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**«Correlation of integral characteristics of equivalent magnetic dipoles in January-February 2023 according to observatory data»**

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# Earthquakes in February 2023 in Turkey

Radius of the preparation zone  $R_d=2260$  km

Major seismic shock

06.02.2023 37,23°N 37,02°E, M7,8



Earthquake epicenters  
U.S. Geological Survey  
<https://earthquake.usgs.gov/>



Ionospheric stations  
GIRO <http://spase.info/SMWG/Observatory/GIRO/>



Magnetic stations  
INTERMAGNET  
<http://www.intermagnet.org>

## Characteristics of the magnetic field in observatories:

**H** is the horizontal component of the magnetic induction vector,

**Z** is the vertical component of the magnetic induction vector,

**T** is the modulus of the magnetic induction vector,

**G** is the local magnetic constant,

**M** is the magnetic moment of the equivalent dipole,

**L** is the distance along the sphere from the observatory to the magnetic pole (in degrees),

**R** is the distance from the observatory to the equivalent dipole (in km)

$$H = M \cdot \sin L / R^3$$

$$Z = 2M \cdot \cos L / R^3$$

$$T = (H^2 + Z^2)^{0,5} = M \cdot (1 + 3(\cos L)^2) / R^3$$

$$G = (H^2 + (0,5Z)^2)^{0,5} = M / R^3$$

The magnitude of the local magnetic constant ( $G$ ) depends both on the magnetic moment of the equivalent dipole ( $M$ ) and on the distance ( $R$ ) between the dipole and the observatory, but does not depend on the orientation of this dipole (which is why this characteristic of the magnetic field got its name). From the change in the magnitude  $G$ , it is possible to estimate not only the nature and scale of the change in the magnetic moment of the equivalent dipole (at a fixed value  $R$ ), but also the scale of the displacement of the equivalent dipole relative to the observatory (at a fixed  $M$ ). In nature, most likely, there is a combination of these processes: it is possible to simultaneously change both the energy of the equivalent current system that creates the Earth's magnetic field, and the change in the distance from this current system to the observation point.

There was a significant increase in the correlation of the above parameters for different magnetic observatories after the seismic events of February 2023 in Turkey.

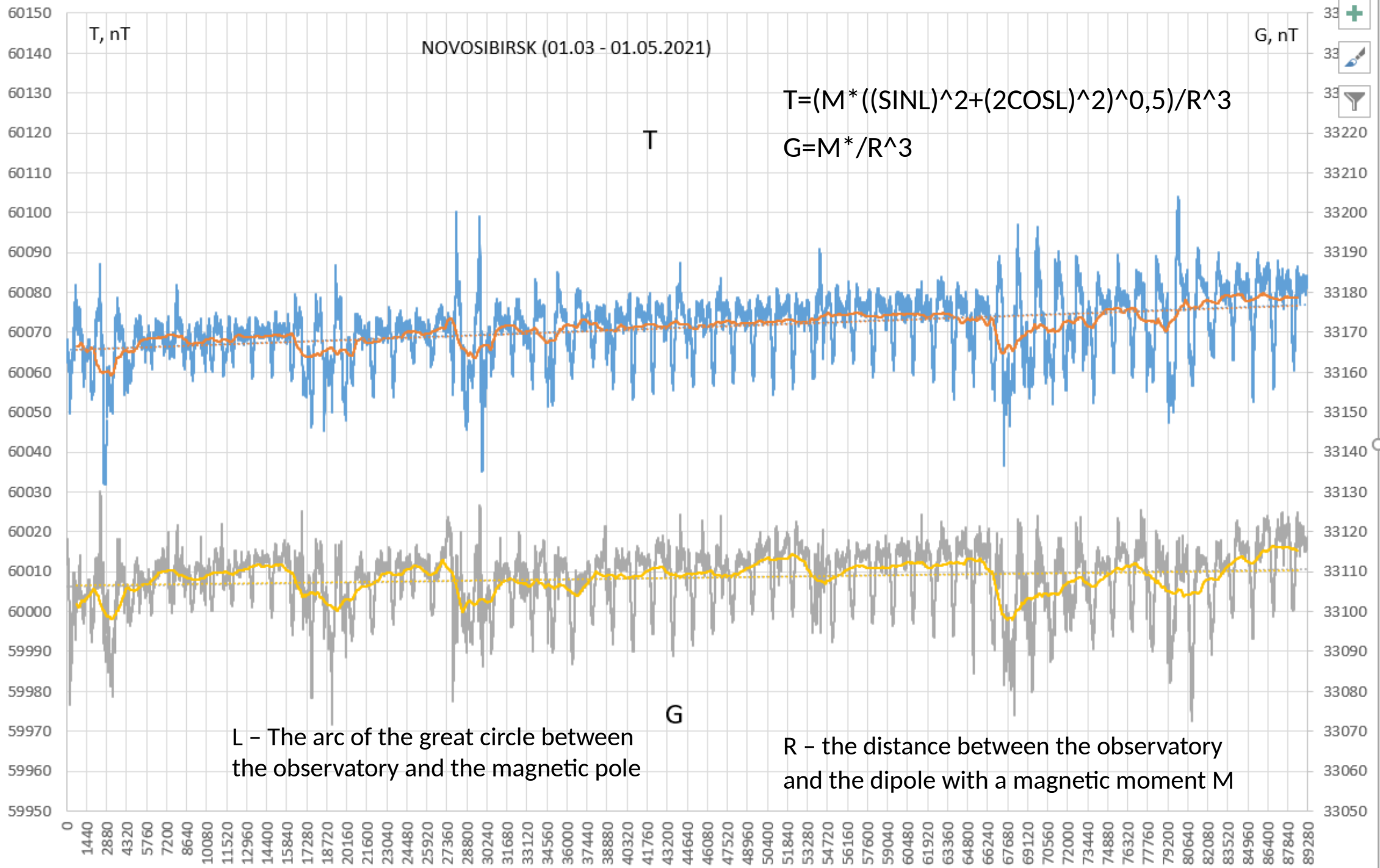
The correlation of this characteristic of the magnetic field for different pairs of magnetic observatories was calculated.

