

The Malignant Non-Hodgkin's Lymphoma and the Cutaneous Melanoma, have a Common Risk Factor? Aren't these the Solar Alpha Particle Streams?

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ABSTRACT

Data on the incidence of certain malignant diseases of the lymphatic system show that there is a relationship between them and the incidence of melanoma. A mysterious common risk factor has been suggested. With examples from mortality statistics in Europe and the Mediterranean, combined with data from satellite observations, it is shown that it is possible that the common risk factor sought is high-energy solar alpha radiation reaching the Earth's orbit. By some mechanism, streams of positively charged particles with high energy entering the Earth's orbit increase mortality on the planet's surface. The increase in mortality is in a zone of maximum risk in the Northern Hemisphere, parallel to the equator and bounded by the parallels of 30° and 60° north latitude. Examples are given for the European and Mediterranean mortality from lymphatic malignant diseases and melanoma, confirming the described phenomenon. A hypothetical mechanism based on observational evidence has been proposed, according to which this dangerous phenomenon is due to solar alpha particles of high energy sufficient to overcome the atmosphere's resistance and reach the Earth's surface in a limited area of maximum death impact.

Keywords: Mortality; Melanoma; Lymphatic Malignant Diseases; Satellites Goes; Cosmic Alpha Radiation

Introduction

The malignant diseases Chronic Lymphocytic Leukemia, Small Lymphocytic Lymphoma, and non-Hodgkin lymphoma increase the risk that patients with them will also develop melanoma [1,2]. This makes these diseases linked, possibly through a common risk factor [3]. A suspected important risk factor for skin cancers is ultraviolet radiation. Studies have been carried out to what extent this risk factor for skin cancer is also a risk factor for the mentioned diseases. The result is negative—ultraviolet radiation is not a risk factor for the mentioned three types of malignant diseases [4,5]. On the other hand, there are arguments in favor of the statement that an important risk factor for the occurrence of melanoma is streams of solar alpha particles with high enough energy, allowing them to penetrate through the atmosphere to the Earth's surface [6]. The mentioned streams are of short duration – from minutes to a few days and reach the Earth's surface in a limited area the size of a medium-sized country, which is why they can hardly be registered on the Earth's surface. Below are argu-

ments in favor of the claim that the mentioned streams of solar alpha particles are also a risk factor, increasing the mortality from the mentioned diseases of the lymphatic system as well as from melanoma.

A series of publications [6-25], discussed the presence of a high correlation between the streams of positively charged particles with high kinetic energy recorded from satellites in the Earth orbit and mortality on the Earth's surface from many diseases.

The main focus of the mentioned publications was on the effect of solar alpha radiation on mortality from diseases, killer number one of mankind – those of the circulatory system. The harmful effects of positive solar corpuscular radiation are also observed on many other organs and systems in the human organism, turning this invisible effect into one of the main causes of death for humanity which has remained beyond the reach of researchers until now. The mentioned dangerous phenomenon of cosmic origin is unevenly spread on the planet's surface. Europe and the Mediterranean are among the most affected. However, in [6-25] are described many examples, where this

phenomenon is also observable in several countries from the Northern Hemisphere - Asia, America, and even Africa. This phenomenon would be expected to influence mortality in countries south of the Equator, but mortality statistics for them are scarce, unreliable, or absent, preventing reliable inferences about such an influence in the Southern Hemisphere. The described phenomenon is not observed in the statistical data of large countries such as the USA, Russia, and China. This (at least for the USA [16]) 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. The European Union has a tradition of maintaining reliable mortality statistics, in which the discussed multifaceted influence of solar positive corpuscular radiation on mortality stands out clearly.

Below, based on data from mortality statistics in the European Union, the unexpected association between solar alpha radiation and mortality from the above-mentioned diseases is shown. The mortality statistic of the European Union is suitable for the study because it is based on statistical regions, smaller than a country, but still big enough, to include a statistically sufficient number of inhabitants. The emission frequency of said radiation depends on the phase of the 11-year cycle of solar activity, which is why the processes that this radiation causes are also influenced by the phase of solar activity.

Material and Methods

Mortality Data

The analysis below is based on an authoritative source of health data - (EUROSTAT [26]). In the study, the parameter annual mortality rate - number of deaths per 100,000 inhabitants was used as a characteristic of mortality. EUROSTAT offers free access to data on mortality rates from causes in the countries of the European Union, the European Economic Area, and the candidate countries for membership in the union. Geographically, these countries occupy Europe and the Mediterranean. Data are grouped by NUTS (Nomenclature Des Unités Territoriales Statistiques in French, the nomenclature of territorial units for statistics). In the study, mortality data from the EUROSTAT shortlist in which mortality rates are grouped by causes of death into 92 groups, mostly diseases, were used. The groups are related to the classes in the International Disease Classifier ICD-10, (10th revision). The shortlist contains mortality data for EU countries (NUTS-1) and EU regions (NUTS-2, smaller areas of the larger NUTS-1 countries). Currently (2023) the shortlist includes mortality rate data for the interval 2011 - 2020. Annual mortality rate data were extracted for 396 European regions (NUTS-2) separately from each of the EUROSTAT shortlist groups for the interval 2011 - 2019 (the last pre-pandemic year).

