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Simultaneous Observations of SEP Elemental Composition and Spectra on Widely-Separated Spacecraft: Comparisons between Ulysses and ACE/Wind in 2000 - 2001.

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As demonstrated by numerous studies in Solar Cycle 23, elemental composition and its temporal evolution are powerful tools for investigating the acceleration and transport processes that govern large, gradual solar energetic particle (SEP) events. Extending such studies to simultaneous observations at widely-separated spacecraft is a key objective of the STEREO mission. However, as of December 2010, the Sun has not produced any sufficiently large SEP events to facilitate such studies. We have therefore undertaken comparisons of simultaneous SEP observations near Earth (by Wind, ACE, and GOES) and at Ulysses. Specifically, we have examined several large SEP events in 2000-2001, including those that occurred when Ulysses was beyond 2 AU and at high solar latitudes, immersed in the fast solar wind. Although the collecting power of the COSPIN/Low Energy Telescope (LET) on Ulysses is only $\sim$1% as large as that of solar heavy-ion instruments on ACE and Wind (and $\sim$10% as large as those on STEREO), it nevertheless has provided statistically-meaningful measurements in these events. We compare temporal evolution in the Fe/O ratio, as well as in spectral shapes and intensities. We also examine solar ions and their spectra in the late decay phase of events, in the so-called “reservoir” regions. We discuss implications of these observations for models of SEP transport. Supported by NASA under grants NNH09AK79I and NNX09AU98G and by European Commission Grant FP7-COMESEP.