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Comparison of Cluster data for VLF chorus waves and the backward-wave oscillator model for chorus formation

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We summarize the recent results of comparison of Cluster data on VLF chorus emissions and estimates based on the backward wave oscillator (BWO) model of chorus generation. The model employs the absolute whistler cyclotron instability in the near-equatorial region of the magnetosphere. For realistic fluxes of energetic particles, the instability of parallel-propagating whistler-mode waves can become absolute if a step-like distortion exists in the distribution function of energetic electrons. The model allows us to estimate the scale of the chorus source region, the growth rate, amplitude, and frequency drift of chorus elements. Moreover, it implies certain spatio-temporal features of the chorus Poynting flux and frequency spectrum. In particular, the chorus spectrum, according to a scheme based on the model, should lack lower frequencies near the center of the generation region. Another important feature following from the model is that the source region should remain near the local magnetic-field minimum even if the magnetic field structure is slowly changing. These features are sought in the Cluster data which allow us to study in detail the chorus spectrum dynamics at different locations. The chorus source is localized using multicomponent measurements of the electric and magnetic fields by the STAFF-SA instrument. Inside the source region, we analyze high-resolution frequency spectra of chorus wave packets based on the data of the WBD instrument. The position of the magnetic-field minimum can be obtained using the magnetic-field data from different Cluster spacecraft. For that,

we fit a parameterized model of the geomagnetic field to these data. The data analysis performed for two different geomagnetically active days confirms the important features of chorus dynamics following from the BWO model. Moreover, quantitative agreement between the data and the model is demonstrated by simultaneous variation of the statistical chorus characteristics and the BWO parameters deduced from data.