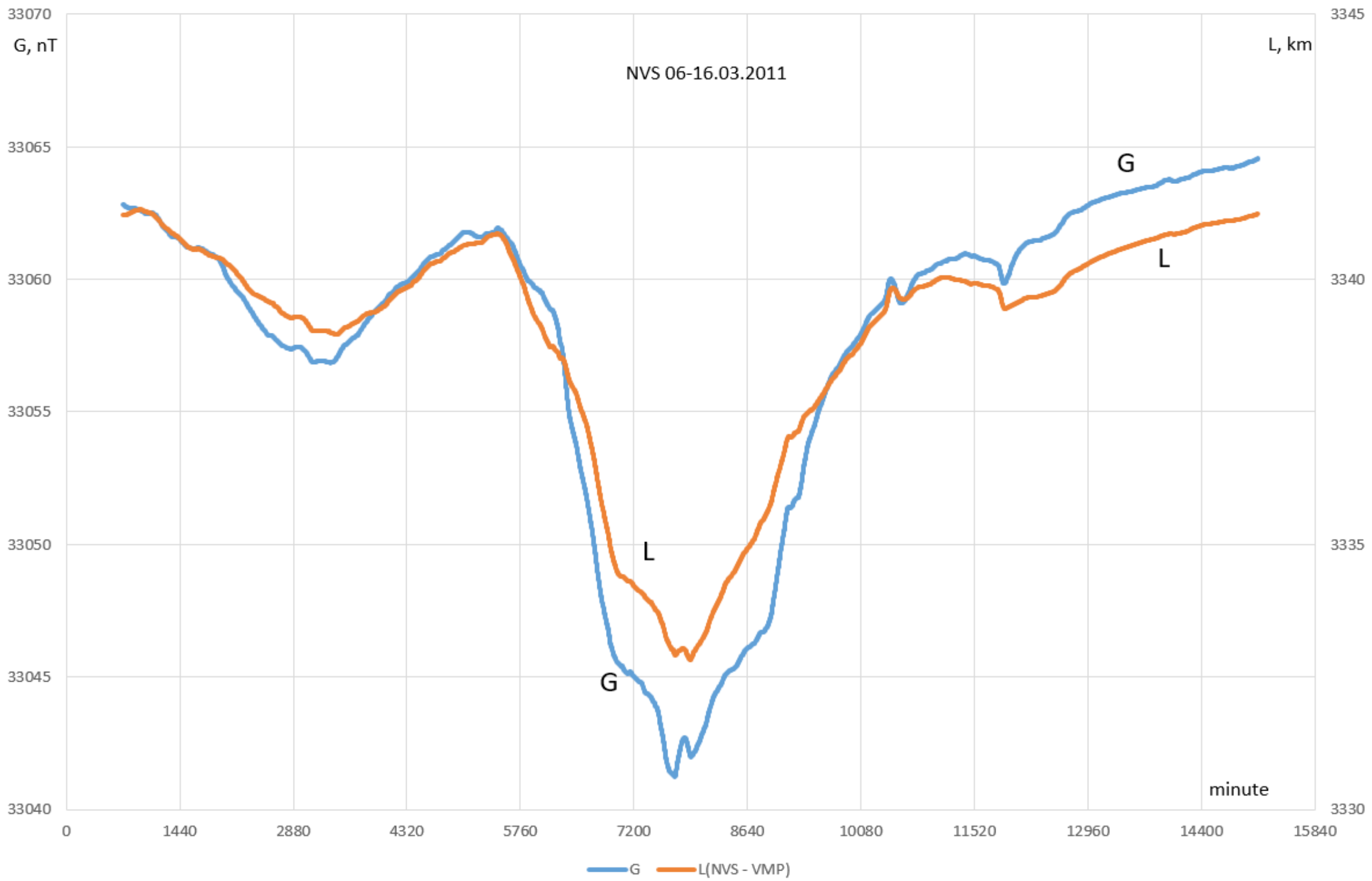
According to minute data, the correlation of the values of the local magnetic constant (G) from January 23 to February 23, 2023 turned out to be quite high not only for closely spaced observatories (SUA-PEG, 99.07%), but also for more distant ones (PEG-THY, 93.08%).

But the most interesting, in our opinion, is the increase in these correlations in the semi-monthly period after February 6 compared to the semi-monthly period preceding the earthquake: for the SUA-PEG pair from 98.32% to 99.26%, and for the PEG-THY pair from 89.24% to 93.33%.

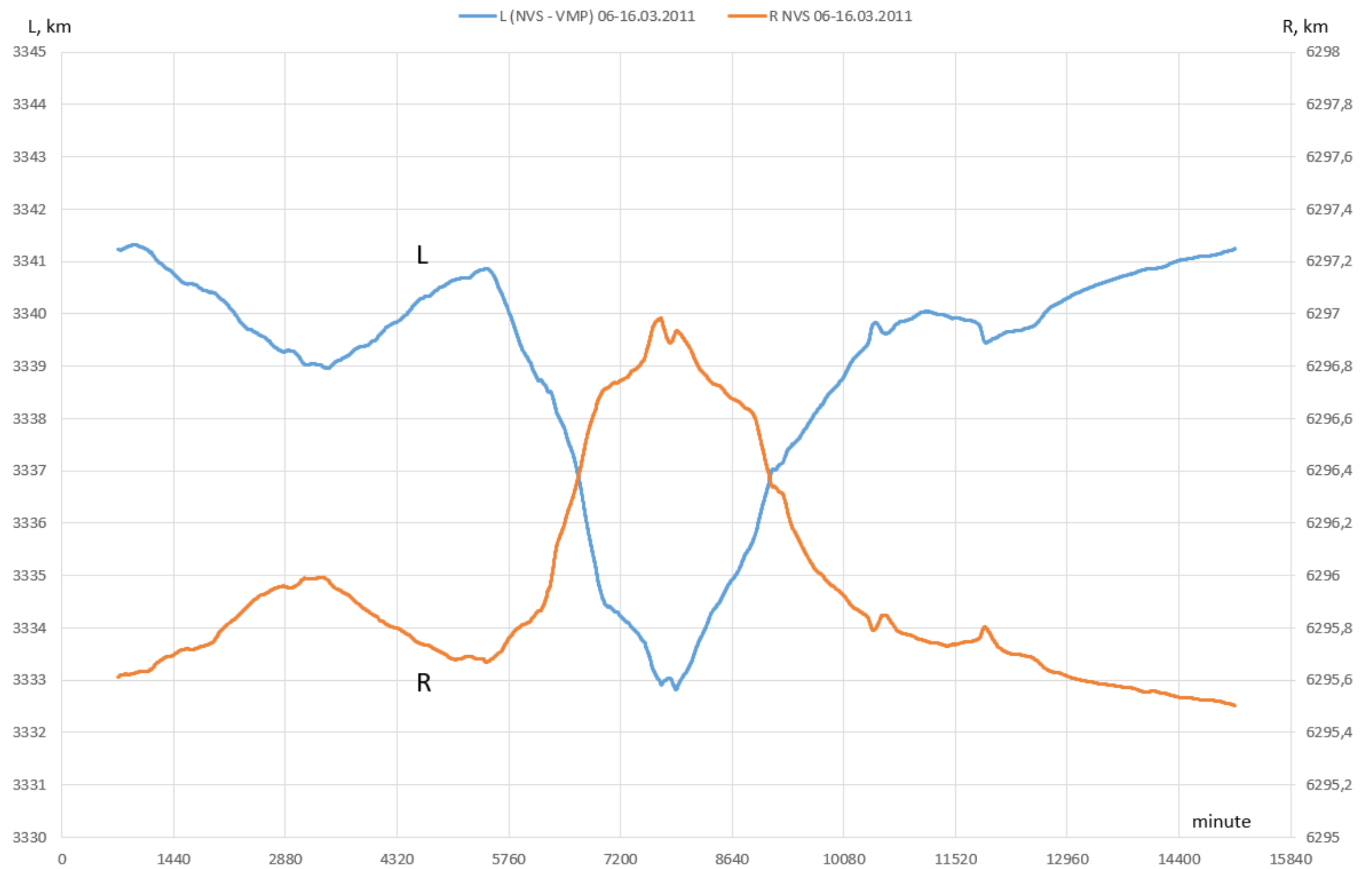
BEHAVIOR OF THE CORRELATION OF THE POWER CHARACTERISTIC OF THE MAGNETIC FIELD (G) IN OBSERVATORIES IN SOUTHERN EUROPE FROM 23.01.2023 TO 23.02.2023

• corr. DG	• corr. G (SUA-PAG)	• corr. G (PEG-THY)	• period
• 0,7951452	• 0,9907091	• 0,93081296	• FOR ALL DAYS
	18	6	
• 0,7127405	• 0,9831803	• 0,89238524	• UNTIL FEBRUARY 6
	64	3	
• 0,8041792	• 0,9925666	• 0,93325661	• AFTER 6 FEBRUARY
	96	3	
• 0,7810273	• 0,9923131	• 0,93173373	• FEBRUARY 6-7
	28	5	

