Schumann Resonance (The Fifth Element)

At any given moment about 2,000 thunderstorms roll over Earth, producing some 50 flashes of lightning every second. Each lightning burst creates **electromagnetic waves that begin to circle around Earth captured between Earth's surface and a boundary about 60 miles up.** Some of the waves - if they have just the right wavelength - combine, increasing in strength, to create a **repeating atmospheric heartbeat** known as **Schumann resonance**. This resonance provides a useful tool to **analyze Earth's weather**, its **electric environment**, and to even help determine what types of atoms and molecules exist in Earth's atmosphere.

The waves created by lightning do not look like the up and down waves of the ocean, but they still oscillate with regions of greater energy and lesser energy. These waves remain trapped inside an atmospheric ceiling created by the lower edge of the **"ionosphere" - a part of the atmosphere filled with charged particles**, which begins about **60 miles up into the sky**. In this case, the sweet spot for resonance requires the wave to be as long (or twice, three times as long, etc.) as the circumference of Earth. This is an extremely low frequency wave that can be as low as **8 Hertz (Hz)** - some one hundred thousand times lower than the lowest frequency radio waves used to send signals to your AM/FM radio.

As this wave flows around Earth, it hits itself again at the perfect spot such that the crests and troughs are aligned. Voila, waves acting in resonance with each other to **pump up the original signal**.

While they'd been predicted in 1952, Schumann resonances were first measured reliably in the early 1960s. Since then, scientists have discovered that variations in the resonances correspond to changes in the seasons, solar activity, **activity in Earth's magnetic environment**, in water aerosols in the atmosphere, and other Earth-bound phenomena.

Centurion Systems PEMF Frequency (The Fifth Element)

The Centurion "EZY System", creates the perfect system for you to have the exact Earths Schumann Resonance frequency to affect all cells of your Body everyday. This will bring your body into Complete Health, Harmony and Balance.

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The Combination of the Earths Geomagnetic Frequency and the Atmospheric heart beat, "The Schumann Resonance", is what keeps all life at the right resonance is the Lifeforce and the Life source of Planet Earth.

Without the Earths Schumann Resonance, all Life on Earth would cease to exist. It's the Frequency of Life.

The Combination of the Earths Geomagnetic Frequency and the Environmental Schumann Resonance Frequency is, "The Fifth Element of Life".

Schumann Resonances – Scientific Description

The **Schumann resonances** (**SR**) are a set of spectrum peaks in the extremely low frequency (ELF) portion of the Earth's electromagnetic field spectrum. Schumann resonances are global electromagnetic resonances, generated and excited by lightning discharges in the cavity formed by the Earth's surface and the ionosphere.[1]

Description

This global electromagnetic resonance phenomenon is named after physicist Winfried Otto Schumann who predicted it mathematically in 1952. Schumann resonances occur because the space between the surface of the Earth and the conductive ionosphere acts as a closed waveguide. The limited dimensions of the Earth cause this waveguide to act as a resonant cavity for electromagnetic waves in the ELF band. The cavity is naturally excited by electric currents in lightning. Schumann resonances are the principal background in the part of the electromagnetic spectrum[2] from 3 Hz through 60 Hz,[3] and appear as distinct peaks at extremely low frequencies (ELF) around 7.83 Hz (fundamental),[4] 14.3, 20.8, 27.3 and 33.8 Hz.[5]

In the normal mode descriptions of Schumann resonances, the fundamental mode is a standing wave in the Earth–ionosphere cavity with a wavelength equal to the circumference of the Earth. This lowest-frequency (and highest-intensity) mode of the Schumann resonance occurs at a frequency of approximately 4.11 Hz, but this frequency can vary slightly from a variety of factors, such as solar-induced perturbations to the ionosphere, which compresses the upper wall of the closed cavity.[citation needed] The higher resonance modes are spaced at approximately 6.5 Hz intervals,[citation needed] a characteristic attributed to the atmosphere's spherical geometry. The peaks exhibit a spectral width of approximately 20% on account of the damping of the respective modes in the dissipative cavity. The 8th partial lies at approximately 60 Hz.[citation needed]

