Regional Comparisons of Marine Stratocumulus Characteristics

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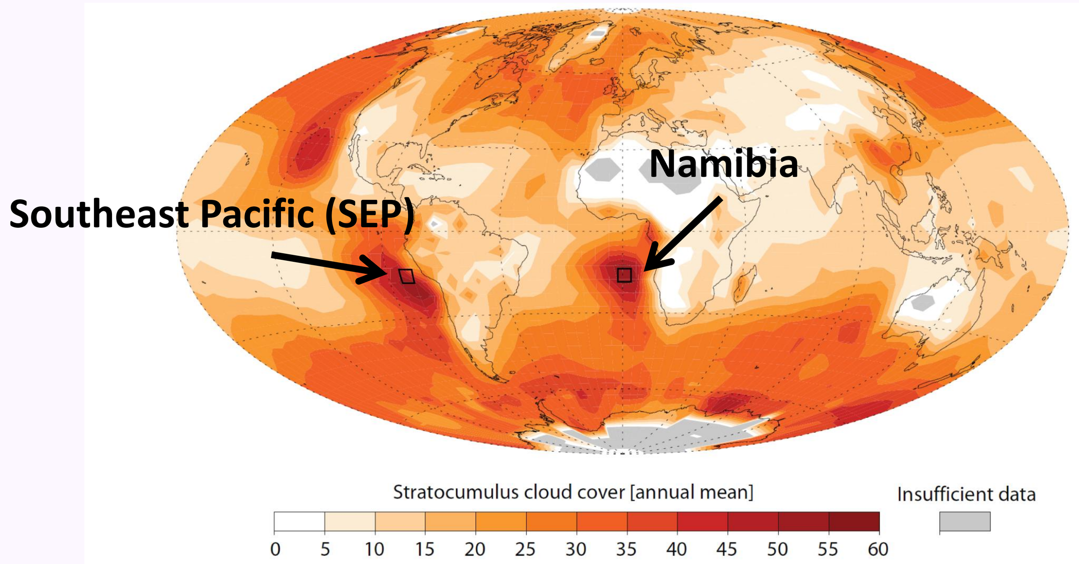


Fig. 1. Annual mean stratocumulus cloud cover with areas of interest outlined (Courtesy of R. Wood). Each area of interest is 5° by 5° (~ 300,000 km²).