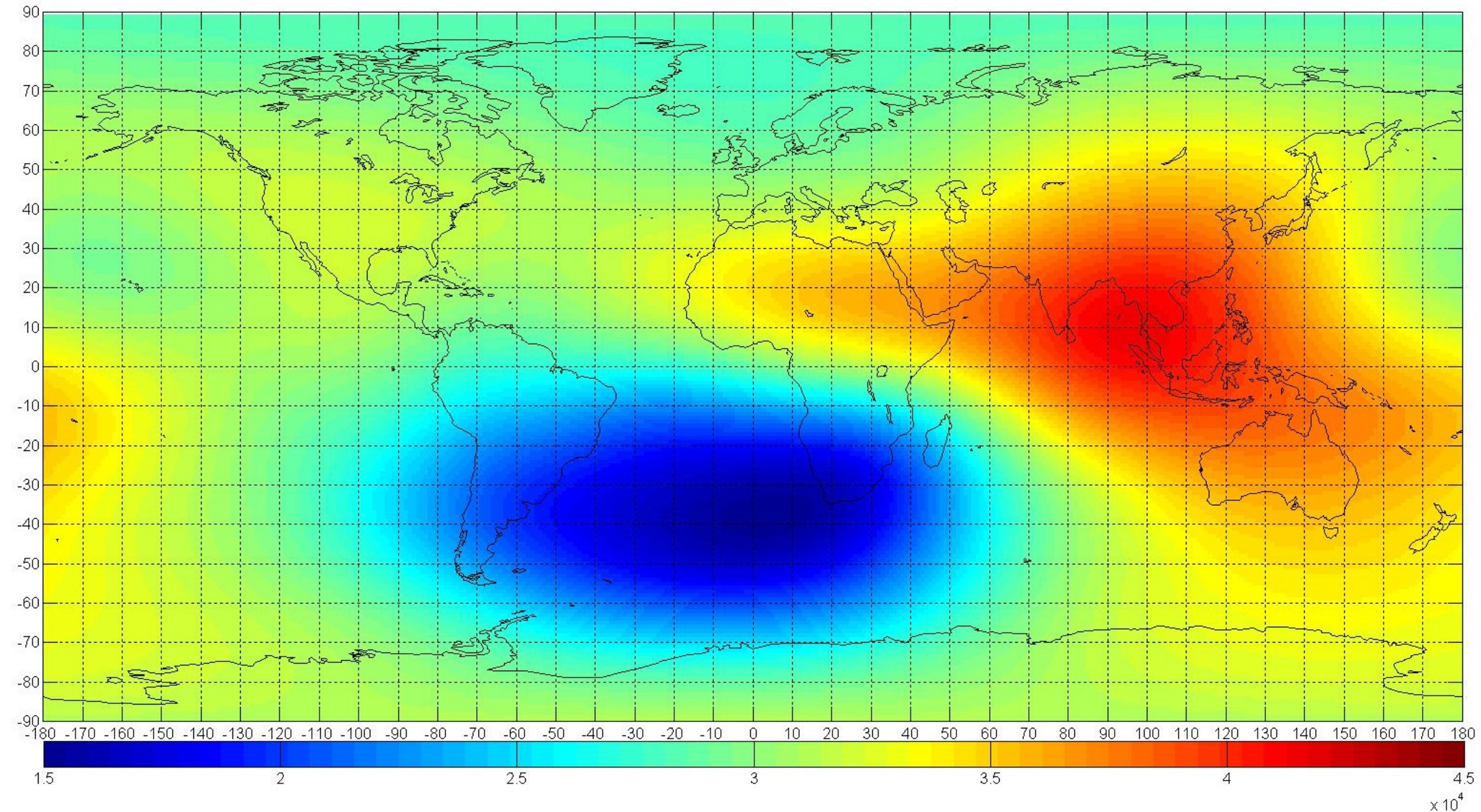








G 2010



x 10<sup>4</sup>

"The results of studies of spatial-temporal changes in water temperature show the huge role of the global thermohaline conveyor of seawater in shaping climate change in the globe. There is also reason to believe that the South Atlantic region, with coordinates from 26 to 36 degrees N and from 20 degrees W to 5 degrees E, is a key indicator of the climate not only of the Atlantic sector of the globe, but also of the entire Northern Hemisphere of the Earth. It is possible that this area of the world's oceans gives rise to the formation of the largest self-oscillatory process in the climate system - quasi-sixty-year-old" (from V.F. Loginov's monograph *"Space Factors of Climate Change"*, Minsk, 2020).

# **Thank you for your attention**

The work was carried out with the financial support of the Ministry of Education and Science of the Russian Federation (project FWZZ-2022-0019). Data on geomagnetic parameters are obtained from the INTERMAGNET site (<http://www.intermagnet.org>).



Величина локальной магнитной постоянной ( $G$ ) зависит как от магнитного момента эквивалентного диполя ( $M$ ), так и от расстояния ( $R$ ) между диполем и обсерваторией, но не зависит от ориентации этого диполя (ввиду чего эта характеристика магнитного поля и получила свое название).

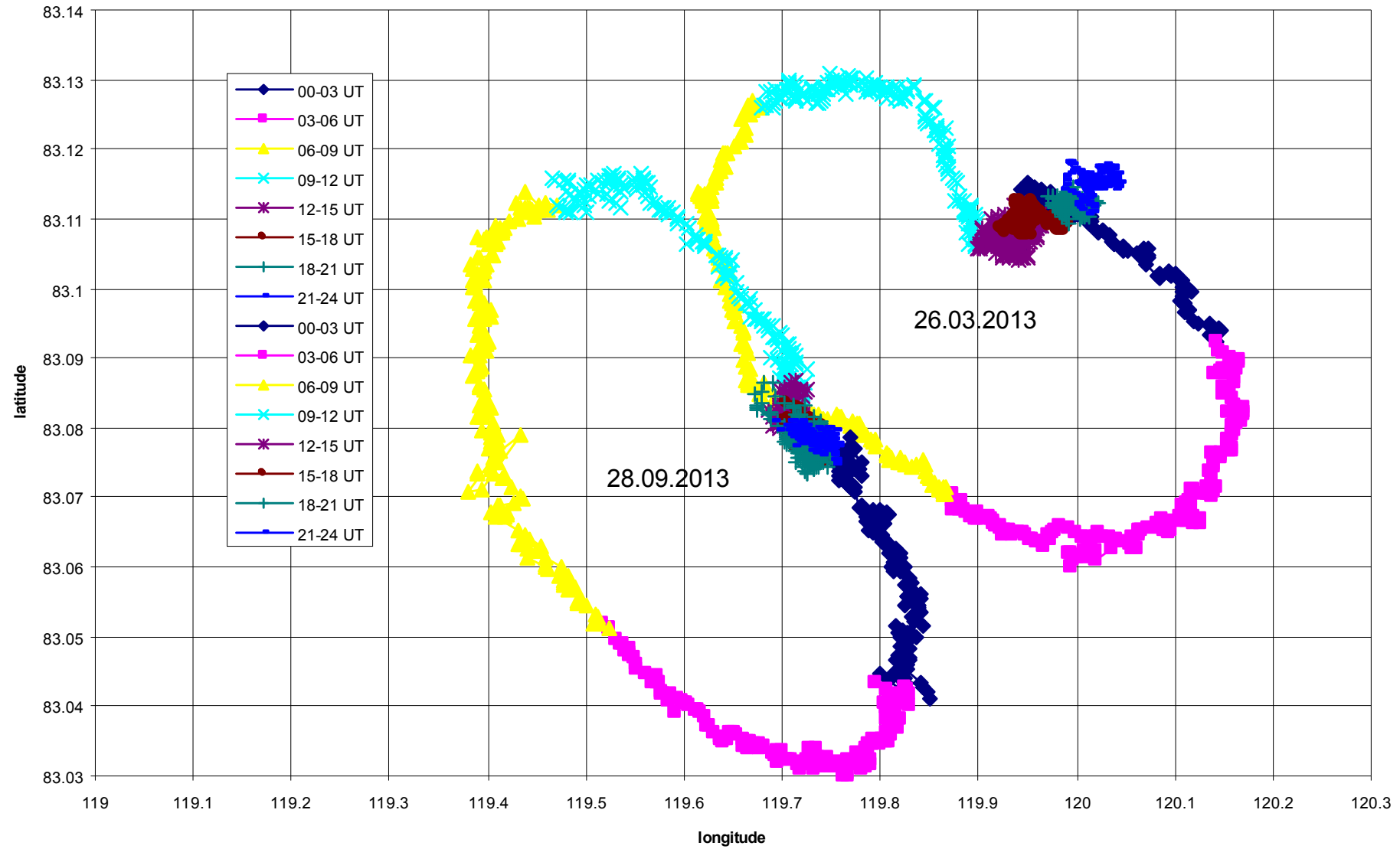
По изменению величины  $G$  можно оценить не только характер и масштаб изменения магнитного момента эквивалентного диполя (при фиксированном значении  $R$ ), но и масштаб смещения эквивалентного диполя относительно обсерватории (при фиксированном  $M$ ).

