The Root Cause of Cancer

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The primary cause of much of the cancer in the U.S. is due to radiation, specifically nuclear radiation. A secondary cancer cause is damage to the body's immune systems. Not all types of radiation are the same. Some forms of radiation are softer and weaker such as electromagnetic radiation, which exists in the form of radio waves, infrared, visible light, ultraviolet, x-ray, gamma rays. These soft forms are photons [light waves]. Another type of radiation is harder because it has mass. Nuclear radiation is so named because it is composed of the particles (protons, neutrons) that make up the nucleus of the atom.

So where does this nuclear radiation come from? Most of this exposure is from Galactic Cosmic Rays (GCRs). GCRs are high-energy charged particles that originate outside our solar system. Cosmic rays are produced when a star exhausts its nuclear fuel and explodes into a brilliant supernova. These stars are generally new short-lived massive blue stars of the spectral type O (20-100 solar masses) or blue-white stars of spectral type B (3-20 solar masses). About 85 percent of GCRs are protons (nuclei of hydrogen atoms), 12 percent alpha particles (helium nuclei) and the remainder are electrons and the nuclei of heavier atoms. The energy levels of GCRs observed in deep space generally lie in the 100 MeV (million electron volts) to 10 GeV (billion electron volts) range. The higher the energy level of these particles; the greater the speed and thus the ability of the particle to drill down through our atmosphere to the planet's surface. Because most cosmic-ray primaries are strongly influenced by the Earth's magnetic field and the interplanetary magnetic field, most of those detected near the Earth originally had kinetic energies in excess of about 1 GeV (about 87 percent the speed of light).

The Earth is shielded from these destructive GCRs by the magnetic field of the sun, the magnetic field of the Earth and the molecules of air and moisture that make up our atmosphere.

The Earth is largely protected from cosmic radiation by the atmosphere. For example the radiation dosage in Low Earth Orbit behind an aluminum shield (1 gm/cm^3) is approximately 1 mSv/day. But at the Earth's surface, the exposure rate is approximately 1 mSv/year. As GCRs travel through Earth's atmosphere, they collide with air molecules producing a variety of secondary particles (X-Rays, Gamma Rays, Alpha Particles, Beta Particles, Neutrons and Heavy Ions). Refer to Figure 1. Each collision will further divide the initial energy with the daughter particles. Very high energy GCRs have sufficient energy to cut through the atmosphere and produce radiation at ground level.

As the GCRs strike the atmosphere, they create a cascade of particles and these particles continue downward striking other particles. The ones of most concern are the heavier particles: protons (p), neutrons (n) and ions.

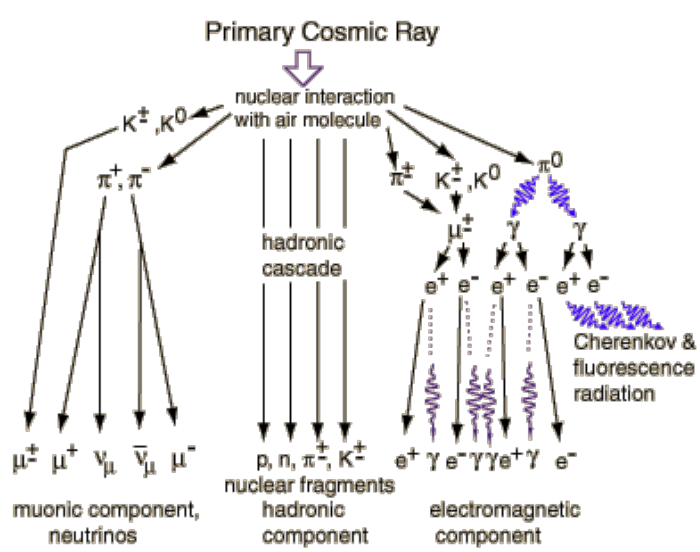

Figure 1. Cascade of particles created as GCRs strike the atmosphere

Cancer

I will focus much of the discussion of cancer on skin cancer because skin cancer is the most common type of cancer and accounts for about half of all cancers in the United States. According to the National Cancer Institute, more than 2 million Americans develop skin cancer annually.[1] Also if left untreated; skin cancer will continue to grow down into the dermis and the subcutaneous tissues. In the most advanced stages, skin cancer may spread into nearby muscle tissue, cartilage or bone. Once the cancer spreads into the blood or lymph fluids, it may reach other areas in the body, like the liver or lungs.[2] The majority of cancers caused by nuclear radiation would be near the outer surface of the human body, our skin, and decrease proportionally with depth.

The three most common types of skin cancer include melanoma, basal cell carcinoma and squamous cell carcinoma. According to the American Cancer Society, basal cell carcinomas are the most common type of skin cancer. Approximately 80% of non-melanoma skin cancers will be basal cell carcinoma. These cancers develop within the basal cell layer of the skin.[2] Squamous cell carcinoma is the second most common type of skin cancer, accounting for approximately 20% of non-melanoma skin cancers. They develop from the flat, squamous cells that are the primary cell type making up the outermost layer of the skin, the epidermis.[2] Melanoma accounts for less than one percent of skin cancer cases, but the vast majority of skin cancer deaths.[3] An estimated 76,380 new cases of invasive melanoma will be diagnosed in the U.S. in 2016. An estimated 10,130 people will die of melanoma in 2016.[3] Melanomas of the skin are considered the most dangerous form of skin cancer because they are more likely to spread to other parts of the body.

