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Mortality from Respiratory Diseases Partly Depends on Solar Alpha Particle Radiation?

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ABSTRACT

A dangerous phenomenon for humanity is described. Through a joint analysis of data from satellites in orbit around the Earth and from the health statistics source EUROSTAT, it became clear that, by some mechanism, the influx of positively charged particles with high energy, as registered by satellites in the Earth's orbit, increases mortality on the planet's surface. The increase in mortality is in a band of maximum risk in the Northern Hemisphere, parallel to the equator and bounded by the parallels of 30° and 50° north latitude. Examples of mortality in the European Union due to respiratory diseases are provided, confirming the phenomenon described. A hypothetical mechanism based on observational evidence has been proposed, according to which this dangerous phenomenon is caused by solar alpha particles with high energy, sufficient to overcome the atmosphere's resistance and reach the Earth's surface in a limited area, resulting in maximum death impact.

Keywords: Respiratory Diseases; Mortality; Solar Alpha Radiation; Satellites; Eurostat

Introduction

Some studies have sought to link exposure to sunlight with certain diseases. The Sun's simultaneous negative and positive effects on health have long been known. Numerous studies have proven the connection between the aforementioned health effects and solar UV radiation, which, like visible light, is a component of solar electromagnetic radiation. Solar UV radiation is composed of short wavelengths, so it does not penetrate deeply into the body. Instead, it is absorbed in the skin layer. This article examines the possibility of a direct effect on the body, both on the skin layer and the internal organs, of solar radiation that penetrates deeply through the atmosphere and the body, and is different from that of solar electromagnetic radiation. These are streams of corpuscular radiation – positively charged particles with high energy. In a series of publications (Takuchev, et al. [1,2]), a potentially hazardous phenomenon of cosmic origin affecting humanity was described – the existence of a high correlation between the flows of positively charged particles with high kinetic energy recorded by satellites in Earth's orbit and mortality on the Earth's surface from various diseases. The main focus of the mentioned publications was on the effect of solar alpha radiation on mortality from diseases, specifically those of the circulatory system, the leading cause of death in humanity.

The harmful effects of solar alpha radiation are also observed in many other organs and systems of the human organism, rendering this invisible effect one of humanity's leading causes of death. The mentioned dangerous phenomenon of cosmic origin is unevenly spread on the planet's surface. This phenomenon is also observable in several countries from the Northern Hemisphere, including Asia, America, and even Africa [Takuchev, et al. [1,2]]. Europe and the Mediterranean are among the most affected. The European Union has a tradition of maintaining reliable mortality statistics, in which the discussed multifaceted influence of solar alpha radiation on mortality stands out clearly. Below, based on mortality statistics from the European Union, the unexpected association between solar alpha radiation and mortality from respiratory system diseases (ICD-10 codes J00-J99) is illustrated. High-energy alpha radiation can ionize the atoms in living organisms, significantly impairing normal cellular metabolism. This type of radiation may also be the leading external cause of respiratory system diseases.

Materials and Methods

Mortality Data

The analysis below is based on an authoritative source of health data (EUROSTAT [3]). The parameter annual mortality rate – number

of deaths per 100,000 inhabitants – was used as a mortality characteristic in the study. Eurostat offers free access to data on mortality rates from specific causes in the countries of the European Union, the European Economic Area, and the candidate countries for EU membership. Geographically, these countries are situated in Europe and the Mediterranean region. 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 were used. In the EUROSTAT shortlist, mortality rates are grouped by causes of death into 92 groups, primarily diseases. The groups are related to the International Statistical Classification of Diseases and Related Health Problems (ICD-10, 2010) classes. The shortlist includes mortality data for EU countries (NUTS-1) and EU regions (NUTS-2, which are smaller areas within the larger NUTS-1 countries). Currently (2023), the shortlist includes mortality rate data for the period 2011–2020. Annual mortality rate data were extracted for 353 European regions (NUTS-2) separately for each shortlist group from 2011 to 2019 (the last pre-pandemic year).

Satellite Data

Satellite data on corpuscular radiation – protons and alpha particles recorded by the satellites of the series GOES (Geostationary Operational Environmental Satellites) were obtained from a NOAA site: Data from GOES satellites [4]. 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, making one lap in 24 hours. They "hang" over a specific point on the Earth's surface and are not shaded 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 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 (Lakin [5]) between the annual averaged alpha radiation flux and the annual mortality rate were calculated. Maps were created showing the distribution of the annual mortality for 353 NUTS-2 European regions from the EUROSTAT shortlist death causes: "Diseases of the respiratory system (J00-J99)" (EUROSTAT mortality shortlist number 53), "Other diseases of the respiratory system (remainder of J00-J99)" (EUROSTAT mortality shortlist number 59), "Chronic lower respiratory diseases" (EUROSTAT mortality shortlist number 56), "Malignant neoplasm of lip, oral cavity, pharynx" (EUROSTAT mortality shortlist number 10), "Malignant neoplasm of larynx" (EUROSTAT mortality shortlist number 16), "Malignant neoplasm of trachea, bronchus and lung" (EUROSTAT mortality shortlist number 17), "Pneumonia" (EUROSTAT mortality shortlist number 55), and "Asthma and status asthmaticus" (EUROSTAT mortality shortlist number 57). With black isolines in the maps, the mortality rate for the year 2012, with the highest solar activity (and mortality), is shown in the studied time interval 2011 – 2019. With red isolines, the maps display the distribution across Europe and the Mediterranean of the correlation coefficient between the annual mortality rates of the diseases and the annually averaged alpha particle flux for the period 2011–2019. Data on the coordinates – latitude and longitude (using Google Earth) - of the centroids of the NUTS-2 regions included in the study were used to create the maps.

Mapping was performed with Golden Software Surfer 10. The kriging interpolation procedure was selected. In mathematical statistics, the level of statistical significance (Lakin [5]) 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 from causes of neoplasms. 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 (Lakin [5]). In scientific studies, a level of statistical significance of 0.05 or less is typically accepted as a criterion for the reliability of the correlation coefficient. Correlation coefficients with a significance level above 0.05 are considered to have high reliability (the higher the number, the lower the significance level). I.e., a causal relationship between cosmic alpha radiation and mortality from neoplasms can be considered reliably established in the areas enclosed by red isolines of the correlation coefficient above 0.668. If there is a coincidence between some of the maxima for mortality rates and the areas of significant correlation coefficients, then in the region of these maxima, the impact of alpha radiation contributes noticeably to mortality.

To the extent that the hypothetical mechanism proposed below, which explains 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 process was calculated using databases and calculators PSTAR [6] and ASTAR [7]. Geomagnetic field data were obtained from the INTERMAGNET site (Data on the geomagnetic field, [8]).

Results

The described dangerous phenomenon is observed in the form of dependence between the annual average flux of radiation from positively charged particles (protons and alpha 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 band parallel to the equator with approximate boundaries along the parallels of 30° and 50° 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 band. It can be inferred that the impact on the Earth's surface is short-lived and limited to a small area, comparable to 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 simultaneously. This conclusion is confirmed for the USA, for which data on mortality in individual states are available (Takuchev N [9]). The mortality statistics of the European Union are suitable for the study because they are based on statistical regions, which are smaller than a country but still large enough to include a statistically sufficient number of inhabitants. This phenomenon is also expected to influence mortality in countries south of the equator. However, their mortality statistics are scarce, unreliable, or absent, which prevents reliable inferences about the influence in the Southern Hemisphere. For particle energies ranging from 3.8 to 21.3 MeV, the year-averaged fluxes of protons and alpha particles are highly correlated, indicating that the studied phenomenon of lethality is noticeable in both the mean proton flux and the mean alpha particle flux data. For the reason explained below, only the average flux of high-energy alpha particles is included as the incident radiation in the following examples. With black isolines, Figures 1-8 show respectively the distribution of the mortality rate for the EUROSTAT shortlist death causes „Diseases of the respiratory system (J00-J99)", "Other diseases of the respiratory system (remainder of J00-J99)", "Chronic lower respiratory diseases", "Malignant neoplasm of lip, oral cavity, pharynx", "Malignant neoplasm of larynx", "Malignant neoplasm of trachea, bronchus and lung", "Pneumonia", and "Asthma and status asthmaticus" for Europe and the Mediterranean, for 2012 the year of maximum solar activity (and mortality), from the studied interval. The distribution of the statistically significant correlation coefficient between solar alpha particle fluxes and the mortality rate is shown with red isolines in the figures.

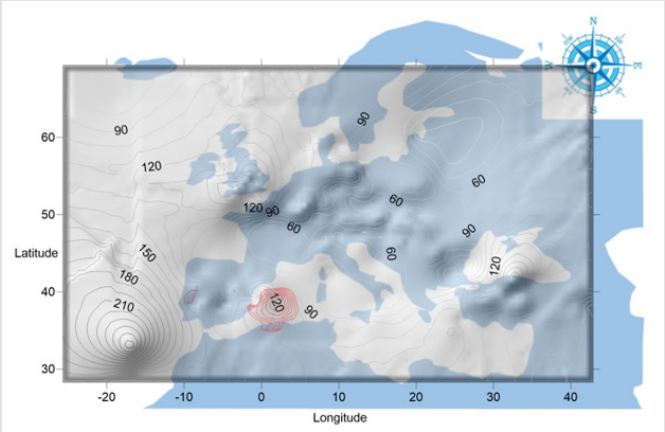

Figure 1: Europe and the Mediterranean, the "Diseases of the respiratory system (J00-J99)" mortality rate for 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval 2011 – 2019.