В природе, скорее всего, происходит сочетание этих процессов: возможно одновременное изменение как энергии эквивалентной токовой системы, создающей магнитное поле Земли, так и изменение расстояния от этой токовой системы до точки наблюдения.

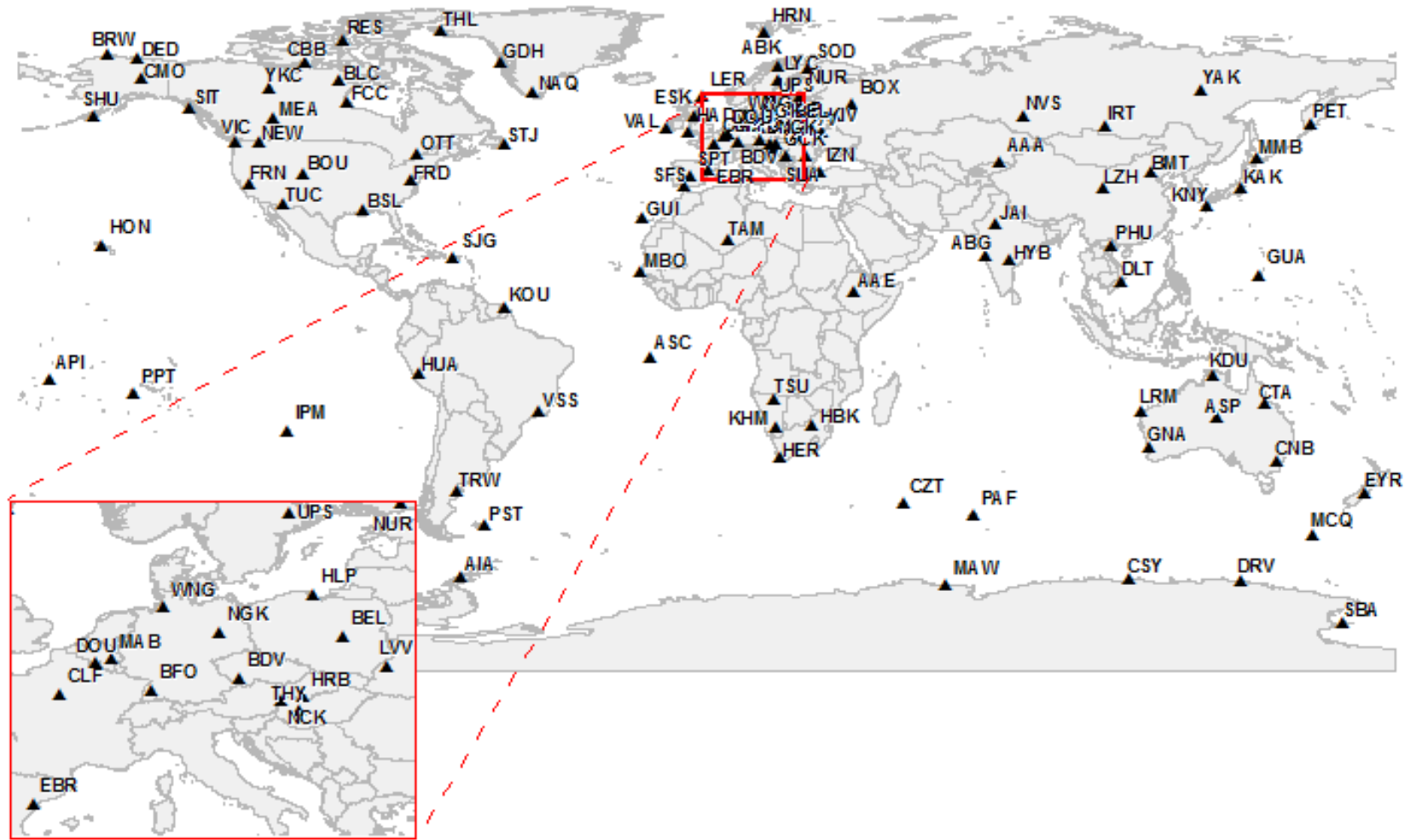
Отмечено значительное повышение корреляции указанных выше параметров для разных магнитных обсерваторий после сейсмических событий февраля 2023 года в Турции.

«Результаты исследований пространственно-временных изменений температуры воды показывают огромную роль глобального термохалинного конвейера морской воды в формировании изменений климата Земного шара. Имеются также основания считать, что регион Южной Атлантики с координатами от 26 до 36 градусов с.ш. и от 20 градусов з.д. до 5 градусов в.д. является ключевым индикатором климата не только Атлантического сектора Земного шара, но и всего Северного полушария Земли. Не исключено, что этот район мирового океана дает начало формированию крупнейшего автоколебательного процесса в климатической системе – квазишестидесятилетнего» (из монографии В.Ф. Логинова «Космические факторы климатических изменений», Минск, 2020).

