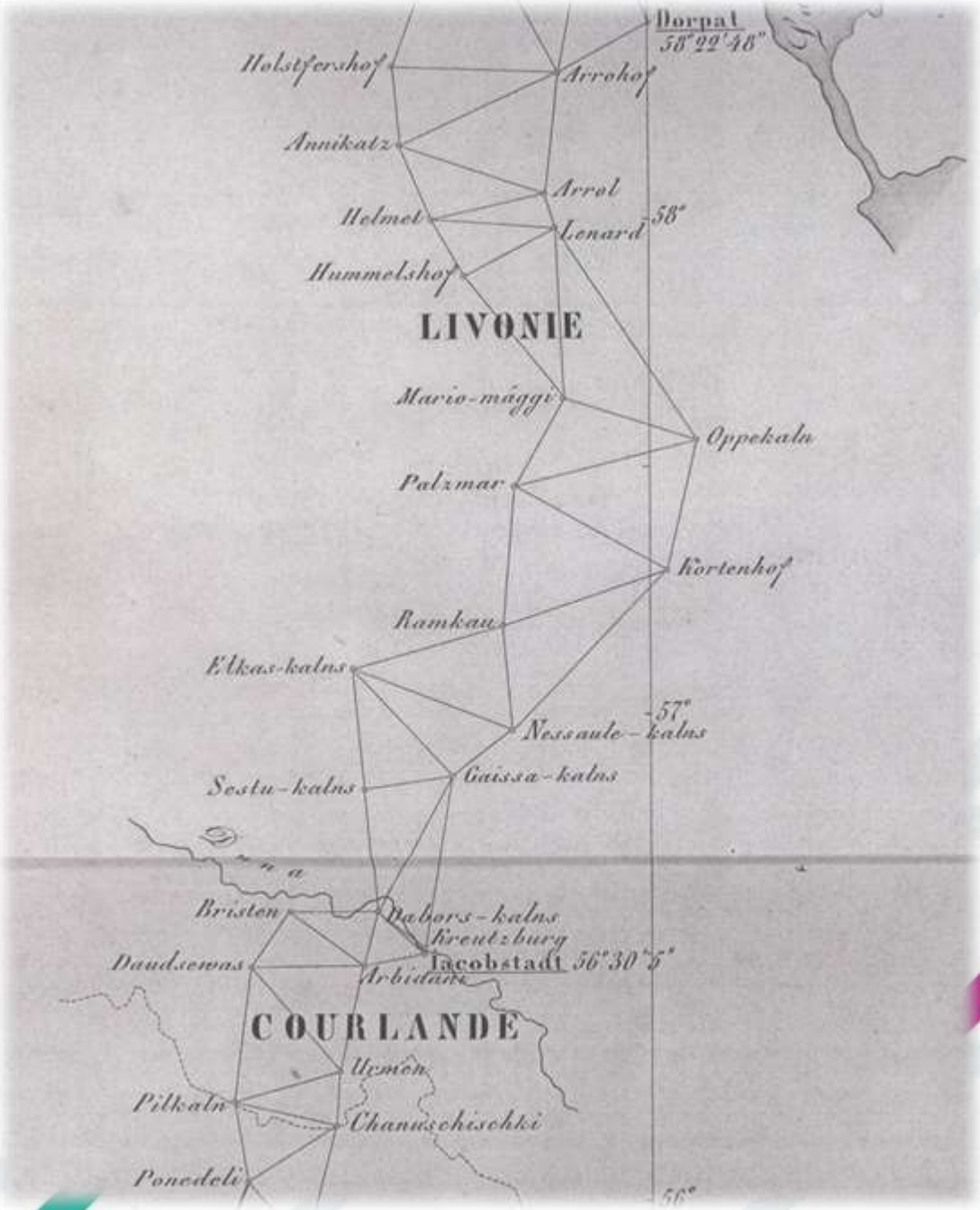
Celsius stone more than 300 years ago



Baltic Ring 1927



Struve Arc through Livonia & Courland

