

Looking at the natural atmospheric electromagnetic environment with ULF/ELF magnetometer arrays

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Introduction

The electromagnetic radiation from natural atmospheric sources is recorded in the ULF/ELF frequency range from 1-1000 Hz with various magnetometer arrays on three different spatial scales. Each magnetometer array includes three magnetometers which are separated by tens, hundreds, and thousands of kilometers on the local, regional, and global scale respectively.

Local scale

The local array of magnetometers can be used for beam forming ULF/ELF radiation and for the development of noise reduction processing schemes, since the natural atmospheric electromagnetic radiation in the ULF/ELF frequency range is highly correlated on the local scale.

Regional scale

The regional array can be used to investigate lightning discharge occurrences and the electromagnetic signatures of sprites in particular. The theoretical description of the observed magnetic field disturbances with the normal mode expansion and frequency dependent ionospheric heights may be extended to the near field, i.e., to source-receiver distances smaller than 2000 km and can be tested with the observed magnetic fields.

Global scale

The global array can be used to triangulate particularly intense lightning discharges on the planetary scale. The source locations are validated with satellite based cloud cover recordings in central Africa and the observed lightning discharge intensities are well correlated to the cloud cover area near the tropopause. Oceanic lightning discharges are of particular interest and their contribution to the global atmospheric electric circuit can be estimated.

Summary

As the digital data acquisition and processing facilities improve their capacities constantly, it is expected that ULF/ELF magnetometer arrays on various spatial scales will continue to contribute significantly to our understanding of the natural atmospheric electromagnetic environment in the future.