TURBULENCE MONITORING EQUIPMENT (ARTES 4.0 SPL OPTICAL COMMUNICATION - SCYLIGHT 6C.009 / SL.046) (RE-ISSUE)

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Objective: To develop a turbulence monitoring equipment to demonstrate an accurate turbulence measurement concept that can be used during daytime and night-time conditions. The equipment shall also include cloud and aerosol monitoring. Targeted Improvements: To support handover decisions of individual optical ground stations and automated operation of a network of optical ground stations. Description: Accurate knowledge of the optical link availability between a spacecraft and optical ground stations is of paramount importance for assessing the feasibility of optical ground space links (OGSL) through the atmosphere. The major contributor to the OGSL unavailability is cloud blockage. In addition, atmospheric turbulence can significantly degrade the quality of an optical signal (in terms of amplitude fluctuations and phase distortion), which further decreases the OGSL availability. In order to make accurate predictions of the OGSL availability it is mandatory to have precise real-time information of local cloud coverage and atmospheric characteristics. Future broadband telecommunication mission requiring implementation of OGSL, so called optical feeder links, specify availability requirement >99.9%. To that aim, a site diversity concept needs to be implemented in order to boost the low availability of an individual optical ground station (OGS) to an acceptable availability of a virtual optical gateway (i.e., a network of OGS implementing handover procedure). Ultimately, the decision and frequency of the handover operation will be determined by the accuracy of the local monitoring of clouds, turbulence and aerosols. This activity will benefit from the on-going developments in the SL.005 "Atmospheric monitoring to assess the availability of optical links through the atmosphere". In SL.005, the objective is to develop a first generation prototype of cloud, aerosol and turbulence monitoring equipment (CATM GSE), suitable to correlate local ground measurements from the CATM GSE with data available from other sources of clouds and turbulence conditions. Typically different principles/instruments are used to derive daytime and night-time parameters, with the associated calibration issues. The present activity will develop the second generation prototype of cloud, aerosol and turbulence monitoring equipment (CA+TM GSE) aiming at concepts that can be used both during daytime and night-time conditions (especially for accurate turbulence measurement). Additional aspects like costs, production time, AIT and calibration activities shall also be considered in the equipment design. The new CATM GSE shall operate autonomously and shall allow remote access for data retrieval, failure diagnostics, equipment re-calibration and/or re-configuration. Possibilities to embed in the CATM GSE the necessary software to transform raw data (e.g., images) into performance indicators (e.g., atmospheric attenuation, Fried parameter, iso planatic angle, etc.) and decisions / recommendations at system level (e.g., proceed immediately with handover) will be investigated in detail, as well as prediction algorithms, which will learn in real-time from the available local measurements also to support provision of Decisions/recommendations at system level (e.g., proceed with hand over in 2 hours from now). The performances of the new CATM GSE in terms of accuracy and precision (including probability of detection and false detection) shall be demonstrated in different environmental conditions and geographical areas under a representative24h/365days operational scenario.