Satellite Data

Satellite data on positive charged corpuscular radiation - protons and alpha particles recorded by the satellites of the series GOES (Geo-

stationary Operational Environmental Satellites) were obtained from a NOAA site [27].

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 on alpha-particle and proton 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 fluxes were recorded by the satellite high-energy particle detectors:

1. Energetic Particles Sensor (EPS), and
2. Energetic Proton, Electron, and Alpha Detector (EPEAD).

The data are available averaged over a 5-minute interval, during which there are up to 25 reports of the instrument.

Data Processing

The correlation coefficients [28] between the annual averaged alpha radiation flux and the annual mortality rate were calculated. Maps were created showing (with black isolines) the distributions of the annual mortality for the EUROSTAT shortlist death causes, discussed below. Maps included data from 396 NUTS-2 European regions for 2012, the year with the highest solar activity (and highest mortality rate) in the studied time interval 2011-2019. With red isolines, the maps show the distribution across the territory of Europe and the Mediterranean of the correlation coefficient between the annual mortality rate from separate causes of mortality with the annually averaged alpha particle flux for the time interval 2011-2019. Data on the coordinates, latitude, and longitude [Google Earth] of the centroids of the NUTS-2 regions included in the study were used in the map. Mapping was performed with Golden Software Surfer10. The kriging interpolation procedure was selected. In mathematical statistics, the level of statistical significance [28] is a parameter, indicating the degree of reliability of the calculated correlation coefficient. 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 solar alpha radiation and mortality rate from a given cause. 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 [28].

In scientific studies, a level of statistical significance no greater than 0.05 is accepted as a criterion for the acceptable reliability of the correlation coefficient. The red isolines on the correlation coefficient distribution in the maps enclose the regions with statistically significant values of the correlation coefficients around and up to a significance level of 0.05. Correlation coefficients with a significant level above the acceptable one (less than 0.05) are of high reliability (the higher the number, the lower the significance level) i.e. the existence

of a causal relationship between cosmic alpha radiation and mortality rate from a given cause can be considered reliably established in the mentioned map areas enclosed by red isolines on the correlation coefficient. If there is a coincidence for some of the maxima for mortality rate and correlation coefficients, then in the region of these maxima, the impact of alpha radiation contributes noticeably to the mortality from the given cause. Three levels of statistical significance were used to classify the impact of solar corpuscular radiation on each of the EUROSTAT shortlist causes of death:

1. A causal relationship between radiation and the cause of death is most reliably established if the correlation coefficient has a significance level of 0.001,
2. An intermediate reliability of the relationship is present at a significance level of 0.01,
3. An acceptable reliability of the relationship is present at a significance level of 0.05.

The strength of the influence of radiation on a particular cause of death was characterized by a weighted sum between three components:

1. The product of the number of regions with significant correlation coefficients with a significance level of 0.001, with a weighting factor of 3. For example, the cause of death under number 28 in the EUROSTAT shortlist "Hodgkin disease and lymphomas" has one region with a correlation coefficient with a significance level of 0.001 which contributes to the mentioned amount by $1 \times 3 = 3$.
2. The product of the number of regions with significant correlation coefficients at a significance level of 0.01, with a weighting factor of 2. For the same cause of death, there are 5 regions with correlation coefficients at a significance level of 0.01, i.e. their contribution to the said amount is $2 \times 5 = 10$.
3. The product of the number of regions with significant correlation coefficients at a significance level of 0.05, with a weighting factor of 1. For the same cause of death, there are 44 regions with correlation coefficients at a significance level of 0.05, i.e. their contribution to the said amount is $1 \times 44 = 44$.

The total sum (impact strength) of the three components is $3 + 10 + 44 = 57$, and the power of solar corpuscular radiation impact on the lymphomas' mortality is 57. The corresponding impact strength was calculated for all 92 causes of death in the EUROSTAT shortlist. The new arrangement of the list of causes of death was obtained and ordered in descending order based on the strength of radiation's influence on the causes of death. The limits of radiation impact strength on mortality are between 123 and 0. All causes of death on the EUROSTAT shortlist for which there is sufficient data to calculate a correlation are influenced by solar alpha radiation (this invisible effect is maybe the main cause of death for humanity). Only the shortlist

causes 54 "Influenza (including swine flu)", 79 "Covid-19, virus identified", 80 "Covid-19, virus not identified", and 81 "Covid-19, other" are not affected (impact strength 0). To the extent that the hypothetical mechanism proposed below explaining the observed phenomenon assumes that charged particles of high energy pass through the atmosphere and reach the Earth's surface, the energy required for this was calculated from databases and calculators PSTAR and ASTAR [29,30]. Geomagnetic field data were obtained from the INTERMAGNET site [31].