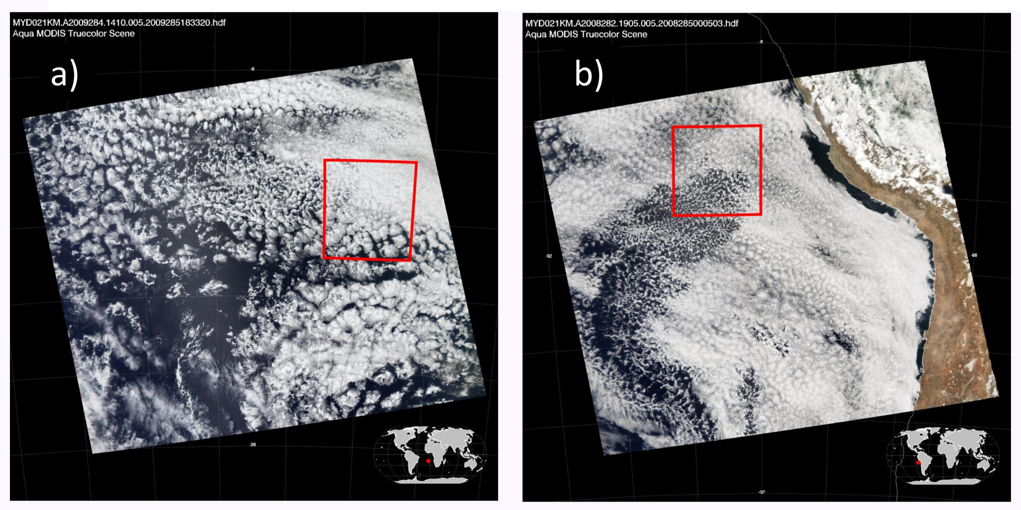
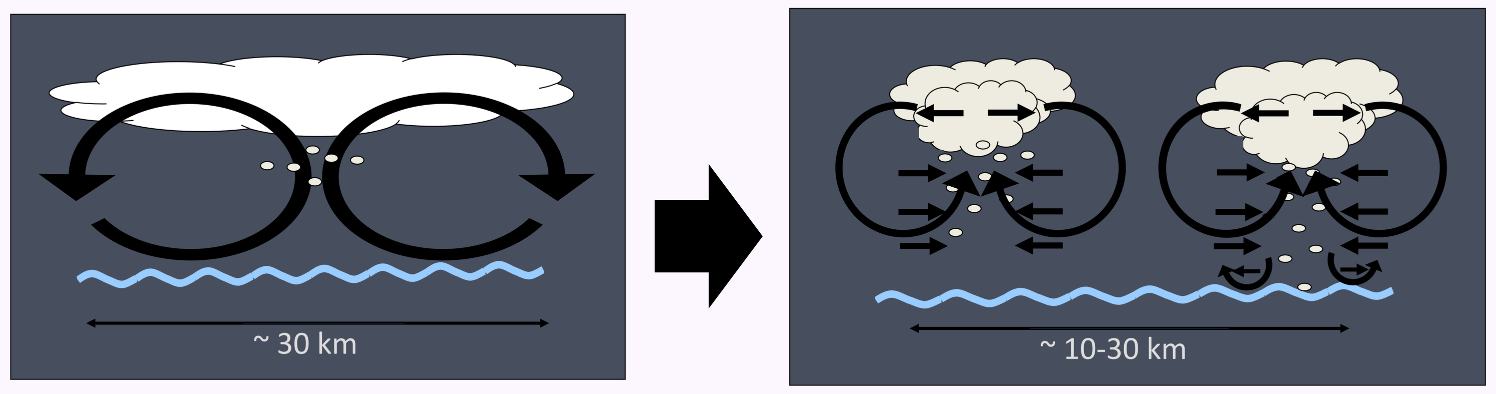


Fig. 2. MODIS visible images of stratocumulus cloud decks in each area of interest (red boxes) - a) off the coast of Peru on 8 October 2008 at 19:05 UTC and b) off the coast of Namibia on 11 October 2009 at 14:10 UTC.

Closed Cell **Drizzling Open Cell**



Drizzle controls on cloudiness: Some drizzling, closed cell clouds transition to drizzling, open cell clouds while others do not.

Introduction

Low marine clouds are an important source of cooling within the Earth's radiation budget. The albedo of these clouds is closely tied to whether a given area of cloudiness has an open cell or closed cell organization. Drizzle has been found to be a necessary but not sufficient condition for closed cells to transition to open cells. Our initial work has focused on mapping the spatial distribution and frequency of drizzle within the southeastern Pacific and southeastern Atlantic (Namibian) cloud decks.

