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LONG-TERM ENVIRONMENTAL EFFECTS OF DEPLOYING THE ONEWEB SATELLITE CONSTELLATION

Abstract

In the last decade a ‘New Space’ age has emerged as a result of technological advances in space launch and space systems, and widespread private sector investments. This ‘New Space’ has been characterised by deployments of small satellites and fleets of small satellites into the Low Earth Orbit (LEO) region. These space systems offer an appealing, low-cost route for startups, and enable opportunities for novel space-based services that would have been unachievable under the traditional ‘Old Space’ paradigm. In particular, large constellations of satellites offering global communications services, which have previously been provided from geosynchronous orbit, are being planned for LEO. This solution represents an opportunity to disrupt the traditional communications sector, thanks to the significant reduction in latency and potential for true global coverage, especially in the domain of internet connectivity. Consequently, a number of companies, including OneWeb, have begun the development of constellations of satellites to deliver broadband internet services to the world. However, the deployment of such constellations would transform space traffic in this important environment and questions arise about the sustainability of this use of the LEO region. This paper reports the results of a study using the Debris Analysis and Monitoring Architecture to the Geosynchronous Environment (DAMAGE) evolutionary model to quantify the long-term environmental effects of deploying the OneWeb satellite constellation. The aims of this study were to (1) assess environmental sensitivity to the OneWeb constellation design operational parameters; (2) illustrate the long-term environmental effects of the OneWeb constellation; (3) investigate the implications of a second large constellations operating in proximity to the OneWeb constellation; and (4) investigate the implications of a collision within the OneWeb constellation. The study incorporated planned design and operational parameters from a genuine satellite constellation and the DAMAGE model was extensively upgraded with features required to simulate those characteristics. In addition, a novel collision prediction method developed specifically for the assessment of large constellations was employed to overcome the limitations of existing methods applied in this context. The study results indicate that environmental degradation can be mitigated through use of high post-mission disposal reliability, short deorbit times, and the separation of orbital planes. Further, if two constellations are to be deployed in the same vicinity, the inter-constellation collision probability can be reduced significantly by introducing a separation between the two systems.