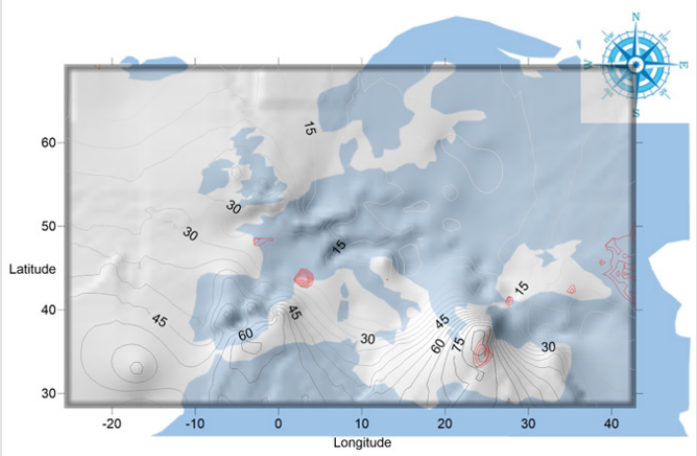

Figure 2: Europe and the Mediterranean, the mortality rate for "Other diseases of the respiratory system (remainder of J00-J99)" in 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval of 2011 – 2019.

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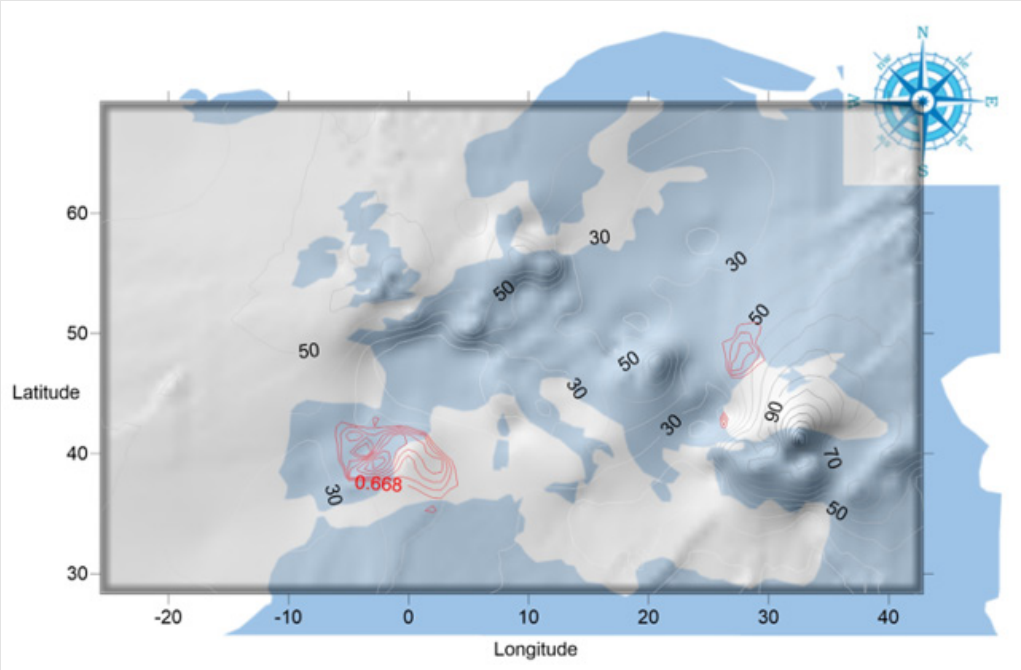

Figure 3: Europe and the Mediterranean, the "Chronic lower respiratory diseases" mortality rate for 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval 2011 – 2019.

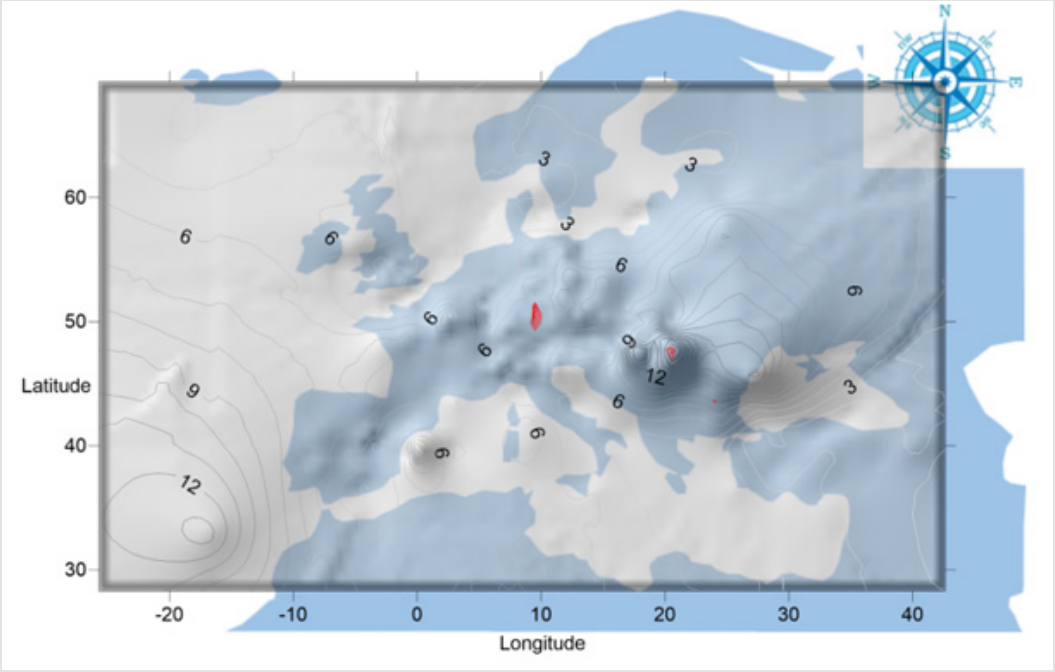

Figure 4: Europe and the Mediterranean, the "Malignant neoplasm of lip, oral cavity, pharynx" mortality rate for 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval 2011 – 2019.

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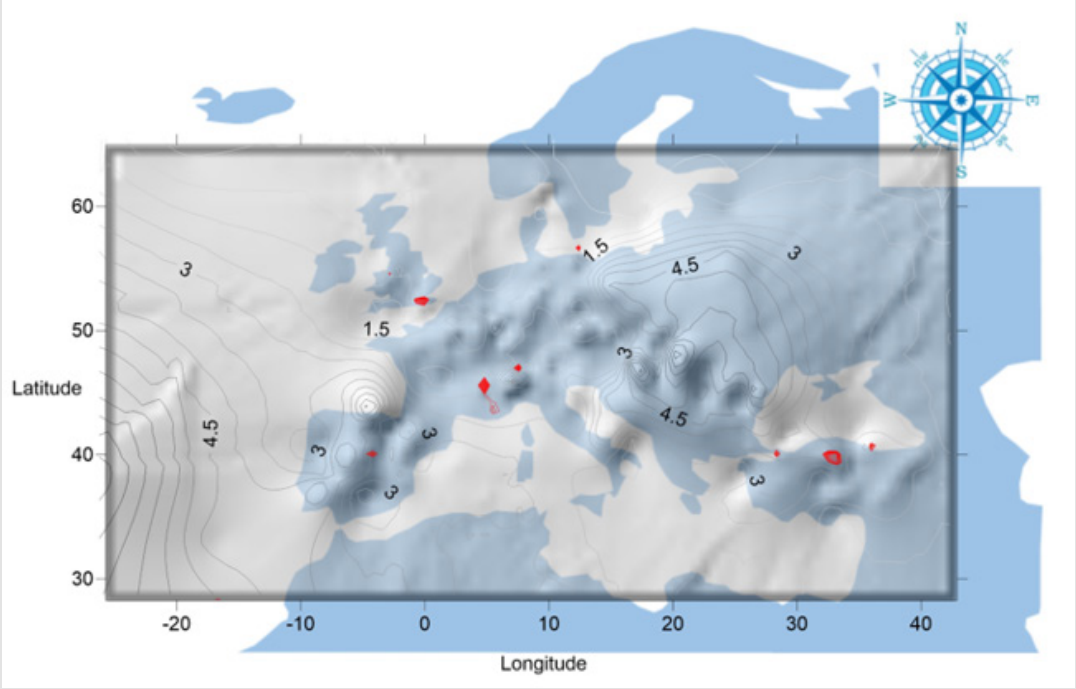

Figure 5: Europe and the Mediterranean, the "Malignant neoplasm of larynx" mortality rate for 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval 2011 – 2019.

