Diurnal Variations in the DPR Raintypes

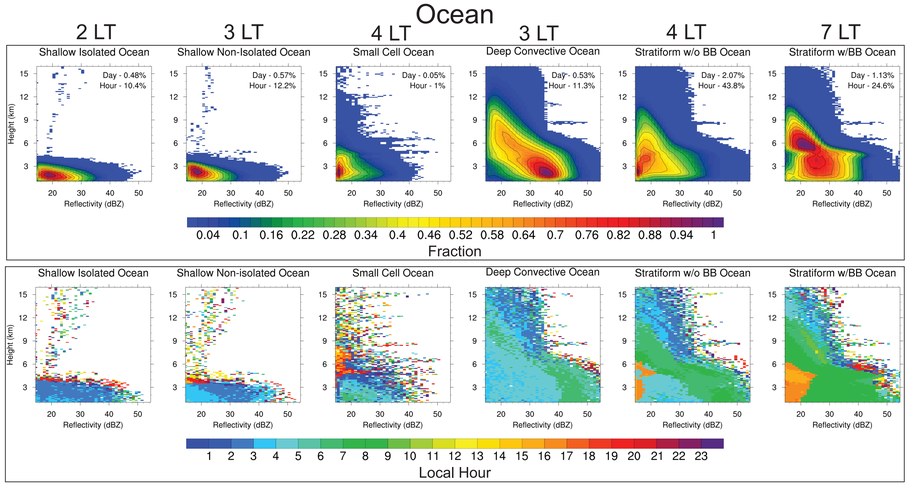
Aaron Funk and Courtney Schumacher
Department of Atmospheric Sciences, Texas A&M University

Introduction

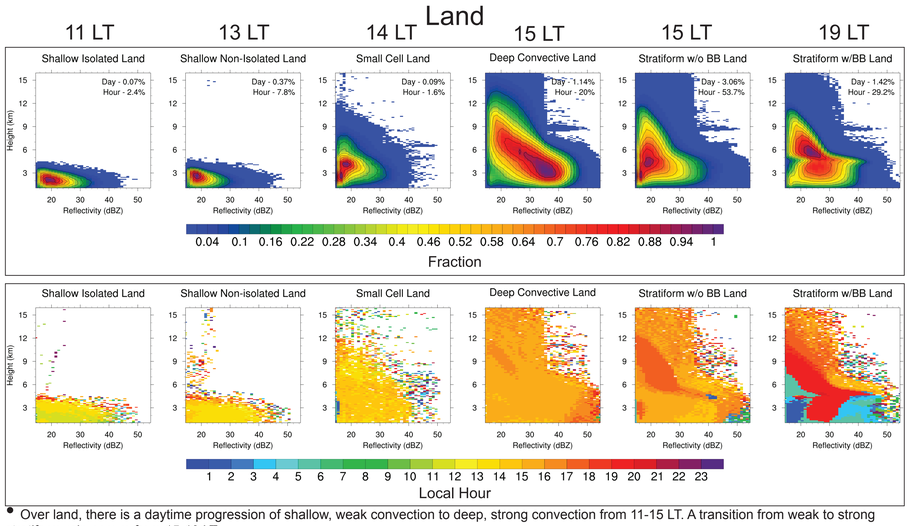
A study of the diurnal cycle's influence on rain is conducted using GPM DPR radar raintype retrievals.The DPR rain classification algorithm classifies reflectivity profiles into two main raintypes: convective and stratiform. It further decomposes convective rain into shallow isolated, shallow non-isolated, and small cell. Stratiform rain can also be partitioned into two subgroups based on the detection of a bright band. This granularity allows for the convective cloud lifecycle to be examined. The subgroups' individual responses to the diurnal cycle in turn validate the methodology of the rain classification algorithms. GPM 2ADPR version 6 data is examined for years 2014 to 2019 between 35S-35N.

Radar Reflectivity CFADs

The top row shows CFADs of radar reflectivity for each raintype's maximum time of occurrence. The second row shows the peak local hour for each CFAD bin.