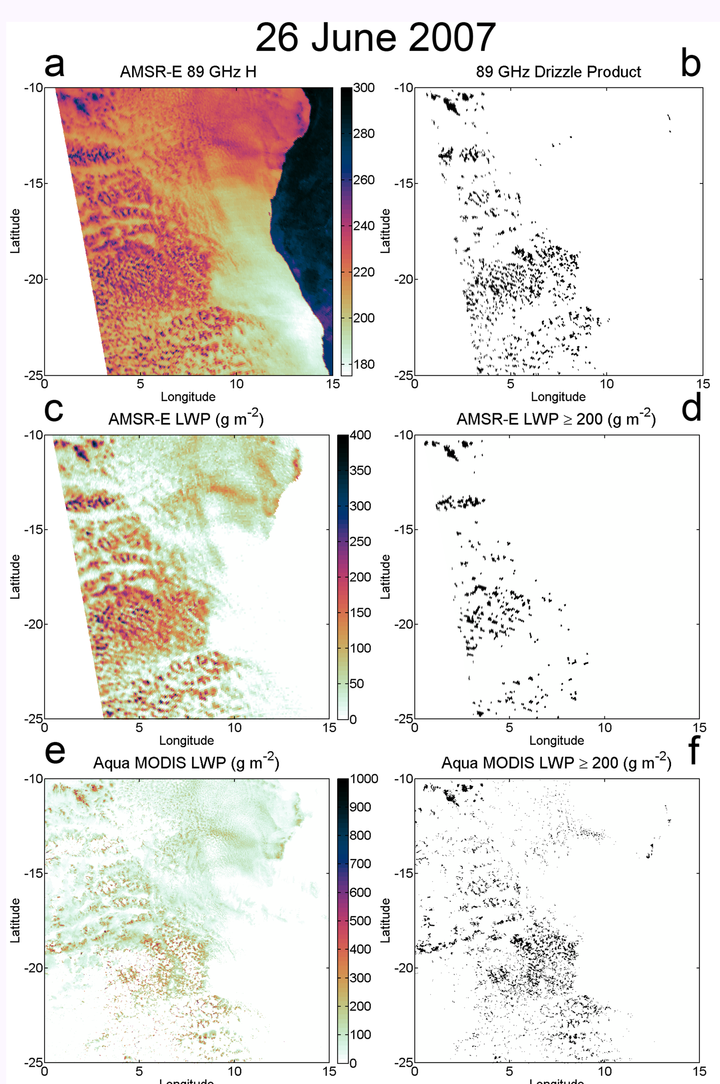


Fig. 3. Comparison among 89 GHz drizzle detection method (top row), AMSR-E LWP > 200g/m2 (middle row) and MODIS LWP (bottom row). Left column shows the indicated product which is simplified to a binary drizzle occurrence map in the right column. Data are from the Namibian region.

Data Inventory - Sep., Oct., Nov. (SON)

	# of Scenes > 10,000 pixels	
Year	SEP	Namibia
2006	99	106
2007	95	103
2008	101	103
2009	103	106

Data

AMSR-E V002

- AE_L2A - AMSR-E/Aqua L2A Global Swath Spatially-Resampled Brightness Temperatures
- AE_Ocean - AMSR-E/Aqua L2B Global Swath Ocean Products derived from Wentz Algorithm

