Paper ID: 24191
poster
student

SPACE EXPLORATION SYMPOSIUM (A3)
Poster Session (P)

Author: Mr. Kevin S. Olsen
University of Toronto, Canada

Dr. Geoff Toon
Jet Propulsion Laboratory, United States
Mrs. Kimberly Strong
University of Toronto, Canada

HIGH-RESOLUTION SOLAR-OCCULTATION FOURIER TRANSFORM SPECTROSCOPY IN A DUSTY ATMOSPHERE.

Abstract

In order to make a detailed inventory of the composition of the Martian atmosphere, the technique of solar occultation Fourier transform spectroscopy has been proposed. Similar to the Canadian Space Agency's Atmospheric Chemistry Experiment in Earth orbit, this would place a high resolution (0.02 cm^{-1}) Fourier transform spectrometer (FTS) in Martian orbit, taking a series of observations through the atmospheric limb using the Sun as a light source each time the spacecraft enters, or comes out of, the shadow of the planet. This technique is self calibrating, offers unprecedented spectral resolution over a broad spectral range, and is sensitive over a large range in altitude. Such an instrument at Mars would allow us to quantify the composition of the atmosphere with a sensitivity 2-3 orders of magnitude better than any previous instrument, while also characterizing the vertical and spatial distribution of trace gases. A major obstacle to this method is that the atmosphere of Mars frequently contains very high levels of dust. Analysis of spectra in the presence of dust content, which produces broad spectral features, can be accomplished, providing that the spectrum of dust absorption is well understood. However, during the acquisition of a single interferogram (which is transformed into an intensity spectrum), the tangent altitude will change by 2 to 6 km (depending on the beta angle). The signal attenuation due to dust can, therefore, greatly vary during the course of a single acquisition. An FTS is highly sensitive to changes in the received solar intensity that occur faster than the interferogram acquisition because the baseline spectral information is not acquired simultaneously with the high-resolution absorption lines. To study this effect, we produced sets of synthetic spectra simulating atmospheric conditions on Mars, and performed inverse Fourier transforms to obtain interferograms. These interferograms were then perturbed to simulate a time varying intensity caused by scanning through increasing dust content. We present the effects of our pertubation, both on the interferograms and on the spectra, and look at a few methods of mitigating these effects, which include high-pass filtering in wavenumber space and AC filtering in optical path difference space. We will also describe the effects of the perturbation on retrievals of key gases in the simulated Martian spectra.