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Role of the nonlinear Landau resonance in intense precipitations of sub-relativistic electrons

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Precipitations of energetic electrons into the Earth's atmosphere are important factor of radiation belt dynamics and the magnetosphere-ionosphere coupling. Microbursts, which are the most intense of such precipitations, are short-living bursts of precipitating fluxes detected by low-altitude spacecraft. Due to wide energy ranges of observed microbursts and their transient nature, they are generally associated with energetic electron scattering into the loss-cone via cyclotron resonance with field-aligned intense whistler-mode chorus waves. In this study, we show that intense sub-relativistic precipitations may be generated via the nonlinear Landau resonance of electrons with very oblique whistler-mode waves. Such precipitations are not associated with electron flux decrease in the radiation belts, but rather indicate the rapid electron acceleration up to 100-200 keV around the equator. We combine theoretical model of the nonlinear Landau resonances and equatorial observations of very oblique intense whistler-mode waves. The proposed scenario of intense sub-relativistic precipitations demonstrate the importance of very oblique whistler-mode waves for the radiation belt dynamics.