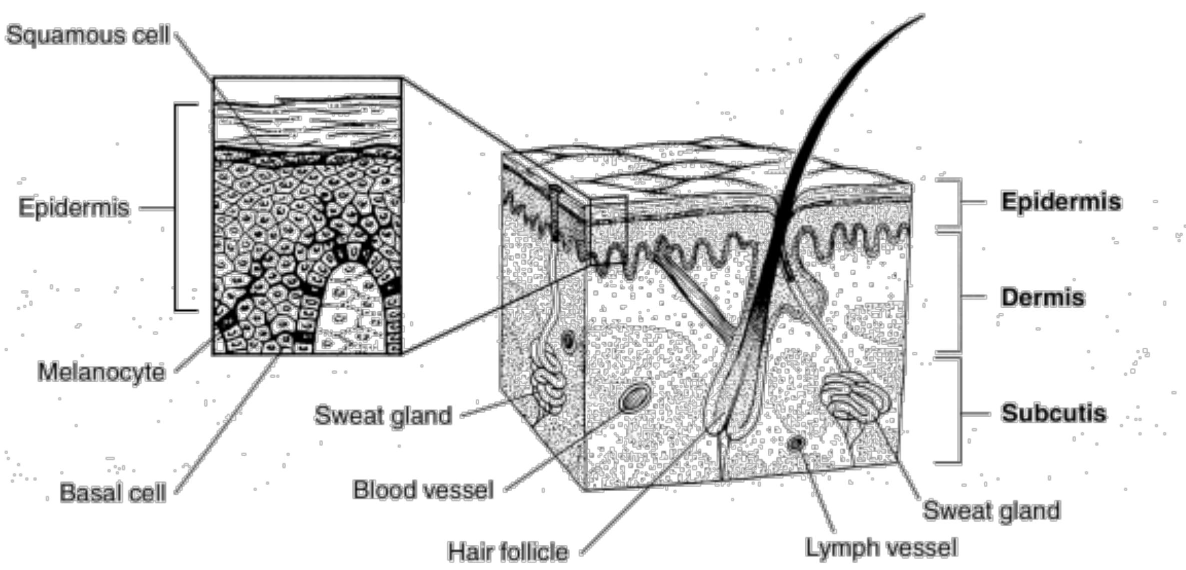

Figure 2. Layers of Skin[4]

Skin is composed of three layers: the epidermis (outermost), the dermis, and the subcutaneous layer (innermost). Refer to Figure 2. Squamous cell carcinoma occurs near the top layer of the epidermis in the squamous cells. Basil cell carcinoma occurs in the basal cells near the bottom of the epidermis. These cells constantly divide to form new cells to replace the squamous cells that wear off the skin's surface. As these cells move up in the epidermis, they get flatter, eventually becoming squamous cells. Melanoma occurs in the melanocytes near the bottom layer of the epidermis. These cells make a brown pigment called melanin, which gives the skin its tan or brown color. Other types of skin cancer that are less common include Kaposi sarcoma, adnexal tumors, Merkel cell carcinoma, and cutaneous lymphoma.[1]

Magnetic Latitude

Generally there are three variables (or risk factors) that affect radiation exposure and thereby cancer risk in the United States. These are Magnetic Latitude, Elevation and Humidity.

