# Polygon "Simeiz–Katsively" – changes in the average pole of the Earth and the geomagnetic field over the last century

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**Abstract.** The character of changing the trajectory of the middle of the North geographical pole of the Earth's surface over the last century is studied. The peculiarities in the changes of its coordinates are established. The epochs of the appearance of especial points are compared with the epochs of jumps in the data on the parameters of the geomagnetic field. A model of secular variations of geomagnetic declination at a point with geodetic coordinates of 90° north latitude, 0° west longitude is obtained. Coherent relationships have been established between changes in the parameters of the Earth's middle pole and the geomagnetic field over the past century.

## 1 Introduction

Unlike two geographic poles, it is customary to consider four poles characterizing the Earth's magnetic field: two geomagnetic and two magnetic.

The north geomagnetic and magnetic poles belong to the conditional distribution of the field into geomagnetic and magnetic. A geomagnetic field, measured at any point on the earth's surface, is a combination of several magnetic fields generated by various sources. These fields overlap and interact with each other. More than 90% of the measured field is generated inside the planet and in the earth's crust. This part of the geomagnetic field is often called the main magnetic field. In a first approximation, the main magnetic field is a dipole, whose magnetic axis makes an angle of about 11.5 degrees with the axis of rotation of the Earth.

The actual process by which a geomagnetic field is created is extremely complex. However, the most plausible hypothesis of the generation of a dipole magnetic field is an analog of a dynamo generator - a device for converting mechanical energy into electrical energy. It is believed that in the outer core there are conditions for such a transformation [*http://geomag.nrcan.gc.ca*]. The interconnection between processes in different shells of the Earth allows the possibility of synchronization of internal and external mechanical movements, and the events reproduced by them even in the absence of causal relationships between these events. Comparison of the time of occurrence of singular points on the graphs of changes in the positions of geographical and geomagnetic poles contributes to further modeling of the relationships and, at this stage of knowledge, physical interpretation.

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## 2 Motion parameters of the geographic and geomagnetic north poles

The age-old variations of the geomagnetic field are not only slowly changing, but also prone to short-term jumps. A geomagnetic jump is a relatively sharp change in the speed of secular variations of one or more parameters of the Earth's geomagnetic field.

Using the latest IGRF-12 geomagnetic field model, we calculate the secular variations of the geomagnetic declination *dD* at a point with geodetic coordinates of 90° north latitude, 0° west longitude for the period 1900 - 2020 using the declination calculator. Based

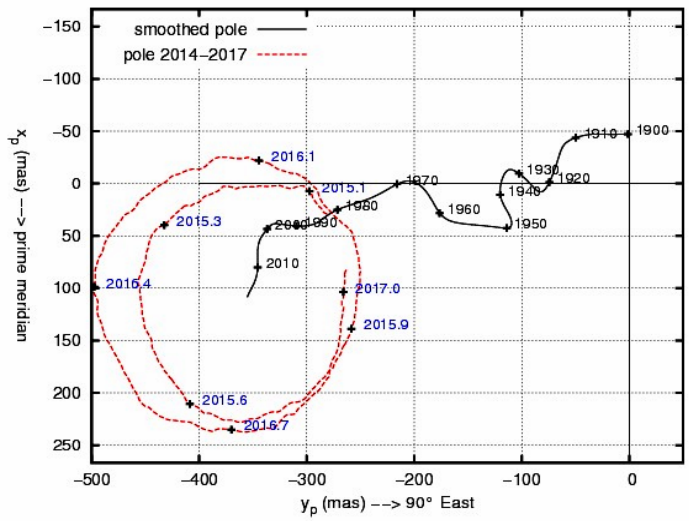


**Fig. 1**. The movement of the North Middle Pole of the Earth in the definition of IERS for the period 1900–2014 and the flood of IERS. Coordinates are given in thousandths of arc seconds (mas) for the period 2014–2017. Figure source:http://hpiers.obspm.fr/eoppc/eop/eopc01/mean-pole.jpg.

