Geophysical Research Abstracts
Vol. 14, EGU2012-13047, 2012
EGU General Assembly 2012

Digital Low Frequency Radio Camera

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This contribution reports the design, realization and operation of a novel digital low frequency radio camera towards an exploration of the Earth's electromagnetic environment with particular emphasis on lightning discharges and subsequent atmospheric effects such as transient luminous events.

The design of the digital low frequency radio camera is based on the idea of radio interferometry with a network of radio receivers which are separated by spatial baselines comparable to the wavelength of the observed radio waves, i.e. $\sim$1-100 km which corresponds to a frequency range from $\sim$3-300 kHz.

The key parameter towards the realization of the radio interferometer is the frequency dependent slowness of the radio waves within the Earth's atmosphere with respect to the speed of light in vacuum. This slowness is measured with the radio interferometer by using well documented radio transmitters.

The digital low frequency radio camera can be operated in different modes. In the imaging mode, still photographs show maps of the low frequency radio sky. In the video mode, movies show the dynamics of the low frequency radio sky. The exposure time of the photograhps, the frame rate of the video, and the radio frequency of interest can be adjusted by the observer. Alternatively, the digital radio camera can be used in the monitoring mode, where a particular area of the sky is observed continuously.

The first application of the digital low frequency radio camera is to characterize the electromagnetic energy emanating from sprite producing lightning discharges, but it is expected that it can also be used to identify and investigate numerous other radio sources of the Earth's electromagnetic environment.