EPSC Abstracts
Vol. 9, EPSC2014-116-1, 2014
European Planetary Science Congress 2014

Aeronomy of the Venus upper atmosphere

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Abstract

The structure and content of the 'aeronomy' chapter of the Venus III book will be discussed. This chapter will review all recent results obtained from remote sensing of the upper atmosphere with emphasis on non-thermal emissions, global transport, wind, chemistry and composition related to airglow observations and modeling. Measurements of the ionospheric structure and its variability will be described. Data collected with instruments on board the Venus Express missions will be complemented with ground-based observations and results collected during the Cassini Venus flyby. Recent developments in global modeling coupling photochemistry, transport and gravity waves will also be compared with this set of new observations.

This chapter will include the following sections:

1. Introduction of the physical and chemical conditions in the Venus upper atmosphere (mesosphere, thermosphere, exosphere)

2. Airglow emissions

- Introduction and background.
Identification of processes leading to dayglow (photons, photoelectrons) and nightglow emissions (exo-energetic chemical reactions).
- Review of observations based on ground equipment, VeX (VIRTIS, SPICAV), HUT, UVIS-Cassini and EUV Explorer: NO (UV, IR 1.22 μm), O_2 ($^1\Delta$, visible), OH (IR), O, C, CO, CO_2^+, He, ….

3. Neutral composition (including what airglow measurements have brought to the field):
O_2 airglow (IR, visible) and O density distribution
OH IR airglow and relationship with O_3 distribution
CO_2 and CO non-LTE IR emissions
CI emission and O_2 density

4. Transport and Dynamics and in the upper atmosphere

- Review of upper atmospheric winds measurements
- NO (UV, IR) and O_2 (IR, visible) airglow morphology and variability.
- Transition between zonal and SSAS circulation
- Global transport-chemical-airglow models and comparison with airglow data.
- Time variability
- Gravity waves: airglow signatures in CO_2 NLTE and O_2 IR emissions, modeling aspects.

5. The ionosphere

Formation
Structure and layers (mainly Vera results)
Variability

6. Conclusions