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Mortality from Diseases of the Circulatory System in Europe and the Mediterranean Connected with Space Energetic Alpha Particles?

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ABSTRACT

In the present work, a dangerous phenomenon for mankind is described, increasing the mortality from the most deadly diseases on the planet – circulatory system diseases, in particular, the deadly ones of ischemic heart diseases. In the joint analysis of data from satellites in orbit around the Earth and from the health statistics sources EUROSTAT, it became clear that, by some mechanism, streams of positively charged solar particles with high energy entering the Earth's orbit increase mortality from circulatory system diseases. The annual increase is by an average of 5% to 15% in a zone of maximum risk in the Northern Hemisphere, parallel to the equator and bounded by the parallels of 30° and 50° north latitude. The dates are given when the risk of a vascular accident is maximum depending on the latitude of the place in the Europe and Mediterranean area. During the day, the risk of a vascular accident is maximum around local noon. In this regard, it is perhaps not a coincidence that in the Mediterranean region, a midday break is practiced indoors ("siesta").

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Introduction

In a series of publications, a dangerous phenomenon for humanity is described, increasing the mortality from the most deadly diseases on the planet – circulatory system diseases, in particular, the deadly ones of ischemic heart diseases (IHD) [1-13]. In the joint analysis of data from satellites in orbit around the Earth and from the health statistics sources EUROSTAT, it became clear that, by some mechanism, streams of positively charged solar particles with high energy entering the Earth's orbit increase mortality from circulatory system diseases. The annual increase is by an average of 5% to 15% in a zone of maximum risk in the Northern Hemisphere, parallel to the Equator and bounded by the parallels of 30° and 50° north latitude.

The phenomenon is difficult to observe because it contributes to the increased mortality from circulatory system diseases among many other, more obvious causes – heredity, age, sex, lifestyle, and other diseases. According to statistics from the World Health Organization (WHO), IHD is at the top of the list of morbid causes of death on the planet [14]. According to WHO data, 8.9 million people died worldwide from IHD in pre-pandemic 2019 [15]. The morbidity and mortality of IHD are not spread evenly across the planet, according to [16]. The highest mortality from IHD is in a region including Central and Eastern Europe.

The mentioned dangerous phenomenon of cosmic origin has remained undetected for a long time, despite a sufficiently long series of years of space observations and medical statistics, because it is not observed in the statistical data of all countries. It is noticeable (i.e. there is a statistically significant correlation) for several small countries in Central and Eastern Europe and the Mediterranean – in the data for Bulgaria, Greece, Austria, Hungary, South Italia, Sicily, Malta, and Balearic Islands. Many examples, where this phenomenon is also observable in several countries from the Northern Hemisphere – Asia, America, and even in Africa, are described in [1-13]. In the affected countries, the phenomenon leads to an increase in circulatory diseases mortality, mainly IHD mortality within wide limits, for example, for the USA, the increase was estimated at 5%, but in individual years in the Mediterranean countries, the increase in IHD mortality reached up to 40% [4-10].

Countries, where circulatory diseases mortality is most strongly correlated with high-energy positively charged particle fluxes, are located in a zone parallel to the Equator with approximate limits between 30°N and 50°N latitude. The described phenomenon is not observed in countries located near the North Pole. It is also not observed in the statistical data of large countries such as the USA, Russia, and China, which are also located in the mentioned area. This (at least for the USA) is due to masking of the phenomenon in the general statistics for the large country if the cause acts on a limited area smaller than the country and for a limited time – lasting much less than data averaging periods for statistical purposes [10]. This phenomenon would be expected to influence circulatory diseases mortality in countries south of the Equator too, but accessible mortality statistics for them are scarce, unreliable, or absent, preventing reliable inferences about such an influence in the Southern Hemisphere.

In a hypothetical mechanism is proposed that explains the described dangerous phenomenon with the penetration of high-energy alpha particles from solar origin to a limited region on the Earth's surface [1-13]. There, they kill living organisms due to ionization in the biological tissue, affecting the circulatory system to the greatest extent. The affected regions on the Earth's surface (deadly spots), for which atmospheric and magnetospheric conditions are favorable to the penetration of alpha particles, change over time and on the planet's surface. They are the size of a small country.

