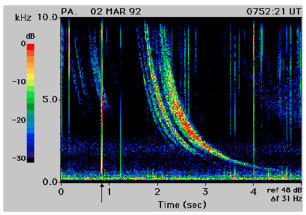


ANNOUNCEMENT OF WINNERS OF THE MAARBLE "SOUNDS OF SPACE" MUSICAL COMPOSITION CONTEST

The MAARBLE "Sounds of Space" Musical Composition Contest

Planet Earth is a natural source of radio waves, which surround us all the time. Although most of these waves are in the acoustic frequency range, they are not audible by humans. They are electromagnetic waves and not acoustic ones. We could "hear" them if we had radio antennas instead of ears.

Radio waves can be detected by our ears if we convert them to sound waves, by using a very low frequency (VLF) receiver. A VLF receiver consists of an antenna and a radio amplifier, and it is sensitive to radio waves. After converting electromagnetic (radio) waves into acoustic (sound) waves, with the same frequency, the sounds produced by our planet

can be “heard”. These sounds correspond to several types of radio emissions propagating in the Earth’s atmosphere, ionosphere and magnetosphere. The way these waves sound, when played through an audio system, defines their name: sferics, tweeks, whistlers, chorus, and hiss. We also call them “Earth Songs”.

The MAARBLE contest of musical composition combines scientific and artistic ways of thinking, i.e. the Art of Music and Space Science. The musical contest is an original idea to provide scientific information to the public, inviting people to “feel” the science and to think about art.

The MAARBLE project invites composers from all EU countries, USA and Canada, to take part in the MAARBLE musical contest. The leading concept is to use the natural sounds of the Earth’s magnetosphere in order to compose electroacoustic music. The relevant Notes for Guidance and the Application Form are available below.

Notes for Guidance - Terms and Conditions
Application form

ANNOUNCEMENT OF WINNERS OF THE MAARBLE “SOUNDS OF SPACE” MUSICAL COMPOSITION CONTEST

We are pleased to announce the successful completion of the MAARBLE Musical Composition Contest. The contest was oversubscribed by a factor of 19 (we received in total 55 applications from 17 countries).

The Selection Committee* met on June 14 for the judging of applications and was very pleased with the overall quality of the submitted compositions, which made the selection of winners a very difficult task.

The Selection Committee concluded on the ten highest ranked (including the three winning) compositions of the Musical Composition Contest as follows:

First Prize (award of 1500 €): **“Breathing Underwater”** by **Otto Wanke** (Czech Republic)

Second Prize (award of 750 €): **“Picnic in the Ionosphere”** by **Antonio J. Cebrian** (Spain)

Third Prize (award of 500 €): **“Golden Waves”** by **Susan Ann Brewster** (UK/USA)

Rank	Composer	Composition	Country

1	Otto Wanke	Breathing Underwater	Czech Republic
2	Antonio J. Cebrian	*Picnic in the Ionosphere*	Spain
3	Susan Ann Brewster	*Golden Waves*	UK/USA
4	David Snow	*Das Lied von der Magnetosphäre*	USA
5	Dimitris Maronidis	*SonoSferics for Tape*	Greece
6	Kalle Vainio	*Silent Travellers*	Finland
7	Elias Kotzias	*EarthVoice*	Greece
8	Damon Alexander Bailey	*Of Space and Earth*	UK
9	Maria-Luisa Acuña	*Shooting Star*	Spain
10	Bruno Misonne	*Solar Storm*	Belgium

The three winning compositions werw officially presented on Tuesday, 16 September 2014, during the international conference "Geospace revisited: a Cluster/MAARBLE/Van Allen Probes Conference" in Rhodes island, Greece.

AWARD CEREMONY - Rodon Municipal Theater

MAARBLE Outreach Team

*The Selection Committee comprises musicians and physicists as follows:
Anastasios Anastasiadis, *PhD, Solar physicist, Leader of MAARBLE Dissemination and Outreach, Research Director at the National Observatory of Athens*
Eleni Chatzichristou, *PhD, Astrophysicist, Outreach officer of the MAARBLE project, Director of Education & Development at the College of Rhodes*
Ioannis A. Daglis, *PhD, Space physicist, Coordinator of the MAARBLE project, Professor of the*

University of Athens
Nickos Harizanos, *MMus, Composer, General Secretary of the Contemporary Music Research Centre, Athens*
Costas Mantzoros, *Composer, Contemporary Music Research Center, Athens*
George Palamiotis, *Musician, bass artist, composer, Athens*
Costas Papadoukas, *Musicologist (DEA Paris IV), film composer and orchestrator, Paris*

Samples and descriptions of characteristic space sounds

Sferics

The shortcut for “atmospherics” because they are emitted by lighting strokes. They propagate great distances round the Earth bouncing between Earth’s surface and the ionosphere, from 90km above the ground to thousands of kilometers in altitude. Their dynamic spectra are characterized by vertical lines indicating the simultaneous arrival of all radio frequencies.

