Sunday

Exoplanetary Atmospheres in 3D: multidimensional processes and opportunities

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Understanding the climates and atmospheres of exoplanets requires a multi-faceted approach. A range of theoretical models with complementary strengths and weaknesses must be used to extract the maximum knowledge from the observations, combining expertise from several areas or disciplines. In this talk I will present an overview of my own group's work building a hierarchical theoretical model framework, based on close collaboration and real-time development links with the UK Met Office and Earth climate researchers.

Using this framework, I will discuss several key results, focusing on gas giant exoplanets. Firstly, I will discuss the pure atmospheric dynamics of such planets, and and how they change as commonly made simplifications and approximations are relaxed. Secondly, I will explore the interactions of the flows with the atmospheric chemistry, and in particular show that 3D treatments are required to correctly capture the processes determining the non-equilibrium gas phase chemical abundances at pressure levels sampled by transmissions spectroscopy. Finally, I will present results from a set of 1D forward models of hot Jupiters, before moving to a 3D cloud model including time evolving, radiatively active clouds. Ultimately, the focus of these studies is the opportunity of using upcoming JWST measurements to probe the atmospheric dynamics, in 3D, especially using phase curves.

If time permits, I will briefly discuss our work on terrestrial planets, the variations of their climates, and the potential for phase curve observations of the hydrological cycle.

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