Observations of Schumann resonances have been used to track global lightning activity. Owing to the connection between lightning activity and the Earth's climate it has been suggested that they may also be used to monitor global temperature variations and variations of water vapor in the upper troposphere. It has been speculated that extraterrestrial lightning (on other planets) may also be detected and studied by means of their Schumann resonance signatures. Schumann resonances have been used to study the lower ionosphere on Earth and it has been suggested as one way to explore the lower ionosphere on celestial bodies. Effects on Schumann resonances have been reported following geomagnetic and ionospheric disturbances. More recently, discrete Schumann resonance excitations have been linked to transient luminous events – sprites, ELVES, jets, and other upper-atmospheric lightning.[citation needed] A new field of interest using Schumann resonances is related to short-term earthquake prediction.[citation needed] Interest in Schumann resonances was renewed in 1993 when E. R. Williams showed a correlation between the resonance frequency and tropical air temperatures, suggesting the resonance could be used to monitor global warming.[6][7].In applied geophysics, the resonances of schumann are used in the prospection of offshore hydrocarbon deposits[8].

History

In 1893, George Francis FitzGerald noted that the upper layers of the atmosphere must be fairly good conductors. Assuming that the height of these layers is about 100 km above ground, he estimated that oscillations (in this case the lowest mode of the Schumann resonances) would have a period of 0.1 second.[9] Because of this contribution, it has been suggested to rename these resonances "Schumann–FitzGerald resonances".[10] However FitzGerald's findings were not widely known as they were only presented at a meeting of the British Association for the Advancement of Science, followed by a brief mention in a column in *Nature*.

Hence the first suggestion that an ionosphere existed, capable of trapping electromagnetic waves, is attributed to Heaviside and Kennelly (1902).[11][12] It took another twenty years before Edward Appleton and Barnett in 1925[13] were able to prove experimentally the existence of the ionosphere.

Although some of the most important mathematical tools for dealing with spherical waveguides were developed by G. N. Watson in 1918,[14] it was Winfried Otto Schumann who first studied the theoretical aspects of the global resonances of the earth–ionosphere waveguide system, known today as the Schumann resonances. In 1952–1954 Schumann, together with H. L. König, attempted to measure the resonant frequencies.[15][16][17][18] However, it was not until measurements made by Balser and Wagner in 1960–1963[19][20][21][22][23] that adequate analysis techniques were available to extract the resonance information from the background noise. Since then there has been an increasing interest in Schumann resonances in a wide variety of fields.

Basic theory

Lightning discharges are considered to be the primary natural source of Schumann resonance excitation; lightning channels behave like huge antennas that radiate electromagnetic energy at frequencies below about 100 kHz. [24] These signals are very weak at large distances from the lightning source, but the Earth–ionosphere waveguide behaves like a resonator at ELF frequencies and amplifies the spectral signals from lightning at the resonance frequencies. [24]

In an ideal cavity, the resonant frequency of the {\display style n} n-th mode {\display style f_{n}} f_{{n}} is determined by the Earth radius {\display style a} a and the speed of light {\display style c} c.[15]

{\display style f_{n}={\frac {c}{2\pi a}}{\sqrt {n(n+1)}}} f_{{n}}={\frac {c}{2\pi a}}{\sqrt {n(n+1)}}

The real Earth–ionosphere waveguide is not a perfect electromagnetic resonant cavity. Losses due to finite ionosphere electrical conductivity lower the propagation speed of electromagnetic signals in the cavity, resulting in a resonance frequency that is lower than would be expected in an ideal case, and the observed peaks are wide. In addition, there are a number of horizontal asymmetries – day-night difference in the height of the ionosphere, latitudinal changes in the Earth's magnetic field, sudden ionospheric disturbances, polar cap absorption, variation in the Earth radius of ± 11 km from equator to geographic poles, etc. that produce other effects in the Schumann resonance power spectra.

Measurements

Today Schumann resonances are recorded at many separate research stations around the world. The sensors used to measure Schumann resonances typically consist of two horizontal magnetic inductive coils for measuring the north-south and east-west components of the magnetic field, and a vertical electric dipole antenna for measuring the vertical component of the electric field. A typical passband of the instruments is 3–100 Hz. The Schumann resonance electric field amplitude (~300 microvolts per meter) is much smaller than the static fair-weather electric field (~150 V/m) in the atmosphere. Similarly, the amplitude of the Schumann resonance magnetic field (~1 picotesla) is many orders of magnitude smaller than the Earth's magnetic field (~30–50 microteslas).[25] Specialized receivers and antennas are needed to detect and record Schumann resonances. The electric component is commonly measured with a ball antenna, suggested by Ogawa et al., in 1966,[26] connected to a high-impedance amplifier. The magnetic induction coils typically consist of tens- to hundreds-of-thousands of turns of wire wound around a core of very high magnetic permeability.

