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

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IN-SITU EXPLORATION OF EARTH'S ATMOSPHERE USING NOVEL SPACECRAFT DESIGN

Abstract

Since the early 70s with the design of the Planetary Atmosphere Experiments Test (PAET) vehicle (Seiff et. al., 1973) lead by NASA Ames Research Center the in-situ exploration of the low Earth atmosphere (altitudes around 100 km and lower) was realized to be a vital research field in planetary physics. In-situ measurements of physical properties (e.g., density and temperature, dynamics like wind speed), chemical properties (composition and constituent mole fractions), and not to forget charging effects (i.e., the degree of ionization due to absorption of EUV radiation) represent an important part to supplement a proper calibration and interpretation of atmospheric remote sensing data which exist in vast amounts mainly from low Earth orbiting Earth observation satellites.

Typical remote satellite orbits are constraint to altitudes not lower than 300 km altitude in order to avoid the stark atmospheric drag that would otherwise significantly decrease the orbital lifetime (i.e., the time at which the spacecraft undergoes the operational altitude). Altitudes around 100 km therefore pose a major challenge in spacecraft design in order to guarantee a lifetime that allows extended spatial and temporal observation coverage (note that the PAET entry probe provided only instantaneous measurements of one single location at the Atlantic Seaboard near Bermuda).

The aim of this paper is to highlight and analyse the need for in-situ data for atmospheric research and to map that into a representative instrument suite which is able to effectively address today's scientific needs. Furthermore it is intended to provide two design sketches of possible spacecraft-concepts that would be able to fly this instrument suite in the desired altitude of 100 km. These designs are mainly based on orbital decay studies for various ballistic coefficients and a rough scaling of spacecraft bus to payload fractions.