Introduction and Motivation

TMI indicates widespread areas of surface precipitation over the ocean that are, in fact, not precipitating. This spurious precipitation represents a source of error in TMI rainfall estimates. Identifying, characterizing, and explaining these areas of spurious precipitation is necessary for the TRMM data validation and error characterization process and is an essential mission goal.

This study characterizes and analyzes the distribution of TMI spurious precipitation, and poses a hypothesis based on cloud thickness for its mischaracterization in TMI products.

Physical Description and Characteristics

Observations from TRMM and GOES satellites, upper-air soundings, and coastal S-band radar indicate that TMI spurious precipitation:

- Does not appear in either PR or more sensitive coastal radar
- Occurs in status clouds under a stable layer
- Has TMI rain rates up to 2.3 mm/hr, mean rain rate varies with case (0.6-1.2 mm/hr)
- Occurs within 3-4.5 km thick clouds with a liquid water path (LWP) from 0.5-1.2 kg/m² and a liquid water content (LWC) from 0.1-0.4 g/m³

TMI spurious precipitation off the coast of Florida from 5 March 2002. The TMI (a) shows a widespread area of precipitation that does not appear in the corresponding PR (b) observations. The Key West and Miami coast WSR-88D (c) radars show some surface clutter, but do not show the widespread area of indication by TMI. Upper-air soundings indicate that areas of spurious TMI precipitation have a cloud base close to the surface and a cloud top just below the freezing level (below left, cloud top indicated by red line). IR satellite indicates liquid-phase stratus cloud (below right).

Frequency and Distribution of TMI Spurious Precipitation

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<tr>
<th>Percentage of Observations with TMI Spurious Precipitation Signature</th>
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<tr>
<td><strong>2002 Annual Total</strong></td>
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<tr>
<td><strong>March 2002</strong></td>
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<tr>
<td><strong>September 2002</strong></td>
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<td><strong>December 2002</strong></td>
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TMI spurious precipitation is most common in the winter season in the lee of continents at latitudes >15°. High frequencies of spurious precipitation occur in the East China Sea, US Atlantic Coast, and western Gulf of Mexico.

Correlation to Environmental Parameters

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<th>Surface Latent Heat Flux</th>
<th>Liquid-Phase Optical Thickness</th>
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| TMI spurious precipitation is weakly correlated with surface latent heat flux (left), and liquid-phase optical thickness (right). This suggests that spurious precipitation is related to moisture rich clouds with a low LCL.

Conclusions

TMI spurious precipitation over ocean:

- Occurs in thick liquid-phase stratus clouds where the LWC is not high enough to support the formation of rain droplets
- High LWP and low LWC can account for TMI rainfall false positive
- Occurs in high and low aerosol environments
  - Aerosol Optical Depth does not correlate with TMI spurious precipitation
  - Aerosol indirect effect may contribute but does not dominate
- Most common in winter season in lee of continents for latitudes >15°
  - East China Sea, US Atlantic Coast, western Gulf of Mexico

Annual Frequency: 1% globally, up to 10% regionally

- Can account for 30% of observations at peak occurrence

Implications:

- Positive bias in TMI and multi-sensor global estimates of precipitation over ocean (e.g. GPCP)

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