Aim

Below are more examples from a study of the effects of cosmic alpha radiation on the mortality of inhabitants of Europe and the Mediterranean.

Material and Methods

A prerequisite for this kind of study is the availability of reliable data – both on possible space causes and mortality.

More complex is the problem of the reliability of mortality data. Their obtainment requires a combination of good medical diagnostics covering the territory of the respective country, accurate administrative reporting, adequate national statistics, and easy access to statistical data for scientific purposes. The analysis below is based on an authoritative source of health data – EUROSTAT [17].

Mortality Data

Eurostat offers (by 2023) free access to data on mortality from causes in the countries of the European Union, the European Economic Area, and the candidate countries for membership in the union, for the interval 2011 – 2020, for some countries there are data from 2006. Geographically, these countries occupy Europe and the Mediterranean. Mortality is measured in "rate"– the number of deaths from IHD per 100,000 inhabitants.

Causes of death are grouped into 88 groups (Eurostat shortlist), mostly diseases, based on the International Disease Classifier, 10th revision (ICD-10). The largest share of the mortality rate is due to Diseases of the circulatory system. In ICD-10 circulatory system diseases are classified in class IX, with codes I00 – I99. In the said shortlist, class IX diseases are grouped into seven groups (Table 1).

Table 1: Groups of Circulatory Diseases in The Shortlist of Eurostat and Their Codes in ICD-10

Diseases of the circulatory system (I00-I99)
Ischemic heart diseases (I20-I25)
Acute myocardial infarction including subsequent myocardial infarction (I21-I22)
Other ischemic heart diseases (I20, I23-I25)
Other heart diseases (I30-I51)
Cerebrovascular diseases (I60-I69)
Other diseases of the circulatory system (I00-I15, I26-I28, I70-I99)

The shortlist contains mortality rate data for EU countries (NUTS-1) and EU regions (NUTS-2, smaller areas of the larger NUTS-1 countries). Annual mortality rate data were extracted for 37 European regions from each of the studied groups of circulatory diseases for the interval 2011 – 2019 (the last pre- pandemic year).

Satellite Data

Satellite data on alpha particles recorded by the satellites of the series GOES (Geostationary Operational Environmental Satellites) were obtained from an NOAA site [18]. Data on alpha-particle fluxes (unit: (number of particles). $cm^{-2}.s^{-1}.sr^{-1}.MeV^{-1}$) with energies of the range 3.8 – 21.3 MeV were used. The satellites of the GOES series fly in geostationary orbit (above the Earth's equator), at an altitude of 36,000 kilometers above the Earth's surface, make one lap in 24 hours, that is, they "hang" over a certain point on the Earth's surface and are not shade by the Earth at their circumference around it.

Data Processing

The correlation coefficients between the annual averaged alpha radiation flux and the annual mortality rate for the 37 European regions for the year interval 2011 – 2019, were calculated. Maps were created showing (with black isolines) the distribution of the annual mortality for European regions from each of the studied Eurostat shortlist groups of death causes for 2012, the year with the highest mortality in the time interval 2011 – 2019 across the territory of Europe and the Mediterranean [17]. With red isolines, the maps show the distribution across the territory of Europe and the Mediterranean of the correlation coefficient between the annual mortality rates from each of the studied shortlist groups with the annually averaged alpha particle flux for the interval of years 2011 – 2019. Data on the coordinates, latitude, and longitude [Google Earth] of the centroids of the regions included in the study were used in the maps. Mapping was performed with Golden Software Surfer10. The kriging interpolation procedure was selected.

In mathematical statistics the level of statistical significance is a parameter, indicating the degree of reliability of the calculated correlation coefficient [19]. The smaller the number of this parameter, the more reliably the correlation coefficient is established, i.e. the more reliably a cause-and-effect relationship has been established, in the case between the annual flux of alpha radiation and mortality from diseases of the circulatory system. In scientific studies, a level of statistical significance no greater than 0.05 is accepted as a criterion for the reliability of the correlation coefficient.

