Convection – the building block of tropical climate

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Key messages

- Convection is the building block of tropical weather and climate
- Convective clouds are organized on scales from a few kilometres to thousands of kilometres
- Climate models can't represent individual clouds but need to take account of their effects

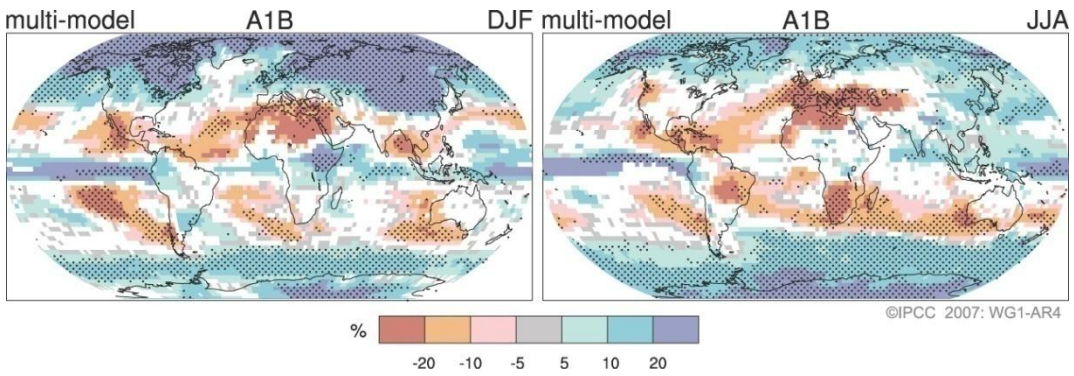
Convection in the tropics

Convection is the building block of weather systems in the tropics and plays a fundamental role in determining the climate of the tropics.

Convection provides almost all of the rainfall in the tropics and is the primary process transporting heat and moisture from the Earth's surface through the depth of the tropical atmosphere

Because of the important role that convection plays in the tropics, its representation in climate and numerical weather prediction (NWP) models is key to their quality in the tropics for all timescales of prediction from short range forecasting through seasonal forecasting to climate prediction.

The large-scale pattern of convection in the tropics can also influence the circulation in the mid-latitudes and can lead to improved predictability in these regions.



Future changes in tropical rainfall are highly uncertain – the white areas above show regions where climate models do not agree even in the sign of the rainfall change.

% change in precipitation for the period 2090-2099, relative to 1980-1999. White areas are where fewer than 66% of the models agree in the sign of the change and stippled areas are where more than 90% of the models agree in the sign of the change. IPCC AR4:

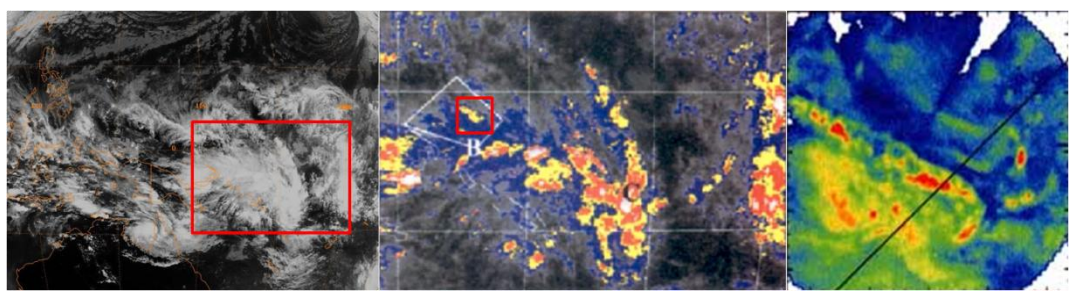
Convective organization

Convection is organized on a range of scales from a few kilometres to thousands of kilometres.

Individual clouds have scales ranging from a few hundred metres to a few kilometres and these clouds can organize in cloud systems with scales ranging from a few kilometres to a few tens of kilometres.

These cloud systems are often organized in larger systems such as mesoscale systems and weather systems such as tropical cyclones with scales of a few hundred to a few thousand kilometres.

On the large scale convection is organized in planetary scale systems such as the Madden-Julian Oscillation and by variations in the underlying surface such as sea-surface temperatures and land-sea contrasts which give rise to the monsoons.



The scales of organization in tropical convection. The left-hand figure spans about 7000km, the middle figure about 3000km and right-hand figure about 200km

Modelling convection

Climate models can't represent individual clouds but need to take account of the effect of these clouds

Climate and NWP models don't have sufficiently fine resolution to model individual clouds but need to take account of the effects of these clouds on the heat, moisture and momentum budgets of the atmosphere.

To improve the representation of convection in our climate and NWP models we need to improve our understanding of the way in which the different scales of convective organization interact with each other. To achieve this we need a model which has sufficiently fine resolution to capture individual clouds over a large enough domain to include the largest scales of organization.

Cascade is an NERC funded consortium project involving scientists at the Walker Institute, the University of Leeds, the University of East Anglia and the Met Office to model convective cloud systems in large domains (up to 10,000x4000km) over Africa and the Indian and West Pacific Oceans at a horizontal resolution of 1km. This will enable an improved understanding of convective cloud systems and a better representation of their effects in our climate and NWP models.

Find out more…..

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http://ncas-climate.nerc.ac.uk/Cascade