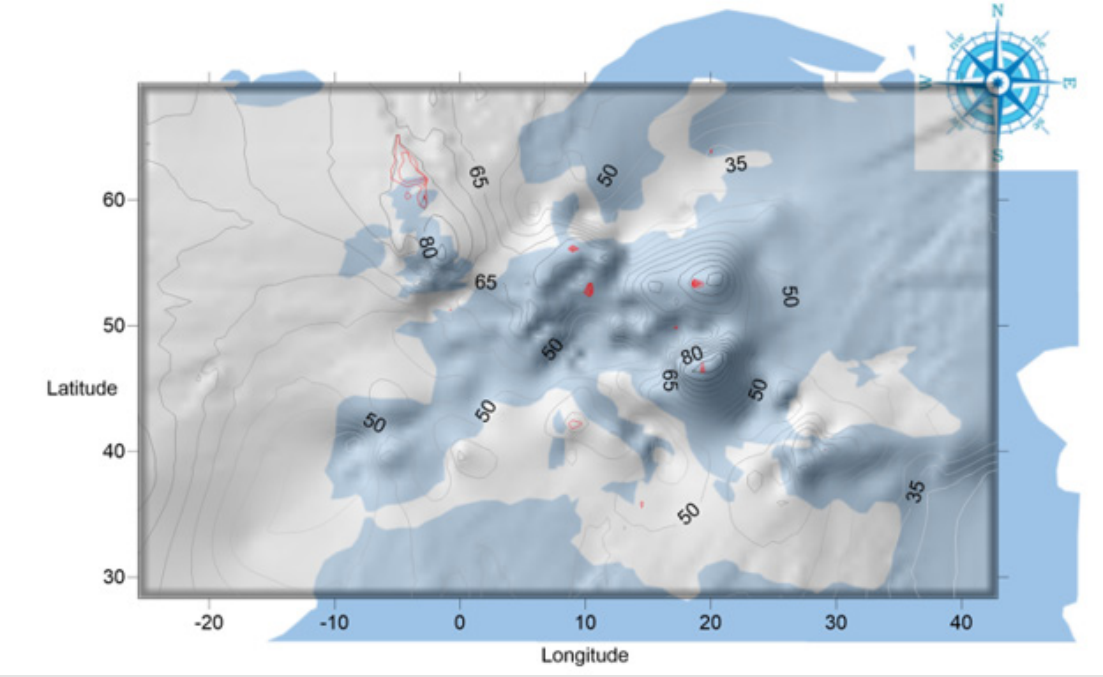

Figure 6: Europe and the Mediterranean, the "Malignant neoplasm of trachea, bronchus and lung" mortality rate for 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval 2011 – 2019.

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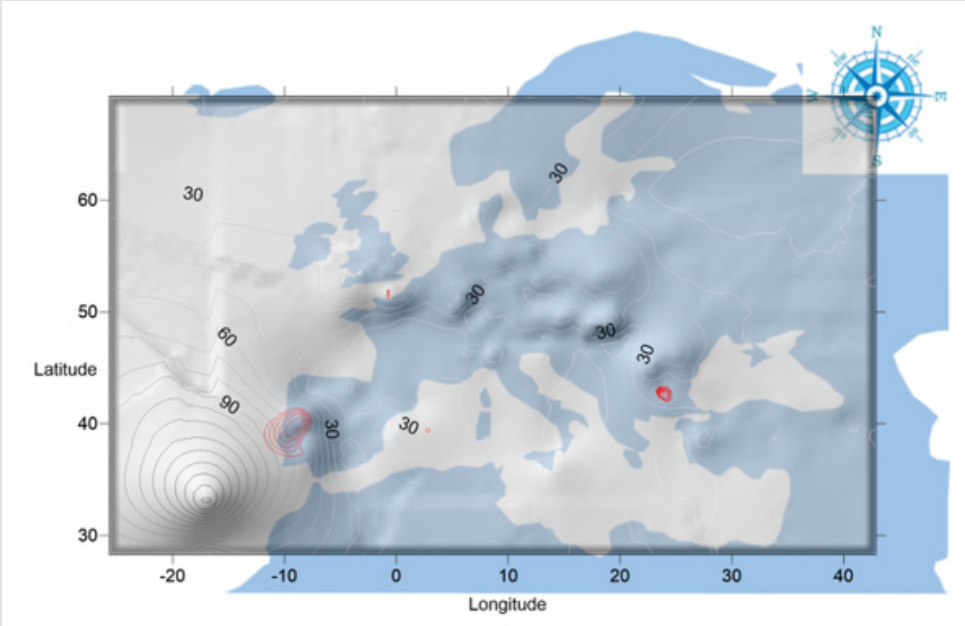

Figure 7: Europe and the Mediterranean, the "Pneumonia" mortality rate for 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval 2011 – 2019.

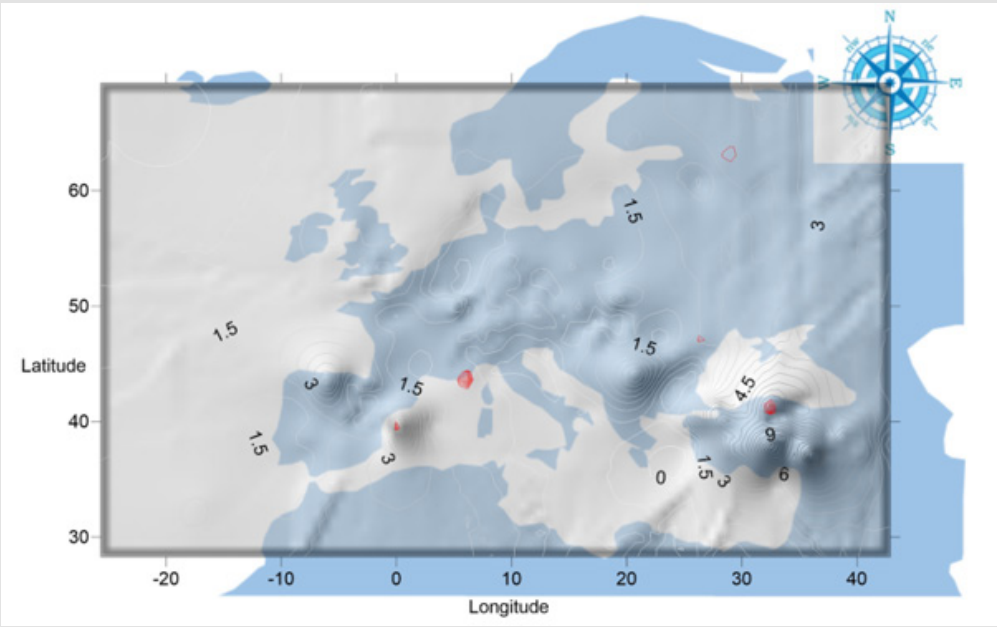

Figure 8: Europe and the Mediterranean, the "Asthma and status asthmaticus" mortality rate for 2012 (black isolines), and its statistically significant correlation with annual alpha particle flux (red isolines) for the studied interval of 2011 –2019.

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The statistically significant influence of alpha radiation on mortality from "Diseases of the respiratory system (J00-J99)" is limited in Figure 1 mainly to a circular area with a radius of 2°, covering the Western Mediterranean with approximate coordinates of its center, 38° north latitude and 2° east longitude (Balearic Islands, Spain). The impact of alpha radiation covers the mentioned area continuously. Central Spain and Portugal are also affected by radiation.

Figures 9 &10 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 – 10, 11, 12, 13, and 14, and,
- Of the annual mortality rate for some of the NUTS-2 regions of the European Union for "Diseases of the respiratory system (J00-J99).

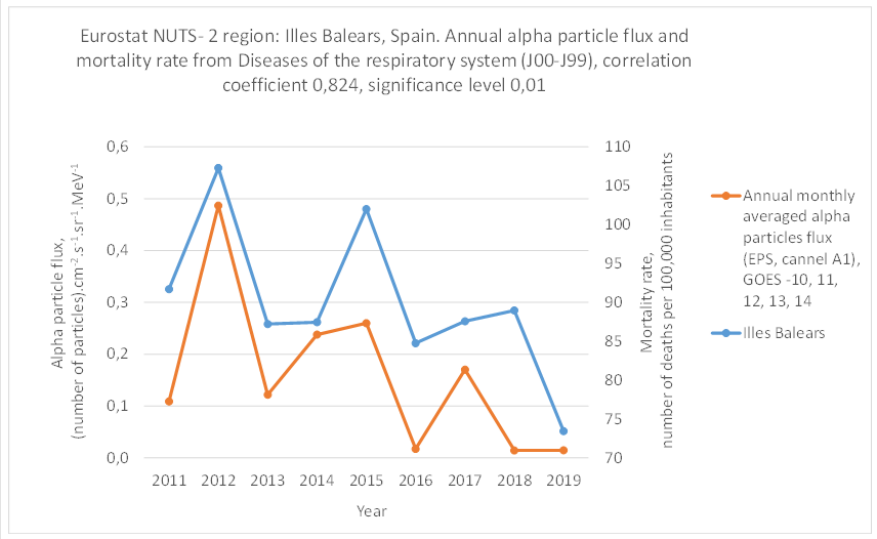

Figure 9: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the "Diseases of the respiratory system (J00-J99)" mortality rate for the EUROSTAT NUTS-2 region Illes Balears, Spain, indicates the presence of a causal relationship between the two phenomena.

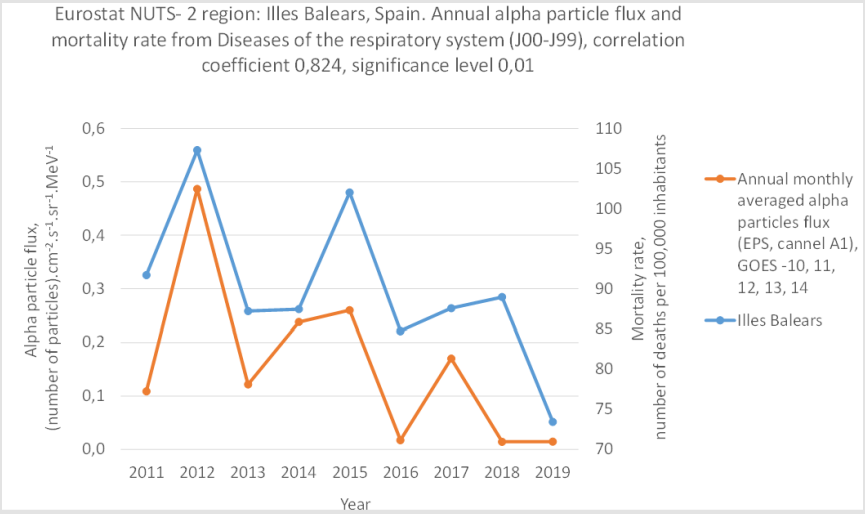

Figure 10: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the "Diseases of the respiratory system (J00-J99)" mortality rate for the EUROSTAT NUTS-2 region Comunidad de Madrid, Spain, indicates the presence of a causal relationship between the two phenomena.

