

Comparative Aeronomy (Ionospheres).

Andrew F. Nagy

Chapman's Original Suggestion in *Nature*, 1946

Some Thoughts on Nomenclature

Our planet the earth is studied in many ways, some of which correspond roughly to the main divisions of universal science, of which physics, mechanics, physics and chemistry. Such specialized branches of the universal sciences are approximately indicated by the prefix 'geo-', giving the words 'geomechanics', 'geophysics' and 'geochemistry'; these are modified on the old word 'geometry', which itself has not lost its special association with the earth, to become the name of a universal science of the measurement and properties of space (and of the 'figure' of the earth, which must be the basis of geometry, the mapping of the earth). The meaning of 'geography' is actually become elaborated to include much more than graphic presentation, and besides physical geography, which studies all in space, covers studies that merge into economics, sociology and natural biology.

Another venerable word, 'geology', the significance of which has always been more limited than the word might imply, has nevertheless in time gained a deeper and wider content, so that now it covers any subdivisions which likewise shade off near their boundaries to geophysics, economics and biology (past and present).

I have long thought that a comprehensive word is needed to cover all these branches of the study of the earth, and the more fitting use of the terms 'the earth addresser' and 'geo-science', as it is indicated that others have felt the same need. I will venture to propose for this purpose the word 'geonomy', analogous to the ancient word 'astronomy', which has many parallel branches such as astrophysics, astrometry and astrography, not to speak of its own displaced astronomy.

The analogy can usefully be carried further. The word 'geonomy' flows smoothly from the tongue, and would exempt not only the geologist and geographer but also such awkwardly named occasions as geophysicist (a too difficult word), geomagnetician or meteorologist.

The corresponding adjective might be either 'geonomic' or 'geonomic'; 'geonomic' seems preferable for its brevity, and has respectable precedents to justify it, such as 'economic'.

The formation 'nomy' also offers a convenient means of creating a new word to replace 'meteorology', which, especially in its English derivative form, is excessively procrustean; and the association of meteorology with the beautiful word 'meteor' is now irrelevant and misleading. I propose that the word be abandoned in all its official and technical uses, in favour of 'aeronomy' (with the associated words 'aeronomics' and 'aeronomics'); 'aerology' is of course an alternative, but already has a specialized meaning for a part of meteorology.

To modify the same model might be followed to provide a name for the study of the ionosphere. 'Iononomy', 'ionomics', 'ionomic' will have to replace 'radio-physics' and the associated words, which are equally less easy to pronounce, and in view of the possible confusion with the physics of radioactivity, somewhat ambiguous; it is to be admitted, however, that iononomy might seem applicable to the ionosphere in the laboratory as well as in the ionosphere.

S. CHAPMAN.

Imperial College of Science and Technology,
London, N.W.7.
Dec. 19.

In this letter he suggested that the term aeronomy should replace meteorology, writing that the association of the word "meteor with meteorology is now irrelevant and misleading".

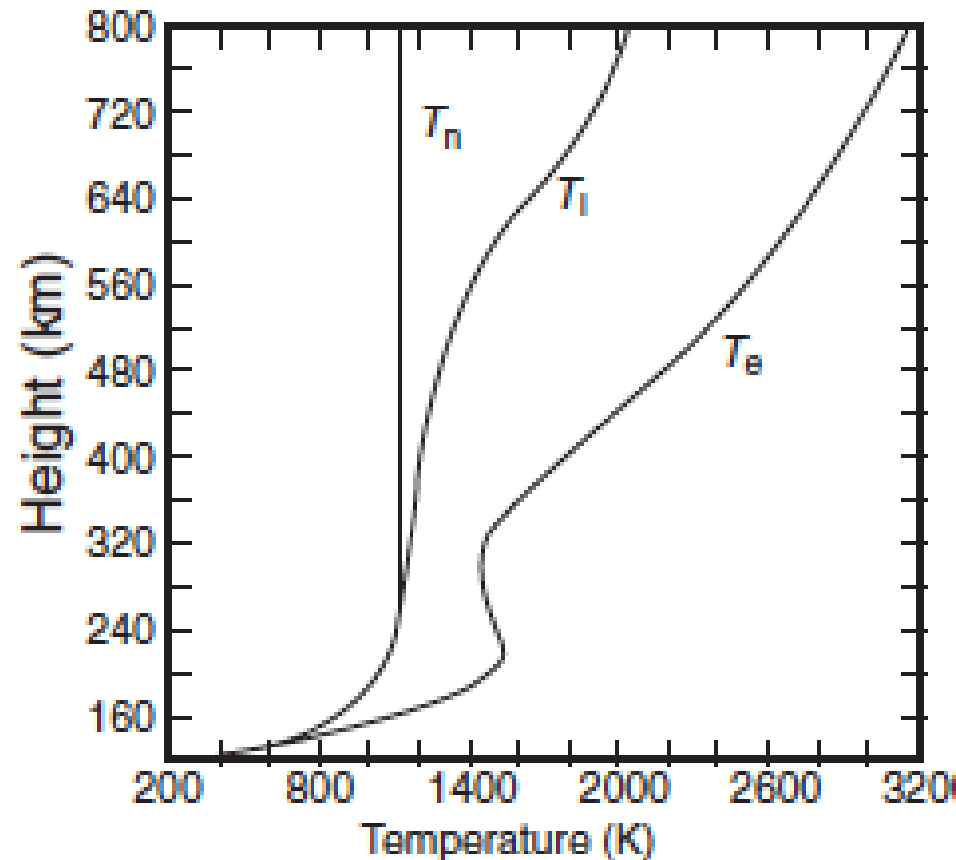
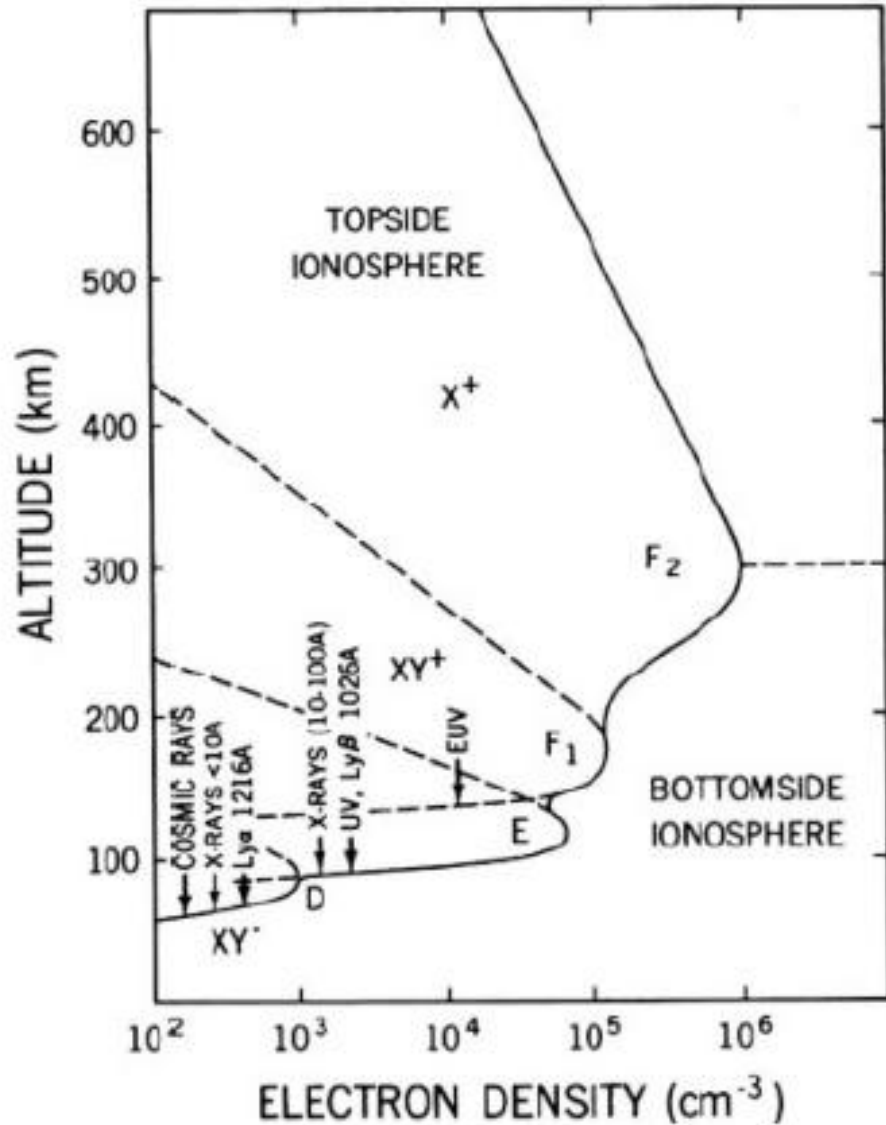
Chapman's Follow-Up Suggestions.

His original proposal was apparently not received with much support so in a short note in *Weather*, in 1953, Chapman, (1953) wrote:

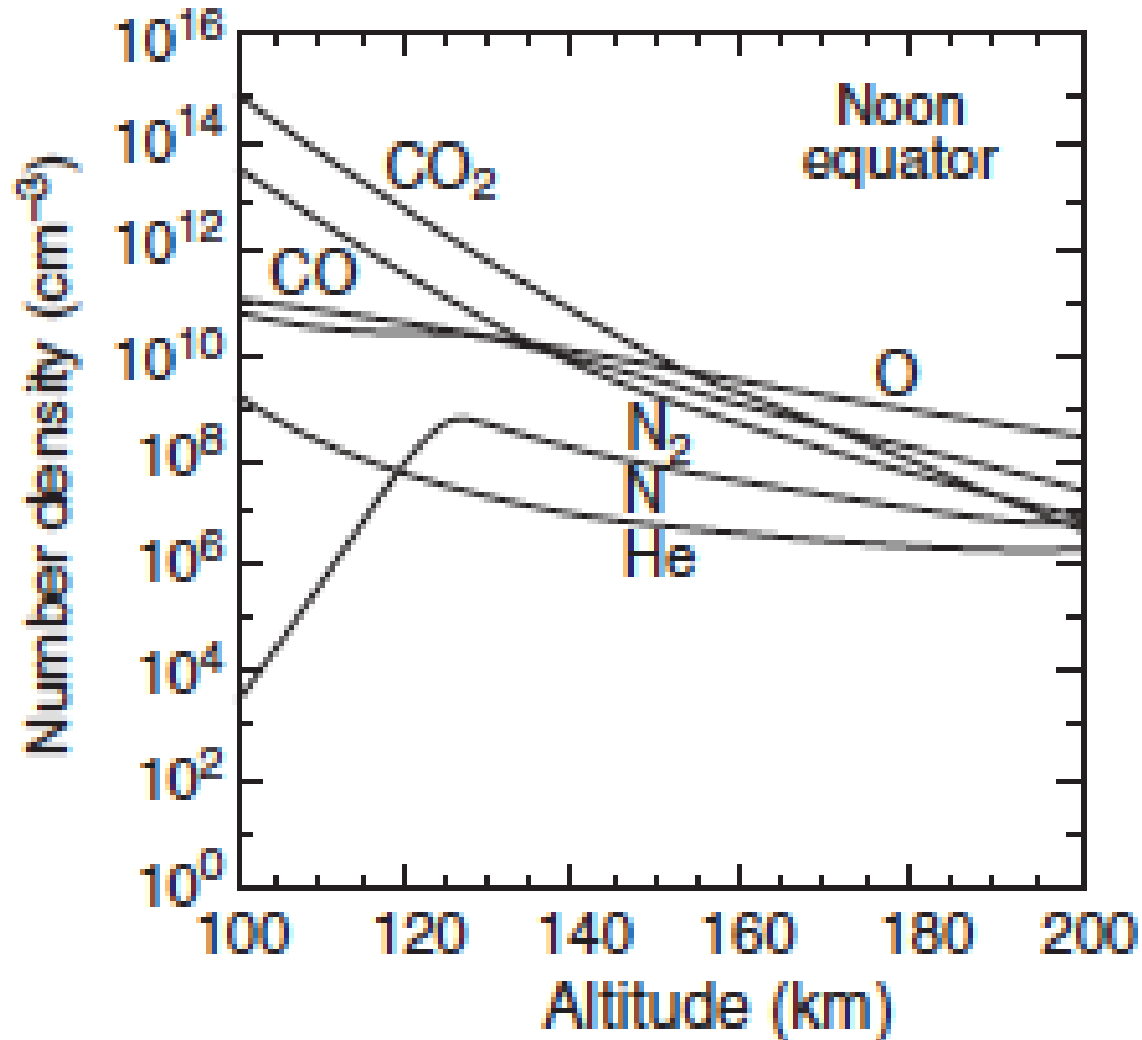
“If, despite its obvious convenience of brevity in itself and its derivatives, it does not commend itself to aeronomers, I think there is a case for modifying my proposal so that instead of the word being used to signify the study of the atmosphere in general, it should be adopted with the restricted sense of the science of the *upper* atmosphere, for which there is no convenient short word.”