VMP Nov osibirsk 26.03.2013- 28.09.2013







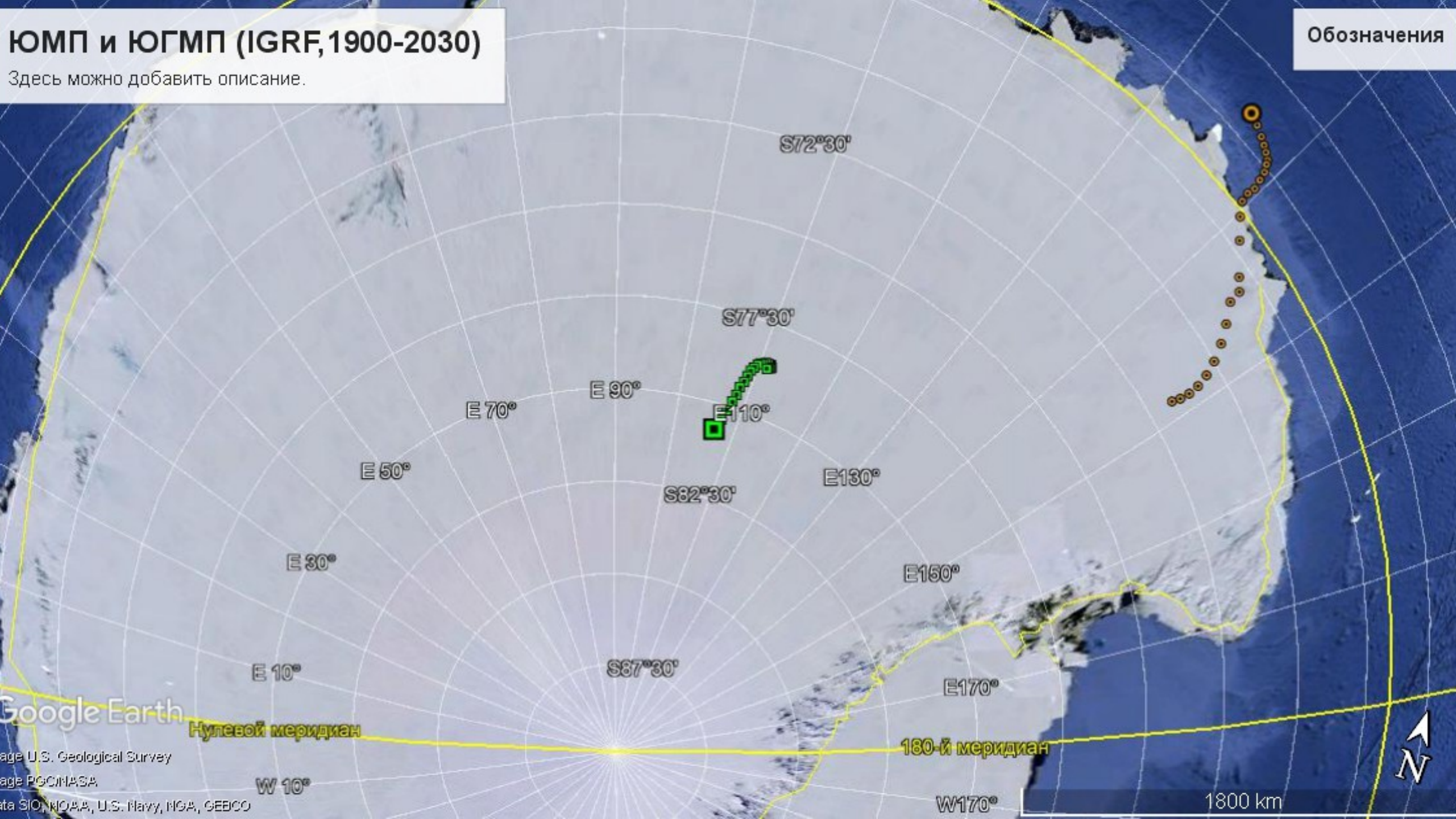


RECORDED AND INDEXED  
FEB 21 1952  
U.S. DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION  
DENVER, COLORADO

# ЮМП и ЮГМП (IGRF, 1900-2030)

Здесь можно добавить описание.

Обозначения



Google Earth

Нулевой меридиан

180-й меридиан

1800 km

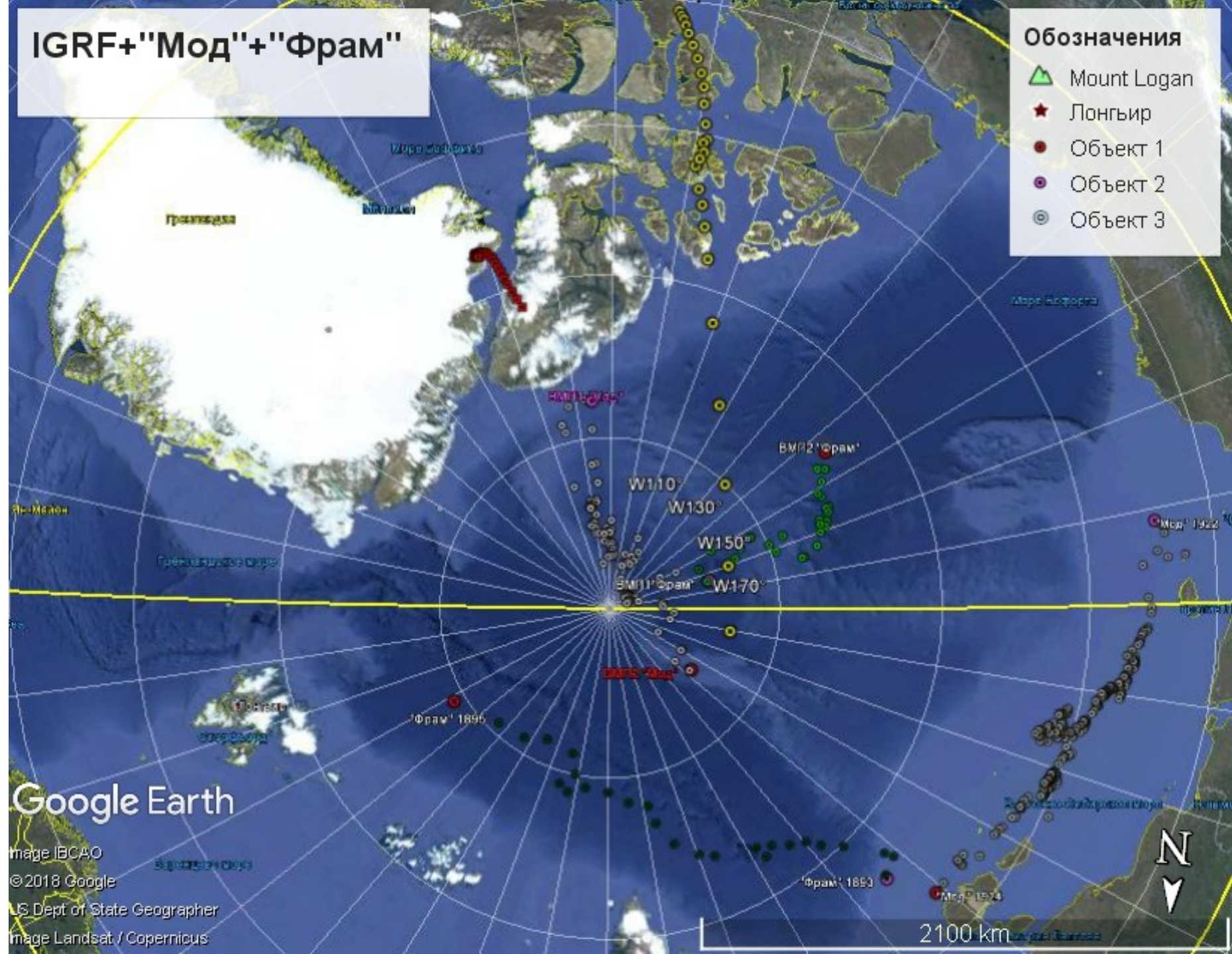
Image U.S. Geological Survey  
Image PGC/NASA  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO



