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# Magnetospheric and solar wind dependences of coupled fast-mode resonances

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Magnetospheric ultralow frequency (ULF) waves are known to be excited by various transient solar wind, foreshock and magnetosheath phenomena. In the absence of any upstream driving at specific frequencies, radially standing fast mode waves between the magnetopause and a turning point are often invoked to explain observed discrete frequency field line resonances. Applying the theory of these coupled fast mode resonances (cFMRs) to a realistic magnetic field model and magnetospheric density profiles observed over almost half a solar cycle, we investigate the magnetospheric and solar wind factors that control their occurrence probabilities, locations and frequencies. We find that the dawn-dusk asymmetry in magnetospheric density profiles results in cFMRs being more likely around dawn. More generally, the probability of cFMR increases with distance between the magnetopause and the Alfvén speed's local maximum. The latter's location depends on magnetospheric activity: during high activity it is situated slightly outside the plasmapause, whereas at low activity it is found at much larger radial distances. The frequencies of cFMR are proportional to the Alfvén speed near the magnetopause, which is affected by both density and magnetic field variations hence exhibit considerable spread. The location of the excited resonance, and thus the penetration of fast waves into the magnetosphere, however depends on the relative steepness of the Alfvén speed radial profile. The steeper this is, the closer the resonance is to the outer boundary and vice versa. These numerical calculations applied to realistic densities and magnetic fields over a wide range of conditions have revealed a number of predictions concerning ULF wave behaviour in the outer magnetosphere which may be tested against observations and applied to ULF wave driving models.