Results

The described dangerous phenomenon is observed in the form of dependence between the annual average flux of radiation from positively charged particles with high kinetic energy, recorded by satellites in orbit around the Earth, and the annual mortality rate in the statistics of several countries from all continents in the Northern Hemisphere. The countries in whose mortality statistics the phenomenon is observed are located in a zone parallel to the equator with approximate boundaries along the parallels of 30° and 60° north latitudes. It is observed in the annual mortality statistics of small countries. It is not noticeable in the statistics of large countries in the same zone. It can be inferred that the impact on the Earth's surface is short-lived and over a limited area the size of a small country, but is masked in large country statistics because it does not affect the entire area of the large country at the same time. This conclusion is confirmed for the USA, for which there is data on mortality in individual states [16]. For particle energies of the order of 3.8 – 21.3 MeV, the year-averaged fluxes of protons and alpha particles are highly correlated, i.e. the studied phenomenon of lethality is noticeable in both the mean proton flux and the mean alpha particle flux data. In the examples below an averaged stream of high-energy alpha particles is included as the incident radiation. The figures below are arranged in descending order of the impact strength of radiation on the causes of death in the EUROSTAT shortlist. First on the list (not presented here) are diseases of the circulatory system and some malignant neoplasms.

EUROSTAT shortlist number 28 „Hodgkin disease and lymphomas“ mortality rate is the cause of death significantly affected by solar corpuscular radiation, 7th in the arranged EUROSTAT shortlist. The question of the mechanism of the radiation's impact on the lymphatic system of the human body remains without a concrete answer, although it is clear that the ionization caused by high-energy alpha particles entering the body leads to irreparable damage to many systems of the body. Figure 1 shows the distribution for 2012 of the „Hodgkin disease and lymphomas“ mortality rates, EUROSTAT shortlist number 28, for Europe and the Mediterranean (black isolines). Red isolines show the distribution of the statistically significant correlation coefficient between solar alpha particle fluxes and the mortality rate for „Hodgkin disease and lymphomas“. A pronounced effect – a statistically significant coincidence between areas with increased annual "Hodgkin disease and lymphomas" mortality rate and its correlation

with annual alpha radiation flux is observed in Western Turkiye, Northwest Italy, North Spain, West France, and Ireland. Figure 2 and all graphs below show the time dependence in the interval 2011 – 2019 of two numerical sequences:

- Of the recorded annual fluxes of alpha particles from satellites of the GOES series – 13, 14, and 15, and,
- Of some examples of EUROSTAT shortlist annual mortality rates for some of the NUTS-2 regions of the European Union.

