A satellite-based perspective of convective systems over the Maritime Continent

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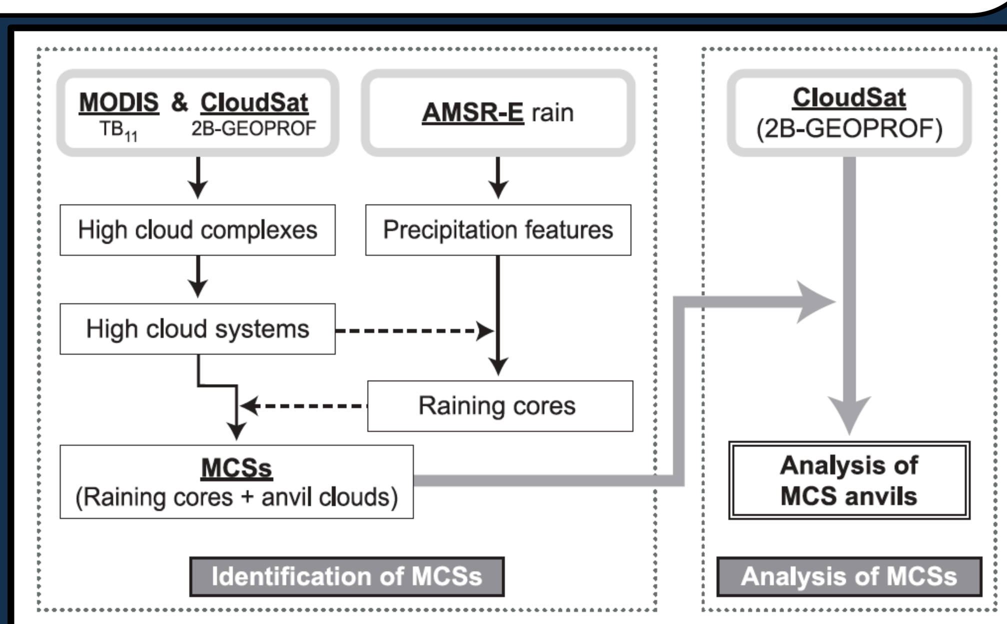
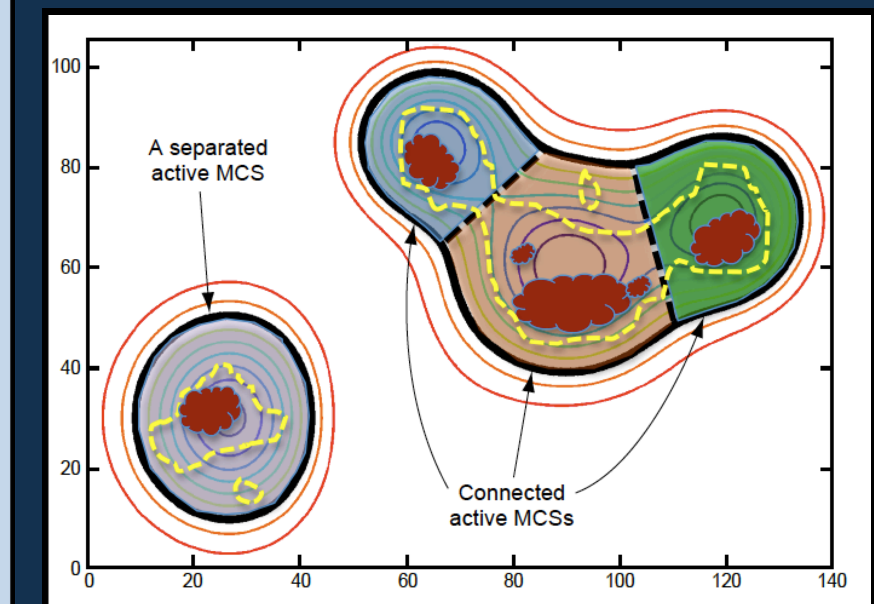
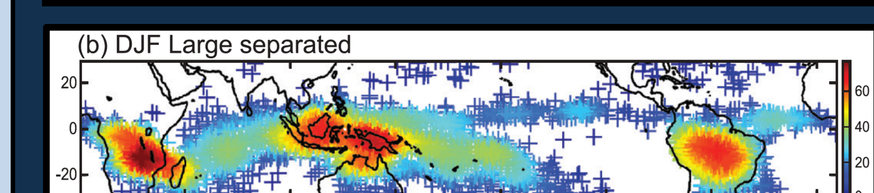
1. Introduction

