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Turbulence properties of magnetic clouds and their sheath regions: Parker Solar Probe and Wind comparison

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Magnetic clouds are large-scale transient structures in the solar wind with low plasma β , low-amplitude magnetic field fluctuations, and twisted field lines with both ends often connected to the Sun. We analyse the normalised cross helicity, σ_c , and residual energy, σ_r , in magnetic clouds observed at sub-1 au heliocentric distances by Parker Solar Probe (PSP), and compare to clouds observed at 1 au by the Wind spacecraft. Magnetic clouds commonly display low values of $|\sigma_c|$, indicating that the Alfvénic wave flux parallel and anti-parallel to the mean field is approximately balanced. This low $|\sigma_c|$ is likely caused by the closed field structure of magnetic clouds, and is in contrast to the generally higher $|\sigma_c|$ found on the open field lines of the solar wind. These properties are compared to those found in the compressed and heated sheath regions upstream of the clouds: sheaths tend to have more solar wind-like turbulence properties.

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