The high correlation between the two numerical sequences is evident, suggesting a causal relationship between them.

Figure 2 shows the distribution of the mortality rate for the EUROSTAT shortlist death cause „Other diseases of the respiratory system (remainder of J00-J99)" for Europe and the Mediterranean for the studied interval. The statistically significant influence of alpha radiation on mortality from "Other diseases of the respiratory system (remainder of J00-J99)" is limited to separate areas covering the coastal areas of France, Turkey, and the islands in the eastern Mediterranean region (Aegean Sea). Examples of a high correlation between solar alpha radiation annual flux and mortality from "Other diseases of the respiratory system (remainder of J00-J99)" are shown in Figures 11 & 12. Figure 3 shows the distribution of the mortality rate for the EUROSTAT shortlist death cause „ Chronic lower respiratory diseases" for Europe and the Mediterranean for the studied interval. The statistically significant influence of alpha radiation on mortality from "Chronic lower respiratory diseases" is limited to specific areas, including Central and Eastern Spain, the Balearic Islands, Southern Ukraine, and Eastern Bulgaria. Large regions of increased mortality in Northern and Eastern Europe and Turkiye are not due to alpha radiation fluxes. Examples of a high correlation between solar alpha radiation annual flux and mortality from "Chronic lower respiratory diseases" are shown in Figures 13 & 14. Figure 4 shows the distribution of the mortality rate for the EUROSTAT shortlist death cause „ Malignant neoplasm of lip, oral cavity, pharynx" for Europe and the Mediterranean for the studied interval.

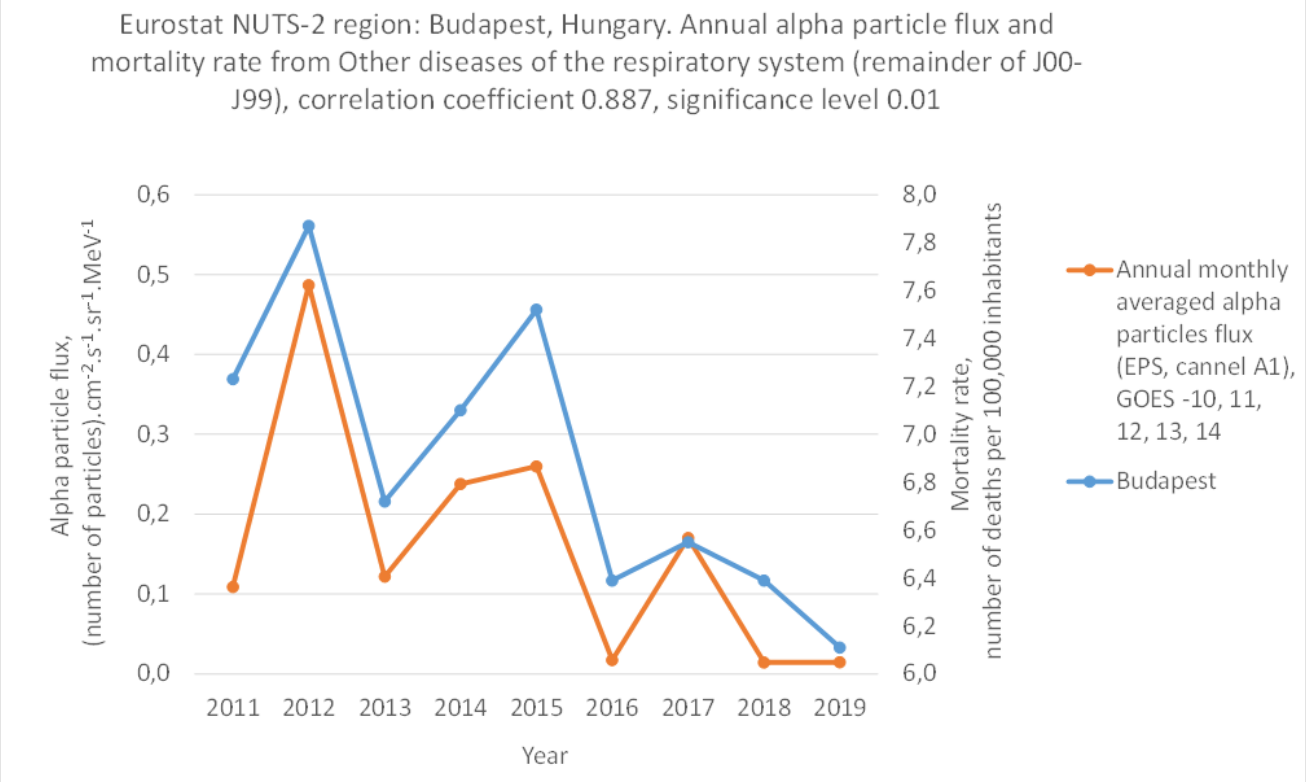

Figure 11: The statistically significant correlation between annual fluxes of cosmic alpha radiation and the mortality rate for "Other diseases of the respiratory system (remainder of J00-J99)" in the EUROSTAT NUTS-2 region, specifically Budapest, Hungary, suggests a causal relationship between the two phenomena.

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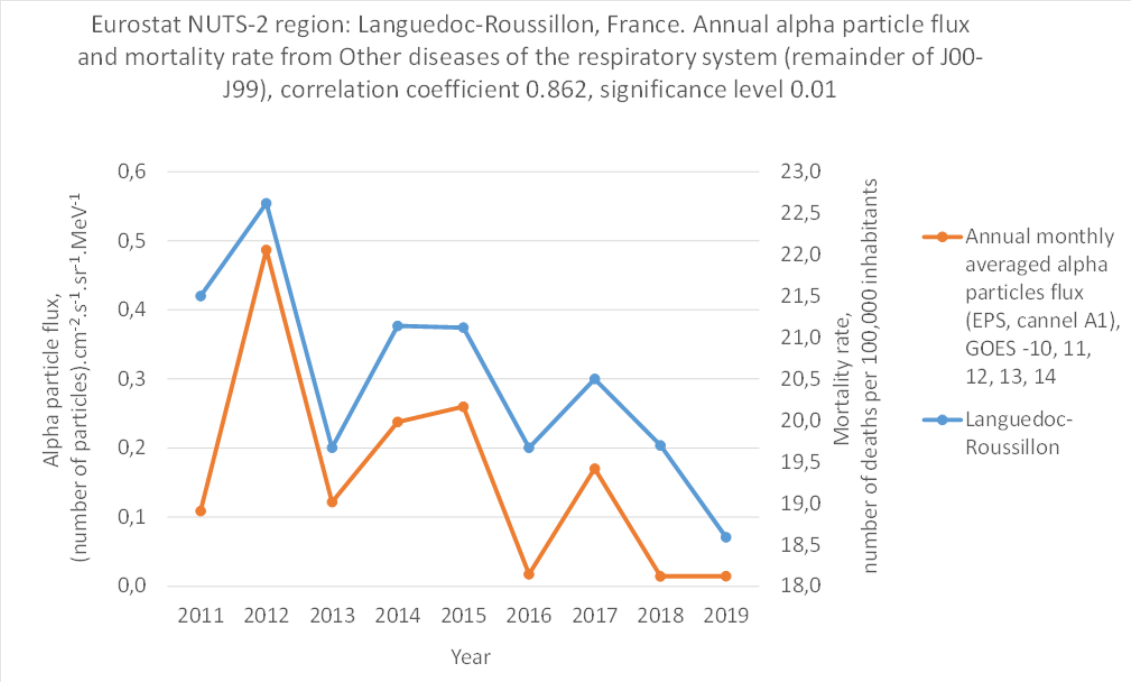

Figure 12: The statistically significant correlation between annual fluxes of cosmic alpha radiation and the mortality rate for "Other diseases of the respiratory system (remainder of J00-J99)" in the EUROSTAT NUTS-2 region of Languedoc-Roussillon, France, indicates the presence of a causal relationship between the two phenomena.