MODIS Series 51

- MYD06_L2 - Aqua MODIS Level 2 Cloud Product

IR

- NCEP/CPC 4-km Global (60°N - 60°S) IR Dataset

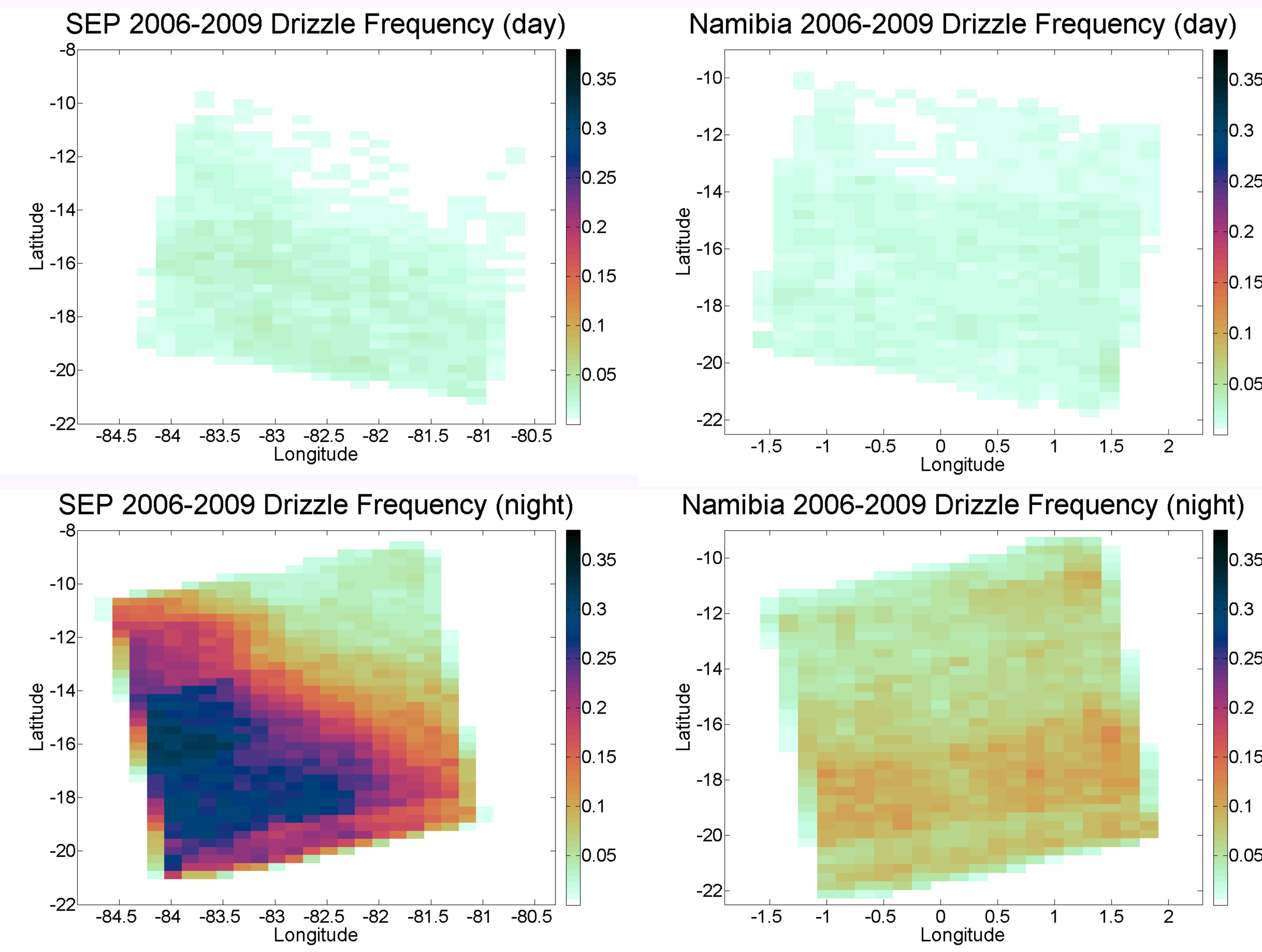


Fig. 4. Spatial frequency of drizzle by region and time from SON 2006-2009 using scenes > 10,000 pixels (~ 217,000 km²).

