# The Biomass of the Earth as the Direct Energy-Mass Equivalence from ~3.5 Billions of Years of Solar Flux

**Michael A. Persinger**

Biomolecular Sciences Program, Laurentian University,
Sudbury, Ontario, P3E 2C6, Canada

E-mail address: mpersinger@laurentian.ca

**ABSTRACT**

Life is considered to be quantitative phenomena based upon principles derived from Astronomy, Physics, and Chemistry. The mass equivalence of the total energy from the Sun that occurred over the terrestrial surface from 3.5 billions ago to present is within the range of empirical estimations for the total biomass on the Earth. If the mass of living systems is the converted photon energy integrated over time then the ubiquitous emissions of photons in the order of picoWatts per square meter may not be a metabolic artifact but a reflection of the matter's origin. Quantification demonstrates this magnitude of photon flux density is an expected dissipation from the photon-mass conversion that defines living systems. Because all energy, particularly photons, within Life on this planet originated from the Sun their maintenance as Popp (virtual) photons creates the conditions for non-local effects between solar activity and Life. The occurrence of entanglement between solar-terrestrial photons could alter the models, mechanisms, and attributions for the persistent and multiple correlations between solar activity and the phenomena measured within various levels of discourse from physical chemistry to large groups of organisms.

*Keywords*: global biomass; solar photons; mass-energy equivalence; entanglement; excess correlation hydronium ions; ultraweak bioluminescence; Popp photons; Cosic resonance

# 1. INTRODUCTION

As indicated in Schrödinger's "*What is Life?*" [1] and Oparin's classic book *Origin of Life* [2] abiogenesis is based upon fundamental chemical reactions whose patterns are determined by physical laws. The nature of elements as the systematic aggregates of single protons within a specific boundary resulting in different properties for these aggregates has been reflected in Mendeleev's periodic table for over a century.

The traditional approach to Life is that there are qualitatively different and distinct properties for these masses. Although "critical masses" and "assimilation-accommodation" phenomena do occur through which a qualitative shift could be perceived that defines a new phenomena, the source of these "qualitative differences" begins as a specific amount of quantification.

There are shared quantified atomic features to elements central to Life. One significant cluster is C, N, and P that exhibit the smallest ionized radii of all elements found naturally within biological systems. This can be demonstrated by applying elementary cluster analysis to the measurements for ionized radii of the first 52 elements (Figure 1). The implications of this structural (C,N)-dynamic (P) triad are apparent.

According to rounded estimates from the CRC *Handbook of Chemistry and Physics* (2000-2001) the ionic radii of these three centrally Life-relevant ions are 16 pm, 16 pm and 17 pm, respectively. Other elements that contribute to the dynamics of Life such as oxygen, potassium, or sodium display ionic radii between 102 pm and 151 pm. The frequency equivalent of 16 pm from the perspective of the velocity of light is $1.88 \cdot 10^{19}$ Hz whose energy equivalence (multiplied by Planck's regular constant) is $1.24 \cdot 10^{-14}$ J.

The mass equivalent of this energy multiplied by $2\pi$ is within 5% of the classical mass of an electron. Although potentially spurious, a distance of space whose energy could reflect recondite properties of electrons also involves potential contributions from photons. They are the dynamic mediators of quanta of energies for electron locations ("shells") with respect to the aggregate of protons and neutrons (the nucleus). Photons may be a central component of the emergence of Life processes.

Traditionally what have been considered more critical are the combinations of those elements which result in molecules. Some life-frequent molecules are found within interstellar space. Within the outflow regions of protostellar winds, for example, the abundance of particular species is enhanced. They include $SiO$, $CH_3OH$, $HCN$, $H_2CO$, $SO$, $SO_2$ and $H_2O$ [3]. This suggests that the conditions for Life may not be planet-specific and may involve more pervasive regions of space.

For those molecules that result in properties defined as Life photons within the visible range (light) or the conditions that release photons (specifically electrical discharges) appeared to have been central to their formation. For example formaldehyde was ubiquitous through photochemical formation from $CO_2$ and water vapor. The light would have originated from the stars.

Hydrogen Cyanide (HCN) is produced in nitrogen-methane mixtures when electric discharges are present. Under experimental conditions as reported by Schwartz and Bakker [4] adenine (a purine) and other nucleoside analogues may have been synthesized from these gases upon the prebiotic earth. Alternatively they may have been synthesized in space and emerged on the earth's surface during brief interfaces with interplanetary or interstellar events [5].