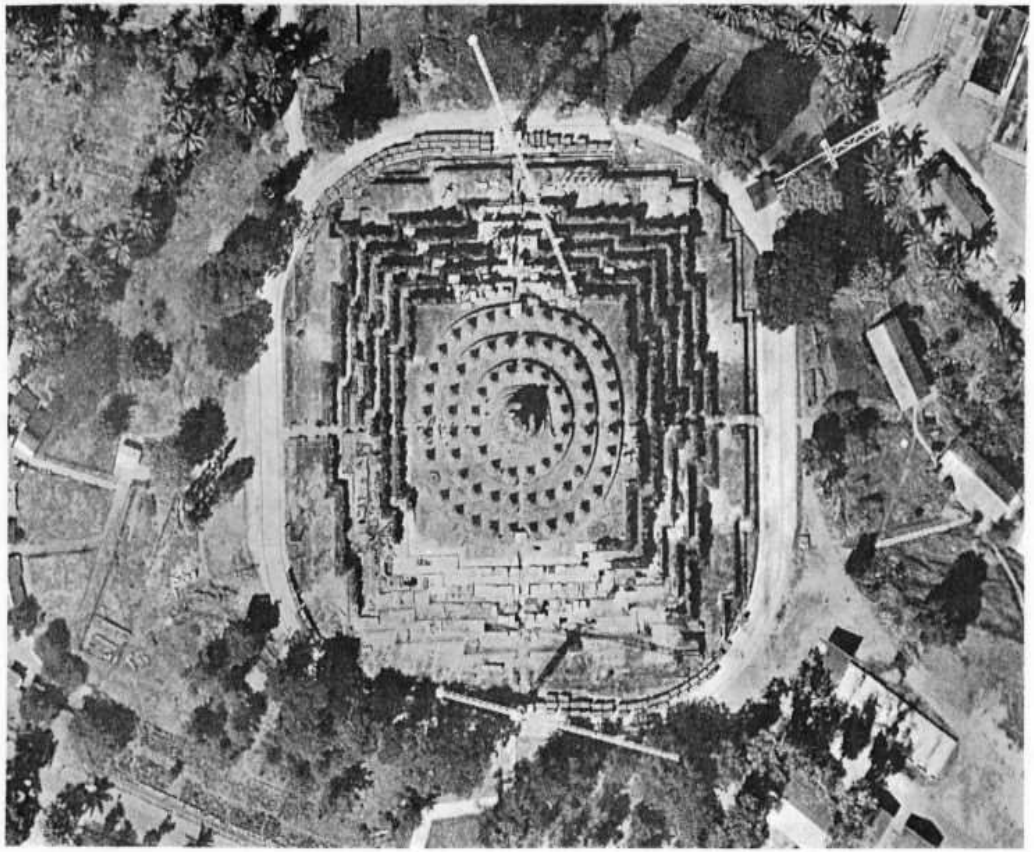


Proceedings from 1977 at the FGI

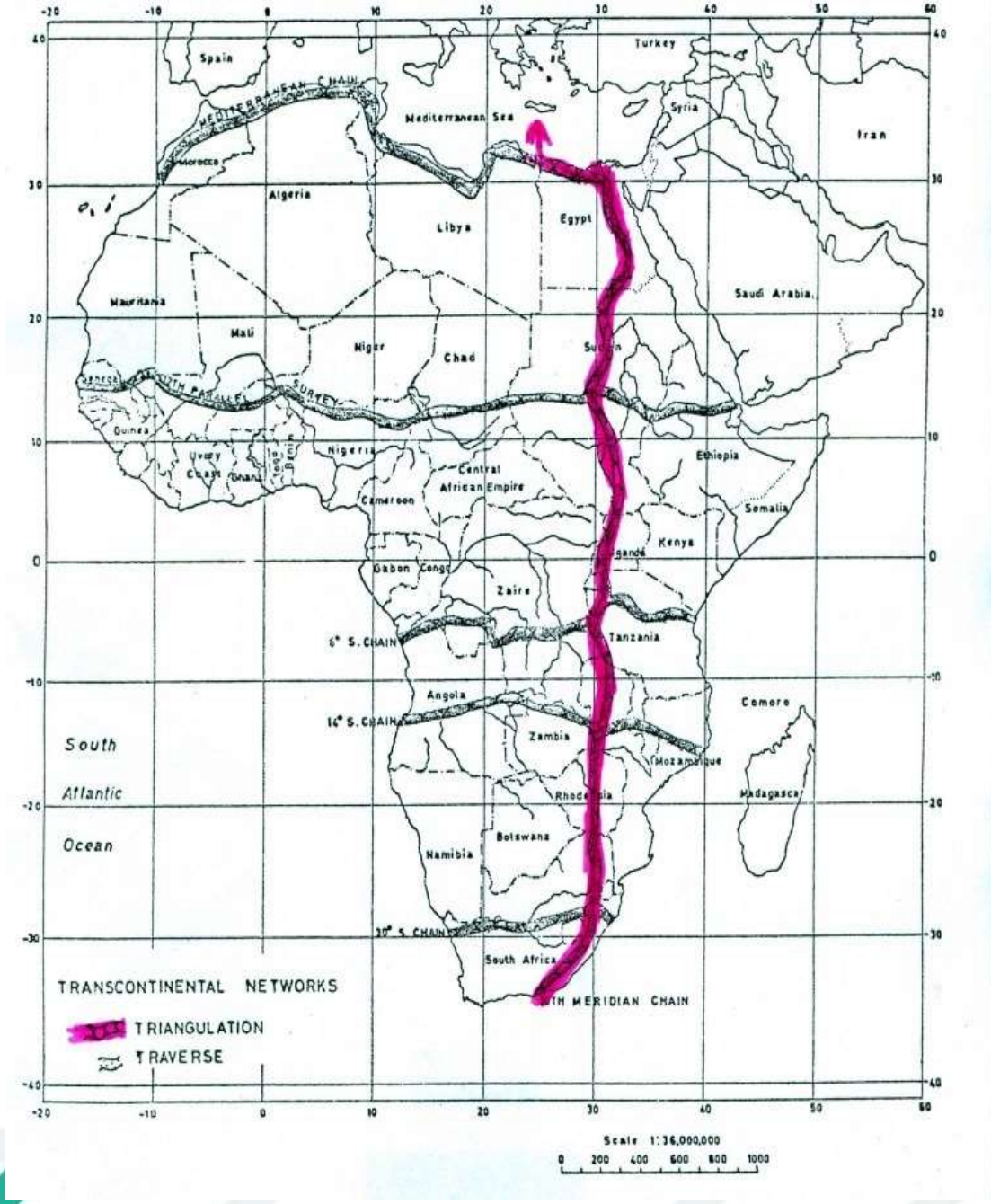
Proceedings
of the
International Geodetic Symposium
on