The correlation coefficient and the level of statistical significance are related. For the 9 years included in the study, a minimum correlation coefficient of 0.668 corresponds to a statistical significance level of 0.05. The isolines on the correlation coefficient distribution in the maps enclose the regions with statistically significant values of the correlation coefficient – higher than 0.668 and with a significance level less than 0.05 which are with high reliability. I.e. the existence of a causal relationship between cosmic alpha radiation and mortality from the relevant circulatory diseases can be considered reliably established in the mentioned areas enclosed by isolines on the correlation coefficient map. If for a given group of circulatory diseases, the areas with mortality rate and with the correlation coefficients overlap for some of the maxima on the map, then in the region of these maxima the impact of alpha radiation contributes noticeably to the mortality from this group of circulatory diseases.

Results

The described dangerous phenomenon is observed in the form of dependence between the annual average flux of radiation from alpha particles with high kinetic energy, recorded by satellites in orbit around the Earth, and the annual human mortality on the Earth's surface from several causes, mainly diseases. Not all of Earth's surface is affected. The area where the phenomenon is observed is located mainly in a zone parallel to the equator with

approximate boundaries along the parallels of 30° and 50° north latitude. The high altitude places are more vulnerable.

As it is mentioned above, the mortality rate from IHD is at its maximum in the area of Central and Eastern Europe. The study described below aimed to reveal the probable connection between space alpha particle streams and mortality from circulatory system diseases in areas encompassing Europe and the Mediterranean reflected in Eurostat mortality statistics. The study showed that there is a relationship between the flux of cosmic alpha radiation and mortality mainly for the group of diseases of the circulatory system. The results of this research are presented below.

Figure 1 shows the time dependence in the interval 2011 - 2019 of two numerical sequences - 1. of the recorded annual fluxes of alpha particles from satellites of the GOES series - 13, 14, and 15, orbiting the Earth at a distance of 36,000 kilometers above the surface, and 2. of the annual mortality from diseases of the circulatory system (codes I00 – I99 from ICD-10) for Greece. The high correlation between the two numerical sequences can be seen, indicating the existence of a causal relationship between them.

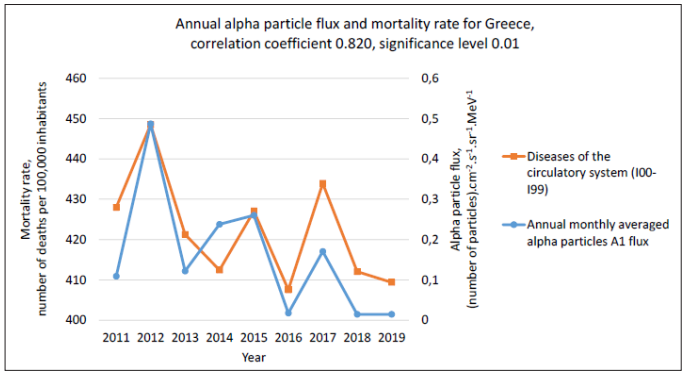

Figure 1: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and circulatory system mortality for Greece. Centroid coordinates 39.16°N, 22.88°E, average elevation 499 m, area 131 957 km^2, population 10640000 (2021)

Figure 2 shows the same time dependence for NUTS-2 Eurostat region Aegean Islands and Crete, Greece, East Mediterranean. The high correlation between the two numerical sequences can be seen, indicating the existence of a causal relationship between them.

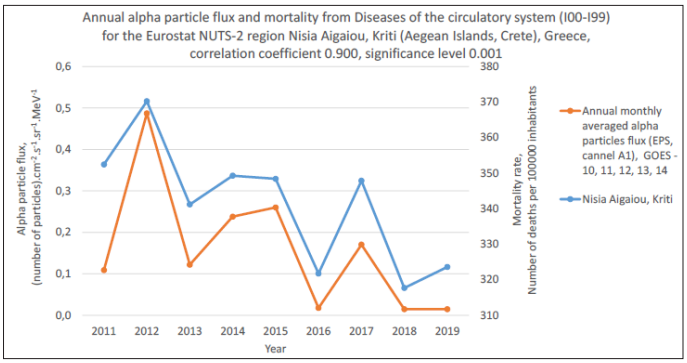

Figure 2: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and Diseases of the circulatory system (I00-I99) mortality rate for the NUTS-2 region of the Aegean Islands and Crete, Greece, East Mediterranean, indicates the presence of a causal relationship between the two phenomena.

