Interactions between the atmospheric large-scale and the small-scale tropical convection properties

*Valentin Louf¹, Christian Jakob¹, Alain Protat²

1. Monash University, 2. Bureau of Meteorology

Accurately representing the properties and impact of tropical convection in climate models is a long standing issue as models have to use parametrisations to represent convection. This requires an understanding of the relationships between the state of a convective cloud ensemble and the environment it is embedded in. We investigate this relationship using 13 years of radar observations (CPOL in Darwin) comprising more than 3 million individual convective cells in the Tropics. Specifically, we focus on convective area fraction and its components, convective cell number and size, and quantify their relationship to atmospheric stability, as well as mid-tropospheric vertical motion and humidity.

We find several key convective states, each with its own unique environment. The most area-average rainfall, and hence strongest area-average convective heating, occur in a state characterised by a moderate number of moderate size convective cell in an environment of high humidity, strong vertical ascent and moderate CAPE and CIN. The strongest rainfall intensities are found with few large cells. Those exist in a dry and subsiding environment with both high CAPE and CIN. Large numbers of convective cells are associated with small CAPE and CIN, weak ascent and a moist mid-troposphere.

Our results advance our understanding of how the convective and larger scales interact and provide guidance to the representation of this interaction in future parametrisations of convection in climate models.

Keywords: Tropical convection, Climatology, Large-scale