In a chapter, he wrote in a 1960 book (*Chapman, 1960*), he give his final and definitive definition, by stating that “Aeronomy is the science of the upper region of the atmosphere, where dissociation and ionization are important”.

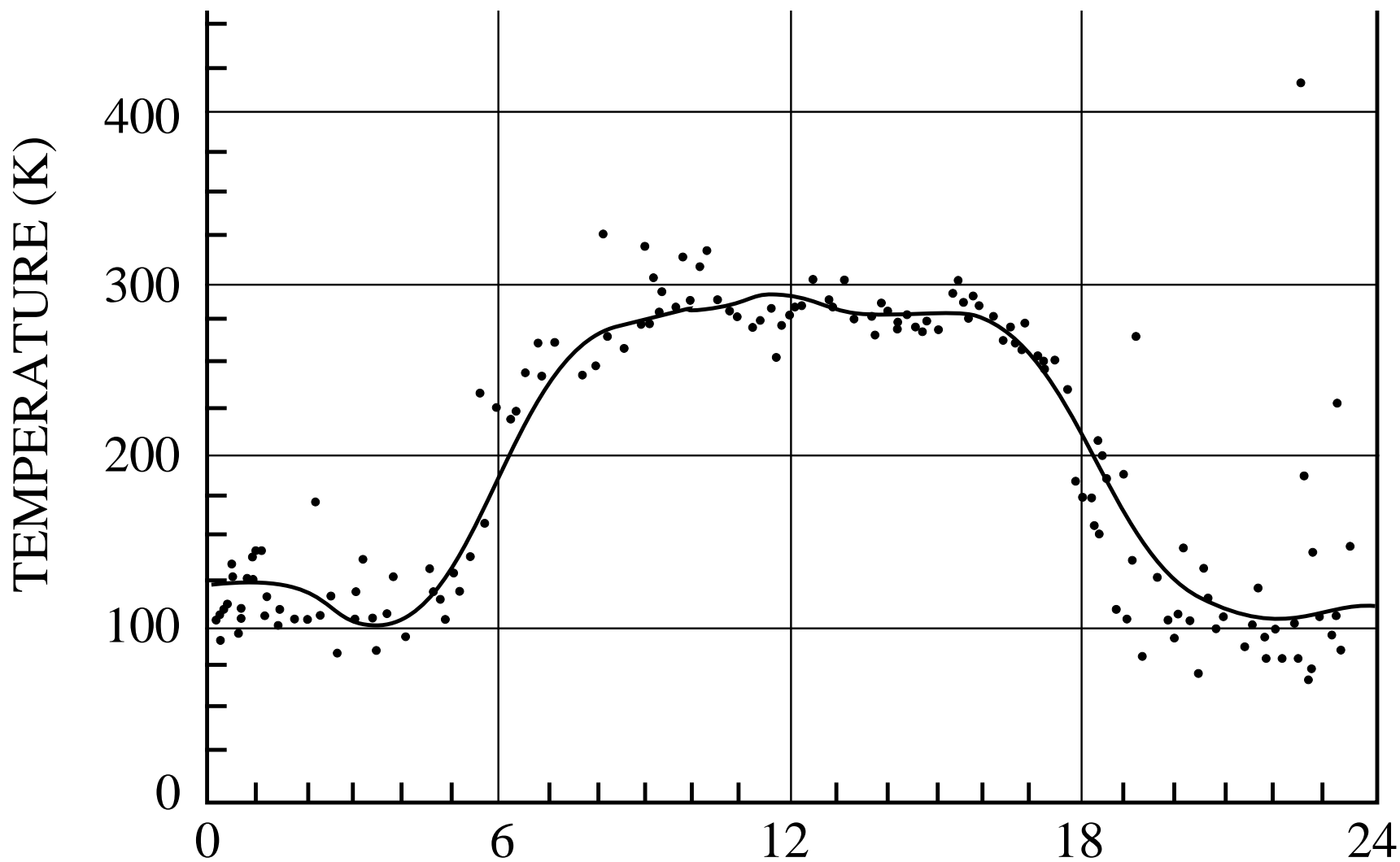
The Ionosphere of the Earth.



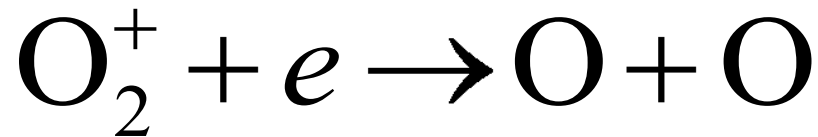
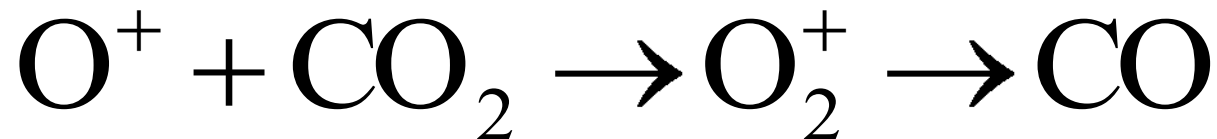
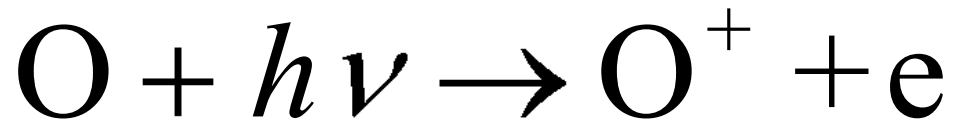
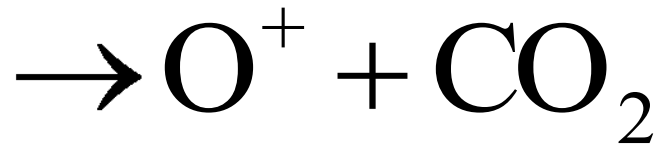
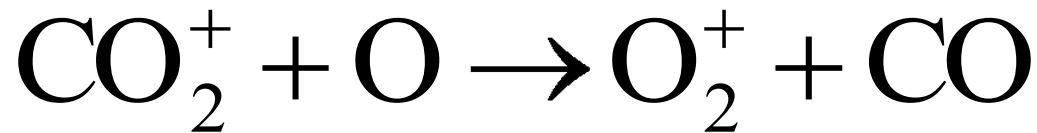
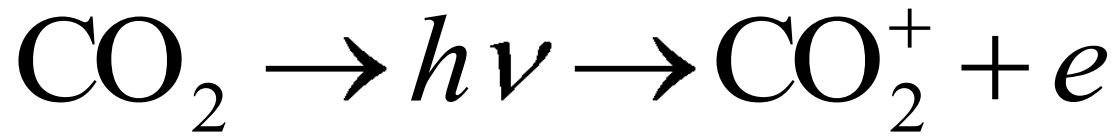
Venus' Thermosphere.



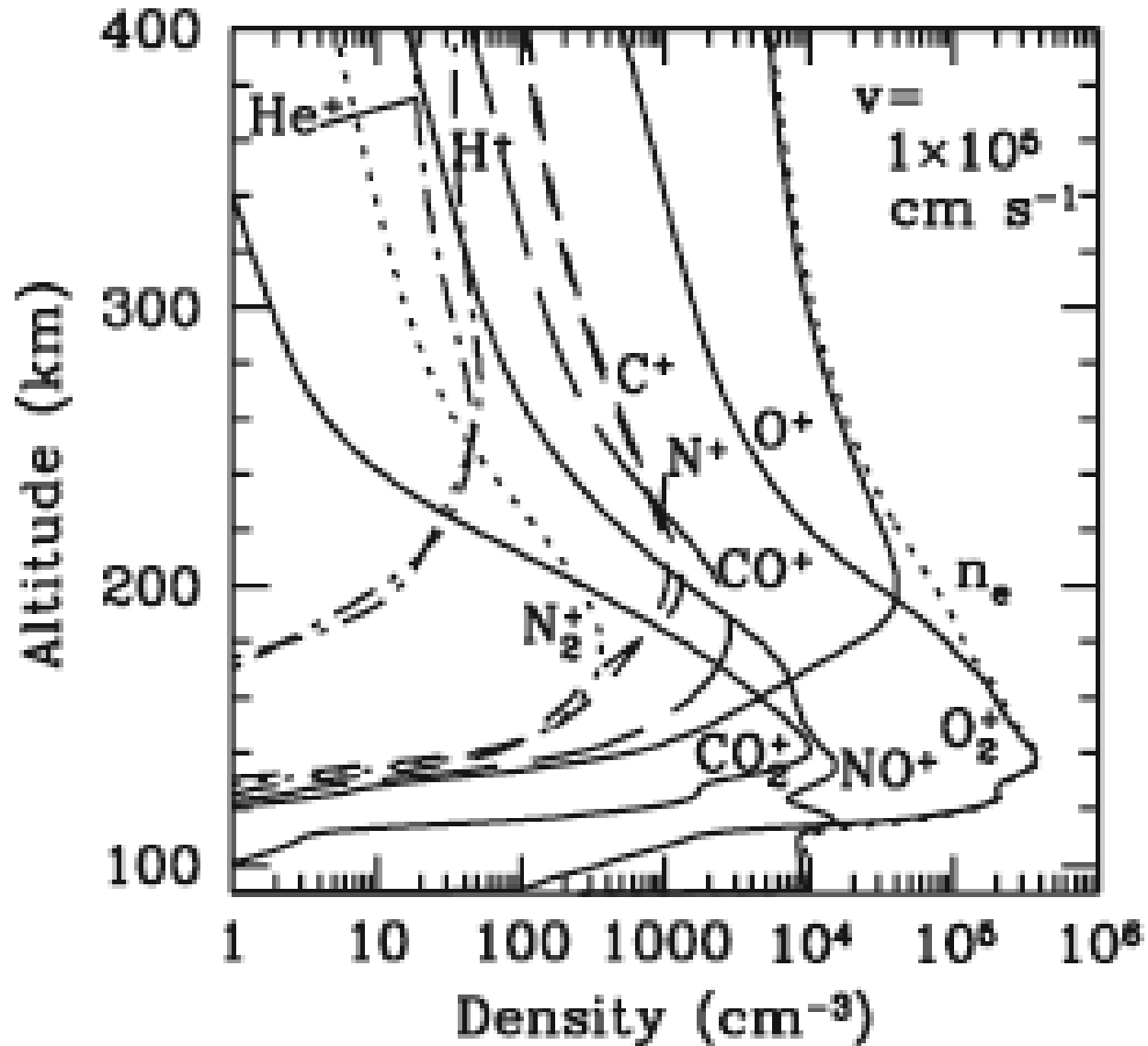
Diurnal Thermospheric Temperature Variations at Venus.