Figure 3s shows the distribution of mortality rates from Diseases of the circulatory system (codes I00- I99 from ICD-10) for the Balkans and the North-East Mediterranean. In the Central Balkans, there is an area of multicenter maximum mortality rate, overlapping with the areas with maxima of moderate correlation between annual cosmic alpha radiation flux and the mortality rate of circulatory system diseases. The overlapping means a noticeable impact and casual relationship between space alpha particle flux and this mortality rate. The pronounced effect – the highest correlation between alpha particle fluxes and the mortality rate is observed for the islands in the Aegean basin (See Figure 2), but the mortality rate in the area is less than in the Central Balkans. To a lesser extent, such a correlation exists in individual small-area regions such as Switzerland, central France, and eastern Spain.

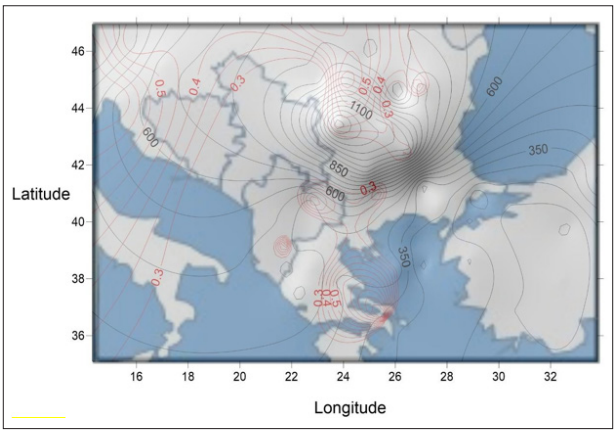

Figure 3: Balkans, the mortality rate (black isolines) from the Eurostat shortlist group "Diseases of the circulatory system" (I00-I99) and its correlation with annual alpha particle flux (red isolines)

The highest as worldwide, and in Europe and the Mediterranean is mortality rate from IHD. Figure 4 presents the distribution of mortality from IHD and its dependence on cosmic alpha radiation in the studied region. The highest mortality rate from IHD is in the Western Balkans, but the highest statistically significant correlation of mortality with cosmic alpha radiation is over the central Mediterranean in the area of Malta and north Tunisia. To a lesser extent, such a correlation exists in individual small-area regions such as Switzerland, the southwest Balkans, and central France. It is noteworthy that all areas of high correlation lie in the zone bounded by parallels 30°N and 50°N.

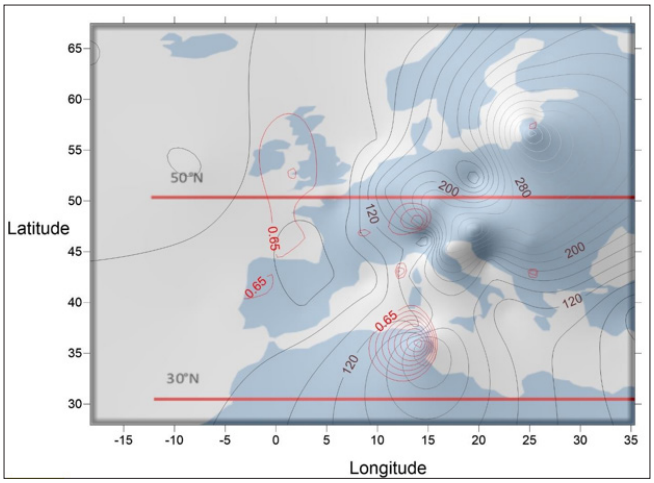

Figure 4: Europe and the Mediterranean, mortality rate (black isolines) from Eurostat shortlist group "Ischemic heart diseases"

(I20-I25) and its correlation with annual alpha particle flux (red isolines)

Figure 5 shows the time dependence in the interval 2011 - 2019 of the recorded annual fluxes of alpha particles and of the annual mortality from IHD for Malta. The high correlation between the two numerical sequences can be seen, indicating the existence of a causal relationship between them.