REGIONAL GEODETIC NETWORKS FOR THE YEAR 2000

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



Display of Struve Arc on the African Geodetic Networks from 1977



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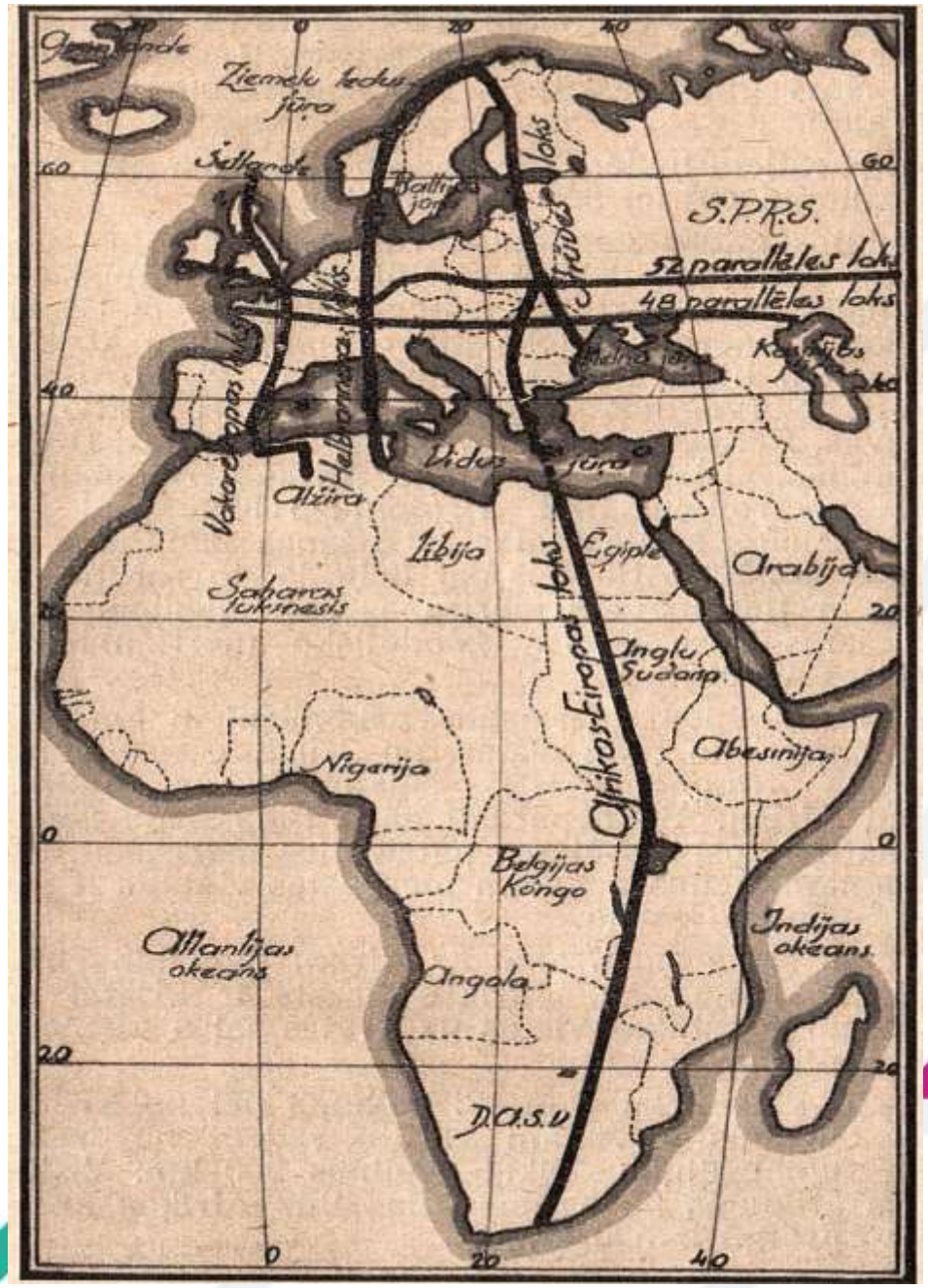
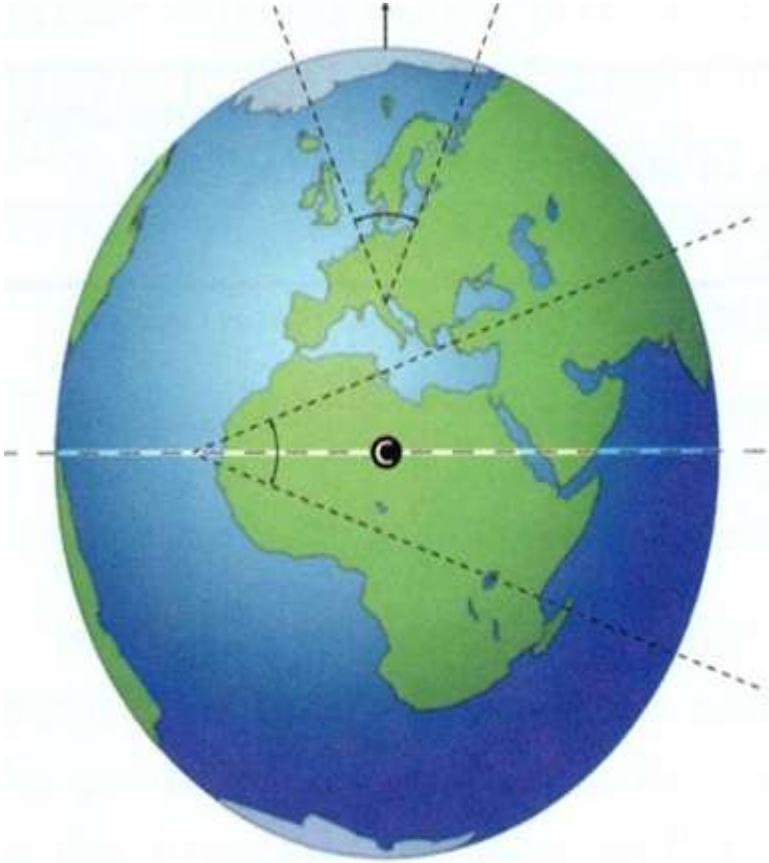


Problems before or still

- 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.