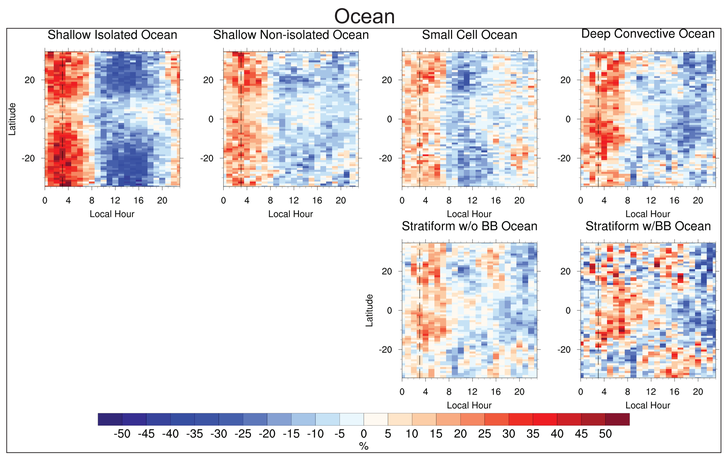


- Over ocean, there is a nocturnal progression of shallow, weak convection to deep, strong convection from 2-4 LT. A transition from weak to strong stratiform rain is evident from 4-7 LT.
- Peak hour CFADs show that shallow convection is strongest from 2-3 LT but attains its highest heights in the afternoon and evening. Deep convection is strongest later in the morning, but is tallest in the late evening and early morning. There is a bimodal pattern for stratiform rain with weak echo in the afternoon and moderate to strong echo in the early morning.

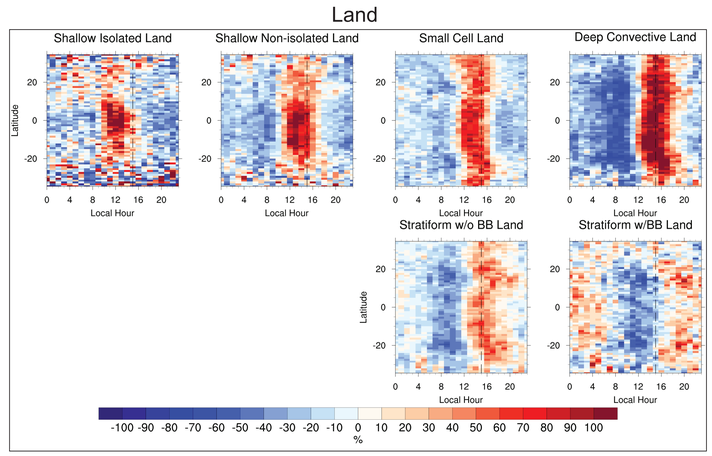


- Over land, there is a daytime progression of shallow, weak convection to deep, strong convection from 11-15 LT. A transition from weak to strong stratiform rain occurs from 15-19 LT.
- Shallow isolated deepens with time from late morning to afternoon, while shallow non-isolated rain occurs mostly near midday. Small cell and deep convective rain types occupy the next hours in the afternoon, with the strongest and deepest convection occurring after 16 LT. Straiform without a BB appears strongly linked to the development of the precursor deep convection, while stratiform with a detectable BB peaks near 19 LT in the most concentrated areas of the CFAD and during early morning for weak and string low level echo.

