OBSERVATIONS OF COMPOSITION FROM PIONEER VENUS

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Low latitude distributions of atmospheric neutral hydrogen have been derived at Venus for the period 1979-1980. In-situ measurements of H^+, O^+, O, and CO_2 obtained from the ion and neutral mass spectrometers on the Pioneer Venus orbiter are combined with the appropriate chemical equilibrium relationship to determine the abundance of neutral hydrogen which is very difficult to measure directly. The measurements are all obtained below 165 km on the nightside and below 200 km on the dayside, based on evidence for chemical equilibrium prevailing up to those altitudes. During the period examined nearly three complete diurnal cycles were available and a comparison of the year-to-year variation in hydrogen content is made across the dawn region where the distributions of light gases are most pronounced. The dawn bulge in H (and also in He) which was reported from the first diurnal cycle by Brinton et al. (1979) is found to persist. The hydrogen concentrations peak near 2-5 x $10^7/cm^3$, which is about 400 times greater than dayside concentrations. Superimposed upon the diurnal variation are strong day-to-day variations in which n(H) changes by as much as a factor of five. Such variations are linked to pronounced changes in the ion and neutral composition which sometimes occur in association with solar wind disturbances passing the planet. The interaction of the solar wind and the planetary environment somehow results in large changes in the relative abundances and scale heights of the ion and neutral species, thus modifying the derived values of n(H). These variations in the ion distributions are not surprising owing to the strong dependence of the nightside ionization upon convection from the dayside and associated sensitivity of this convection to changes in solar wind pressure and interplanetary magnetic field variations. The variation exhibited by the neutrals, however, appears to require some other explanation owing to the limited momemtum transfer between the ions and neutrals. Allowing for these short term perturbations, there appears to be no clear evidence for interannual variation in n(H) during the period examined, apparently consistent with the very small change in solar EUV flux over the same interval.