Major Chemical reactions in the Ionospheres of Venus (and Mars)

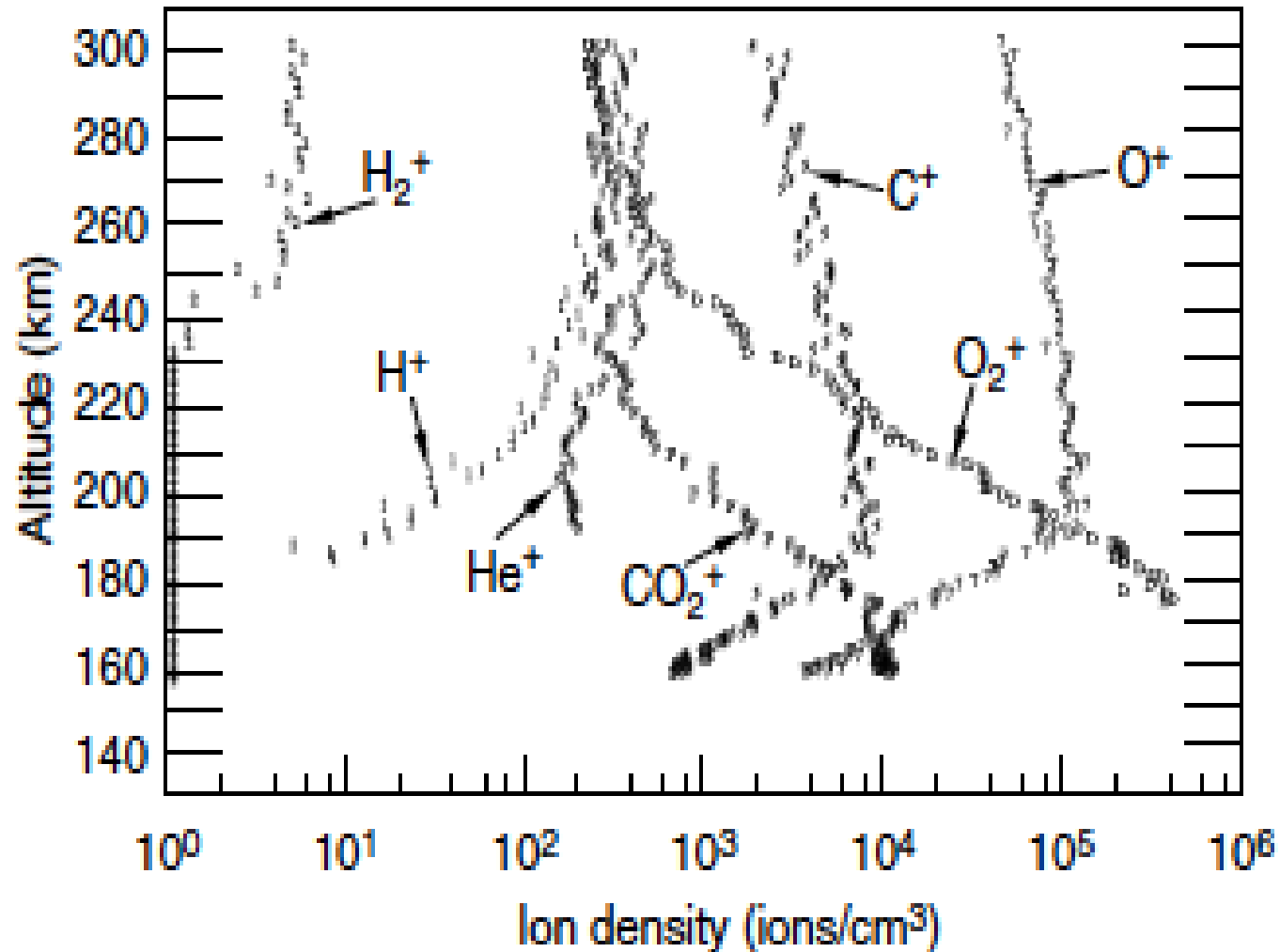


Calculated Ion Density Profiles at Venus.

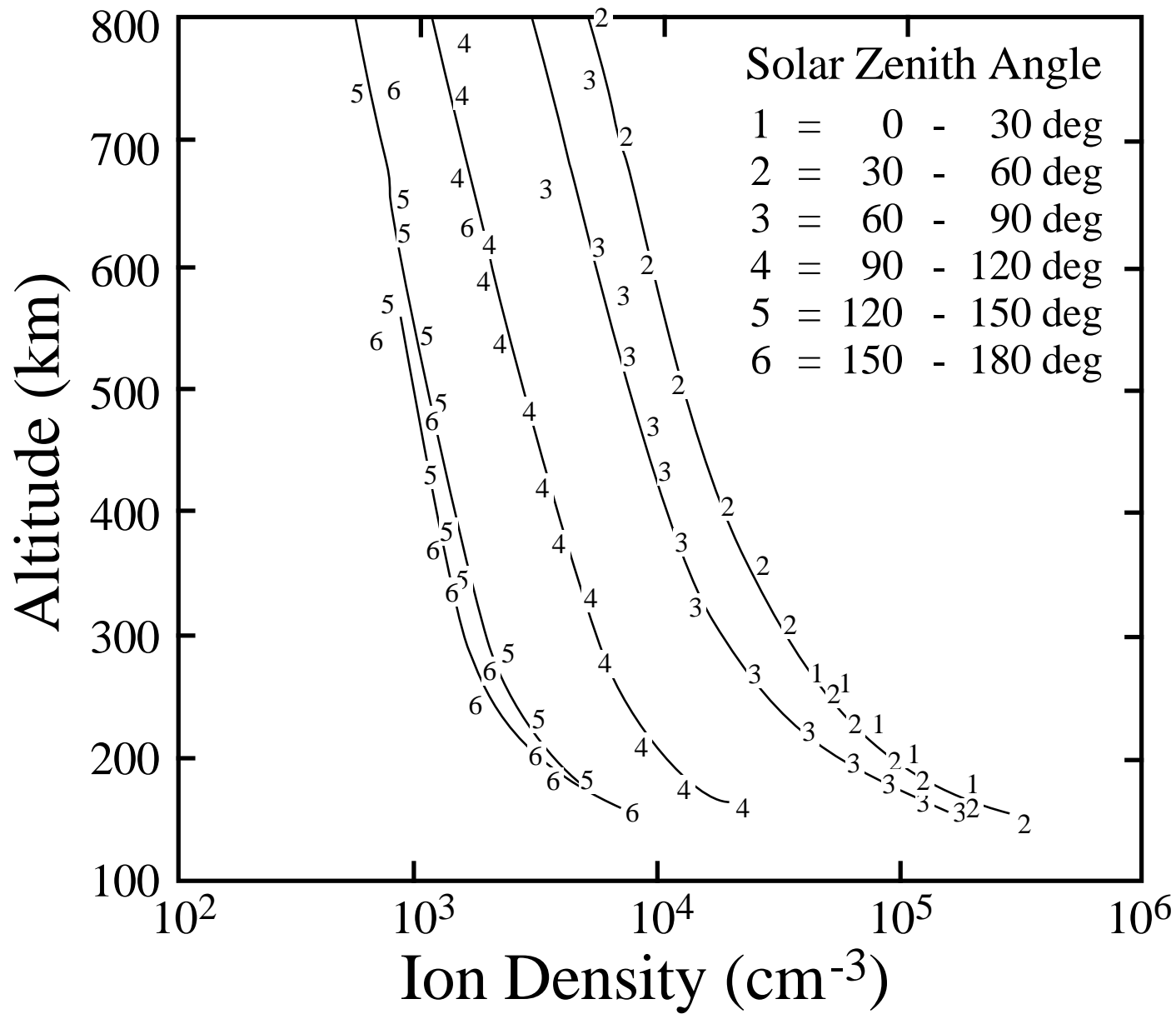


Venus Ionosphere

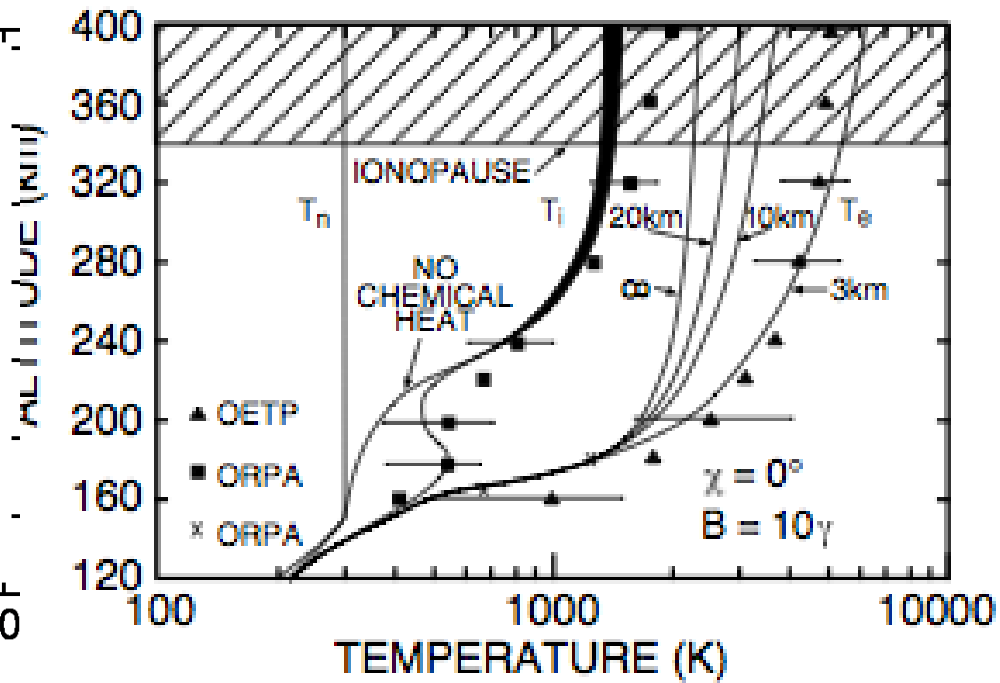
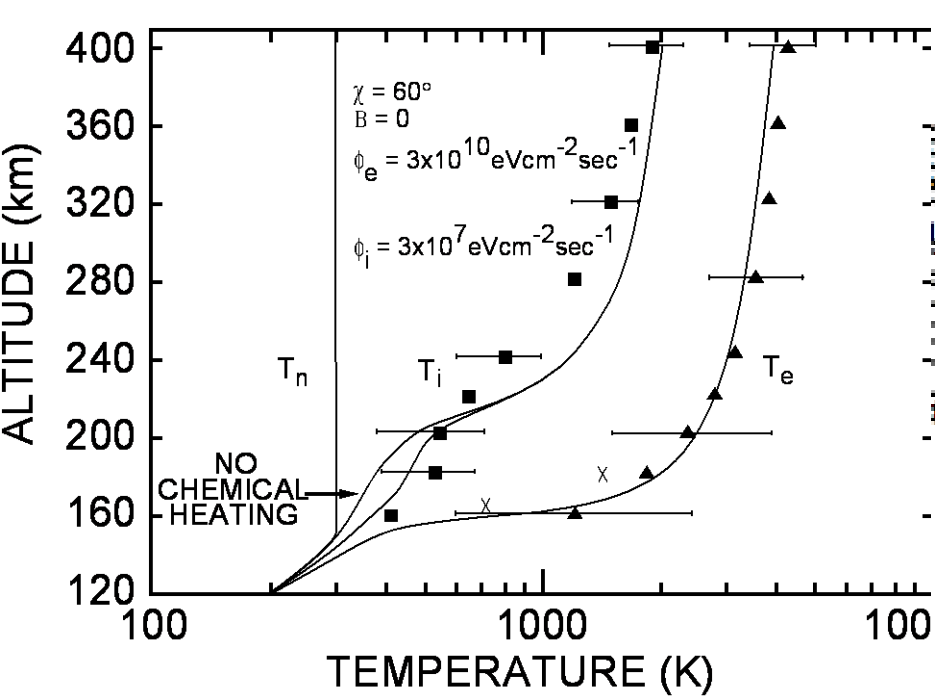
Pioneer Venus OIMS orbit 185 SZA = 11° day



