Met Office
FitzRoy Road
Exeter
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EX1 3PB, UK
4th January 2021

Letter of Support
Dr Fanny Peers

Dear Sir/Madam,

This letter of reference is to support the application of Dr Fanny Peers in her application employment. I have known Fanny personally for around 5 years, having acted as Rapporteur on her Phd panel in 2015, and then as mentor during a 4½ year post-doctoral research associate (PDRA) on the CLouds Aerosol Radiation Interaction and Forcing: Year 2017 (CLARIFY-2017), funded by the UK's Natural Environment Research Council (NERC).

Statement on past and current work: The main focus of Fanny's PDRA position has been on developing a retrieval algorithm for SEVIRI that allows determination of the aerosol optical depth and the radiative forcing of partially absorbing biomass burning aerosol above reflective cloud over the SE Atlantic region. This has involved much radiative transfer modelling in the solar and near infra-red spectrum, and handling and processing large multi-wavelength satellite radiance data sets. A particular issue has been the need to account for the variation in gaseous atmospheric species owing to the relatively broad wavebands used by SEVIRI for retrievals of cloud and aerosol properties. Water vapour, carbon dioxide, ozone and methane all absorb in the SEVIRI bands, and all are products of biomass burning, leading to covariance issues between biomass burning aerosol and the atmospheric transmission. In particular, absorption by water vapour has necessitated the use of accurate water vapour profiles from data assimilated numerical weather prediction models.

Fanny has made some great strides in developing the algorithm to successfully disentangle the complex signal of biomass burning aerosol above cloud; the retrieval algorithm now compares favourably with that developed for MODIS which does not have such wide spectral bands and is therefore not contaminated by water vapour. This will ultimately allow an assessment of the impacts of the radiative forcing of biomass burning aerosols across the full day owing to the continuous nature of the geostationary SEVIRI satellite as compared to the MODIS retrievals that are only able to provide snap-shots twice a day. We are currently working together on this novel facet.

During my time working with Fanny, she has developed a unique understanding of radiative transfer including the importance of gases, particle and clouds in the solar and

near infra-red regions of the electromagnetic spectrum. Fanny has proved a dedicated and reliable researcher, and I have been able to allow Fanny considerable freedom to pursue her own ideas. Her handling of large data sets is excellent and her coding, analysis and presentation of results is first rate. This work has already led to the following well-received lead author papers:

- Peers, F. et al., Observation of absorbing aerosols above clouds over the South-East Atlantic Ocean from the geostationary satellite SEVIRI - Part 2: Comparison with MODIS and aircraft measurements from the CLARIFY-2017 field campaign, Atmos. Chem. Phys., https://doi.org/10.5194/acp-2019-1176, 2020.
- Peers, F., et al., Observation of absorbing aerosols above clouds over the South-East Atlantic Ocean from the geostationary satellite SEVIRI. Part 1: Method description and sensitivity, Atmos. Chem. Phys., https://doi.org/10.5194/acp-2018-1333, 2019.

and numerous co-authored papers. Collaborators have been particularly impressed by the progress that Fanny has made with the SEVIRI sensor as evidenced by comments made to me by Dr Steve Platnick and Dr Kerry Meyer of NASA GSFC who are very experienced with cloud retrievals from the MODIS sensor. Prof Jens Redemann (ORACLES PI, formerly of NASA AMES, now director at University of Oklahoma) has also expressed that he has been impressed by Fanny's work and asked her to apply for a faculty position.

Statement on Research Proposal: I have reviewed Fanny's research proposal, which continues her current research into retrieving aerosol properties and radiative effects above clouds, but with some important new ideas and directions. The proposal broadens the research area considerably to encompass aerosol direct, semi-direct and indirect effects, includes synergistic modelling aspects and also extends the area of investigation from the SE Atlantic, where biomass burning impacts prevail, to the highly reflective Arctic and Arctic haze aerosols.

Fanny proposes improvement of aerosol and cloud characterisation using satellite data and a unique set of data collected during the CLARIFY-2017 and compatriot ORACLES and AEROCLO-sA (2016-2018) campaigns to develop, assess and improve the accuracy of remote sensing retrievals. Use of well-validated SEVIRI geostationary satellite data will enable an assessment of the full diurnal variation of cloud and aerosol properties and their associated direct, semi-direct and indirect radiative effects. Fanny has already demonstrated that SEVIRI retrievals compare favourably with MODIS retrievals of above cloud aerosol, and has also demonstrated that SEVIRI is able to clearly identify the increased cloud top effective radius associated with Pockets of Open Cell convection (POCs). Thus Fanny's goals of providing benchmarking for models of the direct, semi-direct and indirect effect all appear achievable.

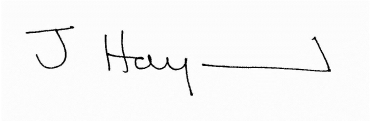
One novel aspect is the combination of cloudy and cloud-free retrievals of aerosols and their direct radiative effects; only when combined can the validity of aerosol modelling approaches be properly evaluated; we know that some models suggest a net positive direct effect over the SE Atlantic and we know that some models suggest a net negative effect. Which is right? By combining both clear and cloudy retrievals, Fanny should be able to tease out this valuable information for model evaluation. Another novel aspect is the use of models and the geostationary retrievals that Fanny has developed to evaluate

the interaction of aerosols and clouds (i.e. aerosol-cloud interactions). The high temporal resolution of the geostationary retrievals makes this sort of evaluation eminently possible and Fanny is currently working on a lead-author peer reviewed paper on this aspect.

In the longer term Fanny suggests extending analysis to the 3MI satellite which includes polarisation measurements and extending analysis geographically to ultimately provide global coverage over the Arctic which is another crucially important area where aerosols may play a significant role. At the University of Exeter both myself and Dan Partridge are pioneering the use of Lagrangian analyses within climate and numerical weather prediction models to improve aerosol processes within models. We would very willingly contribute our efforts to Fanny's future analyses.

I have found Fanny an absolute pleasure to work with and I would implore you to consider Fanny for employment this year; the time is right for Fanny to capitalise on the considerable financial and time investments of CLARIFY-2017, ORACLES and AEROCLO-sA. Without a doubt, Fanny has the potential to be a leader in this field.

Yours sincerely



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