Mesoscale organisation of deep convection: opportunities for community activities

A defining feature of deep convection is the way it organises on a range of scales. Individual convective cells occupy only a few km, but multiple cells in close proximity may interact and produce mesoscale convective systems such as squall lines, mesoscale convective complexes, and tropical cyclones (e.g., Maddox, 1980). Collections of such mesoscale systems themselves interact, producing large-scale cloud features that have been referred to as "superclusters" (Mapes & Houze, 1993).

Organised deep convection accounts for a large fraction of tropical precipitation, and it is known to be an important control on the hydrological cycle and radiative energy budget of the tropics. But there remain several open questions regarding the physical mechanisms that act to organise deep convection and the role played by convective organisation in a changing climate.

The purpose of this breakout group is to brainstorm and plan for a future GASS activity focused on deep convective organisation. Our primary goal is to develop a set of research questions and an accompanying research methodology through which these questions may be answered.

Research on convective organisation has proceeded in two distinct but complementary strands. The first strand focusses on the dynamics of individual mesoscale convective systems and the meteorological circumstances that allow them to form and be maintained. This is exemplified by the well known RKW theory (Rotunno et al. 1988). The second strand is centred around the phenomenon of convective aggregation and its role in climate dynamics. This strand focuses on physical mechanisms, such as radiation and surface fluxes, and is exemplified by idealised modelling studies such as that of Bretheron et al. (2005) and Wing et al (2014). **A second goal of this breakout group and the project it spawns is to bring together researchers to foster collaboration and increased interaction among researchers who have contributed to each strand.**

While the precise research questions to be tackled will be decided in the breakout, expected themes include:

- Identifying and quantifying convective organisation
- Physical and dynamical mechanisms leading to convective organisation
- The behaviour of deep convective organisation in different climates

We seek suggestions for collaborative research projects to tackle these themes under the umbrella of GASS. These projects could include model intercomparisons, targeted workshops, or "hackathons".

References

Maddox, R. A. (1980). Mesoscale convective complexes. *Bull. Amer. Met. Soc.*, 1374-1387.

Mapes, B. E., & Houze Jr, R. A. (1993). Cloud clusters and superclusters over the oceanic warm pool. *Mon. Wea. Rev.*, *121*, 1398-1416.

Rotunno, R., Klemp, J. B., & Weisman, M. L. (1988). A theory for strong, long-lived squall lines. *J. Atmos. Sci.*, *45*, 463-485.

Bretherton, C. S., Blossey, P. N., & Khairoutdinov, M. (2005). An energy-balance analysis of deep convective self-aggregation above uniform SST. *J. Atmos. Sci.*, *62*, 4273-4292.

Wing, A. A., & Emanuel, K. A. (2014). Physical mechanisms controlling self-aggregation of convection in idealized numerical modeling simulations. *J. Adv. Model. Earth Syst.*, *6*, 59-74.