# AERL – A SMALL SATELLITE FOR MEASUREMENT OF AEROSOL PROPERTIES OVER LAND SURFACES

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## ABSTRACT

Accurate information on concentrations and physical properties of atmospheric aerosol over land surfaces is of great importance for air pollution control and climate research. The aerosol distributions over land surfaces are characterized by high spatial variability, depending on topography, meteorological conditions, and the distribution and magnitude of aerosol sources and sinks. Global aerosol satellite missions are collecting important basic data sets for climate research, but are not able to capture the spatial details necessary for air pollution monitoring and for identifying aerosol sources and sinks at local and regional scale. Taking these needs into account, scientific and technical concepts for the Aerosol Land Mission, AERL, have been worked out in a study sponsored by the European Space Agency (ESA). The study is concerned with Earth observation missions that are compatible with implementation on a small satellite. The study is led by Astrium Ltd. (UK), with the contributing partners Astrium SAS (France), Astrium GmbH (Germany), ENVEO IT GmbH (Austria), GMV (Spain) and Verhaert Space (Belgium). The two main objectives of the AERL mission are the support of air pollution monitoring and research and the downscaling of aerosol observations made by global aerosol missions. In the field of air pollution control, the observation of fine particulate matter (PM10 and PM2.5) is of particular importance. This information can be deduced from measurements of aerosol type and concentration made by optical sensors if the vertical stratification of the aerosol layer is known. It is planned to assimilate the aerosol products of AERL in mesoscale numerical meteorological models to provide spatially detailed information on aerosol source, transport and transformation processes.

A constraint for the payload definition is the compatibility with implementation on a small satellite platform of up to 150 kg total spacecraft mass. In order to meet the observation requirements and mass constraints, the proposed measurement concept for the AERL mission employs passive sensors measuring the signal of spectral solar radiance scattered by atmospheric aerosol above dark background targets. Multi-directional and multi-polarization measurements are needed for accurate retrieval of aerosol optical depth and estimating aerosol scattering albedo and size distribution. Trade-off studies show that an efficient technical solution can be based on an instrument measuring in about eight spectral bands in the 400 - 950 nm spectral range with 5 nm to 10 nm spectral width that operates at three viewing angles. For a subset of these spectral bands the polarization state of the observed radiance should be measured.

Various technical concepts for the sensors were investigated. The baseline version consists of two instruments, addressing the measurement of total column aerosol properties, and vertical stratification of the aerosol layer, respectively. The first sensor is a triple view (+50°, 0°, -50° along track) spectro-radiometer with 7 spectral bands, three of which measure two components of the polarization vector. The spectral range is defined by narrow (5 nm and 10 nm) band-pass filters. The sensor will cover a swath of 300 km width and provide a spatial resolution of about 300 m at nadir view. The second sensor is a dispersive spectrometer with grating measuring in 8 channels within the 755 to 775 nm range with 1 nm spectral resolution. The sensor observes in two view directions (0°, -50°) with about 500 m spatial resolution at nadir view. These measurements in the oxygen-A band and its vicinity focus at aerosol layer height which is an important parameter for deducing the concentration of particular matter from aerosol measurements by optical sensors.