This indicates that the condition for polymerization of base nucleotides that defines gene sequences into remarkably stable representations of biological information could have followed.

The classic 1953 publication by Miller [6] that reported over a dozen different amino acid sequences could be formed from the gaseous mixtures present within the prebiotic earth when they were exposed to simulated "lightning" discharges demonstrated in principle that the second essential component to living systems: proteins, could have been present. The effect was so robust that even this author as a young physical chemistry student during 1963-1964 easily produced water and the simplest amino acid residues. This was discernable qualitatively by ninhydrin and chromatography paper strips, following strong coronal discharges within bell jars containing various mixtures of early (pre-Cambrian) atmospheric gases. Recently, Johnson et al [7] re-measured the residuals from Miller's original experiments with more sensitive equipment and identified 22 amino acids and five amines.
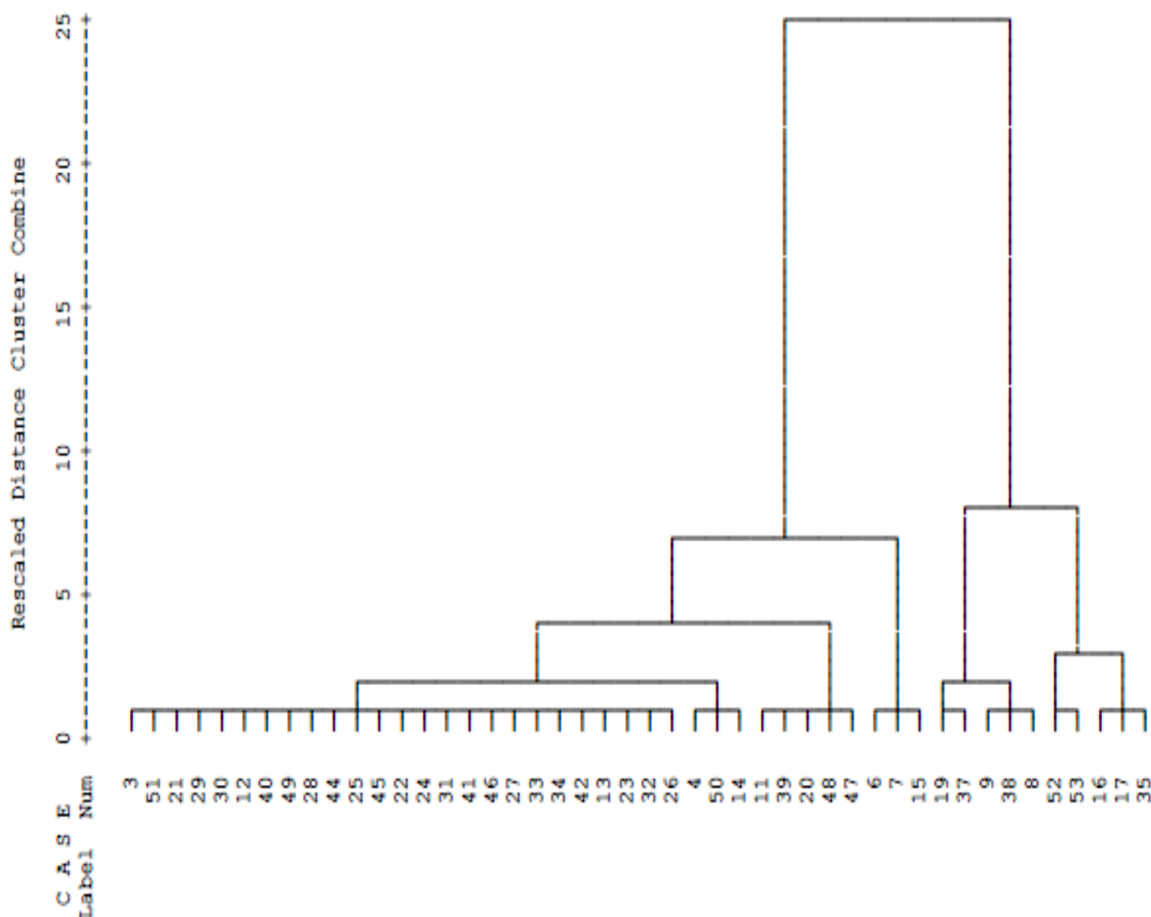


**Figure 1.** Results of cluster analyses directly from a SPSS output for diameters of ionized radii (in pm) for the first 52 elements as indicated by atomic number on the Periodic Table. The shortest radii form a distinct cluster composed of 6 (Carbon), 7 (Nitrogen) and 15 (Phosphorous).

