Convection inhibition in the atmosphere of mini-Neptune planets

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Whether it is inside or outside of the Solar System, the atmospheric structure of Neptune and Neptune like planets remains rather poorly constrained. On the observational side, Ariel will soon change this by observing warm sub-neptunes, possibly like K2-18b, thanks to their relatively large size compared to terrestrial planets. However, on the theoretical side, models of the atmospheric structure and dynamics of these atmospheres are relatively scarce. In particular, it has been proposed that water (or methane) condensation could shut down convection in planets where it is heavier than the background hydrogen rich atmosphere (like Neptune; Leconte et al. 2017). But the dynamics of this effect has never been studied in 3D and its impact of this on observations (in particular for exoplanets) has never been assessed.

I will show results from a 3D cloud-resolving model that we adapted to the study of temperate hydrogen rich atmospheres. This work shows how water condensation naturally shuts down convection in these objects as has been predicted by simple linear theory. Then, we will show how the thermal and compositional structure of these atmospheres is modified. Finally, we will discuss whether convection inhibition yields an observable signature for future missions, like Ariel, to detect.

References

Leconte et al. 2017 - https://ui.adsabs.harvard.edu/abs/2017A%26A...598A..98L/abstract