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Variations of the helium content across interplanetary shocks

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Changes of the abundance of heavy species observed in the solar wind are usually attributed to spacecraft encounters with streams emanating from different places and altitudes in the source region and their further evolution is considered as being negligible. These conclusions are based on the analysis of highly averaged data and much less attention was devoted to variations on the time scale of seconds. The BMSW instrument onboard the Spektr-R spacecraft provides high-time resolution measurements of the helium and proton fluxes and proton velocity, density, and temperature that are suitable for investigations of rapid variations. In this paper, we compare measurements of variations of the helium content across interplanetary (IP) shocks in two points (Spektr-R and Wind) separated about 200 R_E with a focus on the changes of helium abundance on this scale. The case study shows that the proton density exhibits a smooth profile after the IP shock in the data of both spacecraft, but the helium content is highly variable. Our analysis provides a clear evidence that the abrupt changes of the helium content are caused by the turbulence excited by the IP shock. It is important to note that the changes of protons and helium content are not correlated, thus the helium enhancements cannot be attributed to compressional MHD waves because both species vary independently.