CCD Actinic Flux Spectroradiometers (CAFS)/Actinic Flux and Photolysis Frequencies

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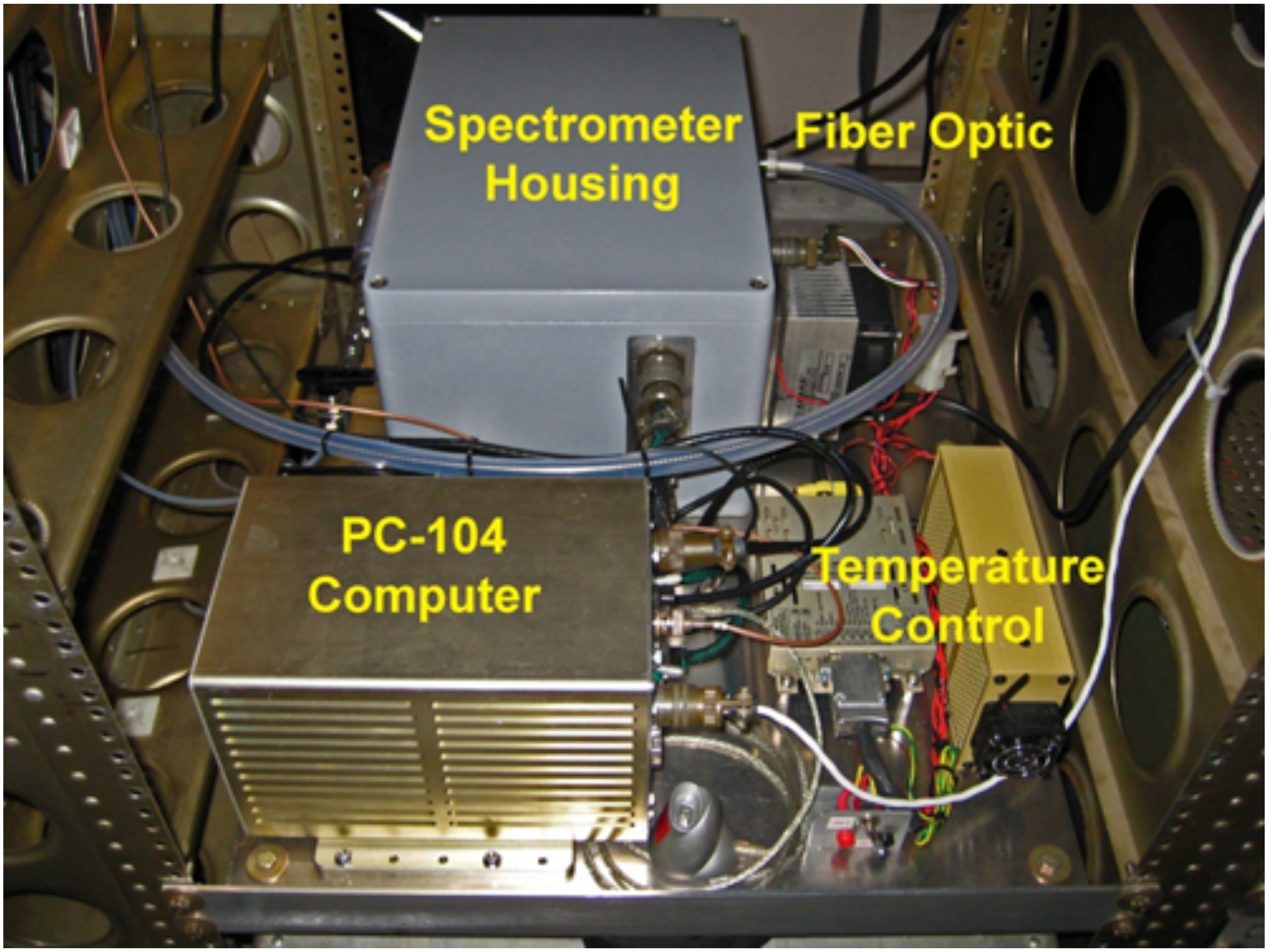
Photochemical reactions provide the driving force for much of the chemistry in the atmosphere. Even in the high solar zenith angles of the Arctic, the photochemistry can rival that of the tropics due to the high surface albedo. The reactions are crucial to deriving the chemistry in the snowpack, fluxes out of the snowpack and the resulting impacts and fates of these chemicals in the overlying atmosphere. The photolysis induced production and lifetime of XOx (ClO, BrO and IO) species and their impact on HOx chemistry, is key to understanding the oxidizing capacity of the Arctic boundary layer. The resulting oxidation of organics may then influence the production of aerosols and Arctic haze while the fate of persistent organic pollutants may be tied to the surface photochemistry. Thus, high quality photolysis frequencies measurements above the snow are essential to the goals of the OASIS project.

The CCD Actinic Flux Spectroradiometers (CAFS) developed in the NCAR/ARIM laboratory will be deployed to measure the spectrally resolved *in situ* downwelling actinic flux at the surface. The photolysis frequencies of important atmospheric constituents are calculated from the measurements. These include: O3, NO2, CH2O, HONO, HNO3, N2O5, HO2NO2, PAN, H2O2, CH3OOH, CH3ONO2, CH3CH2ONO2, CH3COCH3 , CH3CHO, CH3CH2CHO, CHOCHO, CH3COCHO, CH3CH2CH2CHO, CH3COCH2CH3 and some halogen species.

The actinic flux itself is impacted by the chemical changes, including albedo changes in the snowpack and the production of Arctic haze in the boundary layer. Aerosols absorb and reflect light and affect cloud formation, either enhancing or reducing the photolysis frequencies and hence changing the balance of photochemical species. These effects complicate the modeling of Arctic air-surface interactions and enhance the need for in situ photolysis measurements.

Measurement technique:

The CAFS system employs a Zeiss MCS (Multi Channel Spectrometer) monolithic monochromator equipped with a Hamamatsu S 7301-906 windowless back-thinned blue enhanced 534 pixel cooled CCD detector. The combination of the monochromator, slit size and CCD provides a wavelength range of 280-680 nm with an effective ~1.8 nm Full Width at Half Maximum (FWHM) resolution with a 20 micron entrance slit. The CCD temperature is controlled at –1.0° C by a piezoelectric cooler and control electronics. The system exhibits excellent sensitivity from the ultraviolet into the visible, which allows short full spectral acquisition times. Additionally the system shows exceptional stability. Autonomous data acquisition and instrument control are provided by small, lightweight, and low-power PC-104+ computers.



CAFS detector


CAFS optic