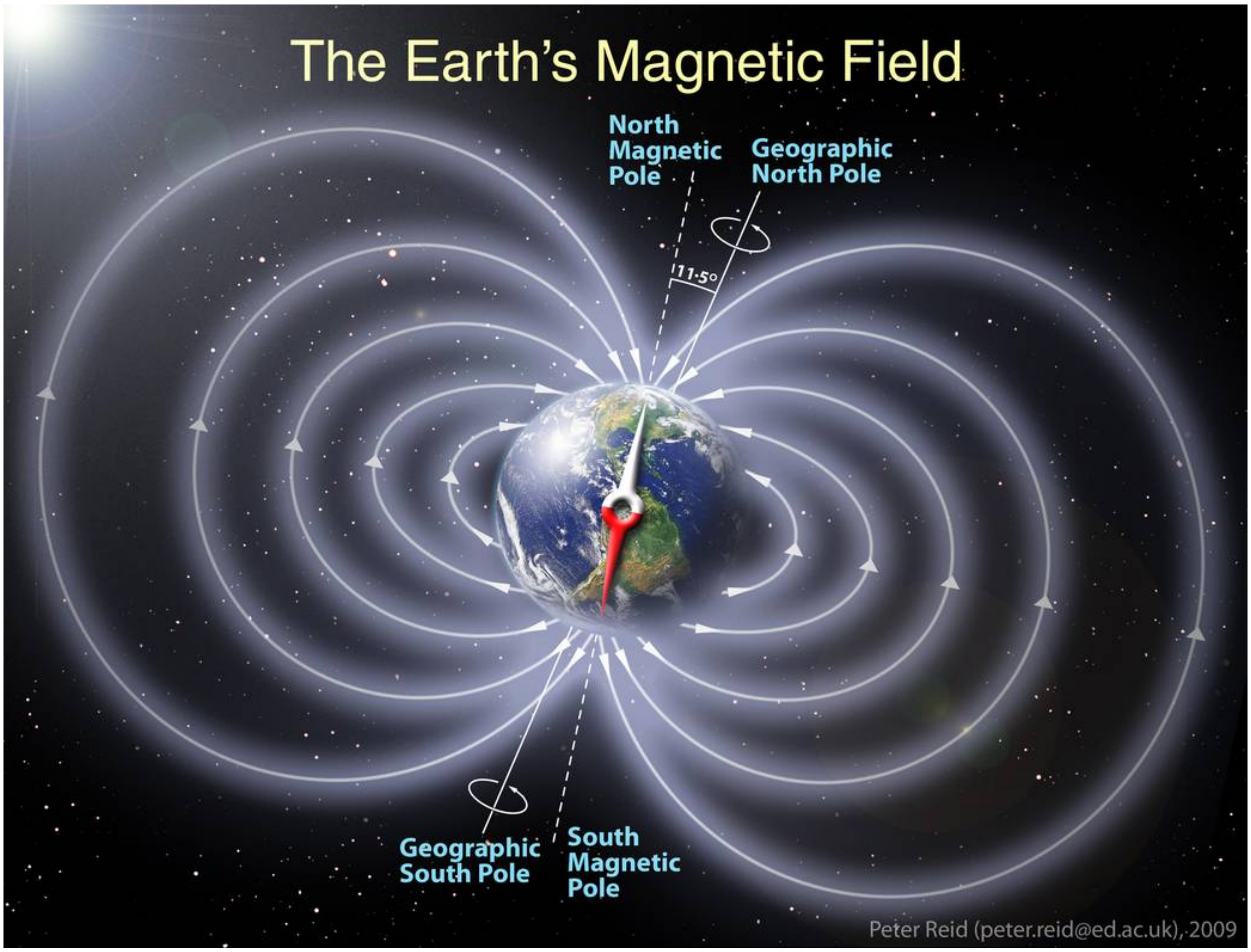

Figure 3. Magnetic Field Lines

Since the GCRs that strike Earth are charged particle, the path that these particles travel are deflected by Earth's magnetic field. Many more GCRs will strike Earth's magnetic poles than the equator. Thus Earth's magnetic latitude has a relationship with an individual's exposure to nuclear radiation and thus cancer. In general, the higher the Magnetic Latitude a person lives the greater the risks.

On 2 September 2016, the students of Earth to Sky Calculus [group of geeky high school science enthusiasts] launched a research balloon from the slopes of Mt. Washington in New Hampshire in order to measure radiation levels in the atmosphere. At the same time, these students launched another balloon in California. The results of their experiment are shown in Figure 4.

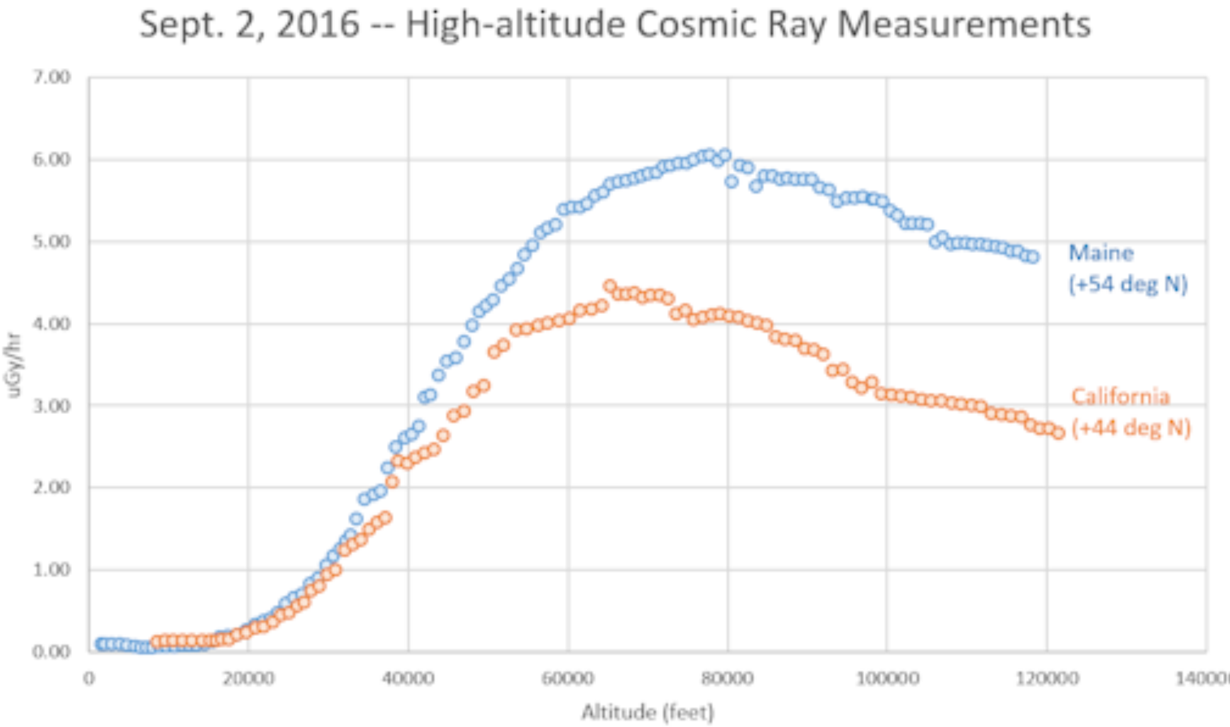

Figure 4. Radiation levels as a function of Earth's latitude.[5]

These profiles show the dose rate of secondary cosmic rays as a function of altitude over central California and southern Maine. Clearly, the atmosphere of Maine is more "radioactive." The reason can be found in the labels. The magnetic latitude in Maine (+54°) is higher than the magnetic latitude in California (+44°). In other words, Maine is closer to Earth's magnetic north pole where cosmic rays are more abundant.

The Center of Disease Control and Prevention (CDC) published a graph showing the Incidence Rates of Melanoma of the Skin by State for 2013. The rates are per 100,000 and are age-adjusted to the 2000 AD U.S. standard population. So does their graph show the relationship between Earth's latitude and melanoma? I can see a trend. If you look at the individual states, nine of the twelve states in blue (those states with the highest melanoma incidence rates) are above 41° North Latitude.[A] These states are Washington, Oregon, Montana, Idaho, Minnesota, Iowa, Maine, Vermont and New Hampshire.

[A] For simplicity I am using Earth's latitude. Magnetic latitude has a slight variation. Based on the WMM2015 coefficients for 2015 the geomagnetic North Pole is at 72.62°W longitude and 80.31°N latitude, and the geomagnetic South Pole is at 107.38°E longitude and 80.31°S latitude. The axis of the magnetic dipole is currently inclined at 9.69° to the Earth's rotation axis.

