Geophysical Research Abstracts
Vol. 21, EGU2019-12710, 2019
EGU General Assembly 2019

Comparison of quasi-linear and hybrid-Vlasov simulations of Earth's ULF foreshock

Alexandr Afanasiev (1), Rami Vainio (1), Yann Pfau-Kempf (2), Urs Ganse (2), Lucile Turc (2), Minna Palmroth (2,3)

(1) Department of Physics and Astronomy, University of Turku, Turku, Finland (alexandr.afanasiev@utu.fi), (2) Department of Physics, University of Helsinki, Helsinki, Finland, (3) Space and Earth Observation Centre, Finnish Meteorological Institute, Helsinki, Finland

The region upstream of the Earth's bow shock, known as the foreshock, has now become accessible for modeling with the focus on both the realistic global spatial extent and kinetic ion-scale physics. This is addressed, in particular, by a hybrid-Vlasov simulation, Vlasiator, which solves the Vlasov equation for ions and applies a fluid description for electrons. On the other hand, the foreshock can be modeled using quasi-linear theory of wave-particle interactions. This approach has been widely used in application to coronal and interplanetary shocks. It is, therefore, useful to compare quasi-linear simulations of the foreshock with more fundamental kinetic plasma simulations. In this work, we use simulations with the SOLar Particle Acceleration in Coronal Shocks (SOLPACS) quasi-linear Monte Carlo code, conducted for the near-Earth plasma parameters, and compare them with a Vlasiator simulation. Specifically, we compare properties of the ultralow frequency (ULF) waves in the inner part of the foreshock. We find agreement between the two simulation models in terms of the wave polarization of transverse magnetic field fluctuations. However, there is essential difference in the temporal evolution of the wave power spectra in the simulations. Among various reasons, this difference could be due to resonance broadening of wave-particle interactions in the presence of a strong beam of protons reflected from the bow shock. We also discuss whether this effect can be expected in the foreshocks of interplanetary and coronal shocks.