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SMALL SPACECRAFT EARTH OBSERVING MISSIONS FOR NATURAL CAPITAL ASSESSMENT

Abstract

Small spacecraft can advance data collection and assessment capabilities for estimating natural capital of countries. Measurements of natural capital are needed for determining the 'Inclusive Wealth Index'. The traditional economic measures of development such as gross domestic product (GDP) has significant deficiencies since depletion and degradation of natural resources such as loss of forests, pollution of water resources, and exhaustion of minerals are not accounted. The inclusive wealth index includes measures of natural capital (as well as produced capital and human capital) of a country to create a more holistic accounting for measuring sustainable development. In many countries, however, an accurate assessment of natural capital (that includes agricultural land, forests, and fisheries) has been limited due to costs of ground-based surveying and verification. A number of existing observatories (such as the Operational Land Imager) provide global coverage, but the 15 to 30-meters resolution only provides a coarse measure of land-use. The quality and accuracy of natural capital assessment can be augmented with additional observations from small spacecraft. Earth observing (EO) platforms consisting of multiple spacecraft as well as single spacecraft in special orbits can provide data for assessing type and yields of crop, forest cover and timber, and quality of fresh water resources. This study presents a cost and value comparison of land imaging mission architectures with small satellites in LEO as well elliptical MEO orbits that provide higher revisit times on a region of interest. The analysis is conducted with a detailed small spacecraft and constellation cost estimation tool. The net scientific data returned over regions of interest over mission lifetime is used as a proxy measure of architecture value. The scientific data returned is modeled as a function of instrument characteristics, coverage, and revisit time for regions of interest. The approach is demonstrated for selected cases and implications for mission architecture selection for natural capital assessment applications are discussed. The relatively low cost of small spacecraft missions is also discussed in relation to affordability for developing countries, where natural capital assessments are lacking and need for low-cost assessment is particularly acute.