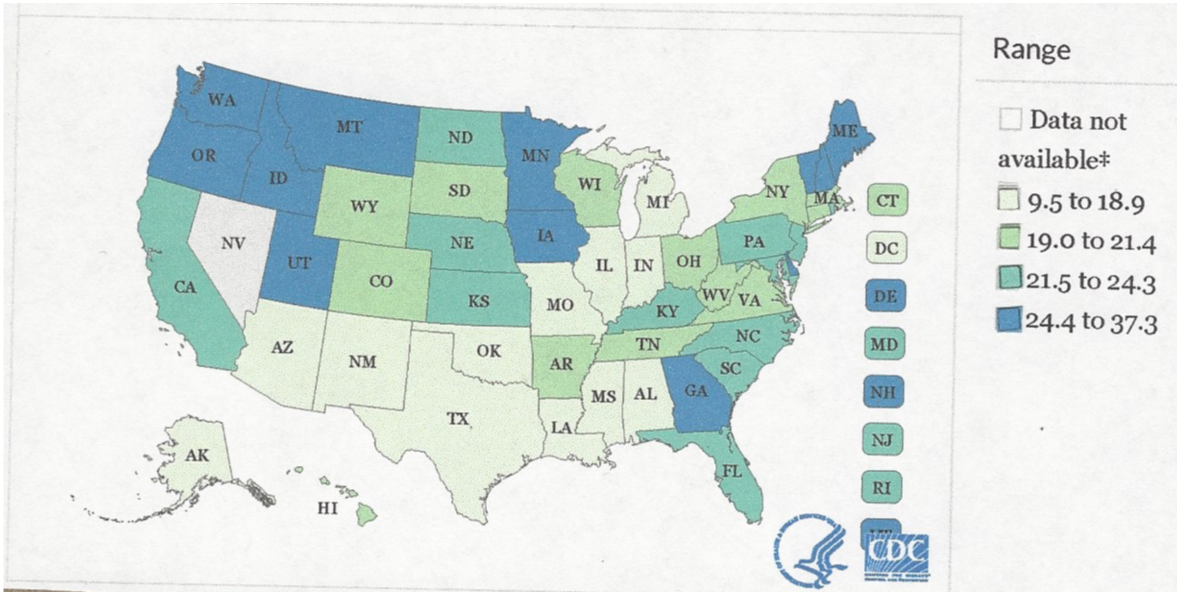

Figure 5. Melanoma of the Skin, Incidence Rates by State, 2013. [6]

Elevation

Generally there are three variables (or risk factors) that affect radiation exposure and thereby cancer risk in the U.S. These are Magnetic Latitude, Elevation and Humidity. So let us discuss the second variable Elevation.

Our atmosphere shields the surface of the planet from Galactic Cosmic Rays (GCRs). But the higher the elevation, the less air molecules are between outer space and the planet's surface. As a result as GCRs tunnel down through the atmosphere, they encounter fewer collisions and arrive with greater energy. At high elevations, there is an increased cancer death rate because the nuclear particles have greater energy and thus greater penetration into the human body and also there is a greater cluster of secondary particles concentrated in the strike.

Figure 6 shows the relationship between altitude and radiation dosage rate. Dose rates are expressed as multiples of sea level. For instance, we see that boarding a plane that flies at 25,000 feet exposes passengers to dose rates ~10 times higher than sea level. At 40,000 feet, the multiplier is closer to 50 times. These measurements were derived from research balloon launches containing cosmic ray radiation detectors passes through aviation altitudes en route to the stratosphere over central California.[7]

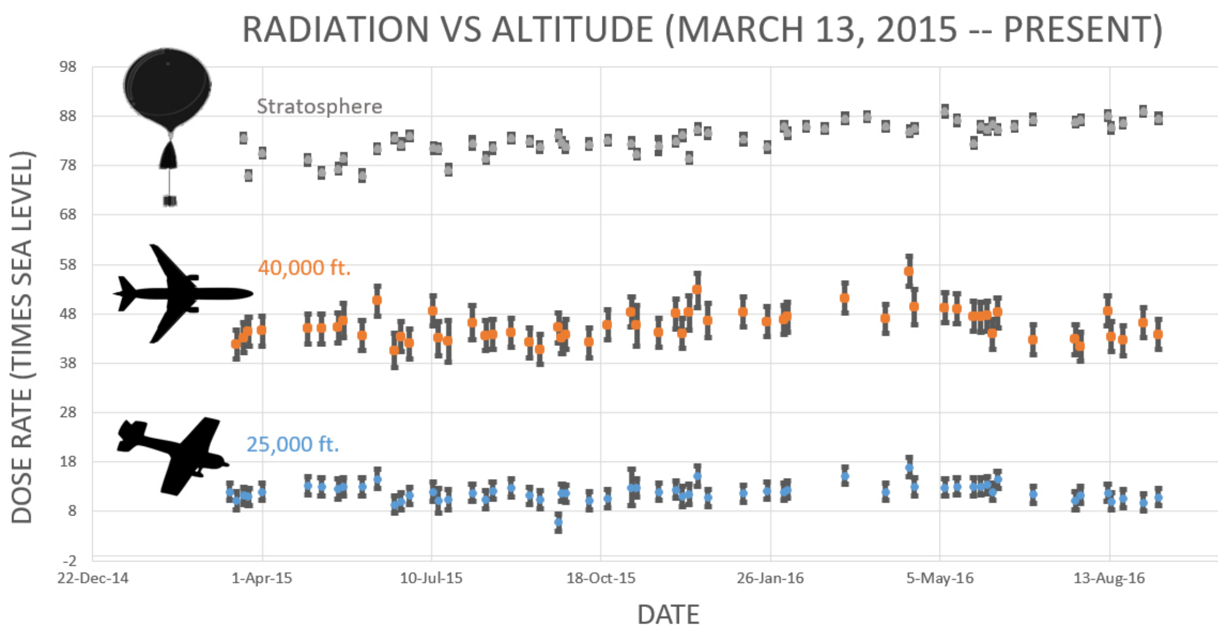

Figure 6. Measured Radiation as a function of Altitude.[7]

The next two graphs show state-by-state; the risk of melanoma cancer deaths [Figure 7] and the next graph shows an elevation map of the U.S. {Figure 8]. The states with the highest death rate for melanoma [those in blue] are generally the states in the great mountain ranges [Rocky Mountain range, Sierra Nevada Mountain range, and Appalachian Mountain range].

