A Remarkable Period of Space Weather
October-November 2003

The current solar cycle 23 has been quite ordinary and there have been few periods of intense space weather activity (notably July 2000, April 2001) - little of excitement for space weather forecasters. But a dramatic burst of activity on the sun in October/November 2003 might just herald a reassessment. This interval had everything: very large sunspot regions; intense solar flares; particle events; and a huge geomagnetic disturbance. The intense space weather activity has had many important effects on the many systems that depend on space weather conditions for their operation

Sunspots and Flares: Three sunspot regions have contributed to activity over the period. The most easterly one (SEC#484) grew rapidly on the visible disk of the sun from around October 18. Despite reaching a size on October 29 that made it the largest sunspot group of the cycle, the region was largely benign, producing just two low X class solar flares (October 19, 26) during its passage across the visible solar disk.

Much more action came from the southern hemisphere region (SEC#486), located about 70 degrees of solar longitude west of #484. This region was visible in extreme ultraviolet images from the SOHO spacecraft for several days before it even appeared on the visible disk (approximately on October 25). Its flare production was impressive with a large number of X class flares (seven events but with most large) during its passage across the sun that ended on around November 6. Most impressive were the flares on October 28 (classed as X17) and October 29 (X10). And as the region was rotating off the visible disk on November 04, it produced a second flare saturating detectors at X17 for 12 minutes. Forecasters at the US Space Environment Center estimated the peak of this flare at X28, at which it would rank as the largest X-ray flare since data became available in 1976. The earlier X17 flare is now ranked fourth in this list

Geomagnetic Disturbances: The X17 solar flare on October 28 took place when the parent region was right in the middle of the solar disk and a full halo coronal mass ejection was observed in conjunction with the flare. Being close to the equinox as well, a forecast of a major geomagnetic storm was not difficult. It was no surprise when a shock reached earth at 0613UT on October 29. This indicated a very fast transit time of just 19 hours from the sun to the earth. The storm was a major event with several 3-hour intervals during which geomagnetic K indices at mid to high latitudes rose to the maximum value of 9. The estimated planetary A index for October 29 was 189, not a bad effort considering that the storm started after 0600UT in the day. It will be sometime until a final value for the A index is available but there is little doubt that, although a remarkably strong storm, it ranks somewhat behind March 13, 1989.

Space Weather Effects: A wide range of effects were felt due to the recent spate of space weather activity, both in Australia and around the world. A summary of these effects follows:

HF Radio Systems

- Disruptions were reported to HF communications in Australia. During the X10 flare, an HF fadeout combined with an ionospheric storm to degrade HF communications in eastern Australia, and across to New Zealand.
- HF communications used by aircraft in the northern hemisphere were disrupted. Communications between aircraft and ground stations were re-routed in some instances to deal with this activity.

Aurora

- Many reports of aurora were received. The northern-most point from which auroral observations were reported in Australia was the Siding Springs Observatory, near Coonabarabran, NSW.
- Reports of aurora were received from as far south as Texas in the northern hemisphere.

Satellites

- The Japanese Kodama satellite was temporarily shut down, and may have suffered permanent damage.

- Routine control operations for many satellites were made more difficult.
- Within Australia, degraded satellite communications were reported over both Indian and Pacific Ocean links.
- Magnetometer data from the Australian research satellite FEDSAT suggest that its attitude control was affected during the initial part of the October 28/29 geomagnetic storm.

Power Systems

- An hour-long power outage that affected 20,000 homes in Sweden's southern city of Malmoe was probably due a geomagnetic storm caused by the solar activity.
- Power grids in the northern USA and Canada limited the amount of electricity they produced, to deal with induced currents in their transmission grids

International Space Station

- Crew on the International Space Station ensured that they were protected from enhanced radiation levels by moving to the aft end of the Service Module as needed.

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