EGU22-7655
https://doi.org/10.5194/egusphere-egu22-7655
EGU General Assembly 2022

Transmission of foreshock waves through the Earth's magnetosheath

Lucile Turc[1], Owen Roberts[2], Daniel Verscharen[3], Andrew Dimmock[4], Primoz Kajdic[5], Minna Palmroth[1,6], Yann Pfau-Kempf[1], Andreas Johlander[1,4], Maxime Dubart[1], Emilia Kilpua[1], Jan Soucek[7], Kazue Takahashi[8], Naoko Takahashi[9], Markus Battarbee[1], and Urs Ganse[1]

[1]University of Helsinki, Faculty of Science, Department of Physics, Helsinki, Finland (lucile.turc@helsinki.fi)
[2]Space Research Institute, Austrian Academy of Sciences, Graz, Austria
[3]Mullard Space Science Laboratory, University College London, UK
[4]Swedish Institute of Space Physics, Uppsala, Sweden
[5]Departamento de Ciencias Espaciales, Instituto de Geofísica, Universidad Nacional Autónoma de México, Mexico
[6]Finnish Meteorological Institute, Helsinki, Finland
[7]Institute of Atmospheric Physics, Czech Academy of Sciences, Czech Republic
[8]The Johns Hopkins University Applied Physics Laboratory, Laurel, MD, USA
[9]National Institute of Information and Communications Technology, Tokyo, Japan

The foreshock, extending upstream of the quasi-parallel shock and populated with shock-reflected particles, is home to intense wave activity in the ultra-low frequency range. The most commonly observed of these waves are the "30-second" waves, fast magnetosonic waves propagating sunward in the plasma rest frame, but carried earthward by the faster solar wind flow. These waves are thought to be the main source of Pc3 magnetic pulsations (10 – 45 s periods) in the dayside magnetosphere, but how the waves can transmit through the bow shock and across the magnetosheath remains unclear. Global hybrid-Vlasov simulations performed with the Vlasiator model provide us with the global view of foreshock wave transmission across near-Earth space. We find that the foreshock waves act as fast-mode pulses hammering periodically the shock, which impulsively sends perturbations in the downstream at the fast-mode speed. These fast-mode disturbances propagate in the magnetosheath all the way to the magnetopause, where they can further transmit into the dayside magnetosphere. The wave propagation across the bow shock appears to be much more complex than the simple "direct transmission" of the foreshock waves which was inferred in early studies. This is due to the complex two-way interactions between the waves and the shock, including shock reformation. We compare our global simulation results with local 1D simulations, and we show that the wave signatures in the downstream strongly depend on the global properties of the shock-magnetosheath system. This emphasises the importance of carrying out global simulations in this context.