

Autonomous aerial observations to extend and complement the Earth Observing System: a science-driven systems-oriented approach

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Abstract

The current Earth observing capability depends primarily on spacecraft missions and ground-based networks to provide the critical on-going observations necessary for improved understanding of the Earth system. Aircraft missions play an important role in process studies but are limited to relatively short-duration flights. Suborbital observations have contributed to global environmental knowledge by providing in-depth, high-resolution observations that space-based and in-situ systems are challenged to provide; however, the limitations of aerial platforms - e.g., limited observing envelope, restrictions associated with crew safety and high cost of operations have restricted the suborbital program to a supporting role. For over a decade, it has been recognized that autonomous aerial observations could potentially be important. Advances in several technologies now enable autonomous aerial observation systems (AAOS) that can provide fundamentally new observational capability for Earth science and applications and thus lead scientists and engineers to rethink how suborbital assets can best contribute to Earth system science. Properly developed and integrated, these technologies will enable new Earth science and operational mission scenarios with long term persistence, higher-spatial and higher-temporal resolution at lower cost than space or ground based approaches. This paper presents the results of a science driven, systems oriented study of broad Earth science measurement needs. These needs identify aerial mission scenarios that complement and extend the current Earth Observing System. These aerial missions are analogous to space missions in their complexity and potential for providing significant data sets for Earth scientists. Mission classes are identified and presented based on science driven measurement needs in atmospheric, ocean and land studies. Also presented is a nominal concept of operations for an AAOS: an innovative set of suborbital assets that complements and augments current and planned space-based observing systems.