As indicated by Graf and Cole [8] to date a near complete roster of naturally occurring organic micromolecules have been synthesized within the pre-biotic Earth ($CH_4$, $Ar^{36}$, $H_2$, He, Ne, $NH_3$, $H_2O$). The search for an environmental asymmetric force to accommodate the predominance of asymmetry of the constituents of Life-related molecules was considered to have originated within the earth's oscillating magnetic field with a 10 Hz Eigen frequency. The Earth's magnetic field was considered an asymmetric force that produced extro-circularly polarized light.

Graf and Cole also replicated Miller's work and indicated that more complex spheroid structures also emerged. Protenoids are composed of proteins which exhibit cell-like structures with double membranes and catalytic activity. During specific shifts in pH and temperature these protenoids increase mass, divide, and proliferate in environments at concentrations of 1 part protein per 100 million parts of water. After electrical arching through "primitive" atmospheric gases, Graf and Cole found 5 nm to 80 nm spheroid bodies within their preparations containing large amounts of mineral, 10% carbon, and ninhydrin reactive material.

However the primary role of the prevalence of the incidence of photons originating from the proximal G2 star, the sun, upon the atmosphere as the solar constant and upon the earth's surface has not been considered thoroughly. The precocious thinker Fritz A. Popp [9] developed the concept that photon storage occurs within biological systems.

That photons are emitted from all living systems, as "mitogenic" radiation, had been known since A. G. Gurwitsch's discovery during the 1920s [10]. However Popp extended this concept and argued that molecules, such as glucose, contained stored virtual photons which have their origin in the Sun. He has hypothesized several mechanisms, with quantitative support, that implicates the role of solar-based photons in the evolution of the complex molecular dynamics of cells, organs and organisms.

The most obvious question is: what is the proportion of determinacy upon terrestrial Life from solar-based photons? The degree to which photon (energy) -mass conversion might have occurred could influence the proportion to which living systems and related complex chemical reactions might respond to and be coupled with the local and non-local phenomena associated with the Sun.

Here I present quantitative evidence that the *entire biomass* might be proportionally related to the direct conversion of solar photon energy during the cumulative period since Life was first presumed to have occurred about 3.5 billion years ago. If this is valid then re-emitting photons from this temporally integrated and accumulated energy-mass conversion would be expected. The emission of photons from this originally converted mass would also create the conditions for entanglement between the nuances of solar activity and all present living systems.

## 2. QUANTIFICATIONS

The solar constant is about 1.36 kW·m$^{-2}$. At the level of the earth's surface, after accommodating daily rotation and other variables, the power density per day would be ~100 J·s$^{-1}$ m$^{-2}$. Present estimates indicate blue-green algae first appeared about 3.5 billion years or $1.1 \cdot 10^{17}$ s ago. This means that the total energy over that period from the Sun upon the Earth's surface would be $(1.1 \cdot 10^{17}$ s$) \cdot (10^2$ J·s$) (5.1 \cdot 10^{14}$ m$^2)$ or $5.6 \cdot 10^{33}$ J. Contributions from

geothermal subsurface sources would at most only change the coefficient but not the order of magnitude.

The mass equivalent of this energy can be obtained by dividing by the square of the velocity of light in a vacuum ($9 \cdot 10^{16}$ m$^2 \cdot$s$^{-2}$). The value is $6.2 \cdot 10^{16}$ kg. Even if the estimates of the solar output and variable terrestrial surface exposure available 3.5 billion years ago was less by a factor of 10, the mass equivalent would still be within this order of magnitude $6.2 \cdot 10^{15}$ kg. A current estimate of the total biomass within terrestrial and marine domains is $5.6 \cdot 10^{14}$ kg [11]. If Life is viewed as a chemical reaction based upon the accumulated energy from the Sun, then the biomass presently on this planet is the total consequence of this energy.

## 3. IMPLICATIONS

If the energy from the Sun incident upon the terrestrial and marine surfaces was within the visible (380 to 780 nm) and paravisible (near ultraviolet and near infrared) wavelengths was a factor of 100 less than the calculated value where Life displayed a high probability of manifestation, the mass equivalence of that energy would still accommodate the current global mass of all living systems. The fact that the mass-energy equivalence solves for this value might be considered unusual considering its classical application to relatively quick (femtosecond to picosecond) atomic reactions.

