Mission and Technologies for the Daedalus VLEO EE10 candidate mission in ESA

DAEDALUS

Was a candidate for ESA's Earth Explorer 10 program (and went through phase 0). It targeted the lower thermosphere and ionosphere (LTI) at altitudes between 100 and 200 km, where the atmosphere transitions from being well-mixed and electrically neutral to heterogeneous and partly ionized (Figure 1), leading to complex processes in this critically unexplored region of the atmosphere.

Although not selected, it was commended by ESA's advisory body, and explored several mission and technical topics as a VLEO mission.

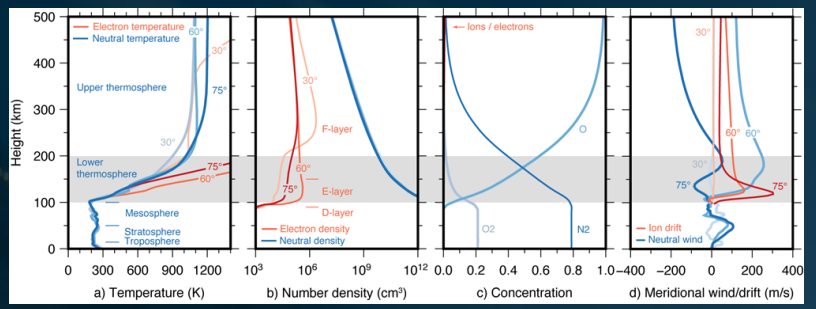

Figure 1: Atmospheric parameters evolution in the 100-200 km region (T, Ne, N, u) as a motivation for Daedalus

VLEO MISSION PROFILE

This a major driver with the 140 km perigee and deep dives at 115 km (Figure 2). This results in very high ΔV budget (3-4 km/s) needing a large electric propulsion system used several times daily.

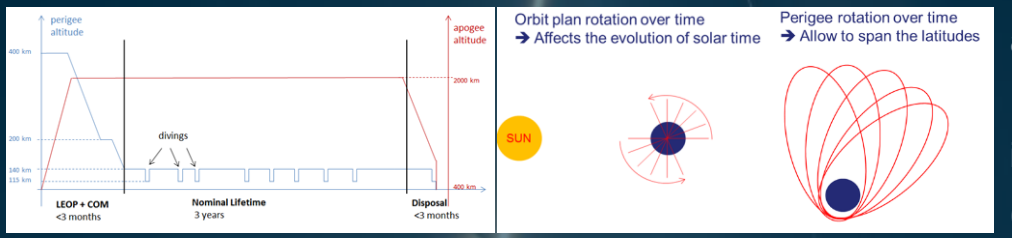

Figure 2: Mission profile - Hp/Ha evolution (left) & area sampling (right)

Flight at orbital velocity in such dense medium also creates a diffuse shockwave, which both affects in-situ instruments observables and generates high thermal and ATOX fluxes (Figure 3).

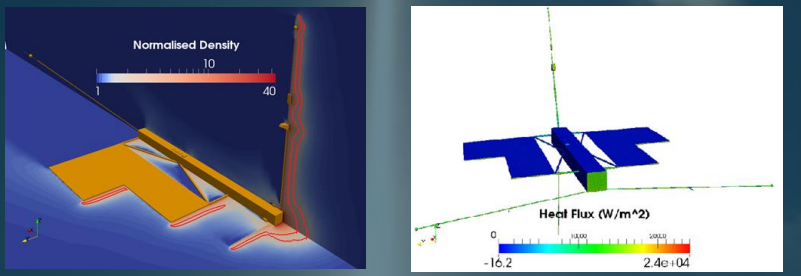

Figure 3: Shockwave (left) and heat flux (right)

TECHNOLOGIES

The resulting system-level concept is a novel configuration for an EO satellite (Figure 4), minimizing drag, accommodating a large suite of in-situ instruments to measure fields, atmosphere, and particle precipitation.

New technologies are needed. Some instruments are new developments (wind sensor) and some need adaptions.

At satellite level thermal shield technologies will be used, either in metal or in PCM (Figure 4). ESA is pursuing potential further work on Daedalus as a Mission of Opportunity in collaboration with NASA.

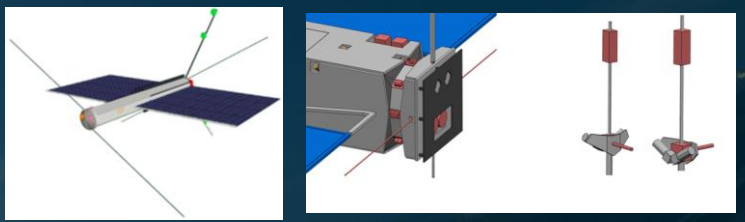

Figure 4: Configuration (left) & shield technologies (right)