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Effects of an enhanced interplanetary magnetic field strength on the large-scale structure of foreshock ULF waves

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The foreshock is the region upstream of the Earth's bow shock which is populated by backstreaming particles reflected at the shock's surface. The interaction of this suprathermal population with the incoming solar wind produces a variety of ultra-low frequency (ULF) waves. In particular, sunward propagating (in the plasma rest frame) magnetosonic waves with a period of about 30s are frequently observed in the terrestrial foreshock. In this work, we concentrate on the large-scale structure of these wave fronts. A recent simulation work using the hybrid-Vlasov model Vlasiator has shown that the wave fronts are organised around two "spines", at which the direction of propagation of the waves changes (Palmroth et al., 2015). We find that when doubling the interplanetary magnetic field (IMF) strength, many more spines arise in the foreshock, resulting in the wave fronts being much shorter in the transverse direction. Their wave length is halved, as expected from the increase in the IMF magnitude. The foreshock therefore appears to be structured over smaller scales in high IMF conditions. We compare our numerical results with Cluster multi-spacecraft measurements in the Earth's foreshock. We estimate the transverse extent of the wave fronts for several intervals of relatively steady IMF, and with different IMF strengths, and comment on similarities between observations and simulations. Finally, we discuss the coupling between small and large scales, as ULF waves can modulate shock rippling and particle reflection, which may in turn affect the structure of the wave fronts.