# IGRF+"Мод"+"Фрам"

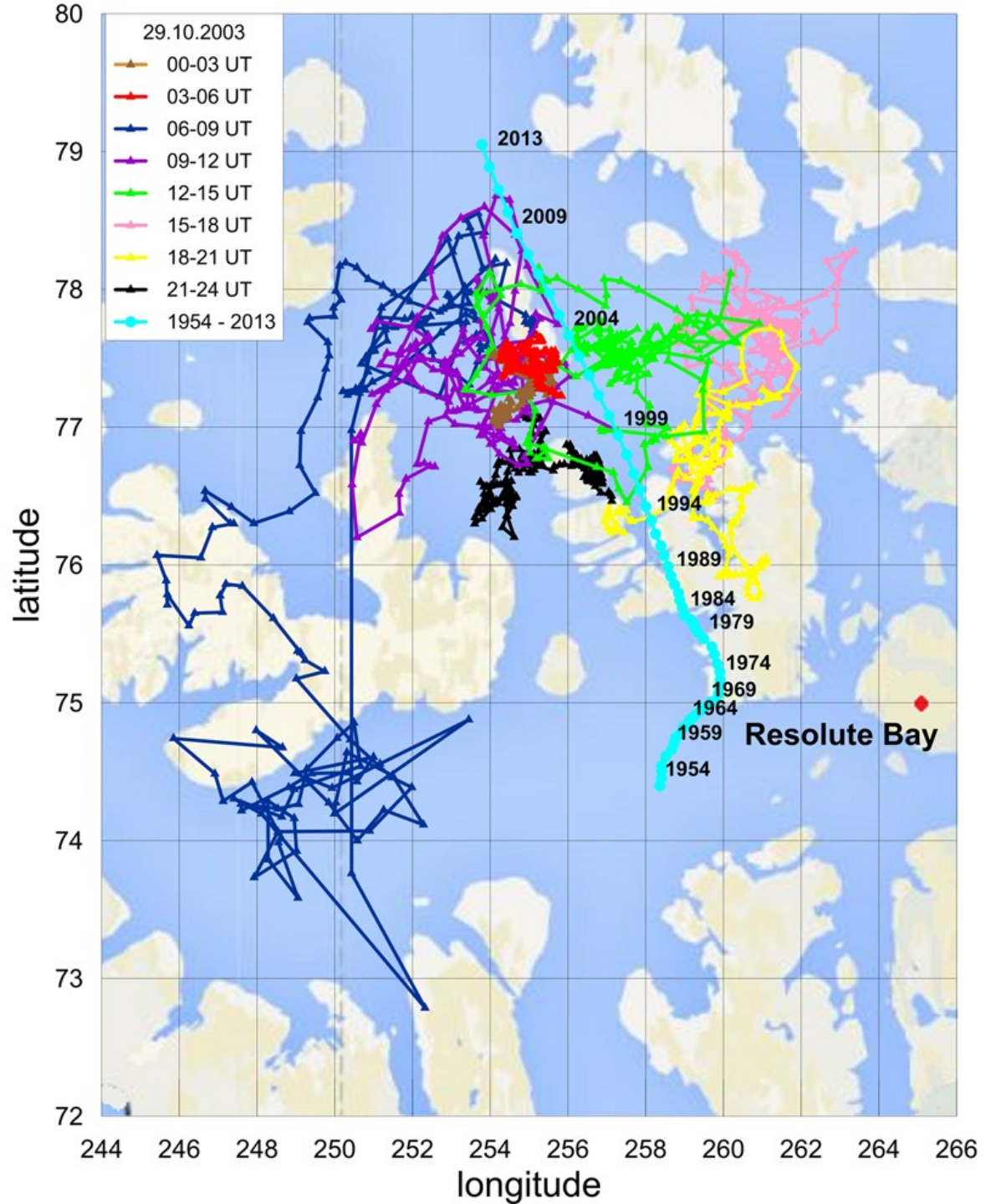
## Обозначения

- ▲ Mount Logan
- ★ Лонгър
- Объект 1
- Объект 2
- Объект 3

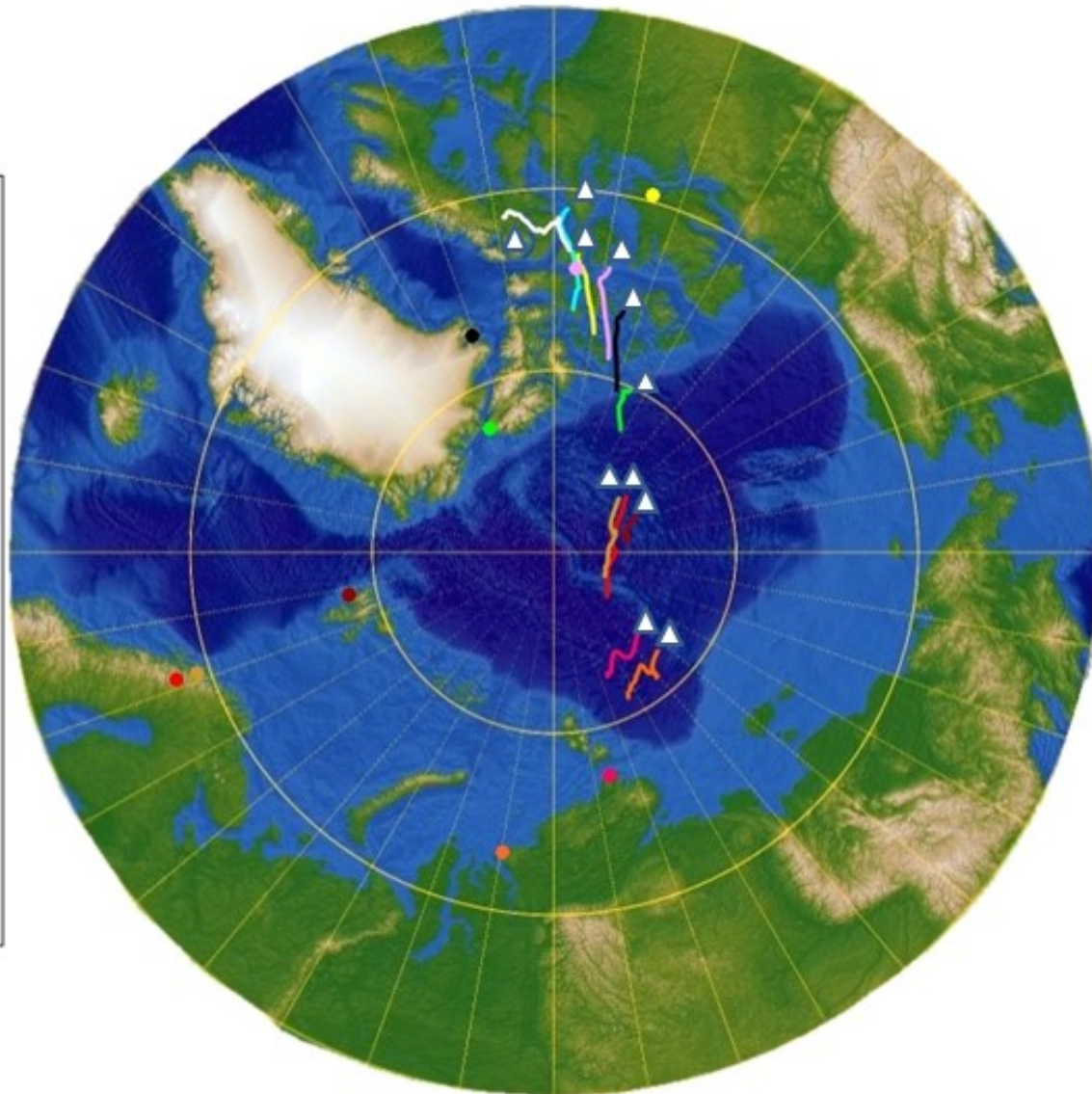
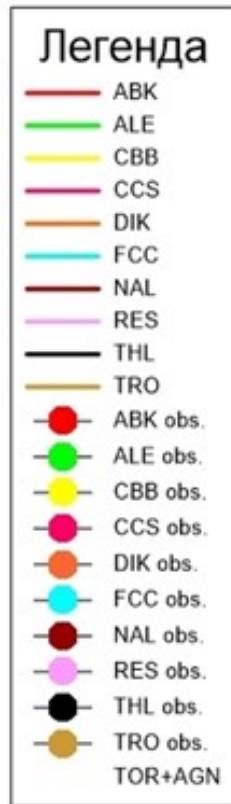


Google Earth

Image IBCAO  
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US Dept of State Geographer  
Image Landsat / Copernicus



# Траектории движения ВМП по обсерваторским данным



ABK 1921-2014 гг.

ALE 1961-2004 гг.

CBB 1972-2012 гг.

