

Research Questions/Objectives:

- microphysics of warm rain systems.
- they occur the most.

Data:

- size (Dm) at 1-4 km.
- Optional Depth (AOD) of smoke, dust, salt, and sulfate.

Methodology:

- with high AOD of smoke, salt, dust, and sulfate are shown for comparisons.

Global distribution of Warm Rain Drop Sizes



Raindrop Microphysics in Warm Rain Precipitation Features Inferred from 6-year GPM Dual Frequency Radar Retrievals

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Figure 4: Population of warm PFs with small and medium drop sizes at 1 km in four seasons over the East Pacific and the Caribbean region.

- Warm rain is prevalent in the East Pacific and the Caribbean in all seasons.
- There are two bands (north vs. south) of warm rain systems in the East Pacific

Figure 5: Population of warm PFs with large (> 2 mm) drop sizes at 1 km in four seasons over the East Pacific and the Caribbean

- Large raindrops are only found in the northwest Caribbean Sea, the north band of East Pacific ITCZ, and a small area southeast of Panama.
- Though warm rain systems are prevalent in all seasons over the East Pacific and Caribbean area, there are more warm rain systems from November to February and the
- Warm raindrop systems have large raindrops at all levels. Most of them are near the west coast of the
- Though a lot of systems with large drops reach 4 km, not all systems reaching 4 km have large drops, implying that a longer collision path does not necessarily lead to large

Warm Rain with High Aerosol Optical Depth



Figure 8: Population of warm PFs with small and medium rain drops at 1 km that are coincident with different types of aerosol AOD > 0.1 km.



Figure 9: Same as Figure 8, but for PFs with large raindrops at 1 km.

Longitude



Summary:

- at altitudes 1-3 km.
- appear in all altitudes in these systems.
- northwest coast of the Caribbean.
- on the warm rain microphysics over the region.

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- There are significant regional and seasonal variations in aerosols of different types.
- Large raindrops over the east Pacific are found with low dust or sea salt AODs. But they can also be found with high dust and sea salt AODs over the west coast of the Caribbean.
- Though there are many warm PFs with large raindrops having large smoke AOD over the East Pacific, they are mainly in MAM. PFs with large raindrops happen in all seasons over the region (Figure 5).

Figure 10: Seasonal variation of the population of warm PFs coincidence with high AOD of different aerosol types over the east Pacific and Caribbean sea region.

The majority of global warm rain has a maximum mass weighted raindrop diameter between 0-2 mm

Longitude

• The warm rain with Dm larger than 2 mm occurs over specific regions and the large raindrops could

• There are more warm rain systems in boreal winter months from December – February over the east Pacific and the Caribbean region. Large raindrops are found in the north band of East Pacific ITCZ,

• The East Pacific and Caribbean region has a complicated aerosol background with strong seasonal and regional variations in aerosol types. It is difficult to draw any conclusion on the impact of aerosols