Introducing the Cloud Aerosol Lidar for Global Scale Observations of the Ocean-Land-Atmosphere System – CALIGOLA

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The Italian space industry, and specifically Leonardo S.p.A., has gained unique skills at an international level in the development of space-qualified power laser sources for lidar Earth observation applications (Aeolus, EarthCARE). Moreover, Leonardo S.p.A. and the Italian optical industry, has a consolidated technical-scientific experience in the development of lidar receiver sub-systems and payload thermo-mechanical structure. The Italian Space Agency (ASI) intends to benefit from these knowledges and skills to design and develop a lidar system for Earth observation. A Phase A study focusing on the technological feasibility of the laser source and receiver is on-going, commissioned by ASI to Leonardo S.p.A., and scientific studies in support of the mission are also on-going, with the University of Basilicata being the leading scientific institution.

CALIGOLA has a primary focus on the atmosphere, but also a strong finalization on the study of the Ocean-Earth-Atmosphere system and the mutual interactions within it. Exploiting the three Nd: YAG laser emissions at 354.7, 532 and 1064 nm and the elastic (Rayleigh-Mie), depolarized and Raman lidar echoes from atmospheric constituents, CALIGOLA will carry out 3λ profile measurements of the particle backscatter coefficient and depolarization ratio and 2λ profile measurements of the particle extinction coefficient from aerosols and clouds, measurements to be used in the determination of particle size and microphysical properties. Furthermore, measurements of the elastic and depolarized backscattered echoes from the sea surface and the underlying layers will be exploited to characterize sea optical properties (ocean color) and the suspended particulate matter. Two specific measurement channels at 680 nm/460 nm will be dedicated to fluorescence measurements from atmospheric aerosols and marine chlorophyll, for the purpose of aerosol typing and for characterizing ocean primary production, respectively. CALIGULA will also allow accurate measurements of the small-scale variability of the earth's surface elevation primarily associated with variations in the terrain, vegetation and forest canopy height.

The CALIGOLA project is explicitly included the on-going ASI Three-Year Activity Plan (2021-2023), with a scheduled tentative launch window of 2026-2028. The exploitation of sub-systems already developed at national level for space applications, with a high TRL (TRL>7), should allow developing the space lidar mission in a relatively short time, ultimately leading to a mission with high scientific impact and timeliness. ASI is willing to pursue this mission in a coordinated way with one or more other European or extra-European Space Agencies, with a bilateral or multi-lateral contributed mission approach, and, in this regard, any interest from other Agencies is welcome and desired.