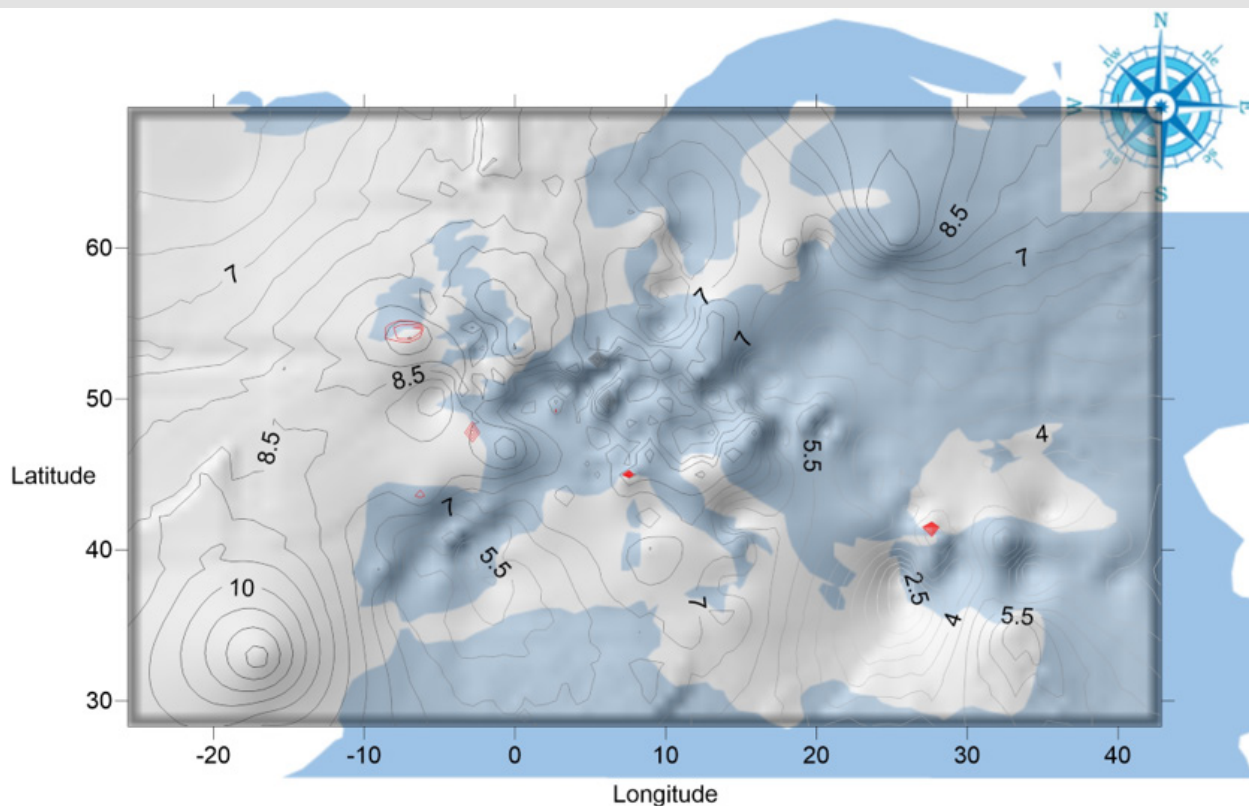


Figure 1: Europe and the Mediterranean, the EUROSTAT shortlist number 28 „Hodgkin disease and lymphomas “mortality rate for 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval 2011 – 2019. Impact index 57, 7th in the ranking of the strength of the influence of radiation on the causes of death in the EUROSTAT shortlist.

Figure 2 shows an example of correlated changes in alpha radiation flux with the “Hodgkin disease and lymphomas” mortality rate for EUROSTAT NUTS-2 region Tekirdağ, Edirne, Kırklareli, Turkiye. EUROSTAT shortlist number 30 „Leukaemia “mortality rate is the next cause of death affected by solar corpuscular radiation, 25th in the arranged EUROSTAT shortlist. The mountain countries Switzerland, Tunisia, Central Italy, France, Eastern Spain, Southern Britain, South-

ern Sweden, and Lithuania are mainly affected, (Figures 3 & 4). EUROSTAT shortlist number 29 „Other malignant neoplasm of lymphoid, hematopoietic and related tissue “mortality rate is the next cause of death affected by solar corpuscular radiation, 50th in the arranged EUROSTAT shortlist. Central Italy and Central Germany are mainly affected (Figure 5).

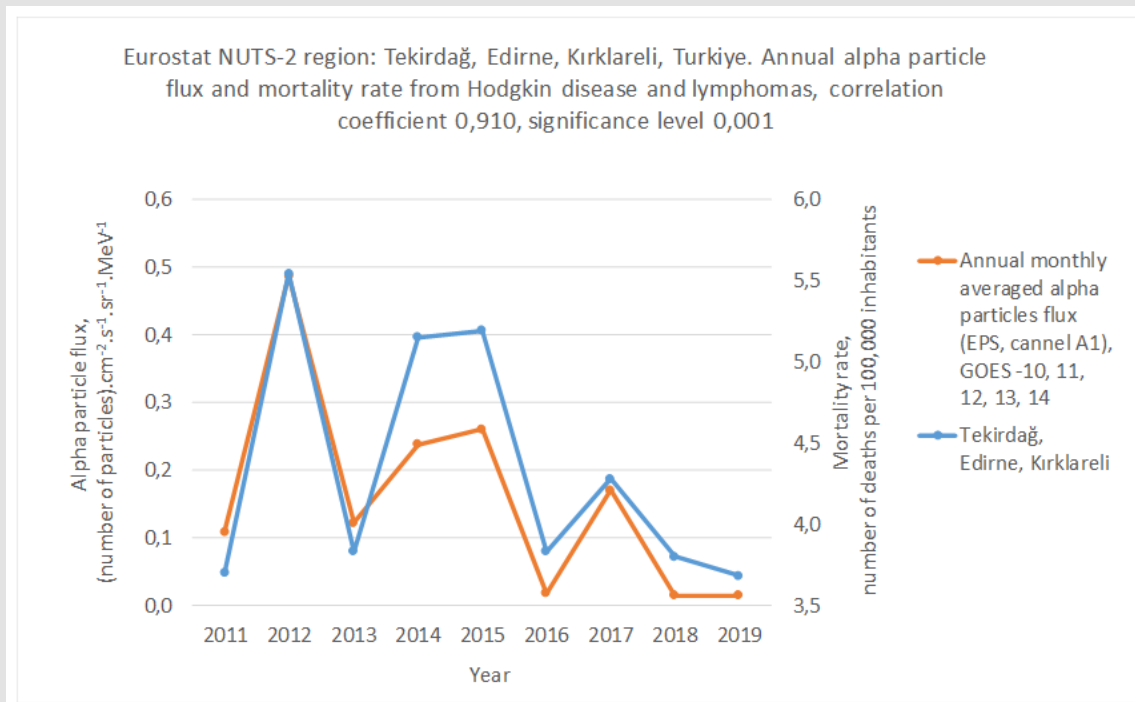


Figure 2: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the Eurostat shortlist number 28 „Hodgkin disease and lymphomas“ mortality rate for the EUROSTAT NUTS-2 region Tekirdağ, Edirne, Kırklareli, Türkiye, indicates the presence of a causal relationship between the two phenomena.