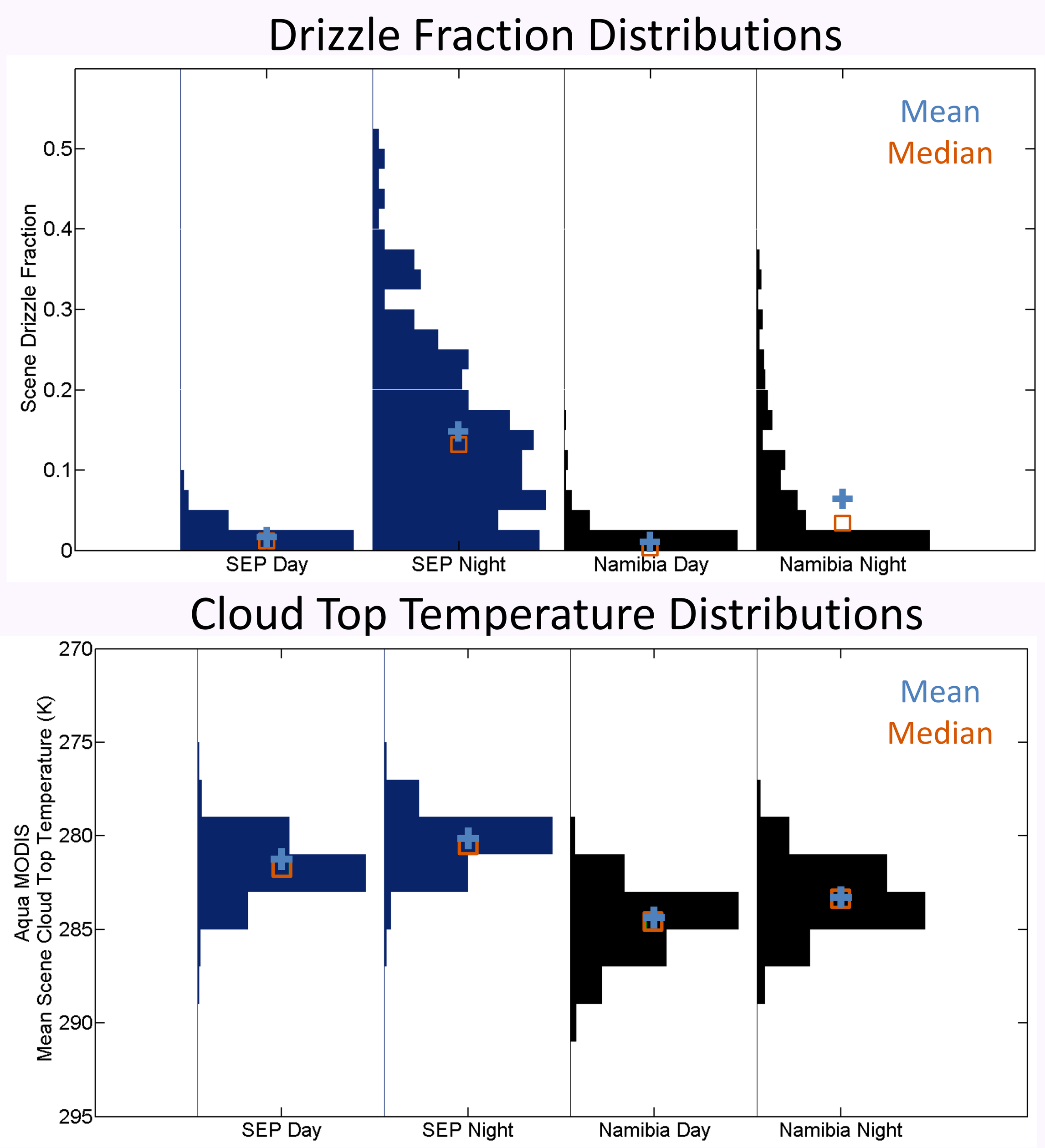


Fig. 5. Distributions of drizzle fraction per scene and mean scene cloud top temperature divided by region and time for SON 2006-2009 considering scenes > 5000 pixels (108,500 km²).

Methodology

We use 89 GHz emission from AMSR-E to detect drizzling clouds with LWP > 200 gm² (Miller and Yuter, 2012). The 89 GHz drizzle detection method and the AMSR-E liquid water path are highly correlated in terms of spatial distribution (Fig. 3) and total area (Fig. 6). The 89 GHz drizzle detection method has the advantage of utilizing finer spatial resolution inputs.

