PRODUCTION RATE AND SPATIAL DISTRUBTION OF CARBON IN THE COMA OF C/1995OI (HALE-BOPP): IMPLICATIONS FOR THE LIFETIME AND COMA VELOCITY STRUCTURE. W. M. Harris[1], J. P. Morgenthaler[2], and R. J. Vervack Jr.[3] [1]Department of Mechanical and Aerospace Engineering, University of California Davis, One Shields Ave., Davis, CA 95616 (wmharris@ucdavis.edu), [2]Planetary Science Institute, 1700 E. Fort Lowell, Suite 106, Tucson, AZ 85719 (jpmorgen@psi.edu), [3]Johns Hopkins Applied Physics Laboratory, Laurel, MD 20723 (Ron.Vervack@jhuapl.edu).

Introduction: Observations of elemental abundances (e.g. C, H, O, S, etc.) are a useful method for obtaining the bulk volatile complement that produced by the dissociation of several different species. Through measurement of production rate, velocity and radial distribution, the role of various dissociation pathways can be determined [1]. To gain full access to this information requires wide-field measurements that capture the long scale lengths of neutral atomic species. Despite their value as a diagnostic, atomic species are not typically observed. One reason for this is that ground state fluorescent neutral emissions are confined the vacuum UV where there are limited observing resources, while the transitions available in the visible (e.g. Hα, Hβ, OI [^{1}S,^{1}D] and CI [^{1}D]) are blended with telluric sources that make their detection difficult. Of all recent comets, C/1995O1 (Hale-Bopp) is the best studied for neutral emissions and includes several wide field UV observations [1,2,3,4] in addition to intermediate length UV spectra [5] and ground based measurement of metastable O [6] and C [7]. In this paper we provide the results of an updated photometric calibration of CI(λ1657Å) multiplet emission from Hale-Bopp along with an improved radial fit to its extended distribution. These data reinforce an existing discrepancy between wide-field/elemental production rate measurements and those obtained from inner coma [5] and photochemical parents [8].

Observations: The observations were obtained using the Wide-field Imaging Survey Polarimeter (WISP), a sounding rocket experiment that was launched from the White Sands Missile Range [2]. The WISP instrument was a narrow bandpass imager with 100Å filter centered on the CI (λ1657Å) multiplet and a 163Å NUV dust region at 2696Å. The flight sequence included 4 images in each filter that were obtained with different rotations of a CaF waveplate reflected from a ZrO Brewster mirror. Each CI exposure (Figure 1) was 40 seconds in length, which was adequate to detect carbon emission out to a distance of ~10^7 km (Figure 2).

Results: In [2] the individual Stokes observations were processed for consistent photometric efficiency on the basis of several stars in the field of view, corrected for the polarimetric efficiency of the WISP experiment and divided to obtain the total polarization of the CI multiplet. The results were consistent with the photo-dissociation of the carbon parents within a region where collisional mixing dominated, which was confirmed by a later study of wide-field OH obtained on the same night [9]. In the present work we complete the absolute photometric analysis using a bright star (HD16857) that is clearly separated from the coma inside the WISP 1.7° x 5° field of view (FOV). In addition, we extract a radial profile of the emission distribution using the ring sum-model approach developed in [9] for a collisionally accelerated coma. To eliminate any continuum effects, the profile deliberately excludes the anti-sunward sector that matches the dust lane observed in the images at 2696Å. Production rates are obtained from both the coma averaged and radial profile techniques using a range of expansion velocities and lifetimes. The results are generally consistent with those obtained for the same emission observed by the Polar satellite [3] and for the CI [^{1}D] emission line, both of which are up to a factor of 3 below the measured production rate of CO [8] and inner coma CI (1657Å). The source of this discrepancy is not clear but may be related to uncertainty in the lifetime of neutral carbon [10] and the outflow velocity in the inner coma [9].

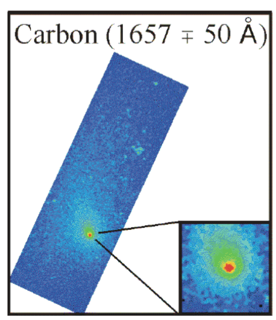

Figure 1.

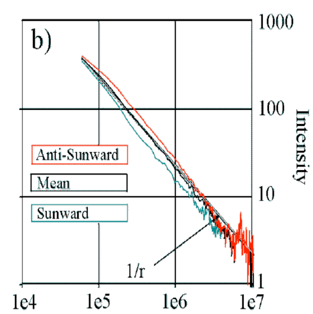

Figure 2.

References: [1] Combi M. R. et al. (2000) *Icarus 144*, 191-202. [2] Harris W. M. et al. (1997) *E, M, & P*, *78*, 161-16.. [3] Brittnacher M. et al. (2001), *GRL, 28*, 2561-2564. [4] Kupperman et al., *unpublished*. [5] McPhate et. al. (1999) *ApJ, 521*, 920-927. [6] Morgenthaler J. et al. (2001), *ApJ, 563*, 451-461. [7] Oliversen R. J. et al. (2002), *ApJ, 581*, 770-775. [8] Biver N. et al., *E, M, & P*, *78*, 5-11. [9] Harris W. M. et al., (2002), *ApJ, 578,* 996-1008. [10] Morgenthaler J. P. et al., *ApJ, 726*.