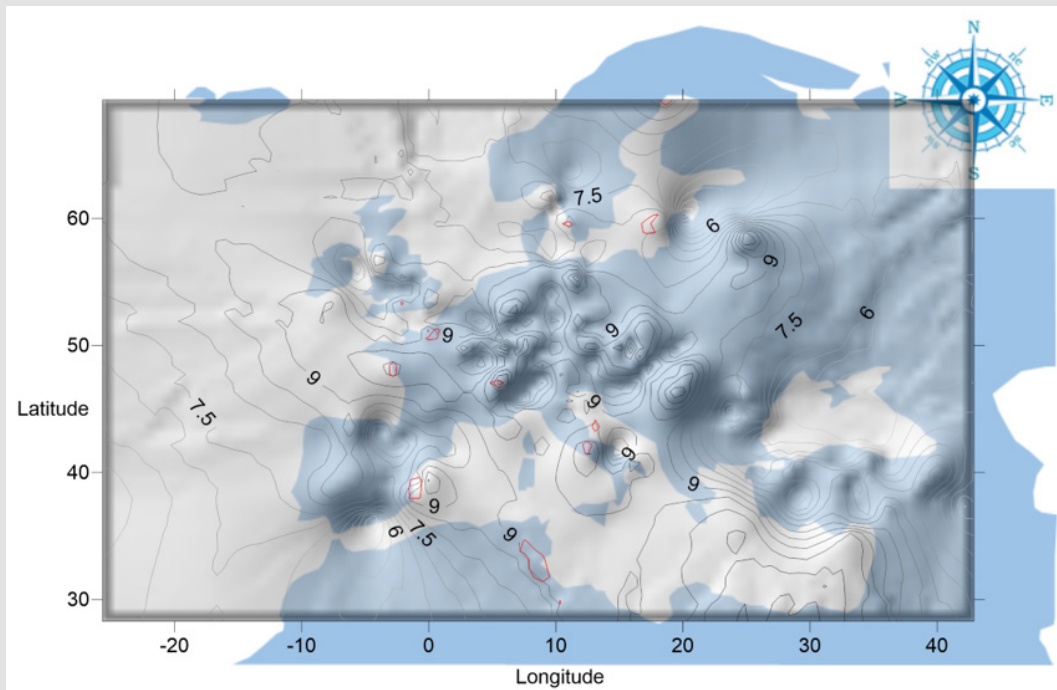


Figure 3: Europe and the Mediterranean, the EUROSTAT shortlist number 30 „Leukaemia“ mortality rate for 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval 2011 – 2019. Impact index 42, 25th in the ranking of the strength of the influence of radiation on the causes of death in the EUROSTAT shortlist.

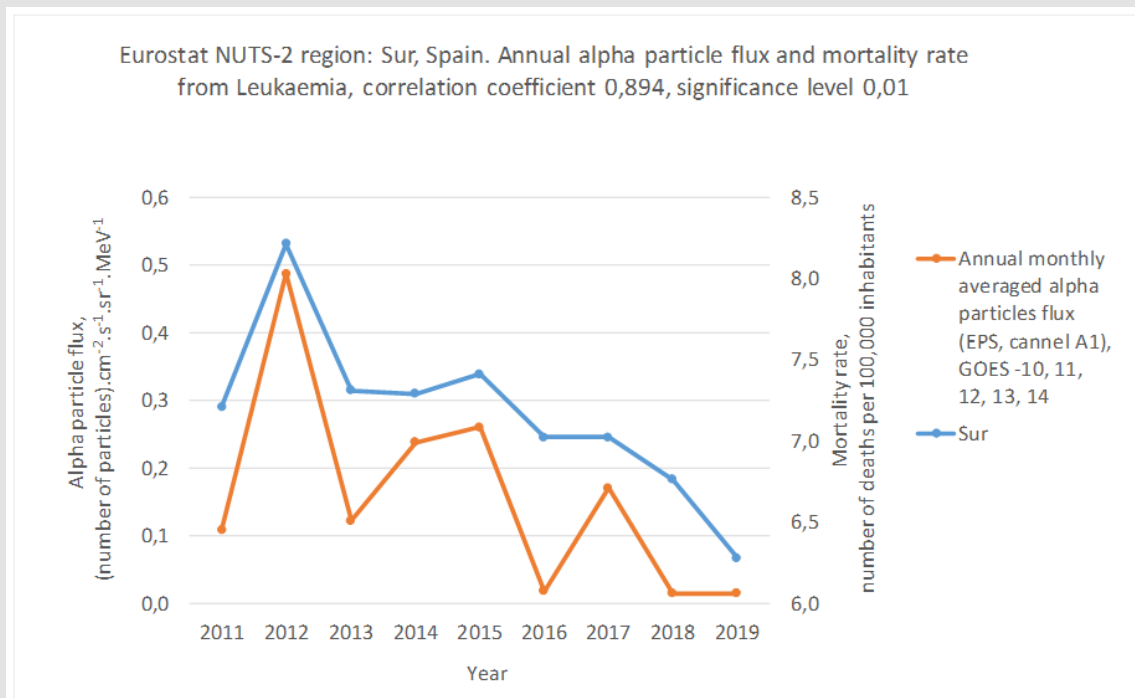


Figure 4: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the EUROSTAT shortlist number 30 „Leukaemia “mortality rate for the EUROSTAT NUTS-2 region Sur, Spain, indicates the presence of a causal relationship between the two phenomena.