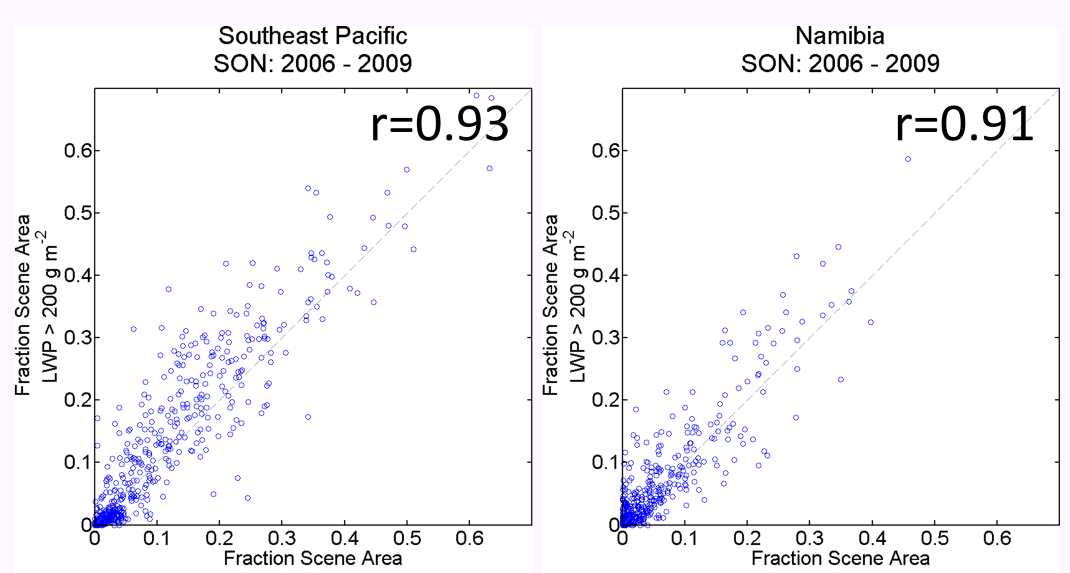


Fig. 6. Distributions of drizzle fraction scene area vs. LWP > 200 gm^{-2} fraction scene area.

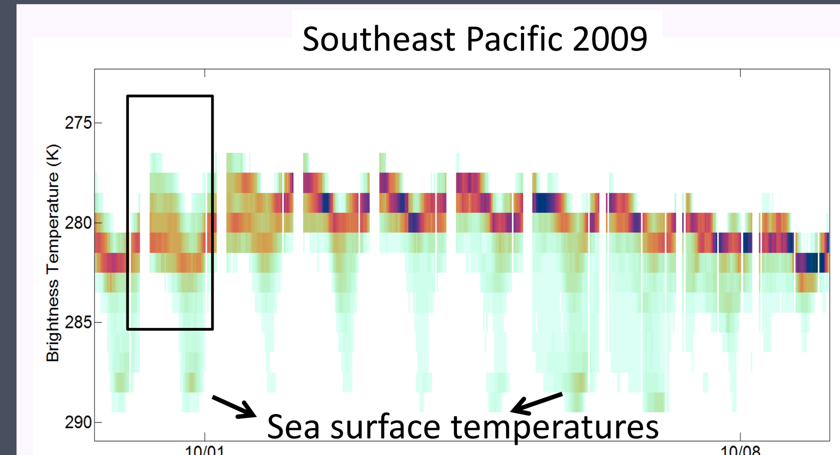


Fig. 7. The distribution of IR brightness temperatures over a week in the SEP. The black box highlights one diurnal cycle.