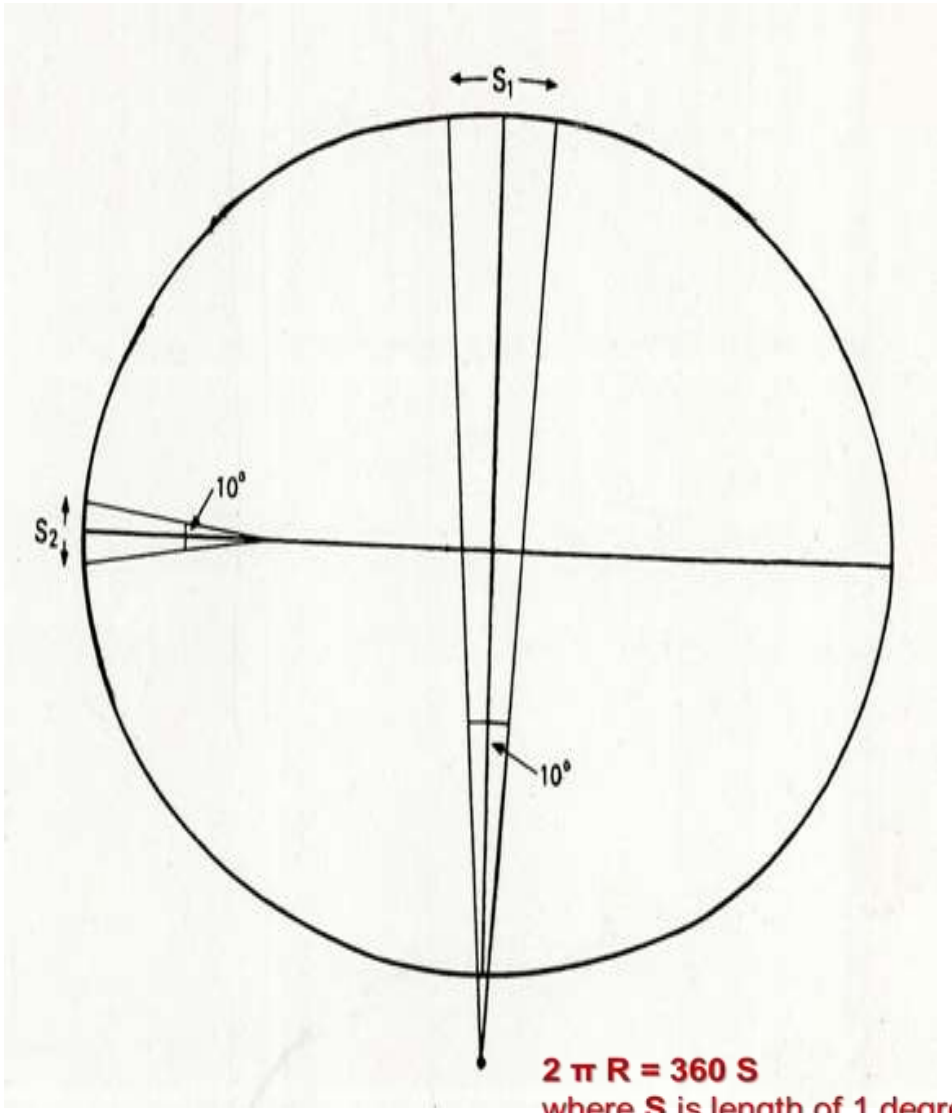
Two different positions about age old question



Dž.Kasīni
(1625 – 1712)

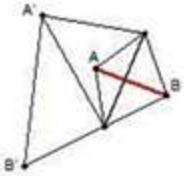
Ī.Ņūtons
(1643 – 1727)

Elements in arc measurement

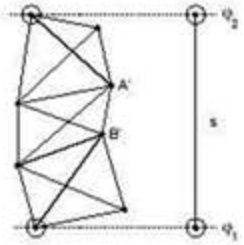


1. Base

2. Expansion network



3. Meridian arc network

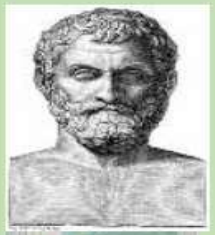


- *Angles, measured*
- *Astronomical observation*

d – distance, tape measured

s – distance, computed

Geodesy – one of the oldest sciences



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)

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 very large universe"

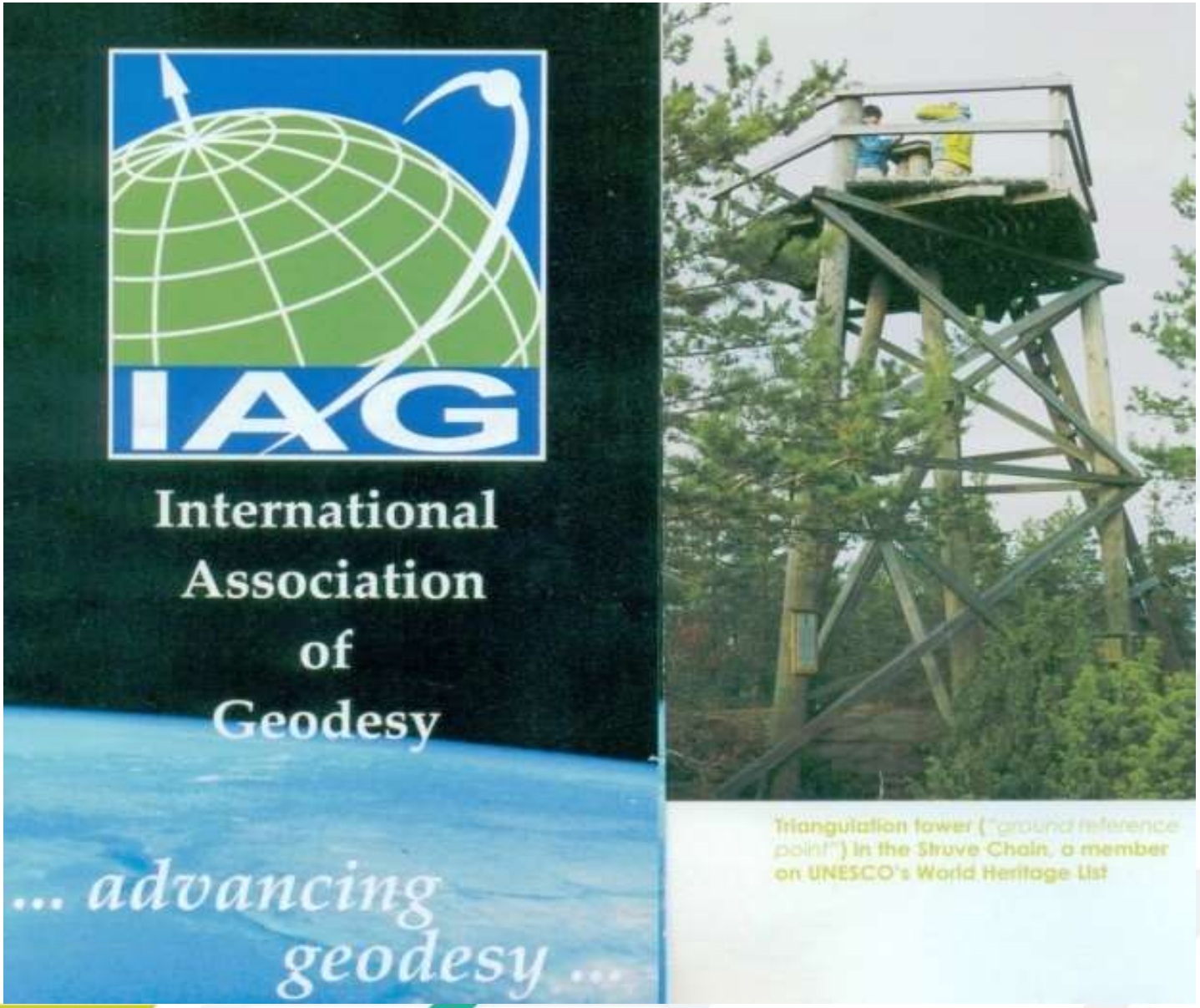
276 – 195 BC **_Eratosthenes of Cyrene:_**
Measurement of the Earth`s radius (astronomic – geodetic method)

