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CNRS Selection Committee

To whom it may concern;

I am pleased to lend my support to the application of **Dr. Maxence LeFevre** for a permanent chercheur position with CNRS. I am the P.I. for the ERC Advance Grant project EXOCONDENSE, which has as one of its prime goals to understand generalized moist convection (for any condensible substance, not just water) in the context of (exo)planetary atmospheres, and so I was very pleased to be able to attract Maxence to my group. Convection and clouds are central players in planetary climate, affecting the fundamental radiation balance of planets in a way that can massively change the position of the habitable zone. While there are now a considerable number of people working on large scale general circulation modeling of exoplanet atmospheres, there are only a handful worldwide who are working on convection in such atmospheres. In this subject, we have mainly Denis Sergeev (a postdoc at Exeter), and Maxence (together with a few other people in my group), though there is a much larger community working on Earth-centric problems in this area. This is a subject that very badly needs more attention, and there are excellent opportunities for cross-fertilization between the Earth atmospheric community working on things like convective aggregation, and the (exo)planetary atmospheres community. Maxence is one of the few researchers currently who is able to work productively in this frontier area.

Maxence did some very significant work in his thesis, on mesoscale modeling of the Venus atmosphere. This established his ability to work productively on frontier areas in buoyant flows modeled at high resolution. At about that time, he began working on convection in the atmosphere of our nearest exoplanet, Proxima Centauri b, in collaboration with Martin Turbet who supplied the large scale GCM environmental conditions needed to drive the convection model. In an extension of his thesis work, Maxence adapted the WRF convection resolving model to this problem, and the work has continued during the time he has been in my group at Oxford. One of the grand-challenge questions has been whether the clouds that form at the substellar point reflect back enough instellation to prevent a planet from succumbing

to a runaway greenhouse and becoming uninhabitable. Results with GCM's indicated this could be the case, but the modeling Maxence did shows that because of mesoscale cloud intermittency, the effect is much weaker when the clouds are resolved properly. This is a very challenging problem, and it took a few years to carry out the simulations and make sense of them, but Maxence has completed a paper on this subject, which I have read closely, and is within a week or two of being ready to submit for publication. I think it will be a very important and highly cited paper.

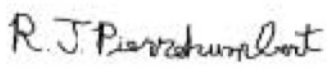
Maxence has been a key member of the EXOCONDENSE team. His thesis work made use of the WRF model, but the software structure of that model makes it hard to adapt to the full range of exoplanet atmospheres that need to be treated. As part of EXOCONDENSE we have been adapting the more flexible CM1 convection model as a general planetary atmosphere convection simulation tool. The software challenges are formidable, and Maxence has fully met them. Among other things, he has coupled CM1 to the general SOCRATES radiative transfer code, and adapted it to use for exoplanet atmospheres. This has been invaluable to both his work and the work of the rest of my group doing convection modeling. The amount of time needed to build an innovative new tool for research has slowed down Maxence's publication rate, but this is poised to accelerate in the near future. He has already completed a very innovative series of simulations of convection in brown dwarf stars, which is close to being ready for publication, and he has many other projects in the works that will shed light on essential aspects of convection in planetary atmospheres.

I have ready Maxence's proposal for his work with CNRS, and find it very exciting. He has picked up on a number of important unifying themes between convection and clouds on Titan, Venus, exoplanets and brown dwarfs. LMD is an outstanding place to carry out this work. I am very familiar with the research environment at LMD, having spent two full year sabbaticals there. There is nobody currently at LMD poised to take the lead in the area Maxence has pursued, and he would be an outstanding addition to the research enterprise there. His work would complement work there (esp. Dr. Caroline Muller, and Dr. Sandrine Bony) on related problems in Earth's atmosphere.

The case for a CNRS appointment for Maxence would certainly be stronger in a year or two, after his current work has been submitted for publication, but I think he shows enough talent in such a crucial area that a strong case can be made for appointing him now. Among other things,the work he has done on adapting CM1 for general planetary atmospheres would bring a whole new set of capabilities to LMD. I have sufficient confidence in Maxence, and in the likely realization of the promise he has shown, that I have no hesitation

in recommending his appointment now, and if he should be appointed to a CNRS position at LMD, it would open up new opportunities for collaboration between LMD and my group at Oxford.

Sincerely,



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