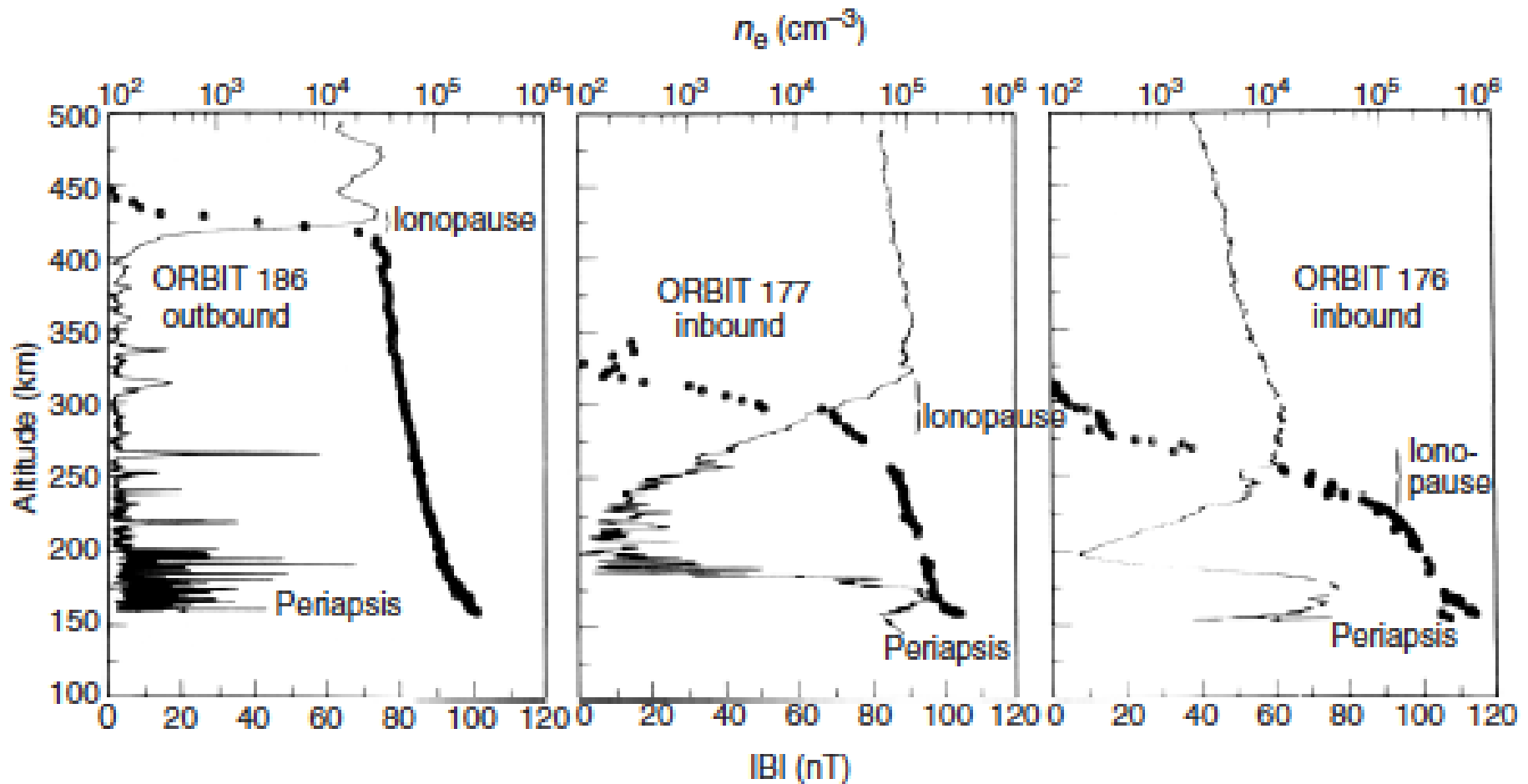
Diurnal Variation of Ion Density.



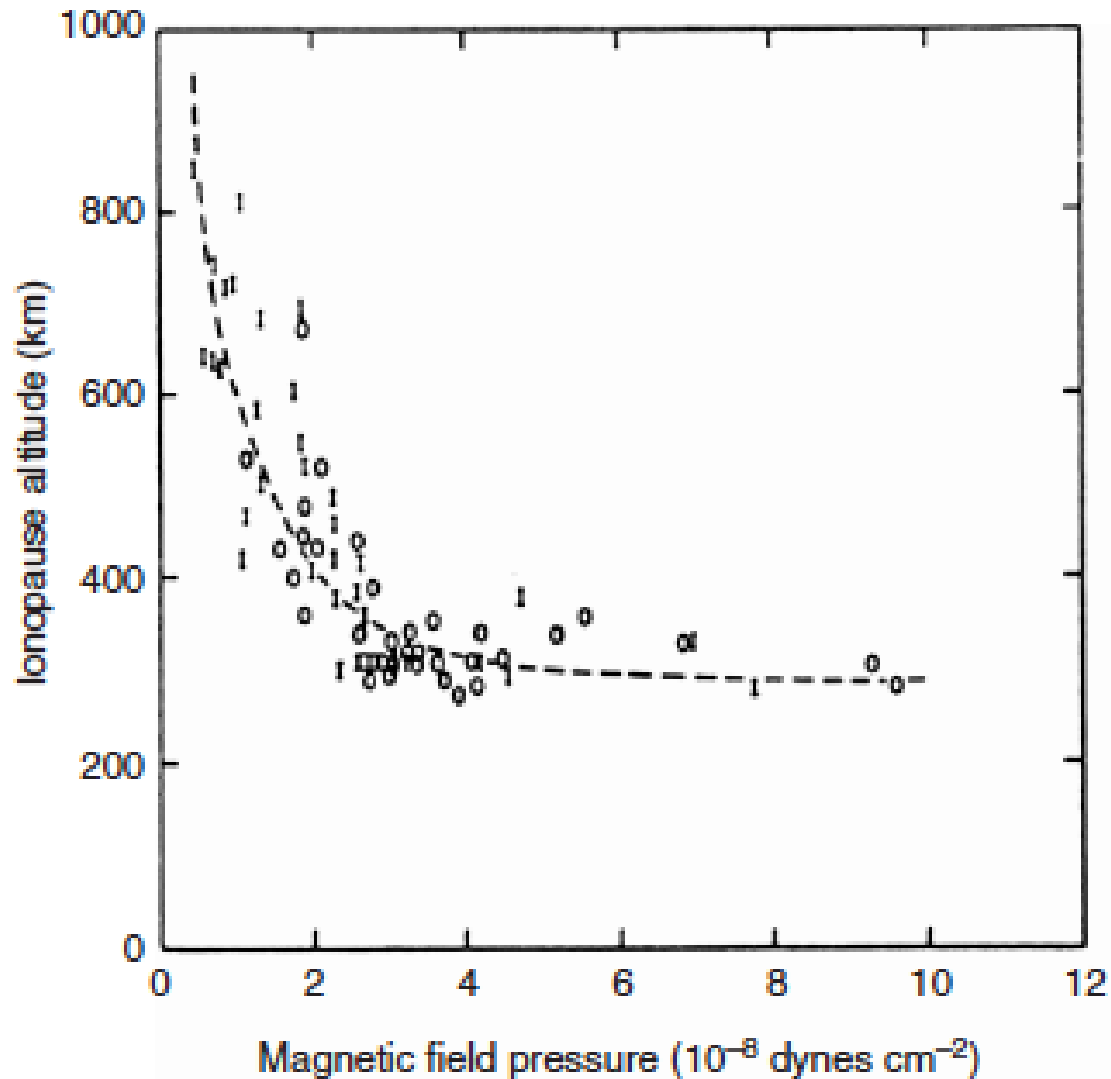
Plasma Temperatures in Venus' Ionosphere.



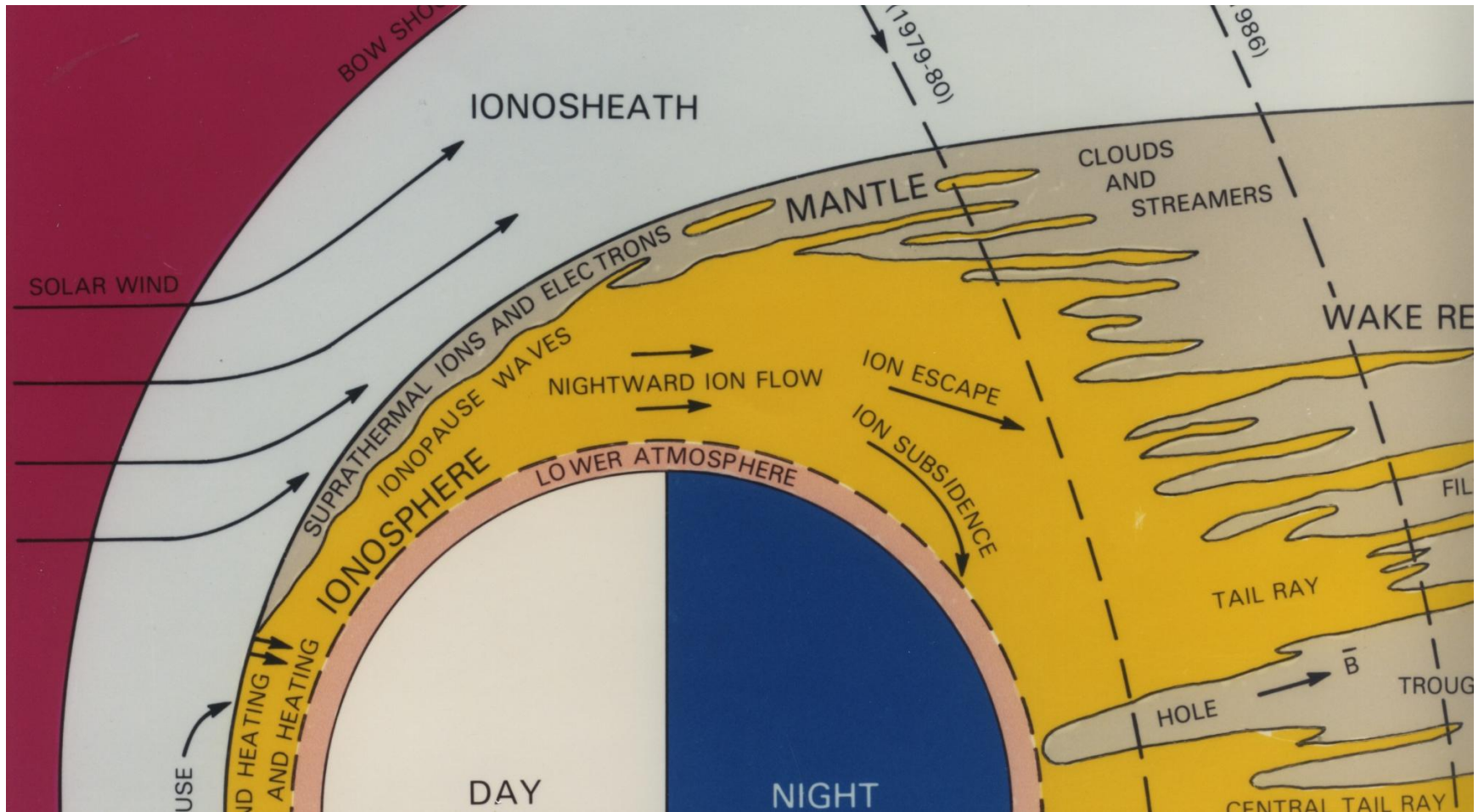
Ionopause and Magnetic Field.



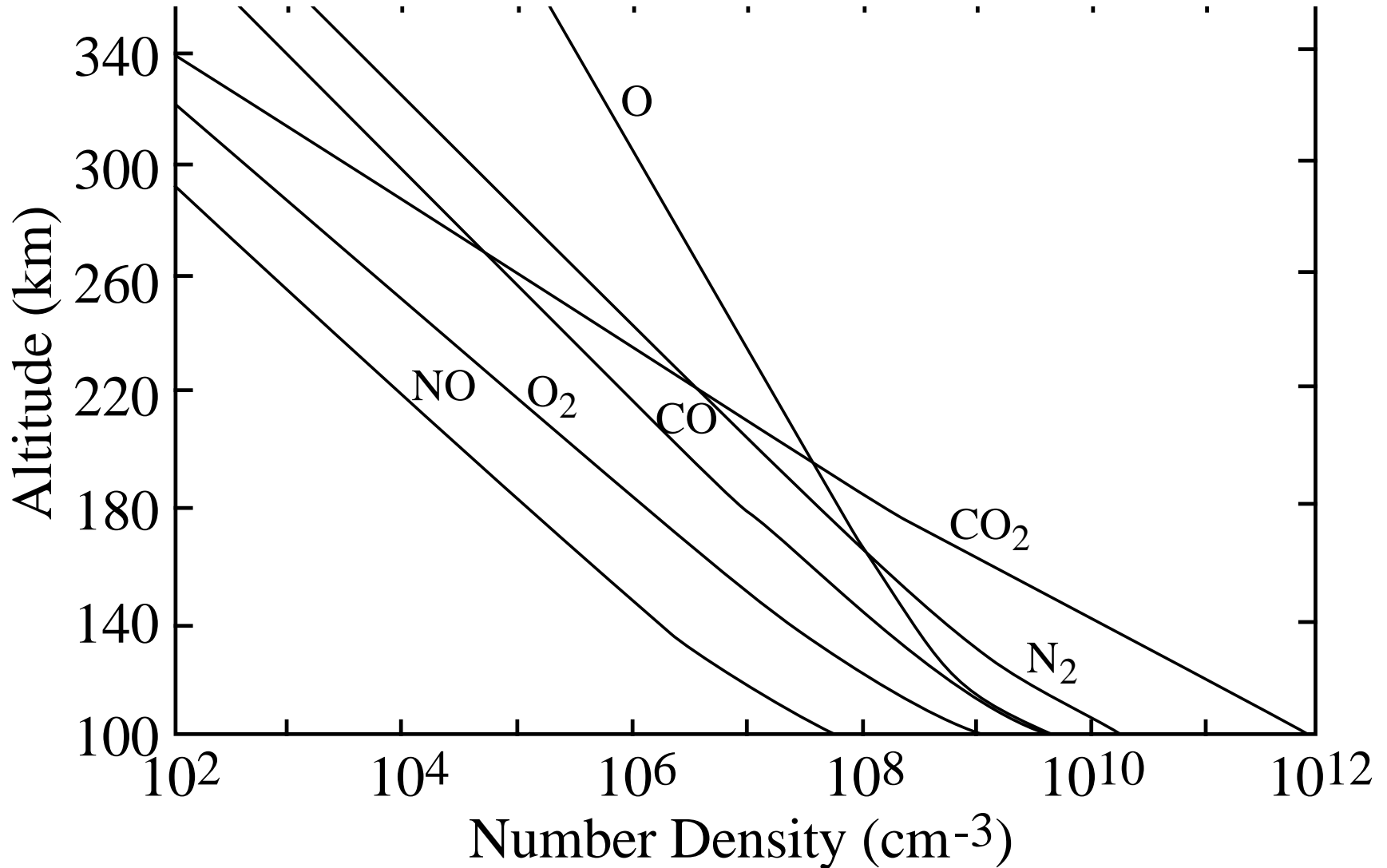
Variations in Ionopause Altitude.



