Continuous coverage of the Arctic: Two-satellite Highly Elliptical Orbit (HEO) system is better than two dozen of LEO polar orbiters

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The paradigm of the global satellite observing system that relies on a combination of geostationary (GEO) and Lower Earth Orbit (LEO) observations to achieve global coverage will advance significantly once the next generation of imagers, notably on GEO satellites, is in place. Nevertheless, the objective of having a global satellite observing system with capability to observe weather at any point and any time is not yet achieved for high latitudes. The constellation of satellites on Highly Elliptical Orbit (HEO) is required to complement the constellation of GEO satellites to achieve continuous coverage at any time and at any point of the Earth.

The idea of HEO satellite constellation has been recently endorsed by the World Meteorological Organization (WMO) as part of its "*Vision for the Global Observing System (GOS) in 2025*" adopted by the sixty-first session of the WMO Executive Council (EC-LXI) (WMO, 2009).

This paper attempts to quantify the advantages of such HEO system relative to a traditional constellation of LEO polar satellites for observing the Arctic region. Results demonstrate that a LEO constellation with orbital characteristics similar to upcoming Joint Polar Satellite System (JPSS) should include as many as 23(35) spacecrafts to obtain coverage with 15(10) min refresh rate at 60degN, i.e. the capability of a two-satellite HEO system. In addition, data reception issues and the need for complex image compositing affect the product latency of a LEO system, and further reduce its efficiency in comparison to a HEO system.

Authors argue that 16-h Three APogee (TAP) orbit represents an optimal choice for HEO mission that combines a required Arctic coverage; image spatial resolution, orbit maintenance and acceptably low radiation doze due to high energy protons which represent a significant risk for the Molniya 12-h orbit. The Canadian Space Agency (CSA) in collaboration with other Canadian Government Departments is preparing for Phase B studies defining a 2-satellite HEO system – the Polar Communication and Weather (PCW) mission - which will include an imager with very similar characteristics to ABI on GOES-R.

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