However when $\sim 10^{17}$ s are involved with processes involving energy-mass equilibrium the subtle shifts that could reflect such mass-energy equivalence with the square of the velocity of light might be quite different than the sudden fracture of nuclear integrity by a high energy particle. Slow time versus fast time differentials are well known in geology.

For example the phenomenon of creep in crystal lattice structures of rock associated with eons of pressure are not simulated in the laboratory by applying compensatory pressure within shorter durations. The formation of matter from energy might occur with specific singularity. To extend the concept of Popp, not only the molecules such as glucose within living systems are virtual photons of solar origin. If the calculations and concept presented in the last section are valid, then *all* of the biological mass has been derived from the direct conversion of solar light.

If photons are the source of the matter for all living forms, then the inter-exchange of photons between livings systems may be more than epiphenomena or metabolic "residuals". Photon emissions from living masses would be the expected dissipation of a small proportion of mass to its initial form: photon energy. Trushin [12] and Fels [13] have indicated that photon emissions from and between adjacent cells or organisms may be the critical method of conveyance for information that sets the structural direction or initiates the sequences for the massively energy consuming molecular pathways.

The Cosic [14] model shows that the polymerized sequence of amino acids (each with a different pseudo-potential value) in proteins are simply the structural stabilities for the actual information. It is mediated by the specific profiles of the spectral power densities that emerge from these different amino acid sequences as specific wavelengths within the visible and paravisible range [15]. The energy from the photon-initiating sequences would be orders of magnitude less than those required for chemical signaling. In other words the spectral power densities from biophotons are not the energy for the molecular pathways. Instead the photons determine the direction and dynamic sequences of the molecular machinery.

The visible photon range does not eclipse the importance of infrared and near infrared for determining the limits of structure. Most physical chemists who study biological systems appreciate the significance of Wien's Law (0.29 cm·deg divided by deg in °K) which relates the peak frequency emitted by a black body as a function of its temperature. The Sun, with a mean temperature of ~5,778 °K, displays a peak around 500 nm. For the mammalian cell that operates optimally around 310°K (37°C) the value is ~10 μm which is very proximal to the median width of a cell.

## 4. THE ORIGIN AND SOURCE OF THE $10^{-12}$ W·m$^{-2}$ DISPLAYED BY LIVING SYSTEMS

The majority of measurements by photomultiplier units indicate that cells [16], bacteria [17], sections of brain tissue [18] and the living human brain engaging in cognition [19] display photons where flux density is in the order of $10^{-12}$ W·m$^{-2}$ with a range of about a factor of 10. Popp and his colleagues [9,20], in the tradition of Gurwitsch [10], have indicated that all living systems emit photons. As shown quantitatively [21] $10^{-12}$ W·m$^{-2}$ can be related to the basic energetic unit of $10^{-20}$ J by the inverse of wave impedance multiplied by the wavelength of the neutral hydrogen line when divided by magnetic permeability. Such intercalation with universal properties may reflect the prevalence of the phenomena.

The ~2·$10^{-20}$ J quantity of energy may be a pervasive value. It is the energy per Planck's voxel when the force of the universe obtained from the multiplication of its mass ($10^{52}$ kg) length ($10^{26}$ m) and square of the Zitterbewegung ($10^{86}$ s$^{-2}$), or $10^{-164}$ N, is divided by the number of Planck's voxels ($10^{183}$) and this value is applied across the hydrogen line [22]. It is the quantity of energy that emerges between the potassium ions that constitutes the resting membrane potential as well as the action potential and the ligand-sequestering potentials for receptors [23]. Thymine, cytosine and uracil exhibit electron affinities around 0.1 eV or ~1.6·$10^{-20}$ J [24]. Because the radiant power flux density that characterizes light emerging from living systems is related to the $10^{-20}$ J quantities the apparent consistency of the ultraweak photon emissions (photon flux density) from biological systems might be accommodated.

If this power density for light was emergent with the organization of Life then its magnitude must be maintained. A specific increment of depth of the oceans would be optimal to allow the variability of power fluctuations within the picoWatt per meter-squared range so that the mediation of "information" would be not be masked by more intense light.

The development of non-aquatic or land animals would have required a thicker organismic boundary between the bright environment and the darkness of the internal milieu where the majority of dynamics cells were located. This could explain why the boundary (epithelium) and peripheral organs, which could have been easily as transparent as the protein aggregates that comprise the ocular lens, became and remained opaque.