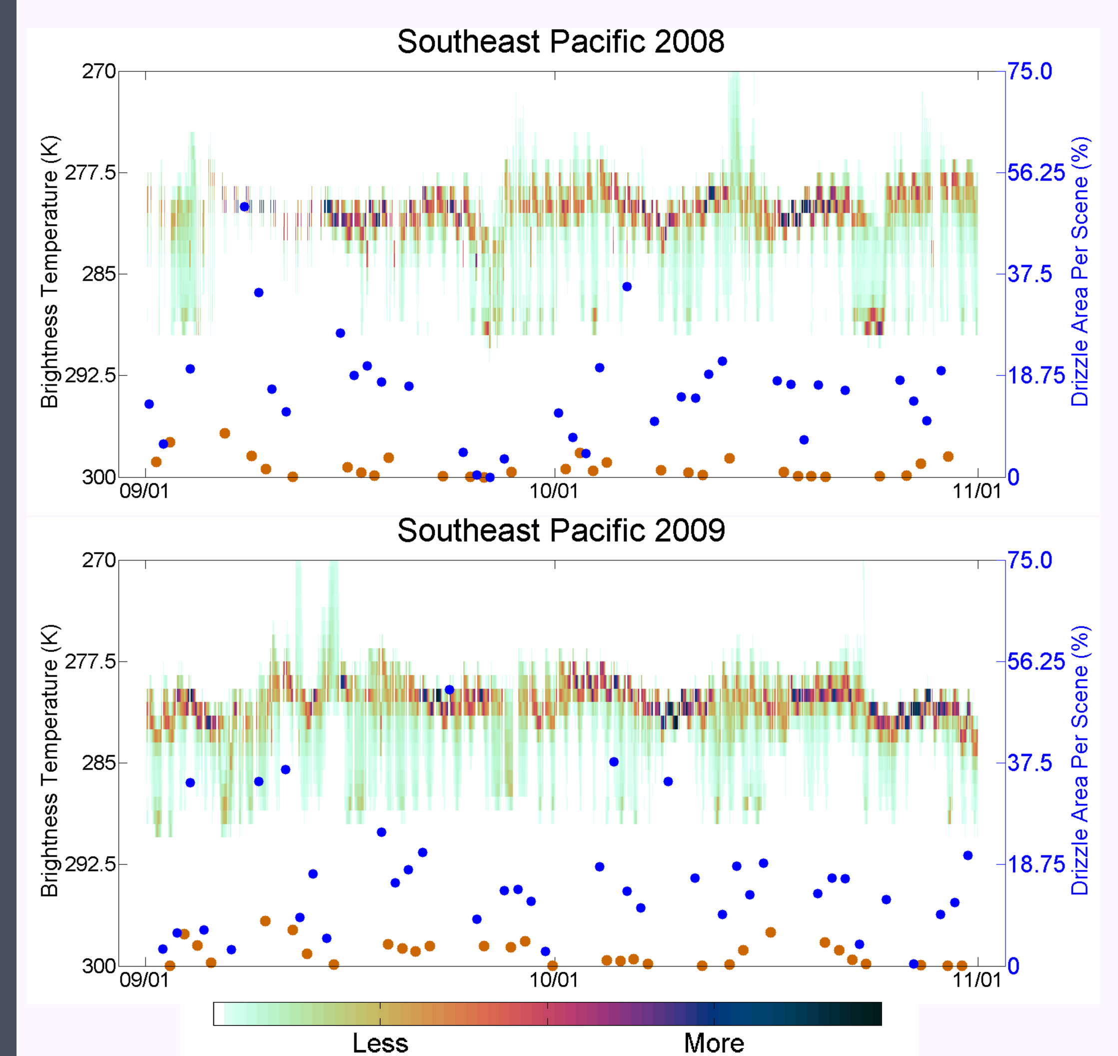
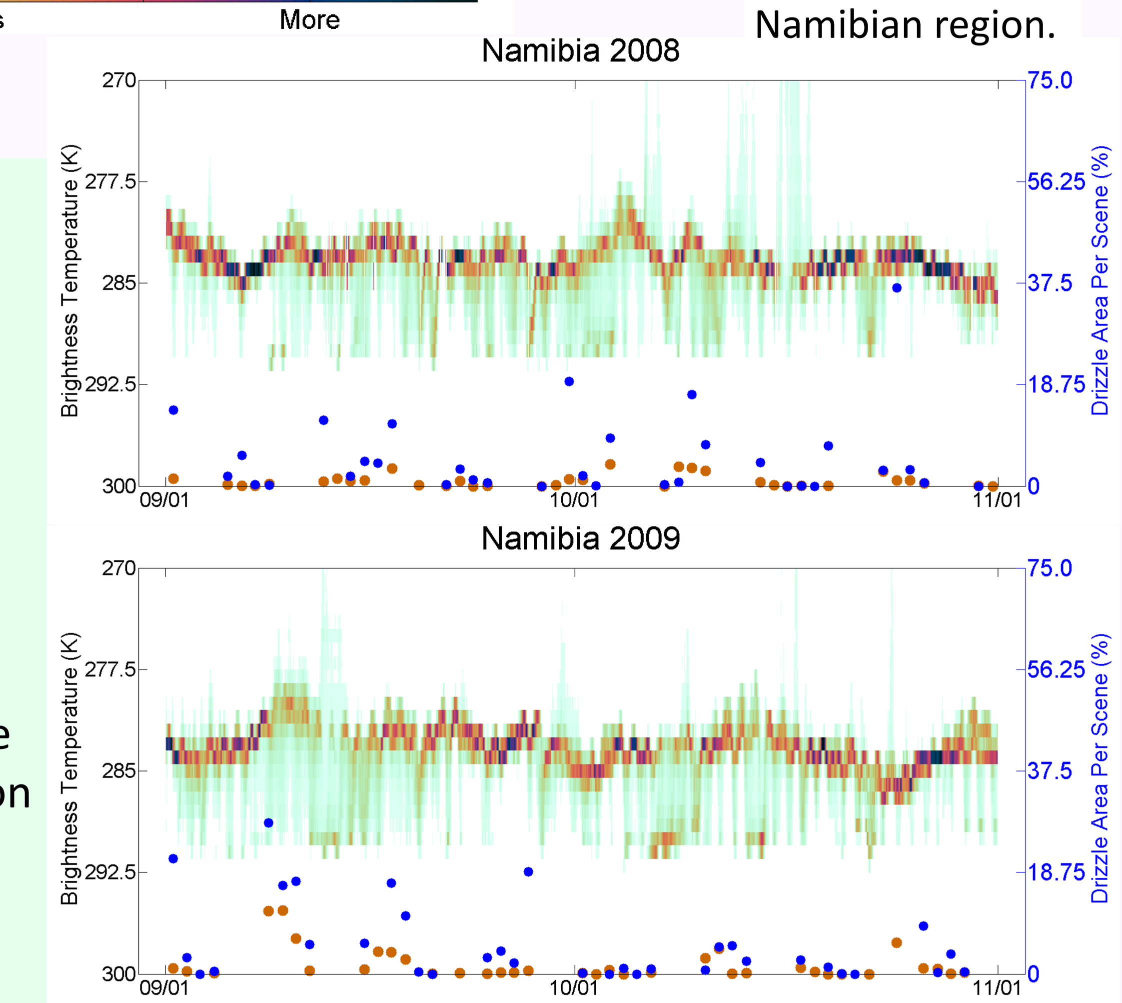