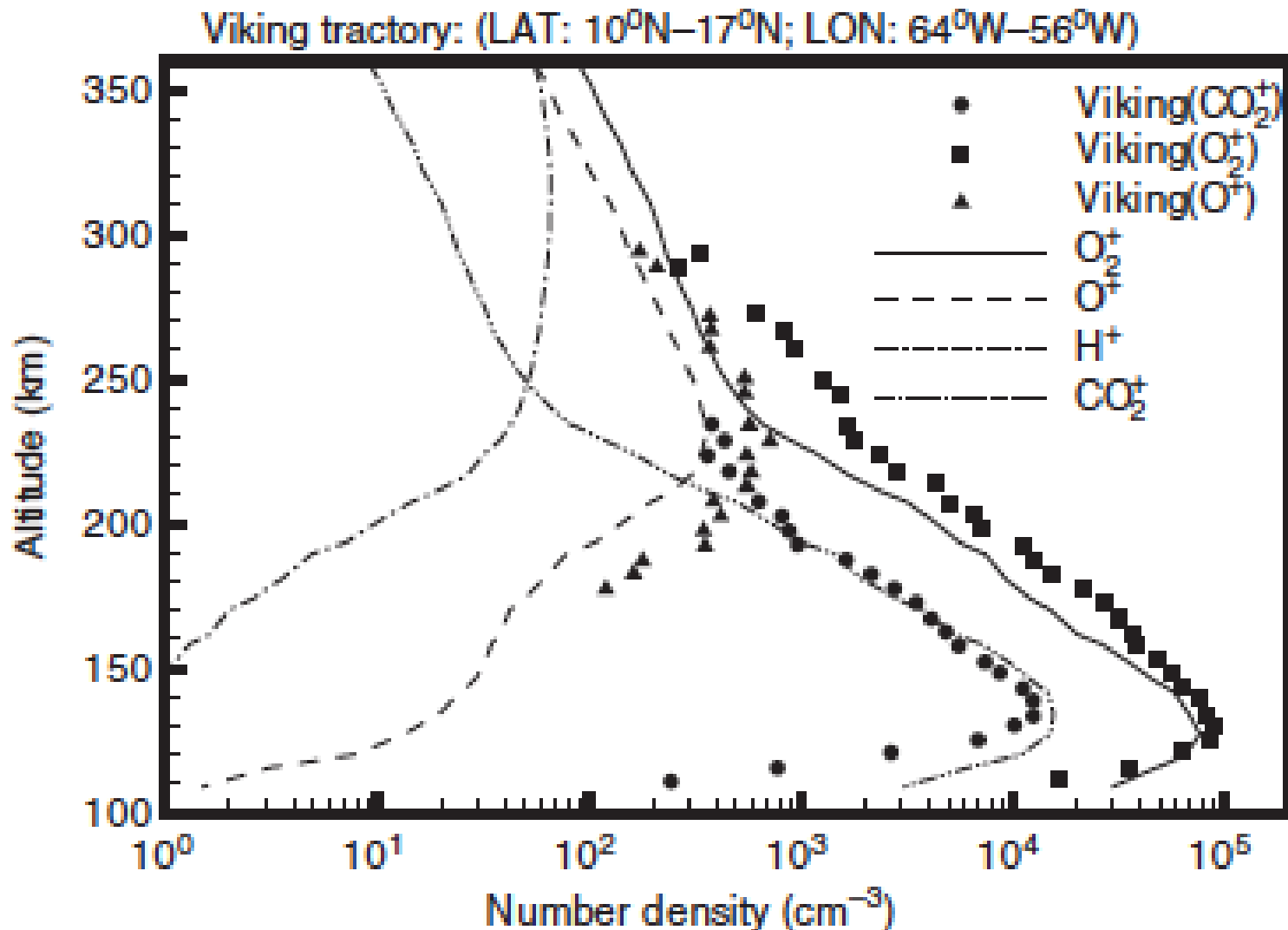
Venus' Overview



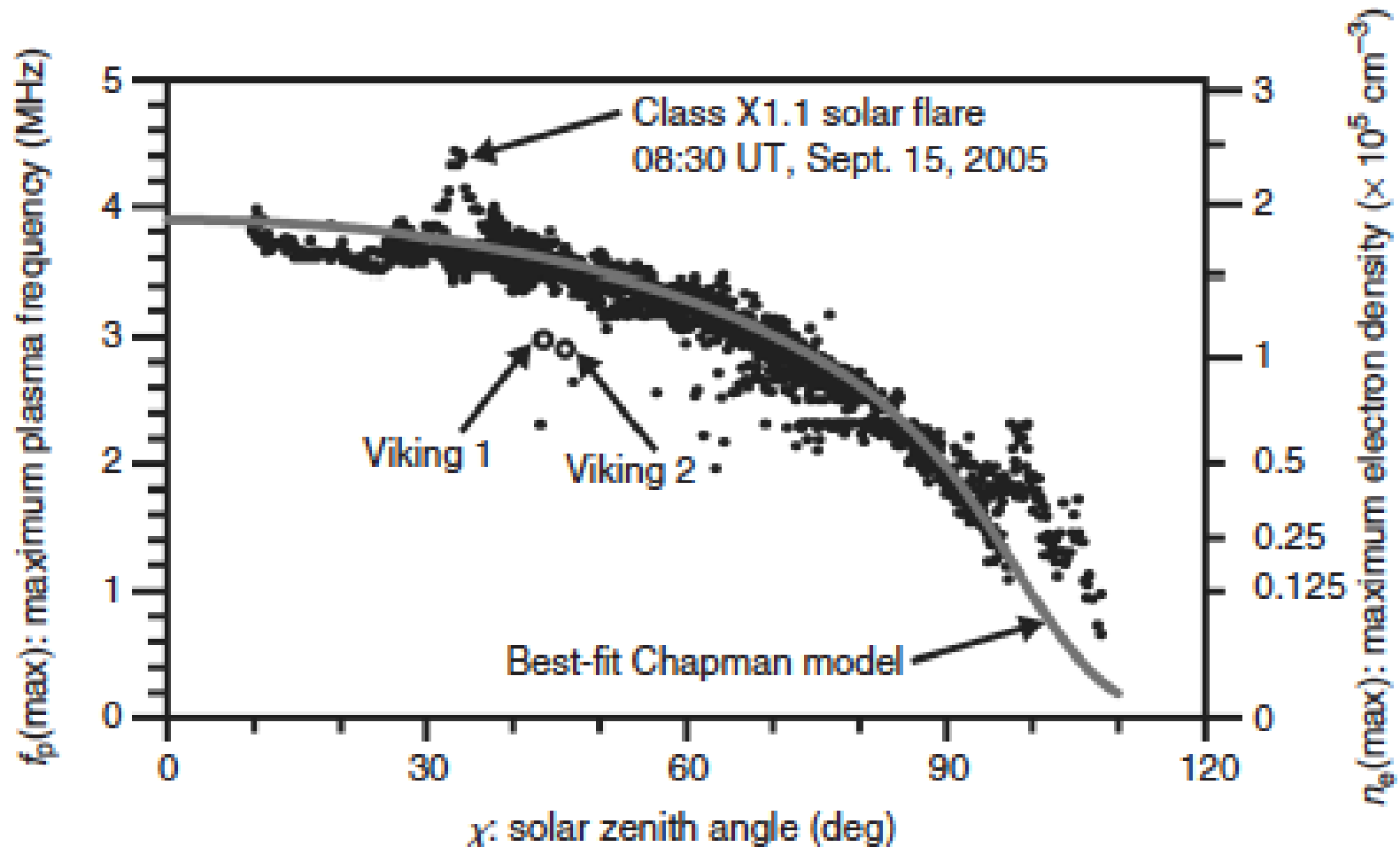
Thermospheric Densities at Mars.



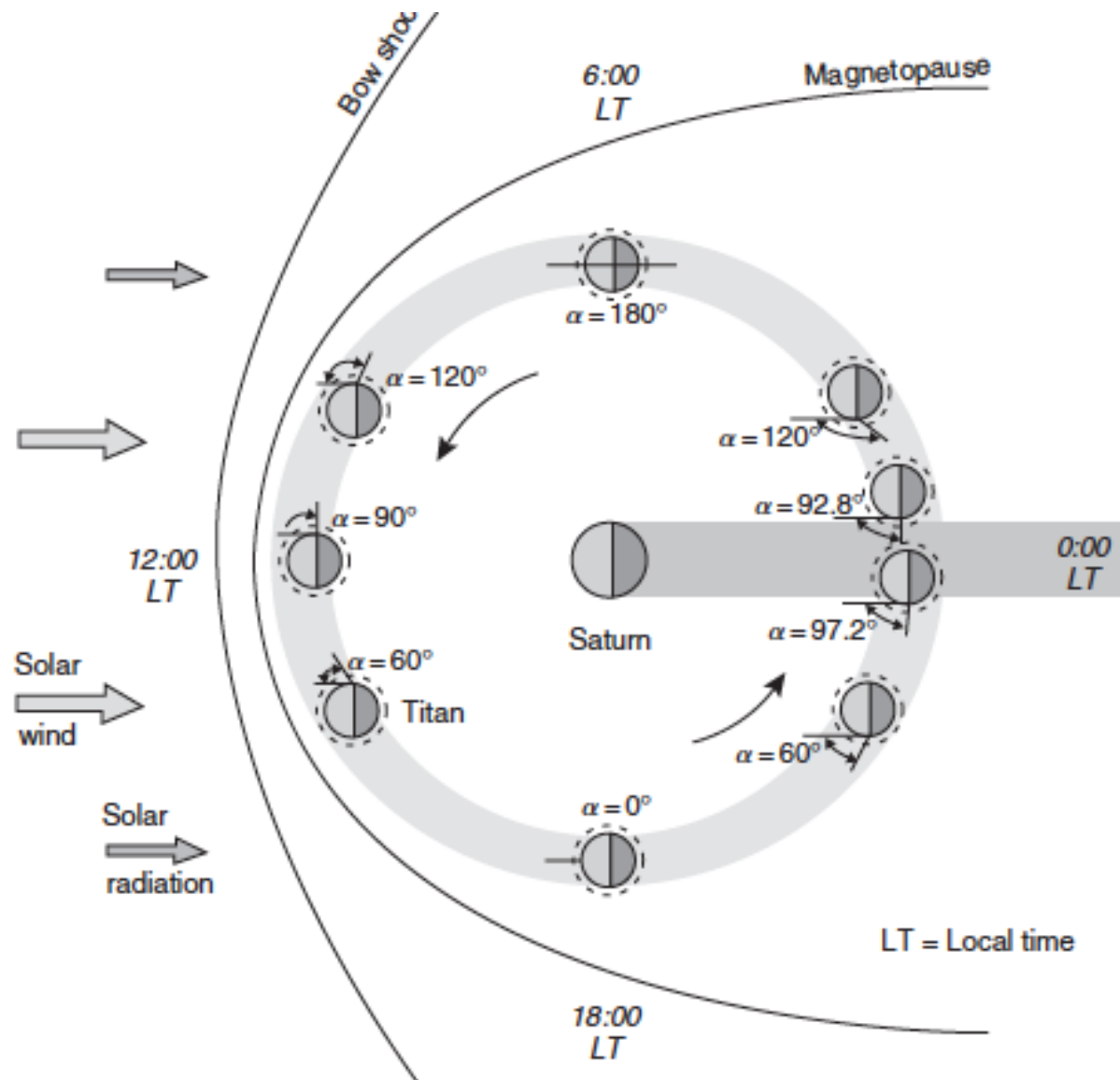
Mars's Ionosphere.