As nuclear particles are slowed down by collisions through the atmosphere, they eventually reach a point where they explode in a large ionization event. This point is referred to as the Bragg peak. At Bragg peak, a large amount of high-energy electrons are produced that cause multiple ionization events at the end of their range in a distance that corresponds to the cross section of a deoxyribonucleic acid (DNA) molecule. This ionization produces cluster damage at the DNA level. Thus energetic protons, neutrons and ions have a greater biological efficiency than X-rays and Gamma Rays to induce genetic damage.

Radiation is a powerful mutagen. The long-term effects of radiation are genetic alteration, cancer induction, damage to the central nervous system and peripheral neurons and accelerated aging. Densely ionizing radiation like alpha particles or heavier ions generate a greater biological effect than the same dose of X-rays. X-rays can produce isolated single and double DNA strand breaks, which can be repaired by the cells rather quickly and cleanly. Proton and ion radiation produces complex cluster damage to the DNA strands that are significantly less repairable. A macroscopic tumor may originate from only one transformed cell. If a single mutated cell survives, cancer may develop. The primary means that multicellular organisms utilize to repair radiation damage is to identify and discard the affected cell and manufacture replacements.

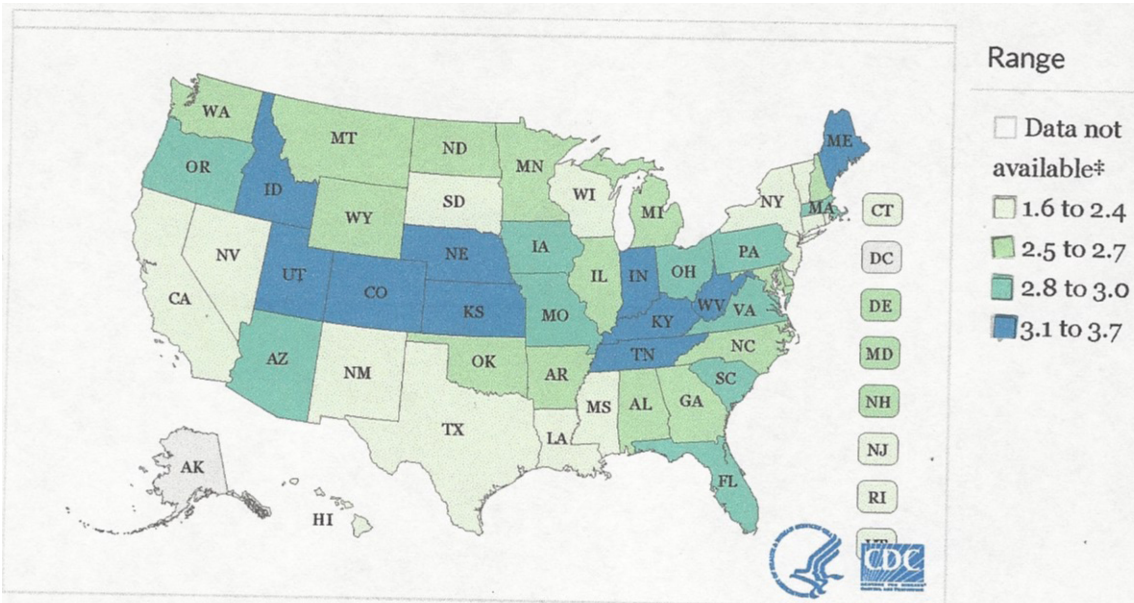

Figure 7. Melanoma of the Skin, Death Rates by State, 2013. [6]