CCS 1935-2007 гг.

DIK 1933-2012 гг.

FCC 1957-2013 гг.

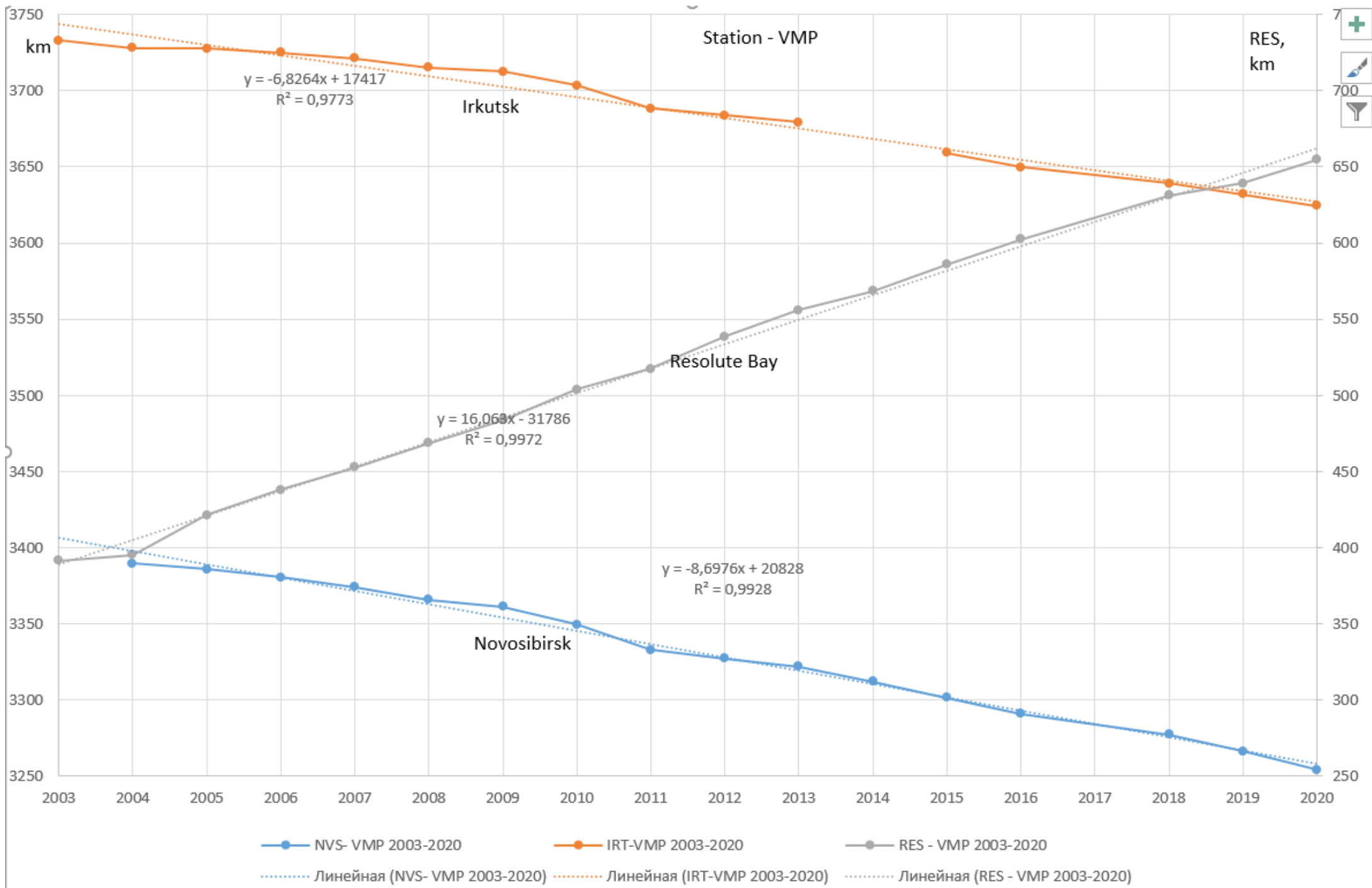
NAL 1966-2002 гг.

RES 1952-2013 гг.

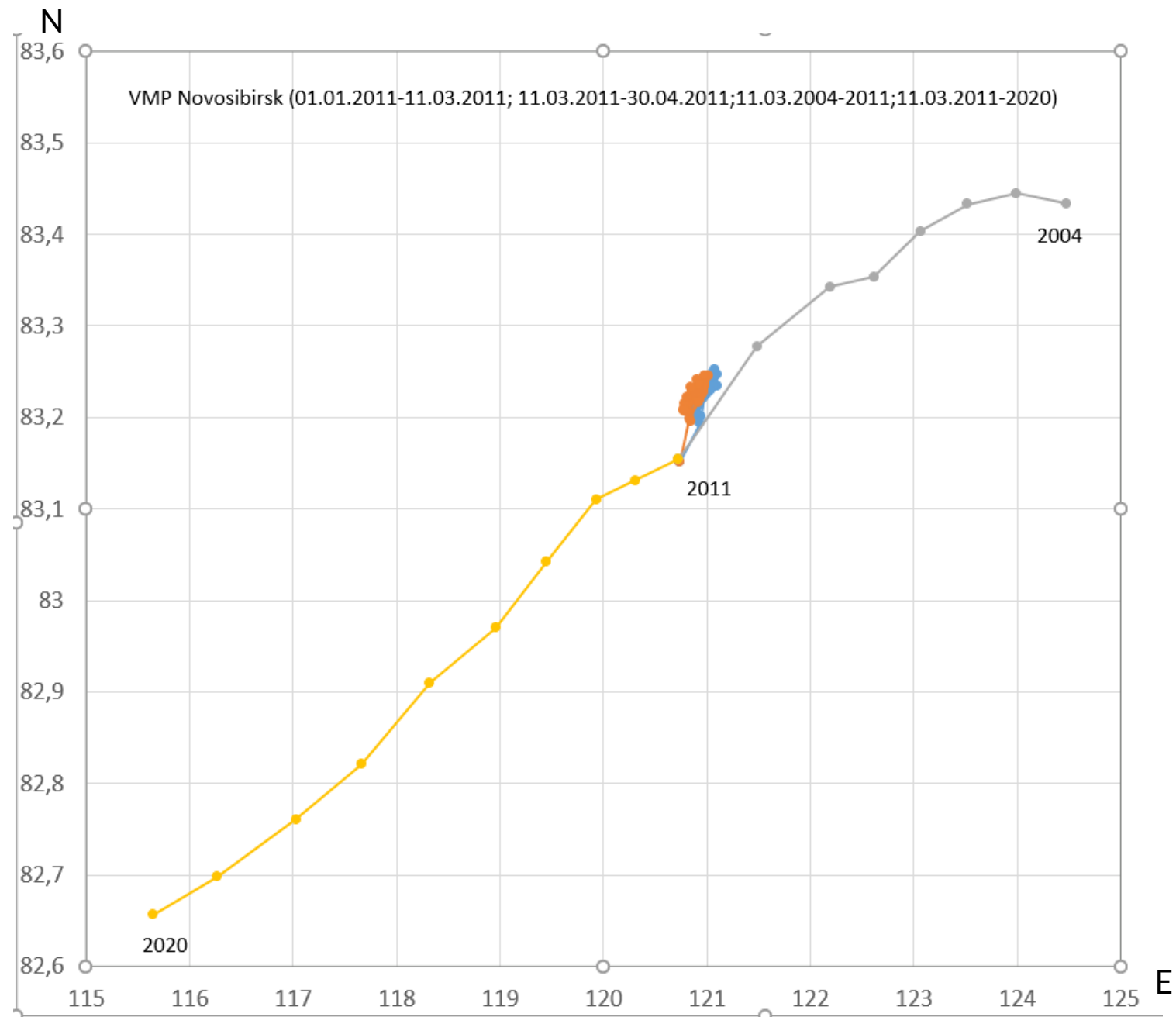
THL 1955-2013 гг.

