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SPACE WEATHER AND EVOLVING GPS AND GNSS SYSTEMS

PAUL KINTNER*, BRADY OHANLON* AND TODD HUMPHREYS†

*School of Electrical and Computer Engineering
Cornell University
Ithaca, NY 1483 USA

†Aerospace Engineering and Engineering Mechanics
The University of Texas at Austin
210 East 24th Street, W. R. Woolrich Laboratories
1 University Station, C0600
Austin, Texas 78712-0235 USA

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Abstract.

GPS and GNSS and the applications of GPS and GNSS are evolving. Currently GPS consists of the legacy signals L1CA, L1P(Y), and L2P(Y) while GNSS consists of WAAS, EGNOS, and GLONASS. In the future GPS signals will change incrementally as satellites are replaced. To the current civilian L1CA signal, a civilian L2C signal and a civilian L5 signal will be added. The first contract to build Galileo satellites has been issued and it might be possible for Galileo to be operational by 2014. In addition augmentation systems in Japan and India are planned and China has suggested that it might field its own system. How will space weather impact these systems? For the next solar maximum virtually all ground based positioning, navigation, and timing products will use the legacy GPS signals. In the future it is likely that ground based systems will use all the available GNSS signals that have demonstrated a commitment to maintaining fully operational constellations with open signals. These developments lead to several questions. Will these new technologies be more vulnerable or less vulnerable to space weather and will they lead to better measurements of space weather. With the new L2C and L5 civilian signals it may be possible with the L1CA signal to make more precise relative TEC measurements at faster cadences and in the presence of scintillation. However, because only one of the signals chips at 10MHz (L5) while the two others chip at 1MHz, absolute TEC measurements will be challenging because of multi-path. Concerning the issue of space weather impacts, particularly scintillation, the new GPS signals all have smaller frequencies and will experience deeper fades. On the other hand the new GPS signals contain pilot codes that can be tracked in deeper fades. How the advantages and disadvantages of these new signals and new systems play out will require another decade of research.