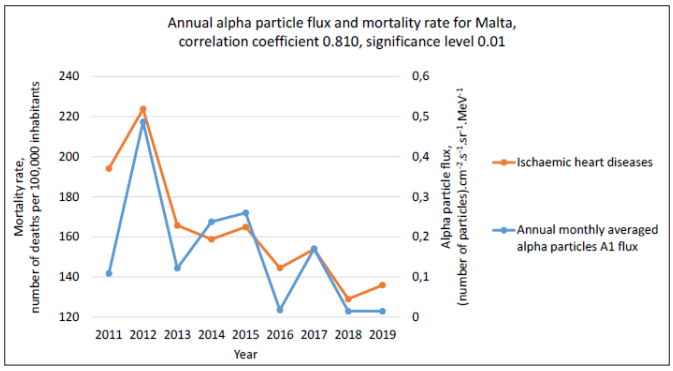

Figure 5: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and IHD mortality rate for Malta indicates the presence of a causal relationship between the two phenomena. Centroid coordinates 35.88°N, 14.39° E, highest point 253 m, area 316 km2, population 518536 (2021)

Mortality from acute myocardial infarction (I21-I22) is a share of ischemic mortality. Figure 6 presents the distribution of mortality rate from acute myocardial infarction and its dependence on cosmic alpha radiation in the studied region. The highest mortality rate from acute myocardial infarction is in the Western Balkans and Tunisia. The highest statistically significant correlation of mortality with cosmic alpha radiation is over the central Mediterranean in northern Tunisia, where the area with the highest correlation coefficient overlaps the area with the highest mortality rate – showing an obvious causal relationship. To a lesser extent, such a correlation exists in individual small-area regions such as Switzerland.

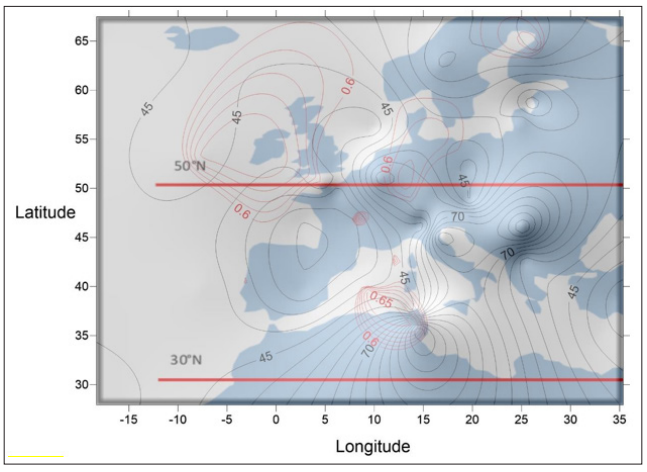

Figure 6: Eurostat shortlist group "Acute myocardial infarction" (I21-I22) annual mortality rate (black isolines) and its correlation with annual alpha particle flux (red isolines)

Figure 7 shows the time dependence of the recorded annual fluxes of alpha particles and of the annual mortality from Acute myocardial infarction in Switzerland.

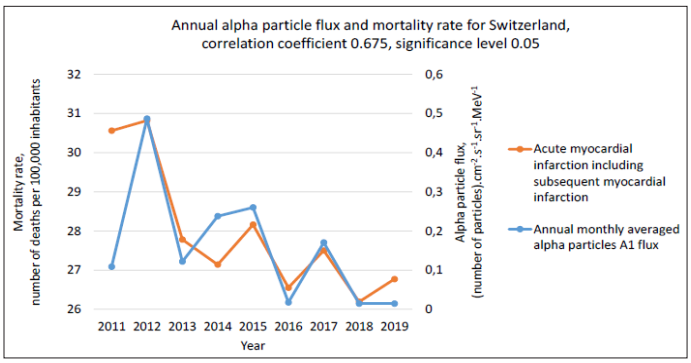

Figure 7: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and acute myocardial infarction mortality rate for Switzerland indicates the presence of a causal relationship between the two phenomena (centroid coordinates 46.84°N, 8.35°E, average elevation 1369.6 m, area 41285 km^2, population 8703000 (2021))

Mortality from diseases of the group 'Other ischemic heart diseases' (I20, I23-I25) is a share of ischemic mortality in the studied region. Figure 8 presents the distribution of mortality rate from 'Other ischaemic heart diseases' and its dependence on space alpha radiation in the studied region. The highest mortality from 'Other ischaemic heart diseases' is in the Baltic countries and the western Balkans. The highest statistically significant correlation of mortality with space alpha radiation is over the central Mediterranean in the area of north Tunisia and Malta. To a lesser extent, such a correlation exists in individual small-area regions with high altitudes such as Switzerland and the south-west Balkans.