Hourly Zonal Count Anomalies

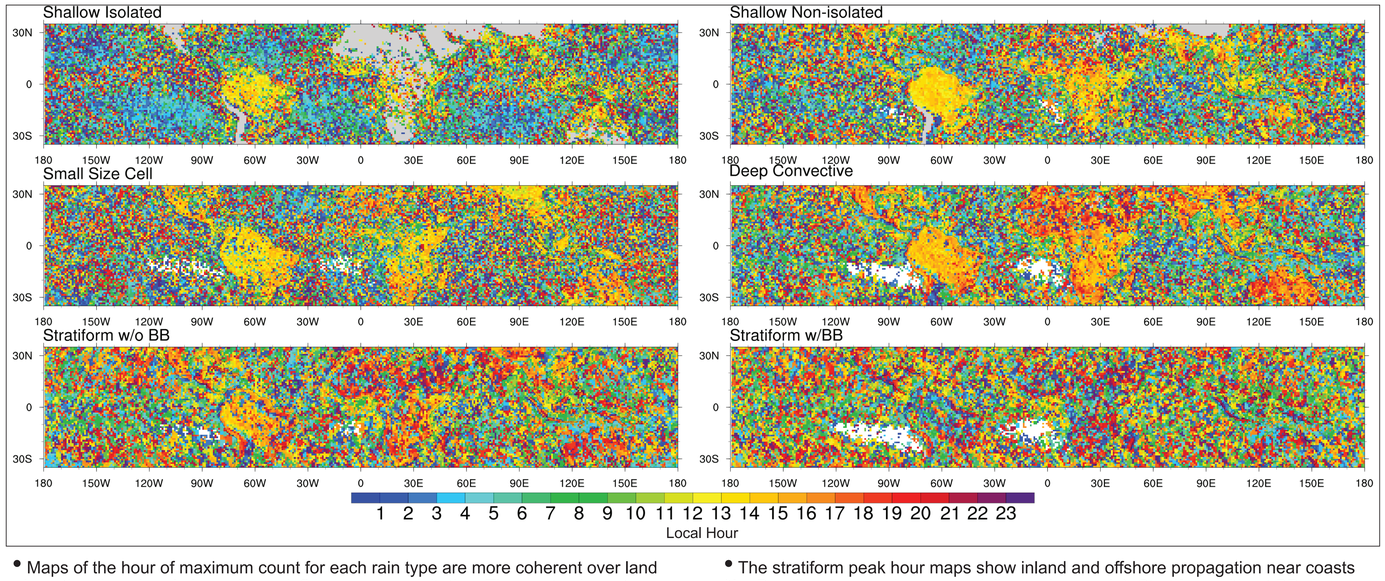


- All convective rain types have maximum occurrence during the early morning (around 3 am, indicated by the vertical dashed line) between 35N and 35S, although there is a weaker diurnal cycle near the equator. Shallow convection precedes deep convection, while small cells are the only convective type that increases in the early evening.
- For both stratiform rain types, maximum occurrence is in the morning (3-8 am), i.e., after the deep convection maximum, between 20N and 20S and in the afternoon (4 pm) poleward of 20N and 20S.



- Convective cell occurrence increases in the afternoon beginning with shallow isolated, shallow non-isolated and then deep convection, suggesting upscale growth. Small cell size retrievals are coincident with deep convection. Maximum deep convective occurrence is at 3 pm (indicated by the vertical dashed line). Shallow isolated and non-isolated rain types are limited to 20N to S, while the small cell and deep convection population seems to have more variability in timing poleward of 20N and 20S.
- Stratiform without a detectable BB maximizes in the late afternoon, similar to the deep convective peak, while stratiform with a detectable BB shows enhanced occurrence in the early evening that continues until early morning, likely associated with nocturnal MCSs.

Peak Hour Maps



- Maps of the hour of maximum count for each rain type are more coherent over land where the diurnal cycle has a larger influence on precipitation. The most coherent diurnal cycle over ocean is in the shallow isolated rain type.
- A late afternoon hourly progression of convective rain types is evident over the equatorial land masses suggesting upgrowth, although variations exist between South America, Africa, and Australia. Notable nocturnal peaks in convection are evident over southern South America.
- The stratiform peak hour maps show inland and offshore propagation near coasts (the Brazilian Amazon is an especially good example). Stratiform without BB shows an earlier propagation time and thus likely represents an earlier time in the MCS life cycle evolution. Overnight MCS propagation over land is represented by stratiform with BB.