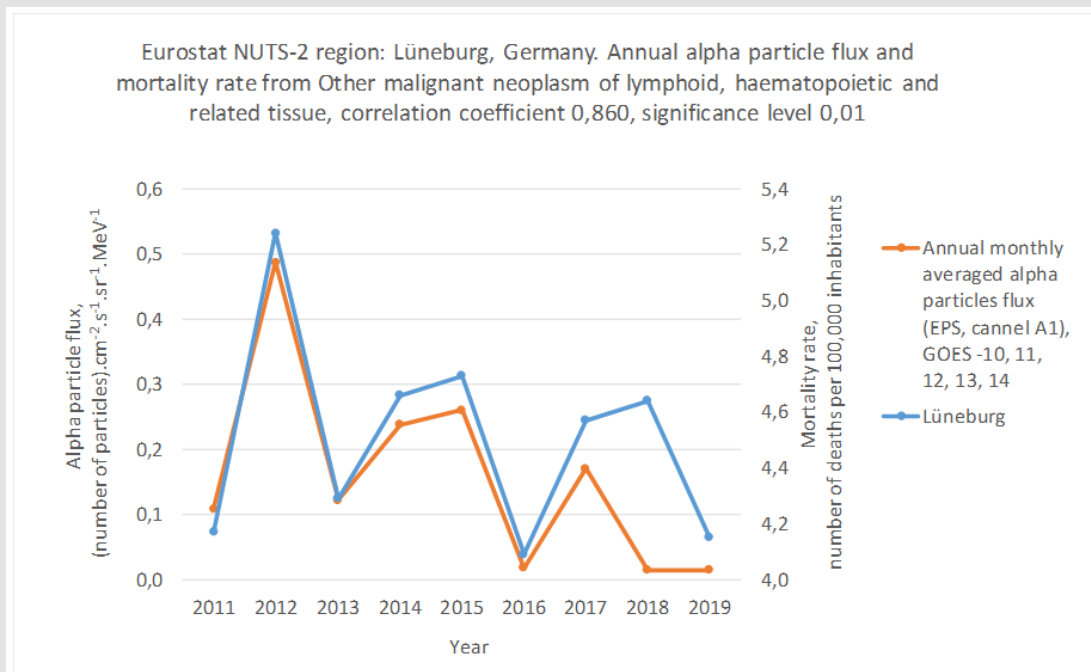


Figure 5: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the EUROSTAT shortlist number 29 „Other malignant neoplasm of lymphoid, hematopoietic and related tissue “mortality rate for the EUROSTAT NUTS-2 region Lüneburg, Germany, indicates the presence of a causal relationship between the two phenomena.

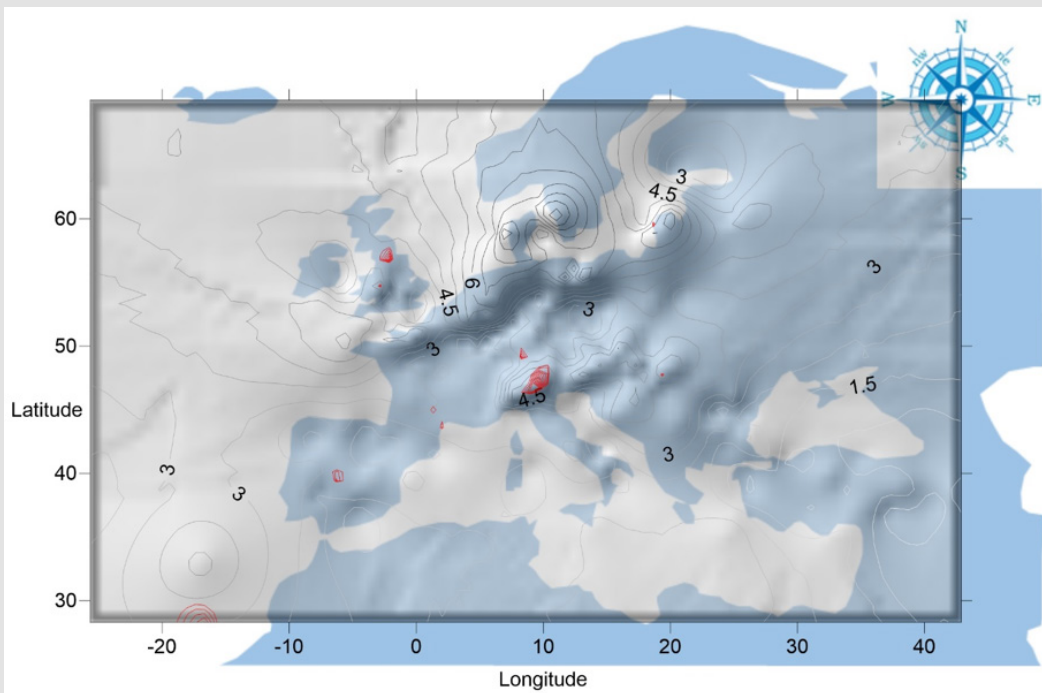


Figure 6: Europe and the Mediterranean, the EUROSTAT shortlist cause of death 18 „Malignant melanoma of skin “mortality rate for 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval 2011 – 2019. Impact index 45, 18th in the ranking of the influence of radiation on the causes of death in the EUROSTAT shortlist.