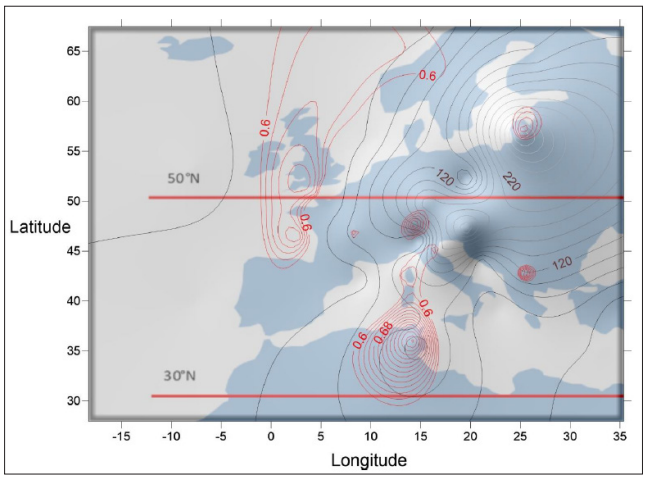

Figure 8: Eurostat shortlist group "Other ischaemic heart diseases" (I20, I23-I25) mortality rate (black isolines) and its correlation with alpha particle flux (red isolines)

Figure 9 shows the time dependence of the recorded annual fluxes of alpha particles and of the annual mortality rate from 'Other ischaemic heart diseases' for Malta. The high correlation between the two numerical sequences can be seen, indicating the existence of a causal relationship between them.

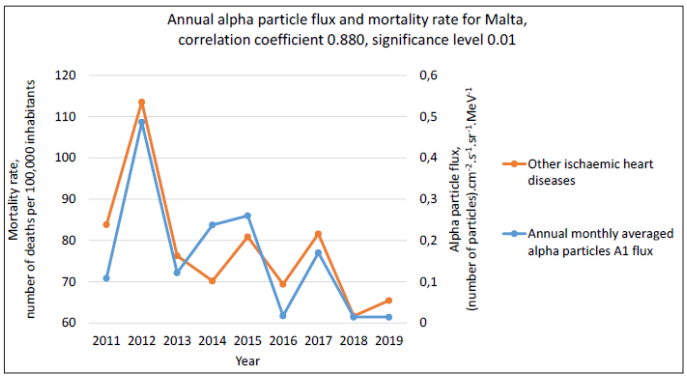

Figure 9: The high statistically significant correlation between annual fluxes of space alpha radiation and 'Other ischemic heart diseases' mortality for Malta indicates the presence of cause and effect relationship between the two phenomena

Figure 10 presents the distribution of mortality from 'Other heart diseases'(I30-I51) and its dependence on space alpha radiation in the studied region. The highest mortality from 'other heart diseases' is in the southwest Balkans, but the highest statistically significant correlation of mortality with cosmic alpha radiation is over the central Mediterranean and north Africa.

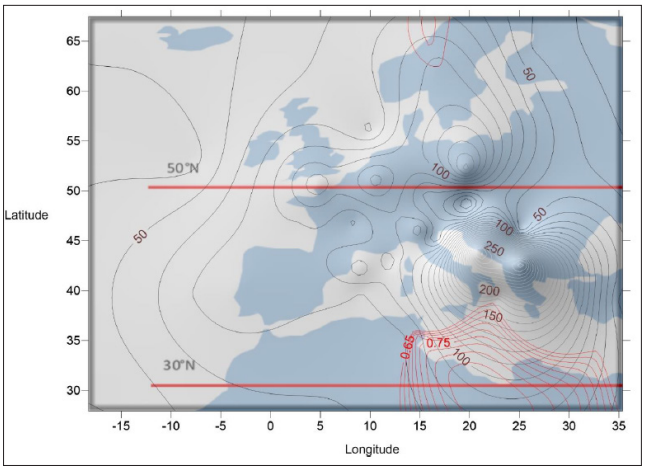

Figure 10: Eurostat shortlist group "Other heart diseases" (I30-I51), the mortality rate (black isolines), and its correlation with alpha particle flux (red isolines)

Figure 11 shows the time dependence of the recorded annual fluxes of space alpha particles and of the annual mortality rate from 'Other heart diseases' for Malta. The high correlation between the two numerical sequences can be seen, indicating the existence of a causal relationship between them.