During November-February, the Maritime Continent is the rainiest regional climate on Earth, thus constituting one of the atmosphere's primary heat sources. Throughout this season, precipitation in this region is strongly modulated by MJO phases, pulsations of the monsoon, and the diurnal effects of the islands and ocean. Data from TRMM, the A-Train satellites, and the Worldwide Lightning Location Network (WWLLN) have been used to study extreme weather throughout low latitudes and is therefore a valuable set of tools to examine the complex patterns of precipitation over the Maritime Continent across multiple temporal and spatial scales.

Yuan and Houze (2010) used MODIS, AMSR-E, and CloudSat data to objectively identify mesoscale convective systems (MCSs) across the Tropics and to separate the anvils from the raining components of the systems.



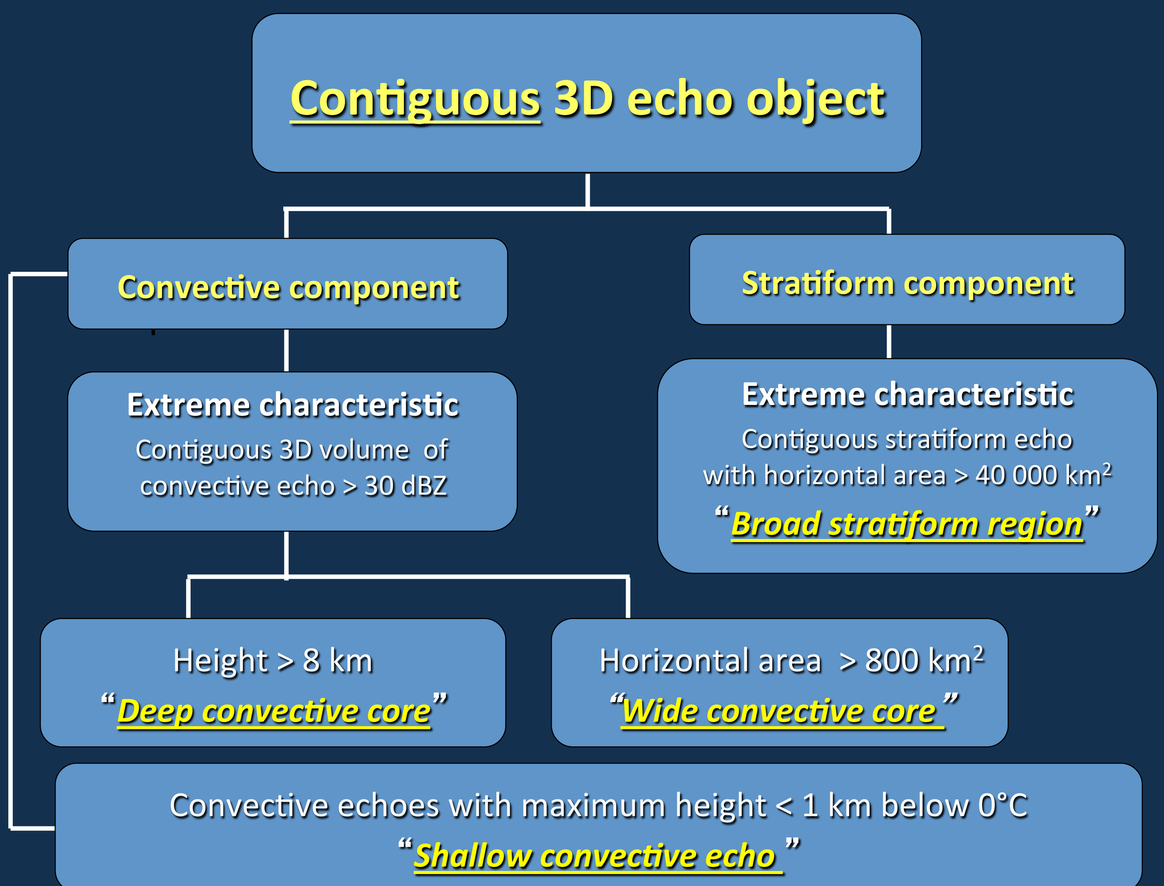




Yuan and Houze (2010) classified the MCSs as either connected or separated, with the separated MCSs further subdivided by size:
- small (< 12000 km², smallest 25%)
- large (> 40000 km², largest 25%)

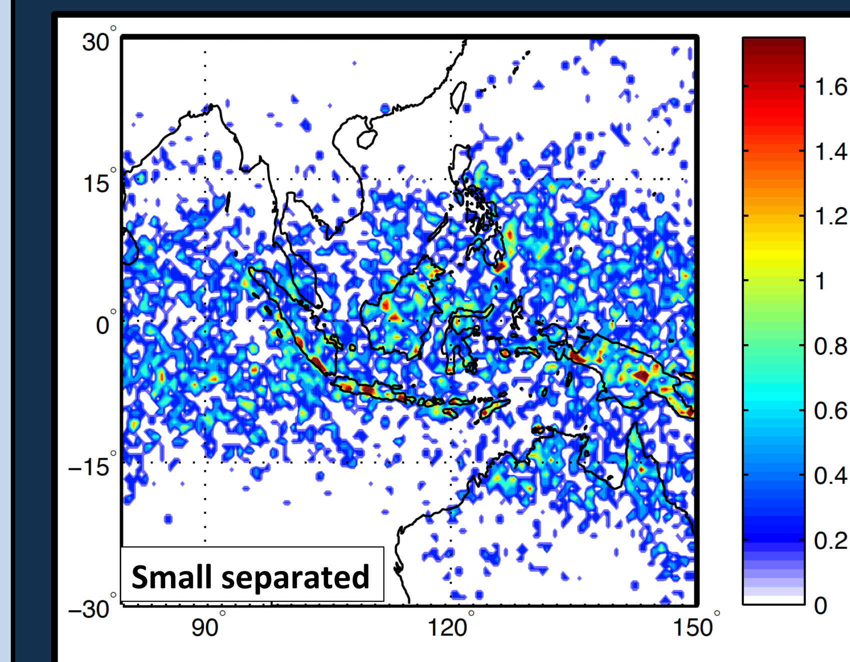
In their study over the Tropics, Yuan and Houze (2010) noted large separated MCSs over the Maritime Continent where there is a relative void of connected MCSs compared to the oceanic warm pool. This present study builds off that work to investigate the patterns over the Maritime Continent in greater detail.