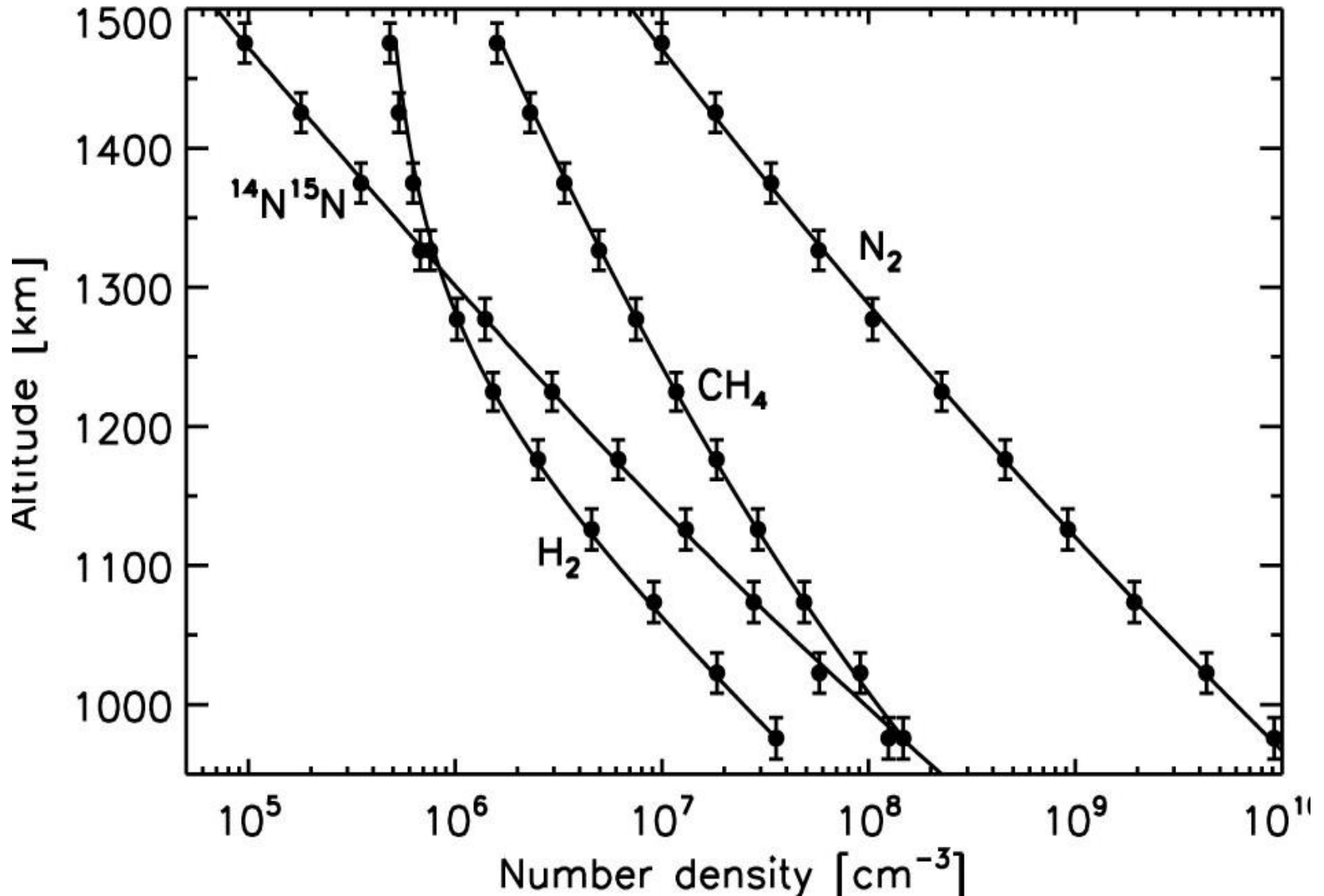
Zenith Angle Variation of the Peak Electron Density.



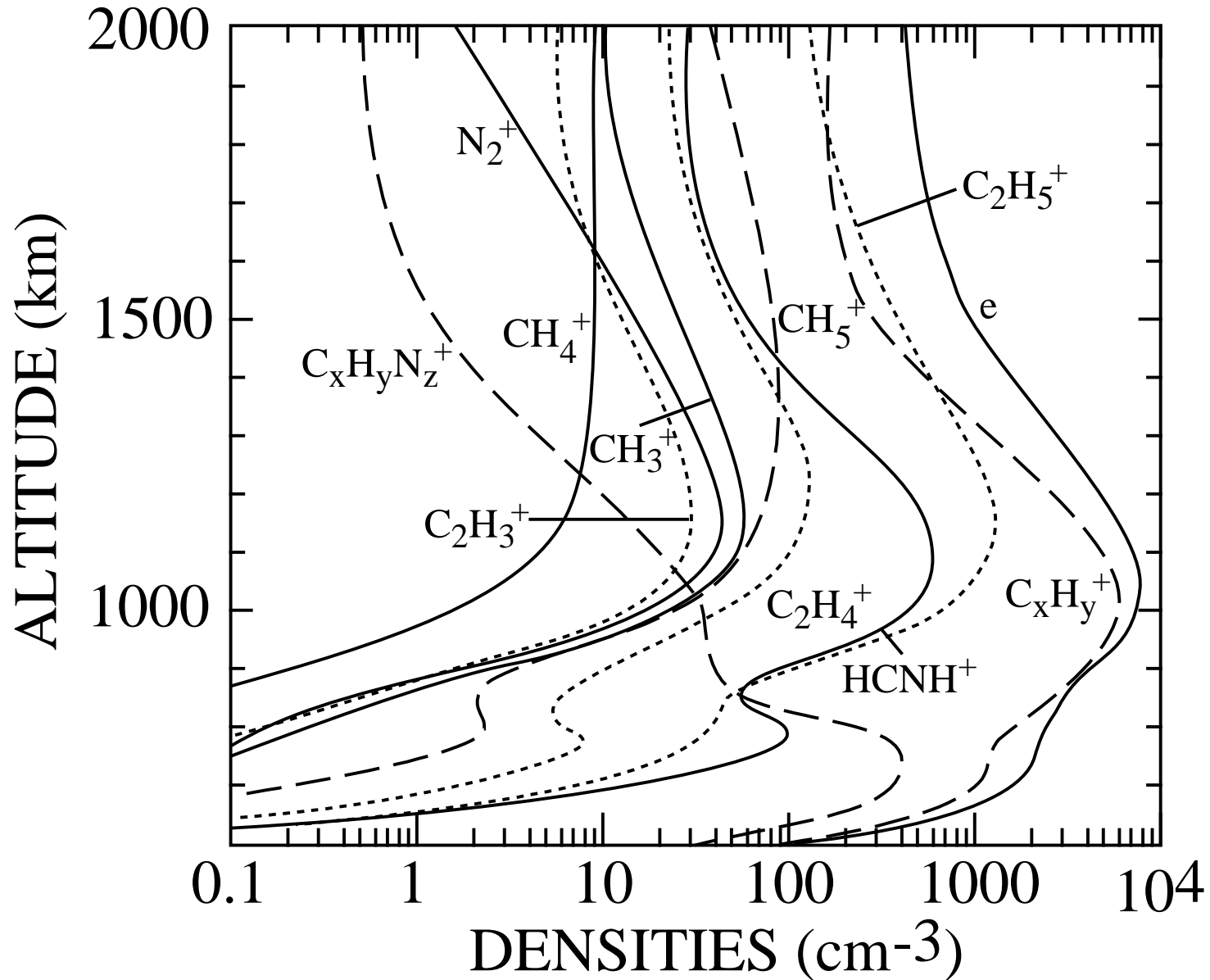
Titan in the Saturn System.



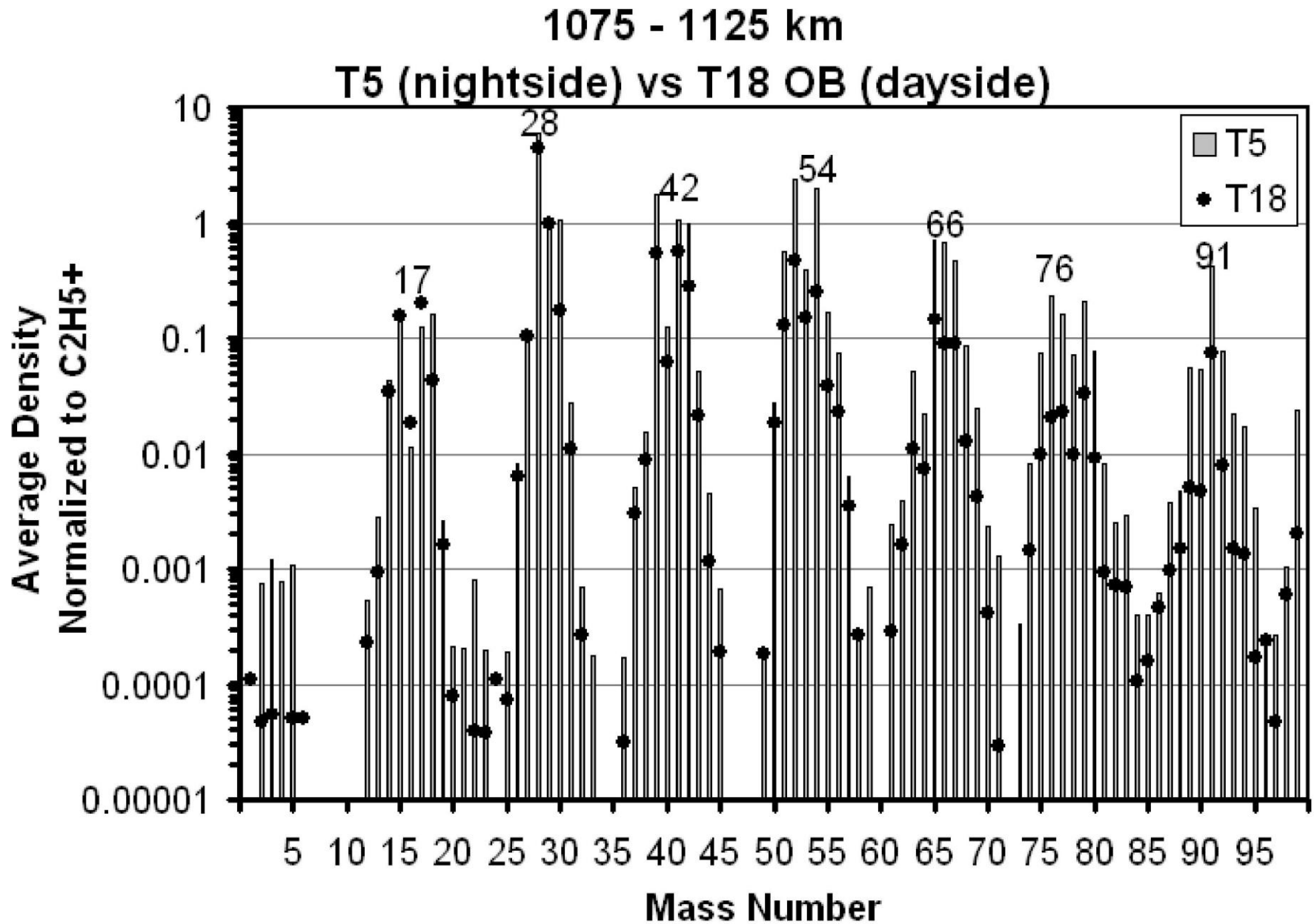
Titan's Thermosphere.



