Using the Weak Temperature Gradient Approximation to Develop and Evaluate Convective Parametrization Schemes

Chimene L. Daleu[1], Steven J. Woolnough[2] and Robert S. Plant[1]

[1] *Department of Meteorology, University of Reading, UK*

[2] *National Centre for Atmospheric Science, University of Reading, UK*

General Circulation Models suffer from long-standing biases in tropical precipitation, including both the representation of the mean tropical climate and its variability. These biases arise through imperfect parametrizations of sub-grid processes, including convection, and the interaction between the convection and the large-scale tropical circulation. As a consequence the representation of the tropical climate in climate models can be highly sensitive to changes in convective parametrization, or parameter choices within those parametrizations (e.g. Ousellati and Bellon, 2013). Even with targeted sensitivity studies (e.g. Bush et al., 2015) it can be difficult to understand these sensitivities.

Modelling hierarchies including for example aquaplanet simulations are an important tools for exploring the sensitivity of models to parametrization changes, but there is still a large gap between the single column model framework in which parametrizations are often developed and the aquaplanet GCM.

Recently developed methods such as the Weak Temperature Gradient (WTG) approach (e.g. Sobel and Bretherton, 2000) and Damped Gravity Wave approach (e.g. Kuang, 2008) offer a simple first step beyond the single column approach for exploring the feedback between convection and the large-scale dynamics, and in particular being able to directly compare the behaviour of parametrization schemes and Cloud Resolving Model (CRM).

We will present an example application of this technique for the transition from suppressed to active convection, using the WTG approach, including comparisons between single column models and cloud resolving models, and the sensitivity of the single column model to parameter choices.

Bush, S. J., A.G. Turner, S.J. Woolnough, G.M. Martin, and N.P. Klingaman (2105), The effect of increased convective entrainment on the Asian monsoon biases in the MetUM general circulation model. *Quart. J. Meteor. Soc.*, **141**, 311-326

Kuang, Z. (2008), Modeling the interaction between cumulus convection and linear gravity waves using a limited domain cloud –system resolving model, *J. Atmos. Sci.*, **65**, 576-591.

Ouselati, B. and G. Bellon (2013), Convective entrainment and large-scale organization of tropical precipitato: Sensitivity of the CNRM-CM5 hierarchy of models, *J. Climate*, **26**, 2931-2946.

Sobel, A. and C. Bretherton (2000), Modeling tropical precipitation in a single column model of the tropical atmosphere, *J. Climate*, **13**, 4378-4392.