100 – 160 AD **_Claudius Ptolemy:_**
Geocentric coordinates of ≈1000 stars and ≈ 8000 locations on Earth
This system is valid until the end the Middle ages

IAG / IUGG for GGOS portal

www.ggos.org

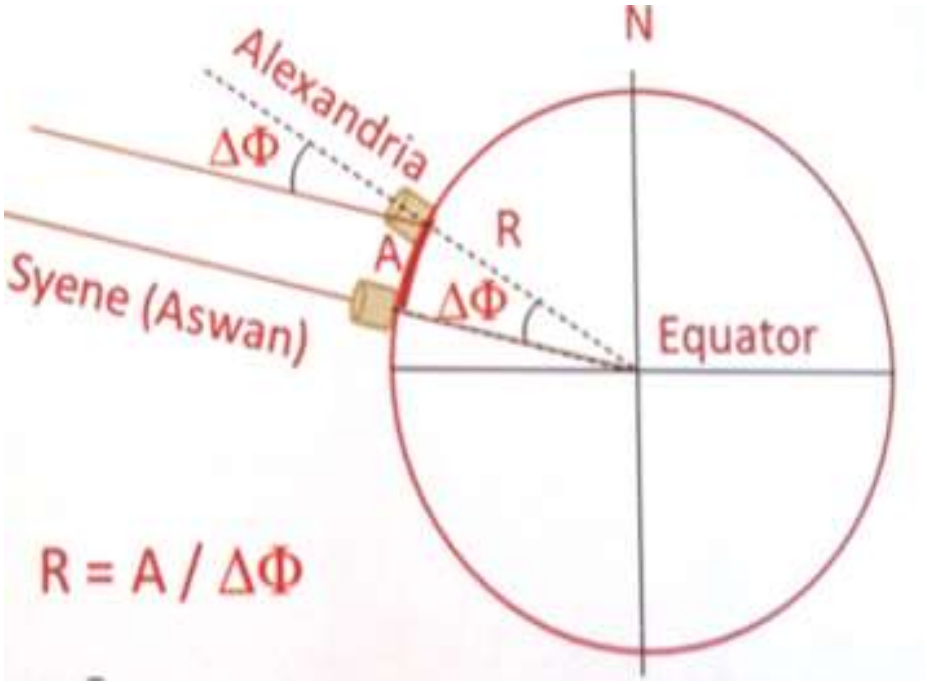
From our surveying roots to nowadays



http://iag-aig.org/

Geodesy for the determination of Earth's radius

Astronomic – geodetic method of Eratosthenes: At summer solstices (June 21) the sun is mirrored in well in Syene (latitude $\Phi = 23.4^{o}$ N, today `s Aswan High Dam), but in Alexandria ($\Phi = 31.1^{o}$ N) the sun is casting a shadow with a lenght corresponding to angle $\Delta\Phi = 7.7^{o}$



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

Base measurements (1744, France)

From Paul Murdin book: «Full Meridian of Glory», USA, 2009

Time of Cassini III

Voltaire → Maupertuis «flattener of the Earth and the Cassinis»

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

Kortenhof, 2011

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 выстроятся 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 «M2M 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)

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.phtml

Научно-популярная международная автомобильная экспедиция

«Миссия Струве»

Василий Яковлевич Струве

Карл Иванович Теннер

Кристофер Ханстен

Нильс Селандер

Project «Struve unites through the centuries» in Gulbene (Latvia)

the meeting was held on May 16, 2013

ALDA
Association of Local Democracy Agencies
Association des Agences de la Démocratie Locale

WORKING TOGETHER for DEVELOPMENT

"Struve unites through the centuries"
PROJEKTS

Facts about the Struve Geodetic Arc →

The longest meridian arc ever measured

In North: Hammerfest	70°	40’ 11.23”	
In South: Ismail (Black Sea)	45°	20’ 02.94”	
Distance in latitude:	25°	20’ 08.29”	
Distance in km:			2 821.853 711

Number of main points:	265
Number of astronomical stations:	13
Number of bases:	10

