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## Alpha transmitter signals observed by the Van Allen Probes: Ducted vs. unducted propagation

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Electromagnetic waves radiated by powerful military very low frequency transmitters can efficiently interact with energetic electrons trapped in the radiation belts and result in their precipitation. However, such interactions ultimately depend on the wave normal angles of propagating emissions. In the equatorial interaction region, these can be either very low (ducted propagation) or comparatively large (unducted propagation). It is thus important to be able to distinguish between the two propagation types and to quantify what portion of the wave energy propagates ducted/unducted. Unfortunately, spacecraft multicomponent wave measurements which would allow to directly experimentally tackle this issue typically do not extend to high enough frequencies with a sufficient frequency resolution. One exception that we exploit are signals from Alpha navigation transmitters, which radiate at frequencies as low as about 11.9 kHz. Such frequencies are readily detectable by the EMFISIS instrument onboard the Van Allen Probes spacecraft operating close to the geomagnetic equator at L-shells between about 1.1 and 6.5. We use respective multicomponent burst mode measurements to distinguish between the ducted and unducted modes of propagation and to evaluate their relative importance under different conditions. We show that while the unducted waves are detected more often, the ducted waves tend to have larger Poynting fluxes, so that the total power propagating in the two modes is roughly comparable.