INTERNATIONAL SPACE SCIENCE INSTITUTE

Report from the Venus climate working group

4th meeting 16-17 November 2009

Participants

Lennart Bengtsson	Switzerland
Roger Maurice Bonnet	Switzerland
Curt Covey	US
David Grinspoon	US
Symeon Koumoutsaris	Switzerland
Sebastien Lebonnois	France
Peter Read	UK
Angelo Pio Rossi	Switzerland
Hauke Schmidt	Germany
Håkan Svedhem	Netherlands
Dimitri Titov	Germany
Masaru Yamamoto	Japan

1. Observational aspect

The latest news from the Venus Express mission were presented by Dimitri Titov and Haakan Svedhem. The Science Committee of ESA approved a further extension of the operation of the Venus Express missions to the end 2012. The group noted this with great satisfaction. Joint operations with the Japanese Venus Climate Orbiter in 2011 will enable simultaneous observations from different positions and provide improved temporal and spacial coverage.

The observations from radio-occultation measurements have provided very useful and important information. The tropopause varies between 56 and 64 km with associated changes in temperature. Below the clouds (within the clouds the lapse rate varies) the temperature follows the dry adiabatic lapse rate (ca 10C/km). The wind shear between 0-60 S is 2-3 m/s per km. The cyclostrophic wind as calculated from the radio occultation measurements follows the wind derived from cloud motions well but is systematically slightly weaker. Maximum wind speed (ca. 150 m/s) occurs around 40 S (at ca 65 km). Poleward of 60 S there is no wind-shear with almost a solid body rotation.

Measurements in the lower atmosphere of Venus show increasing concentration of H_2O at lower altitudes, from 30 ppmv at the cloud base to 40 ppmv at the surface. Significant latitudinal variability is seen in the composition of the Venusian atmosphere.

A brightening event on July 19, 2009 that triggered several speculations (volcanic eruption, solar wind, comet impact) seems to be a local dynamical feature.

The Japan's Venus climate mission is proceeding as planned (launch in June 2010), as presented by Masaru Yamamoto.

2. Modelling sub-group report

The modelling sub-group has met during the first half-day of the meeting (16^{th} of November) under the guidance of Sebastian Lebonnois. A common protocol, proposed by Sebastian Lebonnois, was used by all modelling groups and the joint results were presented to the meeting. The models show important differences in the total angular momentum ranging from 2 to 5 times the starting value. The models should also try to run longer in order to verify if

they reach stability. The UCLA simulations presented by Curt Covey show large oscillations. The reason for that is unknown. The position and amplitude of the jets differs between the models. The lower atmosphere winds are relatively similar, even though the total angular momentum is different (biased towards the deep atmosphere). Important differences were found also between the models on their sensitivity in the lower boundary conditions, topography, vertical and horizontal resolution. The inter-comparison of the models is ongoing and the results will be summarised in the ISSI book (chapter 4.3).

3. Status of the book chapters

The structure of the book and each writer's contribution has been agreed as follows:

Towards understanding the climate of Venus

- Application of terrestrial models to our sister planet -.

Contents

1. Foreword (Bonnet**)**

2. Preface/introduction (Bengtsson et al.)

3. What do we know about Venus?

3.1 History of Venus observations (Grinspoon, Svedhem, Bonnet)
3.2 General background. What do we know about Venus. Previous work in theory and modeling (Grinspoon et al.)
3.3 Atmospheric composition and clouds, atmospheric structure etc., surface interactions incl. volcanism (Titov,Grinspoon)
3.4 Atmospheric circulation and dynamics (Limaye, Titov, Covey)
3.5 Radiation balance of Venus (incl. solar forcing) (Titov et al.)

4. Modeling the atmospheric circulation of Venus (modeling subgroup)

4.1 Modeling and general background/the theoretical framework (Read)
4.2 International modeling efforts + historical background (Lewis, Lebonnois)
4.3 Inter-comparison of model results (protocol description) (Lebonnois)
4.4 Comparison with Earth modeling (Schmidt, Covey)

5. Comparison with Earth climate (past, present, future) (Pierrehumbert to take the lead, Grinspoon, Bengtsson, Bonnet)

6. Future prospects: Prospects, guidance for future missions (Svedhem, Grinspoon)
6.1 Remaining Scientific questions (jointly)

4. Future actions

The presentations of the meeting are available on this password-protected web page:
http://www.issibern.ch/workshops/venusclimate/documents.html

The detailed structure of each chapter of the book should be ready on December 2009. The first draft material should be circulated among the authors by spring 2010.

The next meeting will be held at ISSI, on the 13-14th of September 2010.