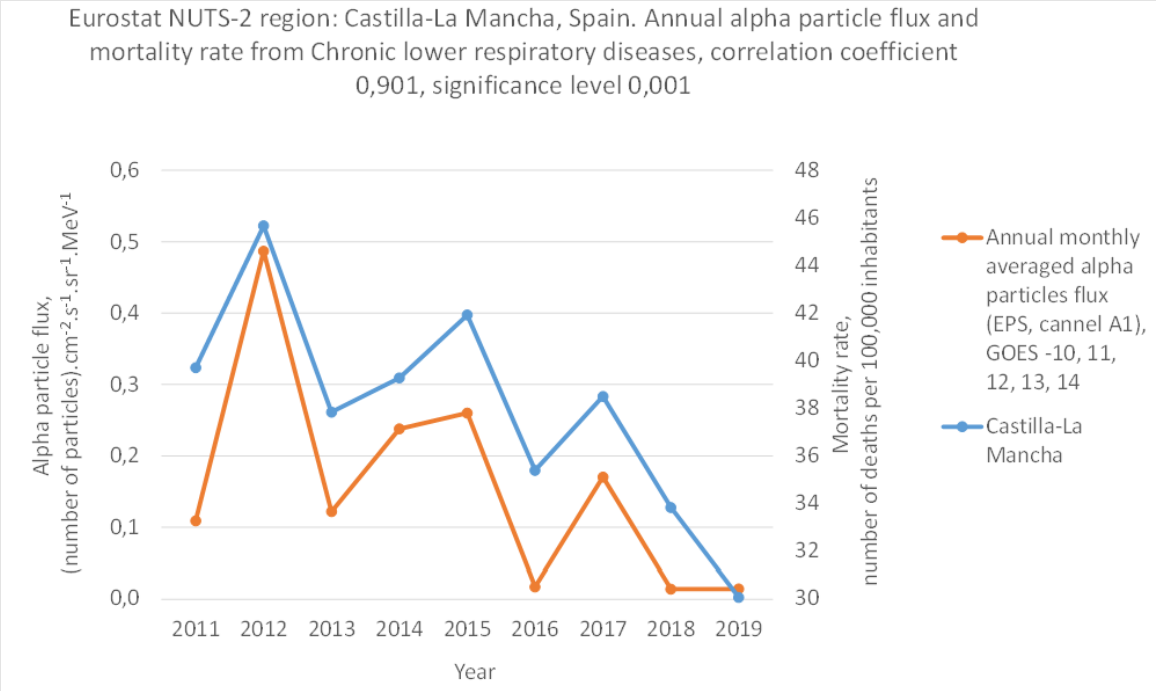

Figure 13: The statistically significant correlation between annual fluxes of cosmic alpha radiation and the mortality rate of "Chronic lower respiratory diseases" for the EUROSTAT NUTS-2 region, Castilla-La Mancha, Spain, suggests a causal relationship between the two phenomena.

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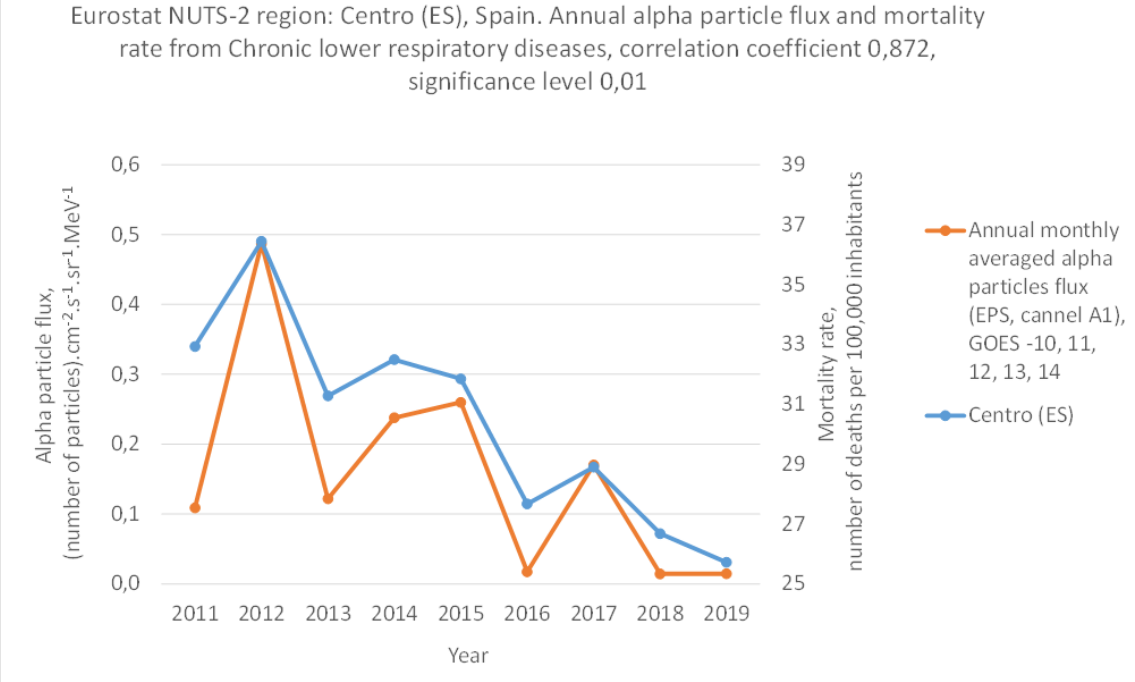

Figure 14: The statistically significant correlation between annual fluxes of cosmic alpha radiation and the mortality rate of "Chronic lower respiratory diseases" in the EUROSTAT NUTS-2 region Centro (ES), Spain, indicates the presence of a causal relationship between the two phenomena.

The statistically significant influence of alpha radiation on mortality from "Malignant neoplasm of lip, oral cavity, pharynx" is limited to separate areas covering Central Germany, Romania, and Bulgaria. The 2012 mortality peak and correlation maximum for Romania between annual mortality with annual solar alpha fluxes coincide, indicating that high-energy solar alpha fluxes are causally related to mortality from the mentioned disease in the specified region. Examples of a high correlation between solar alpha radiation annual flux and mortality from "Malignant neoplasm of lip, oral cavity, pharynx", are shown in Figures 15 & 16. Figure 5 shows the distribution of the mortality rate for the EUROSTAT shortlist death cause „ Malignant neoplasm of larynx" for Europe and the Mediterranean for the studied interval. The statistically significant influence of alpha radiation on mortality from "Malignant neoplasm of larynx" is limited to specific areas covering Southern Britain, Northern Poland, Central Spain, Southern France, Switzerland, and Northern Turkey. The 2012 mortality peak and correlation maximum for Switzerland and Turkiye between annual mortality with annual solar alpha fluxes coincide, indicating that high-energy solar alpha fluxes are causally related to mortality from the mentioned disease in the specified region. Examples of a high correlation between solar alpha radiation annual flux and mortality from "Malignant neoplasm of larynx", are shown in Figures 17 & 18. Figure 6 shows the distribution of the mortality rate for the EUROSTAT shortlist death cause „ Malignant neoplasm of trachea, bronchus and lung" for Europe and the Mediterranean for the studied interval. The statistically significant influence of alpha radiation on mortality from "Malignant neoplasm of trachea, bronchus and lung" is limited to separate areas covering Northern Britain, Central and Northern Germany, Central Poland, and the Northern Balkans. The 2012 mortality peak and correlation maximum for Central Poland and Northern Balkans between annual mortality with annual solar alpha fluxes coincide, indicating that high-energy solar alpha fluxes are causally related to mortality from the mentioned disease in the specified regions. Examples of a high correlation between solar alpha radiation annual flux and mortality from "Malignant neoplasm of trachea, bronchus and lung" are shown in Figures 19 & 20. Figure 7 shows the distribution of the mortality rate for the EUROSTAT shortlist death cause „Pneumonia" for Europe and the Mediterranean for the studied interval. The statistically significant influence of alpha radiation on mortality from "Pneumonia" is limited to separate areas covering Bulgaria, Portugal, Northern France, and the Balearic Islands. Examples of a high correlation between solar alpha radiation annual flux and mortality from "Pneumonia" are shown in Figures 21 & 22.

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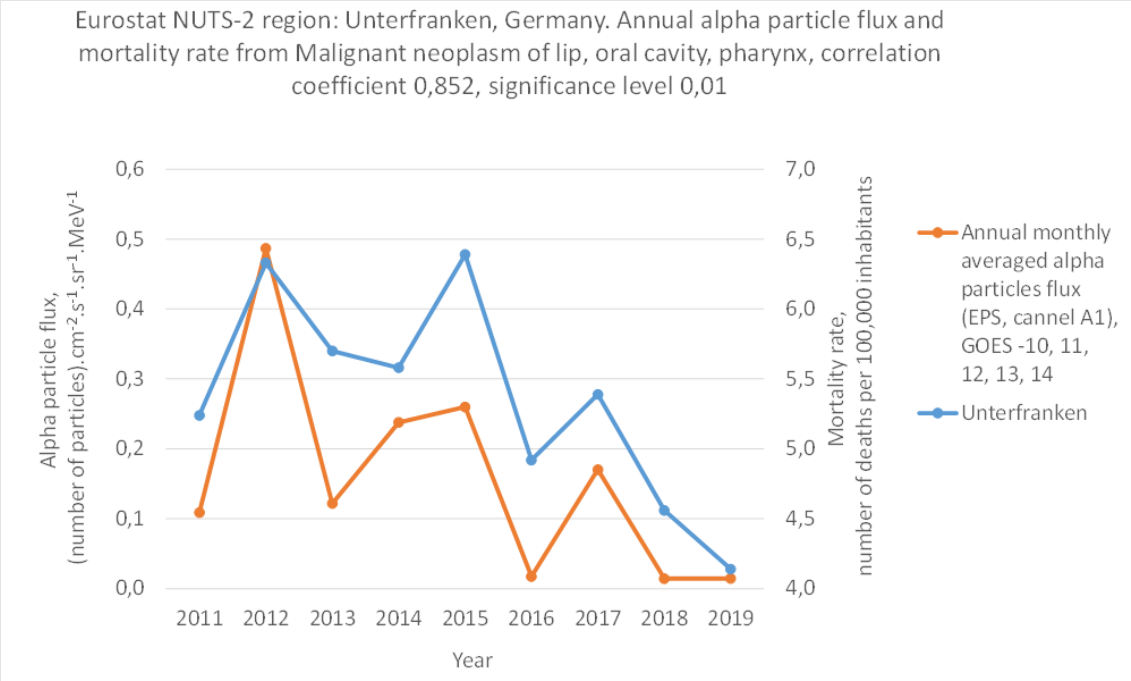

Figure 15: The statistically significant correlation between annual fluxes of cosmic alpha radiation and the mortality rate for "Malignant neoplasm of lip, oral cavity, pharynx" in the EUROSTAT NUTS-2 region of Unterfranken, Germany, indicates the presence of a causal relationship between the two phenomena.