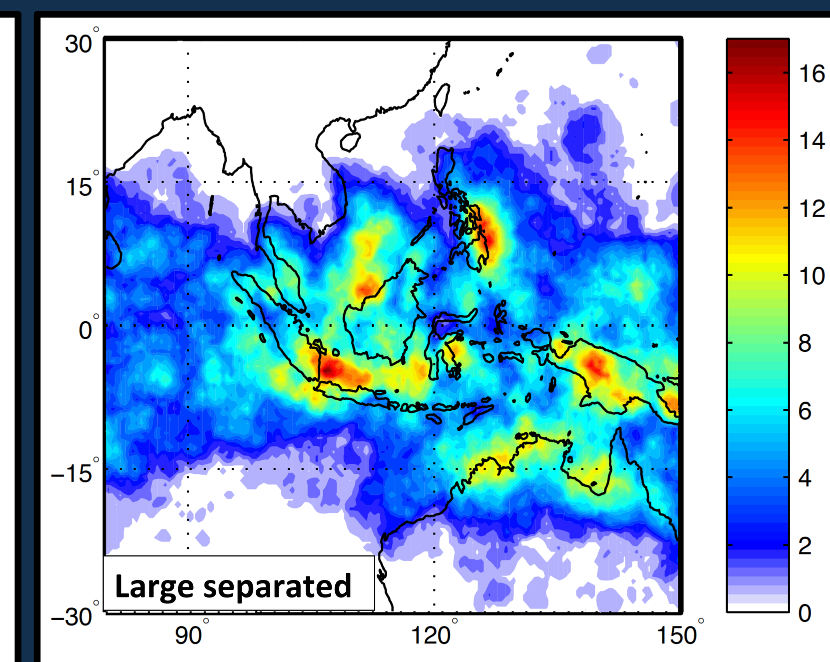
2. TRMM Classification

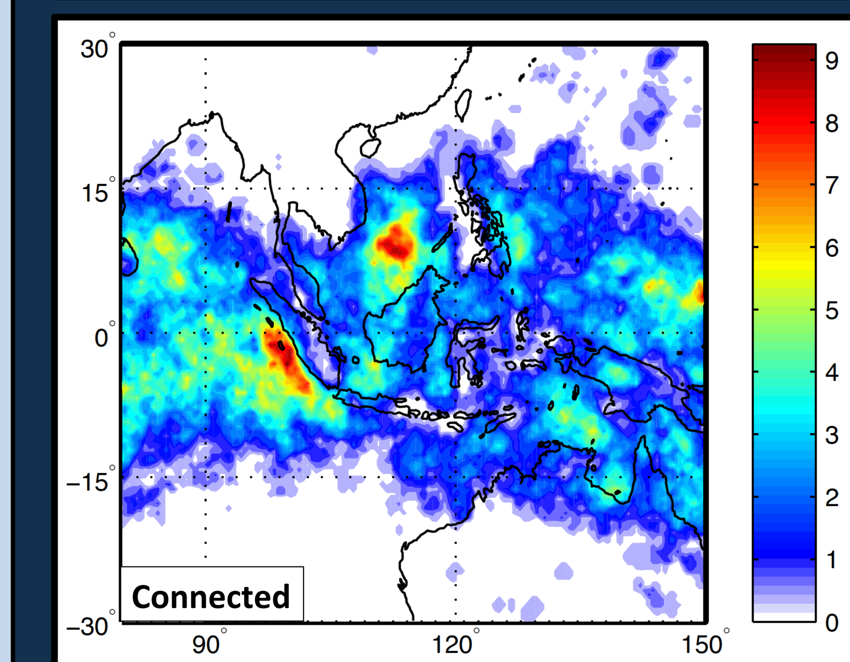


Reflectivity data from the TRMM Precipitation Radar was classified into extreme convective and stratiform features based on intensity, height, and horizontal area thresholds. These thresholds were tuned for oceanic conditions based on Barnes and Houze (2013) and Zuluaga and Houze (2013). This classification allows for details on the structure and evolution of the MCSs identified by the A-Train classification in both spatial and temporal terms.

