ZMT LEIBNIZ CENTRE for Tropical Marine Research

The Leibniz Centre for Tropical Marine Research (ZMT) in Bremen is a member of the Leibniz Association, which is supported by the German Federal and State Governments. Through its research, ZMT contributes to developing science-based strategies for sustainable use of tropical coastal systems.

Master thesis project

Getting organized - the transition to diurnal self-organization

Mesoscale convective systems (MCS) are responsible for the bulk of tropical extreme precipitation, leading to flash floods and storm damage, especially in densely-populated areas (Tan et al., 2015, Fowler et al., 2021). MCS are remarkable, as they constitute clusters of deep convective thunderstorms that self-organize over scales much larger than individual convective updrafts. It is apparent from satellite imagery that such clustering occurs mainly over continental regions, where the day-to-night temperature range, the diurnal cycle, is large. Over the sea, MCS are much less frequent. In recent numerical work it was shown that large diurnal cycles give rise to spontaneous clustering, whereas weak diurnal cycles induce apparently random spatial patterns of rainfall and cloudiness (Haerter et al., 2020; Jensen et al., 2021). The aim of this project is to more deeply understand the nature of this dynamical transition between random and "clumped" convection - thus adding to better modeling of tropical extreme events, which increasingly affect humans and the environment. The project will make use of high-resolution numerical simulations, which can resolve the interactions between thunderstorm clouds directly.

The **intended learning outcome** is to become familiar with the state-of-the-art modeling of tropical deep convection, including the fluid dynamics of Earth's atmosphere, understanding concepts of self-organization and complex systems science, and contribute to an exciting and timely research topic with the potential for publication in a peer-reviewed research journal.

We offer: You will be part of a dynamic, international research group (Complexity & Climate), have the opportunity to collaborate with PhD and postdoctoral researchers and will be able to present your research output at an international conference. Given conclusive results, you will be able to submit them to a peer-reviewed journal.

Candidates should have an interest in extreme events, self-organization and/or the tropics. A quantitative background is an advantage, e.g. physics, applied math, meteorology or engineering. The project start would be as soon as possible.

To apply please contact:
Jan O. Haerter, WG Complexity & Climate (jan.haerter@leibniz-zmt.de) and just explain your interests and background within a short email, as well as your timeframe.

References:

- Tan, Jackson, et al. "Increases in tropical rainfall driven by changes in frequency of organized deep convection." Nature 519.7544 (2015): 451-454.
- Fowler, Hayley J., et al. "Anthropogenic intensification of short-duration rainfall extremes." Nature Reviews Earth & Environment 2.2 (2021): 107-122.
- Haerter, Jan O., Bettina Meyer, and Silas Boye Nissen. "Diurnal self-aggregation." npj Climate and Atmospheric Science 3.1 (2020): 1-11.
- Jensen, Gorm G., Romain Fiévet, and Jan O. Haerter. "The diurnal path to persistent convective self-aggregation." arXiv preprint arXiv:2104.01132 (2021).

Leibniz Centre for Tropical Marine Research (ZMT), Fahrenheitstraße 6, D-28359 Bremen.

Leibniz Gemeinschaft

Zertifikat seit 2018 audit berufundfamilie