

# The transmission of Pc 3 waves from the foreshock into the Earth's magnetosphere: 3D global hybrid simulation

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Although initially it was presumed that foreshock waves would propagate directly into the dayside magnetosphere, observational evidence for sinusoidal Pc3 waves in the downstream of quasi-parallel shocks is scarce. The transmission of these waves from the foreshock into the magnetosphere remains uncertain. In this paper, we employ a 3D global hybrid simulation at a realistic scale to explore the generation and transmission of the dayside ULF waves under a radial interplanetary magnetic field. Our findings demonstrate that the Pc3 waves are self-consistently generated in the foreshock region and then transmitted into the magnetosheath and magnetosphere. In the foreshock, the waves are excited at approximately 25 mHz and exhibit right-handed helicity in the plasma frame, characterizing them as quasi-parallel fast magnetosonic waves. In the magnetosphere, the fluctuating magnetic field is mainly parallel to the background magnetic field, which indicates the dominant wave modes are compressional. Fluctuations in the magnetosheath show a broader spectrum (10–100mHz) compared to those in the magnetosphere and foreshock, potentially explaining the little observation of sinusoidal Pc3 waves in the magnetosheath. Additionally, only lower frequency compressional waves (below 30 mHz) are effectively transmitted into the dayside magnetosphere. Our simulation provides critical insights into the interactions between the solar wind and Earth's magnetosphere.

Keywords: Magnetosphere, Foreshock, Pc 3 waves, Global hybrid simulation