3. MCS Frequency







Use of MCS database (Yuan and Houze 2010) to focus on Maritime Continent

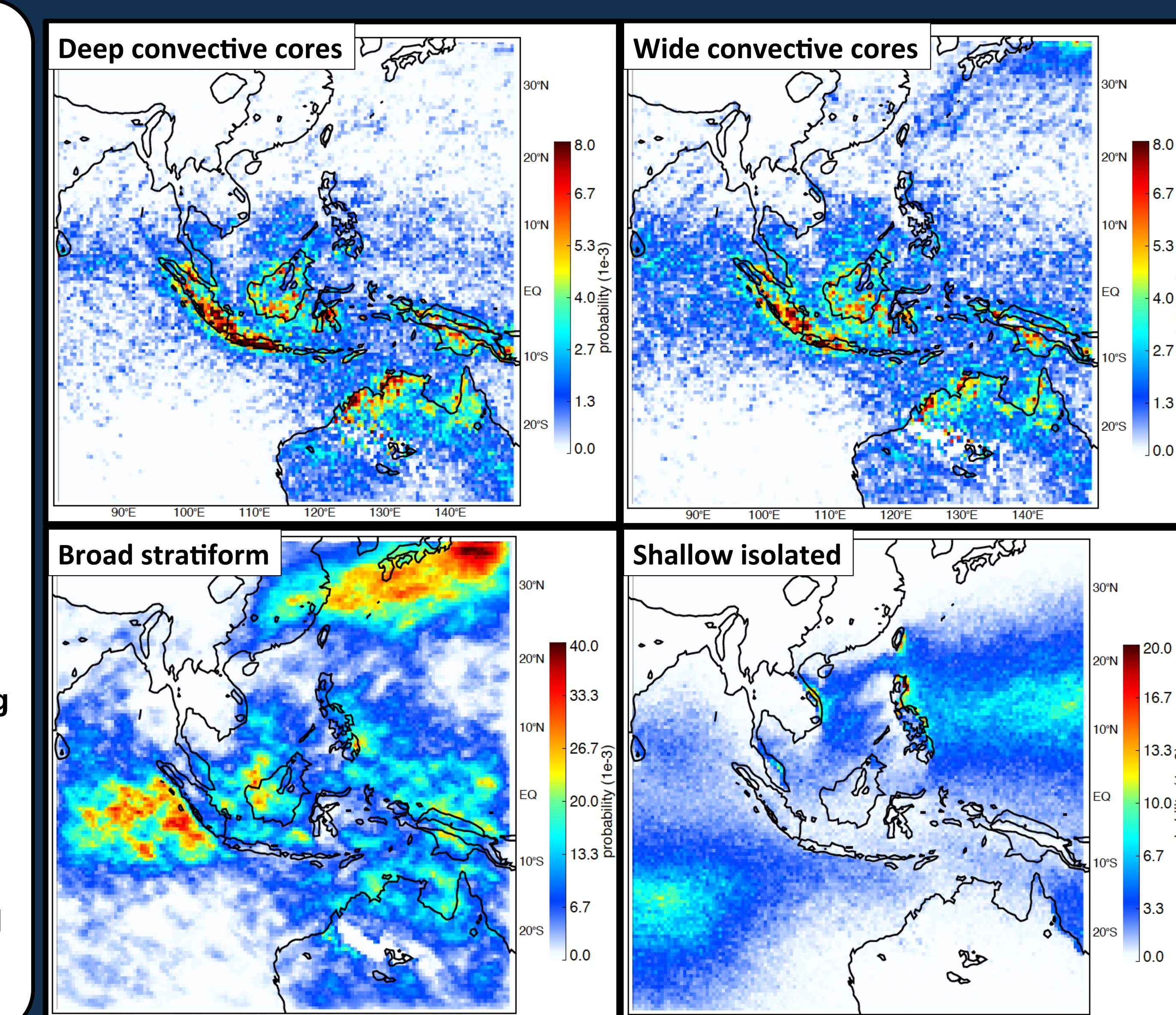
Frequency of small separated, large separated, and connected MCSs for NDJF (2007-2010)

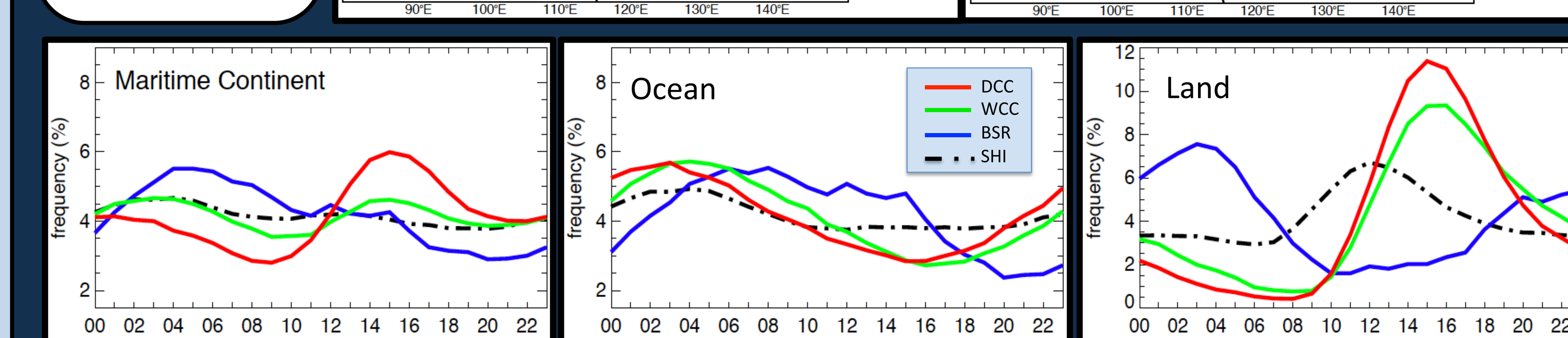
Greater frequency of connected MCSs over ocean while separated MCSs concentrated over land (with peak frequency of large SMCSs just offshore)

