ABSTRACT

Stratospheric aerosol has been measured globally from satellite platforms over the past three decades. The variability of the natural and anthropogenic sources and resulting effect on climate make continued and improved measurements a priority. Yet, few satellite instruments capable of measuring stratospheric aerosol currently exist, with a lack of planned missions to fill the gap left by the ultimate loss of current instruments. The Aerosol Limb Imager (ALI) is an optical remote sensing instrument designed to image scattered sunlight from the atmospheric limb. These measurements are used to retrieve spatially resolved information of the stratospheric aerosol distribution, including spectral extinction coefficient and particle size. Here we present the design, development and test results of an ALI prototype. The instrument design uses a large aperture Acousto-Optic Tunable Filter (AOTF) to image the sunlit stratospheric limb in a selectable narrow wavelength band ranging from the visible to the near infrared. Through the nature of the AOTF operation, ALI measures one orientation of the polarized limb radiance, rather than the historically observed total radiance. A modelling study on the impact of this approach on the retrievals shows that while there is no distinct advantage to the linearly polarized measurement, there are also no clear disadvantages assuming the somewhat lower overall signal levels can be handled in the instrument design or operation.

The long term goal of this work is the eventual realization of ALI on a satellite platform in low earth orbit, where it can provide high spatial resolution observations, both in the vertical and cross-track dimensions. The ALI prototype was tested on a stratospheric balloon flight from the Canadian Space Agency (CSA) launch facility in Timmins, Canada, in September 2014. Preliminary analysis of the hyperspectral images indicate that the radiance measurements are of high quality, and these are used to successfully retrieve vertical profiles of stratospheric aerosol extinction coefficient from 650–950 nm, along with one moment of the particle size distribution.