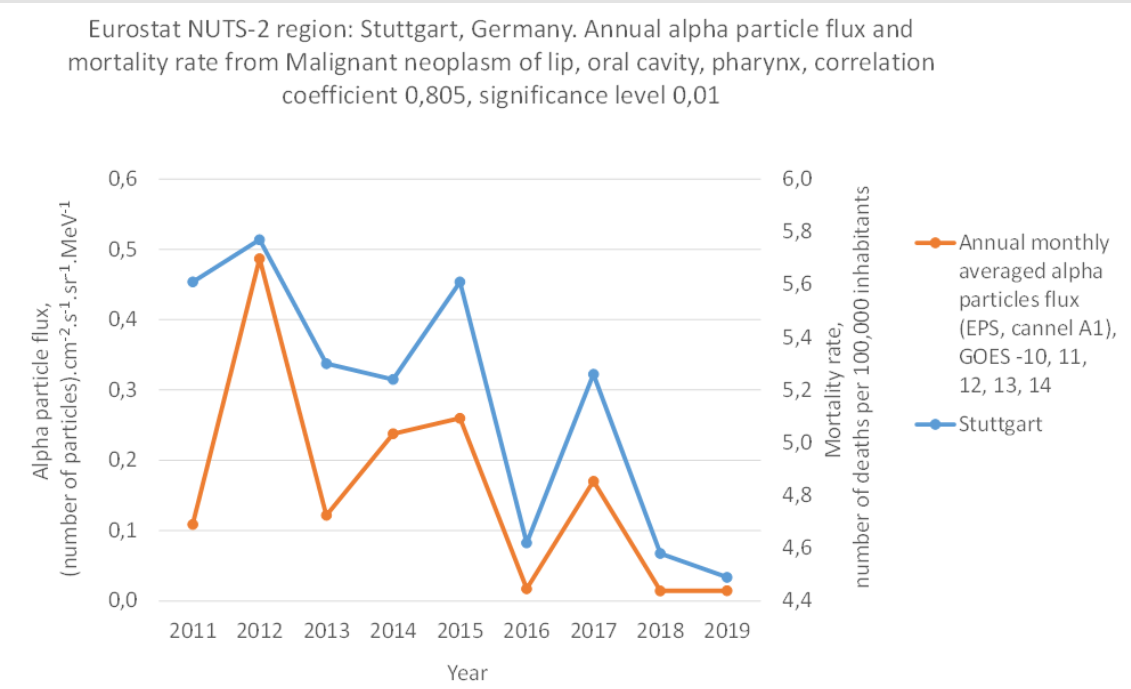

Figure 16: The statistically significant correlation between annual fluxes of cosmic alpha radiation and the mortality rate for "Malignant neoplasm of lip, oral cavity, pharynx" in the EUROSTAT NUTS-2 region of Stuttgart, Germany, indicates the presence of a causal relationship between the two phenomena.

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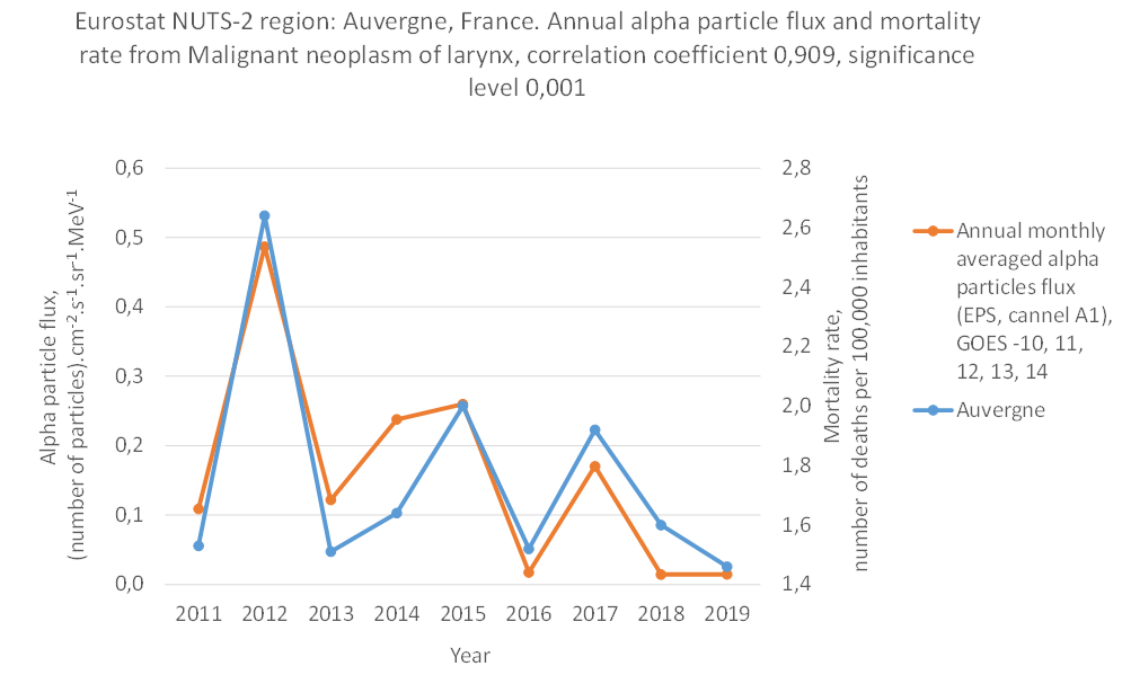

Figure 17: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the "Malignant neoplasm of larynx" mortality rate for the EUROSTAT NUTS-2 region Auvergne, France, indicates the presence of a causal relationship between the two phenomena.

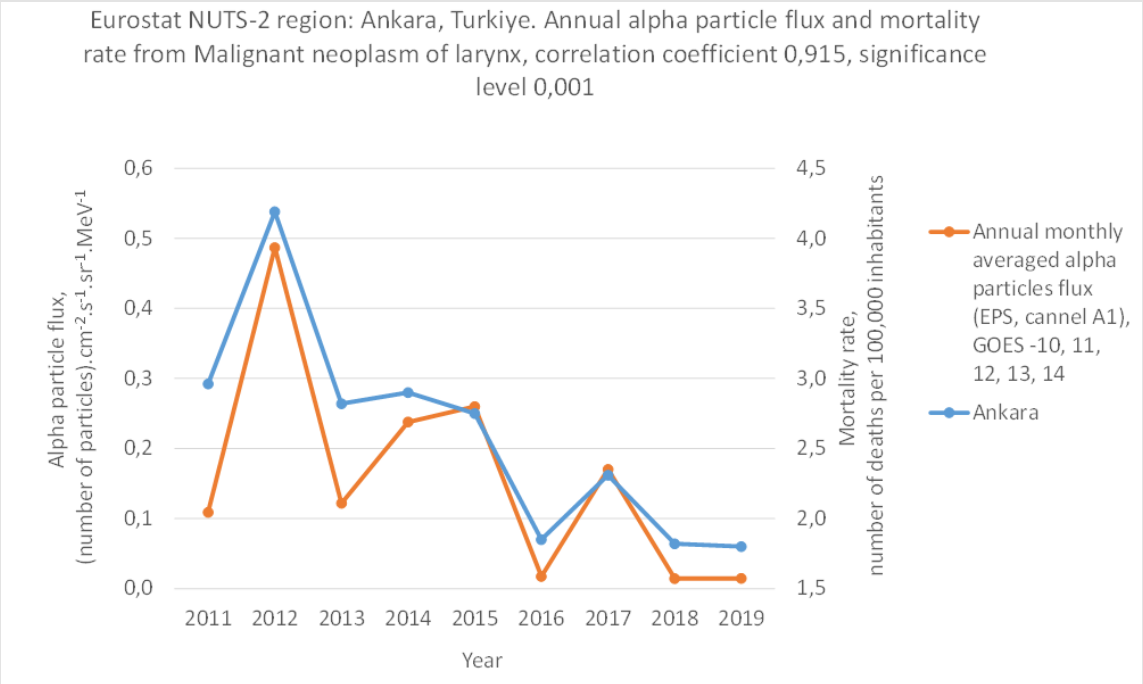

Figure 18: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the "Malignant neoplasm of larynx" mortality rate for the EUROSTAT NUTS-2 region Ankara, Turkiye, indicates the presence of a causal relationship between the two phenomena.

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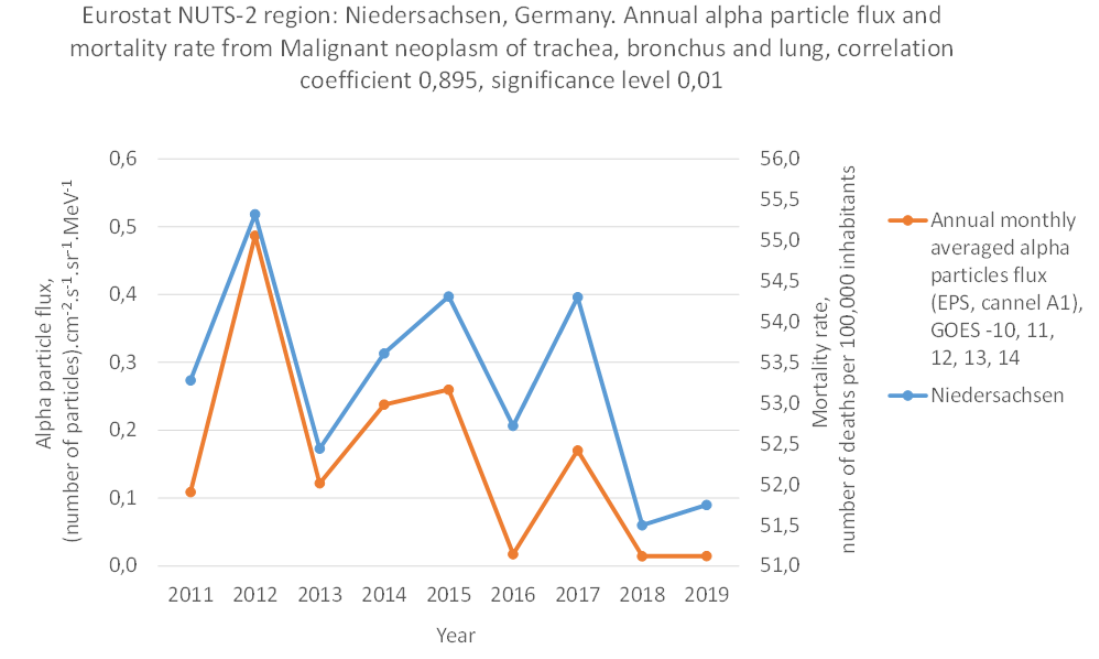

Figure 19: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the "Malignant neoplasm of trachea, bronchus and lung" mortality rate for the EUROSTAT NUTS-2 region Niedersachsen, Germany, indicates the presence of a causal relationship between the two phenomena.