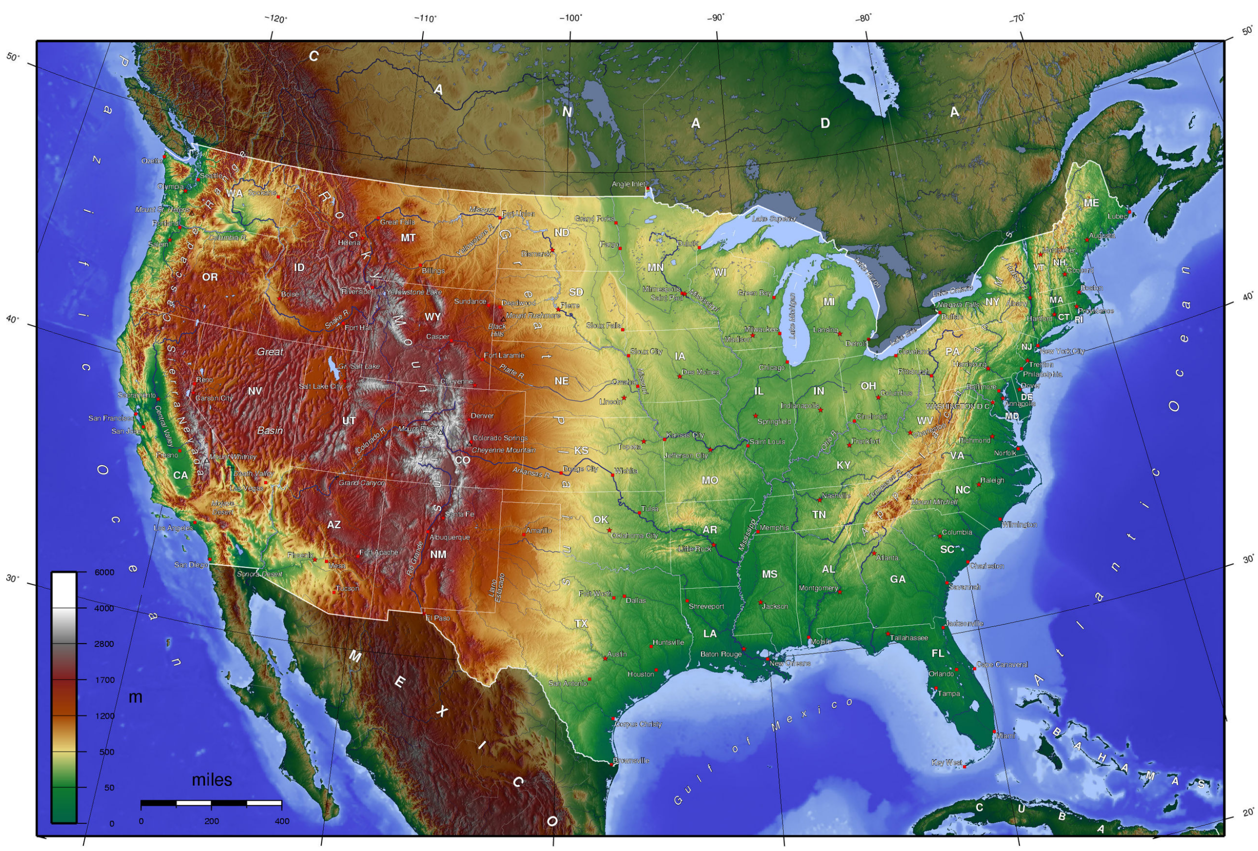

Figure 8. Topographic Map of Contiguous United States. [8]

Humidity

Generally there are three variables (or risk factors) that affect radiation exposure and thereby cancer risk in the U.S. These are Magnetic Latitude, Elevation and Humidity. So let us discuss the third variable Humidity.

The optimal way to slow down a GCR is through elastic collisions. One of the best elements for this task is hydrogen. Water (H_2O) is a molecule that combines two Hydrogen atoms and one Oxygen atom. Therefore an atmosphere loaded with water content (clouds, rain and humidity) is better at shielding these high-energy nuclear particles than an atmosphere with low moisture content.

Therefore regions of low humidity such as deserts and areas suffering from extensive droughts would experience higher incidences rates for cancer.

Risk of Cancer

An individual's risk of cancer is the accumulated exposure to nuclear radiation over their lifetime. This is offset by the protection afforded by our immune system. For some types of radiation such as soft radiation (for example x-rays), dense elements (such as lead) are very effective shielding material. But for nuclear radiation (high energy particle radiation), the hydrogen atoms in water are an effective shielding material because they provide elastic scattering. So our nuclear radiation exposure rate is a function of the region where an individual lives (magnetic latitude, elevation and humidity) and the protection offered by the shielding such as the buildings in which the individual lives (home), the individual works (offices, schools), transportation modes and outdoor exposure.

It is interesting that one of the most effective structures for shielding against nuclear radiation is an igloo. This is because the walls of an igloo are composed of thick sheets of ice (frozen water). But this structure is not the typical American home. Generally, the shielding in a normal home is the moisture content of the plywood and sheetrock that makes up the roof and ceiling of the modern home. Underground homes provide greater shielding due to the moisture content of the soil above the home.

Many individuals work in multi-story offices using steel support beam construction. In many of these building the floors are either metal decking with lightweight concrete topping or precast concrete composite floor and topping. This type of building offers multiple layers of concrete floors as shielding. The moisture content within the concrete provides shielding.

In the area of transportation, underground subway systems offer significant shielding against nuclear radiation due to the moisture content of the soil above the subway system. On the other end of the spectrum is commercial airline travel. The radiation exposure rate is ten times greater at 25,000 feet as compared to sea level. At 40,000 feet the exposure rate is close to 50 times greater. Most commercial jet aircraft fly at cruising altitude of up to 39,000 feet, but long flights are typically assigned higher altitudes. The exposure rate would even be higher if the aircraft took a polar route. [These exposure rates are measured using radiation sensors that detect X-rays and gamma rays in the energy range 10 keV to 20 MeV. But this is soft radiation emitted from collisions of GCRs and the atmosphere. But the real danger is from nuclear particle radiation as it strikes the human body. At high altitudes, these particles have significantly greater energy, penetration depth and the ability to cause great cluster damage to our cells.]

Another consideration is the protective shielding afforded the most vulnerable members of the human race to the threat from nuclear radiation. This is the threat to the unborn child in their mother's womb. These yet unborn are floating in a sack of amniotic fluid. About 98% of the amniotic fluid is water, and the remaining 2% is salt and cells from the baby. This is an ideal shielding medium. The hydrogen in the water provides elastic scattering to slow down the particles and the chloride in the salt captures the massive number of ions that are created when the nuclear particle comes to rest at the Bragg peak. The unborn are the most vulnerable members of the human race to radiation cell damage because of their small number of mature cells and a lack of an effective immune system.

Immune System

Our immune system not only protects us from bacteria, viruses and fungi but also protects us from low levels of radiation exposure and damage.

The human body is endowed with a complex efficient immune system. Generally this immune system is highly effective at identifying cellular damage and either repairing or replacing these damaged cells. But this immune system can be damaged or destroyed in the human body.

A prime example is cigarette smoke. Cigarettes (along with pipe tobacco, cigars, and weed) contain many poisonous chemicals including cyanide, arsenic, benzene, formaldehyde, methanol, acetylene, ammonia, carbon monoxide, nitrogen oxide, nicotine, vinyl chloride, ethylene oxide, chromium, cadmium nitrosamines, polynuclear aromatic hydrocarbons along with others. I assert that inhaling these chemicals over years and years saturates and destroys our immune system that protects the human body from cancer. Thus it opens the door to cancer. So it may not be the direct cause or root cause but rather a link in the cause of cancer.

Other means by which the immune system can be damaged or destroyed is the process of aging, sunburn or overexposure to UV radiation, alcoholism, drugs, chemotherapy, infections such as HIV, lack of physical activity, nutritional deficiencies, obesity, intense stress and chronic illness to name a few.