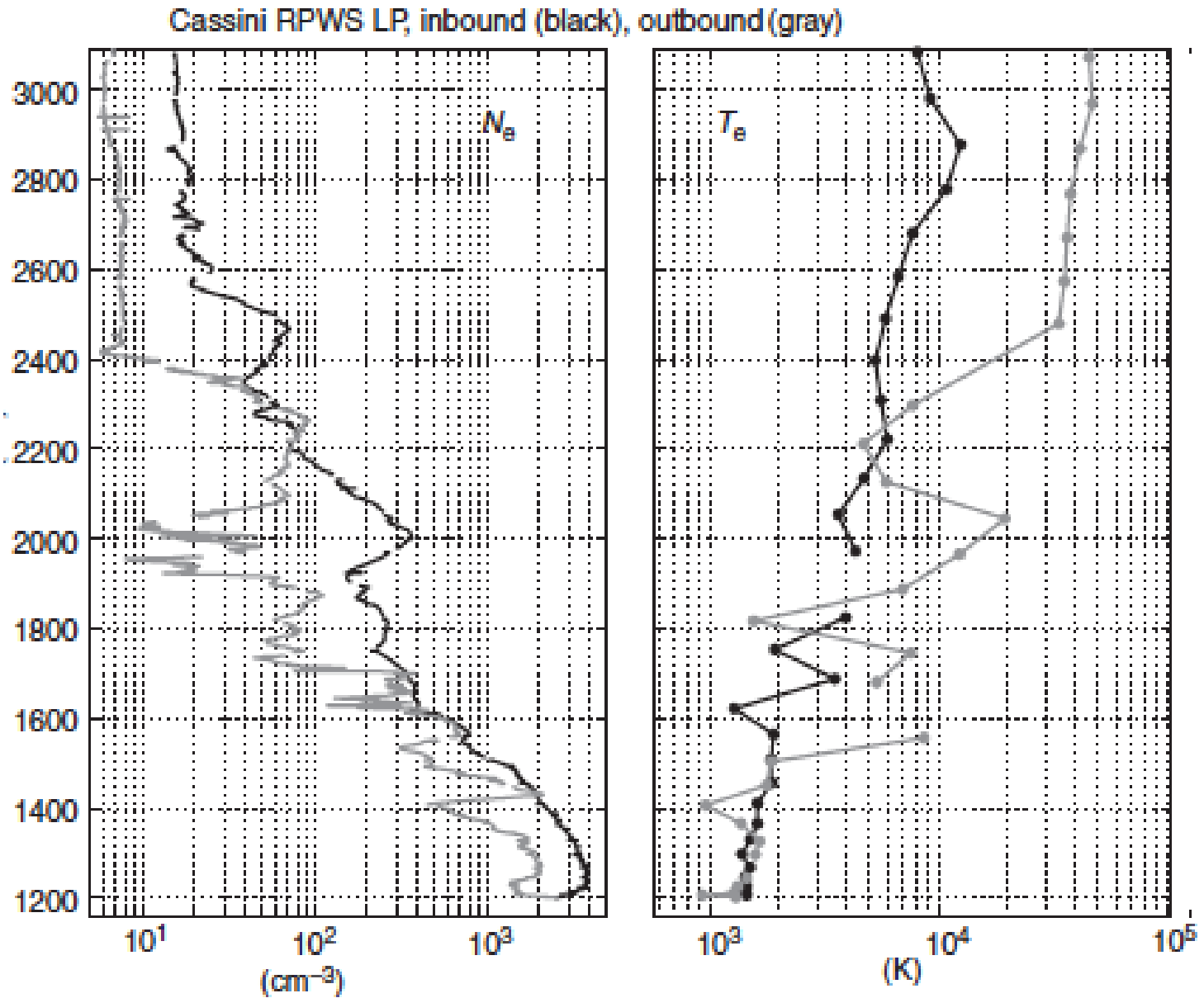
1D Model of Ion Composition at Titan.



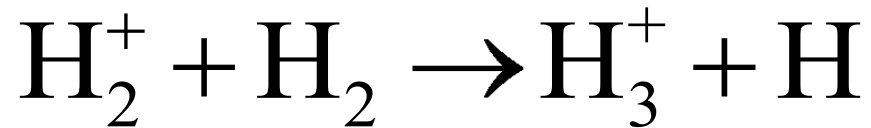
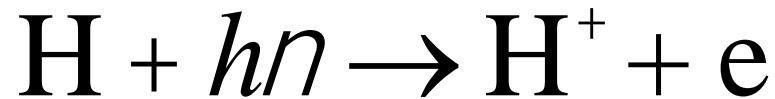
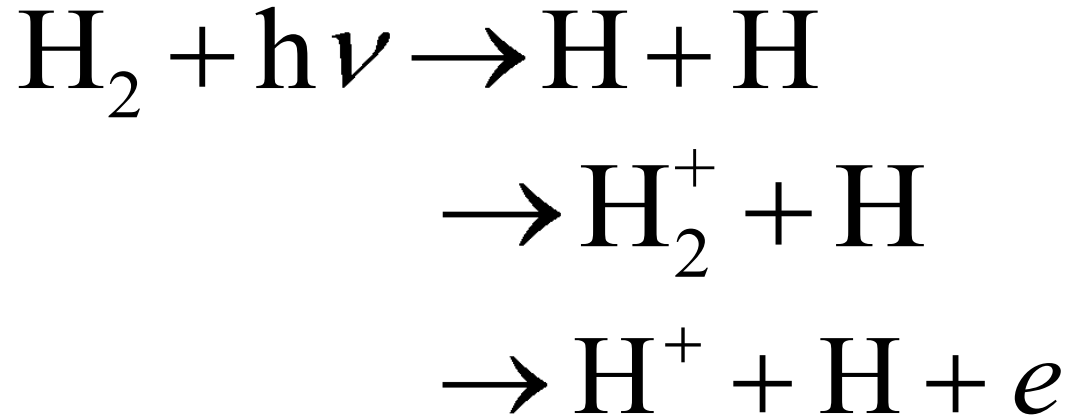
Measured Ion Composition.



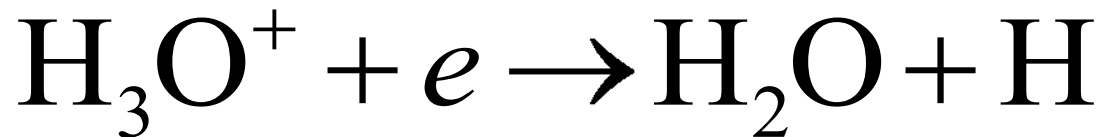
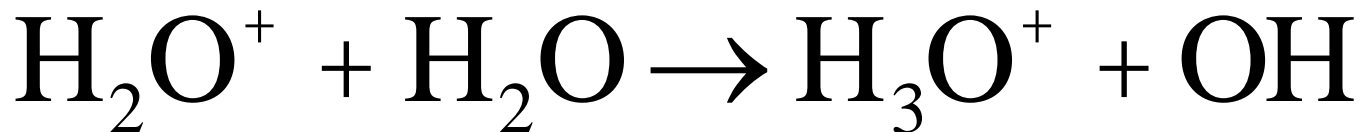
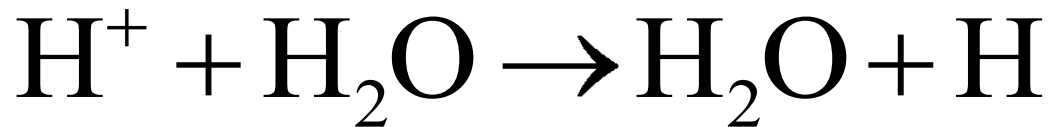
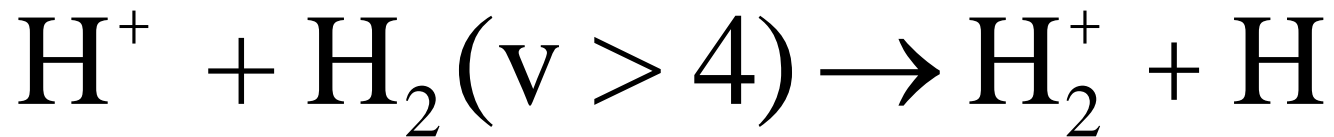
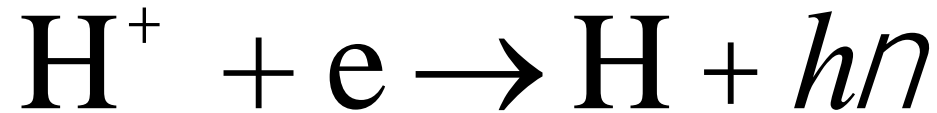
Measured Electron Densities and Temperatures at Titan.



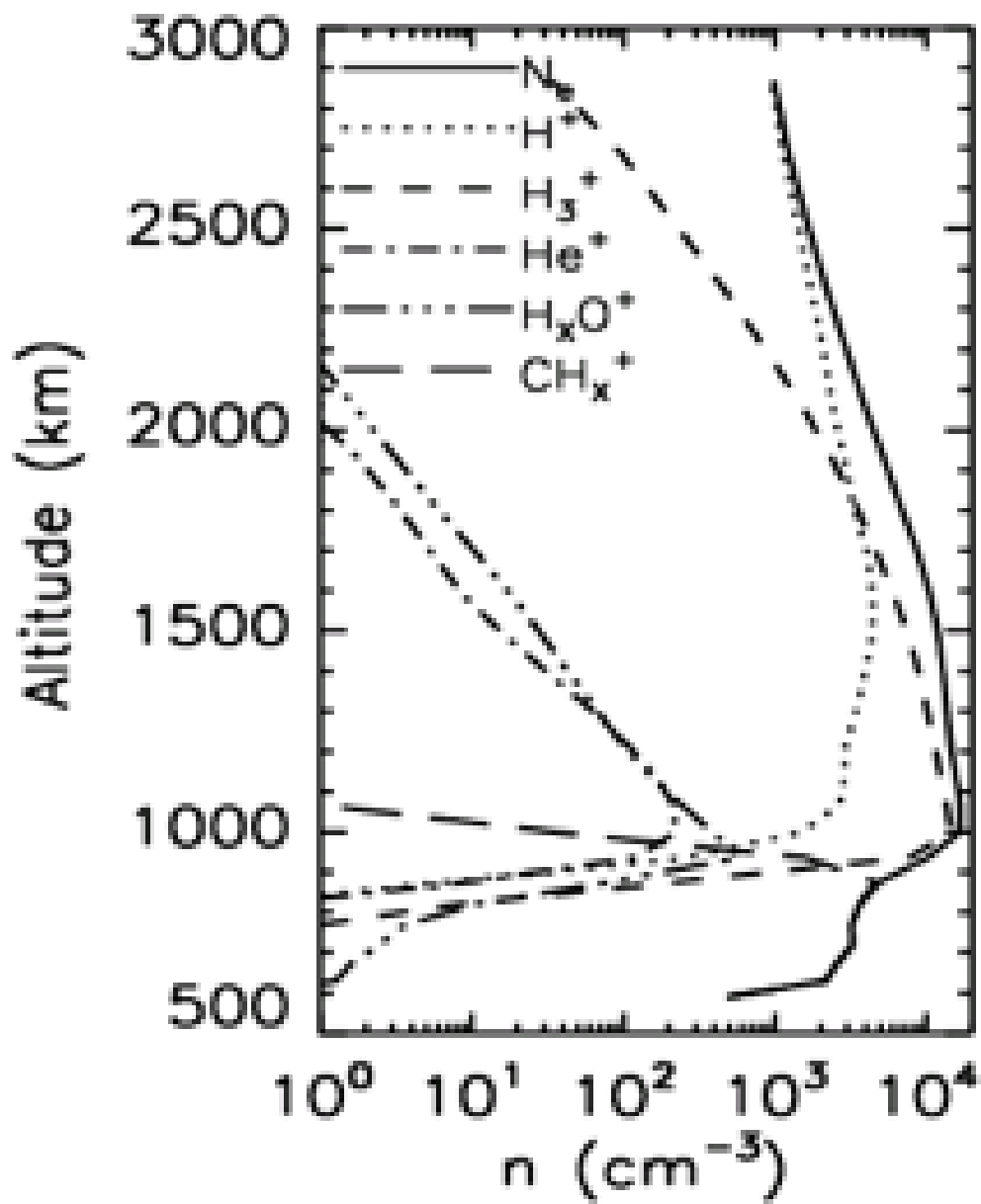
Jupiter/Saturn Ion Chemistry (1)