TRO 1930-2012 гг.

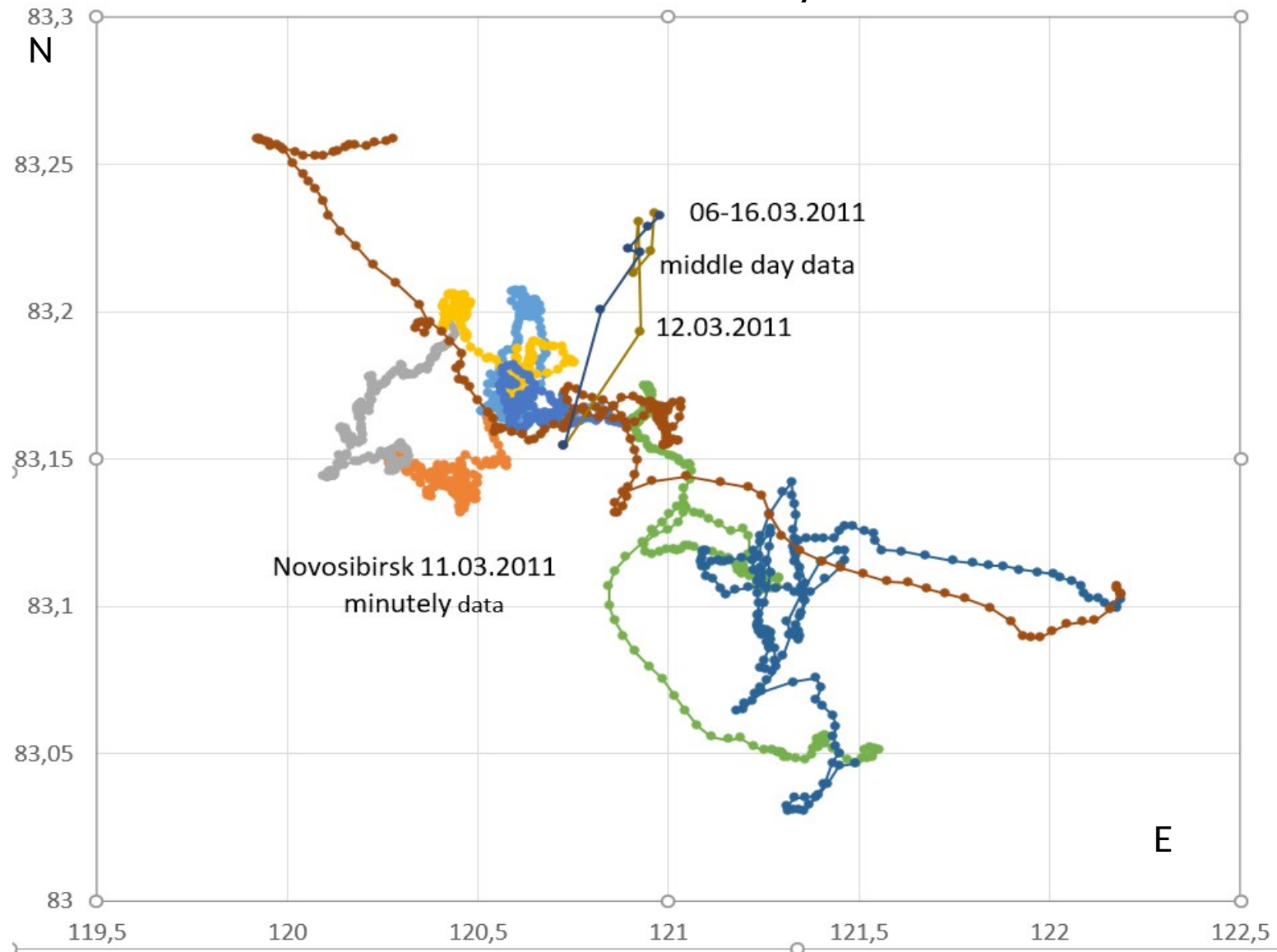
TOR+AGN 1840-1969 гг.

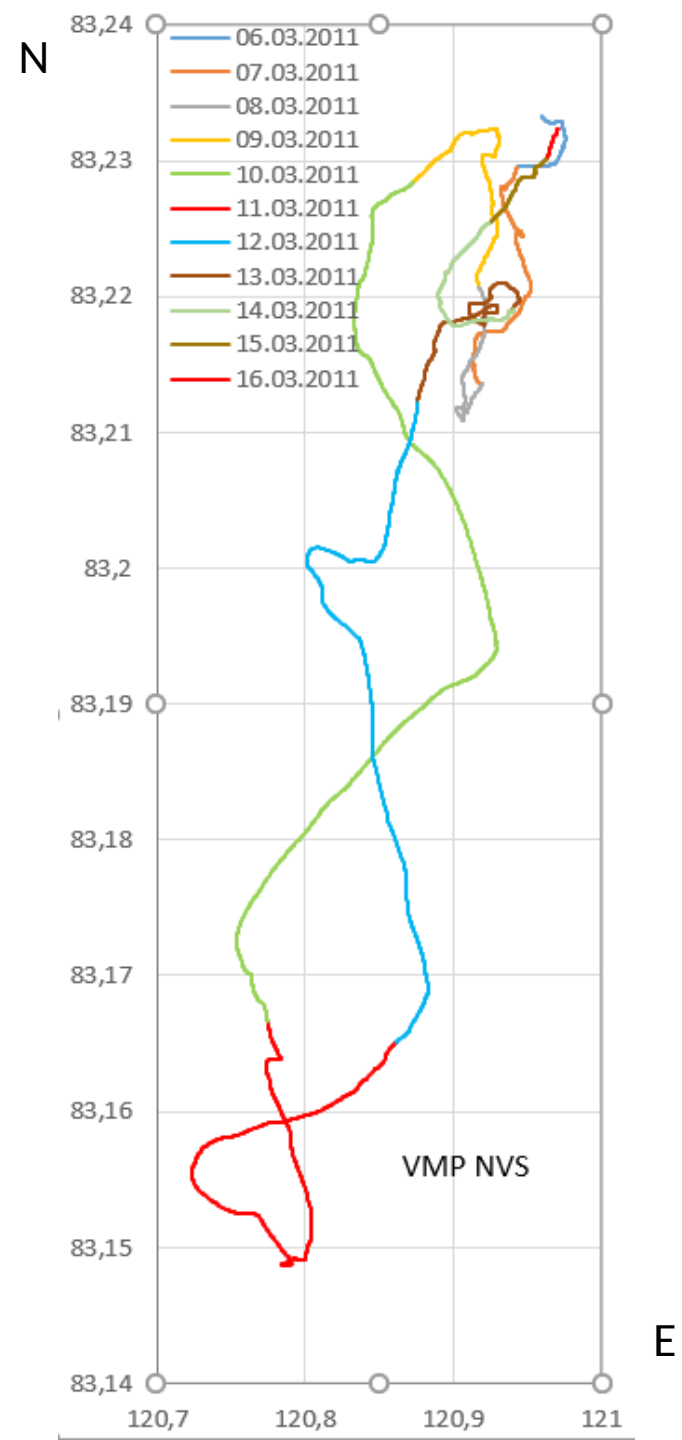






The movement of the magnetic pole on March 11, 2011 (by minute data) and from March 6 to March 16, 2011 (by average daily data) for the Observatory Novosibirsk





G 1900

