

High-Res
Cloud Regimes

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aims

original regimes

isccp

cluster analysis

new regimes

method

applications

summary

Perspectives on Tropical Convection Using a New Dataset of Cloud Regimes with High Time-Resolution

Jackson Tan & Christian Jakob

ARC Centre of Excellence for Climate System Science & Monash University

13th February 2013

Background: Daily Cloud Regimes

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- cloud regimes describe recurring satellite-based cloud distributions at $280 \text{ km} \times 280 \text{ km}$ resolution
- global scale, long record (since 1983), describe dominant modes of convection
- alternative to commonly-used variables like outgoing longwave radiation at TOA or precipitation

Shortcoming: Daily Resolution

Cloud regimes are defined only during **sunlit hours** and are therefore averaged to a **resolution of one day**.

Aims: Cloud Regimes at 3hr Resolution

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Aims

- demonstrate a method to derive cloud regimes using data also available at night
- new regimes are related to the original regimes, which are rich in information from previous studies
- demonstrate the skill of the new regimes in convective phenomena

ISCCP Joint-Histograms

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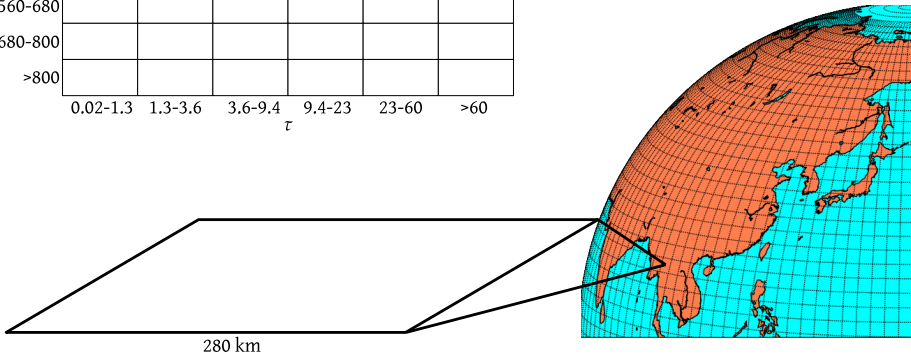
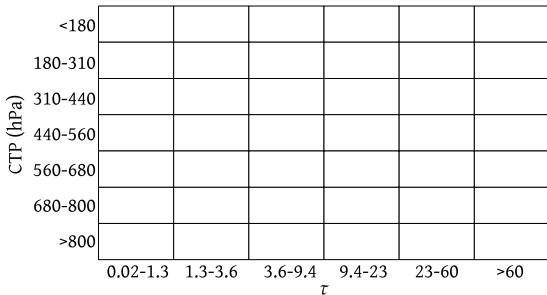
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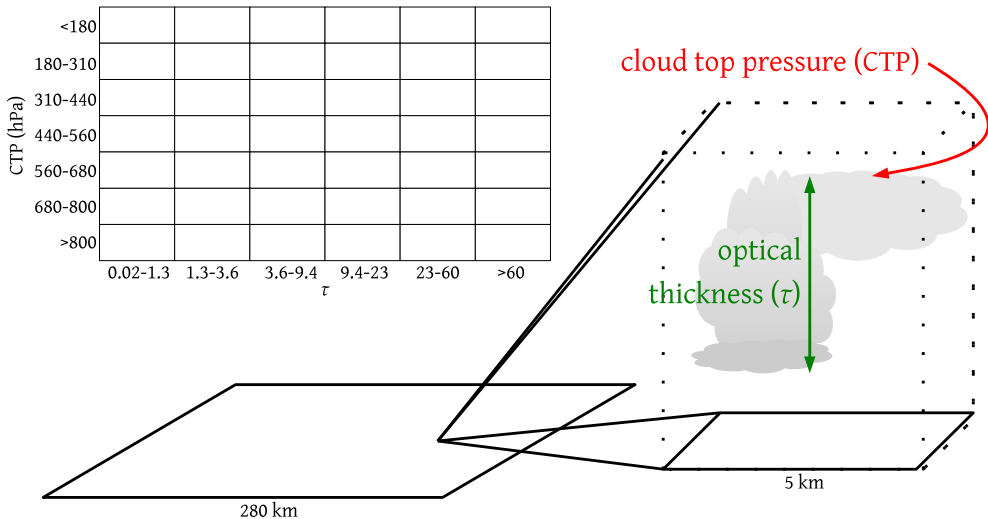
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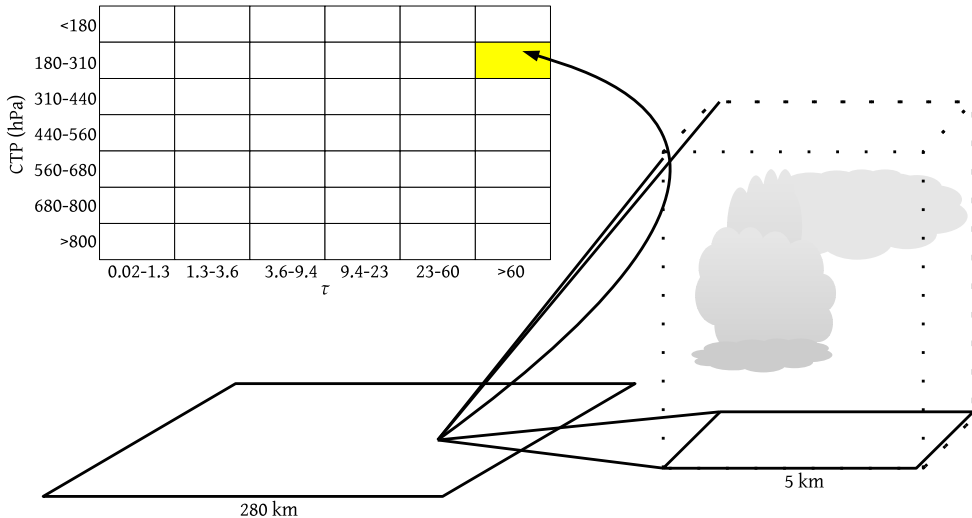
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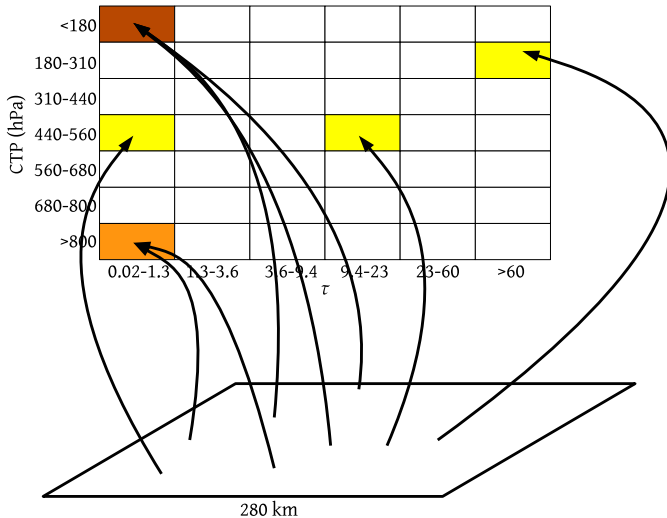
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Examples of Joint-Histograms

