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Modelling the Atmosphere of Hot Jupiter-like Exoplanets using a Global Climate Model

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Understanding the atmospheric circulation, radiative transfer and atmospheric chemistry of exoplanets is crucial for our understanding of these objects. In particular, Hot Jupiters are among the most observed type of exoplanets and have no equivalent in our Solar System. During the last decade, observational and modelling efforts have been made to begin the atmospheric characterisation of these exoplanets.
We set out to use the generic Planetary Climate Model, a 3D Global Climate Model developed for paleoclimate and temperate exoplanets studies to simulate the atmosphere of Hot Jupiter. As a case study, we chose to model WASP-43 b, a Hot Jupiter with an orbital period of 19.5 hours and an equilibrium temperature of 1400 K. This planet has already been observed by the Hubble Space Telescope and the Spitzer Space telescope, yielding crucial information about key atmospheric processes, but also raising substantial questions about cloudiness, chemistry and wind patterns. Moreover, this planet will be observed by JWST on December 1 th 2022, providing astounding data.
Our simulations are able to replicate the already known atmospheric patterns of the atmosphere of Hot Jupiters, that we will present during this talk. We show that cloudless simulations are unable to reproduce the aforementioned data. Thus, we developed and incorporated into our model a scheme to simulate the formation of clouds in the atmosphere, and their radiative effects, in a fully coherent manner. We will discuss our preliminary results using the cloud model and how it could explain the incoming JWST observations.

Auteur principal: TEINTURIER, Lucas (LESIA/LMD)

Co-auteurs: Dr SPIGA, Aymeric (LMD); Dr CHARNAY, Benjamin (LESIA); Dr BÉZARD, Bruno (LESIA)

Orateur: TEINTURIER, Lucas (LESIA/LMD)

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