Dependence on global lightning activity

From the very beginning of Schumann resonance studies, it was known that they could be used to monitor global lightning activity. At any given time there are about 2000 thunderstorms around the globe.[27] Producing ~50 lightning events per second,[28] these thunderstorms are directly linked to the background Schumann resonance signal.

Determining the spatial lightning distribution from Schumann resonance records is a complex problem: in order to estimate the lightning intensity from Schumann resonance records it is necessary to account for both the distance to lightning sources and the wave propagation between the source and the observer. A common approach is to make a preliminary assumption on the spatial lightning distribution, based on the known properties of lightning climatology. An alternative approach is placing the receiver at the North or South Pole, which remain approximately equidistant from the main thunderstorm centers during the day.[29] One method not requiring preliminary assumptions on the lightning distribution[30] is based on the decomposition of the average background Schumann resonance spectra, utilizing ratios between the average electric and magnetic spectra and between their linear combination. This technique assumes the cavity is spherically symmetric and therefore does not include known cavity asymmetries that are believed to affect the resonance and propagation properties of electromagnetic waves in the system.

Diurnal variations

The best documented and the most debated features of the Schumann resonance phenomenon are the diurnal variations of the background Schumann resonance power spectrum.

A characteristic Schumann resonance diurnal record reflects the properties of both global lightning activity and the state of the Earth–ionosphere cavity between the source region and the observer. The vertical electric field is independent of the direction of the source relative to the observer, and is therefore a measure of global lightning. The diurnal behavior of the vertical electric field shows three distinct maxima, associated with the three "hot spots" of planetary lightning activity: one at 9 UT (Universal Time) linked to the daily peak of thunderstorm activity from Southeast Asia; one at 14 UT linked to the peak of African lightning activity; and one at 20 UT linked to the peak of South American lightning activity. The time and amplitude of the peaks vary throughout the year, linked to seasonal changes in lightning activity.

"Chimney" ranking

In general, the African peak is the strongest, reflecting the major contribution of the African "chimney" to global lightning activity. The ranking of the two other peaks—Asian and American—is the subject of a vigorous dispute among Schumann resonance scientists. Schumann resonance observations made from Europe show a greater contribution from Asia than from South America, while observations made from North America indicate the dominant contribution comes from South America.

Williams and Sátori[31] suggest that in order to obtain "correct" Asia-America chimney ranking, it is necessary to remove the influence of the day/night variations in the ionospheric conductivity (day-night asymmetry influence) from the Schumann resonance records. The "corrected" records presented in the work by Sátori, et al.[32] show that even after the removal of the day-night asymmetry influence from Schumann resonance records, the Asian contribution remains greater than American.

Similar results were obtained by Pechony et al.[33] who calculated Schumann resonance fields from satellite lightning data. It was assumed that the distribution of lightning in the satellite maps was a good proxy for Schumann excitations sources, even though satellite observations predominantly measure in-cloud lightning rather than the cloud-to-ground lightning that are the primary exciters of the resonances. Both simulations—those neglecting the day-night asymmetry, and those taking this asymmetry into account—showed the same Asia-America chimney ranking. On the other hand, some optical satellite and climatological lightning data suggest the South American thunderstorm center is stronger than the Asian center.[28]

The reason for the disparity among rankings of Asian and American chimneys in Schumann resonance records remains unclear, and is the subject of further research.

Influence of the day-night asymmetry

In the early literature the observed diurnal variations of Schumann resonance power were explained by the variations in the source-receiver (lightning-observer) geometry.[19] It was concluded that no particular systematic variations of the ionosphere (which serves as the upper waveguide boundary) are needed to explain these variations.[34] Subsequent theoretical studies supported the early estimations of the small influence of the ionosphere day-night asymmetry (difference between day-side and night-side ionosphere conductivity) on the observed variations in Schumann resonance field intensities.[35]

The interest in the influence of the day-night asymmetry in the ionosphere conductivity on Schumann resonances gained new strength in the 1990s, after publication of a work by Sentman and Fraser.[36] Sentman and Fraser developed a technique to separate the global and the local contributions to the observed field power variations using records obtained simultaneously at two stations that were widely separated in longitude. They interpreted the diurnal variations observed at each station in terms of a combination of a diurnally varying global excitation modulated by the local ionosphere height. Their work, which combined both observations and energy conservation arguments, convinced many scientists of the importance of the ionospheric day-night asymmetry and inspired numerous experimental studies. However, recently it was shown that results obtained by Sentman and Fraser can be approximately simulated with a uniform model (without taking into account ionosphere day-night variation) and therefore cannot be uniquely interpreted solely in terms of ionosphere height variation.[37]