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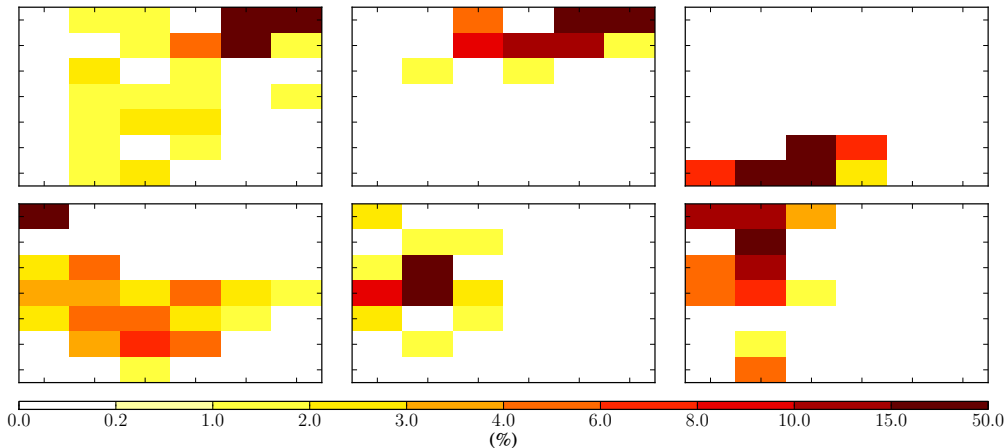
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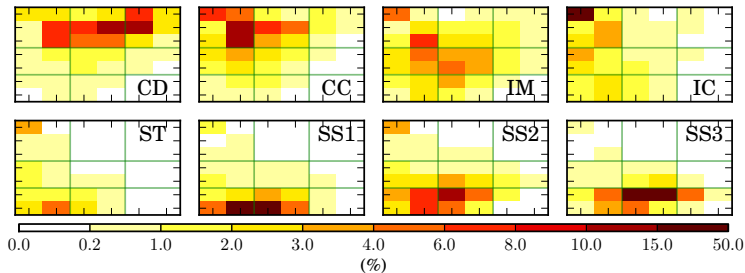
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Deriving the Original Cloud Regimes



1. Apply the *k*-means clustering algorithm to the joint-histograms (35° N/S) to get eight centroids.
2. Assign every joint-histogram to its regime by the shortest Euclidean distance to the centroid.

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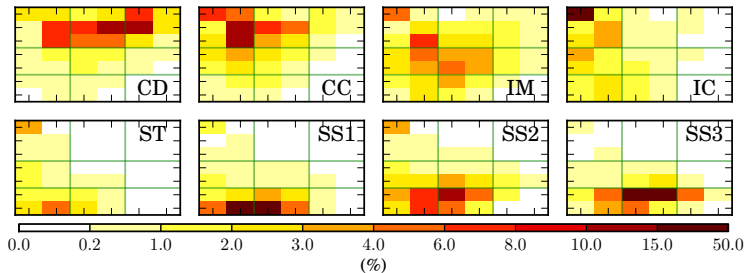
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Properties of the Original Cloud Regimes



- CD: highly-organised intense deep convection
- CC: less organised deep convection with cirrus
- IM: isolated convection with congestus clouds

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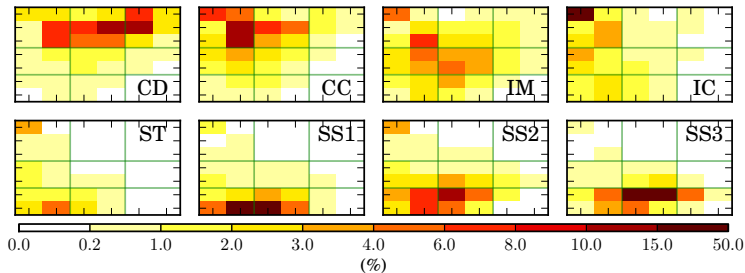
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Properties of the Original Cloud Regimes



- CD: highly-organised intense deep convection
- CC: less organised deep convection with cirrus
- IM: isolated convection with congestus clouds
- *On the Identification of the Large-Scale Properties of Tropical Convection using Cloud Regimes* (submitted to J. Climate)