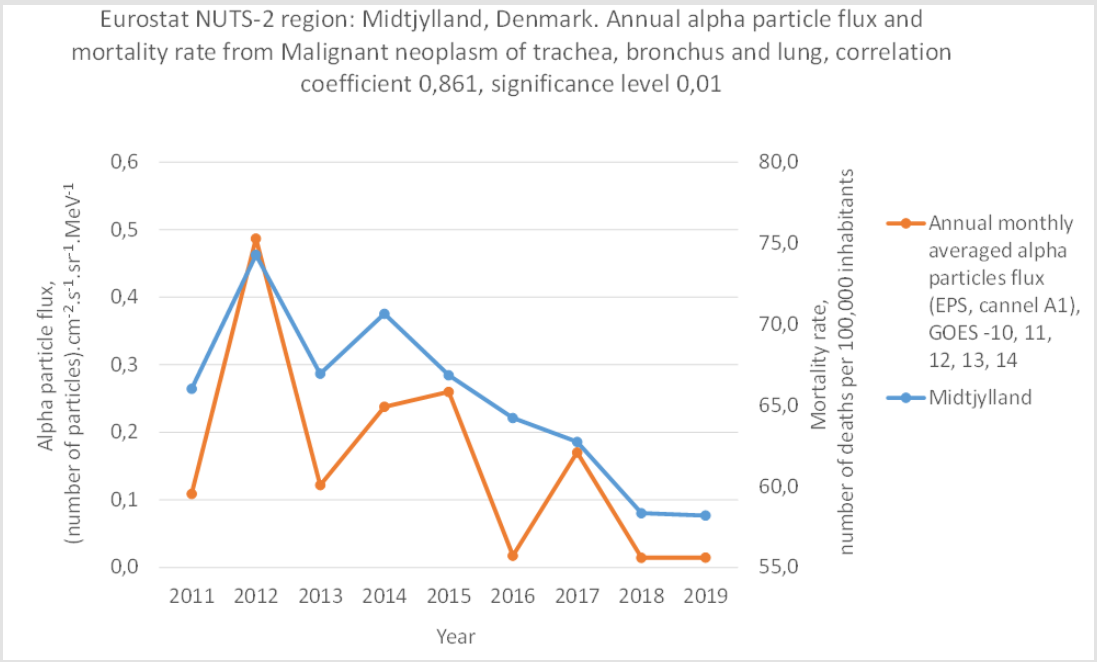

Figure 20: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the "Malignant neoplasm of trachea, bronchus and lung" mortality rate for the EUROSTAT NUTS-2 region Midtjylland, Denmark, indicates the presence of a causal relationship between the two phenomena.

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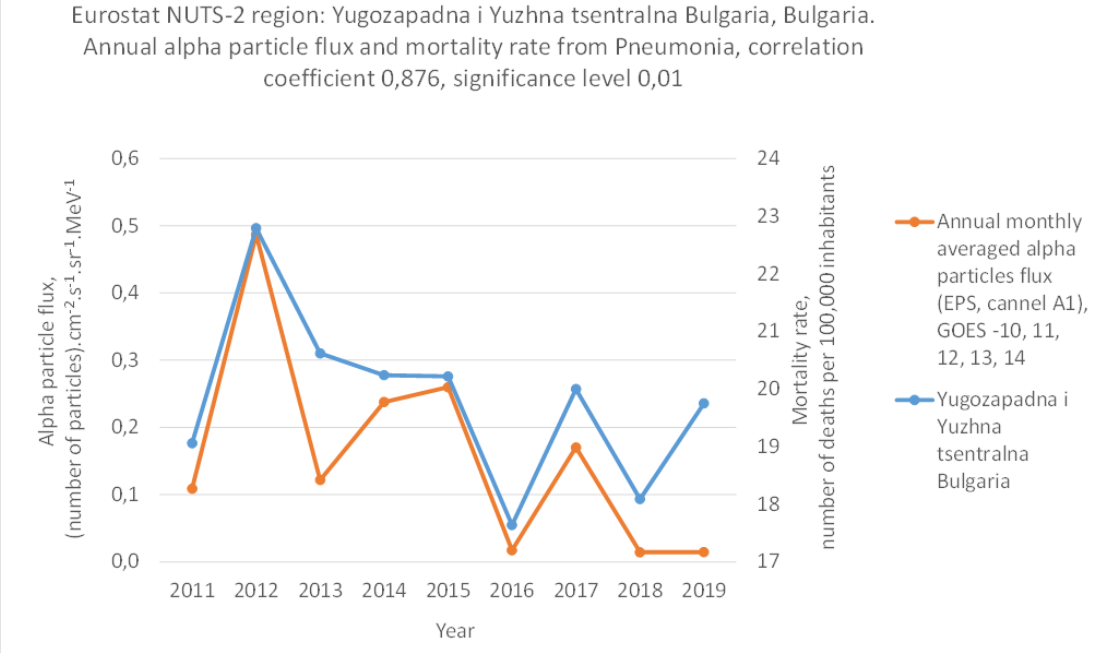

Figure 21: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the "Pneumonia" mortality rate for the EUROSTAT NUTS-2 region Yugozapadna i Yuzhna tsentralna Bulgaria, Bulgaria, indicates the presence of a causal relationship between the two phenomena.

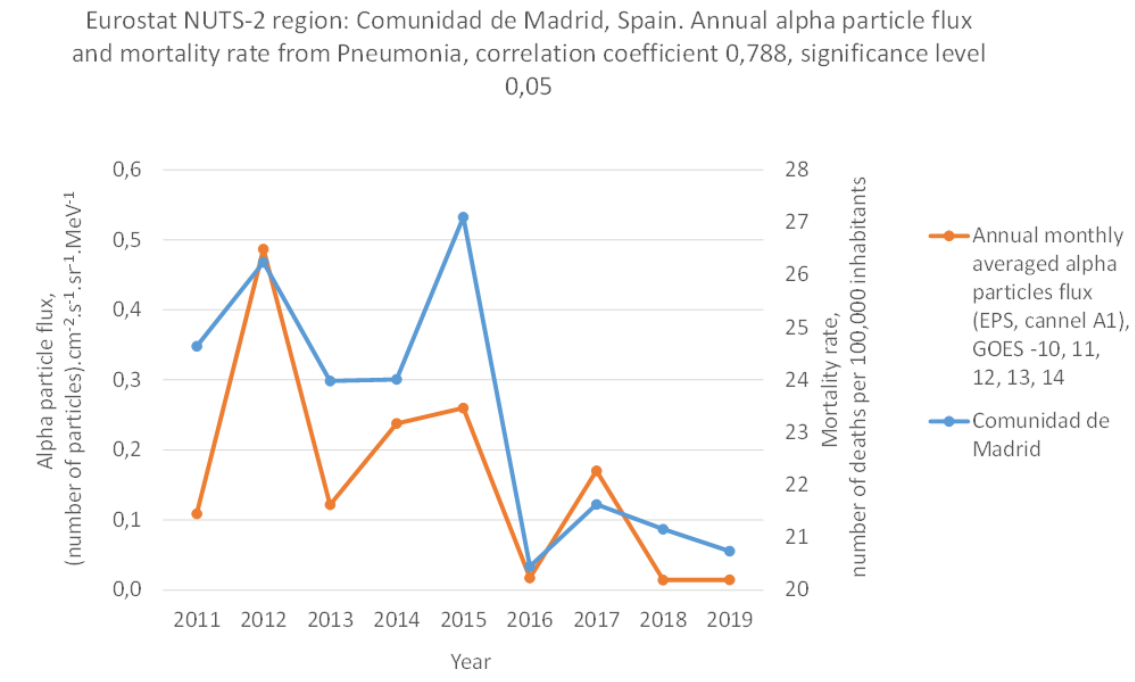

Figure 22: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the "Pneumonia" mortality rate for the EUROSTAT NUTS-2 region, Comunidad de Madrid, Spain, indicates the presence of a causal relationship between the two phenomena.

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Figure 8 shows the distribution of the mortality rate for the EUROSTAT shortlist death cause „Asthma and status asthmaticus" for Europe and the Mediterranean for the studied interval. The statistically significant influence of alpha radiation on mortality from "Asthma and status asthmaticus" is limited to separate areas covering Northern Turkiye, Southern France, the Balearic Islands, and Belarus. The 2012 mortality peak and correlation maximum for Northern Turkey and the Balearic Islands, between annual mortality and annual solar alpha fluxes, coincide, indicating that high-energy solar alpha fluxes are causally related to mortality from the mentioned disease in the specified regions. Examples of a high correlation between solar alpha radiation annual flux and mortality from "Asthma and status asthmaticus" are shown in Figures 23 & 24.