Sample of audio file here:

Credit: NASA INSPIRE

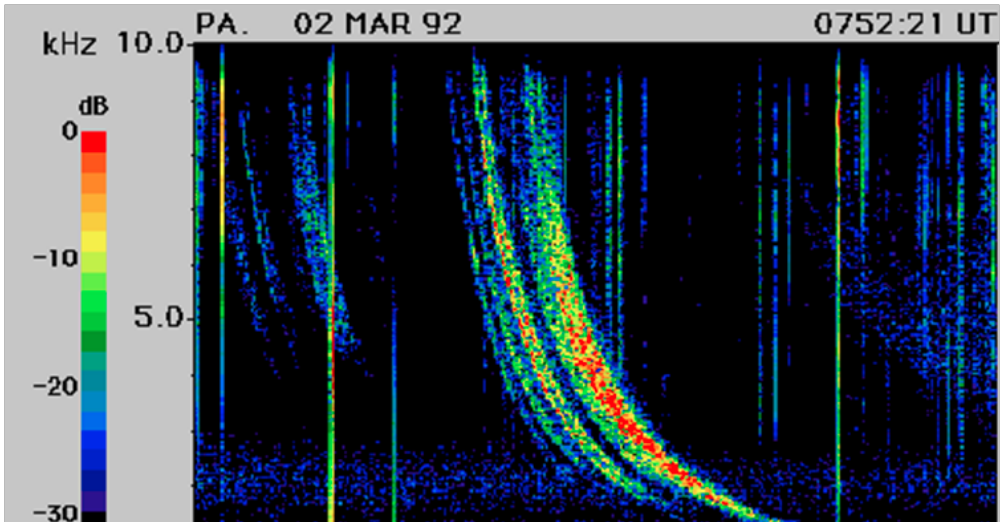
Tweeks

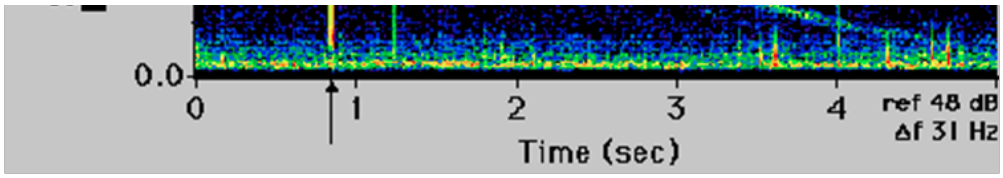
Are sferics that travel farther. Their dynamic spectra illustrates that high frequencies arrive first, followed by the lower ones. The sound they produce is characterized by the non simultaneous arrival of the frequencies they consist of.

Credit: NASA INSPIRE

Whistlers

They originate from thunderstorms or meteorites, or after earthquakes. They propagate at great distances between ground sources and various points in the ionosphere and overlying magnetosphere. They are much more dispersed than the tweeks. They interact with plasma particles in the radiation belts.





Whistler that propagated along geomagnetic-field-aligned paths from a lightning flash in the northern hemisphere to Palmer Station, Antarctica (by the Stanford VLF group)

Credit: NASA INSPIRE

Dawn Chorus

Chorus waves are generated near the magnetic equator outside the plasmasphere, occur over a broad frequency range, from hundreds of Hz up to several kHz and sound like birds singing when played through an audio converter. They interact with high energy electrons in the radiation belts and accelerate them during geomagnetic storms. The accelerated electrons can become dangerous for both satellites (since they can damage electronic

equipment) and astronauts. For this reason they are called “killer electrons”. Chorus emissions are observed over a wide range of local times, having a peak near local dawn. Chorus intensity increases during magnetospheric substorms, periods during which the aurora is observed in high latitudes.

Credit: ESA

Hiss

Plasmaspheric hiss are low-frequency radio waves. Electrons in the outer radiation belt can extract energy from chorus waves to reach near-light speed and become dangerous for human activity in near space environment. When this happens, the chorus evolves into another type of radio wave called hiss. Hiss deflects the speedy particles into Earth's upper atmosphere, where they lose energy and are absorbed when they hit atoms and molecules there.

Sample of audio file here:

Credit: University of Iowa

Read more:
http://www.nasa.gov/mission_pages/themis/news/themis_singing_electrons.html
http://science.nasa.gov/science-news/science-at-nasa/2012/28sep_earthsong/
http://science.nasa.gov/science-news/science-at-nasa/2001/ast19jan_1/

Sample of sounds here:
http://www-pw.physics.uiowa.edu/plasma-wave/istp/polar/magnetosound.html
http://www.spaceweather.com/glossary/inspire.html
http://theinspireproject.org/default.asp?contentID=17