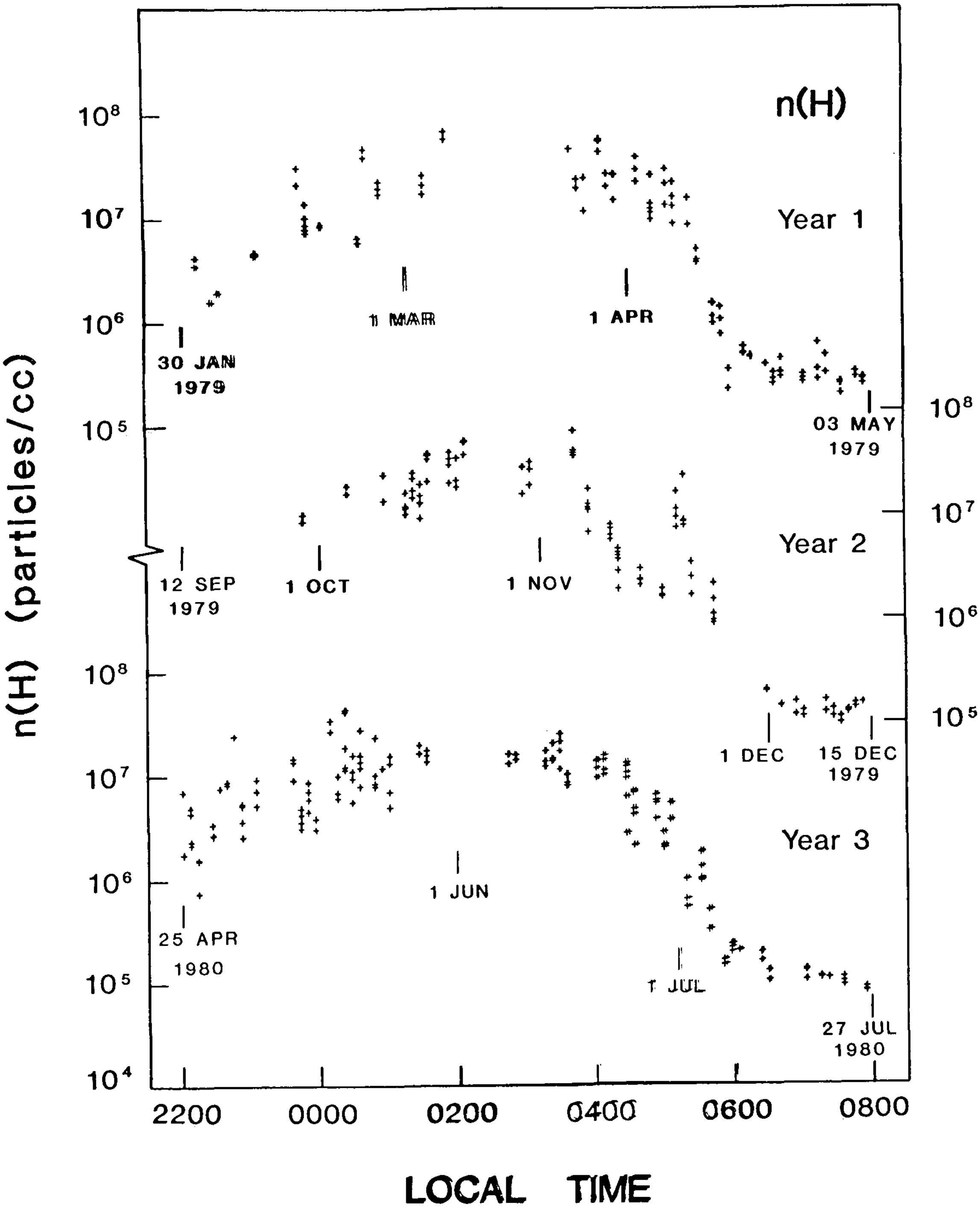

Figure 1. Local time distributions of n(H) derived from in-situ ion and neutral composition measurements at Venus during 1979-1980. Clusters of points are for individual orbits at specific local times. Gaps occur due to data interruptions and mode incompatibilities. The dawn bulge in hydrogen is evident featuring a sharp night-to-day gradient near 0500-0600. Sharp day-to-day variations in n(H) are attributed to solar wind perturbations and associated interaction with the ion and neutral constituents used in the derivation of hydrogen.

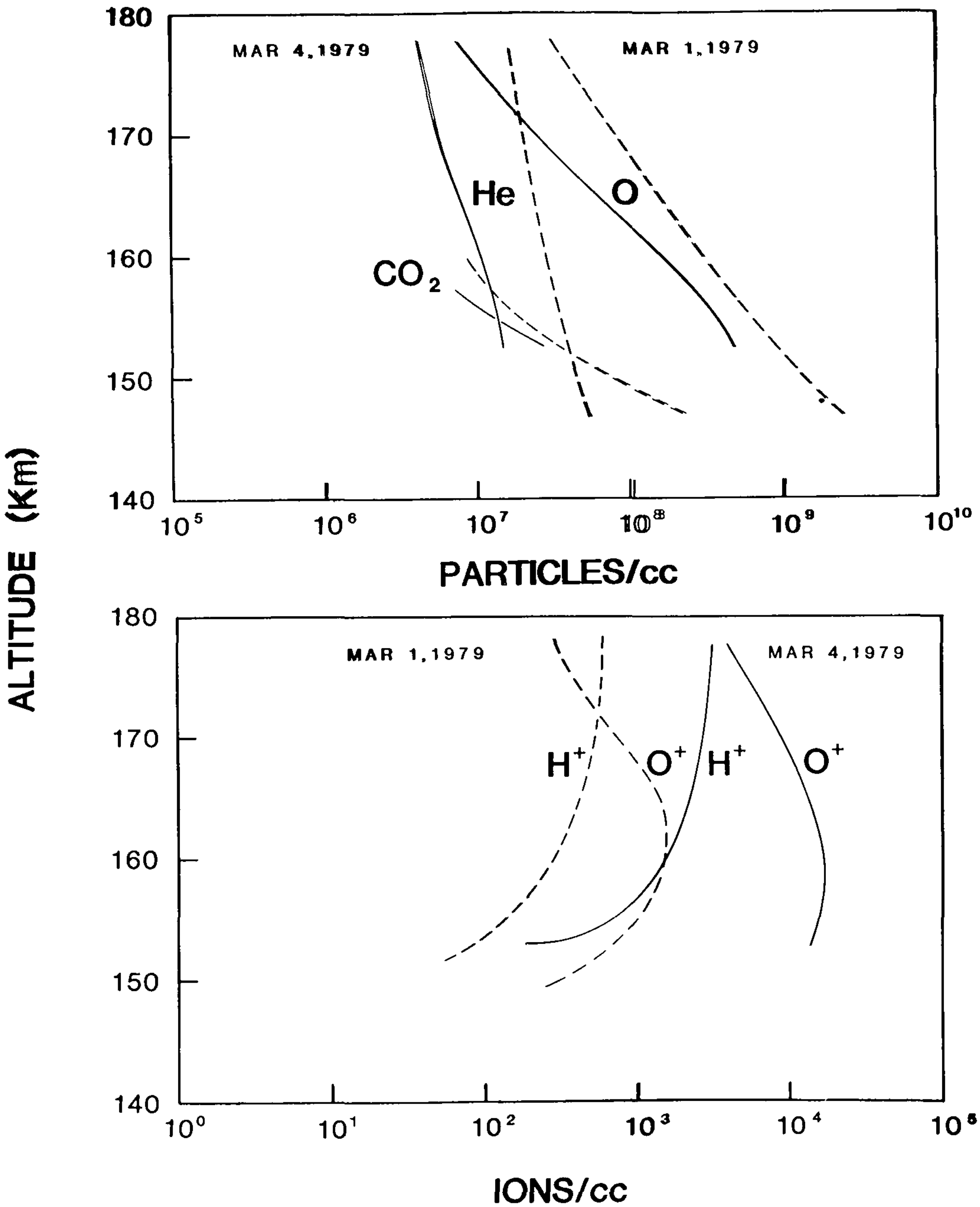

Figure 2. A comparison of the individual neutral and ion species variations observed in association with the passage of a strong solar wind disturbance on March 1 relative to a quiet day on March 4. Note for the neutrals in the upper panel that each of the species is more abundant on the disturbed day while in the lower panel the ion abundances are lower on the disturbed day. The reduction in nightside ion abundances with increased solar wind pressure occurring on March 1 is understandable on the basis of the day-to-night convection necessary for maintenance of the nightside ionosphere. The response of the neutrals is unexplained but apparently reflects compound results of energetic and dynamic perturbations from undetermined sources included in the overall solar wind disturbance event.