The presence of a narrow band of flux power density within the darkness of the internal mass of an organism (or within the incubator for cell cultures) has been shown experimentally. Photon densities that are too intense either suppress or do not create the conditions within del Giudice and Preparata's [25] "coherence domains" of water that allow photons to be represented and maintained.

Recently Murugan et al [26] showed that weak complex magnetic field pulsing coherently with 470 nm light could be represented within melanoma cells maintained in hyper-darkness of the incubator for more than an hour before the energy was "re-emitted" as photons. The total energy associated with the photon emissions, whose centroid was 470 nm, was directly proportional to the magnetic energy from the applied fields within the aqueous volume containing the cells.

We [27] have shown that photons can penetrate the human skull and brain tissue. Application of 10,000 lux ($1.4 \cdot 10^1$ W·m$^{-2}$) pulsed white light to the backs or to the sides of the skulls of human volunteers resulted in reliable, amplitude-frequency dependent increases in photon flux density near the front or other side of the skull that was equivalent to about $10^{-12}$ W·m$^{-2}$. The time required for the response to occur (about 1 s) which was longer in the caudal-rostral direction then the lateral-medial direction and reflected that asymmetric cerebral geometry was within error measurement of the predicted time for the protons from the hydronium ion to move as Grotthuss chains through the tissue volume. The factor of $\sim 10^{13}$ dilution would suggest that this mode of mediation is a narrow band of energy that is similar to the natural emission power density found in living tissue.

## 5. PHOTON EMISSIONS AS DISSIPATION DYNAMICS FROM LIVING MATTER'S SOURCE ENERGY

The narrow band power density for persistent light emissions from living systems could function as a form of inter-cell and inter-organism matrix for maintaining coherence, information exchange, and permitting convergence with universal forces. If the actual source is the reverse conversion of a very small proportion of Living matter to photons, then there should be quantitative solutions that reflect the entirety of the temporal continuity of this energy.

Assuming a typical cell emits $2 \cdot 10^{-12}$ W·m$^{-2}$ then the density within a cell 10 μm in width would be $2 \cdot 10^{-7}$ J·m$^{-3}$ s$^{-1}$. The mass of a cell with this diameter is $5.2 \cdot 10^{-13}$ kg; the equivalent energy would be $4.7 \cdot 10^4$ J. Within the volume of a cell with this diameter ($5.2 \cdot 10^{-16}$ m$^3$) the equivalent energy density would be $9 \cdot 10^{19}$ J·m$^{-3}$.

Hence the proportion of energy released as photons per s compared to the energy contained with the solarogenic mass of the cell would be $0.2 \cdot 10^{-26}$ per s. For that energy to be completely dissipated at this rate over the duration that Life has been present ($\sim 10^{17}$ s) the mediating variation would be in the order of $10^9$ s$^{-1}$. This is within the frequency ($1.42 \cdot 10^9$ Hz) of the neutral hydrogen line. The hydrogen wavelength was the required parameter to relate $10^{-20}$ J to $10^{-12}$ W·m$^{-2}$ and to transform the force per unit Planck's voxel to $10^{-20}$ J [21].

One interpretation of this interesting convergence is that the $\sim 10^{-26}$ proportion of the total energy equivalent of the cell mass to be released as photons is the increment that maintains the $2 \cdot 10^{-12}$ W·m$^{-2}$. The multiplication of this value by the surface area of a 10 μm cell ($3.14 \cdot 10^{-10}$ m$^2$) is $\sim 6 \cdot 10^{-22}$ J per s. This is equivalent to about 3 to 5 mV which is in the range of the typical "ripple frequency" (of about 5.5 to 14.5 Hz, mean about 8 Hz; range 0.5 to 9.7 mV) for fluctuations in cell resting plasma membrane potential of the typical cell [28].

From the perspective of entropy this value of energy from the cell per s is within the range of the Landauer limit (ln2 kT) or $2.96 \cdot 10^{-21}$ J which is the energy associated with the loss of 1 bit of information or following the convergence of two operations into a single

process. If a broader potential range of $10^{-11}$ W·m$^{-2}$ to $10^{-12}$ W·m$^{-2}$ is considered then the continued emission of photons at this quantity would be required to maintain the function connection to entropy [29]. Although Life and its constituents may not meet the criteria for a quantum condensate, some of its components may qualify as a homogenate.

