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Interfacial waves generated by gravity currents in two-layer fluid.

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The mesoscale convective systems of the West African Monsoon have a huge energetic impact on the surrounding environment. Energy is radiated away from these systems by internal waves formed by the vigorous movements of air mass at their core, propagating over long range in the existence of a suitable waveguide. Gravity currents formed by convective downdrafts are an exceedlingly common phenomenon around the monsoon, covering significant distances on the continental scale.

The initiation of solitary waves and bores by gravity currents incident on a marine or nocturnal inversion is well documented, the Morning Glory of Northern Australia being a well known and spectacular example. The interior of the African continent exhibits a further mechanism for the propagation of wave energy, with the environment of the Sahara often characterised by a deep convective boundary layer topped by a well mixed residual layer. This suggests a simple laboratory analogy for the idealised study of deep moist convection at the edge of the monsoon; that of a gravity current generated by lock release into a two layer fluid. This work looks specifically at the waves generated on the interface, especially with regard to their amplitude and propagation speed relative to the current.

A series of simple experiments have been performed in the laboratory and combined with data from previous work. In addition to improving the basic dynamical understanding of the idealised problem the aim of these experiments is to examine whether there exist regions in the bulk parameter space in which waves are generated that are fast and of large amplitude. That is, were this an appropriate analog for the atmosphere, under which conditions are waves produced that would favour the initiation of subsequent convection?

Ultimately this work aims to bring together research from fluid dynamics, field observations and numerical modelling to explore the phenomena of the convective environment of the Sahel. This fundamental work is a small part of efforts initiated in the AMMA* project to further understand the West African Monsoon.

* African Monsoon and Multidisciplinary Analyses