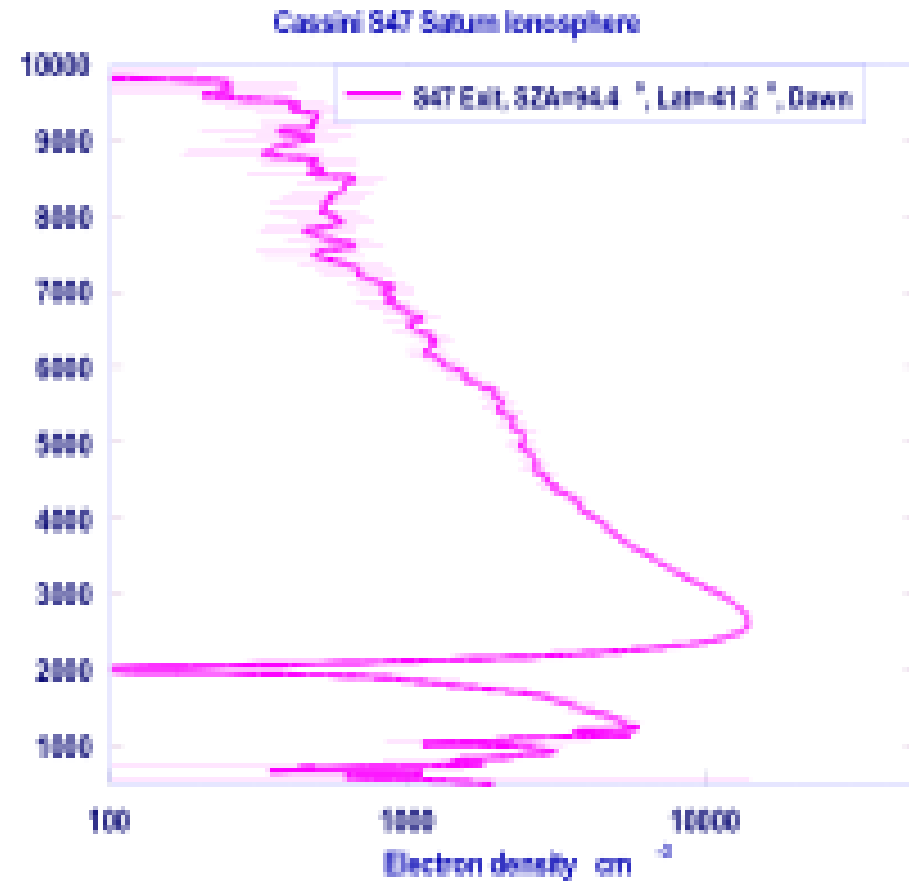
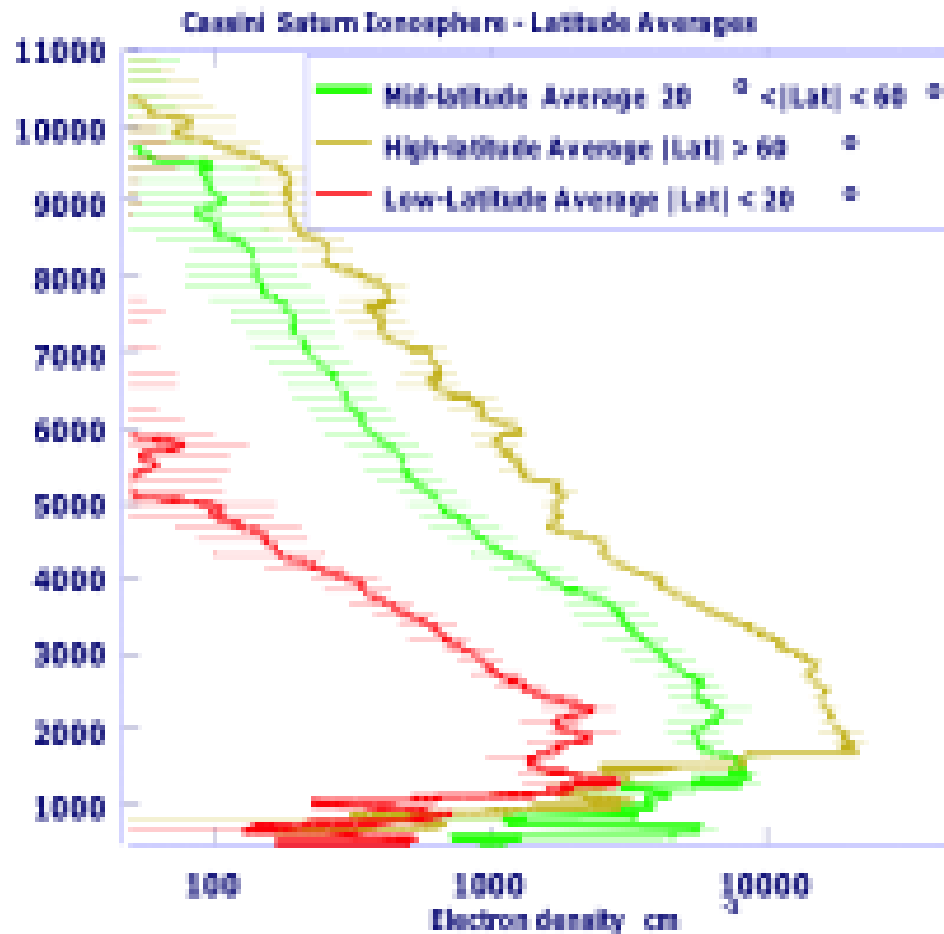
Jupiter/Saturn Ion Chemistry (2)



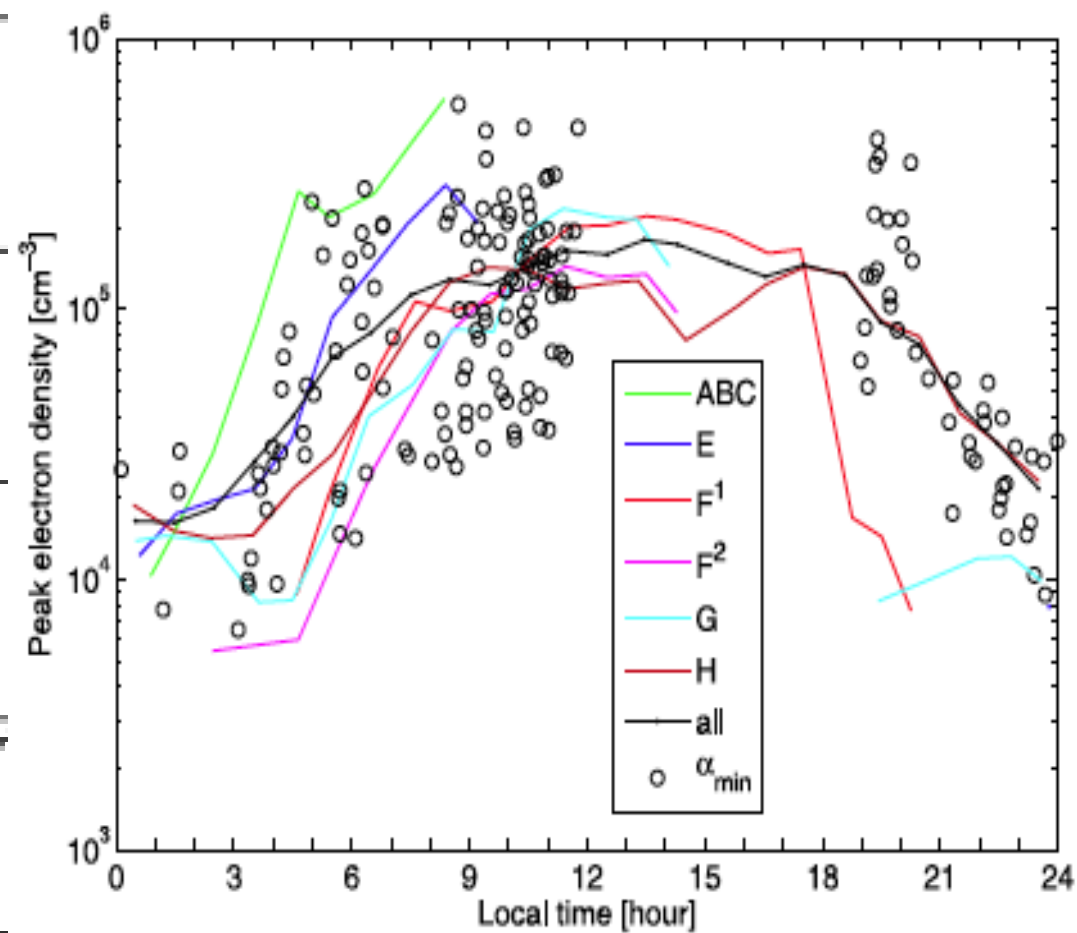
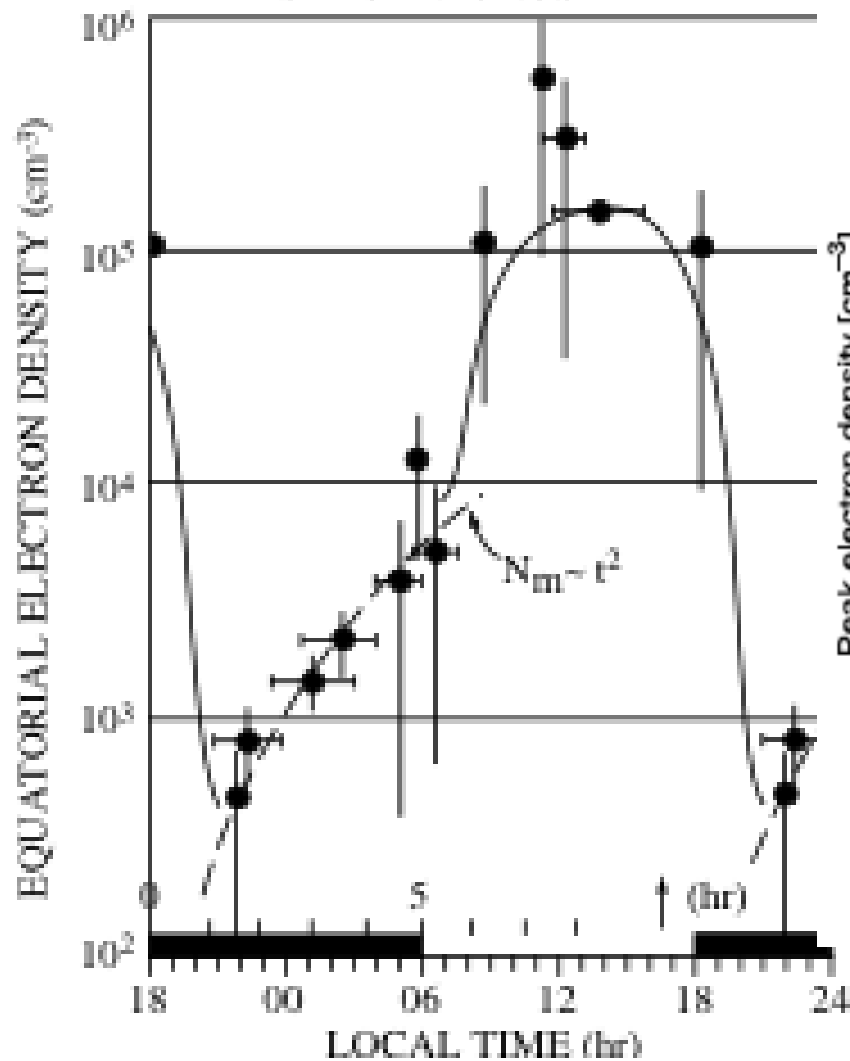
A Model of Saturn's Ionosphere.



Measured Electron Densities at Saturn



Inferred Diurnal Peak Electron Density Variations.



“Take Away” Points.

- Ionospheres are ionospheres! (Thermospheres are thermospheres!)
- Chemistry, dynamics, energetics, gravity etc maybe different, but if you know/understand one, it takes very little to work on other ionospheres (thermospheres).
- Theoretical model formulations, as well as instruments to make measurements, are relatively easy to change/adopt for different ionospheres (thermospheres).
- Thus there is much to be learned from studying and observing different ionospheres (thermospheres).

Prize Book to Best Student Question

A prize of the book on the 2007 conference on 'Comparative Aeronomy' sponsored by ISSI in Switzerland and edited by Andrew Nagy was given to the student in the audience with the best question. This went to William Archer, PhD student of Dr. David Knudsen, of the University of Calgary, Canada. His philosophical question was whether the differences or the similarities were more important between planetary atmospheres and the Earth's atmosphere. The answer was 'It depends.'

(This page added by CEDAR organizer Barbara Emery of HAO/NCAR.)