Probability of DCC, WCC, BSR, and SHI during NDJF (1998-2013) from TRMM

- Deep and wide convection over land while broad stratiform peaks offshore

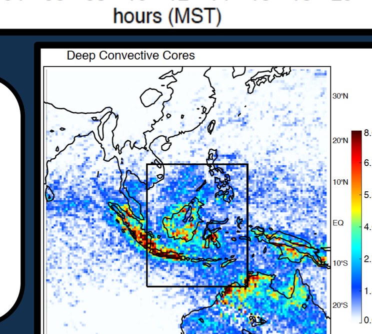
- Deep convection corresponding to small SMCSs while stratiform associated with larger separated and connected systems





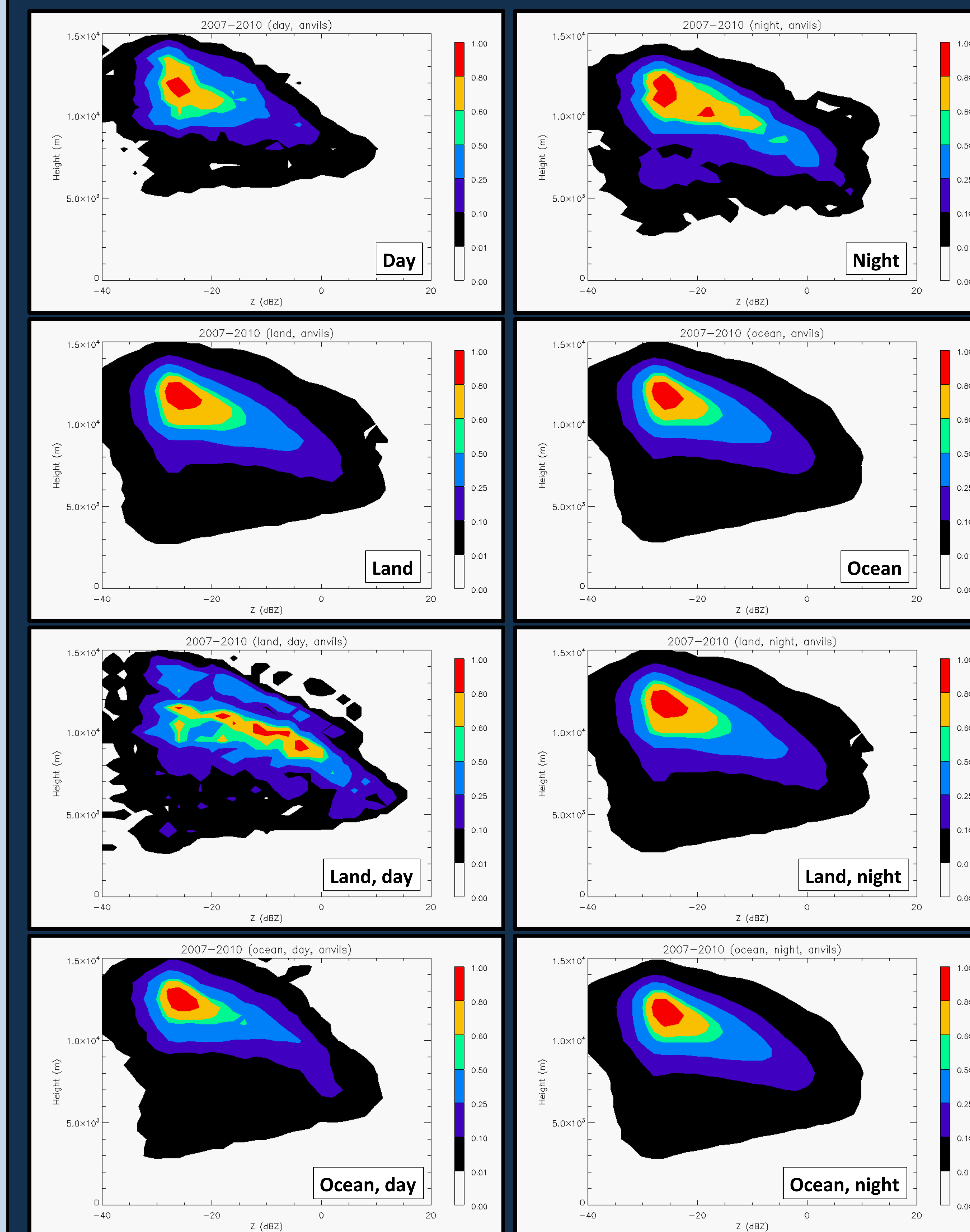
TRMM time series over the Maritime Continent shows a pronounced diurnal cycle that varies when subdivided by ocean and land.

