EARTH OBSERVATION SYMPOSIUM (B1)
Future Earth Observation Systems (2)

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# CONCEPT STUDY OF A LEO CONSTELLATION OF NANOSATELLITES FOR NEAR REAL TIME OPTICAL REMOTE SENSING

**Abstract**

This paper provides results of a concept study on a constellation of over thousand nanosatellites to perform optical remote sensing providing unprecedented global high temporal resolution and event-driven continuous real time monitoring capability.

Nanosatellite technology is evolving and has proven successful technology demonstration and niche science capabilities. The dimensions of nanosatellites constrain potential performance for a single satellite by the laws of physics. They can however be launched in significant quantities by a single launcher, making new applications with vast networks of satellites feasible. This paper will provide a concept design of a constellation of over a thousand nanosatellites, each equipped with an optical camera for Earth observation applications. It will be proven that a diffraction-limited camera allows for a spatial resolution of several meters within common spectral bands (UV, RGB, NIR). The amount and constellation of nanosatellites combined with a hybrid data architecture of distributed ground stations and inter-satellite links, will allow global Earth monitoring capability with a temporal resolution in the order of 15-30 minutes. In case of local events of interests, part of the constellation can be allocated to perform continuous real time monitoring. Orbital debris issues are mitigated by using unpopulated and fast decaying orbits below 400 km which are maintained with electric propulsion throughout the operational lifetime.

Global image sources, such as Google Earth, could be complemented with up-to-date medium resolution imagery. Emerging disasters, such as fires, can be detected in an early stage and from then on be monitored real time. Illegal activities such as rain forest logging and waste dumping can be detected in sufficient time to allow authorities to catch the violators red-handed. Highly dynamic changes to the natural environment can be monitored on a global scale. This paper will provide the opportunities, common elements and limitations for each of these applications. The most promising applications serve for a preliminary set of requirements on the nanosatellite payload, platform and network. A solution for the deployment and maintenance of the constellation and data network is provided and assessed by figures of merit of the delta-V budget and the global data bandwidth and distribution. The requirements on the spacecraft platform and payload will be assessed by comparing them with flown nanosatellite technology, existing terrestrial technology as well as ongoing developments in this field. Finally, conclusions will be provided on technical feasibility, cost estimates and potential development roadmap for this mission.