**Winter School: Physics and Mathematics of Turbulent Flows at Different Scales**

**Motivation Letter**

I am a first-year PhD student on the Centre for Doctoral Training in Mathematics of Planet Earth at Imperial College, London. The principal aim of my current research project is to investigate methods for parameterising the eddy backscatter effect, through which mesoscale eddies are responsible for maintaining the eastward jet extension of western boundary currents like the Gulf Stream; however, running simulations on grids capable of resolving the eddies is not practicable for time-scales relevant to climate studies. One approach is therefore to introduce a parameterisation which represents the eddy backscatter effect in coarse grid simulations. My project will consider several different ways of doing this. Given the turbulent, multiscale nature of the backscatter effect, and the relevance of the Gulf Stream to climate, it seems that the Winter School at Les Houches perfectly fits in with the theme of my research and will allow me to broaden my knowledge of areas unfamiliar to me as well as giving me a deeper understanding of topics related to my project.

The eddy backscatter effect central to my project is currently poorly understood, since it is a highly turbulent process. However, understanding it will be vital for implementing the parameterisation methods. Therefore, those lectures on Geophysical Turbulence will provide valuable insights and techniques which may give me a strong foundation for tackling some of the problems I encounter through the course of my research.

Moreover, I have a strong interest in introducing stochasticity into geophysical fluid dynamics; the fact that Stochastic Dynamics is one of the focuses of the School was another reason for its appeal for me. For my MRes project I studied a system of stochastic differential equations, and for my PhD one of the approaches to the eddy parameterisation will be to introduce noise into the fluid equations. Therefore, it will be highly interesting to me to see how stochasticity is used as an approach to turbulence problems.

Being a student on the Mathematics of Planet Earth programme, I have benefitted from the cohort-based structure which has given me the opportunity to work with many students carrying out projects involving mathematical approaches to climate and weather problems. However, at Les Houches I would have the opportunity to meet people from other parts of the world working in similar areas of research; this contact and the time for discussions could provide valuable insights for my own research and allow me to develop links with other researchers which could be useful through the course of my PhD.

If accepted onto the Winter School, it would be my first experience of travelling abroad as part of my research and I am sure that it would be a highly beneficial one, in which I will have the opportunity to broaden and deepen my knowledge of Mathematics and Physics in fields relevant to my PhD project.

Thank you for considering my application. I would greatly appreciate the opportunity to participate in the Winter School at Les Houches and I look forward to hearing from you.

Yours sincerely,

Stuart Patching