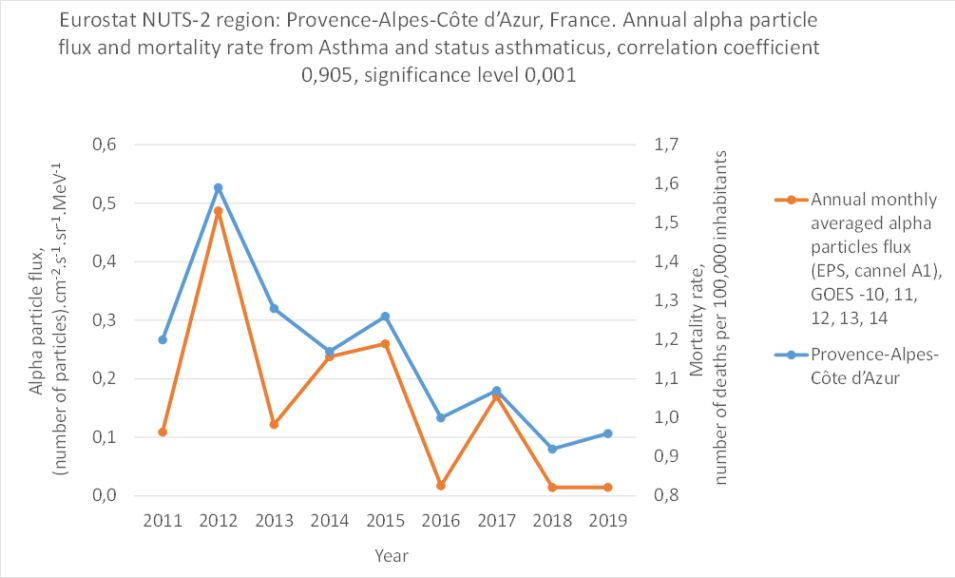

Figure 23: The high statistically significant correlation between annual fluxes of cosmic alpha radiation and the "Asthma and status asthmaticus" mortality rate for the EUROSTAT NUTS-2 region Provence-Alpes-Côte d'Azur, France, indicates the presence of a causal relationship between the two phenomena.

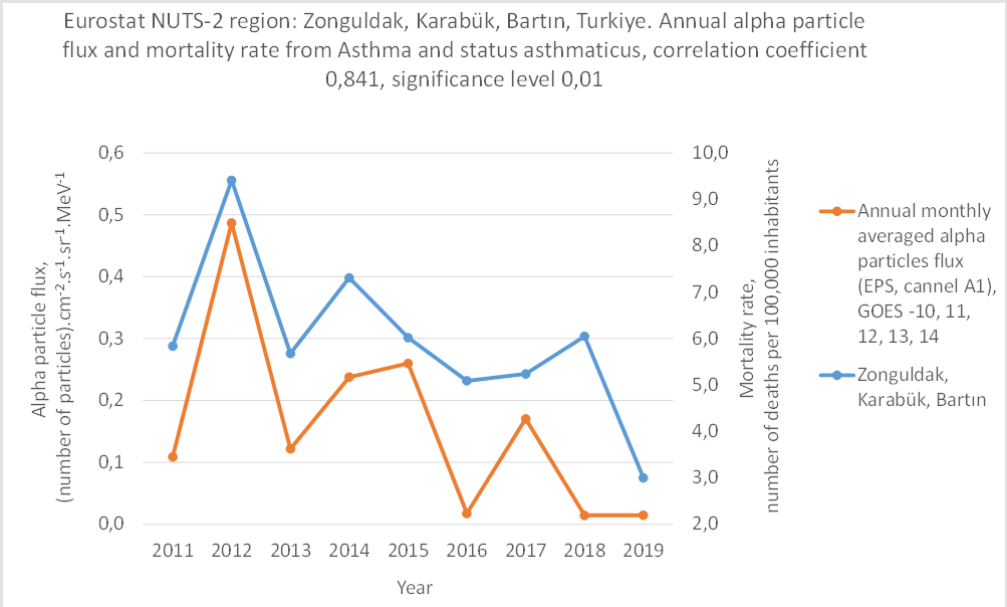

Figure 24: The statistically significant correlation between annual fluxes of cosmic alpha radiation and the "Asthma and status asthmaticus" mortality rate for the EUROSTAT NUTS-2 region of Zonguldak, Karabük, Bartın, Türkiye, indicates the presence of a causal relationship between the two phenomena.

Discussion

The given examples convincingly demonstrate the influence of cosmic radiation on mortality from respiratory system diseases. The mechanism of the described influence remains unclear. A hypothesized mechanism of this influence is outlined below, answering many of the questions that arise.

- An observed phenomenon – mortality from many diseases in the statistics of many countries located mainly in the 30°N – 50°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. The recorded alpha particle flows are mostly pulses with a duration of less than 5 minutes (the averaging interval of the recording device) to a few days.

- 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 mainly in older adults.

- Observed fact: The particle flux-correlated mortality shows an increasing trend with the average altitude of the affected area increasing (Takuchev, et al. [9,10]). 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.

- 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, Takuchev, et al. [9,10]). The Alpha Magnetic Spectrometer (AMS-02) on the International Space Station measures the 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 the galactic cosmic rays. The measurements show (Cosmic Ray Data Base (CRDB), charged cosmic rays, 2020) 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 (See the Figures above). 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 on the surface.

- Positively charged solar particles capable of penetrating the Earth's atmosphere to the Earth's surface are high-energy alpha particles. Calculators (PSTAR [6], ASTAR [7]) calculate the penetration parameters of protons and alpha particles in different substances, particularly in air. Calculations with data for a homogeneous atmosphere – an atmospheric model with constant density, temperature, and pressure decreasing with height (Takuchev, et al. [9,10]) 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 protons above 0.7 GeV by GOES satellites. Still, there are registered alpha particles with energies above 3.4 GeV, hypothetically also those with energies above 6.2 GeV [6, 12, and 14], i.e., the particles that reach the Earth's surface are likely high-energy alpha particles. Only fluxes of alpha particles with a magnitude of at least 1000 particles.$cm^{-2}.s^{-1}.sr^{-1}.MeV^{-1}$ is correlated with the mortality of the Earth's surface.

- It is assumed that the alpha particles recorded by the satellites were emitted simultaneously with the hypothetical fast alpha particles in an explosive process (flares?) on the solar surface. It can be calculated that particles with an energy of 7 GeV need 8.87 minutes to reach the Earth's surface from the Sun's surface, and particles with energies of 5 – 10 MeV registered by satellites 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 Earth's surface in minutes from the center of the solar disk. However, the registered alpha particles indicate that two hours earlier, there was an irradiation of the Earth's surface with fast (unregistered) alpha particles.

- 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:

a. The Sun is culminating at the center of the death spot. During the year, the Sun's apparent position relative to the point of observation shifts so that the maximum angle of elevation of the Sun's disk above the horizon (solar culmination at local noon) 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 hours and minutes of registration (longitude). The center of the dead spot can be calculated – it is approximately 30° east of the registration point (Takuchev [9]). The Earth's angular velocity is 15° per hour.

b. For the center of the death spot, a coincidence is in effect – the direction of the geomagnetic induction vector coincides with the direction of the alpha particle intrusion – 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 (Takuchev [10]). Such a coincidence is impossible for latitudes outside this band, as the fast alpha particles do not reach the Earth's surface, or their flux on the surface decreases rapidly as they move away from the band.

The moment of occurrence of a fast alpha particle stream cannot be predicted, but the dates of increased risk for a given point on the

Earth's surface between 30°N – 50°N can be calculated by the location's latitude (Takuchev [9]). For example, for the EUROSTAT NUTS-2 Zonguldak, Karabük, Bartın, Turkiye (See Figure 24), with a latitude of 41.0°N, the dates with maximum risk are April 6th and September 3rd. On these dates, the inclination (56.7°) of the geomagnetic vector for the Zonguldak, Karabük, Bartın, 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 in favor of the healthfulness of the indoor midday break ('siesta') practiced in Mediterranean countries. The above arguments reveal a new, previously unsuspected cosmic cause of mortality from respiratory system diseases – solar corpuscular alpha radiation. This type of radiation may be the hidden cause of many deadly diseases. The risk is highest for inhabitants in the mountainous regions. During the day, the hours around local noon are the most hazardous for a cosmic impact, potentially leading to subsequent illness. The risk is also increased on certain days of the year (depending on the latitude of the observation point), when the solar culmination coincides with the angle of the geomagnetic vector (inclination).

If a stream of high-energy solar alpha particles were to hit the Earth at this time, there would be no deflecting magnetic force on them, making it easier to reach the Earth's surface. The multifaceted harmful effects of invading alpha particles on the human body can explain the so-called disease clusters, groups of diseases with an unclear relationship between them, which are often diagnosed in some patients. Visca, et al. [11] draw attention to the fact that patients with respiratory diseases often have diabetes mellitus, and the relationship between these diseases is unclear. The relationship between diabetes mellitus and solar alpha particle fluxes is discussed in Takuchev, et al. [2,12]. Carter, et al. [13] found a link between respiratory and cardiovascular diseases, but found that the relationship between them remains unclear (the relationship of cardiovascular diseases to solar alpha particle fluxes is discussed in Takuchev, et al. [1,9,10,14-35].

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