

## **Gulf Stream forcing of mesoscale instabilities and their effect on downstream weather and climate**

Arnaud Czaja (Imperial College) and Michael Vellinga (UK Met Office)

CASE studentship

Contact: [a.czaja@imperial.ac.uk](mailto:a.czaja@imperial.ac.uk)

### Project description

Recent numerical experiments with high horizontal resolution (grid spacing of 25km or less) have suggested that the impact of the Gulf Stream on the “storm track” is mediated by the frontal circulation embedded in extra-tropical cyclones. In a series of controlled experiments with the UK Met Office Model, we were able to show that the frontal circulation can be destabilized by the Gulf Stream, with associated injection of low potential vorticity air at upper levels and a potential impact on blocking events further downstream, but we could not assess whether this effect was systematic (Sheldon et al., 2017). Sensitivity of the atmospheric response to upper ocean temperatures to horizontal resolution was also demonstrated in the North Pacific by Smirnov et al. (2015).

In this project, we propose to address the impact of mesoscale Gulf Stream air-sea interactions on high resolution deterministic and ensemble forecasts with the UM. Building on existing work with EC ensemble forecasts we wish to assess whether a large spread is found amongst ensemble members. If so, rather than systematically affecting the frontal circulation of cyclones, the effect of the Gulf Stream on them has to be understood within a statistical framework. The impact of the Gulf Stream on low frequency atmospheric variability further downstream up to day 7 will be investigated within this framework using a number of UM prediction systems. Differences between the behaviour of instabilities over the Gulf Stream and other western boundary currents (e.g., Kuroshio, Agulhas) can be investigated.

### Multi-disciplinarity

Although the project is rooted in applied physics it will involve a combination of computing (analysis of large datasets), conceptual thinking (instability theory) and quantitative analysis (statistics). The project is also at the boundary of activities in “weather” and “climate”, a new and very active area of current research worldwide.

### Relevance to NERC

NERC identified modelling and data management as the first and third skills critically needed in their 2012 assessment. This project will train extensively the PhD student in both areas. In addition, it will strengthen the basic science carried out at the Grantham Institute, as well as contribute to its visibility, by raising awareness, and by improving our understanding, of the central role played by the ocean in the evolution of our climate over the 21<sup>st</sup> century and beyond.