Space Weather & GPS Reliant Industries

Jennifer L. Meehan
Utah State University

W. Murtagh

Follow this and additional works at: https://digitalcommons.usu.edu/physics_facpub

Part of the Physics Commons

Recommended Citation
Abstract. Since the last solar maximum, our society has become extremely dependent on the Global Positioning System (GPS) often referred to as the "sixth utility" behind electricity, water, and natural gas. Precise GPS is now required by numerous applications—radar control, highway traffic management, precision agriculture, emergency response, commercial aviation, and marine navigation. With each widespread and critical service, GPS-reliant industries are now concerned about space weather effects on this infrastructure. Researching the customers caused by small-scale irregularities in the ionosphere resulting in increased errors in position and navigation, 2) loss of signal due to scintillation effects, and 3) solar radio burst (SBR) impacts on receivers.

Examples of space weather induced errors on GPS

December 6, 2006: an extremely large solar radio burst affected GPS receivers over the entire sunlit side of the Earth. Many GPS receivers experienced total loss of lock. This event prevented Global Differential GPS from generating corrections for users and marked the first time a SIRB event was detected on the Wide Area Augmentation System (WAAS).

November 8, 2004: a fast moving auroral arc caused ionospheric irregularities affecting GPS signals. Even though this event lasted only 10 minutes, due to the intensity, it caused a receiver to lose lock. The event was observed by receiver sites in Norway and Finland.

October 28-31, 2005 (Halloween Storms): a coronal mass ejection (CME) required precise GPS users to delay operations. For a 15 hour period on October 29 and an 11 hour period on October 30 the WAAS system was severely impacted. An international milita...(continued)

Researching the customers

Who’s using navigation products?

SWPC Navigation Industry Customers chart shows industry organizations as a percentage of type of company. - Wide-ranging company categories: All categories include individuals and companies, domestic and international - A majority of the industry provides GPS services and could experience tremendous economical impacts during signal errors or interruptions - Some companies use GPS to improve safety and efficiency of systems, i.e. emergency response groups - Some companies use GPS for the economic value, whether it be the best management decision (e.g., financial decision) or the money saving business (precision agriculture)

Public Safety and Disaster Relief


Transportation

- Air Traffic Control System - Rail

Agriculture, Environment, and GPS Services

- Agriculture - GIS Services - Environmental Services - Space Weather Services - Other Environment Services - Agriculture Composites

Concluding Remarks

- GPS critical for many applications
  - Precision Agriculture
  - Banks
  - Oil Drilling
  - Public Safety
  - National Security
  - Military users
  - Civil government users
  - Industry users

- Space Weather and GPS-Reliant Industries
  - Military includes all Department of Defense operations as well as international defense programs
  - Academic includes colleges, universities, K-12 education programs and international universities
  - Industry includes everything else that did not fit into the above sectors

- Our economy has become extremely reliant on GPS...