There exists a very corrosive and false narrative that the root-cause of most cancers is due to chemicals. Many have focused exclusively on chemicals rather than radiation as the primary actors. This approach is wrong. This approach unjustly condemned many good harmless chemicals to the dustbins of civilization.

Some chemicals can destroy our immune system and cause cancer but this is more the exception than the rule. But almost any chemical in unreasonable high doses can damage and destroy our body, even drinking ordinary water.

The Sun

At the beginning of this article I said, "The Earth is shielded from these destructive GCRs by the magnetic field of the sun, the magnetic field of the Earth and the molecules of air and moisture that make up our atmosphere." We can assume that the sun is ever constant; **but it is not**. The magnetic field exerted by the sun can change dramatically and the protection provided Earth by this strong magnetic field can impact the number of GCRs that strike and thereby the incidence rate of cancer.

Sunspots are dark spots that appear on the surface of the sun. They are the location of intense magnetic activity and they are the sites of very violent explosions that produce solar storms.

The sun goes through a cycle lasting approximately 11 years. It starts at a solar minimum when there are very few sunspots and builds to a solar maximum when hundreds of sunspots are present on the surface of the sun and then returns back to a solar quiet minimum. This cycle is called a solar cycle. We are currently within Solar Cycle 24, so named because it is the 24th consecutive cycle that astronomers have observed. The first documented cycle began in March 1755.

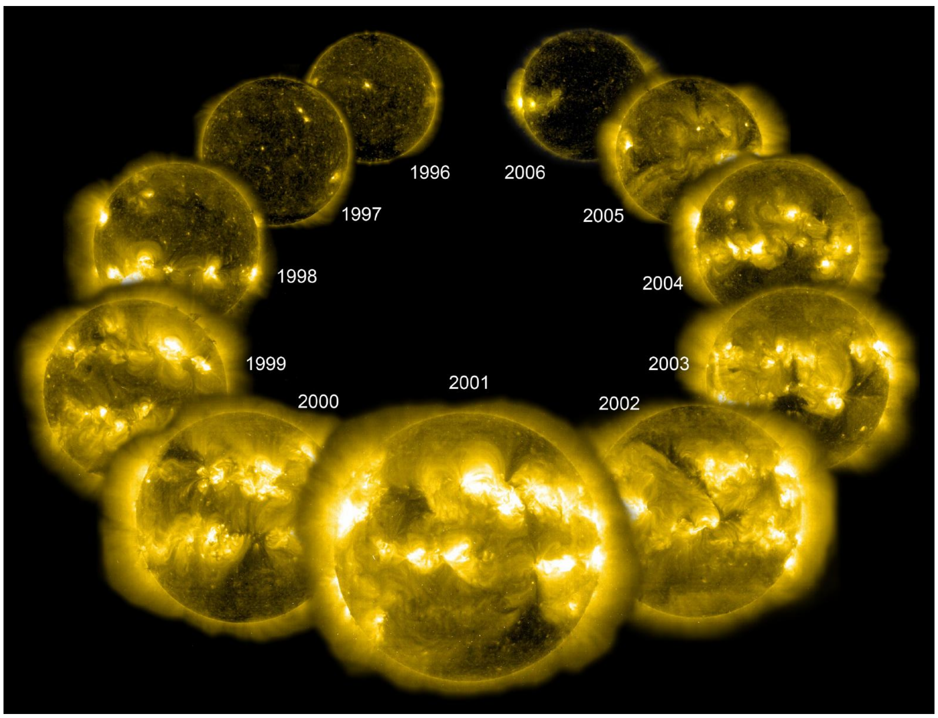

Figure 9. Image of Solar Cycle 23 from the Solar and Heliospheric Observatory (SOHO) by Steele Hill (NASA GSFC)

The sun exhibits great variability in the strength of each solar cycle. Some solar cycles produce a high number of sunspots. Other solar cycles produce low numbers. When a group of cycles occur together with high number of sunspots, this is referred to as a solar *Grand Maxima*. When a group of cycles occur with minimal sunspots, this is referred to as a solar *Grand Minima*. Usoskin details the reconstruction of solar activity during the Holocene period from 10,000 B.C. to the present.[9] Refer to Figure 10. The red areas on the graph denote energetic solar *Grand Maxima* states. The blue areas denote quiet solar *Grand Minima* states.

The reconstructions indicate that the overall level of solar activity since the middle of the 20th century stands amongst the highest of the past 10,000 years. This time period was a very strong solar *Grand Maxima*. Typically these *Grand Maxima's* are short-lived lasting in the order of 50 years. The reconstruction also reveals *Grand Minima* epochs of suppressed activity, of varying durations have occurred repeatedly over that time span. A solar *Grand Minima* is defined as a period when the (smoothed) sunspot number is less than 15 during at least two consecutive decades. The sun spends about 17 percent of the time in a *Grand Minima* state. Examples of recent extremely quiet solar *Grand Minima* are the Maunder Minimum (about 1645-1715 A.D.) and Spörer Minimum (about 1420-1570 A.D.)