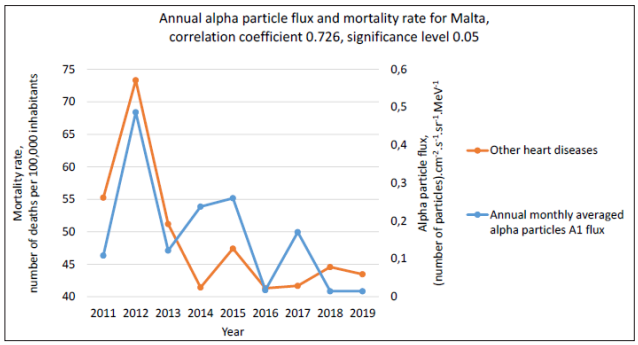

Figure 11: The high statistically significant correlation between annual fluxes of space alpha radiation and 'Other heart diseases' mortality rate for Malta indicates the presence of cause and effect relationship between the two phenomena

Figure 12 shows the distribution (black isolines) of mortality rate from "Cerebrovascular diseases" (codes I60-I69 from ICD-10) for Europe and the Mediterranean. The maximum is in the Southern Balkans. A second maximum is located over the Central Mediterranean, with a peak around the northern coast of Tunisia. The distribution of areas with a statistically significant correlation between mortality rate from Cerebrovascular diseases and cosmic alpha radiation is shown with red isolines. Such areas are the east coast of Spain, the Central Mediterranean, and Austria. Figure 12 shows that the areas with increased mortality from Cerebrovascular diseases overlap with the areas with a statistically significant correlation coefficient in the Central Mediterranean region, i.e. the contribution of cosmic alpha radiation to mortality from Cerebrovascular diseases in the studied region of Europe and the Mediterranean is greatest in the area of the Central Mediterranean – Southern Italy, Sicily, Malta, Corsica and Sardinia.

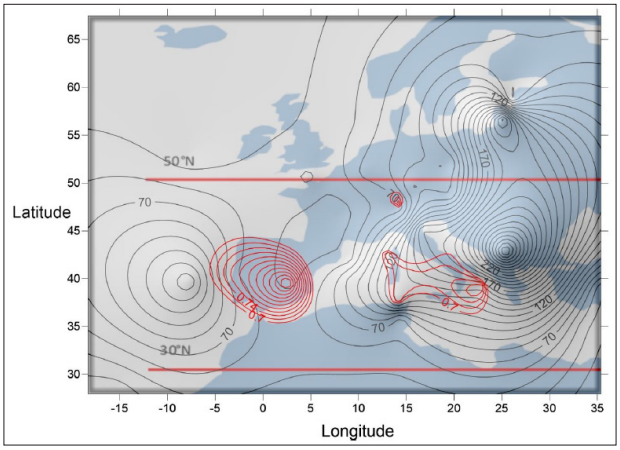

Figure 12: Eurostat shortlist group "Cerebrovascular diseases" (I60-I69), the mortality rate (black isolines), and its correlation with alpha particle flux (red isolines)

Figure 13 shows the correlated time variation of mortality from Cerebrovascular diseases and cosmic alpha radiation for the Balearic Islands. In absolute terms, the death rate is not high, but there is a marked cause-and-effect relationship with cosmic alpha radiation.

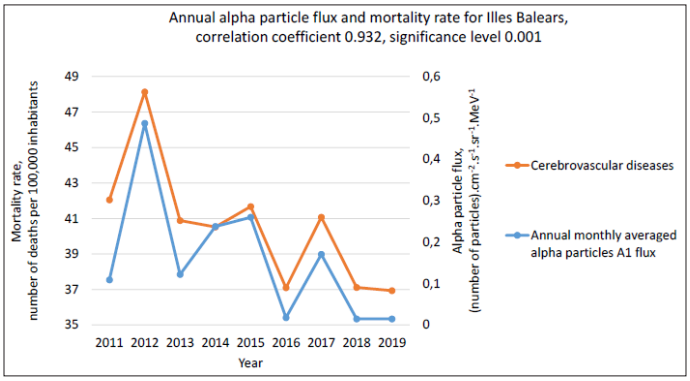

Figure 13: Between mortality from cerebrovascular diseases in Balearic islands, Spain, and the average alpha particles flux reaching Earth's orbit there is a large, statistically significant correlation (centroid coordinates 39.57°N, 2.65° E, average elevation 57 m, area 4992 km2, population 1.2 million)