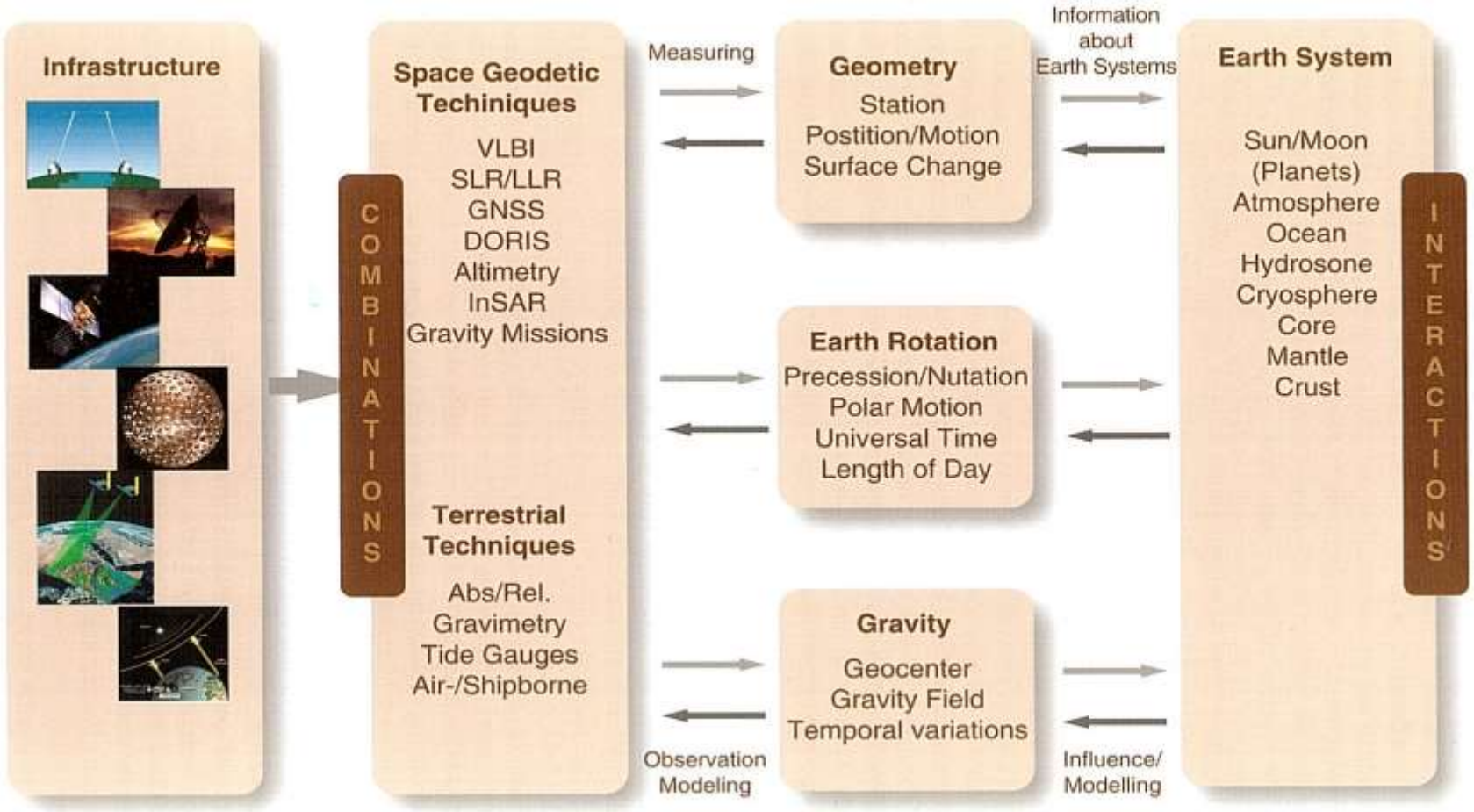
What is especially for the Struve Geodetic Arc →

1. Geodesy is the first scientific subject to appear on the World Heritage List
2. The Struve Geodetic Arc is the first case in the history of the List where more than two countries cooperate in the preparations
3. The Struve Geodetic Arc project is the precursor for international scientific cooperation, predecessor of IAG and IUGG

History of the most significant measurements of mankind and related to Struve Geodetic Arc →

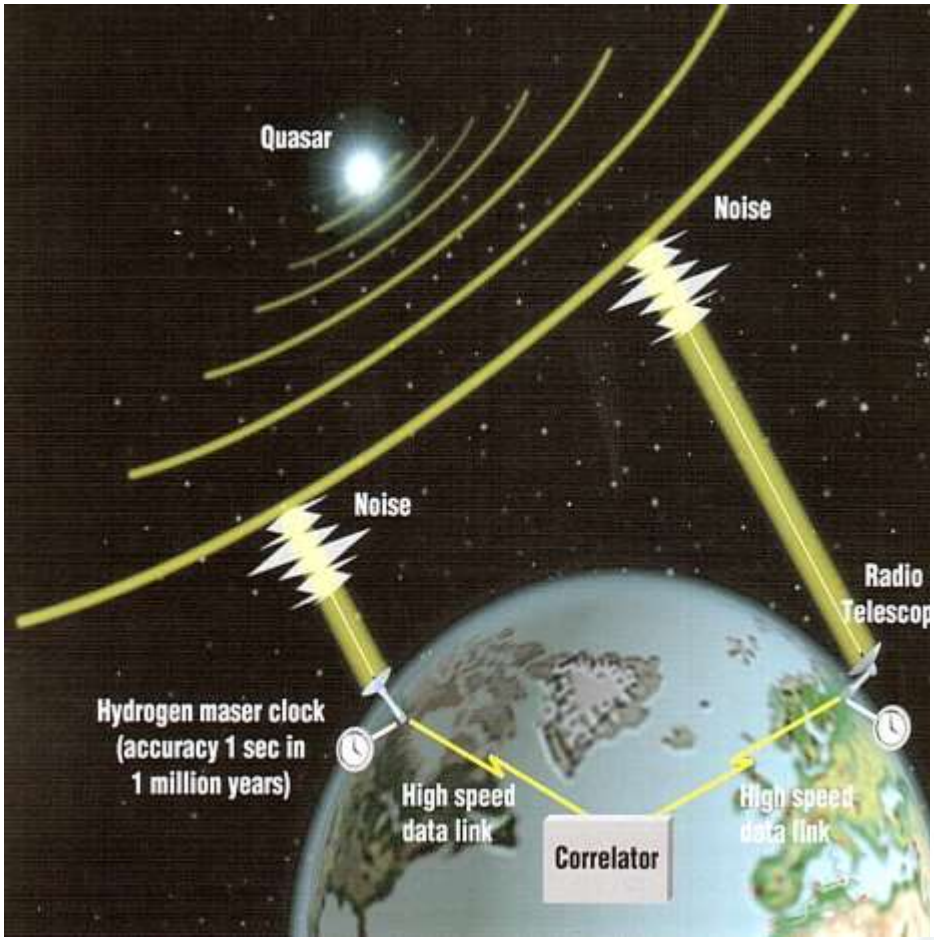
1. **The value of Earth's diameter**
2. **The distance between Earth and Sun** *(Astronomical Unit)*
3. **Parallax of the stars** *(cosmic triangulation)*