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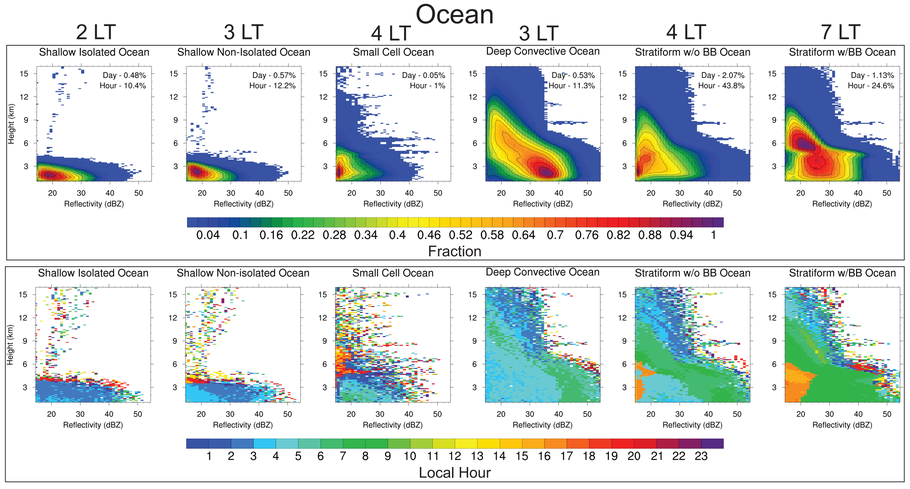

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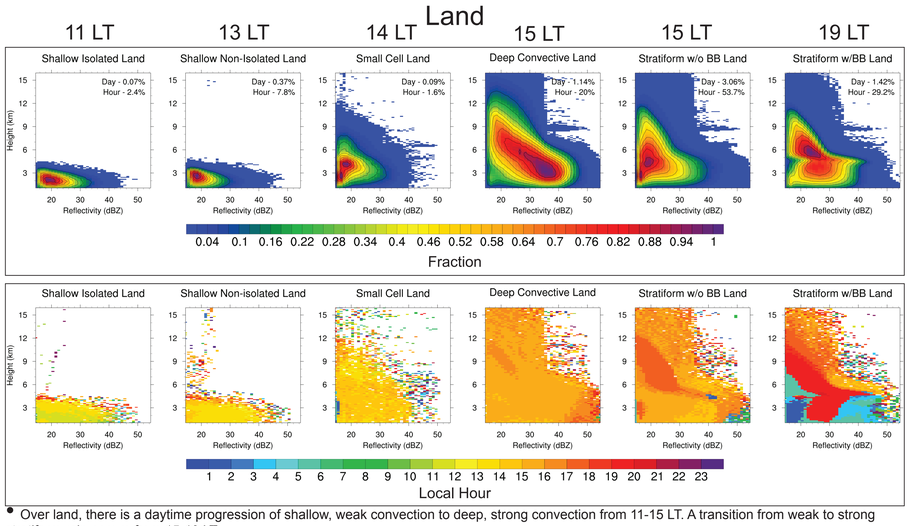

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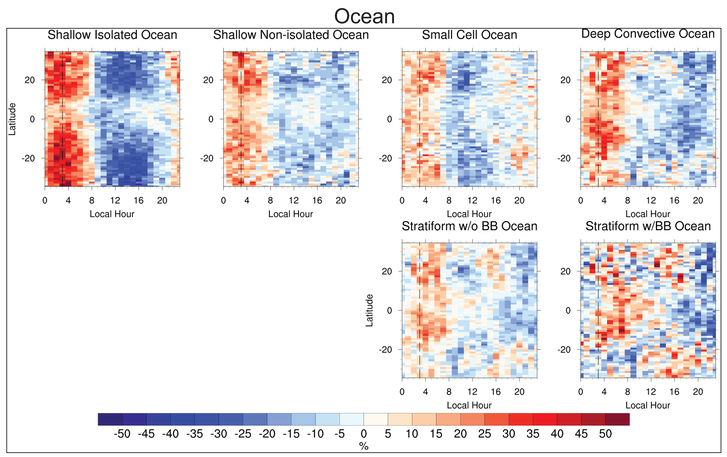