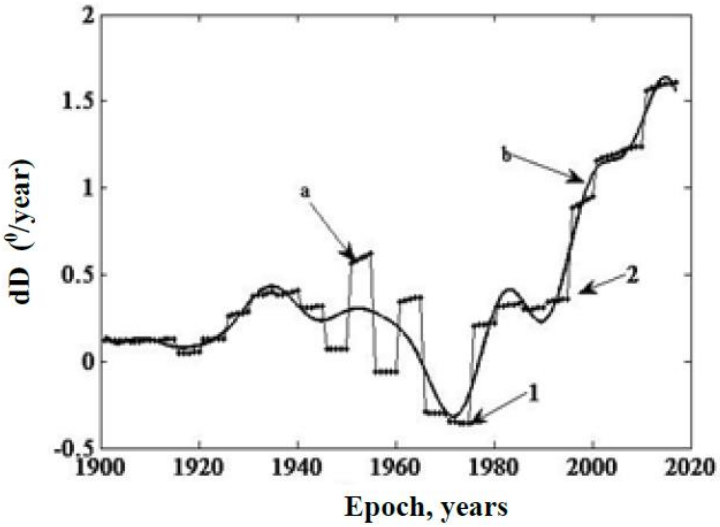


**Fig. 2.** Graphs: a - changes from year to year of geomagnetic declination **dD** at a point with geodetic coordinates of 90° north latitude, 0° west longitude for the period 1900 - 2020; b - approximation of the trend of changes **dD** using the global model.

on the results of these calculations, we construct a graph and a smooth model of secular changes in geomagnetic declination at a point with geodetic coordinates of 90° north latitude, 0° west longitude for the period 1900–2020.

The graphs in the figure 1 show: the global trend of changes in secular variations in the declination of the geomagnetic field increases after 1970 and has a non-linear trend; jumps are observed in 1950, 1955, 1965, and 1975. Comparing the trends in secular variations of geomagnetic declination *dD* (Fig. 1) and the velocity of the northern component of the north dipole pole (Fig. 2), we observe simultaneous accelerated growth after 1970. In addition, the trend in the northern component of the velocity of the north geomagnetic pole after 2000 changes its sign to the opposite; nonlinear trend in *dD* (Fig. 3) reverses the sign in 2015.

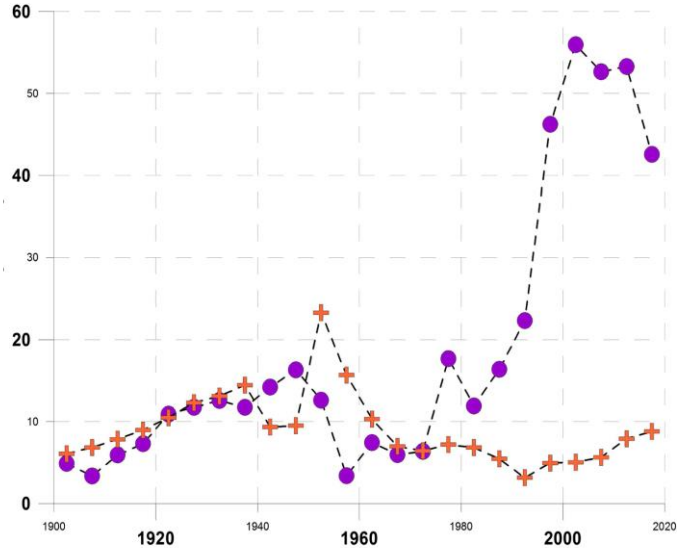


**Fig. 3.** The northern component of the velocity of geomagnetic dipole poles in the northern (balls) and southern (crosses) hemispheres was estimated using the WGS84 spheroid [1].

## 3 Conclusion

The location of singular points on the graphs is the result of overlapping several fluctuations. Therefore, the distance between individual return points (singular points) does not always indicate the existence of a corresponding harmonic oscillation. This is especially true for the determination of variations with large periods, the presence of which in a short time interval limits the reliability of their determination. At the same time, comparisons of special moments of changes in the parameters of the geographical and magnetic fields with global processes in the solar system, with changes in gravitational relationships (for example, a parade of planets, etc.), with energy processes in the core and the movement of the inner and outer shells of the Earth, allow us to study the conditions under which critical points arise (cusp points).

The rotation of the Earth around its axis, in addition to the known gravitational interactions, is exposed to rotational mechanisms associated with other shifts and rotations of substances located both inside the Earth and beyond. In this case, it is difficult to establish which physical process is decisive in changing the geomagnetic characteristics of the field and the Earth's rotation parameters. Nevertheless, since the current state of the system depends on how the system came into this state, the forecast of jumps depends on studying the relationship of factors affecting the current state of the system.

## References

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