AUTOMATIC WHISTLER DETECTION: OPERATIONAL RESULTS FROM NEW ZEALAND

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Abstract

Single-hop lightning-generated whistlers are observed by ground-based VLF detectors after propagation through the source ionosphere, inside a plasmaspheric field-aligned whistler duct, and finally through the ionosphere in the conjugate region. Whistlers can be used to determine plasmaspheric properties. The Eötvös University Automatic Whistler Detector (AWD) system has been operating in New Zealand since mid-May 2005. In this paper we will report on the statistics from the ~ 2 years of operation, in which 236019 whistler traces were measured. This is a step towards providing regular near-automatic plasmaspheric measurements to the scientific community.

Background Information

Whistlers have been regarded as cheap and effective tools for plasmasphere diagnostic since the early years of whistler research. The Eötvös University Automatic Whistler Detector (AWD) system has been operating in New Zealand since mid-May 2005. Single-hop lightning-generated whistlers are observed by ground-based VLF detectors after the electromagnetic energy has propagated through the source ionosphere, inside a field-aligned whistler duct in the plasmasphere, and finally through the ionosphere in the conjugate region. Whistlers can be used to determine plasmaspheric properties, including the plasmaspheric electron density and the L-shell of the whistler duct. Our goal is to examine the effectiveness of a Dunedin-based whistler system for providing regular and semi-automatic measurements of plasmaspheric densities to the wider scientific community.

In this paper we report on the analysis of the first 530 days of AWD system operation, spanning the period from 20 May 2005 - 31 October 2006, and hope to expand the report to include more recent data. While the AWD continued to operate until November 2007 (at which time it was upgraded to a new instrument), all of the first 530 days were analysed by one researcher. The developmental philosophy of the whistler detection algorithm was to "over trigger", i.e., to attempt to capture all possible whistlers but accept some events will be captured which do not represent whistlers. The whistler detector output is then manually examined "by eye" to determine if the 4 s captured record contains a whistler. Over the first 530 days of operation the AWD system captured 147,339 records, of which 61,448 contained whistlers, i.e., a system accuracy of ~42%.

We find that the whistler rate at Dunedin is fairly similar to the whistler rate previously reported from Tihany, Hungary, despite there being ~1500 times more lightning at Tihany's conjugate point. Clearly there is no simple relationship between conjugate lightning activity and whistler rates. Dunedin whistler rates are high, hundreds of times higher than estimated from the conjugate lightning activity, showing that conjugate lightning activity levels are not a good predictor of whistler rates. Dunedin-observed whistlers are most common during the day time, in stark contrast with earlier findings. North American lightning may be the principle source of Dunedin-whistlers, but this is still to be confirmed.

The Eötvös University Automatic Whistler Detector (AWD) has functioned very successfully in Dunedin, detecting a large population of whistlers over a wide range of L-shells and with a relatively small false trigger rate. A newly deployed Automatic Whistler Detector and Analyser system may achieve the goal of providing regular near-automatic plasmaspheric measurements to the wider scientific community.