To estimate the contribution of space alpha radiation to the mortality from the group of Cerebrovascular diseases for the Balearic Islands, Figure 14 is divided into two parts - 1. the same value for all years, not exceeding 36.93 deaths per 100000 inhabitants, i.e. independent of space alpha radiation shown in dark rectangle, and 2. variable over years part dependent on space alpha radiation. The variable part reached its maximum (48.13) in 2012, i.e. the contribution of space alpha radiation to mortality in 2012 reached 23% of total mortality. The average contribution of cosmic alpha radiation to cerebrovascular disease mortality for the Balearic Islands during the study years was 11.5%.

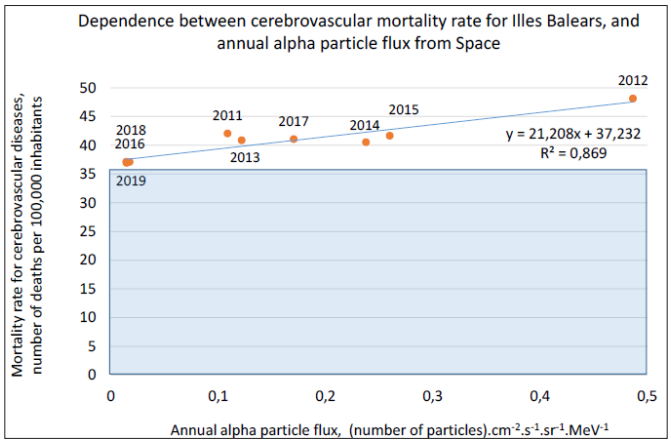

Figure 14: There is a linear relationship between cerebrovascular disease mortality rate and space alpha radiation flux for the Balearic Islands. The contribution of space alpha radiation to cerebrovascular disease mortality reached 23% in 2012

Of the 7 groups of diseases of the circulatory system in the aforementioned Eurostat shortlist of causes of death, no statistically significant correlation with annual space alpha radiation fluxes was found only with the group "Other diseases of the circulatory system" (I00-I15, I26-I28, I70- I99 of ICD-10).

Discussion

The inhabitants living in the zone with boundaries along the parallels between 50°N and 30°N are at maximum risk of damage from fast solar alpha particles twice a year because of the annual movement of the Sun in the sky. At each latitude in the zone, there are dates, connected with the annual position of the Sun, when there are more likely high-energy solar alpha particles to penetrate the atmosphere to the Earth's surface. How these zone boundaries and the dates with the highest risk are calculated is explained in detail in [4]. At noon around these dates, the risk of vascular accidents is maximum, and it should be expected that cardiology units in hospitals would be loaded to a greater extent than the average load during the year – the flow of patients to these units is expected to be increased by 10 - 15% (in case of a sudden appearance of a flow of solar alpha particles).

Table 2 shows the calculated dates with the highest risk of vascular accidents for Europe and the Mediterranean region depending on the geographical latitude of the place.

Table 2: Dates with the maximum risk of vascular accidents caused by high-energy alpha particles penetrating the atmosphere to the Earth's surface

North latitude	Dates with maximum risk of penetration of high-energy alpha particles to the earth's surface	Example
30°	27 January and 16 November	Cairo, Egypt
35°	5 March and 9 October	Cyprus, Malta
40°	4 April and 8 September	Ankara, Istanbul, Turkey; Thessaloniki, Greece; Sardinia, Italy; Balearic islands; Valencia, Madrid, Spain
45°	6 May and 7 August	Crimea, Ukraine; Belgrade, Serbia; Turin, Italy; Bordeaux, France
50°	6 June – 7 July	Kyiv, Ukraine; Krakow, Poland; Prague, Czech Republic; Luxemburg

During the day, the risk of a vascular accident is maximum around local noon. In this regard, it is perhaps not a coincidence that in the Mediterranean region, a midday break is practiced indoors ("siesta").

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