Fig. 8. September through October time series of IR distribution (shaded), daytime drizzle area fraction (orange marks), and nighttime drizzle area fraction (blue marks) in 2008 and 2009 for the SEP. Data from scenes < 10,000 pixels were excluded.

Fig. 9. Same as Fig. 8. except the Namibian region.



Conclusions

There are distinct differences between the Southeast Pacific and Namibian marine stratocumulus regions during the peak drizzle season of September, October and November.

- Overnight drizzle occurs more frequently and over larger areas within Southeast Pacific marine stratocumulus as compared to the Namibian marine stratocumulus.
  - High drizzle area fraction > 15% occurs five times more often in the Southeast Pacific than the Namibian region.
  - Three-month accumulated overnight drizzle area is more than twice as large in the Southeast Pacific compared to the Namibian region.
- Drizzle area fraction > 15% in the southeast Pacific tends to occur for three to four nights in a row before dropping off . In the Namibian region, higher drizzle area fractions tend not to occur on consecutive nights.
- 4-5 day variations in IR cloud top temperatures do not appear to have a direct relationship to variations in drizzle area fraction.
- Our next step in this analysis is to examine cloud drop effective radius and its relation to drizzle occurrence.

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References Miller and Yuter, 2012; *Atmos. Measure. Tech. Disc.*