Schumann resonance amplitude records show significant diurnal and seasonal variations which in general coincide in time with the times of the day-night transition (the terminator). This time-matching seems to support the suggestion of a significant influence of the day-night ionosphere asymmetry on Schumann resonance amplitudes. There are records showing almost clock-like accuracy of the diurnal amplitude changes.[32] On the other hand, there are numerous days when Schumann Resonance amplitudes do not increase at sunriseor do not decrease at sunset. There are studies showing that the general behavior of Schumann resonance amplitude records can be recreated from diurnal and seasonal thunderstorm migration, without invoking ionospheric variations.[33][35] Two recent independent theoretical studies have shown that the variations in Schumann resonance power related to the day-night transition are much smaller than those associated with the peaks of the global lightning activity, and therefore the global lightning activity plays a more important role in the variation of the Schumann resonance power.[33][38]

It is generally acknowledged that source-observer effects are the dominant source of the observed diurnal variations, but there remains considerable controversy about the degree to which day-night signatures are present in the data. Part of this controversy stems from the fact that the Schumann resonance parameters extractable from observations provide only a limited amount of information about the coupled lightning source-ionospheric system geometry. The problem of inverting observations to simultaneously infer both the lightning source function and ionospheric structure is therefore extremely underdetermined, leading to the possibility of non-unique interpretations.

"Inverse problem"

One of the interesting problems in Schumann resonances studies is determining the lightning source characteristics (the "inverse problem"). Temporally resolving each individual flash is impossible because the mean rate of excitation by lightning, ~50 lightning events per second globally, mixes up the individual contributions together. However, occasionally extremely large lightning flashes occur which produce distinctive signatures that stand out from the background signals. Called "Q-bursts", they are produced by intense lightning strikes that transfer large amounts of charge from clouds to the ground and often carry high peak current.[26] Q-bursts can exceed the amplitude of the background signal level by a factor of 10 or more and appear with intervals of ~10 s,[30] which allows to consider them as isolated events and determine the source lightning location. The source location is determined with either multi-station or single-station techniques and requires assuming a model for the Earth–ionosphere cavity. The multi-station techniques are more accurate, but require more complicated and expensive facilities.

Transient luminous events research

It is now believed that many of the Schumann resonances transients (Q bursts) are related to the transient luminous events (TLEs). In 1995 Boccippio et al.[39] showed that sprites, the most common TLE, are produced by positive cloud-to-ground lightning occurring in the stratiform region of a thunderstorm system, and are accompanied by Q-burst in the Schumann resonances band. Recent observations[39][40] reveal that occurrences of sprites and Q bursts are highly correlated and Schumann resonances data can possibly be used to estimate the global occurrence rate of sprites.[41]

Global temperature

Williams [1992][42] suggested that global temperature may be monitored with the Schumann resonances. The link between Schumann resonance and temperature is lightning flash rate, which increases nonlinearly with temperature.[42] The nonlinearity of the lightning-to-temperature relation provides a natural amplifier of the temperature changes and makes Schumann resonance a sensitive "thermometer". Moreover, the ice particles that are believed to participate in the electrification processes which result in a lightning discharge[43]have an important role in the radiative feedback effects that influence the atmosphere temperature. Schumann resonances may therefore help us to understand these feedback effects. In 2006 a paper was published linking Schumann resonance to global surface temperature[44] followed up with a 2009 study.[45]

Upper tropospheric water vapor

Tropospheric water vapor is a key element of the Earth’s climate, which has direct effects as a greenhouse gas, as well as indirect effect through interaction with clouds, aerosols and tropospheric chemistry. Upper tropospheric water vapor (UTWV) has a much greater impact on the greenhouse effect than water vapor in the lower atmosphere,[46] but whether this impact is a positive, or a negative feedback is still uncertain.[47] The main challenge in addressing this question is the difficulty in monitoring UTWV globally over long timescales. Continental deep-convective thunderstorms produce most of the lightning discharges on Earth. In addition, they transport large amount of water vapor into the upper troposphere, dominating the variations of global UTWV. Price [2000][48] suggested that changes in the UTWV can be derived from records of Schumann resonances.