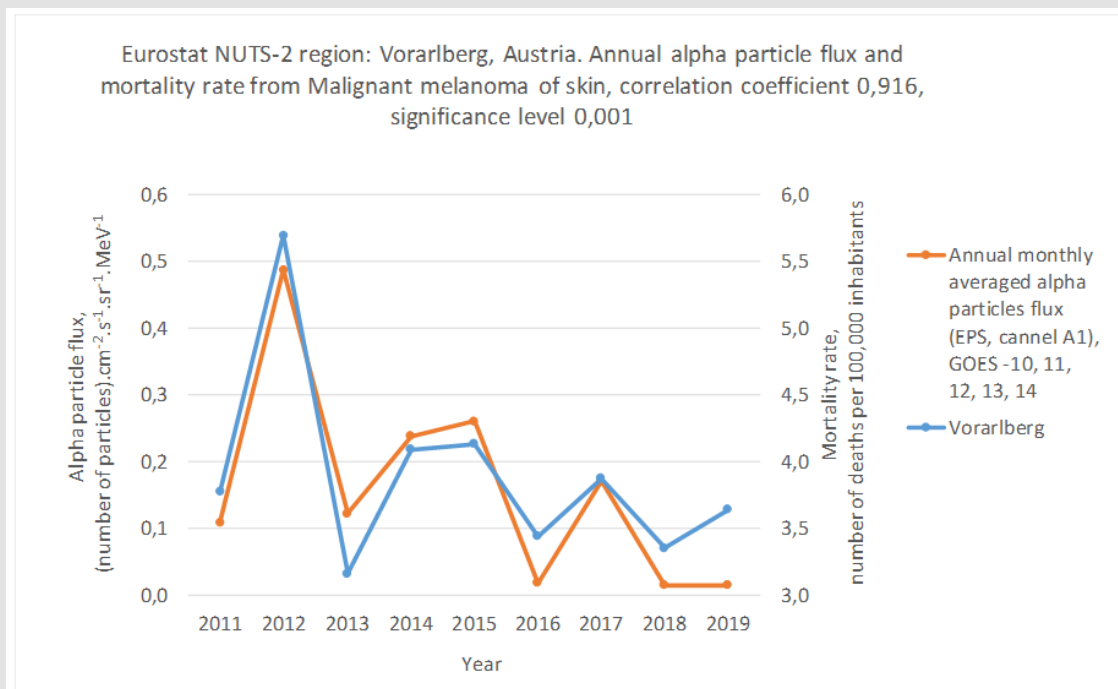


Figure 7: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the “Malignant melanoma of skin” mortality rate for the EUROSTAT NUTS-2 region VORARLBERG, AUSTRIA, indicates the presence of a causal relationship between the two phenomena. A further calculation showed that the alpha radiation-dependent mortality from malignant melanoma of skin for the studied interval for the region reached 50% in 2012 compared to the total mortality from this cause.

The examined examples unequivocally show the presence of a causal relationship between malignant diseases of the lymphatic system and solar fluxes of high-energy alpha particles reaching the Earth's orbit and recorded by Earth-orbiting satellites. As mentioned above, the same type of causation is observed for another type of disease, melanoma. An example of the relationship between melanoma mortality in Europe and the Mediterranean and fluxes of high kinetic energy solar alpha radiation recorded around the Earth by satellites is shown in (Figures 6 & 7). Figure 6 shows that the most affected are the Alpine region, but also Central Spain, South France, Great Britain, Lithuania, and Romania. The examples above show which is the mysterious common risk factor between malignant lymphatic diseases and melanoma - with a high probability this is solar alpha radiation with high kinetic energy.

Discussion

The given examples convincingly prove an observable fact – the existence of an influence of positive solar corpuscular radiation on many causes of death. The problem of the mechanism of the described influence remains unclear. A hypothesized mechanism of this influence is outlined below, answering many of the questions that arise.

