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Nonlinear local parallel acceleration of electrons through Landau trapping by oblique whistler mode waves in the outer radiation belt

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Simultaneous observations of electron velocity distributions and chorus waves by the Van Allen Probe B are analyzed to identify long-lasting (more than 6 h) signatures of electron Landau resonant interactions with oblique chorus waves in the outer radiation belt. Such Landau resonant interactions result in the trapping of $\sim$1–10 keV electrons and their acceleration up to 100–300 keV. This kind of process becomes important for oblique whistler mode waves having a significant electric field component along the background magnetic field. In the inhomogeneous geomagnetic field, such resonant interactions then lead to the formation of a plateau in the parallel (with respect to the geomagnetic field) velocity distribution due to trapping of electrons into the wave effective potential. We demonstrate that the electron energy corresponding to the observed plateau remains in very good agreement with the energy required for Landau resonant interaction with the simultaneously measured oblique chorus waves over 6 h and a wide range of L shells (from 4 to 6) in the outer belt. The efficient parallel acceleration modifies electron pitch angle distributions at energies $\sim$50–200 keV, allowing us to distinguish the energized population. The observed energy range and the density of accelerated electrons are in reasonable agreement with test particle numerical simulations.