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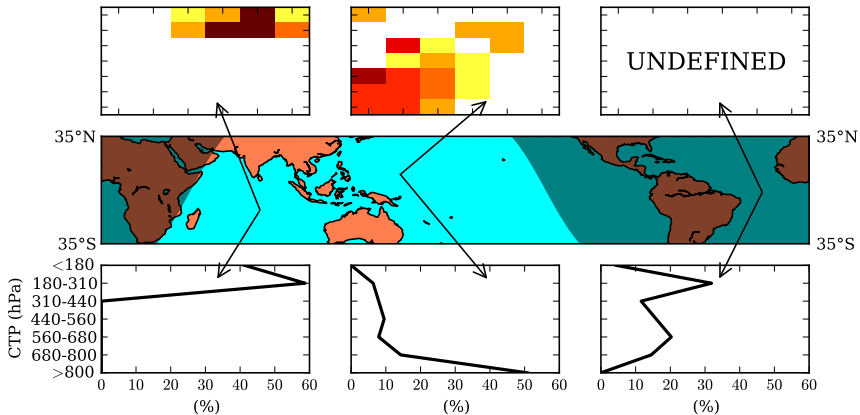
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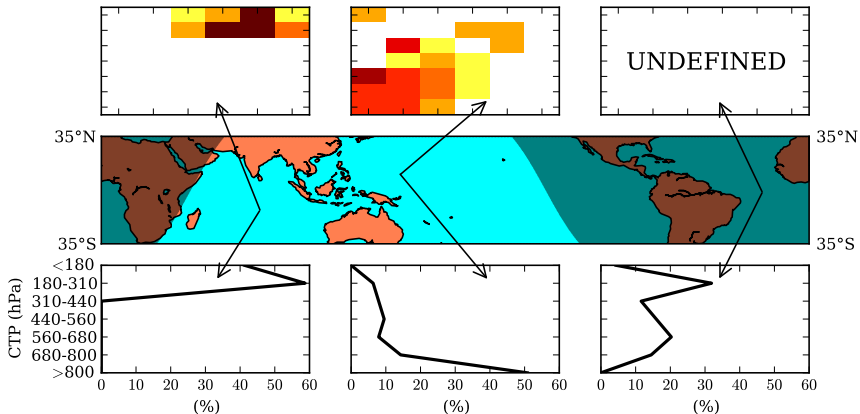
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Simply clustering the CTP-histograms does not work!

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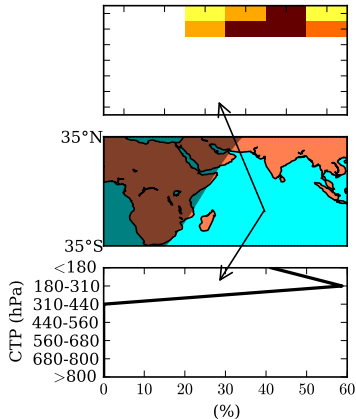
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1. At each three-hour sunlit period, assign the joint-histograms to the *original* cloud regimes.
2. For each *original* regime, find the corresponding CTP-histogram.
3. Average all the CTP-histograms within each *original* regime to obtain the CTP-centroids.
4. Assign every CTP-histogram to its *new* regime by the shortest Euclidean distance.