1. An observed phenomenon – the mortality rate from many diseases in the statistics of many European countries located mainly in the 30°N – 60°N band, is strongly correlated with fluxes of positively charged particles with energy of the order of 4 – 21 MeV, recorded by the GOES series satellites in Earth orbit.
2. The recorded alpha particle flows are mostly pulses with a duration from minutes to a few days.
3. Proposed hypothesis – positively charged particles with high energy penetrate through the Earth's atmosphere to the Earth's surface and damage human health, causing death. Unlike the geomagnetic field, which does not ionize matter, positively charged particles with high energy ionize both the air through which they pass, reaching the Earth's surface, and the living matter in which they fall, causing damage that adversely affects the vital activity of the organism.
4. As the average altitude of the affected countries increases, the particle flux-correlated mortality shows an increasing trend [10,16]. It is probably due to the more intense radiation flux penetrating the thinner atmosphere over the mountainous region of Earth's surface – an argument favoring the hypothesis.
5. The source of the flows of positively charged particles is the Sun – mortality increases with observable processes on the Sun – from Solar Mass Ejections directed to Earth (a phenomenon on the solar surface that could be observed with other astronomical means) [10,16]. The Alpha Magnetic Spectrometer (AMS-02) on the International Space Station measures cosmic rays, excluding those of solar origin (when shielded from the Sun by the station's solar panels). In particular, it measures the flow of ^3He and ^4He (alpha particles) in cosmic rays. The measurements show [32] increasing annual flux of alpha particles in cosmic rays for the interval of years from 2011 to 2017 (last available data), while the flux of GOES registered (solar?) alpha particles for the same interval of years is decreasing (graphs from Figure 2 and the next). Indirect evidence for the Sun as a source of high-energy alpha particles is that this assumption convincingly explains the downstream processes that ultimately lead to death.
6. Positively charged solar particles capable of penetrating through the Earth's atmosphere to the Earth's surface are high-energy alpha particles. Calculators PSTAR [29] and ASTAR [30] calculate the penetration parameters of protons, respectively alpha particles in different substances, in particular in air. Calculations with data for a homogeneous atmosphere – an atmospheric model with constant density, temperature, and pressure decreasing with height [10] show that only particles whose energy is above 2.4 GeV for protons and over 6.2 GeV for alpha particles can penetrate the Earth's atmosphere to the surface. There are no registered by GOES satellites protons above 0.7 GeV, but there are registered alpha particles with energy above 3.4 GeV, hypothetically also those with energy above 6.2 GeV [10,16,18], i.e. the particles that penetrate to the Earth's surface are probably high-energy alpha particles. Only registered by the satellites flows of alpha particles with a magnitude of at least (hundreds of particles). $\text{cm}^{-2} \cdot \text{s}^{-1} \cdot \text{sr}^{-1} \cdot \text{MeV}^{-1}$ is correlated with the mortality of the Earth's surface.
7. It is assumed that the alpha particles registered by the satellites were emitted simultaneously with the hypothetical fast alpha particles in a common explosive process (flares?) on the solar surface. It can be calculated that particles with an energy of 7 GeV need 8.87 min to reach the Earth's surface from the Sun's surface, and registered by satellites particles with energies of 5-10 MeV travel about 2 hours. The registered alpha particles do not have enough energy to penetrate the atmosphere, unlike the hypothetical fast alpha particles that reach the surface of the Earth in minutes from the center of the solar disk. However, the registered alpha particles are an indicator that two hours earlier there was an irradiation of the Earth's surface with fast (unregistered) alpha particles.
8. Although alpha particle streams irradiate the entire illuminated part of the atmosphere, penetration of fast alpha particles to the surface occurs only in a limited area of the surface (death spot), for which two conditions favoring penetration are combined:

- The Sun is culminating for the center of the death spot. During the year, the apparent position of the Sun relative to the point of observation shifts, so that the maximum angle of elevation of the Sun's disk above the horizon (solar culmination) changes depending on the date. The latitude and longitude of a point on the Earth's surface where the solar disk is at its culmination at that moment of registration of the incoming alpha particle flow – the point of registration, can be determined from the date (latitude), and the time (hours and minutes) of registration (longitude). The center of the dead spot can be calculated – it is approximately 30° east of the registration point [16]. The Earth's angular velocity is 15° per hour.
- For the center of the death spot, a coincidence is in effect – the direction of the geomagnetic vector coincides with the direction of the alpha particle intrusion – in such a case the alpha particle movement is not affected by the deflecting magnetic force. Such a coincidence occurs twice a year for latitudes in the band from 28°N to 48°N [10]. For latitudes outside this band, such a coincidence is impossible, the geomagnetic pole deflects the fast alpha particles and they do not reach the Earth's surface, or their flux on the surface decreases fast with their moving away from the band.

The moment of occurrence of a stream of fast alpha particles cannot be predicted, but the dates of increased risk for a given point on the Earth's surface between 30°N – 60°N can be calculated by the latitude of the location [16]. For example, for the EUROSTAT NUTS-2 region of the Vorarlberg, Austria, (Figure 7), with latitude 47°N, the dates with maximum risk are around May 24th and July 20th. On these dates, the inclination (63.6°) of the geomagnetic vector for Vorarlberg is close in magnitude to or coincides with the culmination of the Sun (the Earth's atmosphere is thinnest at the moment of the Sun's culmination, and there is no deflecting magnetic force for alpha particles if they intrude at this time from the Sun). The increased risk of health incidents outdoors around local noon is a further argument for the healthfulness of the indoor midday break ('siesta') practiced in Mediterranean countries. The fluxes of solar alpha radiation become more frequent during the „rise“ phase and the maximum of the 11-year cycle of solar activity, i.e., the impact of alpha radiation on discussed diseases is expected to reach its maximum. The Sun is currently at the maximum of its 25th cycle (the numbering is based on the last 250 years of astronomical observations) and the discussed risk factor is at its maximum.

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