

Project Title	Characterisation of the sea breeze over Indonesia and its importance for severe weather
School	Earth and Environment
Project Supervisor/ Scholar Mentor	Dr Cathryn Birch

### Project overview

The country of Indonesia is comprised of more than one thousand islands of different sizes, many with high mountains and complex coastlines. It is a tropical country that lies over the equator and is influenced by both the northern and southern hemisphere monsoon systems. The region is known as the 'boiler box' of the Earth due to the combination of the high mountains, strong heating from the sun and moisture from the surrounding oceans. These three elements produce the wettest climate on Earth and some of the most intense thunderstorms on the planet. The rainfall is strongly influenced by the Madden-Julian Oscillation (MJO), which takes the form of a cluster of intense storms that form over the Indian Ocean every 1 or 2 months and that propagates eastwards over Indonesia and into the Pacific.

Evidence from satellite observations and model studies suggests that the islands of Indonesia have a strong influence on the MJO during its eastward propagation towards the Pacific. One theory suggests that the sea breezes, which form along the coasts of the islands during the afternoon, play an important role in initiating new storms within the MJO cluster. Dr Cathryn Birch and other scientists in the School of Earth and Environment have simulated this with computer models. The model simulations suggest that the sea breeze strength and storm intensity vary by MJO phase and that the sea breezes themselves are also modulated by the MJO, i.e. there is a two-way interaction between the small-scale sea breeze process and the larger-scale MJO.

This project will utilise surface weather station data to characterise the strength of the sea breeze circulation over the Indonesian islands and will investigate how the sea breeze varies during the passage of MJO events. Results from the project will provide evidence to verify the results of the recent model simulations and will form the basis of a peer-reviewed journal article.

### Key tasks to be pursued by the scholarship holder

#### Period 1:

1. Identify suitable coastal surface weather station data on the islands of Indonesia (available online)
2. Analyse the data using a programming language such as Python or Matlab
3. Build a climatology of the sea breeze circulation using the observations
4. Investigate whether the sea breeze strength varies seasonally and through the phases of the Madden-Julian Oscillation

#### Period 2:

Investigate whether the strength of the sea breeze impacts the formation of severe storms in the region

Or, depending on progress and the interests of the student, develop a second research project that is different to but related to the first, possibly involving the use of weather or climate models

## **Principal academic outcomes/outputs to be generated by the scholarship holders' research**

Recent research by Dr Cathryn Birch and other scientists in Earth and Environment has suggested that the strength of the sea breeze varies through the different phases of the Madden-Julian Oscillation (MJO) and this has significant implications for the development of convective rainfall and severe weather over Indonesia. Understanding how small-scale processes such as the sea breeze impact larger-scale variability such as the MJO is crucial for understanding how our atmosphere works and thus for our ability to simulate and predict such phenomena in weather and climate models. The student project will provide observational evidence for the findings of the model study and will form the basis of a peer-reviewed journal article.

## **Support and personal development**

The majority of the interaction between the supervisor and student will occur during the periods of intensive research, when the student will have weekly supervision meetings and will receive assistance with learning key skills such as computer programming. To prepare the student for the research he/she will be given the opportunity to participate in research group activities during semester 2 of L1 and throughout L2. This will include attendance of research group meetings, where group members present recent research and the opportunity to attend group lunches to get to know the group. The supervisor will also act as an advisor to the student throughout his/her time at Leeds, offering advice on module choices, dissertation topics, career options, interview technique etc.

## **Who should apply?**

Any student studying for a science degree (BSc, MEnv etc) who has an interest in weather and atmospheric science. Maths or Physics A level would be advantageous, as would some experience in using a computer programming language such as Python or Matlab.