The Madden-Julian Oscillation

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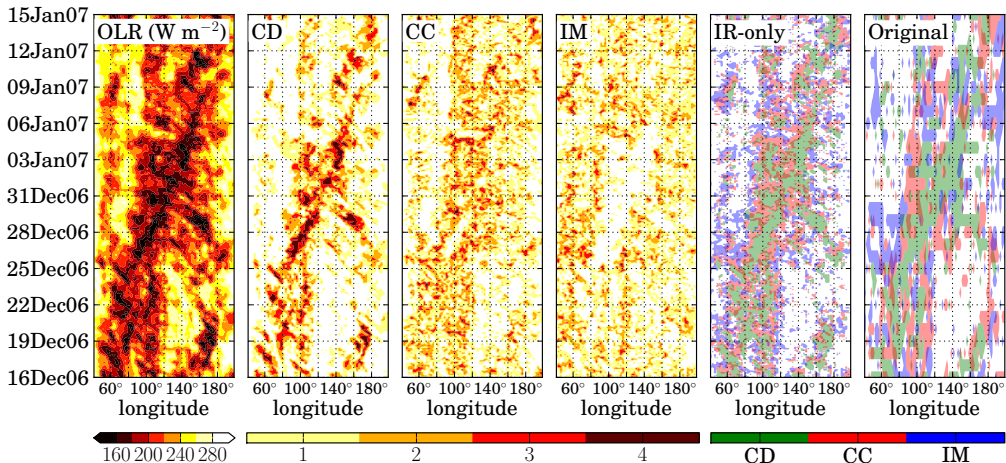
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Diurnal Cycle in South America

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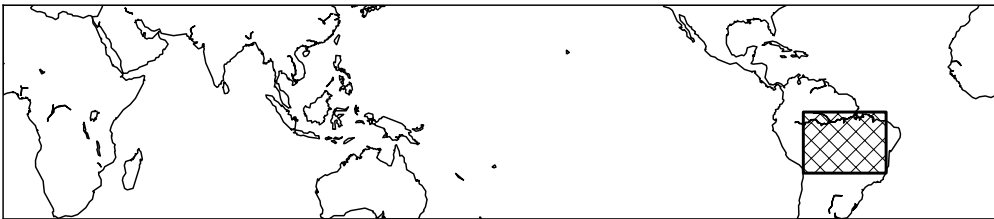
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- sub-daily time resolution enables the study of diurnal cycles
- focus on S. America ($20^{\circ}\text{S} - 0^{\circ}$, $40^{\circ}\text{W} - 70^{\circ}\text{W}$)
- calculate the frequency of occurrence of the regimes at each 3hr interval in DJF over all years

Diurnal Cycle in South America

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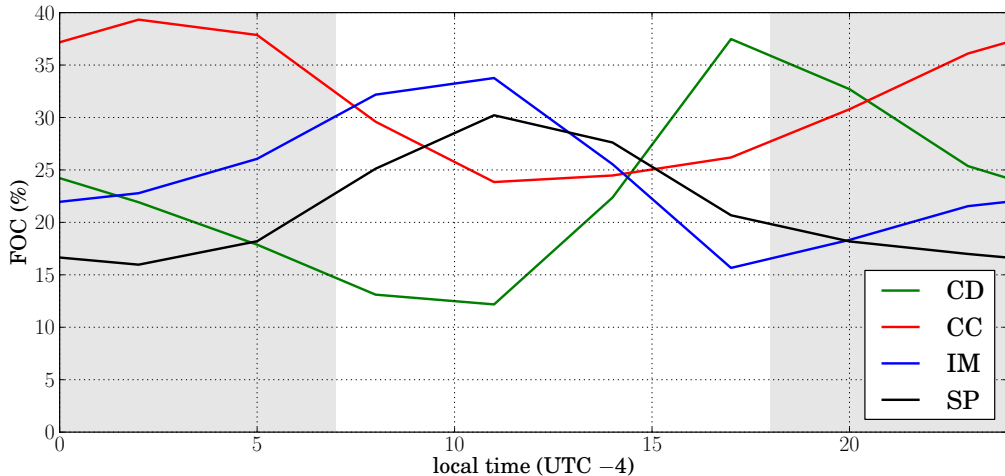
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- we have proposed a technique to derive cloud regimes at 3-hourly resolution
- these regimes are closely associated with the original cloud regimes, which describes recurring modes of tropical convection at daily timescales
- the new regimes can reveal greater details in the MJO and diurnal cycle, which the original regimes cannot
- *A three-hourly dataset of the state of tropical convection based on cloud regimes (submitted to Geophys. Res. Lett.)*
- <http://users.monash.edu.au/~btan/regimes/ir.html>