ABSTRACT

Stratospheric aerosol has been measured extensively from satellite platforms over the past three decades and is an important factor in the climate change discussion. Instruments capable of measuring vertically resolved aerosol extinction profiles are in decline with few future endeavours, if any, are planned to fill the hole left by the loss of current instruments. The Aerosol Limb Imager (ALI) is an optical remote sensing instrument designed to image scattered solar irradiance 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. Additionally, through the nature of the AOTF, ALI is a polarized instrument recording the polarized limb radiance which is a relatively new concept as current techniques measure the total radiance. A study to address if there are any major advantages or concerns in measuring the linear polarization for aerosol is also addressed within this work.

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 we have used these to retrieve vertical profiles of stratospheric aerosol extinction coefficient from 650–950 nm, along with one moment of the particle size distribution.