- Over ocean, convection peaks overnight followed by late morning broad stratiform
- Over land, convection has greatest frequency during afternoon, slightly lagging the peak in wide convective echo followed by a nocturnal peak in stratiform regions.



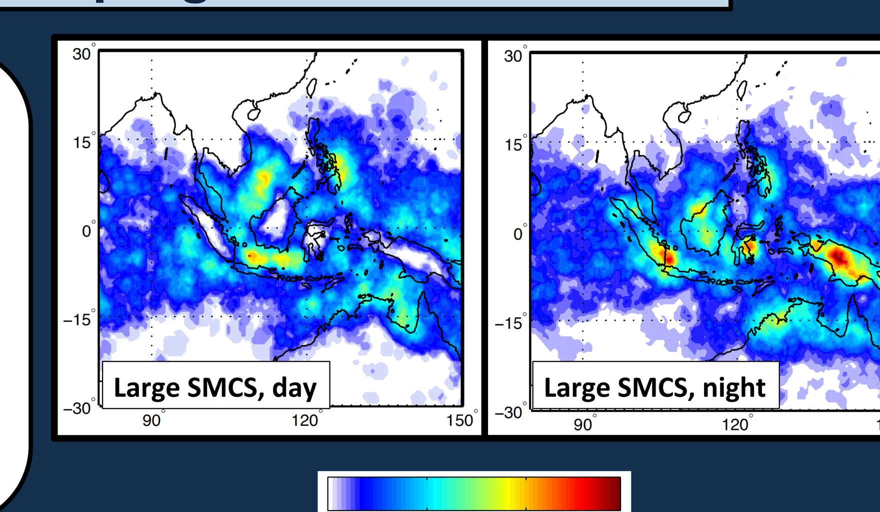
4. Anvil characteristics

Using the CloudSat vertical profiles of reflectivity, characteristics of anvils associated with MCSs over the region can be determined. For this purpose, anvils were defined as reflectivity profiles between -40 and 60 dBZ with cloud top > 10 km and cloud base > 3 km. Contoured frequency by altitude diagrams (CFADs) are presented for MCS anvils (NDJF 2007-2010), subdivided by time of day (overpasses roughly 0130 and 1330 LT each day) and land/ocean.



5. Work in progress

- Further investigate diurnal cycle (land vs. ocean, type of MCS)
- Relate anvil characteristics to distance from rain cores
- Describe trends in context of monsoon patterns and MJO phase
- Add WWLLN data to analysis



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