MicroMAPS Missions for CO Detection

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The ultimate goal of MicroMaps is to detect CO and N2O from an orbital platform. The instrument is equipped with CO and N2O gas cells configured to observe the earth's IR radiance in a band centered at 4.67 microns. Utilizing these gas cells in a selective chopper, the instrument produces its signal by forming the difference between the incoming energy as seen though one of the gas cells and a second cell that is either evacuated or contains a non-absorbing gas. From the chopper the beams are directed to a detector where they are electronically differenced. The resulting signals will be used with pre- and post-flight calibration for data reduction.

A test flight for MicroMAPS is planned on the Proteus aircraft. To prepare for this flight a full-scale theoretical model of the data Proteus is expected to obtain is produced. This model includes total upwelling radiance of the earth in the wavenumber range of 2080cm^{-1} to 2280cm^{-1}, transmission of the earth's radiance through the optical window, the band pass filter, and the optical chopper which includes transmission through and emission of the gas in the gas cells. The model produces 5 K increments in the range of 280.15K to 310.15K for the blackbody source. Each source temperature includes a model of instrument temperatures with the same range. This upwelling radiance vs. wavenumber data is then integrated over wavenumber for all the temperatures to give us a theoretical model of total radiance vs. temperature of the target for multiple instrument temperatures. The atmospheric radiance was obtained using Line By Line Radiative Transfer Model (LBLRTM) with the HITRAN 1992 database. Gas cell transmissions were obtained via HITRANPC, which uses the same database. For comparison, the atmospheric radiance was also generated using HITRAN 1996 with LBLRTM and using HITRAN 2000 with an independent program written in MATLAB with the GENSPECT toolbox.

This theoretical model will be used in conjunction with preflight calibration data to give a theoretical prediction of CO concentration. Once the Proteus flies, the post-flight calibration data will be used to reduce the in-flight difference signals. This result will be compared with the predictions of CO concentrations based on theoretical models.

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