EPSC Abstracts
Vol. 9, EPSC2014-328, 2014
European Planetary Science Congress 2014

THOR-ICO: a General Circulation Model for Exoplanets on an Icosahedral Grid

J. Mendonça (1), K. Heng (1) and S. Grimm (2)
(1) University of Bern, Center for Space and Habitability, Sidlerstrasse 5, CH-3012, Bern, Switzerland. Email: joao.mendonca@csh.unibe.ch
(2) University of Zürich, Institute for Theoretical Physics, Winterthurerstrasse 190, CH-8057, Zürich, Switzerland

Abstract

The study of extrasolar planets has become important since the discovery of a large number of these astronomical objects. The diversity of planetary characteristics observed raises questions about the variety of climates. The influence of the astronomical and planetary bulk parameters in driving the atmospheric circulations continues to be poorly understood. In the solar system the results from planetary spacecraft missions have demonstrated how different the planetary climate and atmospheric circulations can be. The study of exoplanets is going to require a study of a far greater range of physical and orbital parameters than the ones that characterise our neighbour planets (in the solar system). For this reason the study of exoplanets will involve an even greater diversity of circulation and climate regimes.

We are developing a dedicated General Circulation Model (GCM) for extrasolar planets called "Exoclimes Simulation Platform". This model will solve the complex physical and dynamical equations that include fundamental principles of atmospheric fluid dynamics and various idealisations of, for example, radiative transfer [1] and dry or moist convection. The interpretation and analysis of the results from this complex model will help us to have a better understanding on the diversity of climates and atmospheric circulations.

Here we present the first results of our recent scheme which represents the fluid dynamical phenomena in the atmosphere. This new code solves the atmospheric fluid equations in a rotating sphere (fully compressible – elastic - nonhydrostatic system) using an icosahedral grid. The grid is also modified to improve the uniformity of the grid point distribution applying a method called spring dynamics [2]. The results shown include 3D experiments of gravity and acustic waves, Held-Suarez test case [3] and an idealized hot-Jupiter case.

Acknowledgements

The authors thank the Center for Space and Habitability and the Space Research and Planetary Sciences Division of the University of Bern for finantial, logistic and secretarial support.

References

[1] See Jaemin Lee's contribution.

[2] H. Tomita, et al., J. Comput. Phys, 174 (2001), pp. 579-613

[3] I.M. Held, M.J. Suarez, Bull. Am. Meteorol. Soc., 73 (1994), pp. 1825-1830