Whistler-Mode Waves inside Density Ducts Observed by the Van Allen Probes

Sara A. Rosborough, Miles T. Bensington, Roxanne L. Stein, Morgan M. Matheny, Anatoly V. Streltsov

Department of Physical Sciences, Embry-Riddle Aeronautical University

600 S. Clyde Morris Blvd., Daytona Beach, FL, 32114, United States

The Van Allen Probes satellites launched by NASA in 2012 are currently orbiting in Earth's radiation belts collecting data about electromagnetic waves and charged particles in the near-earth space environment. Whistler-mode waves are naturally occurring right-hand polarized, very-low frequency waves (< 30 kHz), that can efficiently interact with the energetic electrons in the earth's radiation belts magnetosphere and remediate them from the magnetosphere by precipitating these particles into the atmosphere. The important property of the whistler-mode waves is that they can be guided by density inhomogeneities extended along the ambient magnetic field and localized in the direction perpendicular to the field. Such density channels can be formed by the density enhancement or depletion and they are called ducts. The primary goal of our research is to find density duct and whistler waves in the data recorded by the Van Allen Probes satellites in the magnetosphere, and to reproduce these data with numerical simulations of time-dependent, two-dimensional electron MHD model. In this paper we present results from our analysis of the observations performed by the Van Allen Probes satellites on 15 October 2014. Data from the probes show the electric and magnetic fields and plasma density. In this event whistler-mode waves were observed from 1:40 to 2:00 UT inside the localized density enhancement coincided with the flux of energetic electrons. Short time intervals, high concentrated electron density, and electron flux gradient activity make this event very interesting for the investigation. Numerical simulations of the electron MHD model revels reasonable quantitative agreement between numerical results and satellite observations, suggesting that the electromagnetic disturbances recorded by the Van Allen Probes satellites, are the whistler-mode waves indeed.