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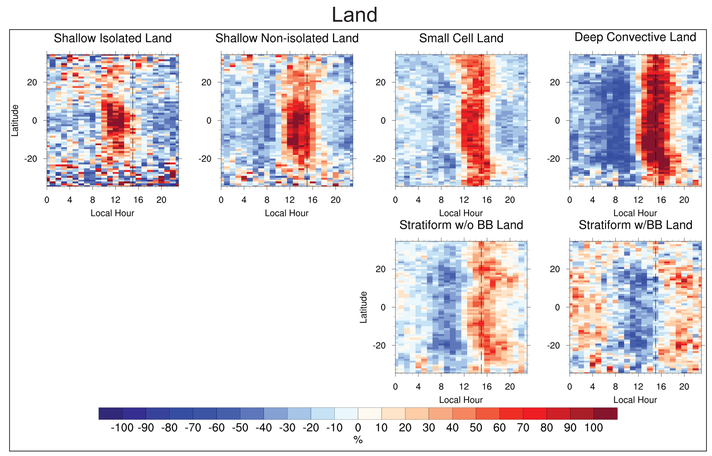

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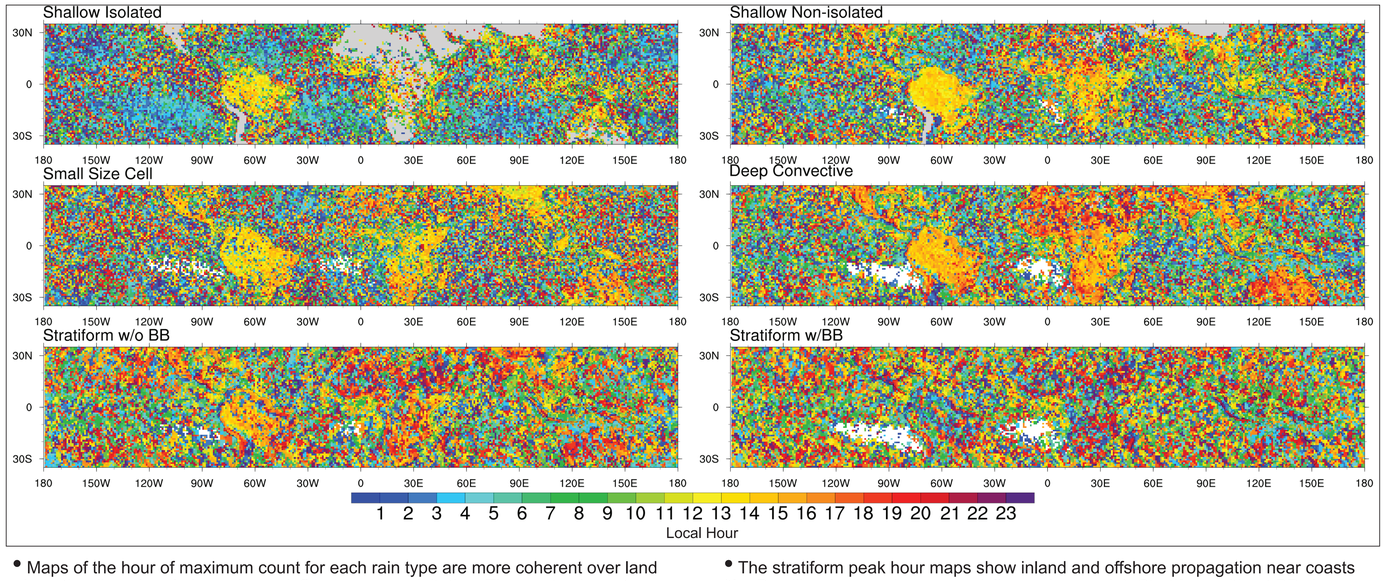

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