## 6. EXCESS CORRELATION AND ENTANGLEMENT

The source of Life mass or total Earth biomass from photon energy from the Sun integrated over $10^{17}$ s creates the conditions for entanglement. This means that pairs of photons with shared inverse parities could share time-space invariant coupling. Hence a change in the parity or polarity of one photon in a pair that remains within the sun could produce the opposite parity in the other photon represented within the volume of a unit biomass. According to Ganichev et al [30] it is well known that "spin polarized electrons can be generated by circularly polarized light and visa versa". In fact a recombination of these spin polarized electrons (or charged particles) is followed by emission of circularly polarized light. That spin can be converted into direct electric current in quantum wells is particularly relevant to Life. These systems behave as a battery with which a spin polarized electric current is associated.

A plethora of correlations between subtle changes in solar activity, such as shifts in solar flux units (1 sfu = $10^{-22}$ W·m$^{-2}$ Hz$^{-1}$), should be expected and has been widely reported [31]. What is critical here is that there would be no requirement for a mediating local variable, such as the sequential pathway from the solar wind (interplanetary magnetic field) to the geomagnetic field to the organism. Instead the effect would be non-local and involve entanglement. Klochek et al [32] showed that specific physical chemical reactions occurred ~8 min (the approximate time for light to be mediated as electromagnetic waves over the distance between the Earth and the Sun) *before* local sunrise. This effect would be consistent with Rowland's concepts of gravitational, non-local influences [33]. Experimental demonstration of excess correlation and entanglement at the macro-spatial level for photons was reported by Dotta and Persinger [34]. They found that when two photochemical reactions (hydrogen peroxide added as sequential aliquots to hypochlorate solutions) separated by 10 m were exposed to the same, changing angular velocity, rotating magnetic fields (with the potential properties of spin) the photon emissions within the non-local spaces doubled.

The phenomenon behaved as if the two loci had been superimposed within the same space. A similar parity-based change occurred with shifts of pH in spring water [35]. Pairs of volumes of spring water sharing the same fields that produced the excess correlation for photon emissions resulted in successive incremental increases (more alkaline) in pH in the volume that was not disturbed when the other volume of water was injected with small quantities of an acid (and hence decreasing pH).

The hydronium ion was the most likely candidate by which this effect was being mediated. This was supported by the calculated magnitude of the energy per molecule for $H_3O^+$ from the applied magnetic field. The life-time of the hydronium ion before the proton is released to be sequestered within another water molecule (and produce another hydronium ion) averages ~$10^{-12}$ s [36].

This picosecond value becomes particularly important when the velocity of diffusivity predicted to be associated with producing light energy from the rest mass of a graviton [37] is

considered. It is also the velocity associated with the process of entanglement [38]. This value is ~$10^{23}$ m·s$^{-1}$; at short observational distances interactions might appear to be "instantaneous". Considering the distance between the earth and the sun to be $1.2 \cdot 10^{11}$ m, the time required for an excess correlation process to occur would be ~$10^{-12}$ s.

The convergence of quantification would be consistent with the argument that water on the Earth and in living systems could be entangled through photon-hydronium ion (proton shifting) with the water on the Sun. The energy associated with the second shell hydrogen bonds that contribute to proton movements is ~$2.1 \cdot 10^{-20}$ J [36]. This is a discrete quantity that reflects the total properties of the universe distributed within the smallest theoretical distance [22]. There is a prominence of water molecules on the Sun, particularly within the lower temperature regions that are perceived as sunspots [39].

The numbers, areas, and relative equatorial positions of these spots have been associated with phenomena on the surface of the Earth that range from the Piccardi effect [40] involving colloids to massive inter-group human conflict behaviors [41]. The presumption has typically attributed the source of these correlates of solar-biological changes to indirect mediation through geomagnetic activity. If this approach is valid, then non-locality because of the shared source of photons within the Sun and the matter (primarily water) that constitutes living systems would be the primary cause.

## 7. CONCLUSIONS

The mass equivalence of the total, temporally integrated energy from the solar constant over the surface of the earth from the beginning of Life about 3.5 billion years ago to present is remarkably similar to the more direct estimates of the total biomass of the Earth. The slow formation of matter from solar energy within the physical chemistry that defines Life is consistent with the constant re-emission of photons from living systems at magnitudes that approach flux densities and energies distributed throughout the universe and is sufficient to be dispersed as entropy. The solar paired photon sources within the space-time continuum of the Sun and on the terrestrial surface create the condition for non-local effects. The consequences of this entanglement between specific magnitude changes in solar activity and all terrestrial Life require different interpretations than the contemporary variants of serially mediated local mechanisms through the interplanetary field, solar wind and geomagnetic activity.

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