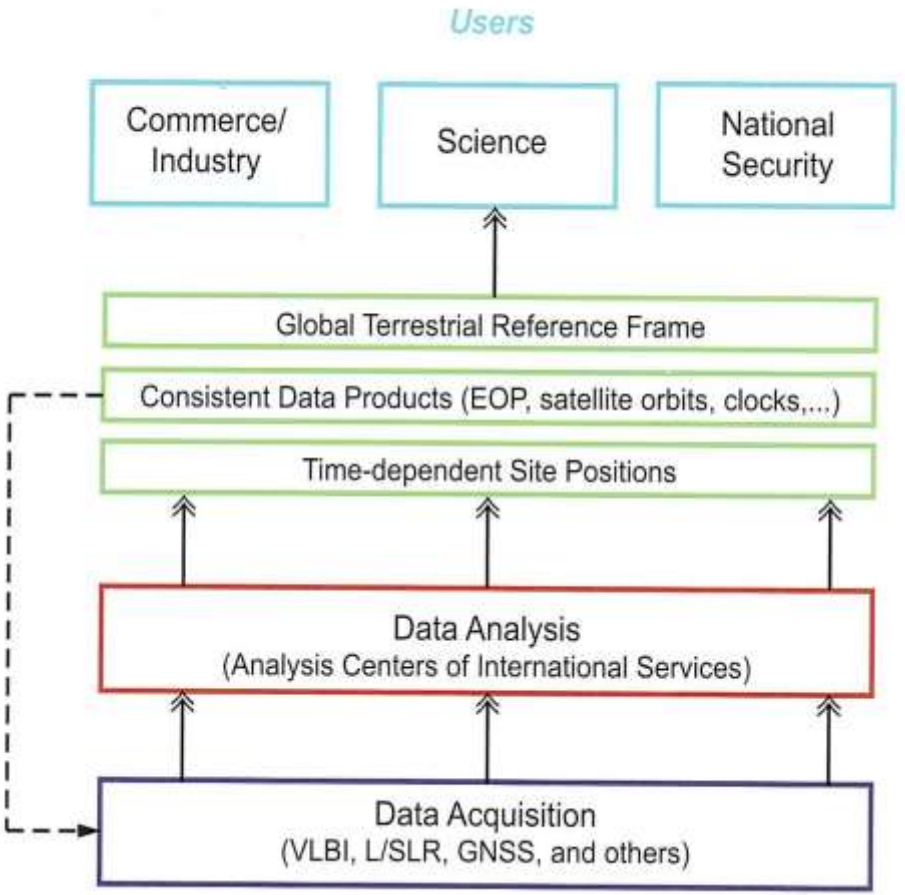
Geodetic infrastructure



All time-dependent elements, also triangulation

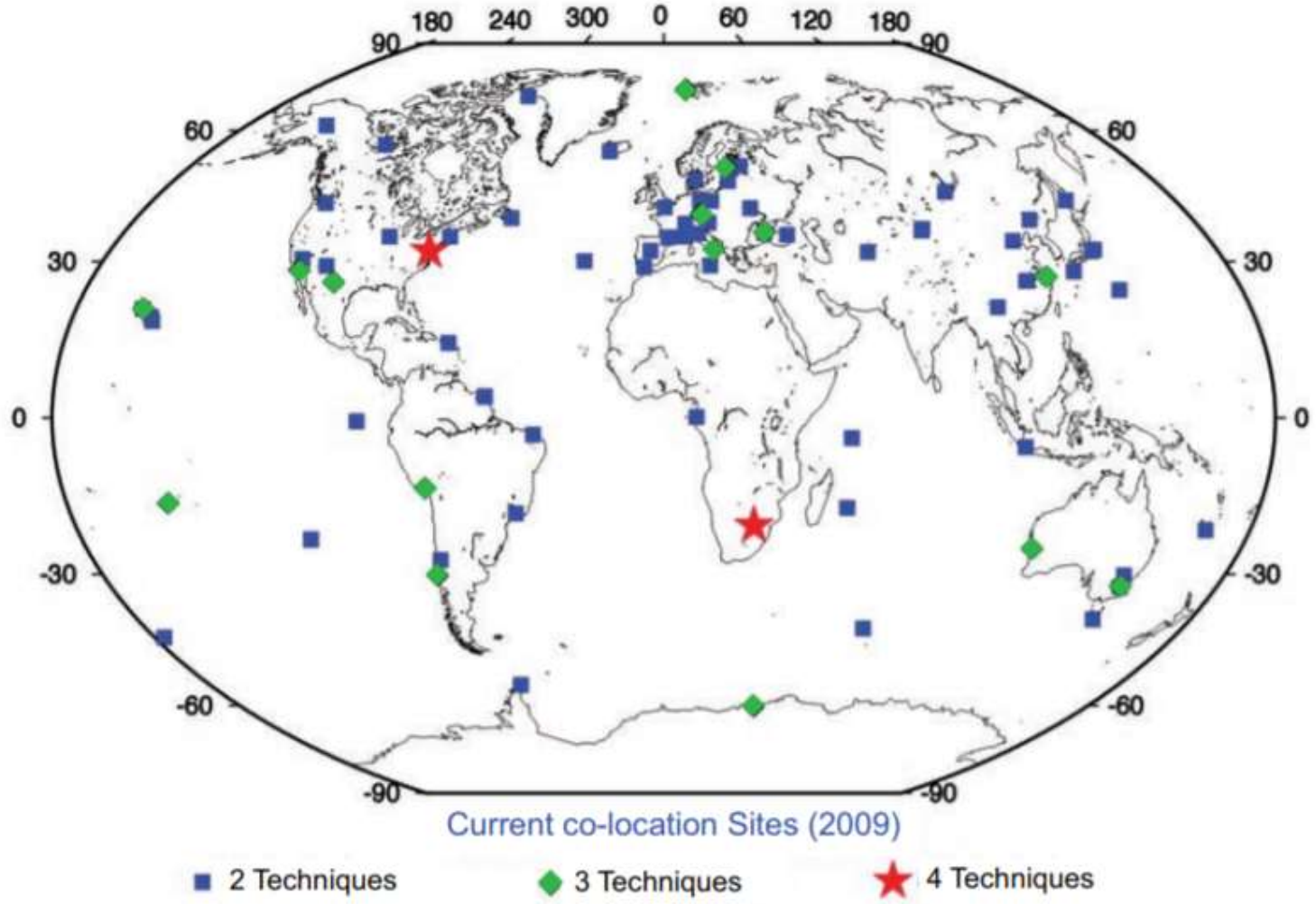
Geodetic infrastructure for users





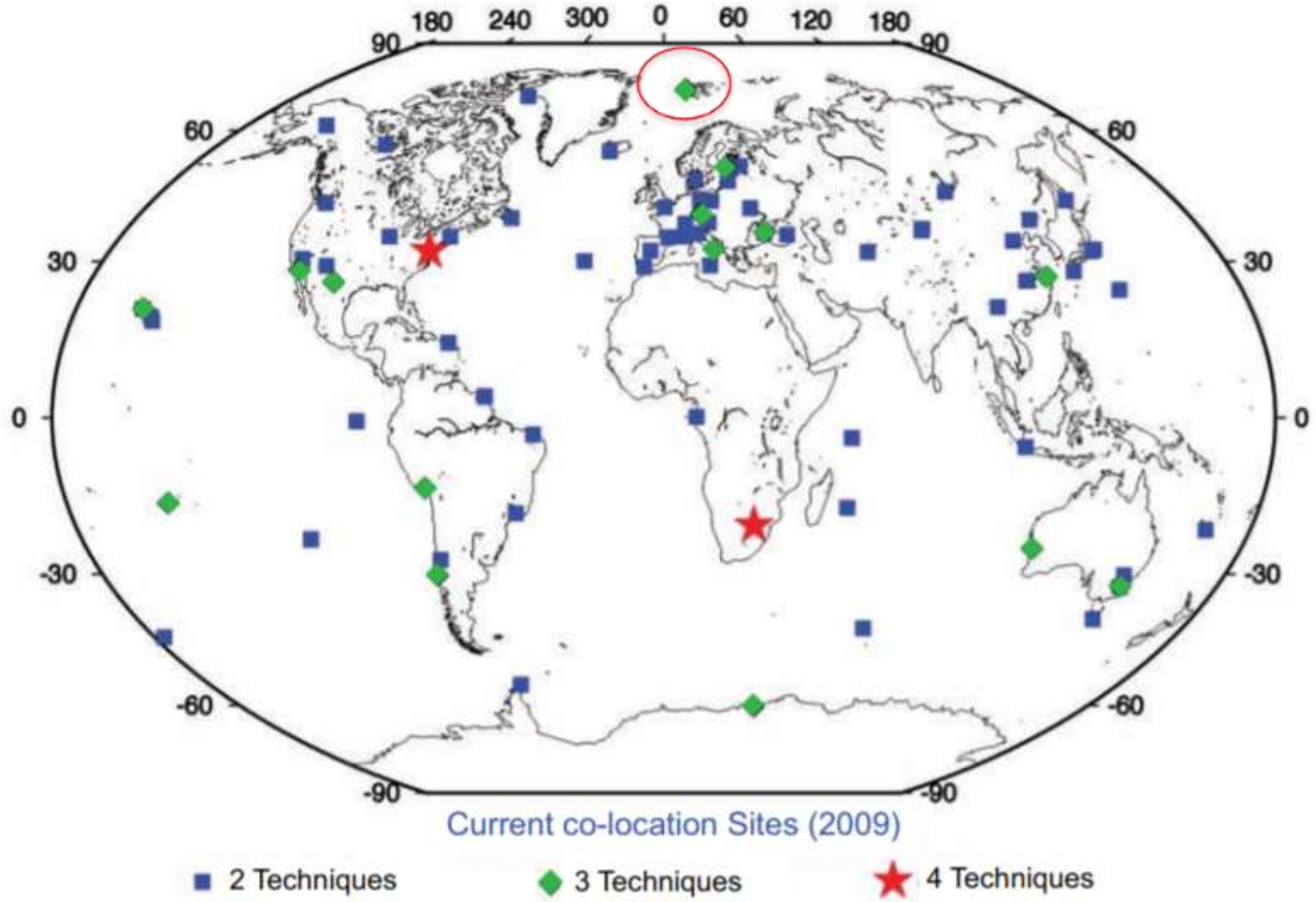
Also in «deep» space with quasars (like C273)

Geodetic infrastructure in Future



Co-location Sites

Geodetic infrastructure in Future



Co-location Sites

Our opinion about Earth in space age

Monument in Struve's park, Jekabpils

The evocative comparison with mission on Mars

Welcome to Struve team board

Mobile exposition, with lecture, from I.Berke

Struve in city center, since 2015

http://demo.mikrokods.lv/Krustpils_pils_3dtiles/App_CCWebViewer2/index.html

3D model of Struve site *Kreutzburg* (15.06.2018)

Magnet for Tourists, Rõuge

International Conference «Struve Arc – the Past and the Future», June 21 (2018), Oshmyany, Byelorussia

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Future plans:

- ✓ *Happiness will never come to those who fail to appreciate what they already have.*
- ✓ *Have been created on 08.06.2018. the Council of Preservation and Development of the Struve Geodetic Arc, which is now developing work plans up to 2023.*
- ✓ *There is much more common with Struve Geodetic ARC in the world (at least 80 %) than different.*

Thank You for Your attention!

«Struve Geodetic Arc – 13 Years in UNESCO World Heritage List»

That happened in summer of 2005 !

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