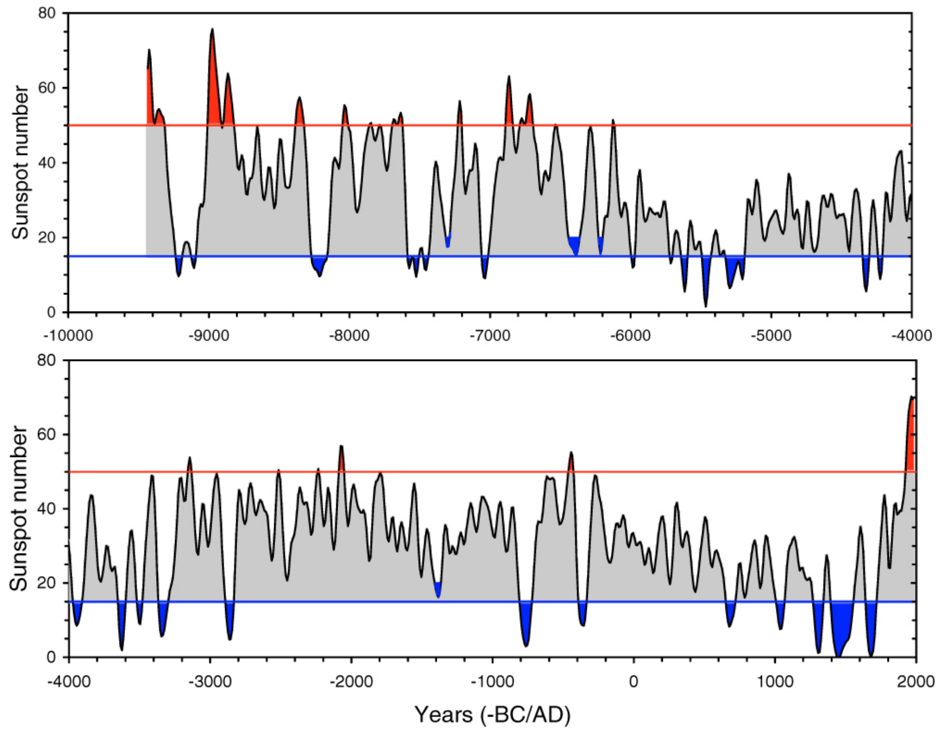

Figure 10. Sunspot activity throughout the Holocene. Blue and red areas denote *grand minima and maxima*, respectively. The entire series is spread out over two panels for better visibility.[9]

During most of the 20th century, the sun was in a Solar Grand Maxima. But that came to an abrupt end beginning in July 2000. The sun produced 6 massive explosions in rapid succession. Each of these explosions produced solar proton events with a proton flux greater than 10,000 pfu @ >10 MeV. These occurred in July 2000, November 2000, September 2001, two in November 2001, and a final one in October 2003. And there hasn't been any of this magnitude since. Then the sun produced one of the weakest solar minimums since the *Ap Index* was first recorded (beginning in 1932).[B] The current solar cycle (Solar Cycle 24) is very weak. Not quite weak enough to be called a Solar Grand Minima but very close. It is analogous to a period referred to as a 'Dalton Minimum'.

[B] The Average Magnetic Planetary Index (*Ap index*) is a proxy measurement for the intensity of solar magnetic activity as it alters the geomagnetic field on Earth. It has been referred to as the common yardstick for solar magnetic activity.

The Sun's magnetic field modulates the GCR flux rate on Earth. Just as cosmic rays are deflected by the magnetic fields in interstellar space, they are also affected by the interplanetary magnetic field embedded in the solar wind (the plasma of ions and electrons blowing from the solar corona at about 400 km/sec), and therefore have difficulty reaching the inner solar system. The effects from the solar winds are felt at distance approximately 200 AU from the sun, in a region of space known as the Heliosphere. Refer to Figure 11. As the magnetic field of the sun weakens, GCRs are able to penetrate in greater numbers into the inner part of the solar system where Earth resides. Recently the number of GCRs striking Earth has increased. Currently the sun's interplanetary magnetic field has fallen to around 4 nano-Tesla (nT) from a typical value of 6 to 8 nT. The solar wind pressure is down to a 50-year low. The heliospheric current sheet is flattening. In 2009, cosmic ray intensities increased 19% beyond anything we've seen since satellite measurements began 50 years ago.[10] An increase in the number of GCRs would correspond to an increase in the number of cancer incidence rates. If we enter another Solar Grand Minimum, a prolonged period of a magnetically quiet sun, the cancer incidence rates will likely increase quite dramatically.

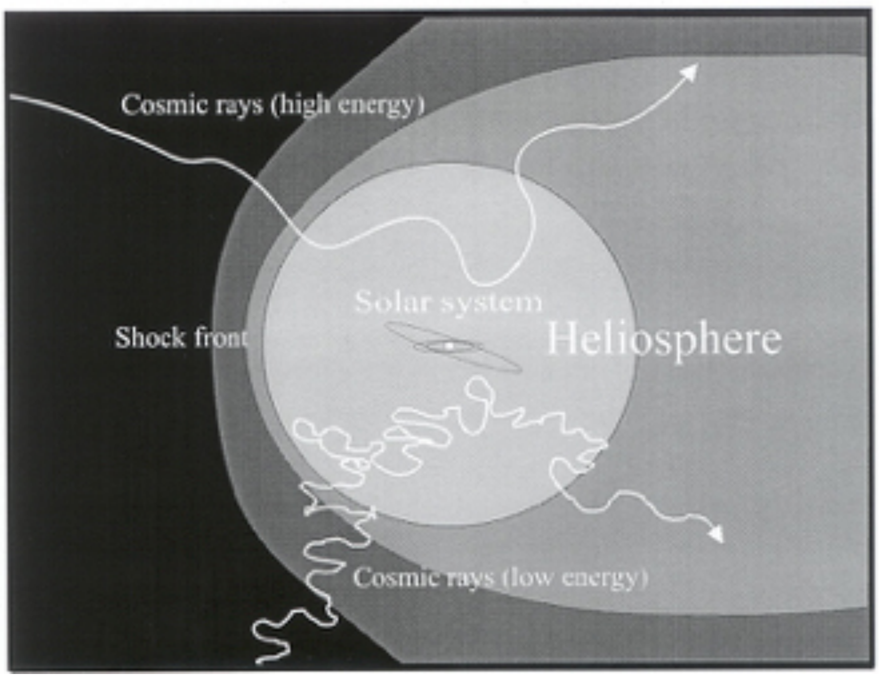

Figure 11. Pictorial of GCR interaction with the Sun's Heliosphere.

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