

Preface

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This topical issue, “Ground Level Enhancement Events of Solar Cycle 23” in Space Science Reviews includes papers based on two Coordinated Data Analysis Workshops (CDAWs) held in Palo Alto, California (January 2009) and University of Alabama, Huntsville (November 2009) on Ground Level Enhancement (GLE) events. GLE events first recorded by Scott Forbush in 1942 opened up the opportunity to observe, by ground-based instruments, particles associated with solar activity. Eventually, the lower energy components of these events originating from the solar corona were observed from space and are known as solar energetic particle (SEP) events. With the increased dependence of humans on space technology, the SEPs have become one of the most significant space weather hazards.

Although the solar origin and the flare association of the GLEs was recognized immediately, the exact mechanism of by which these particles are accelerated to multi-GeV energies has remained elusive. GLEs were observed for three decades before the discovery of coronal mass ejections in the early 1970s, so the early works clearly identified the mechanism as “flare acceleration”, which remains as a viable option to the present. However, CME-driven shocks can also accelerate particles just as the supernova shocks do. There is direct evidence that shocks accelerate particles when an observing spacecraft passes through the CME-driven shock. CME observations overlapping with GLE events became available for a few events in cycle 22, but only during cycle 23 do we have a complete set of CME observations, which formed the basis for some of these investigations.

GLE events are rare: only about a dozen events occur in a solar cycle. This is only about 15% of all large SEP events in a solar cycle. So, the question is: What are the special conditions under which the GLEs occur? Papers in this topical issue discuss in detail the source

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and environmental conditions under which the GLE particles are accelerated. The analyses are aided by the excellent set of space and ground based observations (remote sensing, in-situ, and imaging) from the solar surface to the interplanetary medium that became available just before the beginning of solar cycle 23.

We note that this topical issue was not intended to review the entire field of GLEs, but to focus on newer observations, how they fit in with existing ideas, and how understanding of solar-interplanetary phenomena can be improved with their analyses. Not all the issues were covered because of time limitations, so there may be other papers published outside of this issue. There was some time elapsed after the CDAWs, but we hope the time was utilized in making the manuscripts more valuable.

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Guest Editors