HARP actinic flux on the NCAR/NSF C-130 aircraft

Samuel R. Hall (<u>halls@ucar.edu</u>) Kirk Ullmann (<u>ullmannk@ucar.edu</u>)

Photochemical reactions initiated by sunlight are a driving force for chemistry in the atmosphere. The local radiative field is impacted by solar zenith angle, clouds, aerosols, ozone columns and surface reflectivity. During the FRAPPE mission, *in situ* photolysis frequencies will be a key to understanding the chemical evolution and composition of tropospheric air masses.



HARP G-V rack (left), actinic flux optics on the T-tail fairing and rear fuselage (right).

The HIAPER Airborne Radiation Package (HARP) actinic flux instruments provide *in situ* down- and up-welling spectra from approximately 280 to 680 nm. The charged-couple device detectors measure at a data frequency of up to 1 Hz. From the measured flux and kinetic determinations, the NCAR Atmospheric Radiation and Measurements (ARIM) group calculates photolysis frequencies for important atmospheric trace gases including O₃, NO₂, CH₂O, HONO, HNO₃, N₂O₅, HO₂NO₂, PAN, H₂O₂, CH₃OOH, CH₃ONO₂, CH₃CH₂ONO₂, CH₃COCH₃, CH₃CHO, CH₃CHO, CH₃CHO, CHOCHO, CH₃COCHO, CH₃COCHO, CH₃CH₂CHO, CH₃COCH₂CH₃, Br₂, BrO, Br₂O, BrNO₃, BrCl, HOBr, BrONO₂, Cl₂, ClO, and ClONO₂ using a modified version of the NCAR Tropospheric Ultraviolet and Visible (TUV) radiative transfer model.

The absolute spectral sensitivity of the instruments is determined in the laboratory with 1000 Watt NIST-traceable tungsten-halogen lamps with an uncertainty of 2-4%, depending on the wavelength. In addition, the optical collectors are characterized for angular and azimuthal response and the effective planar receptor distance. During deployments, spectral sensitivity and wavelength assignment calibrations are performed using secondary quartz-tungsten-halogen calibration lamps and Hg line sources in a field calibration unit that attaches directly to the optical collector assembly of the actinic flux instruments. Final primary calibrations are

performed in the laboratory after each mission. In addition, comparisons to extraterrestrial flux have been used to ensure proper wavelength assignment throughout the spectra.

HARP actinic flux instruments are part of the HIAPER Aircraft Instrumentation Solicitation (HAIS), funded by NSF. They have an excellent record of performance on the G-V and C-130 aircraft during the TORERO, DC3, NOMADSS, SEAC4RS and CONTRAST campaigns. Similar NCAR/ARIM instruments have flown on the NASA WB-57 and DC-8 aircraft during NASA AVE (2004 and 2005), PAVE, CR-AVE, TC-4, ARCTAS, DC3, and SEAC4RS campaigns.